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DELTA

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DELTA BUSINESS MODELS
Report D2.3_v1

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Authors List

Leading Author			
First Name	Last Name	Beneficiary	Contact e-mail
Klemens	Leutgöb	e7	klemens.leutgoeb@e-sieben.at

Co-Author(s)				
#	First Name	Last Name	Beneficiary	Contact e-mail
1	Christof	Amann	e7	christof.amann@e-sieben.at
2	Guntram	Preßmair	e7	guntram.pressmair@e-sieben.at
3	Stefanos	Anagnostopoulos	KiWi	Stefanos@kiwipowered.com
4	Nikoleta	Andreadou	JRC	nikoleta.andreadou@ec.europa.eu
5	Venizelos	Venizelou	UCY	venizelou.venizelos@ucy.ac.cy
6	George	Karagiannopoulos	HIT	g.karagiannopoulos@hit-innovations.com
7	Ioannis	Papageogriou	EAC	IPapageo@Eac.com.cy

Reviewers List

Reviewers			
First Name	Last Name	Beneficiary	Contact e-mail
Linda	Henriksson	CARR	linda@carrcommunications.ie
Apostolos	Tsolakis	CERTH	tsolakis@iti.gr

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Executive Summary

The **DELTA project** aims to unleash the demand response (DR) potential of small and medium-sized electricity prosumers (those who both produce and consume) in Europe. DELTA proposes a DR management platform that distributes part of the aggregator's intelligence into lower layers of its architecture, in order to establish a more easily manageable and computationally efficient demand response solution. This approach includes the development of the DELTA Virtual Node (DVN) where a large number of customers (small to medium consumers, producers or prosumers) which share key common characteristics in terms of consumption, generation and available flexibility amongst others is clustered.

Against this background, the **report pursues the objective** to provide a detailed analysis of DR business models allowing small and medium-sized customers (consumers, producers and prosumers) to participate in the energy market and in the provision of innovative DR services. The detailed analysis of DR business models covers the main driving forces behind their marketability, it identifies the main needs of customers and presents the most relevant customer segments. In addition, a closer look is taken on the different channels how prosumers can be addressed and which cost and revenues are associated to the involvement of small and medium-sizes prosumers.

The **main elements of the analysis** can be summarised as follows:

- As a first step for the development of DELTA business models the heterogeneity of the different forms of flexibility markets is assessed, since these markets represent the sources for revenues related to the activation of DR-potential.
- A usual way to categorise DR business models is related to the different nature of the related income streams: Explicit DR or implicit DR. Following to the outcomes of the preceding work in the frame of the DELTA-project the report further develops those generic DR business models, which are generally appropriate for the incorporation of small and medium-sized prosumers. Although these business models are currently assessed only at an ideal-typical level, they represent a necessary basis for fine-tuning the functionalities of the DELTA-platform.
- In the main part of the report all generic DR business models undergo a detailed Business Model Canvas (BMC) assessment. BMC is a methodology that helps analyse the feasibility and marketability of business models in great detail. The BMC assessment shows that there exists a quite broad field of different value propositions, customer segments and ways how to address the customers. At the same time, we observe a broad range of key activities and key resources which are required for the provision of the underlying DR services. In spite of the heterogeneity observed, there exist certain features that are relevant for each business model if applied to small and medium-sized customers. From the point of view of market penetration, these features should be in the development focus for the DELTA-platform.
- For all business models the importance of so-called transaction cost – i.e. cost for information, coordination and decision-taking – increases with the involvement of small and medium-sized prosumers into DR schemes. As the financial incentives for the prosumers are small and profit margins for DR service providers are expected to be small as well all cost related to distribution to and communication with the potential customer need to be kept very low. Only those DR business models that actively manage and reduce transaction cost will be successful in the long run.
- The possible revenue streams depend on the specific DR Business Model applied. There are different markets for flexibility serving different purposes, including wholesale market, balance group trading and control energy market.
- Generally, those business models where the DR service is embedded in a larger service package – such as EES, facility management, supply of electricity, equipment provision – are more promising than DR services offered as stand-alone service. This observation is mostly related to the impact of transaction cost on profitability.

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List of Acronyms and Abbreviations

Term	Description
BG	Balance Group
BRP	Balance Responsible Party
BMC	Business Model Canvas
CAM	Control Area Manager
CPP	Critical Peak Pricing
DA	Day-Ahead
DR	Demand Response
DSO	Distribution System Operators
DVN	DELTA Virtual Node
EE	Energy Efficiency
EES	Energy Efficiency Service
EEX	European Energy Exchange
ENTSO-E	European Network of Transmission System Operators for Electricity
ESCO	Energy (efficiency) Service Company
EU	European Union
FEID	Fog Enabled Intelligent Device
FLESCO	Flexibility Service Company
FM	Facility Management
Hz	Hertz
ID	Intraday
IT	Information Technology
kWh	Kilowatt-hour
O&M	Operation and Maintenance
OTC	over-the-counter
PV	Photovoltaics
RES	Renewable Energy Sources
RTP	Real Time Pricing
SEDC	Smart Energy Demand Coalition
SME	Small and Medium Enterprise
TOU	Time of Use
TSO	Transmission System Operator

1. Introduction

1.1 Background of the DELTA project

The energy system is undergoing a paradigm shift as it evolves from the historic structure of centralised energy generation towards a network of distributed prosumers. Consumers are increasingly being encouraged and empowered to actively participate in the energy network with respect to consumption and generation. The future energy system will be a smart system, where all energy entities are given the opportunity to participate in the market place. This is reflected in the latest round of EU energy market legislation (European Commission 2018).

One of the main elements of energy transition implies an increasing share of renewable energy sources such as wind and solar in our energy mix, increasing volatility of the electricity system. However, that also implies that an energy system has to be managed in a more complex manner than it used to be. The supply of renewable energy is always subject to major fluctuations on a seasonal as well as on a daily scale and the future power network will require major investments in order to be able to cope with smaller and more decentralized generation units.

One important element in coping with the challenge of increasing need for flexibility is the demand side. If the demand side patterns are better adjusted to the supply patterns of the renewables this will reduce investments required on the supply to guarantee grid stability. This concept is called demand response (DR): Peaks and shortages of electricity supply are communicated to the consumers who reply by adapting their current consumption.

Technical solutions to realise the smart grid are already in place, but there is still a need for developing business models in order to make it economically feasible. There is some incentive for all parties involved to make use of demand response as it saves costs for consumers and for suppliers it can work as a tool to better balance their portfolio and optimise the sourcing costs. DR service providers also may be third parties that act as demand response aggregators, contracting directly with consumers, pooling together their demand response actions and selling them on the electricity market. Clarifying the roles and responsibilities of all these players needs to be accomplished in order to create a sound DR environment.

The **DELTA-project aims to unleash the DR potential of small and medium-sized electricity prosumers (those who both produce and consume electricity) in Europe**. DELTA proposes a DR management platform that distributes part of the aggregator's intelligence into lower layers of its architecture, in order to establish a more easily manageable and computationally efficient demand response solution. This approach aims to introduce scalability and adaptiveness into the aggregator's DR toolkits. One of the project's main innovations is the **DELTA Virtual Node** (DVN). The DVN is a cluster of customers (small to medium consumers, producers or prosumers) which share key common characteristics in terms of consumption, generation and available flexibility amongst others. The DVN transforms clusters of small to medium scale consumers, producers and prosumers into entities which can present much larger capacities for delivering DR services to the aggregator. Additionally, under the framework established by the DVN each customer will be equipped with a **fog enabled intelligent device** (FEID) which will gather and monitor energy related data from field devices, such as home appliances, distributed energy resources, storage components etc. The DELTA FEID will allow for real-time reporting of a prosumer's flexibility to the DELTA Nodes, while also being able to receive DR requests and distribute them to the facility's equipment.

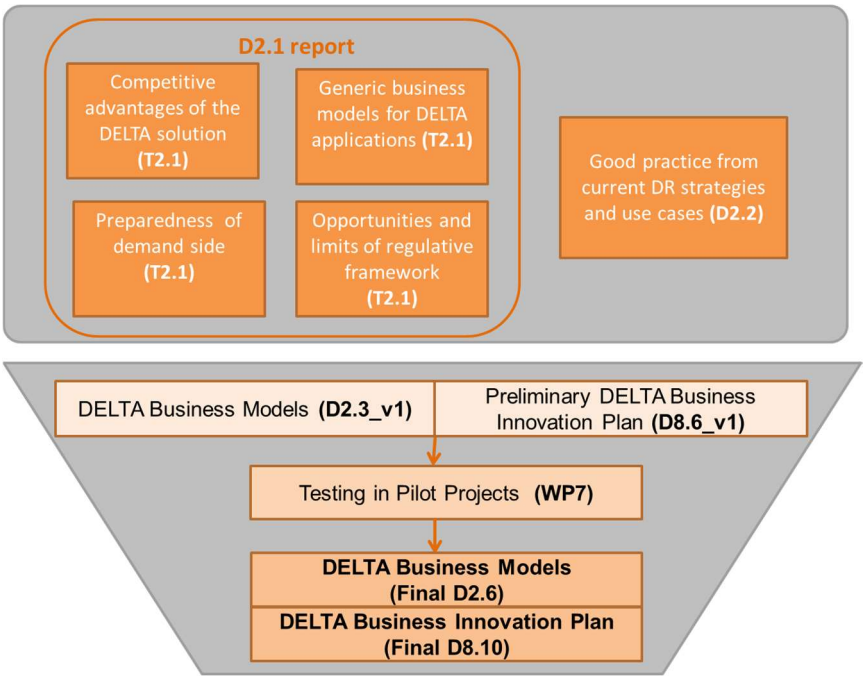
1.2 Scope and objectives of the deliverable and relation to other tasks and deliverables

In the frame of the DELTA-project this report aims at providing a detailed analysis of DR business models allowing small and medium-sized customers (consumers, producers and prosumers) to participate in the energy market and in the provision of innovative DR services. The assessment is based on the outcome of a number of preceding work steps, mainly on the assessment of current flexibility

markets (D2.1 Energy Market Analysis and Regulatory Guidelines specification v1), the analysis of current and future DR strategies (D2.2 Current and Future DR strategies Available and Enhanced DELTA DR Mechanisms Specification) as well as on the first version of D8.6 DELTA Market Analysis and Preliminary Business Innovation Plan.

The detailed analysis of DR business models covers the main driving forces behind their marketability, it identifies the main needs of customers and presents the most relevant customer segments. In addition, a closer look is taken on the different channels how prosumers can be addressed and which cost and revenues are associated to the involvement of small and medium-sizes prosumers. As such, the analysis serves as basis for the elaboration of a business models for the market introduction of the DELTA-platform, including marketing and pricing strategy, cost-benefit analysis as well as risk analysis, which will be the main objective of D8.10 DELTA Market Analysis and Preliminary Business Innovation Plan.

Figure 1 Context of the deliverable D2.3 and its relationship to other tasks



1.3 Structure and main contents of the deliverable

Against the objectives as described above, the structure and main contents of the report can be described as follows:

- In a first step, the various forms of flexibility markets will be summarised, since the value of DR is placed on these markets and they represent the major sources of revenue.
- In the following chapter, the generic DR business models, which have been already presented in D2.1 and D8.6, will be further elaborated.
- Against this background, all generic DR business models undergo a detailed Business Model Canvas (BMC) assessment. This part is the core part of the report as the BMC methodology helps analyse the feasibility and marketability of business models in great detail.
- Based on the outcomes of the BMC assessment the main cost elements and revenue streams related to the different business models are analysed in further detail.

At the current stage, this is a **preliminary deliverable**, since the work plan foresees an **enhancement of report during the further course of the DELTA project**. Among others, the following topics need to be enhanced towards delivery of D2.6 DELTA Business Models final version (due by March 2022):

- The analysed DR business models will be applied to the two pilot cases which are realised in the context of the DELTA project, highlighting their peculiarities and their features common to other EU situations.
- From the practical applications in the pilot projects we expect additional information on the marketability of the business models identified in assessed in this report, with the aim to develop a number of win-win models (both for prosumers and for DR service providers) for at least five types of small and medium-sized prosumer to be conflated by means of DELTA Nodes (average residential consumers/prosumers, average tertiary consumers/prosumers, producers, storage and micro-grids, etc.).
- In particular, we expect additional information from the pilot projects with respect to cost and benefits. On this basis, we will enhance the existing analysis towards a quantification of cost structures as well as expected revenue streams differentiated by DR business models. This will be consolidated towards an exemplary feasibility analysis by means of contribution margin accounting.

2. Heterogeneity of flexibility markets

As a basis for the development of DR business models it is important to understand the **heterogeneity of the different forms of flexibility markets**, since these markets represent the **sources for revenues** related to the activation of DR-potential.

2.1 The flexibility challenge in energy transition

It is widely accepted that flexibility is one of the major elements of the energy transition. With the growth of electricity produced in wind power plants or with photovoltaics, volatility in the electrical system increases accordingly. Transmission and distribution grids face new challenges as well (Figure 2). One of the basic requirements of electrical systems is the strict balance between production and consumption. This physical balance is one of the most challenging tasks of market players on the electricity market.

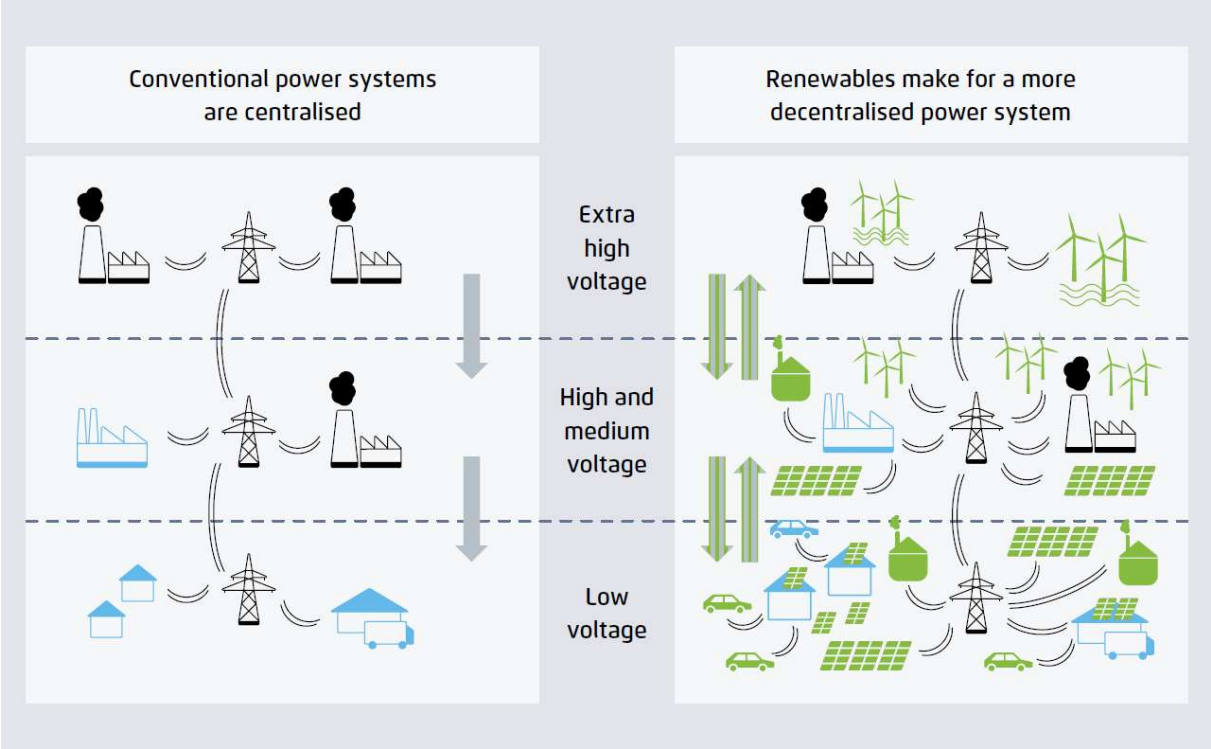


Figure 2: The flexibility challenge
Source: Agora Energiewende 2017, taken from Agora Energiewende 2019, A word on grids

Flexibility can either be offered on the production or on the consumption side (demand response, DR). However, flexibility is not only traded on a single marketplace.

This chapter gives an overview on different markets where flexibility is traded. All these markets have different market players involved, they follow a different reasoning and they try to solve different problems. Furthermore, they underlie different regulatory framework conditions.

2.2 Practical classification of flexibility markets in relation to DR business models

Depending on the focus there are several ways to classify electricity markets:

2.2.1 Regulation

One common way is to divide electricity market into a regulated area (i.e. operation of the grid), where market conditions are set by national and European regulation, further specified by national regulatory bodies and the liberalised area where market players compete to each other.
Main market participants in the regulated area are Transmission System Operators (TSOs), Distribution System Operators (DSOs), Control Area Manager (CAM).
On the other side, the liberalised market, there are electricity production, trade and supply. In this area, market players are competing with each other. The major market participants in the liberalised European electricity system are the Balance Groups (BG), represented by Balancing Responsible Parties (BRPs). BRPs are financially responsible for their imbalance in the electricity market. Imbalance in this sense means any deviation of electricity production and consumption from the schedule reported to the TSO/CAM. All electricity producers, traders, suppliers and consumers (indirectly via their supplier) are members of a balance group.

Flexibility is needed and traded in both spheres, however, for different purposes and with different market mechanisms.

2.2.2 Time resolution

It is very common to classify the electricity market along the time resolution of market procedures (Figure 3), dividing electricity market into:

- Futures Markets,
- Spot Markets, and
- Balancing Markets.

