BestRES

Best practices and implementation of innovative business models for renewable energy aggregators

Existing business models for renewable energy aggregators

June 2016
www.bestres.eu

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 691689.

Acknowledgement

This report has been produced within the BestRES project "Best practices and implementation of innovative business models for Renewable Energy aggregatorS".

The logos of the partners cooperating in this project are shown below and information about them is available in this report and at the website: www.bestres.eu

This report has been written by Ruben Verhaegen (3E) and Carlos Dierckxsens (3E). The authors thankfully acknowledge the valuable contributions from all project partners, especially from Georg Lettner (TUW-EEG) and Andreas Fleischhacker (TUW-EEG) to complete this report.

Disclaimer

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 691689. The sole responsibility for the content of this report lies with the authors. It does not necessarily reflect the opinion of the European Union. Neither INEA nor the European Commission are responsible for any use that may be made of the information contained therein. While this publication has been prepared with care, the authors and their employers provide no warranty with regards to the content and shall not be liable for any direct, incidental or consequential damages that may result from the use of the information or the data contained therein. Reproduction is authorized providing the material is unabridged and the source is acknowledged.

Contacts

Project coordinator

Silvia Caneva, Ingrid Weiss & Mak Dukan
WIP – Renewable Energies
Sylvensteinstrasse 2, Munich, Germany

Email: silvia.caneva@wip-munich.de
Email: Ingrid.weiss@wip-munich.de
Email: mak.dukan@wip-munich.de

Authors

Ruben Verhaegen & Carlos Dierckxsens
3E
Kalkkaai 6, Quai à la Chaux 6, Brussels, Belgium

Email: Ruben.Verhaegen@3e.eu
Email: Carlos.Dierckxsens@3e.eu

BestRES This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 691689.

Table of contents

List of Figures 6
List of Tables 7
Abbreviations 8
Executive summary 9
1. Introduction 12
1.1 The BestRES project 13
1.2 Structure of the document 17
2. Methodology 18
3. Existing business models for energy aggregators 20
3.1 Business models for aggregators with a combined role 21
3.1.1 Combined aggregator-supplier 22
3.1.2 Combined aggregator-BRP 22
3.1.3 A combined aggregator-DSO model: 23
3.2 Business models for independent aggregators 23
3.2.1 Independent aggregator as a service provider 23
3.2.2 Delegated aggregator 24
3.2.3 Prosumer as Aggregator 24
3.3 Building blocks of aggregator business models 25
3.3.1 Key resources and activities 26
3.3.2 Customer segments and value proposition to customers 34
3.3.3 Revenue streams and cost structure depending on key stakeholders. 38
3.3.4 Channels to reach customers and customer relationships 39
4. Business models within the consortium 40
4.1 Existing business models within the consortium 40
4.2 Providers of aggregation services 43
4.2.1 Expected evolutions related to providers of aggregation services 46
4.2.2 Assessing the potential of providers of aggregation services..... 46
4.3 Markets where value is created 47
4.3.1 Participation to wholesale markets 47
4.3.2 Participation to reserves and capacity markets..... 50
4.3.3 Reduction of grid charges 51
4.3.4 Supply to electricity consumers (ESCO services) 51
4.4 Software, data and contract requirements..... 52
4.4.1 Software requirements..... 52
4.4.2 Data requirements..... 53
4.4.3 Contract requirements..... 55
4.5 Revenue streams and costs 55
4.5.1 Revenues 55
4.5.2 Costs 56
4.6 Key partners 58

BestRES This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 691689.

5. Business models outside the consortium 59
5.1 Business models of other aggregators active in the countries covered by the consortium 59
5.1.1 Profile description of the aggregators 59
5.1.2 Existing business models in countries covered by the consortium outside the consortium 64
5.1.3 Markets where value is created 66
5.2 Business models of aggregators in countries that are not covered by the consortium 68
5.2.1 Profile description of the interviewed market actors 68
5.2.2 Existing business models in countries outside the consortium 70
5.2.3 Providers of aggregation services 72
5.2.4 Markets where value is created 73
5.2.5 Revenue streams and costs 73
6. Conclusions 75
6.1 A wide variety of business models for aggregation 77
6.2 Valorisation of aggregation on wholesale markets, reserve markets and for own balancing 77
6.3 Revenues stream and costs components vary between the implemented business models 78
7. Annexes 79
Annex 1: Questionnaire with respect to business models 79
Annex 2: Questionnaire with respect to market design 86
Annex 3: Brief questionnaire with respect to business models 88
Technical references 93

BestRES This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 691689.

List of Figures

Figure 1: Business models within the consortium of the project..... 10
Figure 2: Important aspects of aggregator business models 11
Figure 3: Overview interview partners..... 19
Figure 4: Aggregator Business Models 21
Figure 5: The Canvas Business Model..... 25
Figure 6: Processes with DR potential..... 27
Figure 7: DR potential per country in the European Union..... 28
Figure 8: Industrial and commercial DR in Europe 28
Figure 9: Renewable energy in the European Union 30
Figure 10: Illustration of a Virtual Power Plant (VPP) 33
Figure 11: Users of services offered by aggregators 34
Figure 12: Frequency Deviation and Activation of Reserves 35
Figure 13: The market premium model..... 37
Figure 14: Cost components aggregators 39
Figure 15: countries covered by the consortium 40
Figure 16: Evolution of day-ahead electricity prices across Europe 47
Figure 17: Evolution of intraday electricity prices across Europe..... 48
Figure 18: Evolution of futures electricity prices across Europe 48
Figure 19: Next Kraftwerke's Nextpool 52

BestRES This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 691689.

List of Tables

Table 1: Business models for aggregation 9
Table 2: Aggregation to create value on various markets..... 26
Table 3: Installed capacities renewable energy technologies in the partners countries 31
Table 4: Installed and planned electro-chemical storage capacity across Europe 32
Table 5: Business models for aggregators 41
Table 6: Value created by aggregators of the consortium on the different markets..... 42
Table 7: Mix of aggregator's providers of aggregation services 44
Table 8: Important sectors for DSM in the portfolio of the aggregators 45
Table 9: Participation of aggregators in wholesale markets..... 49
Table 10: Details of the offered ancillary reserves by the partners of the consortium.. 50
Table 11: Data requirements for aggregator business models..... 54
Table 12: Duration of contracts with providers of flexibility 55
Table 13: Most important revenues of aggregators within the consortium 56
Table 14: Cost components of aggregator business models..... 57
Table 15: Business models for aggregators outside the consortium. 65
Table 16: Value created by aggregators outside the consortium. 67
Table 17: Business models for aggregators outside the consortium 70
Table 18: Value created by aggregators outside the consortium 71
Table 19: Demand side management potential in countries outside the consortium 72
Table 20: Business models of aggregators within the consortium..... 75

BestRES This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 691689.

Abbreviations

BM	Business Model
BRP	Balancing Responsibility Provider
CAPEX	Capital Expenditures
CHP	Combined Heat and Power
DR	Demand Response
DSM	Demand Side Management
DSO	Distribution System Operator
EPC	Engineering, Procurement, Construction
ESCO	Energy Service company
EV	Electric Vehicles
FiP	Feed-in-Premium
FiT	Feed-in-Tariff
GPRS	General Packet Radio Service
ICT	Information and Communication Technology
LCA	Life Cycle Analysis
OPEX	Operational Expenditures
PPA	Power Purchase Agreement
ToU	Time-of-Use
TSO	Transmission System Operator
VPP	Virtual Power Plant

BestRES This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 691689.

Executive summary

In a changing electricity market landscape, where the share of intermittent renewable energy in the energy mix is increasing, system flexibility becomes crucial. As part of the solution, the aggregation of renewable energy can significantly accelerate the integration of intermittent electricity sources, complement demand flexibility and decrease the reliance on renewable energy support schemes. Aggregators of demand and/or generation are therefore expected to have an increasingly important role to play in the future.

In that context, the BestRES project investigates the current barriers for aggregators and suggests ways of improving the role of aggregators in future electricity market designs. As part of this report, existing European aggregation business models found within and outside the project consortium have been analysed, taking into account technical, market, environmental and social benefits.

As a starting point, different business models for aggregation which are ready to be implemented have been identified. The main distinction is made between aggregators that combine roles on the one hand and independent aggregators on the other.

Table 1: Business models for aggregation

Business Model	Explanation
Combined aggregator - supplier	Supply and aggregation are offered as a package and there will be one BRP per connection point.
Combined aggregator -BRP	There are 2 BRPs on the same connection point, the BRP (independent aggregator) and the BRP (supplier). The supplier is compensated for imbalances.
Combined aggregator - DSO	*NOT tackled: regulated and unregulated roles should not be combined.*
Independent aggregator as a service provider	The aggregator is a service provider for one of the other market actors but does not sell at own risk to potential buyers.
Independent delegated aggregator	The aggregator sells at own risk to potential buyers such as the TSO, the BRP and the wholesale electricity markets.
Prosumer as aggregator	Large-scale prosumers choose to adopt the role of aggregator for their own portfolios.

BestRES This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 691689.

By making use of the different building blocks of the Osterwalder Business Model Canvas tool describing a company's activities, the partner aggregators of this project were analysed. Figure 1 gives an overview of the 6 project partner aggregators in 9 target countries.

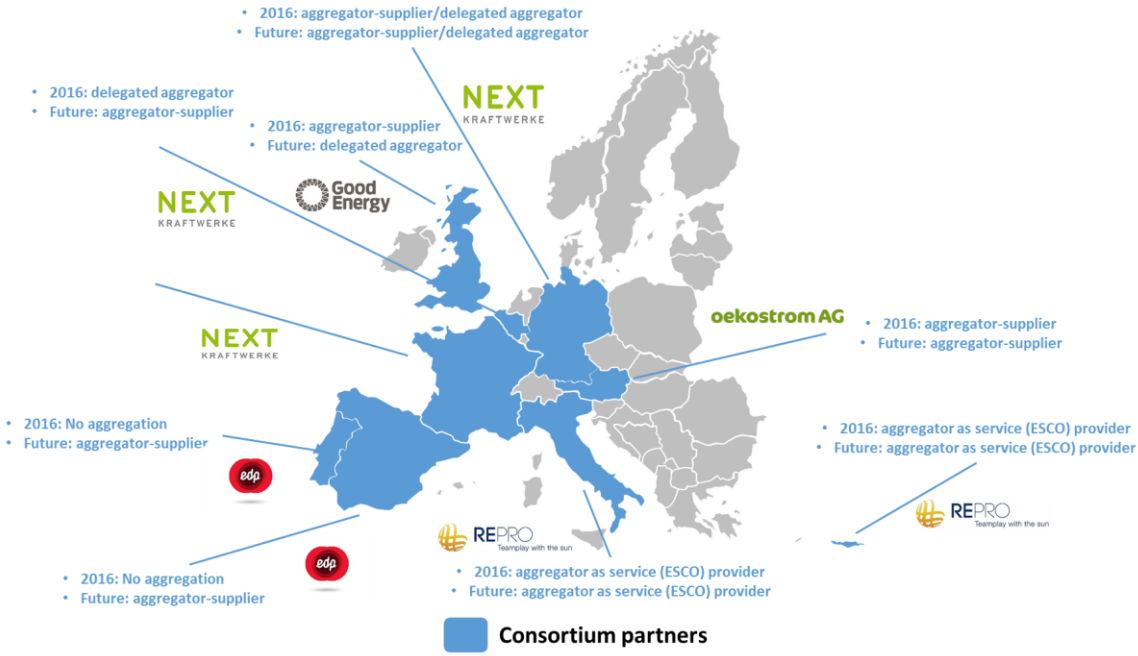

Figure 1: Business models within the consortium of the project

In a next step, other aggregators' business models were studied to complement the analysis, based on the same Canvas building blocks. Looking into other aggregators, three types of aggregators have been identified: (i) new electric utilities, (ii) new flexibility companies focused on provision of flexibility and (iii) technology companies. The analysis covers the countries represented in the BestRES project but as well aggregators in Finland, Sweden, the Netherlands, Slovenia, Romania and Greece were interviewed and integrated. The interviews revealed that aggregators are generally taking up the role of the aggregator-supplier (in combination of the delegated aggregator) or acting as a service provider.

In brief, the analysis has enabled to highlight that though a wide variety of business models are implemented across Europe, most of the aggregators within the consortium take up the role of the combined aggregator-supplier and/or independent delegated aggregator. Figure 2 illustrates other identified important aspects of aggregator business models such as the most relevant cost components and the way value is created, the type of service providers and expected evolutions.

BestRES This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 691689.

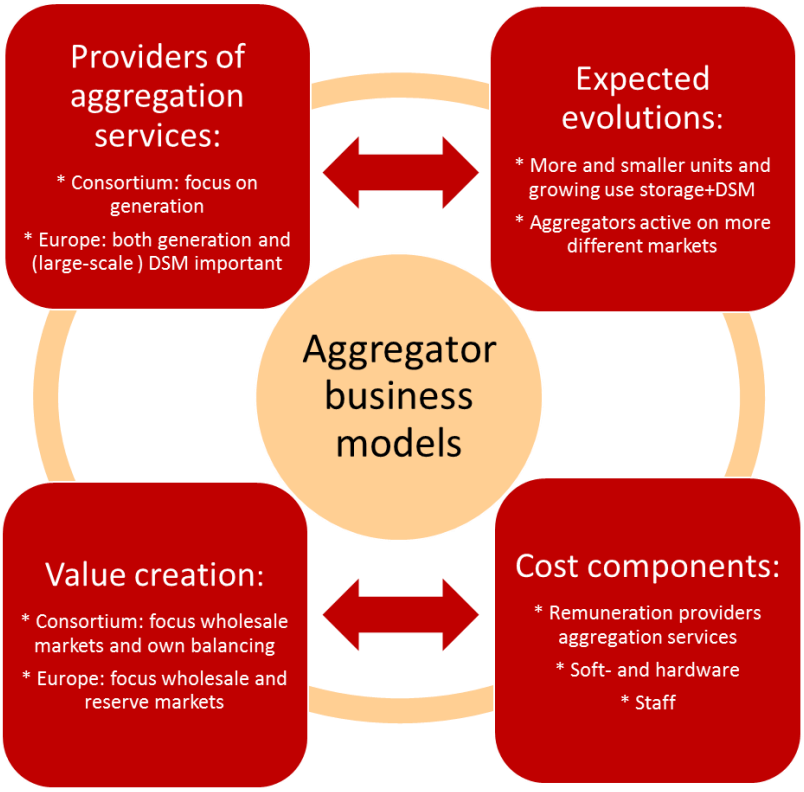

Figure 2: Important aspects of aggregator business models

This report will highlight the importance of aggregators, who act on behalf of consumers and use technological solutions and ICT for optimization, to bring aggregation to the market. Based on the analysis undertaken, focusing on existing European aggregation business models, benefits of and barriers for aggregation will be studied during the next phase of this project.

BestRES This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 691689.

1. Introduction

In the past, European electricity markets were designed around centralized fossil-fuel generation along national or regional borders. The electricity market landscape is however changing because a rising share of distributed generation increases intermittency and price volatility in the system. This requires a more flexible system with more flexible consumption. As highlighted in the state aid guidelines published in April 2014 by the European Commission, this implies that renewable sources are better integrated in electricity markets and rely less on subsidies as was the case in the past. Renewable energy aggregation can significantly accelerate the integration of intermittent electricity sources, enhance demand flexibility and decrease the reliance on renewable energy support schemes.

More aggregation and market integration can however not be achieved by single individual, commercial or domestic consumers since they would only have a limited impact. It is only through a coordinated steering of vast amounts and types of consumers and producers in a market that the use of distributed generation, demand response and battery storage can be effective. A lot of literature has been published with respect to demand response management and more and more market players are active in this field but management of distributed generation and storage including electric vehicles is less developed. An explanation for this might be that this requires the extensive use of new technological solutions and ICT to directly control consumption and generation at lower costs.

For this reason, there is an important role for Renewable Energy Aggregators who act on behalf of consumers and use technological solutions and ICT for optimization. They are defined as legal entities that aggregate the load or generation of various demand and/or generation/production units and aim at optimizing energy supply and consumption either technically or economically. In other words, they are facilitators between the two sides of electricity markets. On the one hand, they develop energy services downstream for industrial, commercial or domestic customers who own generation and storage units or can offer demand response. On the other hand, energy aggregators are offering value to the market players upstream such as BRPs, DSOs, TSOs and energy suppliers to optimize their portfolio and for balancing and congestion management. Furthermore, wholesale electricity markets might benefit from aggregation if appropriate incentives are present. A last option is that energy aggregators offer value to specific customers such as is the case for ESCO's. In this situation, the player downstream and upstream could potentially be the same entity.

BestRES This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 691689.

1.1 The BestRES project

The main objective of the BestRES project is to investigate the current barriers and to improve the role of Energy Aggregators in future electricity market designs. In the first stage, the project is focusing on existing European aggregation business models taking into account technical, market, environmental and social benefits. In the second stage, we will develop improved business models that are replicable in other countries in the EU considering market designs and with a focus on competiveness and LCA. These improved business models will then be implemented or virtually implemented with real data and monitored in the following target countries: United Kingdom, Belgium, Germany, France, Austria, Italy, Cyprus, Spain and Portugal.

The BestRES project will last three years. It entered into force on 1st March 2016 and will end until 28th February 2019.

The target group, the Renewable Energy Aggregators, has been directly involved in the BestRES project consortium as partners:

- Good Energy, renewable energies aggregator active in United Kingdom
- Next Kraftwerke Belgium, renewable energies aggregator active in Belgium
- Oekostrom, renewable energies aggregator active in Austria
- RE-Pro, renewable energies aggregator active in Italy and Cyprus
- Next Kraftwerke Germany, renewable energies aggregator active in Germany and France
- Energias de Portugal, renewable energies aggregator active in Spain and Portugal

The innovative business models to be provided during the project will be based on on-going business models available in Europe and adapted to the future market design by research institutions and energy expert partners such as the Energy Economic Group of the Technical University of Vienna (TUW-EEG) and 3E. The consortium also includes a legal expert, SUER (Stiftung Umweltenergierecht /Foundation for Environmental Energy Law), who will provide a relevant contribution to the development of National and European recommendations on the business models implementation.

The BestRES project is coordinated by WIP – Renewable Energies. The project communication and dissemination will be carried out by WIP with the support of Youris.

A short description of the BestRES project partners is provided in the following paragraphs.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 691689.

WIP – Renewable Energies (WIP)

WIP - Renewable Energies has been founded in 1968 in Munich, Germany, and has been active in the renewable energy sector for over three decades, working with both industrial and public sector clients at the international level. The company's mission is to bridge the gap between research and implementation of sustainable energy systems. WIP's interdisciplinary team of professionals provides consultancy services to improve the grid and market integration of renewable energies. WIP offers project development, project management, technical supervision and realization of projects, which involve the co-ordination of international consortia. WIP counts more than 300 projects accomplished. WIP organizes international events in the field of renewable energies. Website: www.wip-munich.de

3E

3E is an independent consultancy and software service company, delivering solutions for performance optimisation of renewable energy and energy efficiency projects. We provide expert services to support project developers, asset managers, operators, investors and policy-makers and our key areas of expertise are solar, wind, sustainable buildings & sites and grids & markets. Bridging the gap between R&D and the market, 3E combines in-house innovation and partnerships with leading R&D centres. 3E's international team operates from Brussels (HQ), Toulouse, Milan, Istanbul, Beijing and Cape Town. The company has a project track-record of over 15 years in over 30 countries. Website: www.3e.eu

Technische Universitaet Wien (TUW-EEG)

The Energy Economics Group (EEG) is a department of the Institute of Energy Systems and Electric Drives at TU Wien, Austria. The core fields of research of EEG are: (i) system integration strategies of renewable and new energy technologies, (ii) energy modelling, scenario analysis and energy policy strategies, (iii) energy market analysis in general (competition and regulation), (iv) sustainable energy systems and technologies and (iv) environmental economics and climate change policies. EEG has coordinated and carried out many international as well as national research projects, international and national organizations and governments, public and private clients in several fields of research.
www.eeg.tuwien.ac.at

Stiftung Umweltenergierecht (SUER)

The Foundation for Environmental Energy Law (Stiftung Umweltenergierecht – SUER) was created on 1 March 2011 in Würzburg. The research staff of the foundation is concerned with national, European and international matters of environmental energy law. They analyze the legal structures, which aims to make possible the necessary process of social transformation leading towards a sustainable use of energy. Central field of research is the European and German Law of renewable energy and energy efficiency. The different legal instruments aiming towards the substitution of fossil fuels and the rise of energy efficiency are analyzed systematically with regard to their interdependencies. Interdisciplinary questions, e.g. technical and economical questions, are of particular importance. Website: http://stiftung-umweltenergierecht.de/

BestRES This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 691689.

