BestRES

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

# Lessons Learnt and Best Practices


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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

This report has been written by Simon De Clercq (3E) and Carlos Guerrero Lucendo (3E). The authors thankfully acknowledge the valuable contributions from the co-authors and reviewers to complete this report.

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# List of Abbreviations

| | |
|---|---|
| aFRR | automatic Frequency Restoration Reserve |
| B2B | Business-to-business |
| BM | Business Model |
| BRP | Balance Responsible Party |
| CHP | Combined Heat and Power |
| DSO | Distribution System Operator |
| EAN | Electricity Access Point |
| FCR | Frequency Containment Reserve |
| KPI | Key Performance Indicator |
| KDP | Key Market Design Parameters |
| kW | Kilowatt |
| kWh | Kilowatt hour |
| MW | Megawatt |
| MWh | Megawatt hour |
| n.a. | Not applicable |
| NKW BE | Next Kraftwerke Belgium |
| NKW DE | Next Kraftwerke Germany |
| PPA | Power Purchase Agreement |
| R1 | See FCR |
| R2 | See aFRR |
| R3 | manual Frequency Restoration Reserve |
| RES | Renewable Energy Source |
| REST | Representational State Transfer |
| ToE | Transfer of Energy |
| TSO | Transmission System Operator |
| UK | United Kingdom |

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# Executive summary

In electricity systems and markets under transition towards carbon neutrality, where the share of variable renewable energy sources is increasing, system flexibility is crucial. As part of the solution, the aggregation of renewable energy can significantly accelerate the integration of variable 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 an earlier phase, eight aggregation business models (BMs) were implemented by five aggregators in six different regulatory environments in Europe. In the BestRES report “Monitoring and Performance Evaluation of the Real-life Pilot Projects”[1], the implementation of each of these business models is monitored and evaluated over an 18-month implementation period. The implementation was documented through implementation KPIs and qualitative reporting of the aggregators’ implementation activities.

The objective of this report is to summarise the results from the implementation activities to formulate a set of best practices and lessons learnt. The patterns that emerge across the individual aggregator results are captured and used to formulate recommendations that can be extended and applied to the wider aggregation sector. These consider both practical and tactical considerations.

### Good Energy in the UK

In the implementation of its *Automation and Control* BM, Good Energy provided a selected group of customers with a home energy management device called Verv, developed by Green Running. Through this device and its coupled mobile application, customers can live-monitor the consumption of different appliances in their home and react to unique signals and infographics.

The following best practices and lessons learnt are based on the implementation experiences of this BM.

*Personal outreach and flexible contact with the participants through mail and phone improved their engagement with the home energy management tool.*

*Choice for a technology solution that is independent of the supplier gives customers the freedom to easily opt out of the trial.*

*The combination of economic rationale (save money on electricity bill) with green values (decarbonising the UK) is a stronger value proposition than the monetary benefit only.*

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*Avoiding negative customer experiences is the most important with do-it-yourself product set-up and installation of home energy management tool.*

*Under the current structure of electricity retail markets, the economic benefits of installing a home energy management device are not high enough to induce significant shifts in electricity consumption.*

NEXT
KRAFTWERKE

## Next Kraftwerke Germany in Germany.

The implementation of the business model *Supplying mid-scale consumers with time variable tariffs including grid charges optimization* aims to add value to flexible supply contracts by considering the impact of both the wholesale price and the capacity component of the grid charges on the customer's electricity bill. Next Kraftwerke Germany implemented this BM on a portfolio of water pumping stations in Germany.

The following best practices and lessons learnt are based on the implementation experiences of this BM.

*A successful aggregation BM offers a tailor-made flexibility option per technology to maximise the amount of created value.*

*Creating a knowledge base on flexibility markets and mechanisms is a prerequisite to the successful implementation of an aggregation BM.*

*Large-scale data analysis is the key to deal with the complexity of decentral and renewable electricity source.*

*The implementation of an advanced aggregation BM requires a local digital infrastructure and a certain degree of commitment by all involved departments.*

*The value of aggregation BMs is limited by the specific electricity tariff design. This BM can significantly increase the system value of demand side management once dynamic peak-load components are introduced in Germany*

NEXT
KRAFTWERKE

## Next Kraftwerke Germany in Italy.

Next Kraftwerke Germany has started its services in Italy under a subsidiary named Centrali Next. Two business models were implemented during the BestRES implementation period. The first one optimises the marketing of electricity production from renewable production units on the Italian day-ahead market and the intraday market. The second one trades renewable energy sources on Italy's ancillary services market.

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The following best practices and lessons learnt are based on the implementation experiences of these business models.

*Aggregators should adapt their product design to the national and or regional context.*

*The advantage of using in-house developed software is that adaptations to the national conditions can happen internally.*

*The value created in this BM depends on whether the design of the subsidy schemes allows market participation of renewable assets.*

*Unclarity on the future market design for balancing markets causes uncertainty on the aggregator's side.*

NEXT
KRAFTWERKE

## Next Kraftwerke Belgium in Belgium.

Next Kraftwerke Belgium implemented two BMs during the BestRES implementation trial. In the first one, *Trading PV and Wind power*, Next Kraftwerke Belgium trades electricity from renewable sources on spot markets. In the second one, *Using flexibility of customers as a third party*, Next Kraftwerke Belgium trades the flexibility of their customers on reserve markets.

The following best practices and lessons learnt are based on the implementation experiences of these business models.

*A pre-financed technology solution reduces the investment cost and technology lock-in on the customer side, though leads to a fixed cost that needs to be recovered by the aggregator through their sales margin.*

*A technology solution that works with a wide range of assets increases the addressable market.*

*Offering a competitive price is the most important value proposition for the client.*

*Combined trading of electricity and Guarantees of Origin creates a one-stop-shop for the customer's needs.*

*Valorisation of assets in all short-term and long-term markets hedges the customer's risk of volatility in power prices.*

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oekostrom AG

## Oekostrom in Austria.

In its business model *Demand side flexibilization of small consumers*, oekostrom offers a dynamic Time-of-Use tariff to its customers based on measurements from a digital meter.

The following best practices and lessons learnt are based on the implementation experiences of this business models.

*Targeting the existing customer base with innovative products is an effective technique to acquire customers while minimising sales efforts.*

*Being an early adopter of new technologies allows to benefit from market insights before other market players and to attain a large customer portfolio based on new market segments.*

*The integration of new products based on new technologies is accompanied with a large uncertainty about the reliability of external processes, such as those run by the DSO.*

*The value in residential flexibility is currently low, though innovative BMs can attract new customers and expand the aggregator-supplier's market share.*

*A clear definition of the legal and regulatory framework is crucial for the implementation of aggregation BMs.*

## EDP in Portugal.

The BM implemented by EDP Portugal entails the activation and marketing of the flexibility of consumers. EDP provides installations of some of its large office buildings, industrial and agro-industrial customers with price signals that are used to control the customers' electricity consumption. This flexibility is used to lower the imbalance cost and electricity sourcing cost of EDP's entire portfolio.

The following best practices and lessons learnt are based on the implementation experiences of these business models.

*As EDP's service portfolio is well established in the Portuguese energy sector, offering aggregation services alongside other EDP services helps to increase the credibility of aggregation business models.*

*Market expansion by integration aggregation alongside supply services can lead to a higher market share and therefore higher revenues.*

*A software platform that is developed internally with the help from external consultants can reduce costs compared to an external solution.*


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## Conclusions

The following conclusions capture patterns that emerge across the individual aggregator results and are used to formulate a set of best practices that are applicable to wider European context.

*Customer Acquisition*
A successful aggregation Business Model should offer a solution that is **compatible with a wide range of assets or customer types to maximise the addressable market.** The Business Model should at the same time be **adapted to the size of the customer and to the relevant national and or regional context.**

For BMs that target residential consumers, **a personalised approach with a strong focus on customer interaction** is key to convince the customers of the benefits of aggregation.

*Value Proposition*
Offering a **competitive price and limiting the asset owner's risk** is the most important value proposition for the clients of aggregation business models.

Valorisation of assets in **all short-term and long-term markets hedges the customer's risk** of price volatility in power markets.

Offering a **combined set of services** (electricity supply, flexibility services, trading of Guarantees of Origin, etc.) to create a **one-stop-shop for customers** is a successful way of **integrating the role of aggregators in European electricity markets.**

Specifically for residential consumers, **combining an economic rationale** (save money on electricity bill) **with green values** (decarbonisation) is a stronger value proposition than the monetary benefit only.

*Software and hardware*
Depending on the specific application, both **in-house and external hardware and software development** can be a good choice for aggregation Business Models.

The choice for **in-house developed software** allows to **react quickly to customer needs and solve issues.**

**A general lesson learnt is that large-scale data analysis is the key to deal with the complexity of decentral and renewable electricity sources.**

*Revenue and Implementation*
Aggregation BMs require a **clear revenue sharing model** in which the **monetary benefits** are shared **between the aggregator and the customer**.

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*Regulatory Barriers and Market Design*

Country-specific **subsidy schemes, tariff components, access to balancing markets** and **legal metering requirements** significantly affect the **opportunities for aggregators** in specific electricity markets**.**

Furthermore, a **clear definition** of the **legal and regulatory framework** is **crucial** for the implementation of aggregation BMs. Unclear regulation, and the resulting ambiguous market roles and responsibilities, can lead to direct barriers for implementation.

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# Introduction

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

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

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

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# The BestRES project

The main objective of the BestRES project is to investigate the current barriers and to improve the role of Energy Aggregators in future electricity market designs. In the first stage, the project focuses on existing European aggregation business models considering technical, market, environmental and social benefits. In the second stage, improved business models are developed that are replicable in other countries in the EU considering market designs and with a focus on competitiveness and LCA. These improved business models are then 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 lasted three years. It entered into force on 1st March 2016 and ends on 28th February 2019.

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

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

The BestRES activities to be implemented in Cyprus are carried out by FOSS, the research centre for sustainable energy of the University of Cyprus. This is because there are no aggregators in Cyprus at the start of the BestRES project and no market entrants are expected until 2020.

The innovative business models provided during the project are based on on-going business models available in Europe and adapted to the future market design by research institutions and energy experts 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 are carried out by WIP with the support of Youris.