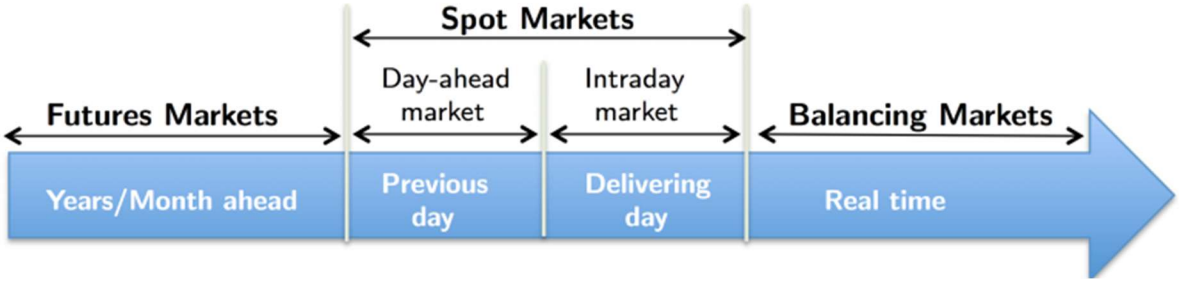


Figure 3: Market classification along time resolution
Source: incite 2019 (http://www.incite-itn.eu/blog/introduction-to-electricity-markets-its-balancing-mechanism-and-the-role-of-renewable-sources/)

One important thing to know is that the price per kWh traded typically increases from future markets towards real time markets, i.e. flexibility is more expensive than future products for the same period of time.
Flexibility is commonly traded within the time frame of spot markets and balancing markets, i.e. from day-ahead to real time.

2.2.3 Organisation of electricity markets

Another very common distinction is the organisation of the electricity markets. Within the liberalised area, he largest share of energy is traded outside organized markets, so-called Over-the-Counter (OTC) market. Products are not standardized and market players interact directly there. However, prices are

oriented at prices from organized markets which are integrated at the European Energy Exchange (EEX). EEX market is further divided into the forward market and the spot market. Within the spot market two main time frames are relevant: Day-ahead (DA) and Intraday (ID).
Market for ancillary services, relevant for reliable and secure operation of the grids, can be considered an organized market as well. Products and criteria for market participation (prequalification etc.) are highly regulated, procurement of services is competitive.
Flexibility is needed and traded in both types of markets.

2.2.4 Retail vs. wholesale market

Final consumers like residents, SMEs, and most of the industry are supplied with electricity from the retail market where electricity provider supply their customers with energy. Larger entities (e.g. energy intensive industry) and energy retailers (traders, suppliers etc.) trade their energy on the wholesale market, either on the EEX or bilaterally (OTC). A rather circular definition defines the retail market as any market where electricity is traded via a retailer and not on the wholesale market. However, a clear definition or criteria for a distinction is not available.

Flexibility is typically traded on wholesale markets, but final consumers are facing an increasing amount of flexible tariff offers (dynamic tariffs). Future regulation will increase the size of this market further.

2.2.5 Practical classification: Flexibility markets

As a kind of first summary, it can be stated, that common classifications do not help to come up with one single and clear definition of a flexibility market. It is rather the case that flexibility may play a role in all classifications but it is an extra task to define, how flexibility contributes to specific markets. For the purpose to understand flexibility markets, it is proposed to use a practical classification that is further elaborated below (Figure 4).

Flexibility (flexible loads) can be traded on different markets:

- Retail market (e.g. dynamic tariffs)
- Wholesale market (forward market, day-ahead market, intraday market)
- Balancing market
- Ancillary and system services markets
- Congestion management and redispatch
- Capacity mechanisms

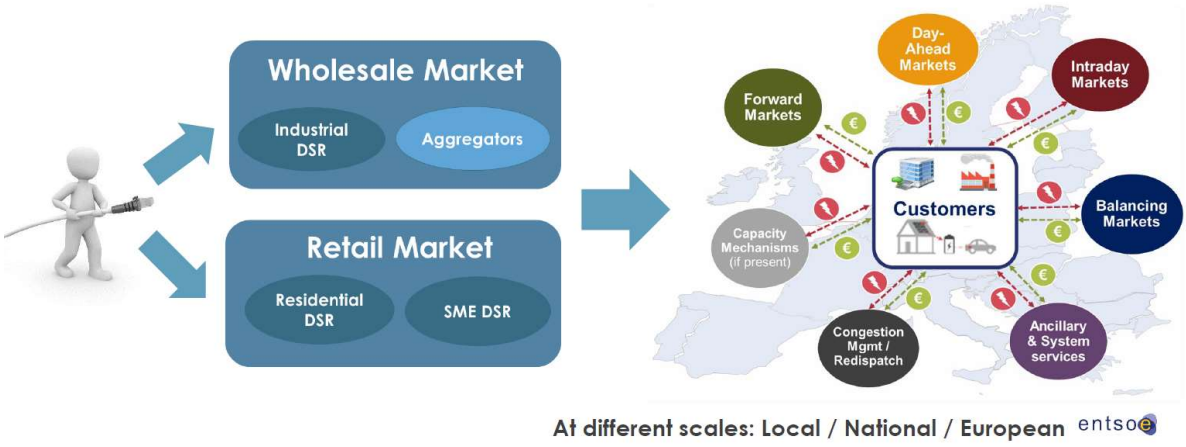


Figure 4: Flexibility markets
Source: ENTSO-E 2018 (Constantinescu, Norela: Transmission and Distribution Interaction: ENTSO-E, Presentation at the IRED 2018, Vienna)

2.3 Flexibility from different perspectives

The next question that will be discussed here is: What is the reasoning behind the different markets from different perspectives. In other words: which technical problems have to be solved with the use of flexibility?

2.3.1 Flexibility from the grid perspective

The grid perspective is the most common when it comes to flexibility markets. Grid operators have to guarantee high quality, reliable and secure operation of transmission and distribution grid continuously. In order to do so, it is necessary that demand equals production all the time. Changes of this balance will immediately lead to a change in frequency (50 Hz), an increase of demand reduces the frequency and vice versa. In the European electricity system, transmission system operators (TSOs) are responsible for (transmission) grid operation, they have to keep frequency, voltage and load imbalances within narrow ranges of tolerance (Figure 5).

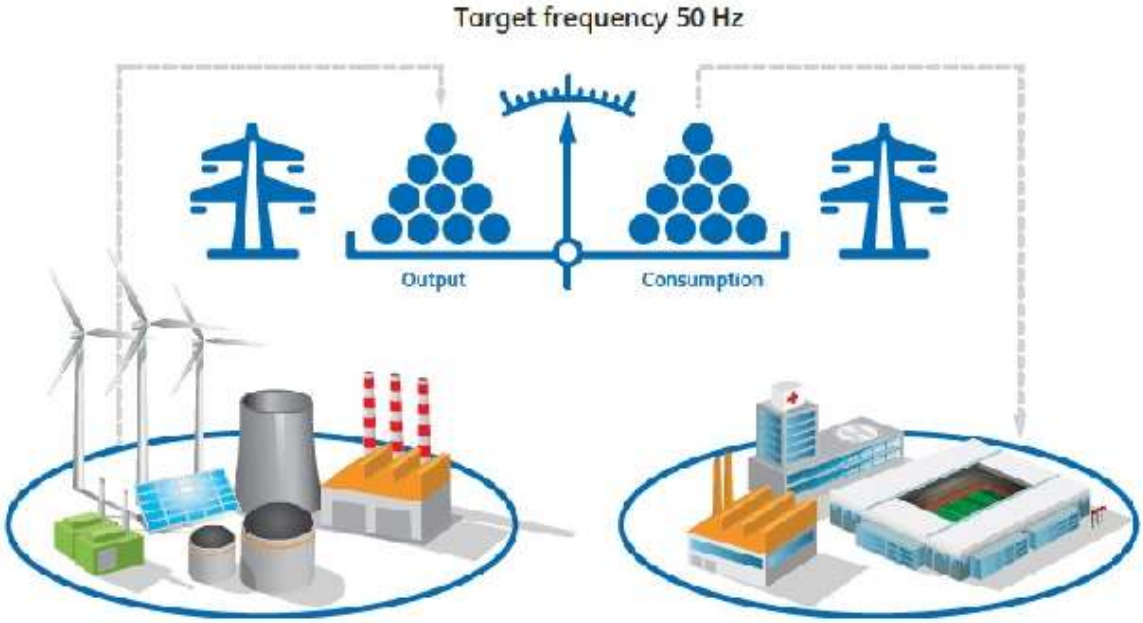


Figure 5: The target frequency of 50 Hz
Source: General Electric 2019 (www.ge.com/content/dam/gepower-pgdp/global/en_US/images/service/upgrades/jenbacher/primary-secondary-tertiary-balancing-power-operation.jpg)

For frequency control well established and clearly defined instruments within the so-called control energy market are available (Figure 6). Whereas control energy market was dominated by traditional power plants in former years, flexible loads are increasingly allowed to participate in this market since quite some time. These flexible loads can be offered directly (typically industrial loads) or via an independent aggregator (medium sized loads). While aggregation is allowed in most countries there are still a lot of regulatory and technical barriers as all market participants have to be approved and consent from the energy suppliers is required.

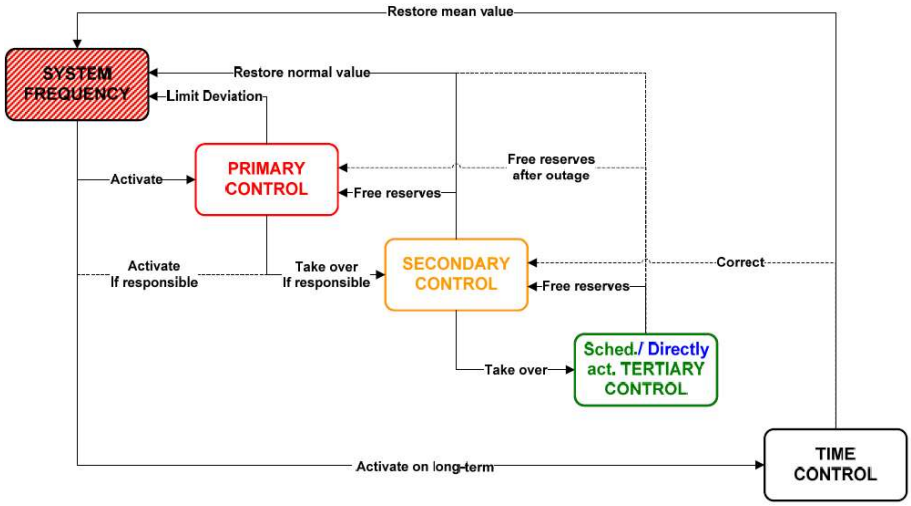


Figure 6: Control scheme and actions starting with the system frequency
Source: UCTE 2009: Policy 1: Load Frequency Control

Instruments or products for grid operation are called ancillary services (dena 2014, pp. 8f.):

- Operational management (feed-in management, congestion management, operational planning, data exchange etc.)
- Frequency control (instantaneous reserve, primary balancing capacity, secondary capacity, minutes reserve capacity)
- Voltage control (transformers gradation, control of reactive power, control of power generation plants)
- System restoration (black start capacity, capacity for island operation, co-ordination beyond grid level)

Relevant flexibility markets: tertiary control, secondary control, and - to a minor extent currently but with increasing relevance - primary control. Flexibility can also be used for congestion management.

2.3.2 Flexibility from the perspective of energy production

One major reason for the need of flexibility is the increasing production of volatile renewable energy like wind power and electricity from photovoltaics. Depending on the weather and the time of the day and year, production changes dramatically within short time periods. This characteristic is reflected in the prices on wholesale markets, which are low in times when production is high and demand is low and vice versa - without any consideration of locality and grid load. There are even times with negative prices, i.e. clients receive money for consuming energy (apart from grid charges and similar fees).
Flexibility can help to increase the amount of energy from renewable resources in the energy system by shifting energy consumption towards times where production is high resulting in a reduced energy bill as high production typically correlates with low energy prices.
From a grid perspective, this relation may lead to problems in the operation of the grid when capacity of the grids is exceeded. TSOs will have to start congestion management measures like re-dispatch activities.

Relevant flexibility markets: Wholesale market (spot market, day-ahead and intraday markets)

2.3.3 Flexibility from the balancing/imbalance perspective

All market participants on the electricity market (producers, traders, suppliers, consumers) have to be members of a commercial balance group (BG). These balance groups are financially responsible for their own balance, i.e. the balance between production and consumption or buying and selling respectively. Deviations from the schedule have to be reported to the TSO and result in cost for

imbalance and hence, balance groups are interested to reduce imbalances as far as possible. This can be done by procuring necessary energy or loads, i.e. flexibility, on short term markets, mainly on the intraday market or by trading energy between BG. As balance groups are part of the open market area, flexible loads on the side of consumers can be used as well. The precondition of this is, that energy suppliers - as part of the balance group - offer delivery contracts with an option for load control.
In contrast to the grid perspective, the focus is on reducing imbalance costs by avoiding deviations from reported schedules. Grid conditions are only affected indirectly.

Relevant flexibility markets: Spot market, mainly intraday market; retail market with load control contracts for final customers; OTC trading.

2.3.4 A kind of summary: Flexibility from the energy system perspective

From the energy system perspective, the overall goals with respect to flexibility are:

- Decarbonisation of the energy production by increasing the share of volatile renewable energy resources (RES) and to increase energy efficiency (EE)
- Secure and reliable system operation by using flexibility to deal with volatility and to handle distributed production of RES (prosumers)

Flexibility is seen as an important means to reach these overall goals. However, as was shown above, market design requires flexibility at different points, requested by different market participants with different, sometimes contrary, reasoning. This has to be kept in mind when market development for flexibility (demand response, DR) is forced. New, innovative business models will have to consider this as well.

3. Generic DR business models for small and medium-sized prosumers

This chapter further elaborates the analysis performed in DELTA-Report D2.1_v1 (Leutgöb, Amann, 2018), since the generic DR business models identified in this report set the basis the market analysis with respect to the DELTA-platform. In this report, it has been analysed whether the current DR business models are appropriate for the participation of small and medium-sized prosumers, or whether there is a need for the definition of new or adapted business models that allow for the participation of small and medium-sized prosumers.

A usual way to categorise DR business models is related to the different nature of the related income streams: Explicit DR or implicit DR. Furthermore, business models Microgrid Management and DR including equipment provision may relate either to explicit DR or implicit DR. Altogether, we have identified to following six generic DR business models which are relevant in the context of the application of the DELTA platform in the future:

- Explicit DR as stand-alone service
- Explicit DR combined with energy efficiency services (EES)
- Implicit DR service for optimal use of time-of-use (TOU) contracts
- Implicit DR including power supply
- DR including equipment provision (may be either implicit or explicit DR)
- Microgrid Management (may be either implicit or explicit DR)

3.1 Business Model "Explicit DR as stand-alone service"

In this business model, a DR Aggregator is bundling DR potentials from different clients, which are too small as stand-alone potentials to be offered to the various flexibility markets. The main characteristics of this business model are as follows (cf. Figure 7):

- The **aggregator acts as facilitator**. He has access to the DR potentials of clients and manages them towards the various flexibility markets. Depending on the regulatory framework he may offer the DR potentials either on the electricity balancing market (tertiary or secondary control markets) or he may participate with these loads in a balance group, represented by a Balancing Responsible Party (BRP).
- The **income streams** originate from payments either from the Transmission System Operator (TSO), from the Distribution System Operator (DSO) or from the BRP – in the latter case, these payments would reflect reduced balance power expenses in a balance group. Depending on the contractual agreement, the aggregator will usually pass on a certain share of these payments to the clients in his portfolio.
- The service of DR aggregation has **no interlinkage to power supply** or any other service to be provided for the client. In other words, this means that in this business model many interfaces need to be managed.

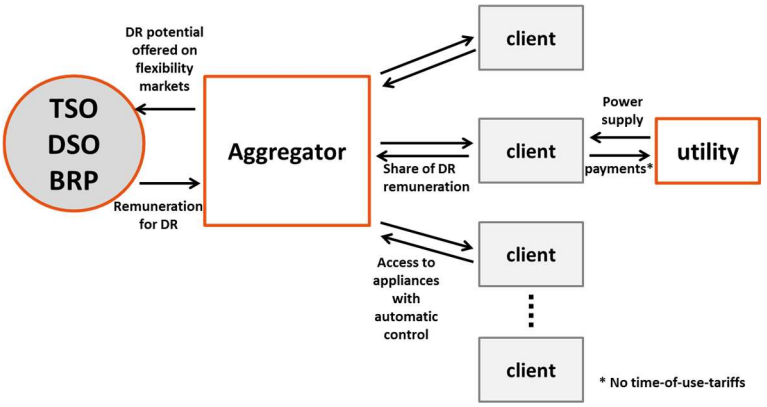


Figure 7: Business Model Explicit DR as stand-alone service

The business modell of explicit DR as stand-alone service is a standard approach widely used for commercial exploitation of large DR potentials, e.g. in industrial plants (typical case cement industry). The transferability to small and medium-sized prosumers depends on better and cheaper incorporation of small and medium loads from the residential and tertiary sector and on higher reliability of DR potentials which are achieved by bundling of small- and medium-sized loads. In particular this addresses the following factors:

- **Improvements to software solutions for aggregation** of small and medium-sized loads: Among other issues, there is a clear requirement to improve the functionalities related to bundling of small loads, to availability forecast as well as to automatic dispatching funtions.
- **Easy access to a large number of switchable devices** needs to be ensured (cf. the section above on latest market development regarding so-called smart devices): If, for example, the access would require up-grade of existing devices, the cost-benefit ratio of such activities would become negative very quickly.
- **Attractive value proposition to the clients:** A more detailed analysis of the user perspective, and namely of the users' willingness to participate in DR programmes (Leutgöb, Amann 2018) concludes that only a limited share of households will react to economic incentives for DR-participation, as the savings achievable for single households are expected to be quite small in most cases. In the tertiary sector the economic incentive has a higher weight than in the household sector, but in return comfort and availability consideration represent a more important barrier. Therefore, the value proposition thus needs to be adapted to the specific customer segment.
- **Distribution channels and customer relationships:** The aggregator needs to be able to address a large number of small and medium-sized customers at low cost. The distribution structure needs to achieve economies of scale very quickly, otherwise the sales cost will exceed the total achievable margin from the sum of single clients[1].