Good Energy

Good Energy is a fast-growing, 100% renewable electricity supplier, offering value for money and award-winning customer service. Good Energy is proud to have been the first dedicated 100% renewable electricity supplier in the UK, with over 68,000 electricity customers – a mix of residential and commercial supplies – 38,000 gas customers and supports over 112,600 homes, business and communities generating their own renewable energy. We source our supply from a large and growing network of over 1,000 independent generators across the country, in addition to operating our own wind farms and solar farms. Website: www.goodenergy.co.uk

Next Kraftwerke Belgium (NKW BE)

Next Kraftwerke Belgium pools distributed renewable generation and flexible demand in a virtual power plant (VPP). We trade and deliver the aggregated power on the most relevant markets and, most importantly, we make the virtual power plant's flexibility available to the grid operator to support the management of the Belgian power system. Next Kraftwerke Belgium is a joint venture with Next Kraftwerke GmbH in Germany.
Website: www.Next-Kraftwerke.be

Next Kraftwerke Germany (NKW DE)

Next Kraftwerke Germany is the operator of a large-scale Virtual Power Plant (VPP) and a certified power trader on various European energy exchanges (EPEX). The concept of a Virtual Power Plant is based on the idea to link and bundle medium- and small-scale power producing and power consuming units. The objective is to smartly distribute supply and demand and to profitably trade the generated and consumed power. Next Kraftwerke's VPP now bundles around 3,000 medium- and small-scale power-producing and power-consuming units. Among other energy sources, it includes biogas, wind, and solar power generators. Next Kraftwerke also operates in Belgium, France and Austria.
Website: https://www.next-kraftwerke.com/

Oekostrom

Oekostrom AG is a holding company owned by about 1.900 stockholders. It was founded in 1999 aiming at building a sustainable energy industry, supplying customers with clean energy and supporting the development of renewable energy sources in Austria. All products and services of oekostrom AG represent an active contribution to climate and environmental protection and increase independence from fossil and nuclear energy sources. Oekostrom AG engages in the fields of power production, trading, sales and energy services and currently supplies 100 % renewable energy from Austria to more than 52.000 customers in all parts of the country.
Website: http://oekostrom.at/

BestRES This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 691689.

RE-Pro Management (RE-Pro)

RE-Pro is a renewable energy provider dedicated to clean and renewable energy sources. Specialized in the fast-growing areas of solar power generation and energy efficiency management, RE-Pro has successfully launched its services through a range of photovoltaic power parks in southern Europe. Guaranteed power purchasing contracts with national grids generate a stable revenue stream, which forms the basis for the development of RE-Pro's innovative energy efficiency management services.
Website: http://www.re-pro.eu/

Centre for New Energy Technology (EDP-CNET)

EDP Group is an integrated energy player, with strong presence in Europe, US and Brazil and the third player in the world in terms of wind installed capacity. EDP is an innovative European Utility with an important presence across all the energy value chain, in Generation, Distribution, Energy Trading and Retail of electricity and gas. EDP owns HC Energia, the 4th Energy Utility in Spain and Energias do Brasil. EDP Centre for New Energy Technologies (EDP CNET) is a subsidiary of the EDP Group with the mission to create value through collaborative R&D in the energy sector, with a strong focus in demonstration projects. Currently, EDP has no activity as an aggregator, but, as the electricity sector evolves, EDP may consider aggregation either on the generation or supplier side through different companies within EDP Group. In the scope of this project EDP has chosen to focus on the supplying activity, therefore the information provided in this report is focused on the retailer side.
Websites: https://rd-new.com and http://www.edp.pt/en/Pages/homepage.aspx

Youris.com (Youris)

youris.com GEIE is an independent non-profit media agency promoting the leading-edge European innovation via TV media and the web. youris.com designs and implements media communication strategies for large research organizations and EU-funded projects and is able to establish permanent links between the research communities and the media. youris.com media products cover a wide spectrum of research areas including ICT, Environment, Energy, Health, Transport, Nanotechnologies, Food, Society, Gender and many others and are designed for large-scale distribution world-wide. Youris.com is a European Economic Interest Group (EEIG) based in Brussels with branch offices in Italy, Germany and France.
Website: http://www.youris.com

BestRES This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 691689.

1.2 Structure of the document

The objective of this report is to define and classify existing European aggregation business models within and outside the consortium of BestRES.

The remainder of the document is structured as follows:

- Section 2 briefly outlines the project methodology
- In Section 3, a description of different possible roles for aggregators is provided together with main business model building blocks according to the Canvas Business Model
- In Section 4, the different business models within the consortium are extensively described
- In section 5, other business models that exist in Europe but are not covered by the consortium partners are outlined
- Section 6 concludes the current discussion of this report

BestRES This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 691689.

2. Methodology

In the preparation phase of the project, project partners in different regions in Europe were selected. 6 aggregators in 9 countries were included:

1. Western Europe: Germany (Next Kraftwerke DE), France (Next Kraftwerke DE), Belgium (Next Kraftwerke BE) and Austria (Oekostrom)
2. Southern Europe: Spain (EDP) and Portugal (EDP), Italy (RE-Pro) and Cyprus (RE-Pro)
3. British Isles: the United Kingdom (Good Energy)

In order to better understand the business models of the partners, 3E carried out an extensive desk research to develop a comprehensive questionnaire (annexes 1 and 2). The questionnaire was revised by the all consortium project partners and afterwards surveys were carried out with the aggregator consortium partners. The results of the surveys and desk research are extensively discussed (section 4).

In parallel, 3E and TUW-EEG used publicly available information to analyse business models of other aggregators mentioned by consortium partners in the same 9 countries (section 5.1). Nevertheless, some countries in Europe are not covered by the partners of the consortium and one of the objectives of the BestRES project is to understand business models across Europe. Therefore, the consortium additionally used their network to identify aggregators and their business models in other countries (section 5.2). For this part of the analysis, a brief questionnaire (annex 3) was used to carry out interviews with the following market actors:

1. Empower in Finland
2. Fortum in Sweden and Finland
3. Svensk Solenergi in Sweden
4. Actility in the Netherlands
5. Gen-I in Slovenia and Romania
6. Re-pro in Greece

Figure 3 provides an overview of all the interview partners.

BestRES This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 691689.

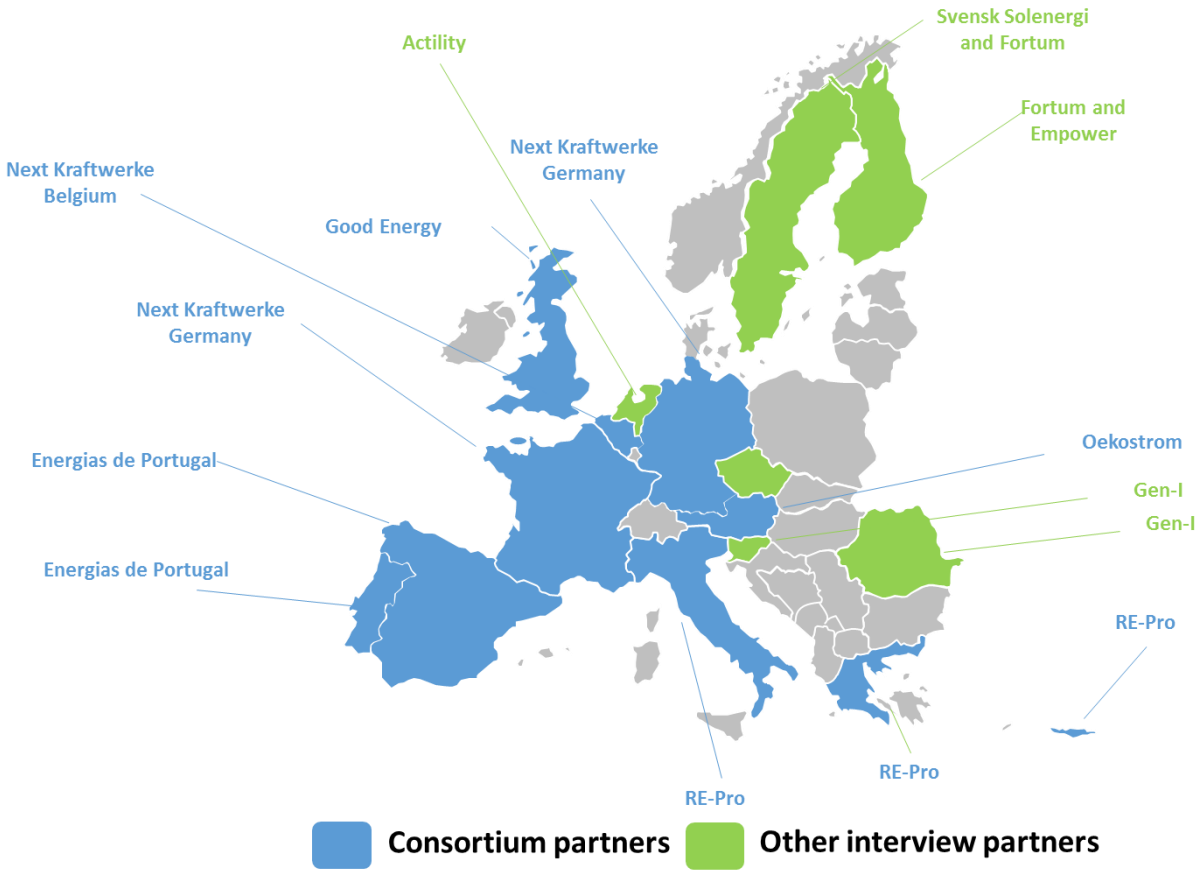

Figure 3: Overview interview partners

BestRES This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 691689.

3. Existing business models for energy aggregators

The objective of this part of the report is to identify all business models for aggregation that can theoretically be implemented. The role of an aggregator can be taken up by a combination of different roles such as an incumbent energy supplier offering aggregation services, a service provider specialized in aggregation services collaborating with a supplier or a joint venture between a traditional supplier and a service provider or by an independent market actor. Independent means in that case that the aggregator is able to act independent from the (usual) supplier and the supplier's BRP. An important advantage of the independent aggregator is that his presence can create more competition in the market whereas combined aggregators are often more compatible with existing market design but hamper competitiveness. A good example of independent aggregation for DSM is the PJM market where independent aggregators are responsible for 82% of demand response (DR) capacity.[1]This is an indication that market actors who have DSM as a core activity could be good for spurring competition. A recent report by the Smart Energy Demand Coalition (SEDC) also accentuates the importance of independent aggregators. This does however not mean that market actors with combined roles, as many are active in Europe, cannot have an important place on the market.[2]

The different business models that are currently appearing across Europe are summarized in Figure 4.[3]

[1] PJM is a regional transmission organization (RTO) that coordinates the movement of wholesale electricity in all or parts of 13 states and the District of Columbia.

Smart Energy Demand Coalition (SEDC), Demand Response: Clarification of the standard processes required between BRPs and independent aggregators, July 2015, Available at: http://www.smartenergydemand.eu/wp-content/uploads/2015/07/SEDC-Standard-processes-required-between-BRPs-and-independent-aggregators1.pdf

2 NordREG Nordic Energy Regulators, Discussion on different arrangements for aggregation of demand response in the Nordic market – February 2016, February 2016, Available at: http://www.nordicenergyregulators.org/wp-content/uploads/2016/02/NordREG-Discussion-of-different-arrangements-for-aggregation-of-demand-response-in-the-Nordic-market.pdf

SEDC (Smart Energy Demand Coalition), Enabling independent aggregation in the European electricity markets, Roles and Responsibilities: Keeping the BRP whole after a demand response event, Position Paper, February 2015

SEDC (Smart Energy Demand Coalition), Demand Response: Clarification of the standard processes required between BRPs and independent aggregators, July 2015, Available at: http://www.smartenergydemand.eu/wp-content/uploads/2015/07/SEDC-Standard-processes-required-between-BRPs-and-independent-aggregators1.pdf

3 USEF, USEF: The Framework Explained, USEF Foundation, 18 November 2015

BestRES This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 691689.

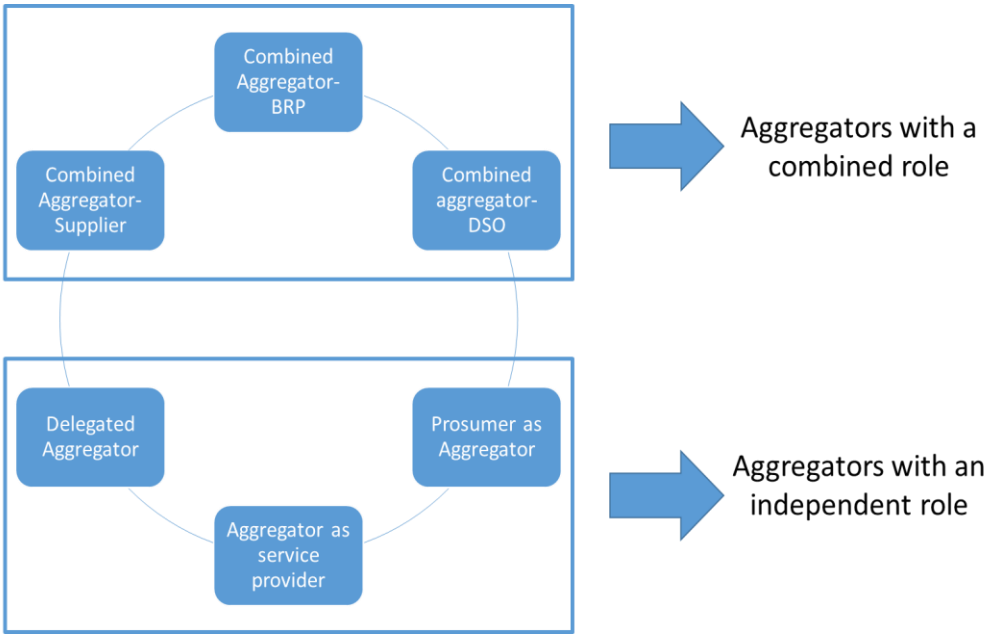

Figure 4: Aggregator Business Models

We will first elaborate on the business models for aggregators with combined roles and subsequently look into the aggregators with independent roles.

3.1 Business models for aggregators with a combined role

In a lot of Member States of the European Union, there is no clear framework for independent aggregators and relationships between independent aggregators, BRPs and suppliers are not always well-defined. This can create problems with respect to balancing and financial compensations for energy suppliers while data transfer issues can equally complicate the market setup. Furthermore, there are cases where aggregators or DSM providers need a bilateral agreement with a BRP to cover for the BRP's sourcing costs, which hinders market entrance. As a consequence, combined aggregators are more compatible with existing electricity market design because they avoid important regulatory changes. In this framework, we elaborate on the following three business models: the combined aggregator-supplier business model, the combined aggregator-BRP business model and the combined aggregator-DSO model.[4]

4 USEF: The Framework Explained, USEF Foundation, November 2015

Commission for the Regulation of Electricity and Gas (CREG), The resources to be applied for facilitating access to demand management in Belgium, 22 January 2016, Available at: http://www.creg.info/pdf/Studies/F1459NL.pdf

SEDC (Smart Energy Demand Coalition), Mapping Demand Response in Europe Today, 2015, Available at: http://www.smartenergydemand.eu/wp-content/uploads/2015/10/Mapping-Demand-Response-in-Europe-Today-2015.pdf

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 691689.

3.1.1 Combined aggregator-supplier

If the consumer-prosumer agrees on it, aggregator and supplier can be combined. In this case, supply and aggregation are offered as a package and there will be one BRP per connection point because aggregator and BRP are the same entity. The main benefits are reduced complexity and the absence of financial settlements between suppliers and aggregators. As proposed in the Network Code on Electricity Balancing by ACER (Agency for the Cooperation of Energy Regulators) and in recent documents by NordREG, there will be no or very few barriers for this model to be developed in countries with well-functioning retail and wholesale electricity market and therefore enough competition. This is also confirmed in a recent report by VTT Technical Research Centre of Finland (VTT) which highlights that retailers are in the best position to become aggregators because they have connections to the electricity market and an existing relationship with the customers.[5]

3.1.2 Combined aggregator-BRP

Another possibility is that the roles of aggregator and BRP (independent aggregator) are combined. In this case, there are 2 BRPs on the same connection point: BRP (independent aggregator) and BRP (supplier). The aggregator has an agreement with the consumers of the supplier and the supplier will have to be compensated for the electricity that was sourced on day-ahead or other markets. For this reason, it might be challenging or impossible to know the correct sourcing costs of the supplier to perform a correct financial transfer. Furthermore, there might be practical implications when the aggregator contracts with multiple customers from different suppliers. Finally, the imbalances of BRP (supplier) and BRP (independent aggregator) need to be adjusted. [6]

5 USEF, USEF: The Framework Explained, USEF Foundation, November 2015

NordREG, Nordic Energy Regulators, Discussion on different arrangements for aggregation of demand response in the Nordic market, February 2016, Available at: http://www.nordicenergyregulators.org/wp-content/uploads/2016/02/NordREG-Discussion-of-different-arrangements-for-aggregation-of-demand-response-in-the-Nordic-market.pdf

DER Aggregator Business: the Finnish Case, VTT, March 2010, Available at: http://www.ece.hut.fi/enete/DER_Aggregator_Business_Finnish_Case.pdf

EG3 Report –Smart Grid Task Force, Regulatory Recommendations for the Deployment of Flexibility, January 2015

6 USEF, USEF: The Framework Explained, USEF Foundation, 18 November 2015

NordREG, Nordic Energy Regulators, Discussion on different arrangements for aggregation of demand response in the Nordic market, February 2016, Available at: http://www.nordicenergyregulators.org/wp-content/uploads/2016/02/NordREG-Discussion-of-different-arrangements-for-aggregation-of-demand-response-in-the-Nordic-market.pdf

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 691689.

3.1.3 A combined aggregator-DSO model:

We suppose that regulated and unregulated roles should not be combined so we are not further investigating this business model.[7]

3.2 Business models for independent aggregators

As underlined in the Network Code on Electricity Balancing by ACER (Agency for the Cooperation of Energy Regulators) and in recent documents by NordREG, independent aggregators can increase competition and subsequently open up the market for new players. The potential to reap these market benefits is certainly present in countries where relationships between aggregators and suppliers are regulated and a standardised framework is put into place. In these countries, a lot more ancillary services and wholesale markets are accessible for demand response and other types of aggregator services.