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

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## WIP - Renewable Energies (WIP)

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

## 3E

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

## Technische Universitaet Wien (TUW-EEG)

The Energy Economics Group (EEG) is a department of the Institute of Energy Systems and Electric Drives at TU Wien, Austria. The core fields of research of EEG are: (i) system integration strategies of renewable and new energy technologies, (ii) energy modelling, scenario analysis and energy policy strategies, (iii) energy market analysis in general (competition and regulation), (iv) sustainable energy systems and technologies and (iv) environmental economics and climate change policies. EEG has coordinated and carried out many international as well as national research projects, international and national organizations and governments, public and private clients in several fields of research. Website: 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 analyse 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 analysed systematically with regard to their interdependencies. Interdisciplinary questions, e.g. technical and economical questions, are of particular importance. Website: http://stiftung-umweltenergierecht.de/


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## Good Energy

Good Energy is a pioneering clean energy company, powering the choice of a cleaner, greener future together with its people, customers and shareholders. Having led the way in renewable energy development since 1999 in areas including small and larger scale wind turbines, solar panels, biogen and hydro, and now in technologies like battery storage and electric vehicles, Good Energy is making it easier for people and businesses to make renewable energy part of their lives. Good Energy powers homes and businesses with 100% renewable electricity from a community of over 1,400 UK generators and owns and operate two wind farms, including the UK's first commercial wind farm, and eight solar farms. In addition, Good Energy offers a green gas product which contains 6% biomethane — gas produced here in the UK from food waste. To make it completely carbon neutral, emissions from the rest of the gas its customers use is balanced through supporting verified carbon-reduction schemes in Malawi, Vietnam and Nepal. As of 30 December 2017, Good Energy had over 250,000 domestic and business customers. Website: www.goodenergy.co.uk

## Next Kraftwerke Belgium (NKW BE)

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

## Next Kraftwerke Germany (NKW DE)

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

## Oekostrom

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


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## 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 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 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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# Methodology

In the previous stages of the BestRES project, business models (BMs) for each of the aggregators in the project were identified, improved and categorised according to their feasibility in the respective markets. The BMs are described using a Business Model Canvas in the report “Improved Business Models of Selected Aggregators in Target Countries” [2].

BMs that were found to be economically viable and did not face direct implementation barriers were implemented by the aggregators during an 18-month implementation period. A complete description of the aggregator’s implementation experiences can be found in the BestRES report “Monitoring and Performance Evaluation of the Real-Life Pilot Projects” [1].

Figure 1 presents a list of the BMs that were implemented as part of the BestRES project.

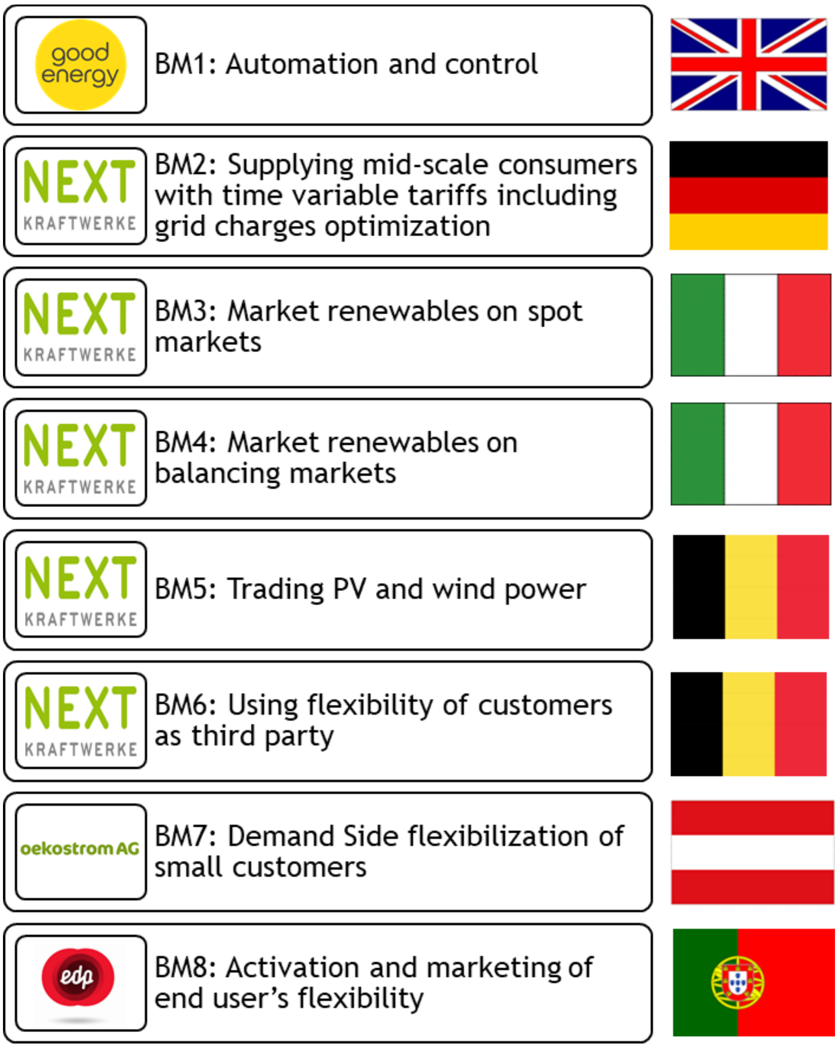


Figure 1: Implemented Aggregation Business Models

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The objective of this report is to summarise the results from the implementation activities of each BM to formulate a set of best practices and lessons learnt. The patterns that emerge across the individual aggregator results are captured and used to formulate recommendations that can be extended and applied to the wider aggregation sector.

The analysis per BM is structured in three parts:

Firstly, the implementation activities of each of the implemented BMs are evaluated by comparing the targets, as set out in September 2017, with the implementation KPIs reported in December 2018.

Secondly, the strategies, issues and solutions, as encountered by the individual aggregators, are summarized and explained. These were reported twice during the implementation period: once after month 9 and a second time in month 18. They are structured according to five categories:

- Customer Acquisition
- Value Proposition
- Software/Hardware
- Revenue and Implementation
- Regulatory barriers and Market Design

The reporting of the lessons learnt and best practices was complemented with a group discussion between all aggregators to share experiences and find common barriers, opportunities and strategies.

Finally, the replicability of each of the BMs in a different European market is assessed. For each aggregator, a potential expansion market is identified, and a comparison is made between the key market design characteristics of the home market and the expansion market. Note that this is a theoretical exercise and that the evaluation is independent of any of the aggregator's actual expansion plans.

Besides the individual analysis of the lessons learnt per BM, a set of general best practices and lessons learnt is outlined in the conclusion. These consider both practical and strategic considerations for the implementation of aggregation BMs in European wholesale and retail electricity markets.

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# Good Energy (UK)

## Introduction

In the implementation of its *Automation and Control* BM, Good Energy provided a selected group of customers with a home energy management device called Verv, developed by Green Running. Through this device and its coupled mobile application, customers can live-monitor the consumption of different appliances in their home. It also allows Good Energy to send unique signals and infographics to its customers. The aim of the business model implementation is to gain an understanding of electricity consumption of domestic customers with a focus on customer engagement and interaction.

## Implementation evaluation

Table 1: Target and Implementation KPIs BM1

| **BM1:** ***Automation and Control*** | Targeted KPIs | Implemented KPIs |
|---|---|---|
| KPI 1 (economic KPI):<br>Portfolio size (implemented households) | 30 | 43 |
| KPI 2 (economic KPI):<br>Monthly Consumption | 11.1 MWh | 14.63 MWh |

Good Energy aggregated a portfolio that consisted of 43 households during the BestRES implementation period. In the final month of the BestRES trial, this portfolio had a monthly consumption of 14.63 MWh. This is slightly above the targets that were set out at the start of the implementation period.

An elaborate discussion of Good Energy's implementation experiences, including additional implementation KPIs, can be found in the BestRES report "Monitoring and Performance Evaluation of the Real-Life Pilot Projects" [1].

## Strategies, issues and solutions

### Customer Acquisition

Participants were recruited through personalised emails and phone calls. While this was relatively time-consuming and resource-intensive, it built a customer relationship which allowed getting to know each participant's electricity demands on a personal level. **This personal and flexible contact with the participants improved their engagement in the trial.** Good Energy reports that this recruitment strategy aimed to support the customer-centric approach of the BM and identifies that direct contact with participants led to a better customer relationship.

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Good Energy's E7 and E10 customer pool was segmented per technology interest, Wi-Fi accessibility and affluence, to target the most suited participants for implementation. Tech-savviness was identified as a segmentation criterium because of the innovative technology solution used in the BM. To increase installation success rate of the Verv device, an adequate Wi-fi connection was also considered as a parameter. While early adopters of new technologies are usually customers in higher income brackets, some responses to the survey from lower income brackets evidenced interest in a device that could help bring down bills. **This segmentation strategy was an appropriate methodology to create a target sample** from the Good Energy customer base on a Time-of-Use tariff and increased the success rate of the trial. Good Energy recognises that this segmentation strategy could be further refined to avoid omitting additional potential market segments to target.

**Offering a technology solution independent from a supply contract gives customers the freedom to easily opt out of the trial** and requires a smaller commitment from the customer to sign up. This however means that the customer is less connected to the energy supplier. Good Energy reports that some participants find it hard to understand the purpose of an energy monitoring device if it is not directly linked to their energy supplier and energy bills.

**Value Proposition**

Placing the customer at the centre of the BM and 'upgrading' them to become active participants can change their attitude towards their energy usage. **Empowering customers to take control of their own energy usage is an effective value proposition for aggregators.** By providing statistics on household energy consumption, disaggregated per device, consumers become more aware of the cost associated with different appliances in their home. This allows participants to make more informed decisions. Good Energy shows participants that they are part of the solution to decarbonise the UK and they observed that this can convince customers of the need to control their energy consumption

By embracing customer participation as a main agent of change, Good Energy reports that it is possible to improve customer trust. **Focussing on what customers need and want, rather than seeing them as simple recipients of a service, makes it easier to involve them in innovation projects.** For this it is important to share with them the possibility of joint actions where customers play an active role for the creation of a resilient energy future.

