Interoperable solutions for implementing holistic **FLEXI**bility services in the distribution **GRID**

Business Model Development – Month 36

Deliverable 8.3
WP8

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Approvals

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ABBREVIATIONS

ARERA: Italian Regulatory Authority for Energy, Networks and Environment
BESS: Battery Energy Storage System
BMS: Building management system
CAGR: Compound annual growth rate
CAPEX: Capital expenditures
CBRD: Croatian Bank for Reconstruction and Development
CEER: Council of European Energy Regulators
CESEC: Central and South Eastern Europe energy connectivity
D: Deliverable
DER: Distributed energy resources
DSO: Distribution system operator
EBRD: European Bank for Reconstruction and Development
EFSI: European Fund for Strategic Investments
EPC: Engineering, Procurement and Construction
ER: Exploitable result
EIB: European Investment Bank
EnC: Energy Community
ESCo: Energy Service Company
ESPC: Energy service performance contract
ESIF: European Structural and Investment Funds
EU: European Union
EV: Electric vehicles
FiT: Feed-in-Tariff
GDP: Gross domestic product
GHG: Greenhouse gas
GME: Italian Power Exchange
HAEE: Hellenic Association for Energy Economics
HEDNO: Hellenic Electricity Distribution Network Operator
HEnEx: Hellenic Energy Exchange
HV: High voltage
ICT: Information and communication technologies
IEA: International Energy Agency
INECP: Integrated National Energy and Climate Plan
JRC: Joint Research Centre
LV: Low voltage
M2C: Meter to customer
MSD: Dispatching Services Market
MV: Medium voltage
NECP: National Energy and Climate Plan
NRA: National regulatory authority
O&M: Operation and maintenance
OPEX: Operating expenses
PR: Public relations
PV: Photovoltaic
R&D: Research and development
R&I: Research and innovation
RAE: Greek Regulatory Authority for Energy

RES: Renewable energy sources
SAIDI: System average interruption duration index
SAIFI: System average interruption frequency index
SCADA: Supervisory control and data acquisition
TEN-E: Trans-European Networks for Energy
TSO: Transmission system operator
UK: United Kingdom
UN: United Nations
VTES: Virtual thermal energy storage
WP: Work package

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EXECUTIVE SUMMARY

This Deliverable, intervening at the end of the third year of implementation of the FLEXIGRID project, continues the FLEXIGRID exploitable results' business model development process, building upon the market analysis, the value proposition of the FLEXIGRID approach and the exploratory business models for FLEXIGRID individual solutions presented in Deliverable 8.2.
While the Covid-19 pandemic and its consequences have had a significant impact on the short-term market conditions, more structural and long-term changes can also be expected, notably in line with the new climate and renewable energy targets defined by the European Union. This deliverable analyses these evolutions in the market outlook, as well as the opportunities and challenges that they create for stakeholders of the electricity value chain. It also proposes an in-depth analysis of the market context of two EU member States where FLEXIGRID demonstration activities are implemented, Croatia and Spain, articulated around the "*main factors affecting the number of projects and the level of investment*" in smart grid projects identified by the European Commission's Joint Research Centre.

In addition to this analysis of the market environment, which is key to prepare the deployment of the FLEXIGRID exploitable results on the market, this deliverable marks a second step in the development of business models for these results. Over the first twelve months of the FLEXIGRID project, exploratory business models have been designed for the nine individual FLEXIGRID solutions, based on a methodology resting on A. Osterwalder and Y. Pigneur's Business Model Canvas. During the second year of implementation of the project, these exploratory business models have been updated and refined using a complementary methodological framework. Besides, exploratory business models have been developed for other exploitable results of the project identified within the framework of the Exploitation Strategy, following the Canvas methodology. This deliverable presents the results of this business model creation process, in which all partners have been involved within the framework of working groups coordinated by each exploitable result's lead partner(s).

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1 INTRODUCTION

Throughout the implementation of the FLEXIGRID project, a reflection on the business models of the associated exploitable results and use cases is carried out within the framework of Task 8.1 of Work Package 8 (WP8), in order to pave the way towards their market deployment.

Intervening at the end of the first year of implementation of the project, Deliverable 8.1 (D8.1), "Business model development", presented an analysis of key market trends and of the challenges that they create for different stakeholders of the electricity value chain, as well as the results of a first value proposition and business model design exercise conducted for the individual solutions constituting the FLEXIGRID approach. All the partners intervening in their development were involved in this interactive process, using a common methodological framework based on A. Osterwalder and Y. Pigneur's Business Model Canvas (A. Osterwalder and Y. Pigneur, 2011). At these early stages of the business model development process, the choice had been made to focus more specifically on four of the Canvas's building blocks: customer segments, value propositions, revenue streams and cost structure.

Deliverable 8.2 aims to take stock of the advances made in this reflection, which will lay the foundations for the definition of a business plan to support the deployment of the FLEXIGRID exploitable results (ERs) on the market. More precisely, it proposes:

- an update of the market analysis presented in D8.1, focusing on evolutions in the marketenvironment and on the opportunities and challenges that they create for stakeholdersof the electricity value chain;
- an in-depth analysis of the market context of two European Union (EU) member Stateswhere FLEXIGRID demonstration activities are implemented: Croatia and Spain;
- a refinement and update of the exploratory business models defined in D8.1 for nine ERs corresponding to the FLEXIGRID solutions;
- exploratory business models for other ERs identified over the course of the project implementation, notably within the framework of the definition of the Exploitation Strategy (Task 8.5).

In order to facilitate the update of the business models presented in D8.1, CAP proposed to the partners a methodology and template designed with two objectives:

i) further refining the analysis on some of the Canvas's key building blocks, notably byconsidering the interactions between them;
ii) and preparing for the beginning of the implementation of the demonstration campaign (WP6) and of the cost-benefit analysis (Task 8.2), by focusing on the exploratory business models' applicability.

Exploratory business models for other identified ERs have been designed using the methodology employed in D8.1 for the nine individual FLEXIGRID solutions, resting on the Business Model Canvas (presented in Appendix 1 of D8.1).

Regarding the Deliverable 8.3 (D8.3), the objective is to go deeper in the development of the FLEXIGRID ER Business Models, with the following actions:

- an update of the market analysis presented in D8.2, focusing on evolutions in the marketenvironment and on the opportunities and challenges that they create for stakeholdersof the electricity value chain;
- an in-depth analysis of the market context of two European Union (EU) member Stateswhere FLEXIGRID demonstration activities are implemented: Greece and Italy;

- an update of the exploratory business models defined in D8.2 for nine ERs corresponding to the FLEXIGRID solutions;
- Refinement of exploratory business models for other ERs identified over the course of the project implementation, notably within the framework of the definition of the Exploitation Strategy (Task 8.5).
- Use Cases Business Model, using the same methodological framework and the ER Business Models previously updated.

For the third deliverables, the analysis was conducted within the framework of working groups gathering all the partners involved in the development of each ER, coordinated by one or several lead partner(s).

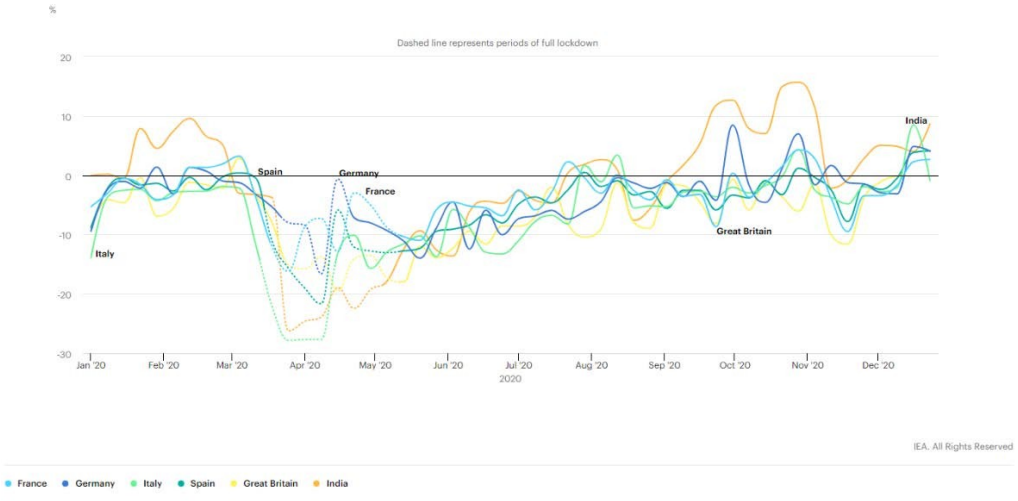
2 MARKET OUTLOOK – UPDATE

2.1 The Covid-19 pandemic: short- and longer-term impact on the market outlook

A rise of uncertainty and challenges for the power system

The Covid-19 pandemic and the measures taken to address it (lockdowns and/or other national or local restrictions) have had a direct impact on the energy system in many countries. In order to assess its consequences in Europe, the Council of European Energy Regulators (CEER) conducted a survey of national regulatory authorities (NRAs) in December 2020 (CEER, 2021). Most of them observed a significant decrease in electricity consumption in the first semester of 2020 (Figure 1), which was estimated at -7% in the European Union (EU) in comparison with the same period of 2019 (CEER, 2021). More generally, the International Energy Agency (IEA) notes that "*countries in full lockdown [experienced] an average 25% drop in energy demand per week and countries in partial lockdown an average 18% decline*", and that "*dramatic reductions in services and industry [were] only partially offset by higher residential use*" (CEER, 2021; IEA, 2021c).

Figure 1. Year-on-year changes in weekly electricity demand, corrected for weather, in 2020



Source: IEA, 2021c

16 of the NRAs surveyed by the CEER also observed important decreases in wholesale electricity prices over the same period, due to the Covid-19 crisis' impact on energy demand and fuel prices, but also, in some cases, to other factors, including weather conditions (CEER, 2021). For instance, in April 2020, prices were inferior to their 2019 levels by 54% in Germany, Greece and Italy, and by 60% in Spain (CEER, 2021). In Austria, the "*pure 'COVID-19 effect'*" on prices was estimated to EUR 9/MWh between March and May 2020 (CEER, 2021).

Changes in the electricity mix have also been noted: in the EU, the share of renewable energy sources (RES) (40%) reached higher levels than that of fossil fuels (33%) for the first time in the first semester of 2020, and record-high shares of variable RES were registered during lockdowns in Germany, Italy and Spain (CEER, 2021; IEA, 2021c).

The economic and social consequences of the Covid-19 pandemic had implications for energy stakeholders: in answer to the CEER's survey, "*several NRAs noted that suppliers reported increases in unpaid bills and that network operators expected loss in tariff revenue*" (CEER, 2021).

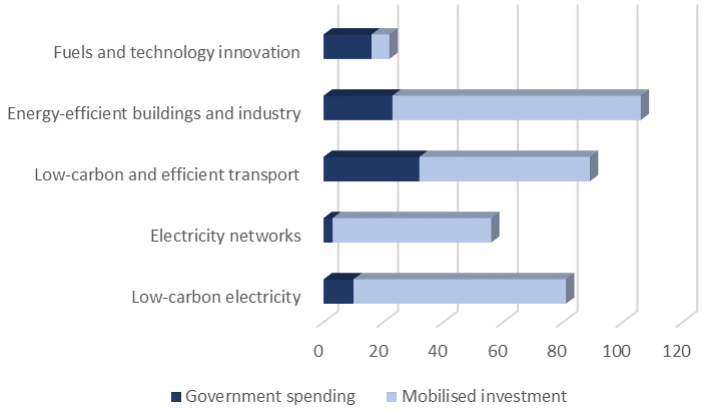
Measures have been taken to deal with the immediate consequences of the Covid-19 pandemic in the energy sector. In order to alleviate its impact on energy consumers, several European countries adopted specific provisions, in addition to social welfare measures and aids for businesses; they included adjusted payment conditions for energy bills, moratoriums on disconnection, and even contractual changes (CEER, 2021). In turn, in certain countries, energy suppliers were allowed to defer network tariff payments (CEER, 2021). Operational conditions also had to be adjusted, with the implementation of network operators' business continuity plans (CEER, 2021). The CEER notes, "*as a result, some countries report delays to network development and smart meter roll-out*" (CEER, 2021).

More long-term lessons have also been drawn from the experience of the energy sector during the Covid-19 pandemic, notably through the analysis of the factors that allowed its relative resilience (CEER, 2021). Among them, the CEER's survey highlights "*the importance of a swift and complete exchange of information with all stakeholders (government, network operators etc.) and the acceleration of digitalisation and remote operations in the energy sector to tackle the crisis*" (CEER, 2021). The latter dimension refers not only to remote working, which was common to many sectors during the Covid-19 crisis, but also, and more specifically, to "*technologies to monitor infrastructure remotely*" (CEER, 2021).

Sustainable solutions for energy and end-use sectors at the heart of recovery packages

In addition to the measures adopted to manage the Covid-19 pandemic, many governments have strived to address the economic crisis that it has triggered by adopting recovery packages. The IEA estimates that "*as of the second quarter of 2021, over USD 16 trillion has been mobilised in fiscal support aimed at stabilising and rebuilding economies around the world*" and, out of them, 2.3 trillion have been oriented towards "*economic recovery, defined as long-term projects and measures that boost growth*" (IEA, 2021b). Among the latter, c. 380 billion are dedicated to clean energy measures (IEA, 2021b). When taking into account the private investment that is expected to be leveraged through this spending, annual average expenditures in this field could register a USD 350 billion increase over the 2021-2023 period, among which 81 billion would be dedicated to low-carbon electricity and 56 billion to electricity networks (Figure 2) (IEA, 2021b).

Figure 2. Recovery packages – Annual investment by sector (annual average 2021-2023, USD billion/year)



Source: IEA, 2021b

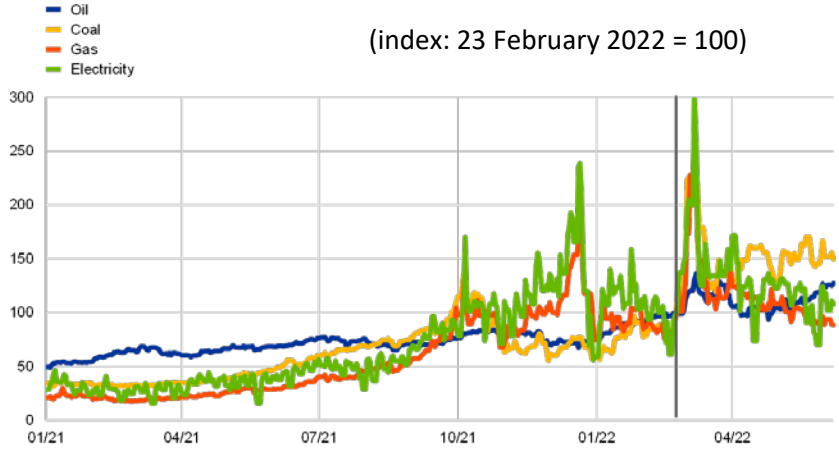
In the EU, a Recovery and Resilience Facility was set up in February 2021 to contribute to member States' recovery reforms and investments financing until 2026, by means of grants and loans representing a total of EUR 672.5 billion (EC, n.d.). To benefit from it, member States have to define recovery and resilience plans detailing intended reforms and investments, which have to be dedicated notably to climate (at least 37% of expenditures) and to the digital transition (at least 20%) (EC, n.d.). "*Flagship areas*" have been suggested for these plans; among them, "*Power up (clean technologies and renewables)*", "*Renovate (energy efficiency and buildings)*" and "*Recharge and refuel (sustainable transport and charging stations)*" can allow support for investments in energy and climate action (EC, n.d.; EC, 2020a). National plans are assessed by the European Commission (EC) and approved by the Council (EC, n.d.).

2.2 War in Ukraine

On 24 February 2022, Russian troops have invaded Ukraine, engaging a conflict still going on, causing thousands of deaths and strong changes on energy supply at a world scale. Responding to this invasion, the European Union has taken economic and diplomatic sanctions against Russia. Russia is the world's second-largest producer of natural gas, behind the United States, and has the world's largest gas reserves (IEA, n.d.a). Therefore, in order to reduce Russian revenue on the energy market, "the EU restrictions will cover nearly 90% of Russian oil imports to Europe" (EC, n.d.). The European' energy production roadmap has changed, towards the installation of more decarbonized sources of energy (Renewable, SMR…) in order to produce local energy and be independent. To mobilize the European citizens on this matter, the IEA and the European Commission has published a report titled "Playing my part - How to save money, reduce reliance on Russian energy, support Ukraine and help the planet" with detailed recommendation toward more energy sobriety.

The war in Ukraine has caused an increase on the electricity prices and on the volatility of the energy market everywhere in Europe. In the first two weeks after the Russian invasion, the prices of oil, coal and gas went up by around 40%, 130% and 180% respectively (Figure 3). Over April, the prices have been moderated, with oil and coal prices standing 27% and 50% respectively above their levels before the invasion, while gas prices are 11% lower than before the invasion. At the beginning of June, the prices have started to rise up again, this can be explained by the EU's agreement to embargo most Russian oil imports and the higher global demand for oil owing to China is easing of COVID-19 restrictions. Regarding the electricity, the prices are 8% higher than before the invasion, they remain volatile because of the policy measures taken in response to the price increases (Feveile Adolfsen et al., 2022)

Figure 3: Prices of oil, coal, gas and electricity before and after the Russian invasion.



Source: Refinitiv, Bloomberg and ECB staff calculations.

Notes: Oil prices are Brent crude oil prices, gas prices are the Dutch Title Transfer Facility day-ahead prices and coal prices are the nearby Rotterdam Coal Futures prices. Wholesale electricity prices for the euro area were calculated as a weighted average (applying net electricity generation as weights) of prices observed in the five biggest markets. The vertical line marks the start of the Russian invasion of Ukraine. The latest observations are for 7 June 2022.

2.3 New climate and renewable energy targets

The year 2020 represented an important milestone in energy and climate policies, as it was the horizon at which the Climate and Energy Package enacted by the EU in 2009 had set objectives in terms of greenhouse gas (GHG) emission reduction, energy efficiency and RES. New objectives have been defined for 2030 and 2050.

The European Climate Law and the "Fit for 55" package

The European Climate Law, approved in June 2021, sets the objective of reducing GHG emissions by 55% at the 2030 horizon (compared to 1990), before reaching climate neutrality by 2050 (EC, 2021a). In July 2021, the EC proposed a set of interconnected measures aiming at fostering progress towards these objectives: the "Fit for 55" package (EC, 2021a; EC, 2021b). It especially provides for a reinforcement and an extension of emission trading in some sectors (notably air, maritime and road transport and buildings), an enhancement of the Innovation and Modernisation Funds, and the creation of a Social Climate Fund aiming to "*help citizens finance investments in energy efficiency, new heating and cooling systems, and cleaner mobility*" (EC, 2021a; EC, 2021b). Besides, it includes an update of the Renewable Energy Directive, which brings the targeted share of RES in gross final energy consumption from 32% to 40% by 2030, and must be complemented by indicative objectives at the level of member States (EC, 2021a; EC, 2021b).

Other evolutions in the regulatory framework

A specific task of the FLEXIGRID project (task 7.3) will be dedicated to the analysis of the regulatory framework in Europe. However, some significant evolutions are mentioned here, insofar as they may have an impact on the market outlook. These include:

- the proposal for a revision of the Trans-European Networks for Energy (TEN-E) regulation adopted by the EC in December 2020: it especially contains "upgraded rules to promote the uptake of smart electricity grids to facilitate rapid electrification and scale up renewable electricity generation" (EC, 2020c);
- the action plan on the digitalisation of the energy sector, which will "*help develop a competitive market for digital energy services and digital energy infrastructure that are cyber-secure, efficient and sustainable*", and "*support energy system integration, participation of 'prosumers' in the energy transition and ensure interoperability of energy data, platforms and services*": the EC released a roadmap outlining it in July 2021(EC, 2021c).

2.4 Challenges for distribution systems in Europe

Since the submission of D8.1, new studies have highlighted the challenges faced by distribution system operators (DSOs) in the context of the energy transition and the Clean Energy Package implementation.

DSOs' readiness to take on the new role defined by the Clean Energy Package

The EC's Joint Research Centre (JRC) released a third edition of its *Distribution System Operator Observatory*, which especially relies on a mapping, survey and data collection from 44 large DSOs

in Europe (JRC, 2021). Its results show "*a clear potential*" for demand-side management and demand response programs: while only 38.5% of respondents already have such programs "*in place*", more than half of the DSOs surveyed (56%) appear to consider them as "*non-wires alternatives [to network infrastructure investments]*" (JRC, 2021). 54% *"manage active consumers*", even though in most cases they only do so "*in emergency situations*" and/or "*in pilot/demonstration projects*" (JRC, 2021). The JRC's study also provides insights regarding distributed energy resources (DER) (notably solar photovoltaic (PV), wind and hydro power) connected to some of the respondent DSOs' grids, as well as electric vehicles (EV) connection points (JRC, 2021).

Besides, the study sheds light on the tools used by the surveyed DSOs to monitor and control assets (JRC, 2021). 63% of respondent DSOs' metering points are equipped with smart meters, yet the share of installed smart meters varies strongly within the sample (JRC, 2021). While remote control capabilities are widespread for high/medium voltage (HV/MV) substations, they are less frequent for medium/low voltage (MV/LV) ones: "*75% of the respondents have less than 7.5% of their MV substations remotely controllable*" (JRC, 2021). Nearly all of the respondent DSOs (97%) "*have a SCADA [(Supervisory Control And Data Acquisition)] system or similar in place*" (JRC, 2021). Last but not least, the JRC's study also inquires about the use that DSOs make of certain "*advanced technologies*" such as "*power flow simulations*" ("*routinely run*" by 44% of the respondents), "*data analytics for asset planning and investment strategies*" ("*in place*" for 82% of the respondents), "*sensor technology for outage detection and prediction*" ("*in place*" for 74% of the respondents), "*advanced load and storage management skills*" (in development by 41% of the respondents, mostly within the framework of pilot projects), and "*DER visualisation and management tool*" ("*in place*" for 38% of the respondents) (JRC, 2021).

Creation of the EU DSO Entity, allowing institutional representation and cooperation with TSOs

The EU DSO Entity was launched in June 2021 and gathers more than 900 registered organisations (EU DSO Entity, n.d.). Its role includes:

- strengthening cooperation between European DSOs and representing them;
- facilitating coordination with Transmission System Operators (TSOs) on network planning and operation;
- contributing to the definition of network codes and guidelines (EU DSO Entity, n.d.; JRC, 2021).

Its agenda will also be articulated around the following missions:

- "*facilitating the integration in DSOs grid of renewable, distributed energy resources and storage*" and "*facilitating demand side flexibility and distribution grid users' access to markets*";
- "*contributing to the digitalisation of distribution systems*" and "*supporting the development of data management, cyber security and data protection*" (EU DSO Entity, n.d.).

Investment needs in distribution networks

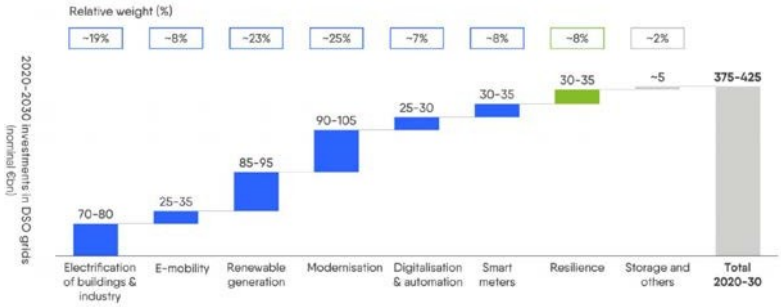
The survey conducted within the framework of the JRC's *Distribution System Operator Observatory* indicates that 77% of the respondent DSOs are "*preparing [a network] investment plan*", which according to the Centre "*[provides] a very promising picture on the take up of long-term planning also at distribution level*" (JRC, 2021).

Eurelectric and E.DSO conducted a study on investment needs in European distribution grids at the 2030 horizon, with the support of Monitor Deloitte and partners in 10 European countries

(Monitor Deloitte, E.DSO and Eurelectric, 2021). According to this study, investments in distribution networks required in the EU and the United Kingdom (UK) would represent EUR 375-425 billion over the period 2020-2030[1] (Monitor Deloitte, E.DSO and Eurelectric, 2021). These investment needs are driven by several factors in the context of the energy transition (Figure 3), among which:

i) electrification: final electricity demand would register a yearly increase of 1.8% in the EU and UK between 2017 and 2030, reaching 3,530 TWh; at this horizon, the number ofEVs would reach 50-70 million, while 40-50 million heat pumps and 335 TWh of industrial and P2X loads would have been added to the grid;
ii) RES: their capacity would reach 940 GW in the EU and UK, thanks to the expected addition of 510 GW of new capacity; about 70% of the latter would be connected to distribution grids;
iii) and modernization: up to 55% of LV lines in the EU could be over 40 years-old at the 2030 horizon (Monitor Deloitte, E.DSO and Eurelectric, 2021).

Figure 3. Drivers of investment needs in distribution grids in the EU and the UK



Source: Monitor Deloitte, E.DSO, Eurelectric, 2021

The required investment effort (estimated by the study at EUR 34-39 billion per year) is 50 to 70% higher than historical trends (Monitor Deloitte, E.DSO, Eurelectric, 2021). However, these investments are projected to have a rather limited impact on the unit cost of electricity, representing a yearly increase of 1.5% (Monitor Deloitte, E.DSO, Eurelectric, 2021).

[1] This evaluation of investment needs has been realised based on a GHG reduction target of 46% by 2030; additional investment needs associated with an increase of this target to 50-55% are estimated to EUR 25-30 billion (Monitor Deloitte, E.DSO, Eurelectric, 2021).

3 MARKET CONTEXT IN DEMO-SITE COUNTRIES: ITALY AND GREECE

The JRC's *Smart Grid Projects Outlook 2017* analyses the "*main factors affecting the number of projects and the level of investment*" in smart grid projects in given markets (Figure 4) (JRC, 2017). These factors reflect the main criteria to be taken into account in order to assess a given geographical market's potential in the field of smart grid development and will therefore be used as a reference to guide our analysis of the market context in the countries where the FLEXIGRID project's demonstration activities are implemented.

3.1 Market context in Italy

General characteristics

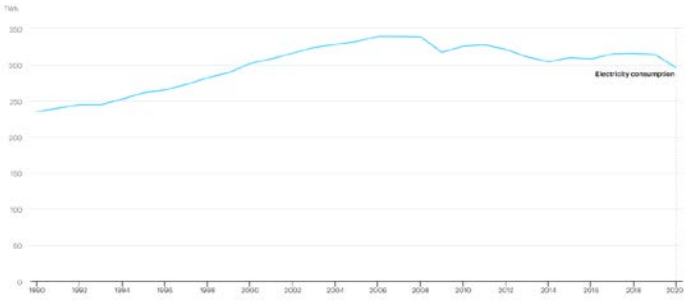
Country's size, population and electricity consumption

With an area of 301 230 squared kilometres, Italy is a peninsula composed of "*some of the most varied and scenic landscapes on Earth*" (Di Palma et al, 2022). It also comprises two main islands: Sicily and Sardinia. The Italian energy market is marked by a high dependence on foreign sources as 74.9% of energy used in the country originated of imports in 2021 (Ministero della Transizione Ecologica, 2021). However, the Italian electricity market is progressing thanks to pro-renewables policies and investments toward infrastructures and improvements in transmissions between the north and the south (IEA, 2021).

Italy's population was 59 million in 2021 according to The World Bank (2022), and is projected to continue to decrease to 58 million in 2030 and 52 million by 2050 (UN, 2022). However, Italy's Integrated National Energy and Climate Plan (INECP) make the hypothesis that the population will grow to 63.3 million by 2030 and to 65.4 million by 2050 (Ministry of Economic Development, 2019). The population density is 200 per squared kilometre (UN, 2022), with a population mostly distributed in cities, with over 71% of the population living in urban areas in 2021 (The World Bank, 2022).

Electricity consumption represented 295.9 TWh in 2020 (Figure 26) (IEA, 2021). The industry sector is the largest electricity consumer, with a share of 41%, while the residential and commercial/public services sector accounted for 22.5% and 30.5% respectively. The transport and agricultural/forestry/fishing sector share the six remaining percent (IEA, 2021). According to the ARERA (Autorità di Regolazione per Energia, -Reti e Ambiente), in 2020, there were 36.8 million electricity users served in the country, of which 29.6 million were households (81%) and 7.2 million were non-domestic points (19%), they respectively withdrew 24% and 76% of the distributed energy (2021). In addition in 2020, "*the most common value of committed power among domestic customers was between 1.5 and 3 kW*" (ARERA, 2021).

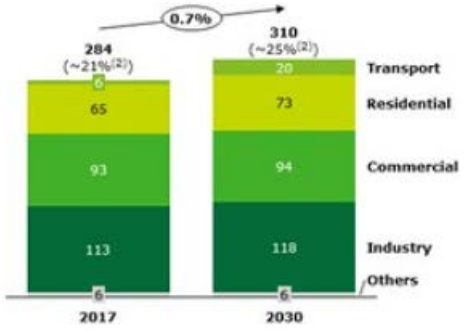
Figure 26. Electricity consumption in Italy (TWh)



Source: IEA Data Services, n.d.

Italy's INECP predicts a rise in electricity demand in the next decades; the Plan also foresees that thanks to current policies encouraging energy efficiency, an impact will be made upon the future numbers of electric consumption (Ministry of Economic Development, 2019). Monitor Deloitte considers a scenario with an electricity demand of 310 TWh in 2030 and a growth of 0.7% between 2017 and 2030 (Figure 27) (Monitor Deloitte, E.DSO, Eurelectric, 2021).

Figure 27. Final electricity demand in Italy (TWh): projected evolution from 2017 to 2030



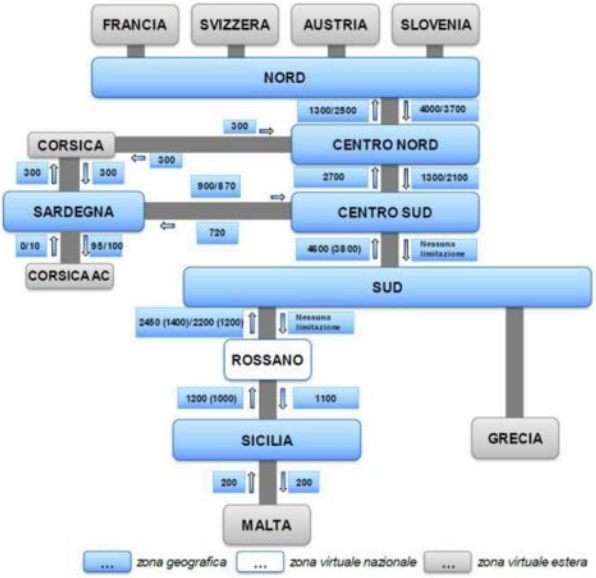
NB: the percentage between parentheses corresponds to the country's electrification rate
Source: Monitor Deloitte, E.DSO, Eurelectric, 2021

State of the electricity grids

Grid infrastructure

In 2017, the Italian national transmission grid was composed of over 66 000 km of lines and cables and 861 stations, it is a deeply connected grid (Figure 28) on the national and international level with interconnections with France, Switzerland, Austria, Slovenia, Greece, Malta and Montenegro (Ministry of Economic Development, 2019). The northern border, gathering most of the interconnections, risks network overload but investments to open new lines are being designed to avoid such a problem (Ministry of Economic Development, 2019).

Figure 28. Limit values for transit between the market areas, winter scenario



Source: Ministry of Economic Development, Integrated National Energy and Climate Plan, 2019

In addition, to improve its grid's infrastructures the Ministry of Economic Development estimates that €21.4 billion should be invested to cover the cost needed to increase the resilience of the network and "*the roll-out of 2G meters*" (2019). The Table 15 below details the investments needed according to the Ministry of Economic Development for the Integrated

National Energy and Climate Plan (2019).

Table 15. Investment needed to update the Italian electrical system

Sector	Investment item	Investments accumulated 2017 -30 [€ million]
Distribution network (MV/LV)	Main stations	2,250
	Secondary substations	4,100
	MV+LV lines	9,850
	Remote control	650
	Other (including metering and resilience)	8,850
	Total distribution	**25,700**
National Transmission Grid development (HV)	Development plan 2017	7,800
	Defence plan	700
	Additional investment needed to achieve the 2030 targets: upgrading of at least 1000 MW of transmission capacity on the Adriatic coast (included in the Development Plan 2018)	2,000
	Total National Transmission Grid	**10,500**
TOTAL		**36,200**
Other investments being evaluated	*Cable HVDC Sardinia-Sicily-South (Proposed in the Development Plan 2018)*	*2,600*

Source: Ministry of Economic Development, Integrated National Energy and Climate Plan, 2019

Smart meter deployment

In the early 20s Italy as one of the first countries to lead a massive campaign to equip distribution point with smart meters. About 36.7 million meters were installed by 2011 of which, about 86% were managed by e-distribuzione (Stagnaro, 2019). Thus, by 2011, the first generation of smart meters equipped 95% of Italian metering points (Ntouros et al., 2021). Then in 2017, Italy's main DSO, e-Distribuzione rolled-out a plan to upgrade their smart meters with a second generation (2G) (Stagnaro, 2019). These new smart meters were implemented "*By way of Resolution No 87/16, the ARERA established the functional requirements for low-voltage smart meters and performance requirements for associated second-generation smart electricity metering systems*." (Ministry of Economic Development, 2019). In 2019, four million 2G meters had already replaced their predecessors. Italy plans to replace all their previous smart meters by 2026 to cover 95% of metering points, the same percentage than previously. (Ministry of Economic Development, 2019).

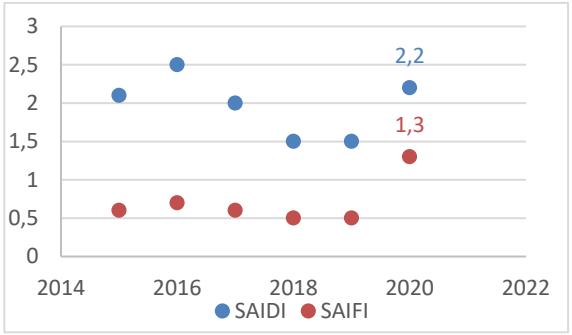
Quality of power supply

Eurelectric proposes three indicators to analyse the quality of power supply: continuity of supply, voltage quality and network losses (Eurelectric, 2020). The state of electricity grids in Italy, in regard of these indicators, is described below.

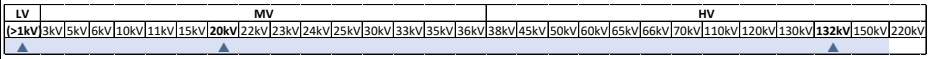
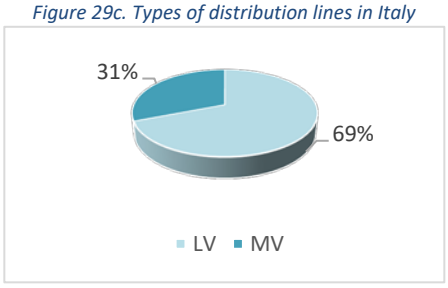
Continuity of supply

Continuity of supply is assessed by means of two indicators: the system average interruption frequency index (SAIFI) and the system average interruption duration index (SAIDI).

Figure 29a. Evolution of SAIDI and SAIFI in Italy (2015-2020)



Source: World Bank, DataBank, Doing Business

Voltage quality	*Figure 29b. Voltage levels used and ranges in which DSOs operate in Italy*  *Source: Eurelectric, 2020* *Figure 29c. Types of distribution lines in Italy*  *Source: Eurelectric, 2020*
Network losses	*Table 16. Distribution losses in Spain (2018)* **Nominal**: 13,758 GWh | **Percentage**: No data *Source: Eurelectric, 2020*

Number and company culture of DSOs

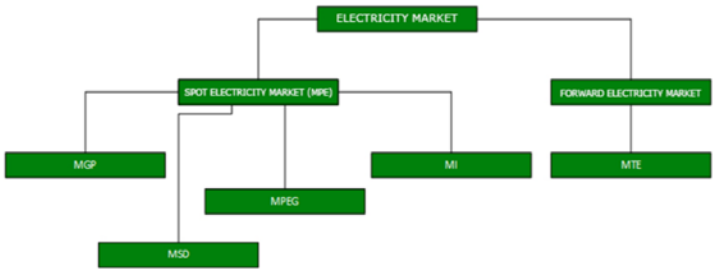
As of 2020, Italy's electricity distribution network is managed by 126 distribution system operators (DSOs), working under the Ministry of Economic Development (62) and the Provinces of Trento and Bolzano (64) (Ministry of Economic Development, 2019 ; ARERA, 2021). These operators act in different territories, different reference benchmarks, and different legal frameworks (Ministry of Economic Development, 2019), but the ten largest supply 98% of the electricity of the distribution networks to 98.1% of the customers. The main operator alone, e-Distribuzione, manages 85.3% of the total of Italian electricity distributed (ARERA, 2021). Therefore, Italy is a country characterized by "*high concentration*" of DSOs as it has "*One dominant DSO (more than 80% of distributed power) and several local DSOs*" (Eurelectric, 2020). Furthermore, DSO ownership is "*largely private*" with "*largely domestic*" shareholding (Eurelectric, 2020).

Regulatory framework

Favourable regulatory framework

The functioning of Italy's electricity markets is managed notably by the Gestore dei mercati energetici (GME) which organises the Italian electricity and gas market (Ministry of Economic Development, 2019). The Legislative Decree no. 79/99 governs the Italian Electricity Market (GME, 2022). The market has been liberalised in 2021 by the Legislative Decree No. 210, which entered into effect to implement the EU Directive 2019/944 (Figueroa, 2022). Furthermore, the electricity market is composed of the Spot Electricity Market (MPE) – divided into the day-ahead market and the intraday market – and of the Forward Electricity Market (MTE) (MTE, 2022).

Figure 30. Italy's electricity market



Source: GME, 2022

The GME as the regulatory authority is in charge of overseeing the Electricity Market. It also oversees the coupling of the market needed because of the interconnections between Italy and France, Italy and Austria, Italy and Slovenia, and Italy and Greece: "*This mechanism simultaneously performs implicit allocation of the daily physical transmission rights and "clearing" of the energy purchase and sale offers*." (GME, 2022). Italy's INECP sets the goal of encouraging "*the siting of installations on the basis of criteria that take into account the availability of resources, suitable sites, and economic constraints and feasibility*" (Ministry of Economic Development, 2019). The INECP also mentions the EU's aim at a harmonised national regulatory framework to move toward an integrated electricity market with the implementation of the Clean Energy Package. Italy aims at following the goal through its Integrated Electricity Dispatching Text, which would provide guidelines for this endeavour (Ministry of Economic Development, 2019). Table 18 lists the measures, which are involved in this effort.

Table 18. The process of strengthening Italy's market integration

Measures	Status
Integration of Italy's day-ahead market thanks to market coupling with France, Austria, and Slovenia.	Finished
Integration of Italy's day-ahead market thanks to market coupling with Greece and Switzerland (the latter being subject to the outcome of negotiations between Switzerland and the EU on the subject of energy markets).	Started
Implementing the European model for the intraday market.	Operational phase Italy will adhere to this project at a later date (2020) once coordination measures between the Intraday Market and the dispatching services market have been implemented.
Develop common platforms for trading flexible resources and services between the network operators of EU countries.	A number of pilot projects have already been launched, including the TERRE project, for designing, developing, implementing and managing a platform for exchanging replacement reserves between the various participating countries (currently Italy, France, Spain, Portugal, the United Kingdom and Switzerland).

Source: Ministry of Economic Development, INECP, 2019

The Italian market shape makes the day-ahead market as a zonal market, meaning, "*the territory is divided into zones representing portions of the transmission grid with limited exchange capacity between them. If flows exceed the maximum transit limit allowed by cross-zonal interconnections, the price is recalculated in each zone as if each was a separate market from the others (market splitting)*." (Ministry of Economic Development, 2019). Therefore, bids are valued thanks to a National Single Price of purchase, which "*is calculated as the average of the zonal prices weighted by the value of zonal purchases, net of pumping and foreign purchases*." (Ministry of Economic Development, 2019). The GME acts as counterparty for operators in this market (Ministry of Economic Development, 2019).

The intra-day market is also shaped as a zonal market. It is split into seven sessions (MI1, MI2, MI3, MI4, MI5, MI6, MI7) with progressive closing times "*and structured as an auction with clearing price where, unlike in the day-ahead market, both bids for sale and bids to buy are valued at the zonal price.*" (Ministry of Economic Development, 2019). Here, the GME also acts as counterparty for operators. (Ministry of Economic Development, 2019).

Lastly, Terna manages the Dispatching Services Market (MSD). As national transmission system operator (TSO), Terna manages the high and very high voltage network and is tasked with maintaining infrastructures, managing, the development, construction, dispatching of the

network. "*The MSD is divided into a programming phase (ex-ante MSD) and the balancing market (ex-post MSD or MB).*" in turn, both the ex-ante MSD and the balancing market are divided into sessions according to the dispatching rule (Ministry of Economic Development, 2019). The ex-ante MSD counts six programming sub-phases: MSD1, MSD2, MSD3, MSD4, MSD5, MSD6, taking place concurrently with the intra-day market seven session.

Similarly, the balancing market is also divided into six sessions where Terna "*selects bids referring to groups of hours on the same day in which session 24 takes place*." (Ministry of Economic Development, 2019). Therefore, "*Operators submit their bids – which Terna can accept throughout the ex-ante MSD and in the first balancing market session – in MSD1 and can subsequently modify them starting from the second balancing market session.*" (Ministry of Economic Development, 2019). In these markets, it is Terna that acts as the counterparty for operators.

The forward electricity market also exists to trade forward contracts with an obligation to deliver and withdraw energy. "*Trades are conducted on a continuous basis and concern two types of contracts, baseload and peakload. These can be traded for monthly (three products listed at the same time), quarterly (four products listed at the same time) and annual (one product) delivery periods*" (Ministry of Economic Development, 2019).

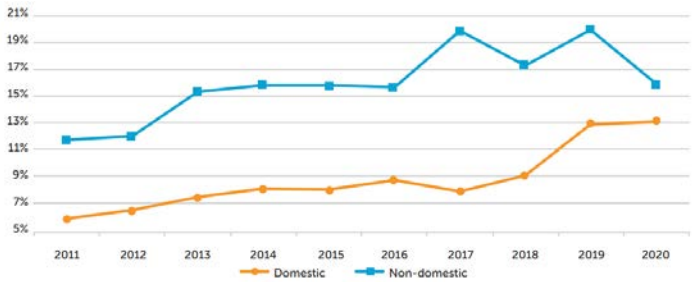
Finally, operators can also chose to sell and buy energy thanks to contracts, which do not take part of the bidding system. Then these contracts are registered on the Energy Account Platform (PCE), giving operators flexibility to optimise "*their portfolio of contracts, including bilateral contracts concluded on brokerage platforms*." (Ministry of Economic Development, 2019).

Electricity markets framework and incentives given to suppliers

In Italy, by law, electricity supplier have to be registered on the list of electricity sellers in order to do business. The companies wishing to be on that list have to comply with certain criteria and requirements determined by the Ministry of Economic Development (Ministry of Economic Development, 2019).

Moreover, as in the rest of Europe, DSOs are required to allow supplier switching upon the request of their customer. This ensures that DSOs "*provide non-discriminatory access to their networks for other system users, like power generators or service providers*" (Eurelectric, 2020). With the liberalization of the Italian electricity market, consumers are free to adopt the most competitive supplier and take part in a liberal price regulation system. Italian households switch supplier freely, "*13.1% of domestic customers switched the supplier at least once during the year (12.9% in 2019)); the volumes corresponding to this portion of customers account for around 14.2% (15.2% in 2019) of the total energy purchased by the domestic sector*." (ARERA, 2021). On the other hand, non-domestic switches are slowing but still at a higher percentage than household switches "*15.9% in terms of withdrawal points and 17.1% in terms of volumes (20% and almost 30% in 2019 respectively)"* (ARERA, 2021).

Figure 31. Switching rates of domestic customers and "other uses" since 2009



Source: ARERA, Annual Report on the State of Services and Regulatory Activity, 2021

More specifically, the transport sector has been identified as a specific target for the Renewable Energy Directive (RED II) stating the obligation to integrate 14% of renewables in the sector for 2030 (Ministry of Economic Development, 2019). Thus, suppliers are expected to provide electricity with a bigger share of renewables specifically to the transport sector.

The INECP identifies some issues to be worked on regarding the Electricity Market Framework: "*Italy needs to make up the delay in regulating wholesale prices, also with regard to market coupling, and provide for the possibility of negative pricing*." (Ministry of Economic Development, 2019). The possibility to submit negative price bids is an important topic regarding Italy's integration in the European electricity market framework. Indeed, "*at the present time, none of the electricity markets in Italy offer the possibility to submit negative price bids, as there is an internal price floor of €0/MWh. Negative prices do occur in several European electricity markets, however*." (Ministry of Economic Development, 2019). Thus, plans have been made to remove the €0/MWh price floor and allow negative prices.

Provisions regarding emerging stakeholders

As stated before, suppliers have to register on the list of electricity vendors to access the market. As a result, emerging stakeholders need to register before accessing the Electricity Market Information System enabling them to make informed decisions regarding the electricity market. "*Information exchange between Market Participants, GME and Terna (including submission of offers/bids, notification of market results and of schedules defined by GME in the MGP and MI, notification of changes to the schedules made by Terna in the MSD) takes place through the exchange of XML files via the Internet or the completion of forms available on GME's website*" (GME, 2022).

Italy plans to develop further energy communities and the participation of consumers in the energy consumption process (Ministry of Economic Development, 2019). Thus, legal frameworks need be created and implemented to provoke citizen-led initiative in the electricity domain.

The Ministry of Economic Development states in the INECP that to achieve its goal regarding the energy transition, that stakeholders be provided with "*clear, timely and up-to date information*." (2019). In addition, the INECP mentions other measures to push the energy transition. Namely, self-consumption is a topic not yet matured in Italy but which has the attention of decision makers. It is currently studied to be developed and answer both the issue of decarbonation of electricity and energy poverty: "*studies are under way to introduce efficiency measures and measures for the installation of renewable energy plants with self-consumption*" (Ministry of Economic Development, 2019). Therefore, Italy would encourage the rise of new stakeholders in the electricity market, of a smaller size.

Completely new systems would need to be created and self-consumption is considered for islands disconnected from the mainland network (Ministry of Economic Development, 2019). Microgrids and smart grids would play an important role in this scenario, encouraging "*high-efficiency self-generation in urban communities and industrial districts*" (Ministry of Economic Development, 2019). Therefore, already integrated new stakeholders in its INECP because of its need to develop its network and prepare the electricity sector to the future.

Specific regulatory funding for innovation projects

European DSOs mainly finance investments by means of tariffs, even though specific incentive mechanisms for innovation activities exist in certain countries (JRC, 2017). In Italy, the private financing of investments in smart grid projects, as measured by the JRC's *Smart Grid Projects Outlook 2017*, represented EUR 117 million, i.e., 48.9% of their total financing (JRC, 2017). The JRC notes that "*private investment is […] high*" in the country (JRC, 2017).

Distribution tariffs, which are the same for the different DSOs in the country, but not legally required to be so, entirely cover distribution costs, including investments and operational expenditures, costs of distribution losses and metering costs (ACER, 2021). In Italy the tariff methodology is defined for an 8-year periods, and split up between two sub-periods, (currently, 2020-2023), yet tariff values can be adjusted annually "*in relation to several parameters. Mainly, yearly updates are based on actual investments committed in the last year and on new forecasts of volume parameters (energy, capacity and # of PoD, per voltage level).*" (ACER, 2021).

The distribution tariff in Italy does not include an injection charge, but consists in a power-based and a fixed charge (ACER, 2021). In addition, public lighting electricity consumption is treated differently than other non-household consumers.

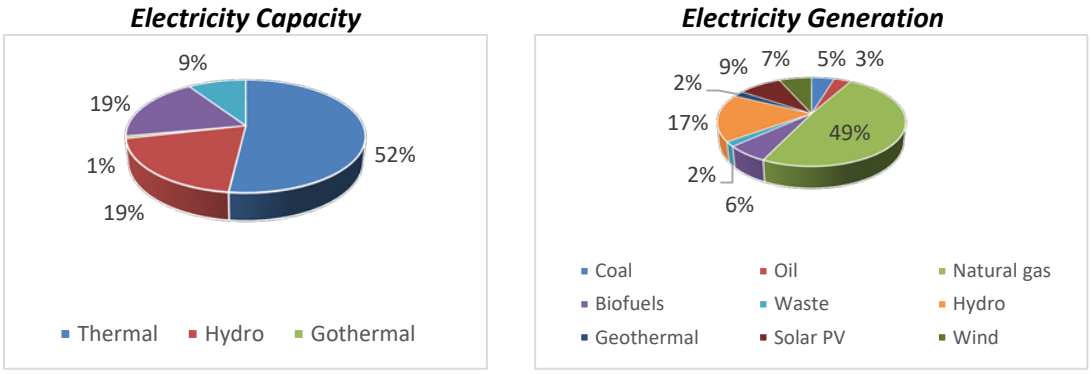
Household and non-household consumers, prosumers and self-consumers are subject to the tariff for withdrawal in Italy, while pumped hydroelectric storage, auxiliary services of generators, and other storage facilities are not (ACER, 2021). However, tariffs are different between household and non-household consumers; it depends upon "*the cost allocation that was defined about 20 years ago, according to participation of each customer group to peak demand*." (ACER, 2021). Operators of publicly accessible EV charging points can opt for a specific tariff, which would be energy-based only, and for which withdrawal tariff would be the same as for other Italian network users (ACER, 2021).

Moreover, the JRC's *Smart Grid Projects Outlook 2017* noted that Italy went further in its regulatory incentives toward innovation activities through additional funding for seven projects. Indeed, the Italian NRA with regulatory decision ARG/elt/39/10 (19) decided to "*elect a number per 29 of demonstration projects that would benefit from an extra remuneration of capital cost — 2 % extra weighted average cost of capital (WACC) in addition to the ordinary return — for a period of 12 years.*" (JRC, 2017).

RES supporting mechanisms and policies

The Ministry of Economic Development is favourable to accelerate the change in Italy's electricity mix, to switch from traditional fuels toward renewable sources "*by promoting the gradual phasing out of coal for electricity generation in favour of an electricity mix based on a growing share of renewables and, for the remainder, gas.*" (2019). Thus, the increased penetration of RES is visible thanks to their share in power generation increased from 18.8% to 37.3% between 2000 and 2020 (IEA, 2021a). This increase was notably driven by solar PV, with an installed capacity rising from 18 GWh in 2000 to c. 24 942 GWh in 2020; hydro energy too plays an important part in the share of renewable energy, with an installed capacity growing from 50 900 GWh in 2000 to 48 558 GWh in 2020, (IEA, 2021a).

Figure 32. Italy's electricity mix as of 2020



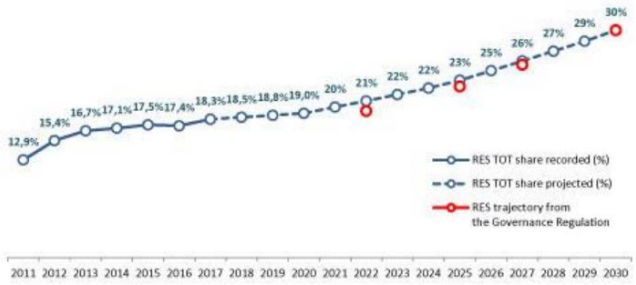
Source: IEA, 2021a; Terna, 2022

RES Development is clearly an important topic for the Italian decision-makers, thus, various mechanisms and policies have been enacted to foster the development of RES in Italy. Namely, Italy passed a number of measures:

- Exemption from self-consumption charges for small plants;
- Promotion of power purchase agreements (PPAs) for large renewable energy plants;
- Incentivisation of large renewable energy plants by means of competitive procedures for more mature technologies;
- Support for large renewable energy plants by means of non-competitive, innovative technologies;
- Aggregation of small plants to access incentives;
- Consultation with regional authorities to identify suitable areas
- Streamlining of authorisations and procedures to revamp/repower existing plants;
- Promotion of initiatives to optimise production from existing plants;
- Support for installing distributed storage systems;
- Streamlining of authorisations for self-consumers and renewable energy communities,
- Review of the rules for granting hydropower concessions;
- Extension and refinement of the obligation to integrate renewables into existing buildings;
- Refinement of the obligation to integrate renewables into new buildings;
- Tax deduction for energy renovations and structural renovations;
- Incentives for promoting electric and thermal renewables on smaller islands

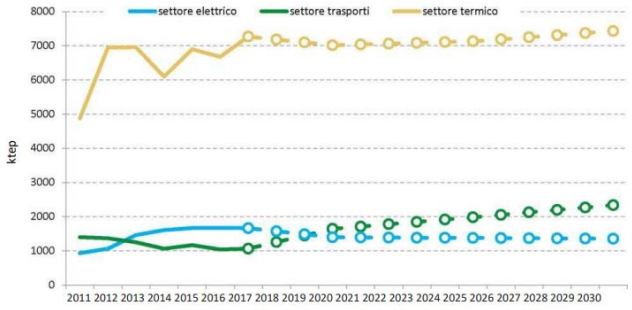
Source: Ministry of Economic Development, INECP, 2019

Figure 33. Trajectory of overall RES share



Source: Ministry of Economic Development, INECP, 2019

Figure 34. Growth trajectory for the contribution of bio energies in different sectors in order to achieve the RES target for 2030.



Source: Ministry of Economic Development, INECP, 2019

Ambitious objectives have been set for RES development over the same period: Renewable electricity generation production should reach 132 TWh in 2030, of which 51.6 TWh of hydro capacity and 37.4 TWh of solar PV capacity (Ministry of Economic Development, 2019). In order to reach these objectives, at the local level Italy, intend "*to conduct an accurate mapping*

exercise, jointly with the local authorities, of the existing potential and those areas most suited to energy production." (Ministry of Economic Development, 2019).

National context

National co-funding mechanisms Adoption of Smart grid Action Plans/National priorities

In Italy, the national (and regional) financing of investment in smart grid projects, as measured by the JRC's *Smart Grid Projects Outlook 2017*, represented EUR 14 million, i.e., 11.9% of total financing (JRC, 2017). Therefore, Italy is not a country providing important funding at the national level.

Adoption of Smart grid Action Plans/National priorities

On one hand, Italy's Integrated National Energy and Climate plan states that the country will "*continue with the task of modernising electricity networks, including in the short-term, with a view to smart grids.*" (Ministry of Economic Development, 2019). Both the distribution and the transformation network will require a modernisation of their hardware components as well as their software components.

On the other hand, Italy's National Recovery and Resilience Plan mentions a smart grid reinforcement scheme, to "*Improve reliability, security and flexibility of the national energy system*" (Italia Domani, 2022). A national investment of EUR 3.61 billion would aim to provide a minimum of 4.000 MW from renewable energy (Italia Domani, 2022). Furthermore, this massive investment would help the development of prosumer (consumers-producers, or self-consumption usages), a type of consumption pushed by Italian decision-makers. Now, this scheme is reported to be at the drafting stage and should have increased the grid distribution capacity to 4.000 MW by December 2024.

Furthermore, Italy's National Energy Strategy also identifies the need increase the resilience and flexibility of the national system to allow the integration of renewables into the national electricity mix (Ministry of Economic Development, 2017).

Creation of Smart Grid Platforms

A smart grid platform has been created in Italy in 2014: SMARTGRIDSITALIA sponsored by the Ministry for Economic Development and supported by the Authority for Electricity, Gas and the Water System. This initiative proposes information, training, communication, and the use of a matching platform to foster collaboration within the Italian network (Smart Grids Italia, n.d.; JRC, 2017).

European context

Accessibility to European co-funding mechanisms

European financing of investment in smart grid projects in Italy was estimated at EUR 108 million – i.e., 45.2% of total financing – by the JRC in its 2017 *Smart Grid Projects Outlook* (JRC, 2017).

Italy plans to continue to resort to European funding mechanisms to accompany its energy transition. Investment needs to fulfil the INECP's objectives are estimated to EUR 36 200 million over the 2017-2030 period; while private investment is expected to cover most of them, European investment is paramount as national investment will not be enough to support all projects. The EC's assessment of Italy's INECP proposes a list of potential EU funding sources that the country could mobilise (Table 19) (EC, 2020c).

Table 19. Potential sources of EU funding

Potential EU funding available to Italy (2021-2027, EUR billion)		Potential EU funding available to all member States (2021-2027, EUR billion)	
Programme	**Amount**	**Programme**	**Amount**
Cohesion policy funds (ERDF, ESF+, Cohesion Fund)	42.1	Horizon Europe	91.0
Common agricultural policy – European Agricultural Fund for Rural Development, and direct payments from the European Agricultural Guarantee Fund.	35.1	InvestEU	9.1
Recovery and Resilience Facility	65.5	Connecting Europe Facility - Energy	5.8
Just Transition Fund	0.9	Recovery and Resilience Facility	360.0
ETS auction revenue	1.4	Technical Support Instrument	0.9
		Programme for Environment and Climate Action (LIFE)	5.4
		European Agricultural Fund for Rural Development	8.2
		Innovation Fund	7.0

Source: adapted from EC, 2020c

In addition, Italy already plans to make use of European funds for joint projects with other member states. A meeting with Malta for example, took place "*on 11 September 2019 with the aim of exchanging best practices and identifying topics of potential common interest*." Ministry of Economic Development, 2019).

Smart grids as priorities in the national and regional Smart Specialisation strategies

Smart specialisation strategies are adopted at the national or regional level in order to define priorities in the field of research and innovation (R&I) (JRC, 2017). Their adoption is a condition to gain access to ESIF (JRC, 2017). Member States were invited by the EC to consider the integration of smart grids into these plans for the 2014-2020 period (JRC, 2017).

Italy has defined smart specialisation strategies at both the national and regional levels through the Agenzia per la Coesione Territoriale. Indeed, the National Smart Specialisation Strategy makes use of "*Regional resources [which] are mobilised through multi-regional plans approved by the "Conference of Regions and Autonomous Provinces""* (Agenzia per la Coesione Territoriale, n.d.). More specifically, the S3 – Smart Specialisation Strategy aims "*at identifying R&D&I investment priorities that complement the resources and production capacity of a territory to build comparative advantages and sustainable growth paths in the medium and long term.*" (Agenzia per la Coesione Territoriale, n.d.).Therefore, decision-makers identified different thematic areas as priorities: Smart and Sustainable Industry, Energy, and Environment, is one of them. "*Technologies for smart grids, renewable sources and distributed generation*" have been identified as needed development in the implementation of the strategic framework.

Participation in EU Working Groups and Platforms

Italy is present on the international innovation scene through international initiatives putting together important public funding as the "*ISGAN initiative (Implementing Agreement for a Co-operative Programme on Smart Grids) under an International Energy Agency framework."* for example (Ministry of Economic Development, 2019). Thus, Italian public research bodies and organisations are expected to play an important role in the development of smart grids innovations.

On the European level, Italy is also a voluntary contributor to the strategic framework effort. Italy was part of the Technical Working Group on INECPs set up with the European Commission and other European Member state between 2018 and 2019, which helped establish National

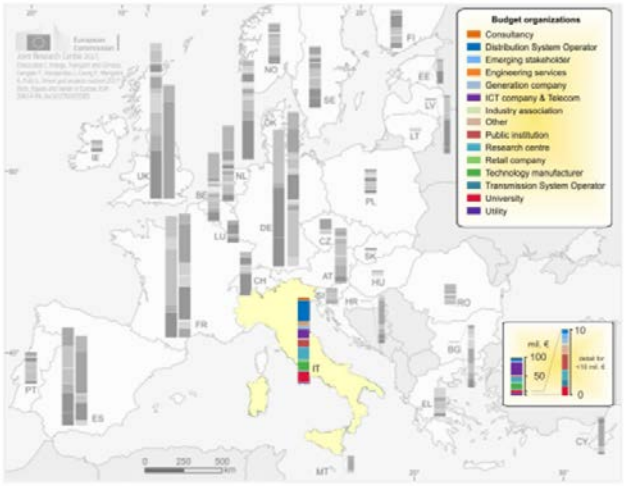
Plans. There, Italy's INECP was deemed at a good stage of development, and "*during the meetings, Italy was often held up as an example of good practice and was invited to set out its approach on various spheres and dimensions.*" (Ministry of Economic Development, 2019).

Market environment

Number and size of established market actors

The JRC's 2017 *Smart Grid Projects Outlook* provides estimates of investment in this domain by the different actors present in Italy (Figure 34) (JRC, 2017). In particular, its database of smart grid projects counts 1 TSO, 7 DSOs, 3 utilities, 4 retail company, 3 industry associations, 9 engineering services companies, 32 information and communication technologies (ICT)/telecom companies, 26 universities, 7 generation companies, 26 technology manufacturers, 27 research centre, 31 public institutions, 13 consultancies, 9 engineering services companies, and 6 emerging stakeholders involved in the inventoried national and multinational projects (JRC, 2017).

Figure 34. Investment in smart grid projects by the different actors in Italy



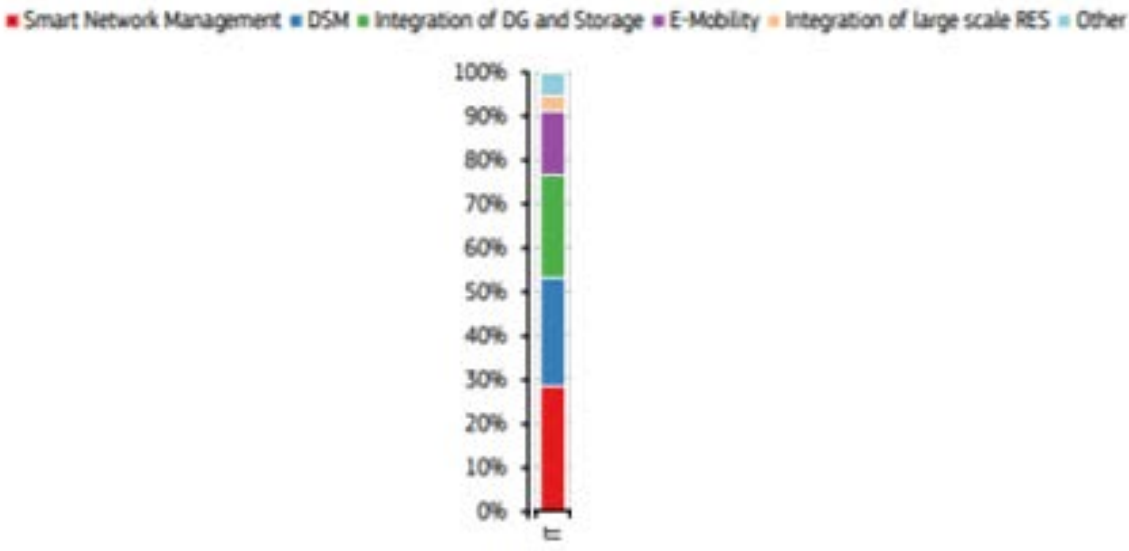
Source: JRC, 2017

It also focuses on "*emerging stakeholders"*, defined as "*organisations that offer solutions and services related to energy generation, supply, distribution or other energy services (such as demand response and energy efficiency)*" and "*organisations that have more recently started to collaborate with traditional smart grid actors to implement smart solutions at local level, such as municipal utilities, housing associations, transport solution providers, energy cooperatives*" (JRC, 2017). Total investment by these actors in Italy represents about EUR 1 million (JRC, 2017).

Existence of a national smart grid value chain

The JRC counted 71 R&D and 77 demonstration projects involving organisations based in Italy in its 2017 *Smart Grid Projects Outlook,* which ranks Italy among the ten member states, which are over the EU average (JRC, 2017). The Centre estimates that this number "*can be considered as an indication of the intention to invest in smart grid solutions in each country*" (JRC, 2017). Among these projects, 18 are "*national projects*", defined as "*projects carried out in one country with the exclusive participation of organisations from that country*" (JRC, 2017). The investment in smart grid projects whose partners are based in Italy was estimated to EUR 67 million for R&D projects and EUR 172 million for demonstration projects (JRC, 2017). Investment in multinational projects (EUR 197 million) is a lot higher than in national projects (EUR 42 million) (JRC, 2017). The projects cover the different smart grid domains (Figure 35) (JRC, 2017).

Figure 35. Investment in smart grid projects per domain in Italy

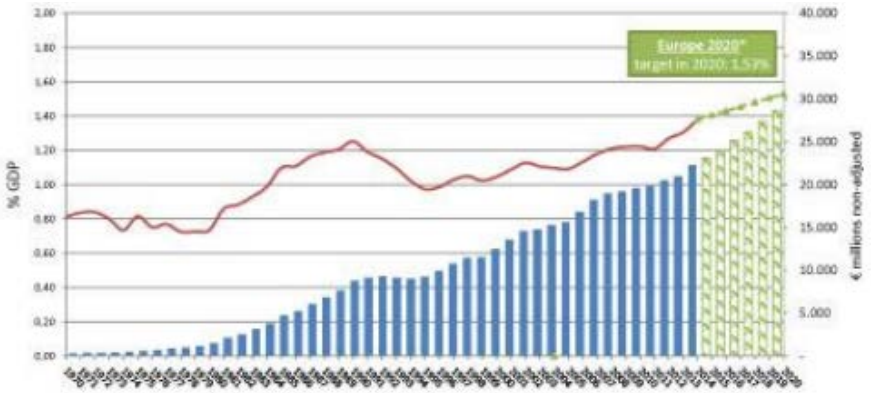


Source: JRC, 2017

Overall climate for innovation

While Italy implemented a Smart Specialisation Strategy and is an active player in the international and European innovation scene, the climate for innovation does not attain its full potential. Indeed, "*Italy is still performing badly when it comes to R&D in the energy sector, as a result of the relatively low priority level attributed to research, the fragmentation of the stakeholders and the lack of coordination*" (Ministry of Economic Development, 2019). As a result, the country is mostly dependant of foreign technologies and innovations, and is unable to weight in high technology product trade (Ministry of Economic Development, 2019). However, R&D expenditures increase over the years (Figure 36). Indeed the INECP states, "*The appropriate tools must therefore be implemented to promote Italian production of clean energy plants and investments in R&D must be increased*" (Ministry of Economic Development, 2019). Italy's R&D expenditures target is 1.53% of GDP in 2020, which would still be below the EU target of 3% (Ministry of Economic Development, 2019).