Nevertheless, it can be very challenging to compensate the supplier for imbalances caused by activation of demand response or battery storage bids from the aggregator. In other words, the financial settlement might be very difficult to calculate because all suppliers procure energy with different strategies and buy electricity on both forward and spot markets. Also, such a set up might be administratively complex and therefore expensive to implement. We elaborate on the following three business models: the business model for an independent aggregator as a service provider without any responsibility, the business model for an independent aggregator as a service provider with responsibility, the business model for a prosumer as aggregator.[8]

3.2.1 Independent aggregator as a service provider

The aggregator is a service provider for one of the other market actors but doesn't sell at own risk to potential buyers. In this case, the aggregator and the other market actor should have a long-term and exclusive relationship because, since the independent aggregator has no balancing responsibility, he will gain the full benefits of his actions. The other market actor, nevertheless, is exposed to price risks. If he is for example an energy supplier (and BRP), he will end up with a positive imbalance and only gain if the imbalance prices are higher than the initial wholesale electricity sourcing costs (futures, day-ahead, intra-day).

[7] USEF, USEF: The Framework Explained, USEF Foundation, November 2015

8 SEDC (Smart Energy Demand Coalition), Mapping Demand Response in Europe Today, 2015, Available at: http://www.smartenergydemand.eu/wp-content/uploads/2015/10/Mapping-Demand-Response-in-Europe-Today-2015.pdf

NordREG, Nordic Energy Regulators, Discussion on different arrangements for aggregation of demand response in the Nordic market, February 2016, Available at: http://www.nordicenergyregulators.org/wp-content/uploads/2016/02/NordREG-Discussion-of-different-arrangements-for-aggregation-of-demand-response-in-the-Nordic-market.pdf

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 691689.

The costs of the actions of the independent aggregator are in this situation not covered by any other party within the settlement function which implies a net loss for the system. Losses will have to be covered by grid users through tariffs or by other BRPs in the balance settlement.[9]

3.2.2 Delegated aggregator

This business model is similar to the previous one but the aggregator sells at own risk to potential buyers such as the TSO, the BRP and the wholesale electricity markets. The actions of the aggregator can have a significant impact on the position of other market players (balancing) so interactions with these market players need to be formalized, making it potentially very complex. The complexity of such a set-up will probably increase in the future because more independent aggregators are active on the market and more aggregators negotiate contracts with different prosumers that have different BRPs.[10]

3.2.3 Prosumer as Aggregator

Commercial and industrial prosumers can choose to adopt the role of aggregator for their own portfolios. For domestic prosumers, it will be a lot more difficult to this but it is possible than one actor aggregates a lot of small household volumes.[11]

9 USEF: The Framework Explained, USEF Foundation, 18 November 2015

Discussion on different arrangements for aggregation of demand response in the Nordic market – February 2016, NordREG Nordic Energy Regulators, February 2016, Available at: http://www.nordicenergyregulators.org/wp-content/uploads/2016/02/NordREG-Discussion-of-different-arrangements-for-aggregation-of-demand-response-in-the-Nordic-market.pdf

SEDC (Smart Energy Demand Coalition), Mapping Demand Response in Europe Today, 2015, Available at: http://www.smartenergydemand.eu/wp-content/uploads/2015/10/Mapping-Demand-Response-in-Europe-Today-2015.pdf

10 USEF: The Framework Explained, USEF Foundation, 18 November 2015

Discussion on different arrangements for aggregation of demand response in the Nordic market – February 2016, NordREG Nordic Energy Regulators, February 2016, Available at: http://www.nordicenergyregulators.org/wp-content/uploads/2016/02/NordREG-Discussion-of-different-arrangements-for-aggregation-of-demand-response-in-the-Nordic-market.pdf

SEDC (Smart Energy Demand Coalition), Mapping Demand Response in Europe Today, 2015, Available at: http://www.smartenergydemand.eu/wp-content/uploads/2015/10/Mapping-Demand-Response-in-Europe-Today-2015.pdf

11 USEF: The Framework Explained, USEF Foundation, 18 November 2015

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 691689.

3.3 Building blocks of aggregator business models

The Business Model Canvas is a very well-known strategic management and entrepreneurial tool that is used to analyze business models for various businesses. It defines the following 9 business model building blocks to describe a company's activities: key partners, key activities, key resources, cost structure, value proposition, revenue streams, customer relationships, channels and customer segments (Figure 5).[12]

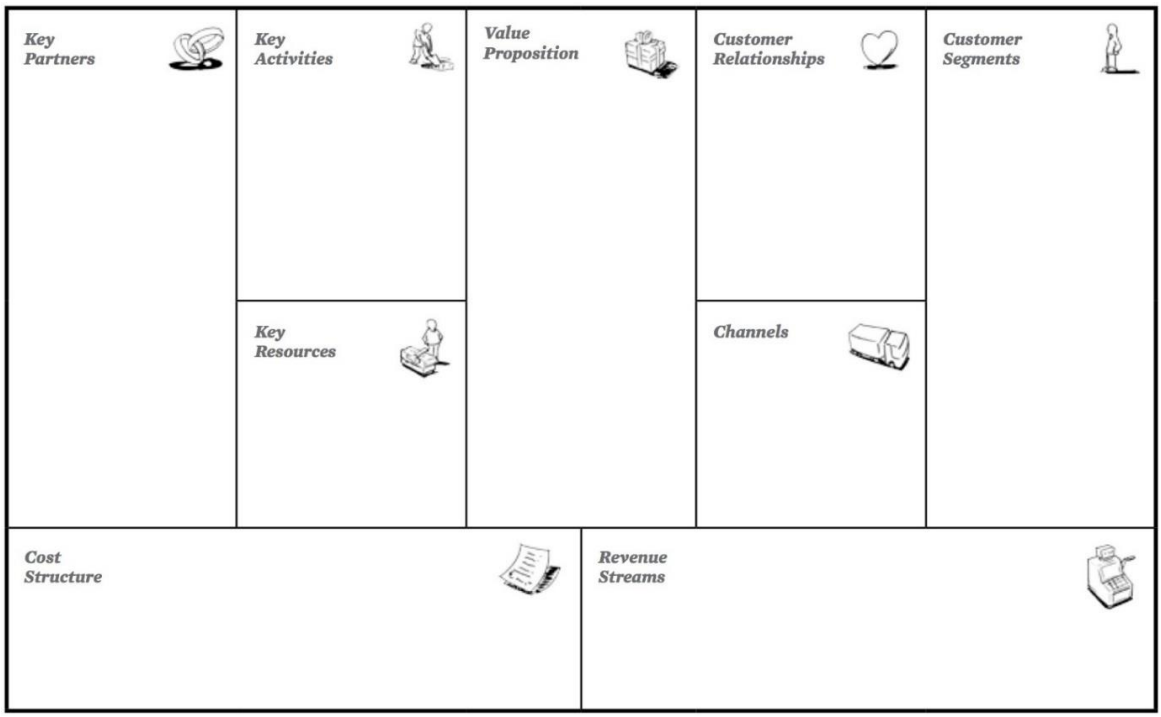

Figure 5: The Canvas Business Model

We will now elaborate on these different building blocks that also cover the questions that are included in the questionnaire that was sent to the aggregators.

12 http://www.businessmodelgeneration.com/canvas/bmc

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 691689.

3.3.1 Key resources and activities

Aggregators can choose to carry out various types of aggregation in order to create value on multiple markets as illustrated in Table 2.

Table 2: Aggregation to create value on various markets

Technology \ Market	Wholesale and retail markets	Reserve and capacity markets	Supply to end electricity consumers	Reduction of grid charges	Own balancing
Wind					
PV					
Biogas					
Hydro					
CHP					
Storage (batteries)					
Demand response (industrial)					
Demand response (domestic)					

The figure can be split up into 3 main providers of aggregation services:

1. Demand response: industrial and domestic
2. Distributed generation: Wind, PV, Biogas, Hydro and non-conventional CHP
3. Storage

Figure 4 shows that different types of small and large industrial and commercial customers and households could offer DR services whereas wind, PV, biogas, hydro and CHP assets can be aggregated to offer the benefits of aggregated production volumes. Storage capacities including EV can also be more useful for the system when volumes are aggregated.[13]

[13] Ecofys, Flexibility options in electricity systems, 10 March 2014, Available at: http://www.ecofys.com/en/publication/flexibility-options-in-electricity-systems/ Information Next Kraftwerke Germany

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 691689.

Aggregated demand response and related processes with high potential

Sia Partners summarized the potential of different processes for the industry, the tertiary sector and residential clients with respect to DR (Figure 6).

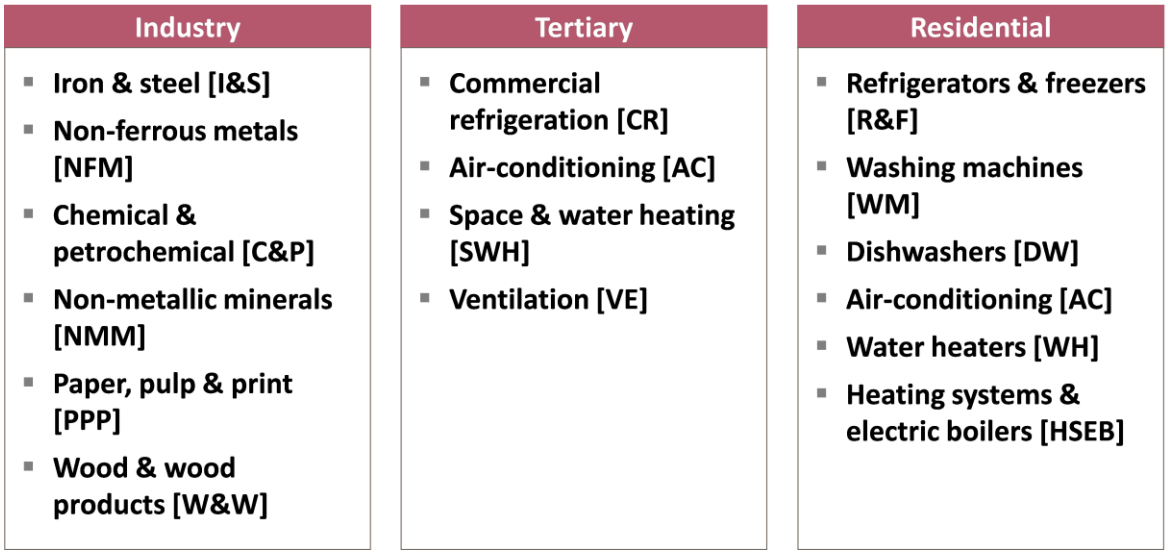

Figure 6: Processes with DR potential[14]

Demand response in the industry and tertiary sector is becoming more and more common across Europe whereas demand response of specific appliances in households is not yet developed on a large scale. In this context, it has been shown that DR in the industry and the tertiary sector can be efficient with manual interventions whereas demand response for households can only be successful with automated services.[15]

According to Sia Partners, the total DR potential in Europe amounts approximately 52 GW across Europe (Figure 7).

[14] Sia Partners, Demand Response: A study of its potential in Europe, February 2015, Available at: http://energy.sia-partners.com/20150205/demand-response-a-study-of-its-potential-in-europe
[15] Energinet.dk, Demand response in households, July 2015, Available at: http://www.ea-energianalyse.dk/projects-english/602_demand_response_in_the_mass_market.html
Linear consortium, Demand Response for Families, 2014, Available at: http://www.linear-smartgrid.be/sites/default/files/Linear%20Final%20Report%20-%20lr2.pdf

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 691689.

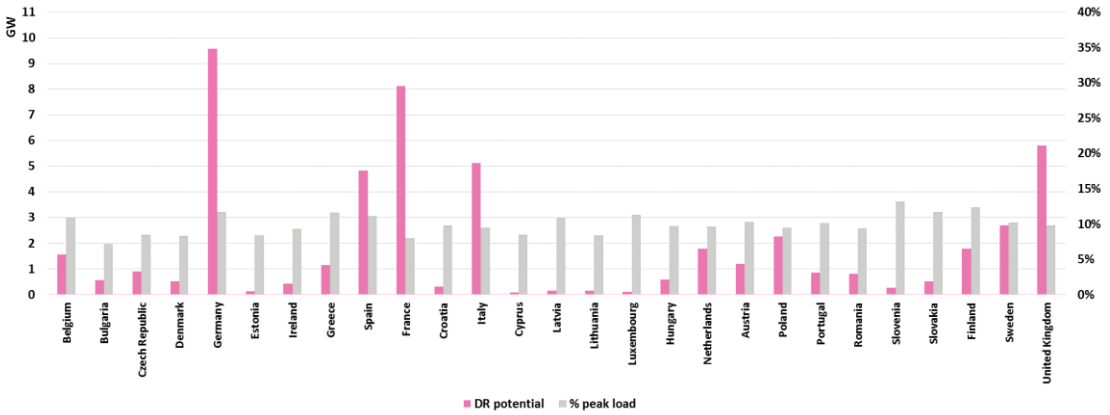

Figure 7: DR potential per country in the European Union[16]

Slovenia (13%), Finland (11%), Germany (11%) and France (11%) have the highest potential in terms of % peak load whereas Germany (9.5 GW), France (8 GW), the UK (6 GW) and Italy (5 GW) have the highest estimated potential in terms of GW. The maturity of the regulatory framework for demand response will be decisive for whether this potential can be unlocked or not (Figure 8).

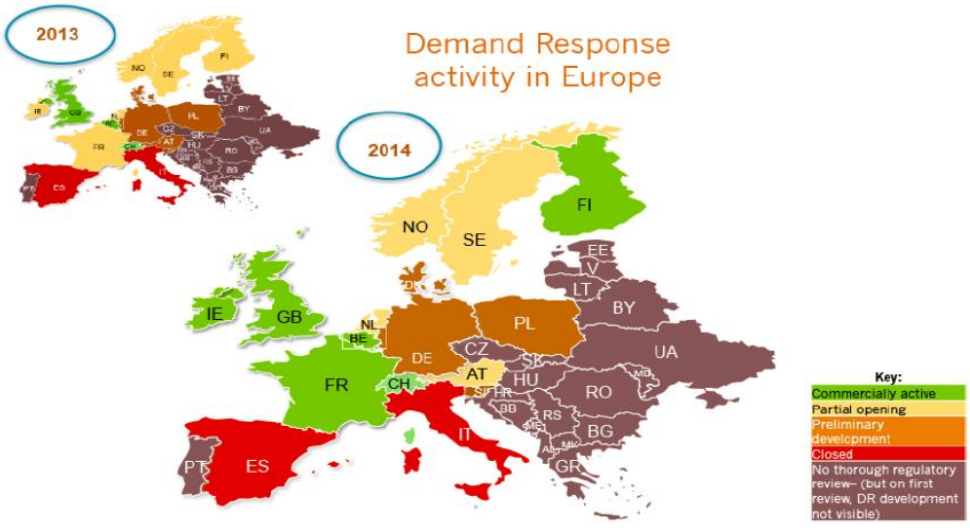

Figure 8: Industrial and commercial DR in Europe[17]

According to Figure 8, the framework for demand response is well-developed in France, Belgium, the United Kingdom, Ireland, Switzerland and Finland (market actors commercially active) whereas there is potential to develop more services in the short term in Austria, the Netherlands, Norway and Sweden (partial opening market).

[16] Sia Partners, Demand Response: A study of its potential in Europe, February 2015, Available at: http://energy.sia-partners.com/20150205/demand-response-a-study-of-its-potential-in-europe
[17] Energypost, Demand response markets in Europe begin to blossom, 20 May 2015, Available at: http://www.energypost.eu/restore-shows-demand-response-markets-europe-begin-blossom/

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 691689.

There is also an important distinction between implicit and explicit demand side management; the first refers to a situation where a DSM provider choses to be exposed to time-varying prices whereas the latter is related to a specific remuneration for changing consumption. Industrial and larger commercial clients will often be in the last case driven by purely financial incentives. Households however will only show a limited interest in offering demand services if this is not automated because they are not willing to follow up prices to see when it is interesting to consume. In other words, they are not very receptive to participate in DR programmes if their convenience is disturbed. Residential programmes should thus be designed in a way that households don't have to choose between providing flexibility and convenience. Furthermore, households can often not benefit from varying prices because prices can only be modified a few times a year in many countries.[18]

Aggregated distributed generation

Figure 9 highlights that some countries have a significantly higher share of renewable energies in the gross final consumption than others. These countries will subsequently have a substantially higher potential for unlocking the benefits of aggregation of distributed generation.

[18] Discussion on different arrangements for aggregation of demand response in the Nordic market – February 2016, NordREG Nordic Energy Regulators, February 2016, Available at: http://www.nordicenergyregulators.org/wp-content/uploads/2016/02/NordREG-Discussion-of-different-arrangements-for-aggregation-of-demand-response-in-the-Nordic-market.pdf

EGE3 Report –Smart Grid Task Force, Regulatory Recommendations for the Deployment of Flexibility Refinement of Recommendations, September 2015, Available at: https://ec.europa.eu/energy/sites/ener/files/documents/EG3%20Refined%20Recommendations_FINAL_clean.pdf

www.linear-smartgrid.be

Smart Energy Demand Coalition (SEDC), Demand Response at the DSO level, Enabling DSOs to harness the benefits of demand-side flexibility, April 2016, Available at: http://www.smartenergydemand.eu/wp-content/uploads/2016/05/SEDC-White-Paper-Demand-Response-at-the-DSO-level.pdf

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 691689.

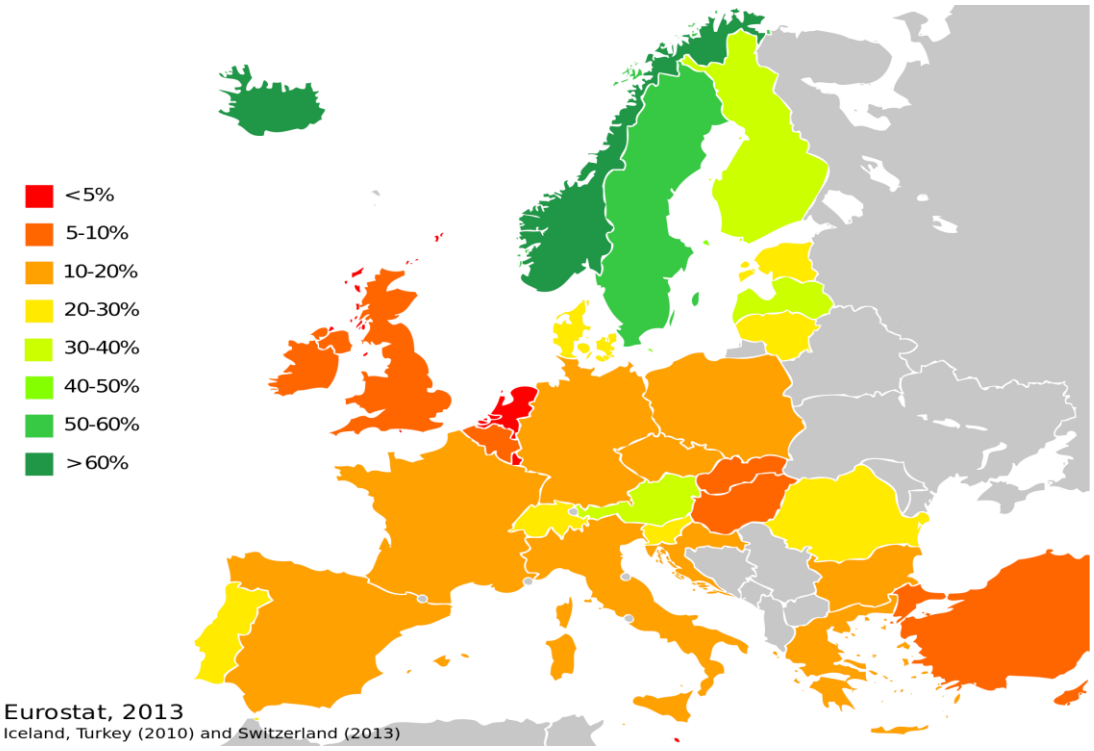

Figure 9: Renewable energy in the European Union

Norway, Iceland and Sweden have the highest share of renewables whereas the Netherlands and Luxemburg had the lowest share in 2013. From the countries covered by the consortium of the BestRES project, the UK had the lowest share in 2013 (5-10%) whereas Austria had the highest share (30-40%).[19]

With respect to specific renewable energy technologies, around 129 GW of wind power, 87 GW of PV solar power, 13 GW of small hydropower and 1.7 million heat pumps were installed at the end of 2014. Germany has the highest installed capacities of wind (39 GW) and PV solar (38 GW) whereas Italy has the highest installed capacities of small hydropower (3 GW) (we consider that large hydropower will not be used for aggregation) and the highest number of heat pumps (860 000). Table 3 reviews the installed capacities of renewable energy technologies for the countries covered by the consortium at the end of 2014.[20]

19 Eurostat 2013, Available at: https://www.google.be/search?q=renewable+energy+sources+europe&biw=1200&bih=543&source=lnms&tbm=isch&sa=X&ved=0ahUKEwjDwJWjqf_LAhWMVhoKHdilBrYQ_AUIBigB&dpr=1.6#imgrc=Ymf1QFLsHYXZTM%3A

20 EurObserv'ER, The State of Renewable Energies in Europe, Edition 2015

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 691689.