Altogether, we conclude that the business model related of explicit DR as stand-alone service has to cope with considerable barriers, mainly related to easy and cheap access to the clients as well as to the formulation of an attractive value proposition due to the fact that the service is offered as stand-alone service. Thus, the transfer of this business model to small and medium-sized customers will be rather difficult except for those customers that are somewhere between a medium and a large customer, such as large non-residential buildings. But even for this target group a combination of DR-services with other service components – as considered in the business models below – may be more attractive than the stand-alone service.

[1] *This challenge of sales cost for overall profitability is similar to the one small-scale energy efficiency services are confronted with. It can by analysed by means of a multi-level contribution margin calculation (cf. Leutgöb et al., 2011)*

3.2 Business Model "Explicit DR combined with EES"

In its general approach, this business model is similar to explicit DR as stand-alone service – as described above – but the DR aggregation service is embedded into a more comprehensive energy efficiency service (EES). This approach, which is sometimes referred to as "**dual service**", is characterised by the following peculiarities:

- As described above, there exists a **trade-off between energy efficiency and demand response**, as load shifts in many cases will lead to an increase of energy consumption. Therefore, the main challenge of a dual service is to find an optimised solution for this trade-off on a day-to-day basis.
- EES and DR services require different fields of expertise and competencies. Whereas the core knowledge of EE service providers (frequently called ESCOs) is related to the operation of technical equipment, the success of DR service providers (usually provided by a DR Aggregator) is mainly based on a thorough understanding of the flexibility markets. Therefore, the combination of both services into one integrated offer is not easy and requires clear and transparent definition of the **ESCO's and the DR Aggregator's role**.

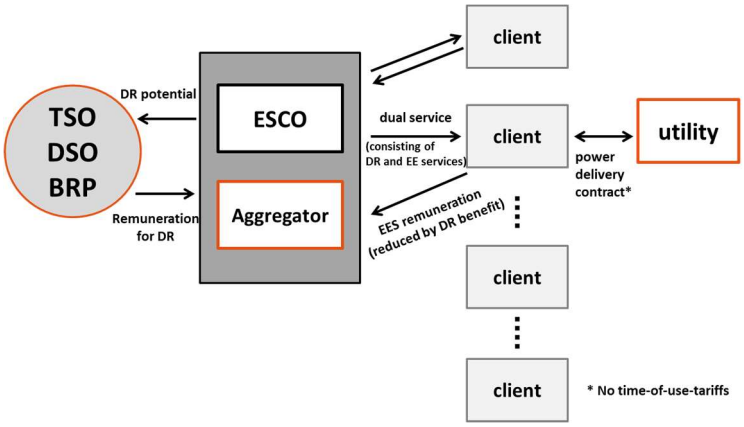


Figure 8: DELTA Business Model Explicit DR combined with EES

Except of a few pilot projects, we are not aware that dual services are already offered on European markets. In any case, this business model is closely linked with the development of EES markets. If EES are increasingly offered also to small and medium-sized customers, DR-potentials could be harvested in this sector, too.

The business model of dual energy services can enforce further monetisation of energy savings by exploiting their potential to be used in the DR market (as soon as national DR markets reach maturity). Furthermore, the business model of dual energy services gives way to higher market penetration of EE-upgrades of buildings and installation of renewable energy sources (RES) systems both in the building/district and the grid scale facilitated by the provision of DR services (including system charges optimisation and direct grid services).

We expect that the business model can become successful in the medium term within the following framework and provided that the following preconditions are fulfilled:

- The package consists of **EES as guiding service** and DR as add-on service. There need to be clear rules for the collaboration between the ESCO and the DR Aggregator. In this context, the functionality of price forecasting gains increasing importance as it supports solving the trade-off between energy efficiency and load shifting in optimised way.
- The **main target groups will be the same as for the EES business**, which – because of transaction costs – are limited to customers with energy cost beyond 20,000 to 30,000 €/a in most European markets.
- The **project structure needs to be adapted to the specific customer**: The main structuring elements of an ESCO contract refer on the one hand to the detailed definition of responsibilities of the ESCO and the related interface to the responsibilities of the client, and on the other hand to the remuneration model – often subdivided into the guaranteed savings model and into the

shared savings model. By introducing the DR-component into the project, the additional structural element of implicit versus explicit DR arises.

3.3 Business Model "Implicit DR service for optimal use of TOU-contracts"

This business model starts from the fact that already now a certain group of electricity customers have electricity tariffs with different price levels depending on the time of consumption – either **time-of-use (TOU) pricing,** or **real-time-pricing (RTP),** or **critical peak pricing (CPP)** (Cooke, 2011):

In EU countries electricity tariffs consist of one component related to electricity delivery and one component related to the utilisation of the grid, where the latter is defined by regulation. Therefore, the time-dependent structure of the tariff may relate either to one of these components or to both of them. For small and medium prosumers, the only time-dependent pricing model that is currently available on the market is TOU contracts, whereas RTP does not exist in this sector. We expect that in the near future more different and more differentiated TOU tariffs will be offered on the market. In addition, we may see in the near future CPP also for medium-sized prosumers, mainly if, for example, a customer with a larger portfolio will explicitly search for a time-dependent tariff for a whole pool of facilities.
The business model related to implicit DR service for optimal use of TOU contracts is characterised by the following elements and success factors related to the its application for small and medium-sizes prosumers:

- The service provider – in D2.1_v1 we have introduced the term **flexibility service company (FLESCO)**, corresponding to the widely used term ESCO – takes care of load shifts at the equipment of the client in a way that the client takes maximum benefit of an (existing) TOU tariff. The FLESCO's remuneration may be either fixed or performance-based.
- The economic advantageousness of the business model is depending on the **spread between high and low price in the tariff structure**. Only if the spread is sufficiently high the achievable savings will be attractive for clients to engage a DR specialist. If perhaps in future dynamic pricing models (CPP, RTP) will be increasingly available on the market there will be a higher need for external expertise.
- Implicit DR services for optimal use of TOU-contracts **can be offered as stand-alone services**. In this case, however, the disadvantages related to all stand-alone DR services apply (high transaction cost require quick achievement of economies of scale, and thus well-established distribution channels and customer relationships).
- We expect that the service will be more successful, if it is **embedded in services which are already offered on the market**. On the one hand, the service is strongly linked to the role of a technical facility manager, as they are usually aiming for a reduction of operating cost. On the other hand, there is an interlinkage with consultancy services related to the identification of the most attractive energy tariff.
- The **most promising target group** are medium-sized are those customers that have already outsourced the facility management to an external partner. In this case, the service may be offered as add-on to existing service elements (cross-selling potential). This approach will require, however, cooperation between facility management companies, which have a solid position at their customers, and DR specialists, such as DR aggregators.
- From the **technical point of view** there exist two crucial success factors for FLESCOs: i) know-how in operating facilities, easiest by means of master control systems (such as building management systems); ii) capability to manage information about price signals – potentially dynamic price signals –at the customers metering points for a larger number of customers.

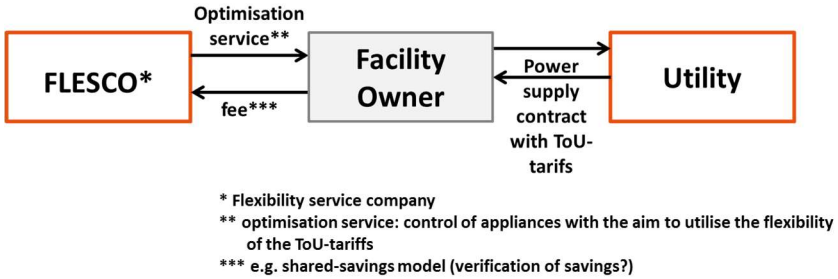


Figure 9: DELTA Business Model Implicit DR service for optimal use of TOU-contracts

3.4 Business Model "Implicit DR including power supply"

This business model related to implicit DR including power supply combines DR services with the role of a retailer on the electricity market. The model is characterised by the following main elements:

- In addition to its usual function of selling electricity to customers, the **retailer has access to DR potential at the customers' sites** and is allowed to shift loads within the contractually agreed limits. Therefore, the business model goes beyond offering TOU tariffs, but includes active management of DR potentials at the customers.
- From the retailer's point of view, the access to **DR potential represents a value** as it may lead to savings both in wholesale prices and in balancing energy payments, since these prices are subject to high fluctuations depending on time of purchase. The more the retailer will be able to adapt the consumption patterns of his customer to the off-peak times on the market, the better will be his average wholesale price.
- In addition, the business model is particularly attractive for retailers that are also producers with a **high share of fluctuating renewables sources (wind, PV) in their supply portfolio**. By activating DR potentials, they can reduce the gap between supply and demand and thus reduce balancing energy payments.

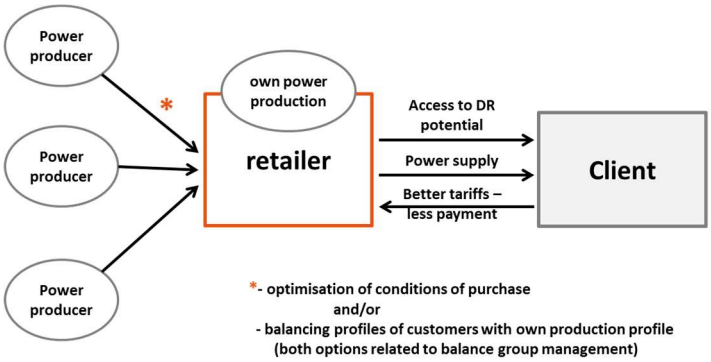


Figure 10: DELTA Business Model Implicit DR including power supply

The business model has a high potential of transferability to small and medium-sized prosumers. The following factors, however, are important for successful market penetration:

- Generally, **retailers are in a good starting position** and can get comparably cheap access to DR-potentials as they have established working distribution channels and customer relationships (including billing) which may help them in offering DR as add-on to existing services.
- The **customer will require an incentive**, so that he is willing to grant access to his technical systems to an external party. The most obvious incentive is to receive a favourable electricity tariff. But for small- and medium-sized customers also non-financial incentives may be decisive – such as environmental considerations or enthusiasm for the most current technical developments.

- Because of comparably low transaction cost for retailers when accessing their customers, we assume that the business model may be also **applicable to the household sector**. Here the main barrier is the access to switchable devices in a way that they can be automatically managed (without manual interventions on a case-by-case basis). Taking into consideration the assessment on smart devices as presented above, the most relevant DR potentials in the short and medium term are heat pumps, air conditioners and possibly electrical heat storage systems. Also, electric batteries might be relevant in this context, but their market is yet quite limited.
- To certain degree, energy retailers are able to play a role on increasing market penetration of smart devices. They could prepare and distribute **programmes where the (subsidised) sale of smart devices is combined with a special tariff** that allows for implicit DR. In the past similar programmes have been successfully implemented by utilities related to the dissemination of highly energy efficient appliances and they might be adapted to the case of increased DR participation of small and medium-sized prosumers.
- Furthermore, the retailer will require **suitable software platforms** that are to bundle and to dispatch automatically as many DR potentials at the costumer's side as possible. The retailer will have core interest in the platforms ability to synchronise the use of DR potentials with productions patterns – if the retailer is also an electricity producer – and/or with price signals on the wholesale market.

3.5 Business model "DR combined with equipment provision"

Equipment providers can be either "equipment manufacturers" selling own devices or "equipment aggregators" selling also integrated platforms to provide interoperability with devices from other manufacturers. (c.f. role definition in Table X). In this generic DR business model, the equipment provider integrates services related to DR in its core business model. This can result in explicit or in implicit DR. The following sections highlight the main elements in both models.

3.5.1 Explicit DR by equipment providers

- In addition to its core business model, the equipment provider acts as a DR aggregator bundling DR capacities from prosumers and selling these capacities on flexibility markets.
- In this way the equipment provider can generate additional revenues from flexibility markets while controlling their devices sold to the prosumer.
- In return the prosumer receives a remuneration which can be a direct payment or also a discount on products or services of the equipment provider.
- The key advantages in this model are the already established relationship between prosumer and provider and the fact that the equipment provider knows exactly the load shifting potential of their devices.
- If this model is applied by a specialised equipment manufacturer (e.g. heat pump manufacturer) it is specifically suitable for accurately targeting the most promising DR capacities.
- Note: The explicit model is only applicable to prosumers with conventional energy tariffs (no variable tariffs).

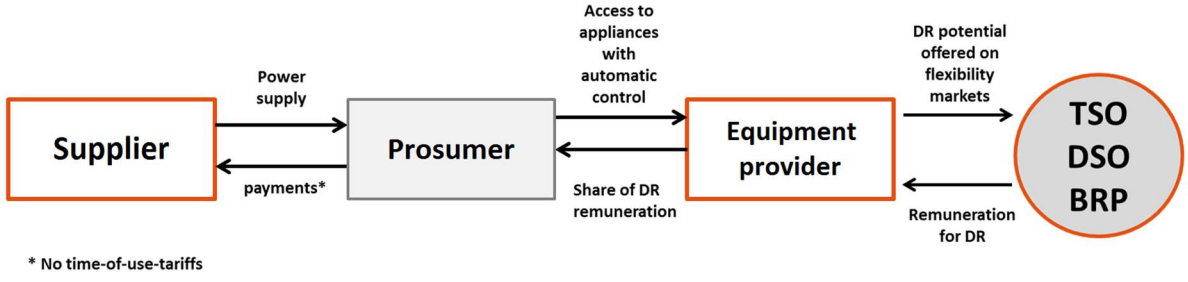


Figure 11: Business Model Explicit DR by equipment providers

3.5.2 Implicit DR by equipment providers

- In addition to its core business model, the equipment provider offers the service of a FLESCO. The equipment provider operates the devices sold to the prosumer ensuring optimal use of the prosumer's variable tariff.
- The equipment provider generates additional revenue from a service fee paid by the prosumer for the service of optimal load shifting.
- In return the prosumer can make the most of the variable tariff and minimises its electricity costs.
- The advantages of this model are the same as in the explicit model.
- Note: The implicit model is only applicable to prosumers with variable energy tariffs.

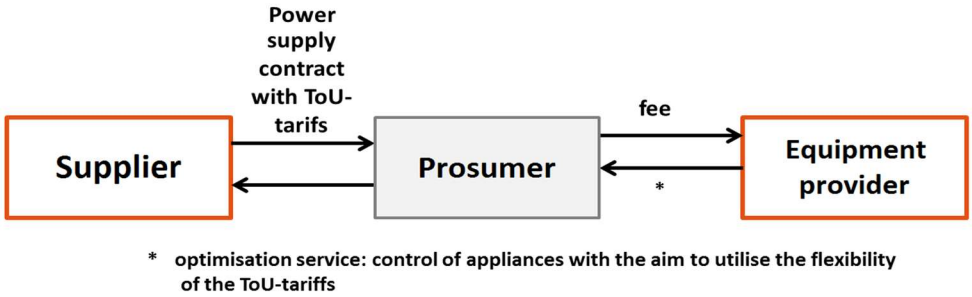


Figure 12: Business Model Implicit DR by equipment providers

3.6 Business Model "Microgrid Management"

According to the US Department of Energy Microgrid Exchange Group a microgrid can be defined a group of interconnected loads and distributed energy resources (such as distributed generators, storage devices, or controllable loads) within clearly defined electrical boundaries that acts as a single controllable entity with respect to the (macro)grid. A microgrid can connect and disconnect from the grid to enable it to operate in both grid-connected or island-mode (Berkley Lab, 2018).

- If operated in **island-mode** the microgrid manager has to ensure at each point in time that power supply is equal to power demand. In achieving this prerequisite, the exploitation of DR potentials including proactive operation of storage devices is decisive.
- If operated in **grid-connected mode** the microgrid manager can make use of the DR potentials available internally in the microgrid. He can either offer the loads in tenders of TSO, DSO or BRP (explicit DR) of optimised electricity cost by adapting the load profile of the microgrid to dynamic pricing (implicit DR).

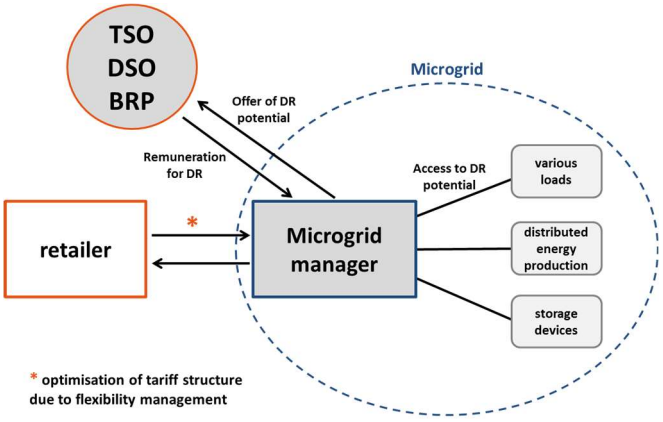


Figure 13: Business Model Microgrid Management

Microgrid management is a very relevant business model for the activation of medium-sized DR potential that qualify for formation of a microgrid. The most relevant application fields for this business model will be those cases where a complex demand structure is complemented by decentral renewable energy production on the site or nearby the site (e.g. university campus, green-field neighbourhood development, business parks etc.).

However, in practically all EU countries the **regulatory environment is a current blockage for microgrid development**. According to Energati (2018) Europe is accounting for just 9% of the global microgrid capacity. There are, however, several pilot microgrids, e.g. related to university campuses or to industrial and commerce centres.

A professional software solution for managing and dispatching the various loads is a "must" for microgrid managers, independently from whether they operate the microgrid in island-mode or grid-connected mode. The larger and more complex the microgrid the more relevant a professional platform is to enable dispatching the interconnected loads and distributed energy resources and to optimise the exchange with the external macrogrid.