Good Energy reports that the **combination of economic rationale (save money on electricity bill) with green values (decarbonising the UK) is a stronger value proposition than the monetary benefit only**. The trial intends to connect the two by raising awareness of daily energy usage as well as the impact energy use at different times of the day has on the environment.

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### Software/Hardware

Good Energy worked with Green Running, an external software provider, for the implementation of this BM. They report that **this has both advantages and disadvantages.** On one hand, it has extended the knowledge base of the Good Energy team without incurring additional cost. Technical queries related to the software itself are resolved directly by the external provider without the need for Good Energy to intervene. On the other hand, communication during the development phase and customising the mobile application required more coordination. Customer relationship management was also more complicated and required bilateral communication between Good Energy and Green Running. When working with an external provider, Good Energy finds that communications need to be flexible yet regular. Further it is important to align the success and outcome of the trial to motivate the collaboration.

The set-up of the Verv device did not require an electrician and was expected to be carried out by the participants themselves. However, in some cases this led to implementation issues. The first reason for this is that electricity meters in the UK vary from one customer to another, especially for the targeted E7 and E10 Time-of-Use customers. The standard instructions provided by the external provider were not clear enough to cover each of the different systems and could result in installations that didn't collect the correct consumption data. Secondly, the installation of the accompanying mobile application depended on the type of mobile operating system. Good Energy found it challenging to resolve technical queries since they didn't have the same level of understanding of the technology as the external provider. In conclusion, a**voiding negative customer experiences is the most important with do-it-yourself product set-up and installation.**

Data analysis is an important aspect of the trial as it allows to analyse and interpret participants energy needs and behaviour to gain customer insights. The data collected by the Verv device is shared with Good Energy in a user-friendly format so less processing and development work is needed on their side. However, due to the nature of the raw data processing, the data measured by Verv requires demanding and time-consuming processing before it can be turned into a meaningful format. This can lead to delays in data sharing and thus delaying the different start dates of the Stages. **Secure, compliant and accurate data sharing is critical to the success of the trial.**

### Revenue and Implementation

Good Energy placed a lot of importance on customer retention & customer lifetime value. One of the main drivers of the trial was to assess the potential of customer engagement tools to create a stronger customer loyalty relationship. One of their main findings was that **it is important to assess the customer's appetite to the right level of engagement to have a good understanding of customers' needs and avoid disinterest.**

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**Regulatory Barriers and Market Design**

All of the participants of the trial were customers on a Time-of-Use tariff (E7/E10). While these tariffs give consumers incentives to shift consumption from peak hours to off-peak hours, Good Energy found that **under the current structure of electricity retail markets, the benefits are not enough to induce significant shifts in electricity consumption**. Optimised static Time-of-Use tariffs, enabled through smart meters can create more value for residential load shifting. Half-hourly settlement of residential customers would be another significant step forward, as this would encourage suppliers to offer not only static, but also dynamic Time-of-Use tariffs that are indexed to the energy market. This way, customers will be encouraged to make maximum use of their available flexibility.

# Expansion Market Analysis

In order to discern to what extent this business model can be replicated and transferred to another market area, Key Market Design Parameters (KDPs) of the BM's home market, the UK, and a potential expansion market, France, are compared. A complete overview of this comparison can be found in Table 9 in Appendix A.

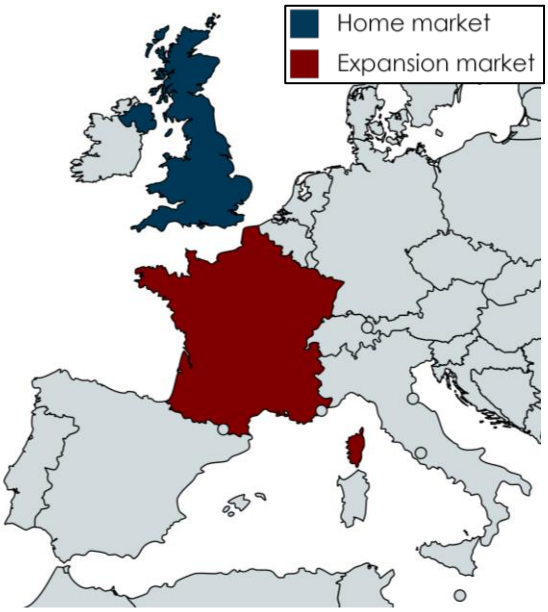


Figure 2: Home market and expansion market BM1

The discussions and official communication at a regulatory level in the UK happen in English, while in France they happen in French. Knowledge of the local language is thus a first requirement to enter the French market. While the average power price for residential consumers is comparable in both markets, the level of competition on the retail markets is different. In France, 80% of the retail market is served by EDF, while in the UK no single retail supplier has a market share larger than 20%. The size of the domestic retail markets is comparable: the UK has 28 million electricity meter points in its domestic market, whereas France has 32 million. In both France and the UK, between 13 and 15 million smart meters have been installed by the end of 2018.

These KDPs indicate that the circumstances in the French and the British market differ significantly. While the market conditions do not directly prevent a replication of this BM in France, a more extensive country analysis would be necessary to reveal further barriers and opportunities.


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# Next Kraftwerke Germany (Germany)

## Introduction

The implementation of the business model “Supplying mid-scale consumers with time variable tariffs including grid charges optimization” aims to add value to flexible supply contracts by considering the impact of both the wholesale price and the capacity component of the grid charges on the customer’s electricity bill. Initially, Next Kraftwerke Germany (NKW DE) only carried out an optimisation of the wholesale price. The research from the first phase of the BestRES project showed that flexible power consumption that considers the peak-load component of the grid charges can lead to an additional cost reduction. The BM implemented in the BestRES implementation period combined these two optimisation approaches. By jointly reducing the wholesale price as well as the grid charges, all components of electricity costs that can be influenced by demand side management are addressed.

## Implementation evaluation

Table 2: Target and Implementation KPIs BM2

| **BM2: *Supplying mid-scale consumers with time variable tariffs including grid charges optimization*** | **Targeted KPIs** | **Implemented KPIs** |
|---|---|---|
| KPI 1 (economic KPI)<br>Portfolio size<br>*Water pumps<br>*Battery storage<br>*Emergency generators | 36 MW<br>2 MW<br>5 MW | 32 MW<br>0 MW<br>0 MW |
| KPI 2 (economic KPI) Price reduction<br>*Water pumps<br>*Battery storage<br>*Emergency generators | n.a. | 7.5%<br>n.a.<br>n.a. |
| KPI 3 (technical KPI) Reduction of peak load<br>*Water pumps<br>*Battery storage<br>*Emergency generators | n.a. | 20-25%<br>n.a.<br>n.a. |
| KPI 4 (economic KPI) Break even? | n.a. | Yes |

NKW DE aggregated a portfolio of 32 MW for their BM *Supplying mid-scale consumers with time variable tariffs including grid charges optimization* during the BestRES implementation period. The portfolio led to a price reduction of 7.5% and reduced the peak load of the installation by 20-25%. While this is below the targets that were set out at the start of the implementation period, it was concluded that the BM broke even at the end of the implementation period.

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An elaborate discussion of NKW DE's implementation experiences for its BMs in Germany can be found in the BestRES report "Monitoring and Performance Evaluation of the Real-Life Pilot Projects" [1].

## Strategies, issues and solutions

### Customer Acquisition

During the BestRES implementation period, NKW DE witnessed a clear difference between how aggregation services are contracted by large investors and small players. Large investors will usually tender the services they require, which means that aggregators have to actively look for customers (market push). Smaller players, on the other hand, usually look for aggregators with competitive offers themselves (market pull). While large contracts are preferred, NKW DE notes that winning a contract through tendering is difficult since most of the tenders compare static power supply tariffs, and not dynamic tariffs. The downside of small contracts is that there is a minimum size for customers to guarantee profitability of the BM. This posed a structural problem in client acquisition and made the sales process costly. In conclusion, **aggregators should adapt their client acquisition techniques to the size of the client.**

NKW DE built its VPP infrastructure in a technology-agnostic way in order to integrate a broad range of assets. **To create the maximum amount of value, the infrastructure aims to valorise each asset through all possible flexibility mechanisms.** For example, water pumps do not run continuously and are carefully scheduled in advance, which makes the combination of grid charges optimisation and flexible power sources optimal. On the contrary, batteries or emergency generators are nearly continuously available, which means that these can be activated with little or no prior notice. The can therefore create most value on balancing markets such as FCR, aFRR or mFRR. Providing technological compatibility with multiple technologies and multiple markets is a strategic decision that requires more investment costs since adaptation is required for each product and infrastructure. However, NKW DE is able to recuperate this extra investment through economies of scale.

### Value Proposition

NKW DE's baseline value proposition is to reduce a customer's electricity cost through optimal trading on short-term and balancing markets. Since only a few potential customers are familiar with these markets, it took a significant amount of effort to convince potential customers about the benefits of their BM. This issue was addressed by offering a price cap for the flexible tariff, which is comparable to a well-known long-term electricity contract. Nonetheless, the lack of expertise on electricity markets among customers is one of the reasons why the implementation of this BM was only partly successful. **NKW DE therefore identifies that creating a knowledge base on flexibility markets and mechanisms is a prerequisite to the successful implementation of a complex aggregation BM.** NKW DE identifies that as soon as market signals create more

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financial incentives and customers become more aware about the value of flexibility, the implementation of the BM can be more successful.

**Software/Hardware**

Using the data generated by a large portfolio of assets leads to better forecasts and a better understanding of the real time status of the electricity system. While this requires dedicated resources and infrastructure, NKW DE recognise that **large-scale data analysis is the key to deal with the complexity of decentral and renewable electricity source.**

The BM requires different levels of data and information exchange. In case balancing services should be provided, Next Kraftwerke uses its remote-control unit "Next Box" as an interface to the asset of the customer. Next Kraftwerke uses, amongst other technologies, REST API to transmit price signals. The tools and interfaces that are used for forecasting are developed in-house, which allows NKW DE to efficiently adapt functionalities to the needs of the customer. As a lesson learnt, **the choice for in-house developed software allows to react quickly to customer needs.**

**Revenue and Implementation**

Because of the multiple market participation optimisations in this BM, its complexity is a significant barrier for its implementation. In the case of the water pumps, the BM combines grid charges optimisation, which has been done since several years, with optimal sourcing on wholesale electricity markets, which is relatively new to companies. NKW DE learnt that **the implementation of such an advanced aggregation BM requires a local digital infrastructure and a certain degree of commitment by all involved departments in the client company.**

**Regulatory Barriers and Market Design**

Demand response to limit grid charges is a well-established way to optimise electricity consumption for large consumers. However, current peak-load prices are static, which limits the potential of demand response as a grid service. The technology that is developed in **this BM can significantly increase the system value of demand side management once dynamic peak-load components are introduced in Germany**.

