BestRES

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

An assessment of the economics of and barriers for implementation of the improved business models

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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

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Disclaimer

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Table of Contents

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

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

List of Figures

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

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

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Abbreviations

AEEGSI	Authority for electricity and gas in Cyprus
aFRR	Automatic Frequency Restoration Reserve
AMR	Automatic Meter Reading
BM	Business Model
BRP	Balancing Responsibility Provider
CAPEX	Capital Expenditures
CCGT	Combined Cycle Gas Turbine
CERA	Cyprus Regulatory Authority for Energy
CfD	Contracts for Difference
CHP	Combined Heat and Power
DR	Demand Response
DSM	Demand Side Management
DSO	Distribution System Operator
EAC	Electricity Authority of Cyprus
Elia	Transmission System Operator Belgium
ENTSO-E	European Network of Transmission System Operators for Electricity
EPEX SPOT SE	European Power Exchange
ERSE	Regulator electricity market Portugal
EV	Electric Vehicles
FCR	Frequency Containment Reserve
FiP	Feed-in-Premium
FiT	Feed-in-Tariff
GME	Gestore Mercati Energetici
IPP	Independent Power producer

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MB	Balancing Market in Italy
mFRR	manual Frequency Restoration Reserves
MIBEL	Iberian Electricity Market
National Grid	Transmission System Operator United Kingdom
Ofgem	Office of Gas and Electricity Markets
OPEX	Operational Expenditures
P2P	Peer-to-peer
PPA	Power Purchase Agreement
PPEC	Plan to Promote Efficiency in Electric Energy Consumption
PV	Photovoltaic
R1	Primary Reserve Market
R2	Secondary Reserve Market
R3	Tertiary Reserve Market
REE	Transmission System Operator Spain
REN	Information system energy market Portugal
RES	Renewable Energy Sources
RTE	Transmission System Operator France
Terna	Transmission System Operator Italy
TSO	Transmission System Operator
TSOC	Transmission System Operator Cyprus
UK	United Kingdom
VPP	Virtual Power Plant
VRE	Variable Renewable Energy
WP	Work Package

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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.

The BestRES project investigates the current barriers for aggregators and suggests ways of improving the role of aggregators in future electricity market designs. In D3.2 "Improved business models (BMs) of selected aggregators in target countries" of the BestRES project, relevant improved aggregator BMs are identified in each of the countries covered by the consortium. This report investigates if each of these improved BMs is ready for implementation. For this purpose, the BMs are allocated to different groups based on their feasibility:

- Group 1 if economic BMs are ready for implementation
- Group 2 if BMs are economically viable but face barriers that prevent direct implementation
- Group 3 if BMs are not economically viable or face substantial barriers

Our assessment is on the one hand based on an economic analysis of turnover and profits and, on the other hand focused on an investigation of technical, legal, regulatory and other barriers. Figure 1 shows the results of the economic assessment for all improved aggregator BMs in the BestRES project.

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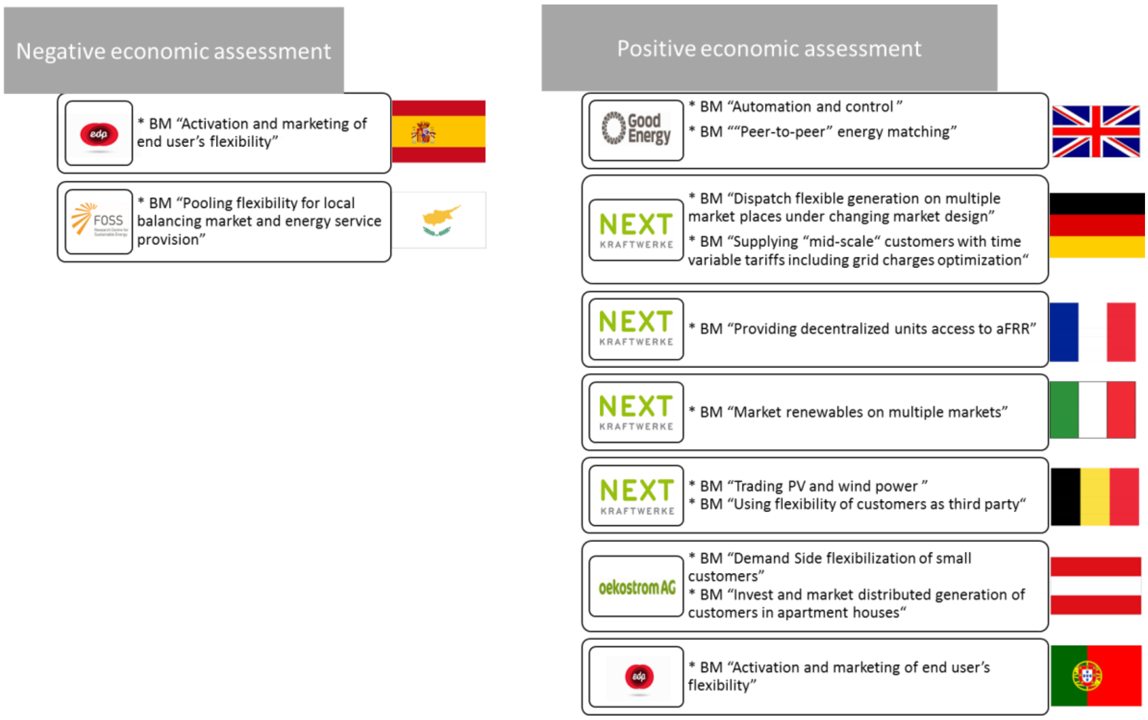

Figure 1: Economic assessment improved business models

Figure 1 illustrates that feasible aggregator BMs exist in the United Kingdom, Germany, France, Italy, Belgium, Austria and Portugal. By contrast, in Spain and Cyprus, new types of businesses analysed within the project are not economically feasible mainly due to low electricity prices and markets that are closed for aggregators. Figure 2 highlights if different barriers exist for each of the covered BMs.

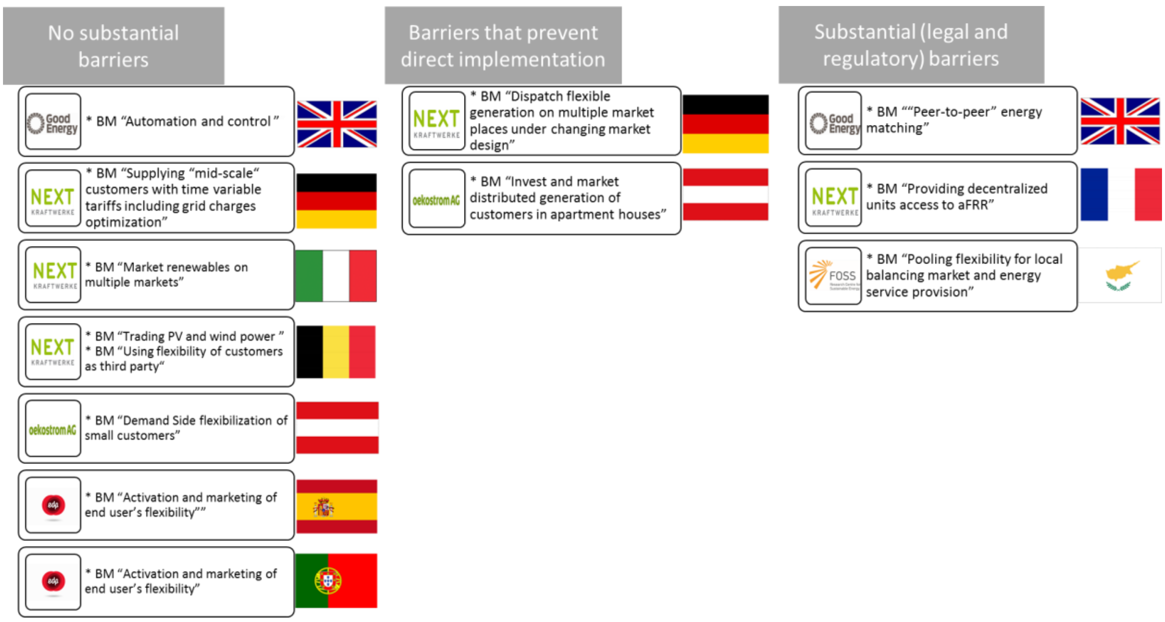

Figure 2: Analysis of barriers for implementation of improved business models

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Figure 2 shows that, for 8 out of the 13 improved BMs, there are no significant barriers. For 2 BMs, barriers prevent direct implementation. For the BM “Dispatch flexible generation on multiple market places under changing market design” (Germany), an updated favourable market design will be implemented only in 2018 whereas for the BM “Invest and market distributed generation of customers in apartment houses” (Austria), a new favourable law was passed but the details of the law are not yet known. Finally, for 3 BMs, there are significant legal and regulatory barriers making it not feasible to implement the models in the short to medium term.

Our analysis of both the economic feasibility and barriers allowed us to allocate BMs to the 3 different groups as explained above and highlighted in Figure 3.

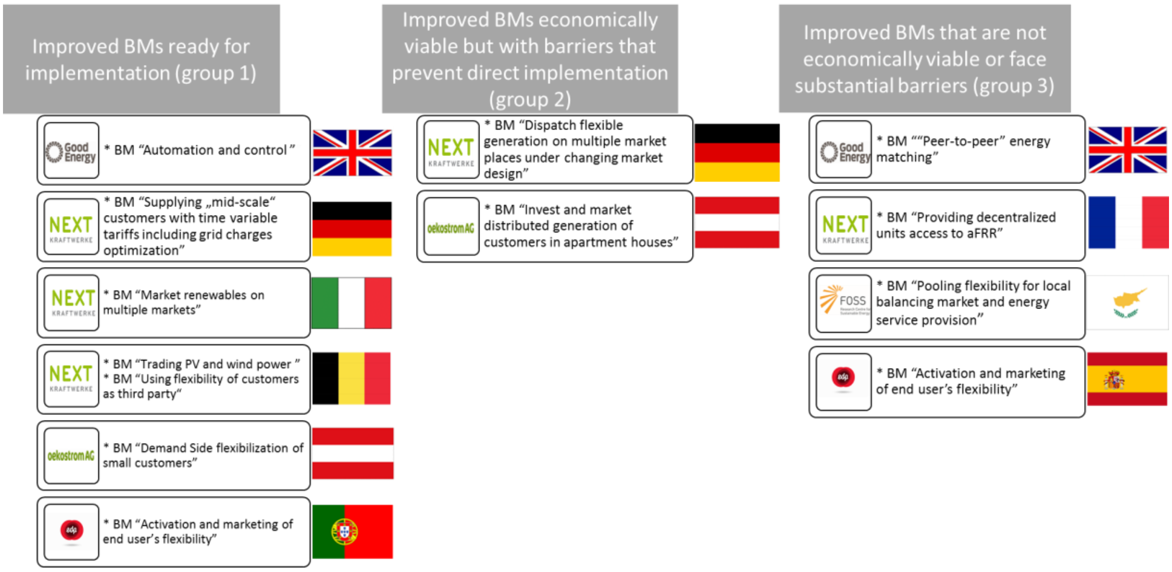

Figure 3: Allocation of improved business models to groups

BMs ready for implementation (7 out of the 13 BMs) are identified in the United Kingdom, Austria, Germany, Italy, Belgium and Portugal. For both group 1 BMs in the United Kingdom and Austria, the aggregator manages to decrease sourcing costs whereas costs (and turnover) to end customers decrease. In Germany, Next Kraftwerke optimizes capacity tariffs and individual network tariffs. In both Italy and Belgium, Next Kraftwerke generates revenues from capacity and activation fees on reserve power markets. Next Kraftwerke, with another improved BM, also trades weather dependent renewables such as PV and wind on spot markets in Belgium. Finally, in Portugal, EDP uses flexibility from loads to decrease imbalance penalties of the own portfolio.

2 BMs face barriers that prevent direct implementation and 4 BMs are not feasible. Figure 1, Figure 2 and Figure 3 also underline that almost all BMs that have no significant barriers for implementation are ready for implementation. EDP with its BM “Activation and marketing of end user’s flexibility” in Spain is the only exception. In this case, although there are no significant technical, legal, regulatory or other barriers for implementation, the BM is not feasible due

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to low imbalance tariffs. For all other BMs that are not yet ready for implementation, the main hurdles are related to regulation. Therefore, aggregators will only be able to implement these BMs in the medium (group 2) to long (group 3) run.

For BMs that are ready for implementation (group 1), aggregators should focus on a few aspects to set up a viable new business in the following 18 months of the BestRES project (from September 2017 until February 2019). A first take away from the analysis is that client acquisition is key to make a BM viable. In this context, the consortium is further supporting aggregators with the development of a questionnaire for targeting small-scale providers of flexibility (Good Energy) and with providing documentation on renewable energy assets and investors in Italy (Next Kraftwerke) in D4.2 "Documentation of pilot business model implementation and results". Another important fact is that aggregators should follow up on regulation related to market actor relationships, minimum bid and pooling sizes and other market design updates on a constant basis to valorise opportunities. For this reason, in D4.2, the consortium is supporting aggregators with analysing the potential grid modifications in Germany (Next Kraftwerke) and with providing documentation on the operation of the green and CHP certificate system, related market players and PPAs in Belgium (Next Kraftwerke). Other support for implementation that aggregators specifically requested is an analysis of existing time-of-use pricing structures for small-scale consumers (Oekostrom) and load forecasting of loads within the own portfolio in Portugal (EDP).

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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 changing because a rising share of distributed generation increases variability and price volatility in the system. This requires a more flexible system with more flexible consumption and generation. 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 weather dependent 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 larger amounts, numbers and types of consumers and producers in a market that the use of flexible distributed generation and demand response in combination with storage technologies 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. Apart from the inadequate market design in several countries, an explanation for this is the requirement 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 technically and/or economically. In other words, they are facilitators between the two sides of electricity markets – demand and supply. 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 benefit from aggregation if appropriate incentives are present.[1]

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[1] Guidelines on State aid for environmental protection and energy 2014-2020

Sauba G., Van der Burgt J., Varvarigos E., Makris P., Schoofs A., VIMSEN – Smart Tool for Energy Aggregators, Conference Paper, 37th IEEE International Telecommunications & Energy Conference (INTELEC), October 2015

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-

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1.1 The BestRES project

The main objective of the BestRES project is to investigate the current barriers for aggregators and to improve the role of energy aggregators in future electricity market designs. In the first stage from March till September 2016, the consortium identified business models of aggregators across Europe. In the second stage, we will develop improved business models that are replicable within the EU investigating different market designs with a focus on competitiveness and life-cycle assessment (LCA). These improved business models will 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 started on 1 March 2016 and will end on 28 February 2019.

The target group, the Renewable Energy Aggregators, has been directly involved in the BestRES project as consortium 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
- Next Kraftwerke Germany, renewable energies aggregator active in Germany, France and Italy
- Energias de Portugal, a utility active in Spain and Portugal and intending to start aggregation activities of consumers' flexibility in Spain and Portugal

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content/uploads/2016/02/NordREG-Discussion-of-different-arrangements-for-aggregation-of-demand-response-in-the-Nordic-market.pdf

IndustRE project, Main variations of business models for Flexible Industrial Demand combined with Variable Renewable Energy, Working Document, Deliverable 2.1, April 2015, Available at: http://www.industre.eu/downloads/category/project-results

Quentin Lambert, Business Models for an Aggregator, Application to the situation on Gotland, KTH Royal Institute of Technology, Available at: https://www.kth.se/social/upload/5093c048f276545fbd1c6378/KTH%20Energy%20Award-QL.pdf

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Sauba G., Van der Burgt J., Varvarigos E., Makris P., Schoofs A., VIMSEN – Smart Tool for Energy Aggregators, Conference Paper, 37th IEEE International Telecommunications & Energy Conference (INTELEC), October 2015

Eurelectric, Flexibility and aggregation, Requirements for their interaction in the market, January 2014, Available at: http://www.eurelectric.org/media/115877/tf_bal-agr_report_final_je_as-2014-030-0026-01-e.pdf

European Commission-Seventh Framework Programme, DREAM electricity market design, WHITE PAPER, October 2014, Available at: https://webhotel2.tut.fi/units/set/ide4l/DREAM2%20DREAM-market-design.pdf

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The BestRES activities to be implemented in Cyprus will be carried out by FOSS, the research centre for sustainable energy of the University of Cyprus. This is due to the fact that there are no aggregators in Cyprus at the time being (2016) and no market entrants are expected until 2020.