Figure 36. Trend in R&D spending in Italy



Source: Ministry of Economic Development, INECP, 2019

3.2 Market context in Greece

General characteristics

Country's size, population and electricity consumption

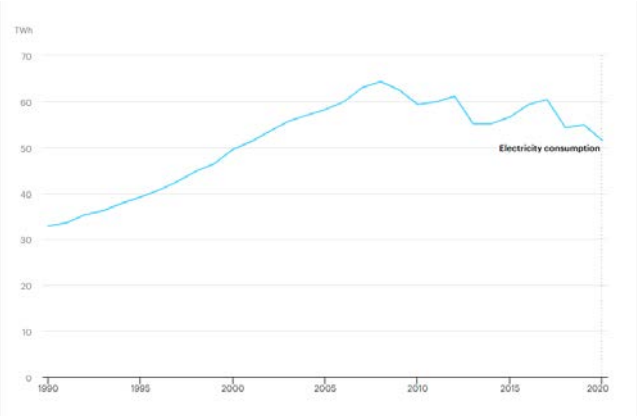
With an area of 132 2049 squared kilometres, Greece is located at the south of the Balkan

peninsula the landscape is described as "*conspicuous not only for its rugged beauty but also for its complexity and variety."* (Dan forth et al, 2022). It also comprises more than 2 000 islands of which only about 170 are inhabited. The Greek energy market was marked by a dependence on lignite, which has now been addressed, but it still represents 12 124 GWh of electricity generated in the country in 2019 (IEA, 2021). However, the government set out a strategy "*the so-called lignite phase-out, by implementing a relevant front-loaded programme in the following decade and putting a complete end to the use of lignite for power generation in Greece by 2028*." (Figure 38) (Ministry of the Environment and Energy, 2019). In addition, the Greek electricity market is progressing thanks to the lead of the Greek government towards a just and affordable transition with renewable projects and coupling with the rest of Europe (IEA, 2021).

Greece's population was 10.6 million in 2021 according to The World Bank (2022), and is projected to continue to decrease to 10 million in 2030 and 9.1 million by 2050 (UN, 2022). Greece's National Energy and Climate Plan (NECP) also make the hypothesis that the population will decrease, but is more optimistic, it would drop to 10.3 million by 2030 (Ministry of Environment and Energy, 2019). The population density is 80 per squared kilometre (UN, 2022), with a population mostly distributed in cities, with over 80% of the population living in urban areas in 2021 (The World Bank, 2022).

Electricity consumption represented 51.5 TWh in 2020 (Figure 37) (IEA, 2021). The commercial and public services sector is the largest electricity consumer, with a share of 36%, while the residential and industry sector accounted for 35% and 24% respectively. The transport and agricultural/forestry/fishing sector share the five remaining percent (IEA, 2021).

Figure 37. Electricity consumption in Greece (TWh)



Source: Ministry of the Environment and Energy, NEPC, 2019

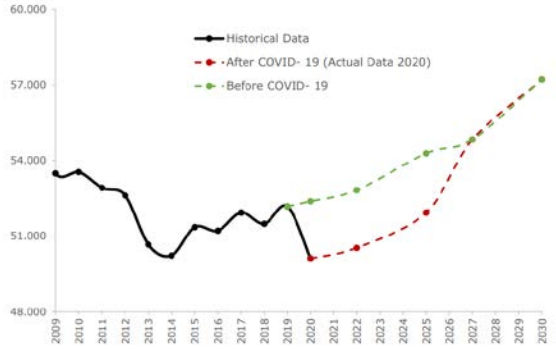
The Greek Energy Market of 2021 predicts a rise in electricity demand to 61 TWh by 2030 due to "the interconnection of the islands and the implementation of green and sustainable technologies" (HAEE, 2021). Indeed despite a decrease in the consumption numbers in 2019 attributed to the COVID-19 pandemic (Figure 39), the Hellenic Association for Energy Economics (HAEE) is optimistic regarding future numbers as *" during the next years Astypalea, Chalki and other Greek islands will implement green energy, electromobility and other smart innovative technologies [and] the gradual interconnection of Crete, Cyclades, North Aegean and Dodecanese with the mainland and the electrification of transport and heating/cooling*" will impact electricity demand.

Figure 38. Summary of national objectives in the context of the NECP

Year of objective: 2030	Final NECP	Initial NECP draft	New NECP objectives compared to EU objectives
RES share in gross final energy consumption	≥35%	31%	More ambitious than the corresponding core EU objective of 32%
RES share in gross final electricity consumption	≈61-64%	56%	
Final energy consumption	≈16.1-16.5 Mtoe (≥38% compared to the 2007 predictions)	18.1 Mtoe (32%) (referring to 17.3 Mtoe without ambient heat)	More ambitious than the corresponding core EU objective of 32.5% and attainment of the objective on the basis of a new EU indicator for reducing consumption compared to 2017
Share of lignite in power generation	0%	16.5%	
Reduced GHG	≥42% compared to 1990, ≥56% compared to 2005	33% compared to 1990, 49% compared to 2005	Identical with core EU objectives and overperformance compared to national commitments in non-ETS sectors

Source: IEA Data Services

Figure 39. Evolution for Total Demand of Electricity in Greece (GWh) (2008-2030)



Source: HAEE, Greek Energy Market Report, 2021

State of the electricity grids

Grid infrastructure

In 2017, the Greek national transmission grid was composed of 11 508 km of lines and cables and 343 substations, most of the generation is situated in northern Greece where coal mines are situated when the consumption mainly takes place in central and southern Greece (65%) (IEA, 2017). On the other hand, the distribution network is made up of "*237 390 km of medium and low-voltage lines and 945 km of high-voltage lines, and 225 high/medium-voltage and 161 900 medium/low voltage substations.*" (IEA, 2017). Moreover, the owner and operator HEDNO operates 32 electrical systems and 31 microgrids while serving 7.4 million customers (IEA, 2017).

Greece's NECP highlights the necessity to expand the country's transmission and distribution system in the context of a rising share of RES in the energy network (Ministry of the Environment and Energy, 2019). Investments in electrical system infrastructures are estimated to reach EUR 5, 500 million over the 2020-2030 period, while investments regarding works for the development of an electricity distribution network are estimated around 3, 500 million (Ministry of the Environment and Energy, 2019). Thus, "*the Greek government is promoting projects to increase the capacity of electricity interconnections to and from the North, both by constructing new transmission lines and strengthening existing ones*" within the country as well as projects about interconnection with the Balkan grid to meet a 15% interconnectivity target by 2030 (Ministry of the Environment and Energy, 2019).

Smart meter deployment

Greece's NECP recognizes that "*with respect to demand response measures, changes need to be made to their implementation process, the completion of the electricity market reform, the development of the necessary monitoring infrastructure and systems*" as smart meters for example (Ministry of the Environment and Energy, 2019). Thus, about 7.5 million smart meters are to replace conventional electricity meters by 2026 (SEE Energy News, 2020). Indeed, *"the programme for the deployment of smart meters will contribute significantly towards the rational*

use of energy by final consumers. Furthermore, combined with the new regulatory framework for the demand response mechanism, better electricity balancing and peak load management are to be achieved." (Ministry of the Environment and Energy, 2019). Greece ambitions to comply with the European Directive 2009/72/EC and set 2020 as the deadline to replace at least 80% of old electricity meters according to Law no. 4001/2011 (RAE, 2020).

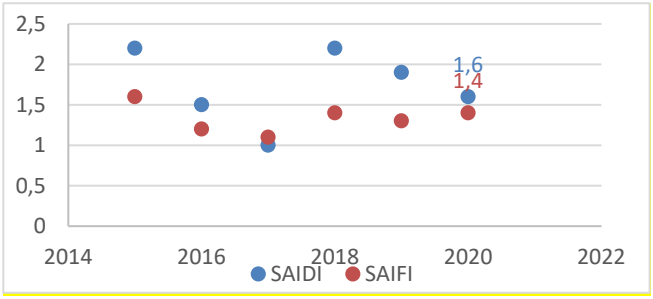
Quality of power supply

Eurelectric proposes three indicators to analyse the quality of power supply: continuity of supply, voltage quality and network losses (Eurelectric, 2020). The state of electricity grids in Greece, in regard of these indicators, is described below.

Continuity of supply

Continuity of supply is assessed by means of two indicators: the system average interruption frequency index (SAIFI) and the system average interruption duration index (SAIDI).

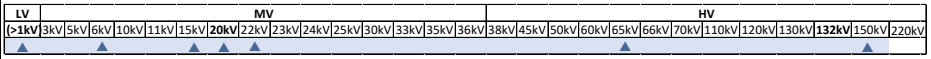
Figure 40. Evolution of SAIDI and SAIFI in Greece (2015-2020)



Source: World Bank, DataBank, Doing Business

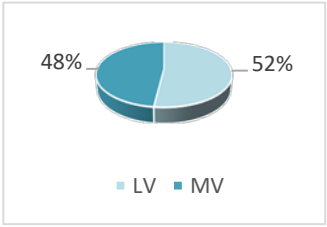
Voltage quality

Figure 41. Voltage levels used and ranges in which DSOs operate in Greece



Source: Eurelectric, 2020

Figure 42 Types of distribution lines in Greece



Source: Eurelectric, 2020

Network losses

Table 20. Distribution losses in Greece (2018)

Nominal:	**Percentage**:
3,979 GWh	33

Source: Eurelectric, 2020

Number and company culture of DSOs

Greece's electricity distribution network is managed by a single DSO: HEDNO. Therefore, Eurelectric considers Greece as a country characterised by "*very high concentration*" regarding DSOs (Eurelectric, 2020). Electricity distribution is a regulated public service, and DSO ownership is "*largely public*" and national and shareholdings are "*100% Domestic*" (Eurelectric, 2020).

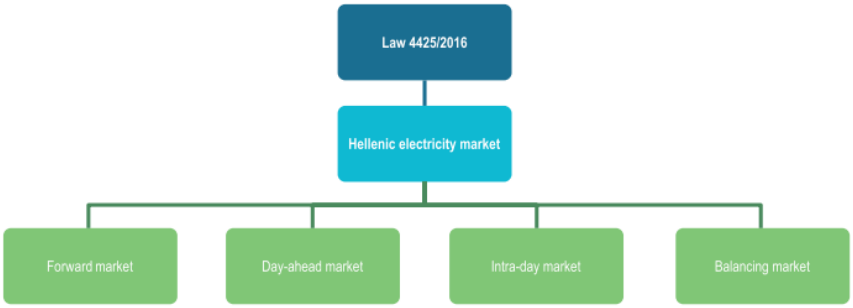
Regulatory framework

Favorable regulatory framework

The functioning of Greece's electricity markets is "*operated as a mandatory pool in which scheduled demand and supply (production and imports) are matched only on a day-ahead*

market." (IEA, 2017). The Greek electricity market went through a reform to favor competitive prices and attract investors (Laws 4336/2015, 4389/2016, and 4393/2016) and be liberalised (Law 4001/2011) (IEA, 2017). In addition, the reorganisation of the electricity market is the occasion to further interconnection with the European market and enhance competition and economic benefits (Ministry of the Environment and Energy, 2019). Furthermore, the electricity market is now composed of the day-ahead market, the intraday market, the forward market, and of the balancing market (Ministry of the Environment and Energy, 2019).

Figure 43. Greek electricity market design



Source: IEA, Greece Review, 2017

Electricity markets framework and incentives given to network operators

Greece's regulatory authority in charge of overseeing electricity markets, RAE, was established by the Law 2773/1999 (RAE, n.d.). The market operator, LAGIE manages the day-ahead scheduling and settles the day-ahead market depending on the system marginal price (comparable to day-ahead price) (IEA, 2017). HEDNO, the Hellenic Electricity Distribution Network Operator, is in charge of managing the Greek distribution network as well as operating the market for the non-interconnected island of the country (RAE, 2020).

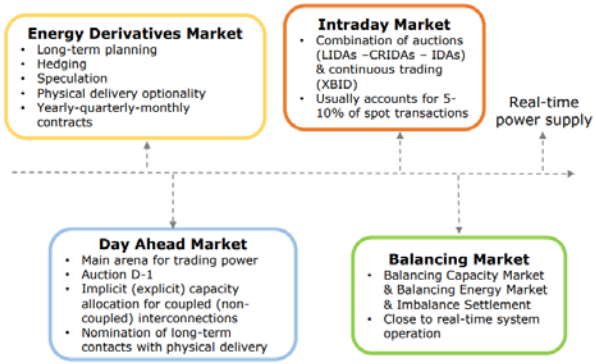
As Greece ambitioned to move toward the EU target model market, its parliament implemented the law 4425/2016 and charged RAE to transition toward the new market framework (IEA, 2017). While the transition was supposed to take place in 2018, it was delayed until 2020. It launched the Hellenic Energy Exchange (HEnEx) operating the forward market.

The Intra-day market is predicted to be the object of enhanced liquidity as intra-day trading is to allow participation of traders, in relation to Article 20 of the Regulation (EU) 2019/943 and RES are to be fully introduced by 2022 and under full balancing responsibility (EC, 2021c).

The new Greek balancing market is composed of three different parts: "*the balancing capacity market (to ensure that sufficient reserves are available), the balancing energy market (to activate energy in real time to ensure that the system is in balance while meeting demand for energy and reserves and respects all technical plant operation constraints) and the imbalance settlement process (to allocate revenues and costs of the balancing market and to market participants).*" (EC, 2021c).

In addition, the new regulatory framework was also the occasion to re-evaluate network theft risks and reflect upon a system to "*provide incentives to the Network Operator to decrease the non-technical power losses by associating a part of its regulated revenue with the observed level of power losses*." (RAE, 2017).

Figure 44. Greek electricity market target model

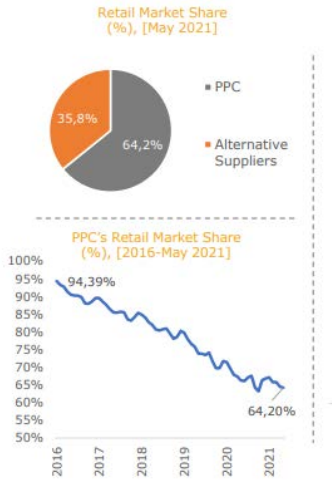


Source: IEA, Greece Review, 2017

Electricity markets framework and incentives given to suppliers

Greek's retail electricity market allows its customers to choose their supplier, and is attached to the transparency of prices. Indeed, RAE publishes comparatives estimates of both alternative suppliers (based on the tariffs on their websites) and ensures that customers can access clear information on prices (RAE, 2020). As of 2020, 26 suppliers were present on the retail market (EC, 2021c), regarding the Non-Interconnected Islands, 19 suppliers are present, including the Universal Service Provider and the Supplier of Last Resort (HAEE, 2021). However, PPC (Public Power Corporation the main electricity supplier about 64 % of the electricity market shares, while the trend shows a decrease in this number, it still quite high as the other 25 supplier share the 35 % of market shares (Figure 45) (HAEE, 2021).

Figure 45. Greek electricity market repartition



Source: HAEE, Greek Energy Market Report, 2021

Besides, the supplier-switching rate are increasing (7.8% in 2020 against 2.81% in 2017) (TAable 21) (EC, 2021c). The highest level of switches connection wise involves household customers, on the other hand in terms of volumes the commercial and industrial are the actor switching suppliers the most (RAE, 2020). In 2019, "*compared to 2018, the switching trend shows a great rise in terms of number of connections (+4.51%) which means a year-to-year increase of 89%, while in terms of volume) the switching trend was downward (-3.96%), i.e., a decrease of 44% within one year.*" This can be explained by the fact that household consumes lower volumes of electricity (Table 21) (RAE, 2020).

Table 21. Consumers changing electric suppliers 2014-2020 in Greece

Year	Number of customers switching supplier as % of total	Customers switching supplier as % of total electricity consumption
2020	7.8	8.12
2019	8.5	2.22
2018	4.51	3.96
2017	2.81	1.91
2016	1.58	2.22
2015	0.44	1.03
2014	0.19	0.48

Source: EC, Market Reform Plan for Greece, 2021

Greece is committed to energy efficiency, and acts towards it thanks to energy audit policies, therefore, "*This presents an opportunity for energy suppliers to work with industry to undertake energy audits and to identify and implement efficiency opportunities, because there are synergies with the introduction of the obligation programme*." (Ministry of the Environment and Energy, 2019).

Provisions regarding emerging stakeholders

Greece's NEPC states that a single governance framework is to be developed to evaluate and monitor its policy measures. It would benefit the possibilities of cooperation between national or even European stakeholders (Ministry of the Environment and Energy, 2019). Greece intends to develop partnerships between stakeholders thanks to networking actions and the development of synergies (Ministry of the Environment and Energy, 2019).

Therefore, the Action Plan for Sustainable Energy and the Action Plans for Energy Efficiency of Buildings for example would engage stakeholders and enact their propositions "*with support from targeted financing programmes under the regional operational programmes for the new programming period*" (Ministry of the Environment and Energy, 2019). It would commit stakeholder to develop partnership and act in favour of future planning efforts.

Furthermore, the Energy Efficiency Fund will promote the funding regarding energy efficiency measure, cost-result indicator for all stakeholders (Ministry of the Environment and Energy, 2019). It will enable stakeholders to facilitate the possibilities to finance their programmes.

Specific regulatory funding for innovation projects

European DSOs mainly finance investments by means of tariffs, even though specific incentive mechanisms for innovation activities exist in certain countries (JRC, 2017). The JRC classifies the "*regulatory funding*" of DSOs as "*own/private financing*" (JRC, 2017). In Greece, the private financing of investment in smart grid projects, as measured by the JRC's *Smart Grid Projects Outlook 2017*, represented EUR 14 million, i.e., 17.9% of total financing (JRC, 2017).

Distribution tariffs, which are the same for the different DSOs in the country, but not legally required to be so, the NRA just decided to apply the same tariff methodology, entirely cover distribution costs, including investments and operational expenditures, costs of distribution losses and metering costs (ACER, 2021). In Greece RAE has regularly updated the tariff methodology: "*It established a decoupled entry/exit tariff system in 2013, and reviewed the regulation and the tariffs in 2016, which it will implement in 2017. The latest review provides for revision of the capacity and commodity charge, and also for implementation of the capacity allocation mechanism by setting the price methodology for bundled products*." (IEA, 2017).

The distribution tariff in Greece does not include an injection charge at the moment, but the RAE is considering their implementation in distribution tariffs as the framework is being reviewed (ACER, 2021).

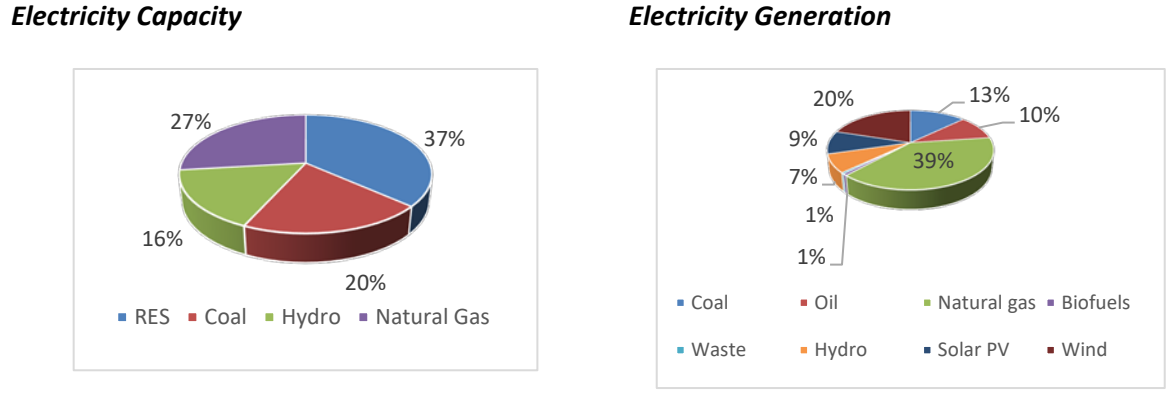
Household and non-household consumers, auxiliary services of generators and prosumers are

subject to the tariff for withdrawal in Greece. (ACER, 2021). Different rules apply regarding the treatment of network users. Indeed, in Greece "*Aggregated (c€/kWh) charge is the same for all low voltage consumers. However, charges for households are based 90% on energy and 10% on contracted power, whereas charges for all other users are based 80% on energy and 20% on contracted power. In addition, the largest low voltage consumers are also charged for reactive power consumption. This charge is incorporated in the calculation of the energy component of the tariff.*" (ACER, 2021).

RES supporting mechanisms and policies

Greece's NECP aspires to a change in the electricity mix, so that RES represents "*the dominant share in the electricity mix compared to all other fuels, and that advanced biofuels will be used for the same reasons.*" (Ministry of the Environment and Energy, 2019). Thus, the increased penetration of RES is visible thanks to their share in power generation increased from 8.5% to 37.4% between 2000 and 2020 (IEA, 2021a). This increase was notably driven by the phase out of coal, a share in power generation decreasing from 63,9% in 2000 to 13% in 2020 (IEA, 2021). The introduction of more solar PV, with a generation of 1 GWh rising in 2005 to 4 358 GWh in 2020 also played an important part in the rise of RES in Greece's electricity mix.

Figure 46. Greece's electricity mix as of 2020



Source: IEA, 2021a; HAEE, 2021

RES Development is an important topic for the Greek decision-makers. Thus, a list of priorities has been identified to achieve the objective of 35% of RES share in gross final energy consumption in the country by 2030 (Ministry of the Environment and Energy, 2019). Then, various mechanisms and policies have been enacted to foster the development of RES in Greece. The later have been compiled in Table 22 below:

Table 22. Policy measures for RES penetration in Greece

Numbering of policy measure	Name of policy measure	Category of measure
M1	Competitive procedures for commercially mature RES technologies	Regulatory, economic measure
M2	Obligations to participate in the market and gradual increase of obligations by type of RES plant and of contract models.	Regulatory measure
M3	Continuation of support scheme with dynamic adjustment of operating support for new installations of individual RES technologies.	Regulatory measure
M4	Support to innovative pilot projects with high domestic added value.	Economic measure
M5	Guaranteed liquidity of operating support mechanism for RES plants with optimal structure of inflow mechanism.	Regulatory, economic measure
M6	Use of guarantees of origin.	Regulatory, economic measure

M7	Updating, simplification and optimisation of the functioning of the licensing framework.	Regulatory measure
M8	Updating, simplification and optimisation of the functioning of the physical planning framework.	Regulatory measure
M9	Licensing and physical planning framework for offshore wind farms	Regulatory measure
M10	Regulatory and statutory framework for storage facilities	Regulatory measure
M11	Maintenance of self-generation and net metering scheme, and control and updating of the regulatory framework for its operation where necessary.	Regulatory measure
M12	Support for the deployment of RES energy projects by energy communities also through the use of specialised financing tools.	Regulatory measure
M13	Reform of the electricity market regulatory framework as regards opportunities for the participation of decentralised energy schemes.	Regulatory measure
M14	Aid for energy infrastructures to deal with congestion (in transmission and distribution) and development of new financing models to speed up deployment of such infrastructures. Provision for optimal utilisation of RES capacity in the context of new interconnections.	Technical measure
M15	Development of demand management schemes.	Regulatory measure
M16	Development and optimisation of licensing framework and of technical specifications for RES district heating networks, feeding of biogas into the natural gas network, exploitation of geothermal fields (correlation with the measures referred to in the section on waste management).	Regulatory measure
M17	New Regulation on Energy Efficiency of Buildings (correlation with measure M2.1 and the measures referred to in the section on waste management).	Regulatory measure
M18	Public buildings (correlation with measure M2.1 and the measures referred to in the section on waste management).	Regulatory measure
M19	Financing instruments in the context of the new programming period.	Economic measure
M20	Application of obligations to energy suppliers.	Regulatory measure
M21	Use of tax incentives for installations in the residential and tertiary sectors.	Fiscal measure
M22	Development of a regulatory framework for the production of thermal energy from RES and the feeding of biomethane into the natural gas network.	Regulatory, economic measure
M23	Development of supply chains for residual biomass/biodegradable matter and support for the development and implementation of optimal environmental and energyefficient bioenergy applications	Regulatory, technical measure
M24	Utilisation of RES power generation for heating/cooling and transport as well as for the operation of storage systems.	Regulatory, economic measure
M25	Completion of the necessary energy infrastructures for recharging electric vehicles.	Regulatory measure
M26	Development of a framework of incentives for the use of electric vehicles.	Regulatory, economic measure
M27	Pilot actions for the use of RES gaseous fuels in the transport sector.	Regulatory, technical measure

Source: Adapted from Ministry of the Environment, NECP, 2019

Table 23. Goals for RES penetration in Greece's energy mix

Progress in respect of the share of RES energy in attaining the objective for 2030.	2022	2025	2027	2030
in gross final energy consumption	31.8%	53.6%	68.5%	100%
in final consumption for heating and cooling	27.0%	52.3%	64.5%	100%
in gross electricity consumption	29.6%	55.4%	74.6%	100%
in final consumption for transport	5.6%	28.3%	41.3%	100%

Source: Ministry of the Environment, NECP, 2019

Table 24. Goals for RES penetration in Greece's energy mix

Evolution of RES shares	2020	2022	2025	2027	2030
RES share in gross final energy consumption [%]	19.7%	23.4%	27.1%	29.6%	**35%**
RES share in final consumption for heating and cooling [%]	30.6%	33.8%	36.8%	38.3%	**42.5%**
RES share in gross electricity consumption [%]	29.2%	38.6%	46.8%	52.9%	**61%**
RES share in final consumption for transport [%]	6.6%	7.3%	10.1%	11.7%	**19.0%**

Source: Ministry of the Environment, NECP, 2019

National context

National co-funding mechanisms

In Greece, the national (and regional) financing of investment in smart grid projects, as measured by the JRC's *Smart Grid Projects Outlook 2017*, represented EUR 28 million, i.e., 35.9% of total financing (JRC, 2017). Greece is part of the seven member states where national funding is over 20% of overall investment (JRC, 2017). Therefore, Greece is considered to have a high share of national funding; more precisely, the area around Athens is the main receptacle for national funding.

Adoption of Smart grid Action Plans/National priorities

Greece's Integrated National Energy and Climate list smart rids development as a priority for the country in the research, innovation and competitiveness domain, it states "*The key priority of research and innovation for the coming period in the field of energy networks are the challenges of digitising them and developing smart grids.*" (Ministry of the Environment and Energy, 2019).

After 2013, the General Secretariat for Research and Technology became the leaders regarding the Greek Strategy for Research and Innovation to enable smart specialisation (Ministry of the Environment and Energy, 2019). It "*applied a comprehensive and inclusive bottom-up process for the design of the GSRI by nominating experts from academia, research institutes, and the private sector into a platform to help shape the priorities within each area*." during this process, smart grids technologies were given a priority place in the research and development area (Ministry of the Environment and Energy, 2019).

Furthermore, HEDNO, the Greek national DSO, identifies several planning objectives to modernize the Greek electricity network, among them: "*Focusing on innovative development and smart grids*" (HEDNO, n.d.). As a result, strategic projects target the promotion of smart grids.

Creation of Smart Grid Platforms

A smart grid platform has been created in Greece in 2014: the Hellenic Technology Platform for Smart Grids. (JRC, 2017).

European context

Accessibility to European co-funding mechanisms

European financing of investment in smart grid projects in Greece was estimated at EUR 36 million – i.e., 46.2% of total financing – by the JRC in its 2017 *Smart Grid Projects Outlook* (JRC, 2017).

Greece plans to "*making optimal use of national and European financing mechanisms*" to accompany its energy transition (Ministry of the Environment and Energy, 2019). Investment needs to fulfil the NECP's objectives are estimated to EUR 43,800 billion over the 2020-2030 period; it is expected that EUR 21,581 million will be allocated to Greece by the EC for the 2021-2027 time period (Ministry of the Environment and Energy, 2019). The EC's assessment of

Greece's NECP proposes a list of potential EU funding sources that the country could mobilise (Table 14) (EC, 2020d).

Table 25. Potential sources of EU funding

Potential EU funding available to Italy (2021-2027, EUR billion)		Potential EU funding available to all member States (2021-2027, EUR billion)	
Programme	**Amount**	**Programme**	**Amount**
Cohesion policy funds (ERDF, ESF+, Cohesion Fund)	20.4	Horizon Europe	91.0
Common agricultural policy – European Agricultural Fund for Rural Development, and direct payments from the European Agricultural Guarantee Fund.	18.6	InvestEU	9.1
Recovery and Resilience Facility	16.2	Connecting Europe Facility - Energy	5.8
Just Transition Fund	0.8	Recovery and Resilience Facility	360.0
ETS auction revenue	3.6	Technical Support Instrument	0.9
		Programme for Environment and Climate Action (LIFE)	5.4
		European Agricultural Fund for Rural Development	8.2
		Innovation Fund	7.0

Source: adapted from EC, 2020d

In particular, the NECP states that the Connecting Europe funds are "*being used to finance major energy infrastructures (Common Interest Projects), which will be used in the coming period with the expansion of Energy Sector eligibility, including, in addition to Common Interest Projects, cross border cooperation projects in the field of RES generation, as well as smart grid applications."* (Ministry of the Environment and Energy, 2019). As connection to the European network is an important matter for Greece, those funds are paramount. In addition Greece received about 2% of the EU contribution for 'secure, clean and efficient energy' part of the Horizon 2020 programme i.e., over EUR 36 million (EC, 2017).

Smart grids as priorities in the national and regional Smart Specialisation strategies

Smart specialisation strategies are adopted at the national or regional level in order to define priorities in the field of research and innovation (R&I) (JRC, 2017). Their adoption is a condition to gain access to ESIF (JRC, 2017). Member States were invited by the EC to consider the integration of smart grids into these plans for the 2014-2020 period (JRC, 2017).

Greece has defined smart specialisation strategies at both the national level, through the General Secretariat for Research and Technology, and regional level, through the Ministry of Economy and Development. On the national level, the Strategy for Smart Specialisation identified the sectors to target, identified the measures needed to improve their competitiveness and the needs for structural changes, and identified the research areas/technologies to implement in the national strategy (GSRI, n.d.). On the regional level, the decentralised decision-makers are expected to contribute. Indeed, they are "*expected to identify structure and make full use of their competitive advantages, to support innovation and to focus on investments, in order to achieve the intended transformation of local economies by involving relevant stakeholders in all stages*."(GSRI, n.d.).

Participation in EU Working Groups and Platforms

Greece participates to European and international cooperation programs in the field of energy. Its institutions, RAE for example takes part in multiple work groups organized by a number of European institutions. It is involved in ACER's Board of Regulators, working groups, and task forces, the CEER's (the Council of Europe Energy Regulators) General Assembly, working groups, and working stream, as well as the Energy Community's (EnC) working group, and task forces

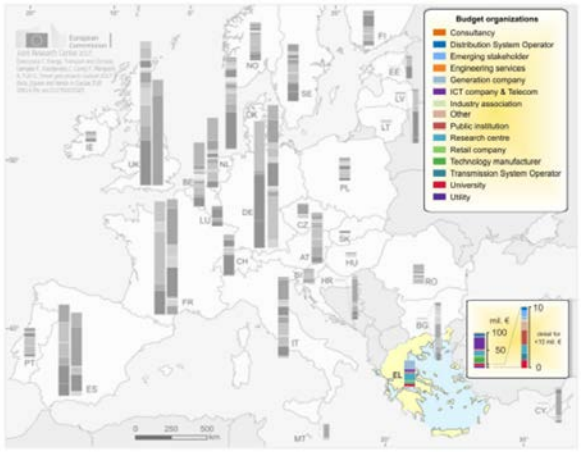
(RAE, 2019). Finally, Greece was an original member of CESEC' (Central and South Easter Europe energy connectivity) high-level working group (RAE, 2019). Thus, Greece is an active player on the European collaboration scene, dedicated to the cooperation and interconnection of its network.

Market environment

Number and size of established market actors

The JRC's 2017 *Smart Grid Projects Outlook* provides estimates of investment in this domain by the different actors present in Greece (Figure 47) (JRC, 2017). In particular, its database of smart grid projects counts 2 TSOs, 1 DSO, 1 retail company, 13 information and communication technologies (ICT)/telecom companies, 7 universities, 2 generation companies, 3 technology manufacturers, 8 research centre, 7 public institutions, 2 consultancies, 1 industry association, and 1 emerging stakeholder involved in the inventoried national and multinational projects (JRC, 2017).

Figure 47. Investment in smart grid projects by the different actors in Greece



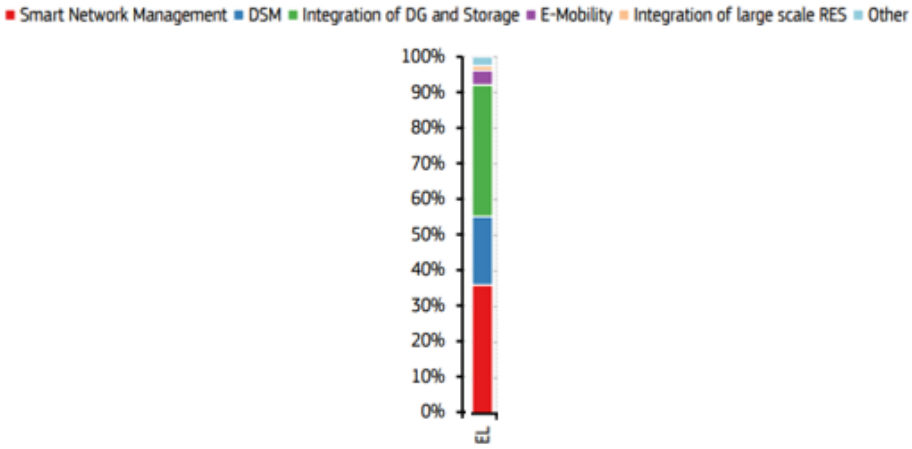
Source: JRC, 2017

It also focuses on "*emerging stakeholders"*, defined as "*organisations that offer solutions and services related to energy generation, supply, distribution or other energy services (such as demand response and energy efficiency)*" and "*organisations that have more recently started to collaborate with traditional smart grid actors to implement smart solutions at local level, such as municipal utilities, housing associations, transport solution providers, energy cooperatives*" (JRC, 2017). Total investment by these actors in Greece represents less than EUR 1 million (JRC, 2017).

Existence of a national smart grid value chain

The JRC counted 33 R&D and 29 demonstration projects involving organisations based in Greece in its 2017 *Smart Grid Projects Outlook* (JRC, 2017). The Centre estimates that this number "*can be considered as an indication of the intention to invest in smart grid solutions in each country*" (JRC, 2017). Among these projects, 2 are "*national projects*", defined as "*projects carried out in one country with the exclusive participation of organisations from that country*" (JRC, 2017). The investment in smart grid projects whose partners are based in Greece was estimated to EUR 25 million for R&D projects and EUR 53 million for demonstration projects (JRC, 2017). Investment in multinational projects (EUR 47 million) is higher than in national projects (EUR 32 million) (JRC, 2017). The projects cover the different smart grid domains (Figure 48) (JRC, 2017).

Figure 48. Investment in smart grid projects per domain in Greece



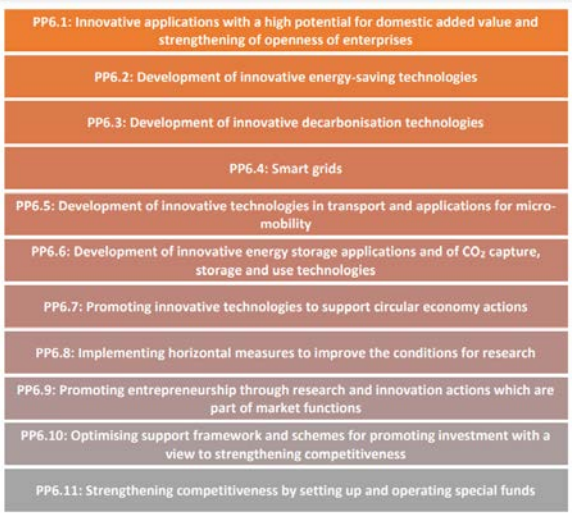
Source: JRC, 2017

Overall climate for innovation

Greece has made supporting research and innovation one of its priorities with its National Strategic Development Plan (EC, 2017). The NECP precisely mentions renewable energies as the focus for innovative actions (EC, 2020). The Greek NECP is confident that the country can be an active state regarding innovation in the energy sector "*the Greek Research and Innovation System is one of the strengths of the Greek economy, which can further contribute towards solving many problems*" (Ministry of the Environment and Energy, 2019).

Greece's annual investment expenditures aims to reach EUR 3.8 million by 2030, of which, 800 million should be directed toward innovation (Ministry of the Environment and Energy, 2019). Indeed, Greece identifies as a priority research and innovation for next years in order to strengthen actively "*important technologies which will contribute to the attainment of all energy objectives*." (Ministry of the Environment and Energy, 2019). The NECP sets eleven priorities for policy measure for the period 2020-2030 "*to promote Research, Innovation and Competitiveness*" which are listed below (Figure 49).

Figure 49. Policy priorities of policy measures to promote Research, Innovation and Competitiveness in the period 2020-2030 in Greece



Source: Ministry of the Environment and Energy, 2019

Furthermore, the country identified the digitalisation of electricity network and the development of smart grids as a prime concern of the research and innovation domain. Indeed, improving energy efficiency of buildings for example would benefit from technologies developed

to optimise operations in the local and national network (Ministry of the Environment and Energy, 2019). Finally, the NECP states, "*Promoting research and innovation in the energy sector requires the active involvement of all market players*." (Ministry of the Environment and Energy, 2019). Therefore, Greece encourages synergies to upgrade the national network and the progression of innovation in the country.

4 BUSINESS MODELS OF FLEXIGRID EXPLOITABLE RESULTS: UPDATES AND NEW DEVELOPMENTS

Over the first twelve months of the FLEXIGRID project, exploratory business models have been designed for the nine individual FLEXIGRID solutions. CAP defined and proposed to the partners a methodology resting on A. Osterwalder and Y. Pigneur's Business Model Canvas (presented in Appendix 1 of D8.3) and the corresponding template. At these early stages of the business model development process, the choice was made to focus more specifically on four of the Canvas's building blocks: customer segments, value propositions, revenue streams and cost structure.

During the second year of implementation of the FLEXIGRID project, CAP proposed to the partners a methodology (presented in Appendix 1) and template (presented in Appendix 2) to revisit these exploratory business models, with two objectives:

i) further refining the analysis on some of the Canvas's key building blocks, notably by considering the interactions between them;
ii) and preparing for the beginning of the demonstration campaign implementation and of the cost-benefit analysis, by focusing on the exploratory business models' applicability.

Besides, exploratory business models have been developed for other exploitable results of the FLEXIGRID project identified within the framework of the Exploitation Strategy (Task 8.5), using the Canvas methodology already applied for individual solutions.

The analysis was conducted within the framework of working groups gathering all the partners involved in the development of each ER, coordinated by one or several lead partner(s). The exploratory and updated business models designed were then discussed and refined during progress meetings between CAP and the lead partner(s) of each working group.

This deliverable developed the work done in D8.2 and expanded on previous market and competition analysis, the identification of critical success factors, as well as the documentation of revenue streams and cost structures.

4.1 ER 1a: Secondary substation of the future

Customer segment analysis

Three potential customer segments have been identified for the secondary substation of the future, and are expected to be addressed with the following prioritisation: i) DSOs, ii) electrical energy end users, and iii) renewable energy manufacturers. Their analysis is presented in Table 26 to Table 28.in the appendix

Customer journey analysis

An analysis of the customer journey has been performed for the different customer segments in order to refine the "Channels" and "Key activities" buildings blocks of the business model canvas. Its results are presented in Figure 50 to Figure 52.

Figure 50. Customer journey analysis for potential customer segment #1: DSOs

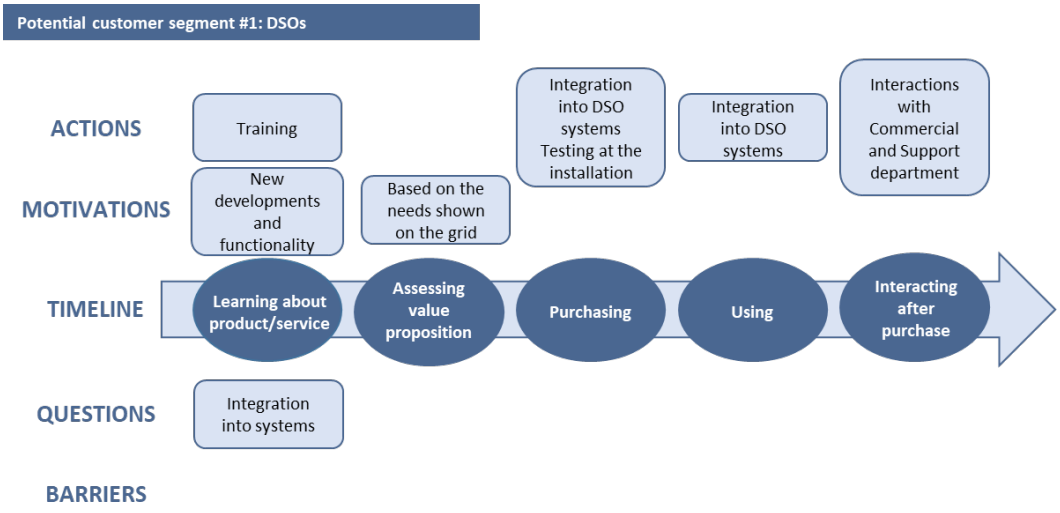


Figure 51. Customer journey analysis for potential customer segment #2: Electrical energy end users

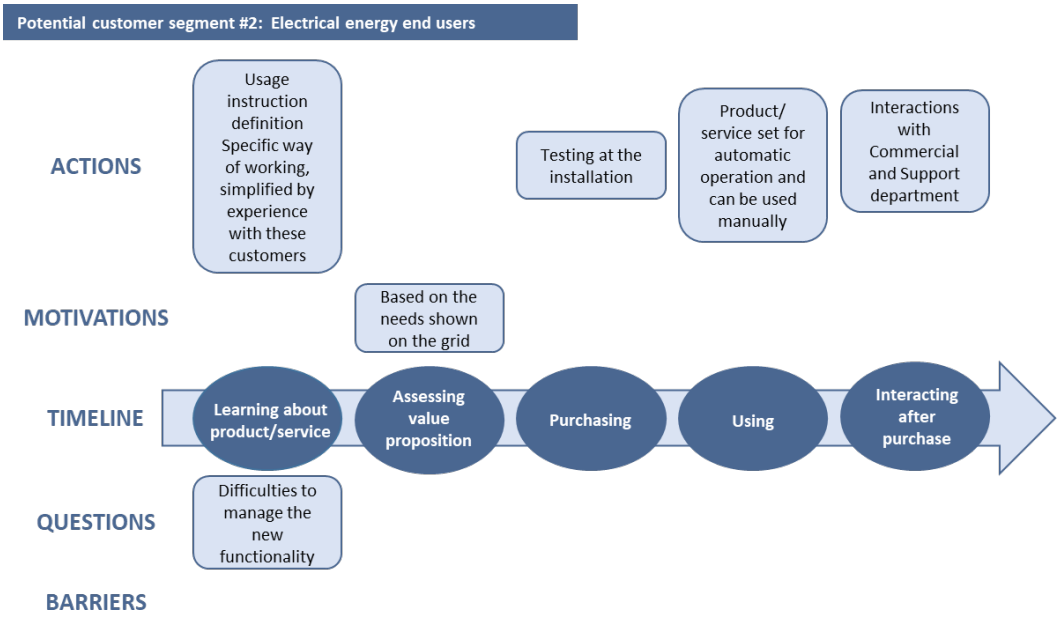
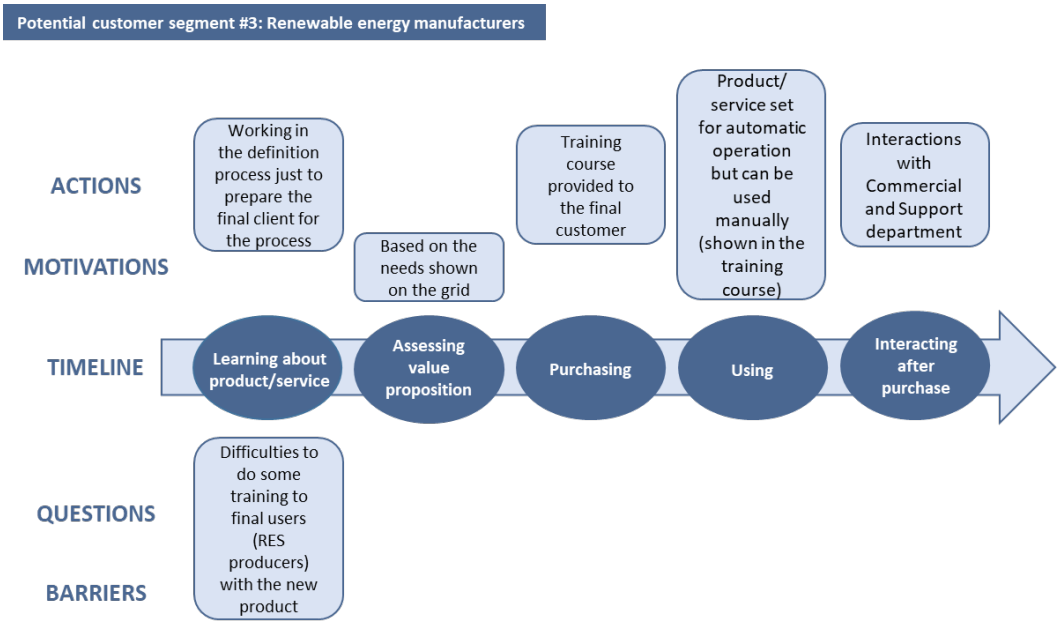


Figure 52. Customer journey analysis for potential customer segment #3: Renewable energy manufacturers



In relation with these customer journey maps, the solution provider's key activities, their output and the extent to which they are assessable, critical and timely have been specified (Table 29). As a result, the different activities presented in the "Key activities" building block of the business model canvas have been updated.

Table 29. Analysis of key activities

Activity	Assessable?	Critical?	Timely?	Output of the activity
R&D	Medium	Medium	High	New functionality
Industrial manufacturing	Medium	Medium	High	New products
Sales	Low	Low	Medium	Access to the market

Market and competition analysis

A market and competition analysis has been performed in order to refine ER1a's value proposition (Table 30).

Table 30. Market and competition analysis for ER1a – Secondary substation of the future – in national markets inEurope

Current competitors
Electrical equipment manufacturers.

New entrants
• No expected new entrants. • Barriers to entry: national technical regulations in each market.

Substitutes
None.

Suppliers and other actors in the value chain
None (only internal suppliers).

Stakeholders
Actors that may have an impact on the activity or the competitive environment: public authorities, through national regulations.

Within this environment, the competitive advantages of the Secondary substation of the future are expected to rest notably on its advanced functionalities.

Critical success factors for the considered business model

The critical success factors for the business model considered for ER1a are evidenced in Table 31.

Table 31. Critical success factors for the business model considered for ER1a

Critical success factor	Data to be collected and sources
National regulations	Regulation documents
Training of customers	/
omated control of thefunctionality	Manuals and instructions

Documenting the revenue streams and cost structure

The analysis allowed to specify the variables which are likely to have the most significant impact on revenues and costs. Revenues associated with the Secondary substation of the future will depend on its market positioning and on the needs and trends observed in the market (e.g., decarbonation targets, development of EVs…) and on the product's functionalities. As for costs, items related to components and raw materials will play a significant role in their evolution.

4.2 ER 1b: Secondary substation of the future specially designed for remote isolated areas

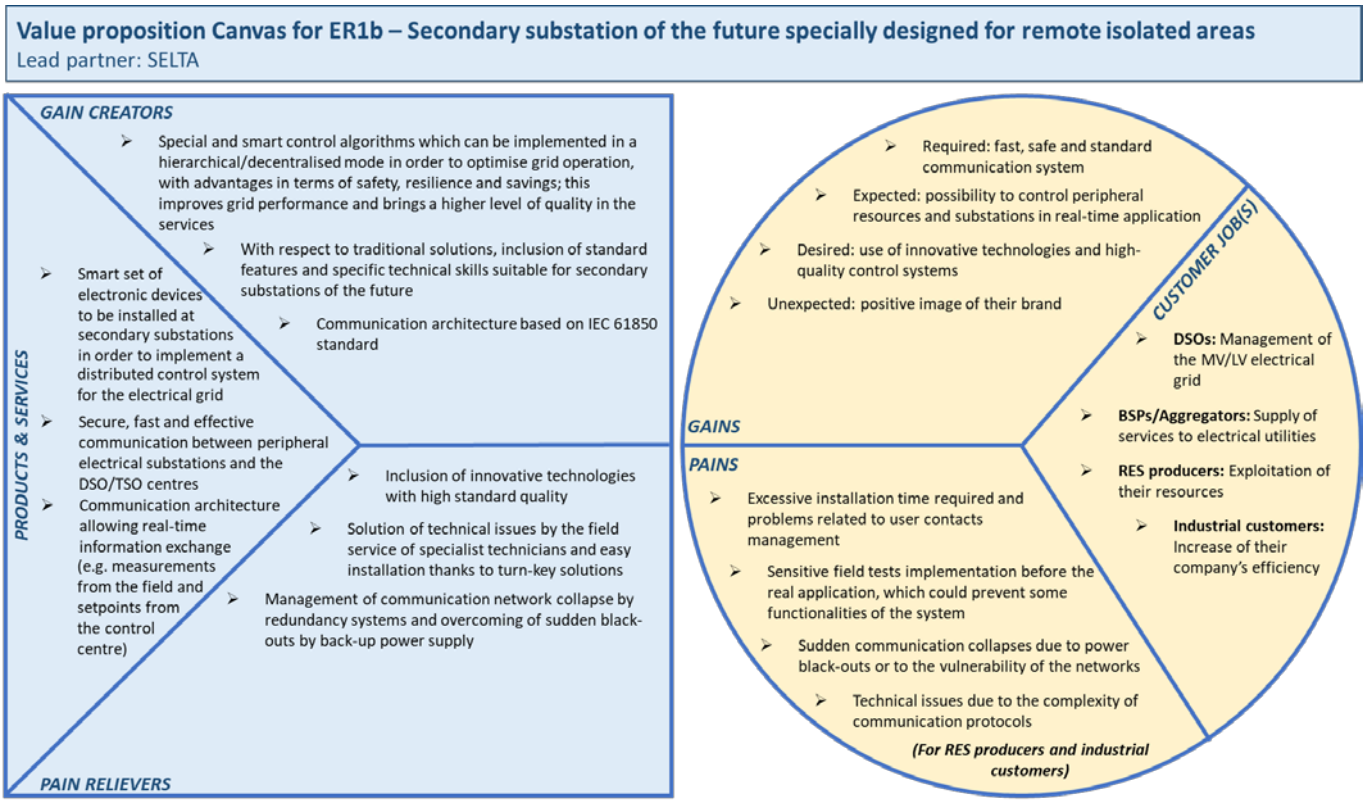
The Secondary substation of the future specially designed for remote isolated areas includes a smart set of electronic devices to be installed in order to implement a distributed control system for the electrical grid. The solution provides secure, fast and effective communication between the peripheral substations and the TSO/DSO centers. The communication architecture allows real-time bidirectional information exchange (e.g., measurements from the field and setpoints from the control center). It permits the implementation of specific hierarchical algorithms studied for power flow management and MV voltage regulation.

Customer segment analysis

The main customer segment for the Secondary substation of the future specially designed for remote isolated areas is expected to be DSOs in their quality of electrical MV grid managers. Aggregators and BSPs providing ancillary services to utilities may also be interested in it, as well as RES producers owning smart distributed generators and industrial customers owning flexible business equipment.

TSOs can be considered as potential beneficiaries of the distributed communication system.In terms of geographical markets, the EU would be the main target.

Value Proposition Canvas



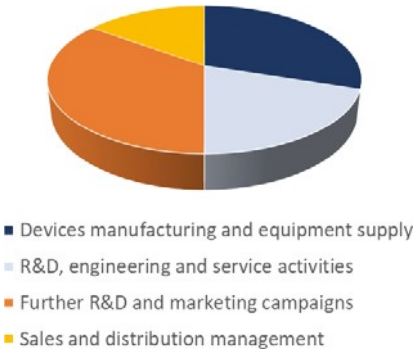
The Value Proposition Canvas is very similar for the various customer segments, although they are performing different functions. DSOs aim to manage the MV/LV electrical grid, consisting in a large number of secondary substations. They need to involve large and small power plants in order to have the electrical parameters of the MV grid under control. Aggregators and BSPs' main activity is the supply of services to electrical utilities. They need to implement a reliable and innovative communication system in order to optimise control of the resources and to improve their business. RES producers' main task is the exploitation of their resources. They need to continuously improve their plants' technologies and to increase communication with DSOs. As for industrial customers, while the business of their venture is their main priority, they are constantly looking for new ways to increase their company's efficiency.

Documenting the revenue streams and cost structure

Figure 53. ER1b – Secondary substation of the future specially designed for remote isolated areas – Revenue streams

The revenue streams associated with the Secondary substation of the future specially designed for remote isolated areas involve both products and services (Figure 29). For DSOs, the supply of the devices would rest on a recurring pricing mechanism related to the portions of the MV grid and the number of substations involved. For other customer segments, it may be recurring or one-off depending on the functionalities and features that they choose to implement. Installation steps and field service could also be the object of either one-off or recurring pricing mechanisms, depending on the customers' intentions.

Figure 54. ER1b – Secondary substation of the future specially designed for remote isolated areas – Cost structure



The cost structure associated with this ER involves both variable and fixed costs (Figure 30). All of the variable costs – devices manufacturing and equipment supply (production and manufacturing, project management, purchasing department), as well as R&D, engineering and service activities (system engineering, testing and reporting costs and service activities) – are proportional to the number of requested devices. The costs related to R&D, engineering and service (especially for installation) activities will also be contingent upon the complexity of the use cases. Fixed costs will include the conduct of further R&D and marketing campaigns, depending on new products and services. Together with sales and distribution management, they will be continuous activities.

4.3 ER2: New generation of smart meters

Customer segment analysis

Three potential customer segments have been identified for the new generation of smart meters: i) DSOs, ii) renewable energy producers, and iii) industrial and residential customers. Their analysis is presented in Table 33 to Table 34.in the appendix The market for ER2 will be driven by utilities(DSOs), which will be the customer segment with the highest priority. Industrial and residentialcustomers will benefit from the new generation of smart meters' features once they are in place. Power generation owners will also follow DSOs' decisions and actions and

might come up with specific needs based on the information that they require.

Customer journey analysis

An analysis of the customer journey has been performed for potential customer segments in order to refine the "Channels" and "Key activities" buildings blocks of the business model canvas. Its results are presented in Figure 55 and Figure 56.

The problem faced by DSOs and renewable energy producers stems from the need to know the specific feeders of their end customers. For them to learn about the new generation of smart meters, the solution provider can organise seminars and/or trainings explaining the new algorithms implemented and the advantages of these new features. Papers, technical notes and the instruction book of the meters can be used as support documentation. For DSOs to assess the value proposition before the actual purchase, they could be provided with meters to prepare a pilot case and analyse the data that can be procured thanks to these new features. As for renewable energy producers, they will usually assess the value proposition through pilot experiences or different projects evidencing the potential of the product. Then, DSOs can purchase meters directly or through a tender specifying the required features. Renewable energy producers can also purchase meters directly or through a tender, or to an integrator providing the whole system. After their deployment, DSOs and renewable energy producers can exploit the data generated by the meters and take decisions on this basis. Support is provided for the products sold, and trainings can also be organised.

In the case of industrial and residential customers, the problem addressed by ER2 is the need to know the real-time status of their demand and take decisions accordingly. These end-users can learn about the product from information provided by either DSOs or retailers. For them to assess its value proposition, simulations of the experience could be provided to leverage the benefit of the new features, especially for industrial customers, which are keener to procure their own meters. Then, customers can directly purchase the meters to a retailer, even though this would apply more to industrial customers than to residential customers. After deployment, these customers can analyse the data generated to take decisions on this basis. After the purchase, they would contact the retailer, and the latter may contact the smart meter provider if necessary.

Figure 55. Customer journey analysis for potential customer segment #1: DSOs and renewable energy producers

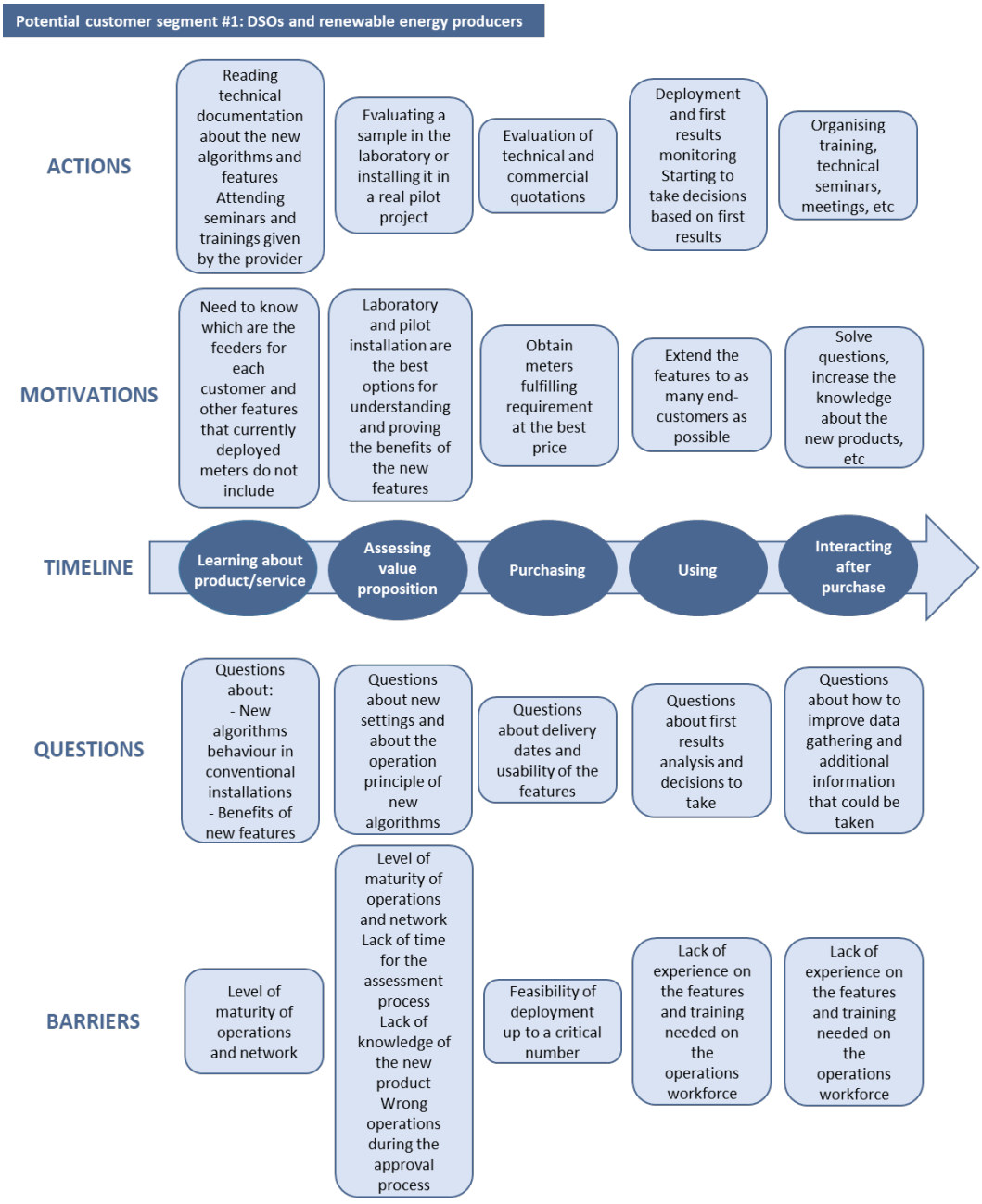
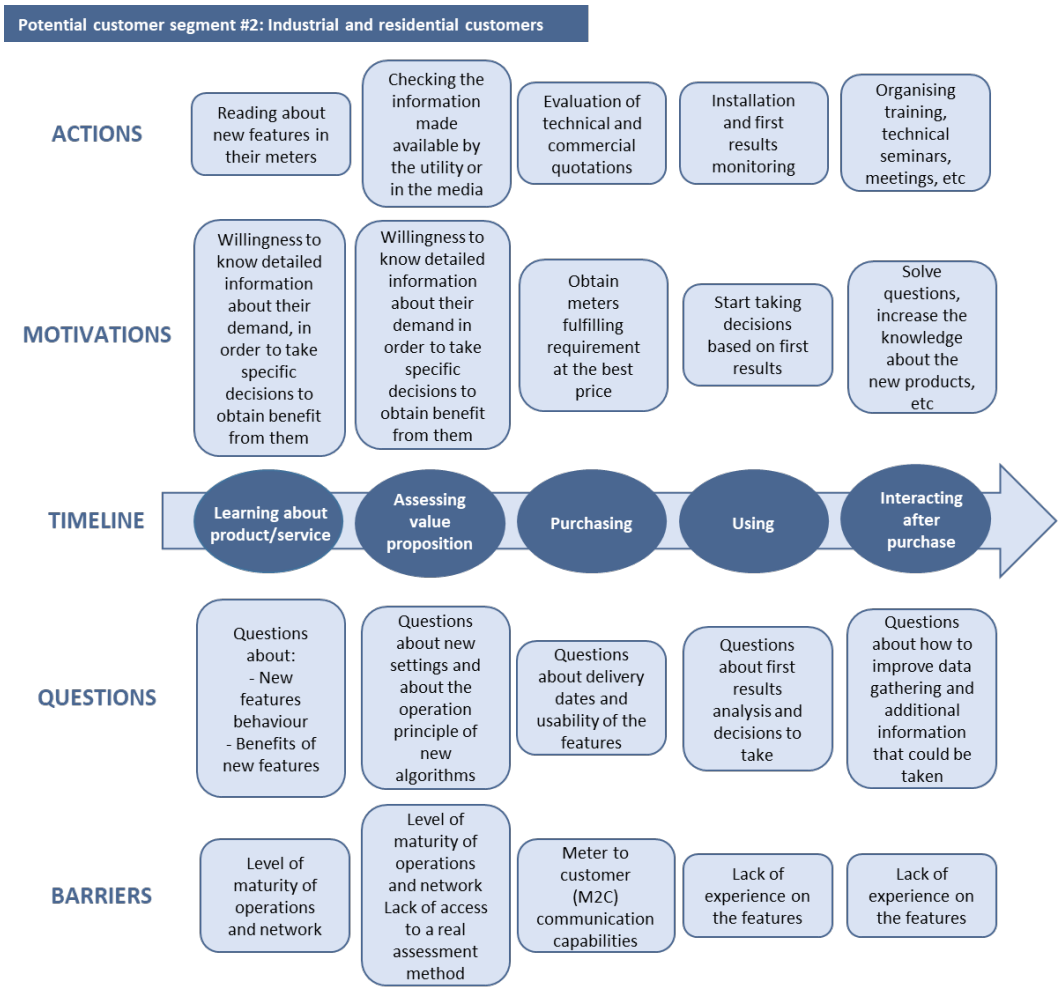


Figure 56. Customer journey analysis for potential customer segment #2: Industrial and residential customers



In relation with this customer journey map, the smart meters provider's key activities, their output and the extent to which they are assessable, critical and timely have been specified (Table 35). As a result, the scope of the activities retained in the "Key activities" building block of the business model canvas has been refined.

Table 35. Analysis of key activities

Activity	Assessable?	Critical?	Timely?	Output of the activity
Development	Medium	High	High	Meter including allrequested features
Pre-sales activity, making the new features known to the customers	Medium	High	Medium	DSOs' technical departments aware of the product and ready to test it
Pilot phase	Medium	Medium	High	Positive assessment of the new product by customers
Sales	High	High	High	Orders for the product
Manufacturing	High	High	High	ucts shipped tocustomers
st-sales activity,field support	Medium	High	High	Customers fully aware of deployed functionalities and benefiting from them

Market and competition analysis

A market and competition analysis has been performed in order to refine ER2's value

proposition (Table 36).

Table 36. Market and competition analysis for ER2 – New generation of smart meters – in Europe

Current competitors
Global meter manufacturers, which include new features in products once they are published in different tendersor by interacting with customers.

New entrants
Meter manufacturing does not have many new entrants: it is a highly competitive electronics manufacturing market based on volume. New entrants could come from small software providers offering different algorithms to be included in other meters.

Substitutes
No known substitutes, product- or service-wise.

Suppliers and other actors in the value chain
Electronic components manufacturers and distributors; DSOs' technical departments (which prepare technical requirements in tenders).

Stakeholders
Other actors that may have an impact on the activity or the competitive environment: regulatory authorities, governments and other similar stakeholders.

Within this environment, the competitive advantage of the new generation of smart meters will stem from the fact that their provider is a known meter manufacturing company, with a strong expertise on technical solutions and innovation. The solution will be tested within the pilots with DSOs, so the time-to-market, critical in such cases, will be reduced and the competitive advantage will be clear.

Critical success factors for the considered business model

The critical success factors for the business model considered for ER2 are evidenced in Table 37.

Table 37. Critical success factors for the business model considered for ER2

Critical success factor	Key metric	Data to be collected and sources
ity of DSOs in a position touse the new features	r of tenders includingthese features	Public tenders
lata from feeders anddemand	Growth in the number oftenders including these features	Publications, public tenders

Documenting the revenue streams and cost structure

The analysis allowed to specify the variables that are likely to have the most significant impact on revenues and costs. Revenues will especially depend on tenders including new features and on the tenders' volume, while product certifications and development will have the most significant impact on costs.