Table 3: Installed capacities renewable energy technologies in countries of the project partners

	Installed wind capacity (MW)	Installed PV solar capacity (MW)	Installed small hydro capacity (MW)	Number of heat Pumps
United Kingdom	12987	5203	314	18550
Germany	39193	38301	1283	59500
Belgium	1818	3105	64	5540
France	9068	5600	2029	418957
Austria	2095	770	1239	14268
Portugal	4953	419	388	7521
Spain	22975	4787	1948	54000
Italy	8683	18450	3086	863780
Cyprus	147	65	0	0

Aggregated storage

In recent months and years, aggregation of storage is appearing across electricity markets worldwide. For example in the United States, storage systems are aggregated to offer services to the TSO whereas several players are looking into the potential of aggregating services in Germany.[21] Table 4 highlights that, across Europe, Italy is far ahead of all other markets in terms of installed and planned electro-chemical storage capacity (August 2015). Only Italy, Germany and the UK have installed and planned capacities in excess of 1,000 MWh of electro-chemical energy storage.[22]

21 Greenbiz.com, The nuts and bolts of aggregated energy storage, October 2015, Available at: https://www.greenbiz.com/article/nuts-and-bolts-aggregated-energy-storage
Energy Storage Update, German firms turn batteries into power plants to aid grid control, June 2015, Available at: http://analysis.energystorageupdate.com/german-firms-turn-batteries-power-plants-aid-grid-control

22 Energy Storage Update, Top Markets for Energy Storage in Europe, December 2015, Available at:
http://www.energystorageupdate.com/europe/pdf/TopMarkets.pdf?utm_campaign=4362%2015SEP15%20Content%20Autoresponder.htm&utm_medium=email&utm_source=Eloqua&elqTrackId=b9a1f93ea9ff4379bf9c7e9c8f452f59&elq=a7ee52886d0c42319be9dd43a8c2d0bb&elqCampaignId=&elqaid=8769&elqat=1

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 691689.

Table 4: Installed and planned electro-chemical storage capacity across Europe

Country	Total installed and planned electro-chemical storage capacity (in MWh)
Italy	6,667
United Kingdom	1,608
Germany	1,457
France	534
Netherlands	186
Spain	131
Portugal	43
Denmark	34
Russia	17
Switzerland	11
Greece	5
Hungary	1

Research from Navigant also assumes that utility-scale storage capacity will grow by 63% per year up to 2023. This is mainly driven by considerable cost decreases of storage technologies. Few data is available for home storage but Germany is the only European market where this is really coming up.[23]

Software and data requirements for aggregation

When working together with a high number of providers of aggregation services, aggregators need platforms with software allowing for a high number of providers to connect. Furthermore, the platform should be able to capture data that is needed such as wind/PV forecasts, time series of generation and price signals.

Virtual Power Plants: a combination of elements

The above mentioned elements can all be combined in a Virtual Power Plant (VPP) which can be defined as "a system that relies on software and other technology to remotely and automatically dispatch and optimize distributed energy resources via an aggregation and optimization platform linking retail to wholesale markets". The VPP bundles medium and small-scale power producing and power consuming units.[24] An illustration of such as VPP is displayed in Figure 10.

23 Insight-E-7th Framework programme for Research and Technological Development, How can batteries support the EU electricity network?, November 2014, Available at: http://www.insightenergy.org/ckeditor_assets/attachments/48/pr1.pdf
24 http://www.elp.com/articles/powergrid_international/print/volume-19/issue-11/features/how-real-are-virtual-power-plants.html

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 691689.

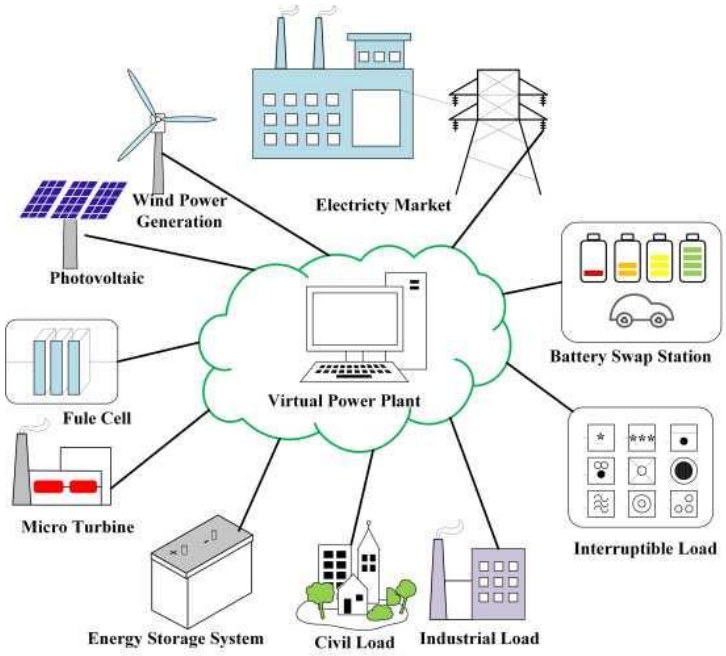

Figure 10: Illustration of a Virtual Power Plant (VPP)[25]

Navigant Research, Virtual Power plants, available at: https://www.navigantresearch.com/research/virtual-power-plants
https://www.next-kraftwerke.com/press
25 http://www.mdpi.com/1996-1073/8/3/2268

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 691689.

3.3.2 Customer segments and value proposition to customers

When aggregators enter certain markets with flexible assets (Figure 11), they target specific customer segments or users of aggregation services. Figure 11 highlights the possible relations between aggregators and other market actors in the electricity market. The figure indicates that aggregators can deliver services to the following users:

1. BRPs (power exchange market)
2. TSOs and DSOs (balancing the market and ancillary services)
3. It can also be interesting for aggregators to directly sell on the different wholesale electricity markets: intraday, day-ahead and futures markets (monthly, quarterly and yearly futures markets)[26]
4. Aggregators can directly optimize production and consumption of prosumers on a specific site

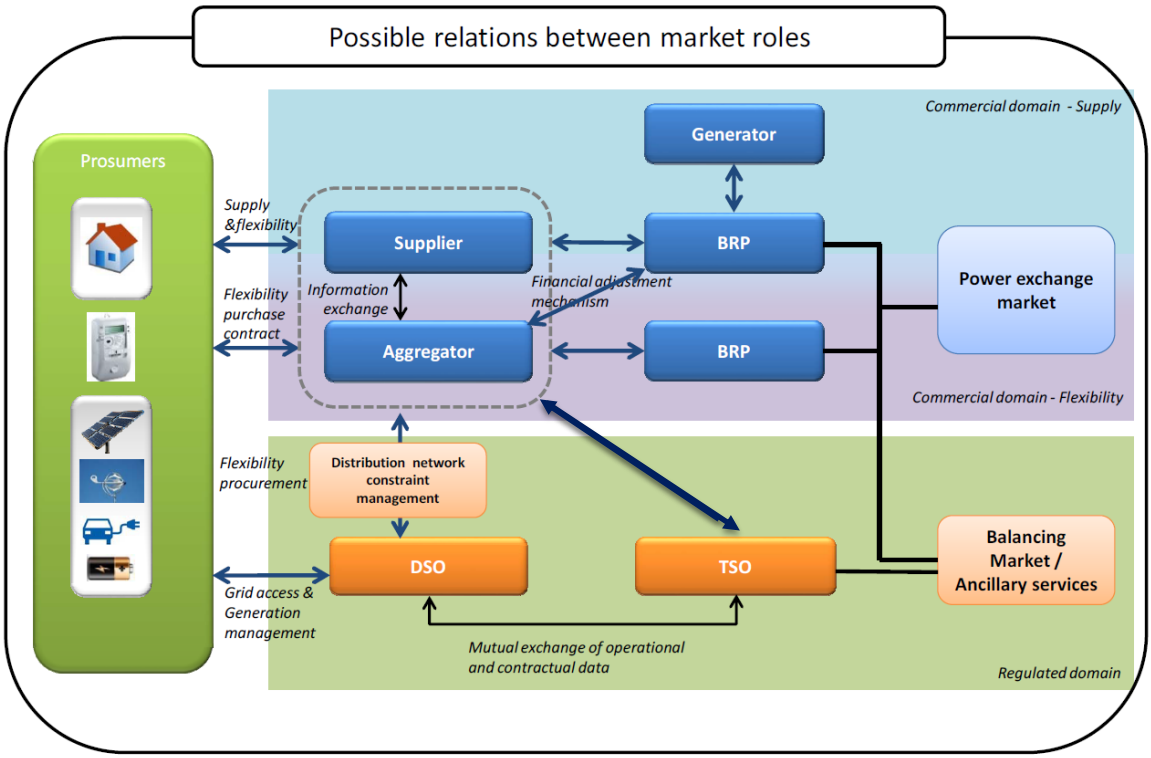

Figure 11: Users of services offered by aggregators [27]

26 Interviews with aggregators
27 EG3 Report –Smart Grid Task Force, Regulatory Recommendations for the Deployment of Flexibility, January 2015
European Commission – Seventh Framework Programme (FP7), DREAM electricity market design, White Paper, October 2014

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 691689.

In the following we elaborate on how different users might benefit from collaborating with aggregators.

Balance Responsibility Parties (BRPs)

BRPs can optimize their portfolio and reduce imbalances. In order to do this, BRPs will often need to decrease or increase outputs of wind and PV installations in combination with other generation/supply units and demand side management. Trading will also be required for further optimizing the portfolio.

Transmission System Operators (TSOs)

The electricity system balance should always be maintained and TSOs are responsible for this. They should also manage congestion in the system and reduce the amount of electricity lost in the electricity system. In this framework, TSO's use various types of reserves to respond to imbalances and each type of reserves has a different activation time (Figure 12). Also, all these reserves can be translated into generation and demand adjustments, generation curtailment, provision of reactive power and peak shifting.[28]

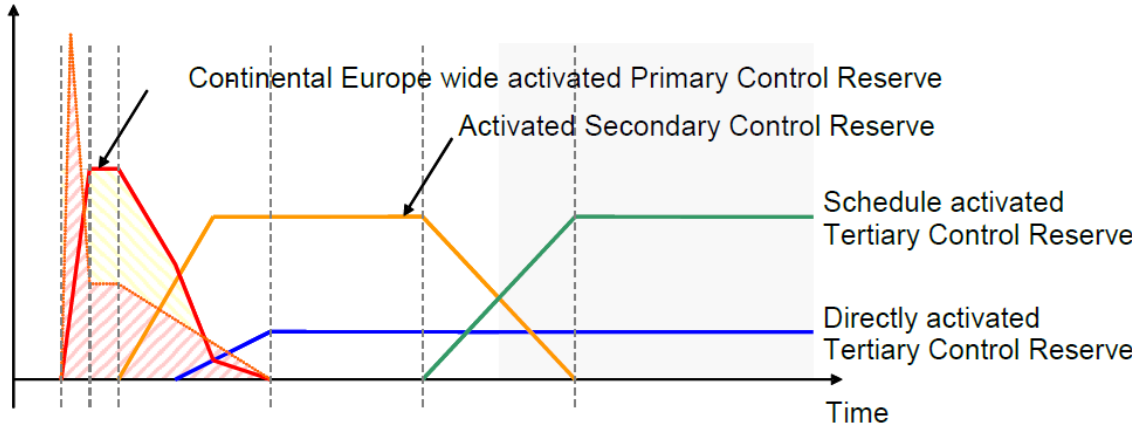

Figure 12: Frequency Deviation and Activation of Reserves[29]

The objective of Frequency Containment Reserve (FCR) or primary frequency control (R1) is to maintain the balance between generation and consumption within the high-voltage European interconnected system and the reaction should be less than 30 second. Automated activation Frequency Restoration Reserve (aFRR) or Secondary frequency control (R2) is activated to balance the own grid and is used to free up the frequency control capacities.

28 EG3 Report –Smart Grid Task Force, Regulatory Recommendations for the Deployment of Flexibility, January 2015

29 ENTSOE, Supporting Document for the Network Code on Load-Frequency Control and Reserves, June 2013, Available at: http://networkcodes.entsoe.eu/wp-content/uploads/2013/08/130628-NC_LFCR-Supporting_Document-Issue1.pdf

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 691689.

It is activated between 30 seconds and 15 minutes.

Lastly, manual activation Frequency Restoration Reserve (mFRR) or tertiary Frequency Control (R3) are contracted with loads connected to the TSO and the DS0. These loads should be activated between a few minutes and 15 minutes.[30]

Aggregation has the following value for the TSOs:

a. **Congestion management**. Network operators can avoid network investments and the value of flexibility will thus be the CAPEX and OPEX of the avoided reinforcement
b. **Grid losses reduction**. The value of flexibility corresponds to the amount of electricity that has not been lost
c. **Voltage control** through active or reactive power. The value of flexibility equals CAPEX and OPEX of the avoided reinforcement and voltage control
d. **Frequency control** through frequency containment reserves (FCR), frequency restoration reserves (FRR) and replacement reserves (RR)

Distribution System Operators (DSOs)

Similar to the needs of TSOs, DSOs will require flexibility to deal with congestion and avoid voltage increases in the grid. Through generation and demand adjustments, provision of reactive power, peak shifting and manual or automatic curtailment is provided.[31]

Wholesale electricity markets

Aggregators can choose to sell their electricity on different wholesale electricity markets. The attractiveness of this option partly depends on the subsidy mechanism that is in place in the country. Whereas owners of distributed generation assets will receive a fixed remuneration in Euro/MWh in the case of a Feed in Tariff (FiT) or a tender system, they will receive whatever they raise for electricity on the spot market plus the market premium in the case of a feed in Premium (FiP) or the value of green certificates in the case of a system of green certificates. A first advantage of this variable remuneration is that generators are supposed to familiarise themselves with wholesale market workings so that market integration of renewables is improved.

30 http://www.elia.be/en/suppliers/purchasing-categories/energy-purchases/Ancillary-services
Elia, Studie over de nood aan "Adequacy" en aan flexibiliteit in het Belgische elektriciteitssyteem, Periode 2017-2027, April 2016, Available at: http://www.elia.be/~/media/files/Elia/publications-2/studies/20160418-Adequacy-flexibility-report-2017-2027-NL.PDF
31 idem

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 691689.

Another important benefit is that renewable energy generators are encouraged to dispatch of renewable energy in a way that the electricity is fed in at times of high demand and not at times of negative prices (Figure 13).[32]

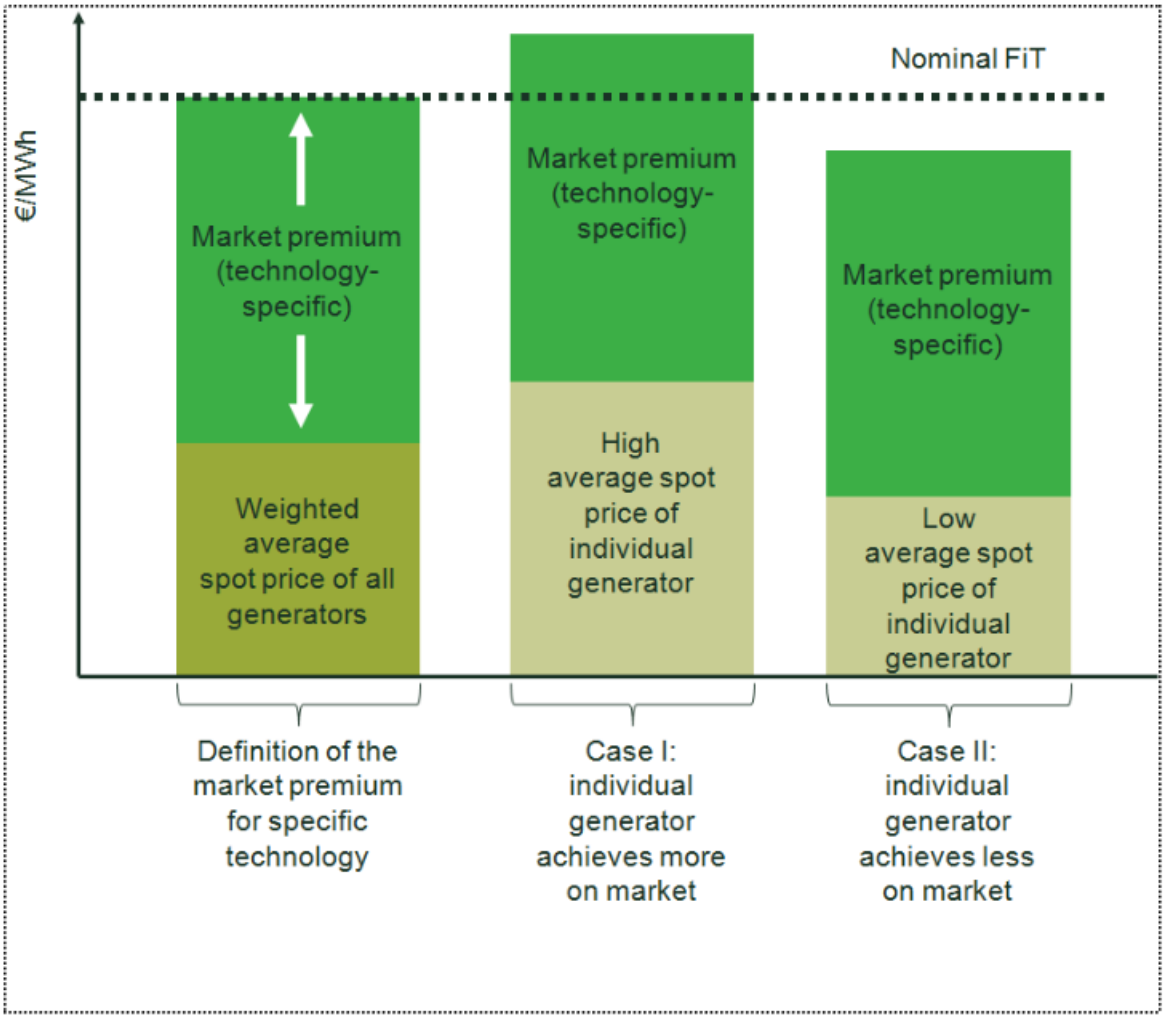

Figure 13: The market premium model

Nevertheless, RE-Pro clearly mentioned that we are approaching grid parity with a lot of technologies and solutions across Europe. Therefore, subsidies will become less and less common and the valorisation of flexibility on wholesale markets will become more and more important.