The innovative business models to be worked out during the project will be based on currently applied business models in Europe and adapted to the expected future market design. They will be developed 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.

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

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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, Paris, London, Istanbul, Delhi 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 aim 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/

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

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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/

Research Center for Sustainable Energy of the University of Cyprus (FOSS)

The Research Centre for Sustainable Energy of the University of Cyprus (FOSS) was created in order to play a key role in research and technological development activities in the field of sustainable energy within Cyprus and at international level with the aim of contributing to the achievement of the relevant energy and environment objectives set out by Europe. FOSS is heavily involved in all spheres of sustainable energy spreading from sources of energy, smoothly merging RES in the integrated solutions of the grid, development of enabling technologies such as storage and ICT that will facilitate the seamless merging of sustainable technologies in the energy system of

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tomorrow, the complete transformation of energy use by the effective introduction of sustainable alternatives in meeting the needs for mobility, heating and cooling and exploring ways of achieving even higher levels of efficiency in all areas of the economy.
Website: http://www.foss.ucy.ac.cy

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

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1.2 Structure of the document

The objective of this report is to decide if the different improved BMs of aggregators in each of the target countries, described in D3.2 “Improved business models (BMs) of selected aggregators in target countries” of the BestRES project, should be allocated to group 1 (economic BMs ready for implementation), group 2 (BMs economically viable but with barriers that prevent direct implementation) and group 3 (BMs that are not economically viable or face substantial barriers).

The remainder of the document is structured as follows:

- Section 2 briefly outlines the project methodology
- Section 3 assesses the economic feasibility of each improved business model for different aggregators.
- Section 4 describes the barriers for implementation of each improved business model for the different aggregators
- In section 5, based on the economic and barriers analysis and in collaboration with the aggregators, we will decide if improved business models should be allocated to group 1, group 2 and group 3
- Section 6 concludes with an overview of the assessment for each of the improved business models

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2. Methodology

4 aggregators and 1 research centre (section 1.1 of this document) in 9 countries in different regions in Europe are included in the BestRES project:

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

In D3.2 "Improved business models (BMs) of selected aggregators in target countries" of the BestRES project, the consortium described 13 improved BMs of these aggregators in the 9 countries (Table 1)

Table 1: Improved business models of all aggregators in the countries covered by the consortium

	Improved business model
Good Energy (UK)	Automation and control (BM1)
	"Peer-to-peer" (local) energy matching (BM2)
Next Kraftwerke Germany (Germany)	Dispatch flexible generation under changing market design on multiple markets (BM3)
	Supplying "mid-scale" customers with time variable tariffs including grid charges optimization (BM4)
Next Kraftwerke Germany (France)	Providing decentralized units access to balancing markets (BM5)
Next Kraftwerke Germany (Italy)	Market renewables on multiple market places (BM6)
Next Kraftwerke (Belgium)	Trading PV and Wind power (BM7)
	Using flexibility of customers as third party (BM8)
Oekostrom AG (Austria)	Demand Side flexibilization of small customers (BM9)
	Invest and market distributed generation of customers in apartment houses (BM10)
EDP (Portugal)	Activation and marketing of end user's flexibility (BM11): • Day-ahead energy sourcing optimization • Imbalance optimization
EDP (Spain)	Activation and marketing of end user's flexibility (BM12): • Day-ahead energy sourcing optimization • Imbalance optimization
FOSS (Cyprus)	Pooling flexibility for local balancing market and energy service provision (BM13)

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We used the description of these BMs as a starting point for an assessment of the economic feasibility and the barriers. For the economic analysis, we focus on a preliminary analysis of turnover and profits. For the barriers analysis, we use the barriers framework from D2.3 “Current market design of each consortium country; technical, regulatory and legal barriers for optimal deployment and operations of current BMs” in the BestRES project as a starting point (Figure 4). In addition, the consortium also included an assessment of social and other barriers.

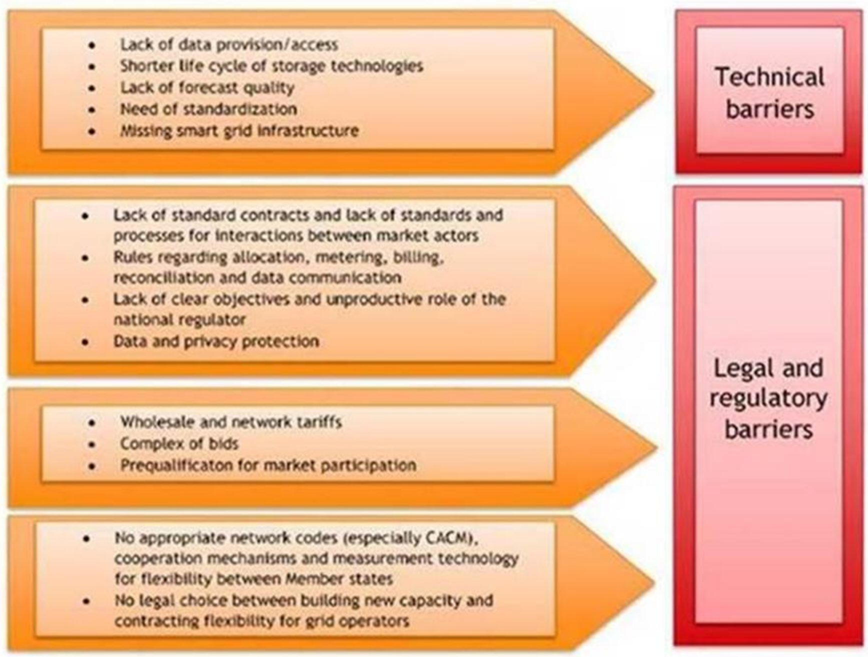

Figure 4: Barriers for implementing aggregator business models (D2.3 of the BestRES project)

Based on this analysis of the economic feasibility and barriers, the aim is to place the improved BMs in the following 3 groups:

- Group 1: Aggregators that have economic BMs and no substantial barriers. Aggregators having such BMs shall proceed with real-life implementation with consortium support (economic BMs ready for implementation)
- Group 2: Aggregators with BMs that are economically viable but face barriers that prevent direct implementation only in the short or medium term. Aggregators should proceed with virtual implementation, involving scenario modelling with actual customer data (economic BMs with feasibility issues)
- Group 3: Aggregators with BMs that are not economically viable and/or face substantial barriers. Such aggregators should not proceed with implementation (BMs that are not economic)

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In this context, after discussion with the project partners, the consortium decided that barriers are not “substantial” if aggregators can directly impact barriers and proceed to implementation of the improved BM (group 1 BM). An example of such a barrier is the acquisition and marketing costs for acquiring enough customers. By contrast, if barriers are substantial -mostly related to regulation- improved BMs will be in group 3 as it is not possible to implement the BM. An example of such a barrier is a market design that does not allow for the participation of aggregated units. Finally, for group 2 BMs, barriers make it impossible to proceed to direct implementation at this moment but it can still be expected that barriers will be lifted in the short to medium term. For each improved BM, a detailed analysis will be provided.

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3. Assessment of the economics of each improved business model

The objective of this part of the report is to assess the economics of each improved business model in order to identify if these business models are ready for implementation. The results of D3.2 "Improvement of BMs of selected aggregators and in target countries and for technical benefits and market options" are used as a starting point for this analysis.

3.1 Good Energy (United Kingdom)

3.1.1 Automation and control (BM1)

In this improved BM, Good Energy is focusing on different devices to provide flexibility for balancing and on wholesale and reserve power markets. The model is comparable to Oekostrom's "Demand side flexibilization of small customers" BM. For this preliminary analysis, the consortium is only considering the profits on wholesale markets of offering real-time pricing to small-scale customers. We investigated the viability of implementing the improved business models in a distribution grid segment of 206 customers (households & small commercial segment with an average demand of 3.9 MWh) in the United Kingdom. 58 of these customers operate a PV system with a battery storage system whereas 166 consumers have flexible electric loads such as refrigerators, freezers, water boilers, heat pumps and electric radiators. The energy consumed by those devices can be deferred as follows: refrigerators: 1h, freezers: 4h, water boilers: 12h, heat pumps: 1h, electric radiators: 1h.[2]

The main cost of this improved business model will be the sourcing of electricity, assumed to be at the level of the average portfolio purchasing costs. Furthermore, client acquisition will not be an important cost in this case as Good Energy is, in a first step, only targeting existing Good Energy customers. Revenues come from the monthly fees small customers pay (for both the existing and the improved BM) and from what customers pay for electricity (time-of-use tariffs in the improved BM). Based on some first discussions with Good Energy, it is estimated that, when revenues are optimized by shifting demand from day to night, customers can increase their share of consumption during low tariff hours by 10%.

Table 2 provides the reader with an overview of estimates of the turnover and the profit in case the improved BM is implemented for customers with an annual consumption of 3.9 MWh.

[2] https://nachhaltigwirtschaften.at/de/e2050/publikationen/biblio/loadshift-lastverschiebung-in-haushalt-industrie-gewerbe-und-kommunaler-infrastruktur-potenzialanalyse-fuer-smart-grids.php

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Table 2: Estimate of turnover/profit for the "Small-scale automation and flexibility" BM

Demand Side flexibilization of small customers	Existing BM (EUR /year/customer)	Improved BM (EUR /year/customer)
Turnover (EUR)	303	278
Costs (EUR)	215	190
Profit (EUR)	89	88

Table 2 underlines that, with time-of-use tariffs, the profit for Good Energy stays the same whereas the costs for end customers go down by almost 10% (from EUR 303 to EUR 278).

3.1.2 Peer-to-peer energy matching (BM2)

In this improved business model, virtual platforms/blockchains are used to enable customers to directly buy power from generators (D3.1 "Review of future electricity market options" of the BestRES project). As in the case of the other improved business model, some domestic clients already have smart meters and, through meter readings that customers send to Good energy themselves, the company will be able to estimate daily profiles of customers without smart meters.

However, it is very difficult to estimate the potential of peer-to-peer energy matching as peer-to-peer platforms are, according to Good Energy, not truly commercial projects but rather part of supplier propositions. However, in a recent pilot project in Cornwall (Piclo Pilot), it was proven that 54% of the electricity generated in Cornwall was matched by demand in Cornwall.[3] In this context, blockchain technology certainly has the potential to reduce grid costs, enhance efficiency of trading platforms, establishing smart contracts and, most of all, adding customer value through more detailed and transparent information about energy origin and evolution. However, within current regulatory frameworks, the impact will almost be non-existent, because wholesale costs only account for approximately 35% of an electricity bill, so blockchain can only have a significant impact on costs by accelerating the emergence of local markets with peer-to-peer trading.[4] In the same pilot project, it was shown that local generation matching could reduce the annual system charge by up to 39%.

For this first preliminary analysis, we however tried to get a first idea about the potential revenues and costs related to such an improved business model. Benefits will highly depend on the number of customers interested in buying electricity from a specific origin and location. In this context, per Good Energy, the company has a highly-engaged customer base that has provided willingness to be involved in the pilots and the company is very experienced with recruiting engaged customers for trials/tests. For a recent implementation of a

[3] Open Utility, A glimpse into the future of Britain's energy economy, 2016, Available at: https://www.openutility.com/

[4] German Energy Agency (DENA), Blockchain in the energy transition. A survey among decision-makers in the German energy industry, November 2016, Available at: https://www.esmt.org/system/files_force/dena_esmt_studie_blockchain_english.pdf?download=1

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demonstration project for a combined solar PV-thermal-heat pump system, Good Energy invited 32000 customers to respond to a survey, 10 000 customers responded, 8000 completed the survey, 4500 were eligible for the trial and 3800 wished to be considered for the trial. For the peer-to-peer energy matching, the consortium assumes that 50% (2400) of those customers will participate and that they will agree to pay the same as they are paying today (7.77 pence/kWh). This would result in an estimated yearly turnover of around 560k GBP. For the costs, we use publicly available information on VPPs in Austria as Figure 5 highlights.[5]

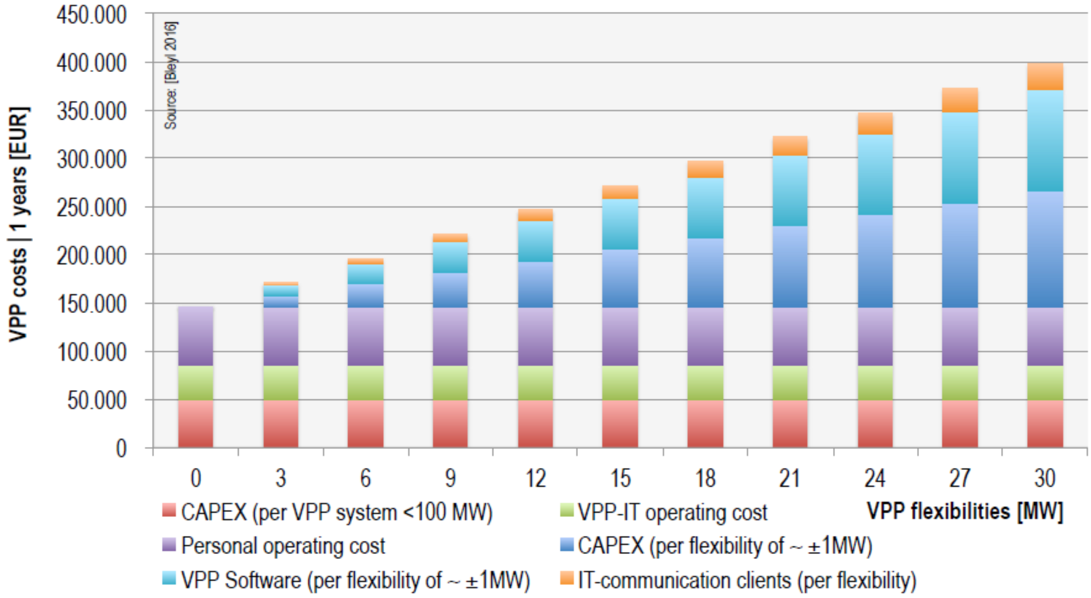

Figure 5: Economic appraisal of VPP use cases for Austria

The CAPEX and OPEX costs for the VPP system and personal operating costs will certainly be relevant for this business model and are estimated at around £135k. Sourcing costs will highly depend on the type of generation that will be used within the peer-to-peer market place. Distribution network costs could furthermore decrease significantly as consumers, matching on a half-hourly basis, would only pay for the extent of the distribution network they use. However, as already previously mentioned, the peer-to-peer business should rather be seen as an acquisition tool that sits on top of the standard purchasing and supply arrangements.[6]

[5] For this preliminary analysis, we assume that VPP costs in Austria and Germany and comparable
Hybrid VPP4DSO, Economic Appraisal of selected VPP Use Cases, December 2016, Available at: http://www.hybridvpp4dso.eu/upload/workshop_161214/vpp4dso_ws-wirtschaftlichkeit_161212_to_workshop.pdf
[6] Open Utility, A glimpse into the future of Britain's energy economy, 2016, Available at: https://www.openutility.com/

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3.2 Next Kraftwerke Germany (Germany)

3.2.1 Dispatch flexible generation under changing market design on multiple market (BM3)

Next Kraftwerke has an extensive experience with optimizing flexible decentral generation in Germany. For the implementation of this BM, Next Kraftwerke is specifically considering market design changes on aFRR (automatic Frequency Restoration Reserve) as the tendering will change from weekly products (peak product during Monday-Friday 8 AM-8PM and off-peak product during weekends and Monday-Friday before 8AM and after 8PM) towards shorter availability-periods and daily procurements (4-hour products).