3.7 Stakeholders driving the generic DR business models

The generic DR business models as presented above point out to **different stakeholder groups** that are the driving forces behind the implementation of the business model, thus becoming the core customer groups for the DELTA-platform. To sum up, the following stakeholders may become the most important users of the platform in the future:

- **DR Aggregators:** The DELTA-solution helps them to expand their business model to the segment of small and medium-sized prosumers in a cost-efficient way thus increasing the value which they are able to offer to the various flexibility markets as described in chapter 0.
- **Energy Retailers:** They utilize the DELTA-platform to ensure access to DR-potential as means of enforcing their position on the energy supply markets (wholesale market, balancing market) – due to the activation of DR-potential they may be able to achieve better purchase prices.
- **EES-providers and Facility Managers:** For this target group the DELTA-platform may be useful as a tool to extend their portfolio mainly towards implicit DR services since these are closely related to facility operation and optimisation.
- **Microgrid-Managers:** For the moment, this target group is rather small, but with changing regulatory framework – for example related to the so-called local energy communities – their importance may grow over time.
- **Equipment providers:** Similar to the target groups of EES-providers and facility managers DR-related services may become an additional business field for equipment providers, if they intend to enlarge their value chain for operation phase (e.g. as add-on to maintenance and operation services that are already implemented in the market for some technical units that offer DR-potential)

4. Application of the Business Model Canvas to the DELTA Business Models

4.1 Brief Introduction to the BMC Methodology

One of the most common tools for business model development is the so-called business model canvas (BMC, cf. Figure 14). The BMC provides a framework that helps to structure business ideas and to evaluate their marketability, still being flexible for adaptations and the integration of new elements.

The general structure of the BMC consists of the following parts:

- The right side summarizes those **business model elements that are connected with the customer**: customer relationship, channels for customer approach, customer segments and revenue streams;
- The left side is related to business model elements that describe the **internal situation and challenges at the provider's side**: Key activities connected with the implementation of the business model, key resources required to implement the key activities, key partners and cost structure.
- Both sides are connected by the most crucial element of each business model, the so-called **value proposition**, which refers to the following key questions: Which problems at the customer's side is the service/product helping to solve? Which customer needs are satisfied by the service/product? What is the specific offering? What features or benefits match customer needs?

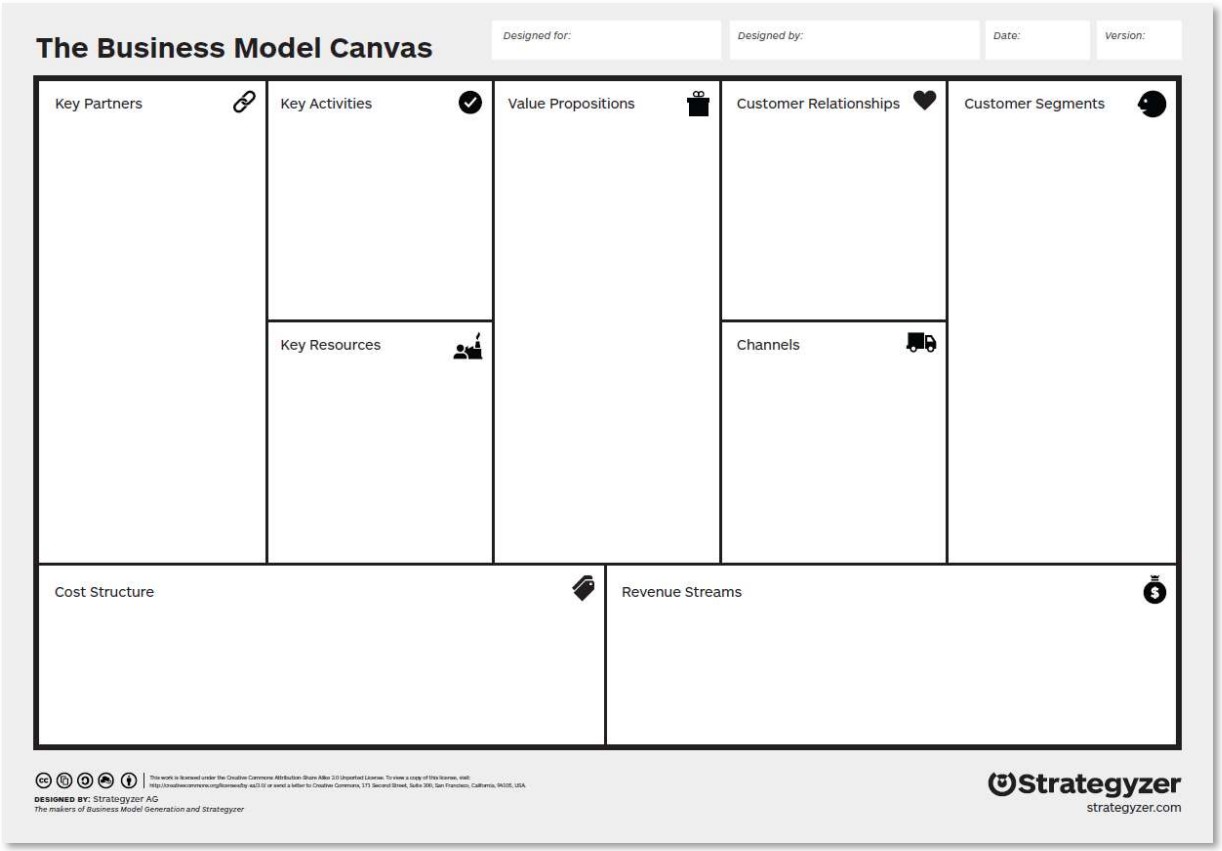


Figure 14: The business model canvas
Source: Strategyzer (https://www.strategyzer.com/canvas/business-model-canvas)

In this report we apply the full BMC to the business models which have been developed so far and which have been summarised in chapter 3. Starting from the value proposition which is the key driver behind each business model we will have a closer look at the right side of the BMC identifying the **relationship,**

channels and segments that stimulate prosumers to participate in the DR. On the left side of the BMC we will further elaborate on the issues that are directly related to the DELTA-Platform as a tool to support the incorporation of small and medium-sized prosumers into DR services, i.e. the part called **key resources**. From there we derive the **key activities** that need to be implemented by the DR service provider. Key activities and key resources are closely interrelated, since key resources consist of those tools that enable service providers to implemented those key activities that are decisive for the success of a business model. In this context we have to understand the DELTA-platform as a key resource for DR business models addressing small and medium-sized prosumers. Therefore, the analyses related to key resources and key activities highlight the functionalities that are required by the DELTA-platform in order to become a useful tool for DR service providers. Finally, we will have a closer look on the **revenue streams** that are required to sustain the various business models as well as on the **cost structures** which may differ from case to case.

4.2 Definition of Roles for the DELTA Business Model Canvas

To clarify the terminology used in this report, we define a set of roles describing the main players in the DELTA business models (Table 1). These roles follow the Universal Smart Energy Framework (USEF 2015) and are preponderantly aligned in with the definitions established by the European Network of Transmission System Operators for Electricity (ENTSO-E) that are accepted throughout Europe. Some of the roles require additional definitions and, in a few cases, definitions are slightly amended in order to fit the purpose of the DELTA business models.

Table 1: Definition of roles

Prosumer	Prosumers can be regarded as end users that no longer only consume energy, but also may produce energy. DELTA focuses on small and medium sized prosumers regardless of their user type.
Technical unit	Technical units represent all types of systems that either demand energy or supply energy. USEF also refers to active demand & supply units. Here, also the expressions “device” and “equipment” are used.
Aggregator	The role of an DR aggregator is to accumulate flexibility from prosumers and their technical units and sell it on flexibility markets.
Supplier	The role of a supplier is to source, supply and invoice energy to its customers. A supplier may be also a producer with own power generation units, or a pure retailer buying energy from the market and selling it to prosumers.
ESCO	An ESCO or Energy Service Company offers auxiliary energy related services to prosumers. These services include, but are not limited to, energy efficiency services such as energy performance contracting.
FLESCO	In the generic DR business models, we refer to the term FLESCO or Flexibility Service Company for ESCOs that provide energy optimisation services for prosumers with variable electricity tariffs in order to facilitate implicit DR.
TSO	Transmission System Operator (TSO) are responsible for providing and operating high and extra-high voltage networks for long-distance transmission of electricity as well as for supply to lower-level regional distribution systems and directly connected customers.
DSO	The DSO or Distribution System Operator is responsible for the management of the distribution grid and connects prosumers to it.
BRP	Balance Responsible Parties (BRP) are responsible to keep the supply and demand of their balance group members in balance. In this context, they are financially responsible for keeping their own position (sum of their injections, withdrawals and trades) balanced over a given timeframe (the imbalance settlement period).
FM	FM or Facility Management enterprises are dedicated to ensure functionality, comfort, safety and efficiency of their clients’ buildings.
Equipment provider	In the DELTA business models we refer to an equipment provider as an enterprise selling or providing technical units to prosumers.

Equipment manufacturer	We define an equipment manufacturer as an equipment provider selling its own designed and manufactured technical units.
Equipment aggregator	We define an equipment aggregator as an equipment provider that focuses on selling integrative communication platforms allowing the interconnection of technical units from different manufacturers.
ToU tariff	ToU tariffs is used as collective term for any kind of tariff where the tariff level is dependent on the time when energy is consumed. If tariffs are based on real-time movements in electricity prices based on trade in spot markets, balancing markets or other exchanges. the term real-time-pricing (RTP) is sometimes used, whereas the term critical peak pricing (CPP) refers to a combination of traditional time of use rates and real time pricing.

When applying the BMC, we need to clarify who is considered as a "customer" in the sense as the BMC methodology uses this term. According to the framework of USEF (2015) customers in the DR business can be prosumers who provide DR capacities as well as parties such as BRPs, DSOs and TSOs buying flexibility on flexibility markets. However, in the context of BMC assessment for DR business models, we think that is more useful to **equate the terms prosumers and customers**. Therefore, in the following discussion of the business models, the customer segment, relationships, channels etc. relate to the stakeholder group of prosumers.

In any case, we have to take into account that at this stage the **BMC assessment is done at an ideal-typical level** for generic business models. Partly it transfers the experience gained from existing DR business that is addressing exclusively large (industrial) customers as well as from related business models, such as energy efficiency services. To a large degree, however, the current assessment consists of theoretical considerations which will need practical testing and verification. In the frame of the DELTA-project, this will be done during the implementation of the DELTA pilot project.

4.3 BMC assessment for explicit DR as stand-alone service

Value proposition

The DR aggregator acts as facilitator between the prosumers who provide DR potential – in the case of the DELTA-project we are mainly interested in small and medium-sized prosumers – and the stakeholder of the flexibility markets. Therefore, the aggregator has to be successful on two different markets, i.e. it has to provide convincing value propositions to prosumers and stakeholders at both sides. The following description of main elements of value proposition for the business model "Explicit DR as stand-alone service" takes into consideration the intermediary position of a DR aggregator:

- **Additional revenues from various flexibility markets:** Additional revenues are the most attractive element of the value proposition to larger consumers that offer their DR potential via aggregators to the various flexibility markets. Specifically, for the extension of the business model "Explicit DR as stand-alone service" towards small and medium-size prosumers, we have to take into account, however, that the amounts per prosumer will be very small under usual conditions. Therefore, we do not expect that the additional revenues alone will provide sufficient incentive to attract a larger share of the target group. This expectation is based on experience with respect to the willingness to change suppliers in a liberalized power market: Consumers' switching rates differ largely between EU countries. Even though switching processes have been facilitated by regulation and the automation of processes in many member states, there is still a high number of consumers – especially households – who remain with their incumbent supplier.
- **Participation in energy transition:** Our impression is that the economic benefit has to be complemented by a non-economic benefit related to the importance of flexibility in the future electricity system. We think that there exists a certain share of small and medium sized customers that are interested to actively participate in the energy transition by making available their potential for load shifting under certain conditions. From our point of view, there may be a certain analogy with the development of the market for green electricity as it has developed over the past 15 to 20 years. We have to underline, however, that also with respect to market

success of green electricity there exist big differences between EU countries. Literature finds that markets have grown significantly in recent years and the products are now available in many more countries. Those countries where green electricity tariffs have been on sale for longer periods of time have also seen significantly increased consumer uptake.

- **Supplementary elements of value propositions:** Some of the customer segments may be interested in supplementary services that may become part of a more comprehensive service package. For example, facility owners or managers may be interested in remote supervision of systems and devices with respect to operability and availability. This aspect will gain importance in some of the other business models, but also for the business model of "Explicit DR as stand-alone service" it may contribute to an attractive value proposition under certain conditions.
- **Value proposition to flexibility markets:** With respect to value generation on the flexibility markets the main value proposition is that DR potentials of small and medium-sized prosumers can be activated at very low (practically zero) *variable* cost. From our point of view, this characteristic is the main factor of competitiveness compared to other participants of the flexibility markets, such as peak load power plants. At the same time, the business model "Explicit DR as stand-alone service" suffers from a high level of fixed cost – mainly transaction cost related to access to clients and cost for securing connectivity in legacy equipment.

Target prosumer segment

The DELTA approach is to enable DR for small and medium sized prosumers in large scale. Therefore, target segment considerations are rather characterised by a mass market approach, making the aggregator' role essential. However, when assessing this market, the target segments of this business model are determined by two components. Firstly, the suitability of a facility depends on its **electricity consumption or production**. Facilities with higher consumption or production usually have a higher probability for cost-efficient DR potential which means a higher leverage related to project cost (installation, maintenance, operation etc.). Secondly, the **specific technical units** operated at the facility are vital. Due to their nature some technical units have higher DR potentials than others. As a result, the decision, if the DR business model should be applied in a prosumer's facility or not, is taken based on a few key devices that have a high individual DR potential. Finally, targeted prosumers are characterised by their high affinity towards engaging in the energy transition.

The table below demonstrates how separation into target prosumer segments could look like based on the two parameters introduced. Each segment comprises facilities with certain key devices and a specific level of electricity consumption or production.

Table 2: Target prosumer segments for Explicit DR as stand-alone service

<table>
<tr><td></td><td colspan="2">Electricity consumption or production</td></tr>
<tr><td>Key devices</td><td>low</td><td>high</td></tr>
<tr><td>Cogeneration unit</td><td rowspan="6">Mass market prosumers</td><td rowspan="6">Comprehensive prosumers</td></tr>
<tr><td>Heat pump</td></tr>
<tr><td>Storage water heater</td></tr>
<tr><td>Storage space heater</td></tr>
<tr><td>Electrical storage</td></tr>
<tr><td>EV charging point</td></tr>
<tr><td>Cooling</td><td rowspan="3">No target prosumer segment</td><td rowspan="3">Specialised prosumers</td></tr>
<tr><td>Ventilation</td></tr>
<tr><td>White goods</td></tr>
</table>

Mass market prosumers have low energy consumption or production but operate a few technical units that have high individual DR potentials such as heat pumps. This segment may be a difficult one for stand-alone aggregators as it relies on highly standardised channels to small prosumers, which is considered challenging.

Comprehensive prosumers additionally have high energy consumption or production and therefore a very high overall DR potential. The relationship with these prosumers may be more in-depth as revenues per prosumer are relatively high.
Specialised prosumers have high energy consumption or production, but the individual potential of technical units operated is low. They may be an interesting segment, if their high energy consumption results from large scale use of these less suitable technologies (e.g. large-scale laundry service).
Small facilities operating technical units not very suitable for DR are considered **not as a target prosumer segment**.

It is essential to note that in explicit DR programmes only prosumers can participate who are subscribed to a conventional supplier tariff with flat energy prices. Prosumers that adapt their energy consumption to variable tariffs such as ToU or RTP are not eligible for this business model because because their ambitions to lower energy costs within the variable tariff leads to implicit DR actions. In turn this means that the DR capacity might not be accessible for explicit DR aggregators.

Channels

A stand-alone DR aggregator does not have available existing channels to access prosumers with promising DR potentials. In order to reach the desired target segment, the aggregator firstly has to **raise the prosumers' awareness** and secondly needs to **assess their individual DR potential** that is required so that investment costs for the whole group of prosumers pay off. The aggregator can establish channels to prosumers on the one hand through direct marketing and on the other hand through contract stipulations that require certain technical units or a certain minimum energy consumption and production. Alternatively, the aggregator could **establish partnerships** with stakeholders who are in a better position to access prosumers, such as suppliers and equipment providers (cf. section key partners). Partnerships may be the preferable option as a stand-alone aggregator is neither in a good position to raise awareness of small and medium-sized prosumers nor to assess their DR potential.
In the purchase phase the process of signing contracts with a big amount of prosumers needs a standardised channel, which is an important element of the aggregator business. In the delivery phase also hardware installation is necessary, which may require a channel via professional staff, depending on the complexity of technical units addressed.

Prosumer relationships

The relationship between the aggregator and the prosumer has to be established through a **new contract** and cannot be built on existing relationships. The contract allows the aggregator to implement the necessary installations at the prosumer's property and grants the aggregator access to the agreed technical units for the purpose of load shifting. In addition, the parties agree on a remuneration model in which payments to the prosumer go along with each dispatch of the prosumer's DR capacities. It may be a fixed price per shifted kWh or varying with the actual real time market price. Furthermore, the aggregator has to guarantee that the operation of the contracted technical units will be conducted safely and without major interference with user comfort.
In order to keep transaction cost low, **interaction** with the large number of prosumers has to happen via an automated services platform with additional personal support if required. Only for larger prosumers personal communication may pay off.