4.4 ER3: Protections for high RES penetration

Customer segment analysis

Six potential customer segments have been identified for the Protections for high RES penetration: i) DSOs, ii) TSOs, iii) industrial and other MV customers, iv) renewable energy producers, v) switchgear manufacturers and vi) integrators and Engineering, Procurement and Construction (EPCs). Their analysis is presented in Table 38 to Table 43 in the appendix. Utilities (TSOs and DSOs) are expected to drive this market, so they will be considered as customer segments with the highest priority. Other segments will have to comply with new network codes and utilities' requirements.

Customer journey analysis

An analysis of the customer journey has been performed for potential customer segments in order to refine the "Channels" and "Key activities" buildings blocks of the business model canvas. Its results are presented in Figure 57 and Figure 58.

The problems faced by all customer segments stem from the fact that conventional protective relays do not operate correctly in networks with high RES penetration. For potential customers to learn about the ER, the protective relays provider can organise seminars and/or trainings to explain the new algorithms implemented and their advantages with regard to conventional algorithms. Papers, technical notes and the instruction book of the protective relays can be used as support documents. To assess the ER's value proposition before the actual purchase, potential customers could be provided with some recordings with false operations of conventional algorithms and correct operations of new algorithms. The protection system provider could also propose a sample for customer evaluation: the customer could install it in a substation during a certain time to evaluate its behaviour, and support would be ensured during the evaluation process. Protective relays could then be purchased directly by potential customers, or through EPCs, system integrators, representatives of their provider, etc. The purchase will take place once the customer has approved the product. The relays will be installed in the customer's network, and the end customer will normally operate them. Maintenance can be done by the customer or outsourced. Support will be provided for the products sold, and trainings can also be organised.

Figure 57. Customer journey analysis for potential customer segment #1: TSOs, DSOs, renewable energy producersand industrial and other MV customers

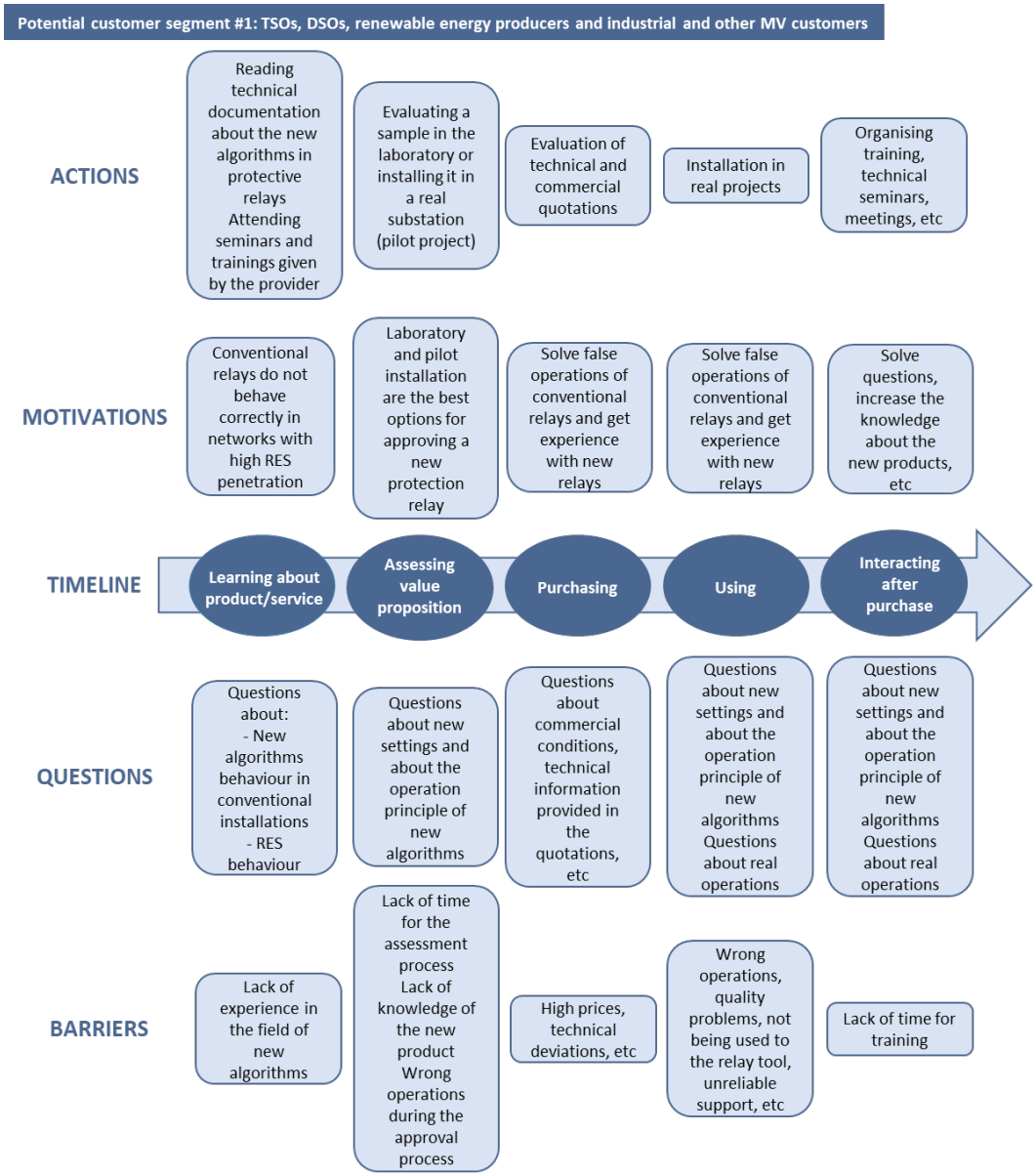
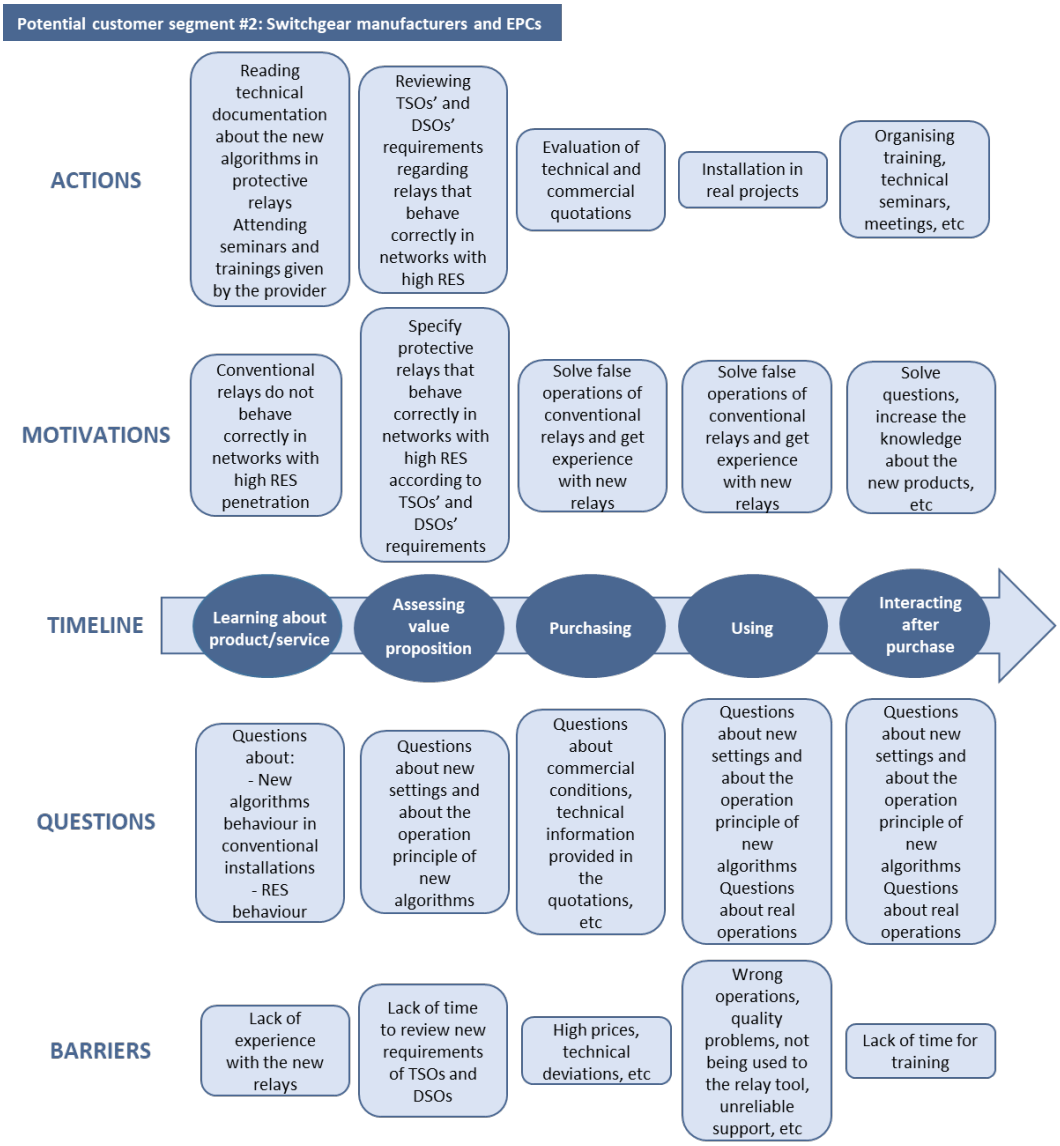


Figure 58. Customer journey analysis for potential customer segment #2: Switchgear manufacturers and EPCs



In relation with this customer journey map, the protection system provider's key activities, their output and the extent to which they are assessable, critical and timely have been specified (Table 44). As a result, the scope of the activities retained in the "Key activities" building block of the business model canvas has been refined.

Table 44. Analysis of key activities

Activity	Assessable?	Critical?	Timely?	Output of the activity
Simulation of networks withhigh RES	High	Medium	High	faults simulationfiles
Application and design engineering	Medium	High	High	Application and design specifications. Technical documentation for customers
Development of newalgorithms	High	High	High	Deployable software modules, together with the software testing files and reports
Testing	High	High	High	Test plans and test reports
Field installation	Medium	Medium	Medium	Report about the performanceand issues detected during normal operation

Market and competition analysis

A market and competition analysis has been performed in order to refine ER3's value proposition (Table 45).

Table 45. Market and competition analysis for ER3 – Protections for high RES penetration – at the global level

Current competitors
Siemens: distance protection including some algorithms for better operation (improved phase selector). **ABB**: conventional distance protection. **SEL**: conventional distance protection. **GE**: distance protection including some algorithms for better operation (improved phase selector). **INGETEAM**: conventional distance protection. **Toshiba**: conventional distance protection.

New entrants
Potential new entrants: relay manufacturers selling in other countries and/or segments, trying to expand their business. Barriers to entry: Lack of knowledge of their products; Local support requirement.

Substitutes
No known substitutes.

Suppliers and other actors in the value chain
EPCs and system integrators enter in the purchase process, so it is important that they are satisfied with the products.

Stakeholders
TSOs define grid codes that specify requirements for RES, which affects protective relay algorithms.

Within this environment, the competitive advantage of the Protections for high RES penetration will rest on the improved performance of the protection system, tested in the field in real environment.

Critical success factors for the considered business model

The critical success factors for the business model considered for ER3 are evidenced in Table 46.

Table 46. Critical success factors for the business model considered for ER3

Critical success factor	Key metric	Data to be collected and sources
Growth of RES penetration in electricity networks	Growth percentage of installed capacity of RESworldwide	ports evidencing new RESinstalled power
Adaptation of network codes	Number of countries with updated network codes	Countries' regulatory authorities

Documenting the revenue streams and cost structure

The analysis allowed to specify the variables that are likely to have the most significant impact on revenues and costs. Revenues will especially depend on sales of protection IEDs and fault detectors, while human resources (engineers) will have the most significant impact on costs.

4.5 ER 4: Energy Box

Customer segment analysis

Six potential customer segments have been identified for the Energy Box: i) DSOs, ii) aggregators, iii) renewable energy producers, iv) industrial, commercial and residential customers and energy communities, v) experts and actors of the refurbishment industry and vi) local authorities in charge of the management of social housing. The first four are considered as primary customer segments. Their analysis is presented in Table 47 to Table 50 in the appendix.

Customer journey analysis

An analysis of the customer journey has been performed for primary customer segments[4] in order to refine the "Channels" and "Key activities" buildings blocks of the business model canvas. Its results are presented in Figure 59.

The problems faced by customers vary depending on the considered customer segment:

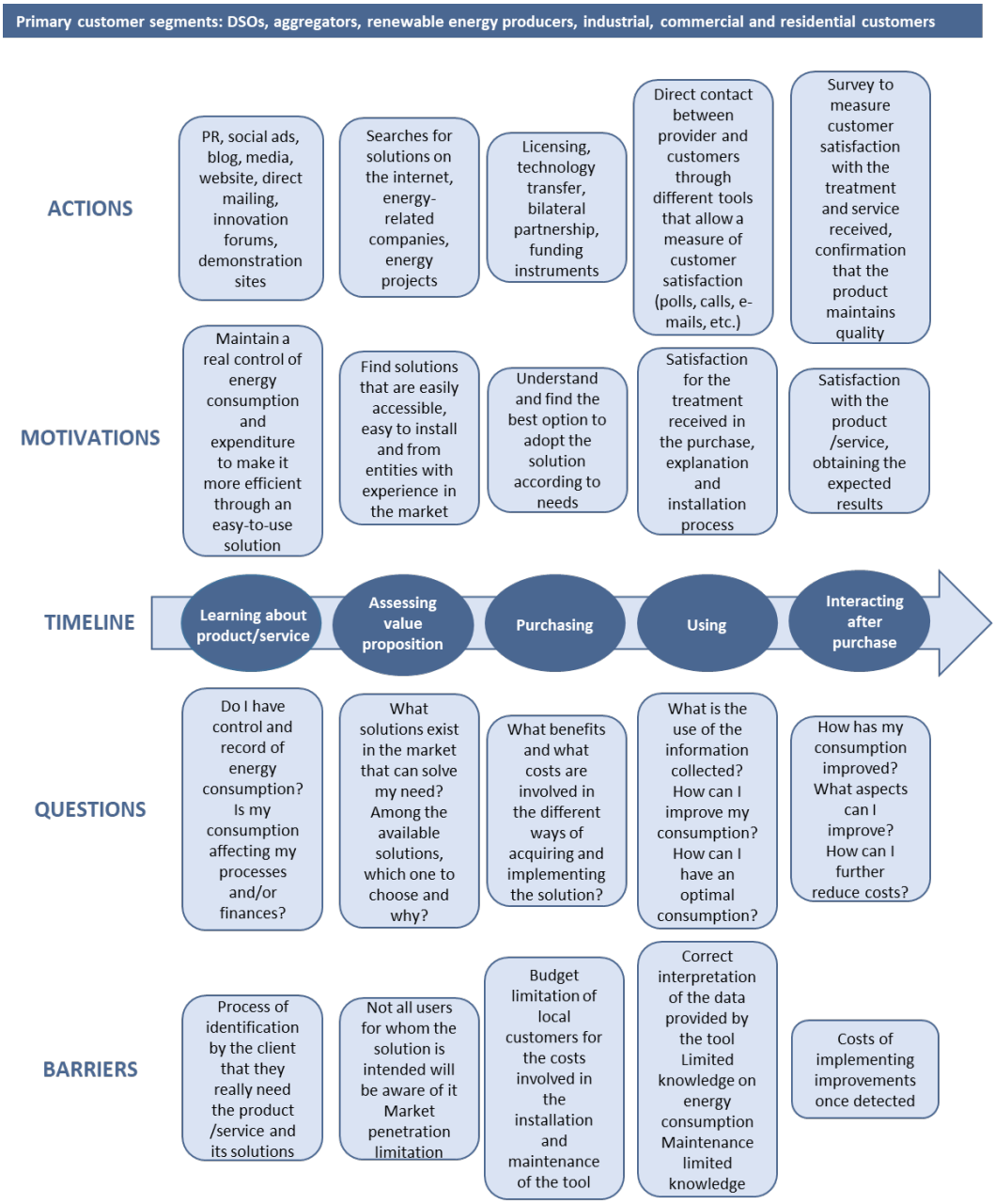
- DSOs need an enabler for advanced systems such as prediction and optimisation algorithms, since without an intelligent element in the field they are not able to perform calculated control.
- Aggregators need a controller able to manage energy intelligent devices in several environments to keep control of minimum communication requirements, reducing the number of ports and easy to manage in an industrial environment.
- Industrial, commercial and residential customers need to maintain control of energy consumption in their homes or companies through agile and easy-to-use systems and without the need to know in-depth data from the electrical network.

The ways in which customers can learn about the Energy Box also vary depending on the considered segment:

- This result will be approved and offered initially to the DSOs that are part of the FLEXIGRID project and to DSOs that are not part of the consortium but with whom the Energy Box provider has previously worked or already has commercial relationships.
- Aggregators can learn about the Energy Box through the EC, the FLEXIGRID website, events where the project and/or result is presented, the press and articles, business websites or list of clientele.
- Industrial, commercial and residential customers can learn about it through the company or FLEXIGRID website, the Energy Box provider's list of clients, public relations(PR), social media and/or marketing.

Customers can then assess the Energy Box's value proposition before actually purchasing it by being shown the results obtained in the validations and tests on site (notably during the FLEXIGRID project's lifetime). In the case of DSOs and aggregators, the purchase itself can take the form of licensing, sale or joint venture creation. In the case of industrial, commercial and residential customers, it can consist in licensing or sale, depending on whether the customer is a company or a direct user. Then, the Energy Box will be adopted in the customer's facilities or home. After the purchase, there should be a user manual for initial configuration. For DSOs and aggregators, once data can be extracted, the algorithmic system can be updated and improved according to the user's needs. Maintenance service for troubleshooting and software updates can be done remotely via Over The Air (OTA). In the case of industrial, commercial and residential customers, surveys will be conducted to measure satisfaction.

Figure 59. Customer journey analysis for primary customer segments



This customer journey map evidenced key interactions between the Energy Box provider and customer segments, which allowed to refine the analysis of the "Channels" building block of the business model canvas.

Besides, in relation with this customer journey map, the Energy Box provider's key activities, their output and the extent to which they are assessable, critical and timely have been specified (Table 51). As a result, the scope of the activities retained in the "Key activities" building block of the business model canvas has been refined.

Table 51. Analysis of key activities

Activity	Assessable?	Critical?	Timely?	Output of the activity
Testing the solution in demonstration sites	High	High	High	Confirm the correct adaptation and implementation of the solution before being brought tothe market

Market analysis	Medium	High	High	Market assessment; learn about ınd further explore the different business outlets of the solution
Dissemination, replicationand exploitation	Medium	Medium	High	Make the solution known in the markets already identified in the analysis and explore the different methods of exploitation and sale
Installation at customer premises	High	High	High	Deliver the product to the customer and carry out custominstallation according to their needs
Cooperation with other projects and networking	Low	Medium	High	Constantly improve the EnergyBox in each project Obtain commercial agreements and interact with interestedpartners

Market and competition analysis

A market and competition analysis has been performed in order to refine ER4's value proposition (Table 52).

Table 52. Market and competition analysis for ER4 – Energy Box – in the European market

Current competitors
Due to differences in the regulatory framework among European countries, competition may vary from one market to another. The main competitors identified in the case of the Spanish market would be the following: **Schweitzer Engineering Laboratories (SEL):** powerMAX for Mobile Microgrids system; **Opus One Solutions:** GridOS™ smart grid system; **S&C Electric:** GridMaster Microgrid Control System; **Other competitors:** ABB, Schneider Electric, Power Secure, Emerson, Clean Spark, OATI, General Electric, Eaton; **Research centres and universities**, e.g., in Spain: IREC, CENER, TECNALIA, CARTIF, CIEMA. In international markets, the following solution may be mentioned for reference: **Revolution PI** (industrial PC based on Raspberry Pi).

New entrants
Communication protocols: 5G, LoRA. Barriers to entry: Certifications; Finding partners to commercialise the solution; DSOs and aggregators market evolution (as these actors may produce their own solutions).

Substitutes
Merytronic: Low Voltage Network Monitoring system **Socomec:** services of protection, distribution, measuring and monitoring of LV electrical grids **Embedded Monitoring System (EMSNI):** Sub.net-SLV product Since 2000, the national electric utility of Greece has installed and put in operation a modern **energy management system (EMS)** as a supervisory control and data acquisition (SCADA) system that could maybe substitute the Energy Box in the country.
Suppliers and other actors in the value chain
AMMI Technologies: PCB maker; LTP Atelier Plastique: all plastic components; RS components: additional components (microSD memory, 3V battery, WIFI, etc).

Stakeholders
Components manufacturers; Installers; Maintenance entity.

The analysis allowed to identify the Energy Box's competitive advantages, which especially include:

- the monitoring of sensors, controllers and system analysers;
- the communication of the information collected by the control centre and the application of the orders received from it in physical devices;
- the implementation of relevant communication protocols in the IoT scope and measurement and energy control (ZigBee, MQTT, Wi-Fi, Modbus);
- the real-time management of the associated physical system by following the general parameters established by the control centre;
- the implementation of local control algorithms for the system according to general parameters established by the control centre;
- the management and maintenance of a database for the treatment of system information.

Critical success factors for the considered business model

The critical success factors for the business model considered for ER4 are evidenced in Table 53.

Table 53. Critical success factors for the business model considered for ER4

Critical success factor	Key metric	Data to be collected and sources
Research	Marketing metrics	ehaviour, competitors, possiblesales, social sentiment
Anticipation of failures	Level of errors in implementation	Errors reported by customers and users
Teamwork/project team competence	Quality of final product	Personnel retention, quality of final product
Strong brand	Market valuation	Company's reputation
Success	Software as a Service metrics	Customer lifetime value, customer churn rate, monthly recurring revenue, customer retention rate

Documenting the revenue streams and cost structure

In order to meet the needs of new generations of smart grid control, demand management, DER or intelligent micro-networks, the Energy Box has been developed as a local management system capable of performing advanced monitoring and control, as well as processing large amounts of information, combining the most current technologies (IoT, optimisation algorithms, etc.). While leading companies in the sector (e.g., ABB, Schneider Electric…) have been mentioned in the market analysis as possible competitors, a possible alternative option has been identified: the Energy Box provider could also be placed in a position of seller and consider such companies as potential clients.

The analysis also allowed to specify the variables that are likely to have the most significant impact on revenues and costs. The elements that will have the greatest impact on revenues through the different selling processes are the components that provide the greatest added value to the final product, which are the compute module and the communication modules of2G, Wi-Fi and Bluetooth. Regarding costs, LV remote terminal units can be used for the digitalisation of the LV network in secondary substations.

4.6 ER 5: Software module for fault location and self-healing

Customer segment analysis

Two potential customer segments have been identified for the software module for fault location and self-healing: while DSOs would be the main customer segment, energy communities facing some specific issues within their energy supply grids may also be interested in this result. The customer segment analysis is presented in Table 54 and Table 55 in the appendix.

Customer journey analysis

An analysis of the customer journey has been performed for both customer segments in order to refine the "Channels" and "Key activities" buildings blocks of the business model canvas. Its results are presented in Figure 60.

The problems faced by customers vary depending on the considered customer segment:

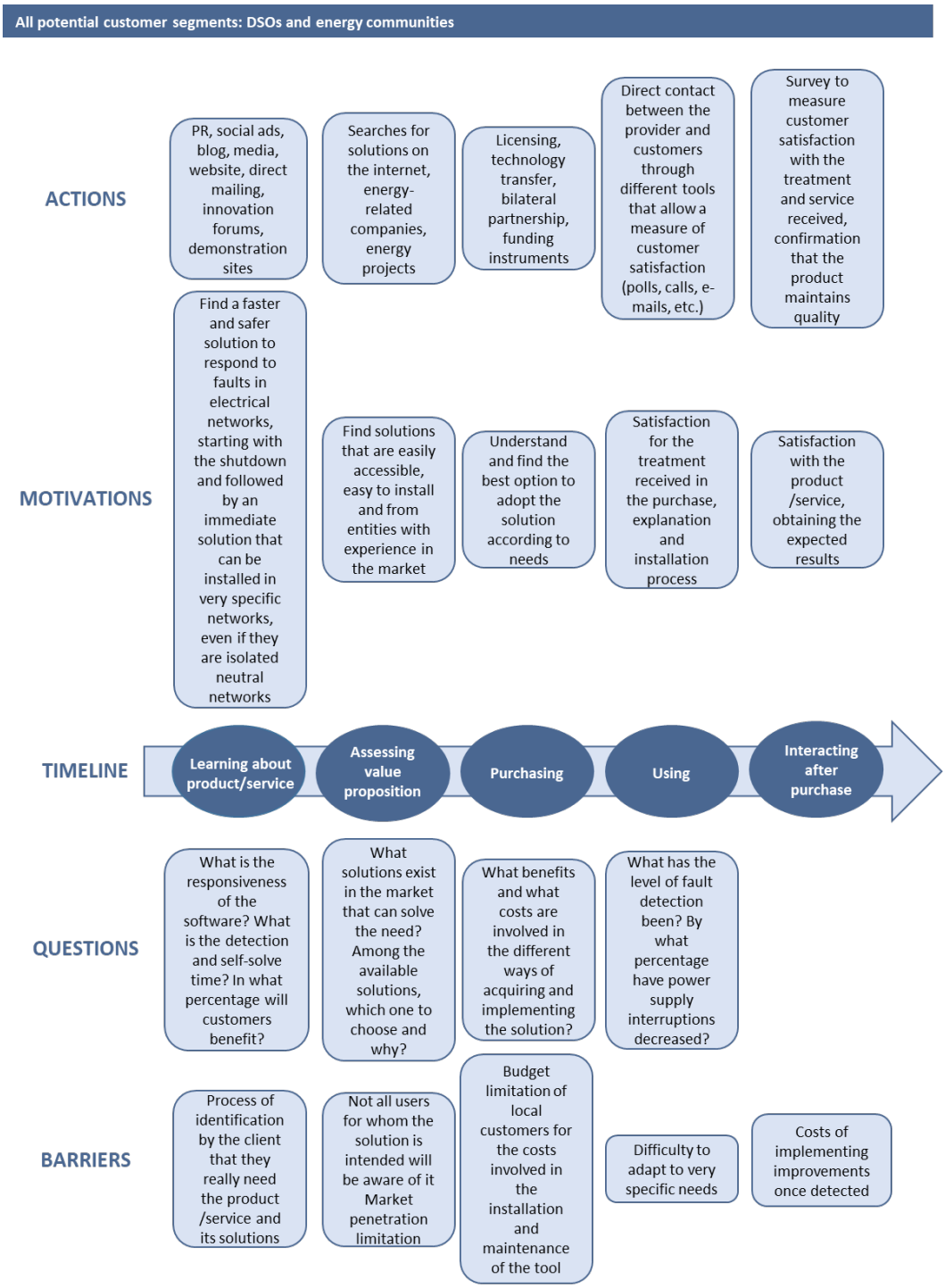
- DSOs need an enabler for advanced systems such as prediction and optimisation algorithms: without an intelligent element in the field, they would not be able to perform calculated control.
- Energy communities aim to make energy more accessible to consumers within the community. Because of their funding limitations, networks may face failures that affect supply.

The ways in which customers can learn about the software module also vary depending on the considered segment:

- This result will be approved and offered initially to the DSOs that are part of the FLEXIGRID project and to DSOs that are not part of the consortium but with whom the software module provider has previously worked or already has commercial relationships.
- Energy communities can learn about the software module through the EC, the FLEXIGRID website, events where the project and/or result is presented, the press and articles, business websites or list of clientele.

To assess the software module's value proposition before the actual purchase, potential customers will be shown the results obtained in the validations and on-site tests (notably during the FLEXIGRID project's lifetime). The purchase itself can consist in licensing, selling or creating a joint venture. DSOs can then adopt the solution through the software module provider's servers, while energy communities will adopt it in their facilities.

Figure 60. Customer journey analysis for all potential customer segments



This customer journey map evidenced key interactions between the software module provider and customer segments, which allowed to refine the analysis of the “Channels” building block of the business model canvas.

Besides, in relation with this customer journey map, the software module provider’s key activities, their output and the extent to which they are assessable, critical and timely have been specified (Table 56). As a result, the scope of the activities retained in the “Key activities” building block of the business model canvas has been refined.

Table 56. Analysis of key activities

Activity	Assessable?	Critical?	Timely?	Output of the activity
Testing the solution in demonstration sites	High	High	High	Confirmation of the correct adaptation and implementation of the solution before being brought to the market
Market analysis	Medium	High	High	Market assessment. Learning about and further exploring the different business outlets of the solution
ssemination, replicationand exploitation	Medium	Medium	High	Making the solution knownin the markets already identified in the analysis and exploring the different methods of exploitationand sale
llation at customerpremises	High	High	High	Delivering the product to customers and carrying out custom installation according to their needs
Cooperation with other projects and networking	Low	Medium	High	Constant improvement ofthe algorithm once needsare identified after launch in user/client facilities

Market and competition analysis

A market and competition analysis has been performed in order to refine ER5's value proposition (Table 57).

Table 57. Market and competition analysis for ER5 – Software module for fault location and self-healing – in theEuropean market

Current competitors
The main competitors identified for the ER are the following: technology manufacturers for the energy sector; manufacturers of protection technologies and network analysis. Examples include Siemens and Schneider, as well as technological centres that develop solutions for the energy market.

New entrants
Barriers to entry: Certification to penetrate the market; Adaptation of solutions to different customer needs; Necessity to know very specific network data to be able to demonstrate the functionality of the algorithms to potential customers.

Substitutes
Other commercial solutions exist, but they often involve the use of a particular technology (a single vendor) which makes it difficult to work with heterogeneous networks.

Suppliers and other actors in the value chain
The main supplier needed for production is the commercial hardware that is needed to create own hardware and run the software itself.

Stakeholders
Components manufacturers; Installers; Maintenance entity.

Critical success factors for the considered business model

The critical success factors for the business model considered for ER5 are evidenced in Table 58.

Table 58. Critical success factors for the business model considered for ER5

Critical success factor	Key metric	Data to be collected and sources
Research	Marketing metrics	Market behaviour, competitors, possible sales, social sentiment
Anticipation of failures	Level of errors inimplementation	Errors reported by customers and users
Teamwork/project team competence	Quality of final product	Personnel retention, quality of final product
Strong brand	Market valuation	Company's reputation
Success	Software as a Service metrics	Customer lifetime value, customer churn rate, monthly recurring revenue, customer retention rate

Documenting the revenue streams and cost structure

The analysis allowed to specify the variables which are likely to have the most significant impact on revenues and costs. The variable that will have the greatest impact on revenues is expected to be the precision of the software to detect faults and solve them, while the commercial hardware that needs to be purchased to run the software is the expense that will have the most significant impact on costs.

4.7 ER 6: Software module for forecasting and grid operation

Customer segment analysis

Four potential customer segments have been identified for the software module for forecasting and grid operation: i) network operators (TSOs, DSOs), ii) aggregators/energy service companies (ESCos) and energy retailers, iii) renewable energy producers, and iv) commercial and industrial customers. Their analysis is presented in Table 59 to Table 62 in the appendix.

Customer journey analysis

An analysis of the customer journey has been performed for the different customer segments in order to refine the "Channels" and "Key activities" buildings blocks of the business model canvas. Its results are presented in Figure 61 to Figure 62.

The problems faced by customers vary depending on the considered segment:

- Network operators (TSOs, DSOs) want to be able to optimise their operation efficiency while at the same time increasing the hosting capacity of RES in the grid. Without the ability to accurately match RES generation and load at any given time, grid security andresilience could be compromised.
- Aggregators, ESCos and energy retailers trade electricity in the energy market. Dealing with interruptible and non-predictable RES, they need to rely on accurate forecasting services to be able to make informed decisions regarding their trades on the market.
- Renewable energy producers own and operate renewable energy assets and sell their electricity either to aggregators or directly to the energy market. The unpredictability of energy generation from these sources may pose a significant challenge when negotiating prices since an accurate forecast of the energy produced needs to be in place to allow making informed trades.
- Commercial and industrial customers often install RES on their premises in order to reduce their energy bill while benefiting from a given level of energy services. At the same time, they need to satisfy their building occupants' level of comfort and their businesses' specific energy needs. This implies a high level of complexity in their operations, introducing the need for accurate load and energy generation forecasting

from their assets.

These different customer segments could learn about the software module through dissemination activities such as articles, conferences and events or by looking at their competitors' activities and replicating strategies. To enable them to assess the software module and its capabilities, a trial version could be available for a specific period of time (e.g., 3 months) before purchasing it. Then, they could purchase the module either by being given access to it using a license (with a monthly/yearly fee) or purchasing it from the developer through a one-off payment.

The use of the software module will be tailored to each customer segment's specific needs:

- Network operators can use the load and generation forecasting module to better understand demand and generation participation in flexibility and demand response markets.
- Aggregators can use it to produce hourly and daily forecasts of the energy production of their assets in order to be able to participate in the energy market.
- Renewable energy producers would use it mainly for long-term forecasts if they are selling to aggregators or for shorter-term forecasts if they are participating in the energy trading market.
- Commercial and industrial customers can use it to accurately predict their energy demand and RES generation on a daily basis. Buildings' facility managers could this way have a very good overview of their energy needs and adjust operations accordingly, aiming at reducing their energy costs.

Then, for all customer segments, interaction with the software module provider post-purchase could be done through emails in order to ensure that support is provided for any technical issue that may arise. An operation and maintenance contract could also be provided to customers.

Figure 61. Customer journey analysis for potential customer segment #1: Network operators (TSOs, DSOs)

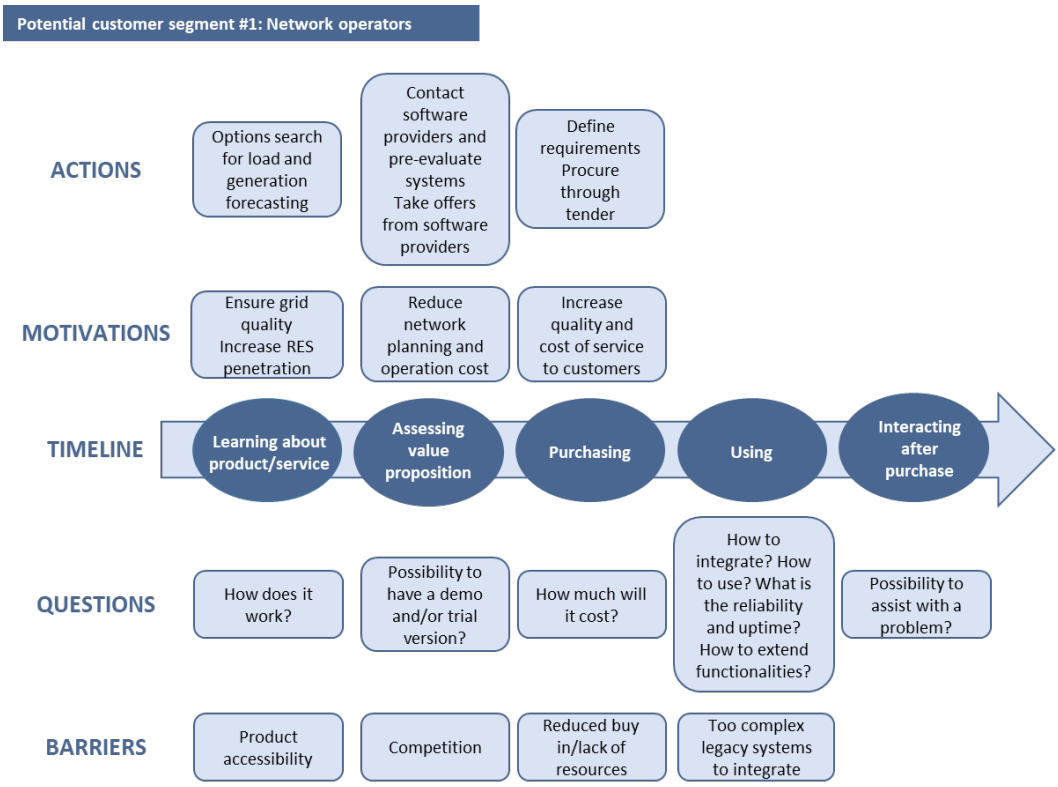


Figure 62. Customer journey analysis for potential customer segments #2 and 3: Aggregators/ESCos, energy retailers and renewable energy producers

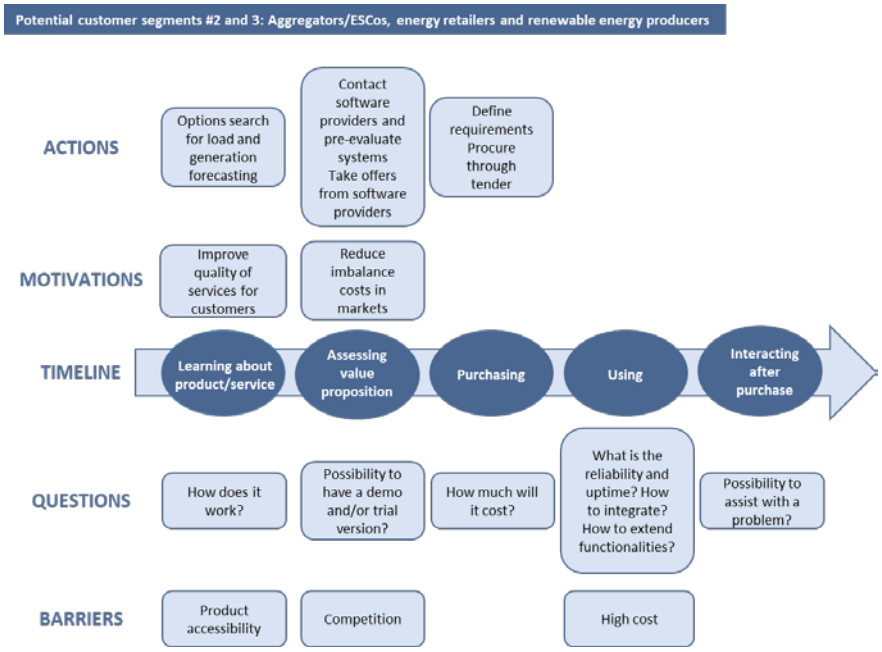
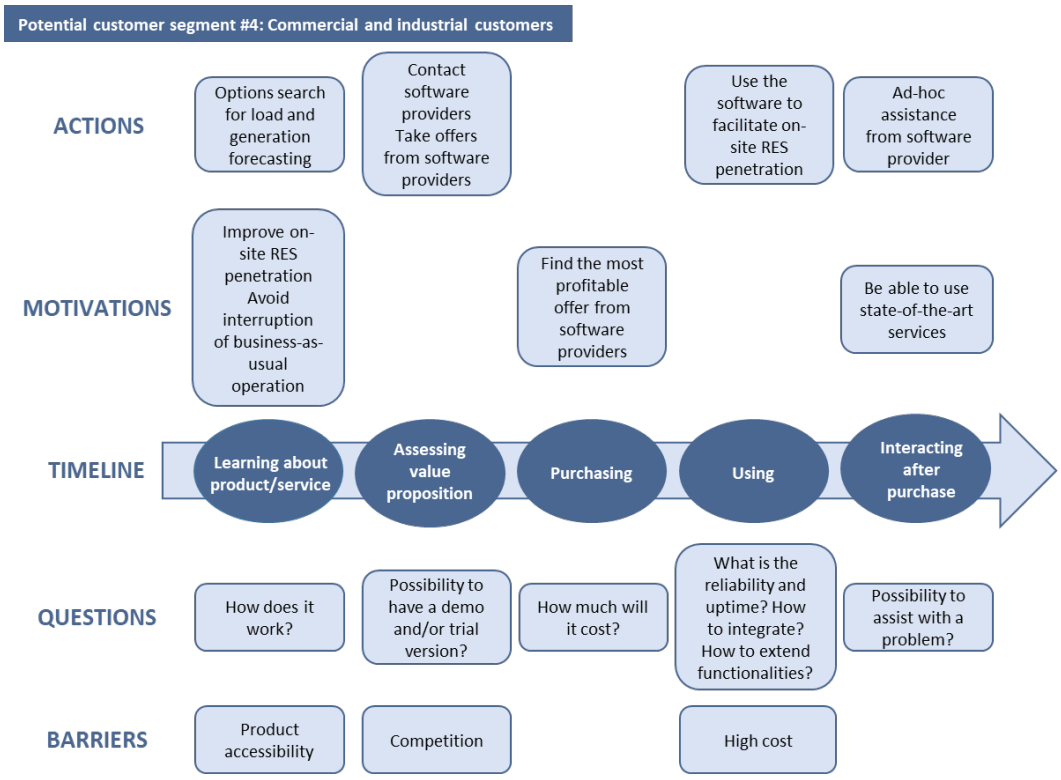


Figure 63.Customer journey analysis for potential customer segment #4: Commercial and industrial customers



These customer journey maps evidenced key interactions between the software module provider and customer segments, which allowed to refine the analysis of the "Channels" building block of the business model canvas.

Besides, in relation with these customer journey maps, the software module provider's key activities, their output and the extent to which they are assessable, critical and timely have been specified (Table 63). As a result, the scope of the activities retained in the "Key activities" building block of the business model canvas has been refined.

Table 63. Analysis of key activities

Activity	Assessable?	Critical?	Timely?	Output of the activity
Market analysis	High	High	Medium	Understanding of competition and targetmarkets
Identification, assessment and comparison of the technological solutions for monitoring and control systems in the distribution network and in customer premises	Medium	Low	High	Understanding of competition and potentialgaps in existing markets
Testing of algorithms (simulation, small scale demonstration)	High	Medium	Medium	Product testing and refinement
Performance test of the developed applications in a real grid	High	High	High	Final product refinementand customisation to specific customer needs
Cooperation with other projectsand networking	High	Medium	Low	Development of new ideas, potential overcoming of obstacles, creation of new market opportunities

Market and competition analysis

A market and competition analysis has been performed in order to refine ER6's value proposition (Table 64).

Table 64. Market and competition analysis for ER 6 – Software module for forecasting and grid operation – in theEuropean market

Current competitors
Meteologica: forecasting services **EDF store and forecast:** PVSCOPE™, SKYSCOPE™, EOLSCOPE™ and CONSOSCOPE™ **Enfor:** forecasting tools and services **Energymeteo:** customised forecasting services **NextKraft Werke:** NEMCOS live monitoring, forecasting and nowcasting solution **AleaSoft:** forecasting services

New entrants
Barriers to entry: High competition in the field of forecasting services; Software companies create dedicated products; RES developers and aggregators often use in-house products, thus they do not need specific services from third parties.

Substitutes
Products/services that can act as substitutes: In-house software: companies may build their own forecasting algorithms/software in order to avoid going out to the market and seeking a customised solution to their needs; A forecasting module included in a wide purpose software (e.g., VPP software).

Suppliers and other actors in the value chain
Weather forecast companies; IT companies; RES producers which could use their sites to validate the developed solutions; Facility managers; Network operators.

Stakeholders
Other actors that may have an impact on the activity or the competitive environment: Public authorities; Regulators; Utilities; Facility management consultants; Energy experts.

Critical success factors for the considered business model

The critical success factors for the business model considered for ER6 are evidenced in Table 65.

Table 65. Critical success factors for the business model considered for ER6

Critical success factor	Key metric	Data to be collected and sources
Forecast accuracy	%error	PV production and load demand from demonstration site in Greece
Reliability/Uptime	%time	roduction and load demand from demonstration site in Greece
Cost to run and maintain	Hardware/software resources and personnel	Resources used in FUSE (data storage,user interface) and average time to maintain after demonstration in the demonstration site in Greece

Documenting the revenue streams and cost structure

A possible alternative option has been identified: marketing the software module as a bundle with ER7 to provide a holistic forecasting and scheduling service.

The analysis also allowed to specify the variables that are likely to have the most significant impact on revenues and costs. Revenues will be contingent upon the number of customers and

the number of sites, as well as customer maintenance, which is linked with persisting product quality (stable and satisfactory forecast accuracy). As for costs, they will depend mainly on integration costs with the customer, the training and support required, maintenance costs, and customisation/upgrade costs.

4.8 ER 7: Software module for congestion management

Customer segment analysis

Three potential customer segments have been identified for the software module for congestion management: i) aggregators/ESCos, ii) commercial and industrial customers, and iii) residential customers. Their analysis is presented in Table 66 to Table 68 in the appendix.

This analysis suggests that congestion management is more likely to be useful to aggregators and ESCos in the near future, as congestion issues will need to be resolved primarily at the network level. At a later stage the need might arise for congestion management at a smaller scale (i.e., smaller network), which will then open the market for such software services to commercial, industrial and residential customers.

Customer journey analysis

An analysis of the customer journey has been performed for the different customer segments in order to refine the "Channels" and "Key activities" buildings blocks of the business model canvas. Its results for the primary customer segment, i.e., aggregators/ESCos, are presented in Figure 64.

The problems faced by customers vary depending on the considered segment:

- Aggregators and ESCos want to be in position to offer complete energy management solutions (bundled services) to their customers on top of their traditional roles, satisfying their need for complete energy management that will safeguard both financialprofitability and local network and equipment resilience.
- Commercial and industrial customers may want to reduce their environmental footprintby introducing RES into their systems. However, complex control technologies might be needed to effectively manage those resources and increase their potential, leaving room for the deployment of a congestion management software in their facilities.
- Residential customers want to optimise their energy use.

The channels through which potential customers could learn about the software also vary depending on the considered segment:

- For aggregators/ESCos, the software module provider could conduct workshops to promote it.
- Commercial, industrial and residential customers could learn about the software module through direct customer support channels (web portal, social media, etc.). Awareness raised by government and regulation could also help to promote the need for congestion management services.

Potential customers could assess the software before purchasing it by requesting a free trial period in the form of a personalised report based on simulation. They could then purchase a fixed-term license for using the product (e.g., a one-year license) or agree with the software provider on specific payments depending on the level of support.

The use of the software module will be tailored to each customer segment's specific needs:

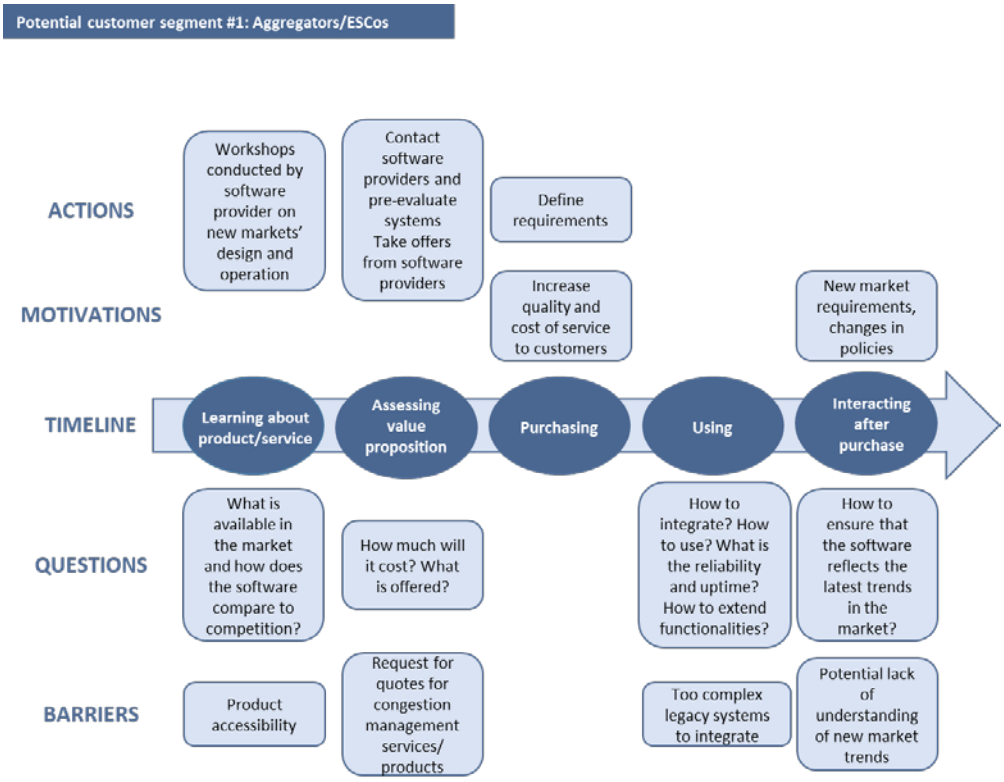
- For aggregators/ESCos, the service could be a one-stop solution for setting up, developing and exploiting flexible energy provisioning from their customers to the

DSO.

- Commercial and industrial customers can harvest the full potential of their energy assets by using the service in order to reduce network and energy charges while potentially providing services to the grid.
- Residential customers can either set up the relevant SaaS to be functioning in an automated preconfigured way or interact in real time with the application's suggestions to accept or not a congestion mitigation or an energy management optimisation action.

After the purchase, customers will need to interact with the software services supplier at the beginning for training purposes. Aggregators/ESCos and commercial and industrial customers will also need to interact with the provider on a regular basis during the time that they use the service for questions and issues that may arise and/or for updates or adjustments needed to the software in order to customise it to specifically address their needs. As for residential customers, they will need to interact with the provider during an active license period for support purposes. The interaction will be realised through the available communication channels defined in the relevant contractual agreement (e.g., e-mail, phone, dedicated support platform).

Figure 64. Customer journey analysis for potential customer segment #1: Aggregators/ESCos



This analysis of the customer journey evidenced key interactions between the software module provider and customer segments, which allowed to refine the contents of the "Channels" building block of the business model canvas.

Besides, in relation with this analysis, the software module provider's key activities, their output and the extent to which they are assessable, critical and timely have been specified (Table 69).

As a result, the scope of the activities retained in the "Key activities" building block of the business model canvas has been refined.

Table 69. Analysis of key activities

Activity	Assessable?	Critical?	Timely?	Output of the activity
Business development and marketing	High	High	Low	Identification of targetmarket and clients
Development of a turn-key solution	High	High	High	Product development
Adaptation and customisation of the turn-key solution	High	High	High	Customised product to fitthe specific needs of particular clients
Continuous updating to comply with market rulesand tariff structure	Medium	Medium	Low	A product remaining state-of-the-art at any point

Market and competition analysis

A market and competition analysis has been performed in order to refine ER7's value proposition (Table 70).

Table 70. Market and competition analysis for ER7 – Software module for congestion management – in Europe

Current competitors
There are currently no known competitors in the market selling congestion management software. At the moment, congestion management is performed at a network or utility level using internal tools built by TSOs and DSOs. Besides, scheduling and monitoring is performed at device level (e.g., batteries' inverters).

Substitutes
On-site equipment might be equipped with basic congestion management algorithms.

Suppliers and other actors in the value chain
RES and technology providers (e.g., PV and battery suppliers); Facility managers; Communications hardware suppliers (e.g., gateways).

Stakeholders
Other actors that may have an impact on the activity or the competitive environment: Network operators; Aggregators; Public authorities; Policymakers.

This analysis helped to refine the value proposition of the software module, notably for aggregators: it provides them with a one-stop solution for setting up, developing and exploiting flexible energy provisioning from the customer to the DSO.

Critical success factors for the considered business model

The critical success factors for the business model considered for ER7 are evidenced in Table 71.

Table 71. Critical success factors for the business model considered for ER7

Critical success factor	Key metric	Data to be collected and sources
Cost to run and maintain	Hardware/software resourcesand personnel	Resources used in FUSE (data storage, interface) and average timeto maintain after the demonstrationin the demonstration site in Greece
In the case of commercial and industrial customers: availability of data on the evolution of electricity and CO_2 costs, reliabilityindices	Number of sales of battery systems, electricity and carbonprices	Average electricity cost

Documenting the revenue streams and cost structure

A possible alternative option has been identified: marketing the software module as a bundle with ER6 to provide a holistic forecasting and scheduling service.

The analysis also allowed to specify the variables which are likely to have the most significant impact on revenues and costs. Revenues will be contingent upon the number of customers and the number of sites, as well as customer maintenance, which is linked with persisting product

quality (stable and satisfactory forecast accuracy). As for costs, they will depend mainly on integration costs with the customer, the training and support required, maintenance costs, and customisation/upgrade costs.

4.9 ER 8: Virtual Thermal Energy Storage Module

Customer segment analysis

Seven potential customer segments have been identified for the virtual thermal energy storage (VTES) module: i) energy retailers, ii) aggregators, iii) ESCos / energy service performance contracts (ESPCs), iv) building management system (BMS) providers, v) residential customers, vi) energy communities, and vii) local authorities. Their analysis is presented in Table 72 to Table78 in the appendix. They can be prioritised according to the following criteria:

i) How well ER8 meets the purchasing criteria and satisfies the needs of each customer segment (i.e., how likely it is for the customer segment to purchase the product);
ii) The current size and expected growth of each segment in Europe;
iii) The size of the client portfolio of each segment (e.g, an aggregator may have 50 clients to whom they can sell the solution, while a retailer may have 1,000 customers).

Following these criteria, the prioritisation of customer segments would be the following: i) energy retailers, ii) ESCos / ESPCs, iii) energy communities, iv) BMS providers, v) aggregators, vi) local authorities, and vii) residential customers. The latter, although they are in size the largest segment, are more difficult to approach at an individual level, so targeting them through retailers, ESCos etc. seems to be a more reasonable approach. Therefore, the VTES module provider will follow primarily a B2B approach, whereby a smaller pool of customers (retailers, ESCos, BMS providers, etc.) are targeted in the first instance and can resell the products to their customers under a different commercial arrangement.
This knowledge about customer segments was used to refine the analysis of customer relationships in the corresponding building block of the business model canvas.

Customer journey analysis

An analysis of the customer journey has been performed for the different customer segments in order to refine the “Channels” and “Key activities” buildings blocks of the business model canvas. Its results are presented in Figure 65 to Figure 68.

The problems faced by customers vary depending on the considered segment:

- Energy retailers face difficulties in gaining market advantage over competition and wantto increase their client portfolio.
- Aggregators are willing to diversify their portfolio of flexible assets, increase liquidity (i.e., increase the number of contracted demand-response providers) at lower voltage levels to offer services to DSOs, and increase customer buy-in for participation in demand-response schemes.
- ESCos and ESPCs are seeking ways to increase the loyalty of current customers, but alsoto expand their client portfolios. They strive to offer customisable services to their clients.
- BMS providers are willing to expand their market share in commercial and residential buildings with solutions that do not require high implementation costs.
- Residential customers want to increase their energy efficiency and save on energy bills with solutions that are user-friendly, non-intrusive and do not compromise their

comfort and energy needs.

- Energy communities wish to increase participation in collective actions that can offer additional revenue streams to the community and its members. They may have a limitedunderstanding of revenue stacking opportunities within the energy flexibility landscape.
- Local authorities aim to increase energy efficiency and energy cost savings in public buildings.

All customer segments may learn about the software module through the provider's network of existing clients, through targeted commercialisation activities (including marketing campaigns), and through demonstration campaigns in specific pilot sites, where they may be involved. Residential customers and energy communities may also learn about it by word of mouth (through other customers that have previous, positive experience of the products/services), and, in the case of residential customers, from their energy retailers, ESCos, aggregators or their community if they are part of an energy community. Energy communities and local authorities may also learn about the solution through social media.

Customers can assess the module's value proposition before the actual purchase through different means:

- Participation in demonstration campaigns at pilot sites;
- Evidence from the validation activities and demonstration campaigns carried out in EU-funded projects;
- Potentially, the use of Net Promoter Score;
- Potentially, a free trial of the module for a limited amount of time.

For energy retailers, aggregators, ESCos and ESPCs and BMS providers, the purchase of the module can be made over-the-counter or through an online shop. In the case of residential customers, energy communities and local authorities, the products and services will be sold mainly through a network of energy retailers, ESCos / ESPCs, aggregators, etc. (B2B scenario); in a B2C scenario, products and services could also be sold directly to customers, mainly through an online shop.

The use of the module will vary depending on the customer segment:

- The products/services provided to energy retailers and BMS providers will be resold to interested end customers (mainly residential and commercial customers). In the case ofenergy retailers, they can be sold as standalone items or as parts of existing or new/innovative service offerings. For BMS providers, they can be sold, after appropriateintegration, as part of existing or new/innovative service offerings.
- Aggregators are expected to resell the products and services to their clients. An interfacing between the VTES module and existing aggregator tools may be required, inwhich case the service sold to the aggregator will include the development and testing of such interfaces.
- ESCos and ESPCs may resell the products and services to their clients as part of more holistic energy service offerings.
- For residential customers, the necessary kit will be installed at home or in the building. A Customer App (as part of a certain type of offering) will enable customers to use the smart box remotely, through their mobile phone (with a user-friendly interface).
- For energy communities, the necessary solution equipment will be distributed to members that are keen to use the relevant technology and service. Customers can realise energy efficiency improvements and energy cost savings, while the community

can also participate in demand-response schemes for additional revenue streams.

- In the case of local authorities, the solution will be deployed in the buildings that they own to improve energy efficiency and achieve energy cost savings.

After the purchase, depending on the commercial agreement between the module provider and energy retailers, aggregators, ESCos/ESPCs and BMS providers, interactions can involve ongoing technical and troubleshooting support, training of certified installers, continuous feedback loops for product and service improvements, personalisation and customisation of product/service offerings, etc. In the case of residential customers, energy communities and local authorities, in a B2B scenario (in which the customer purchases the module through a BMS provider, retailer, etc.), interaction only involves the customer and the product seller; in a B2C scenario, interactions between the module provider and customers can range from ongoing technical and troubleshooting support to continuous feedback loops for product and service improvements, etc.

Figure 65. Customer journey analysis for potential segment #1: Energy retailers, aggregators, ESCos / ESPCs, BMs providers

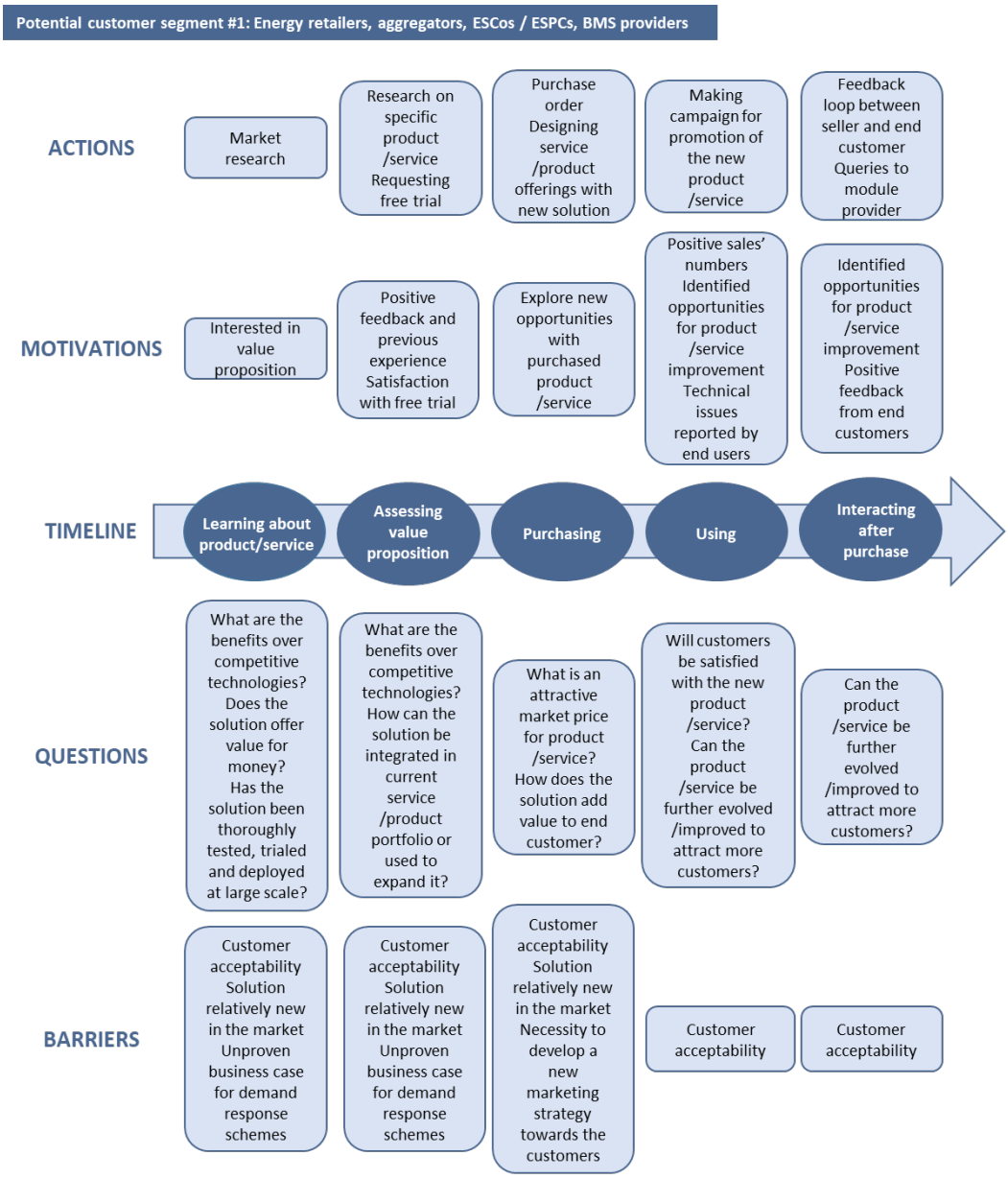


Figure 66. Customer journey analysis for potential segment #2: Residential customers

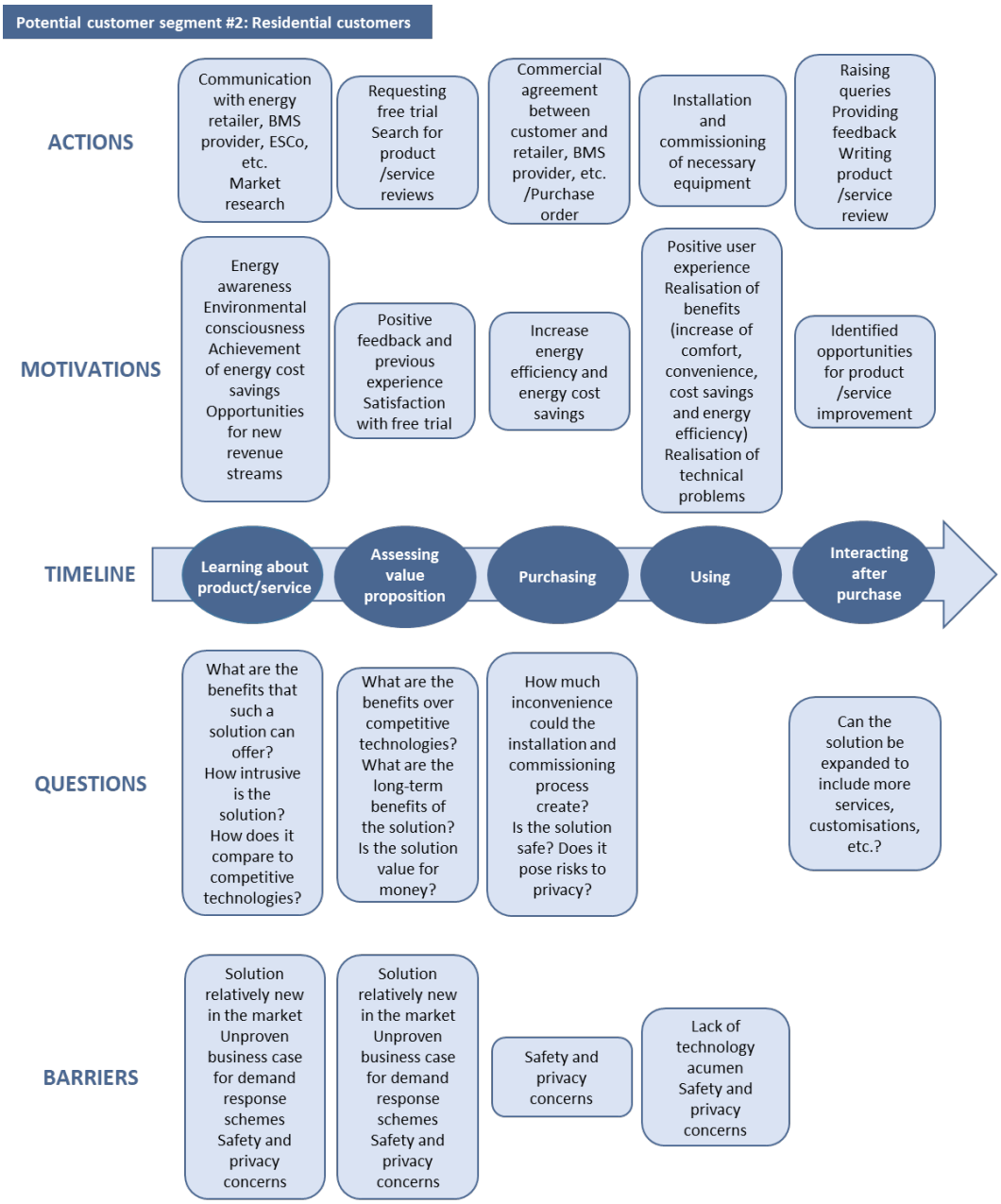


Figure 67. Customer journey analysis for potential segment #3: Energy communities

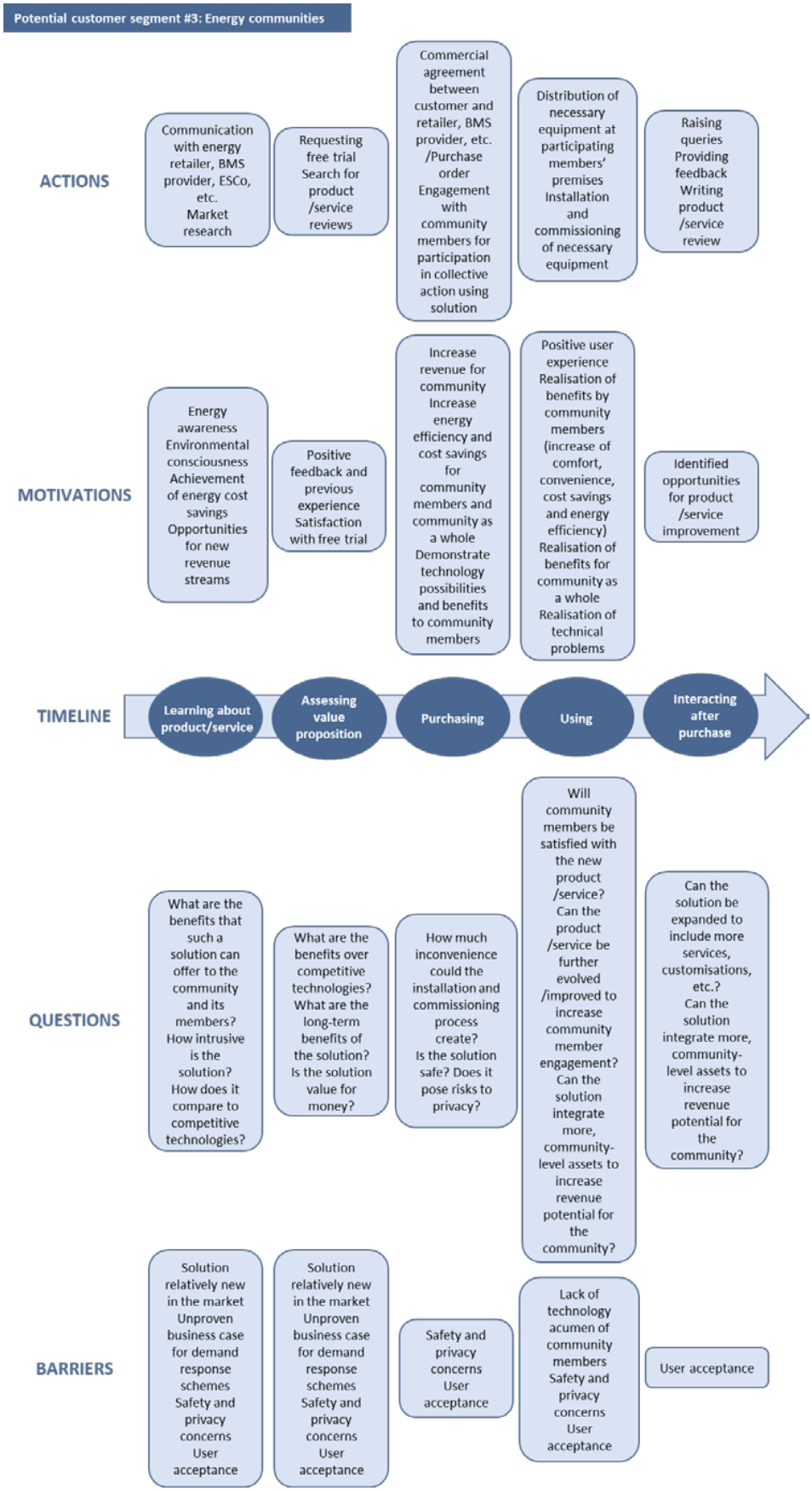
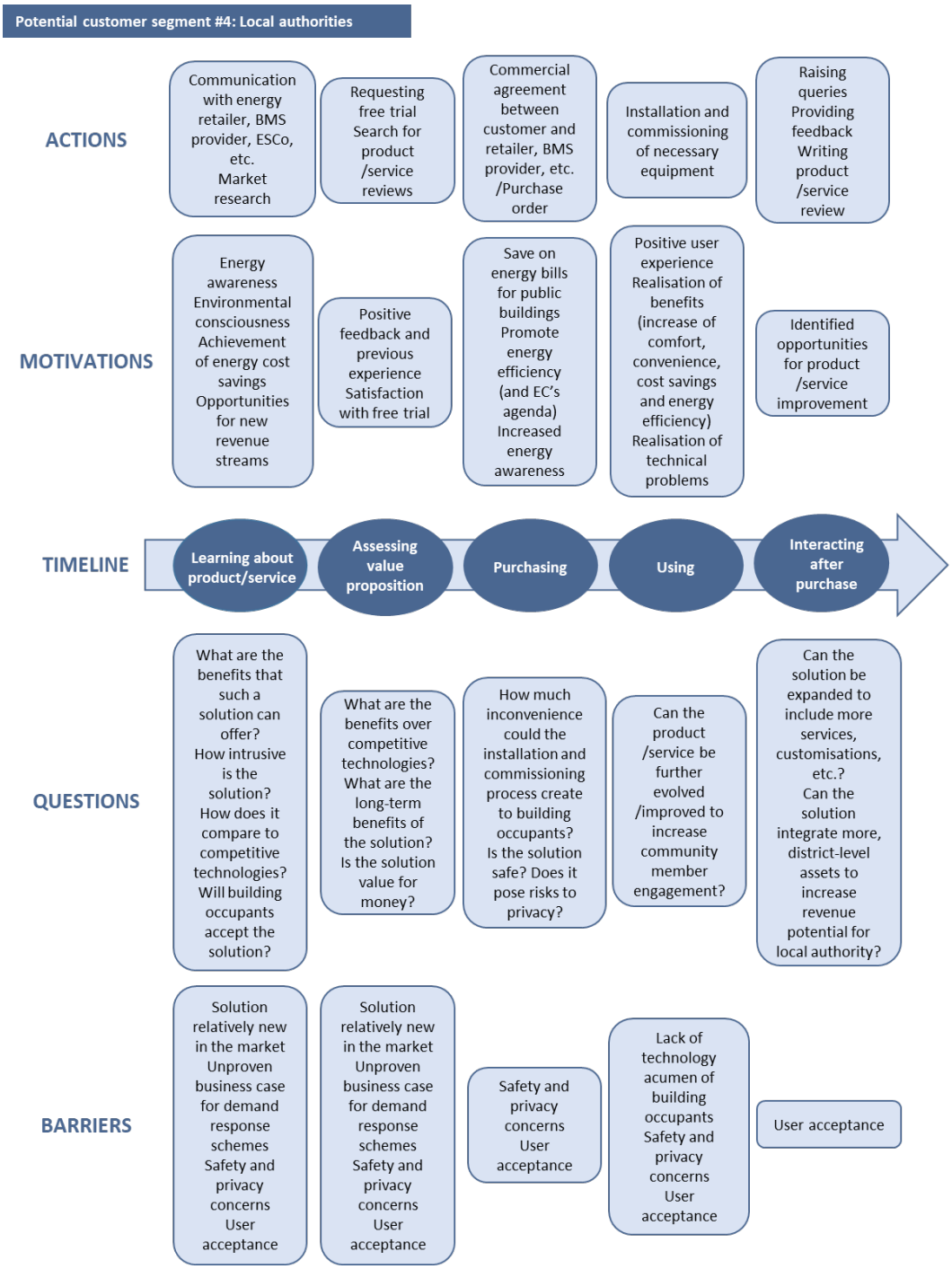


Figure 68. Analysis of customer journey for potential segment #4: Local authorities



This analysis of the customer journey evidenced key interactions between the VTES module provider and customer segments, which allowed to refine the contents of the "Channels" building block of the business model canvas.