For this preliminary analysis, we are investigating the potential of dispatching a 1.3 MW biogas power plant on the spot and secondary reserve power market (aFRR) in Germany. The basic idea of this investigation is that shorter reserve market products allow for better dispatching the flexibility on the spot and reserve market. 4 different scenarios have been simulated:

1. **Passive**: a standard, market-agnostic scenario
2. **Spot**: the daily production is optimized purely with respect to day-ahead market prices
3. **Baseline**: assuming current reserve power market design, we analyse the potential of marketing 0.5MW on positive and negative reserve power markets and marketing the remaining capacity on the day-ahead market
4. **New**: assuming the new reserve power market design with 4-hour reserve power market products, we analyse the potential of marketing 0.5MW on positive and negative reserve power markets and marketing the remaining capacity on the day-ahead market

For simulating the revenues, spot market data from EPEX and reserve power market data from regelleistung for the year 2016 were used.[7] On the cost side, especially production costs of the biogas plant will be important but also the cost of offering flexibility is relevant. Furthermore, subsidies (EUR/MWh), depending on the year of starting operations, and electricity output must be considered. In Germany subsidies are calculated following a sliding market premium which adjusts the premium according to market prices (D3.1 of the BestRES project). Finally, besides the market premium, the “Act on the Development of Renewable Energy Sources” also incentivizes existing biogas plants to invest in additional capacity — without changing the energy output— with a flexibility premium (as described in D2.2 of the BestRES project).[8]

For this preliminary analysis, it is assumed that additional (compared to the existing business) operating and maintenance costs for flexibility provision can be covered by this flexibility premium for increased capacity. Therefore, no

[7] https://www.epexspot.com/en/product-info/auction/germany-austria
https://www.regelleistung.net/ext/

[8] Federal Ministry for Economic Affairs and Energy, Act on the Development of Renewable Energy Sources (Renewable Energy Sources Act - RES Act 2014), Available at: http://www.bmwi.de/Redaktion/EN/Downloads/renewable-energy-sources-act-eeg-2014.html

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additional costs are considered for flexibility provision. Forecasting algorithms, software as well as the bidding strategy will also need to be adapted. Nevertheless, Next Kraftwerke has a large volume in Germany, around 761 MW of prequalified capacity, for secondary reserve and the pool is still growing. Therefore, it can be assumed that the costs are split over many units and costs per unit of flexibility are neglected for this preliminary analysis. In summary, since Next Kraftwerke is currently implementing the "Baseline" and this is a viable business model, the "New" scenario will also be a viable business model if estimations of revenues are higher compared to the revenues in the "Baseline" scenario.

Table 3 provides the reader with an overview of estimates of the benefits on spot markets of changing the market design considering the abovementioned assumptions. In both the "Baseline" and "New" assumptions, there will be an additional revenue from the reserve power market (as opposed to the "Spot") but this revenue is assumed to be the same in both scenarios for the preliminary analysis. This simplified assumption is due to the uncertainty concerning reserve capacity price development with the new market design. New market players are entering the aFRR market and opportunity costs are evolving which will affect the market prices. However, in both scenarios ("Baseline" and "New"), the offered volumes of reserve capacity are the same per day but the "New" scenario allows for higher profits from spot market spreads for instance by shifting from a solar peak and related low spot prices to the evening with higher spot prices. Within the current reserve market design, it would not be possible to shift capacity between reserve power and spot markets that often.

Table 3: Estimate of benefits on spot markets for the "Dispatch flexible generation under changing market design on multiple markets" BM

Dispatch flexible generation under changing market design on multiple market	Passive	Spot	Baseline	New
Revenues spot market (EUR)	165480	197490	189860	195820
Revenues reserve power market (EUR)*	/	/	32 000	32 000

* This is only first estimation to show the reader that there are revenues from reserve power markets in "Baseline" and "New". A more detailed estimation will be provided in D3.3 of the BestRES project

Table 3 shows that the scenario "New" could potentially become more attractive than the "Baseline" as revenues on spot markets are higher whereas revenues on the reserve power market are assumed to be the same. More detailed results will be made available in D3.3 of the BestRES project. It is furthermore important to highlight that profits on the reserve power market are highly impacted by the chosen bidding strategy and the considered technology.

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3.2.2 Supplying “mid-scale” consumers with time variable tariffs including grid charges optimization (BM4)

As explained in D3.2 “Improved BMs of selected aggregators in target countries” of the BestRES project, Next Kraftwerke is considering flexible power supply products for “mid-scale” customers by offering price signals on day-ahead and intraday markets and by optimizing capacity tariffs and individual network charges. Next Kraftwerke already has a couple of flexible power tariffs but taking into account grid charges could increase the value for the consumer.

For analysing the implementation of this improved business model, the consortium investigated how much additional earnings can be generated by optimizing the annual power component of the network charges and spot prices. A 2.5 MW water-pump load, connected to the medium voltage level, with an annual consumption of approximately 10700 MWh, was considered. The profile of this water-pump load is illustrated in Figure 6.

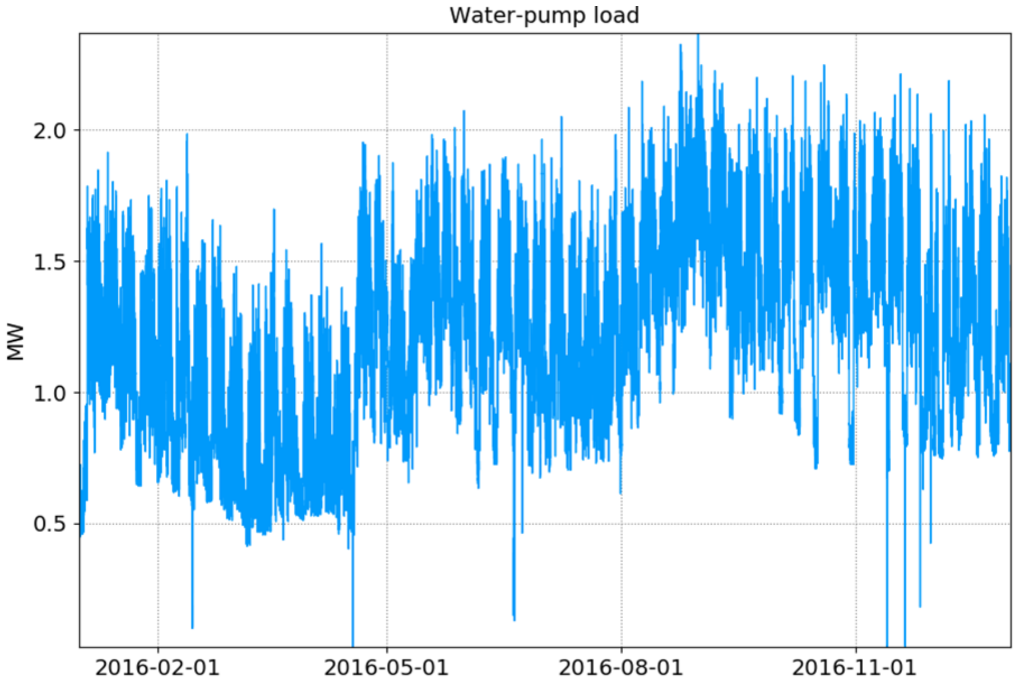

Figure 6: Original water-pump load profile

The flexibility of the load is characterized by the following restrictions:

- Increase and reduction between 0.1 MW and 0.5 MW;
- Flexibility activation only available on weekdays;
- A reduction or increase has to last for at least four hours.
- There has to be a pause of at least four hours between two flexibility activations.
- At most three flexibility activations are allowed per day.
- The total daily consumption must not be changed by flexibility activations.

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The considered tariff assumptions are described in Table 4.[9] For the day-ahead spot market price, EPEX historical data from 2016 is used.[10]

Table 4: Customer tariff assumption

Component	Value	Unit
Network Charges		
Fixed annual component	465	EUR/a
Energy component	10.7	EUR/MWh
Power component	133550	EUR/(MW_{max}·a)
Fees		
First 1000 MWh	8.04	EUR/MWh
Over 1000 MWh	5.32	EUR/MWh

The consortium assumes that, if there is a cost decrease related to spot market and grid costs and, moreover, this decrease is higher than the potential cost increase for offering flexibility, the economic assessment is positive.

Table 5 provides the reader with an overview of the cost impact when the new business model (“grid”) is implemented and when the daily production is optimized with respect to spot market prices only (“spot”). We furthermore assume that there are no additional CAPEX and OPEX costs for managing the VPP itself as Next Kraftwerke already managed a platform with more than 4000 units. The customer however has additional costs for enabling its planning tools to deal with additional parameters such as price signals. This set up costs vary for each customer depending on adaptability of existing software. As a first rough estimation, for the water pump, the consortium calculates a 15000 EUR set-up cost depreciated over 5 years. As a consequence, we assume 3000 EUR/year (not taking into account the time value of money).

[9] Mitnetz Strom, Preisblatt 1 - Netzentgelte für Entnahmen mit Leistungsmessung, Entgelte gültig ab 01.01.2017
[10] https://www.epexspot.com/en/product-info/auction/germany-austria

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Table 5: Estimate cost impact "supplying mid-scale consumers with time variable tariffs including grid charges optimization" BM

Supplying "mid-scale" customers with time variable tariffs including grid charges optimization	"Spot"	"Grid"
Increase costs spot market (EUR)	-18910	-18620
Increase costs charges (EUR)	17360	-31980
Total cost decrease spot market and charges (EUR)	-1550	-50600
Increase other costs for offering flexibility (EUR)	0	3000
Total impact costs (EUR)	**-1550**	**-47600**

Table 5 shows that the economic assessment is only slightly positive in the case of the "spot" business model whereas it is highly positive in the case of the "grid" business model (a negative "Total impact costs" corresponds to a cost reduction). The "grid" business model therefore illustrates that a total optimisation of market and grid fees can add significant value. It is however important to accentuate that aggregators can only benefit from revenue increases derived from the spot market whereas benefits related to charges will go to the client.

Our analysis shows that, in Germany, the value of flexibility (on the spot market) slightly decreases when also peak-load is reduced. Therefore, it can be interesting for clients to combine flexible power supply with the avoidance of extreme peak loads. However, benefits highly depend on consumption profiles and cannot be applied to each consumer.

3.3 Next Kraftwerke Germany (France)

3.3.1 Providing decentralized units access to balancing markets (BM5)

In France, Next Kraftwerke is planning to implement one improved business model: "Providing decentral units' access to balancing and reserves markets". The key aspects of this business model are explained in D3.2 "Improved BMs of selected aggregators in target countries" of the BestRES project and the business model can be split up in two improved sub-business models. The first one is the participation on the manual Frequency Restoration Reserves (mFRR) market whereas the second one is the participation on the automatic Frequency Restoration Reserves (aFRR) market.

For this preliminary analysis, we analysed possibilities for the marketing of a run-of-river hydropower plant of 1MW capacity. In both cases, Next Kraftwerke will only be able to provide negative capacity assuming there is limited storage in the portfolio. On mFRR, market players can make upward and downward bids and notify RTE (the French TSO) of their technical and financial conditions. Subsequently, RTE selects bids according to costs and requirements so the mechanism enables the most effective bid in technical and economic terms to be selected. These bids are also used to solve congestion problems in the grids.

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aFRR, by contrast, is still related to obligations for the major generators who can then sub-contract their provision in a secondary market (pro rata activation).[11] Below is a list of the most important providers on the aFRR market in the beginning of 2017:[12]

- Actility
- ALPIQ
- Compagnie Nationale du Rhône
- DIRECT ENERGIE SA
- Électricité de France
- Uniper Global Commodities SE
- Energy Pool Developpement SAS
- ENGIE
- POWEO Pont-sur-Sambre Power
- REstore France
- Smart Grid Energy

An analysis of downward balancing market prices on mFRR shows that market participation of pooled hydro plants with very limited storage potential is currently not economic in France. In 2016, there were 174 half hours with negative prices (positive remuneration for the provider) for balancing activities with a total value of 764 € on a yearly basis.[13] Therefore, given that costs will come with ramping down activities, mFRR market participation does not seem attractive to compensate for additional expenses. Nevertheless, it is foreseen to align the French balancing mechanism with the European market design standards such as proposed by ENTSOE (European Network of Transmission System Operators for Electricity) soon.[14] This could mean a standardisation of the mFRR and can increase the attractiveness for market participation for controllable renewables.

On the aFRR market, by contrast, there is capacity remuneration for downward reserves of 9.29 EUR/MW/30 minutes for the years 2016 and 2017. It seems to be economically attractive for controllable renewables such as pooled smaller to participate on this market. Currently only aFRR providers (major providers who have an obligation) who provide a symmetrical provision receive a remuneration but, in theory, other market participants, such as Next Kraftwerke, could provide asymmetrical products via the secondary market as well. However, a secondary market is not transparent. Consequently, the potential value of downward provision can only be roughly estimated at this moment.

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[11] RTE, Balancing Mechanisms, Available at: http://www.rte-france.com/en/article/balancing-mechanism
SEDC, Explicit demand Response in Europe, mapping the Markets 2017, April 2017, Available at: http://www.smartenergydemand.eu/wp-content/uploads/2017/04/SEDC-Explicit-Demand-Response-in-Europe-Mapping-the-Markets-2017.pdf
[12] http://clients.rte-france.com/lang/fr/include/data/services_clients/telecharge/Liste_Responsables_Reserve.pdf
[13] RTE, Volumes and prices, 17/07/2017, Available at: http://clients.rtefrance.com/lang/an/visiteurs/vie/mecanisme/volumes_prix/equilibrage.jsp
[14] RTE, Feuille de route de l'équilibrage du système électrique français, Livre vert, June 2016,

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According to Next Kraftwerke, it can be assumed that positive reserves have a higher value than negative reserves as is the case in other markets with asymmetrical aFRR products such as Germany. A preliminary price analysis indicates that, in Germany, approximately 16% of the total average capacity price of positive and negative capacity in 2016 was paid for negative capacity. However, due to market design differences between France and Germany, this is only a rough estimation. For a first economic assessment on the aFRR market, the consortium calculates with 20% of the total capacity remuneration (9,29 EUR/MW*30 Minutes*8760 h * 2* 20%= 32552 EUR/MW) for downward reserve. From experiences on other markets, where Next Kraftwerke already offers negative aFRR with small-scale hydro plants, such as Austria or Germany, Next Kraftwerke moreover knows that a reduction of the availability of around 30% also needs to be considered. This availability reduction is driven by fluctuating primary energy supply, which is created by impacts such as icing or melting. Considering these assumptions, yearly revenues of 22786 EUR/MW (32552 EUR/MW*0.70) for downward flexibility can be estimated. This revenue must be distributed between the aggregator-BRP and the flexibility provider but also has to cover for pool redundancies and potential secondary market transaction costs. Activation of aFRR energy is remunerated by spot market prices. Therefore, it is not calculated with an impact of utilization payments in the first economical assessment.[15]

On the cost side, the customer must invest in additional remote control units and has to assess its individual costs for ramping down. EUR 4000/provider of flexibility to participate in a VPP is assumed for the preliminary calculations in this document. A depreciation period of four years is estimated which leads to yearly costs of approximately EUR 1000 (not considering the time value of money). From publicly available information on VPPs in Austria, we can furthermore estimate that the cost of offering additional flexibility leads to EUR 5000 OPEX per client per year.[16] For a generation unit, this would result in an additional cost of EUR 6000 per year. The provision of ancillary services is also driven by the increased production forecast activities, availability planning of the portfolio and modifications of the existing software/hardware to the French market conditions. These costs are fixed and are neglected for this preliminary analysis since they are very limited when the pool size is increased.