Key resources

The extension of the business model "Explicit DR as stand-alone service" towards small and medium-sized prosumers requires a very high level of digitisation and automation. Otherwise the comparably small number of switchable loads per prosumer and the related small amount of revenues could not cover the fixed amount of transaction costs. Therefore, the aggregator will require as **major key resource a high-level IT-platform** that comprehensively supports the key activities as described in the next section. Against this background, we conclude that the DELTA-Platform has to fulfil the following features and functionalities in order to reflect the requirements of the main value propositions related to the business model "Explicit DR as stand-alone service":

- **Handling small and medium loads:** Solutions are required that make use of existing infrastructure through suitable interfaces and that facilitate participation of all types of medium and small loads, including residential prosumers, e.g. through a **well-developed approach for self-subscription**.
- **User clustering**, allowing for automatic detection and classification of technical units without consuming resources during installation and commissioning, e.g. based on **self-assessment of switchable devices** and of technical conditions for shiftability.
- **Load forecasting:** Requirement to allow more accurate load forecasts, enabling near real time assessment of future availability of technical units to improve revenue from availability declarations.
- **Individual price forecasting tools** for each significant market, allowing stakeholders to better monetise their assets.
- **Grid stability assessment**, with the aim to achieve a holistic view of the grid status.
- **High-level of interoperability** to ensure easy access to clients' devices on the one hand and for easy exchange with the various stakeholders of the flexibility markets.
- **Secure management of contractual agreements ("smart contracts"):** Time-resources spent for the conclusion of contracts as well as all activities related to monitoring of contract implementation (including billing) represent a considerable share of transaction cost if we talk about small and medium-sized clients. Therefore, digitisation related to facilitation of contracting activities is crucial from the point of view of transaction cost.
- **Administrative applications** for user management (communication with prosumers, complaint handling etc.), payment transactions etc.

Key activities

Following key activities need to be implemented by the aggregator in order to ensure the success of the business model:

- From the technical point of view, the first key activity is the **bundling of small and medium-sized DR potentials** to a larger DR pool which is ready to offer on the various flexibility markets.
- In this context, the **precision of forecast of available loads** is a crucial success factor, since each kWh that can be offered on flexibility markets influences the revenues.
- Furthermore, there is a need to **check the general DR potentials** of various technical units at the prosumer either through site-visits or remote.
- Another core activity consists of "simple" **administrative tasks** related to small and medium-sized DR potentials. This refers to the administration of the entrance process of load to a DR pool as well as the withdrawal. Furthermore, the regular update of basic characteristics of the available loads and the disbursement to prosumers have to be administered.
- With respect to the different market places of flexibility markets, the aggregator has to have a **clear overview and regular update on the development of prices** as well as on **eventual changes of the market rules**.
- From there, the aggregator has to **optimize the sales strategy** for the switchable loads in its portfolio. On the one hand, this refers to the selection of the most suitable market place, on the other this relates to best possible formulation of offers (timing, price, amounts…).
- If the DR service includes **supplementary services** as described above (e.g. remote supervision of technical units with respect to operability and availability), the aggregator has to implement the related activities (regular control, identification of malfunctions, communication with the prosumer etc.)

Key partners

Partners are expected to play a vital role in this business model as the aggregator is not in a good position to reach its target prosumer segment. Especially for **customer acquisition** partners will be helpful in order to avoid intense marketing efforts. Also, **sales activities** can be outsourced to qualified partners that already have a well-established relationship with the desired target prosumer segment. In order to keep administrative efforts low, prosumers usually prefer a one-stop shop for their energy services.

Therefore, this approach seems to be promising as it keeps the faces limited a customer has to deal with. Following potential partners are suitable for providing these channels:

- **Facility management** enterprises have existing contracts with a large client base that is part of the target prosumer segment. They are in permanent contact providing a trusted channel. They have a very good insight into the building's infrastructure and therefore are in an excellent position to assess its DR potential.
- **Equipment providers** sell or lease specific electric devices to prosumers. They know exactly the DR potential of these devices and have also information about its interoperability with DR gateways. They have established a relationship to their clients that may be ongoing due to warranty or service agreements. Therefore, they represent a promising partner for DR aggregators especially because they can provide access to specific technologies that have a high individual DR potential (e.g. heat pump providers).
- Similarly, **installation professionals** know the DR potential of the devices they install at the prosumer's property. As a partner for DR aggregators they can establish a direct contact with the operator of the facility. Due to their on-site work, assessment of the overall DR potential and further installation needs (e.g. installation of the FEID) could go along at low extra cost.
- Electricity **suppliers** have a well established steady relationship with a large amount of prosumers. They are also in a rather good position to assess their DR potential as they estimate the electricity consumption of a facility when placing a new client under a supply contract. However, suppliers may be interested in tapping into their clients' DR potential themselves to provide flexibility within their balance group so that they may be reserved against collaboration with aggregators.
- **Distribution system operators (DSOs)** also have relationships to a large number of prosumers as they are the only grid operator in a specific region. They are also in an excellent position to assess the DR potential of prosumers. That's because they request a rough description of the major technical units that will be operated in each building or facility that is getting connected to the grid, in order to properly plan and dimension the grid connection. However, as DSOs usually have the grid monopoly they underlie strict regulation which may prohibit a DSO from cooperating with a DR aggregator. Therefore regulatory changes would be necessary to enable participation in this business model for DSOs. Additionally, DSOs may be not interested in cooperating with a DR aggregator but rather in tapping into the DR potential themselves to stabilize their grid.

Beside the partners for developing channels discussed above, DR aggregators may also **outsource other tasks** in this business model. Following services may be or are expected to be delivered by external service providers:

- Development and provision of the FEID
- Development of the DR algorithm
- Operation of helpdesk and technical support

In a new market such as DR for small and medium-sized prosumers, setting technological standards is vital in order to reduce costs in the long term. Therefore, strategic partnerships with the aim of setting standards can be supportive.

Revenue streams

In this business model two revenue streams can be distinguished:

- The main revenue is expected to be generated by **selling aggregated capacities on different flexibility markets**. In this context, there exists no difference compared to a business model including only large-scale prosumers (e.g. from industry).
- Additional revenue may result from the provision of optional **supplementary services** (e.g. supervision, monitoring).

Cost Structure

Generally, the cost structure in the business model of a stand-alone aggregator will be dominated of transaction cost related to gaining access to prosumers. A comprehensive classification and detailed description of cost elements relevant for all business models addressing small- and medium-scale prosumers is included in the separate chapter 5.

4.4 BMC assessment for explicit DR combined with energy efficiency services (EES)

Value proposition

In this business model the DR aggregator provides a complementary service that enriches the core energy efficiency service (EES) provided by an ESCO (so-called **dual service**). Therefore, we assume that the main drivers behind the value proposition of this dual service business model are related to the EES, such as (Bachner and Leutgöb 2018):

- **Outsourcing of non-core activities** to an external EE expert who provides a complete one-stop service
- **Comprehensive analysis of energy saving potential** and derivation of suitable EE improvement measures
- **Technical quality related to the implementation** of EE improvement measures
- **Transfer of technical risks** to the external EE expert by means of saving guarantees and a remuneration element that is coupled to the achievement of guaranteed savings.
- Professional approach related to **measurement and verification** of energy savings
- Services connected to **value retention and maintenance** of buildings systems and other devices
- Incorporation of users in EE activities taking into account the **compliance with agreed user comfort levels**

The additional value proposition related to the **DR element in the one-stop service package** refers to **additional revenues from flexibility markets** that are shared between the ESCO and the prosumer. With respect to value generation on the flexibility markets the observation made for the business model "Explicit DR as stand-alone service" apply, i.e. the competitive advantage of DR potentials of small and medium-sized prosumers is the very low (practically zero) variable cost.

Target prosumer segment

Generally, targeted prosumers for this business model are those engaging in an energy efficiency service contract. However, as for "Explicit DR as stand-alone service", the viable target prosumer segments for which the additional DR service can be offered are limited by two components. Firstly, the overall **electricity consumption or production** of the facility and secondly, the **specific load shifting potential of the technical units** operated. The table below demonstrates how separation into target prosumer segments could look like based on the two parameters introduced. Each segment comprises facilities with certain key devices and a specific level of electricity consumption or production.

Table 3: Target prosumer segments for Explicit DR combined with EES

<table>
<tr><td></td><td colspan="2">Electricity consumption or production</td></tr>
<tr><td>Key devices</td><td>low</td><td>high</td></tr>
<tr><td>Cogeneration unit</td><td rowspan="8">No target prosumer segment for EES → no target prosumer segment for dual service</td><td rowspan="4">Comprehensive prosumers</td></tr>
<tr><td>Heat pump</td></tr>
<tr><td>Storage water heater</td></tr>
<tr><td>Storage space heater</td></tr>
<tr><td>Electrical storage</td><td rowspan="4">Specialised prosumers</td></tr>
<tr><td>EV charging point</td></tr>
<tr><td>Cooling</td></tr>
<tr><td>Ventilation</td></tr>
<tr><td>White goods</td><td></td></tr>
</table>

The main difference to the business model "Explicit DR as stand-alone service" is that in most European markets an EES contract and therefore also the add-on of the DR contract is only feasible for **facilities with energy costs beyond 20,000 to 30,000 €/a**.
Therefore, only the two following target prosumer segments are relevant for this business model:

- **Comprehensive prosumers** that operate technical units with high specific load shifting potential and also have high energy consumption or production, which results in a very high overall DR potential.
- **Specialised prosumers** that have high energy consumption but the individual potential of technical units operated is low. Under certain conditions, they may be an interesting segment if their high energy consumption results from large scale use of these less suitable technologies (e.g. large-scale laundry service).

Again, it is essential to note that in explicit DR programmes only prosumers can participate who are subscribed to a conventional supplier tariff with flat energy prices (Non-ToU-tariffs).

Channels

In general, the channels that can be used are the same as for conventional EES projects. The close **cooperation** or even fusion of the ESCO providing the EES and the DR aggregator **reduces the costs for establishing these channels**. Assessment of the prosumers' DR potential can go along with an energy audit which is a standardised element for initiating an EES project, leading to cost synergies in the assessment phase. Also, installation of the hardware necessary to enable DR can happen as part of the refurbishment works in an EES project.

Prosumer relationships

For including DR in an EES project the **EES contract has to be extended** accordingly, allowing for load shifts to be implemented by the aggregator at the prosumer's technical units. As there is always a trade-off between energy efficiency and DR, also the ESCO's service fee and the DR remuneration for the prosumer have to be adjusted accordingly in order to deliver a significant financial benefit for the prosumer. **Interaction** with the prosumer has to happen via a **one-stop shop**, which is preferably the ESCO. This reduces complexity and is demanded by the prosumer as stated in the value proposition above.

Key resources

With respect to the provision of DR services – as part of an EES package – the key resources are very similar to the ones required for the business model "Explicit DR as stand-alone service". There exist, however, a few features that are specifically relevant in the context of this business model:

- The platform should be able to support the **comparative impact assessment of EE improvement measures and DR activities** with an optimization algorithm for those cases where the DR activity may potentially lead to an increase of energy consumption.
- The impact assessment needs to be done in the **design phase** as well as in the **operation phase**. In the design phase the investment decision has to be taken: Does it pay off to invest into controllability of switchable loads? In the operation phase the ESCO has to decide on the actual activation of the DR action taking into consideration its potentially antagonistic impact on energy savings.

Key activities

When activating the DR potential as part of an EES project, generally the same key activities as in the business model "Explicit DR as stand-alone service" need to be implemented. There exist, however, a few peculiarities related to this business model:

- The core markets for EES are larger and the prosumers rather medium-sized since transaction cost is usually too high for small customers. Therefore, during **energy audit** which is the usual starting point of any EES the ESCO has the **possibility to check the shiftability of technical units**, consisting of an assessment of DR potentials as well as of the connectivity of technical

units for external control of the loads. Therefore, we may expect certain cost-reducing synergies if DR services are provided in connection with EES.

- There is a need to **integrate DR activities into EE improvements measures** and in some cases, we will observe conflicting goals in this context: Some of the DR actions may lead to an increase in energy consumption compared to optimized system operation. Therefore, the ESCO will have to take decisions on prioritizing a certain set of measures under certain conditions.

Key partners

The cooperation or fusion of DR aggregator and ESCO represents a **strong partnership creating valuable synergies**. Other partners are only expected to play a role when it comes to **outsourcing tasks** such as provision of hardware and software.

Revenue Streams

In this business model two revenue streams can be distinguished:

- Just like in conventional EES projects, the main revenue is generated from the prosumer in the form of **EES fees**. For these payments, usually a guaranteed savings model or a shared savings model is applied.
- Additional revenue comes from **selling aggregated DR capacities on different flexibility markets**. The revenues generated on flexibility markets are subject to dynamic pricing. Therefore, the profitability of aggregated DR capacities may depend on the real time market price for flexibility.

The conflict between the goals of DR and energy efficiency is also reflected in the revenue. Therefore, this trade-off is considered a high priority issue in the dual service business model.

Cost Structure

Compared to other explicit DR business models, the integration of DR in an EES project makes use of following synergies:

- **Assessment of prosumers' DR potential** comes at practically no cost as it can be included in the energy audit that has to be implemented by the EES provider anyway.
- **Hardware installation** can be accomplished during EE refurbishment works leading to a reduction of installation cost compared to a stand-alone approach
- If we assume that most customers that are suitable for an EES also qualify for DR services, we do not expect additional cost for **customer acquisition** related only to the DR element in the dual service.
- **Measurement and verification (M&V)** is already necessary in an EES project to measure energy savings. Therefore, we expect only limited additional costs for M&V for the purpose of DR.

4.5 BMC assessment for implicit DR service for optimal use of ToU-contracts

Value proposition

Depending on the exact shaping of the services provided under the business model "Implicit DR service for optimal use of ToU-contracts" we assume that the following elements of the value proposition will be decisive for market success:

- **Cost reduction through selection of the optimal ToU tariff** depending on the load shift potential at the prosumer's site: In general, most prosumers do not have a good overview on various forms of tariffs available on the market, and in particular, they have difficulties to assess whether a ToU tariff pays off for their specific case of consumption pattern. Therefore, there is a need for tariff consultancy which actually is already available on many markets – e.g. in the

form of organization of tariff tenders for pools of small and medium-sized consumers[2]. Taking into consideration the additional cost saving potential emerging from ToU tariffs there is an even larger need for consultancy since the tariff structure has to fit to the given consumption pattern on the one hand, and to achievable potential for load shift on the other hand. We assume that most small and medium-sized prosumers will be overstrained by the complexity of this task so that the provision of orientation is expected to be a powerful element of value proposition in this context.

- **Making full use of the cost saving potential of ToU tariffs by adapting the facility operation** in line with the conditions of the ToU contract: In addition to providing an overview on the tariff landscape, a further important value proposition of the service provider FLESCO (flexibility service company) is the capability to adjust the facility operation in a way that the prosumer benefits fully from the cost saving potential offered by the ToU contract. In the case of a simple ToU rate the adjustment of facilities will be done once covering a longer period of time, whereas in the case of more dynamic pricing (RTP or CPP) the adjustments need to be done as regular part of facility operation.
- Starting from the adjustments of facilities as described above, the way is paved towards more **comprehensive facility management services**. Actually, we think that most promising application of the business model "Implicit DR service for optimal use of ToU-contracts" is its integration into a broader portfolio of facility management activities. In this context, facility management (FM) is defined as a profession that encompasses multiple disciplines to ensure functionality, comfort, safety and efficiency of the built environment by integrating people, place, process and technology[3].
- Similar to clients for explicit DR business models as described above we think that **participation in energy transition** will be a convincing argument also for this business model related to implicit DR. Many prosumers will wish to demonstrate themselves as innovative and resource-friendly so that an offer that addresses both of these aspects may fall on good soil.

Target prosumer segment

A service facilitating implicit DR as offered by the FLESCO in this business model is **only applicable for prosumers with a variable electricity tariff** (ToU, RTP, CPP). If the value proposition also includes the consultancy service for the selection of the most suitable tariff, the target prosumer segment also includes prosumers who are looking for a new tariff and are willing to subscribe for a variable one.

As an analogue to the business case of explicit DR the main parameter for distinguishing the target prosumer segments are on the one hand the **electricity consumption or production of the facility** and on the other hand the **individual DR potential of the technical units** operated, including their connectivity.

Additionally, in implicit DR a third factor plays a role when clustering the target prosumer segments: The **spread between high and low price (ToU) or the price range (RTP) in the tariff structure** decides if a prosumer is part of an interesting segment, because only if the spread is sufficiently high the achievable savings will be enough for prosumers to engage a FLESCO.

[2] In Austria, for example, the Association for Consumer Protection (VKI) regularly organises a tender among electricity and gas suppliers for which households are pooled in order to achieve advantageous wholesale prices (cf. https://vki.at/energiekosten-stop?vki-cc=accepted)

[3] cf. definition of the term "Facility Management (FM)" according to IFMA (International Facility Management Association): https://www.ifma.org/about/what-is-facility-management

Summing up, the suitability of customer segments for this business model represents a triangle as shown in Figure 15.

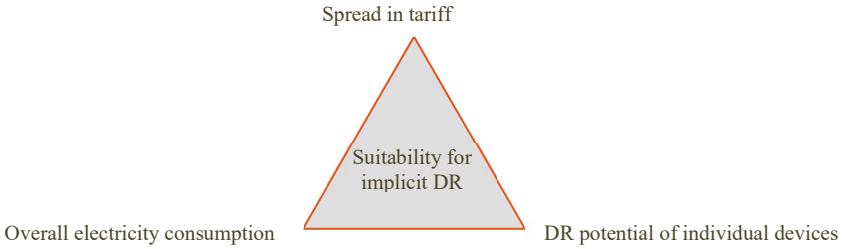


Figure 15: Prosumers' benefit in implicit DR

We expect that the FLESCO business model will be especially successful, if it is **embedded in other services** which are already offered on the market, because transaction costs may be too high to establish it as a stand-alone business for small and medium scale prosumers. Therefore, especially prosumers with already **outsourced facility management** are attractive for this business model. Other possible service packages concern equipment provision, for instance (cf. chapter 3.5).

Finally, targeted prosumers are characterised by their high affinity towards engaging in the energy transition.

Channels

Which channels have to be established depends on the type of business where this business model is integrated. If it is applied as a **stand-alone service**, the situation is similar to an explicit stand-alone DR aggregator. In this case, the FLESCO cannot build on existing channels, neither for awareness raising nor for distribution. Therefore, we assume that this business model will be only viable as stand-alone service, if the prosumer's overall suitability for this business model (cf. triangle above with price range, consumption and DR potential) is very high so that the transactions costs related to prosumer access can pay off.