Besides, in relation with this analysis, the VTES module provider's key activities, their output and the extent to which they are assessable, critical and timely have been specified (Table 79). As a result, the scope of the activities retained in the "Key activities" building block of the business model canvas has been refined.

Table 79. Analysis of key activities

Activity	Assessable?	Critical?	Timely?	Output of the activity
Marketing of solution	Medium	High	Medium	Marketing campaign
Training of installers/commissioners(B2B scenario)	Medium	High	High	Trained personnel
Installation/commissioning (B2C scenario)	Medium	High	High	Deployed and fully functional solution
Creation of necessary documentation to address issues and concerns ofusers	Medium	High	Medium	Privacy policy Installation guide Troubleshooting manual
Customer satisfaction measurement	High	Medium	Medium	Net Promoter Score Customer feedback and reviews
Website and online shop development	High	High	High	Website Online shop
Development of commercial product andservice offerings	High	High	High	Commercial product Fully developed serviceofferings
Consumer/end-customer interfaces development	High	High	High	App Web-based platform
Networking activities / customerengagement	Low	High	Medium	Increased number of clients
Technical support provision	Medium	High	High	Lower number of remaining troubleshooting tickets

Market and competition analysis

A market and competition analysis has been performed in order to refine ER8's value proposition (Table 80).

Table 80. Market and competition analysis for ER8 – VTES module – in Europe

Current competitors
Demand-side management providers like Enel X (formerly EnerCON) offer customised solutions to commercial, institutional and industrial businesses that want to participate in demand-side management programs, including energy efficiency and demand response, without affecting business operations, comfort or product quality. As for consumers' data aggregation, **WattDepot** is an open-source software system available in the market for collecting and storing data from electricity meters in a smart grid. Regarding demand-response simulation strategies, **Spara Hub®** is a diagnostics application that uses data to simulate demand control actions and provides them on an energy dashboard. The **Power Matcher** technology uses virtual power plants that collect and cluster numerous distributed generators, responsive loads and electricity storage systems in a single operational unit. Defining automated or price-based demand-response strategies and dispatching signals to consumer cluster is a function implemented in **Siemens DRMS**, which creates an automated, integrated and flexible demand-response dispatching system. In addition, **AutoGrid DROMS** is a tool that includes customer enrolment, program management, load-shed forecasting, portfolio optimisation, customer notification, automated signals and post-event reporting.

New entrants
Potential new entrants: most of the aforementioned competitors are relatively new in the market or their products/services are relatively new. Barriers to entry: Large market share of few dominant energy entities; Low user buy-in/acceptability; Unproven business case of demand-response schemes; Lack of regulatory frameworks for demand-response; Lack of incentives for participation in demand-response schemes

Substitutes

From the point of view of electricity network operators looking to resolve grid constraints using demand-response schemes which rely on the virtual energy storage of buildings and thermal loads, alternatives could be the following:
Network upgrades to resolve constraints. This alternative may not be the most cost-efficient option. It is also very time consuming.
Deployment of other flexible assets, such as distributed generation or storage (both stationary and mobile).

The latter is also an alternative for product users, such as aggregators, ESCos/ESPCs and energy communities.

Electricity customers can participate in demand-response schemes using other building-level flexible assets:
Storage assets (mobile and/or stationary) at building-level;
Smart appliances (white appliances for example that are smart-enabled).

From the point of view of energy retailers and BMS providers, commercially available smart home solutions could be an alternative.

It should be noted, however, that none of the abovementioned alternatives offer the same exact services as the VTES module.

Suppliers and other actors in the value chain
Commercialisation of the product: The VTES module will be mainly commercialised following a B2B approach (the B2C scenario is not discarded; it is however second in priority), whereby energy retailers, aggregators, BMS providers, ESCos/ESPCs are targeted in the first instance, as they serve a large pool of customers. **Product evaluation:** End users are key to the business model viability. They will be evaluating the solution and providing useful feedback and evidence to prove the business case for demand response in residential and commercial buildings.

Stakeholders
Energy regulators: The lack of appropriate demand-response regulatory frameworks is a barrier to the large-scale deployment of demand-response solutions. Regulatory authorities should be actively engaged and provided with evidence of the business cases developed for demand-response schemes in order for relevant frameworks to be pushed high in the implementation agenda. Regulatory authorities may also be able to provide certain incentivesto network operators for a higher uptake of demand-response schemes (as an alternative to costly and time-consuming network upgrades).

This analysis helped to refine the value proposition of the module, notably by specifying its competitive advantage. Commercially available demand-response solutions are mainly targeting larger customers, such as large producers and consumers, industrial and commercial entities, etc. These solutions are, to a large extent, non-customisable, standardised and generic to accommodate for most of users' requirements; however, they do not easily account for specificities and variations in customer systems and needs and they lack the intelligence and flexibility to cope with smaller energy consumers/prosumers (such as residential customers). The latter group of users require systems that are non-intrusive, easy to install (almost plug-and-play), with demand-response models and strategies that do not compromise the comfort of the users and offer them tangible benefits (e.g., economic gains from greater energy efficiency, participation in demand-response schemes, etc.). The adaptability of current systems to such requirements is very low and this represents a key advantage of the FLEXIGRID VTES solution (including the comfort-based flexibility profiling engine). As the project progresses and the VTES module will be deployed and trialled at the Croatian pilot sites, more of its competitive advantages will be realised. Therefore, this section can be further refined based on the outcomes of these trials.

Critical success factors for the considered business model

The critical success factors for the business model considered for ER8 are evidenced in Table 81.

Table 81. Critical success factors for the business model considered for ER8

Critical success factor	Key metric	Data to be collected and sources
Proven positive demand-response business case	Positive cost-benefit analysisfor main customer segmentsof the solution	KPIs from demonstration activities, end-user feedback
End-user buy-in	Increased customer acceptability for the solution	Net Promoter Score, product sales, market share / value

Documenting the revenue streams and cost structure

Two main options are being explored with regards to revenue streams: option 1 rests on software-as-a-service, while option 2 involves a combination of smart box purchases andlicenses for software products (Table 82).

Table 82. Options for ER8 revenue streams

Options	Advantages	Disadvantages
Option 1: Software-as-a-Service (SaaS)	This approach does not require any intermediary party for itsdeployment: the software component is centrally hosted andcan be deployed (e.g., over a web browser) easily within seconds (it does not require any specialised knowledge from the end user). Customers pay a subscription for the use of the software (e.g., on a monthly basis), therefore they do not need topay a high upfront cost, making this approach attractive to a wider set of customers. Opportunities exist for charging customers (especially in the case of retailers, ESCos, etc.) on a per- user basis (i.e., a subscription fee is paid for every client of the retailer, ESCo, etc.). This option provides the capability of developing a configuration /customisation self-service interface, which allows customers to personalise their application. Updates to the software are more easily implemented as it is centrally hosted and there is only one version that needs to be updated and maintained (i.e., the latest installed version on the centralserver/system).	As the software and hence customer data are hosted centrally, security and privacy become a top priority issue. Due to inherent latency of response (as the software is centrally hosted), the SaaS approach is not appropriatefor fast-response demand-responsescheme applications (which may require a response within a few milliseconds). Ongoing operating costs (for themaintenance, update and support required for the software) may behigher for the module provider.
Option 2: Smart box purchases andlicenses for software products	Security measures are onlyimplemented at the componentdevelopment stage, using far less resources (both financial and human). The local deployment nature of this approach makes it suitable for demand-response schemes that require a fast response (within milliseconds). Lower operating costs for the moduleprovider	For B2B scenarios, where the customer (usually an aggregator, retailer, etc.) buys the product to deploy it in its portfolio, this option may have a significant overhead in terms of CAPEX and OPEX. In these cases, option 1 should probably be preferred. Updates and maintenance of software versions become a time- consuming and cumbersome task, as there may be many versions of the product available on customer systems.

The analysis also allowed to specify the variables that are likely to have the most significant impact on revenues and costs. Revenues will be contingent upon:

- The solution acceptability by customer segments and customer buy-in;
- The strength of demand-response schemes' business case;
- The development (where not already existent) of the regulatory framework for the provision of demand-response services to interested parties;
- The market size and the share of customers interested in the solution.

As for costs, they will depend mainly on user requirements for the solution (especially in cases where a personalisation/customisation of the solution is requested).

4.10 ER 9: FUSE platform

Upon internal discussion, the lead partner for ER9, ATOS, considers that it does not make sense to present an adaptor as an ER, since it is quite specific and cannot be exploited on its own and sold as a separate item. The business model development process will therefore focus on the FUSE platform.

Customer segment analysis

Two potential customer segments have been identified for the FUSE platform: i) energy utilities and ii) energy communities, building managers and aggregators. These segments are notably differentiated by the expected complexity in convincing them to opt for this new solution: energy utilities are characterised by high complexity, as they may already have deployed similar systems, while energy communities, building managers and aggregators would only be medium-complexity. Special efforts are on-going to provide solutions based on the FUSE platform and services to the growing number of energy communities and associations focused on interoperability. The analysis of the two potential customer segments is presented in Table 83 and Table 84 in the appendix.

Customer journey analysis

An analysis of the customer journey has been performed for the different customer segments in order to refine the “Channels” and “Key activities” buildings blocks of the business model canvas. Its results are presented in Figure 69 and Figure 70.

The problems faced by customers vary depending on the considered segment:

- For energy utilities, the specific service provided by the FUSE platform is not available in their current deployed solutions.
- Energy communities and aggregators lack a digital tool to gather and valorise data.

Both customer segments can learn about the FUSE platform through dissemination activities conducted within the framework of the FLEXIGRID project. They can assess its value proposition before the actual purchase by accessing the results of real-life demonstrations carried out in environments such as the ones posed by FLEXIGRID use cases. The purchase itself then takes the form of licensing through the channels established by the solution provider. The platform is used by self-operation with technical assistance from the solution provider, after successful integration into the customers’ systems. Interactions with the solution provider after the purchase take place through an open channel to act upon potential issues and provide support.

Figure 69. Customer journey analysis for potential segment #1: Energy utilities

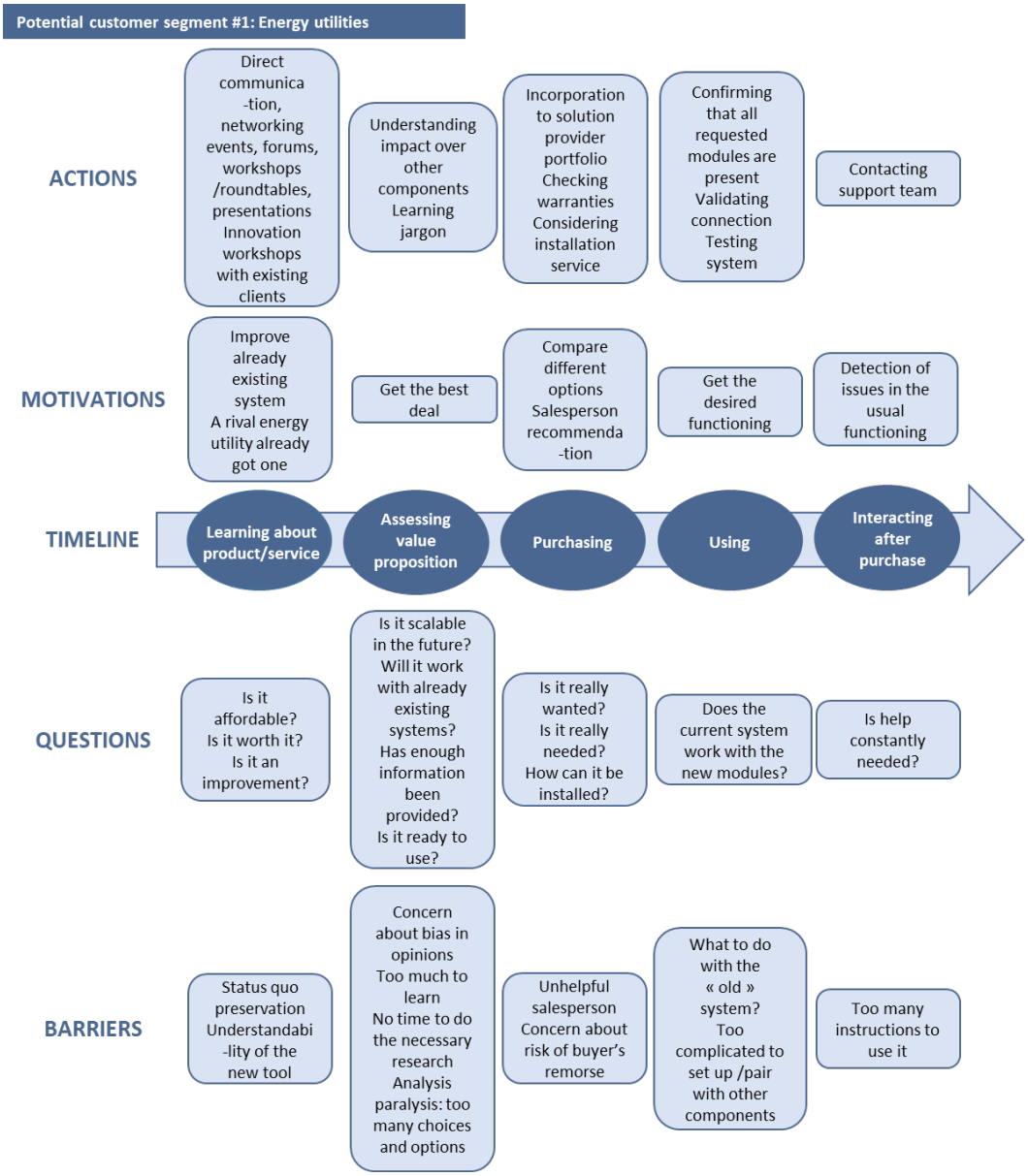
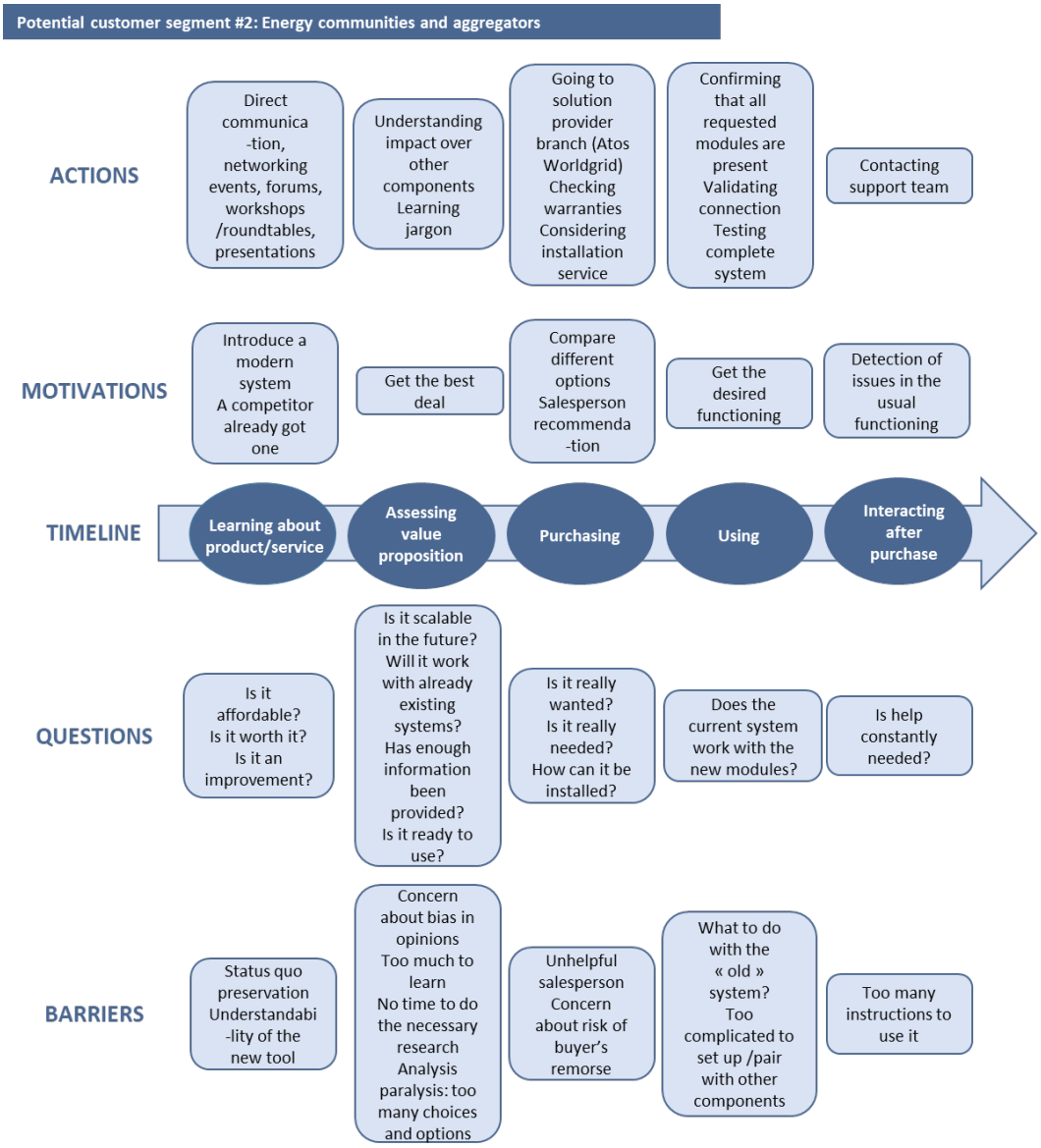


Figure 70. Customer journey analysis for potential segment #2: Energy communities and aggregators



In relation with the customer journey analysis, the FUSE platform provider's key activities, theiroutput and the extent to which they are assessable, critical and timely have been specified (Table 85).

Table 85. Analysis of key activities

Activity	Assessable?	Critical?	Timely?	Output of the activity
Digitalisation of energyassets	High	Medium	Medium	Digital version of every asset
Data processing	Medium	High	High	Data adapted to a Common Information Model
Monitoring	High	Medium	Medium	Keeping continuous track of data flow
Data analytics	High	Medium	Medium	Extracting valuable insight that drives decision-making
Forecasting	Medium	Medium	Medium	Ability to prevent the occurrenceof problems
Harmonisation	Low	Medium	Low	Sharing a common methodology

Market and competition analysis

A market and competition analysis has been performed in order to refine ER9's value proposition (Table 86).

Table 86. Market and competition analysis for the FUSE platform in the EU

Current competitors
EcoStruxure ADMS (Schneider Electric) **C3.ai** **IBM Solution Architecture for Energy and Utilities Framework**

New entrants
Sogno – GridHound DMS on a research grade (state estimation, fault location isolation and restoration, generation and load prediction, power quality evaluation)

Substitutes
Dynamic Demand 2.0: open-source IoT data-driven platform from Open Energi, which is already market-ready (frequency regulation, energy trading, capacity services, peak price management, constraint management, energy efficiency, energy scheduling). **Monet** (Siemens): IoT data-driven platform, energy management system, offered under a proprietary license and ready for validation (EV manager, assets manager, distributed generation forecast, demand-response functionalities).

Suppliers and other actors in the value chain
The focus for scalability is oriented towards new market applications where the involvement of a great number of small players could originate huge volumes of transactions. FLEXIGRID's solution will establish and scale up new value chains in Europe involving utilities, service providers and charging infrastructure providers.

Stakeholders
ESCos/electricity suppliers/utilities: they may undertake the administration of the networks of energy generation stations, as well as RES micro-generation; Local and regional authorities (and their associated organisations/companies): they will provide the necessary approvals, space for the stations' installations, and may well procure the installation and operation of client/server networks; Smart grid stakeholders (ESCos/electricity suppliers): for the provision of relevant energy services (demand response, ancillary services, etc.) through public-private partnerships/multi-annual contracts.

Critical success factors for the considered business model

The critical success factors for the business model considered for ER9 are evidenced in Table 87.

Table 87. Critical success factors for the business model considered for ER9

Critical success factor	Key metric	Data to be collected and sources
Recognition of real value servedby the solution	Acceptance surveys	User feedback about usability and results
Income streams	Licensing fees	
Proven scalability	Number of new modulesintegrated Replication in different countries and/or use cases	

Documenting the revenue streams and cost structure

In order to map potential revenue streams, a matrix has been proposed, facing frequency (of interactions with the key customer) vs. ownership (of these interactions) (Table 88).

Table 88. Frequency vs. ownership matrix of revenue streams

FREQUENCY		
High	Recurring indirect revenue model (via recurring contractor)	Recurring direct revenue model
	Indirect Specific offerings: ad hoc services, adaptations, tenders, etc.	Direct Commercialised as a product license and its maintenance
Low	No	Yes
	OWNERSHIP	

Besides, a possible alternative option has been identified: that of indirect benefit, with an aggregator-to-system operator. In this model, the FUSE platform would be provided to aggregators, which would then leverage their network of contacts to offer it to system operators (for congestion management on the distribution network through coordinated load shifting/peak shaving and reactive power support/voltage control).

The analysis also allowed to specify the variables that are likely to have the most significant impact on revenues and costs. Revenues will be contingent upon the appearance of tenders where the solution fits, the recurring contractor's willingness to keep on hiring the solution, and the number of modules that raise interest in potential and already existing customers. As for costs, they will depend mainly on the detection of functioning issues that require to devote effort to solve them, and the development of specific middleware and/or adaptors to integrate the solution with some tools owned by customers.

4.11 ER 10: Software module for sizing and siting of the battery storage system

This ER will consist in a software or web service relying on novel algorithms which allow to model electricity networks and their constraints, and then to optimize the sizing (capacity and power) and placement (installation node within the network) of Battery Energy Storage Systems (BESSs). It takes into account the trade-offs between their potential impact on the electricity system and the costs associated with their deployment, with a view to maximize the technical and economic benefits of such investments.

Many actors in the energy system, notably DSOs and aggregators/ESCos, are resorting to batteries to fulfil several functions (e.g., quality correction), which makes them a promising product for flexibility provision. However, their use is costly. The software module for sizing and siting of the battery storage system provides these actors with a tool to optimise investment as well as technical KPIs.

Customer segment analysis

The software module for sizing and siting of the battery storage system is intended to be exposed as an open-source tool on a public repository: GitHub (GitHub.com, n.d.). Therefore, in its case, "customer segments" should be understood as potential target users. This open-source status will enable research entities to provide feedback on the first versions of the software.

In line with its above-mentioned functionalities, the software module could interest DSOs looking for alternative solutions to grid upgrade or reinforcement. Aggregators and ESCos offering services to grid operators (e.g., power quality, voltage and frequency stability) could also leverage it to help ensure revenue streams by a wise investment. Other potential users include ancillary services providers and energy communities.

Regarding the geographical scope to be retained for exploitation, the software is potentially applicable worldwide, as it is intended to be published on a public repository as an open-source tool.

Customer journey analysis

An analysis of the customer journey has been performed for the different customer segments and allowed to refine the "Channels" and "Key activities" buildings blocks of the business model canvas. Its results are presented in Table 89.

Table 89. Customer journey analysis for potential customer segments

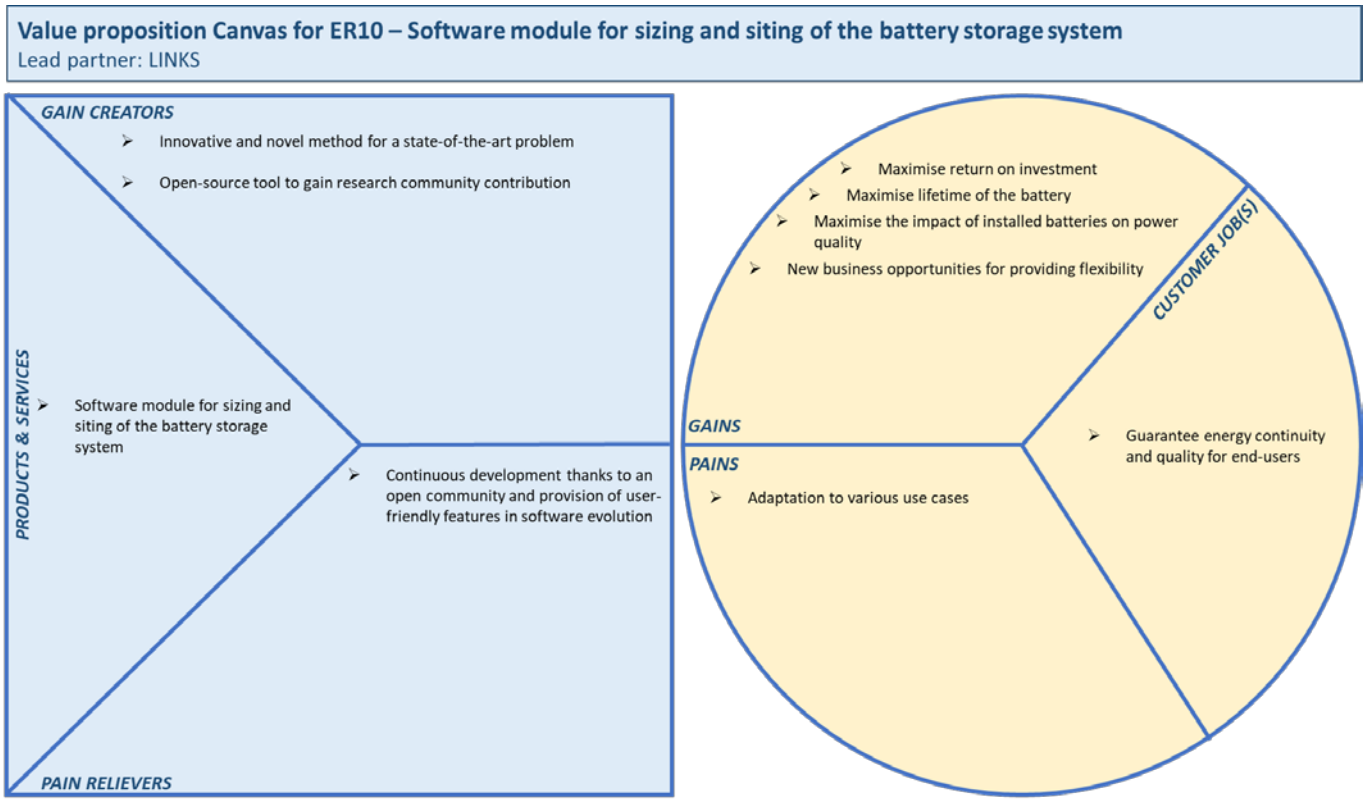
Problem faced by the customer	**DSOs:** The changing centralised energy generation paradigm to a distributed and active distribution system with a high penetration of RES and EVs requires an upgrade of the distribution system, with considerable costs. **Aggregators/ESCos and energy communities:** These users might optimise investments with wise decisions. **Research entities:** A wide range of use cases for hosting more RES in the electricity system can be considered.
How the customer can **learn** about the product or service	Potential users can learn about the software through dissemination activities and presentations in project events.
How the customer can **assess** the productor service's value proposition before the actual purchase	The software can be accessed and used freely.
How the customer can **purchase** theproduct or service	Users will get the software from a public repository: no transactionis required.
How the customer can **use** the product or service	The software will be standalone and necessary usage instructions will be released on the public repository.
How the customer **interacts** with theprovider after the purchase	Interactions can be done by email to the author of the software, orby creating a new issue on GitHub.

In relation with this customer journey analysis, the software module provider's key activities, their output and the extent to which they are assessable, critical and timely have been specified (Table 90).

Table 90. Analysis of key activities

Activity	Assessable?	Critical?	Timely?	Output of the activity
Development	Medium	Low	Medium	Deployable softwaremodule

Value Proposition Canvas



The value proposition of this software rests on its optimisation features, which allow to maximise the investment's benefits and expected impact and/or to minimise investment costs. The algorithms cover major objective functions and, from a practical point of view, require a lower time to calculate. The software can therefore enable grid operators to avoid network reinforcement and expansion expenses and service providers to maximise their expected income.

Documenting the revenue streams and cost structure

No revenue stream is expected, as the software will be released as an open-source tool.

The cost structure would essentially involve operating expenses associated with the development team, i.e., human resources.

4.12 ER 11: Protection algorithm development to improve current protections used in distribution grids with high RES penetration

ER 11 consists in a new system for protection of the MV grid, composed by software algorithms improving current protection relay behaviour in distribution grids.

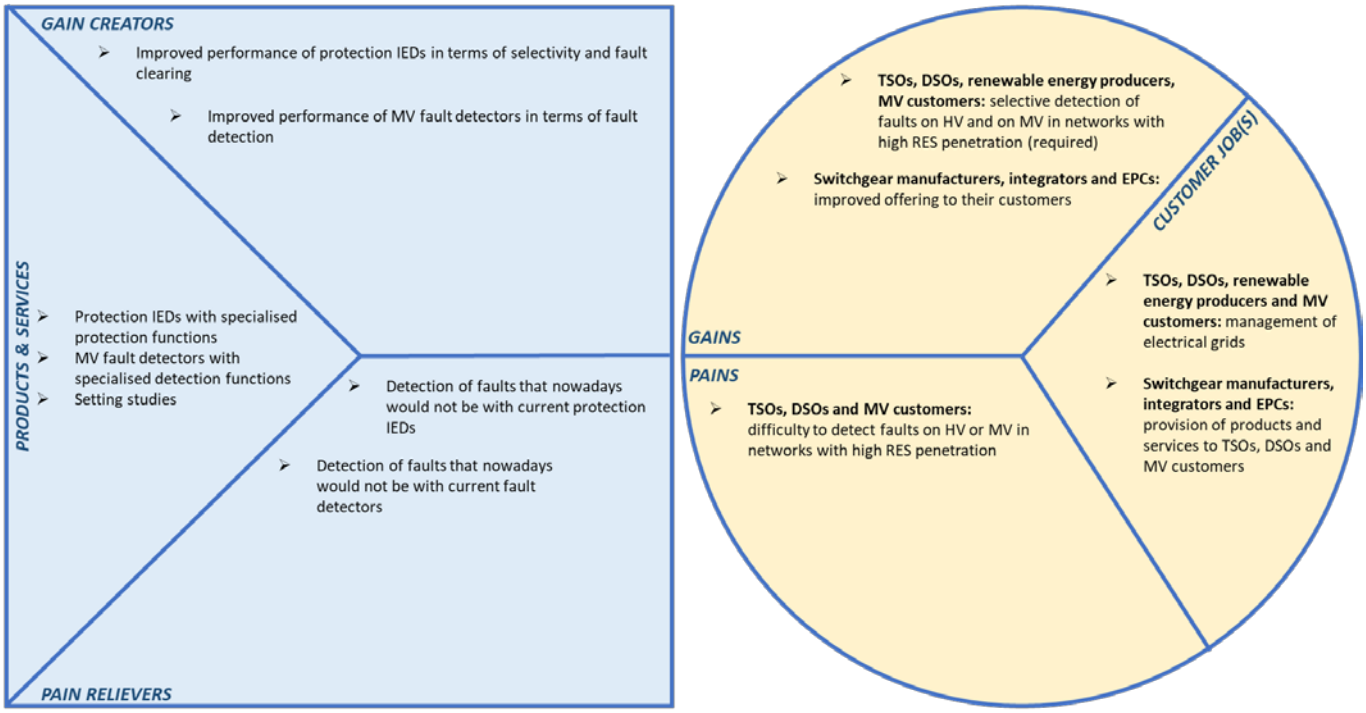
Customer segment analysis

Customer segments for ER11 would include TSOs and DSOs, as well as owners of renewable energy-based generators and MV customers (especially industrial customers) owning their own grid or microgrid infrastructure. Besides, this ER could also be sold through switchgear manufacturers (i.e., manufacturers of HV and MV breakers, load break switches and reclosers) and integrators and EPCs (i.e., integrators of sub-systems and project providers). Relay manufacturers would be another customer segment.

In terms of geographical markets, target markets would include Spain, Greece, France, Switzerland, Austria and Slovenia, Italy, the UK, Germany, Denmark, the Netherlands, Switzerland, Sweden, Luxembourg and other European countries.

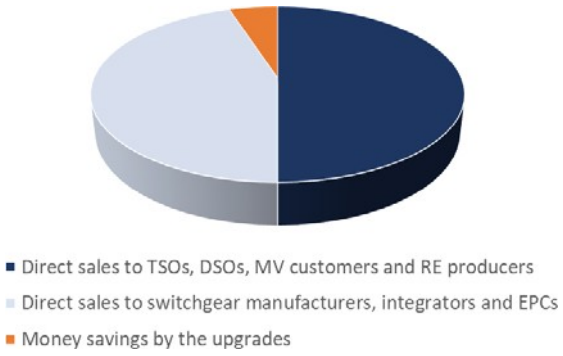
Value Proposition Canvas[5]

Value proposition Canvas for ER11 – Protection algorithm development to improve current protections used in distribution grids with high RES penetration
Lead partner: CIRCE



Documenting the revenue streams and cost structure

Figure 71. ER 11 – Protection algorithm development to improve current protections used in distribution grids withhigh RES penetration – Revenue streams



Revenue streams from ER11 would include both products and services (Figure 71). The software algorithm would be sold directly to the different customer segments.[6] Besides, revenue streams more akin to services would include a monthly fee based on the money savings permitted by the upgrades.

Figure 72. ER 11 – Protection algorithm development to improve current protections used in distribution grids with high RES penetration – Cost structure: OPEX

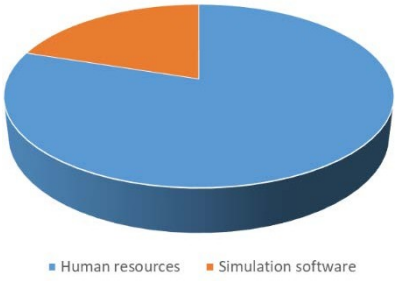
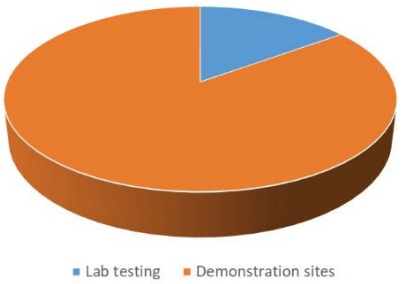


Figure 73. ER 11 – Protection algorithm development to improve current protections used in distributiongrids with high RES penetration – Cost structure: CAPEX



The costs related to ER11 would include both OPEX (Figure 72) and CAPEX (Figure 73). Along with human resources, OPEX would be associated with the simulation software used for validation. CAPEX would consist in lab testing, as well as in demonstration sites that could be arranged after the FLEXIGRID project implementation.

4.13 ER 12: Software module for flexibility assets emergency operation

ER 12 will consist in machine learning algorithms for a one-minute forecast combined with a discriminator of the status of the network (with or without network issues like over/under voltage problems or overloaded lines). This will allow to send specifics setpoints to avoid the issues previously anticipated through a flexibility assets operation algorithm (also developed by CIRCE).

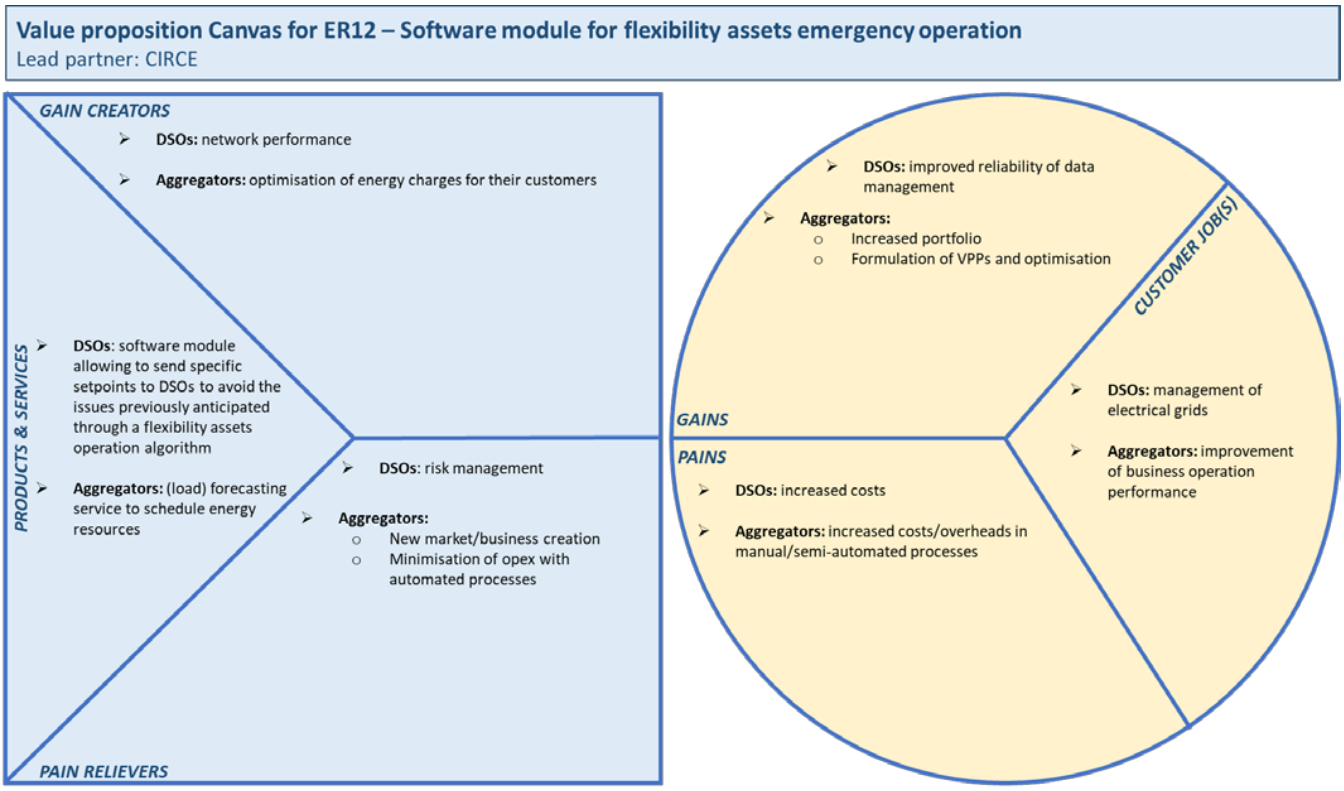
Customer segment analysis

DSOs may be interested in the software module for flexibility assets emergency operation. Aggregators may also use it to expand their activities on the consumption and production sides.

Other potential beneficiaries would include renewable energy producers, technology providers and associations, as the ER will allow large RES penetration in the grid and may therefore open market opportunities for them in case of a wide application. Besides, TSOs, energy retailers, ESCos, industrial, commercial and residential customers and actors of the refurbishment industry (including PV installation companies) may benefit from improvements of their quality of service thanks to the ER.

In terms of geographical markets, specific European markets – namely France, Switzerland, Austria and Slovenia, Northern Italy, the UK, Germany, Greece and Spain – would be the main targets.

Value Proposition Canvas



Documenting the revenue streams and cost structure

Figure 74. ER 12 – Software module for flexibility assets emergency operation – Revenue streams

Revenue streams from ER12 will consist in direct sales or licencing to DSOs. Besides, for aggregators, the software module will allow an optimised participation in energy markets and help them to reach energy communities and other potential customers.

Figure 75. ER 12 – Software module for flexibility assets emergency operation – Cost structure

The costs related to the software module will include human resources (for software module and interfaces operation, billing and invoicing, training and customer support), testing, simulations and software licencing, as well as sales and marketing costs.

4.14 ER 13: Fault location TDR prototype

The fault location prototype will estimate a distance between the fault point and the place where the locator is installed, using a special approach of time domain reflectometry technique. This prototype and the location algorithm (ER 5) will be upgraded in order to fix previously detected problems regarding range and accuracy.

Customer segment analysis

DSOs are likely to be interested by the fault location TDR prototype, as it will provide them with the range between the locator and the fault. Other customer segments would include TSOs, renewable energy producers (as well as related technology providers and associations), aggregators, other energy actors (electricity retailers, utilities) and MV customers (especially industrial customers) owning grid or microgrid infrastructure. Customers of the software module for fault location and self-healing (ER5) may also be interested in this ER, as both ERs are complementary, even though they can operate separately. They may be sold together.

In terms of geographical markets, target markets would be mostly European in the case of TSOs, DSOs and aggregators. They would especially include France, Spain, Switzerland, Austria, Slovenia, Italy, Germany and the UK. As for other customer segments, international markets could also be targeted.

Value Proposition Canvas

Documenting the revenue streams and cost structure

Value proposition Canvas for ER13 – Fault location TDR prototype
Lead partner: CIRCE

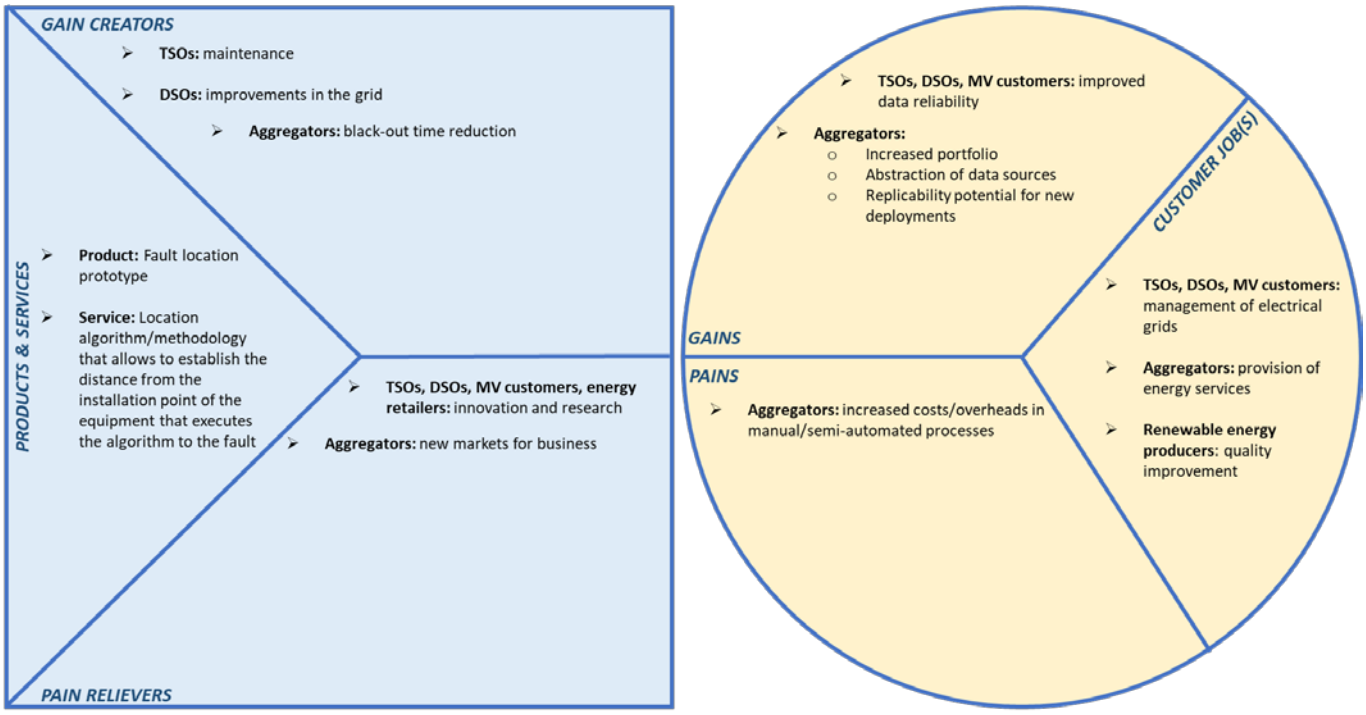


Figure 76. ER 13 – Fault location TDR prototype – Revenue streams

Revenue streams from ER13 would include both products and services. Direct sales would be proposed to TSOs, DSOs, MV customers, aggregators and software module for fault location (ER5) customers. Besides, technology services such as the estimation of the distance between the fault point and the locator of the algorithm could be provided to other energy actors (electricity retailers and utilities) and to renewable energy producers.

Figure 77. ER 13 – Fault location TDR prototype – Cost structure

The costs related to the fault location TDR prototype will include human resources, testing and in-site demonstrations, as well as sales and marketing costs.

5 BUSINESS MODELS OF FLEXIGRID USE CASES

During the third year, an analysis was conducted within the framework of working groups gathering all the partners involved in the development of each ER, coordinated by one or several lead partner(s). BM for Use Cases were built on the same basis and methodology than the BM for each ER (D8.3 Section 5). The exploratory Use Case business models designed were proposed by lead partners thanks to CAP's templates.

Thus; the following BMs were created in part thanks to the methodology previously created and through the combination of the ER which were previously analysed. Partners were asked to identify which ERs corresponded to the different UCs. The following table resulted from this thought process. The UCs were then constructed to combine findings and then the analysis were refined to correspond to the expected business models.

Table 91. Correspondence between exploitable results and use cases

Exploitable Results \ Use Cases		UC 1	UC 2	UC 3	UC 4	UC 5	UC 6	UC 7	UC 8
		Secondary Substation upgrading for higher grid automation and control	Protections functions operating with large RES share penetration in the distribution grid	Holistic energy system optimization and emulation for commercial and residential customers;	Microgrid congestion management and peak shaving	Coordinating distribution network flexibility assets and protections schemes coordination in urban districts	Virtual Energy Storage for urban buildings	Dispatching platform for MV generation	Isolated valley grid operating in islanding mode
1a	Secondary Substation of the future	x							
2	Smart meters with feeder-mapping capabilities	x							
3	Protections for high RES penetration	x	x						
4	Energy Box	x		x	x				
5	Software module for fault location and self-healing	x				x			
6	Software module for forecasting and grid operation			x	x	x		x	
7	Software module for congestion management			x	x			x	
8	Virtual thermal energy storage module						x		
9	FUSE platform	x	x	x	x	x	x	x	x
1b	Secondary Substation of the future specially designed for remote isolated areas							x	x
10	Sizing and siting of the battery storage system								
11	Protection algorithm to improve protections in distribution grids with high RES penetration		x						

12	Software module for flexibility assets emergency operation								x
13	Fault location TDR prototype	x							

5.1 Use Case 1 Secondary substation of the future upgrading for higher grid automation and control

Use Case #1: Secondary substation of the future upgrading for higher grid automation and control	
Lead partner	*Ormazabal*
Working group members	*CIRCE-EDYNA-IOSA-SELTA-UNICAN-VERD-VIESGO*

Customer segments analysis

Three potential customer segments have been identified for the holistic energy system optimization and emulation for commercial and residential customers: i) DSOs, ii) electrical energy end users, and iii) renewable energy manufacturers. Their analysis is presented in Table 92 to Table 94 in the appendix.

Customer journey analysis

An analysis of the customer journey has been performed for the different customer segments (Table 95 to 97 in the appendix). Its results are presented in Table 98 to Table 100.

Table 98. Customer journey analysis for potential customer segment #1: DSOs

Potential customer segment #1: DSOs					
ACTIONS	Training		Integrated in DSO systems. Testing at the installation	Integrated in DSO systems	*Commercial & Support department*
MOTIVATIONS	New developments & functionality	*Based on the needs show on the grid*			
TIMELINE	**Learning about product/service**	**Assessing value proposition**	**Purchasing**	**Using**	**Interacting after purchase**
QUESTIONS	*Integration in systems*				

BARRIERS					

Table 99. Customer journey analysis for potential customer segment #2: Electrical energy end users

Potential customer segment #2: Electrical energy end users					
ACTIONS	*Usage instruction define for E3U. Specific way of working, simplify by experience with the E3U customer*		Testing at the installation	Fully automated & can be used manually	*Commercial & Support department*
MOTIVATIONS		*Based on the needs show on the grid*			
TIMELINE	**Learning about product/service**	**Assessing value proposition**	**Purchasing**	**Using**	**Interacting after purchase**
QUESTIONS	*Difficulties to manage the new functionality*				
BARRIERS					

Table 100. Customer journey analysis for potential customer segment #3: Renewable energy manufacturers

Potential customer segment #3: Renewable energy manufacturers					
ACTIONS	*Working in the definition process just to prepared final client for the process*		*Training course will be held with the final client*	*Will be set for automatic operation. But it can be use manually. Show on the training course*	*Commercial & Support department*

MOTIVATIONS		*Based on the needs show on the grid*			
TIMELINE	**Learning about product/service**	**Assessing value proposition**	**Purchasing**	**Using**	**Interacting after purchase**
QUESTIONS	Difficulties to do some training to the final clients with the new products				
BARRIERS					

Key interactions evidenced by the map to refine the analysis of CHANNELS

Table 101. Analysis of key activities

Activity	Assessable?	Critical?	Timely?	Output of the activity
R+D	*Medium*	*Medium*	*High*	New functionality
Industrial manufacturing	*Medium*	*Medium*	*High*	New products
Sales Deparment	Low	Low	Medium	Access to the market

Market and competition analysis to specify the VALUE PROPOSITION

MARKET AND COMPETITION ANALYSIS FOR ER #[1a] – [Secondary substation of the future] IN National & European marketS

Current competitors
Identification of key competitors and analysis of their positioning (products and/or services offered, value proposition, targeted customer segments…)
Electrical equipment manufacturers

New entrants
Identification of (potential) new entrants and analysis of their positioning (products and/or services offered, value proposition, targeted customer segments…) *Identification of barriers to entry*
Not expected new entrants National´s Technical regulations in every market.

Substitutes
Identification of products and/or services that could act as substitutes *Analysis of their value proposition, their advantages and drawbacks (notably in terms of performance and price) and of the factors that may motivate (or dissuade) customers to resort to them*

None

Suppliers and other actors in the value chain
Identification of key suppliers and other actors in the value chain and of their importance for the business model
None

Stakeholders
Identification of other actors that may have an impact on the activity or the competitive environment (e.g., public authorities)
Public authorities: national regulations.

Critical success factors for the considered business model(s)

Table 102. Critical success factors for UC 3

Critical success factor	Key metric	Data to be collected and sources
National regulations	-	Regulation documents
Clients training	-	-
Automated control of the functionality	-	Manuals and instructions

5.2 Use Case 2 Protections functions operating with large RES share penetration in the distribution grid

Due to the differences between the Business Models (BMs) of ER3, ER9 and ER11, ZIV found it difficult to create a common Business Model for the three exploitation results. Therefore, the partner decide to include in the BM of UC2 includes the three entire BMs

Use Case #2: Protections functions operating with large RES share penetration in the distribution grid	
Lead partner	*ZIV*
Working group members	

Exploitable Result #[10]: [software for Sizing and Siting of the Battery Storage System]	
Lead partner	*ZIV*
Working group members	

Customer segments analysis

Six potential customer segments have been identified ER 10: i) DSO/ESCO, ii) TSOs iii) MV customers, iv) generator owners, v) switchgear manufacturers and vi) integrators and ECPs. Their analysis is presented in Table 103 to Table 108 in the appendix.

The market will be driven by the utilities (DSOs & TSOs), so they will be the highest priority of the potential customers segments. The rest of segments will have to comply with the new network codes and the utilities' requirements.

Knowledge about customer segments to refine the analysis of *CUSTOMER RELATIONSHIPS*

Setup, maintenance, and technical support.
Customer loyalty based on confidence and continuous improvement of the solution.

Customer journey analysis

An analysis of the customer journey has been performed for the different customer segments (Table 109 to 114 in the appendix). Its results are presented in Table 115 to Table 116.

Table 115. Customer journey analysis for potential customer segment #1: DSO / TSO / Generator owners / MV customers

Potential customer segment #1: DSO / TSO / Generator owners / MV customers					
ACTIONS	Reading technical documentation about the new algorithms in protective relays. Attending seminars and trainings given by ZIV	Evaluating a sample in the laboratory or installing it in a real substation (pilot project)	Evaluation of technical and commercial quotations	Installation in real projects	Organizing training, technical seminars, meetings, etc
MOTIVATIONS	Conventional relays do not behave correctly in networks with high RES penetration	Laboratory and pilot installation are the best option for approving a new protection relay	Solve false operations of conventional relays and getting experience with new relays	Solve false operations of conventional relays and getting experience with new relays	Solving questions, increasing the knowledge about the new products, etc
TIMELINE	**Learning about product/service**	**Assessing value proposition**	**Purchasing**	**Using**	**Interacting after purchase**
QUESTIONS	Questions about: The behavior of new algorithms in conventional installations Behavior of RES	Questions about new settings and about the operation principle of new algorithms	Questions about commercial conditions, technical information provided in the quotations, etc	Questions about new settings and about the operation principle of new algorithms. Questions about real operations	Questions about new settings and about the operation principle of new algorithms. Questions about real operations

BARRIERS	Lack of experience in the field of new algorithms	Lack of time for the assessment process Lack of knowledge of the new product Wrong operations during the approval process	High prices, technical deviations, etc	Wrong operations, quality problems, not being used to the relay tool, unreliable support, etc	Lack of time for training

Table 116. Customer journey analysis for potential customer segment #2: [Switchgear manufacturers / EPCs]

Potential customer segment #2: Switchgear manufacturers / EPCs					
ACTIONS	Reading technical documentation about the new algorithms in protective relays. Attending seminars and trainings given by ZIV	Reviewing the requirements of DSOs and TSOs with regard to relays that behave correctly in networks with high RES	Evaluation of technical and commercial quotations	Installation in real projects	Organizing training, technical seminars, meetings, etc
MOTIVATIONS	Conventional relays do not behave correctly in networks with high RES penetration	Specifying protective relays that behave correctly in networks with high RES according to DSOs / TSOs requirements	Solve false operations of conventional relays and getting experience with new relays	Solve false operations of conventional relays and getting experience with new relays	Solving questions, increasing the knowledge about the new products, etc
TIMELINE	**Learning about product/service**	**Assessing value proposition**	**Purchasing**	**Using**	**Interacting after purchase**

QUESTIONS	Questions about: The behavior of new algorithms in conventional installations Behavior of RES	Questions about new settings and about the operation principle of new algorithms	Questions about commercial conditions, technical information provided in the quotations, etc	Questions about new settings and about the operation principle of new algorithms. Questions about real operations	Questions about new settings and about the operation principle of new algorithms. Questions about real operations
BARRIERS	Lack of experience with the new relays	Lack of time to review new requirements of DSOs / TSOs	High prices, technical deviations, etc	Wrong operations, quality problems, not being used to the relay tool, unreliable support, etc	Lack of time for training

Key interactions evidenced by the map to refine the analysis of CHANNELS

Direct relationship with DSOs, TSOs and MV customers
Sales through integrators and EPC
Sales through Switchgear manufacturers

Promotion by means of seminars and conferences

Table 117. Analysis of key activities

Activity	Assessable?	Critical?	Timely?	Output of the activity
Development	*Medium*	*Low*	*Medium*	Deployable software module

Key activities evidenced by the map to refine the analysis of CHANNELS

Application and design engineering
Simulation of networks with high RES
Testing

Field installation

Market and competition analysis to specify the VALUE PROPOSITION

MARKET AND COMPETITION ANALYSIS FOR [Use Case 2]

Current competitors
Identification of key competitors and analysis of their positioning (products and/or services offered, value proposition, targeted customer segments…)
SIEMENS: distance protection including some algorithms for better operation (improved phase selector) ABB: conventional distance protection SEL: conventional distance protection

GE: distance protection including some algorithms for better operation (improved phase selector) INGETEAM: conventional distance protection TOSHIBA: conventional distance protection

New entrants
Identification of (potential) new entrants and analysis of their positioning (products and/or services offered, value proposition, targeted customer segments…) *Identification of barriers to entry*
Relay manufacturers selling in other countries / segments try to expand their business Barriers: unknown of their products, local support, etc

Substitutes
Identification of products and/or services that could act as substitutes *Analysis of their value proposition, their advantages and drawbacks (notably in terms of performance and price) and of the factors that may motivate (or dissuade) customers to resort to them*
No substitutes found

Suppliers and other actors in the value chain
Identification of key suppliers and other actors in the value chain and of their importance for the business model
EPCs and System Integrators enter in the purchase process, so it is important that they are satisfied with the products

Stakeholders
Identification of other actors that may have an impact on the activity or the competitive environment (e.g., public authorities)
TSOs define grid codes that specify the requirements of RES. This affects protective relay algorithms

ER's competitive advantage(s), relying on the above analysis:

- Improved performance of the protection system, tested in the field in real environment.

Update of the "Value Propositions" block

Improved performance of the protection system

Critical success factors for the considered business model(s)

Table 118. Critical success factors for UC 2

Critical success factor	Key metric	Data to be collected and sources
1. Growth of RES penetration in the electricity networks	Growth percentage of installed MW of RES worldwide	Global reports reporting the new installed power of RES
2. Adaptation of network codes	Number of countries with updated network codes	Countries' regulators

REVENUE STREAMS and COST STRUCTURE

Table 119. Cost structures and revenue streams presentation

COST STRUCTURE	REVENUE STREAMS
Opex: Personnel costs (engineers) Simulation SW Lab tests	**Products:** Protection IEDs and fault detector sales **Services:** Setting studies sales
Capex: Test sets	

Variables that will have the most significant impact on revenues:

- Protection IEDs and fault detector sales

Variables that will have the most significant impact on costs:

- Personnel costs (engineers)

Exploitable Result #9: - FUSE platform	
Lead partner	*ATOS*
Working group members	*CIRCE, LINKS*

Upon internal discussion, and as already mentioned, ATOS considers it does not make sense to present an adaptor as an ER, since it is quite specific, and will not be possible to exploit it on its own and sell it as a separate item.

Customer segments analysis

Two potential customer segments have been identified ER 10: i) Energy utilities, and ii) Energy communities, building managers and aggregators. Their analysis is presented in Table 120 to Table 121 in the appendix.

Knowledge about customer segments to refine the analysis of *CUSTOMER RELATIONSHIPS*

Setup, maintenance, and technical support.
Customer loyalty based on confidence and continuous improvement of the solution.

Customer journey analysis

An analysis of the customer journey has been performed for the different customer segments (Table 122 to 123 in the appendix). Its results are presented in Table 124 to Figure 125.