Table 6 provides the reader with an overview of estimates of the turnover and the profit in case the improved BM (valorisation on aFRR) is implemented in France and this for the following scenarios of availability reduction:

[15] SEDC, Explicit demand Response in Europe, mapping the Markets 2017, April 2017, Available at: http://www.smartenergydemand.eu/wp-content/uploads/2017/04/SEDC-Explicit-Demand-Response-in-Europe-Mapping-the-Markets-2017.pdf

[16] For this preliminary analysis, we assume that VPP costs in Austria and Germany and comparable
Hybrid VPP4DSO, Economic Appraisal of selected VPP Use Cases, December 2016, Available at: http://www.hybridvpp4dso.eu/upload/workshop_161214/vpp4dso_ws-wirtschaftlichkeit_161212_to_workshop.pdf

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1)40% availability reduction, 2)30% availability reduction (base case as explained above) and 3)20% availability reduction.

Table 6: Estimate of turnover and costs for the "Providing decentral units access to aFRR" BM for different scenarios of availability reduction

Providing decentral units access to aFRR	40% availability reduction	30% availability reduction	20% availability reduction
Revenues (EUR/MW)	19531	22786	26041
Costs (EUR/Unit and Year)	6000	6000	6000
Available cash to cover for other costs (EUR/MW)	**13531**	**16786**	**20041**

3.4 Next Kraftwerke Germany (Italy)

3.4.1 Market renewables on multiple market places (BM6)

Next Kraftwerke has started its activities in Italy in 2016 and is implementing the “Market renewables on multiple market places” business model. The company is entering the market and, currently, the focus is mainly on trading renewable energy on spot markets and creating additional value by using live data and forecasting algorithms. One further improvement could be the access to the balancing/congestion markets.

In Italy, the Dispatch Market (MSD) is the ancillary service market that is operated by Terna (TSO). It is used for the procurement of secondary and tertiary reserve, changes of plant dispatch (Central Dispatch System) and for releasing intra-zonal congestions. This market is currently limited to controllable producers >10 MVA as explained in D3.1 “Review of future electricity market options” of the BestRES project. However, Terna (the Transmission System Operator in Italy) is currently planning demonstration projects allowing the participation of aggregated units. The main purpose is to investigate what market design is required for aggregated units to participate. Also, this new market design should contribute to cost-efficient developments of the Italian electricity grid and enable new market participants to enter the market. The market rules for the pilot project have already been defined. The pilot phase consists of two pilots. The first one is targeting Demand-Side aggregators. The second one focuses on pooling of generation units.[17]

For this preliminary analysis, we analyse possibilities for marketing a pool of controllable renewables on the Dispatch Market (MSD, four sessions during

[17] Autorita per l’energia, PRIMA APERTURA DEL MERCATO PER IL SERVIZIO DI DISPACCIAMENTO (MSD) ALLA DOMANDA ELETTRICA ED ALLE UNITÀ DI PRODUZIONE ANCHE DA FONTI RINNOVABILI NON GIÀ ABILITATE NONCHÉ AI SISTEMI DI ACCUMULO. ISTITUZIONE DI PROGETTI PILOTA IN VISTA DELLA COSTITUZIONE DEL TESTO INTEGRATO DISPACCIAMENTO ELETTRICO (TIDE) COERENTE CON IL BALANCING CODE EUROPEO, May 2017, Available at: http://www.autorita.energia.it/allegati/docs/17/300-17.pdf

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delivery day). Since the market is only opening at the writing of this document, only a very rough estimate of revenues can be provided based on available prices from the past.

Regarding the costs of flexibility activation, opportunity costs related to specific types of generation technologies are a crucial element. Typical opportunity costs for renewables would be missed revenues such as spot market earnings or lost subsidies. If a generation unit has storage potential available (for example gas storage) and the unit is not running at full power all the time, flexibility potential can however be sourced at nearly zero production costs.

For this first preliminary analysis, it is assumed that Next Kraftwerke's pool has a limited storage capacity and, therefore, flexibility activation does not result in missed revenues from the spot market. The storage potential enables the units to generate revenues from downward activations on the MSD-Market. Terna, as the dispatcher, sells and buys electricity on the MSD market to reserve balancing capacity or to solve congestions. In case a generation asset participates on the downward MSD-Market, the operator buys from Terna (so the provider will pay Terna) and does not produce the volumes at that moment anymore. This price paid to Terna is usually lower than the spot market price. However, the producer can generate a margin by shifting production and selling it later the on the spot market assuming he can earn a similar price compared to the one he could have earned initially. In case the asset has no storage potential (for example with wind or solar projects), the units would have to be switched off (and production cannot be shifted) to offer downward flexibility so it would not make sense economically since negative prices do not occur.

Because of these observations, this first preliminary analysis is focused on units with storage potential such as smaller scale hydro, biogas/biomass and combined heat and power (CHP) (gas storage, heat storage). It is assumed that the pool has a high electricity output but does not produce at maximum power all the time (7000 full load-hours). Furthermore, it is supposed that the pool has at least storage potential of 1 hour available and can at least shift once per day. Finally, we suppose that the aggregated units are all installed in a single pricing zone.

In 2016, the medium MSD-downward price when downward volumes were sold by Terna was, on average, 15.48 EUR/MWh in the Central Nord zone (D3.2 of the BestRES project). The medium GME day-Ahead market price over the same period and in the same region was at 42.88 EUR/MWh. This potentially allows to earn 27.40 EUR per downward activation (if electricity is shifted and sold on the wholesale market). This value was calculated by subtracting the average MSD-Downward prices of the MGP day-ahead prices which illustrates the revenues from offering the service.[18] If we consider the abovementioned assumptions, Next Kraftwerke's virtual power plants could generate approximately 8000 EUR each maximum marketable MW of flexibility per year (8000=(7000h/8760h) * 27.44 EUR/MWh*365 H). Revenues can be further increased by also offering

[18] http://www.mercatoelettrico.org/En/Esiti/MGP/InformazioniPreliminariMGP.aspx

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upward flexibility or participating on MB (balancing market in Italy). This is foreseen to be investigated in a later stage of the project (D3.3 of the BestRES project).

On the cost side, if flexibility can be sourced at zero production cost, crucial drivers will be increased production forecast activities, availability planning of Next Kraftwerke's portfolio and modifications of the existing software/hardware to the Italian market conditions. However, such costs are fixed and are neglected at the current stage since their unit specific component is marginalized when the pool is growing. Furthermore, providers of flexibility must invest in additional remote control units and costs for ramping down will be different in every case. The consortium assumes (based on input from Next Kraftwerke) a cost of 3000 EUR for the initial investment on behalf of the providers of flexibility/generators. A depreciation period of four years is assumed resulting in a yearly cost of 750 EUR (not considering the time value of money).

Table 7 provides the reader with an overview of estimates of the turnover and costs in case the improved BM is implemented in Italy in 3 different zones (including the Central Nord zone as described above). Wholesale electricity prices and MSD-prices will be different in each of the 3 zones as zonal prices exist in Italy thus revenues will vary between the 3 regions.

Table 7: Estimate of turnover and costs for the "Market renewables on multiple market places " BM

Access to MSD-Market in different zones	Central Nord	Central Sud	Nord
Revenues (EUR/MW)	8007,56	10532,57	7446,35
Costs (EUR/Unit and Year)	750	750	750
Available contribution margin to cover for other costs (EUR/MW)	7257,56	9782,57	6696,35

3.5 Next Kraftwerke Belgium (Belgium)

In Belgium, Next Kraftwerke is planning to implement 2 improved business models. The first one is “Trading PV and wind power” (Trading BM). The second one is “Using flexibility of customers as third party” (Flex BM). Both improved BMs are explained in D3.2 of the BestRES project.

3.5.1 Trading PV and wind power (BM7)

For implementing this improved BM, Next Kraftwerke is focusing on trading weather dependent renewables such as PV and wind (D3.2 of the BestRES project). The Next Kraftwerke group, connecting more than 4500 technical units, has a lot of experience with the required technology, forecasting and trading techniques in Germany and other European countries. It is a logical step to transfer this business model to Next Kraftwerke Belgium.

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The market data used for this investigation are the hourly day-ahead and intraday spot market prices for the years 2015 and 2016 in Belgium. Our assumption is that forecasted generation will first be marketed on the day-ahead market and, if there is a remaining shortage or surplus, it will be procured on the intraday market.[19] For comparing the forecasted data with actual generation data, information from the ENTSO-E Transparency platform was used. [20]

The main implementation cost is expected to be client acquisition in the relatively small market of Belgium and it is certainly a challenge to contract generators for new PPAs (Power Purchase Agreements). Another important cost parameter is the management and further development of the Virtual Power Plant (VPP). Regarding the revenues, the large majority will come from trading on the day-ahead market (and a smaller share from trading on the intraday market). Based on discussions with Next Kraftwerke Belgium and looking at the current market development of PPAs for renewables, the consortium assumes that the minimum profit will be 1% whereas maximum profit will be 3% of these revenues.

Figure 7 provides the reader with an overview of estimates for the turnover and the profit margin in case the improved BM based on data for 2015 and 2016.

[19] Since there is a lot of uncertainty with respect to imbalance prices and because balancing cannot be attributed to one asset, balancing is not included in the analysis. We can however assume that the intraday price is a good estimate of the average imbalance price
[20] ENTSOE, Actual Generation per Generation Unit, Available at: https://transparency.entsoe.eu/

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Figure 7: Estimate of turnover/profit for " Trading PV and wind power " (Trading BM)

Figure 7 illustrates that estimates of the revenues and profit are similar for all 3 covered technologies (solar, onshore wind, offshore wind). Furthermore, the table shows that revenues are decreasing in 2016 compared to the year 2015. This can be explained by the decreasing trend on wholesale electricity price over the period 2015/2016; the average price on EPEX Spot Belgium (formerly Belpex) was about 44 EUR/MWh in 2015 whereas it decreased to about 36 EUR/MWh in 2016.

3.5.2 Using flexibility of customers as third party (BM8)

For implementing this business model, customers with access points for which Next Kraftwerke is neither supplier nor balancing responsible party are targeted. If the customer holds any kind of flexibility and wishes to market it, an additional flexibility contract with the aggregator needs to be concluded (D3.2 of the BestRES project).

For a preliminary analysis, we performed a high-level study of the potential to provide flexibility on 1) R3 Flex and 2) R3 free bids positive (new product). According to Next Kraftwerke, those are interesting segments to consider at the time of writing of this document.

On R3 flex, data from the Belgian TSO Elia show that, in 2015, the capacity price was 3 EUR/MW for each hour of the year (no activation fees are paid on R3 flex). On R3 Free upward (we are not analysing downward activation for this preliminary analysis), potential activation fees were 458280 EUR in 2015 and

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30461 EUR in 2016 (no capacity price on R3 Free). According to Next Kraftwerke, related activation costs (all costs included) are very difficult to estimate at this stage so the consortium decided to perform the analysis for 3 different cost scenarios:

1. Scenario with an activation cost of 0 EUR per MWh (Scenario 1)
2. Scenario with an activation cost of 50 EUR per MWh (Scenario 2)
3. Scenario with an activation cost of 100 EUR per MWh (Scenario 3)

Table 8 provides the reader with an overview of estimates of the turnover and the profit in EUR in case R3 Flex would be targeted and for different scenarios of activation costs.[21]

Table 8: Estimate turnover and profit R3 Flex 2015

Valorising flexibility R3 Flex	Scenario 1	Scenario 2	Scenario 3
Turnover (EUR)	26280	26280	26280
Costs (EUR)	0	200	400
Profit (EUR)	26280	26080	25880

Table 8 indicates that the business model is feasible for different scenarios of activation costs and calculating with the assumptions from 2015. Table 9 provides the reader with an overview of estimates of the turnover and the profit in EUR in case R3 Free positive would be targeted and for different scenarios of activation costs.

Table 9: Estimate turnover and profit R3 Free positive 2015 and 2016

Valorising flexibility R3 Free bids	2015			2016		
	Scenario 1	Scenario 2	Scenario 3	Scenario 1	Scenario 2	Scenario 3
Turnover (EUR)	114570	114570	114570	7615.25	7615.25	7615.25
Costs (EUR)	0	45625	91250	0	3825	7650
Profit (EUR)	114570	68945	23320	7615.25	3790.25	-34.75

Table 9 indicates that the business model is feasible for different scenarios of activation costs and calculating with the assumptions from 2015 and 2016. However, our preliminary analysis shows that there was already an important difference in estimations of profit between 2015 and 2016.

[21] There were 4 hours of full activation in 2015

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3.6 oekostrom (Austria)

In Austria, oekostrom is planning to implement 2 improved business models. The first one is the “demand-side flexibilization of small customers” BM, similar to the automation and control BM of Good Energy. The second one is the “Valorise distributed generation of customers in apartment houses” BM. Both improved BMs are explained in D3.2 of the BestRES project.

3.6.1 Demand side flexibilization of small customers (BM9)

For implementing this improved BM, oekostrom is offering a time of use tariff to customers who can use power-to-heat and cooling services to shift their loads (D3.2 of the BestRES project). Time of use tariffs are designed to incentivise shifting power consumption from high demand and cost hours to times with lower system costs. Such demand shifts can generate a benefit for DSOs, suppliers and customers. DSOs benefit from more efficient infrastructure use, reduced congestion at times of high demand and could potentially even avoid investments in grid infrastructure. The customers can reduce their electricity bill by shifting demand. Finally, the supplier could reduce purchasing costs if demand at hours of high peak prices is reduced.

The main costs are the client acquisition and the sourcing of electricity. It is assumed that acquisition costs are lower for the improved business model than for the reference business model, since customers can be attracted by the innovative character of the product rather than by financial incentives. For this preliminary analysis, the cost of sourcing electricity is assumed to be at the level of the average portfolio purchasing costs. Revenues come from the monthly fees small customers pay (for both the existing and the improved BM) and from what customers pay for electricity (time of use tariffs in the improved BM). When revenues are optimized by shifting demand from day to night, it is estimated that customers can almost double their share of consumption in low tariff hours (from 22% in the standard load profile to 40%). The challenge is that, even if smart meter devices are installed, standard profiles have to be used for load scheduling at the writing of this document. Consequently, the supplier would be losing revenues to the DSO.

Table 10 provides the reader with an overview of estimates of the turnover and the profit in case the improved BM is implemented for customers with an annual consumption of 3 MWh.

Table 10: Estimate turnover/profit for the "Demand side flexibilization of small customers" BM in Austria

Demand Side flexibilization of small customers	Existing BM (EUR/year/customer)	Improved BM (EUR/year/customer)
Turnover (EUR)	203	196.8
Costs (EUR)	190	147.4
Profit (EUR)	13	49.4

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The table illustrates that yearly revenues per customer for oekostrom stay stable, whereas the profit per customer is significantly increasing. Assuming a minimum quantity of 1.000 potential and interested customers, profits can be expected accordingly. Also, there is only a small difference (slight decrease of 3%) in what customers pay between the existing and the improved BM.

3.6.2 Valorise distributed generation of customers in apartment houses (BM10)

In this case, oekostrom intends to introduce an improved BM focusing on a common PV installation that is installed on multiple apartment blocks in cities (D3.2 of the BestRES project). For performing an economic assessment of this business model, we are assuming a pilot project consisting of 22 apartments and a participation rate of 75% (17 apartments). Those participating units are benefiting from the installation of the PV installation. Oekostrom's role in this BM is marketing PV production and supplying to clients in the same apartment block, while project development and investment would be carried out by other parties.