If this business model is **embedded in a broader service package**, there may be already existing channels. We consider integration by following service providers:

- **Facility management providers** have existing channels to a large amount of facility owners including ongoing service contracts. They have a very good insight into the building's infrastructure and therefore are in an excellent position to assess its DR potential. Moreover, the core business of a technical facility manager is to minimise operating costs of the facility, which is strongly linked to the value proposed in this DR business model.
- **Consultants** dedicated to **identification of the most suitable energy tariff** ("tariff consultants") may also add the FLESCO service to their package. They already spend high efforts on awareness raising towards prosumers and collect data on the prosumer's electricity consumption facilitating the assessment of its DR potential. Their main resources are a comprehensive market overview and additionally the ability to efficiently handle changes of supplier contracts (possibly using "smart contracts"). The main barrier for integrating DR in this kind of business may be that mostly they don't have any technical experience in operating facilities, which means no channel for value distribution in this business model.
- **Other** businesses with valuable existing channels for implicit DR include equipment providers, for instance, that are discussed in section 4.7.

Prosumer relationships

Prosumer relationships again may vary depending on the core service in which this business model is integrated. Concerning stand-alone FLESCOs the **contractual relationship** has to be newly established for each prosumer and must allow the FLESCO to implement the necessary installations (e.g. FEID) at the prosumer's property and grant access to the agreed facilities for the purpose of load shifting.

Remuneration for the service has to be agreed on and may be a flat rate or performance-based fee. Furthermore, the FLESCO has to guarantee safely conducted load shifting without major interference with user comfort.
Also, **interaction with the user** will build on the established structures in the core business or preferably has to happen via an automated services platform for stand-alone FLESCOs in order to strictly minimise transaction costs and achieve economies of scales.

Key resources

In order to be able to implement the key activities as described above the FLESCO that operates on the market of small and medium-sized prosumers has to have access to the following key resources – part of which can be covered by the solutions provided by the DELTA platform:

- **Tool for easy and cost-efficient load profile assessment** including impact assessment of load shifts: For small and medium-sized prosumers the tool needs to be able to work with limited data set, e.g. based on metering data (preferable from smart meters) and basic description of technical units supplied behind the meter.
- **Tool that supports the automatic comparison between load profile and tariff structure**, preferable with automatic detection of cost saving potential from adapting the load profile through utilising DR-potentials at the prosumer.
- **Database that keeps updated tariff structure at different prosumers:** This feature is crucial for the case of dynamic pricing and requires communication with the electricity supplier.
- **Bundling of loads** across one prosumer, potentially incorporating various sites of the same prosumer if the tariff applies different sites.
- **Easy access to technical units at the prosumers' side:** In general, this refers to the possibility of remote control so that the FLESCO can quickly react to changes in the tariff regime.
- Whereas for stable ToU-tariffs we assume, that adjustment can be made manually, for the case of dynamic pricing, the FLESCO needs to have available **algorithms for automatic adjustments** in system operations.
- **Secure management of contractual agreements ("smart contracts"):** If the service is provided without a more comprehensive facility management contract, the conclusion of contracts as well as all activities related to monitoring of contract implementation (including billing) represent a considerable share of transaction cost if we talk about small and medium-sized prosumers. Therefore, digitisation related to facilitation of contracting activities are crucial from the point of view of transaction cost.
- **Administrative applications** for user management (communication with prosumers, complaint handling etc.), payment transactions etc.

Key activities

Following key activities need to be performed by the FLESCO:

- **Permanent market observation**, mainly with respect to ToU-tariffs, in order to keep track with the most current development on the market
- **Assessment of demand profiles and potential for load shift**, either through site-visits or remote
- **Selection of most beneficial tariff** for a given facility, based on a comparison between load profile (taking into account potential load shifts) and tariff structures: This activity may include the active search among suppliers, e.g. by means of a competitive tender.
- **Facility management services** related to the operation, control and monitoring of technical units, with the aim to utilize the saving potentials of a given tariff by shifting loads to low-cost periods (late night, weekend, etc.)
- **Permanent updating of tariffs applicable to single prosumers:** This aspect is most relevant for the case of dynamic price models, but also the ToU-tariffs more stable patterns change over time and require new assessment of the situation and adjustment in operation

- **Administrative tasks** related to management of a larger bundle of small and medium-sized **prosumers**, including communication with the prosumer, calculation of service fees, invoicing, etc.

Key partners

For stand-alone FLESCOs especially partners with good channels to the targeted prosumers are vital. The following partners may play a role in reaching the target prosumer segment or performing some of the key activities:

- **Facility management** enterprises could provide channels to a large amount of facility owners and undertake the assessment of the prosumer's DR potential.
- **Tariff consultants** could additionally promote the FLESCO's DR service when acquiring customers providing a channel for awareness raising. They could also contribute with market observation on variable tariffs and by finding the best tariff for each customer to make the most of it using DR.
- **Equipment providers** (discussed in section 4.7) have a channel to prosumers of the target group with very specific technical units and well-known DR potential. They are promising partners for accurately targeting the most efficient DR capacities.
- **Distribution system operators (DSOs)** have the best insight into prosumers' technical DR potential. Therefore, they could relatively easy identify attractive prosumers. However, their cooperation with a FLESCO may be limited as they underlie a strict regulatory framework.

If the FLESCO service is embedded in an already existing business, different constellations of complementary partners are conceivable. For example, a facility management enterprise could implement the FLESCO business model being responsible for handling DR capacities of their existing clients. Additionally, a "tariff consultant" can be sub-contracted as a partner for suggesting the right tariff for each prosumer.
Besides that, also in this business model many other tasks are expected to be outsourced such as provision of the FEIDs and of the software solution that is required to offer the service.

Revenue Streams

In this business model revenue is solely generated from the prosumer who is purchasing the service of implicit DR. The pricing model may be designed in different ways, including the following:

- A flat rate service fee depending on overall electricity consumption and production or the number of devices included in the load shifting service.
- A performance-based service fee that depends on the actual savings generated at the prosumer. This requires accurate M&V and the definition of a baseline against which savings can be calculated.
- A mixture of the above pricing models, consisting of a basic remuneration covering the fixed cost of installations on the site and a performance-based service fee reflecting the actual savings achieved for the client (shared-savings model).

Cost Structure

A comprehensive classification and also quantification of all relevant costs is undertaken in chapter 5. Compared to explicit DR aggregators, FLESCOs as implicit DR providers have a lighter cost structure since they **do not have to carry any costs related to access to flexibility markets** and the communication with stakeholders on the various flexibility markets.

4.6 BMC assessment for implicit DR including power supply

Value proposition

The following elements define the value proposition of the business model "Implicit DR including power supply" for the market of small and medium-sized prosumers:

- **Reduction of energy costs** through a more favourable energy tariff – in turn for allowing access to and load shift of selected facilities. We assume that only a limited share of small and medium-sized prosumers will respond to the promise of cost reduction since the savings will be limited in most cases.
- Similar to the product of green power we think that a certain share of small and medium-sized prosumers will be interested in **participating actively in the energy transition**.
- In addition to the two core value propositions as described above, the service provider may try to **enrich its service by additional elements** that might be attractive for some prosumers, such as services related to monitoring, optimisation and energy efficiency improvements of a technical system that is embedded in the DR service – e.g. for the case of a heat pump, remote control can contribute to higher efficiency in operation as well as to access to DR potential.

Target prosumer segment

The power supply industry delivers services to a mass market. In this respect, it is closely linked to the objective of DELTA to enable DR for small and medium-sized prosumers in large scale. However, separating this market, the target prosumer segments of this business model are characterised by two components. Similarly, to the market segmentation for explicit DR services, the suitability of a facility depends on its **electricity consumption or production**. Facilities with higher consumption or production usually have a higher potential for DR Secondly, the **specific electrical devices** operated in the facility are important, because due to their nature and application fields some appliances have higher DR potentials than others. As a result, the decision, if the DR business model should be applied in a facility or not, is taken based on a few key devices that have a high individual DR potential.
The table below demonstrates how separation into target prosumer segments can be achieved based on the two parameters. Each segment comprises facilities with certain key devices and a specific level of electricity consumption or production.

Table 4: Target prosumer segments for "Implicit DR including power supply"

<table>
<tr><td></td><td colspan="2">Electricity consumption or production</td></tr>
<tr><td>Key devices</td><td>low</td><td>high</td></tr>
<tr><td>Cogeneration unit</td><td rowspan="6">Mass market prosumers</td><td rowspan="6">Comprehensive prosumers</td></tr>
<tr><td>Heat pump</td></tr>
<tr><td>Storage water heater</td></tr>
<tr><td>Storage space heater</td></tr>
<tr><td>Electrical storage</td></tr>
<tr><td>EV charging point</td></tr>
<tr><td>Cooling</td><td rowspan="3">No target prosumer segment</td><td rowspan="3">Specialised prosumers</td></tr>
<tr><td>Ventilation</td></tr>
<tr><td>White goods</td></tr>
</table>

Mass market prosumers have low energy consumption or production but operate a few electrical technical units that have high individual DR potentials such as heat pumps. This segment has to be addressed using highly standardised channels and processes. In this market segment a high affinity towards engaging in the energy transition may become crucial for the access to prosumers.
Large scale prosumers additionally have high energy consumption or production and therefore a very high overall DR potential. The relationship with these prosumers may be more in-depth as revenues per prosumer are relatively high.
Specialised prosumers have high energy consumption but the individual potential of technical units operated is low. They may be an interesting segment if their high energy consumption results from large scale use of these less suitable technologies (e.g. large-scale cooling appliances).
Small facilities operating technical units not very suitable for DR are considered **not as a target prosumer segment**.

Channels

There are already **well-established channels** in place between the electricity supplier and the prosumer that can be used in this business case. However, to make use of DR, it is essential for the supplier to focus on prosumers reaching a certain level of DR potential. Therefore, the supplier has to **know the devices** each potential prosumer is operating to make sure a significant potential exists before a contract and installations are made:

- The first step in gathering this data is to **survey new customers** when signing a supply contract.
- The second step is offering **conditional tariffs** for customers with certain technical units such as heat pumps, or certain minimum energy consumption or production. In this way tailor-made tariffs can be offered in return of a well specified load shifting capacity committed by the prosumer.

In general, the **supplier is in a good position** to assess the prosumers' stock of electrical devices. When a contract for electricity supply is signed, energy costs are roughly estimated based on the technical units the prosumer intends to operate. Standardising and detailing the data acquisition on technical units into the process of contract signing may deliver the important information for being able to offer customised tariffs that include DR. Compared to other DR business models, we expect that existing channels for power supply will lead to a considerable reduction of transaction costs at the side of the supplier
In the delivery phase additional **hardware installation** is necessary, which may require a channel via professional staff, depending on the technical complexity.

Prosumer relationships

Again, the relationship between supplier and customer is well established in a power supply contract However, the energy supply contract has to include a section allowing the supplier to do the necessary installations (e.g. FEID installation) at the prosumer's property and allowing access to the agreed facilities for the purpose of load shifting. In return the supplier offers an attractive tariff and has to guarantee that the operation of the contracted facilities will be conducted safely and without major interference with user comfort.
The interaction with the prosumer will be closely linked to the supply business. That means prosumers can manage their subscriptions via an automated service platform with additional personal support, if required. Especially for larger prosumers personal communication may be useful.

Key resources

Many of the key resources required for this business model are very similar to key resources needed for "Explicit DR as stand-alone service". Therefore, the **DELTA-Platform as a major key resource** has to fulfil the following functionalities and features:

- **Handling of small and medium loads** (control, monitoring, load shift etc.)
- **User clustering** for automatic detection and classification of assets
- **Self-subscription and self-assessment** of switchable devices
- **Precise load forecasting** connected with the utilisation of accessible DR-potential
- In addition, it seems important for the supplier to have available a tool that support the **permanent matching** of price relation on the wholesale markets with accessible DR-potential, so that energy trade decision can reflect the increased flexibility of the supplier.
- **Administrative applications** for user management, as well as applications supporting **"smart contracts"**.

Key activities

When implementing the business model "Implicit DR including power supply" to small and medium-sized prosumers the retailer needs to implement the following key activities:

- **Energy trade:** This in not specific to the business model as it represents the core business of any energy supplier – the innovative aspect is that the energy trade decisions have to take into account the suppülier's increased flexibility through its access to DR-potential at its clients.

- **Assessment of demand profiles and potential for load shift**, either through site-visits or remote, with the aim to offer the additional service only to those customers that have available sufficient DR-potential
- **Handling the operation of large amount of small and medium-sized DR potential:** Depending on the price developments on the wholesale markets and depending on production cost (if the supplier is also a producer), the supplier has to utilise the accessible DR-potential in an optimal way.
- If the service package includes additional elements with respect to **monitoring, optimisation and related efficiency improvements of a technical system**, these activities become key activities as well.

Key partners

The number of key partners depends on the **level of outsourcing** which the supplier is choosing for implementing its business model. The decision which services are acquired from external partners depends on the cost difference of in-house provision and contracting external service providers. We expect that the following services may be delivered by external partners:

- Development and provision of the FEID or other installations ensuring connectivity
- Development of the DR algorithms
- Installation works (if professional on-site installation is necessary)
- Operation of helpdesk and technical support.

Revenue Streams

In this business model there are 2 possible strategies in terms of revenue:

- **Minimising sourcing costs:** The supplier is using DR to shift its clients' loads in a way that production and/or purchasing costs are as low as possible for the supplier. Here, also the cost accruing at the supplier's side from disbalances between supply and demand can get reduced.
- **Sale of flexibility:** The supplier is generating revenue by trading the aggregated flexibility on various flexibility markets.

Besides that, prosumers allowing access to their facilities for load shifting will benefit by receiving a more attractive energy tariff. This competitive advantage may lead to **an increase in the customer stock** and therefore additional revenues from the supplier's core business**.** The revenue emerging from an increasing customer stock is a function of prosumers' sensitivity on electricity prices and their willingness to change the supplier.
The different revenue streams are closely examined in chapter 6.

Cost Structure

The cost structure of a supplier is different from a specialised implicit DR service provider (cf. chapter 4.5). That's because a supplier needs to compensate its customers for the load shifting activities. This can happen in different ways:

- The supplier can offer a better flat tariff.
- The supplier can offer an attractive variable tariff (ToU, RTP, CPP).
- The supplier can pay to the client a flat remuneration per period.
- The supplier can pay to the client a remuneration for each DR dispatch.

Depending on the type of compensation this business model may be considered to be not fully implicit DR, but somewhere between explicit and implicit, according to this classification.

A comprehensive classification and detailed description of all relevant costs is included in chapter 5.

4.7 BMC assessment for DR combined with equipment provision

There are some plausible reasons for providers of electrical equipment to enter the DR business. Some equipment manufacturers are active in the development of smart devices which provide connectivity

and therefore may enable remote switching of DR capacities. However, the **main value propositions** of manufacturers developing smart devices are mainly as follows: (RKW 2017):

- Optimising **energy** consumption and energy costs; e.g. smart energy management system including smart sensors and switches.
- Enhancing **security and safety**; e.g. alarm systems, automated lighting control, smoke detectors, water and humidity detectors
- Increasing **comfort**; e.g. (app-based) remote control, personal assistance applications

In addition to the sale of products providing the value propositions above, equipment providers may strive to increase after sales services such as maintenance. Smart devices open up new opportunities for after sales services including services related to DR. To make use of these opportunities, equipment providers can choose from different strategies as outlined by Mücke (2013). In general, these strategies can be divided into two approaches:

- Equipment providers can focus on providing connectivity for their own products by developing **own gateways** and platforms.
- In contrast, equipment providers can focus on the aggregation of devices and therefore develop **integrative gateways** allowing also devices from other manufacturers to work with them. Especially for making use of small DR capacities such an integrative approach is essential. Therefore also "interoperability platform providers" appear on the market, which solely focus on the aggregation of smart devices from different manufacturers. On the German market the company qivicon is an example for this approach[4].

These distinct approaches lead to different potential business models for DR combined with equipment provision, which are shown in the following matrix (Table 5).

Table 5: Business models for DR by equipment providers

	Fixed tariff	RTP or ToU tariff
Few devices with high DR potential	Explicit DR by equipment manufacturers	Implicit DR by equipment manufacturers
Many devices with low DR potential	Explicit DR by equipment aggregators	Implicit DR by equipment aggregators

The focus on own products and gateways leads to DR by equipment manufacturers. This can be a feasible business model if the devices of the manufacturer have a high individual DR potential (e.g. heat pumps).
The focus on integrative platforms leads to a business model where an aggregator (hereafter called equipment aggregator) is pooling together many devices creating a cumulated significant DR potential. This model may be also feasible for devices with low individual DR potential.
If the business model is applicable for explicit or implicit DR is up to the prosumers' tariff (fixed or flexible).

In the following sections, the elements of the business model canvas are described in brief for the 4 business models identified in Table 5.

4.7.1 Explicit DR by equipment manufacturers

Value proposition
The manufacturer can create value at the prosumer mainly through one of the following elements:

- **Additional revenue** for the prosumer received for each dispatch or as a flat rate.
- **Discount** on the purchased **device**
- **Discount** on **supplementary services** such as maintenance

[4] https://www.qivicon.com/en/

Target prosumer segment
The main target segment comprises prosumers purchasing devices with high DR potential from the manufacturer. Moreover, prosumers need to have a conventional flat electricity tariff.

Channels
For customer acquisition the same channels as for selling the devices can be used. Assessment of the DR potential is not necessary as the manufacturer knows exactly the DR potential of its own products.

Prosumer relationships
A new contractual relationship has to be established. Interaction will be limited on the one hand to the manufacturer interfering operation of the device with the purpose of load shifting and on the other hand to possible cash flows to the prosumer for each dispatch.