Table 124. Customer journey analysis for potential customer segment #1: DSO / TSO / Generator owners / MV customers

Potential customer segment #1: DSO / TSO / Generator owners / MV customers	

ACTIONS	Reading technical documentation about the new algorithms in protective relays. Attending seminars and trainings given by ZIV	Evaluating a sample in the laboratory or installing it in a real substation (pilot project)	Evaluation of technical and commercial quotations	Installation in real projects	Organizing training, technical seminars, meetings, etc
MOTIVATIONS	Conventional relays do not behave correctly in networks with high RES penetration	Laboratory and pilot installation are the best option for approving a new protection relay	Solve false operations of conventional relays and getting experience with new relays	Solve false operations of conventional relays and getting experience with new relays	Solving questions, increasing the knowledge about the new products, etc
TIMELINE	**Learning about product/service**	**Assessing value proposition**	**Purchasing**	**Using**	**Interacting after purchase**
QUESTIONS	Questions about: The behavior of new algorithms in conventional installations Behavior of RES	Questions about new settings and about the operation principle of new algorithms	Questions about commercial conditions, technical information provided in the quotations, etc	Questions about new settings and about the operation principle of new algorithms. Questions about real operations	Questions about new settings and about the operation principle of new algorithms. Questions about real operations

BARRIERS	Lack of experience in the field of new algorithms	Lack of time for the assessment process Lack of knowledge of the new product Wrong operations during the approval process	High prices, technical deviations, etc	Wrong operations, quality problems, not being used to the relay tool, unreliable support, etc	Lack of time for training

Table 125. Customer journey analysis for potential customer segment #2: [Switchgear manufacturers / EPCs]

Potential customer segment #2: Switchgear manufacturers / EPCs					
ACTIONS	Reading technical documentation about the new algorithms in protective relays. Attending seminars and trainings given by ZIV	Reviewing the requirements of DSOs and TSOs with regard to relays that behave correctly in networks with high RES	Evaluation of technical and commercial quotations	Installation in real projects	Organizing training, technical seminars, meetings, etc
MOTIVATIONS	Conventional relays do not behave correctly in networks with high RES penetration	Specifying protective relays that behave correctly in networks with high RES according to DSOs / TSOs requirements	Solve false operations of conventional relays and getting experience with new relays	Solve false operations of conventional relays and getting experience with new relays	Solving questions, increasing the knowledge about the new products, etc
TIMELINE	**Learning about product/service**	**Assessing value proposition**	**Purchasing**	**Using**	**Interacting after purchase**

QUESTIONS	Questions about: The behavior of new algorithms in conventional installations Behavior of RES	Questions about new settings and about the operation principle of new algorithms	Questions about commercial conditions, technical information provided in the quotations, etc	Questions about new settings and about the operation principle of new algorithms. Questions about real operations	Questions about new settings and about the operation principle of new algorithms. Questions about real operations
BARRIERS	Lack of experience with the new relays	Lack of time to review new requirements of DSOs / TSOs	High prices, technical deviations, etc	Wrong operations, quality problems, not being used to the relay tool, unreliable support, etc	Lack of time for training

Key interactions evidenced by the map to refine the analysis of CHANNELS

Direct relationship with DSOs, TSOs and MV customers
Sales through integrators and EPC
Sales through Switchgear manufacturers
Promotion by means of seminars and conferences

Table 126. Analysis of key activities

Activity	Assessable?	Critical?	Timely?	Output of the activity
Development	*Medium*	*Low*	*Medium*	Deployable software module

Key activities evidenced by the map to refine the analysis of CHANNELS

Application and design engineering
Simulation of networks with high RES
Testing
Field installation

Market and competition analysis to specify the VALUE PROPOSITION

MARKET AND COMPETITION ANALYSIS FOR [Use Case 2]

Current competitors
Identification of key competitors and analysis of their positioning (products and/or services offered, value proposition, targeted customer segments…)
SIEMENS: distance protection including some algorithms for better operation (improved phase selector) ABB: conventional distance protection

SEL: conventional distance protection GE: distance protection including some algorithms for better operation (improved phase selector) INGETEAM: conventional distance protection TOSHIBA: conventional distance protection

New entrants
Identification of (potential) new entrants and analysis of their positioning (products and/or services offered, value proposition, targeted customer segments…) *Identification of barriers to entry*
Relay manufacturers selling in other countries / segments try to expand their business Barriers: unknown of their products, local support, etc

Substitutes
Identification of products and/or services that could act as substitutes *Analysis of their value proposition, their advantages and drawbacks (notably in terms of performance and price) and of the factors that may motivate (or dissuade) customers to resort to them*
No substitutes found

Suppliers and other actors in the value chain
Identification of key suppliers and other actors in the value chain and of their importance for the business model
EPCs and System Integrators enter in the purchase process, so it is important that they are satisfied with the products

Stakeholders
Identification of other actors that may have an impact on the activity or the competitive environment (e.g., public authorities)
TSOs define grid codes that specify the requirements of RES. This affects protective relay algorithms

ER's competitive advantage(s), relying on the above analysis:

- Improved performance of the protection system, tested in the field in real environment.

Update of the "Value Propositions" block

Improved performance of the protection system

Critical success factors for the considered business model(s)

Table 127. Critical success factors for UC 2

Critical success factor	Key metric	Data to be collected and sources
1. Growth of RES penetration in the electricity networks	Growth percentage of installed MW of RES worldwide	Global reports reporting the new installed power of RES
2. Adaptation of network codes	Number of countries with updated network codes	Countries' regulators

REVENUE STREAMS and COST STRUCTURE

Table 128. Cost structures and revenue streams presentation

COST STRUCTURE	REVENUE STREAMS
Opex: Personnel costs (engineers) Simulation SW Lab tests	**Products:** Protection IEDs and fault detector sales
Capex: Test sets	**Services:** Setting studies sales

Variables that will have the most significant impact on revenues:

- Protection IEDs and fault detector sales

Variables that will have the most significant impact on costs:

- Personnel costs (engineers)

Exploitable Result 11: Protection Algorithm development to improve current protections used in distribution grids with high RES penetration	
Lead partner	*CIRCE*
Working group members	*CIRCE is the integral developer of the algorithm*

Customer segments analysis

Two potential customer segments have been identified ER 10: i) DSO & TSO, ii) Switchgear and protection relays manufacturers. Their analysis is presented in Table 129 to Table 130 in the appendix.

Knowledge about customer segments to refine the analysis of *CUSTOMER RELATIONSHIPS*

Setup, maintenance, and technical support.
Customer loyalty based on confidence and continuous improvement of the solution.
Quality follow-ups with customers

Customer journey analysis

An analysis of the customer journey has been performed for the different customer segments (Table 131 to 132 in the appendix). Its results are presented in Table 133.

Table 133. Customer journey analysis for potential customer segment: All customer segments

All customer segments	

ACTIONS	PR, Social Ads, Blog, Media, Website, Direct Mail, Innovation Forums, Demonstration Sites.	Searches for solutions on the internet, energy related companies, energy projects, etc.	Licensing, Technology transfer, bilateral partnership, funding instruments.	Direct contact between CIRCE and customers through different tools that allows a measure of customer satisfaction (polls, calls, emails, etc.)	Survey to measure customer satisfaction with the treatment and service received, confirmation that the product maintains quality.
MOTIVATIONS	Improve performance of the protection system and the grid by algorithms that improve the network behavior.	Wants to find solutions that are easily accessible, easy to install and from entities with experience in the market.	Understand and find the best option to adopt the solution according to their needs.	Confirmation of customer satisfaction for the treatment received in the purchase, explanation, and installation process.	Confirmation of customer satisfaction with the software, confirmation that they are obtaining the expected results.
TIMELINE	**Learning about product/service**	**Assessing value proposition**	**Purchasing**	**Using**	**Interacting after purchase**
QUESTIONS	What is the responsiveness of the algorithm? What is the detection and self-solve time? In what percentage will the consumers benefit?	What solutions exist in the market that can solve my need?	What benefits and what costs are involved in the different ways of acquiring and implementing the solution?	How has the level of fault detection been? By what percentage have the network improve?	What is the maintenance required? What service will the consumer need after the installation of the algorithm?

BARRIERS	Process of identification by the client that he really needs the software and its solutions.	Not all users for whom the solution is intended will be aware of this solution, market penetration limitation.	Budget limitation of local consumers for the costs involved in the installation and maintenance.	Overcome the challenge of adapting particularly to each distribution grid	Costs of implementing improvements / maintenance

Key interactions evidenced by the map to refine the analysis of CHANNELS

Direct relationship with DSOs, TSOs and MV customers
Sales through integrators and EPC
Sales through Switchgear manufacturers
Promotion by means of seminars and conferences

Table 134. Analysis of key activities

Activity	Assessable?	Critical?	Timely?	Output of the activity
Testing the solution in demonstration sites	*High*	*High*	*High*	Confirmation of the correct adaptation and implementation of the software before being brought to the market.
Market analysis	*Medium*	*High*	*High*	Market assessment. Learn about and further explore the different business options of the solution.
Dissemination, replication and exploitation	*Medium*	*Medium*	*High*	Make the solution known in the markets already identified in the analysis and explore the different methods of exploitation and sale.
Installation at customer premises	*High*	*High*	*High*	Deliver the product to the customer and carry out custom installation according to their needs.
Cooperation with other projects and networking	*High*	*Medium*	*High*	Constant improvement of the software once needs are identified after launching in user / client facilities.

Key activities evidenced by the map to refine the analysis of CHANNELS

Application and design engineering
Simulation of networks with high RES
Testing
Field installation

Market and competition analysis to specify the VALUE PROPOSITION

MARKET AND COMPETITION ANALYSIS FOR [Use Case 2]

Current competitors
Identification of key competitors and analysis of their positioning (products and/or services offered, value proposition, targeted customer segments…) The main sectors/ companies that could be competitors are: Protection systems manufacturers Technological centers that develop similar technologies Examples: Kombisave+: This type of devices from Phoenix Contact are the best ones for all kind of distribution network activities. The equipment includes a wide range of functions such as overcurrent protection, low voltage reactive power compensation, etc. FAME: It is the newest modular test system from Phoenix Contact. Fame is useful for all measurement and test tasks in the field of network protection technology for medium and high voltage installations.

New entrants
Identification of barriers to entry: Dependency of the manufacturer. The service is always offered through some type of licensing with a manufacturer of protection systems.

Substitutes
Identification of products and/or services that could act as substitutes No equal solutions are identified in the market. Each manufacturer of protection systems will be able to develop their own software to solve this fault detection problem.

Suppliers and other actors in the value chain
No suppliers identified

Stakeholders
Identification of other actors that may have an impact on the activity or the competitive environment (e.g., public authorities) Power electronic manufacturers Laboratories Technology developers

ER's competitive advantage(s), relying on the above analysis:

- Improved performance of the protection system and the grid by algorithms that improve the network behaviour.

Critical success factors for the considered business model(s)

Table 135. Critical success factors for UC 2

Critical success factor	Key metric	Data to be collected and sources
1. Research	Marketing metrics	Market behaviour, competitors, possible sales, social sentiment.

2. Anticipation of failures	Level of errors in implementation	Errors reported by customers and users.
3. Teamwork / Project team competence	Quality of final product	Personnel retention, quality of final product.
4. Strong Brand	Market valuation	Company's reputation.
5. Success	Software as a Service metrics	Customer lifetime value, Customer Churn Rate, Monthly Recurring Revenue, Customer retention rate.

REVENUE STREAMS and COST STRUCTURE

Table 136. Cost structures and revenue streams presentation

Cost structures	
costs will vary depending on the client's needs.	
Components	**Estimated costs**
Human Resources, SW Simulation, Lab testing, Demo sites	Costs cannot yet be determined. The calculation will be made based on the work done in the demo sites.
Revenue Streams	
Direct sales and/or licensing	

Variables that will have the most significant impact on revenues:

- Direct sales of a software that improves performance of protection systems and the behaviours of the protection relays.

Variables that will have the most significant impact on costs:

- Human resources and demo sites.

5.3 Use Case 3 Holistic energy system optimization and emulation for commercial and residential customers

Use Case #3: Holistic energy system optimization and emulation for commercial and residential customers	
Lead partner	*VERD*
Working group members	*VERD, CIRCE, LINKS, ATOS, IOSA*

Customer segments analysis

Three potential customer segments have been identified for the holistic energy system optimization and emulation for commercial and residential customers: i) commercial and Industrial (C&I) customers, ii) residentials, and iii) aggregators and ESCOs. Their analysis is presented in Table 137 to Table 139 in the appendix.

Knowledge about customer segments to refine the analysis of *CUSTOMER RELATIONSHIPS*

CUSTOMER RELATIONSHIPS

Network operators

- Sales representatives
- Workshops, conference and events

Aggregators/ESCOs and retailers

- Sales representatives
- Company website and dedicated website giving access to non IP-sensitive results

RES energy producers

- Sales representatives
- Workshops, conference and events

C&I customers

- Local support
- Sales representatives
- Company website and dedicated website giving access to non IP-sensitive results

Customer journey analysis

An analysis of the customer journey has been performed for the different customer segments (Table 140 to 142 in the appendix). Its results are presented in Table 143 to Table 144.

Table 143. Customer journey analysis for potential customer segment #1: C&I customers

Potential customer segment #1: C&I customers					
ACTIONS	Need to look at options for load and generation forecasting	Contact software providers Take offers from software providers		Use the software to facilitate on-site RES penetration	Ad-hoc assistance from software providers
MOTIVATIONS	Improve on-site RES penetration Do not interrupt business-as-usual operation		Find the most profitable offer from software providers		Be able to use state-of-art services

TIMELINE	**Learning about product/service**	**Assessing value proposition**	**Purchasing**	**Using**	**Interacting after purchase**
QUESTIONS	How does it work?	Can I have a demo and/or trial version?	How much will it cost?		Could you assist with the problem?
BARRIERS	Product accessibility	Competition			

Table 144. Customer journey analysis for potential customer segment #2: [AGGREGATORS/ESCOs] and RES producers

Potential customer segment #2: [AGGREGATORS/ESCOs] and RES producers					
ACTIONS	Search for options for load and generation forecasting	Contact software providers and pre-evaluate systems Take offers from software providers	Define requirements Procure through tender		
MOTIVATIONS	Improve quality of services for our customers	Reduce imbalance costs in markets			
TIMELINE	**Learning about product/service**	**Assessing value proposition**	**Purchasing**	**Using**	**Interacting after purchase**
QUESTIONS	How does it work?	Can I have a demo and/or trial version?	How much will it cost?	What is its reliability and uptime? How do I integrate? How do I extend functionalities?	Could you assist with the problem?
BARRIERS	Product accessibility	Competition		High cost	

Key interactions evidenced by the map to refine the analysis of CHANNELS

CHANNELS

- Company website with non IP-sensitive material
- Online and printed marketing tools
- Media and social media

B2B bilateral direct communications through sales department

Market and competition analysis to specify the VALUE PROPOSITION

MARKET AND COMPETITION ANALYSIS
FOR Holistic energy system optimization and emulation for commercial and residential customers IN EUROPE

Current competitors
Identification of key competitors and analysis of their positioning (products and/or services offered, value proposition, targeted customer segments…)
Meteologica *Meteologica offers forecasting services for wind and solar farms on a global scale since 2004. They offer short, medium and long-term forecasts for a variety of weather-driven variables[6] such as generation of RES, power demand, temperature and spot prices by country, market area or specific sites*
EDF store and forecast *EDF store and forecast have four distinct solutions for their customers. PVSCOPE™ calculates the PV production forecast the day before for the next day and an intraday basis. SKYSCOPE™ generates a forecast for PV production in the very short term (time horizon of 15 minutes). EOLSCOPE™ calculates the wind production forecast up to 3 days upstream and intraday by combining weather forecasts and production measurements taken in real time. CONSOSCOPE™ forecasts electricity consumption over an intraday horizon up to D+7. It combines temperature forecasts and other local weather variables that influence consumption, integrates triggers for industrial use or load shedding and relies on real-time consumption measurements for better accuracy.[7]*
Enfor *Enfor use a variety of tools to produce PV, wind and hydro generation forecasts, as well as heat and electricity demand forecasts. They also offer a total forecasting service delivering country level forecasts for solar and wind power production as well as electricity load.[8]*
Energymeteo *Energymeteo offer individually customised solar and wind forecasting services. In addition, they offer grid and plant operators as well as power traders' real-time projections for solar power including behind-the-meter generation and grid-oriented forecasts. They also offer a web-based customer portal allowing their customers to capture their measurement and prediction data at a glance.[9]*
NextKraft Werke *Next offer live monitoring, forecasting and now casting solution to energy traders, RES portfolio operators and utilities called NEMCOS.[10]*
AleaSoft *AleaSoft offer energy price, demand, and renewable energy forecasting services. Their value proposition lies on the highly reliable forecasts for prices, demand and renewable energy, adapted to the needs of the energy market for the short, medium and long-term horizons. Their target clients are all companies in the energy sector: TSOs, utilities, traders, retailers, large and electro intensive consumers, renewable energies, investment funds and banks.[11]*

New entrants
• *Identification of (potential) new entrants and analysis of their positioning (products and/or services offered, value proposition, targeted customer segments…)* • *Identification of barriers to entry*
Barriers to entry • *High competition in the field of energy optimisation and grid operation services* • *Software companies create dedicated products* • *RES developers and Aggregators often use their in-house products thus they do not need specific services from third parties*

Substitutes
• *Identification of products and/or services that could act as substitutes* • *Analysis of their value proposition, their advantages and drawbacks (notably in terms of performance and price) and of the factors that may motivate (or dissuade) customers to resort to them*
In-house software *Value proposition: Companies may build their own forecasting algorithms/software in order to avoid going out to the market and seeking a customised solution to their needs and use these softwares for microgrid operation*
Forecasting module included in a wider purpose software (e.g., VPP software)

Suppliers and other actors in the value chain
Identification of key suppliers and other actors in the value chain and of their importance for the business model
Weather forecast companies
IT companies
RES producers who could use their sites to validate the developed solutions
Facility managers
Network operators

Stakeholders
Identification of other actors that may have an impact on the activity or the competitive environment (e.g., public authorities)
Public authorities
Regulators
Utilities
Facility management consultants
Energy experts

ER's competitive advantage(s), relying on the above analysis:

Our product has not been tested yet so at this point we cannot know for sure how it can be ranked against competitive solutions.
What we can consider as competitive advantage is the holistic approach we test in this UC where we integrate the forecasting and congestion management solutions with the Energy Box acting as Gateway and the FUSE platform acting as the storage database and we provide an end-to-end solution for our customers

Update of the "Value Propositions" block

- Forecasting algorithms to accurately predict energy generation, demand and electricity price
- Hardware and software solution to solve field-level communication and management
- Modern and compact design of the Energy Box
- Open-source framework that enables the integration of devices at the edge by fully exploiting the available data from local and distributed energy resources to build value-added services for the several user profiles

Critical success factors for the considered business model(s)

Table 145. Critical success factors for UC 3

Critical success factor	Key metric	Data to be collected and sources
1. **Forecast accuracy**	%error	PV production and load demand from Greek pilot
2. **Reliability/Uptime**	%time	PV production and load demand from Greek pilot
3. **Cost to run and maintain**	Hardware/software resources and personnel	Resources used in FUSE and average time to maintain after demonstration in Greek pilot

REVENUE STREAMS and COST STRUCTURE

Analysis of different options that may be explored further and of their respective advantages and drawbacks.
The main revenue streams and the most significant cost items is the License per year per site

Variables that will have the most significant impact on revenues:

- Number of customers
- Number of sites
- Customer maintenance which is linked with persisting product quality (stable and satisfactory forecast accuracy)

Variables that will have the most significant impact on costs:

- Integration costs with client
- Training and support required
- Maintenance costs
- Customization/upgrade costs

5.4 Use Case 4 Microgrid congestion management and peak shaving

Use Case #4: Microgrid congestion management and peak shaving	
Lead partner	*VERD*
Working group members	*VERD, CIRCE, LINKS, ATOS, IOSA*

Customer segments analysis

Two potential customer segments have been identified for the microgrid congestion management and peak shaving: i) commercial and industrial (C&I) customers, and ii) aggregators and ESCOs. Their analysis is presented in Table 146 and Table 147 in the appendix.

Knowledge about customer segments to refine the analysis of *CUSTOMER RELATIONSHIPS*

Network operators
- Sales representatives
- Workshops, conferences and events

C&I customers
- Local support
- Sales representatives
- Company website and dedicated website giving access to non IP-sensitive results

Aggregators/ESCOs and retailers

- Sales representatives
- Company website and dedicated website giving access to non IP-sensitive results

RES energy producers

- Sales representatives
- Workshops, conferences and events

Customer journey analysis

An analysis of the customer journey has been performed for the different customer segments (Table 148 to 149 in the appendix). Its results are presented in Table 150 to Table 151.

Table 150. Customer journey analysis for potential customer segment #1: C&I customers

Potential customer segment #1: C&I customers					
ACTIONS	Need to look at options for load and generation forecasting	Contact software providers Take offers from software providers		Use the software to facilitate on-site RES penetration	Ad-hoc assistance from software providers
MOTIVATIONS	Improve on-site RES penetration Do not interrupt business-as-usual operation		Find the most profitable offer from software providers		Be able to use state-of-art services
TIMELINE	**Learning about product/service**	**Assessing value proposition**	**Purchasing**	**Using**	**Interacting after purchase**
QUESTIONS	How does it work?	Can I have a demo and/or trial version?	How much will it cost?		Could you assist with the problem?
BARRIERS	Product accessibility	Competition			

Table 151. Customer journey analysis for potential customer segment #2: RES producers

Potential customer segment #2: [AGGREGATORS/ESCOs] and RES producers					
ACTIONS	Search for options for load and generation forecasting	Contact software providers and pre-evaluate systems Take offers from software providers	Define requirements Procure through tender		

MOTIVATIONS	Improve quality of services for our customers	Reduce imbalance costs in markets			
TIMELINE	**Learning about product/service**	**Assessing value proposition**	**Purchasing**	**Using**	**Interacting after purchase**
QUESTIONS	How does it work?	Can I have a demo and/or trial version?	How much will it cost?	What is its reliability and uptime? How do I integrate? How do I extend functionalities?	Could you assist with the problem?
BARRIERS	Product accessibility	Competition		High cost	

Market and competition analysis to specify the VALUE PROPOSITION

MARKET AND COMPETITION ANALYSIS FOR Microgrid congestion management and peak shaving IN EUROPE

Current competitors
Identification of key competitors and analysis of their positioning (products and/or services offered, value proposition, targeted customer segments…)
There are currently no known competitors in the market selling congestion management software. At the moment congestion management is performed at a network or utility level using internal tools built by the TSOs and DNOs. At the low level, scheduling and monitoring is performed at a device level (e.g., batteries' inverters)

New entrants
• *Identification of (potential) new entrants and analysis of their positioning (products and/or services offered, value proposition, targeted customer segments…)* • *Identification of barriers to entry*

Substitutes
• *Identification of products and/or services that could act as substitutes* • *Analysis of their value proposition, their advantages and drawbacks (notably in terms of performance and price) and of the factors that may motivate (or dissuade) customers to resort to them*
On site equipment might be equipped with basic congestion management algorithms

Suppliers and other actors in the value chain
Identification of key suppliers and other actors in the value chain and of their importance for the business model
RES and technology providers (e.g., PV and battery suppliers)
Facility managers

Communications H/W suppliers (e.g., gateways)

Stakeholders
Identification of other actors that may have an impact on the activity or the competitive environment (e.g., public authorities)
Network operators
Aggregators
Public authorities
Policy makers

REVENUE STREAMS and COST STRUCTURE

Variables that will have the most significant impact on revenues:

- Number of customers
- Number of sites
- Customer maintenance which is linked with persisting product quality (stable and satisfactory forecast accuracy)

Variables that will have the most significant impact on costs:

- Integration costs with client
- Training and support required
- Maintenance costs
- Customization/upgrade costs

5.5 Use Case 5 Coordinating distribution network flexibility assets and protections schemes coordination in urban districts

Use Case #5: Coordinating distribution network flexibility assets and protections schemes coordination in urban districts	
Lead partner	CIRCE
Working group members	*VERD, ATOS, CIRCE*

Customer segments analysis

Four potential customer segments have been identified for coordinating distribution network flexibility assets, and protections schemes coordination in urban districts: i) network operators (TSOs, DSOs), ii) energy communities, iii) aggregators, and iv) renewable energy producers. Their analysis is presented in Table 152 to Table 154 in the appendix.

Knowledge about customer segments to refine the analysis of *CUSTOMER RELATIONSHIPS*

Network operators
- *Sales representatives*
- *Workshops, conferences and events*

Energy communities
- *Local support*
- *Sales representatives*
- *Company website and dedicated website giving access to non IP-sensitive results*

Building operators
- *Sales representatives*
- *Company website and dedicated website giving access to non IP-sensitive results*

Aggregators
- *Sales representatives*
- *Company website and dedicated website giving access to non IP-sensitive results*

Energy retailers
- *Sales representatives*
- *Workshops, conferences and events*

RES energy producers
- *Sales representatives*
- *Workshops, conferences and events*

C&I customers
- *Local support*
- *Sales representatives*
- *Company website and dedicated website giving access to non IP-sensitive results*

Customer journey analysis

An analysis of the customer journey has been performed for the different customer segments (Table 155 to 159 in the appendix). Its results are presented in Table 160 to Table 162.

Table 160. Customer journey analysis for potential customer segment #1: Network Operators

Potential customer segment #1: Network Operators	

ACTIONS	Options search for load and generation forecasting	Contact providers and pre-evaluate systems Take offers from providers	Define requirements Procure through tender		
MOTIVATIONS	Ensure grid quality and security Increase RES penetration	Reduce network planning and operation cost	Increase quality and cost of service to customers		Be able to use state-of-art services
TIMELINE	**Learning about product/service**	**Assessing value proposition**	**Purchasing**	**Using**	**Interacting after purchase**
QUESTIONS	How does it work?	Can I have a demo and/or trial version?	How much will it cost?	How do I integrate? How to I use? What is its reliability and uptime? How to I extend functionalities?	Could you assist with the problem?
BARRIERS	Product accessibility	Competition			

Table 161. Customer journey analysis for potential customer segment #2: Energy Communities

Potential customer segment #2: Energy Communities					
ACTIONS	Search for options for load and generation forecasting Search for digital tools to gather and valorise data	Contact software providers and pre-evaluate systems Take offers from software providers	Define requirements Procure through tender		
MOTIVATIONS	Improve quality of services for members	Reduce network planning and operation cost for members	Find the most profitable offer from providers		Be able to use state-of-art services
TIMELINE	**Learning about product/service**	**Assessing value proposition**	**Purchasing**	**Using**	**Interacting after purchase**

QUESTIONS	How does it work?	Can I have a demo and/or trial version?	How much will it cost?	What is its reliability and uptime? How do I integrate? How do I extend functionalities?	Could you assist with the problem?
BARRIERS	Product accessibility	Competition		High cost	

Table 162. Customer journey analysis for potential customer segment #6: RES energy producers

Potential customer segment #3: RES energy producers					
ACTIONS	Need to look at options for load and generation forecasting	Contact providers Take offers from providers			Ad-hoc assistance from software providers
MOTIVATIONS	Improve RES penetration in the market. Improve trade operation on the electricity market. Improve flexibility of production thanks to forecasting.	Digitalise energy demand and price to operate the market in real time.	Find the most profitable offer from software providers		Be able to use state-of-art services
TIMELINE	**Learning about product/service**	**Assessing value proposition**	**Purchasing**	**Using**	**Interacting after purchase**
QUESTIONS	How does it work?	Can I have a demo and/or trial version?	How much will it cost?	What is its reliability and uptime? How do I integrate? How do I extend functionalities?	Could you assist with the problem?
BARRIERS	Product accessibility	Competition			

Key interactions evidenced by the map to refine the analysis of CHANNELS

CHANNELS

- Distribution at demonstration sites
- Sales representatives
- Conferences, workshop and events
- Online and printed marketing tools
- Active media relations and social media

- Websites
- B2B and/or bilateral multiservice offerings using existing clientele channels

Update of the "Key Activities" block

KEY ACTIVITIES

- Identification, assessment and comparison of the technological solutions for monitoring and control systems in the distribution network and in the customer premises
- Development of recommendations for the cost-effective application of advanced distributed sensors, monitoring and control systems to increase distribution networks' intelligence
- Development of a device for electricity grids monitoring with new functionalities
- Testing of algorithms (simulation, small scale demonstration)
- Performance test of the developed applications in a real grid
- Cooperation with other projects and networking
- Digitalisation of energy assets
- Data analytics, Forecasting
- - Harmonisation

Table 163. Analysis of key activities

Activity	Assessable?	Critical?	Timely?	Output of the activity
Market analysis	*High*	*High*	*Medium*	*Understanding of competition and target markets*
Identification, assessment and comparison of the technological solutions for monitoring and control systems in the distribution network and in the customer premises	Medium	Low	High	*Understanding of competition and potentialgaps in existing markets*
Testing of algorithms (simulation, small scale demonstration)	High	Medium	Medium	*Product testing and refinement*
Performance test of the developed applications in a real grid	High	High	High	*Final product refinementand customisation to specific customer needs*
Cooperation with other projects and networking	High	Medium	Low	*Development of new ideas,potential overcoming of obstacles, creation of new market opportunities*
Digitalisation of energy assets	High	Medium	Medium	*Digital version of every asset*
Data analytics, Forecasting	Medium	Medium	Medium	*Extracting valuable insight that drives decision-making Ability to prevent the occurrence of problems*
Harmonisation	Low	Medium	Low	*Sharing a common methodology*

Market and competition analysis to specify the VALUE PROPOSITION

MARKET AND COMPETITION ANALYSIS FOR SOFTWARE MODULE FOR FORECASTING AND GRID OPERATION IN EUROPE

Current competitors
Meteologica *Offers forecasting services for wind and solar farms on a global scale since 2004. They offer short, medium and long-term forecasts for a variety of weather-driven variables[10] such as generation of RES, power demand, temperature and spot prices by country, market area or specific sites*
EDF store and forecast *Has four distinct solutions for their customers. PVSCOPE™ calculates the PV production forecast the day before for the next day and an intraday basis. SKYSCOPE™ generates a forecast for PV production in the very short term (time horizon of 15 minutes). EOLSCOPE™ calculates the wind production forecast up to 3 days upstream and intraday by combining weather forecasts and production measurements taken in real time. CONSOSCOPE™ forecasts electricity consumption over an intraday horizon up to D+7. It combines temperature forecasts and other local weather variables that influence consumption, integrates triggers for industrial use or load shedding and relies on real-time consumption measurements for better accuracy.[11]*
Enfor *Uses a variety of tools to produce PV, wind and hydro generation forecasts, as well as heat and electricity demand forecasts. They also offer a total forecasting service delivering country level forecasts for solar and wind power production as well as electricity load.[12]*
Energymeteo *Offers individually customised solar and wind forecasting services. In addition, they offer grid and plant operators as well as power traders' real-time projections for solar power including behind-the-meter generation and grid-oriented forecasts. They also offer a web-based customer portal allowing their customers to capture their measurement and prediction data at a glance.[13]*
NextKraft Werke *Offers live monitoring, forecasting and now casting solution to energy traders, RES portfolio operators and utilities called NEMCOS.[14]*
AleaSoft *Offers energy price, demand, and renewable energy forecasting services. Their value proposition lies on the highly reliable forecasts for prices, demand and renewable energy, adapted to the needs of the energy market for the short, medium and long-term horizons. Their target clients are all companies in the energy sector: TSOs, utilities, traders, retailers, large and electro intensive consumers, renewable energies, investment funds and banks.[15]*
Monet (Siemens) *IoT data-driven platform, energy management system, offered under a proprietary license and ready for validation (EV manager, assets manager, distributed generation forecast, demand-response functionalities).*
EcoStruxure (Schneider Electric) *IoT-enabled, plug-and-play, open, interoperable architecture and platform, operating in Homes, Buildings, Data Centers, Infrastructure and Industries. It connects innovation at Every Level from Connected Products to Edge Control, and Apps, Analytics and Services.*
Dynamic Demand 2.0 *Open-source IoT data-driven platform from Open Energi, which is already market-ready (frequency regulation, energy trading, capacity services, peak price management, constraint management, energy efficiency, energy scheduling).*

C3.ai *The C3 AI Platform provides all necessary software services in one integrated suite to rapidly develop, provision, and operate Enterprise AI applications. The solution is tailored to the company/industry.*
IBM Solution Architecture for Energy and Utilities Framework *Provides the necessary integrated model content to cover the main aspects of a typical model-driven business intelligence development ranging from definitions of business requirements, to centralized analysis, and to the design of specific business intelligence/data warehouse physical artefacts.*

New entrants
Identification of (potential) new entrants and analysis of their positioning (products and/or services offered, value proposition, targeted customer segments…)
Barriers to entry *High competition in the field of forecasting services* *Software companies create dedicated products* *Certification to penetrate the market;* *Adaptation of solutions to different customer needs;* *Necessity to know very specific network data to be able to demonstrate the functionality of the algorithms to potential customers.* *RES developers and Aggregators often use their in-house products thus they do not need specific services from third parties*

Substitutes
Identification of products and/or services that could act as substitutes *Analysis of their value proposition, their advantages and drawbacks (notably in terms of performance and price) and of the factors that may motivate (or dissuade) customers to resort to them*
In-house software *Value proposition: Companies may build their own forecasting algorithms/software in order to avoid going out to the market and seeking a customised solution to their needs*
Forecasting module included in a wider purpose software (e.g., VPP software)

Suppliers and other actors in the value chain
Identification of key suppliers and other actors in the value chain and of their importance for the business model
Weather forecast companies
IT companies
RES producers who could use their sites to validate the developed solutions
Facility managers
Network operators

Stakeholders
Identification of other actors that may have an impact on the activity or the competitive environment (e.g., public authorities)
Public authorities
Regulators
Utilities
Facility management consultants
Energy experts

Components manufacturers
Installers
Maintenance entity
ESCos/electricity suppliers
Smart grid stakeholders

Update of the "Value Propositions" block, highlighting the competitive advantage

VALUE PROPOSITION

- Hardware and software solution to solve field-level communication and management
- Provide its user with both information and control on the network to operate it in real time, ensuring the security of the supply, and prevent network congestion.
- Fault detection/location software and energy supply restoration through self-healing algorithms
- Forecasting algorithms to accurately predict energy generation, demand and electricity price and suggest grid operation orders

Critical success factors for the considered business model(s)

Table 164. Critical success factors for UC 7

Critical success factor	Key metric	Data to be collected and sources
Forecast accuracy	%error	PV production and load demand
Reliability/Uptime	%time	PV production and load demand
Cost to run and maintain	Hardware/software resources and personnel	Resources used and average time to maintain
Recognition of real value servedby the solution	Acceptance surveys	User feedback about usability and results
Income streams	Customer fees	Number and price of sales
Proven scalability	Number of new modules integrated Replication in different countries and/or use cases	Number of sales in different countries and/or use cases
Research	Marketing metrics	et behaviour, competitors, possible sales, social sentiment
Anticipation of failures	Level of errors in implementation	Errors reported by customers and users
Teamwork/project team competence	Quality of final product	Personnel retention, quality of final product
Strong brand	Market valuation	Company's reputation
Success	Software as a Service metrics	Customer lifetime value, customer churnrate, monthly recurring revenue, customer retention rate

REVENUE STREAMS and COST STRUCTURE

The main revenue streams and the most significant cost items is the License per year per site and the price of the hardware solutions.

Variables that will have the most significant impact on revenues:

- Number of customers

- Number of sites
- Customer maintenance which is linked with persisting product quality (stable and satisfactory forecast accuracy)
- Precision of the software to detect faults and solve them

Variables that will have the most significant impact on costs:

- Integration costs with client
- Commercial hardware
- Training and support required
- Maintenance costs
- Customization/upgrade costs

5.6 Use Case 6 Virtual Energy Storage for urban buildings

Use Case #6: Virtual Energy Storage for urban buildings	
Lead partner	*HYPERTECH*
Working group members	*ATOS, HEP-ODS*

Customer segments analysis

Seven potential customer segments have been identified for the virtual energy storage for urban buildings: i) energy retailers, ii) aggregators, iii) ESCOs /ESCPs, iv) BMS provides, v) residential customers, vi) energy communities, and vii) local authorities. Their analysis is presented in Table 165 to Table 171 in the appendix.

Priority of potential customer segments is shown below. It has been mainly based on the following: i) How well the ER8 meets the purchasing criteria and satisfies the needs of each customer segment (i.e., how likely it is for the customer segment to purchase the product), and ii) the current size and expected growth of the relevant segment in Europe, iii) the size of the client portfolio of each segment (e.g., an aggregator could have 50 clients to whom they can sell the solution, while a retailer could have 1,000 customers).

1. Energy retailers
2. ESCOs/ESCPs
3. Energy communities
4. BMS providers
5. Aggregators
6. Local authorities
7. Residential customers

Residential customers, although in size they are the largest segment, are more difficult to approach on an individual level, so targeting them through retailers, ESCOs, etc. seems like a more reasonable approach. We assume that Hypertech will follow primarily a B2B approach, whereby a smaller pool of customers (namely retailers, ESCOs, BMS providers etc.) are approached in the first instance, reselling Hypertech's products to their customers under a different commercial arrangement.

Knowledge about customer segments to refine the analysis of *CUSTOMER RELATIONSHIPS*

- Training of certified installers and commissioners

- Product self-learning
- Customer support team
- Troubleshooting manual
- Web platform and customer app
- Social media

Customer journey analysis

An analysis of the customer journey has been performed for the different customer segments (Table 172 to 188 in the appendix). Its results are presented in Table 189 to Table 192.

Table 189. Customer journey analysis for potential customer segment #1: Energy Retailer / Aggregator / ESCO, ESCP / BMS provider

Potential customer segment #3: Energy Retailer / Aggregator / ESCO, ESCP / BMS provider					
ACTIONS	Market research Direct communication, networking events, forums, workshops/roundtables, presentations	Research on specific product/service Request free trial	Purchase order Design service/product offerings with new solution	Marketing campaign for promotion of new product/service	Feedback loop between seller and end customer Queries to Hypertech
MOTIVATIONS	Interested in value proposition Competition is already investing in the offered service.	Positive feedback and previous experience Happy with free trial	Keen to explore new opportunities with purchased product/service	Positive sales' numbers Identified opportunities for product/service improvement Technical issues reported by end users	Identified opportunities for product/service improvement Positive feedback from end customers
TIMELINE	**Learning about product/service**	**Assessing value proposition**	**Purchasing**	**Using**	**Interacting after purchase**

QUESTIONS	What are the benefits over competitive technologies? Does the solution offer value for money? Has the solution been thoroughly tested, trailed and deployed at large scale?	What are the benefits over competitive technologies? How can the solution be integrated in current service/product portfolio or used to expand it?	What is an attractive market price for product/service? How does the solution add value to end customer?	Will customer be satisfied with new product/service? Can the product/service be further evolved/improved to attract more customers?	Can the product/service be further evolved/improved to attract more customers?
BARRIERS	Customer acceptability and level of understanding of the offered services Solution relatively new in market Unproven business case for demand response schemes	Customer acceptability Solution relatively new in market Unproven business case for demand response schemes	Customer acceptability Solution relatively new in market Uncertainty around marketing strategy Uncertainty around end price	Customer acceptability	Customer acceptability

Table 190. Customer journey analysis for potential customer segment #2: Residential customer

Potential customer segment #2: Residential customer				
ACTIONS	Communication with energy retailer, BMS provider, ESCO, etc. Market research	Request free trial Search for product/service reviews	Commercial agreement between customer and retailer, BMS provider, etc. / purchase order	Installation and commissioning of necessary equipment	Raise queries Provide feedback Write product/service review

MOTIVATIONS	Energy awareness Environmental consciousness Achievement of energy cost savings Opportunities for new revenue streams	Positive feedback and previous experience Happy with free trial	Keen to increase energy efficiency and energy cost savings	Positive user experience Realisation of benefits (increase of comfort, convenience, cost savings and energy efficiency) Realisation of technical problems	Identified opportunities for product/ service improvement
TIMELINE	**Learning about product/service**	**Assessing value proposition**	**Purchasing**	**Using**	**Interacting after purchase**
QUESTIONS	What are the benefits that such a solution can offer? How intrusive is the solution? How does it compare to competitive technologies?	What are the benefits over competitive technologies? What are the long-term benefits of the solutions? Is the solution value for money?	How much inconvenience could the installation and commissioning process create? Is the solution safe? Does it pose risks to privacy?	N/A	Can the solution be expanded to include more services / customisations, etc.?
BARRIERS	Solution relatively new in market Unproven business case for demand response schemes Safety and privacy concerns	Solution relatively new in market Unproven business case for demand response schemes Safety and privacy concerns	Safety and privacy concerns	Lack of technology acumen Safety and privacy concerns	N/A

Table 191. Customer journey analysis for potential customer segment #3: Energy Community

Potential customer segment #3: Energy Community

ACTIONS	Communication with energy retailer, BMS provider, ESCO, etc. Market research	Request free trial Search for product/service reviews	Commercial agreement between customer and retailer, BMS provider, etc. / purchase order Engagement with community members for participation in collective action using solution	Distribution of necessary equipment at participating members' premises Installation and commissioning of necessary equipment	Raise queries Provide feedback Write product/service review
MOTIVATIONS	Energy awareness Environmental consciousness Achievement of energy cost savings Opportunities for new revenue streams	Positive feedback and previous experience Happy with free trial	Increase revenue for community Increase energy efficiency and costs savings for community members and community as a whole Demonstrate technology possibilities and benefits to community members	Positive user experience Realisation of benefits by community members (increase of comfort, convenience, cost savings and energy efficiency) Realisation of benefits for community as a whole Realisation of technical problems	Detection of issues in the usual functioning. Identified opportunities for product/ service improvement
TIMELINE	**Learning about product/service**	**Assessing value proposition**	**Purchasing**	**Using**	**Interacting after purchase**

QUESTIONS	What are the benefits that such a solution can offer to the community and its members? How intrusive is the solution? How does it compare to competitive technologies?	What are the benefits over competitive technologies? What are the long-term benefits of the solutions? Is the solution value for money? Is it ready to be used?	How much inconvenience could the installation and commissioning process create? Is the solution safe? Does it pose risks to privacy?	Will community members be satisfied with new product/service? Can the product/service be further evolved/improved to increase community member engagement? Can the solution integrate more, community level assets to increase revenue potential for community?	Can the solution be expanded to include more services / customisations, etc.? Can the solution integrate more, community level assets to increase revenue potential for community?
BARRIERS	Solution relatively new in market Unproven business case for demand response schemes Safety and privacy concerns User acceptance	Solution relatively new in market Unproven business case for demand response schemes Safety and privacy concerns User acceptance	Safety and privacy concerns User acceptance	Lack of technology acumen of community members Safety and privacy concerns User acceptance Too complicated to set up / pair with other components	User acceptance

Table 192. Customer journey analysis for potential customer segment #4: Local Authority

Potential customer segment #4: Local Authority	

ACTIONS	Communication with energy retailer, BMS provider, ESCO, etc. Market research	Request free trial Search for product/service reviews	Commercial agreement between customer and retailer, BMS provider, etc. / purchase order	Installation and commissioning of necessary equipment	Raise queries Provide feedback Write product/service review
MOTIVATIONS	Energy awareness Environmental consciousness Achievement of energy cost savings Opportunities for new revenue streams	Positive feedback and previous experience Happy with free trial	Save on energy bills at public buildings Promote energy efficiency (and EC's agenda) Increased energy awareness	Positive user experience Realisation of benefits (increase of comfort, convenience, cost savings and energy efficiency) Realisation of technical problems	Identified opportunities for product/ service improvement
TIMELINE	**Learning about product/service**	**Assessing value proposition**	**Purchasing**	**Using**	**Interacting after purchase**
QUESTIONS	What are the benefits that such a solution can offer? How intrusive is the solution? How does it compare to competitive technologies? Will building occupants accept the solution?	What are the benefits over competitive technologies? What are the long-term benefits of the solutions? Is the solution value for money?	How much inconvenience could the installation and commissioning process create to building occupants? Is the solution safe? Does it pose risks to privacy?	Can the product/service be further evolved/improved to increase community member engagement?	Can the solution be expanded to include more services / customisations, etc.? Can the solution integrate more, district-level assets to increase revenue potential for local authority?

BARRIERS	Solution relatively new in market Unproven business case for demand response schemes Safety and privacy concerns User acceptance	Solution relatively new in market Unproven business case for demand response schemes Safety and privacy concerns User acceptance	Safety and privacy concerns User acceptance	Lack of technology acumen of building occupants Safety and privacy concerns User acceptance	User acceptance

In relation with these customer journey maps, UC6's key activities, their output and the extent to which they are assessable, critical and timely have been specified (Table 124). As a result, the scope of the activities retained in the "Key activities" building block of the business model canvas has been refined.

Key interactions evidenced by the map to refine the analysis of CHANNELS

- Stakeholder ecosystem
- B2B collaboration (esp. with actors seeking to offer DR smart services, certified installers, ESCOs and energy product retailers)
- Targeted communication with existing clients
- Website (with online shopping platform) / social media
- Marketing and dissemination activities
- Cooperative / networking events
- Co-creation activities for product improvement (following up on user feedback)
- Documentation covering user concerns and issues (such as privacy policies, troubleshooting guides, etc.)

Table 193. Analysis of key activities

Activity	Assessable?	Critical?	Timely?	Output of the activity
Marketing of solution	Medium	High	Medium	Marketing campaign
Training of installers/commissioners (B2B scenario)	Medium	High	High	Trained personnel
Installation/commissioning (B2C scenario)	Medium	High	High	Deployed and fully functional solution
Create necessary documentation for addressing issues and concerns of users	Medium	High	Medium	Privacy policy Installation guide Troubleshooting manual
Measure customer satisfaction	High	Medium	Medium	Net promoter score Customer feedback and reviews

Website and online shop development	High	High	High	Website Online shop
Development of commercial product and service offerings	High	High	High	Commercial product Fully developed service offerings
Develop consumer / end-customer interfaces	High	High	High	App Web-based platform
Networking activities / customer engagement	Low	High	Medium	Increased number of clients
Provide technical support	Medium	High	High	Lower number of remaining troubleshooting tickets

Market and competition analysis to specify the VALUE PROPOSITION

MARKET AND COMPETITION ANALYSIS FOR VIRTUAL THERMAL ENERGY STORAGE MODULE IN EUROPE
Current competitors
Identification of key competitors and analysis of their positioning (products and/or services offered, value proposition, targeted customer segments…)
Demand-side management providers like Enel X (formerly EnerCON) offer customised solutions to commercial, institutional, and industrial businesses that want to participate in demand-side management programs, including energy efficiency and DR, without affecting business operations, comfort, or product quality. As for consumer's data aggregation, the WattDepot is an open-source software system available in the market for collecting and storing data from electricity meters from a smart grid. Regarding DR simulation strategies, Spara Hub® is a diagnostics application that uses data to simulate demand control actions and provides them on an energy dashboard. The Power Matcher technology uses virtual power plants that collect and cluster numerous distributed generators, responsive loads and electricity storage systems in a single operational unit. Defining automated or price-based DR strategies and dispatching signals to consumer cluster is a function implemented in Siemens DRMS, which solves the challenge of creating an automated, integrated, and flexible DR dispatching system. In addition, AutoGrid DROMS is a tool that includes customer enrolment, program management, load-shed forecasting, portfolio optimisation, customer notification, automated signals, and post event reporting. Kapacity.io provides electricity Load Balancing services, focused on buildings and specifically to electric heating and cooling appliances (heat pumps), PVs, batteries and EV charging. The aim of this company is to shift energy consumption in order to deflect high electricity prices, also taking into account CO2 emissions. Itron enables utilities and municipalities to offer energy and water infrastructure services (including remand response) to communities through a range of activities that include smart networks, software, services, meters, and sensors. Honeywell assists utilities by locating and enlisting promising clients, then creating shed strategies that are suited to the requirements of both the utility and the client. These strategies may include adjustment or shutting off specific equipment, pre-cooling of buildings, usage of emergency generators and optimal lighting operation. Cooper Power Systems provides smart grid technologies to utility, commercial, and industrial customers, including Advanced Metering Infrastructure (AMI), Demand Response (DR), Smart Sensors, Power Systems Engineering Software and Services, Substation Automation and Feeder Automation.
New entrants

Identification of (potential) new entrants and analysis of their positioning (products and/or services offered, value proposition, targeted customer segments…) *Identification of barriers to entry*
Most of the aforementioned competitors are either relatively new in the market or their products/services are relatively new. Barriers: Large market share of few dominant energy entities, low user buy-in/acceptability, unproven business case of demand response schemes, lack of regulatory frameworks for demand response, lack of incentives for participation in demand response schemes.

Substitutes
Identification of products and/or services that could act as substitutes. *Analysis of their value proposition, their advantages and drawbacks (notably in terms of performance and price) and of the factors that may motivate (or dissuade) customers to resort to them.*
Alternatives to VTES: From the point of view of electricity network operators looking to resolve grid constraints using DR schemes which utilise the virtual energy storage of buildings and thermal loads, alternatives could be the following: - Network upgrades, whereby the network operator upgrades their network to resolve their constraints. This alternative may not be the most cost-efficient option. It is also very time consuming. - Deployment of other flexible assets, such as distributed generation, storage (both stationary and mobile). The latter is also an alternative for product users, such as aggregators, ESCOs/ESCPs and energy communities. From a point of view of electricity customers, they can participate in DR schemes using other building-level flexible assets: - Storage assets (mobile and/or stationary) at building-level, - Smart appliances (white appliances for example that are smart enabled). From a point of view of energy retailers and building management system providers, commercially available smart home solutions could be an alternative. It should be noted, however, that none of the abovementioned alternatives offer the same exact services as the VTES module.

Suppliers and other actors in the value chain
Identification of key suppliers and other actors in the value chain and of their importance for the business model
Commercialisation of product: As previously mentioned, the VTES solutions will be mainly commercialised following a B2B approach (the B2C scenario is not discarded, it is however second in priority), whereby energy retailers, aggregators, BMS providers, ESCOs/ESCPs are targeted in the first instance, as they serve a large pool of customers. **Product evaluation:** End users are a vital part of the business model viability. They will be evaluating the solution and providing useful feedback and evidence for proving the business case of demand response in residential and commercial buildings. **Energy regulators:**

The lack of appropriate demand response regulatory frameworks is a barrier to the large-scale deployment of DR solutions. Regulatory authorities should be actively engaged and provided with evidence of the business cases developed for demand response schemes in order for relevant frameworks to be pushed high in the implementation agenda. Regulatory authorities may also be able to provide certain incentives to network operators for a higher uptake of DR schemes (as an alternative to costly and time-consuming network upgrades).

Stakeholders
Identification of other actors that may have an impact on the activity or the competitive environment (e.g., public authorities)
Energy regulators

ER's competitive advantage(s), relying on the above analysis:

No updates. Value proposition as before:
- Comfort-based flexibility offering
- Data-driven thermal comfort profiling
- Participation in explicit DR programs
- Delivery of dynamic energy tariffs (implicit DR)
- Monitoring, programming and configuration of smart energy appliances
- Automation and increased convenience
- New revenue streams for consumers
- New business models for Energy Communities
- Increased energy awareness through monitoring of energy consumption and indoor thermal conditions

Critical success factors for the considered business model(s)

Table 194. Critical success factors for UC 6

Critical success factor	Key metric	Data to be collected and sources
Proven positive DR business case	Positive CBA for main customer segments of solution	KPIs from demonstration activities, end-user feedback
End user buy-in	Increased customer acceptability for solution	Net Promoter Score, product sales, market share/value

REVENUE STREAMS and COST STRUCTURE

There are two main options concerning revenue streams explored:

Option 1: Software-as-a-Service

Advantages:

- The Software-as-a-Service (SaaS) approach does not require any intermediary parties for its deployment – the software component is centrally hosted and can be deployed (e.g., over a web-browser) easily (does not require any specialized knowledge from end-user) within seconds.
- The customer pays a subscription for the use of the software (e.g., on a monthly basis), therefore the customer does not need to pay a high upfront cost, making this approach attractive to a wider set of customers. Opportunities exist for charging customers (especially in the case of retailers, ESCOs, etc.) on a per user basis, meaning that a subscription fee is paid for every client the retailer, ESCO, etc. has.

- Provides the capability of developing a configuration/customization self-service interface, which allows customers to personalize their application.
- Updates to the software are more easily implemented as the software is centrally hosted and there is only one version that needs to be updated and maintained (the latest installed version on the central server/system).

Disadvantages:

- As the software and hence customer data are hosted centrally, security and privacy become a top priority issue.
- Due to inherent latency of response (as the software is centrally hosted), the SaaS approach is not appropriate for fast response DR scheme applications (which may require a response within a few milliseconds).
- Ongoing operating costs (for the maintenance, update and support required for the software) may be higher for Hypertech.

Option 2: i) Smart box purchases, ii) Licenses for software products

Advantages:

- Security measures are only implemented at the component development stage, using far less resources (both financial and human).
- The local deployment nature of this approach makes it suitable for DR schemes that require a fast response (within milliseconds).
- Lower operating costs for Hypertech.

Disadvantages:

- May be a less favourable option for B2B scenarios.
- Updates and maintenance of software versions becomes a time-consuming and cumbersome task, as there may be many versions of the product available on customer systems.

  For both options (Software-as-a-Service and Smart box purchases / Licenses for software products, the analysis below considers that a B2B approach will be followed, meaning that a smaller pool of customers (retailers, aggregators, ESCOs, BMS providers etc.) will be reselling Hypertech's products to their customers under a different commercial arrangement.

Table 195. Cost structures and revenue streams presentation

	Main revenue streams	Significant cost items
Software-as-a-Service	Software annual fee (billing per client) Training fees Platform Customisation (billing per client) Hosting and resources utilisation (billing per client) Annual Support fees (billing per client)	Operational costs: Personnel salaries (first years) for further development required for the solution to go-to-the-market. Operational costs: Personnel salaries (continuous) for continuous development/upgrade and configuration/customization of the service IT infrastructure Third party licenses (software fees) Website services Marketing and sales promotion (prior and after the starting of the actual sales) Accounting and legal fees for starting the business

Smart box purchases, Licenses for software products	Smart box installation (billing per client) Smart box /software products annual fee (billing per license) Training fees Smart box /software products Customisation (billing per client) Hosting and resources utilisation (billing per client) Annual Support fees (billing per client)	Equipment purchase Operational costs: Personnel salaries (continuous) for installation of smart box Operational costs: Personnel salaries (first year) for further development required for the solution to go-to-the-market. Operational costs: Personnel salaries (continuous) for continuous development/upgrade and configuration/customization of the service IT infrastructure Third party licenses (software fees) Website services Marketing and sales promotion (prior and after the starting of the actual sales) Accounting and legal fees for starting the business

Variables that will have the most significant impact on revenues:

- Solution acceptability by customer segments / customer buy-in
- Strength of DR schemes' business case
- Development (where not already existent) of regulatory framework for provision of DR services to interested parties
- Market size/share of customers interested in the solution
- Competition evolution
- Effectiveness of marketing campaign
- Availability of necessary equipment (microchip shortage)

Variables that will have the most significant impact on costs:

- User requirements for solution (especially in cases where personalisation/customisation of solution is requested)
- Cost of necessary equipment (increased prices due to unforeseen factors

Data necessary to build estimates and potential sources:

- *Equipment price*
- *Personnel cost*
- Third party licenses price

5.7 Use Case 7 Dispatching platform for MV generation

Use Case #7: Dispatching platform for MV generation	
Lead partner	*EDYNA*
Working group members	*VERD, ATOS, SELTA, LINKS, CIRCE*

Customer segments analysis

Five potential customer segments have been identified for the dispatching platform for MV generation: i) network operators (TSOs, DSOs), ii) aggregators/ESCOs and retailers, iii) RES energy producers, iv) commercial and Industrial (C&I) customers, and v) residential customers. Their analysis is presented in Table 196 to Table 200 in the appendix.

Knowledge about customer segments to refine the analysis of *CUSTOMER RELATIONSHIPS*

Network operators
- *Sales representatives*
- *Workshops, conferences and events*

Aggregators/ESCOs and retailers
- *Sales representatives*
- *Company website and dedicated website giving access to non IP-sensitive results*

RES energy producers
- *Sales representatives*
- *Workshops, conferences and events*

C&I customers
- *Local support*
- *Sales representatives*
- *Company website and dedicated website giving access to non IP-sensitive results*

Residential customers
- *Sales representatives*
- *Company website and dedicated website giving access to non IP-sensitive results*

Customer journey analysis

An analysis of the customer journey has been performed for the different customer segments (Table 201 to 205 in the appendix). Its results are presented in Table 206 to Table 208.

Table 206. Customer journey analysis for potential customer segment #1: Network Operators

Potential customer segment #1: Network Operators					
ACTIONS	Options search for load and generation forecasting	Contact software providers and pre-evaluate systems Take offers from software providers	Define requirements Procure through tender		

MOTIVATIONS	Ensure grid quality Increase RES penetration	Reduce network planning and operation cost	Increase quality and cost of service to customers		
TIMELINE	**Learning about product/service**	**Assessing value proposition**	**Purchasing**	**Using**	**Interacting after purchase**
QUESTIONS	How does it work?	Can I have a demo and/or trial version?	How much will it cost?	How do I integrate? How to I use? What is its reliability and uptime? How to I extend functionalities?	Could you assist with the problem?
BARRIERS	Product accessibility	Competition	Reduced buy-in/lack of resources	Too complex legacy systems to integrate	

Table 207. Customer journey analysis for potential customer segment #2: Aggregators/ESCOs and RES producers

Potential customer segment #2: ***[AGGREGATORS/ESCOs] and RES producers***					
ACTIONS	Search for options for load and generation forecasting	Contact software providers and pre-evaluate systems Take offers from software providers	Define requirements Procure through tender		
MOTIVATIONS	Improve quality of services for our customers	Reduce imbalance costs in markets			
TIMELINE	**Learning about product/service**	**Assessing value proposition**	**Purchasing**	**Using**	**Interacting after purchase**
QUESTIONS	How does it work?	Can I have a demo and/or trial version?	How much will it cost?	What is its reliability and uptime? How do I integrate? How do I extend functionalities?	Could you assist with the problem?
BARRIERS	Product accessibility	Competition		High cost	

Table 208. Customer journey analysis for potential customer segment #3: C&I customers

Potential customer segment #3: C&I customers					
ACTIONS	Need to look at options for load and generation forecasting	Contact software providers Take offers from software providers		Use the software to facilitate on-site RES penetration	Ad-hoc assistance from software providers
MOTIVATIONS	Improve on-site RES penetration Do not interrupt business-as-usual operation		Find the most profitable offer from software providers		Be able to use state-of-art services
TIMELINE	**Learning about product/service**	**Assessing value proposition**	**Purchasing**	**Using**	**Interacting after purchase**
QUESTIONS	How does it work?	Can I have a demo and/or trial version?	How much will it cost?		Could you assist with the problem?
BARRIERS	Product accessibility	Competition			

In relation with these customer journey maps, UC7's key activities, their output and the extent to which they are assessable, critical and timely have been specified (Table 139). As a result, the scope of the activities retained in the "Key activities" building block of the business model canvas has been refined.

Key interactions evidenced by the map to refine the analysis of CHANNELS

CHANNELS

- Company website with non IP-sensitive material
- Online and printed marketing tools
- Media and social media
- B2B bilateral direct communications through sales department
- Awareness raised by government and regulations promoting new policies and market schemes
- Workshops conducted by network operators on new markets' design and operation

Table 209. Analysis of key activities

Activity	Assessable?	Critical?	Timely?	Output of the activity
Market analysis	*High*	*High*	*Medium*	*Understanding of competition and target markets*
Identification, assessment and comparison of the technological solutions for monitoring and control	*Medium*	*Low*	*High*	*Understanding of competition and potential gaps in the existing markets*

systems in the distribution network and in the customer premises				
Testing of algorithms (simulation, small scale demonstration)	*High*	*Medium*	*Medium*	*Product testing and refinement*
Performance test of the developed applications in a real grid	*High*	*High*	*High*	*Final product refinement and customisation to specific clients' needs*
Cooperation with other projects and networking	*High*	*Medium*	*Low*	*Development of new ideas, potential overcoming of obstacles, creation of new market opportunities*
Business development and marketing	*High*	*High*	*Low*	*Identification of target market and clients*
Development of a turn-key solution	*High*	*High*	*High*	*Product development*
Adaptation and customisation of the turn-key solution	*High*	*High*	*High*	*Customised product to fit the specific needs of particular clients*
Continuous updating to comply with market rules and tariff structure	*Medium*	*Medium*	*Low*	*The product remains at any point state-of-the-art*

Update of the "Key Activities" block

KEY ACTIVITIES

- Market analysis
- Identification, assessment and comparison of the technological solutions for monitoring and control systems in the distribution network and in the customer premises
- Testing of algorithms (simulation, small scale demonstration)
- Performance test of the developed applications in a real grid
- Cooperation with other projects and networking
- Business development and marketing
- Development of a turn-key solution
- Adaptation and customization of the turn-key solution
- Continuous updating to comply with market rules and tariff structure

Market and competition analysis to specify the VALUE PROPOSITION

MARKET AND COMPETITION ANALYSIS FOR SOFTWARE MODULE FOR FORECASTING AND GRID OPERATION IN EUROPE

Current competitors
Meteologica
Meteologica offers forecasting services for wind and solar farms on a global scale since 2004. They offer short, medium and long-term forecasts for a variety of weather-driven variables[10] such

as generation of RES, power demand, temperature and spot prices by country, market area or specific sites
EDF store and forecast *EDF store and forecast have four distinct solutions for their customers. PVSCOPE™ calculates the PV production forecast the day before for the next day and an intraday basis. SKYSCOPE™ generates a forecast for PV production in the very short term (time horizon of 15 minutes). EOLSCOPE™ calculates the wind production forecast up to 3 days upstream and intraday by combining weather forecasts and production measurements taken in real time. CONSOSCOPE™ forecasts electricity consumption over an intraday horizon up to D+7. It combines temperature forecasts and other local weather variables that influence consumption, integrates triggers for industrial use or load shedding and relies on real-time consumption measurements for better accuracy.*[11]
Enfor *Enfor use a variety of tools to produce PV, wind and hydro generation forecasts, as well as heat and electricity demand forecasts. They also offer a total forecasting service delivering country level forecasts for solar and wind power production as well as electricity load.*[12]
Energymeteo *Energymeteo offer individually customised solar and wind forecasting services. In addition, they offer grid and plant operators as well as power traders real-time projections for solar power including behind-the-meter generation and grid-oriented forecasts. They also offer a web-based customer portal allowing their customers to capture their measurement and prediction data at a glance.*[13]
NextKraft Werke *Next offer live monitoring, forecasting and now casting solution to energy traders, RES portfolio operators and utilities called NEMCOS.*[14]
AleaSoft *AleaSoft offer energy price, demand, and renewable energy forecasting services. Their value proposition lies on the highly reliable forecasts for prices, demand and renewable energy, adapted to the needs of the energy market for the short, medium and long-term horizons. Their target clients are all companies in the energy sector: TSOs, utilities, traders, retailers, large and electro intensive consumers, renewable energies, investment funds and banks.*[15]

New entrants
Identification of (potential) new entrants and analysis of their positioning (products and/or services offered, value proposition, targeted customer segments…)
Barriers to entry •*High competition in the field of forecasting services* •*Software companies create dedicated products* *RES developers and Aggregators often use their in-house products thus they do not need specific services from third parties*

Substitutes
Identification of products and/or services that could act as substitutes *Analysis of their value proposition, their advantages and drawbacks (notably in terms of performance and price) and of the factors that may motivate (or dissuade) customers to resort to them*
In-house software *Value proposition: Companies may build their own forecasting algorithms/software in order to avoid going out to the market and seeking a customised solution to their needs*
Forecasting module included in a wider purpose software (e.g., VPP software)

Suppliers and other actors in the value chain
Identification of key suppliers and other actors in the value chain and of their importance for the business model
Weather forecast companies
IT companies
RES producers who could use their sites to validate the developed solutions
Facility managers
Network operators

Stakeholders
Identification of other actors that may have an impact on the activity or the competitive environment (e.g., public authorities)
Public authorities
Regulators
Utilities
Facility management consultants
Energy experts

Update of the "Value Propositions" block, highlighting the competitive advantage

VALUE PROPOSITION

- Forecasting algorithms to accurately predict energy generation, demand and electricity price
- Optimisation algorithm taking advantage of the forecasting results and suggesting grid operation orders
- Provision of optimal settings for network controllable assets, prevention of network congestion

Critical success factors for the considered business model(s)

Table 210. Critical success factors for UC 7

Critical success factor	Key metric	Data to be collected and sources
1. **Forecast accuracy**	%error	PV production and load demand
2. **Reliability/Uptime**	%time	PV production and load demand
3. **Cost to run and maintain**	Hardware/software resources and personnel	Resources used and average time to maintain
4. **For C&I customers: evolution of electricity and CO2 costs, reliability indices**	Number of sales of battery systems, electricity and carbon prices	Average electricity cost

REVENUE STREAMS and COST STRUCTURE

The main revenue streams and the most significant cost items is the License per year per site

Alternative Option

Market this as a bundle with ER7 to provide a holistic forecasting and scheduling service

Variables that will have the most significant impact on revenues:

- Number of customers
- Number of sites
- Customer maintenance which is linked with persisting product quality (stable and satisfactory forecast accuracy)

Variables that will have the most significant impact on costs:

- Integration costs with client
- Training and support required
- Maintenance costs
- Customization/upgrade costs

5.8 Use Case 8 Isolated valley grid operating in islanding mode

Use Case #8: Isolated valley grid operating in islanding mode	
Lead partner	*EDYNA*
Working group members	*ATOS, SELTA, CIRCE, LINKS*

Customer segments analysis

Three potential customer segments have been identified for the isolated valley grid operating in islanding mode: i) DSOs, ii) aggregators, iii) RES producers. Their analysis is presented in Table 211 to Table 213 in the appendix.

Knowledge about customer segments to refine the analysis of *CUSTOMER RELATIONSHIPS*

CUSTOMER RELATIONSHIPS
Network operators
- *Sales representatives*
- *Workshops, conferences and events*

Aggregators
- *Sales representatives*
- *Company website and dedicated website giving access to non IP-sensitive results*

RES energy producers
- *Sales representatives*
- *Workshops, conferences and events*

Customer journey analysis

An analysis of the customer journey has been performed for the different customer segments (Table 213 to 215 in the appendix). Its results are presented in Table 216 to Table 217.