The data used for this analysis is based on an offer for the construction of a PV plant for a building block of the size of the pilot project. It is assumed that all investment costs are depreciated (annuities) over 20 years. The annuity together with OPEX of the PV plant should at least be covered by the revenues from selling electricity of the solar production. Another crucial cost parameter is client acquisition. Due to the innovative character of the improved BM, and similar to BM1, it is assumed that less incentives should be offered and thereby costs for customer acquisition are lower than for normal tariff customers. Additional important costs come from buying the PV production and sourcing electricity for the remaining client demand (as part of the portfolio). Revenues come from electricity that is auto-consumed, the non-consumed overproduction that is put on the grid (10% of total production), from selling the remaining energy demand to the customers and monthly fees small customers pay.

Table 11 provides the reader with an overview of estimates of the turnover and the profit in case the improved BM is implemented for customers with an annual consumption of 3 MWh.

Table 11: Estimate turnover/profit for the "Invest and market distributed generation of customers in apartment houses" BM in Austria

Valorise distributed generation of customers in apartment houses	Existing BM (EUR/year/customer)	Improved BM (EUR/year/customer)
Turnover (EUR)	203	234
Costs (EUR)	190	190
Profit (EUR)	13	44

The table illustrates that yearly revenues per customer for oekostrom increase by 31 EUR/year if the new business model is implemented. The consortium is assuming a potential of 10% of Vienna's 170.000 roofs for PV construction.

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The company has been analysing this potential for many years and, once the legal and technical barriers are overcome, oekostrom aims to tap this potential. Furthermore, our analysis has shown that yearly costs per customer remain about the same (slight increase of around 1%) in the case of this improved business model.

3.7 EDP (Spain and Portugal)

3.7.1 Activation and marketing of end user's flexibility (BM11 and BM12)

In both Spain and Portugal, EDP is planning to implement 1 main improved BM (EDP is currently not classified as an aggregator): "Activation and marketing of end user's flexibility". The key aspects of this business model are explained in D3.2 of the BestRES project but it can be split up in two improved sub-business models. A first one is the "day-ahead energy sourcing optimization" by shifting consumption from peak to off-peak and shifting peak hour consumption to the following hour. The second one is an "imbalance penalties optimization" given that imbalances for a portfolio of clients can be minimized, using some clients' flexibility, and thus the imbalances penalties are reduced. For implementing both improved business models, EDP is focusing on flexible processes such as refrigeration systems and batteries in large industrial and commercial consumers. Also, the company is targeting both industrial and agroindustry companies within the portfolio of EDP as new customers. In a first stage, EDP is aiming to valorise the flexibility of around 20 providers of flexibility with a focus on Portugal.

For implementing this improved BM, the consortium assumes that customers will be triggered to offer flexibility when peak-prices on the spot market are higher than a certain reference value. Spain and Portugal have a common day-ahead spot market and, in accordance with the partners within the project, the price threshold was set at 60 EUR/MWh. The average spot market price on the Iberian spot market MIBEL was rather around 50 EUR/MWh but a higher value was taken for this preliminary analysis to avoid non-realistic estimates of the benefits.

As EDP is not an active aggregator at the writing of this document, and although EDP has a dedicated energy monitoring infrastructure (independent from the one from the Portuguese DSO) in Portugal, the company will need some time to start up the activities.

3.7.1.1 Day-ahead energy sourcing optimization

In this case, revenues come from shifting consumption from peak to off-peak and shifting peak hour consumption to the following hour. A first analysis, using prices on the MIBEL market for 2015, indicates that shifting consumption from peak to off-peak can result in a benefit of 5902 EUR/MW per year (applying the shift 237 days in a year) whereas shifting peak hour to the following hour can

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result in a benefit of 565.66 EUR/MW. Consequently, peak-to-off-peak shifting appears to be a more profitable activity than intra-peak shifting.

On the cost side, client acquisition will be a relatively small cost for EDP as the company has a large customer portfolio. However, some of those customers have limited knowledge on flexibility so it will take time to convince them to take part in the project. From publicly available information on VPPs in Slovenia, we can estimate the activation cost of valorising the flexibility as Figure 8 illustrates.[22]

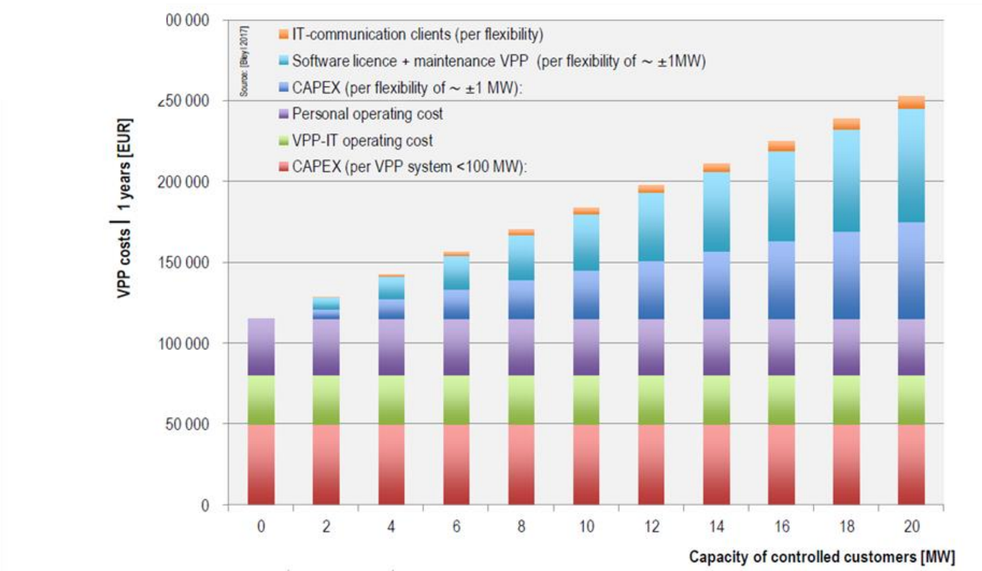

Figure 8: Economic appraisal of VPP use cases for Slovenia

For this analysis, a CAPEX cost of 50 000 EUR for setting up a VPP system (VPP system<100 MW), a CAPEX cost of 3000 EUR/MW of flexibility (technician and hardware at client, sales, marketing and drawing of contract), an OPEX cost of EUR 65000 per VPP system for VPP-IT and personal costs and an OPEX cost of approximately 4000 EUR per client per year are used. In summary, this gives a fixed cost of 115 000 EUR and other variable costs. For 20MW of controllable capacity, this would result in a total cost of 250 000 EUR.[23]

Table 12 provides the reader with an overview of estimates of the turnover and the profit for various scenarios where consumption is shifted from peak to off-peak moments assuming the costs mentioned above. Since Spain and Portugal have a common wholesale electricity market, the analysis is valid for both countries.

[22] The reference case for this analysis is a VPP system in Slovenia as the GDP per capita for Slovenia and Portugal/Spain are comparable
[23] Hybrid VPP4DSO, Economic Appraisal of selected VPP Use Cases, June 2017, Available at: http://www.hybridvpp4dso.eu/upload/workshop_170609/hybrid-vpp4dso_workshop_economicevaluation.pdf

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Table 12: Estimate of turnover/profit for the "Day-ahead energy sourcing optimization" BM in Spain and Portugal

Day-ahead energy sourcing optimization	Parameters	5 clients with 4MW flexibility each	20 clients with 2MW flexibility each	5 clients with 20MW flexibility each	20 clients with 5MW flexibility each
Revenue (EUR/MW)	5902	118040	236080	590200	590200
Fixed costs VPP system (EUR)	115000	115000	115000	115000	115000
Variable Cost flexibility (EUR/MW)	3000	60000	120000	300000	300000
Variable cost per client (EUR/client)	4000	20000	80000	20000	80000
Estimation profit (EUR)		**-76960**	**-78920**	**155200**	**95200**

Table 12 illustrates that, assuming the above-mentioned costs for Spain and Portugal, EDP would need to either contract a few very large-scale providers of flexibility or a higher number of large-scale providers of flexibility. If only smaller volumes of flexibility can be contracted, fixed costs will be too significant to have a viable business model. However, in Portugal, EDP has access to a financing of around 580 000 EUR from ERSE (the Portuguese regulator) under the PPEC (Plan to Promote Efficiency in Electric Energy Consumption) program, to implement a pilot project on the demand response and demand side management technologies for industry and agroindustry companies. Furthermore, the company has a large market share on the Portuguese market. Therefore, the consortium assumes that EDP will use the subsidies to set up contracts with a limited number of companies in the first 2 years whereas the company will manage to contract larger companies within a timeframe of 5 years and, consequently, have a feasible business running. Furthermore, costs can be further lowered and revenues increased as EDP is planning to target the same customers for implementing BM1 and BM2 (see description further below). In Spain, by contrast, the subsidy is not available and EDP is significantly less known so we assume that setting up the business model is not economically viable on this market in 2017.

3.7.1.2 Imbalance optimization

Through the providers of flexibility EDP is working with, the company could help balancing their own portfolio as there are sometimes high imbalance tariffs (in both directions). Similar to peak shifting, client acquisition will be a relatively small cost for EDP as the company will partly be targetting existing customers. The other costs will also be very similar to BM1.

For analysing the revenues in this preliminary analysis and assuming values and directions of electricity demand forecast errors can be predicted, both a reduction of 1 hour per day of deficit deviations and 1 hour per day of excess deviations are considered. If such deviations are optimized and data (REN: Sistema de Informação de Mercados de Energia) for 2015 is used[24], our analysis

[24] REN, Imbalances, Available at: http://www.mercado.ren.pt/EN/Electr/MarketInfo/MarketResults/Imbalances/Pages/default.aspx

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illustrates that 28 283 EUR/MW can be earned during 334 days on a yearly basis in Portugal if no forecast errors are made. In Spain, also using data for 2015 (REE: Red Electrica de Espana), our first preliminary calculations indicate that only 314 EUR/MW can be earned during 4 days on a yearly basis.

Table 13 provides the reader with an overview of estimates of the turnover and the profit for Portugal if we consider the same costs as for the “Peak-shifting business model” and if no forecasting errors are made.

Table 13: Estimate of turnover/profit for the "Deviations optimization" BM in Portugal

Deviations optimization	Parameters	5 clients with 4MW flexibility each	5 clients with 1MW flexibility each	5 clients with 2MW flexibility each	10 clients with 1MW flexibility each
Revenue (EUR/MW)	28283	565660	141415	282830	282830
Fixed costs VPP system (EUR)	115000	115000	115000	115000	115000
Variable Cost flexibility (EUR/MW)	3000	60000	15000	30000	30000
Variable cost per client (EUR/client)	4000	20000	20000	20000	40000
Estimation profit		370660	-8585	117830	97830

Table 14 provides the reader with an overview of estimates of the turnover and the profit for Spain if we consider the same costs as for the “Peak-shifting business model” and if no forecasting errors are made.

Table 14: Estimate of turnover/profit for the "Deviations optimization" BM in Spain

Deviations optimization	**Parameters**	**5 clients with 4MW flexibility each**	**5 clients with 1MW flexibility each**	**5 clients with 2MW flexibility each**	**10 clients with 1MW flexibility each**
Revenue (EUR/MW)	314	6280	1570	3140	3140
Fixed costs VPP system (EUR)	115000	115000	115000	115000	115000
Variable Cost flexibility (EUR/MW)	3000	60000	15000	30000	30000
Variable cost per client (EUR/client)	4000	20000	20000	20000	40000
Estimation profit		-188720	-148430	-161860	-181860

Table 13 and
Table 14 highlight that, assuming the above-mentioned costs for Spain and Portugal, EDP would need to contract sufficiently high volumes of flexibility to make the business viable in Portugal. Similar to BM1, the consortium assumes that, given the high imbalance tariffs, the availability of the subsidy and the strong brand of EDP, the business model will be viable in Portugal. This viability will be further increased by targeting the same customers for both business models. In Spain, by contrast, imbalance tariffs are significantly lower, the subsidy is not available and EDP is significantly less known so we assume that setting up the business model is not economically viable on this market in 2017.

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3.8 FOSS (Cyprus)

3.8.1 Pooling flexibility for local balancing market and energy service provision (BM13)

In Cyprus, FOSS is considering only 1 improved BM; “Local aggregation services for providing flexibility to grid operation including congestion management”. In this case, FOSS is analysing the benefits of being the aggregator and BRP for all the activities within a big university campus (the campus is fed from one single grid connection point). This includes DSM (Demand Side Management), local resources such as PV, storage, heat pumps and EV charging points.

However, as already briefly explained in D3.2 of the BestRES project, in Cyprus, TSOC (Transmission System Operator Cyprus) is operating the transmission grid and has the responsibility for operating the market as well. The electricity market is open in theory but market rules are not yet operational and the purpose is to have them operational by July 2019. [25] The Cyprus Regulatory Authority for Energy (CERA) however approved interim market rules in order to allow for bilateral contracts between new Independent Power Producers (IPPs) and prospective consumers.[26] However, all trading is happening without a working market as there is only one bidder on spot and reserve power markets (as explained in D3.1 of the BestRES project). Therefore, aggregators cannot yet be active on the markets and the improved business model cannot be implemented before July 2019.

Nevertheless, a first analysis of the potential for implementing this improved business model will be done in another Horizon 2020 running project, GOFLEX (results expected to be available by the beginning of 2019). In this project, the DSO has agreed to investigate the possibilities of valorising flexibility of a big aggregated end user like the University of Cyprus and to identify all possible benefits including cost reductions for the DSO. For this preliminary analysis, we are looking at existing tariffs and activation costs for providing ancillary services.

For this first preliminary analysis, we performed an analysis of how flexibility could, in the long run, be marketed to provide ancillary services in Cyprus. Recent available data sets (for the year 2017) show that the activation remuneration for such ancillary services is approximately EUR 6.7/MWh.[27]

Furthermore, as we do for several other aggregators within the BestRES project, we can estimate the activation cost of valorising the flexibility by using publicly available data (Figure 9).

[25] Cyprus Energy Regulatory Authority (CERA), Regulatory decision ΚΔΠ34/2017, May 2017, Available at: http://www.cera.org.cy/el-gr/apofasis/details/apofasi-84-2017
[26] Cyprus Energy Regulatory Authority (CERA), Regulatory decision 159/2017, August 2017, Available at: http://www.cera.org.cy/el-gr/apofasis/details/apofasi-159-2017
[27] Cyprus Energy Regulatory Authority (CERA), New tariffs as of 1st of September 2017

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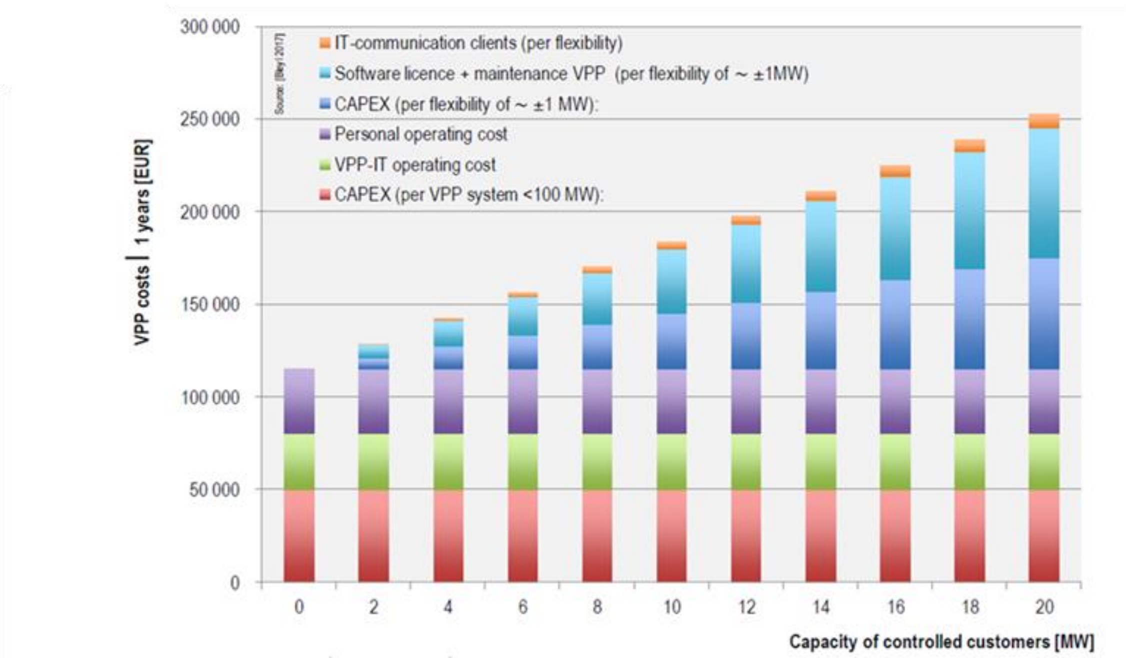

Figure 9: Economic appraisal of VPP use cases for Slovenia

According to this information, we can use a CAPEX cost of 50 000 EUR for setting up a VPP system (VPP system<100 MW), a CAPEX cost of 3000 EUR/MW of flexibility (technician and hardware at client, sales, marketing and drawing of contract), an OPEX cost of 65000 EUR per VPP system for VPP-IT and personal costs and an OPEX cost of approximately 4000 EUR per client per year. However, in this case, since only one structure will provide the flexibility, there is no need to set up a VPP plant. Therefore, considering the university campus can provide 1 MW of flexibility, we can estimate the cost at 7000 EUR per year.[28]

With a cost of 7000 EUR per year and a potential revenue of 6.7 EUR/MWh, the university campus would have to provide ancillary services around 1000 hours a year to make the business model feasible.