## Expansion Market Analysis

In order to discern to what extent this business model can be replicated and transferred to another market area, KDPs of the BM's home market, Germany, and a potential expansion market, France, are compared. A complete overview of this comparison can be found in Table 10 in Appendix A.

The discussions and official communication at a regulatory level in Germany happen in German, while in France they happen in French. Knowledge of the

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local language is thus a first requirement to enter the French market. Industrial power prices differ between the two markets; while the average power price for industrial consumers in France is around 90€/MWh, in Germany the price is approximately 150€/MWh. Both markets offer access to balancing markets to aggregators. The market size in Germany is low due to the static grid charges. In 2018 in France, a new methodology to calculate grid charges (Turpe 5) was introduced. This methodology follows the principle of hourly/seasonal adjustments, which makes the grid charges more dynamic. This can make the BM more attractive in France than in Germany.

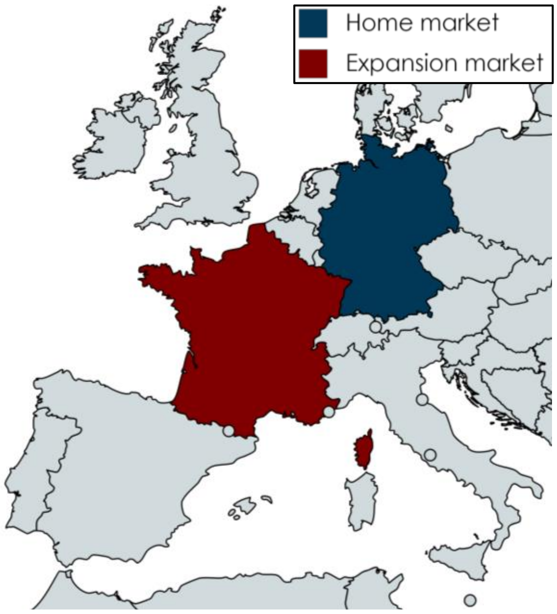

Figure 3: Home market and expansion market BM2

In general, this BM could potentially be brought to each market where consumers have a smart meter, grid charges are part of the electricity bill and short-term markets are accessible to aggregators. However, it is crucial that these components provide the end-consumer an incentive for load shifting. In the future, price spreads are expected to increase due to more fluctuating production of renewables in the electricity supply system. In addition, grid management on TSO as well as on DSO level will become more complex. A more variable scheme for grid charges could incentivize consumers to avoid grid congestions. In many countries, pilots and research projects investigate how flexibility from DSO level could be sourced. In case more flexible grid charges play a role in the future market design, a further expansion of the BM this development should be considered.


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# Next Kraftwerke Germany (Italy)

## Introduction

Next Kraftwerke Germany (NKW DE) has started its services in Italy under a subsidiary named Centrali Next. Two BMs were implemented during the BestRES implementation period. The first BM (BM3) optimises the marketing of electricity production from renewable production units on the Italian day-ahead market and the intraday market. The second BM (BM4) analyses the trading of renewable energy sources on Italy's ancillary services market.

## Implementation evaluation

Table 3: Target and Implementation KPIs BM3

| **BM3: *Market renewables on spot markets*** | **Targeted KPIs** | **Implemented KPIs** |
|---|---|---|
| KPI 1 (economic KPI) Portfolio size<br>*PV<br>*Wind<br>*Hydro/biogas<br>*CHP | <br>100 MW<br>100 MW<br>20 MW<br>50 MW | <br>15 - 30 MW<br>300 - 350 MW<br>5 - 15 MW<br>0 - 5 MW |
| KPI 2 (economic KPI) Trading turnover | n.a. | Not disclosed |
| KPI 3 (economic KPI) breakeven or not | n.a. | Yes |

For the BM *Market renewables on spot markets*, NKW DE aggregated a portfolio containing a significant capacity of three different technologies during the BestRES implementation period. While the targeted portfolio size per technology was not reached for every technology, the total aggregated capacity of 360 MW largely exceeded the targeted portfolio size of 270 MW. The trading turnover was not disclosed, though NKW DE reports that the BM broke even at the end of the implementation period.

Table 4: Target and Implementation KPIs BM4

| **BM4: *Market renewables on balancing markets*** | **Targeted KPIs** | **Implemented KPIs** |
|---|---|---|
| KPI 1 (economic KPI) Portfolio size<br>*Biogas<br>*Hydro<br>*CHP/Demand response | <br>0 MW<br>0 MW<br>10 MW | <br>0 MW<br>0 MW<br>0 MW |
| KPI 2 (economic KPI) Flexibility turnover | n.a. | 0 EUR |
| KPI 3 (economic KPI) breakeven or not | n.a. | no |
| KPI 4 (technical KPI) | | 0 MWh |

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Balancing capacity offered

Due to slow regulatory development, NKW DE did not aggregate any assets for their BM *Market renewables on balancing markets* in Italy. The resulting KPIs are therefore all zero, which is below the target of 10 MW.

An elaborate discussion of NKW DE's implementation experiences for its BMs in Italy can be found in the BestRES report "Monitoring and Performance Evaluation of the Real-Life Pilot Projects" [1].

## Strategies, issues and solutions

### Customer Acquisition

To address the Italian market NKW DE adopted the same customer acquisition strategy used in Germany, which consists of participation in trade fairs and content marketing to acquire new customers through direct sales. However, several market differences were identified, which led NKW DE to **adapt their strategy to the Italian context**. One-year PPAs are common in the Italian market, which means that that most of the tenders and sales activities happen at the end of the year. Furthermore, the trading products for renewable generators had to be adapted depending on an asset's subsidy scheme. Specifically, the scheme "Conto energia", applicable to PV plants, adds a premium to the market price. This premium is fixed and does not depend on the price level. This makes a PPA with a long-term hedge of potential interest. In contrast, revenue from wind subsidies (DM 6/7/2012) is based on a variable incentive, which adapts to current price level.

### Value Proposition

NKW DE's value proposition in their Italians BMs is to provide **trading services and asset control that limit the risk of the asset owner and increases their revenue**. Live monitoring data, enhanced with continuously updated weather forecasts, are used to reduce the imbalance risk of the entire VPP infrastructure. The successful implementation of the BM *Market renewables on spot markets*, reflected in the large scale-up of the portfolio size during the BestRES implementation period, indicates that this value proposition is able to convince customers to choose for NKW DE. Because of the delayed implementation of the BM *Market renewables on balancing markets*, this cannot yet be confirmed for this BM.

### Software/Hardware

The initial phase of the implementation period was dedicated to the adaptation of the software processes to the Italian market. Particular in Italy is that each unit needs to be bid individually. This is different from other TSO areas, such as Germany, where bidding happens on a portfolio level. **The advantage of using in-house developed software is that these adaptations could happen in-house.**

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**Regulatory Barriers and Market Design**

As mentioned under *Customer Acquisition*, NKW DE found that the Italian subsidy schemes had an important impact on the implementation of the BM *Market Renewables on Spot Markets*. The purpose of this BM is to create value through optimised trading. However, when assets are not exposed to market signals and instead are locked in through rigid subsidy schemes, asset owners do not receive any of the created value. **The value that is created through this BM depends on whether the design of the subsidy schemes allows market participation of renewable assets.** An example of a subsidy that causes a complete lock-in of assets is the Tariffa Omnicomprensiva, a subsidy mechanism for controllable units based on a fixed feed-in tariff. It does not allow trading activities since all electricity is directly sold to the market facilitator GSE. In case operators of such plants like to use the services of NKW DE, they would need to leave this scheme.

For the BM *Market Renewables on Balancing Markets*, the implementation was strongly dependent on the TSO's timeline of pilot project. Italian TSO Terna has been investigating different forms of aggregation through pilot projects, which indicates that they are planning to further develop this. However, **it is not clear yet what kind of market design will be applied in the Italian balancing market in the future, which causes uncertainty on NKW DE's side.**

## Expansion Market Analysis

In order to discern to what extent this business model can be replicated and transferred to another market area, KDPs of the BM's home market, Italy, and a potential expansion market, France, are compared. A complete overview of this comparison can be found in Table 11 in Appendix A.

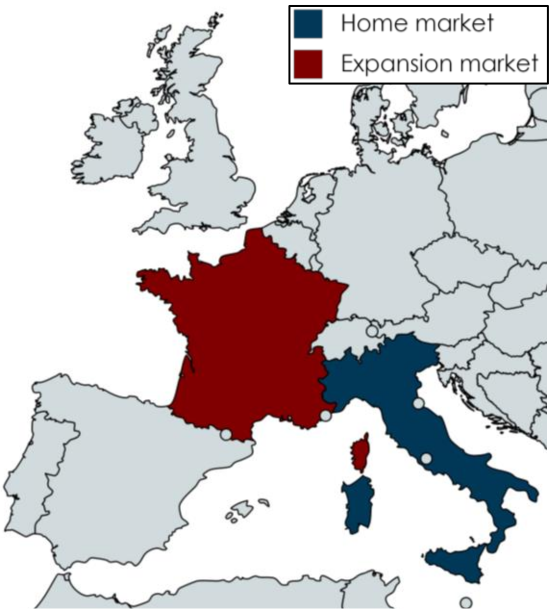


Figure 4: Home market and expansion market BM3 & 4

Both countries have a significant share of renewable energy sources in the electricity generation mix: Italy is at 34%, while France has 19.2%. This means that in both countries, BMs that target RES have a large addressable market. Besides a high share of renewables, it is crucial that the subsidy schemes foresee market participation. In France, there is only a slow transition towards more market integration of renewables due to Feed-In tariffs. The "Complément de remuneration", which includes market participation, is only obligatory for new installation. While recently put in place, this subsidy creates a stronger customer need for trading and aggregation services. In Italy, several subsidy mechanisms


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hamper market participation, as discussed above. In France, the balancing services products provided by aggregators are mainly based on demand response. Controllable renewables do not play a role in terms of aggregation for balancing services yet. While in Italy market opening is only starting now, both aggregated consumption and production units are considered.