[32] Almost a reform: the new German support scheme for renewable electricity, August 2014, Available at: http://www.oxera.com/Latest-Thinking/Agenda/2014/Almost-a-reform-the-new-German-support-scheme-for.aspx

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 691689.

Prosumers

Prosumers in the large and SME sector are mainly focused on corporate stability and reduction of energy costs. In this situation, ESCO providers offer technical solutions to impose technical efficiency increases and, if applicable, add auto consumption production units (CHP, Tri-generation & quarto-generation) to substitute high energy costs. The big challenge is the availability of infrastructure, legislation, grid stability and gas as well as financing sources.

3.3.3 Revenue streams and cost structure depending on key stakeholders

Revenues that are generated by aggregators go together with specific costs. Also, the difference between revenues and costs and their origin will be driven by the presence of key financial and non-financial stakeholders. An aggregation business could thus be developed purely for financial reasons by private investors or for example by a software or technology provider who can use such a business not only to sell flexibility but also as a leverage to sell its technology. Siemens could be an example of such an aggregator (see also section 5).[33] The main stakeholder of the aggregation business can also be an energy supplier as described in the aggregator-supplier business model before.

Revenue streams

On the one hand, the market of aggregation and revenue models can be customer-tailored and not standardized. For example in the case of a BRP using the flexibility or in the case of the energy consumption of a prosumer being optimized, this revenue model can be volume dependent. On the other hand, in the case of the TSO and the DSO being the user of flexibility, the revenues will be generated through a predefined availability and or activation fee. If an aggregator directly sells and buys on wholesale electricity markets, he will earn money by selling and buying when there is a spread between the generation cost of the aggregated portfolio and wholesale electricity market prices.[34]

Costs

In order to generate revenues, aggregators will have to bear certain costs. A very important part of total costs will be the remuneration that aggregators pay to providers. Additionally, aggregators have to develop a software platform and develop other technology. Technology costs can be limited if an existing platform can be used (for example in the case of an aggregator-supplier). If no existing platform is suited for the aggregation business or the aggregator is an independent player who has to develop the platform from scratch, costs can

33 Siemens, Enrolling With a Demand Response Aggregator, Curtail load with less risk and larger incentive payments, Available at: https://www.downloads.siemens.com/download-center/Download.aspx?pos=download&fct=getasset&id1=A6V10594514

[34] Interviews with aggregators
http://www.businessmodelgeneration.com/canvas/bmc

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 691689.

however be very high. Costs for contracts and staff can also play an important role, certainly when a business is starting up. The economies of scale of scope which can be realized highly depend on the split up between fixed and variable costs (Figure 14).[35]

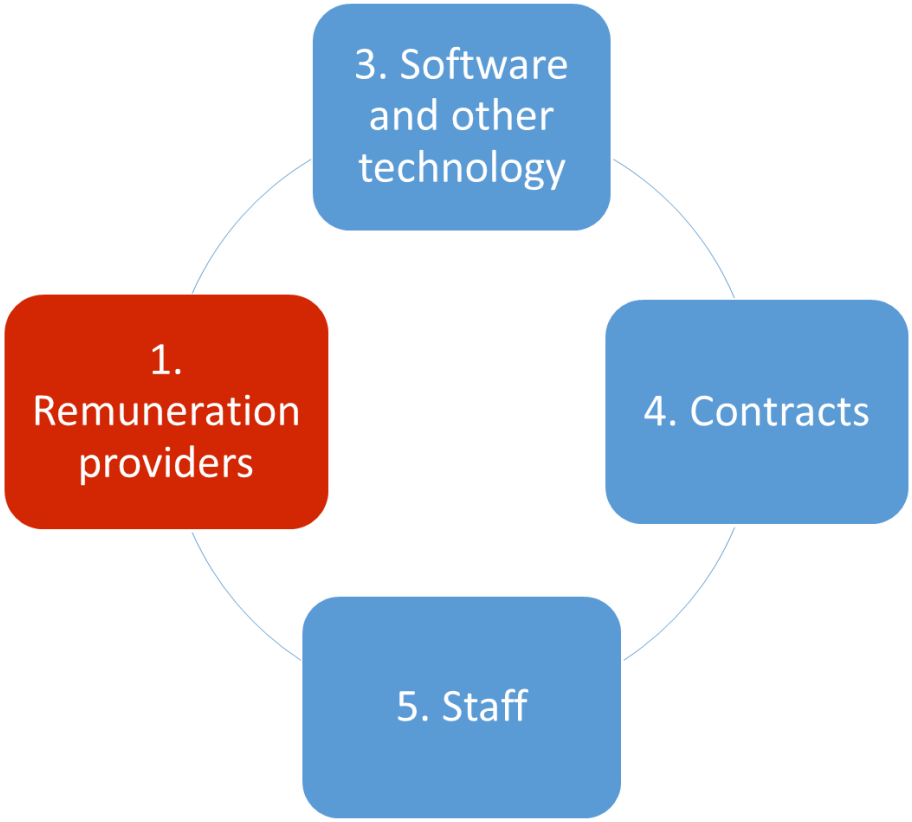

Figure 14: Cost components aggregators

3.3.4 Channels to reach customers and customer relationships

The aggregation business is a relatively new business across Europe and, therefore, a key differentiator with competitors is the ability to reach new interesting providers of aggregation services (demand side management, distributed generation assets and storage). Aggregators that are also energy suppliers can use their existing residential and commercial customers, contracted prosumers and industry events in order to reach potential targets. Independent aggregators will probably be less able to rely on such a network and will thus need to target new clients with visits on site to reach out through the phone/websites and social media.

35 Interviews with aggregators
http://www.businessmodelgeneration.com/canvas/bmc

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 691689.

4. Business models within the consortium

The 6 aggregators who are part of the consortium are active in 9 countries: the United Kingdom, Germany, France, Belgium, Austria, Portugal, Spain, Italy and Cyprus.

Figure 15: Countries covered by the consortium

4.1 Existing business models within the consortium

When analysing business models, we have simultaneously focused on two sides:

1. On existing business models as they exist
2. On planned implementations of new business models in the near future (period between 2 and 3 years)

The result of this analysis is illustrated in Table 5.

BestRES This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 691689.

Table 5: Business models for aggregators

	Aggregator-supplier	Aggregator-BRP	Delegated aggregator	Aggregator as service provider	Prosumer as aggregator
Good Energy (United Kingdom)	X		/		
Next Kraftwerke Germany (Germany)	X	X	X		
Next Kraftwerke Germany (France)	/	X	X		
Next Kraftwerke (Belgium)	/	X	X		
Oekostrom (Austria)	X	X			
EDP (Portugal)	*	*			
EDP (Spain)	*	*			
RE-Pro (Italy)				X	
RE-Pro (Cyprus)				X	

X=Business model that is implemented in the beginning of 2016
/=Business model that the aggregator is planning to implement in the short to medium-term (2 to 3 years)
*= EDP is more focussing on business models in the medium-term than in the short-term

Table 5 underlines that the aggregators within the consortium are generally taking up the role of the aggregator-supplier and/or delegated aggregator. On the one hand, Good Energy, Oekostrom and EDP are all electricity suppliers who are using or planning to use their portfolio of existing clients to offer aggregation services or optimize the own portfolio. On the other hand, the core of Next-Kraftwerke Germany and Next Kraftwerke Belgium business is aggregation but they are equally focusing on electricity supply in Germany and Belgium and developing it in France. All aggregators are thus in transition towards a model where they combine roles so none of the aggregators is only taking up the role of an independent aggregator in the future. RE-Pro is another type of aggregator because the company offers ESCO services; they optimize the production and consumption of prosumers on site. Table 6 provides the reader with an overview of the service providers aggregators work together with in order to create value on the different markets.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 691689.

Table 6: Value created by aggregators of the consortium on the different markets

	Wholesale and retail markets	Reserve and capacity markets	Supply to end electricity consumers (ESCO services)	Reduction of grid charges	Own balancing
Good Energy (United Kingdom)	Wind, PV, Biogas, Hydro, Small-scale generation, storage (batteries), Industrial and domestic DSM		Wind, PV, Biogas, Hydro, Small-scale generation, storage (batteries), Industrial and domestic DSM		Wind, PV, Biogas, Hydro, Small-scale generation, storage (batteries), Industrial and domestic DSM
Next Kraftwerke (Germany)	Wind, PV, Biogas, Hydro, CHP, Industrial DSM	Biogas, Hydro, CHP			Wind, PV, Biogas, Hydro, CHP, Industrial DSM
Next Kraftwerke (France)	Wind, PV, Biogas, Hydro, CHP, Industrial DSM	Biogas, Hydro, CHP			Wind, PV, Biogas, Hydro, CHP, Industrial DSM
Next Kraftwerke (Belgium)	Wind, PV, Biogas, Hydro, CHP, Industrial DSM	Biogas, CHP, Industrial DSM			Wind, PV, Biogas, Hydro, CHP, Industrial DSM
Oekostrom (Austria)	Wind, PV, hydro, Biogas		Wind, PV, Biogas, Hydro		Wind, Hydro
EDP (Portugal)	Industrial DSM	Industrial DSM			Industrial DSM
EDP (Spain)	Industrial DSM	Industrial DSM			Industrial DSM
RE-Pro (Italy)			Auto production, energy saving measures		
RE-Pro (Cyprus)			Auto production, energy saving measures		

* If underlined, we are dealing with assets that are already used to create value in the beginning of 2016. If not underlined, we are dealing with assets that the aggregators are planning to use in the next 2 to 3 years. EDP is focusing more on business models in the medium-term.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 691689.

4.2 Providers of aggregation services

Table 6 reveals that all aggregators, with the exception of EDP (retailer side), are using or planning to use generation technologies to offer flexibility: wind, PV, biogas, CHP and hydro. Good Energy, Next Kraftwerke Germany, Next Kraftwerke Belgium, Oekostrom and RE-Pro indicated that aggregated distributed generation is the largest source of aggregation, but that DSM is becoming a more and more important asset in their portfolio.

EDP however sets its major focus on DSM. Also, an important difference between EDP on the one hand and Good Energy on the other hand, is that Good Energy is targeting smaller-scale players whereas EDP targets bigger industrial players. Next Kraftwerke is focusing on both types of clients. With respect to domestic DSM, which is not yet used for providing flexibility among the aggregators, electricity suppliers will probably be better placed to do it because there will be a large cost of customer service and billing. Finally, with respect to storage, Good Energy is planning to proceed to implementation in the near future.

Table 7 provides an overview of the mix of assets within the portfolio of aggregators. Good Energy and Oekostrom are mainly focused on wind (more than 50% of the production mix for both aggregators) whereas EDP is entirely focused on DSM for aggregation. For Next Kraftwerke and RE-Pro, the split up generation/DSM now might not reflect the situation in the near future.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 691689.

Table 7: Mix of aggregator's providers of aggregation services to create value on different markets

	Wind	PV	Other Renewable Generation (Biogas, Hydro etc.)	DSM
Good Energy (United Kingdom)	58.4%	23.3%	18.3%	
Next Kraftwerke (Germany)	The largest part of the portfolio is generation but the split up generation/DSM now might not reflect the situation in the near future			
Next Kraftwerke (France)	The largest part of the portfolio is generation but the split up generation/DSM now might not reflect the situation in the near future			
Next Kraftwerke (Belgium)	The largest part of the portfolio is generation but the split up generation/DSM now might not reflect the situation in the near future			
Oekostrom (Austria)	71%	9%	20%	/
EDP (Portugal)				Industrial DSM
EDP (Spain)				Industrial DSM
RE-Pro (Italy)		Highly case-specific		Highly case-specific
RE-Pro (Cyprus)		Highly case-specific		Highly case-specific

Both aggregated generation and DSM can be activated in an automated and manual way and aggregators generally do this in both ways. In the latter case, an aggregator will discuss optimizations with the provider of aggregation services before activating volumes. In this context, Good Energy highlighted that a personal/tailored-made service is required in many cases.

Furthermore, since Next Krafwerke, Good Energy and Oekostrom are targeting a large number of small-and medium-scale providers, they will rely on many different channels such as industry network, social media to reach these clients. Larger clients are generally targeted with site visits. In this context, EDP is only planning to source DSM from industrial clients in their existing portfolio and, in a first step, the client managers of these clients will thus be responsible for it. RE-Pro is also using site visits for targeting new clients.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 691689.

Table 8 highlights the most important sectors for providing DSM in each of the aggregator's portfolios.

Table 8: Important sectors for DSM in the portfolio of the aggregators

	Industrial	Appartment house
Good Energy (United Kingdom)	Mainly small-scale. Targeting is also business specific or driven by environmental aims.	Solar diverters, domestic storage, electric vehicles, electrical heating
Next Kraftwerke Germany (Germany)	Water treatment and CHP	/
Next Kraftwerke Germany(France)	Not active yet but focusing on industrial	/
Next Kraftwerke (Belgium)	Not active yet but focusing on industrial clients	/
Oekostrom (Austria)	/	Plug-in PV systems
EDP (Portugal)	Chemical and foundry industry, telecommunications	
EDP (Spain)	Industry and services, in particular electrometallurgy	
RE-Pro (Italy)	F&B, hotels, hospitals, Chemical and pharmaceutical industry	/
RE-Pro (Cyprus)	F&B, hotels, hospitals, Chemical and pharmaceutical industry	/

Table 8 shows that, with regards to industrial DSM, many different industries can offer flexibility. For domestic DSM (apartment houses), many devices can have an interesting potential.

BestRES This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 691689.

4.2.1 Expected evolutions related to providers of aggregation services

An important insight from the interviews is that there will be a trend towards aggregation of more and smaller generation units up to 2020.

With respect to the future evolution of storage, Good Energy is expecting to use more and more storage. Next Kraftwerke already uses integrated battery storage in their virtual power plant. RE-Pro also sees growing importance in the storage market combined with the ESCO services depending on customer energy prices and CO_2 emission costs. As others both RE-Pro and Next Kraftwerke observe the rapid developments in battery technologies closely. Whether or not it will play a significant role in the end depends on the economics of batteries. Oekostrom however mentioned that a relevant number of distributed storage systems could become an issue if it threatens the viability of generation assets.

With regards to future domestic DSM, there is a belief amongst the aggregators that there is significant potential but not in the first 2 to 3 years. In this context, Good Energy emphasizes that they will mainly focus on solar diverters domestic electricity storage and that half-hourly settlements of domestic customers will be the key. Oekostrom would only go into it if the regulatory framework makes it feasible while Next Kraftwerke Germany, Next Kraftwerke Belgium and EDP stated that domestic DSM development within their portfolio are very unlikely in the coming years.

RE-Pro is furthermore expecting that the need for energy efficiency measures (an implementation of DSM) will rapidly increase and further developments are imminent and necessary. Local legislation, open markets and emission charges can lead to a significant and broad turnaround.

4.2.2 Assessing the potential of providers of aggregation services

When an aggregator identifies a prospective provider of aggregation services, his potential should be assessed as accurate as possible. In this context, aggregators generally appeal to interviews, on site visits and, in more rare cases, they also use knowledge from similar projects or projects in other countries. Suppliers like Good Energy and Oekostrom accentuated that hard calls and emails (interviews) are mostly used for the first contacts. Additionally Oekostrom carries out on site visits for the implementation.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 691689.

4.3 Markets where value is created

Aggregators can create value in many different ways as was explained in section 3. If services are supplied to customers of a supplier or the supplier/BRP uses flexibility for own balancing, the aggregator offers services for **internal** reasons. Table 6 shows that Good Energy, Next Kraftwerke and Oekostrom use such volumes for balancing of the internal portfolio and related clients and that RE-Pro offers ESCO services to prosumers. All these companies are using flexible generation assets to supply electricity to their client portfolio. If flexibility is used on wholesale and retail markets, reserve and capacity markets and for reduction of grid charges, it is used **on external** markets. Apart from RE-Pro, all aggregators are valorising or planning to valorise aggregation services on wholesale markets. Next Kraftwerke is the only aggregator already active on the reserve markets whereas EDP is assessing the benefits of participating in this market with DSM in the future (although changes in the regulatory and legal framework are required).

4.3.1 Participation to wholesale markets

As illustrated in the EC Market4RES study, both day-ahead, intraday and futures electricity market prices have been decreasing over the last few years across Europe. This can at least partly be attributed to the steady increase of RES-E penetration and the market coupling between countries.[36]

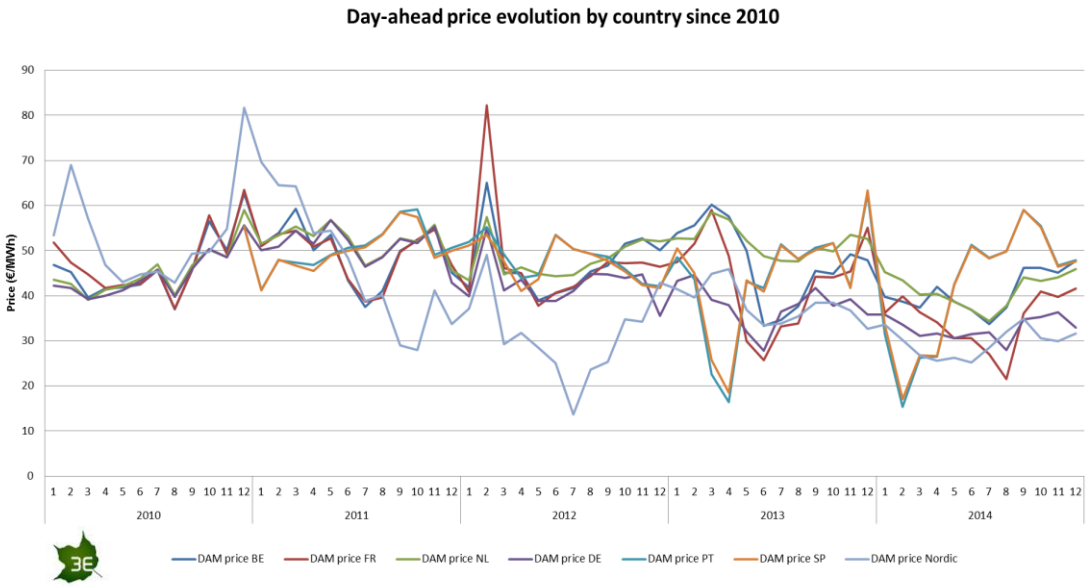

Figure 16: Evolution of day-ahead electricity prices across Europe

[36] European Commission, Market4RES: Opportunities, Challenges and Risks for RES-E Deployment in a Fully Integrated European Electricity Market, Available at: Market4RES.eu

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 691689.