Table 216. Customer journey analysis for potential customer segment #1: DSOs

Potential customer segment #1: DSOs					
ACTIONS	Options search for islanded grid mode	Contact software providers and pre-evaluate systems	Define requirements Procure through tender		

		Take offers from software providers			
MOTIVATIONS	Ensure a rapid re-energization of the costumers on its grid	Reduce network operation cost and the SAIDI	Increase quality and cost of service to customers		
TIMELINE	**Learning about product/service**	**Assessing value proposition**	**Purchasing**	**Using**	**Interacting after purchase**
QUESTIONS	How does it work?	Can I have a demo and/or trial version?	How much will it cost?	How do I integrate? How to I use? What is its reliability and uptime? How to I extend functionalities?	Could you assist with the problem?
BARRIERS	Product accessibility	Competition	Reduced buy-in/lack of resources	Too complex legacy systems to integrate	

Table 217. Customer journey analysis for potential customer segment #2: Aggregators and RES producers

Potential customer segment #2: AGGREGATORS and RES producers					
ACTIONS	Search for options for islanded mode	Contact software providers and pre-evaluate systems Take offers from software providers	Define requirements Procure through tender		
MOTIVATIONS	Improve a new service to sell	Reduce the stops of production			
TIMELINE	**Learning about product/service**	**Assessing value proposition**	**Purchasing**	**Using**	**Interacting after purchase**
QUESTIONS	How does it work?	Can I have a demo and/or trial version?	How much will it cost?	What is its reliability and uptime? How do I integrate? How	Could you assist with the problem?

				do I extend functionalities?	
BARRIERS	Product accessibility	Competition		High cost	

In relation with these customer journey maps, UC8's key activities, their output and the extent to which they are assessable, critical and timely have been specified (Table 149). As a result, the scope of the activities retained in the "Key activities" building block of the business model canvas has been refined.

Key interactions evidenced by the map to refine the analysis of CHANNELS

CHANNELS

- Company website with non IP-sensitive material
- Online and printed marketing tools
- Media and social media
- B2B bilateral direct communications through sales department
- Awareness raised by government and regulations promoting new policies and market schemes
- Workshops conducted by network operators on new markets' design and operation

Table 218. Analysis of key activities

Activity	Assessable?	Critical?	Timely?	Output of the activity
Market analysis	*High*	*High*	*Medium*	*Understanding of competition and target markets*
Identification, assessment and comparison of the technological solutions for monitoring and control systems in the distribution network and in the customer premises	*Medium*	*Low*	*High*	*Understanding of competition and potential gaps in the existing markets*
Testing of algorithms (simulation, small scale demonstration)	*High*	*Medium*	*Medium*	*Product testing and refinement*
Performance test of the developed applications in a real grid	*High*	*High*	*High*	*Final product refinement and customisation to specific clients' needs*
Cooperation with other projects and networking	*High*	*Medium*	*Low*	*Development of new ideas, potential overcoming of obstacles, creation of new market opportunities*
Business development and marketing	*High*	*High*	*Low*	*Identification of target market and clients*

Development of a turn-key solution	*High*	*High*	*High*	*Product development*
Adaptation and customisation of the turn-key solution	*High*	*High*	*High*	*Customised product to fit the specific needs of particular clients*
Continuous updating to comply with market rules and tariff structure	*Medium*	*Medium*	*Low*	*The product remains at any point state-of-the-art*

Update of the "Key Activities" block

KEY ACTIVITIES

- Market analysis
- Identification, assessment and comparison of the technological solutions for monitoring and control systems in the distribution network and in the customer premises
- Testing of algorithms (simulation, small scale demonstration)
- Performance test of the developed applications in a real grid
- Cooperation with other projects and networking
- Business development and marketing
- Development of a turn-key solution
- Adaptation and customization of the turn-key solution
- Continuous updating to comply with market rules and tariff structure

Market and competition analysis to specify the VALUE PROPOSITION

MARKET AND COMPETITION ANALYSIS FOR [Use Case 2]

Current competitors
Identification of key competitors and analysis of their positioning (products and/or services offered, value proposition, targeted customer segments…)
No competitor is known at the moment. On the market, a product to manage the grid in islanded mode is not present.

New entrants
• *Identification of (potential) new entrants and analysis of their positioning (products and/or services offered, value proposition, targeted customer segments…)* • *Identification of barriers to entry*
Who will offer a product/software for managing islanded mode will enter in a new market. The difficulties will be in to offer a product modulable adapted for all situation and condition.

Substitutes
• *Identification of products and/or services that could act as substitutes* • *Analysis of their value proposition, their advantages and drawbacks (notably in terms of performance and price) and of the factors that may motivate (or dissuade) customers to resort to them*
In-house software *Value proposition: Companies may build their own forecasting algorithms/software in order to avoid going out to the market and seeking a customised solution to their needs*

Suppliers and other actors in the value chain

Identification of key suppliers and other actors in the value chain and of their importance for the business model
DSO and MV producers are the main actors. Without an agreement between DSO and producer for the technical aspects, any islanded mode is impossible.

Stakeholders
Identification of other actors that may have an impact on the activity or the competitive environment (e.g., public authorities)
National Regulator Authority
Aggregator
TSO

Update of the "Value Propositions" block, highlighting the competitive advantage(s)]

Algorithm to optimizing the islanded mode: regulate power, voltage and frequency of the power plants involved to ensure the respect the correct values for the costumers connected to the grid

Critical success factors for the considered business model(s)

Table 219. Critical success factors for UC 8

Critical success factor	Key metric	Data to be collected and sources
1.Success of islanded mode	% of success	Number of tries of passage in islanded mode with success
2.Maintenance of islanded mode	Time	Time of maintenance of the grid in islanded mode without outage of the service. The islanded mode will terminate with command of DSO
3.Manintence of the values of the supplier	Values of voltage and frequency	The values of voltage and frequency at the points of supplier of all costumers must be ever in the standard limits
4.Cost to run and maintain	Hardware/software resources and personnel	Resources used and average time to maintain

REVENUE STREAMS and COST STRUCTURE

An alternative option would be to manage the islanded mode with an agreement between DSO and producer, without a specific software

Variables that will have the most significant impact on revenues:

- Number of producers
- Number of costumers connected to the grid in islanded mode

Variables that will have the most significant impact on costs:

- Update of the power plant to adapt it for managing the islanded mode
- Training and support required
- Maintenance costs
- Customization/upgrade costs

Data necessary to build estimates and potential sources:

- Results from Italian demo site
- Check how many power plant are already available to manage a grid in islanded mode and how much it costs to adapt them

6 CONCLUSION

6.1 A new step in the business model development process

This deliverable constitutes the third of four yearly reports over the course of the FLEXIGRID project dedicated to the FLEXIGRID exploitable results' business model development.

The market environment has registered significant evolutions in this third year of implementation of the project, marked by the short-term impact of the Covid-19 pandemic on the energy sector, but also by the more long-term perspectives emerging from the new targets set by the EU within the framework of the European Climate Law and the Fit for 55 package.

As explained in the previous deliverable (D8.2), Croatia and Spain, two EU member States where FLEXIGRID demonstration activities are implemented, have also defined specific objectives in terms of GHG emission reduction and RES development, which have important implications for energy stakeholders in both countries. This deliverable proposes an in-depth analysis of the market context in these two countries, focusing notably on the distribution network level and on the perspectives of development of smart grid and flexibility solutions.

This year deliverable (D8.3) also analyses in depth the two other countries where FLEXIGRID demonstration activities are implemented: Italy and Greece. Similarly to Spain and Croatia, these two EU member States, also have defined specific objectives in terms of GHG emission reduction and RES development, which have important implications for energy stakeholders in both countries. Thisdeliverable proposes the same an in-depth analysis of the market context in these two countries as done previously, focusing notably on the distribution network level and on the perspectives of development of smart grid and flexibility solutions.

Besides, this deliverable presents the results of the reflection carried out within the framework of working groups for both the refinement and update of the business models designed for the nine FLEXIGRID solutions and the definition of exploratory business models for four other ERs identified within the framework of the development of the Exploitation Strategy.

6.2 Implications for next steps

In the next steps of the business model development process, the market outlook analysis will have to be updated, taking into account possible context and policy evolutions.

In addition, the business models designed for FLEXIGRID exploitable results will have to be updated, taking into account advances in their development and demonstration, and complemented by a reflection at the level of the use cases.

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8 APPENDIX

8.1 Appendix 1: Methodology to refine the exploratory business models designed in D8.1

Over the first twelve months of the FLEXIGRID project, exploratory business models have been designed for the nine individual FLEXIGRID solutions. CAP defined and proposed to the partners a methodology resting on A. Osterwalder and Y. Pigneur's Business Model Canvas and the corresponding template. At these early stages of the business model development process, the choice was made to focus more specifically on four of the Canvas's building blocks: customer segments, value propositions, revenue streams and cost structure. The analysis was conducted within the framework of working groups gathering all the partners involved in the development of each solution, coordinated by one or several lead partner(s). The exploratory business models designed were then discussed and refined during progress meetings between CAP and the lead partner(s) of each working group.

The present note proposes a methodology and template to revisit these exploratory business models, with two objectives:

i) further refining the analysis on some of the Canvas's key building blocks, notably byconsidering the interactions between them;
ii) and preparing for the beginning of the demonstration campaign implementation and of the cost-benefit analysis, by focusing on the exploratory business models' applicability.

The proposed steps are the following:

Reviewing the exploratory business models designed in D8.1

✓ Checking that the exploratory business model designed for each exploitable result(ER) in D8.1 can be considered as an up-to-date starting point

In light of the advances in the development of solutions which have intervened since the finalisation of D8.1, working group members may wish to modify and/or update some elements presented in the exploratory Business Model Canvas. Business model definition should indeed be viewed as a dynamic, evolving process, throughout – and beyond – the ER's development.

✓ Considering alternative business models for each ER

The first step of the business model development process consisted in the definition of an exploratory business model for each ER, which was presented in D8.1. Some of these exploratory business models include various possible options, especially regarding potential revenue streams. The approach consisting in considering multiple potential business models – possibly distinct from the ones retained for other products/services already provided by the partners – should be systematised. A. Osterwalder indeed underlines that "*exploring the possibilities is critical to finding a successful business model. Settling on first ideas risks the possibility of missing potential that can only be discovered by prototyping and testing different alternatives*" (A. Osterwalder, quoted by A. J. Bock and G. George, 2018). Working groups may therefore brainstorm and come up with several options to be explored further.

⇨ This review will ensure to have an up-to-date starting point for the next steps, whichaim at refining specific blocks of the Business Model Canvas.

Refining the analysis of CUSTOMER SEGMENTS and RELATIONSHIPS

✓ Specifying customer segmentation (*CUSTOMER SEGMENTS* block)

Potential customer segments for each ER have been identified in the dedicated block of the Business Model Canvas. To specify them, two elements have to be considered:

- the profile and characteristics of these customers;
- and the value for which they are willing to pay.

This analysis can be realised with the support of the template presented in Table 80, adapted from A. J. Bock and G. George (n.d.).

Table 220. Template for customer segment analysis

Potential segment #1: [Name of the segment]	
Relevant characteristics[7]	
Segment **size** (current size and expected growth)	
Hypothesised customer **needs and aspirations**	
Hypotheses about segment **purchasing behaviour and criteria**	
Information and data required to verify these hypotheses	

Source: adapted from A. J. Bock and G. George (n.d.)

This step allows to deepen knowledge about customer segments (characteristics, size) and to shed light on the key assumptions made about their needs, aspirations and behaviour.[8] It can also help to specify the information and data that needs to be collected (possibly within the framework of the demonstration campaign) in order to verify these assumptions.

This analysis, and especially the estimates regarding customer segments' size and purchasing behaviour, is key to determine which potential customer segments are the most important and should be addressed first (A. J. Bock and G. George, 2018).

This step also lays the groundwork for the identification of the risks associated to this specific section of the Business Model Canvas, which will be useful for the evaluation of the considered business model(s) (to be performed at a later stage).

✓ Leveraging this knowledge about customer segments to refine the analysis of *CUSTOMER RELATIONSHIPS*

The knowledge about customer segments can be used to specify the type of relationship(s) that should be favoured for each of them. A. J. Bock and G. George suggest considering requirements on two dimensions to characterise it:

- "*proximity*", which "*refers to how close or direct the relationship is*";
- and "*engagement*", which "*refers broadly to the level of interaction and contribution to the relationship*" (A. J. Bock and G. George, 2018).

Another question that needs to be addressed is whether these relationships will vary from one customer segment to another (A. J. Bock and G. George, 2018).

Studying the customer journey to refine the analysis of CHANNELS and KEY ACTIVITIES

✓ Designing a customer journey map

A customer journey map is a tool which depicts and allows to visualise customers' interactions with the solution provider within the framework of the purchase and use of its products or

[7] Examples of relevant characteristics may include, in the case of business customers, their size, location, and/or industry/sector; however, A. J. Bock and G. George underline that "*the critical determinant of whether two customers are in the same segment is whether, for a given situation, they make the same purchasing decision*" (A. J. Bock and

G. George, n.d.).

[8] The literature review and survey realised within the framework of Deliverable 2.3 (*Stakeholders' Common Requirements Report*) provide insights on these issues.

services (A. J. Bock and G. George, n.d.). In order to build it, the following methodology, inspired by A. J. Bock and G. George (n.d.), can be followed:

i) Answering the questions in Table 81, by adopting the customer's viewpoint:

Table 221. Template for customer journey map design (step 1)

Potential customer segment #1: [Name of the segment]	
Problem faced by the customer	
How the customer can **learn** about the product orservice	
How the customer can **assess** the product or service's value proposition before the actual purchase	
How the customer can **purchase** the product or service	
How the customer can **use** the product or service	
How the customer **interacts** with the company after the purchase	

Source: adapted from A. J. Bock and G. George (n.d.)

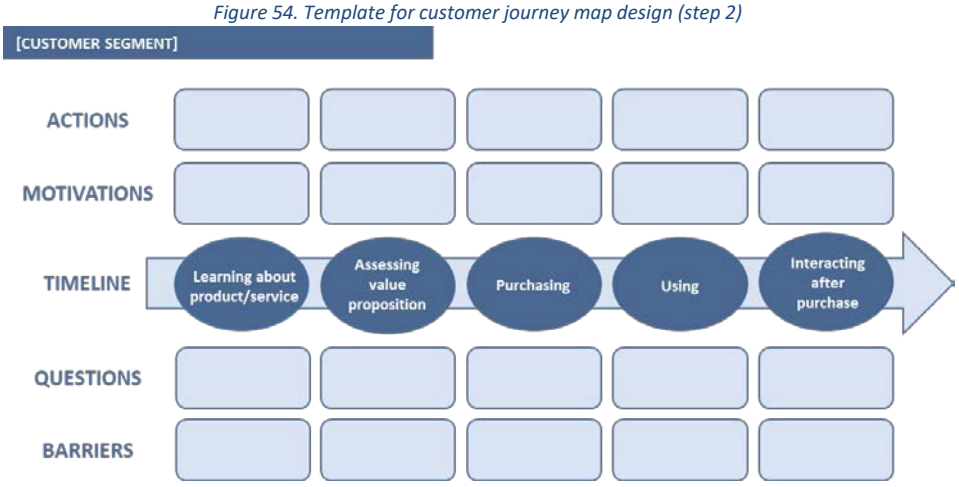
ii) Drawing a customer journey map encompassing all of these steps

The customer journey map should highlight, in a visual, clear and simple way, the "*key moments, events, information, or interactions in the process*" (A. J. Bock and G. George, n.d.). To design it, A. Richardson proposes a framework articulated around the "*timeline*", which covers the different steps followed by the customer (corresponding to Table 81 above) and, for each of these steps, the analysis of:

- "*actions*" undertaken by the customer;
- "*motivations*", defined as the customer's "*emotions*" at this stage and her "*[reasons] to keep going to the next stage*";
- "*questions*", which are "*the uncertainties […] or other issues preventing the customer from moving to the next stage*";
- and "*barriers*", which may especially be "*structural, process, cost, implementation*" (A. Richardson, 2010).

The proposed template (Figure 54) may of course be adapted depending on the ER and on customer segments' specificities. In particular, the step concerning the use of the product/service can be broken down into several stages.

Figure 54. Template for customer journey map design (step 2)



Source: adapted from A. Richardson (2010)

✓ Focusing on the key interactions evidenced by the map to refine the analysis of CHANNELS

The customer journey map can be used to evidence key interaction points between the solution provider and the customer. This analysis can help to refine the definition of the channel(s) that should be mobilised by the solution provider at each of these points.

Besides, the design of the customer journey map invites the solution provider to consider customer needs and anticipate the questions that customers may have and the issues and barriers that they may face at each step. It should therefore facilitate the identification of the stages at which service can be improved to ease or enhance customer experience and trigger a reflection on how to do so.

✓ Leveraging the customer journey map to refine the analysis of KEY ACTIVITIES

In order to point out the solution provider's activities which are key to the considered business model, A. J. Bock and G. George propose to use three criteria: these activities should be "*assessable, critical and timely*" (A. J. Bock and G. George, 2018). The customer journey map can be used to identify them. It indeed evidences key steps, processes and interactions throughout the product or service's lifecycle, which should be covered by one or several key activity(ies) of the solution provider (A. J. Bock and G. George, 2018). Then, in order to evaluate each activity's contribution to the business model, A. J. Bock and G. George suggest using the template presented in Table 82 (A. J. Bock and G. George, n.d.).

Table 222. Template for the analysis of key activities

Activity	**Assessable?** (High/Medium/Low)	**Critical?** (High/Medium/Low)	**Timely?** (High/Medium/Low)	**Output of the activity**

Source: adapted from A. J. Bock and G. George (n.d.)

Carrying out a market and competition analysis to specify the VALUE PROPOSITION

According to A. J. Bock and G. George, the definition of a product or service's value proposition is a process which entails:

- "*Identifying the pain or gain.*
- *Demonstrating that the product/service addresses the customer need.*
- *Linking the value proposition to the competitive advantage.*" (A. J. Bock and G. George, 2018).

The analysis carried out for each ER in D8.1, with the support of the Value Proposition Canvas, has initiated a reflection on the first two steps of this process. The proposed market and competition analysis aims to focus on the third step and is also useful to prepare for the identification of the strengths, weaknesses, opportunities and threats associated to the considered business model(s), which will be part of their evaluation (to be performed at a later stage).

In order to analyse the competitive environment, A. Osterwalder and Y. Pigneur propose a framework which includes the study of the "*sector forces*" (Table 83) (A. Osterwalder and Y. Pigneur, 2011). The elements that it suggests considering are reminiscent of M. Porter's model of the "*five competitive forces that shape strategy*" (M. E. Porter, 2008). These forces - namely the "*rivalry among existing competitors*", the "*threat of entry*", the "*power of suppliers*" and that

of "*buyers*", and the "*threat of substitutes*" - and their relative strength are characteristic features of a given industry's structure (M. E. Porter, 2008). The latter, in turn, "*determines the industry's long-run profit potential because it determines how the economic value created by the industry is divided*" (M. E. Porter, 2008). M. Porter underlines that this analysis should be realised with a dynamic approach, taking into account recent and expected changes and trends that may influence each force (M. E. Porter, 2008).

Table 223. Template for market and competition analysis

MARKET AND COMPETITION ANALYSIS FOR [Exploitable Result] IN [Country/Region/At the global scale]
Current competitors
Identification of key competitors and analysis of their positioning (products and/or services offered, value proposition, targeted customer segments…)
New entrants
Identification of (potential) new entrants and analysis of their positioning (products and/or services offered,value proposition, targeted customer segments…) *Identification of barriers to entry*
Substitutes
Identification of products and/or services that could act as substitutes[9]
Analysis of their value proposition, their advantages and drawbacks (notably in terms of performance and price) and of the factors that may motivate (or dissuade) customers to resort to them
Suppliers and other actors in the value chain
Identification of key suppliers and other actors in the value chain and of their importance for the business model
Stakeholders
Identification of other actors that may have an impact on the activity or the competitive environment (e.g., public authorities)

Source: adapted from A. Osterwalder and Y. Pigneur (2011)

Once this analysis has been carried out, its results can help to identify the specificities which differentiate the ER from rival solutions or potential substitutes and constitute its competitive advantage(s). A. J. Bock and G. George define "*an 'unfair advantage' [as] something that competitors cannot easily copy, acquire or otherwise execute*"; the examples that they provide involve protected intellectual property, specific expertise or experience, or long-term contractual relationships with key partners, among others (A. J. Bock and G. George, 2018). This competitive advantage may exist from the onset; however, it may also be acquired only at a later stage and/or built over time (A. J. Bock and G. George, 2018). In both cases, "*the business model needs to guide the firm towards sustainable competitive advantage*" (A. J. Bock and G. George, 2018).

The competitive advantage, either existing or to be developed, should be highlighted in the ER's value proposition, as it participates in its differentiation. The other building blocks of the Business Model Canvas can also be re-examined in light of it, in order to make sure that they

capitalise on this advantage or, conversely, that they contribute to its development and its sustainability (A. J. Bock and G. George, n.d.).[1]

Identifying the critical success factors for the considered business model(s)

The market analysis and the Business Model Canvases realised within the framework of D8.1, as well as their refinement by means of the above-mentioned steps, should be leveraged to identify the critical success factors (CSFs) that will condition the viability and sustainability of the business model(s) considered for each ER. Identifying these CSFs can be useful for the preparation of the demonstration campaign, as well as for the evaluation, at a later stage, of the considered business model(s) and the analysis of the risks associated to them.

A. J. Bock and G. George propose a template (Table 84) in order to identify the CSFs and specify them by defining related key metrics and required data (A. J. Bock and G. George, 2018).

Table 224. Template for the identification of critical success factors

Critical success factor	Key metric	Data to be collected and sources
1.		
2.		
3.		
4.		
5.		

Source: adapted from A. J. Bock and G. George (n.d.)

The CSFs may be related to:

- the opportunity itself: in this case, they may especially be linked to the analysis of the market context and trends and of the competitive environment, and to the "customer segments" block of the Business Model Canvas;
- the way in which the solution provider is addressing it: in this case, the CSFs may notablybe linked to the "value propositions", "key resources" and "key activities" blocks (A. J. Bock and G. George, 2018).

Key metrics should be associated with each of the CSFs. They consist in quantifiable indicators allowing to test whether the conditions are fulfilled (A. J. Bock and G. George, 2018). The data required to validate or invalidate these hypotheses should be identified and the sources for its collection should be specified. The demonstration campaign can be one of these sources.

Documenting the REVENUE STREAMS and COST STRUCTURE

The business models presented in D8.1 include an exploratory analysis of potential revenue streams and of the main expected cost items associated with each ER. This last step aims at refining this analysis.

✓ Considering alternative options

"Revenue streams" and, to a lesser extent, "cost structure" are building blocks for which it is particularly important to consider various possibilities and analyse the advantages and drawbacks of alternative options before retaining a given business model. Ideas on the hypotheses that may be contemplated could especially be drawn from:

- the knowledge about customer segments that has been gathered, which should have

[1] The exploitation strategy (developed within the framework of task 8.5) and IPR management (task 8.3) can play a key role to achieve this objective

9 According to M. Porter's definition, "*a substitute performs the same or a similar function as an industry's product by a different means*" (M. E. Porter, 2008).

highlighted the value for which they are willing to pay, and may also help to specify howthey want to pay for it;
- the market and competition analysis, which may have evidenced the practices of competitors (or even providers of substitutes) in terms of pricing, their revenues and their cost structure.

This does not imply that the choices made for the ER should be aligned with competitors'. However, the solution provider should be aware of the similarities and differences between the considered business model(s) and the ones existing in the industry and of the reasons justifying them.

✓ Building a spreadsheet detailing the elements necessary to build estimates of the main revenue streams and cost items

Once the options to be considered are selected, the next step is to create a matrix on a spreadsheet identifying the main revenue streams and the most significant cost items and decomposing them into underlying variables which are necessary to compute them (examples of the elements to be considered in the case of revenue streams are provided in Table 85). This analysis should help to:
- identify the variables which will have the most significant impact on either costs orrevenues;
- specify the data necessary to build estimates and identify potential sources (specific research, benchmarks, demonstration campaign…).

Table 85. Elements to be taken into account to decompose revenue streams into underlying variables

For each revenue stream:
- The targeted customer segments, their potential size, and hypotheses regarding customer acquisition (e.g., market share and its evolution over time)
- The time frame, which depends on the nature of the revenue stream:
  - If it is one-time: when will it intervene?
  - If it is recurring: at which frequency will it be charged?
- The pricing mechanism which will be used for the revenue stream's computation: on which elements will it depend?
  - If it is fixed: on the solution's features or options? the customer segment?
  - If it dynamic: on a negotiation? an auction? a market?

This step is a key prerequisite to:
- identify underlying hypotheses and specify how they can be tested within the framework of the demonstrations;
- build estimates, which will in turn be used to assess the profitability of the considered business model(s).

Appendix 2: Template to refine the exploratory business models designed in D8.1

This template is intended to be used in conjunction with the methodology, which provides the guidelines and references corresponding to each proposed activity. It only aims at facilitating the gathering of inputs within the framework of the working groups.

Exploitable Result #[Number of the ER]: [Name of the ER]	
Lead partner	
Working group members	

Reviewing the exploratory business model designed in D8.1

✓ **Checking that the exploratory business model designed for the ER in D8.1 canbe considered as an up-to-date starting point**

[Please use the template below to update the exploratory business model presented in D8.1, if necessary]

Business Model Canvas for ER #[Number of the ER] – [Name of the ER]
Lead partner: [Name]

KEY PARTNERS	***KEY ACTIVITIES***	***VALUE PROPOSITIONS***	***CUSTOMER RELATIONSHIPS***	***CUSTOMER SEGMENTS***
	KEY RESOURCES		***CHANNELS***	
COST STRUCTURE			***REVENUE STREAMS***	

✓ **Considering alternative business models for the ER**

[If relevant, please reuse the template above to state different options to be explored further and present them here]

Refining the analysis of CUSTOMER SEGMENTS and RELATIONSHIPS

✓ **Specifying customer segmentation (*CUSTOMER SEGMENTS* block)**

Template for customer segment analysis (to be completed for each customer segment):

Potential segment #1: [Name of the segment]	
Relevant characteristics	
Segment size (current size and expected growth)	*[Size in relevant geographical markets: the European Union / other potential target markets]*
Hypothesised customer needs and aspirations	
Hypotheses about segment purchasing behaviour and criteria	

Information and data required to verify these hypotheses	

Potential segment #2: [Name of the segment]	
Relevant characteristics	
Segment size (current size and expected growth)	*[Size in relevant geographical markets: the European Union / other potential target markets]*
Hypothesised customer needs and aspirations	
Hypotheses about segment purchasing behaviour and criteria	
Information and data required to verify these hypotheses	

Potential segment #3: [Name of the segment]	
Relevant characteristics	
Segment size (current size and expected growth)	*[Size in relevant geographical markets: the European Union / other potential target markets]*
Hypothesised customer needs and aspirations	
Hypotheses about segment purchasing behaviour and criteria	
Information and data required to verify these hypotheses	

Comments/conclusions regarding the prioritisation of potential customer segments:

✓ **Leveraging knowledge about customer segments to refine the analysis of *CUSTOMER RELATIONSHIPS***

[Please insert here the update of the "Customer Relationships" block, considering requirements in terms of proximity and engagement, as well as the potential differentiation of relationships between customer segments]

Studying the customer journey to refine the analysis of CHANNELS and KEY ACTIVITIES

✓ **Designing a customer journey map**

iii) Answering the questions in the table below, by adopting the customer's viewpoint:

Potential customer segment #1: [Name of the segment]	
Problem faced by the customer	
How the customer can **learn** about the product or service	
How the customer can **assess** the product or service's value proposition before the actual purchase	
How the customer can **purchase** the productor service	
How the customer can **use** the product or service	

How the customer **interacts** with the company after the purchase	

Potential customer segment #2: [Name of the segment]	
Problem faced by the customer	
How the customer can **learn** about theproduct or service	
How the customer can **assess** the product or service's value proposition before the actual purchase	
How the customer can **purchase** the productor service	
How the customer can **use** the product or service	
How the customer **interacts** with the company after the purchase	

Potential customer segment #3: [Name of the segment]	
Problem faced by the customer	
How the customer can **learn** about theproduct or service	
How the customer can **assess** the product or service's value proposition before the actual purchase	
How the customer can **purchase** the productor service	
How the customer can **use** the product or service	
How the customer **interacts** with the company after the purchase	

iv) Drawing a customer journey map encompassing all of these steps

[Please draw the customer journey map using the proposed template - possibly adapting it depending on the ER and on the customer segment's specificities, and breaking down the step concerning the use of the product/service into several stages]

[CUSTOMER SEGMENT]					
ACTIONS					
MOTIVATIONS					

TIMELINE	Learning about product/service	Assessing value proposition	Purchasing	Using	Interacting after purchase
QUESTIONS					
BARRIERS					

✓ **Focusing on the key interactions evidenced by the map to refine the analysis of CHANNELS**

[Please insert here the update of the "Channels" block, building on key interaction points between the solution provider and customers evidenced by the customer journey map]

✓ **Leveraging the customer journey map to refine the analysis of KEY ACTIVITIES**

Template for the analysis of the solution provider's key activities, to be identified using the customer journey map:

Activity	Assessable?	Critical?	Timely?	Output of the activity
	High/Medium/Low	*High/Medium/Low*	*High/Medium/Low*	

[Please insert here the update of the "Key Activities" block, retaining the ones which fulfil the "assessable / critical / timely" criteria]

Carrying out a market and competition analysis to specify the VALUE PROPOSITION

Template for market and competition analysis:

MARKET AND COMPETITION ANALYSIS FOR [Exploitable Result] IN [Relevant geographical market: Country/Region/At the global scale]

Current competitors
Identification of key competitors and analysis of their positioning (products and/or services offered, value proposition, targeted customer segments…)

New entrants
Identification of (potential) new entrants and analysis of their positioning (productsand/or services offered, value proposition, targeted customer segments…) *Identification of barriers to entry*

Substitutes
Identification of products and/or services that could act as substitutes *Analysis of their value proposition, their advantages and drawbacks (notably in terms of performance and price) and of the factors that may motivate (or dissuade) customers to resort to them*

Suppliers and other actors in the value chain
Identification of key suppliers and other actors in the value chain and of their importance for the business model

Stakeholders
Identification of other actors that may have an impact on the activity or the competitive environment (e.g., public authorities)

Identification of the ER's competitive advantage(s), relying on the above analysis:

[Please insert here the update of the "Value Propositions" block, highlighting this (these) competitive advantage(s)]

Identifying the critical success factors for the considered business model(s)

Template for the identification of critical success factors:

Critical success factor	Key metric	Data to be collected and sources
1.		
2.		
3.		
4.		
5.		

Documenting REVENUE STREAMS and COST STRUCTURE

✓ **Considering alternative options**

Analysis of different options that may be explored further and of their respective advantages and drawbacks

✓ **Building a spreadsheet detailing the elements necessary to build estimates ofthe main revenue streams and cost items**

[Please insert here the matrix identifying the main revenue streams and the most significant cost items and decomposing them into underlying variables which are necessary to compute them]

Identification of the variables that will have the most significant impact on revenues:

Identification of the variables that will have the most significant impact on costs:

Recap of the data necessary to build estimates and potential sources:

8.2 Appendix 2: Section 4 Tables

Refined and updated business model for ER1a

Business Model Canvas for ER1a – Secondary substation of the future
Lead partner: Ormazabal

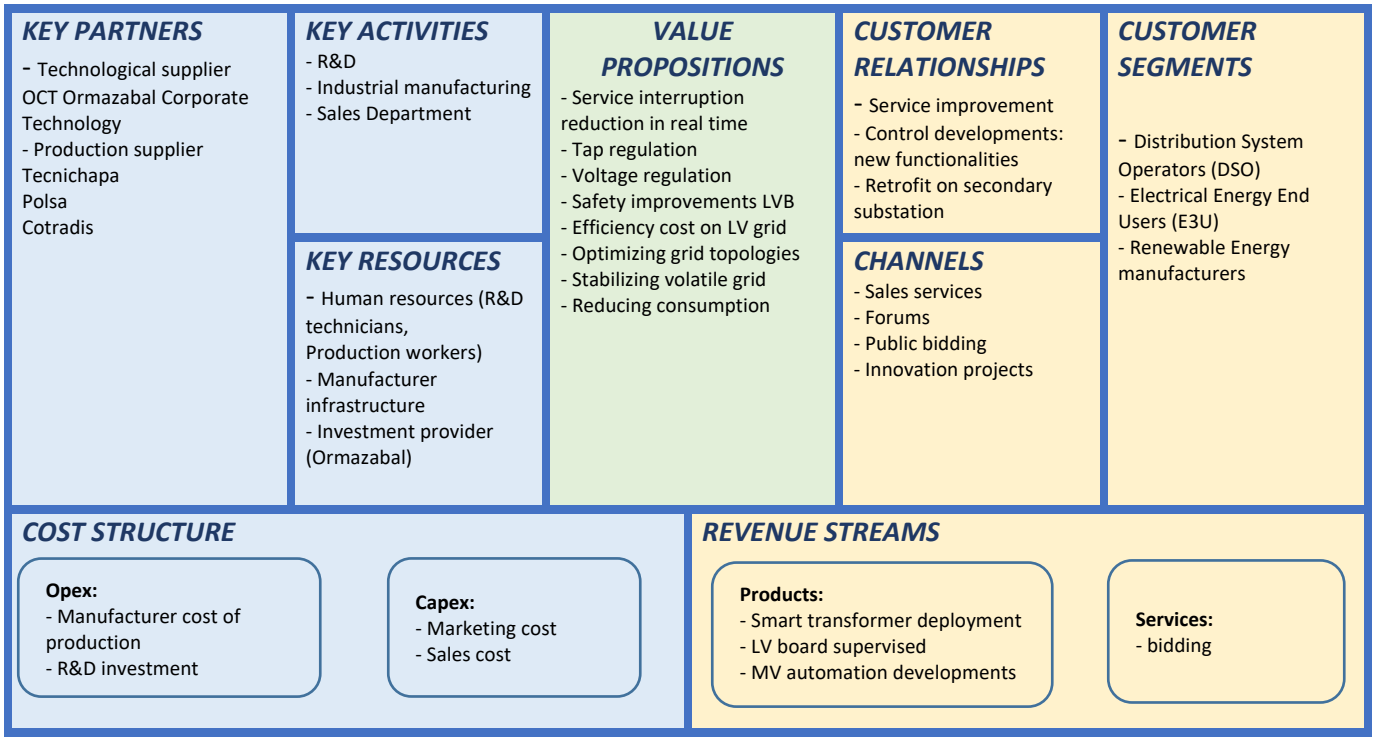


Table 26. Analysis of potential customer segment #1: DSOs

Potential segment #1: DSOs	
Relevant characteristics	Large DSOs, looking for: Service improvement; Control developments: new functionalities; Retrofit on secondary substation.
Segment size	Target markets are national markets in Europe.
Hypothesized customer needs and aspirations	Distributed generation, decarbonisation and arrival of EVs
Hypotheses about segment purchasing behaviour and criteria	Functionality and price
Information and data required to verifythese hypotheses	KPIs: SAIFI, CAIDI

Table 27. Analysis of potential customer segment #2: Electrical energy end users

Potential segment #2: Electrical energy end users	
Relevant characteristics	Small DSOs and industrial and commercial customers, looking for: - Service improvement; - Control developments: new functionalities; - Retrofit on secondary substation.
Segment size	Target markets are national markets in Europe and international markets.
Hypothesised customerneeds and aspirations	Simplicity in Secondary substation control and automation
Hypotheses about segment purchasing behaviour and criteria	Functionality and price
Information and data required to verify these hypotheses	KPIs: SAIFI, CAIDI

Table 28. Analysis of potential customer segment #3: Renewable energy manufacturers

Potential segment #3: Renewable energy manufacturers	
Relevant characteristics	Renewable energy manufacturers (especially wind and solar power) are the targeted customer segment, yet final users are RES producers. This customer segment is looking for service improvement.
Segment size	Target markets are national markets in Europe and international markets.
Hypothesised customer needs and aspirations	Size of the engines and increase of electrical production
Hypotheses about segment purchasing behaviour and criteria	Functionality and price
Information and data required to verify these hypotheses	KPIs: SAIFI, CAIDI

Exploratory business model canvas for ER1b

Business Model Canvas for ER1b – Secondary substation of the future specially designed for remote isolated areas
Lead partner: SELTA-DP

KEY PARTNERS
- SELTA-DP
- EDYNA

KEY ACTIVITIES
- Producing / manufacturing
- Conducting further R&D
- Marketing campaigns
- System engineering
- Testing and reporting
- Sales and distribution management

KEY RESOURCES
- R&D
- Engineering and service
- Project management
- Marketing management and sale office
- Field test by partner EDYNA
- Production
- Purchasing department

VALUE PROPOSITIONS
- Innovative equipment to monitor, control and manage the secondary substations of MV electrical grids
- Specific communication system that allows real time information change from control centre to peripheral resources and vice versa
- Implementation of specific algorithms studied and tested
- High level of design, customisation, technical support and fitting of undesired problems

DSOs:
Improved control and manage of the electrical parameters related to MV grid, as well as voltage profiles, power congestions, black-out event and distributed generation penetration

BSPs/Aggregators:
Possibility in real time communication with the aggregated energy resources, in order to provide the ancillary services requested by the DSOs and TSOs

RES producers:
Making their source smarter and connected with the DSO, which can lead to multiple scenarios in the future of the electrical grid operation. Producers being selected by DSO in order to regulate the nodal voltages of the MV grid by controlling the generation of reactive power.

Industrial customers:
Being selected by DSOs in order to regulate the power flow over MV lines by controlling the active power absorption of their modulable loads

SELTA:
Leader of telecontrol system for electrical utilities offers its expertise in engineering and provides innovative technologies for customer satisfaction. SELTA offers its support and experience in the electrical system field. The value of the solution achieves high level in terms of design, customization, technical support and fitting of undesired problems.

CUSTOMER RELATIONSHIPS
Generally: acquisition by the customers DSOs may have partner role in new research pilot projects and field tests.

CHANNELS
- Marketing
- Use cases and publications due to innovative pilot projects
- Customer support in design, engineering and management
- Service activities, installation and testing phases

CUSTOMER SEGMENTS
- DSOs & electrical MV grid managers
- BSPs/ Aggregators
- RES producers
- Industrial customers

Other potential beneficiaries:
- TSOs

COST STRUCTURE

Opex:
- R&D investment
- Producing/manufacturing
- Project management
- Purchasing department
- System engineering
- Testing and reporting
- Service

All are proportional to the number of requested devices

Capex:
- R&D
- Marketing
- Sales and distribution management

REVENUE STREAMS

Products:
- Devices supply has the characteristic of recurring pricing mechanism related to portions of the MV grid and the number of substations involved or, one-off nature depending on the customers' intention.

Services:
Installation steps and field service has the characteristic of one-off / recurring pricing

Refined and updated business model for ER2

Business Model Canvas for ER2 – New Generation of Smart Meters
Lead partner: ZIV

KEY PARTNERS
- DSOs
- Smart meter manufacturers
- Research centers
- Laboratories
- Big Data/AI software providers
- Software providers

KEY ACTIVITIES
Development:
- Application and design engineering
- Simulation of feeder identification
- Demand Simulation
- Testing

Pre-sales:
- Seminars and document release
- Pilot field activity

meter manufacturing

Post-sales:
Field activity

KEY RESOURCES
- Application and design engineers
- DSOs' Demo sites with multiple feeders
- Test sets
- Intellectual property
- Laboratories for simulation

VALUE PROPOSITIONS
- Improved performance of the network thanks to LV network monitoring
- Improve end-user information, paving the way for demand management
- Promotion of efficient use through extended information on the demand profile of smart meters' end users
- Flexible smart meter, preparedness for changes in communication technologies, cybersecurity or regulation

CUSTOMER RELATIONSHIPS
- Setup, maintenance, and technical support
- Customer loyalty based on confidence and continuous improvement of the solution

CHANNELS
- Direct relationship with DSOs
- Utility Tenders

CUSTOMER SEGMENTS
- DSOs
- LV customers

COST STRUCTURE

Opex:
- Human resources (engineers)
- Simulation software
- Lab tests

Capex:
- Test sets
- Smart meter production lines
- Meters deployment
- Software and systems oriented to retrieve data from smart meters

REVENUE STREAMS

Products:
- Smart meters
- Software specifically designed for demand profile analysis for the customer
- Software specifically designed for demand profile analysis for DSOs

Service:
- Data analysis for provision of services to customers
- Data analysis for provision of information to DSOs

Table 33. Analysis of potential customer segment #1: DSOs

Potential segment #1: DSOs

Segment size	There are more than 280 M electricity customers in Europe, with a penetration of smart meters estimated to reach c. 40% in 2020 (EC, 2019). Electricity demand is expected to grow at a 1.8% CAGR by 2030 (Monitor Deloitte, E.DSO and Eurelectric, 2021). EUR 30-35 billion are expected to be invested in smart meters up to 2030 (Monitor Deloitte, E.DSO and Eurelectric, 2021).
Hypothesised customer needs and aspirations	Enhancing grid monitoring, stability and control. Fostering demand participation (through real-time monitoring) and the development of new flexibility services (e.g., smart charging, generation flexibility, EV batteries flexibility). Smart meters are a key enabler to do so and will allow to identifythe feeders for each customer.
Hypotheses about segment purchasing behaviour and criteria	It is a regulated market. Smart meter deployments are realised through tenders. Some utilities will change to smart metering because there is a mandate from the government and, if not, they may do so based on a positive business case. The latter may come both from partial compensation with public funds and operations' Efficiency enhancements.
Information and data required to verify these hypotheses	No data required (public information).

Table 34. Analysis of potential customer segment #3: Industrial and residential customers

Potential segment #2: Industrial and residential customers	
Relevant characteristics	Industrial and residential customers are the DSOs' customers.
Segment size	These are the DSO customers. Typically, could be the 281M electricity customers, domestic and industrial
Hypothesised customer needs and aspirations	LV customers need a real time view of their demand to be able to take decisions and economically benefit from an efficient energy usage.
Hypotheses about segment purchasing behaviour and criteria	Metering is a regulated market. Customers will typically get a contract with a retailer, the one offering the most convenient price, but also the one that can provide the means to gain an efficient energy usage.
Information and data required to verify these hypotheses	No specific data.

Refined and updated business model for ER 3

Business Model Canvas for ER3 – Protections for high RES penetration
Lead partner: ZIV

KEY PARTNERS
- DSOs
- TSOs
- Power electronic manufacturers
- Research centers
- Laboratories

KEY ACTIVITIES
- Application and design engineering
- Simulation of networks with high RES penetration
- Testing
- Field installation

KEY RESOURCES
- Application and design engineers
- Simulation tools
- Test-sets
- Demonstration sites

VALUE PROPOSITIONS
Improved performance of the protection system

CUSTOMER RELATIONSHIPS
- Setup, maintenance and technical support
- Customer loyalty based on confidence and continuous improvement of the solution

CHANNELS
- Direct relationship with DSOs, TSOs, MV customers and generator owners
- Sales through integrators and EPC
-Sales through Switchgear manufacturers
- Promotion by means of seminars and conferences

CUSTOMER SEGMENTS
- DSOs
- TSOs
- Industrial and other MV customers
- Generator owners
- Switchgear manufacturers
- Integrators and EPCs

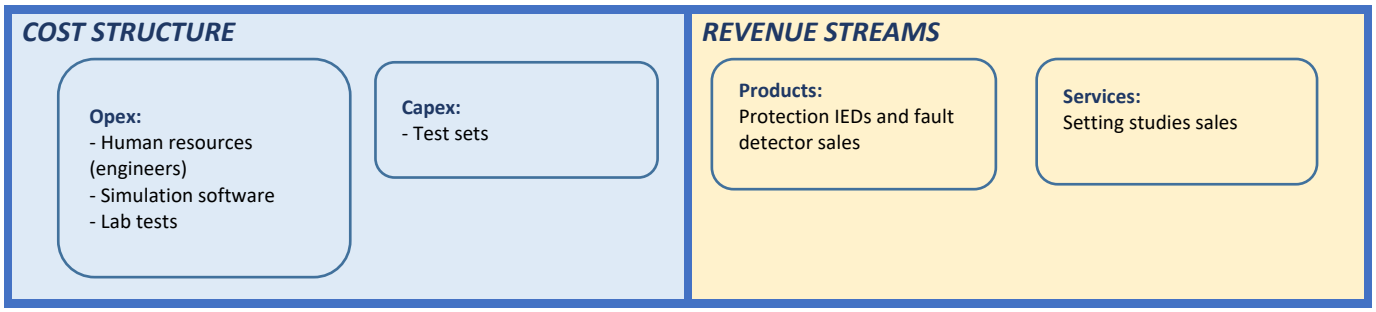


Table 38. Analysis of potential customer segment #1: DSOs

Potential segment #1: DSOs	
Relevant characteristics	Global. Electricity sector.
Segment size	As RES penetration is growing very fast, the implementation of thenew algorithms could be a key differentiator to acquire more customers/enter new markets. A 10% business growth could be considered yearly.
Hypothesised customer needs and aspirations	DSOs require correct protection operation (no unwanted trips and no lack of trips), including in networks with high RES penetration.
Hypotheses about segment purchasing behaviour and criteria	DSOs will tend to buy complete automation packages, updating their functional specifications to this new scenario of high RES penetration.
Information and data required to verifythese hypotheses	Contact with customers.

Table 39. Analysis of potential customer segment #2: TSOs

Potential segment #2: TSOs	
Relevant characteristics	Global. Electricity sector.
Segment size	As RES penetration is growing very fast, the implementation of thenew algorithms could be a key differentiator to acquire more customers/enter new markets. A 10% business growth could be considered yearly.
Hypothesised customer needs and aspirations	TSOs require correct protection operation (no unwanted trips andno lack of trips), including in networks with high RES penetration.
Hypotheses about segment purchasing behaviour and criteria	TSOs will tend to buy complete automation packages, updating their functional specifications to this new scenario of high RES penetration.
Information and data required to verify these hypotheses	Contact with customers.

Table 40. Analysis of potential customer segment #3: Industrial and other MV customers

Potential segment #3: Industrial and other MV customers	
Relevant characteristics	Global. Electricity sector.
Segment size	Growth is expected to be aligned with RES penetration in distribution networks. Hence, the same growth as for the utilities sector (10% yearly) may be considered.
Hypothesised customer needs and aspirations	MV customers will have to comply with network codes and DSOs' requirements.
Hypotheses about segment purchasing behaviour and criteria	New MV customers will have to purchase their substations according to DSOs' specifications; the new algorithms will be necessary to comply with them.
Information and data required to verify these hypotheses	Experience and contact with customers.

Table 41. Analysis of potential customer segment #4: Renewable energy producers

Potential segment #4: Generator owners

Relevant characteristics	Global. Electricity sector.
Segment size	Growth is expected to be high as RES penetration is rising. Hence, a yearly growth of 25% can be considered.
Hypothesised customer needs and aspirations	Renewable energy producers will have to comply with network codes and utilities' requirements.
Hypotheses about segment purchasing behaviour and criteria	New renewable energy producers will have to purchase their substations according to DSOs' specifications; the new algorithms will be necessary to comply with them.
Information and data required to verifythese hypotheses	Experience and contact with customers.

Table 42. Analysis of potential customer segment #5: Switchgear manufacturers

Potential segment #5: Switchgear manufacturers	
Relevant characteristics	Global. Electricity sector.
Segment size	Growth is expected to be aligned with RES penetration in distribution networks. Hence, the same growth as for the utilities sector (10% yearly) may be considered.
Hypothesised customer needs and aspirations	Switchgear manufacturers will have to comply with network codes and DSOs' requirements.
Hypotheses about segment purchasing behaviour and criteria	Switchgear manufacturers will have to provide switchgears according to DSOs' specifications; the new algorithms will be necessary to comply with them.
Information and data required to verify these hypotheses	Experience and contact with customers.

Table 43. Analysis of potential customer segment #6: Integrators and EPCs

Potential segment #6: Integrators and EPCs	
Relevant characteristics	Global. Electricity sector.
Segment size	Growth is expected to be aligned with RES penetration in distribution networks. Hence, the same growth as for the utilities sector (10% yearly) may be considered.
Hypothesised customer needs and aspirations	Integrators and EPCs will have to comply with network codes and utilities' requirements.
Hypotheses about segment purchasing behaviour and criteria	Integrators and EPCs will have to provide their solutions (full package) according to DSOs' specifications; the new algorithms willbe necessary to comply with them.
Information and data required to verify these hypotheses	Experience and contact with customers.

Refined and updated business model for ER4

Business Model Canvas for ER4 – Energy Box
Lead partner: CIRCE

KEY PARTNERS	KEY ACTIVITIES	VALUE PROPOSITIONS	CUSTOMER RELATIONSHIPS	CUSTOMER SEGMENTS
- Flexigrid partners and European Commission - Materials suppliers Energy Box manufacturers - Commercial partner	**Development:** - Solution testing (demonstration sites) - Market analysis - Project dissemination and replication - Exploitation - Installation at customer premises - Manufacturing - Commercial activities - Cooperation with other projects and networking	**Hardware and software solution to solve field-level communication and management** - High-level services and monitoring (performed remotely) and locally-processed services, improving service quality, security and efficiency - Autonomous real-time management - High interoperability when using standard protocols - Adaptability to each specific scenario for improving management - Debian-based computer operating-system - Different physical communication interfaces (modules): Ethernet, ZigBee, WiFi	- Customer and maintenance services - Customer service call center	- DSOs - Aggregators - Renewable energy producers - Industrial, commercial and residential customers - Energy communities - Experts and actors of the refurbishment industry
	KEY RESOURCES		CHANNELS	

	- Human resources - IP legal and administrative assistance - Components and material hardware - Design of modular architecture - Technological features: signal injection and time domain reflectometry (TDR), IoT communication protocols, Linux-based OS, real-time management	**Modern and compact design** - Reduced form factor, light weight - Quiet operation - Low power consumption - Competitive price	- Distribution at demonstration sites - Dedicated website (giving access to relevant non-IP sensitive results) - Media, conferences, workshops and events - Innovation forum	- Local authorities in charge of the management of social housing

COST STRUCTURE

Opex:
- Human resources
- Manufacturing
- Hardware components costs
- I&D activities
- Marketing costs
- Sales costs

Capex:
- Aggregation and transmission hardware infrastructure

REVENUE STREAMS
- Direct sales
- Sales through intermediaries
- Technology transfers

Table 47. Analysis of potential customer segment #1: DSOs

Potential segment #1: DSOs	
Relevant characteristics	DSOs that are managers or owners of energy distribution networks: they serve as simplifiers of the installation process for the energy distribution network and related devices, automate operation and increase their portfolio of customers (energyconsumers).
Segment size	Target markets would include Spain, Greece, France, Switzerland, Austria and Slovenia, Italy, the UK, Germany, Denmark, the Netherlands, Switzerland, Sweden, Luxembourg and other European countries.
Hypothesised customer needs and aspirations	DSOs' mission throughout Europe is to operate and manage distribution networks in a safe and secure manner. They are also responsible for developing distribution grids to ensure the long- term ability of the system to deliver high-quality services to grid users and other stakeholders of the power system. DSOs are considered to have a "natural monopoly" on local grids and therefore play a crucial role in the effective roll-out of demand response in a given locality. DSOs are regulated players and provide their services in a strict regulatory framework that is traditionally focused on CAPEX- intense investments for security of supply. Thus, DSOs have been mostly involved in maintenance and expansion of the grid infrastructure ("hardware"), whereas with a forward-lookingsmart grid regulation DSOs would be incentivised to also invest in OPEX. In the coming years, several challenges for local distribution grids will accentuate: electrification of transport, with EV charging patterns and electric heating patterns overlapping; more distributed RES leading to bidirectional flows on the grid; more flexible consumption patterns, with consumers reacting simultaneously to price signals (on the wholesale market) or curtailment instructions (for balancing services). Overall, there will be a growing uncertainty over the exact requirements and standards that the power grid will have to fulfil, making long-term investment cycles even more risky. Investments in monitoring and control functionalities, in order to manage demand side-flexibility on a local level (hence, rather the "software"), could

	represent a cost-effective alternative for DSOs.
Hypotheses about segment purchasing behaviour and criteria	If demand-side flexibility of end customers is used to reduce local network capacity issues and to limit capital-intense infrastructure investments, DSOs will be ultimately responsible for designing and maintaining these programs. A multi-purpose concentrator for operation in various scenarios of advanced electrical networks and smart grids (the Energy Box) will facilitate decisions and responsibility and allow to obtain better results.
Information and data required to verifythese hypotheses	Data that permits to know the limitations of the network that DSOs in the European electricity market will have to mitigate as RES penetration increases. Studies or real cases of how much energy an installation/buildingis capable to offer to the flexibility market, to know if the needs can be covered with that energy. Information on system costs, savings against new investments, etc.

Table 48. Analysis of potential customer segment #2: Aggregators

Potential segment #2: Aggregators	
Relevant characteristics	Aggregators are entities that group the energy consumption and/or generation of various consumers/prosumers.
Segment size	Target markets would include Spain, Greece, France, Switzerland, Austria and Slovenia, Italy, the UK, Germany, Denmark, the Netherlands, Switzerland, Sweden, Luxembourg, and other European countries.
Hypothesised customer needs and aspirations	Aggregators would expect functionalities able to make consumers' data accessible in real time to end customers via a web application, meaning an enhancement of the service platforms.
Hypotheses about segment purchasing behaviour and criteria	With the purchase and installation of the Energy Box, aggregators will obtain a platform where end consumers could consult their electricity consumption and generate important data and use themto participate in the market. They would most likely exploit the data accessibility through the Energy Box by developing new business based on such data.
Information and data required to verify these hypotheses	The required data to verify these hypotheses will depend on the application of the Energy Box by the DSOs.

Table 49. Analysis of potential customer segment #3: Renewable energy producers

Potential segment #3: Renewable energy producers	
Relevant characteristics	Solar facilities or projects of different companies (big renewable projects). Companies or different associations, even countries.
Segment size	Target markets would include Spain, France, Switzerland, Austria and Slovenia, Italy, the UK, Germany, Denmark, the Netherlands, Switzerland, Sweden, Luxembourg and other European countries.
Hypothesised customer needs and aspirations	This customer segment's main need is to reduce energy production costs, reduce costs to bring renewable energy to direct consumers, reduce installation and maintenance costs, as well as to reduce cyberattacks, obtain a better management of data and a new approach on wiring aesthetic.
Hypotheses about segment purchasing behaviour and criteria	Renewable energy production is currently in a phase of boom, growth and adaptation to market needs, because despite the fact that it is already known to all, there is still much to be implemented and improved. That said, producers are looking for actions, mainly technologies, that streamline the commercial process and provide greater understanding and better quality to customers.
Information and data required to verify these hypotheses	Producers' opinions and reactions towards the product and the solutions offered.

Table 50. Analysis of potential customer segment #4: Industrial, commercial and residential customers and energycommunities

Potential segment #4: Industrial, commercial and residential customers and energy communities	
Relevant characteristics	Energy communities: residential houses, shopping centres,RESCoop initiatives. People who own a grid infrastructure/microgrid. Individual consumers.
Segment size	Target markets would include Spain, Greece, France, Switzerland, Austria and Slovenia, Italy, the UK, Germany, Denmark, the Netherlands, Switzerland, Sweden, Luxembourg and other European countries.
Hypothesised customer needs and aspirations	This customer segment is wishing to manage energy consumptionin real time through a user-friendly, modern and compact design that can be adapted to a wide variety of facilities and business models and different types of housing, at a competitive price.
Hypotheses about segment purchasing behaviour and criteria	Many energy communities and some industries may benefit from providing energy consumers with valuable information to promote sustainable consumption and reduce unnecessary costs caused by spikes in energy prices. This tool would facilitate this function for this entire segment.
Information and data required to verifythese hypotheses	Opinions and reactions towards the product and the solutions offered.

Refined and updated business model for ER5

Business Model Canvas for ER5 – Software module for fault location and self-healing
Lead partner: CIRCE

<table>
<tr>
<td rowspan="2">KEY PARTNERS
- 2 RTOs (CIRCE, LINKS)
- 2 universities (UNIZG-FER, UNICAN)
- 5 technology providers: 3 large companies (ATOS, OPA, ZIV))+ 2 SMEs (HYPER TECH, SELTA)
- 2 large companies
- 2 associations
- 3 DSOs (VIESGO, HEP-ODS, EDYNA)</td>
<td>KEY ACTIVITIES
Market analysis
- Identify, assess and compare the technological options for monitoring and control systems in the distribution networks and in the customer premises
- Develop recommendations for the cost-effective application of advanced distributed sensors, monitoring and control systems to increase the intelligence of electricity distribution networks
- Obtain a device for the monitoring of low voltage grids with new functionalities
- Algorithm tests at simulation level or small-scale demonstrations at first
- Performance test of applications developed in a real grid
- Cooperation with other projects and networking</td>
<td rowspan="2">VALUE PROPOSITIONS
- Hardware and software solution to solve field-level communication and management
- Provide its user with both information and control on the MV network to operate it in real time, ensuring the security of the supply
- Fault detection/location software and energy supply restoration through self-healing algorithms:
o Detection of faults in the distribution grid
o Orders to open/close the relevant breakers to isolate the affected area in a milliseconds range</td>
<td>CUSTOMER RELATIONSHIPS
- Customer and maintenance services
- Customer service call center
- Press media, conferences, workshops and events- to promote the solution</td>
<td rowspan="2">CUSTOMER SEGMENTS
- DSOs
- Energy Communities</td>
</tr>
<tr>
<td>KEY RESOURCES
- Developers and other human resources
- Gathered data
- Technical knowledge
- Electricity market knowledge
- Close knowledge of consumers and local markets</td>
<td>CHANNELS
- Distribution at demonstration sites
- Sales representatives
- Conferences, workshop and events
- Online and printed marketing tools
- Active media relations
- Company website
- Social media
B2B and/or bilateral multiservice offerings using existing clientele channels</td>
</tr>
</table>

COST STRUCTURE	***REVENUE STREAMS***
- Human resources - Testing lab - Marketing costs - Sales costs	- Licenses - Technology transfers - Service: self-healing software

Table 54. Analysis of potential customer segment #1: DSOs

Potential segment #1: DSOs	
Relevant characteristics	DSOs which are managers or owners of energy distribution networks: they serve as simplifiers of the installation process for the energy distribution network and related devices, automate operation and increase their portfolio of customers (energy consumers).
Segment size	Target markets would include Spain, France, Switzerland, Austria and Slovenia, Italy, the UK, Germany, Denmark, the Netherlands, Switzerland, Sweden, Luxembourg and other European countries.
Hypothesised customer needs and aspirations	DSOs' mission throughout Europe is to operate and manage distribution networks in a safe and secure manner. They are also responsible for developing distribution grids to ensure the long- term ability of the system to deliver high-quality services to grid users and other stakeholders of the power system. DSOs are considered to have a "natural monopoly" on local grids and therefore play a crucial role in the effective roll-out of demand- response in a given locality. DSOs are regulated players and provide their services in a strict regulatory framework that is traditionally focused on CAPEX- intense investments for security of supply. Thus, DSOs have been mostly involved in maintenance and expansion of the grid infrastructure ("hardware"), whereas with a more forward-looking smart grid regulation DSOs would be incentivised to also invest in OPEX. In the coming years, several challenges for local distribution grids will accentuate: electrification of transport, with EV charging patterns and electric heating patterns overlapping; more distributed RES leading to bidirectional flows on the grid; more flexible consumption patterns, with consumers reacting simultaneously to price signals (on the wholesale market) or curtailment instructions (for balancing services). Overall, there will be a growing uncertainty over the exact requirements and standards that the power grid will have to fulfil, making long-term investment cycles even more risky. Investments in monitoring and control functionalities in order to manage demand-side flexibility on a local level (hence, rather the "software") could represent a cost-effective alternative for DSOs.
Hypotheses about segment purchasing behaviour and criteria	If demand side flexibility of end customers is used to reduce local network capacity issues and to limit capital-intense infrastructure investments, DSOs will be ultimately responsible for designing and maintaining these programmes. A multi-purpose concentrator for the operation in various scenarios of advanced electrical networks and control on the MV network to operate in real time ensuring the security of the supply will facilitate decisions and responsibility and better results can be obtained.
Information and data required to verifythese hypotheses	Data that permits to know the limitations of the network that DSOsin the European electricity market will have to mitigate as RES penetration increases.

Table 55. Analysis of potential customer segment #2: Energy communities

Potential segment #2: Energy communities	
Relevant characteristics	Energy community refers to a wide range of collective energyactions that involve citizens' participation in the energy system.

Segment size	Target markets would include Spain, Greece, France, Switzerland, Austria and Slovenia, Italy, the UK, Germany, Denmark, the Netherlands, Switzerland, Sweden, Luxembourg and otherEuropean countries.
Hypothesised customer needs and aspirations	Energy communities can promote social and solidarity-based economy and innovation in the energy sector, tackling energy poverty, promoting energy sustainability and innovation, ensuring production, storage, self-consumption, distribution and/or supply of energy as well as improving local acceptance of RES and energy efficiency in end-use at the local and regional level.
Hypotheses about segment purchasing behaviour and criteria	Energy communities, in order to mitigate the lack of access to energy and to improve energy systems throughout the population, will be interested in technological solutions that allow the minimisation of failures (reducing interruption time) in electrical networks and guarantee stability to consumers.
Information and data required to verifythese hypotheses	Range that energy communities cover; Number of points to which they supply energy; Frequency of failures in their networks; Time to resolve these failures; Specific network data.

Refined and updated business model for ER6

Business Model Canvas for ER6 – Software module for forecasting and grid operation
Lead partner: VERD

KEY PARTNERS
- TSOs
- DSOs
- Aggregators/ESCOs
- Energy retailers
- Renewable energy producers
- Industrial and commercial partners

KEY ACTIVITIES
- Market analysis
- Identification, assessment and comparison of the technological solutions for monitoring and control systems in the distribution network and in the customer premises
- Development of recommendations for the cost-effective application of advanced distributed sensors, monitoring and control systems to increase distribution networks' intelligence
- Development of a device for LV grids monitoring with new functionalities
- Testing of algorithms (simulation, small scale demonstration)
- Performance test of the developed applications in a real grid
- Cooperation with other projects and networking

KEY RESOURCES
- Human resources (developers)
- Gathered data
- Technical knowledge
- Electricity market knowledge
- Close knowledge of consumers and local markets

VALUE PROPOSITIONS
- Forecasting algorithms to accurately predict energy generation, demand and electricity price
- Optimisation algorithm taking advantage of the forecasting results and suggesting grid operation orders
- Provision of optimal settings for network controllable assets, prevention of network congestion

CUSTOMER RELATIONSHIPS
- Distribution at demonstration sites
- B2B and/or bilateral multiservice offerings (using existing clientele channels)
- Sales representatives
- Company website and dedicated website giving access to non IP-sensitive results
- Online and printed marketing tools
- Media and social media
- Workshops, conferences and events

CHANNELS
- Distribution at demonstration sites
- Company website and dedicated website giving access to non-IP sensitive results
- Online and printed marketing tools
- Media and social media
- Conferences, workshops and other events

CUSTOMER SEGMENTS
- Network operators (TSOs, DSOs)
- Aggregators and retailors
- Renewable energy producers
- Commercial and industrial customers

COST STRUCTURE
- Human resources
- License for a specific software
- Testing lab
- Marketing costs
- Sales costs

REVENUE STREAMS
- Direct sales

Table 59. Analysis of potential customer segment #1: Network operators (TSOs, DSOs)

Potential segment #1: Network operators (TSOs, DSOs)	
Relevant characteristics	Network operators are responsible for the management ofelectricity grids, hence load and generation forecasting services could allow them to optimise their operations.
Segment size	Around 2,500 network operators are currently operating in Europe (JRC, 2017a). Assuming a penetration rate of 0.1%, the potential market volume in this area would be of 2 customers.
Hypothesised customer needs and aspirations	Optimisation of the performance of networks. Overall efficiency improvement in forecasting processes.
Hypotheses about segment purchasing behaviour and criteria	The sector is changing at a much slower pace than other markets/clients, hence a fast-purchasing behaviour is notexpected from network operators' side. Clients would require high quality and low prices as normally they would pass on the cost to their customers and are typicallyheavily regulated and monitored regarding operational expenditure.
Information and data required to verifythese hypotheses	Actual spending on generation and demand forecasting forflexibility markets and demand response markets. Practical requirements and specifications of forecastingprocesses required.

Table 60. Analysis of potential customer segment #2: Aggregators/ESCos and energy retailers

Potential segment #2: Aggregators/ESCos and energy retailers	
Relevant characteristics	Aggregators and ESCos are responsible for managing energy resources on behalf of their customers, hence generation forecasting services would allow them to offer improved services to their customers. The ER will target specifically aggregators with solar assets, which is the technology currently covered by it.
Segment size	There are currently around 5,000 licensed aggregators/ESCos in Europe (JRC, 2017a). Assuming a penetration rate of 0.75%, the potential market volume in this area would be of 37 customers. In Europe, the market for demand response aggregators is projected to represent USD 3.5 billion by 2025 (Nicolas Nhede, 2018).
Hypothesised customer needs and aspirations	Optimisation of energy charges for their customers. Optimisation of flexibility estimation associated with prosumers' forecasted consumption profile. Improvement of bidding/trading operations in energy markets.
Hypotheses about segment purchasing behaviour and criteria	Energy forecasting services would allow aggregators/ESCos to minimise their OPEX by introducing automated processes in their businesses.
Information and data required to verifythese hypotheses	Actual spending on generation and demand forecasting for participation in energy trading market and flexibility markets.

Table 61. Analysis of potential customer segment #3: Renewable energy producers

Potential segment #3: Renewable energy producers	
Relevant characteristics	RES producers are managing and operating renewable energy resources. They are benefitting from selling the electricity either to aggregators/ESCos or directly to the energy market. PV producers in particular would benefit from the forecasting solutions, as the latter would enable them to better understand the productionpatterns of their assets.
Segment size	At the global scale, the renewable energy market was estimated atUSD 928 billion in 2017 and would represent more than USD 1,500billion by 2025 (Allied Market Research). More specifically, in Europe, this market's growth would register a highest compound annual growth rate (CAGR) of 6.7% between 2018 and 2025 (Allied Market Research).

Hypothesised customer needs and aspirations	Accurate forecasting of the electricity produced by their assets. Ability to understand potential future generation in order to beable to calculate future revenues. Creation of robust business cases for new RES installations basedon accurate forecasting of future revenues.
Hypotheses about segment purchasing behaviour and criteria	Only interested in PV energy forecasting for potential market self-participation.
Information and data required to verifythese hypotheses	Information on current spending for PV energy generation forecasting.