Next Kraftwerke is already present in France, and reports that they are able to replicate both BM to participate with renewables on spot and balancing markets. However, very important is that the BMs are adapted to the national context regarding market access, subsidy schemes, tariff components and legal metering requirements.

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# Next Kraftwerke Belgium

## Introduction of the BMs

Next Kraftwerke Belgium (NKW BE) implemented two BMs during the BestRES implementation trial. In the first one, "Trading PV and Wind power" (BM5), NKW BE trades electricity from renewable sources on spot markets. In the second one, "Using flexibility of customers as a third party" (BM6), NKW BE markets the flexibility of their customers on reserve markets. For a complete overview of the implementation activities of the aggregator for these two BMs, the reader is referred to the report "Monitoring and Performance Evaluation of the Real-Life Pilot Projects" [1].

## Implementation evaluation

For the BM *Trading PV and Wind* power (BM5), the targets, as defined in September 2017, and the implementation results, as reported in December 2018, are shown in Table 5. NKW BE has largely exceeded their targets to acquire more than 10 MW of both solar and wind power, and currently has a portfolio of more than 100 MW in both market segments. NKW BE has reported an annual turnover of up to 100k€, and the BM break even.

Table 5: Target and Implementation KPIs BM5

| **BM5: *Trading PV and Wind power*** | Targeted KPIs | Implemented KPIs |
|---|---|---|
| KPI 1 (economic KPI):<br>Portfolio size<br>* Solar<br>* Wind | <br><br>>10 MW<br>>10 MW | <br><br>> 100 MW<br>> 100 MW |
| KPI 2 (economic KPI):<br>* Annual turnover | n.a. | 0-100k €/yr |
| KPI 3 (economic KPI):<br>* Breakeven or not | n.a. | Yes |

For the BM *Using flexibility of customers as a third party* (BM6), the targets, as defined in September 2017, and the implementation results, as reported in December 2018, are shown in Table 5. NKW BE has succeeded to acquire the targeted portfolio of 5 MW. They currently report a portfolio of up to 10 MW on all considered reserve markets. NKW BE reported an annual turnover of up to 100k€, and that the BM breaks even over the implementation period.

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Table 6: Target and Implementation KPIs BM6

| BM6: *Using flexibility of customers as a third party* | Targeted KPIs | Implemented KPIs |
|---|---|---|
| KPI 1 (economic KPI):<br>* Portfolio size | >5 MW | 0-10 MW |
| KPI 2 (economic KPI):<br>* Turnover | n.a. | 0-100k €/yr |
| KPI 3 (economic KPI):<br>* Breakeven or not | n.a. | yes |

An elaborate discussion of NKW BE's implementation experiences can be found in the BestRES report "Monitoring and Performance Evaluation of the Real-Life Pilot Projects" [1].

## Strategies, issues and solutions

### Customer Acquisition

The client acquisition strategy in Belgium is largely based on **targeting customer based on a publicly available list of Green Certificates (GSC) installations**. This list is made available by the Flemish regulator. NKW BE identifies that this significantly eases market research and drives down cost for sales. However, this data is publicly available for anyone, also the competing traders on the Belgium market. Customers are encouraged to directly contact NKW BE through a contact form on their website. The website features a knowledge hub, which creates a lot of organic traffic. This is a successful technique to bring in a good amount of leads without any additional sales effort.

NKW BE uses their in-house developed 'Next Box' for the implementation of both BMs. Clients do not have to buy this hardware, instead it is pre-financed by NKW BE. This means that clients do not have a high investment fee to join NKW BE's portfolio and they don't experience technology lock-in. NKW BE reports that this is appreciated by clients and creates trust. However, from a customer acquisition point of view, this leads to a fixed cost per client that has to be recovered through the sales margin. Due to this model, smaller units with limited flexibility might not be profitable for NKW BE to contract. Currently NKW BE is working on a 'Next Box light' to lower the pre-financed cost. In the case that only data collection is necessary without steering, NKW BE is able to work with the existing data loggers and APIs.

The advantage of the Next Box is that it works with a wide range of assets: solar, wind, gensets, batteries, CHPs, biogas, industrial processes. This means that NKW BE has a large target market, and that different installations of the same client can be valorised in different ways. This means that an **interesting and individualized sales package can be presented to the customers**. However, NKW BE reports that they still have to build and program the Next Box depending

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the communication protocol that can be used by the client. This means that they can only start assembling and preparing the Next Box for a client after they have received the plant's technical information.

NKW BE have noticed that customers on the Belgian market receive offers from competitors that they perceive as unrealistic. While some clients are able to realise that the promised numbers are unrealistic, many clients do not realise the problem and go for these cheap service providers. NKW BE points out that it is important to realise that such companies could face financial difficulties in the future, which can create insolvability problems. It is therefore risky to engage in long term contracts with them. NKW BE tries to overcome this barrier by being very open and transparent about their own pricing. They also indicate to potential clients when they deem prices offered by other parties to be unsustainable on the long term.

A characteristic of the Belgian market is that large installations are often contractually 'locked in' for several years This means that there **are little opportunities and short time windows to contract new large installations**. Long-term contracts increase their financial risk, which is something that requires financial hedging. NKW BE recognises that they are best at short-term trading and that they are not specialised in providing long-term financial securities. In some tenders, the wind or solar farm owners contract several parties for trading to diversify the risk in case of bankruptcy of one of them. Sometimes Next Kraftwerke can then do the short-term part and a partner does the long-term hedging.

**Value Proposition**

Above all, NKW BE realises that **offering a competitive price is the most important value proposition for the client**, as this is their main consideration when comparing offers between competing aggregators.

NKW BE reports that **transparency is a value that is appreciated by their clients**. They try to have an open way of working by operating according to a clear revenue sharing model. They furthermore always offer to go through the contract together and explain what all the clauses imply.

An additional value proposition in BM5 is that NKW BE trades both the customer's electricity and Guarantees of Origin (GOs). Initially NKW BE did not have this intention as GOs have a rather low market value which would not able to generate significant revenues. They furthermore entail a significant amount of administrative work. Nonetheless, NKW BE felt a strong market pull to include trading GOs in their services which is why they bought a license to a GO trading platform.

An advantage that NKW BE has over other aggregators in the Belgium market is that **their technology allows to valorise flexibility in all short-term markets**. This means that in case the value of one product decreases, the asset's energy or flexibility can be valorised in another market. This hedges the risk of the

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costumer for future (balancing) power prices. In Belgium they are the only ones that are able to do this, which is a very strong sales argument. On the downside, this is labour-intensive as it requires to stay up to date on all the regulatory and procedural developments in the different markets. NKW BE reports that this requires them to actively participate in the working groups of the grid operator and follow-up on their design notes.

As NKW BE does not own assets and only valorises third-party installations, there is no conflict of interest to prioritise their assets over the clients.

**Software/Hardware**

As discussed under *customer acquisition*, the client does not have to buy the monitoring and control hardware, instead it remains NKW BE's property. While this means that the customer does not experience a technology lock-in, it also results in a significant financial burden since NKW BE has to pre-finance a fixed cost per client. This cost has to be recovered through their sales margin. Therefore, mainly larger installations were initially targeted because the trading fees for large plants (>500kW) cover the balancing risk, sales and invoicing costs and margin.

On the other hand, working with **in-house developed technology means that the level of in-house expertise on hardware development** is high, and that the NKW BE team is able to directly address clients' concerns. There is no dependence on an external provider and if necessary NKW BE can independently work out custom hardware and software solutions.

For both BMs, NKW BE tries to duplicate the data management and contract structure from the German parent company. This results in less implementation work in back-end data management for the trading and the virtual power plant team. Contracts are furthermore easier to discuss with the German legal team when the contract structure is similar. This means that from an operational point of view, adding renewables to the pool is relatively similar as what is already done in the other countries of NKW. For ancillary services, this only works to a certain extent. Product design and data exchange requirements differ quite a bit from TSO to TSO and still ask a lot of custom work. NKW BE therefore needs to foresee enough lead time internally before a new ancillary service product can be offered.

**Revenue and Implementation**

**The service fees for the BM *Trading PV and Wind power* depend on the size of the installation.** For smaller installations, customers pay a fixed fee that depends on the capacity of the installation. Customers know what they will pay in advance, independent of weather conditions and traded volumes. Invoicing is therefore easy and results in a predictable and recurrent revenue stream. NKW BE reports that the fixed fee needs to be relatively high to make the customer segment profitable. For larger installations, a fixed trading fee per MWh is charged. This trading fee covers the external trading fees, the imbalance

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risks, and operational costs. It is also what works best for NKW BE in the different countries.

In the BM *Using Third-Party flexibility*, **the earned revenue is based on the ancillary service income from Elia and shared with the client according to the contractually defined revenue share**. This assures that there is a transparent and clear way for the client to know how much he is getting from the generated revenues. It also does not prevent NKW BE to pay a minimum amount to the client, which means they do not have to hedge the risk of price fluctuations in the ancillary service markets. However, if prices on the ancillary service markets crash, the income does so as well and might not cover the operational cost anymore. This model works well for generation assets. Storage projects, however, require a different approach. Investors in battery projects usually want a minimum price guarantee for the market incomes, which comes down to asking a financial hedge against a price crash in the FCR market

**Regulatory Barriers and Market Design**

In Belgium there is no national regulation on support schemes for renewable energy (except for offshore wind). **The fact that each region has its own tariffs, rules, and tracking mechanisms for the green certificates and guarantees of origin support schemes, makes it harder to learn how the systems work and keep track of regulatory changes.** As a best practice, NKW BE tries to avoid selling Guarantees of Origin to the regional regulators. Instead it sells them on a European trading platform, which they can also use for other countries where they are active.