[28] The reference case for this analysis is a VPP system Slovenia as the GDP per capita for Slovenia and Cyprus are comparable
Hybrid VPP4DSO, Economic Appraisal of selected VPP Use Cases, June 2017, Available at: http://www.hybridvpp4dso.eu/upload/workshop_170609/hybrid-vpp4dso_workshop_economicevaluation.pdf

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4. Assessment of barriers for implementation of each improved business model

The objective of this part of the report is to assess if aggregators face barriers for implementing each improved BM. The results of D2.3 “Current market design of each consortium country; technical, regulatory and legal barriers for optimal deployment and operations of current BMs” are used as a starting point for this analysis. In addition, the consortium also included an assessment of social and other barriers.

4.1 Good Energy (United Kingdom)

4.1.1 Automation and control (BM1)

Table 15 provides an overview of the different barriers for implementation for this business model.

Table 15: Barriers for implementing the "Small-scale automation and flexibility" BM in the UK

Type of barrier	Element 1	Element 2	Element 3	Element 4	Element 5
Technical barriers	Issues with grid infrastructure	Lack of data access (smart meters, EV)/consumption profiles	Assessment of suitable vehicles/storage solutions and apps to be used		
Legal and regulatory barriers	Lack of stable grid charges	Data and privacy protection	TSO will change rules with respect to reserve power markets	Competing discussions around the need of smart charging for EVs (driven by TSO, DSO, OEM, charge point installers)	Market mechanisms and ancillary services require guaranteed flexibility
Social and other barriers	Making the BM economically viable so that third-party aggregators are interested to participate	Lack of interest of customers to participate/insufficient number of EV and storage systems	Competitors that are able to copy the business model and drive the prices further down		

A very important barrier for this improved BM is that, to source the flexibility, providers of flexibility would have to be equipped with smart grid infrastructure so that the data is available. If smart grid infrastructure exists, another problem is that a lot of existing grid protocols exist that are competing. An additional crucial challenge for the implementation is finding a third-party aggregator and an number of providers of flexibility high enough to provide the service.

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Furthermore, Ofgem (Office of Gas and Electricity Markets) recently decided to decrease network credits, called embedded benefits, for local generators that help to reduce specific transmission charges during peak times. This encourages small-scale generators significantly less to offer flexibility and is therefore a barrier for the implementation of this business model.[29]

Another crucial regulatory change is that the TSO (National Grid) is planning to drastically change the rules with respect to reserve power markets in the second half of 2017. The objective of National Grid is to simplify services as the number of balancing services has grown to more than 20 over time. They want to standardise contracts and improve market information. These changes create a lot of uncertainty on the market and are therefore considered to be a barrier. However, depending in the updates, these changes could also be an enabler in the long run.[30]

Good Energy finally highlighted that it is extremely difficult to estimate the acquisition and technology cost for such a BM. Therefore, some sensitivity analysis would be useful in the analysis in D3.2-D3.4 of the BestRES project.

4.2.2 Peer-to-peer energy matching (BM2)

Table 16 provides an overview of the different barriers for implementing the "P2P energy matching" BM.

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[29] Clean Energy News, Ofgem poised to enact drastic cuts to embedded benefits, March 2017, Available at: https://www.cleanenergynews.co.uk/news/solar/ofgem-poised-to-enact-drastic-cuts-to-embedded-benefits
Ofgem, Embedded Benefits: Consultation on CMP264 and CMP265 minded to decision and draft Impact Assessment, April 2017, Available at: https://www.ofgem.gov.uk/publications-and-updates/embedded-benefits-consultation-cmp264-and-cmp265-minded-decision-and-draft-impact-assessment
Ofgem, Targeted Charging Review: A consultation, May 2017, Available at: https://www.ofgem.gov.uk/publications-and-updates/targeted-charging-review-consultation
Ofgem, Embedded Benefits: Impact Assessment and Decision on industry proposals (CMP264 and CMP265) to change electricity transmission charging arrangements for Embedded Generators , June 2017, Available at https://www.ofgem.gov.uk/publications-and-updates/embedded-benefits-impact-assessment-and-decision-industry-proposals-cmp264-and-cmp265-change-electricity-transmission-charging-arrangements-embedded-generators
[30] National grid, Future of Balancing Services, Available at: http://www2.nationalgrid.com/UK/Services/Balancing-services/Future-of-balancing-services/
Clean Energy News, National Grid teases huge reforms to grid balancing services market, June 2017, Available at: https://www.cleanenergynews.co.uk/news/storage/national-grid-teases-huge-reforms-to-grid-balancing-services-market

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Table 16: Barriers for implementing the "P2P energy matching" BM in the UK

Type of barrier	Element 1	Element 2	Element 3	Element 4
Technical barriers	Issues with grid infrastructure	Lack of data access and quality/consumption profiles	High development and maintenance cost	Communication and data matching
Legal and regulatory barriers	No mechanism to promote local self-consumption	Lack of mechanisms that allow for the local settlement of generation and demand portfolios	Lack of mechanisms in the UK that allow for the local settlement of generation and demand portfolios	
Social and other barriers	Making the BM economically viable so that third-party aggregators are interested to participate	Insufficient number of potential clients who want to buy the electricity/who want to submit regular meter readings for a short period of time		

As for the “Small-scale automation and flexibility” BM, this model requires a larger-scale roll-out of smart meters and competing protocols are a problem. Other challenges are the high development cost to set up the communication towards households on the matching process.

According to Good Energy, with respect to legal and regulatory barriers, a first principal barrier is the lack of mechanisms to promote local self-consumption. In the United Kingdom, smaller generators get paid for their “deemed expert because the assumption is that they export 50% of produced power. As a consequence, the amount they export does not vary based on the amount the really self-consume so they are not encouraged to self-consume as much as possible.

A second important legal barrier is the lack of mechanisms that allow for the local settlement of generation and demand portfolios. Nowadays, benefits and charges are levied on energy suppliers based on their generation-to-demand ratios in each of the 14 supply groups at the national level (Figure 10). In this context, there are no mechanisms in place benefiting subregional generation and demand matching. This will however be a consideration within Ofgem’s Targeted Charging Review and, according to Good Energy, one which is important for implementation of reflective grid charging within the UK.

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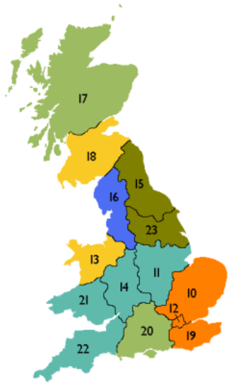

Figure 10: Supply groups in the United Kingdom[31]

Finally, there is also a need to research more if enough potential clients would be interested in the service. However, as explained before, Good Energy has a well-established base of highly-engaged customers.

4.2 Next Kraftwerke Germany (Germany)

4.2.1 Dispatch flexible generation under changing market design on multiple market (BM3)

Table 17 provides an overview of the different barriers for implementation of this improved business model.

Table 17: Barriers for implementing the "Dispatch flexible generation under changing market design on multiple market" BM in Germany

Type of barrier	Element 1	Element 2
Technical barriers	Expected decrease of market prices in Germany	High requirements regarding data processing and optimization algorithms
Legal and regulatory barriers	Not clear how exactly prequalifications for aFRR will change and it is only planned for 2018*	
Social and other barriers	High acquisition and marketing costs	Lack of interest of consumers to participate due to expected increase in workload and low incentives coming from markets

* Prequalifications were only published during the writing of this document[32]

According to Next Kraftwerke, a very important barrier for this improved business model is given by the decreasing prices on reserve power markets in

[31] Ofgem, The GB electricity distribution network, September 2013, Available at: https://www.ofgem.gov.uk/electricity/distribution-networks/gb-electricity-distribution-network

[32] Bundesnetzagentur, Bundesnetzagentur verbessert die Bedingungen zur Teilnahme an den Regelenergiemärkten Strom, 28 June 2017, Available at: https://www.bundesnetzagentur.de/SharedDocs/Pressemitteilungen/DE/2017/28062017_Regelenergie.html?nn=265778

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Germany. The lower prices are mainly due to increased competition because there are significantly more market participants. Figure 11 demonstrates the evolution of capacity prices on R2 in Germany over the period 2014-2016.

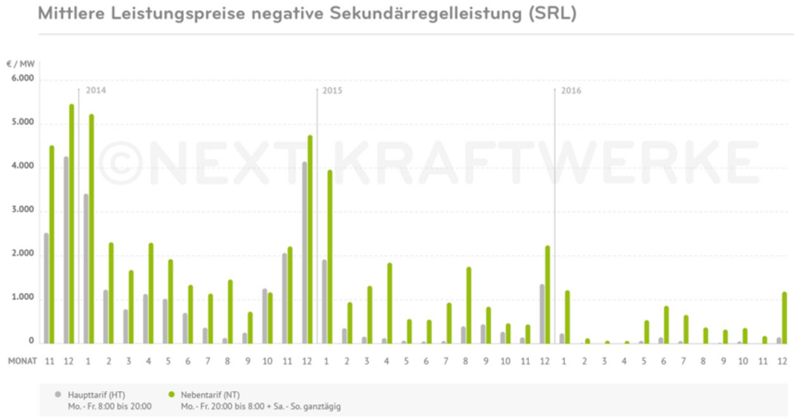

Figure 11: Evolution of the capacity remuneration R2 in Germany 2014-2016[33]

If availability periods (weekly to daily products) are decreased, market entry barriers will again be lowered and, therefore, prices could further drop. However, such a market design change would also be favourable if we consider the evolution of the structure of balancing service assets such as the shut–down of conventional power plants because renewables can provide the aFRR services. Significant opportunity costs could be avoided if the most cost-efficient assets would be providing balancing services and appropriate price signals for flexibility can be expected in the long term.

Finally, it could be very challenging to find new customers, as operators who run a plant with flexibility potential are not always well-informed about the potential of generating additional revenues. Such operators will for example need to understand the increased maintenance interventions and ramping down and starting up costs. Also, plant operators will not know on beforehand when exactly the schedule of a plant will change and how much they will earn. Next Kraftwerke will thus also have to manage these “expectations”. According to Next Kraftwerke, there are mainly two ways to overcome this. A first option is that prices would rise. A second option is to focus, as an aggregator, on the simplification of processes to operate biogas plants and to communicate in a transparent way with clients.

[33] Internal data Next Kraftwerke Germany

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4.2.2 Supplying "mid-scale" consumers with time variable tariffs including grid charges optimization (BM4)

Table 18 elaborates on the various barriers for implementation of this business model.

Table 18: Barriers for implementing the " Supplying "mid-scale" consumers with time variable tariffs including grid charges optimization " BM in Germany

Type of barrier	Element 1	Element 2	Element 3	Element 4
Technical barriers	Currently low spreads in the wholesale market	High complexity of the product	Uncertainty about future developments	
Legal and regulatory barriers	Grid tariffs incentivize steady consumption in many cases	Value of aggregation regarding grid charges is limited	Data and privacy protection	Fixed components dominate a relative high share of the end consumer price such as EEG-surcharge and taxes
Social and other barriers	Lack of interest of consumers to participate	High acquisition and marketing costs		

A very important barrier for this improved BM is that, to source the flexibility, providers of flexibility would have to be equipped with smart grid infrastructure so that the data is available. Besides, price spreads on intraday markets are relatively low in Germany as Figure 12 shows for the first half of the year 2017. Consequently, it might become more challenging to generate earnings with this business model in the coming years.

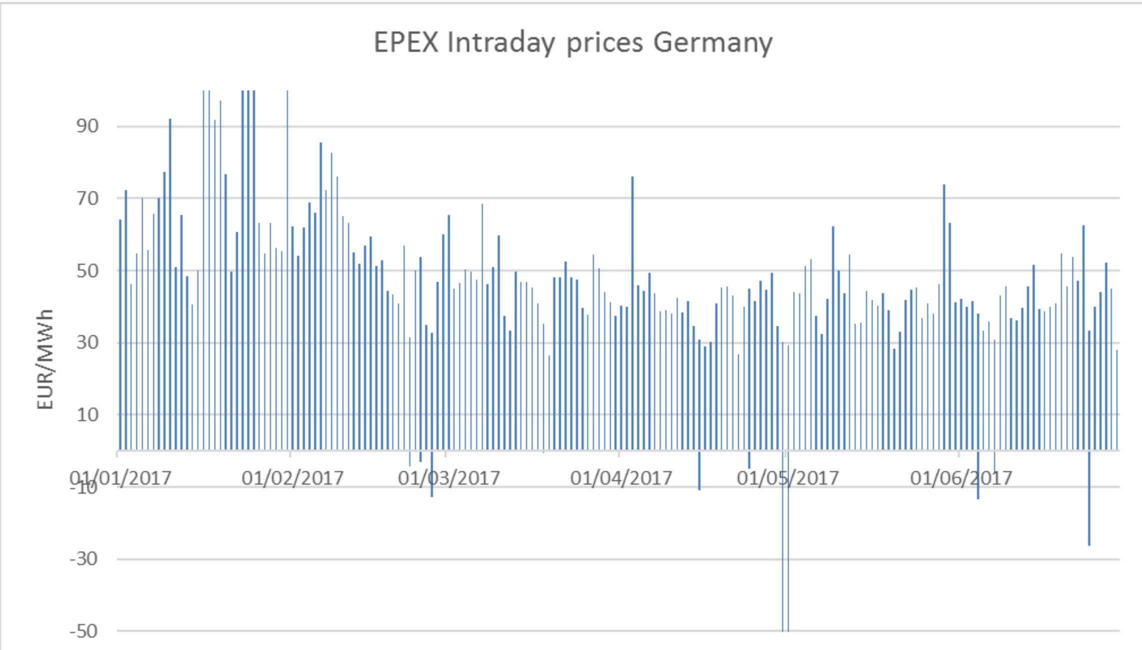

Figure 12: Price spread intraday market Germany Q1/Q2 2017

However, the German nuclear phase-out and an increase in distributed generation could be drivers for higher price spreads in the coming years.

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With respect to legal and regulatory barriers, grid tariffs are rather incentivizing steady consumption instead of flexibility. Consumers above 100 MWh yearly consumption are charged both an energy based fee as well as a yearly capacity fee. According to Next Kraftwerke, it would be beneficial if the Distribution System Operators (DSOs) would adapt the grid charges so that the actual market situation, consisting of many generators at DSO-level, is better reflected. It could for example be encouraged to consume electricity during peaks of solar production. In this case, a high peak-load should not be penalized as the electricity grid is benefiting from it. Therefore, smartly applied variable grid charges could reduce grid expansion cost and DSOs could benefit from aggregators providing signals to consumers.