Key resources
The major key resources for the manufacturer related to this business model are the **connectivity of the sold devices** and the **DELTA platform for aggregating** these devices.
Compared to the other business models discussed so far, here the requirements for the DELTA platform are lower concerning self-assessment of switchable devices. That's because only the devices provided by the manufacturer itself need to be detected and connected to the platform.

Key activities
The key activities are similar to other DR business models and include mainly the **handling and operation of large amounts of small and medium-sized DR potentials** and **trading the capacities on flexibility markets**. Also, with the application of the DELTA platform these activities are expected to be very challenging for a manufacturer as they are substantially different from the typical activities in the core business.

Key partners
It is expected, that customer acquisition and distribution towards prosumers can be achieved by the manufacturer itself. However, partners seem to be necessary when it comes to **selling the aggregated DR capacities** on flexibility markets. In general, following potential partners are in a better position for acting on flexibility markets:

- Electricity **suppliers** may be interested in DR capacities because of obligations within their balance group. They also may be already trading flexibility on other markets.
- **High level DR aggregators** may be interested in purchasing the manufacturer's DR capacities in order to sell larger aggregated capacities on flexibility markets.

Revenue Streams
The following revenue streams can be distinguished in relation to the manufacturers DR activities:

- The main revenue is expected to be generated by **selling the aggregated flexibility** on different flexibility markets.
- **Increasing product sales** due to attractive discounts or service packages enabled by DR activities.

Cost Structure
The cost structure is similar to other explicit DR business models but with following distinctive differences:

- Costs for the **assessment of prosumers' DR potential** are negligible, as only devices are used for DR that have been designed and provided by the manufacturer.
- **Hardware installation** costs are low, as installation works are necessary anyways in order to deliver the new devices.
- **Remuneration** can be delivered as a discount on products or additional services of the manufacturer.

4.7.2 Explicit DR by equipment aggregators

Value proposition
The equipment aggregator can create value for the prosumer mainly through one of the following elements:

- **Additional revenue** for the prosumer received for each dispatch or as a flat rate.
- **Discount** on platform services that are not related to DR but to security, safety or comfort.

Target prosumer segment
It comprises prosumers purchasing integrative platforms for smart devices, allowing interoperability of devices from different manufacturers. In this case also devices with a low individual DR potential can be included. Moreover, the prosumers need to have a fixed electricity tariff.

Channels
As core business, the equipment aggregator is selling the platform (probably in combination with some devices) to the prosumer proposing value such as comfort and safety. Therefore, in the DR business model the equipment aggregator can use the **same channels for customer acquisition** as in the core business. **Assessment of the DR potential** is still necessary in this case, but **relatively easy** as all the devices considered for DR are already interconnected on a platform where many of the devices' properties are stored.

Prosumer relationships
A **contractual relationship** may already be in place for the usage of the platform but has to be **extended** in order to allow DR dispatches by the equipment aggregator and determine a form of remuneration in return. Further interaction will be rather limited.

Key resources
The major key resources for the equipment aggregator related to this business model are the device-**connecting platform** and its ability to enable DR dispatches at the devices using the DELTA approach.

Key activities
The key activities are similar to other DR business models and include mainly the **handling and operation of large amounts of small and medium-sized DR potentials** and **trading the capacities on flexibility markets**. As the equipment aggregators considered here are focussing on the aggregation of smart devices (equipment aggregators), they could be in a good position for handling a large amount of DR capacities. However, for selling capacities on flexibility markets, a partner that is already acting on these markets can be helpful.

Key partners
For **selling the aggregated DR capacities** on flexibility markets, again electricity **suppliers** and **high-level DR aggregators** can be considered as valuable partners.

Revenue Streams
Following revenue streams can be distinguished in relation to the equipment aggregator's DR activities:

- The main revenue is expected to be generated by **selling the aggregated flexibility** on different flexibility markets.
- DR as an additional use case for device-connecting systems may lead to increasing attractiveness of such platforms and therefore result in **higher number of platform customers.**

Cost Structure
The cost structure is similar to other explicit DR business models but with following distinctive differences:

- Costs for the **assessment of prosumers' DR potential** are low, as all the devices considered for DR are already interconnected on a platform where many of the devices' properties are stored.
- There are **no extra costs for provision of hardware** as the connectivity platform is part of the package in the core business facilitating services other than DR such as those related to comfort etc.
- Therefore, there are also **practically no extra costs for hardware installation**
- **Remuneration** can be delivered as a discount on platform provision or on other platform services (comfort, safety etc.).

4.7.3 Implicit DR by equipment manufacturers

Value proposition
In implicit DR the manufacturer can create value at its client mainly through:

- **Cost savings** due to optimal use of a flexible tariff when operating the purchased device.
- **Ensuring efficient operation of the device** as a result of steady control by the manufacturer for the purpose of load shifting (especially important in a performance-based service contract cf. section "Revenue streams")

Target prosumer segment
It comprises prosumers purchasing devices with high DR potential from the manufacturer. Moreover, prosumers need to have a flexible electricity tariff (ToU, RTP, CPP) with a specific minimum range of price variation.

Channels
For customer acquisition towards prosumers the same channels as for selling the devices can be used. Assessment of the DR potential is not necessary as the manufacturer knows exactly the DR potential of its own products.

Prosumer relationships
A new service contract has to be established defining a service fee for the manufacturer. Interaction will be limited to the manufacturer interfering operation of the device with the purpose of load shifting.

Key resources
The major key resources for the manufacturer related to this business model are the **connectivity of the sold devices** and the **DELTA platform for operating and controlling** these devices.
The requirements towards the DELTA platform in this business model are similar to those in the stand-alone FLESCO model (section 4.5), but are lower concerning access to technical systems at the prosumers' side as the manufacturer can ensure interoperability with the platform.

Key activities
The key activities are similar to other implicit DR business models and mainly include an **optimal operation of the sold devices** in order to make the most of the prosumer's variable electricity tariff. To fulfil this proposition the manufacturer has to adapt its load shifting strategy for each prosumer depending on the variability of the specific tariff. This may be challenging for a manufacturer and therefore the main value of the DELTA platform in this case is a device-specific automation of this process. If the provision of an optimal electricity tariff should also be included in this business model, we expect that cooperation with partners such as electricity retailers or tariff consultants are necessary.

Key partners
It is expected, that customer acquisition and distribution towards prosumers can be achieved by the manufacturer itself. As discussed above, partners could be helpful in order to provide the prosumer with a suitable variable tariff. There are two promising partners:

- Electricity **suppliers**: The manufacturer could offer a package that includes the device, a DR service contract and suitable tariff from a third-party electricity supplier. This could ensure that the business model is economically viable for the prosumer as the tariff's price range needs to be sufficiently high.
- With a **tariff consultant** the idea is similar but there exist more opportunities to provide an attractive tariff because the choice of tariffs is not limited to those offered by a single supplier.

Revenue Streams
Following revenue streams can be distinguished in relation to the manufacturers DR activities:

- The main revenue is generated from the **prosumer who is purchasing the service of load shifting**. The pricing model can be designed as a flat rate or a performance-based service fee.
- **Increasing product sales** due to attractive packages including the sale of the device and a DR service contract for optimal operation under a variable tariff. This newly established DR service could function as a USP to stand out from competitors.

Cost Structure
The cost structure is similar to other implicit DR business models but with following distinctive differences:

- Costs for the **assessment of prosumers' DR potential** are negligible, as only devices are used for DR that have been designed and provided by the manufacturer.
- **Hardware installation** costs are low, as installation works are necessary anyways in order to deliver the new devices.

4.7.4 Implicit DR by equipment aggregators

Value proposition
In implicit DR the equipment aggregators can create value at the client mainly through:

- **Cost savings** due to optimal use of a variable tariff when operating the devices interconnected on the platform.
- **Ensuring efficient operation of the devices** as a result of steady control by the equipment aggregator for the purpose of load shifting (especially important in a performance-based service contract cf. section "Revenue streams")

Target prosumer segment
It comprises prosumers purchasing integrative platforms for smart devices, allowing interoperability of devices from different manufacturers. In this case also devices with a low individual DR potential can be included. Moreover, prosumers need to have a variable electricity tariff.

Channels
As core business, the equipment aggregator is selling the platform (probably in combination with some devices) to the prosumer proposing value such as comfort and safety. Therefore, in the DR business model the equipment aggregator can use the **same channels for customer acquisition** as in the core business. **Assessment of the DR potential** is still necessary in this case, but **relatively easy** as all the devices considered for DR are already interconnected on a platform where many of the devices' properties are stored.

Prosumer relationships
A **contractual relationship** may already be in place for the usage of the platform but has to be **extended** in order to allow load shifting and define a service fee for the equipment aggregator. Further interaction will be rather limited.

Key resources
The major key resources for the equipment aggregator related to this business model are the device-**connecting platform** and its ability to enable DR dispatches at the devices using the DELTA approach.

Key activities
The key activities are similar to other implicit DR business models and mainly include an **optimal operation of the devices interconnected in the platform** in order to make the most of the prosumer's variable electricity tariff. As the equipment providers considered here are focussing on the aggregation of smart devices (equipment aggregators), they could be in a good position for operating a large amount of DR capacities. If the provision of an optimal electricity tariff should also be included in this business model, we expect that cooperation with partners such as electricity suppliers or tariff consultants are necessary.

Key partners
For equipment aggregators the same applies as for manufacturers in an implicit DR business model. As discussed above, partners could be helpful in order to provide the prosumer with a suitable variable tariff. The two promising partners are electricity suppliers and tariff consultants.

Revenue streams
Following revenue streams can be distinguished in relation to the equipment aggregator's DR activities:

- The revenue is generated from the **prosumer who is purchasing the service of load shifting**. The pricing model can be designed as a flat rate or a performance-based service fee which is probably embedded in the service package for usage of the integrative platform.

- DR as an additional use case for device-connecting systems may lead to increasing attractiveness of such platforms and therefore result in **higher number of platform customers.**

Cost Structure

The cost structure is similar to other implicit DR business models but with following distinctive differences:

- Costs for the **assessment of prosumers' DR potential** are low, as all the devices considered for DR are already interconnected on a platform where many of the devices' properties are stored.
- There are **no extra costs for provision of hardware** as the connectivity platform is part of the package in the core business facilitating services other than DR such as those related to comfort etc.
- Therefore, we do not expect **extra costs for hardware installation**

4.8 BMC assessment for microgrid management

If operated in **island-mode** a microgrid manager has to ensure at each point in time that power supply is equal to power demand. For achieving this prerequisite, DR can play an important role and the DELTA solution could be a helpful tool which handles the aggregation and the dispatching of loads.
However, whether DR is a business case for a microgrid in island mode depends on many internal factors of the specific microgrid and therefore cannot be analysed any further here.
As a result, following discussion of the BMC focuses on microgrids in grid-connected mode.

Generally, we think that the position of a microgrid manager is rather similar to a FLESCO's position as described for the business model **"Implicit DR service for optimal use of ToU-contracts"**, mainly because of following considerations:

- Microgrid managers aim to optimise the electricity costs for the whole microgrid. ToU tariffs and their optimal use may be an attractive tool to achieve this goal.
- The microgrid management may not have enough resources (staff and know-how) to sell capacities on flexibility markets, which is the main characteristic of explicit DR.
- So-called Local Energy Communities are promising microgrid operators, but by definition they have to be run predominately by local entities such as municipalities, SMEs, and non-profit organisations. This means very limited resources with the consequences as described in the point above.
- Also, in contrast to explicit DR implicit DR for optimal use of ToU contracts does not require extensive M&V.

However, we assume that under certain conditions, a microgrid manager can offer explicit DR potential on various flexibility markets. In this case the microgrid management would be very similar either to the business model **"Explicit DR as stand-alone service"** or to the business model **"Explicit DR combined with EES"**. Microgrid management based on explicit DR requires the following preconditions:

- Particularly large microgrids
- Prosumers in the microgrid (devices, production units, storage units) can provide more flexibility capacities than necessary for just stabilising the microgrid itself.
- Well institutionalised microgrid management with sufficient resources to sell capacities on flexibility markets

As mentioned above, this business model is quite similar to those already described. Therefore, in the following section implicit and explicit DR for microgrids is only briefly discussed highlighting the main characteristics in the BMC.

Value proposition

- **Reduction of energy costs** through optimal use of a ToU contract or sales on flexibility markets.
- By applying DR, the microgrid operator can **participate in the energy transition** and can create an **innovative image**.

- When achieving the prerequisites for the application of DR (communication, smart devices), the operator can implement other smart building features for the users (comfort etc.).

Target prosumer segment

In general, all members of the specific microgrid can be considered as targeted prosumers. However, also in this business model trade-offs have to be made between DR potential and investment costs to facilitate DR at the final prosumers. This may exclude some microgrid members from participating in DR.

Channels

The channels between microgrid operator and final prosumers are well established. The microgrid manager has detailed knowledge about the operated technical units and the potential for shifting loads.

Prosumer relationships

A close cooperation and certain level of trust may be already in place for the purpose of microgrid operation. Therefore, interaction is also expected to be very close with a contact person available for prosumers' requests.

Key resources

The key resources are mainly expected to be covered by the DELTA platform and correspond to the aforementioned implicit and explicit DR business models.

Key activities

The key activities as well correspond to the aforementioned implicit and explicit DR business models.

Key partners

In the **implicit** business model, a microgrid manager is not necessarily in the need of strategic partners. However, in this case important roles play the electricity supplier providing the flexible tariff and the technical equipment provider ensuring DR readiness of the technical units.
In the **explicit** business model, the need for partnerships depends on the structure of the microgrid. For instance, a large microgrid with high DR potential may sell capacities on flexibility markets, whereas a small one may need the help of a higher-level aggregator to sell capacities on the market.

Revenue Streams

Similar to the other business models discussed here, revenue streams can consist of cost savings (implicit DR) or cash flows from sales on flexibility markets (explicit DR). It depends on the structure of the microgrid, if the revenues are passed on to the final prosumers or if the microgrid operator is the final prosumer and therefore gains the benefit.

Cost Structure

For the microgrid business model, the costs differ from the general cost structure as follows:

- Costs for assessment of DR potential are lower, as the microgrid manager is aware of the major technical devices in the grid.
- There are no customer acquisition costs towards prosumers
- Especially if the microgrid operator is the final prosumer entity, there are no costs for contract conclusion with the final prosumer and there is also no prosumer remuneration that needs to be agreed on.

5. Analysis of major cost elements

5.1 Overview on cost classification for the provision of DR services

With the provision of business models as described above the DR service provider has to carry cost at different levels. In addition to the assessment of cost structure implemented at the BMC, this chapter classifies the cost elements related to the provision of DR services and analyses the major cost elements.

Figure 16 gives an overview on cost classification for DR services. On the one hand, we have common cost items that occur independently from the business model provided. These cost elements are related to the access and to small- and medium-sized prosumers and to securing their connectivity over longer period of time. On the other hand, there exist cost items that are specific either to implicit DR or to explicit DR.

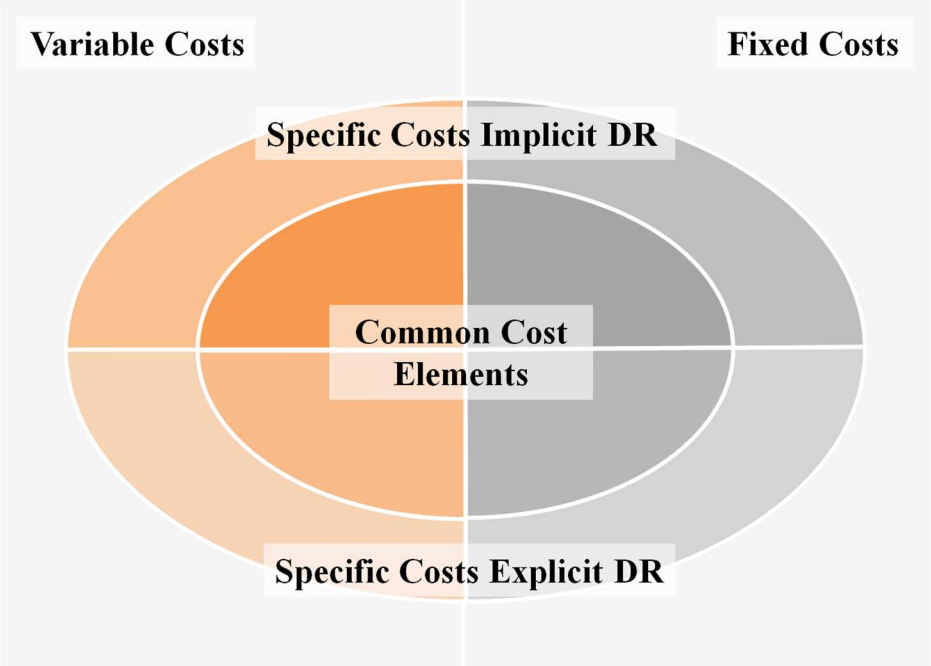


Figure 16 Classification of cost elements related to the provision of DR services

5.2 Common cost items

When assessing the cost structure of a business usually variable costs and fixed costs are differentiated. A variable cost varies with the amount of production or with the volume of services provided, while a fixed cost the same independent from the output level. For our case of common cost items in DR services we will apply this differentiation as major structural element. In practice, however, we have to keep in mind that it is not so simple to distinguish whether a cost is fixed or variable since there exist a number of intermediate stages.

5.2.1 Major variable cost among common cost items for provision of DR services

In the context of common cost items variable cost depend on the number of prosumers that are interlinked with services provider and that give access to their technical units. This category includes the following major cost items:

- **Cost for the assessment of DR potential of a prosumer:** This cost element may differ very much from the approach chosen. Mainly for small-sized prosumers it is crucial that the DR service provider is able to assess the DR potential remotely without necessity for an on-site visit.

From the EES business we know that a low failure rate in distinguishing between promising and non-promising customers (in the case of DR prosumers) is one important factor for success of the business model. This depends highly on the level of information on the technical units, on their connectivity and on the user behaviour that is easily accessible for the DR service provider.