In Belgium there is no requirement for control of installations, as is the case in Germany for all plants greater than 100 kW. When units have pre-installed local control, they can be contracted by NKW BE without installing their own control box. Real time production data is crucial for traders to trade away difference between the forecast and real production within each quarter hour. To compensate the lack of local control, NKW BE has integrated the APIs of inverters of major solar inverter companies and many of them can now be connected with the data management system of their trading team.

Belgium has furthermore no legal requirement to trade the solar or wind power on the power exchange in order to receive a subsidy, in contrast to the market premium model in Germany and the Netherlands. In particular, owners of smaller PV installations are not interested in a performant trader, since their subsidy is fixed independent of the income from the power sold. They are hence more likely to choose for a convenient solution where they can sell their solar power for a fixed price to a supplier company. **This creates less opportunities for NKW BE in Belgium in the small and medium size market segment.** NKW BE has identified the need to make their trading offer as convenient as possible for smaller clients (e.g. including buying up the guarantees of origin etc). For larger clients, the trading performance is the most important factor, where NKW BE is able to offer competitive trading fees.

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For the BM *Using third-party flexibility*, there are several ongoing developments in European guidelines for ancillary service provision which will be a step forward to proper recognition of the role of aggregators. In general, European law requires time before it has an impact on the national and region level and leaves a considerable amount of room for interpretation by the national legislators. NKW BE therefore foresees that the impact will be quite low for at least the next 3 years. On a national level, NKW BE has the opportunity to weigh in on some important design aspects that are still under discussion before the aFRR market will be opened by the end of 2019. While in theory NKW BE has been able to provide aFRR for several years, the process to open up the market, led by the Belgian TSO Elia, happens very slowly. NKW BE identifies that this gives their competitors the time to develop their own technologies and decreases NKW BE's head start.

An issue in Belgium that NWK BE faced for the second BM is the **regulation with respect to the Transfer of Energy (ToE)**. In essence, the current accepted proposal should make it impossible for suppliers to block independent aggregators from valorising flexibility on their sites. However, NKW BE finds that the ToE rules have not optimally been put in place in the best way since they only cover net offtake points, they do not address the BRP impact properly, and they create a considerable administrative burden.

## Expansion Market Analysis

The replicability of both BMs in the Netherlands is assessed by a comparison of KDPs. NKW BE is currently already rolling out both BMs in the Netherlands, which means that the assessment is based on their actual implementation experiences.

The comparison of KDPs is given in Table 12 in Appendix A. KDP1 and KDP 2 are general indicators that are relevant for both BMs. The discussions and official communication at a regulatory level in Belgium happen in English, while in the Netherlands they happen in Dutch. As the NKW BE team is proficient in both languages, this does not have an impact on their activities. At the market side, on the other hand, Belgium is bilingual French and Dutch. This means that all contracts, marketing material and online communications have to be available in both Dutch and French. In the Netherlands they only have to be made in one language, which makes implementation easier.

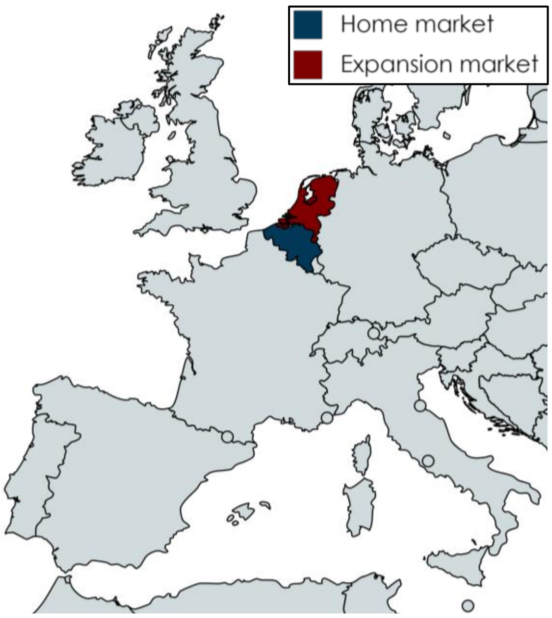

Figure 5: Home market and expansion market BM5 & 6

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KDPs 3 to 5 in Table 12 lists those KDPs that are relevant for the BM *Trading of solar and wind power*. In the Netherlands, NKW BE has found that solar and wind farms engage in shorter PPAs than in Belgium, especially if the trader can offer attractive trading fees. As NKW BE is specialised in making competitive offers for shorter contract durations, this is an advantage. NKW BE also reports that there are more large-scale PV and wind installations in the Netherlands and that the market potential in the Netherlands is as a result larger. In contrast, in Belgium a high percentage of solar power installations are at a residential level. These are too small for NKW BE to be profitable. The Netherlands witnesses a growth in medium-sized wind farms which creates additional market potential.

The subsidy scheme in the Netherlands, the SDE+ market premium scheme, is an advantage compared to the separate regional schemes in Belgium. SDE+ is harmonious across the country, making it easier to follow-up on regulatory developments. New SDE+ subsidised installations are published every year, which makes it easier to contact potential customers. The subsidy scheme furthermore requires asset owners to find a competitive trader for them to trade the power on the spot market. There is thus a higher customer need for competitive traders.

KDPs 6 to 8 list the KDPs relevant for the BM *Using flexibility of customers as a third party*. In Belgium, one market player was able to add most of the 'low hanging fruit' to their portfolio before Next Kraftwerke became active in the country's reserve markets. NKW BE's first activities in the Netherlands have shown that there is substantial growth potential in both R3 (Noodvermogen) and R2 (Regelvermogen). The market design in the Netherlands is in that sense advantageous: all ancillary service markets in the Netherlands have in principle been opened and ancillary service prices are higher than in Belgium. In Belgium, the opening of some markets is still pending: the FCR market is opened but auctions are linked to aFRR, which is not yet opened to aggregators. This gives substantial FRC market power to the CCGT units that Elia needs for aFRR capacity. aFRR will be opened mid-2020. mFRR is opened, although the split between CIPU and non-CIPU contracts still works distortive. NKW BE furthermore reports that Belgian TSO Elia has stricter telemetering requirements than its Dutch counterpart TenneT. However, TenneT does not always communicate clearly about the metering provisions that it requires, which can be frustrating for new players.

In conclusion, the comparison of KDPs between Belgium and the Netherlands shows that for both BMs the implementation conditions are more favourable in the Netherlands. The main advantages include a larger addressable market, less competition, and a better and more harmonised regulatory framework. This has convinced NKW BE to start their implementation activities in this market.

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# oekostrom (Austria)

## Introduction

In its implemented BM, oekostrom offers a dynamic Time-of-Use tariff to its customers based on measurements from a digital meter. Primarily, oekostrom expects to attract new price-sensitive clients that are interested to reduce their electricity bill through a Time-of-Use tariff. For these customers, oekostrom can avoid the cost of client acquisition and address new customer groups. In the long run, the flexibility mobilised in the BM will allow oekostrom, as an aggregator-supplier, to supply and source more of its electricity at times of lower prices (off-peak). A Time-of-Use tariff forwards part of this reduction to flexible customers as a reduction in the electricity bill.

## Implementation evaluation

Table 7: Target and Implementation KPIs BM7

| **BM7: *Demand side flexibilization of small customers*** | Targeted KPIs | Implemented KPIs |
|---|---|---|
| KPI 1 (economic KPI)<br>Number of implemented households | 27 | 0 |
| KPI 2 (economic KPI) Portfolio size | 35.1 kW | 0 kW |
| KPI 3 (economic KPI) Flexibility turnover | n.a. | 0 k€/year |
| KPI 4 (economic KPI) Breakeven or not | n.a. | No |

Due to implementation barriers related to delays in the Austrian legal framework, the postponed rollout of smart meters in Austria, delays in the definition of the interfaces for data exchange between the market participants and data quality issues, oekostrom was not able to reach an actual product launch for their dynamic Time-of-Use tariff. While they initially targeted a portfolio of 27 households, implementation did not take place and the final implementation KPIs were all zero.

An elaborate discussion of oekostrom's implementation experiences can be found in the BestRES report "Monitoring and Performance Evaluation of the Real-Life Pilot Projects" [1].

## Strategies, issues and solutions

### Customer Acquisition

In the first place, oekostrom targeted existing oekostrom customers for their BM *Demand Side Flexibilization*. A survey was sent out to 17000 customers to poll their stance on Time-of-Use tariffs. This contact moment, together with

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additional calls and emails, **tightened the customer relationship and provided costumer insights**. A main survey result was that customers expect an incentive for forwarding their personal data.

oekostrom has found that in the client acquisition phase, an aggregator should be well prepared for the many questions of customers to new products and new technology. It is especially important to find good arguments to tackle people's fears about e.g. electromagnetic radiation of smart meters, (cyber)security, the ecological justification of smart meters, etc. oekostrom reports that they lost customers that were very sceptic towards the benefit of smart meters and who see smart meters as a data risk. A good strategy is to focus on the customers' benefits from receiving hourly data: e.g. visualisation of the data in our web portal, optimisation of energy costs, etc.

**Value Proposition**

The main value proposition in this BM is that it empowers customers to take control of their own flexibility by providing variable tariffs. Customers can access their hourly consumption records in the web portal and can optimize their behaviour accordingly. The BM uses **a combination of sustainable and economic values to convince the customer of their contribution to a less $CO_2$-intensive world and decrease their electricity bill**.

oekostrom believes that Time-of-Use tariffs will be standard in the future. **Being an early adopter therefore allows to benefit from market insights before other market players and to attain a large customer portfolio based on new market segments.** However, during the implementation of this BM, oekostrom has experienced the technological risks related to new technologies as well as uncertainty about investment cost and generated revenue.

**Software/Hardware**

The main barriers that oekostrom faced during the implementation of this BM were related to smart meters (hardware) and data communication protocols (software). The former limited the customer pool ex-ante since only DSOs with more than 80% smart meter rollout could be considered for the implementation. Regarding the latter, each Austrian DSO has their own interpretation of the data communication protocols that need to be integrated in oekostrom’s infrastructure. oekostrom therefore experienced that **the integration of new products based on new technologies is accompanied with a large uncertainty about the reliability of processes**. When faced with the integration of many different market players, it is best to focus on a small selection of them and not to try to start with all at the same time. Criteria should be defined to make the selection of ‘pilot’ market players, for example focussing on DSOs of areas and regions where smart meter roll out is most advanced. The learning from this phase can be used to prepare for the final roll-out phase. As a lesson learnt, testing in a completed system is therefore very important.