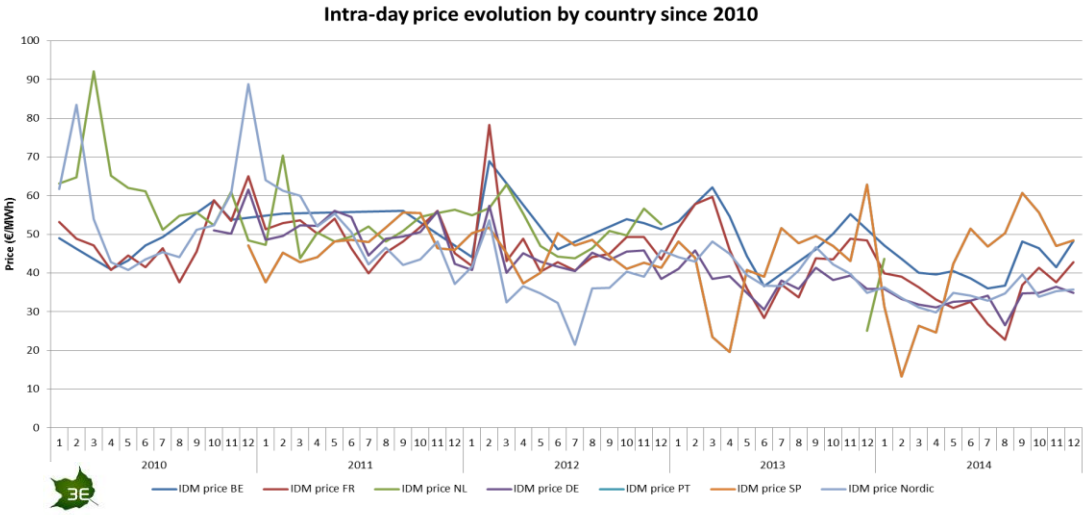

Figure 17: Evolution of intraday electricity prices across Europe

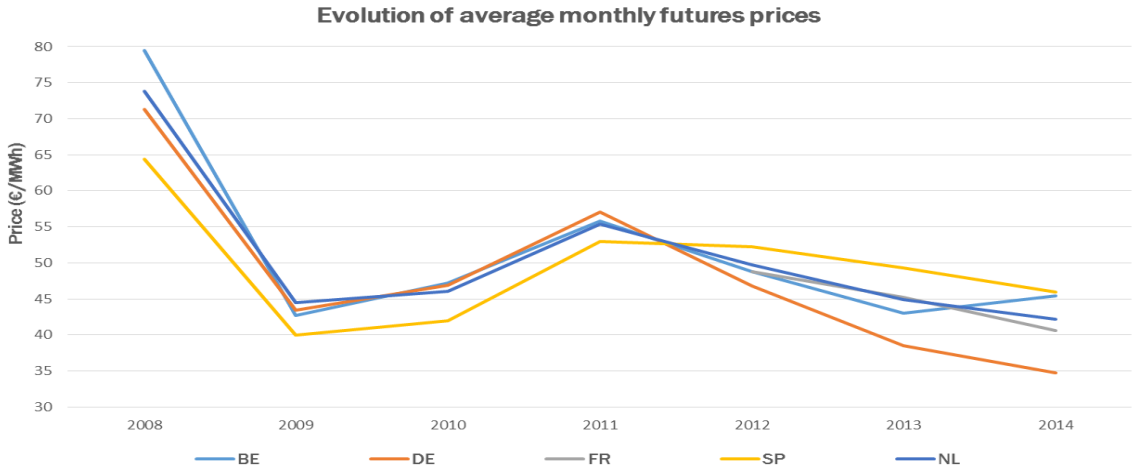

Figure 18: Evolution of futures electricity prices across Europe

Despite these decreasing prices and the fact that aggregators highlight competition is increasing on wholesale electricity prices, aggregators are active on these markets: Good Energy, Next Kraftwerke Germany (only in Germany) and Oekostrom. Moreover, Next Kraftwerke Belgium and Next Kraftwerke Germany (only In France) are starting up activities in these markets. Also, large volumes of centralized generation will close in the years to come so price peaks could potentially occur more and more in the years to come. Currently, RE-Pro and EDP are not participating in the wholesale markets as aggregators (Table 9).

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 691689.

Table 9: Participation of aggregators in wholesale markets

	Participation?	Subsidy scheme in place for renewables	Drivers for participating with flexible assets
Good Energy (United Kingdom)	Yes	Contracts for Difference , feed-in tariffs	*Contracts for difference and feed-in tariff: no driver because a feed-in tariff is a purely volume driven system
Next Kraftwerke (Germany)	Yes	Feed-in premium	*Efficient trading= more profits+management fee
Next Kraftwerke (France)	Starting up	Feed-in tariff but feed-in premium expected in Q3/2016	*Efficient trading= more profits+management fee
Next Kraftwerke (Belgium)	Starting now	Green certificates	Efficient trading= more profits+management fee
Oekostrom (Austria)	Yes	Feed-in tariff	* No driver because a feed-in tariff is a purely volume driven system. However, some generation units are no longer under support and traded on the free market or used for own balancing
EDP (Portugal)	No	Feed-in tariff	* No driver because a feed-in tariff is a purely volume driven system
EDP (Spain)	No	Wholesale market price + fixed remuneration for several years	* Can be interesting but EDP is not focusing on generation in this project
RE-Pro (Italy)	No	Feed-in tariff	* No driver because a feed-in tariff is a purely volume driven system
RE-Pro (Cyprus)	No	Feed-in tariff	* No driver because a feed-in tariff is a purely volume driven system

Table 9 displays that the subsidy scheme is an important driver(s) for participation to wholesale markets in each of the covered countries. Since feed-in tariffs and tenders are systems only driven by volumes, there is no reason to use flexible assets in wholesale markets. By contrast, in countries with feed-in premiums (and green certificates), there are incentives for aggregators to be as efficient as possible on these different markets.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 691689.

4.3.2 Participation to reserves and capacity markets

Table 10 shows the details of participation of the aggregators on the different reserves markets

Table 10: Details of the offered ancillary reserves by the partners of the consortium

	Primary Frequency Control (R1)	Secondary Frequency Control (R2)	Tertiary Frequency Control (R3)
Good Energy (United Kingdom)	Not active	Not active	Not active
Next Kraftwerke Germany (Germany)	Implementation process started	R2 with biogas, hydro, CHP and industrial DSM	Minute reserve biogas, hydro, CHP and industrial DSM
Next Kraftwerke Germany (France)	Implementation process started	Planned, but not possible yet due to regulatory barriers	Planned, but not possible yet due to regulatory barriers
Next Kraftwerke (Belgium)	Active	Planned but mot possible yet due to regulatory barriers	Active
Oekostrom (Austria)	Not active	Not active	Not active
EDP (Portugal)	No market because all generators must participate	Not active but eventually possible in the future **	Not active but eventually possible in the future **
EDP (Spain)	No market because all generators must participate	Not active but eventually possible in the future **	Not active but eventually possible in the future **
RE-Pro (Italy)	Not active	Not active	Not active
RE-Pro (Cyprus)	Not active	Not active	Not active

* R1 downwards: this product is activated between [100 MHz, 200 MHz], whereas the total contracted volume must be activated at 200 MHz

** In Portugal and Spain, generation and retail activities are separated. In Portugal, R2 and R3 markets are designed for conventional generation, namely hydro and thermal power plans. Therefore, retailers don´t participate in these markets. In Spain, wind is also allowed to participate in the reserves markets.

Similar to the wholesale markets, it is clear from Table 10 that participation in reserves markets highly varies across the countries and aggregators that are covered by the consortium. Next Kraftwerke Germany is most present, with a widest variety of generation assets, whereas Good Energy, Oekostrom, EDP (retailer side) and RE-Pro are not present at all on these markets. Also, Next

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 691689.

Kraftwerke Germany is the only aggregator of the project partners participating with DSM on reserves market. The figure equally reveals that EDP cannot participate in the R1 market in Spain and Portugal because all generators are obliged to participate, and it is not remunerated, so there is no real R1 market working.

With regards to capacity markets, aggregators can participate in the United Kingdom, Belgium, France, Italy and Cyprus. Good energy is not yet active in this market but is engaged in some demonstration projects so this might change in the near future, certainly, because the market is not well-designed for participation of DSM. In Belgium, the capacity market is dominated by a very limited amount of players and therefore Next Kraftwerke Belgium is not yet participating. In France, the capacity market only opened in October 2015 and market actors are waiting for the final design. The markets in Cyprus is not opened yet, therefore there is no capacity market. In Italy, Germany, Austria, Spain and Portugal, there are no capacity markets.

4.3.3 Reduction of grid charges

DSM approaches like Energy saving measures conducted by RE-Pro aims on a reduction of energy purchase and therefore achieve a reduction of grid charges too. However, none of the aggregators is now specifically targeting grid charge reductions with aggregation activities.

4.3.4 Supply to electricity consumers (ESCO services)

Energy Savings Companies (ESCO's) are offering various types of energy related measures to increase efficiency, decrease consumption, reduce CO_2 emissions and still meet the customers projected energy related needs. Based on an Energy Audit (EA), the technical and construction related weak points are determined and a solution is presented in order to achieve the best results. The technical measures targeted by RE-Pro are based on on-site power generation e.g. PV, Solar thermal, Solar cooling, CHP, heat pumps etc. whereby two contractual agreements are offered currently: Power Purchase Agreements (PPA) and Energy Performance Contracts (EPC).

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 691689.

4.4 Software, data and contract requirements

4.4.1 Software requirements

From the aggregators within the consortium, Next Kraftwerke is furthest developed with their VPP and remote control unit “Next Box”. It allows to connect almost 2000 of decentralized electricity producers and consumers for a total portfolio size of 2 GW. It sends information on the operation of the remote unit to the central control system and allows for starting up or shutting down units. Furthermore, the basis of the Next Box consists of a PLC, a modem and an antenna and data communication takes place over a GPRS connection. Next Box is used by Next Kraftwerke in Germany, France and Belgium (Figure 19).[37]

Figure 19: Next Kraftwerke’s Nextpool

Oekostrom uses a remote control unit with an algorithm based on market signals. Because RE-Pro’s generation plants are mostly isolated from the market (like energy efficiency devices) or remunerated with FiT no software or measuring equipment (except for metering net generation/consumption) is used. EDP does not yet have a platform since they don’t have any aggregation activities but, as an electricity producer and supplier, they have existing platform and a home management system that they are planning to use as a starting point for developing DSM in the near future. Good Energy doesn’t use any type of remote control at this moment.

37 www.Next-kraftwerke.com
Interviews with aggregators

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement N° 691689.

4.4.2 Data requirements

For using a platform with a remote control unit, various types of data are required: forecasts for wind/PV and demand, times series of generation and wholesale electricity market data are required. Forecasting and time series of generation should be detailed enough but too detailed data (for example on less than a second) would not be useful because it would make the systems too heavy. Data related to day-ahead, intraday and balancing markets will thus also be needed (Table 11).

BestRES This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 691689.

Table 11: Data requirements for aggregator business models

	Day Ahead Market (DAM) Gate Closure Time	Intraday Market (IDM) Closure Time	Publishing of DAM Market Results	Publishing of IDM Market Results	DAM Market Resolution	IDM Market Resolution	Balancing Settlement Resolution
United Kingdom	11:00 (UK local time)	1hr 15mins before delivery	11:42	Gate closure	30 MIN	30 MIN	30 MIN
Germany	12:00	Continuous: until 30 minutes before delivery ; Auction 15.00 pm	12:40	Continuous	1 H	15 MIN	15 MIN
France	12:00	Continuous until 30 Minutes until delivery	12:40	Continuous	1 H	1 H	15 MIN
Belgium	D-1 12:00	D H-0h00	13:05	Continuous	1 H	1 H	15 MIN
Austria	D-1 10:12	Continuous: until 30 minutes before delivery ; Auction 15.00 pm	D-1 10:20	Continuous	1 Q	15 MIN	15 MIN
Portugal	D-1 11:00	6 sessions: D-1 18h45; D-1 21:45; D 01:45; D 0 4:45; D 08:45; D 12:45	D-1 15:00	D-1 20:45; D-1 23:45; D 03:45; D 06:45; D 10:45; D 14:45	1 H	1 H	15 MIN
Spain	D-1 11:00	6 sessions: D-1 18h45; D-1 21:45; D 01:45; D 0 4:45; D 08:45; D 12:45	D-1 15:00	D-1 20:45; D-1 23:45; D 03:45; D 06:45; D 10:45; D 14:45	1 H	1 H	15 MIN
Italy	not participating	not participating	not participating	not participating	not participating	not participating	not participating
Cyprus	not participating	not participating	not participating	not participating	not participating	not participating	not participating

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 691689.

4.4.3 Contract requirements

An important insight from the interviews is that almost all information with respect to contracts is confidential or that contracts are not yet well-defined (Table 12). A significant driver for this is that contracts are not standardized yet because we are dealing with a young growing sector. However, some aggregators mention that a typical contract duration is between 1 year and several years.

Table 12: Duration of contracts with providers of aggregation services

	Duration of contracts with providers of flexibility
Good Energy (United Kingdom)	Typically linked to power contracts for 2 years. Other contracts not yet in the stage of planning.
Next Kraftwerke Germany (Germany)	Confidential
Next Kraftwerke Germany(France)	Confidential
Next Kraftwerke (Belgium)	Confidential
Oekostrom (Austria)	Mostly 1 year
EDP (Portugal)	Not yet in the stage of planning this
EDP (Spain)	Not yet in the stage of planning this
RE-Pro (Italy)	Case-specific
RE-Pro (Cyprus)	Case-specific

4.5 Revenue streams and costs

4.5.1 Revenues

Table 13 accentuates the most important revenue stream for each of the aggregators. The exact revenues are not included since this is highly confidential information.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 691689.

Table 13: Most important revenues of aggregators within the consortium

	Most important revenue stream for the aggregator
Good Energy (United Kingdom)	Own balancing
Next Kraftwerke (Germany)	Next Kraftwerke offers or plans to offer on all reserve power markets and the wholesale market. This allows Next Kraftwerke to put the flexibility of the client where it is worth most to maximise the overall revenue. One month most might be earned with R1, another month with R3 or on the Day Ahead and Intra-day markets.
Next Kraftwerke (France)	
Next Kraftwerke (Belgium)	
Oekostrom (Austria)	Wholesale markets and own balancing
EDP (Portugal)	Own balancing
EDP (Spain)	Own balancing
RE-Pro (Italy)	PPA and EPC contracts
RE-Pro (Cyprus)	PPA and EPC contracts

Table 13 illustrates that RE-Pro is not generating revenues on the same markets compared to the other aggregators. RE-Pro generates revenues through the ESCO business. These revenues are related to PPAs for the independent on-site generated energy delivered. For EPC related contractual agreements, the increase of efficiency is measured according to a pre-agreed methodology. Depending on the type of energy needed, the internal processes and pre-ESCO equipment, a calculation method is agreed between the parties. The achieved savings in relation to the baseline are the basis for the concept of sharing the savings with the customer and Re-Pro.

4.5.2 Costs

Although detailed information with respect to costs for aggregation is confidential, the consortium managed to summarize a few important cost components in Table 14 (for aggregators not active yet, values are estimated).

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 691689.

Table 14: Cost components of aggregator business models

	Providers: most important costs	Other important costs inherent in the business model
Good Energy (United Kingdom)	Distributed generation providers	1) Staff, 2) Contracts, 3) Technology and software
Next Kraftwerke (Germany)	Distributed generation providers	1)Development costs software and technology, 2) Staff costs
Next Kraftwerke (France)	Distributed generation providers	1)Development costs software and technology, 2) Staff costs
Next Kraftwerke (Belgium)	Distributed generation providers	1)Development costs software and technology, 2) Staff costs
Oekostrom (Austria)	Distributed generation providers: wind and hydro	1) Technology, 2) Software, 3) Contracts, 4) Staff
EDP (Portugal)	DSM providers	Costs are highly variable and case-specific
EDP (Spain)	DSM providers	Costs are highly variable and case-specific
RE-Pro (Italy)	PV	1) Technology and contracts, 2) Staff, 3) Personnel
RE-Pro (Cyprus)	PV	1) Technology and contracts, 2) Staff, 3) Personnel

Table 14 shows that distributed generators are the principal providers of flexibility for Good Energy in the UK, for Next Kraftwerke in Germany, France and Belgium, for Oekostrom in Austria and RE-Pro in Italy and Cyprus. DSM is the most interesting for EDP in Portugal.

Table 14 furthermore illustrates that other important costs vary between the aggregators. Staff costs are most important for Good Energy. Next Kraftwerke Germany highlight that the development costs of software and technology is an important cost component for Next Kraftwerke in the different countries. Oekostrom and RE-Pro equally underline the significance of costs of technology for aggregation whereas, for EDP, since they are no active yet, it is estimated that costs will be highly case-specific and it is therefore not possible to rank different costs.

Depending on the split up between fixed and variable costs, there might be significant economies of scope and economies of scale. Fixed costs will mostly be related to algorithms and software whereas it will be required to install hardware at every provider of flexibility's site and this will result in important variable costs. The exact split up between fixed and variable costs was

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 691689.

however confidential information in most of the cases but we identified that both types of costs generally play an important role.

4.6 Key partners

The aggregators within the consortium have different profiles (beginning of this section) and have therefore very different financial and non-financial stakeholders.

Next Kraftwerke Germany was created with venture capital and, as an independent company, owns Next Kraftwerke Germany in France and Next Kraftwerke Belgium. RE-Pro is also an independent company created with venture capital. Good Energy and Oekostrom (1900 shareholders of who the biggest shareholder holds 5.3%) are owned by a very high number of small shareholders.[38] In both cases, the companies have a lot of shareholders with environmental concerns. Finally, the majority of the shares of EDP are owned by important institutional shareholders such as China Three Gorges (21.35% of shares) and Capital Group Companies (16.97% of shares).[39]

According to the interviews, the most important non-financial stakeholders are technology and software providers. For Next Kraftwerke this is less relevant because they developed their own platform over the last few years. In this context, Good Energy underlines the significance of working together with other companies for generation monitoring, customer account management, and data flow management and for developing forecasting tools. Oekostrom and EDP equally confirmed the importance of working together with technology and software providers.

[38] http://www.businessawardseurope.com/vote/entry/1/10940
[39] http://www.edp.pt/en/Investidores/accaoedp/estruturaaccionista/Pages/ShareholderStructure2.aspx

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 691689.

5. Business models outside the consortium

The previous section of this report (section 4) provided the reader with a detailed overview of existing business models of the aggregator project partners within the 9 countries that are covered by the consortium. In this section, we will look into business models of other aggregators in these countries (section 5.1). These aggregators were identified through interviews with project partners. Furthermore, the consortium partners used their industry network and literature to study aggregation in other countries. For this part of the analysis, we decided to focus on Northern and South-East Europe since these regions are not covered by the consortium (section 5.2)

5.1 Business models of other aggregators active in the countries covered by the consortium

5.1.1 Profile description of the aggregators

In order to analyse other aggregator business models in the countries covered by the consortium, we asked the project partners to identify other aggregators in the each of the countries. We established the following non-exhaustive list of aggregator examples:

- United Kingdom: Flexitricity Limited, Open Energi, Kiwi Power, LimeJump
- Germany: Energy2Market, Clean Energy Sourcing, Siemens, N-ERGIE / Caterva
- France: Actility, Restore
- Belgium: Actility Benelux, REstore, Flexiris/Lampiris, Anode, Teamwise, Powerhouse
- Austria: Verbund, Wien Energie, Next Kraftwerke Austria, A1 Energy Pool, Clean Energy Sourcing, CyberGRID
- Portugal: No other aggregators identified
- Spain: Only aggregator W2M, who is starting-up, was identified
- Italy: No other aggregators identified
- Cyprus: No other aggregators identified

This section gives a brief overview of selected aggregators and describes the core points of their business models based on an internet research.

BestRES This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 691689.

Flexitricity Limited (UK)

Flexitricity [40] operates the largest demand-response portfolio in UK. The products and services of Flexitricity include:

- Frequency response consisting of Frequency Control by Demand Management (FCDM), Firm Frequency Response (FFR) and Smart Frequency Control (SFC)
- Footroom / Demand turn: Utilization of excess wind power.
    - Small generators are paid to reduce generation for the toughest half-hours in a high wind event.
    - Flexible loads earn revenues by consuming more when wind output is high.
- Participating the Short-Term Operating Reserve (STOR) as the largest STOR aggregator. This is National Grid's most important source of reserve energy.
- Triad management (One of the most lucrative demand-response revenue sources)
- Providing demand response for DSO
- Participating Capacity Markets (CM): Flexitricity is the only demand-response company to hold contracts for the first (2018) delivery year.
- Optimization of CHP generation

Open Energi (UK)

Open Energi[41] is an aggregator in UK. The products and services of Open Energi include:

- Frequency response consisting
- Participating the Short-Term Operating Reserve (STOR).
- Triad management (Triads are the three highest national system peaks across the winter. One of the most lucrative demand-response revenue sources)
- Providing demand response for DSO

KiWipower (UK)

KiWi Power[42] is a demand response aggregator participating in the electricity market in UK and Ireland. The products and services of KiWipower are comparable to those of Open Energi and Flexitricity.