Finally, this BM is quite complex to implement and therefore high acquisition and marketing costs are expected for customers to fully understand the business models.

4.3 Next Kraftwerke Germany (France)

4.3.1 Providing decentralized units access to balancing markets (BM5)

Table 19 provides an overview of the different barriers for implementation of this improved business model. We are focusing on aFRR as the analysis shows that Next Kraftwerke's business on this market is economically viable while this is not the case for mFRR.

Table 19: Barriers for implementing the "Providing decentral units access to aFRR" BM in France

Type of barrier	Element 1	Element 2	Element 3	Element 4
Technical barriers	Availability hydro plants and other assets difficult to estimate: Impact on run-of-river hydro due to icing and melting	Time and costs to modify VPP for pro rata activation	Expected decrease of prices for capacity remuneration on aFRR when market is opened	
Legal and regulatory barriers	Obligation of conventional power plants to offer reserve power	Pro rata activation instead of merit order on aFRR	Symmetrical products on primary market for aFRR	RTE does not accept mixed offers of pooled generation and demand-side assets
Social and other barriers	Conventional power plant owners have market power	High acquisition and marketing costs	A lot of competition to source hydro projects in the portfolio	

As Table 19 underlines, many important barriers in France are related to the law and regulation. One key element is that all generators in France who own generation assets of more than 120 MW are obliged to participate on aFRR

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(obliged providers).[34] A list of these obliged providers was provided earlier in this document.[35] However, the obliged providers can trade their obligations on a secondary market.

The total market need on aFRR is generally between 500MW and 1180MW and volumes of these large-scale generators will be activated pro-rata so all bids are activated in/proportional with the bid size. 36 Since Next Kraftwerke is developing a portfolio of controllable renewable generation assets, these are disadvantages due to the market power of conventional power plant operators and because pro rata activation hinders to bid with diverging activation costs of new flexibility options. For instance, an emergency generator has cheap availability costs and high activation costs. In this case the pro rata activation would be way too costly. If merit order activation would be applied, it could be argued that a more cost-efficient market with heterogeneous providers can be expected. If Next Kraftwerke would like to enter aFRR, the company would have to get an obligation from one of the obliged providers and get a certification from RTE, the French TSO, to offer the aFRR.

Furthermore, RTE does not accept mixed offers so bids should include (aggregated) generation only or aggregated demand only and demand response and generation cannot be mixed into a single VPP offer. This can potentially limit the activities of Next Kraftwerke since pooling of demand side and generation assets could enable aggregators to bid symmetrical.

On the technical level, one major challenge for Next Kraftwerke is to estimate, in an accurate way, the availability of the hydro assets and to modify the existing VPP, used for aggregation in countries such as Germany, Austria, and Belgium. Furthermore, because the company needs to go through the secondary market (D3.1 of the BestRES project), it might be difficult to find conventional generators that are willing to sell their obligation. Next Kraftwerke is also a new player on the market, so acquisition and marketing costs could be high. Finally, there might be a lot of competition from other aggregators to source similar assets in the portfolio since Demand-Side aggregation is relatively mature in France and direct marketing activities are operated by several other companies.

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[34] SEDC, Explicit demand Response in Europe, mapping the Markets 2017, April 2017, Available at: http://www.smartenergydemand.eu/wp-content/uploads/2017/04/SEDC-Explicit-Demand-Response-in-Europe-Mapping-the-Markets-2017.pdf
Commission de Régulation de l'Energie (CRE), Services système et mécanisme d'ajustement, Available at : http://www.cre.fr/reseaux/reseaux-publics-d-electricite/services-systeme-et-mecanisme-d-ajustement
[35] http://clients.rte-france.com/lang/fr/include/data/services_clients/telecharge/Liste_Responsables_Reserve.pdf
[36] Commission de Régulation de l'Energie CRE), Services système et mécanisme d'ajustement, Available at :
RTE, Services système, Available at : http://clients.rte-france.com/lang/fr/clients_producteurs/services_clients/services_systeme.jsp

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4.4 Next Kraftwerke Germany (Italy)

4.4.1 Market renewables on multiple market places (BM6)

Table 20 elaborates on the barriers for implementation of this improved business model.

Table 20: Barriers for implementing the " BM Market renewables on the MSD market in Italy

Type of barrier	Element 1	Element 2	Element 3
Technical barriers	Pooling is restricted to certain areas	Minimum capacity for participation to pilot projects 5 MW (aggregated capacity) and to existing market 10 MW (production units)	No negative prices for downward activation (MSD market and tertiary reserve)
Legal and regulatory barriers	Only in pilot phase	Providing aFRR not possible during pilot phase	Uncertainty about compatibility of subsidies and MSD Market participation
Social and other barriers	Many plant operators stick to GSE instead of taking market risks/opportunities due to uncertainty	Still many PPAs between generators and GSE	

As described in D3.1 of the BestRES project, participation on the MSD market is currently limited to production units > 10 MVA whereas participation to the pilot projects is restricted to aggregated capacity > 5 MVA. A market design update is however foreseen to open the market for aggregators but only information on the market design of the pilots is available at the writing of this document. This new market design however requires market participants to comply with certain requirements that can be considered barriers for implementation of the business model. Aggregation of units is restricted locally and, therefore, the minimum bid sizes might be difficult to achieve. In this context, aggregators cannot pool units across these different regions. In total, there are 15 regions defined by Terna as Figure 13 provides an overview of these different regions.

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PERIMETRI DI AGGREGAZIONE DI CUI AL PARAGRAFO 2.2 LETTERA A) DEL REGOLAMENTO MSD

1 –NOV_TO	**3 – NOV_BS**	**5-NES_VE**	**7-TIR_CZ**	**9-SICI_PA**	**10-TIR_RM**	**13-ADR_AN**	**15-SARD_CA**
AOSTA	**BERGAMO**	**BELLUNO**	**COSENZA**	**AGRIGENTO**	**L'AQUILA**	**ANCONA**	**CAGLIARI**
BIELLA	BRESCIA	BOLZANO	CROTONE	CALTANISSETTA	LATINA	ASCOLI PICENO	MEDIO CAMPIDANO
NOVARA	MANTOVA	GORIZIA	MATERA	ENNA	RIETI	MACERATA	CARBONIA-IGLESIAS
TORINO	**4- NOV_MI**	PADOVA	POTENZA	PALERMO	ROMA	PERUGIA	NUORO
VERBANO-CUSIO-OSSOLA	COMO	PORDENONE	TARANTO	TRAPANI	VITERBO	PESARO URBINO	ORISTANO
VERCELLI	CREMONA	ROVIGO	CATANZARO	CATANIA	**11-TIR_NA**	FERMO	OGLIASTRA
2 NOV_GE	LECCO	TRENTO	REGGIO C.	MESSINA	AVELLINO	**14-TIR_FI**	SASSARI
ALESSANDRIA	LODI	TREVISO	VIBO VALENTIA	RAGUSA	BENEVENTO	AREZZO	OLBIA TEMPIO
ASTI	**MILANO**	TRIESTE	**8-ADR_BA**	SIRACUSA	CASERTA	FIRENZE	
CUNEO	PAVIA	UDINE	BARI		FROSINONE	GROSSETO	
GENOVA	SONDRIO	VENEZIA	BARLETTA-ANDRIA-TRANI		NAPOLI	LIVORNO	
IMPERIA	VARESE	VERONA	BRINDISI		SALERNO	PISTOIA	
	MONZA E DELLA						
LA SPEZIA	BRIANZA	VICENZA	CAMPOBASSO		**12-ADR_PE**	PRATO	
SAVONA		**6-NES_BO**	FOGGIA		CHIETI	SIENA	
		BOLOGNA	ISERNIA		PESCARA	TERNI	
		FERRARA	LECCE		TERAMO	LUCCA	
		FORLI'-CESENA				MASSA CARRARA	
		MODENA				PISA	
		PARMA					
		PIACENZA					
		RAVENNA					
		REGGIO					
		EMILIA					
		RIMINI					

Figure 13: 15 regions for aggregation in the pilot phase for market design related to ancillary services in Italy[37]

For further improving market integration and implementing this business model, it should be considered to revise certain requirements regarding the future design of the ancillary services market. It could be beneficial to extend the local perimeters (or areas) in which aggregation is allowed so that minimum bid sizes can be achieved more easily. Besides, the authorities should consider lowering the limits for participation in terms of decreased minimum capacity for participation in specific areas. Furthermore, in the future, it should also be possible to provide aFRR with aggregated units, which is not covered in the pilot phase. However, since aggregation is tested during the pilot project, it is understandable that Terna start with a limited number of products.[38]

Finally, negative prices for ramping down activities should be investigated since it is the only way to enable participation of renewable generation. Renewables, without considering storage potential, generally generate earnings from downward activations to cover up for missed wholesale market earnings.

Despite the presence of these barriers, there are also favourable conditions for renewable aggregators implemented in the pilot phase such as the legal possibility for fluctuating renewables to participate on the MSD-market. Looking at the new market design, aggregated renewable generation units, which offer balancing/dispatching services to the grid, increase market efficiency, foster market integration of RES and support the electricity system in the transformation process towards less conventional baseload plants.

[37] http://download.terna.it/terna/0000/0930/32.PDF

[38] TERNA, Progetto pilota sulla partecipazione della generazione distribuita al MSD ai sensi della delibera 300/2017/R/eel, 19 July 2017, Available at : http://download.terna.it/terna/0000/0961/90.PDF

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Therefore, it is crucial to set a clear framework regarding the impact of flexibility activation and granting subsidies.

4.5 Next Kraftwerke Belgium (Belgium)

4.5.1 Trading PV and wind power (BM7)

Table 21 provides an overview of the different barriers for implementation of this improved business model.

Table 21: Barriers for implementing the " Trading PV and wind power " BM in Belgium

Type of barrier	Element 1	Element 2	Element 3
Technical barriers	Adaptation of the VPP to the Belgian market	Volume of renewable generators looking for a contract could be limited	Long-term PPAs require hedging on forward markets
Legal and regulatory barriers	System green certificates is complex and changing quickly	The validation of certificates happens with long delays and thus can result in negative cash flows if certificates need to be prefinanced.	
Social and other barriers	Competitors that are able to copy the business model or offer lower prices	Opposition against wind projects	

Next Kraftwerke Belgium must first contract PPAs (Power Purchase Agreements) with generators. Most existing generators are already under long-term PPAs so the company will mainly target new projects but the volume of such projects is limited. Furthermore, there is a significant number of projects that is challenged and, in such cases, project development is delayed. For example, in Wallonia (southern part of Belgium), 392MW of wind projects is currently being challenged by opponents against wind power.[39] If Next Kraftwerke Belgium manages to contract long-term PPAs, the company would finally have to hedge such contracts on forward markets. Next Kraftwerke is already actively approaching wind and PV project owners to identify them and notify them about their interest to bid in the next PPA tender.

In deliverables D2.1 and D3.1 of the BestRES project, the consortium elaborated on the green certificate system in Belgium. The complexity lies in the fact that 3 different green certificate subsystems exist for the 3 regions (Flanders, Wallonia, and Brussels region) in the country. Each of these systems is characterised by different awards mechanisms, payment conditions and market prices which makes it complex to set up standardised contracts. Furthermore, it is very challenging to forecast certificate prices in the mid- to long-term. A last important barrier related to the green certificates is that there are important delays in payment of the green certificates (Wallonia 120 days, Flanders 6

[39] APERE, Situation de l'éolien en Région wallonne au 31/12/2016, 2017, Available at : http://www.apere.org/sites/default/files/170112_liste_projets_publics.pdf

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weeks).[40] As a consequence, Next Kraftwerke might have to pay generators for the green certificates immediately whereas Next Kraftwerke would potentially only receive the payment from the grid operators' months afterwards.

Finally, price competition will be an important aspect for implementing this business model. However, Next Kraftwerke, through its mother company in Germany, has a significant experience as a trader. Weather-dependant forecasts and actual production always differ even for the very short term markets. Therefore, the VPP and the trading floor process a variety of different forecasts and real-time data for the production of contracted assets but also all other assets in the market. Furthermore, the market development is anticipated for the day-ahead and intraday market and imbalance prices. These are updated continuously giving insight on the development of the own position and the value of this position on the market. Next Kraftwerke has a key strength in this short-term trading and therefore considers itself in a perfect position to enter the market for weather dependent renewables in Belgium

4.5.2 Using flexibility of customers as third party (BM8)

In this improved business model, the potential of using flexibility from third-party customers is exploited. In D3.1 of the BestRES project, we have already shown that aggregators are aiming to market flexibility directly on intraday, day-ahead and reserve power markets and to use it for balancing. Table 22 however elaborates on the various barriers for implementing the "Using flexibility of customers as third party" BM.

Table 22: Barriers for implementing the " Using flexibility of customers as third party" BM in Belgium

Type of barrier	Element 1	Element 2	Element 3	Element 4
Technical barriers	Lack of smart grid infrastructure on the client side	Additional costs for marketing and compensating market actors can be high		
Legal and regulatory barriers	The current BRP needs to give his consent – with a few exceptions for some reserve power products- and a price for activating the volume needs to be agreed on	Contractual definition of legal persons obliged charged with costs related to flexibility not defined	Not all reserve power products are open for demand, pools and DSO connected units	Data and privacy protection
Social and other barriers	Risk that the Supplier/BRP approaches client to deliver the service himself	Lack of interest of customers to participate		

A very important barrier for this improved BM is that the number of clients that can participate is already limited to AMR metered clients. For all other clients, the standard load profile system would at least prohibit to valorise the flexibility

[40] VREG, http://www.vreg.be/nl/uw-netbeheerder-betaalt, Available at: http://www.vreg.be/nl/uw-netbeheerder-betaalt
Cwape, Vente des certificats verts (CV), Available at : http://www.cwape.be/?dir=6.1.08
Elia, Date de réception des demandes de paiement des certificats verts wallons, Available at : http://www.elia.be/fr/produits-et-services/certificats-verts/date-de-reception

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on the electricity market. For reserve power products, however, they would still be a candidate, if the production is submetered with a meter certified by the DSO/TSO.

On the legal and regulatory side, the BRP needs to give his consent for Next Kraftwerke Belgium to implement the described activities for almost all possible products apart from primary reserve and some unique tertiary reserve products. Thus, it is today not possible to bring the flexibility of a client to the short-term markets if no bilateral agreement with the BRP is signed. Next Kraftwerke does not question this overall rule as it is also important that the supplier and BRP relationship is protected, but it is clearly a general limit to the discussed business model. An example: you cannot just activate upward power e.g. by demand response at an industry site as the positive power is going into the suppliers metering data and the BRP's imbalance. To do so you would need to have an agreement with the BRP to transfer the activated energy volumes to your own BRP and potentially reimburse the supplier for the not-supplied energy. This is also the reason Next Kraftwerke, in parallel to the development of this business model, became BRP and supplier in Belgium to also follow the classic approach to valorise flexibility in their own BRP.

Furthermore, several reserve power products cannot be offered with load processes, pools of smaller units or DSO connected units. An example: The framework for secondary reserve in Belgium does today only allow the provision by large CCGTs (Combined Cycle Gas Turbines).

For avoiding too high costs for marketing and compensating market actors, Next Kraftwerke is targeting mid- and large-scale customers with typical flexible processes for demand response services such as flexible production and demand in chemicals, metal-processing, paper industry, industry with back-up diesel gensets, water treatment, cold stores, etc… The potential for offering flexibility in such processes in Belgium is for example being demonstrated in the ongoing project InduStore.[41]

In addition to these barriers, since Next Kraftwerke is in this business model targeting providers of flexibility that already have a supplier contract with another energy supplier, there is a realistic risk that the BRP/supplier will offer the same type of services in the medium-to long term.