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**Revenue and Implementation**

oekostrom identifies that at the moment there is not so much value in residential flexibility. Demand side flexibility of small customers therefore has to be perceived as a long-term project, where acceptance and demand of customers can only be developed slowly. When it comes to the integration of new technologies, there is a large uncertainty about investment costs and generated revenue. It is therefore important not to expect revenues in the early implementation phase. The benefits of this BM in the short term are to gain customer insights through the real-time data while maintaining sales margin.

**Regulatory Barriers and Market Design**

oekostrom has found **that a clear definition of the legal and regulatory framework is crucial for the implementation for aggregation BMs. Unclear regulation can lead to different interpretations of the roles of the market participants**. oekostrom faced difficulties to set up a functioning data exchange process with the Austrian DSOs because the processes were not unambiguously defined. As a general recommendation, oekostrom identifies that if there are several different market participants, the number of interfaces should be reduced and a central/single point for data exchange should be considered as the optimal solution. To overcome this boundary, market participants (DSOs and suppliers) and policymakers should perform extensive tests of rules and processes under real market conditions to avoid the need for changes of the regulatory framework. Aggregators are therefore recommended to wait to implement new software functionalities before the legal framework is clearly defined since implementation costs can otherwise be unnecessarily high.

## Expansion Market Analysis

The replicability of the BM in Germany is assessed by a comparison of KDPs between Germany and Austria.

The comparison of KDPs is given in Table 13 in Annex A. The discussions and official communication at a regulatory level in Austria and Germany both happen in German. In both markets the liberalisation is sufficiently advanced. Since the number of suppliers is higher in Germany, the competition for customers and therefore the costs for gaining new customers are much higher. The smart meter rollout for residential consumers in Austria is more advanced than in Germany: more than 1 million smart meters have been

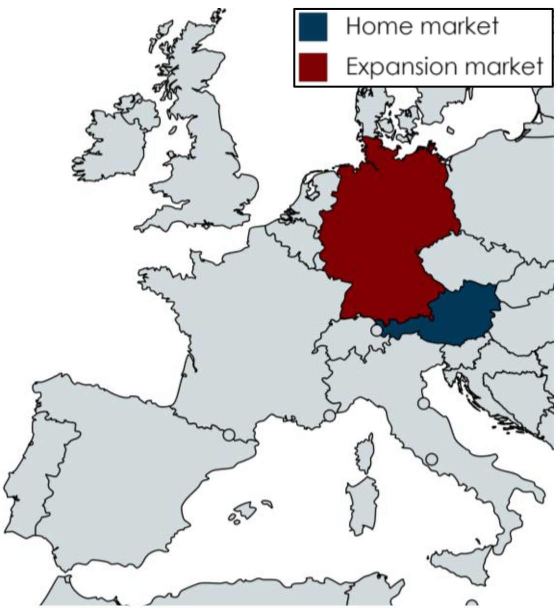


Figure 6: Home market and expansion market BM7


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installed in Austria, whereas in Germany a large-scale rollout of modern metering equipment and smart metering systems for residential consumers is expected in the coming years.

oekostrom has investigated replicating this BM in the German market, though has not made a positive evaluation of this replication. The main barrier is the high number of DSO that operate on the German market and the higher competition on the retail supply market.

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# EDP (Portugal)

## Introduction

The BM implemented by EDP Portugal entails activating and marketing the flexibility of consumers. EDP provides installations of some of its large office buildings, industrial and agro-industrial customers with price signals that are used to control the customers' electricity consumption. This flexibility is used to lower the imbalance cost and electricity sourcing cost of EDP's entire portfolio. The customer, who is the flexibility provider, receives a remuneration for the offered flexibility.

## Implementation evaluation

Table 8: Target and Implementation KPIs BM8

| **BM8: *Activation and marketing of end user's flexibility*** | Targeted KPIs | Implemented KPIs |
|---|---|---|
| KPI 1 (economic KPI) Number of controlled customers BM | 5 | 1 |
| KPI 2a (economic KPI) Capacity of controlled customers | 147 MW | 0.625 MW |
| KPI 2b (economic KPI) Annual consumption of controlled customers | n.a. | 1511 MWh |
| KPI 3 (economic KPI) Revenue from flexibility | n.a. | 1660 €/year |
| KPI 4 (economic KPI) Breakeven or not | n.a. | Yes |
| KPI 5 (technical KPI) Avoided imbalance | n.a. | 3-4 MWh |

While EDP initially targeted to have a portfolio of 5 customer, only a single customer was contracted by the end of the BestRES implementation period. The final implementation KPIs indicate a total capacity of 0.625 MW and an annual consumption of 1511 MWh. The flexibility leads to a revenue of 1660 €/year.

## Strategies, issues and solutions

### Customer Acquisition

The main customer acquisition strategy was to offer the aggregation service alongside other EDP services and present it as an upgrade of the existing monitoring solution. Account managers integrated the BM in their usual acquisition activities, which lead to a direct way of presenting these solutions to new or existing clients. EDP reports that **this helped to increase the credibility**

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**of this innovative service as EDP's service portfolio is well established in the Portuguese energy sector.** EDP also launched a webpage to inform potential clients about the BM, though reports that this strategy was not effective.

Before the BM was implemented, each potential customer was evaluated on a case-by-case basis. This preliminary study assessed the flexibility potential of the clients and evaluated the BM's economic incentives (revenue potential) and implementation costs. While this raised the chance of a successful implementation, it also required accurate flexibility models to evaluate the potential costs and benefits for each customer. **Pre-financing this study exposes the retailer to a financial risk.**

**Value proposition**

The flexibility service allows EDP to provide additional customised services to the clients and to propose better prices to the most flexible clients. The value proposition is **to reduce energy costs through flexibility activation compensations**. As mentioned under client acquisition, EDP is a very strong and reliable brand in Portugal, which is very relevant to the implementation of this innovative BM.

**Software/Hardware**

The IT platform was developed internally with support from external consultants. This means that there was easy communication between customer and developer and problems could be solved internally. While this approach required dedicated and expert resources, EDP has found **that this approach has reduced costs compared to an external solution**. It furthermore brought additional know-how to the company.

The hardware equipment was specified by EDP and acquired through external suppliers. **Interoperable** and **off-the-shelf solutions** are used instead of inhouse developed equipment, which assured the **compatibility** of the hardware components. The provider selection process and qualification led to internal delays due. This approach allows the access to existing industrial solutions and creates independence from a single supplier

**Revenue and implementation**

This BM allows to improve the revenue streams from existing assets through optimal control by developing an optimal management strategy of the flexibility in the building's thermal inertia. The HVAC systems' flexibility can be used without changing the thermal comfort of the office buildings' occupants. To have significant revenues from this business model, participation of a large number of flexible assets is required.

EDP Comercial intends to launch a service based on this business model to capture new B2B clients in Portugal and to expand their activities to other countries. The aim is that this expansion will lead to a higher market share for

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electricity supply and therefore more revenues. A closer relationship with the clients is pivotal for a successful implementation of this business model.

**Regulatory Barriers and Market Design**

EDP faced two important barriers regarding the market design:

- Accessing the customer's data
- Accessing the aFRR market

A complete overview of regulatory barriers is given in the report "Preparation of legal and regulatory recommendations for the European level", written by the BestRES consortium.

# Expansion Market Analysis

The replicability of the BMs in Germany is assessed by a comparison of KDPs between Portugal and Spain.


Figure 7: Home market and expansion market BM8

The comparison of KDPs is given in Table 14 in Annex A. The discussions and official communication at a regulatory level in Portugal happen in Portuguese, while in Spain they happen in Spanish. In both markets, the average power price for medium-size consumers is around 100-150€/MWh. As Spain and Portugal share the Iberian spot market (MIBEL), price variability in both markets is the same. Since a floor price and cap price are in place, the volatility is limited compared to other European markets. In both markets the access to balancing markets is prohibited to aggregators. While the rollout of smart meters in Portugal is not completed, in Spain all customers have a smart meter.

The KDPs do not differ significantly between Portugal and Spain. There are specific differences in market conditions between the two countries that lead to barriers to the replication of this BM in the Spanish market. More information on this topic can be found in the BestRES report "An Assessment of the Economics of and Barriers for the Implementation of the Improved Business Models" [3]. The virtual implementation of this BM in the Spanish market is also described in the BestRES report "Documentation of Virtual Business Model Implementation and Results" [4].

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# Conclusion

As part of the BestRES project, 8 aggregation Business Models were implemented in 6 different European electricity markets. Based on the implementation experiences, as described in the BestRES report “Monitoring and Performance Evaluation of the Real-Life Pilot Projects” [1], several best practices and lessons learnt were identified.

The following conclusions capture patterns that emerge across the individual aggregator results. They are used to formulate a set of best practices that are applicable to wider European context.

## Customer Acquisition

A successful aggregation Business Model offers a solution that is **compatible with a wide range of assets and customer types to maximise the addressable market.** The Business Model should at the same time be **adapted to the size of the customer and to the relevant national and or regional context.**

For BMs that target residential consumers, **a personalised approach with a strong focus on customer interaction** is key to convince the customers of the benefits of aggregation.

## Value proposition

Offering a **competitive price and limiting the asset owner’s risk** is the most important value proposition for the clients of aggregation business models.

Valorisation of assets in **all short-term and long-term markets hedges the customer's risk** of price volatility in power markets.

Offering a **combined set of services** (electricity supply, flexibility services, trading of Guarantees of Origin, etc.) to create a **one-stop-shop for customers** is a successful way of **integrating the role of aggregators in European electricity markets.**

Specifically for residential consumers, **combining an economic rationale** (save money on electricity bill) **with green values** (decarbonisation) is a stronger value proposition than the monetary benefit only.

## Software and hardware

Depending on the specific application, both **internal and external hardware and software development** can be a good choice for aggregation Business Models.