LimeJump (UK)

LimeJump[43] is a VPP operator in UK. The portfolio consist of DSR, flexible renewables, conventional PP. Additionally, PPAs are provided, trading that power into the market in addition to offering the grid ancillary services

[40] https://www.flexitricity.com
[41] http://www.openenergi.com/
[42] http://kiwipower.co.uk/
[43] http://www.limejump.com/home/

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 691689.

Energy2market (Germany)

The business models of energy2market (e2m)[44] focuses on portfolio and balance group management, energy trading and operation of VPP in Germany. E2m provides secure access to trading venues, exchanges and to TSO for the provision and marketing of ancillary services (control energy: R1 – R3). Additionally, e2m has subsidiary companies in following countries: Austria, Poland, Italy and Finland.

Clean Energy Sourcing (Germany, Austria)

Clean Energy Sourcing[45] (clens) is one of the leading direct marketers and operators of VPP in Germany. The clients of clens can select from energy services and products, starting with marketing decentralized renewable energy and CHP plants, and including extensive flexibility management and the supply to industrial, commercial and domestic customers.

The products and services of the Clean Energy Sourcing Group include:

- Supply of green electricity to industrial, commercial and domestic customers
- Direct marketing of electricity from renewable energy plants (FiP)
- VPP and flexibility is offered at
    - Balancing energy markets
    - Wholesale markets
    - Load management for consumers
- Energy procurement for electricity suppliers
- Energy management services

Siemens (Germany)

Siemens[46] as a provider and supplier of technology offers a wide range of electrical engineering- and electronics-related products and services. For development of enhancement hard- and software for aggregating decentralized generation, the so called "*Decentralized Energy Management System*" (DEMS), cooperation with energy supply companies were founded, e.g. RWE and Mark-E[47]. The advantages of this approach are:

- A mature IT solution is easier scalable at a low investment risk
- Short amortization periods despite rapidly changing regulations and business models.
- Ensure the latest version of technology and security
- No personal or coordination efforts for operation and maintenance of the infrastructure. Siemens takes care of the operation, IT security and maintenance of the DEMS portal on its servers

[44] https://www.energy2market.de/
[45] http://www.clens.eu/
[46] http://www.siemens.com/
[47] http://www.mark-e.de/Home/Geschaeftskunden.aspx

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 691689.

N-ERGIE / Caterva (Germany)

N-ERGIE[48] is a local Bavarian energy supplier. In cooperation with Caterva[49] a business model for PV and electricity storages installation at customer side was developed (exclusively for N-ERGIE customers). Additionally, smart grid infrastructure and applications (e.g. a smart phone app as monitoring device) are provided, enabling the customer to check the storage's level of charge, etc.

In the Project "swarm"[50] the business model was further developed, by the aspect of aggregating decentralized storages and participate the control energy market.

Actility (France, Belgium)

Actility[51] bases on two business models: (i) "*ThingPark*" as an end-to-end Machine-2-Machine (M2M) and Internet of Things Service (IoT) and (ii) "*Actility Energy*" as demand response and smart energy management for industrial sites. As a part of "*Actility Energy*" energy efficiency measures and DR enhancing an improved flexibility are implemented.

REstore (France, UK, Belgium)

REstore[52] is an energy technology company providing advanced automated Demand Response. The company offers Demand Response programs to commercial and industrial consumers and provides cloud-based DSM software for utilities. For many years, the company participates in the European Primary Reserve / Frequency Control markets and operates in all ancillary services and capacity markets in Europe. The company's proprietary platform Flexpond is used by more than 125 of Europe's largest industrial energy consumers, and utility clients.

Flexiris (Lampiris) (Belgium)

Flexiris, an activity of the aggregator-supplier Lampiris, aggregates both demand side management and generation units to valorise flexibility on wholesale and reserves markets. If investments for valorising flexibility are needed, Lampiris will prefinance those investments. There is also active

[48] https://www.n-ergie.de
[49] http://www.caterva.de/
[50] http://www.swarm.bayern/
[51] http://www.actility.com/en
[52] https://www.resunktore.eu

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 691689.

cooperation with Alphabet Inc. /Google (especially Nest Labs). In this context, Lampiris provides devices and solutions for home automation [53]

Anode Energy (Belgium)

Anode[54] is an independent energy supplier that is focused on generators and consumers in various sectors

Teamwise (Belgium)

Teamwise [55] is an aggregator of various production facilities in order to participate on the reserve markets in Belgium. Furthermore, Teamwise helps clients to translate fluctuating wholesale electricity prices into concrete business opportunities.

Powerhouse (Belgium)

Powerhouse[56] developed the Powerhouse Energy Platform. This platform helps clients to adapt to changing energy needs, by providing with real-time, 24/7 insights into energy developments in both the market place and the business. The company helps customers to trade on the market.

Verbund (Austria)

Verbund[57], Austria's largest utility company currently develops its range of energy efficient solutions, business models. At the moment, Verbund is offering two innovative solutions for local industry and businesses:

- VERBUND Power Pool: Verbund is implementing demand-response and operates virtual power plant operator together with Entelios AG as data management provider
- VERBUND-ECO-NET: An advisory service for increased energy efficiency for industrial enterprises and other large electricity consumers in Austria

Wien Energie (Austria)

Wien Energie is an Austrian utility company and energy provider focused on Austria's capital Vienna. The business model focuses on the provision of energy services e.g.:

- energy efficiency analysis and measures
- reduction of reactive power
- FlexPool: a VPP-concept mainly used for the control energy market (RR)

[53] http://www.lampiris.be/sites/lampiris.be/files/flexiris_fr.pdf
http://nest.lampiris.be/fr
[54] http://www.anode.nl/BE/VL/html/bedrijven.html
[55] http://teamwise.be/werking-teamwise/
[56] Interviews and http://powerhouse.nl/en/#powerhouse
[57] http://www.verbund.com/

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 691689.

Next Kraftwerke (Austria)

The business models[58] are equal to those implemented in Germany and Belgium by Next Kraftwerke.

A1 Energy Pool (Austria)

A1[59] is Austria's major mobile and telecommunication network operator. As part of diversifying the portfolio, A1 Energy Pool[60] a VPP operator was founded. Currently A1 Energy Pool is participating at control energy markets (FSR and RR).

CyberGRID (Austria, Germany)

CyberGRID[61] is a supplier of technology solutions for Demand Response and Virtual Power Plants for utilities, power traders, balance responsible parties and large industries. CyberGRID is not an aggregator, rather CyberGRID enables utilities and companies to provide demand response services for their clients. CyberGRID operates in Austria, Germany and Slovenia and is owned by Toshiba.

5.1.2 Existing business models in countries covered by the consortium outside the consortium

Table 15 illustrates the business models of aggregators in countries covered by the consortium. Some aggregators are both, delegated aggregators and aggregator as service provider. This is not a contradiction, because on the one hand aggregators can provide IT infrastructure or energy efficiency measures to enable the customer to reduce energy (aggregator as service provider) and on the other hand they can participate on electricity markets (delegated aggregators).

As Table 15 underlines that the 3 types of aggregators identified are:

1. New Suppliers: New electric utilities (such as Clean Energy Sourcing)
2. New flexibility companies focused on provision of flexibility (such as Flexitricity, REstore, A1 Energy Pool)
3. Technology companies (such as Siemens and Cybergrid)

The following section gives a brief description of those aggregators.

[58] https://www.next-kraftwerke.at/
[59] https://www.a1energypool.at/
[60] https://www.a1energypool.at/
[61] https://www.cyber-grid.com/

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 691689.

Table 15: Business models for aggregators outside the consortium. Source: public information available at the homepages (of the individual aggregators)

	Aggregator	Aggregator-supplier	Aggregator-BRP	Delegated aggregator	Aggregator as service provider	Prosumer as aggregator
United Kingdom	Flexitricity			X		
	Open Energi			X		
	KiWipower			X		
	LimeJump			X	X	
Germany	Energy2market			X	X	
	Clean Energy Sourcing	X	X	X		
	Siemens				X	
	N-ERGIE Caterva	X		X	X	
France	Actility	X	X	X	X	
	REstore			X		
Belgium	Actility Benelux	X	X	X	X	
	REstore			X		
	Lampiris	X	X	X		
	Anode	X	X		X	
	Teamwise			X	X	
	Powerhouse				X	
Austria	Verbund	X	X	X	X	
	Wien Energie	X	X	X	X	
	Next Kraftwerke Austria			X		
	A1 Energy Pool			X		
	Clean Energy Sourcing	X	X	X		
	CyberGRID				X	

X = Business model that is implemented in the beginning of 2016[62]

[62] Some traditional suppliers/large utilities also act as an aggregator and participate on wholesale market and reserve markets or use flexibility for own balancing. Nevertheless, the focus of their business is still largely on energy supply and not on aggregation. Therefore, the consortium decided not to go into the details of the business models of those companies, although some of them are listed in Table 15 (e.g. Verbund (Austria)).

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 691689.

New Supplier

Due to the liberalization, new suppliers entered the market. Their business model focuses on the generation, retail and supply of electricity. The generation portfolio of these aggregators mainly consists of (subsidized) renewable generation

As the incumbents, they also try to diversify the product portfolio, e.g. with energy efficiency measures, provide and market renewables and flexibility, provision of energy services.

New flexibility companies

These companies are usually independent from supply companies. Their business model mainly focuses on the provision and leverage of flexibility e.g. at the control energy market. Usually they do not have energy supply contracts with end customers.

Technology companies

The business model of technology companies is developing and selling IT services as hardware infrastructure and software solutions. To improve and distribute their products, technology companies cooperate with electricity utilities. Technology companies don't offer their products directly on electricity markets but on technology and infrastructure markets.

5.1.3 Markets where value is created

Aggregators can create value in many different ways, as it was explained in previous sections. Table 16 shows that most of the aggregators participate in wholesale, retail, reserves and capacity markets (if they are available). Especially new suppliers create value on multiple markets, because of their manifold business portfolio. Following nomenclature of section 4, they are using their flexibility for both internal reasons and external markets. Flexibility companies, furthermore, focus mainly on reserves and capacity markets. Technology companies don't offer their products directly on electricity markets but on technology and infrastructure markets. Therefore, they are not included in Table 16.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 691689.

Table 16: Value created by aggregators outside the consortium. Source: public information available at the homepages (of the individual aggregators)

	Aggregator	Wholesale and retail markets	Reserve and capacity markets	Supply to end electricity consumers	Reduction of grid charges	Own balancing
United Kingdom	Flexitricity		X (both)			
	Open Energi		X (reserves market only)			
	KiWipower		X (both)			
	LimeJump	X (VPP)	X (reserves market only)			
Germany	Energy2market	X	X (reserves market only)			X
	Clean Energy Sourcing	X	X (reserves market only)	X		X
	N-ERGIE Caterva	X	X (reserves market only)	X		X
France	Actility	X	X			X
	REstore	X	X (both)			
Belgium	Actility Benelux	X	X			X
	REstore	X	X (both)			
	Lampiris	X	X	X		X
	Anode	X	X	X		X
	Teamwise	X	X			
	Powerhouse	X				
Austria	Verbund	X	X	X		X
	Wien Energie	X	X	X		X
	Next Kraftwerke Austria	X	X			
	A1 Energy Pool		X			
	Clean Energy Sourcing	X	X (reserves market only)	X		X
	CyberGRID	nothing (technology provider)				

X = Participating in the beginning of 2016

BestRES This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 691689.

5.2 Business models of aggregators in countries that are not covered by the consortium

The consortium used its industry network to contact the following market actors with focus on Northern and South-East Europe:

1. Finland: aggregator "Empower IM Oy" [63]
2. Sweden: Solar Energy Association of Sweden "Svensk Solenergi"[64]
3. Sweden and Finland: energy supplier and aggregator "Fortum"[65]
4. Netherlands: aggregator, Smart Energy and Internet of Things (IoT) technology provider "Actility Benelux"[66]
5. Slovenia, Romania: energy supplier and aggregator "Gen-I"[67]
6. Greece: aggregator "Re-Pro" (partner of the consortium)[68]

Brief interviews were carried out with each of these market actors to better understand the situation of renewable energy aggregation. The questionnaires that were used for the interviews are included in annex 3.

5.2.1 Profile description of the interviewed market actors

Empower IM Oy (Finland)

Empower IM Oy is an independent service provider whose main business domain is the energy markets and related services. The company provides a wide range of different flexible energy market services and IT-solutions to energy producers, distribution system operators, energy traders and energy intensive industry. The company's business can be divided into three different categories: Energy Market Services, Smart Grid Solutions and Energy Sector IT Systems. Developed and provided IT systems include Customer Information Systems, Energy Data Management Systems and Energy Management Systems.

Svensk Solenergi (Sweden)

Svensk Solenergi is the Solar Energy Association of Sweden. It is a national organisation with approximately 140 professional members representing Swedish research institutes working with solar energy.

[63] http://www.empower.eu/
[64] http://www.svensksolenergi.se/
[65] http://www.fortum.com/
[66] http://www.actility.com/en
[67] http://www.gen-i.si/en/?cr=1
[68] http://www.re-pro.eu/

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 691689.

Fortum (Sweden and Finland)

Fortum's vision is to be the forerunner in clean energy. They provide customers with electricity, heat and cooling as well as other energy solutions that improve present and future life. Already 64% of their electricity generation is CO_2 free and their main markets are the Nordic and the Baltic countries, Russia, Poland and India.

Actility Benelux (Netherlands)

Since its foundation in 2010 Actility is recognized as thought leader in Internet of Things and Smart Energy platforms. Today Actility Energy is active as a demand response service provider in France, Belgium, UK and entering the Dutch market. In this field it focusses on offering flexibility solutions based on Energy Efficiency & Demand Response, to deliver integrated innovative solutions and service offerings to the market.

Gen-I (Slovenia and Romania)

Ever since its establishment in 2004, the GEN-I Group has ranked as one of the most innovative and rapidly-growing players on the European electricity and gas market. With operations in more than 20 European countries, 15 subsidiaries and more than 200 experts, they can offer their partners the most advanced trading, retail and purchase services. They help partners and business customers seize opportunities, create added value, and manage their energy costs and the price risks that arise from the market at any point of the day.

Re-Pro (Greece)

RE-Pro is a renewable energy provider dedicated to clean and renewable energy sources. Specialized in the fast-growing areas of solar power generation and energy efficiency management, RE-Pro has successfully launched its services through a range of photovoltaic power parks in southern Europe. Guaranteed power purchasing contracts with national grids generate a stable revenue stream, which forms the basis for the development of RE-Pro's innovative energy efficiency management services.

BestRES This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 691689.

5.2.2 Existing business models in countries outside the consortium

The result of our business model analysis is displayed in Table 17.

Table 17: Business models for aggregators outside the consortium

	Aggregator-supplier	Aggregator-BRP	Delegated aggregator	Aggregator as service provider	Prosumer as aggregator
Empower IM (Finland)				X	
Fortum (Finland)	X	X	X		
Fortum (Sweden)	X	X	X		
Actility Benelux (Netherlands)			X	X	
Re-pro (Greece)				X	
Gen-I (Slovenia)	X	X	X		
Gen-I (Romania)	X	X			

Table 17 highlights that, as for the aggregators within the consortium, aggregators outside the consortium are taking up the role of the aggregator-supplier (and aggregator-BRP) in combination with the role of the delegated aggregator (Fortum and Gen-I). The aggregator as service provider business model was also mentioned in 3 out of the 7 cases (Empower, Actility and Re-Pro).

Furthermore, it was explicitly highlighted by several market actors that aggregator-suppliers are the most active parties with respect to aggregation services in Sweden and Finland whereas there are also some independent aggregators active. In the Netherlands, aggregation and smart energy activities are starting up. In Greece, similar to the situation in Italy and Cyprus, RE-Pro is optimizing the energy situation of clients on site. In Slovenia and Romania, there are limited opportunities for aggregation. In both countries, our interview partner Gen-I highlighted that they are not aware of any independent aggregators and that the aggregator-supplier business model is most common.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 691689.

Table 18 provides the reader with an overview of the service providers aggregators work together with in order to create value on the different markets

Table 18: Value created by aggregators outside the consortium on the different markets

	Wholesale and retail markets	Reserve and capacity markets	Supply to end electricity consumers (ESCO business)	Reduction of grid charges	Own balancing
Empower IM (Finland)	Small-scale commercial DSM	Small-scale commercial DSM			
Fortum (Finland)	Small-scale DSM, CHP and renewables	Small-scale DSM, CHP and renewables			Small-scale DSM, CHP and renewables
Fortum (Sweden)	Small-scale DSM, CHP and renewables	Small-scale DSM, CHP and renewables			Small-scale DSM, CHP and renewables
Actility Benelux (Netherlands)	Starting up Small-scale DSM, CHP and renewables	Industrial DSM, CHP, but also small-scale batteries			
Re-pro (Greece)			PV, energy saving measures		
Gen-I (Slovenia)		Industrial DSM, CHP and renewables			Industrial DSM, CHP and renewables
Gen-I (Romania)					Industrial DSM, CHP and renewables

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 691689.

5.2.3 Providers of aggregation services

Table 18 underlines that all aggregators are developing generation technologies whereas DSM is commonly implemented. In Sweden but also in Finland, it was specifically mentioned that there is a focus on rooftop solar developments and that several independent players aggregate the loads of thousands of small renewable energy generation units. Furthermore, DSM is most important for Empower, Fortum, Actility and Gen-I but all actors underline that the importance of distributed generation is increasing. With respect to storage, all interviewed aggregators are following up the market whereas only Actility is already implementing it for commercial purposes in the Netherlands.

Similar to the business models for aggregators within the consortium, the interview partners generally indicated that large commercial and industrial DSM is more important than small commercial and industrial and domestic DSM. The exceptions are Empower and Fortum; they emphasized that smaller-scale customers are more important for demand side management than large industrial customers. Table 19 highlights the most important sectors for DSM in each of the countries.

Table 19: Demand side management potential in countries outside the consortium

	Demand Side Management
Finland	Pulp and paper industry, steel, hot water storage tanks (small-scale DSM)
Sweden	Pulp and paper Industry, steel, chemistry and mining, hot water storage tanks (small-scale DSM)
Netherlands	Water management, cooling, chemistry, CHP
Greece	Food, hotels, hospitals, supermarkets and malls
Slovenia	Steel & paper
Romania	No information available

With respect to DSM for domestic and smaller industrial and commercial consumers, Fortum highlighted that time-of-use (ToU) tariffs exist in Finland and Sweden.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 691689.

Because there is a large heating capacity in households (about 600 000 electrically heated homes), it is interesting to source this flexibility.[69] Since the DSO is controlling the measuring data, Fortum has to acquire the data through this DSO. They highlighted that large industrial and commercial consumers are less interesting targets because they valorise their flexibility directly themselves. In the Netherlands there are also demonstration projects for ToU tariffs but there is no commercial use up to date.

5.2.4 Markets where value is created

Table 18 accentuates that aggregation services are used on all different markets by aggregators. Fortum is mostly focusing on valorising flexibility on wholesale electricity markets; they are buying surplus electricity from a large amount of customers with installed generation capacity and subsequently valorise the surplus on the wholesale markets. Subsidies for green electricity don't play a role for valorising flexibility on these markets. It is however important to highlight that Finland, Sweden and Norway have the common wholesale electricity market Nordpool. This increases market liquidity and decreases price spreads but the presence of a relatively high number of aggregators on wholesale electricity markets underlines that the market is still interesting.[70]

With regards to reserve markets, Empower, Fortum, Actility and Gen-I are participating and starting up or looking into programmes for participation in more reserves markets. In Nordic countries, we know from our interviews that hydro power capacities play an important role on reserves markets whereas independent aggregators participate with DSM. In Slovenia there is only a limited amount of market actors participating in reserves markets while in Romania there is no participation because the TSO has no real need for flexibility.