Table 62. Analysis of potential customer segment #4: Commercial and industrial customers

Potential segment #4: Commercial and Industrial customers	
Relevant characteristics	Commercial and industrial customers are looking to maximise RES uptake on their sites in order to reduce their energy costs. More specifically, facility managers and building owners with PV systems installed in their premises would benefit from a forecasting solution which would allow them to better understand the production capacity of their assets.
Segment size	Commercial and industrial customers typically represent 50% of the total energy use (Eurostat, 2020). The total electricity production in Europe reached a net 2,800 TWh in 2018, which at an average electricity unit cost of 7.7 cents/kWh represents a total market worth c. EUR 108 billion (Eurostat, 2020; Eurostat, 2021a).
Hypothesised customer needs and aspirations	Emissions reduction by deploying RES and EVs. Taking advantage of the forecasting results aiming at maximisingthe integration of RES generation without compromising business-as-usual operation. Reduced operating expenses.
Hypotheses about segment purchasing behaviour and criteria	Customers would need a stable and profitable business model in order to invest in the software. Customers would probably be looking for a payback period lowerthan 5 years in order to invest.
Information and data required to verifythese hypotheses	Current strategies and energy forecasting/optimisation actions as well as energy costs relevant for the offered solution.

This knowledge about customer segments was used to refine the analysis of customer relationships in the corresponding building block of the business model canvas.

Refined and updated business model for ER7

Business Model Canvas for ER7 – Software module for congestion management
Lead partner: VERD

KEY PARTNERS	KEY ACTIVITIES	VALUE PROPOSITIONS	CUSTOMER RELATIONSHIPS	CUSTOMER SEGMENTS
- TSOs - DSOs - Aggregators/ESCOs - Energy retailers - Renewable energy producers - Industrial and commercial partners	- Market analysis - Identification, assessment and comparison of the technological solutions for monitoring and control systems in the distribution network and in the customer premises - Development of recommendations for the cost-effective application of advanced distributed sensors, monitoring and control systems to increase distribution networks' intelligence - Development of a device for LV grids monitoring with new functionalities - Testing of algorithms (simulation, small scale demonstration) - Performance test of the developed applications in a real grid - Cooperation with other projects and networking	- Forecasting algorithms to accurately predict energy generation, demand and electricity price - Optimisation algorithm taking advantage of the forecasting results and suggesting grid operation orders - Provision of optimal settings for network controllable assets, prevention of network congestion	- Distribution at demonstration sites - B2B and/or bilateral multiservice offerings (using existing clientele channels) - Sales representatives - Company website and dedicated website giving access to non IP-sensitive results - Online and printed marketing tools - Media and social media - Workshops, conferences and events	- Network operators (TSOs, DSOs) - Aggregators and retailors - Renewable energy producers - Commercial and industrial customers

	KEY RESOURCES - Human resources (developers) - Gathered data - Technical knowledge - Electricity market knowledge - Close knowledge of consumers and local markets		***CHANNELS*** - Distribution at demonstration sites - Company website and dedicated website giving access to non-IP sensitive results - Online and printed marketing tools - Media and social media - Conferences, workshops and other events	
COST STRUCTURE - Human resources - License for a specific software - Testing lab - Marketing costs - Sales costs			***REVENUE STREAMS*** - Direct sales	

Table 66. Analysis of potential customer segment #1: Aggregators/ESCos

Potential segment #1: Aggregators/ESCos	
Relevant characteristics	Aggregators/ESCos trade electricity in the energy market. Dealing with interruptible and non-predictable RES, they need to use customised congestion management tools in order to be able to benefit from the flexible energy resources of their customers.
Segment size	There are currently around 5,000 licensed aggregators/ESCos in Europe (JRC, 2017a). Assuming a penetration rate of 0.75%, the potential market volume in this area would be of 37 customers. In Europe, the market for demand response aggregators is projected to represent USD 3.5 billion by 2025 (Nicolas Nhede, 2018).
Hypothesised customer needs and aspirations	The software module would help aggregators and ESCos to undertake a comprehensive one-stop solution to set up, develop and exploit flexible energy provisioning from customers to DSOs. It would also allow them to drive decarbonation and minimise their customers' burdens in monetising flexibility.
Hypotheses about segment purchasing behaviour and criteria	The software services would enable aggregators/ESCos to minimise their OPEX by introducing automated processes in their businesses.
Information and data required to verifythese hypotheses	Current spending and strategy for congestion management.

Table 67. Analysis of potential customer segment #2: Commercial and industrial customers

Potential segment #2: Commercial and industrial customers	
Relevant characteristics	Commercial customers often install RES on their premises in orderto reduce their energy bill while benefitting from a given level of energy services. At the same time, they need to satisfy their building occupants' level of comfort and their businesses' specific energy needs. This implies a high level of complexity in their operations, introducing the need for accurate monitoring and operation of their equipment.
Segment size	Commercial and industrial customers typically represent 50% of the total energy use (Eurostat, 2021a). The total electricity production in Europe reached a net 2,800 TWh in 2018, which at an average electricity unit cost of 7.7 cents/kWh represents a total market worth c. EUR 108 billion (Eurostat, 2020; Eurostat, 2021a).
Hypothesised customer needs and aspirations	The software could be leveraged by commercial facility owners which do not fully exploit their energy assets (RES, batteries, EV charging points, etc.) and face high energy costs. It would enable them to benefit from the full potential of their equipment's capabilities in order to reduce network and energy charges, while potentially providing services to the grid.

Hypotheses about segment purchasing behaviour and criteria	Commercial facility owners would probably like to see a detailed business case with the potential benefits of the purchase/use of the software before making an investment as they typically invest in low-risk projects.
Information and data required to verifythese hypotheses	Current spending and strategy for congestion management, ifany; Identification of individual issues for specific sub-segments of this customer segment.

Table 68. Analysis of potential customer segment #3: Residential customers

Potential segment #3: Residential customers	
Relevant characteristics	Residential customers would need to increase self-consumption rates from their RES. Optimisation and scheduling algorithms wouldallow for optimisation of energy use in residential premises.
Segment size	Energy consumption in households represents a steadycontribution of c. 25% of the total energy consumption in Europe (Eurostat, 2021b). Electricity production in Europe reached 2,800 TWh in 2018 (Eurostat, 2020). The average price paid by EU households with an annual consumption superior to 2,500 kWh was 21.13 cents per kWh in 2018, representing a total spending on electricity for residential customers of around EUR 147 billion (Statista, 2020).
Hypothesised customer needs and aspirations	Improved reliability of supply; Reduced energy costs; Reduced environmental footprint; Introduction of new technologies in the household (e.g., small storage systems).
Hypotheses about segment purchasing behaviour and criteria	Residential customers are not expected to be very eager to purchase these services as there is currently no strong motivationfor them to manage their loads.
Information and data required to verifythese hypotheses	Potential issues with reliability of supply, energy bills and/or potential opportunities for reduced energy costs depending on thecountry of reference might help to verify the need for congestion management at a residential level.

Refined and updated business model for ER 8

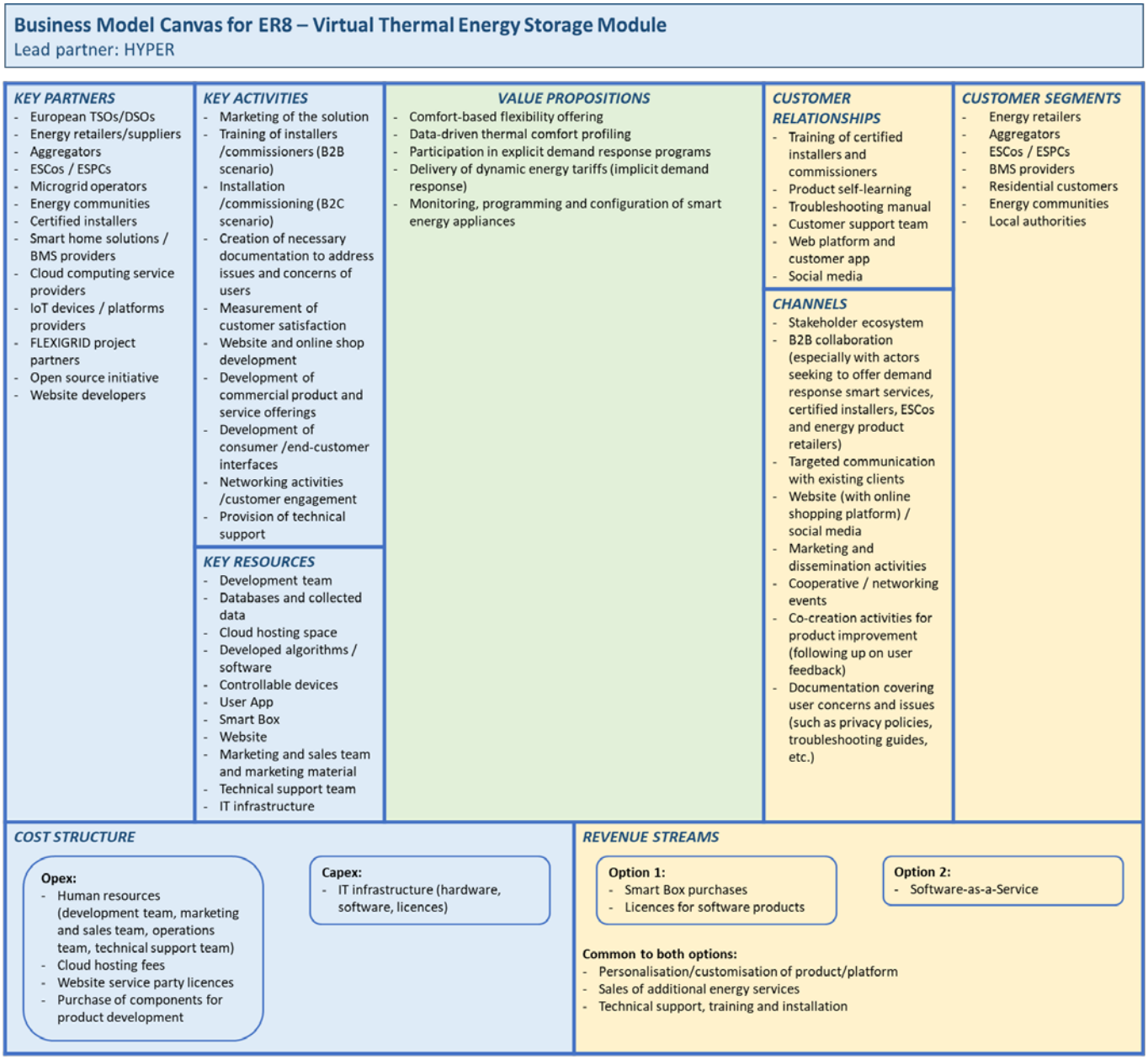


Table 72. Analysis of potential customer segment #1: Energy retailers

Potential segment #1: Energy retailers	
Relevant characteristics	Energy retailers in Europe that want to expand their product offerings towards demand response services, in markets where thisis feasible.
Segment size	As of 2018, there were c. 1500 electricity suppliers across Europe (including Great Britain) (CEER, 2019). An increasing trend was observed in most European countries between 2017 and 2018 (CEER, 2019). A similar growth rate may continue for countries which still have a relatively low supplier/consumer ratio.
Hypothesised customer needs and aspirations	Energy retailers will need to expand their offerings' portfolio to attract more customers. Their aspiration is to increase their marketshare nationally, but also internationally if possible.
Hypotheses about segment purchasing behaviour and criteria	Any low-cost solution that could be combined with existing offerings or help to create new offerings for electricity customers. Potentially, disruptive technologies that could provide a market advantage to early adopters and providers.

Information and data required to verify these hypotheses	Feedback on the hypotheses.

Table 73. Analysis of potential customer segment #2: Aggregators

Potential segment #2: Aggregators	
Relevant characteristics	All aggregators active in explicit demand response markets whereDirect Load Control (DLC) is needed. The solution may also be useful for the implementation of implicit demand response andrecommendation services.
Segment size	There were c. 60 aggregators in the EU in 2019 (including the UK) (K. Poplavskaya and L. de Vries, 2020). One can assume that by 2025, their number will have reached 100 in the EU (excluding the UK).
Hypothesised customer needs and aspirations	Aggregation gives relatively low returns; therefore, aggregators aimat increasing their market share and portfolio size to achieve viability and profitability (K. Poplavskaya and L. de Vries, 2020).
Hypotheses about segment purchasing behaviour and criteria	Solutions that may open up new value streams to aggregators. Solutions that could add more assets to aggregators' portfolios. Solutions that reduce energy transaction costs and minimise risks for the prosumers/customers within aggregators' portfolios.
Information and data required to verify these hypotheses	Feedback on the hypotheses.

Table 74. Analysis of potential customer segment #3: ESCos / ESPCs

Potential segment #3: ESCOs / ESPCs	
Relevant characteristics	ESCos that want to augment their traditional products with human-centric demand-side management offerings.
Segment size	There were up to 1,500 ESCos/ESPCs in Europe in 2013 (excluding the UK) (B. Boza-Kiss, P. Bertoldi et al., 2015). They represented a EUR 8.5 billion market in the EU in 2013 (JRC, 2017a). The market change has been slow in most EU countries from 2013 to 2016 (JRC, 2017a). One may assume that growth will continue to be quite slowuntil 2025 (JRC, 2017a).
Hypothesised customer needs and aspirations	Improve their public image by demonstrating ways ofpromoting energy efficiency; Offer ways to improve the comfort of building occupants; Find ways to increase the loyalty of current customers, but alsoto expand their client portfolios; Achieve financial gains for both their clients and themselves.
Hypotheses about segment purchasing behaviour and criteria	Any low cost, non-intrusive technologies/solutions that could achieve any or several of the aforementioned aspirations and needs of ESCos and ESPCs.
Information and data required to verify these hypotheses	Feedback on the hypotheses.

Table 75. Analysis of potential customer segment #4: BMS providers

Potential segment #4: BMS providers	
Relevant characteristics	BMS providers that want to include human-centric modelling and optimisation routines to their management systems.
Segment size	There are approximately 8-10 top market players owning the majority of the BMS market share (Markets and Markets, 2017). The market of BMS is expected to grow until 2025 with a CAGR of approximately 3%-7.5% (Mordor Intelligence, n.d.; Research and Markets, 2019). This is partly due to legislation pushing for greaterenergy performance in buildings and energy efficiency.
Hypothesised customer needs andaspirations	Increase market share and profits by expanding solutions' portfolio; Solutions that can be used in both commercial and residential buildings, as these two building types are expected to make useof BMSs the most; Solutions that require low implementation costs.
Hypotheses about segment purchasingbehaviour and criteria	Solutions that could offer significant cost savings to end-users; Automated solutions that could simplify daily operations and improve the energy performance of buildings; Non-intrusive, low-cost solutions to manage the energyconsumption and generation of a building without compromising user comfort.

Information and data required to verify these hypotheses	Feedback on the hypotheses.

Table 76. Analysis of potential customer segment #5: Residential customers

Potential segment #5: Residential customers	
Relevant characteristics	Small energy consumers that want to become active energy market players through an aggregator or are interested in energyautomation for efficiency and comfort.
Segment size	There are more than 200 million households in the EU (Statista, 2021). However, only a small proportion of them is likely to be interested in smart home and BMS solutions. More than 8 million units of smart lights, thermostats and monitoring devices for domestic premises were sold in 2020 across Europe (IDC, 2021). Atthe same time, between 2018 and 2019, there was a c. 43% increase in the number of households in the EU using building energy management systems (from 35,000 to 50,000 households) (Mordor Intelligence, n.d.). Those trends, in combination with the push towards a more energy efficient management of residential buildings, leads to the assumption that the number of potential residential customers for the VTES solution will increase in the future.
Hypothesised customer needs and aspirations	Achieve cost savings on energy bills; Achieve higher energy efficiency at home; Have remote control over specific domestic loads.
Hypotheses about segment purchasing behaviour and criteria	Low-cost, automated solutions that could help to achieveenergy, and hence energy bill, savings; Solutions that are plug-and-play (easy to install and operate); Non-intrusive solutions that do not compromise the comfort ofcustomers; Solutions that allow the visualisation of energy consumptionand offer remote control capabilities for specific residential loads.
Information and data required to verifythese hypotheses	The validation of the solution through the relevant project KPIs,such as customer satisfaction, energy savings achieved per customer and thermal discomfort, could help verify most of the aforementioned hypotheses.

Table 77. Analysis of potential customer segment #6: Energy communities

Potential segment #6: Energy communities	
Relevant characteristics	The term “energy community” is used here to describe any collective action that enables the active participation of citizens tothe energy transition. Energy communities may act as retailers, aggregators and/or ESCos; as such, the relevant characteristicsmentioned in the tables above are valid here according to the caseat hand.
Segment size	In Europe, in 2020, around 3,500 energy cooperatives were identified (including approximately 500 cooperatives in the UK) (JRC, 2020). Due to lack of relevant data on expected growth, one may assume that the number of energy communities in Europe is going to remain stable in the next five years.
Hypothesised customer needs and aspirations	Achieve improvements in energy efficiency at community level; Increase community-level self-consumption; Achieve energy cost savings at community level; Facilitate the participation of the community as a whole, as well as of members of the community as individuals, in the energy market (local energy market, local flexibility market, wholesale market, etc.); Explore new revenue streams for the community.
Hypotheses about segment purchasing behaviour and criteria	Solutions that offer opportunities for revenue stacking for the community as a whole and open up ways to new revenue streams; Solutions with high acceptability potential by members of the community.
Information and data required to verifythese hypotheses	Feedback on the hypotheses.

Table 78. Analysis of potential customer segment #7: Local authorities

Potential segment #7: Local authorities

Relevant characteristics	Local authorities interested in or required to participate in green energy initiatives and decarbonation activities.
Segment size	There are approximately 88,000 local authorities in the EU (CEMR, 2016). One may assume that the number of local authorities will not significantly change over the next five years in the EU.
Hypothesised customer needs and aspirations	Local authorities have a key role in promoting the agenda of and achieving the commitments made by EU member States and the EC with regards to the decarbonation, decentralisation and digitalisation of the energy sector. They especially implement key energy and cost efficiency measures in municipality buildings.
Hypotheses about segment purchasing behaviour and criteria	Solutions that are low-cost, non-intrusive, ideally plug-and- play, and that help to achieve energy and cost savings in publicbuildings without compromising occupant comfort; Solutions that help to raise energy awareness (e.g., through the visualisation of energy consumption and generation in public buildings).
Information and data required to verify these hypotheses	Feedback on the hypotheses.

Refined and updated business model for ER 9

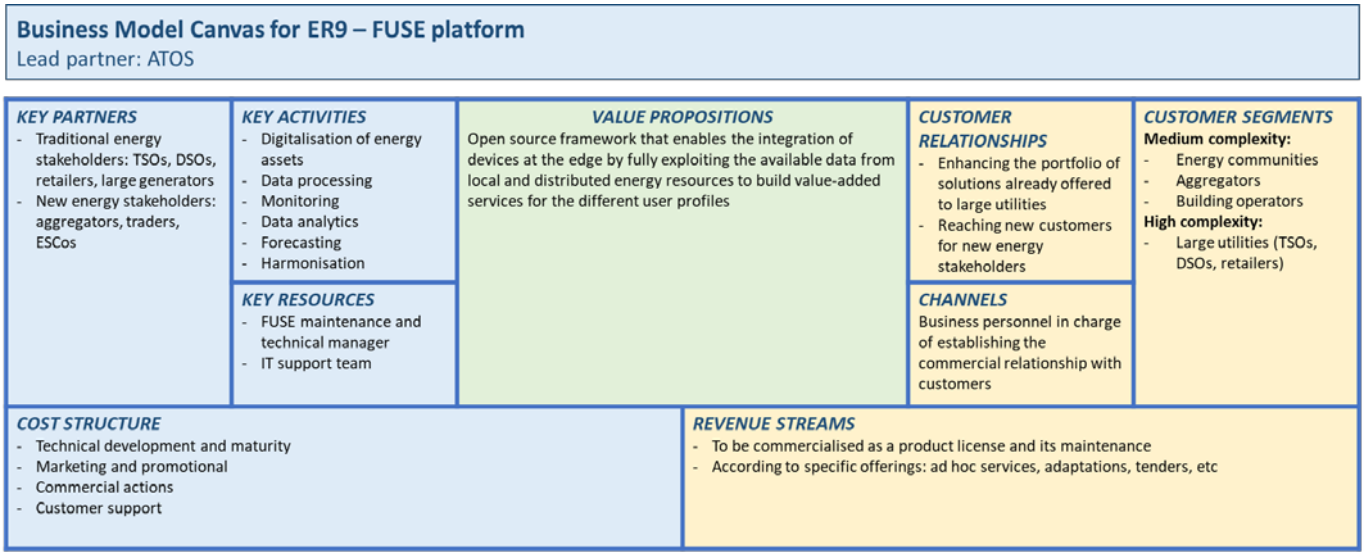


Table 83. Analysis of potential customer segment #1: Energy utilities

Potential segment #1: Energy utilities	
Relevant characteristics	The energy and utilities industry globally covers electric generation: transmission, distribution and retailing of energy.
Segment size	The main customers would be DSOs and so far, the targeted geographical market is Europe.
Hypothesised customer needs and aspirations	Specific and highly innovative modules answering particularidentified new business needs, to be integrated in the (most likely already in place) data gathering platform that customers are using.
Hypotheses about segment purchasing behaviour and criteria	Initial reluctance to incorporate new functionalities into theiralready consolidated systems. Possibility to receive requests for customised designs.
Information and data required to verifythese hypotheses	Interviews with representatives of energy utilities.

Table 84. Analysis of potential customer segment #2: Energy communities, building managers and aggregators

Potential segment #2: Energy communities, building managers and aggregators

Relevant characteristics	Energy communities and large buildings put together aggregate, resident-driven energy activities that add to making ready towards energy transition, while carrying citizens to the cutting edge. They contribute to expand public acknowledgment of RES projects and to align private interests with this energy change. Simultaneously, they can possibly give direct advantages to citizens by fostering energy productivity and reducing power bills (COME-RES, n.d.). Aggregators are another kind of energy specialist co-op that can increment or moderate the power utilisation of a gathering of customers dependent on the absolute power demand on the network.
Segment size	Current European policies are empowering the advancement of energy communities. At this beginning phase of development, EU member States are relied upon to configure instruments for their support (free specialised and legal guidance or endowments to employ specialised help; market access rules and grid usage guidelines for energy communities). Communities dealing with their own electricity networks can coordinate the inclusion of more RES in neighbourhoods, allowing them to act as an aggregator and offer flexibility services to the regional or national grid. Energy communities are generally restricted to not-revenue-driven status and they may face issues in terms of access to subsidising and funding (EC, 2021c).
Hypothesised customer needs and aspirations	As new actors on the value chain, these potential customers are most likely not to have yet their own digital tool for data acquisition and valorisation. Therefore, FUSE can pose as an end-to-end value proposition for them to enter digital energy.
Hypotheses about segment purchasing behaviour and criteria	FUSE can be used (1) as a data management platform for the control and supervision of the whole community/set of users and (2) bundled as an additional service to be used individually by community users or aggregator customers to manage their own premises.
Information and data required to verifythese hypotheses	Contact and discussions with representatives from these sectors.

Exploratory business model canvas for ER10

Business Model Canvas for ER10 – Software module for sizing and siting of the battery storage system
Lead partner: LINKS

KEY PARTNERS
- TSOs
- DSOs
- Aggregators/ESCos
- Energy retailers
- Ancillary services providers
- Microgrid operators
- Energy communities
- Research institutions

KEY ACTIVITIES
Algorithm development for optimisation of the size and location of the battery storage system in the electricity system and development of back-end

KEY RESOURCES
- Development team
- Webservice and computation capacity provider

VALUE PROPOSITIONS
- Maximising economic benefit from storage system investment
- Opening space for more RES hosting in the energy system

CUSTOMER RELATIONSHIPS
Introduction and instructions for the interested parties

CHANNELS
- Stakeholders
- Project partners
- Direct contacts with potential targets
- Website, social media
- Public repository
- Dissemination activities

CUSTOMER SEGMENTS
- DSOs
- Aggregators/ESCos
- Ancillary services providers
- Energy communities
- Research entities

COST STRUCTURE
Development team

REVENUE STREAMS
None: the software will be exposed as an open-source tool

Exploratory business model canvas for ER11

Business Model Canvas for ER11 – Protection algorithm development to improve current protections used in distribution grids with high RES penetration
Lead partner: CIRCE

KEY PARTNERS
- TSOs and DSOs
- Power electronic manufacturers
- Relay manufacturers
- Laboratories
- Technology developers

KEY ACTIVITIES
- Application and design engineering
- Simulation of networks with high RES
- Testing
- Field installation

KEY RESOURCES
- Application and design engineers
- Simulation tools
- Test sets
- Intellectual property
- Demonstration sites

VALUE PROPOSITIONS
Improved performance of the protection system and the grid by algorithms that improve network behaviour

CUSTOMER RELATIONSHIPS
- Setup, maintenance and technical support
- Customer loyalty based on confidence and continuous improvement of the solution
- Quality follow-ups with customers

CHANNELS
- Direct relationship with TSOs, DSOs and MV customers
- Sales through integrators and EPCs
- Sales through switchgear manufacturers
- Promotion by means of seminars, articles and conferences

CUSTOMER SEGMENTS
- TSOs
- DSOs
- Renewable energy producers
- Industrial and other MV customers
- Switchgear manufacturers, integrators and EPCs
- Relay manufacturers

COST STRUCTURE

Opex:
- Human resources
- Software simulation

Capex:
- Demonstration sites
- Lab testing

REVENUE STREAMS

Products:
Direct sales

Services:
Money savings by the upgrades

Exploratory business model canvas for ER 12

Business Model Canvas for ER12 – Software module for flexibility assets emergency operation
Lead partner: CIRCE

KEY PARTNERS
- DSOs
- European Commission
- Universities
- Technology providers

KEY ACTIVITIES
- Development of machine learning algorithms
- Identification, assessment and comparison of technological options for forecasting and control systems in the distribution network
- On-site validations
- Market analysis
- Cooperation with other projects and networking
- Testing of algorithms at simulation level or small-scale demonstrations at first
- Testing by Atos

KEY RESOURCES
- Researchers and developers
- Gathered data
- Technical knowledge
- Local and international market knowledge
- Presence in the electricity market

VALUE PROPOSITIONS
Machine learning algorithms for a one-minute forecast combined with a discriminator of the network status (with or without network issues like over/under voltage problems or overloaded lines), allowing sending specific setpoints to avoid the issues previously anticipated through a flexibility assets operation algorithm

CUSTOMER RELATIONSHIPS
B2B demonstrations and bilateral multiservice offerings to new and existing customers

CHANNELS
- Sales representatives / market developers
- Company website, social media, PR and a dedicated website to demonstrate non-IP sensitive information and results
- Media and workshops, scientific journals, etc.
- Other marketing tools

CUSTOMER SEGMENTS
- DSOs
- Aggregators

COST STRUCTURE
- Human resources
- Tests, simulations and software licences
- Marketing costs
- Sales costs

REVENUE STREAMS

Products:
Direct sales and licences

Services:
Optimised participation in energy markets

Exploratory business model canvas for ER13

Business Model Canvas for ER13 – Fault location TDR prototype
Lead partner: CIRCE

KEY PARTNERS
- DSOs
- Technology providers
- RTOs

KEY ACTIVITIES
- Strengthening the algorithms and the prototype
- Testing and simulations of the algorithms and the prototype
- Performance test on a real grid
- Market analysis for the sale of the development and for possible cooperation with projects
- Identification, assessment and comparison of the technological options for monitoring and control systems in the distribution network

KEY RESOURCES
- Developers and other staff
- Technical knowledge
- Electricity market knowledge
- Close knowledge of consumers and local markets
- Gathered data

VALUE PROPOSITIONS
- Estimation of a distance between the fault point and the place where the locator is installed, using a special approach of time domain reflectometry technique
- Upgrade of this prototype, as well as the location algorithm (ER5), in order to fix previously detected problems regarding range and accuracy

CUSTOMER RELATIONSHIPS
- Customer and maintenance services
- Inclusion in promotional activities and customer relations of ER5 (software module for fault location and self-healing)

CHANNELS
- B2B and/or bilateral multiservice offerings using existing clientele channels
- Sales representatives
- Scientific magazines
- Company websites
- Active media relations
- Conferences, workshops and events to promote the solution

CUSTOMER SEGMENTS
- TSOs
- DSOs
- Aggregators
- Renewable energy producers
- Other energy actors (electricity retailers and utilities)
- Industrial and other MV customers
- Software module for fault location (ER5) customers

COST STRUCTURE
- Human resources
- Testing and in-site demonstrations
- Marketing costs
- Sales costs

REVENUE STREAMS

Products:
- Direct sales

Services:
Technology services such as the estimation of the distance between the fault point and the locator of the algorithm

8.3 Appendix 3: Section 5 Tables

Reviewed business model designed in 8.2, applied to the Use Case 1

Business Model Canvas for Use Case #1 – *Secondary substation of the future upgrading for higher grid automation and control*
Lead partner: Ormazabal

KEY PARTNERS
- Technological supplier
OCT Ormazabal
Corporate Technology
- Production supplier
Tecnichapa
Polsa
Cotradis

KEY ACTIVITIES
- R&D
- Industrial manufacturing
- Sales Department

KEY RESOURCES
- Human resources (R&D technicians, Production workers)
- Manufacturer infrastructure
- Investment provider (Ormazabal)

VALUE PROPOSITIONS
- Service interruption reduction in real time
- Tap regulation
- Voltage regulation
- Safety improvements LVB
- Efficiency cost on LV grid
- Optimizing grid topologies
- Stabilizing volatile grid
- Reducing consumption

CUSTOMER RELATIONSHIPS
- Service improvement
- Control developments: new functionalities
- Retrofit on secondary substation

CHANNELS
- Sales services
- Forums
- Public bidding
- Innovation projects

CUSTOMER SEGMENTS
- Distribution System Operators (DSO)
- Electrical Energy End Users (E3U)
- Renewable Energy manufacturers

COST STRUCTURE

REVENUE STREAMS

Opex:
- Manufacturer cost of production
- R&D investment

Capex:
- Marketing cost
- Sales cost

Products:
- Smart transformer deployment
- LV board supervised
- MV automation developments

Services:
- bidding

Table 92. Analysis of potential customer segment #1: DSOs

Potential segment #1: DSOs	
Relevant characteristics	Large DSOs, looking for: Service improvement; Control developments: new functionalities; Retrofit on secondary substation.
Segment size	Target markets are national markets in Europe.
Hypothesized customer needs and aspirations	Distributed generation, decarbonisation and arrival of EVs
Hypotheses about segment purchasing behaviour and criteria	Functionality and price
Information and data required to verifythese hypotheses	KPIs: SAIFI, CAIDI

Table 93. Analysis of potential customer segment #2: Electrical energy end users

Potential segment #2: Electrical energy end users	
Relevant characteristics	Small DSOs and industrial and commercial customers, looking for: Service improvement; Control developments: new functionalities; Retrofit on secondary substation.
Segment size	Target markets are national markets in Europe and internationalmarkets.
Hypothesised customer needs and aspirations	Simplicity in Secondary substation control and automation
Hypotheses about segment purchasing behaviour and criteria	Functionality and price
Information and data required to verifythese hypotheses	KPIs: SAIFI, CAIDI

Table 94. Analysis of potential customer segment #3: Renewable energy manufacturers

Potential segment #3: Renewable energy manufacturers	
Relevant characteristics	Renewable energy manufacturers (especially wind and solar power) are the targeted customer segment, yet final users are RES producers. This customer segment is looking for service improvement.
Segment size	Target markets are national markets in Europe and international markets.
Hypothesised customer needs andaspirations	Size of the engines and increase of electrical production
Hypotheses about segment purchasingbehaviour and criteria	Functionality and price
Information and data required to verify these hypotheses	KPIs: SAIFI, CAIDI

Table 95. Analysis of customer journey #1: DSOs

Potential customer segment #1: [DSOs]	
Problem faced by the customer	*Integration in systems*
How the customer can **learn** about the product or service	*Working in the integration process and definition*
How the customer can **assess** the product or service's value proposition before the actual purchase	*Based on the needs show on the grid*

How the customer can **purchase** the product or service	*It will be tested in their own systems to be installed with the new SS*
How the customer can **use** the product or service	*Will be prepared to be integrated in their systems.*
How the customer **interacts** with the company after the purchase	*Commercial & Support department will continue with this work*

Table 96. Analysis of customer journey #2: Electrical energy end users

Potential customer segment #2: [Electrical energy end users]	
Problem faced by the customer	*Difficulties to manage the new functionality*
How the customer can **learn** about the product or service	*Usage instruction define for E3U. Specific way of working, simplify by experience with the E3U customer*
How the customer can **assess** the product or service's value proposition before the actual purchase	*Based on the needs show on the grid*
How the customer can **purchase** the product or service	*It will be tested while it is installed the new SS*
How the customer can **use** the product or service	*Will be set for automatic operation. But it can be use manually*
How the customer **interacts** with the company after the purchase	*Commercial & Support department will continue with this work*

Table 97. Analysis of customer journey #3: Renewable energy manufacturers

Potential customer segment #3: [Renewable energy manufacturers]	
Problem faced by the customer	*Difficulties to do some training to the final clients with the new products*
How the customer can **learn** about the product or service	*Working in the definition process*
How the customer can **assess** the product or service's value proposition before the actual purchase	*Based on the project*
How the customer can **purchase** the product or service	*Training course will be held with the final client*
How the customer can **use** the product or service	*Will be set for automatic operation. But it can be use manually. Show on the training course*
How the customer **interacts** with the company after the purchase	*Commercial & Support department will continue with this work*

Reviewing the exploratory business model designed in D8.1 applied to the Use Case 2

Business Model Canvas for Use Case #2 - *Protections functions operating with large RES share penetration in the distribution grid*
Lead Partner: ZIV

KEY PARTNERS	KEY ACTIVITIES	VALUE PROPOSITIONS	CUSTOMER RELATIONSHIPS	CUSTOMER SEGMENTS
DSOs TSOs Power electronic manufacturers Research centers Laboratories	Application and design engineering Simulation of networks with high RES Development of new algorithms Testing Field installation	Improved performance of the protection system	Setup, maintenance and technical support Customer loyalty based on confidence and continuous improvement of the solution	DSOs TSOs MV customers Generator owners Switchgear manufacturers Integrators and EPCs
	KEY RESOURCES Application and design engineers Simulation tools Test-sets Demo-sites		CHANNELS Direct relationship with DSOs, TSOs, MV customers and generator owners Sales through integrators and EPC Sales through Switchgear manufacturers Promotion by means of seminars and conferences	

COST STRUCTURE	REVENUE STREAMS
Opex: - Personnel costs (engineers) - Simulation SW - Lab tests **Capex:** Test sets	**Products:** Protection IEDs and fault detector sales **Services:** Setting studies

Table 103. Analysis of potential customer segment #1: DSO/ESCO

Potential segment #1: [DSO/ESCO]	
Relevant characteristics	*Global. Electricity sector.*
Segment size (current size and expected growth)	*Because RES penetration is growing very fast, and the forecast shows that will continue doing it, the implementation of the new algorithms could be a key differentiator to enter new customers/markets. A 10% business growth could be considered yearly.*
Hypothesised customer needs and aspirations	*DSOs require correct protection operation (no unwanted trips and no lack of trips). They also require this behaviour in networks with high RES penetration*
Hypotheses about segment purchasing behaviour and criteria	*DSOs will tend to buy complete automation packages, updating their functional specifications to this new scenario of high RES penetration*
Information and data required to verify these hypotheses	*There is no data, it's based on the contact with customers.*

Table 104. Analysis of potential customer segment #2: TSOs

Potential segment #2: [TSOs]	
Relevant characteristics	*Global. Electricity sector.*
Segment size (current size and expected growth)	*Because RES penetration is growing very fast, and the forecast shows that will continue doing it, the implementation of the new algorithms could be a key differentiator to enter new customers/markets. A 10% business growth could be considered yearly.*
Hypothesised customer needs and aspirations	*TSOs require correct protection operation (no unwanted trips and no lack of trips). They also require this behaviour in networks with high RES penetration*

Hypotheses about segment purchasing behaviour and criteria	*TSOs will tend to buy complete automation packages, updating their functional specifications to this new scenario of high RES penetration*
Information and data required to verify these hypotheses	*There is no data, it's based on the contact with customers.*

Table 105. Analysis of potential customer segment #3: MV customers

Potential segment #3: [MV customers]	
Relevant characteristics	*Global. Industrial sector.*
Segment size (current size and expected growth)	*The growth will be aligned with the penetration of RES in the distribution network. Hence, we can consider the same growth, 10% yearly, as for in the utilities sector.*
Hypothesised customer needs and aspirations	*MV customers will have to comply with the network codes and DSO's requirements.*
Hypotheses about segment purchasing behaviour and criteria	*New MV customers will have to purchase their substations according to DSO's specifications, what means that the new algorithms will be necessary to comply with them.*
Information and data required to verify these hypotheses	*There is no data, it's based on the experience and the contact with customers.*

Table 106. Analysis of potential customer segment #4: Generators owners

Potential segment #4: [Generator owners]	
Relevant characteristics	*Global. Electricity/renewables sector.*
Segment size (current size and expected growth)	*The growth will be high since worldwide all the countries are promoting the substitution of conventional generation by renewable generation. Hence, we can consider a growth of 25% yearly.*
Hypothesised customer needs and aspirations	*Generator owners will have to comply with the network codes and utilities' requirements.*
Hypotheses about segment purchasing behaviour and criteria	*New generator owners will have to purchase their substations according to DSO's specifications, what means that the new algorithms will be necessary to comply with them.*
Information and data required to verify these hypotheses	*There is no data, it's based on the experience and the contact with customers.*

Table 107. Analysis of potential customer segment #5: Switchgear manufacturers

Potential segment #5: [Switchgear manufacturers]	
Relevant characteristics	*Global. Electricity sector.*
Segment size (current size and expected growth)	*The growth will be aligned with the penetration of RES in the distribution network. Hence, we can consider the same growth, 10% yearly, as for in the utilities sector.*
Hypothesised customer needs and aspirations	*Switchgear manufacturers will have to comply with the network codes and DSO's requirements.*
Hypotheses about segment purchasing behaviour and criteria	*Switchgear manufacturers will have to provide their switchgears according to DSO's specifications, what means that the new algorithms will be necessary to comply with them.*
Information and data required to verify these hypotheses	*There is no data, it's based on the experience and the contact with customers.*

Table 108. Analysis of potential customer segment #6: Integrators and EPCs

Potential segment #6: [Integrators and EPCs]	
Relevant characteristics	*Global. Electricity sector.*
Segment size (current size and expected growth)	*The growth will be aligned with the penetration of RES in the distribution network. Hence, we can consider the same growth, 10% yearly, as for in the utilities sector.*
Hypothesised customer needs and aspirations	*Integrators and EPCs will have to comply with the network codes and utilities' requirements.*
Hypotheses about segment purchasing behaviour and criteria	*Integrators and EPCs will have to provide their solutions (full package) according to DSO's specifications, what means that the new algorithms will be necessary to comply with them.*
Information and data required to verify these hypotheses	*There is no data, it's based on the experience and the contact with customers.*

Table 109. Analysis of customer journey #1: DSO

Potential customer segment #1: [DSO]	
Problem faced by the customer	*Conventional protective relays do not operate correctly in networks with high RES penetration*
How the customer can **learn** about the product or service	*ZIV can do seminars / trainings explaining the new algorithms implemented and their advantages with regard to conventional algorithms. Papers, technical notes and the instruction book of the protective relay can be used as support documents*
How the customer can **assess** the product or service's value proposition before the actual purchase	*ZIV can provide the customer with some recordings with false operations of conventional algorithms and good operations of new algorithms. It can also provide a sample for customer evaluation and provide support in the evaluation process. The customer can install the sample in a real substation during a certain time to evaluate its behaviour*
How the customer can **purchase** the product or service	*Protection relays can be purchased directly or through EPCs, system integrators, ZIV representers, etc. The purchase will be done once the customer has approved the product*
How the customer can **use** the product or service	*The relays will be installed in the customer network. Their operation is normally done by the final customer. Maintenance can be done by the customer or outsourced*
How the customer **interacts** with the company after the purchase	*ZIV normally provides support for the products sold by means of the Technical Assistance Service or the Application Engineering departments. Trainings can also be organized*

Table 110. Analysis of customer journey #2: TSO

Potential customer segment #2: [TSO]	
Problem faced by the customer	*Conventional protective relays do not operate correctly in networks with high RES penetration*
How the customer can **learn** about the product or service	*ZIV can do seminars / trainings explaining the new algorithms implemented and their advantages with regard to conventional algorithms. Papers, technical notes and the instruction book of the protective relay can be used as support documents*
How the customer can **assess** the product or service's value	*ZIV can provide the customer with some recordings with false operations of conventional algorithms and good operations of new algorithms. It can also provide a sample for customer evaluation and provide support in the evaluation process. The*

proposition before the actual purchase	*customer can install the sample in a real substation during a certain time to evaluate its behaviour*
How the customer can **purchase** the product or service	*Protection relays can be purchased directly or through EPCs, system integrators, ZIV representers, etc. The purchase will be done once the customer has approved the product*
How the customer can **use** the product or service	*The relays will be installed in the customer network. Their operation is normally done by the final customer. Maintenance can be done by the customer or outsourced*
How the customer **interacts** with the company after the purchase	*ZIV normally provides support for the products sold by means of the Technical Assistance Service or the Application Engineering departments. Trainings can also be organized*

Table 111. Analysis of customer journey #3: MV customers

Potential customer segment #3: [MV customers]	
Problem faced by the customer	*Conventional protective relays do not operate correctly in networks with high RES penetration*
How the customer can **learn** about the product or service	*ZIV can do seminars / trainings explaining the new algorithms implemented and their advantages with regard to conventional algorithms. Papers, technical notes and the instruction book of the protective relay can be used as support documents*
How the customer can **assess** the product or service's value proposition before the actual purchase	*ZIV can provide the customer with some recordings with false operations of conventional algorithms and good operations of new algorithms. It can also provide a sample for customer evaluation and provide support in the evaluation process. The customer can install the sample in a real substation during a certain time to evaluate its behaviour*
How the customer can **purchase** the product or service	*Protection relays can be purchased directly or through EPCs, system integrators, ZIV representers, etc. The purchase will be done once the customer has approved the product*
How the customer can **use** the product or service	*The relays will be installed in the customer network. Their operation is normally done by the final customer. Maintenance can be done by the customer or outsourced*
How the customer **interacts** with the company after the purchase	*ZIV normally provides support for the products sold by means of the Technical Assistance Service or the Application Engineering departments. Trainings can also be organized*

Table 112. Analysis of customer journey #4: Generator owners

Potential customer segment #4: [Generator owners]	
Problem faced by the customer	*Conventional protective relays do not operate correctly in networks with high RES penetration*
How the customer can **learn** about the product or service	*ZIV can do seminars / trainings explaining the new algorithms implemented and their advantages with regard to conventional algorithms. Papers, technical notes and the instruction book of the protective relay can be used as support documents*
How the customer can **assess** the product or service's value proposition before the actual purchase	*ZIV can provide the customer with some recordings with false operations of conventional algorithms and good operations of new algorithms. It can also provide a sample for customer evaluation and provide support in the evaluation process. The customer can install the sample in a real substation during a certain time to evaluate its behaviour*

How the customer can **purchase** the product or service	*Protection relays can be purchased directly or through EPCs, system integrators, ZIV representers, etc. The purchase will be done once the customer has approved the product*
How the customer can **use** the product or service	*The relays will be installed in the customer network. Their operation is normally done by the final customer. Maintenance can be done by the customer or outsourced*
How the customer **interacts** with the company after the purchase	*ZIV normally provides support for the products sold by means of the Technical Assistance Service or the Application Engineering departments. Trainings can also be organized*

Table 113. Analysis of customer journey #5: Switchgear manufacturers

Potential customer segment #5: [Switchgear manufacturers]	
Problem faced by the customer	*Conventional protective relays do not operate correctly in networks with high RES penetration*
How the customer can **learn** about the product or service	*ZIV can do seminars / trainings explaining the new algorithms implemented and their advantages with regard to conventional algorithms. Papers, technical notes and the instruction book of the protective relay can be used as support documents*
How the customer can **assess** the product or service's value proposition before the actual purchase	*ZIV can provide the customer with some recordings with false operations of conventional algorithms and good operations of new algorithms. It can also provide a sample for customer evaluation and provide support in the evaluation process. The customer can install the sample in a real substation during a certain time to evaluate its behaviour*
How the customer can **purchase** the product or service	*Protection relays can be purchased directly or through EPCs, system integrators, ZIV representers, etc. The purchase will be done once the customer has approved the product*
How the customer can **use** the product or service	*The relays will be installed in the customer network. Their operation is normally done by the final customer. Maintenance can be done by the customer or outsourced*
How the customer **interacts** with the company after the purchase	*ZIV normally provides support for the products sold by means of the Technical Assistance Service or the Application Engineering departments. Trainings can also be organized*

Table 114. Analysis of customer journey #6: Integrators and EPCs

Potential customer segment #6: [Integrators and EPCs]	
Problem faced by the customer	*Conventional protective relays do not operate correctly in networks with high RES penetration*
How the customer can **learn** about the product or service	*ZIV can do seminars / trainings explaining the new algorithms implemented and their advantages with regard to conventional algorithms. Papers, technical notes and the instruction book of the protective relay can be used as support documents*
How the customer can **assess** the product or service's value proposition before the actual purchase	*ZIV can provide the customer with some recordings with false operations of conventional algorithms and good operations of new algorithms. It can also provide a sample for customer evaluation and provide support in the evaluation process. The customer can install the sample in a real substation during a certain time to evaluate its behaviour*

How the customer can **purchase** the product or service	*Protection relays can be purchased directly or through EPCs, system integrators, ZIV representers, etc. The purchase will be done once the customer has approved the product*
How the customer can **use** the product or service	*The relays will be installed in the customer network. Their operation is normally done by the final customer. Maintenance can be done by the customer or outsourced*
How the customer **interacts** with the company after the purchase	*ZIV normally provides support for the products sold by means of the Technical Assistance Service or the Application Engineering departments. Trainings can also be organized*

Reviewing the exploratory business model designed in D8.1 applied to the Use Case 2

Business Model Canvas for ER #9 – FUSE platform
Lead partner: ATOS

KEY PARTNERS	KEY ACTIVITIES	VALUE PROPOSITIONS	CUSTOMER RELATIONSHIPS	CUSTOMER SEGMENTS
Traditional energy stakeholders (big generators, TSOs, DSOs, retailers) New energy stakeholders (aggregators, traders, ESCos)	Digitalisation of energy assets Data processing Monitoring Data Analytics Forecasting Harmonization	Open-source framework that enables the integration of devices at the edge by fully exploiting the available data from local and distributed energy resources to build value-added services for the several user profiles	Enhancing the portfolio of solutions Atos already offers to large Utilities. Reaching new customers for new energy stakeholders	Medium complexity: Building operators, Energy communities, Aggregators, etc. High Complexity: Big Utilities
	KEY RESOURCES FUSE maintenance and technical manager IT support team		CHANNELS Atos Resources and Services industry, channeling Atos offering to Energy clients	

COST STRUCTURE	REVENUE STREAMS
Technical development and maturity Marketing and promotional Commercial actions Customer support	According to specific offerings (ad hoc services, adaptations, tenders, etc.) To be commercialized as a product license and its maintenance

Table 122. Analysis of potential customer segment #1: Energy utilities

Potential segment #1: Energy utilities	
Relevant characteristics	The Energy and Utilities Industry globally covers electric generation: transmission, distribution and retailing of energy.
Segment size (current size and expected growth)	The market capitalization of large electric and multi-utilities companies in Europe increased by about €74.1 billion in the third quarter of 2020. Our main customers are the DSOs, who are already our customers. Possible extra clients would be the rest, but we cannot make a study of each case as there are many of them. So far, we focus on the EU market.
Hypothesised customer needs and aspirations	Provide specific and highly innovative modules answering particular identified new business needs, to be integrated in the (most likely already in place) data gathering platform they are using.

Hypotheses about segment purchasing behaviour and criteria	Initial reluctance to incorporate new functionalities to their already consolidated systems. Possibility of receiving requests for customized designs.
Information and data required to verify these hypotheses	Interviews with representatives of Energy Utilities.

Table 123. Analysis of potential customer segment #2: Energy communities, building managers and aggregators

Potential segment #2: Energy communities, building managers and aggregators	
Relevant characteristics	Energy communities and big buildings organise collective and citizen-driven energy actions that will help pave the way for a clean energy transition, while moving citizens to the fore. They contribute to increase public acceptance of renewable energy projects and make it easier to attract private investments in the clean energy transition. At the same time, they have the potential to provide direct benefits to citizens by advancing energy efficiency and lowering their electricity bills. On the other hand, an aggregator is a new type of energy service provider which can increase or moderate the electricity consumption of a group of consumers according to total electricity demand on the grid
Segment size (current size and expected growth)	European policy is encouraging the development of energy communities. In this early stage of development, European member states should produce the necessary tools for support. Firstly, national governments should offer free technical and legal advice to energy communities or subsidies for community projects to hire technical assistance. Secondly, market access rules and grid usage rules should be more in favour of energy communities. Communities managing their own grids can integrate more renewables in local areas, allowing them to act as an aggregator and offer flexible services to the regional or national grid. Finally, as energy communities are often limited to not-for-profit status and are relatively small compared to traditional energy players, communities face issues regarding access to funding and finance.
Hypothesised customer needs and aspirations	As new actors on the value chain, these potential customers are most likely not having yet their own digital tool for data acquisition and valorization. Therefore, FUSE can pose as an end-to-end value proposition for them to enter the digital energy.
Hypotheses about segment purchasing behaviour and criteria	FUSE can be used (1) as data management platform for the control and supervision of the whole community/set of users and (2) bundled as an additional service to be used individually by community users or aggregator customers to manage their own premises.
Information and data required to verify these hypotheses	Establish contact and generate discussions with representatives from these sectors.

Table 124. Analysis of customer journey #1: Energy utilities

Potential segment #1: Energy utilities	
Relevant characteristics	The Energy and Utilities Industry globally covers electric generation: transmission, distribution and retailing of energy.

Segment size (current size and expected growth)	The market capitalization of large electric and multi-utilities companies in Europe increased by about €74.1 billion in the third quarter of 2020. Our main customers are the DSOs, who are already our customers. Possible extra clients would be the rest, but we cannot make a study of each case as there are many of them. So far, we focus on the EU market.
Hypothesised customer needs and aspirations	Provide specific and highly innovative modules answering particular identified new business needs, to be integrated in the (most likely already in place) data gathering platform they are using.
Hypotheses about segment purchasing behaviour and criteria	Initial reluctance to incorporate new functionalities to their already consolidated systems. Possibility of receiving requests for customized designs.
Information and data required to verify these hypotheses	Interviews with representatives of Energy Utilities.

Table 125. Analysis of customer journey #2: Energy communities, building managers and aggregators

Potential segment #2: Energy communities, building managers and aggregators	
Relevant characteristics	Energy communities and big buildings organise collective and citizen-driven energy actions that will help pave the way for a clean energy transition, while moving citizens to the fore. They contribute to increase public acceptance of renewable energy projects and make it easier to attract private investments in the clean energy transition. At the same time, they have the potential to provide direct benefits to citizens by advancing energy efficiency and lowering their electricity bills. On the other hand, an aggregator is a new type of energy service provider which can increase or moderate the electricity consumption of a group of consumers according to total electricity demand on the grid
Segment size (current size and expected growth)	European policy is encouraging the development of energy communities. In this early stage of development, European member states should produce the necessary tools for support. Firstly, national governments should offer free technical and legal advice to energy communities or subsidies for community projects to hire technical assistance. Secondly, market access rules and grid usage rules should be more in favour of energy communities. Communities managing their own grids can integrate more renewables in local areas, allowing them to act as an aggregator and offer flexible services to the regional or national grid. Finally, as energy communities are often limited to not-for-profit status and are relatively small compared to traditional energy players, communities face issues regarding access to funding and finance.
Hypothesised customer needs and aspirations	As new actors on the value chain, these potential customers are most likely not having yet their own digital tool for data acquisition and valorization. Therefore, FUSE can pose as an end-to-end value proposition for them to enter the digital energy.
Hypotheses about segment purchasing	FUSE can be used (1) as data management platform for the control and supervision of the whole community/set of users and (2) bundled as an additional service to be used individually by

behaviour and criteria	community users or aggregator customers to manage their own premises.
Information and data required to verify these hypotheses	Establish contact and generate discussions with representatives from these sectors.

Reviewing the exploratory business model designed in D8.1 applied to the Use Case 2

Business Model Canvas for Use Case #2 - *Protections functions operating with large RES share penetration in the distribution grid*
Lead Partner: ZIV

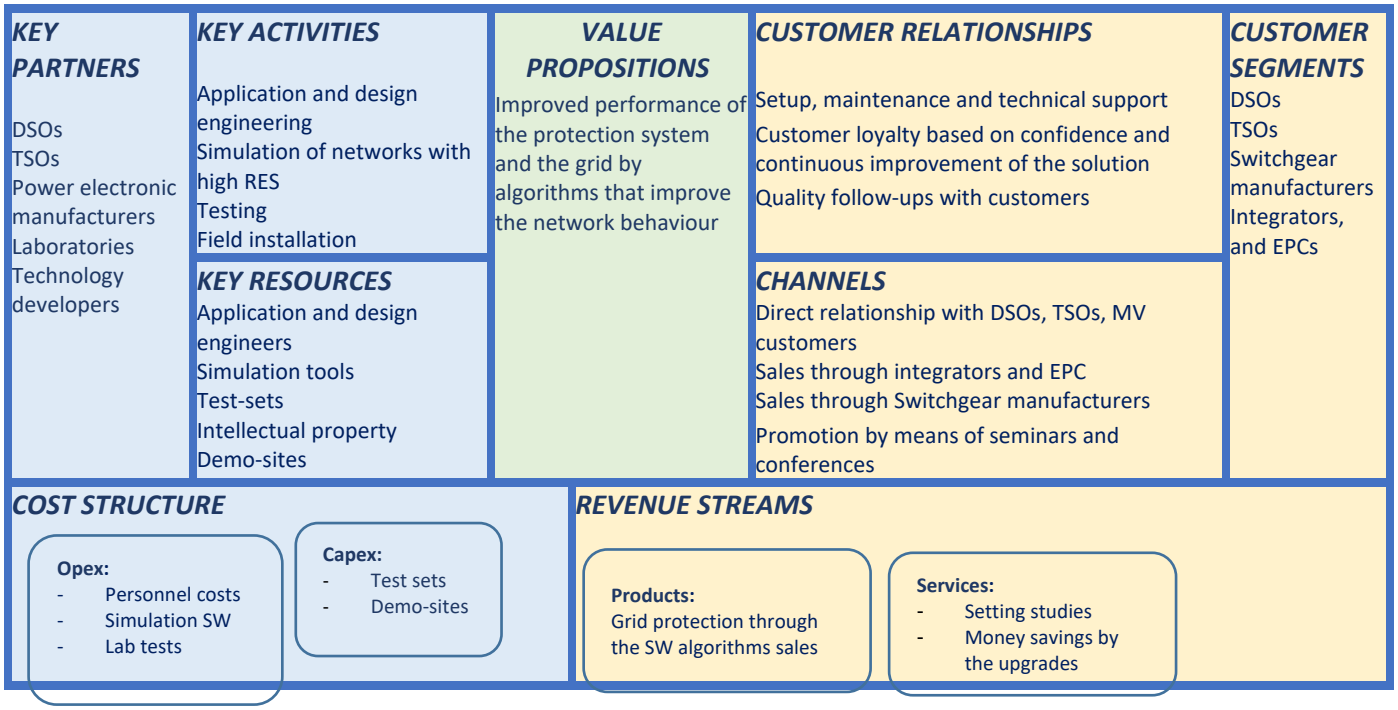


Table 129. Analysis of potential customer segment #1: DSO & TSO

Potential segment #1: DSO & TSO	
Relevant characteristics	**Distribution System Operators (DSO)** who are managers or owners of energy distribution networks. The DSOs serve as simplifiers of the installation process, automates the operation process and increasers of the portfolio. A **transmission system operator (TSO)** is an organisation committed to transporting energy in the form of natural gas or electrical power on a national or regional level, using fixed infrastructure.
Segment size (current size and expected growth)	Spain, France, Switzerland, Austria and Slovenia, Italy, UK, Germany, Denmark, The Netherlands, Switzerland, Sweden, Luxembourg, and rest of the European countries.
Hypothesised customer needs and aspirations	The mission of **DSOs** throughout Europe is to operate and manage the distribution networks in a safe and secure manner. They are also responsible for developing the distribution grids to ensure the long-term ability of the system to deliver high-quality services to grid users and other stakeholders of the electric power system. DSOs are thus considered to have a "natural monopoly" on local grids, and therefore play a crucial role in the effective roll out of demand response in each locality. DSOs are in fact regulated players and provide their services in a strict regulatory framework that is traditionally focused on CAPEX-intense investments for security-of-supply. Thus, DSOs have been mostly involved with maintenance and expansion of the grid infrastructure, the "hardware", whereas with a more forward-looking smart grid regulation DSOs would be incentivised to also invest in OPEX. In the coming years, several challenges for local distribution grids will accentuate:

	• Electrification of transport, with electric car charging patterns and electric heating patterns overlapping. • More distributed renewable energy sources leading to bi-directional flows on the grid. • More flexible consumption patterns, with consumers reacting simultaneously to price signals (on the wholesale market) or curtailment instructions (for balancing services). Overall, there will be a growing uncertainty over the exact requirements and standards that the power grid will have to fulfil, making long-term investment cycles an even more risky business. Investments in monitoring and control functionalities, in order to manage demand side flexibility on a local level (hence, rather the "software"), could represent a cost-effective alternative for DSOs. Regarding **TSOs**, safety and reliability are critical issues for them, with natural hazards and generation/consumption imbalances being the main concerns. The roles of the TSO in a wholesale electricity market include managing the security of the power system in real time and co-ordination of supply and demand for electricity that avoids fluctuations in frequency or interruptions of supply. The TSO service is normally specified in rules or codes established as part of the electricity market. The TSOs also carry out investigations and planning to ensure that supply can meet demand and system security can be maintained during future trading periods.
Hypotheses about segment purchasing behaviour and criteria	The algorithm allows to make an adequate selection of the phase that has a fault. The value contribution is related to the improvement of the performance of the protection system and the grid by algorithms that improve the network behaviour.
Information and data required to verify these hypotheses	Existing failures and poor operation of protection functions.

Table 130. Analysis of potential customer segment #2: Switchgear and protection relays manufacturers

Potential segment #2: Switchgear and protection relays manufacturers	
Relevant characteristics	Manufacturers of HV and MV breakers, load break switches and reclosers.
Segment size *(current size and expected growth)*	Spain, France, Switzerland, Austria and Slovenia, Italy, UK, Germany, Denmark, The Netherlands, Switzerland, Sweden, Luxembourg, and rest of the European countries.
Hypothesised customer needs and aspirations	The use of renewable energies produces significant changes in the way electrical installations work and, consequently, affects the operation of the protection and automation devices used to protect said installations. The interest of this sector will be in being able to adapt its protection systems to the needs of its customers and incorporate the solutions required by the new energy demand.
Hypotheses about segment purchasing behaviour and criteria	The algorithm allows to make an adequate selection of the phase that has a fault. They buy this algorithm so they can include it within their protection systems.
Information and data required to verify these hypotheses	Existing failures and poor operation of protection functions.

Table 131. Analysis of customer journey #1: DSO & TSO

Potential customer segment #1: DSO & TSO	
Problem faced by the customer	The problem occurs in protection systems that do not correctly identify the phase where the fault occurs. The algorithm improves the performance of the systems and activates the protection actions.
How the customer can **learn** about the product or service	For this segment, this result will be approved and offered initially to the DSOs that are part of the project's knowledge and to DSOs & TSO that are not part of the consortium but with whom CIRCE has previously worked or already has commercial relationships.
How the customer can **assess** the product or service's value	Showing them the results obtained in the validations and tests process.

proposition before the actual purchase	
How the customer can **purchase** the product or service	Due to the type of solution, it will be offered as an added service, rather than a product per se since the software must be adapted to the client's needs. Selling, licencing, start-upping, for policy making use and/or licencing to a spin-out.
How the customer can **use** the product or service	It is sold to manufacturers of protection systems. DSOs & TSOs will use these protection systems to improve the operation of their grids.
How the customer **interacts** with the company after the purchase	Maintenance and solution of possible errors related to the algorithm.

Table 132. Analysis of customer journey #2: Switchgear and protection relays manufacturers

Potential segment #2: Switchgear and protection relays manufacturers	
Problem faced by the customer	It would improve the performance of protection systems and the behaviour of the protection relays.
How the customer can **learn** about the product or service	Advice/ counselling on equipment and operations would be provided. Ad-hoc training could be offered.
How the customer can **assess** the product or service's value proposition before the actual purchase	Showing them the results obtained in the validations and tests process.
How the customer can **purchase** the product or service	Due to the type of solution, it will be offered as an added service, rather than a product per se since the software must be adapted to the client's needs. Selling, licencing, start-upping, for policy making use and/or licencing to a spin-out.
How the customer can **use** the product or service	It is sold to manufacturers of protection systems to install it in their hardware and include it among their services.
How the customer **interacts** with the company after the purchase	Maintenance and solution of possible errors related to the algorithm.

Reviewed business model designed in 8.2, applied to the Use Case 3

Business Model Canvas for Use Case #3 - Holistic energy system optimization and emulation for commercial and residential customers
Lead Partner: VERD

KEY PARTNERS

-Flexigrid partners and European Commission
- Materials suppliers
- Energy Box manufacturers
- Commercial partners
- TSOs
- DSOs
- Aggregators/ESCOs
- Energy retailers
- Renewable energy producers
- Industrial and commercial partners
- Software vendors

KEY ACTIVITIES

Market analysis
Identification, assessment and comparison of the technological solutions for monitoring and control systems in the distribution network and in the customer premises
Development of recommendations for the cost-effective application of advanced distributed sensors, monitoring and control systems to increase distribution networks' intelligence
Manufacturing
Installation at customer premises
Development of a device for LV grids monitoring with new functionalities
Testing of algorithms (simulation, small scale demonstration)
Performance test of the developed applications in a real grid
Cooperation with other projects and networking
Digitalisation of energy assets
Data processing

KEY RESOURCES

Human resources (developers)
Gathered data
Technical knowledge
Electricity market knowledge
Close knowledge of consumers and local markets
IP legal and administrative assistance
Components and material hardware
Design of modular architecture
Design of material hardware
Technological features : signal injection and time domain reflectometry (TDR), IoT communication protocols, Linux-based OS, real-time management
FUSE maintenance and technical manager
IT support team

VALUE PROPOSITIONS

Forecasting algorithms to accurately predict energy generation, demand and electricity price
Hardware and software solution to solve field-level communication and management
Modern and compact design of the Energy Box
Open-source framework that enables the integration of devices at the edge by fully exploiting the available data from local and distributed energy resources to build value-added services for the several user profiles

CUSTOMER RELATIONSHIPS

Distribution at demonstration sites
B2B and/or bilateral multiservice offerings (using existing cliantele channels)
Sales representatives
Company website and dedicated website giving access to non IP-sensitive results
Online and printed marketing tools
Media and social media
Workshops, conferences and events
Customer and maintenance services
Customer service call center
ATOS Worldgrid

CHANNELS

Distribution at demonstration sites
Company website and dedicated website giving access to non-IP sensitive results
Online and printed marketing tools
Media and social media
Conferences, workshops and other events
Innovation forum
ATOS Worldgrid solutions and its analytics engine

CUSTOMER SEGMENTS

Aggregators and ESCOs
RES producers
C&I customers and prosumers
Energy communities
Experts and actors of the refurbishment industry
Local authorities in charge of the management of social housing

COST STRUCTURE

Opex:
- Human resources
- Testing and simulation
- License for a specific software
- Marketing costs
- Sales costs
- Manufacturing
- Technical developement and maturity
- Customer support
- Commercial actions

Capex:
Aggregation and transmission hardware infrastructure

REVENUE STREAMS

Direct sales
Sales through intermediates
Technology tranfers
For FUSE : according to specific offering (ad-hoc services, adaptations, tenders, etc.)