The choice for **in-house developed software** allows to **react quickly to customer needs and solve issues.**

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A general lesson learnt is that **large-scale data analysis is the key to deal with the complexity of decentral and renewable electricity sources.**

## Revenue and Implementation

Aggregation BMs require a **clear revenue sharing model** in which the **monetary benefits** are shared **between the aggregator and the customer**.

## Regulatory barriers & market design

Country-specific **subsidy schemes**, **tariff components**, **access to balancing markets** and **legal metering requirements** significantly affect the **opportunities for aggregators** in specific electricity markets.

Furthermore, a **clear definition** of the **legal and regulatory framework** is **crucial** for the implementation of aggregation BMs. Unclear regulation, and the resulting ambiguous market roles and responsibilities, can lead to direct barriers for implementation.

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# A Appendix A

## A.1 Key Market Design Parameters UK and France

Table 9: Key Market Design Parameters in the UK and France

| UK | France |
|---|---|
| *KDP 1: Language* | |
| English | French |
| *KPD 2: Average power price for residential consumers* | |
| 18.39 c€/kWh (2018) [5] | 17,54 c€/kWh (2018) [5] |
| *KPD 3: Status of market liberalisation* | |
| Competitive retail supply market with no more than 20% market share by any participant. | Fully opened to competition in 2007. EDF is the main electricity generation and still accounts for 80% of retail power market. |
| *KDP 4: Competitors* | |
| 73 active licensed suppliers in June 2018. [6] | 116 authorised suppliers (as June 2018) from which 20 active suppliers on the residential and non-residential markets. [7] |
| *KDP 5: Smart meter rollout* | |
| 12.8 million smart meters installed (both domestic and non-domestic) as of 30 September 2018. [8] | Roll out of Linky smart meters began in 2009, to be completed by 2020. 15.3 million Linky smart meters installed at the end of 2018. [9] |
| *KDP 6: Market size and potential* | |
| 28 million electricity meter points in the British domestic electricity supply market. [10] | 35 million electricity meters in the French domestic electricity supply market. [11] |
| *KDP 8: Metering responsibilities* | |
| Department for Business, Energy & Industrial Strategy is responsible for the roll out of smart meters in the UK. | Enedis is responsible for deployment of Linky smart meters in France. |

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## A.2 Key Market Design Parameters Germany and France

Table 10: Key Market Design Parameters in Germany and France

| Germany | France |
|---|---|
| *KDP 1: Language* | |
| English | French |
| *KPD 2: Average power price for industrial consumers* | |
| 150 €/MWh [12] | 90 €/MWh [12] |
| *KDP 3: Price volatility on spot markets* | |
| Min: -76,01 €/MWh<br>Max: 128,26 €/MWh<br>Average: 44,47 €/MWh [13] | Min: -31,82 €/MWh<br>Max: 259,95 €/MWh<br>Average: 50,1984852 €/MWh [13] |
| *KPD 4: Access to balancing markets for aggregators* | |
| *Yes* | Yes |
| *KDP 5: Market Size and Potential* | |
| Rather low due to static grid charges | In 2018, a new grid charges methodology (Turpe 5) was introduced. [14] |
| *KDP 6: Metering requirements* | |
| First smart meter gateway certified, roll-out expected to start from 2019. Metering requirements are already established for consumers > 100.00 kWh. | Roll-out already started, Enedis already installed 13 Million meters |
| KDP 7: Intraday Trading | |
| Continuous Intraday trading of 15 minutes contracts | Continuous Intraday trading of 30 minutes contracts |


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# A.3 Key Market Design Parameters Italy and France

Table 11: Key Market Design Parameters in Italy and France

| Italy | France |
|---|---|
| *KDP 1: Language* | |
| Italian | French |
| *KDP 2: Average power price on wholesale markets* | |
| Average: 61.31 €/MWh<br>Min: 6.97 €/MWh<br>Max: 159.40 €/MWh<br>[15] | Average: 50.20 €/MWh<br>Min: -31.82 €/MWh<br>Max: 259.95 €/MWh<br>[13] |
| *KPD 3: Access to balancing markets for aggregators* | |
| Yes, market opening in progress | Yes, mainly demand response |
| *KDP 4: Market size and potential* | |
| Share of renewables in electricity production: 34.0% (2016)<br>[16] | Share of renewables in electricity production: 19.2% (2016)<br>[16] |
| *KDP 5: Relevant Subsidy schemes* | |
| • Tariffa Omnicomprensiva<br>• DM 6/7/2012<br>• Conto Energia | • Complément de rémunération |
| *KDP 6: Continuous Intraday Trading* | |
| No | Yes |

# A.4 Key Market Design Parameters Belgium and the Netherlands

Table 12: Key Market Design Parameters in Belgium and the Netherlands

| Belgium | Netherlands |
|---|---|
| *KDP 1: Language at regulatory level* | |
| Discussions and market design documents of TSO are usually in English | Documents and market design documents of TSO are usually in Dutch |
| *KDP 2: Language at market side* | |

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| | |
|---|---|
| Dutch and French | Dutch |
| *KDP 3: Usual PPA duration* | |
| Large solar or wind farms usually work with PPAs of 5 years or more. | Larger farms also work with slightly shorter PPAs |
| *KDP 4: Market potential* | |
| A lot of solar power is at household level. | There is strong growth in the solar market, and projects are on average larger. |
| Relatively little wind power projects come online. | There is growth in medium-sized wind farms. |
| *KDP 5: Subsidy scheme* | |
| Subsidy schemes are regional | There is a single subsidy scheme across the country. Netherlands works with the SDE+ market premium model, |
| Certificates and Guarantees are tracked by the regional regulators, leading to separate databases. | New SDE+ subsidised installations are published every year |
| Subsidy schemes do not require that the renewable power is traded on spot market, nor that the subsidy considers the performance of the trader. | The SDE+ scheme requires asset owners to find a competitive trader for them. This creates a stronger customer need. |
| *KDP 6: Competitors* | |
| There is strong competition with one market player that exerts a significant market power in certain products. | Competition is perceived less fierce. |
| *KDP 7: Ancillary service market opening* | |
| FCR market is opened but auctions are linked to aFRR, which is not yet opened to aggregators.<br>aFRR will be opened mid-2020.<br>mFRR is opened | All markets have been opened. However, for aFRR an aggregator can only participate in free bids (not capacity bids).<br>In general, ancillary service prices lie higher than in Belgium. |
| *KDP 8: Metering requirements* | |
| Elia has strict telemetering requirements. | Tennet is somewhat less strict about metering. However, the exact technical metering requirements are not always clear. |

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## A.5 Key Market Design Parameters Austria and Germany

Table 13: Key Market Design Parameters in Austria and Germany

| Austria | Germany |
|---|---|
| *KDP 1: Language* | |
| German | German |
| *KDP 2: Average power price for residential consumers* | |
| 19.76 ct€/kWh (first half of 2018) [5] | 29.88 ct€/kWh (first half of 2018) [5] |
| *KDP 3: Status of market liberalisation* | |
| More than 140 electricity suppliers and over 30 natural gas suppliers are active on the Austrian energy markets, providing a wide range of offers and prices. Some of these companies offer their services all across the countries, while others have specialised in individual regions. | In 2016, there were more than 1,000 energy supply companies active in the German electricity market. More than half of these companies supply less than 10,000 customers. |
| *KDP 4: Competitors* | |
| 140 suppliers | More than 1.000 suppliers |
| *KDP 5: Smart meter rollout* | |
| In Austria there are about 6 150 000 meters installed. Up to now, about 1 100 000 are smart meters (December 2017: 730 000 smart meters; December 2016: 519 000 smart meters)" | In 2016, there were no smart metering systems for residential consumers available in the German market. The rollout of smart metering systems is no longer expected to begin before the end of 2018, since no BSI-certified smart meter gateways are yet available in the market. |
| *KDP 6: Market Size and potential* | |
| A total of 6.15 million meters | A total of 50 million meters |
| KDP 7: Metering responsibilities | |
| In Austria, metering is a task of the DSOs. | In Germany, metering is a liberalised business. |

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# A.6 Key Market Design Parameters Portugal and Spain

Table 14: Key Market Design Parameters in Portugal and Spain

| Portugal | Spain |
|---|---|
| *KDP 1: Language* | |
| Portuguese | Spanish |
| *KDP 2: Average power price for medium-size consumers* | |
| 0.1 – 0.15 €/kWh | 0.1 – 0.15 €/kWh |
| *KDP 3: Price volatility on spot markets* | |
| The price on the Iberian spot market (MIBEL) are quite stable compared to other European markets. There is a floor price of 0 €/MWh which inhibits negative prices and the cap price is 180.3 €/MWh. In 2016, the maximum price was 75€/MWh. | |
| *KPD 3: Access to balancing markets for aggregators* | |
| In Spain and Portugal, aggregators are not allowed to participate in balancing services | |
| *KDP 4: Usual supply contract duration* | |
| 1-2 years | 1 year (renewable for 1-year periods) |
| *KDP 5: Metering Requirements* | |
| In Portugal the roll out of smart meters is not completed | The roll out of smart meters in Spain was finished in 2018. |

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# Technical references

| | |
|---|---|
| Project Acronym | BestRES |
| Project Title | Best practices and implementation of innovative business models for Renewable Energy aggregatorS |
| Project Coordinator | Silvia Caneva<br>WIP – Renewable Energies<br>silvia.caneva@wip-munich.de |
| Project Duration | 1st March 2016 – 28th February 2019 |
| Deliverable No. | D4.5 |
| Dissemination level* | PU |
| Work Package | WP 4 - Implementation and monitoring of improved business models |
| Task | T4.5 - Lessons learnt, best practices, extension of results to other market regions and aggregation levels |
| Lead beneficiary | 2 (3E) |
| Contributing beneficiary/ies | 5 (Good Energy), 6 (NKW BE), 7 (NKW DE), 8 (oekostrom), 10 (EDP CNET) |
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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 | Author |
|---|---|---|---|
| 1.0 | 12/02/2019 | 3E | Simon De Clercq & Carlos Guerrero Lucendo |
| 2.0 | 20/02/2019 | WIP | Silvia Caneva |
| | | | |

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