The only interviewed aggregator that is not participating on reserves markets, RE-Pro, is fully concentrated on supplying electricity to electricity consumers. More specifically, they are focused on improving the energy efficiency and energy consumption by installing different types of generation on site.

Finally, all aggregators that are also suppliers, use flexibility for balancing of the own portfolio.

5.2.5 Revenue streams and costs

For RE-Pro, revenues come for provisions based on the service type and software and technology costs will generally be less important than contract and staff costs.

[69] VTT, Real-time pricing project at small customers in Finland, MAHIS,19 April 2005, Available at: http://www.ieadsm.org/wp/files/Content/7.%20Helsinki_Pekka%20Koponen.pdf
[70] http://www.nordpoolspot.com/

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 691689.

For both Actility and Fortum, development of technology and software are important costs whereas Fortum also underlines that customer acquisition is a very important labour cost. As DSM is the most important activity for both aggregators, this will equally generate the most important revenue. Actility also mentioned that their business model is based on a mix of fixed/variable costs: they ask for a fixed remuneration for using the platform while charging variable fees for activating the flexibility.

BestRES This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 691689.

6. Conclusions

The rising share of distributed generation across Europe requires a more flexible system and better integration of renewables into electricity markets. In this context, RES aggregators can accelerate market integration and flexibility of demand and generation and decrease the reliance on renewable energy support schemes. The objective of this report is to analyse business models that RES aggregators are adopting across Europe. In-depth interviews were carried out by 3E and TUW with 6 project partner aggregators (Good Energy, Next Kraftwerke Belgium, Next Kraftwerke Germany, Oekostrom, RE-Pro and EDP) in 9 countries. Also, a literature study and brief surveys with other market actors were carried out to complement the analysis (section 5).

Table 20 provides an overview of the business models and building blocks of each of the aggregators within the consortium.

Table 20: Business models for aggregators within the consortium

Good Energy United Kingdom	• Aggregator-supplier business model and moving towards delegated aggregator business model • Focus of aggregation: distributed generation (mainly wind) but DSM (small-scale industrial) more and more important • Valorization aggregation: wholesale markets, optimization situation electricity consumers and own balancing • Most important revenues: own balancing • Most important costs: remuneration distributed generation providers and staff • Owned by high number of small stakeholders
NEXT KRAFTWERKE Belgium	• Delegated aggregator business model and moving towards aggregator-supplier business model • Focus of aggregation: distributed generation but DSM (industrial) more and more important • Valorization aggregation: wholesale markets, reserve markets and own balancing • Most important revenues: varies between wholesale and reserve markets • Most important costs: remuneration distributed generation providers and development cost software and technology • Majority owned by Next Kraftwerke Germany

BestRES This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 691689.

NEXT KRAFTWERKE Germany and France	• Delegated aggregator business model and aggregator-supplier business model in Germany. Starting up aggregation in France. • Focus of aggregation: distributed generation but DSM (industrial) more and more important • Valorization aggregation: wholesale markets, reserve markets and own balancing • Most important revenues: varies between wholesale and reserve markets • Most important costs: remuneration distributed generation providers and development cost software and technology • Created with venture capital
oekostrom AG Austria	• Aggregator-supplier business model • Focus of aggregation: distributed generation (mainly wind) but DSM (domestic plug –in PV systems) more and more important • Valorization aggregation: wholesale markets, optimization situation electricity consumers and own balancing • Most important revenues: wholesale market and own balancing • Most important costs: remuneration distributed generation providers and technology and software • Owned by high number of small stakeholders
REPRO Teamplay with the sun Italy and Cyprus	• Aggregator as service provider business model • Focus of aggregation: distributed generation (PV) but DSM (commercial/industrial) more and more important • Valorization aggregation (planned): auto production and energy saving measures • Most important revenues: PPA and EPC contracts • Most important costs: remuneration distributed generation providers and technology and contracts • Created with venture capital

BestRES This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 691689.

  Spain and Portugal	• No aggregation but assessing the feasibility of the aggregator-supplier business model • Focus of aggregation: DSM • Valorization aggregation (planned): wholesale markets, reserve markets and own balancing • Most important revenues (planned): own balancing • Most important costs: DSM providers • Major stakeholders are institutional shareholders

6.1 A wide variety of business models for aggregation

Table 20 shows that, within the consortium of the project, a wide variety of business models is implemented: Good Energy, Oekostrom and EDP are focused on the aggregator-supplier model, Next Kraftwerke is focused on both the delegated aggregator and aggregator-supplier business models whereas RE-Pro is developing ESCO services. Our analysis from section 4 and 5 highlights that, across Europe, the combination of the aggregator-supplier role and delegated aggregator role is most common while independent aggregators (delegated aggregator and aggregator as service provider) also have a significant presence.

6.2 Valorisation of aggregation on wholesale markets, reserve markets and for own balancing

Our interviews with project partners demonstrate that the focus of aggregation within the consortium is on generation providers (5 out of 6 aggregators). Nevertheless, across Europe, a lot of aggregators put emphasis on DSM. Market actors in all analysed countries are looking more and more into large-scale DSM in the medium-term and into smale-scale DSM in the long-term. Within the consortium, aggregation is most often valorized on wholesale markets and for own balancing (5 out of 6 aggregators) whereas it is relatively often used for optimizing the situation of electricity consumers (3 out of 6 aggregators). Across Europe, we observe that aggregators are often active on multiple

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 691689.

markets; the combined participation on wholesale and reserve markets is most common.

6.3 Revenues stream and costs components vary between the implemented business models

Flexibility is often used for own balancing but revenues also come from wholesale markets and reserve markets to cover for the remuneration of aggregation service providers and other costs. For ESCO business models long-term contracts (PPAs) are essential to hedge the investment risk. Furthermore, for IT and generation-based business models (e.g. flexibility providers), the costs for (developing) technology consisting of soft- and hardware, is the most important cost component (4 out of 6 aggregators). Additionally, costs for staff and contracts are essential.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 691689.

7. Annexes

Annex 1: Questionnaire with respect to business models

	Identification of different types of business models
1) What type of aggregator business model of the ones below are you implementing	**1.1) Combined aggregator-supplier;** The supplier and aggregator roles are combined for offering a supply contract including flexibility options. There will be one BRP per connection point and there is no need for financial settlements between suppliers and aggregators
	1.2) **Combined aggregator-BRP;** The Aggregator and BRP roles are combined and all portfolio optimizations are generated directly within the portfolio of the combined business.
	1.3) **Delegated aggregator;** The aggregator buys flexibility from prosumers and sells it at own risk to potential buyers (he is a flexibility-BRP). The challenge is to formalize all interactions with other market players. If the aggregator has a long-term exclusive relationship with for example a BRP, they will seek energy in optimizing the value of flexibility. If the aggregator bids on different markets, the aggregator and the BRP will be competitors
	1.4) **Aggregator as service provider;** The aggregator is the flexibility provider for one of the other market roles. He only offers access to flexibility and thus has no BRP responsibility or doesn't sell flexibility at own risk.
	1.5) **Prosumer as aggregator;** The prosumer adopts the aggregator role for own portfolios (commercial and industrial prosumers)
	1.6) **A combined aggregator-DSO model**: Regulated and unregulated roles should not be combined so we are not investigating this business model
2) Can you share documents with general information on your business model with the consortium if those are available?	
3) Are you aware of any other business models than the ones mentioned in this sheet? If yes, can you please send us documents or send us inks to the information	

BestRES This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 691689.

	Key resources
4 a) What type of providers do you mainly work together with? ***[please also rank 1-4 with 1: most important]***	4a.1) Different types of small industrial and commercial consumers
	4a.2) Different types of large industrial and commercial customers
	4a.3) Aggregated domestic customers
	4a.4) Aggregated distributed generation (cogeneration, CHP, wind turbines, solar panels,)
	4a.5) Aggregated operators of energy storage and electric vehicles
	4a.6) Others?
4 b) How are you assessing the potential of a potential providers?	4b.1) On site visits
	4b.2) Interviews
	4b.3) Knowledge from similar projects or projects in other countries
	4b.4) Others?
5) What are the most important sectors (industrial and commercial consumers) in your portfolio? ***[please also rank 1-4 with 1: most important]***	
6) What are the existing contractual relationships on market and what is the duration of contracts?	
7) What type of software/technology is required for implementing your business model?	
8) What type of data is required for implementing your business model?	8.1) Data related to time resolution
	8.2) Data related to price signals
	8.3) Data related to operation/switching signals
	8.4) Others?
9) What type of flexibility/aggregation do you purchase?	9.1) Demand Side Management (DSM)
	9.2) Storage in aggregation

BestRES This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 691689.

	9.3) Production
	9.4) Others such as everything together in a VPP?
10) How do you expect your portfolio to evolve in the next 5 years?	10.1) More storage (prices are rapidly decreasing)
	10.2) More aggregation of domestic consumers
	10.3) More focus on 1 specific industrial or commercial sector
	10.4) Others trends?

	Key activities
9) What type of flexibility/aggregation do you purchase?	9.1) Demand Side Management (DSM)
	9.2) Storage in aggregation
	9.3) Production
	9.4) Others such as everything together in a VPP?
10) How do you expect your portfolio to evolve in the next 5 years?	10.1) More storage (prices are rapidly decreasing)
	10.2) More aggregation of domestic consumers
	10.3) More focus on 1 specific industrial or commercial sector
	10.4) Others trends?

BestRES This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 691689.

	Customer segments
11) What type of users of aggregation services do you mainly work together with 1) BRP, 2) DSO, 3) TSO, 4) energy suppliers, 5)producers, 6)others)? ***[please also rank 1-4 with 1: most important]***	
12) What is your relationship with the providers of aggregation services based on?	12.1) Price
	12.2) Quality of service
	12.3) Others?

	Value proposition
13) What is your value proposition? Which one of the users of aggregation services problems are you helping to solve? ***[please also rank 1-4 with 1: most important]***	13.1) (Long-term and short-term) congestion management (TSO/DSO)
	13.2) Portfolio optimization (BRP)
	13.3) Frequency control (TSO) through frequency containment reserves (FCR), frequency restoration reserves (FRR) and replacement reserves (RR))
	13.4) Grid losses reduction (TSO)
	13.5) Voltage control (TSO/DSO) through active or reactive power
	13.6) Increase revenues of customers with flexible tariffs
	13.7) Others?

BestRES This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 691689.

	Revenue streams
14) Which providers of aggregation services generate your most important revenue streams?	
15) How are revenue models exactly organised?	15.1) Product feature dependent
	15.2) Customer segment dependent
	15.3) Volume dependent
	15.4) Negotiation/bargaining
16) What is your annual turnover/annual profit?	
17) How do users of aggregation services pay?	17.1) Licence
	17.2) Subscription
	17.3) Fixed purchase of the service
	17.4) Others?
18) Are you considering another payment model in the near future?	

	Customer relationships
19) What type of relationship do users of aggregation services expect?	19.1) Automated services
	19.2) Creation of communities for domestic consumers
	19.3) Personal assistance

BestRES This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 691689.

	Cost structure
20) What are the most important costs/resources inherent in your business model? ***[please also rank 1-4 with 1: most important]***	20.1) Software
	20.2) Technology
	20.3) Contracts
	20.4) Staff
	20.5) Others?
21) Are there any economies of scale or economies of scope that are important to mention? What is the split up fixed costs/variable costs for participating in the market?	

	Key partners
22) Which of the following stakeholders is part of your business model?	22.1) Financial institutions/investors
	22.2) Specific groups of stakeholders
	22.3) Software and technology providers
	22.4) Others?
23) What key resources do you offer them?	23.1) Additional revenues
	23.2) Visibility
	23.3) Others?

BestRES This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 691689.

	Channels
24) How are you reaching providers and users of aggregation services?	24.1) Industry network/industry events
	24.2) Social media/website
	24.3) Targeted visits clients/visits on site
	24.4) Others?
25) What tools are you using for calculating revenues?	25.1) Platform on the internet
	25.2) Personal assistance
	25.3) Others?

BestRES This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 691689.

Annex 2: Questionnaire with respect to market design

	General market design
1) What markets are open for aggregator services? How big is each of these markets in MW?	1.1) Reserves (primary, secondary and tertiary)
	1.2) Capacity market
	1.3) Wholesale (forward, day-ahead, intraday)
	1.4) Others (heat, gas markets)?
*2) Can you provide us with information on the following aspects of **control reserves markets**?*	2.1) Where can we find information with respect to product and access requiremements in your country? (Please provide exact links to the different websites)
	2.2) Is there a lot of competition and who are the most important market players? Have a lot of these market players entered the market in recent years?
	2.3) Do you expect prices to go up or down?
	2.4) To what extent is the market adapted to DSM, RES and battery storage?
	2.5) Are you as an aggregator active on this market and, if yes, with which providers of flexibility do you work together with?
	2.6) Any other important market aspects?
*3) Can you provide us with information on the following aspects of **capacity markets**?*	3.1) Where can we find information with respect to product and access requiremements in your country? (Please provide exact links to the different websites)
	3.2) Is there a lot of competition and who are the most important market players? Have a lot of these market players entered the market in recent years?
	3.3) Do you expect prices to go up or down?
	3.4) To what extent is the market adapted to DSM, RES and battery storage?

BestRES This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 691689.

	3.5) Are you as an aggregator active on this market and, if yes, with which providers of flexibility do you work together with?
	3.6) Any other important market aspects?
*4) Can you provide us with information on the following aspects of **wholesale markets**?*	4.1) Where can we find information with respect to product and access requirements in your country? (Please provide exact links to the different websites)
	4.2) Is there a lot of competition and who are the most important market players? Have a lot of these market players entered the market in recent years?
	4.3) Do you expect prices to go up or down?
	4.4) To what extent is the market adapted to DSM, RES and battery storage?
	4.5) Are you as an aggregator active on this market and, if yes, with which providers of flexibility do you work together with?
	4.6) Any other important market aspects?
5) Does market coupling have a high impact on the development of the different markets for flexibility (balancing, reserves, and wholesale markets)?	

BestRES This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 691689.

Annex 3: Brief questionnaire with respect to business models

	Identification of different types of business models
1) What type of aggregator business model of the ones below are you implementing	**1.1) Combined aggregator-supplier;** The supplier and aggregator roles are combined for offering a supply contract including flexibility options. There will be one BRP per connection point and there is no need for financial settlements between suppliers and aggregators
	1.2) **Combined aggregator-BRP;** The Aggregator and BRP roles are combined and all portfolio optimizations are generated directly within the portfolio of the combined business.
	1.3) **Delegated aggregator;** The aggregator buys flexibility from prosumers and sells it at own risk to potential buyers (he is a flexibility-BRP). The challenge is to formalize all interactions with other market players. If the aggregator has a long-term exclusive relationship with for example a BRP, they will seek energy in optimizing the value of flexibility. If the aggregator bids on different markets, the aggregator and the BRP will be competitors
	1.4) **Aggregator as service provider;** The aggregator is the flexibility provider for one of the other market roles. He only offers access to flexibility and thus has no BRP responsibility or doesn't sell flexibility at own risk.
	1.5) **Prosumer as aggregator;** The prosumer adopts the aggregator role for own portfolios (commercial and industrial prosumers)
	1.6) **A combined aggregator-DSO model**: Regulated and unregulated roles should not be combined so we are not investigating this business model
2) Can you share documents with general information on your business model with the consortium if those are available?	
3) Are you aware of any other business models than the ones mentioned in this sheet? If yes, can you please send us documents or send us inks to the information	

BestRES This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 691689.

	Key resources
4 a) What type of providers do you mainly work together with? ***[please also rank 1-4 with 1: most important]***	4a.1) Different types of small industrial and commercial consumers
	4a.2) Different types of large industrial and commercial customers
	4a.3) Aggregated domestic customers
	4a.4) Aggregated distributed generation (cogeneration, CHP, wind turbines, solar panels,)
	4a.5) Aggregated operators of energy storage and electric vehicles
	4a.6) Others?
5) What are the most important sectors (industrial and commercial consumers) in your portfolio? ***[please also rank 1-4 with 1: most important]***	

	Key activities
6) What type of flexibility/aggregation do you purchase?	6.1) Demand Side Management (DSM)
	6.2) Storage in aggregation
	6.3) Production
	6.4) Others such as everything together in a VPP?
	6.5) Others trends?

BestRES This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 691689.

	Customer segments
7) What type of users of aggregation services do you mainly work together with 1) BRP, 2) DSO, 3) TSO, 4) energy suppliers, 5)producers, 6)others)? ***[please also rank 1-4 with 1: most important]***	

	Value proposition
8) What is your value proposition? Which one of the users of aggregation services problems are you helping to solve? ***[please also rank 1-4 with 1: most important]***	8.1) (Long-term and short-term) congestion management (TSO/DSO)
	8.2) Portfolio optimization (BRP)
	8.3) Frequency control (TSO) through frequency containment reserves (FCR), frequency restoration reserves (FRR) and replacement reserves (RR))
	8.4) Grid losses reduction (TSO)
	8.5) Voltage control (TSO/DSO) through active or reactive power
	8.6) Increase revenues of customers with flexible tariffs
	8.7) Others?

BestRES This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 691689.

	Revenue streams
9) Which providers of aggregation services generate your most important revenue streams?	
10) How are revenue models exactly organised?	10.1) Product feature dependent
	10.2) Customer segment dependent
	10.3) Volume dependent
	10.4) Negotiation/bargaining

	Customer relationships
11) What type of relationship do users of aggregation services expect?	11.1) Automated services
	11.2) Creation of communities for domestic consumers
	11.3) Personal assistance

	Cost structure
12) What are the most important costs/resources inherent in your business model? ***[please also rank 1-4 with 1: most important]***	12.1) Software
	12.2) Technology
	12.3) Contracts
	12.4) Staff
	12.5) Others?

BestRES This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 691689.

	Key partners
13) Which of the following stakeholders is part of your business model?	13.1) Financial institutions/investors
	13.2) Specific groups of stakeholders
	13.3) Software and technology providers
	13.4) Others?

	Channels
14) How are you reaching providers and users of aggregation services?	14.1) Industry network/industry events
	14.2) Social media/website
	14.3) Targeted visits clients/visits on site
	14.4) Others?
15) What tools are you using for calculating revenues?	15.1) Platform on the internet
	15.2) Personal assistance
	15.3) Others?

BestRES This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 691689.

Technical references

Project Acronym	BestRES
Project Title	Best practices and implementation of innovative business models for Renewable Energy aggregators
Project Coordinator	Silvia Caneva WIP silvia.caneva@wip-munich.de
Project Duration	March 2016 – February 2019 (36 months)

Deliverable	D2.1 - Definition, classification and differentiation of European aggregation BMs within and outside the consortium
Dissemination level*	PU
Work Package	WP2 - Adequacy Analysis of Current Business Models
Task	Task 2.1- Define and classify existing European aggregation business models (BMs) within and outside the consortium
Lead beneficiary	3E
Contributing beneficiaries	All partners
Due date of deliverable	31 May 2016
Actual submission date	9 June 2016

* PU = Public

PP = Restricted to other programme participants (including the Commission Services)

RE = Restricted to a group specified by the consortium (including the Commission Services)

CO = Confidential, only for members of the consortium (including the Commission Services)

v	Date	Beneficiary	Author
1.0	07/06/2016	3E	Ruben Verhaegen
2.0	09/06/2016	WIP	Silvia Caneva

BestRES This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 691689.