- **Variable contracting cost** include the cost directly related to the conclusion of a contract with a prosumer. For small and medium-sized prosumers this cost item have to be kept very small through standardisation, web-based implementation and eventually blockchain-related technologies.
- **Hardware cost** consisting of the cost of hardware that is required to ensure the connectivity of the prosumer's technical units as well as of the cost for installation. We assume that this cost element will be of utmost importance for the cost efficiency of any DR business model addressing small and medium-sizes prosumers. Therefore, there is a distinct need to explore potential for cost reduction in this field, such as:
  - Making use of measurement and control technology already installed at the technical unit (e.g. so-called smart devices)
  - Making use of existing (building) automation systems (only applicable for medium-sized prosumers)
  - Standardisation of installation works related to FEID –enabling eventually self-installation by the prosumer.
- **Variable cost for operation and maintenance (O&M):** Each prosumer gives rise to a certain amount of variable O&M cost that occur for keeping continuous communication with the facility and for operating them remotely, including cost for trouble-shooting and helpdesk.
- **Replacement cost of installations:** After a certain period of time or after a longer period of malfunction hardware installation need to be renewed. From EES-business we can learn that the quality of products – expressed by its expected lifespan – are important for the cost-benefit ratio of the service. We expect that the same rule may also apply to the DR business.
- **Variable cost related to the provision of additional services:** Some of the business models include the provision of additional services – such as technical monitoring of appliances, services related to the optimisation of operation of technical units etc. Depending on the kind of services, there will be certain variable cost elements depending on the number of customers under contract.

5.2.2 Major fixed cost among common cost items for provision of DR services

Fixed cost items in the context of common cost elements for the provision of DR services are those that occur independently from the number of prosumers that are connected to services provider and that give access to their technical units – or to say it with other words, independently from the success of the DR service provider in addressing potential prosumers and in convincing them to participate in the DR service. In detail, the following major cost items are included in this category:

- **Prosumer acquisition cost:** The prevailing part of this cost item refers to the effort related to raising prosumers' awareness. From our point of view, this cost item will be very important with respect small and medium-sized prosumers since it is closely interlinked with marketing and communication activities. In this context, we also refer to the importance of targeted market segmentation as a means to improve the success rate in addressing prosumers and in getting them engaged.
- **Cost for required IT-infrastructure:** Any DR service provider who becomes active in the field of small and medium-sizes prosumers will have to invest in a high-level IT-platform that comprehensively supports the key activities that have to be performed, such as handling and clustering the loads, load forecasting, price forecasting, management of contracts, communication with the single prosumers, complaint handling, payment transactions etc. We assume that IT-infrastructure will be a major cost element which is largely independent from the number of prosumers that are managed by the platform, although some parts of the software license may depend on the amount of data and/or level of activities.

- **Other fixed O&M cost:** A part of the O&M cost will be independent from the number of prosumers that are included in the scheme, e.g. basic infrastructure cost for the helpdesk; cost related to guarantee of privacy policy towards prosumers, etc.
- **Fixed cost related to the provision of additional services:** Depending on the kind of additional services provided together with the DR services, there will be certain share of fixed cost that do not depend on the number of customers under contract.

5.3 Specific cost items for explicit DR

The business models referring to explicit DR have a few specific cost elements that go beyond the common cost items as described above. Furthermore, some cost elements occurring in explicit DR have peculiarities which distinguish them from implicit DR. In detail, the following observations can be made:

- Firstly, there exists a bundle of **cost that are related to the active participation in flexibility markets (market-related cost)**, consisting inter alia of the following elements:
  - Cost related to the fulfilment of legal and administrative obligations (depending on the specific flexibility market and related programme): This may be one-time cost (market entrance cost or continuous cost.
  - Business development cost related to the development of in-house expertise and/or acquisition of external know-how: The amount of this cost depends largely on the starting point of DR provider. Therefore, an equipment provider or a facility manager that wants to get engaged in DR business will have much higher business development cost than a retailer or even an aggregator that is already engaged in DR with large-scale prosumers.
  - Continuous provision of capacities for activities on the flexibility markets (personnel, infrastructure)
- **Cost related to the remuneration of prosumers:** For explicit DR this cost is usually a variable cost, since payments to the customers are made generally for each successful dispatch. There is, however, a trade-off between M&V cost (see below) and amount of payments per event, therefore we may expect that for small and medium-sized prosumers easier ways of remuneration may get introduced in the future (e.g. fixed remuneration per month; performance-based remuneration over a larger pool of prosumers; or similar). There is very little evidence, about the amount of remuneration that is required to get small and medium-sized prosumers engaged in DR schemes[5]. In analogy with the non-energy benefit discussion that has enriched the EES business over the last few years, we think that DR services involving small and medium-sized prosumers should not focus too much on financial remuneration, but on other benefits that may be of higher relevance in this market segment.
- **Specific M&V cost:** The cost for M&V depend on the remuneration model chosen as well as on the requirements defined for the various flexibility markets on which the aggregator offers the DR potentials. M&V cost are partly fixed cost (provision of expertise, collection of data etc.) and partly variable cost depending on the number of events that need to be assessed.

5.4 Specific cost items for implicit DR

In addition to the absence of cost items related to the active participation in flexibility markets, the following cost items are managed in a different way in implicit DR compared to explicit DR:

[5] For the residential sector, highly diverse figures can be obtained from the literature. Torstensson and Wallin (2015) conducted a survey among residential consumers in Sweden and their findings suggest that for participating in demand response schemes most respondents would require a reduction of their energy bill of at least 250 SEK/month (ca. 23 EUR). Other results by Safdar et al. (2019) range from 7.9% of the electricity costs of the shifted loads to 1.47 EUR/kW for a three-hour shift.

- **Remuneration of the prosumers:** In implicit DR the remuneration of the prosumer is usually linked to sharing of cost savings achieved by the DR service provider. Depending on the business model applied the savings may be passed on to the prosumer through an advantageous power supply contract and/or through an optimal use of the variable element in an existing power supply by shifting loads. If the remuneration is performance based (depending on the savings achieved compared to a predefined baseline), the remuneration represents a variable cost item. In future, however, we may expect business models that remunerate participating prosumers on a lump sum basis (mainly in the business model "Implicit DR including power supply") – in this case, this cost element becomes a semi-fixed cost item, which is dependent on the number of prosumers, but independent from the amount of load shift actually performed.
- **Specific M&V cost:** M&V works different in implicit DR schemes compared to explicit DR. If there is a performance-based remuneration of the prosumer, the M&V approach is similar to the EES business where savings are calculated against a cost baseline before the implementation of optimisation measures. If the remuneration is based on lump-sum payments, the cost for M&V get largely reduced. In developing a detailed business model the trade-off between cost for M&V and (expected) success in engaging prosumers by means of performance-based remuneration has to be assessed in further detail.

6. Assessment of revenue streams

This section shows an overview of different types of revenue streams a business entity can develop by applying the different DELTA Business Models. Table 6 summarizes these revenue streams.

Table 6: Different types of revenue streams in the DELTA Business models

Cost savings	Service fees	Wholesale market	Balance groups (BG)		Ancillary services/ balancing market
			BG internal	Other BG	
Cost savings Minimize energy costs Minimize sourcing costs	FLESCO-service Supplemen-tary services Energy efficiency service (EES)	European Energy Exchange (EEX) or over the counter (OTC) Day-ahead (DA) Intraday (ID) dispatched energy (=loads) are traded positive or negative energy	Using flexibility within BG To avoid imbalance costs or for selling flexibility to other actors within BG	Selling flexibility to other BGs over the counter (OTC)	= control energy market = reserve capacity market Procured by TSO Revenue for keeping available capacity + revenue for actual dispatch of capacity (=load)

6.1 Cost savings

In some DELTA Business Models the benefit for the business entity lies in cost savings compared to the status quo in which no DELTA Business Model is applied. This means the result is not an additional cash flow but a reduction of existing cash flows.
This is the case in following DELTA Business Models:

- Microgrid Management (implicit DR): Here, the microgrid is shifting loads to optimally make use of their variable tariff and therefore gains cost savings.

- Implicit DR including power supply (minimize sourcing costs): A supplier is shifting loads at its clients in a way that sourcing costs on the supplier's side are minimized. Here, also costs for any imbalances in the suppliers balance group are minimized.

6.2 Service fees

Here, the revenue for the business entity comes from the prosumers who are paying for certain services. Firstly, there is the **FLESCO-service**, which is shifting loads remotely so the prosumer maximises its benefit from a variable electricity tariff. This is the case in following DELTA Business Models:

- Implicit DR service for optimal use of ToU-contracts
- Implicit DR combined with equipment provision

Secondly, there are **supplementary services** that may be optionally offered by the business entity. These include but are not limited to energy monitoring, functionality checks, comfort optimisation etc. Such services may be offered in following DELTA Business Models:

- Explicit DR as stand-alone service
- Implicit DR including power supply (sale of flexibility/minimize sourcing costs)
- Explicit DR combined with equipment provision

Thirdly, a fee is imposed for energy efficiency services (**EES-fee**) which are part of following DELTA Business Model:

- Explicit DR combined with EES

6.3 Wholesale market

In some DELTA Business Models, business entities can generate revenues by selling flexibility on the wholesale market.
On the wholesale market larger consumers (e.g. energy intensive industry) and energy suppliers (pure retailers or also producers) as well as independent DR aggregators and suppliers/aggregators can trade their energy. This can happen either on the **European Energy Exchange (EEX) or bilaterally (over the counter - OTC)**. The EEX is a standardised and organised market and is divided into the forward market (years/month ahead) and the spot market. Within the spot market two main time frames are relevant: **Day-ahead (DA) and Intraday (ID)**. On the wholesale market actual dispatched loads are traded. Therefore, flexibility can be traded in terms of positive energy (supply of energy/reduction of consumption) or negative energy (consumption of energy/reduction of supply).
Business entities can sell loads on the wholesale market in following DELTA Business Models:

- Explicit DR as stand-alone service
- Explicit DR combined with EES
- Implicit DR including power supply (sale of flexibility)
- Explicit DR combined with equipment provision
- Microgrid management (explicit DR)

6.4 Balance groups

All market participants on the electricity market (producers, traders, suppliers, consumers) have to be members of a commercial balance group (BG). These balance groups are financially responsible for their own balance, i.e. the balance between production and consumption or buying and selling respectively. Deviations from the schedule to be reported to the TSO result in cost for imbalance and hence, balance groups are interested to reduce imbalances as far as possible.
By applying some of the DELTA Business Models, business entities can generate revenues by selling flexibility (positive or negative energy) **within their balance group** as well as trading flexibility with **other balance groups**.
Direct sales to BRPs are arranged bilaterally and therefore considered as OTC transactions.
In following DELTA Business Models, sales of flexibility to BRPs are possible:

- Explicit DR as stand-alone service
- Explicit DR combined with EES

- Implicit DR including power supply (sale of flexibility)
- Explicit DR combined with equipment provision
- Microgrid management (explicit DR)

6.5 Ancillary services/ balancing market

Ancillary services include a range of products supporting grid operation and balancing of the grid. Frequency control can be referred to as one of the most important ancillary services and it is traded on the control energy market which is also called reserve capacity market or balancing market. This is an organized market where the responsible TSO procures balancing services for a determined price.
On the control energy market, business entities can generate revenues in 2 complementary ways:

- Firstly, the TSO contracts and pays market actors to have **capacities** available that can provide frequency control to a specific amount in a given timeframe. These can be positive capacities (providing energy/reducing consumption) or negative capacities (consuming energy/reducing production).
- Secondly, for each actual **dispatch of these contracted capacities** an additional payment is made by the TSO.

In the following DELTA Business Models, business entities can sell capacities (and resulting loads) on the control energy market:

- Explicit DR as stand-alone service
- Explicit DR combined with EES
- Implicit DR including power supply (sale of flexibility)
- Explicit DR combined with equipment provision
- Microgrid management (explicit DR)

Figure 17 Overview on revenue streams differentiated by DR business models

				Sales towards		
Generic DR Business Models	Business entity	Cost savings	Service fees	Wholesale market	Balance groups	Ancillary services/ balancing market
Explicit DR as stand-alone service	Independent aggregator		(x)	x	x	x
Explicit DR combined with EES	Independent aggregator		x	x	x	x
Implicit DR service for optimal use of ToU-contracts	FLESCO		x			
Implicit DR including power supply (minimize sourcing costs)	Supplier	x	(x)			
Implicit DR including power supply (sale of flexibility)	Supplier		(x)	x	x	x
Explicit DR combined with equipment provision	Equipment provider		(x)	x	x	x
Implicit DR combined with equipment provision	Equipment provider		x			
Microgrid management (explicit DR)	Microgrid management			x	x	x
Microgrid management (implicit DR)	Microgrid management	x				

(x)…. applies for optional supplementary services (e.g. monitoring

6.6 Compensation Mechanism

In some of the DELTA Business Models an independent aggregator is shifting loads of many prosumers, aggregating these loads and selling them on various flexibility markets. By doing this, an aggregator will change the consumption patterns of a prosumer who is part of another balance group than the aggregator. In such a case, the energy supplier in the prosumer's balance group needs to be compensated for the lost profits resulting from not delivered energy due to the aggregator's interference ("Fair compensation"). This fact needs to be considered in following DELTA Business Models, where an independent aggregator plays a key role:

- Explicit DR as stand-alone service
- Explicit DR combined with EES
- Explicit DR combined with equipment provision
- Microgrid management (explicit DR)[6]

[6] In this case the microgrid manager may also act as a subordinate DSO. It needs to be clarified if such a DSO can be a DR aggregator according to current regulation.

There is no need for compensation in the business model “Implicit DR including power supply” where a supplier acts as an aggregator. That’s because the prosumers under contract are part of the same balance group as the supplier.

7. Preliminary conclusions and next steps

From the assessment performed in the context of this deliverable we can draw the following preliminary conclusions:

- Starting from a limited number of six generic DR business models, the **detailed BMC assessment broadens heterogeneity of possible business approaches**. There exists a quite broad field of different value propositions, customer segments and ways how to address the customers. At the same time, we observe a broad range of key activities and key resources which are required for the provision of the underlying DR services.
- In spite of the heterogeneity observed, there exist **certain features that are relevant for each business model** if applied to small and medium-sized customers. From the point of view of market penetration, these features should be in the development focus for the DELTA-platform. The most important features that are relevant to all generic DR business models are as follows:
    - **Handling of small and medium loads** (control, monitoring, load shift etc.) including automatic dispatch under certain conditions
    - **User clustering** for automatic detection and classification of assets
    - **Self-subscription and self-assessment** of switchable devices
    - **Precise load forecasting** connected with the utilisation of accessible DR-potential
    - **Price forecast** for different flexibility markets
    - **Administrative applications** for user management, as well as applications supporting **"smart contracts"**.

  In addition, **implicit DR business models** require some specific features that relate to the observation and **continuous up-date of tariffs** at the clients' side.
- The **importance of so-called transaction cost** – i.e. cost for information, coordination and decision-taking – increases with the involvement of small and medium-sized prosumers into DR schemes. As the financial incentives for the prosumers are small and profit margins for DR service providers are expected to be small as well all cost related to distribution to and communication with the potential customer need to be kept very low. Major transaction cost in this context are:
    - cost for filtering out the facilities and/or technical units with promising DR-potential
    - marketing and sales cost
    - cost for checking and ensuring connectivity and switchability (including hardware installation, if required)
    - cost for user clustering and user management
    - cost for M&V of DR events
    - cost related to contractual arrangements and administration
    - invoicing cost
    - etc.
- Only those DR **business models that actively manage and reduce transaction cost will be successful in the long run**. Among others, this includes
    - activities that facilitate the access to switchable devices at prosumers' side;
    - making use of existing distribution and information channels related to the target groups addressed;
    - reducing contracting cost by standardisation and eventually application of blockchain technologies
    - reducing the cost for M&V trough lump sum remuneration models (applicable mainly to implicit DR schemes)
- The possible **revenue streams** depend on the specific DELTA Business Model applied. There are **different markets for flexibility serving different purposes**, including wholesale market, balance group trading and control energy market.
- Future development on **the control energy market** and concerning **balance group trading** is highly depending on the **accuracy of load forecasting** on the supply side as well as on the

demand side. If there are high accuracy tools available and supply and demand can react accordingly, there is less need for trading flexibility on these markets.

- For future development on the **wholesale market** we find, that there is a need for **dynamic grid pricing** in a temporal as well as in a regional context. In this way congestion management and redispatch management could be taken into account and reflected by a price signal.
- Although it is premature to exclude certain business models from the list of implementable schemes, we can draw a few preliminary conclusions with respect to the suitability of business models to a given context. Although we expect that a **number of business models will be applicable for the medium-sized prosumers** – e.g. larger non-residential buildings, microgrids, business parks etc. – we assume that only the business model related to implicit DR including power supply is appropriate to address household clients. This is because of **a good starting position of retailers** that can get a comparably cheap access to DR potentials as they have established well-functioning distribution channels and customer relationships (including billing).
- Generally, those business models where the **DR service is embedded in a larger service package** – such as EES, facility management, supply of electricity, equipment provision – are more promising than DR services offered as stand-alone service. This is mostly related to the impact of transaction cost on profitability.

In any case, we have to take into account that at this stage the **BMC assessment is done at an ideal-typical level** for generic business models. Partly it transfers the experience gained from existing DR business that is addressing exclusively large (industrial) customers as well as from related business models, such as energy efficiency services. To a large degree, however, the current assessment consists of theoretical considerations which will need practical testing and verification. In the frame of the DELTA-project, this will be done during the implementation of the DELTA pilot project (WP7). Against this background, the **preliminary conclusions as presented above will be further enhanced in the course of the DELTA project** mainly related to the development of the final version of the DELTA Business Models v2 (D2.5, due by April 2021) and to the deployment of the DELTA Market Analysis and Preliminary Business Innovation Plan v2 (D8.10., due by April 2021).

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