[41] InduStore, Gestion optimisée des moyens de flexibilité, de stockage et de production des sites industriels, April 2017, Available: http://docs.wixstatic.com/ugd/ed4e66_8b8005966b4845bd9e3643116dc170e3.pdf

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4.6 oekostrom (Austria)

4.6.1 Demand side flexibilization of small customers (BM9)

Table 23 provides an overview of the different barriers for implementation of this improved business model.

Table 23: Barriers for implementing the "Demand side flexibilization of small customers " BM in Austria

Type of barrier	Element 1	Element 2	Element 3
Technical barriers	Issues with grid infrastructure	Assessment of suitable solutions and apps to be used	Clearing of small customers with the actual load profile
Legal and regulatory barriers	Data and privacy protection	Data exchange/collaboration with DSOs	
Social and other barriers	Lack of interest of customers to participate	Competitors that can copy the business model and drive the prices further down	

A very important barrier for this improved BM is that, to offer the product, customers would have to be equipped with smart grid infrastructure so that the data is available. Currently, an estimated 5-10 % of all metering points have been equipped with smart meters whilst the aim was to reach 70% by the end of the year 2017. By 2020 80% of all customers are to be equipped with smart meters.[42] Smart meter roll-out is a task of the DSOs, so for the moment only those customers with existing smart meters are potential customers for this improved BM.

Furthermore, during the interviews, Oekostrom accentuated that data and privacy protection could be issues. Customers must agree explicitly to the reading of the 15-minute time interval- values or have an electricity contract that requires this time resolution. The values will be passed from the DSOs to the suppliers. Many small DSOs in some parts of the country make it a challenging task to establish data exchange interfaces and processes with all of them.[43] Another issue is the use of standard profiles that do not consider the load shift of the small customers. Such profiles are used for clearing even if smart devices are installed.

Also, there are concerns that it might become a challenge to find enough potential customers, since there is no practical experience with shifting flexibility among small consumers. oekostrom however has the benefit of having a very large customer base of over 50.000 customers so they will target the most loyal customers within this group of existing customers. Furthermore, some of

[42] https://www.e-control.at/konsumenten/energie-sparen/smart-metering

[43] https://www.ris.bka.gv.at/GeltendeFassung.wxe?Abfrage=Bundesnormen&Gesetzesnummer=20007045

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these customers are expected to be attracted by the flexible tariff and shift loads for power-to-heat and cooling services, charging of electronic vehicles etc. Considering the smart meter device as a technical restriction, oekostrom expects around 1.000 customers to be potentially interested in the BM. Currently there is only one competitor offering a time of use-tariff in the Austrian market. However, an increasing number of competitors offering this type of tariff can intensify competition in the future and put pressure on prices.

4.6.2 Valorise distributed generation of customers in apartment houses (BM10)

In the case of this improved business model, the huge potential of installing PV systems in multi-apartment houses is exploited. In D3.1 of the BestRES project, we illustrated that such self-consumption is encouraged since network tariffs can be avoided. Table 24 however elaborates on the various barriers for implementing the "Valorise distributed generation of customers in apartment houses" BM.

Table 24: Barriers for implementing the " Valorise distributed generation of customers in apartment houses " BM in Austria

Type of barrier	Element 1	Element 2	Element 3
Technical barriers	Issues with grid infrastructure	Assessment of suitable solutions and apps to be used	Capital-intensive business so more collaboration with financiers, manufacturers and contractors needed
Legal and regulatory barriers	Details of new law that was passed in July 2017 need to be defined	Data and privacy protection	Difficulties to work with DSO
Social and other barriers	Lack of interest of customers to participate	Difficulty to come to agreement on split up electricity within multi-apartment block	Challenge to collaborate with a new sector: the real-estate sector

The most important barrier for the implementation of this business model is on the legal and regulatory side as the implementation is not allowed by the law at this moment. The construction of decentralized renewable plants in apartment blocks requires an agreement amongst all participants which is harder to achieve the more parties are involved in a project. Moreover, the current legal situation does not allow auto-consumption by multiple parties in apartment blocks. The produced energy needs to be put on the grid and to be consumed from the grid. A new law, that was passed in July 2017, allows for a model where consumption of the PV production from the roof is voluntary (not all parties of the block need to take part) and energy and costs are split and billed, based on measured smart meter data amongst the parties taking part. The excess production is put on the grid and cleared in the balancing group of the contracted supplier.[44] However, a more detailed regulation is not yet defined and published.[45]

[44] https://www.parlament.gv.at/PAKT/PR/JAHR_2017/PK0268/
https://www.parlament.gv.at/PAKT/VHG/XXV/I/I_01519/fname_618840.pdf
[45] https://www.parlament.gv.at/PAKT/VHG/XXV/I/I_01519/index.shtml

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Furthermore, as for BM1, the model requires a large-scale roll-out of smart meters. For this business model, only apartment blocks equipped with both smart metering devices and a PV installation are possible customers to be targeted. Since investing in PV systems is a capital-intensive business, oekostrom will also have to collaborate with different market actors such as financiers, manufacturers and contractors. In a first step, the company is working on collaborations with the real estate sector where PV projects are developed and maintained. oekostrom will focus on acquisition and marketing of the PV production and on further client acquisition.

Besides, other challenges are the high development costs to set up the communication towards households. The details of this matching process are not completely defined yet. A dynamic solution that distributes the actual production in the same proportion as the actual consumption of all involved parties for every 15 minutes-time period is currently the preferred option. Possibly the DSOs will have the key role for the calculations and communication to the supplier. Data and privacy protection is also an issue, as for BM1. Observation during the project showed that concerns among customers about their personal data being collected are important.

Apart from all these barriers, according to oekostrom, the main challenge for the implementation of the business model will probably be the customer acquisition. Since oekostrom has no experience in this field yet, it must join forces with some well-established real-estate development and property management companies to get the business model on track.

4.7 EDP (Portugal and Spain)

4.7.1 Activation and marketing of end user's flexibility (BM11 and BM12)

The barriers for implementation of both improved business models in Spain and Portugal are very comparable. Therefore, to make the document as readable as possible, the consortium summarized those barriers in one table (Table 25).

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Table 25: Barriers for implementing both improved BMs in Portugal and Spain

Type of barrier	Element 1	Element 2	Element 3	Element 4
Technical barriers	Issues with grid infrastructure	Assessment of suitable solutions and apps to be used	Limited number of clients will be able to provide flexibility without cost-impact on business	Price forecast errors will occur
Legal and regulatory barriers	Data and privacy protection			
Social and other barriers	Lack of interest of customers to participate	Suppliers or competitors who will offer services themselves	Customers that valorise flexibility on the market themselves (very large-scale customers)	Difficult or expensive to find a good forecast provider

A very important barrier for this improved BM is that, to source the flexibility, providers of flexibility would have to be equipped with smart grid infrastructure so that the data is available. If smart grid infrastructure exists, another problem is that a lot of existing grid protocols that are competing.

Another determining barrier for the implementation is that there is only a limited number of clients that will be able to provide flexibility without cost-impact on the business. This will be a more important barrier for BM1 where loads are shifted over many hours compared to BM1 where the load is increased or decreased for a very short period. According to EDP, a good example of a process where loads can be shifted, is cooling. EDP however has a very large number of clients from different industries such as metallurgy, the food industry, the chemical industry and the automobile industry so the potential for offering flexibility of each client should be further investigated.

For this analysis, we finally assumed that EDP is able to forecast the cost and directions of deficit and excess deviations for each hour. With this information and the measurement of its clients' portfolio imbalance in real-time, EDP will be able to decide if it's profitable to activate the flexibility or not, based on the penalty cost compared to the activation cost. Therefore, finding a good forecasting provider who works with the most advances forecasting tools will be key for the implementation of this business model. EDP is currently analysing how they are going to organise this forecasting.

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4.8 FOSS (Cyprus)

4.8.1 Pooling flexibility for local balancing market and energy service provision (BM13)

Table 26 provides an overview of the different barriers for implementation of the improved business model.

Table 26: Barriers for implementing the "Local aggregation services for providing flexibility to grid operation including congestion management" BM in Cyprus

Type of barrier	Element 1	Element 2	Element 3	Element 4
Technical barriers	Issues with grid infrastructure	Lack of data access (smart meters, EV)/consumption profiles	Assessment of suitable vehicles/storage solutions and apps to be used	No need for the service on the side of the DSO
Legal and regulatory barriers	No framework for aggregation	No framework for grid services	Data and privacy protection	No framework for installation and use of storage
Social and other barriers	No competitors on the market to create a market that works	Costs of VPP system could be high for a relatively small system		

On 1st July 2019, when market players could potentially enter the market, an important barrier will be that there is no framework for aggregators and offering grid services (frequency control) including the implied demand response through the aggregated flexibilities. Cyprus could learn from the best practices in other countries, also described in the different deliverables in this project, to set up an appropriate framework.

As for other improved business models within the BestRES project, another obstacle for implementation is that, to source the flexibility, providers of flexibility on the university campus would have to be equipped with smart grid infrastructure so that the data is available. In the same context, the most suitable technologies and applications will have to be assessed by FOSS. However, as highlighted by FOSS, soon, the university will be connected through broad band connection including required sensors, smart meters and an energy management system for managing a solar storage system. If market rules are updated, FOSS should therefore be able to offer the service.

Finally, it is key to highlight that the costs of the Virtual Power Plant (VPP) could be high for a relatively small system. However, it might not be needed to set up such a VPP at the start of the project as explained before.

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5. Business model selection

In section 3 and 4 of this report, the consortium elaborated on the details of the economic and barriers analysis of each of the improved BMs. Table 27 provides an overview of this assessment that is used to allocate business models. Our analysis is split between aggregators and summarizes the feasibility of each of the analysed business models.

Table 27: Assessment of the economics of and barriers for implementation of the improved BMs in the 9 target countries

Good Energy United Kingdom	**1. Automation and control (BM1)** • BM economically feasible • No substantial legal, social and technical barriers	Group 1 BM
	2. “Peer-to-peer” energy matching (BM2) • Economic assessment very challenging but BM could be feasible • Significant legal and regulatory barriers exist such as the absence of a framework for the local settlement of generation and demand portfolios	Group 3 BM
NEXT KRAFTWERKE Germany	**1. Dispatch flexible generation on multiple market places under changing market design (BM3)** • BM economically feasible • Favourable market design only to be implemented in 2018 when it will be clear how the prequalification criteria on aFRR change	Group 2 BM
	2. Supplying "mid-scale” customers with time variable tariffs including grid charges optimization (BM4) • Economic assessment very challenging but BM could be feasible • No substantial legal, social and technical barriers	Group 1 BM

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NEXT KRAFTWERKE France	**1. Providing decentralized units access to aFRR (BM5)** • BM economically feasible • Important regulatory barriers exist such as 1) the obligation for conventional power plants to offer reserve power, 2) pro rata activation (instead of merit order) and 3) symmetrical products requirement	Group 3 BM
NEXT KRAFTWERKE Italy	**1. Market renewables on multiple market (BM6)** • BM economically feasible • Although only pilots related to the new market design for reserve power markets are running, Next Kraftwerke considers existing barriers manageable for the BM to be implemented in the short term	Group 1 BM
NEXT KRAFTWERKE Belgium	**1. Trading PV and wind power (BM7)** • BM economically feasible • No substantial legal, social and technical barriers **2. Using flexibility of customers as third party (BM8)** • BM economically feasible • No substantial legal, social and technical barriers	Group 1 BM Group 1 BM
oekostrom AG Austria	**1. Demand Side flexibilization of small customers (BM9)** • BM economically feasible • No substantial legal, social and technical barriers **2. Invest and market distributed generation of customers in apartment houses (BM10)** • BM economically feasible	Group 1 BM

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	• Until mid-2017, regulation did not allow for auto-consumption by multiple parties in apartment blocks. A new law was passed in July 2017 but the details of the implementation of the law needs to be passed	Group 2 BM
Portugal	**1. Activation and marketing of end user's flexibility (BM11)** • Economic assessment very challenging but BM could be feasible as imbalance tariffs are relatively high and an important subsidy is available for implementing the BM • No substantial legal, social and technical barriers	Group 1 BM
Spain	**1. Activation and marketing of end user's flexibility (BM12)** • Economic assessment very challenging but BM probably not feasible because imbalance tariffs are relatively low and subsidy is not available • No substantial legal, social and technical barriers	Group 3 BM
Cyprus	**1. Pooling flexibility for local balancing market and energy service provision (BM13)** • Economic assessment very challenging but BM could be feasible • Very important regulatory barriers as the market will be open for aggregators the earliest by 2019	Group 3 BM

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6. Conclusions

The objective of this report was to decide if identified improved BMs of aggregators in each of the target countries should be allocated to group 1 (economic BMs ready for implementation), group 2 (BMs that are economically viable but face barriers that prevent direct implementation) or group 3 (BMs that are not economically viable or face substantial barriers). The result is summarized in Table 27. Hereunder, we summarise some of the principal observations drawn from our analysis.

6.1 Approximately half of the analysed improved business models is ready for implementation (group 1 BM)

As Table 27 illustrates, a wide variety of improved BMs is implemented. The consortium identified that, as of writing of this document, 7 out of the 13 analysed improved BMs are ready for implementation (Group 1). 2 improved BMs are allocated to group 2 (BMs that are economically viable but face barriers that prevent direct implementation) whereas 4 improved BMs are allocated to group 3 (BMs that are not economically viable or face substantial barriers).

6.2 A Wide variety of BMs ready for implementation is to be found

BMs ready for implementation (group 1) are to be found in the United Kingdom, Austria, Germany, Italy, Belgium and Portugal. The BMs "Demand Side flexibilization of small customers" from Oekostrom (Austria) and "Automation and control" from Good Energy (UK) are very comparable. In both cases, the aggregator manages to decrease sourcing costs whereas costs to end customers (and turnover), small-scale providers of flexibility, also go down. In Germany, revenues can be optimized by Next Kraftwerke by optimizing capacity tariffs and individual network tariffs. In both Italy and Belgium, an improved BM of Next Kraftwerke is to valorise flexibility on reserve power markets by generating revenues through capacity and activation fees. Next Kraftwerke, with another improved BM, also focuses on trading weather dependent renewable such as PV and wind on spot markets in Belgium. Finally, in Portugal, the market design does not allow for aggregation but EDP can use flexibility from loads to decrease imbalance penalties of their own portfolio.

6.3 If BMs are not ready for implementation, this is mainly due to legal and regulatory barriers

Our research clearly illustrates that, if improved BMs are not ready for implementation, this is mainly due to regulation that is not appropriate. For the

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group 2 BMs ("Invest and market distributed generation of customers in apartment houses BM" in Austria and "Dispatch flexible generation on multiple market places under changing market design BM" in Germany), this is because the market design is changing with details that are not yet clear enough. For the group 3 BMs, the issue is in most of the cases that the market design changes are not at all ongoing or only planned far in the future (Cyprus, France, UK (BM2)). Only in the case of Spain, the main issue is that prices (imbalance tariffs) are too low for generating enough revenues to cover for the costs.

6.4 Targeting the right providers of flexibility and providing appropriate support actions will be key for the success of the implementation of the BMs

It was generally mentioned by aggregators that it will be very important to attract a number of providers of flexibility high enough so that sufficient revenues can be generated to cover for the costs. In order to target the right providers of flexibility and to approach them in the best manner, support will be provided to aggregators in D4.2 "Documentation of pilot business model implementation and results" of the BestRES project: the consortium will perform market research studies on time-of use tariffs for small-scale customers (Oekostrom (Austria)), grid tariffs (Next Kraftwerke (Germany)) and investors and owners of renewable energy plants (Next Kraftwerke (Italy)), develop a questionnaire for Good Energy (UK), help Next Kraftwerke Belgium to understand the impact of the system of certificates on their businesses and support EDP to improve the load forecasting techniques (Portugal).

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Technical References

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* 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	Authors
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