Table 137. Analysis of potential customer segment #1: Commercial and Industrial (C&I) customers

Potential segment #1: Commercial and Industrial (C&I) customers	
Relevant characteristics	*C&I customers are looking to maximise RES uptake on their sites in order to reduce their energy costs.* *More specifically, facility managers and building owners with PV systems installed in their premises would benefit from a forecasting solution that would allow them to better understand the production capacity of their assets.*
Segment size (current size and expected growth)	*Commercial and industrial customers typically represent 50% of the total energy use[7]. The total electricity production in Europe reached a net 2,800TWh in 2018[1] which at an average electricity unit cost of 7.7[2] cents/kWh represents a total market worth of c.108 billion €*
Hypothesised customer needs and aspirations	• *Reduce emissions by deploying RES and EVs* • *Taking advantage of the forecasting results aiming at maximising the integration of RES generation without compromising business-as-usual operation* • *Reduced operating expenses*
Hypotheses about segment purchasing behaviour and criteria	• *Customers would need a stable and profitable business model in order to invest in the software* • *Customers would probably be looking for a payback period lower than 5 years in order to invest*
Information and data required to verify these hypotheses	*Current strategies and energy forecasting/optimisation actions as well as relevant energy costs against the offered solution*

Table 138. Analysis of potential customer segment #2: residentials

Potential segment #2: Residentials	
Relevant characteristics	*Residential customers would need to increase self-consumption rates from their RES. Optimisation and scheduling algorithms would allow for optimisation in energy use in residential premises*
Segment size (current size and expected growth)	*Energy consumption in households represents a steady contribution of ~25% of the total energy consumption in Europe according to Eurostat[3]. Electricity production in Europe reached 2,800TWh in 2018 with a slight 0.5% drop compared to 2017.* *Prices for an annual consumption of 2,500 to 5,000 kWh were most expensive for households in Germany and Denmark in 2019, with these nations paying an average of 30.88 cents and 29.84 cents per kWh,*

	respectively. In comparison, costs were lowest in Bulgaria where households paid less than 10 cents per kWh. In 2018, the average household price throughout the EU was 21.13 cents[4] per kWh representing a total spending on electricity for residential customers of around 147 billion €.
Hypothesised customer needs and aspirations	• *Improved reliability of supply* • *Reduced energy costs* • *Reduced environmental footprint* • *Introduce new technologies in their household (e.g., small storage systems)*
Hypotheses about segment purchasing behaviour and criteria	*Residential customers are not expected to be very eager to purchase these services, as there is currently no strong motivation for them to manage their loads.*
Information and data required to verify these hypotheses	*Potential issues with reliability of supply, energy bills and/or potential opportunities for reduced energy costs depending on the country of reference might verify the need for congestion management at a residential level*

Table 139. Analysis of potential customer segment #3: Aggregators and ESCOs

Potential segment #3: Aggregators and ESCOs	
Relevant characteristics	*Aggregators and ESCOs are responsible of managing energy resources on behalf of their customers hence generation forecasting services would allow them to offer improved services to their customers.* *In addition to that, aggregators/ESCOs trade electricity in the energy market. Dealing with interruptible and non-predictable RES means that they need to use customised congestion management tools in order to be able to benefit from the flexible energy resources of their customers* *We will target specifically aggregators with solar assets, as this is the technology our solution currently covers.*
Segment size (current size and expected growth)	*In Europe $3.5b is projected to be the market by 2025 for demand response aggregators[5]* *Licensed aggregators/ESCOs currently add up to around 5000 in Europe[1]. Assuming a penetration rate of 0.75% we estimate a potential market volume of 37 customers within this area*
Hypothesised customer needs and aspirations	*The software modules tested in this Use Case would help aggregators and ESCOs to undertake a comprehensive one-stop solution to set-up, develop and exploit flexible energy provisioning from customers to DSOs.* *The modules would also allow them to drive decarbonisation and minimise their customers' burdens in monetising flexibility*
Hypotheses about segment purchasing behaviour and criteria	*These services would allow the aggregators/ESCOs to minimise their OPEX by introducing automated processes in their businesses*
Relevant characteristics	*Aggregators/ESCOs trade electricity in the energy market. Dealing with interruptible and non-predictable RES means that they need to use customised congestion management tools in order to be able to benefit from the flexible energy resources of their customers*

Table 140. Analysis of customer journey #1: Commercial & Industrial customers

Potential customer segment #1: Commercial & Industrial customers

Problem faced by the customer	*C&I customers often install RES on their premises in order to reduce their energy bills while benefitting from a given level of energy services. At the same time, they need to satisfy their buildings occupants' level of comfort and their businesses' specific energy needs. This implies a high level of complexity in their operations introducing the need for an accurate load and energy generation forecasting from their assets.*
How the customer can **learn** about the product or service	*Customers could learn about the product through dissemination activities such as articles, conferences and events or by looking at their competitors' activities and replicating strategies*
How the customer can **assess** the product or service's value proposition before the actual purchase	*A trial version of the product could be available in order for the customers to be able to assess its capabilities for a specific period of time (e.g., 3 months) before purchasing it*
How the customer can **purchase** the product or service	*The product/service can be purchased either by being given access to the service or the product using a license on a monthly/yearly fee or by an one-off payment to purchase the product from the developer*
How the customer can **use** the product or service	*C&I customers could use the product in order to accurately predict their energy demand and RES generation on a daily basis. Facility managers of the buildings could this way have a very good overview of their energy needs on a daily basis and adjust operations accordingly aiming at reducing their energy costs*
How the customer **interacts** with the company after the purchase	*Interaction with the company post-purchase could be done through emails in order to ensure support is provided for any technical issues that may arise.* *Contract for O&M of the product could also be provided to the customer by the company developing the product*

Table 141. Analysis of customer journey #2: Residential customers

Potential customer segment #2: Residential customers	
Problem faced by the customer	*Residential customers want to optimise their energy use*
How the customer can **learn** about the product or service	*Residential customers could learn about the product through direct customer support channels (web portal, social media etc.).* *Awareness raised by government and regulation could also help promoting the need for congestion management services*
How the customer can **assess** the product or service's value proposition before the actual purchase	*The customers can assess the product before purchasing it by requesting a free trial period in the form of a personalized report based on simulation*
How the customer can **purchase** the product or service	*The customer could purchase a fixed-term license for using the product (e.g., one-year license) or agree with the solution provider on specific payments depending on the level of support*
How the customer can **use** the product or service	*The customer either sets up the relevant SaaS to be functioning in an automated preconfigured way, or interacts in real time with the application's suggestions to accept or not a congestion mitigation or energy management optimization action.*
How the customer **interacts** with the	*These customers will need to interact with the supplier of the software services at the beginning for training purposes as well as during an*

company after the purchase	*active license period for support purposes. The interaction will be realized through the available communication channels as defined in the relevant contract agreement (e.g., email, phone, dedicated support platform)*

Table 142. Analysis of customer journey #3: Aggregators/ESCOs and retailers

Potential customer segment #3: Aggregators/ESCOs and retailers	
Problem faced by the customer	*Aggregators, ESCOs and retailers trade electricity in the energy market. Dealing with interruptible and non-predictable RES means that they need to rely on accurate forecasting services in order to be able to make informed decisions regarding their trades in the market.*
How the customer can **learn** about the product or service	*Customers could learn about the product through dissemination activities such as articles, conferences and events or by looking at their competitors' activities and replicating strategies*
How the customer can **assess** the product or service's value proposition before the actual purchase	*A trial version of the product could be available in order for the customers to be able to assess its capabilities for a specific period of time (e.g., 3 months) before purchasing it*
How the customer can **purchase** the product or service	*The product/service can be purchased either by being given access to the service or the product using a license on a monthly/yearly fee or by a one-off payment to purchase the product from the developer*
How the customer can **use** the product or service	*The aggregators could use the product to produce hourly and daily forecasts of the energy production of their assets in order to be able to participate in the energy market.*
How the customer **interacts** with the company after the purchase	*Interaction with the company post-purchase could be done through emails in order to ensure support is provided for any technical issues that may arise.* *Contract for O&M of the product could also be provided to the customer by the company developing the product*

Reviewed business model designed in 8.2, applied to the Use Case 4

Business Model Canvas for Use Case #4 - Microgrid congestion management and peak shaving
Lead Partner: VERD

KEY PARTNERS	***KEY ACTIVITIES***	***VALUE PROPOSITIONS***	***CUSTOMER RELATIONSHIPS***	***CUSTOMER SEGMENTS***
-Flexigrid partners and European Commission - Materials suppliers - Energy Box manufacturers - Commercial partners - TSOs - DSOs - Aggregators/ESCOs - Energy retailers - Renewable energy producers - Industrial and commercial partners - Software vendors	Market analysis Identification, assessment and comparison of the technological solutions for monitoring and control systems in the distribution network and in the customer premises Development of recommendations for the cost-effective application of advanced distributed sensors, monitoring and control systems to increase distribution networks' intelligence Manufacturing Installation at customer premises	Forecasting algorithms to accurately predict energy generation, demand and electricity price Hardware and software solution to solve field-level communication and management Modern and compact design of the Energy Box Open-source framework that enables the integration of devices at the edge by fully exploiting the available data from local and distributed energy resources to build value-added services for the several user profiles	Distribution at demonstration sites B2B and/or bilateral multiservice offerings (using existing clientele channels) Sales representatives Company website and dedicated website giving access to non IP-sensitive results Online and printed marketing tools Media and social media	Aggregators and ESCOs RES producers C&I customers and prosumers Energy communities Experts and actors of the refurbishment industry Local authorities in charge of the management of social housing

	Development of a device for LV grids monitoring with new functionalities Testing of algorithms (simulation, small scale demonstration) Performance test of the developed applications in a real grid Cooperation with other projects and networking Digitalisation of energy assets Data processing		Workshops, conferences and events Customer and maintenance services Customer service call center ATOS Worldgrid	
	KEY RESOURCES Human resources (developers) Gathered data Technical knowledge Electricity market knowledge Close knowledge of consumers and local markets IP legal and administrative assistance Components and material hardware Design of modular architecture Design of material hardware Technological features : signal injection and time domain reflectometry (TDR), IoT communication protocols, Linux-based OS, real-time management FUSE maintenance and technical manager IT support team		***CHANNELS*** Distribution at demonstration sites Company website and dedicated website giving access to non-IP sensitive results Online and printed marketing tools Media and social media Conferences, workshops and other events Innovation forum ATOS Worldgrid solutions and its analytics engine	
COST STRUCTURE **Opex:** - Human resources - Testing and simulation - License for a specific software - Marketing costs - Sales costs - Manufacturing - Technical developement and maturity - Customer support - Commercial actions **Capex:** Aggregation and transmission hardware infrastructure			***REVENUE STREAMS*** Direct sales Sales through intermediates Technology tranfers For FUSE : according to specific offering (ad-hoc services, adaptations, tenders, etc.)	

Table 146. Analysis of potential customer segment #1: Commercial and Industrial (C&I) customers

Potential segment #1: Commercial and Industrial (C&I) customers	
Relevant characteristics	*C&I customers are looking to maximise RES uptake on their sites in order to reduce their energy costs.* *More specifically, facility managers and building owners with PV systems installed in their premises would benefit from a forecasting solution that would allow them to better understand the production capacity of their assets.*

Segment size (current size and expected growth)	*Commercial and industrial customers typically represent 50% of the total energy use[7]. The total electricity production in Europe reached a net 2,800TWh in 2018[1] which at an average electricity unit cost of 7.7[2] cents/kWh represents a total market worth of c.108 billion €*
Hypothesised customer needs and aspirations	• *Reduce emissions by deploying RES and EVs* • *Taking advantage of the forecasting results aiming at maximising the integration of RES generation without compromising business-as-usual operation* • *Reduced operating expenses*
Hypotheses about segment purchasing behaviour and criteria	• *Customers would need a stable and profitable business model in order to invest in the software* • *Customers would probably be looking for a payback period lower than 5 years in order to invest*
Information and data required to verify these hypotheses	*Current strategies and energy forecasting/optimisation actions as well as relevant energy costs against the offered solution*

Table 147. Analysis of potential customer segment #2: Aggregators and ESCOs

Potential segment #2: Aggregators and ESCOs	
Relevant characteristics	*Aggregators and ESCOs are responsible of managing energy resources on behalf of their customers hence generation forecasting services would allow them to offer improved services to their customers.* *In addition to that, aggregators/ESCOs trade electricity in the energy market. Dealing with interruptible and non-predictable RES means that they need to use customised congestion management tools in order to be able to benefit from the flexible energy resources of their customers* *We will target specifically aggregators with solar assets, as this is the technology our solution currently covers.*
Segment size (current size and expected growth)	*In Europe $3.5b is projected to be the market by 2025 for demand response aggregators[3]* *Licensed aggregators/ESCOs currently add up to around 5000 in Europe[1]. Assuming a penetration rate of 0.75% we estimate a potential market volume of 37 customers within this area*
Hypothesised customer needs and aspirations	• *Optimisation of energy charges for their customers* • *Optimisation of flexibility estimation associated with prosumers' forecasted consumption profile* • *Improvement of bidding/trading operations in energy markets* *The software modules tested in this Use Case would help aggregators and ESCOs to undertake a comprehensive one-stop solution to set-up, develop and exploit flexible energy provisioning from customers to DSOs.* *The modules would also allow them to drive decarbonisation and minimise their customers' burdens in monetising flexibility*
Hypotheses about segment purchasing behaviour and criteria	*These services would allow the aggregators/ESCOs to minimise their OPEX by introducing automated processes in their businesses*
Information and data required to verify these hypotheses	*Actual spending on generation and demand forecasting for participation in the energy trading market and flexibility markets. Aggregators/ESCOs trade electricity in the energy market. Dealing with interruptible and non-predictable RES means that they need to use customised congestion*

	management tools in order to be able to benefit from the flexible energy resources of their customers

Table 148. Analysis of customer journey #1: Commercial & Industrial customers

Potential customer segment #1: Commercial & Industrial customers	
Problem faced by the customer	*C&I customers often install RES on their premises in order to reduce their energy bills while benefitting from a given level of energy services. At the same time, they need to satisfy their buildings occupants' level of comfort and their businesses' specific energy needs. This implies a high level of complexity in their operations introducing the need for an accurate load and energy generation forecasting from their assets.*
How the customer can **learn** about the product or service	*Customers could learn about the product through dissemination activities such as articles, conferences and events or by looking at their competitors' activities and replicating strategies*
How the customer can **assess** the product or service's value proposition before the actual purchase	*A trial version of the product could be available in order for the customers to be able to assess its capabilities for a specific period of time (e.g., 3 months) before purchasing it*
How the customer can **purchase** the product or service	*The product/service can be purchased either by being given access to the service or the product using a license on a monthly/yearly fee or by an one-off payment to purchase the product from the developer*
How the customer can **use** the product or service	*C&I customers could use the product in order to accurately predict their energy demand and RES generation on a daily basis. Facility managers of the buildings could this way have a very good overview of their energy needs on a daily basis and adjust operations accordingly aiming at reducing their energy costs*
How the customer **interacts** with the company after the purchase	*Interaction with the company post-purchase could be done through emails in order to ensure support is provided for any technical issues that may arise.* *Contract for O&M of the product could also be provided to the customer by the company developing the product*

Table 145. Analysis of customer journey #2: Aggregators/ESCOs, retailers

Potential customer segment #2: Aggregators/ESCOs, retailers	
Problem faced by the customer	*Aggregators, ESCOs and retailers trade electricity in the energy market. Dealing with interruptible and non-predictable RES means that they need to rely on accurate forecasting services in order to be able to make informed decisions regarding their trades in the market.*
How the customer can **learn** about the product or service	*Customers could learn about the product through dissemination activities such as articles, conferences and events or by looking at their competitors' activities and replicating strategies*
How the customer can **assess** the product or service's value proposition before the actual purchase	*A trial version of the product could be available in order for the customers to be able to assess its capabilities for a specific period of time (e.g., 3 months) before purchasing it*
How the customer can **purchase** the product or service	*The product/service can be purchased either by being given access to the service or the product using a license on a monthly/yearly fee or by a one-off payment to purchase the product from the developer*

How the customer can **use** the product or service	*The aggregators could use the product to produce hourly and daily forecasts of the energy production of their assets in order to be able to participate in the energy market.*
How the customer **interacts** with the company after the purchase	*Interaction with the company post-purchase could be done through emails in order to ensure support is provided for any technical issues that may arise.* *Contract for O&M of the product could also be provided to the customer by the company developing the product*

Reviewed business model designed in 8.2, applied to the Use Case 5

Business Model Canvas for Use Case UC5 - *Coordinating distribution network flexibility assets and protections schemes coordination in urban districts*
Lead Partner: CIRCE

KEY PARTNERS	***KEY ACTIVITIES***	***VALUE PROPOSITIONS***	***CUSTOMER RELATIONSHIPS***	***CUSTOMER SEGMENTS***
RTOs TSOs DSOs Energy retailers Large generators Aggregators ESCOs Renewable energy producers Technology providers Universities	- Market analysis -Identification, assessment and comparison of the technological solutions for monitoring and control systems in the distribution network and in the customer premises - Development of recommendations for the cost-effective application of advanced distributed sensors, monitoring and control systems to increase distribution networks' intelligence - Development of a device for grids monitoring with new functionalities - Testing of algorithms (simulation, small scale demonstration) -- Performance test of the developed applications in a real grid - Cooperation with other projects and networking - Digitalisation of energy assets - Data analytics, Forecasting - Harmonisation	- Hardware and software solution to solve field-level communication and management - Provide its user with both information and control on the network to operate it in real time, ensuring the security of the supply, and prevent network congestion. - Fault detection/location software and energy supply restoration through self-healing algorithms - Forecasting algorithms to accurately predict energy generation, demand and electricity price and suggest grid operation orders	- Distribution at demonstration sites - Sales representatives - Social media, websites, printed marketing tools - Customer and maintenance services - Customer service call center - Press media, conferences, workshops and events- to promote the solution	- Network operators (DSOs and TSOs) - Energy Communities - Aggregators - Renewable energy producers
	KEY RESOURCES - Maintenance and Technical manager - IT support team - Gathered Data - Technical knowledge - Electricity market knowledge - Close knowledge of consumers and local markets		***CHANNELS*** - Distribution at demonstration sites - Sales representatives - Conferences, workshop and events - Online and printed marketing tools - Active media relations and social media - Websites - B2B and/or bilateral multiservice offerings using existing clientele channels	

COST STRUCTURE	***REVENUE STREAMS***
- Human resources - Testing lab - Technical development and maturity - Marketing and promotional costs - Customer support -Commercial actions - Sales costs - License for a specific software	- Direct sales - Licencing - Maintenance. - Technology transfers - Service: self-healing software

Table 152. Analysis of potential customer segment #1: Network operators (TSOs, DSOs)

Potential segment #1: Network operators (TSOs, DSOs)	
Relevant characteristics	Network operators are responsible for the management of electricity grids, the transmission, distribution and retailing of energy. Hence, load and generation forecasting services could allow them to optimise their operations.
Segment size	Around 2,500 network operators are currently operating in Europe (JRC, 2017a). Assuming a penetration rate of 0.1%, the potentialmarket volume in this area would be of 2 customers.
Hypothesised customer needs andaspirations	Operate network safely and securely Optimisation of the performance of networks. Modules integrated in used data gathering platform Overall efficiency improvement in forecasting processes. Prepare for upcoming challenges regarding the electricity grids
Hypotheses about segment purchasingbehaviour and criteria	Initial reluctance to incorporate new functionalities into theiralready consolidated systems. The sector is changing at a much slower pace than other markets/clients; hence, a fast-purchasing behaviour is notexpected from network operators' side. Clients would require high quality and low prices as normally they would pass on the cost to their customers and are typicallyheavily regulated and monitored regarding operational expenditure. Possibility to receive requests for customised designs. Need for DSOs to be able to design and maintain these programs
Information and data required to verifythese hypotheses	Actual spending on generation and demand forecasting forflexibility markets and demand response markets. Practical requirements and specifications of forecastingprocesses required. Data regarding the limitations of the network that DSOs in the European electricity market will have to mitigate as RES penetration increases.

Table 153. Analysis of potential customer segment #2: Energy communities

Potential segment #2: Energy communities	
Relevant characteristics	Energy community refers to a wide range of collective energy actions involving citizens' participation in the energy system, and prepare, to energy transition. They contribute to expand public acknowledgment of RES projects and to align private interests with this energy change. Simultaneously, they can possibly give direct advantages to citizens by fostering energy productivity and reducing power bills (COME-RES, n.d.).
Segment size	Target markets includes a wide range of European countries. Current European policies are empowering the advancement of energy communities. At this beginning phase of development, EU member States are relied upon to configure instruments for their support (free specialised and legal guidance or endowments to employ specialised help; market access rules and grid usage guidelines for energy communities). Communities dealing with their own electricity networks can coordinate the inclusion of moreRES in neighborhoods, allowing them to act as an aggregator andoffer flexibility services to the regional or national grid. Energy communities are generally restricted to not-revenue-driven status, and they may face issues in terms of access to subsidising and funding (EC, 2021c).
Hypothesised customer needs and aspirations	As new actors on the value chain, these potential customers are most likely not to have yet their own digital tool for data acquisitionand valorisation. Therefore, they need to need to acquire a digital tool to enter digital energy.

Hypotheses about segment purchasing behaviour and criteria	Energy communities need a data management platform for thecontrol and supervision of the whole community/set of users. In addition, in order to mitigate the lack of access to energy and to improve energy systems throughout the population, energy communities will be interested in technological solutions that allow the minimisation of failures (reducing interruption time) in electrical networks and guarantee stability to consumers
Information and data required to verify these hypotheses	Range that energy communities cover; Number of points to which they supply energy; Frequency of failures in their networks; Time to resolve these failures; Specific network data. Contact and discussions with representatives from these sectors.

Table 154. Analysis of potential customer segment #3: Aggregators

Potential segment #3: Aggregators	
Relevant characteristics	Aggregators are a kind of energy specialist co-op that can increment or moderate the power utilisation of a gathering of customers dependent on the absolute power demand on the network. They are responsible for managing energy resources on behalf of their customers, hence generation forecasting services would allow them to offer improved services to their customers.
Segment size	There are currently around 5,000 licenced aggregators/ESCos in Europe (JRC, 2017a). Assuming a penetration rate of 0.75%, the potential market volume in this area would be of 37 customers. In Europe, the market for demand response aggregators is projected to represent USD 3.5 billion by 2025 (Nicolas Nhede, 2018).
Hypothesised customer needs and aspirations	- Optimisation of energy charges for their customers. - Optimisation of flexibility estimation associated with prosumers'forecasted consumption profile. - Improvement of bidding/trading operations in energy markets. - Introduction to digital energy
Hypotheses about segment purchasing behaviour and criteria	Aggregators can make use of a data management platform for the control and supervision of the whole community, as well as an additional service to manage their own premises thanks to an automated process.
Information and data required to verifythese hypotheses	Contact and discussions with representatives from these sectors.

Table 155. Analysis of potential customer segment #4: RES energy producers

Potential segment #4: Renewable energy producers	
Relevant characteristics	RES producers are managing and operating renewable energy resources. They are benefitting from selling the electricity either toaggregators/ESCos or directly to the energy market. PV producers in particular would benefit from the forecasting solutions, as the latter would enable them to better understand the productionpatterns of their assets.Also, The general approach for power generators is to minimise generation curtailment by being able to more directly control the assets involved.
Segment size	At the global scale, the renewable energy market was estimated atUSD 928 billion in 2017 and would represent more than USD 1,500 billion by 2025 (Allied Market Research). More specifically, in Europe, this market's growth would register a highest compound annual growth rate (CAGR) of 6.7% between 2018 and 2025 (AlliedMarket Research).
Hypothesised customer needs and aspirations	Accurate forecasting of the electricity produced by their assets. Ability to understand potential future generation in order to beable to calculate future revenues. Creation of robust business cases for new RES installations basedon accurate forecasting of future revenues.
Hypotheses about segment purchasing behaviour and criteria	Only interested in PV energy forecasting for potential market self-participation. Minimise generation curtailment scenarios.
Information and data required to verify these hypotheses	Information on current spending for PV energy generationforecasting.

Table 156. Analysis of customer journey #1: Network operators (DSOs, TSOs)

Potential customer segment #1: Network operators (DSOs, TSOs)	
Problem faced by the customer	*Network operators want to be able to optimise their operation efficiency while at the same time increasing the hosting capacity of RES in the grid. Without being able to accurately match RES generation and load at any given time the grid security and resilience could be compromised*
How the customer can **learn** about the product or service	*Customers could learn about the product through dissemination activities such as articles, conferences, events, and bilateral multiservice offerings using existing clientele channels, or by looking at their competitors' activities and replicating strategies. Visits at demonstration are also to be used as marketing tools.*
How the customer can **assess** the product or service's value proposition before the actual purchase	*A trial version of the product could be available in order for the customers to be able to assess its capabilities for a specific period of time (e.g., 3 months) before purchasing it.*
How the customer can **purchase** the product or service	*The product/service can be purchased either by being given access to the service or the product using a license on a monthly/yearly fee or by an one-off payment to purchase the product from the developer*
How the customer can **use** the product or service	*Network operators can use the dispatching platform for electricity generation to better understand demand and generation participation in flexibility and demand response markets. They could gain an overview of the grid state in real time and control electricty network to avoid congestion and ensure security of supply. In addition, they could predict energy generation, demand and electricity price*.
How the customer **interacts** with the company after the purchase	*Interaction with the company post-purchase could be done through emails in order to ensure support is provided for any technical issues that may arise.* *Contract for O&M of the product could also be provided to the customer by the company developing the product*.

Table 157. Analysis of customer journey #2: Energy Communities

Potential customer segment #2: Energy Communities	
Problem faced by the customer	*Energy communities aim at increasing participation in collective actions that can offer additional revenue streams to the community and its members. They have a limited understanding of revenue stacking opportunities within the energy flexibility landscape, and lack of digital tool to gather and valorise data.*
How the customer can **learn** about the product or service	*Customers could learn about the product through dissemination activities such as articles, conferences, events, and bilateral multiservice offerings using existing clientele channels, or by looking at their competitors' activities and replicating strategies. Visits at demonstration are also to be used as marketing tools.*
How the customer can **assess** the product or service's value proposition before the actual purchase	*A trial version of the product could be available in order for the customers to be able to assess its capabilities for a specific period of time (e.g., 3 months) before purchasing it.*
How the customer can **purchase** the product or service	*The product/service can be purchased either by being given access to the service or the product using a license on a monthly/yearly fee or by an one-off payment to purchase the product from the developer*

How the customer can **use** the product or service	*Energy communities can use the dispatching platform for electricity generation in order to accurately understand the state of the grid in real time. They could also improve on-site RES penetration and avoid interruption of business-a-usual operation. They could gain an overview of the grid state in real time and control the network to avoid congestion and ensure security of supply. In addition, they could predict energy generation, demand and electricity price.*
How the customer **interacts** with the company after the purchase	*Interaction with the company post-purchase could be done through emails in order to ensure support is provided for any technical issues that may arise.* *Contract for O&M of the product could also be provided to the customer by the company developing the product.*

Table 158. Analysis of customer journey #3: Aggregators

Potential customer segment #3: Aggregators	
Problem faced by the customer	*Aggregators, trade electricity in the energy market. Dealing with interruptible and non-predictable RES means that they need to rely on accurate forecasting services in order to be able to make informed decisions regarding their trades in the market.*
How the customer can **learn** about the product or service	*Customers could learn about the product through dissemination activities such as articles, conferences, events, and bilateral multiservice offerings using existing clientele channels, or by looking at their competitors' activities and replicating strategies.*
How the customer can **assess** the product or service's value proposition before the actual purchase	*A trial version of the product could be available in order for the customers to be able to assess its capabilities for a specific period of time (e.g. 3 months) before purchasing it.*
How the customer can **purchase** the product or service	*The product/service can be purchased either by being given access to the service or the product using a licence on a monthly/yearly fee or by an one-off payment to purchase the product from the developer*
How the customer can **use** the product or service	*Aggregators could use the product in order to accurately understand the state of the grid in real time. They could have a good overview of the grid on a daily basis and adjust operations accordingly aiming at making profit.*
How the customer **interacts** with the company after the purchase	*Interaction with the company post-purchase could be done through emails in order to ensure support is provided for any technical issues that may arise.* *Contract for O&M of the product could also be provided to the customer by the company developing the product.*

Table 159. Analysis of customer journey #4: RES energy producers

Potential customer segment #6: RES energy producers	
Problem faced by the customer	*RES energy producers own and operate renewable energy assets and sell their electricity either to aggregators or directly to the energy market. The unpredictability of the energy generation from these sources may pose a significant challenge when negotiating prices since an accurate knowledge of the electricity grid, and of the energy produced will need to be in place to allow them to make informed trades.*

How the customer can **learn** about the product or service	*Customers could learn about the product through dissemination activities such as articles, conferences, events, and bilateral multiservice offerings using existing clientele channels, or by looking at their competitors' activities and replicating strategies.*
How the customer can **assess** the product or service's value proposition before the actual purchase	*A trial version of the product could be available in order for the customers to be able to assess its capabilities for a specific period of time (e.g., 3 months) before purchasing it*
How the customer can **purchase** the product or service	*The product/service can be purchased either by being given access to the service or the product using a license on a monthly/yearly fee or by an one-off payment to purchase the product from the developer*
How the customer can **use** the product or service	*RES energy producers would use this product mainly for long-term forecasts if they were selling to aggregators or for shorter-term forecasts if they are participating in the energy trading market. In addition, they would be able to prevent network congestion and predict energy demand, allowing them to operate the market in real time.*
How the customer **interacts** with the company after the purchase	*Interaction with the company post-purchase could be done through emails in order to ensure support is provided for any technical issues that may arise.* *Contract for O&M of the product could also be provided to the customer by the company developing the product.*

Reviewed business model designed in 8.2, applied to the Use Case 6

Business Model Canvas for Use Case #6: Virtual Energy Storage for urban buildings
Lead Partner: HYPERTECH

KEY PARTNERS
- Certified installers
- ESCOs / ESPCs
- Smart home solutions/ BMS providers
- Cloud computing service providers
- IoT devices / platforms providers
- Aggregators
- Energy retailers/ suppliers
- Microgrid operators
- Energy Communities
- FLEXIGRID project partners
- European DSOs/ TSOs
- Software vendors
- Open-Source initiative
- Website developers

KEY ACTIVITIES
- Algorithm development
- Software development, operation and maintenance
- Product assembly, testing, packaging and integration
- Product demonstration
- Installation
- Training
- User interface (UI) design
- Technical support
- Website development
- Marketing
- Customer engagement
- Digitalisation of energy assets
- Data Analytics

KEY RESOURCES
- Development team
- Databases and collected data
- Cloud hosting space
- Developed Algorithms / software
- Controllable devices
- User App
- Smart Box
- Website
- Marketing and sales team and marketing material

VALUE PROPOSITIONS
- Comfort-based flexibility offering
- Data-driven thermal comfort profiling
- Participation in explicit DR programs
- Delivery of dynamic energy tariffs (implicit DR)
- Monitoring, programming and configuration of smart energy appliances

CUSTOMER RELATIONSHIPS
- Training of certified installers
- Product self-learning
- Customer support team
- Web platform and customer app
- Social media

CHANNELS
- Stakeholder ecosystem
- B2B collaboration (esp. with actors seeking to offer DR smart services, certified installers, ESCOs and energy product retailers)
- Targeted communication with existing clients
- Website (with online shopping platform) / social media
- Marketing and dissemination activities

CUSTOMER SEGMENTS
- Energy retailers
- Aggregators
- ESCOs / ESPCs
- BMS providers
- Residential customers
- Energy communities
- Local authorities
- Building operators

	- Technical support team - IT infrastructure		- Cooperative / networking events	

COST STRUCTURE

Opex:
- HR (development team, marketing and sales team, operations team, technical support team)
- Cloud hosting fees
- Website service party licenses
- Purchase of components for product development

Capex:
IT infrastructure (hardware, software, licenses)

REVENUE STREAMS

Option 1:
- Smart Box purchases
- Licenses for software products

Option 2:
- Software-as-a-Service

Common to both options:
- Personalisation/customisation of product/platform
- Sales of additional energy services
- Technical support, training and installation

Table 165. Analysis of potential customer segment #1: Energy Retailers

Potential segment #1: Energy Retailers	
Relevant characteristics	*Estimated 4286 (2020) electricity retailers across the EU.*
Segment size (current size and expected growth)	*Estimated 4286 (2020) electricity retailers across the EU. An increasing trend, in most European countries, was observed between 2013 and 2020. We expect that a similar growth rate will continue for countries with still a relatively low supplier/consumer ratio.*
Hypothesised customer needs and aspirations	*In a liberated energy market, energy retailers will need to expand their offerings' portfolio to attract more customers. Their aspiration is to increase their market share nationally, but also internationally if possible.*
Hypotheses about segment purchasing behaviour and criteria	*Any low-cost solution that could be combined with existing offerings or help create new offering for electricity customers.* *Potentially, disruptive technologies that could provide a market advantage to early adopters and providers.*
Information and data required to verify these hypotheses	*No energy retailer is participating in the FLEXIGRID project; hence, external feedback on the hypotheses would be useful.*

Table 166. Analysis of potential customer segment #2: Aggregators

Potential segment #2: Aggregators	
Relevant characteristics	*60 in 2019 (incl. the UK)*
Segment size (current size and expected growth)	*Assumption that by 2025 the number of aggregators will have reached 100 in the EU (excl. the UK).*
Hypothesised customer needs and aspirations	*Aggregation gives relatively low returns; therefore, aggregators aim at increasing their market share and portfolio size to achieve viability and profitability.*
Hypotheses about segment purchasing behaviour and criteria	*Solutions that may open up new value streams to the aggregator.* *Solutions that could add more assets to aggregators' portfolios.* *Solutions that reduce energy transaction costs and minimise risks for those within the aggregators' portfolios.*

Information and data required to verify these hypotheses	*No aggregator is participating in the FLEXIGRID project; trialling the ER8, hence, external feedback on the hypotheses would be useful.*

Table 167. Analysis of potential customer segment #3: ESCOs / ESCPs

Potential segment #3: ESCOs / ESCPs	
Relevant characteristics	*Up to 3,645 in 2018 (excl. the UK)*
Segment size (current size and expected growth)	*8.5 billion euros market size in 2013 within the EU (excl. the UK) / The market change from 2013 to 2016 has been slow in most EU countries. Assumptions that the growth will continue to be quite slow until 2025.*
Hypothesised customer needs and aspirations	*Improve their public image by demonstrating ways of promoting energy efficiency* *Offer ways of improving the comfort of building occupants* *Find ways of increasing the loyalty of current customers, but also ways to expand their client portfolios* *Achieve financial gains for both their clients and themselves*
Hypotheses about segment purchasing behaviour and criteria	*Any low cost, non-intrusive technologies/solutions that could achieve any or multiple of the aforementioned aspirations and needs of ESCOs and ESCPs.*
Information and data required to verify these hypotheses	*No ESCO/ESCP is participating in the FLEXIGRID project; hence, external feedback on the hypotheses would be useful.*

Table 168. Analysis of potential customer segment #4: BMS providers

Potential segment #4: BMS providers	
Relevant characteristics	*There are approximately 8-10 top market players owning the majority of the BMS market share.*
Segment size (current size and expected growth)	*The market of building management systems is expected to grow until 2025 with a compound annual growth rate of approximately 3%-7.5%. This is partly due to legislation pushing for greater energy performance in buildings and energy efficiency.*
Hypothesised customer needs and aspirations	*Increase their market share and profits by expanding their solutions' portfolio. Solutions that can be used at both commercial and residential buildings, as the latter two building types are expected to make use of BMSs the most. Solutions that require low implementation costs.*
Hypotheses about segment purchasing behaviour and criteria	*Solutions that could offer significant cost benefits to end-users. Automated solutions that could simplify the daily operation and improve the energy performance of buildings. Non-intrusive, low-cost solutions which manage the energy consumption and generation of a building without compromising the user comfort.*
Information and data required to verify these hypotheses	*No BMS provider is participating in the FLEXIGRID project; hence, external feedback on the hypotheses would be useful.*

Table 169. Analysis of potential customer segment #5: Residential customers

Potential segment #5: Residential customers	
Relevant characteristics	*There are more than 195 million households in the EU (2020). However, only a small proportion of those households will be interested in smart home and BMS solutions.*

Segment size (current size and expected growth)	*More than 8 million units of smart lights, thermostats and monitoring devices for domestic premises were sold in 2020 across Europe. At the same time, between 2018 and 2019, there was almost a 43% increase in the number of households in the EU using building energy management systems (from 35,000 to 50,000 households).Those trends, in combination with the push towards a more energy efficient management of residential buildings, leads to the assumption that the number of potential residential customers purchasing the VTES solution will increase in the future.*
Hypothesised customer needs and aspirations	*Achieve cost savings on energy bills.* *Achieve higher energy efficiency at home.* *Have remote control over specific domestic loads.*
Hypotheses about segment purchasing behaviour and criteria	*Low-cost, automated solutions that could help achieve energy, and hence energy bill, savings. Solutions that are plug 'n' play (easy to install and operate). Non-intrusive solutions that do not compromise the comfort of the customers. Solutions that allow the visualisation of energy consumption and offer remote control capabilities for specific residential loads.*
Information and data required to verify these hypotheses	*The validation of the solution through the relevant project KPIs, such as customer satisfaction, energy savings achieved per customer, and thermal discomfort, could help verify most of the aforementioned hypotheses.*

Table 170. Analysis of potential customer segment #6: Energy Communities

Potential segment #6: Energy Communities	
Relevant characteristics	*The term 'energy community' here is used to describe any collective action that enables the active participation of citizens to the energy transition.* *In Europe, in 2022, around 7,700 energy cooperatives were identified.*
Segment size (current size and expected growth)	*At the moment, as previously mentioned, there are approximately 7,700 energy communities in Europe. Due to lack of relevant data on expected growth, we assume that the number of energy communities in Europe is going to remain stable in the next five years.*
Hypothesised customer needs and aspirations	*Achieve improvements of energy efficiency at community level.* *Increase community level self-consumption.* *Achieve energy cost savings at community level.* *Facilitate the participation of the community as a whole, as well as of members of the community as individuals, in the energy market (local energy market, local flexibility market, wholesale market, etc.).* *Explore new revenue streams for the community.*
Hypotheses about segment purchasing behaviour and criteria	*Solutions that offer opportunities for revenue stacking for the community as a whole and opens up ways to new revenue streams.* *Solutions with high acceptability potential by members of the community.*
Information and data required to verify these hypotheses	*No energy community is participating in the FLEXIGRID project; hence, external feedback on the hypotheses would be useful.*

Table 171. Analysis of potential customer segment #7: Local authorities

Potential segment #7: Local authorities	
Relevant characteristics	*Approximately 88,000 local authorities in the EU*
Segment size (current size and expected growth)	*Assumption that the number of local authorities will not significantly change over the next five years in the EU.*
Hypothesised customer needs and aspirations	*Key role in promoting the agenda of and achieving the commitments made by the EU MSs and the EC concerning decarbonisation, decentralisation and digitalisation of the energy sector.* *Implement key energy and cost efficiency measures at municipality buildings.*
Hypotheses about segment purchasing behaviour and criteria	*Solutions that are low-cost, non-intrusive, and ideally plug 'n' play that help achieve energy and cost savings at public buildings without compromising occupant comfort.* *Solutions that help raise energy awareness (e.g., through the visualisation of energy consumption and generation at public buildings).*
Information and data required to verify these hypotheses	*No local authority is participating in the FLEXIGRID project; hence, external feedback on the hypotheses would be useful.*

Table 172. Analysis of customer journey #1: Energy Retailers

Potential customer segment #1: Energy retailers	
Problem faced by the customer	*Difficulty in gaining market advantage over competition and increase client portfolio.*
How the customer can **learn** about the product or service	*Through network of existing Hypertech clients.* *Targeted commercialisation activities, incl. marketing campaigns.* *Through demonstration campaigns at specific pilot sites, where energy retailers may be involved.* *Dissemination activities of the project.*
How the customer can **assess** the product or service's value proposition before the actual purchase	*Participation in demonstration campaigns at pilot sites.* *Evidence from the validation activities and demonstration campaigns carried out in EU-funded projects.* *Potential use of Net Promoter Score.* *Potential free trial of product/service for a limited amount of time.*
How the customer can **purchase** the product or service	*Over-the-counter purchase of products and services.* *Online shop.*
How the customer can **use** the product or service	*The products/services provided to energy retailers will be resold to interested end customers (mainly residential and commercial). The products/services can be sold as standalone items or as parts of existing or new/innovative service offerings.*
How the customer **interacts** with the company after the purchase	*Depending on the commercial agreement between Hypertech and the energy retailer, the interactions between the two parties can range from ongoing technical and troubleshooting support, training of certified installers to continuous feedback loops for product and service improvements, personalisation and customisation of product/service offerings, etc.*

Table 173. Analysis of customer journey #2: Aggregators

Potential customer segment #2: Aggregators	
Problem faced by the customer	*Diversification of portfolio of flexible assets. Increase liquidity (increase number of contracted DR providers) at lower voltage*

	levels for offering services to the DSO. Increase customer buy-in for participation in demand response schemes.
How the customer can **learn** about the product or service	*Through network of existing Hypertech clients.* *Targeted commercialisation activities, incl. marketing campaigns.* *Through demonstration campaigns at specific pilot sites, where aggregators may be involved.* *Dissemination activities of the project.*
How the customer can **assess** the product or service's value proposition before the actual purchase	*Participation in demonstration campaigns at pilot sites.* *Evidence from the validation activities and demonstration campaigns carried out in EU-funded projects.* *Potential use of Net Promoter Score.* *Potential free trial of product/service for a limited amount of time.*
How the customer can **purchase** the product or service	*Over-the-counter purchase of products and services.* *Online shop.*
How the customer can **use** the product or service	*It is expected that aggregators will resell the products and services to their clients. Possible interfacing between the Hypertech VTES module and existing aggregator tools may be required; in which case the service sold to the aggregator will include the development and testing of such interfaces.*
How the customer **interacts** with the company after the purchase	*Depending on the commercial agreement between Hypertech and the aggregator, the interactions between the two parties can range from ongoing technical and troubleshooting support, training of certified installers to continuous feedback loops for product and service improvements, personalisation and customisation of product/service offerings, etc.*

Table 174. Analysis of customer journey #3: ESCOs/ESCPs

Potential customer segment #3: ESCOs/ESCPs	
Problem faced by the customer	*Find ways to increase the loyalty of current customers, but also ways to expand their client portfolios. Offer customisable services to their clients.*
How the customer can **learn** about the product or service	*Through network of existing Hypertech clients.* *Targeted commercialisation activities, incl. marketing campaigns.* *Through demonstration campaigns at specific pilot sites, where ESCOs/ESCPs may be involved.* *Dissemination activities of the project.*
How the customer can **assess** the product or service's value proposition before the actual purchase	*Participation in demonstration campaigns at pilot sites.* *Evidence from the validation activities and demonstration campaigns carried out in EU-funded projects.* *Potential use of Net Promoter Score.* *Potential free trial of product/service for a limited amount of time.*
How the customer can **purchase** the product or service	*Over-the-counter purchase of products and services.* *Online shop.*
How the customer can **use** the product or service	*ESCOs/ESCPs may resell the products and services to their clients as part of more holistic energy service offerings.*
How the customer **interacts** with the company after the purchase	*Depending on the commercial agreement between Hypertech and the ESCO/ESCP, the interactions between the two parties can range from ongoing technical and troubleshooting support, training of certified installers to continuous feedback loops for product and*

	service improvements, personalisation and customisation of product/service offerings, etc.

Table 175. Analysis of customer journey #4: BMS providers

Potential customer segment #4: BMS providers	
Problem faced by the customer	*Expand their market share in commercial and residential buildings with solutions that do not require high implementation costs.*
How the customer can **learn** about the product or service	*Through network of existing Hypertech clients.* *Targeted commercialisation activities, incl. marketing campaigns.* *Through demonstration campaigns at specific pilot sites, where BMs providers may be involved.* *Dissemination activities of the project.*
How the customer can **assess** the product or service's value proposition before the actual purchase	*Participation in demonstration campaigns at pilot sites.* *Evidence from the validation activities and demonstration campaigns carried out in EU-funded projects.* *Potential use of Net Promoter Score.* *Potential free trial of product/service for a limited amount of time.*
How the customer can **purchase** the product or service	*Over-the-counter purchase of products and services.* *Online shop.*
How the customer can **use** the product or service	*The products/services provided to BMS providers will be resold to interested end customers (mainly residential and commercial). The products/services can be sold, after appropriate integration, as part of existing or new/innovative service offerings.*
How the customer **interacts** with the company after the purchase	*Depending on the commercial agreement between Hypertech and the BMS provider, the interactions between the two parties can range from ongoing technical and troubleshooting support, training of certified installers to continuous feedback loops for product and service improvements, personalisation and customisation of product/service offerings, etc.*

Table 176. Analysis of customer journey #5: Residential customers

Potential customer segment #5: Residential customers	
Problem faced by the customer	*Increase their energy efficiency and save on energy bills with solutions that are user friendly, non-intrusive and do not compromise their comfort and energy needs.*
How the customer can **learn** about the product or service	*Through network of existing Hypertech clients.* *Targeted commercialisation activities, incl. marketing campaigns.* *Through demonstration campaigns at specific pilot sites, where residential customers may be involved.* *Word of mouth – through other residential customers that have already purchased the solution and are happy with it.* *From their energy retailers, ESCOs, aggregators, their community (if part of an energy community).* *Dissemination activities of the project.*
How the customer can **assess** the product or service's value proposition before the actual purchase	*Participation in demonstration campaigns at pilot sites.* *Evidence from the validation activities and demonstration campaigns carried out in EU-funded projects.* *Potential use of Net Promoter Score.*

How the customer can **purchase** the product or service	*We envisage that the products and services of Hypertech will be sold to residential customers mainly through a network of energy retailers, ESCOs/ESCPs, aggregators, etc.* *In a B2C scenario, products and services of Hypertech can be sold to customers directly mainly through an online shop.*
How the customer can **use** the product or service	*Installation of necessary kit at home/building. A Customer App (as part of a certain type of offering) will allow customers to use the smart box remotely, through their mobile phone (and a user-friendly UI).*
How the customer **interacts** with the company after the purchase	*In a B2B scenario, where the customer purchases the Hypertech solution through a BMS provider, retailer, etc., the interaction is limited between the customer and the product seller.* *In a B2C scenario, interactions between Hypertech and the residential customer can range from ongoing technical and troubleshooting support to continuous feedback loops for product and service improvements, etc.*

Table 177. Analysis of customer journey #6: Energy communities

Potential customer segment #6: Energy communities	
Problem faced by the customer	*Increase participation in collective actions that can offer additional revenue streams to the community and its members.* *Limited understanding of revenue stacking opportunities within the energy flexibility landscape.* *Lack of digital tool to gather and valorise data.*
How the customer can **learn** about the product or service	*Through network of existing Hypertech clients.* *Targeted commercialisation activities, incl. marketing campaigns.* *Through demonstration campaigns at specific pilot sites, where energy communities/cooperatives may be involved.* *Social media.* *Word of mouth – from other energy communities that have previous, positive experience of the products/services.* *Dissemination activities of the project.*
How the customer can **assess** the product or service's value proposition before the actual purchase	*Participation in demonstration campaigns at pilot sites.* *Evidence from the validation activities and demonstration campaigns carried out in EU-funded projects.* *Potential use of Net Promoter Score.* *Potential free trial of product/service for a limited amount of time.*
How the customer can **purchase** the product or service	*Through energy retailers, aggregators, BMS providers, etc.* *Online shop.*
How the customer can **use** the product or service	*Distribution of necessary solution equipment to members of the energy community/cooperative that are keen to use the relevant technology and service. Customers can realise energy efficiency improvements and energy cost savings, while the community can also participate in demand response schemes for additional revenue streams.*
How the customer **interacts** with the company after the purchase	*In a B2B scenario, where the customer purchases the Hypertech solution through a BMS provider, retailer, etc., the interaction is limited between the customer and the product seller.* *In a B2C scenario, interactions between Hypertech and the energy community/cooperative can range from ongoing technical and*

	troubleshooting support to continuous feedback loops for product and service improvements, etc.

Table 178. Analysis of customer journey #7: Local authorities

Potential customer segment #7: Local authorities	
Problem faced by the customer	*Increase energy efficiency and energy cost savings in public buildings.*
How the customer can **learn** about the product or service	*Through network of existing Hypertech clients.* *Targeted commercialisation activities, incl. marketing campaigns.* *Through demonstration campaigns at specific pilot sites, where local authorities may be involved.* *Social media.* *Dissemination activities of the project.*
How the customer can **assess** the product or service's value proposition before the actual purchase	*Participation in demonstration campaigns at pilot sites.* *Evidence from the validation activities and demonstration campaigns carried out in EU-funded projects.* *Potential use of Net Promoter Score.* *Potential free trial of product/service for a limited amount of time.*
How the customer can **purchase** the product or service	*We envisage that the products and services of Hypertech will be sold to local authorities mainly through a network of energy retailers, ESCOs/ESCPs, BMS providers, aggregators, etc. (B2B scenario).* *In a B2C scenario, products and services of Hypertech can be sold to local authorities directly mainly through an online shop.*
How the customer can **use** the product or service	*Deploy the solution at buildings owned by the local authorities to achieve higher energy efficiency and energy cost savings.*
How the customer **interacts** with the company after the purchase	*In a B2B scenario, where the customer purchases the Hypertech solution through a BMS provider, retailer, etc., the interaction is limited between the customer and the product seller.* *In a B2C scenario, interactions between Hypertech and the local authority can range from ongoing technical and troubleshooting support to continuous feedback loops for product and service improvements, etc.*

Reviewed business model designed in 8.2, applied to the Use Case 7

Business Model Canvas for Use Case UC7 - Dispatching platform for MV generation
Lead Partner: EDYNA

KEY PARTNERS
- TSOs
- DSOs
- Aggregators/ESCOs
- Energy retailers
- Renewable energy producers
- Industrial and commercial partners

Utilities
Industrial, commercial and residential customers
Facility management consultants
Energy experts
Regulators

KEY ACTIVITIES
Market analysis
Identification, assessment and comparison of the technological solutions
Development of a device for LV grids monitoring with new functionalities
Testing of algorithms
Performance test of the developed applications in a real grid
Cooperation with other projects and networking
Business development and marketing
Development, adaptation and customisation of turn-key solutions
Continuous updating to comply with market rules and tariff structure
Producing/manufacturing
Conducting further R&D
Marketing campaigns
System engineering
Testing and reporting
Sale and distribution management

KEY RESOURCES
Human resources (developers)
Gathered data
Technical knowledge
Electricity market knowledge
Close knowledge of consumers and local markets
Historical consumption and generation data to feed the forecasting algorithm that will facilitate the scheduling
Expertise in energy management
Software engineering personnel
Aggregators' asset:
Communicatons Smart Box
R&D
Engineering and service
Project management
Marketing management and sale office
Producing
Purchasing department

VALUE PROPOSITIONS
DSOs: establishing an integration layer with load-intensive customers, facilitating the exploitation of their flexibility and thereby creating shared benefits.
Better control and manage of the electrical parameters related to MV grid, as well as voltage profiles, power congestions, black-out event and distributed generation penetration

Aggregators: one-stop solution for setting-up developing and exploiting flexible energy provisioning from the customer to the DSO.
possibility in real time communication with the aggregated energy resources, in order to provide the ancillary services requested by the DSOs and TSOs

Commercial customers: harvesting the full potential of their energy assets in order to reduce network and energy charges while potentially providing services to the grid
RES producers: to make their source smarter and connected with the DSO; this can bring them to multiple scenarios in the future of the electrical grid operation; a typical scenario is when the producers are selected by DSO in order to regulate the nodal voltages of the MV grid by controlling the generation of reactive power.

Industrial customers: to make their sources smarter and connected to the DSO; this can bring them to multiple scenarios in the future of the electrical grid operation. A typical scenario is when the industrial customers are selected by DSO in order to regulate the power flow over the MV lines by controlling the active power absorbsion of their modulable loads.

CUSTOMER RELATIONSHIPS
Distribution at demonstration sites
B2B and/or bilateral multiservice offerings (using existing clientele channels)
Sales representatives
Company website and dedicated website giving access to non IP-sensitive results
Online and printed marketing tools
Media and social media
Workshops, conferences and events
Customer acquisition, audits and contracts
Integration, technical operation and maintenance
Account management (contract, support, loyalty schemes, billings/settlements)
Generally, acquisition by the customers
DSOs may have partner role in new research pilot projects and field tests.

CHANNELS
Distribution at demonstration sites
Company website and dedicated
Online and printed marketing tools
Media and social media
Conferences, workshops and other events
Awareness raised by government and regulations promoting new policies and market schemes
Networks of DSOs
Direct customer support by DSOs and aggregators
Use cases and publications due to innovative pilot projects;
Customer support in design, engineering and management;
Service activities, installation and testing phases.

CUSTOMER SEGMENTS
DSOs as well electrical MV grid managers

BSPs (Aggregators) as well providers of ancillary services for utilities

RES producers as well owners of smart distributed generators

Industrial customers as well owners of flexible business equipment

TSOs can be considered as potential beneficiaries of the distributed communication system

COST STRUCTURE

Opex:
- Hardware and software infrastructure maintenance
- Human resources
- Producing/manufacturing
- Project management
- System engineering
- testing and reporting

Capex:
- Hardware and software infrastructure development and integration
- Conducting further R&D and marketing campaigns

REVENUE STREAMS

Direct sales
Licencing
Payments for level of support

Devices supply, Installation steps and field service have the characteristic of one-off / recurring pricing mechanism, depending on the customers' intention.

Table 196. Analysis of potential customer segment #1: Network operators (TSOs, DSOs)

Potential segment #1: Network operators (TSOs, DSOs)	
Relevant characteristics	*Network operators are responsible for the management of electricity grids hence load and generation forecasting services could allow them to optimise their operations.*
Segment size (current size and expected growth)	*There are [1]around 2,500 network operators currently operating in Europe. Assuming a penetration rate of 0.1%, we estimate a potential market volume of 200 customers in this area.*
Hypothesised customer needs and aspirations	• *Optimisation of the performance of networks* • *Overall efficiency improvement in forecasting processes*
Hypotheses about segment purchasing behaviour and criteria	• *The sector is changing at a much slower pace than other markets/clients hence we would not expect a fast-purchasing behaviour from network operators' side* • *Clients would require high quality and low prices as normally they would pass on the cost to their customers and are typically heavily regulated and monitored regarding operational expenditure*
Information and data required to verify these hypotheses	*Actual spending on generation and demand forecasting for flexibility markets and demand response markets. Practical requirements and specifications of forecasting processes required.*

Table 197. Analysis of potential customer segment #2: Aggregators/ESCOs and retailers

Potential segment #2: Aggregators/ESCOs and retailers	
Relevant characteristics	*Aggregators and ESCOs are responsible of managing energy resources on behalf of their customers hence generation forecasting services would allow them to offer improved services to their customers. Dealing with interruptible and non-predictable RES means that they need to use customised congestion management tools in order to be able to benefit from the flexible energy resources of their customers*
Segment size (current size and expected growth)	*In Europe $3.5b is projected to be the market by 2025 for demand response aggregators[3]* *Licensed aggregators/ESCOs currently add up to around 5000 in Europe[1]. Assuming a penetration rate of 0.75% we estimate a potential market volume of 37 customers within this area[4]* [5]
Hypothesised customer needs and aspirations	• *Optimisation of energy charges for their customers* • *Optimisation of flexibility estimation associated with prosumers' forecasted consumption profile*

	• *Improvement of bidding/trading operations in energy markets*
Hypotheses about segment purchasing behaviour and criteria	• *Energy forecasting services would allow the aggregators/ESCOs to minimise their OPEX by introducing automated processes in their businesses*
Information and data required to verify these hypotheses	*Actual spending on generation and demand forecasting for participation in the energy trading market, flexibility markets* and *congestion management*

Table 198. Analysis of potential customer segment #3: RES energy producers

Potential segment #3: RES energy producers	
Relevant characteristics	*RES producers are managing and operating RES energy resources. They are benefitting from selling the electricity either to aggregators/ESCOs or directly to the energy market.* *PV producers would benefit more from our forecasting solutions as it would allow them to better understand the production patterns of their assets*
Segment size (current size and expected growth)	*The global renewable energy market accounted of revenue of $928b in 2017 and is expected to generate more than $1,500b by 2025.* *More specifically, the European energy market was expected to grow at a highest CAGR of 6.7% between 2018 and 2025* [6].
Hypothesised customer needs and aspirations	• *Accurate forecasting of the electricity produced by their assets* • *Ability to understand potential future generation in order to be able to calculate future revenues* • *Create robust business cases for new RES installations based on accurate forecasting of future revenues*
Hypotheses about segment purchasing behaviour and criteria	*Only interested in PV energy forecasting for potential market self-participation*
Information and data required to verify these hypotheses	*Information on current spending for PV energy generation forecasting*

Table 199. Analysis of potential customer segment #4: Commercial and Industrial (C&I) customers

Potential segment #4: Commercial and Industrial (C&I) customers	
Relevant characteristics	*C&I customers are looking to maximise RES uptake on their sites in order to reduce their energy costs.* *More specifically, facility managers and building owners with PV systems installed in their premises would benefit from a forecasting solution that would allow them to better understand the production capacity of their assets.*
Segment size (current size and expected growth)	*Commercial and industrial customers typically represent 50% of the total energy use*[7]*. The total electricity production in Europe reached a net 2,800TWh in 2018*[8] *which at an average electricity unit cost of 7.7 cents/kWh*[9] *represents a total market worth of c.108 billion €*
Hypothesised customer needs and aspirations	• *Reduce emissions by deploying RES and EVs* • *Taking advantage of the forecasting results aiming at maximising the integration of RES generation without compromising business-as-usual operation*

	• *Reduced operating expenses*
Hypotheses about segment purchasing behaviour and criteria	• *Customers would need a stable and profitable business model in order to invest in the software* • *Customers would probably be looking for a payback period lower than 5 years in order to invest*
Information and data required to verify these hypotheses	*Current strategies and energy forecasting/optimisation actions as well as relevant energy costs against the offered solution*

Table 200. Analysis of potential customer segment #5: Residential customers

Potential segment #5: Residential customers	
Relevant characteristics	*Residential customers would need to increase self-consumption rates from their RES. Optimisation and scheduling algorithms would allow for optimisation in energy use in residential premises*
Segment size (current size and expected growth)	*Energy consumption in households represents a steady contribution of ~25% of the total energy consumption in Europe according to Eurostat[22]. Electricity production in Europe reached 2,800TWh in 2018 with a slight 0.5% drop compared to 2017.* *Prices for an annual consumption of 2,500 to 5,000 kWh were most expensive for households in Germany and Denmark in 2019, with these nations paying an average of 30.88 cents and 29.84 cents per kWh, respectively. In comparison, costs were lowest in Bulgaria where households paid less than 10 cents per kWh. In 2018 the average household price throughout the EU was 21.13 cents[23] per kWh representing a total spending on electricity for residential customers of around 147 billion €.*
Hypothesised customer needs and aspirations	• *Improved reliability of supply* • *Reduced energy costs* • *Reduced environmental footprint* • *Introduce new technologies in their household (e.g., small storage systems)*
Hypotheses about segment purchasing behaviour and criteria	*Residential customers are not expected to be very eager to purchase these services, as there is currently no strong motivation for them to manage their loads.*
Information and data required to verify these hypotheses	*Potential issues with reliability of supply, energy bills and/or potential opportunities for reduced energy costs depending on the country of reference might verify the need for congestion management at a residential level*

Table 201. Analysis of customer journey #1: Network operators (DSOs, TSOs)

Potential customer segment #1: Network operators (DSOs, TSOs)	
Problem faced by the customer	*Network operators want to be able to optimise their operation efficiency while at the same time increasing the hosting capacity of RES in the grid. Without being able to accurately match RES generation and load at any given time the grid security and resilience could be compromised*
How the customer can **learn** about the product or service	*Customers could learn about the product through dissemination activities such as articles, conferences and events or by looking at their competitors' activities and replicating strategies*

How the customer can **assess** the product or service's value proposition before the actual purchase	*A trial version of the product could be available in order for the customers to be able to assess its capabilities for a specific period of time (e.g., 3 months) before purchasing it*
How the customer can **purchase** the product or service	*The product/service can be purchased either by being given access to the service or the product using a license on a monthly/yearly fee or by an one-off payment to purchase the product from the developer*
How the customer can **use** the product or service	*Network operators can use the load and generation forecasting module to better understand demand and generation participation in flexibility and demand response markets*
How the customer **interacts** with the company after the purchase	*Interaction with the company post-purchase could be done through emails in order to ensure support is provided for any technical issues that may arise.* *Contract for O&M of the product could also be provided to the customer by the company developing the product*

Table 202. Analysis of customer journey #2: Aggregators/ESCOs, retailers

Potential customer segment #2: Aggregators/ESCOs, retailers	
Problem faced by the customer	*Aggregators, ESCOs and retailers trade electricity in the energy market. Dealing with interruptible and non-predictable RES means that they need to rely on accurate forecasting services in order to be able to make informed decisions regarding their trades in the market.*
How the customer can **learn** about the product or service	*Customers could learn about the product through dissemination activities such as articles, conferences and events or by looking at their competitors' activities and replicating strategies*
How the customer can **assess** the product or service's value proposition before the actual purchase	*A trial version of the product could be available in order for the customers to be able to assess its capabilities for a specific period of time (e.g., 3 months) before purchasing it*
How the customer can **purchase** the product or service	*The product/service can be purchased either by being given access to the service or the product using a license on a monthly/yearly fee or by a one-off payment to purchase the product from the developer*
How the customer can **use** the product or service	*The aggregators could use the product to produce hourly and daily forecasts of the energy production of their assets in order to be able to participate in the energy market.*
How the customer **interacts** with the company after the purchase	*Interaction with the company post-purchase could be done through emails in order to ensure support is provided for any technical issues that may arise.* *Contract for O&M of the product could also be provided to the customer by the company developing the product*

Table 203. Analysis of customer journey #3: RES energy producers

Potential customer segment #3: RES energy producers	
Problem faced by the customer	*RES energy producers own and operate renewable energy assets and sell their electricity either to aggregators or directly to the energy market. The unpredictability of the energy generation from these sources may pose a significant challenge when negotiating prices since an accurate forecast of the energy produced will need to be in place to allow them to make informed trades.*

How the customer can **learn** about the product or service	*Customers could learn about the product through dissemination activities such as articles, conferences and events or by looking at their competitors' activities and replicating strategies*
How the customer can **assess** the product or service's value proposition before the actual purchase	*A trial version of the product could be available in order for the customers to be able to assess its capabilities for a specific period of time (e.g., 3 months) before purchasing it*
How the customer can **purchase** the product or service	*The product/service can be purchased either by being given access to the service or the product using a license on a monthly/yearly fee or by an one-off payment to purchase the product from the developer*
How the customer can **use** the product or service	*RES energy producers would use this product mainly for long-term forecasts if they were selling to aggregators or for shorter-term forecasts if they are participating in the energy trading market.*
How the customer **interacts** with the company after the purchase	*Interaction with the company post-purchase could be done through emails in order to ensure support is provided for any technical issues that may arise.* *Contract for O&M of the product could also be provided to the customer by the company developing the product*

Table 204. Analysis of customer journey #4: Commercial & Industrial customers

Potential customer segment #4: Commercial & Industrial customers	
Problem faced by the customer	*C&I customers often install RES on their premises in order to reduce their energy bills while benefitting from a given level of energy services. At the same time, they need to satisfy their buildings occupants' level of comfort and their businesses' specific energy needs. This implies a high level of complexity in their operations introducing the need for an accurate load and energy generation forecasting from their assets.*
How the customer can **learn** about the product or service	*Customers could learn about the product through dissemination activities such as articles, conferences and events or by looking at their competitors' activities and replicating strategies*
How the customer can **assess** the product or service's value proposition before the actual purchase	*A trial version of the product could be available in order for the customers to be able to assess its capabilities for a specific period of time (e.g., 3 months) before purchasing it*
How the customer can **purchase** the product or service	*The product/service can be purchased either by being given access to the service or the product using a license on a monthly/yearly fee or by an one-off payment to purchase the product from the developer*
How the customer can **use** the product or service	*C&I customers could use the product in order to accurately predict their energy demand and RES generation on a daily basis. Facility managers of the buildings could this way have a very good overview of their energy needs on a daily basis and adjust operations accordingly aiming at reducing their energy costs*
How the customer **interacts** with the company after the purchase	*Interaction with the company post-purchase could be done through emails in order to ensure support is provided for any technical issues that may arise.* *Contract for O&M of the product could also be provided to the customer by the company developing the product*

Table 205. Analysis of customer journey #5: Residential customers

Potential customer segment #5: Residential customers	
Problem faced by the customer	*Residential customers want to optimise their energy use*
How the customer can **learn** about the product or service	*Residential customers could learn about the product through direct customer support channels (web portal, social media etc.).* *Awareness raised by government and regulation could also help promoting the need for congestion management services*
How the customer can **assess** the product or service's value proposition before the actual purchase	*The customers can assess the product before purchasing it by requesting a free trial period in the form of a personalized report based on simulation*
How the customer can **purchase** the product or service	*The customer could purchase a fixed-term license for using the product (e.g., one-year license) or agree with the solution provider on specific payments depending on the level of support*
How the customer can **use** the product or service	*The customer either sets up the relevant SaaS to be functioning in an automated preconfigured way, or interacts in real time with the application's suggestions to accept or not a congestion mitigation or energy management optimization action.*
How the customer **interacts** with the company after the purchase	*These customers will need to interact with the supplier of the software services at the beginning for training purposes as well as during an active license period for support purposes. The interaction will be realized through the available communication channels as defined in the relevant contract agreement (e.g., email, phone, dedicated support platform)*

Reviewed business model designed in 8.2, applied to the Use Case 8

Business Model Canvas for Use Case #8 - Isolated valley grid operating in islanding mode
Lead Partner: EDYNA

KEY PARTNERS	***KEY ACTIVITIES***	***VALUE PROPOSITIONS***	***CUSTOMER RELATIONSHIPS***	***CUSTOMER SEGMENTS***
DSOs: VIESGO, HEP, EDYNA European Commission Associations like CAP and CEDEC Universities Technology providers: ATOS,	Developing machine learning algorithms Identify, assess and compare the technological options for forecasting and control systems in the distribution network. On-site validations Market analysis Cooperation with other projects and networking. Testing of algorithms at simulation level or small scale demonstrations at first. ATOS testing	Machine learning algorithms for a one-minute forecast combined with a discriminator of the status of the network (with or without network issues like over/under voltage problems or overloaded lines) this will allow sending specifics set	B2B Demonstrations and bilateral multiservice offerings to new and existing clients	DSOs Agreggators

OPA, ZIV, HYPERTECH, SELTA	***KEY RESOURCES*** Investigators and developers Gathered data Technical knowledge Local and international market knowledge Presence in the electricity market	points to avoid the issues previously anticipated through a flexibility assets operation algorithm.	***CHANNELS*** Sales representatives / Market developers Company websites, social media, PR and a dedicated website to demonstrate non-IP sensitive information and results Media and workshops, scientific journals, etc. Other marketing tools	
COST STRUCTURE **Opex:** - *Personel costs* - *Tests and simulations* - *Softwares licenses* - *Infraestructures needed* **Capex:** - *Market development costs* - *marketing costs* - *Sales costs*			***REVENUE STREAMS*** **Products:** *Licensing of the algorithm* **Services:** - *Status of network forecasting services to the agreggators* - *Shipping of specifics setpoints to avoid related problems* - *Forecasting services to DSOs*	

Table 211. Analysis of potential customer segment #1: DSOs

Potential segment #1: DSOs	
Relevant characteristics	Distribution System Operators who are managers or owners of energy distribution networks
Segment size (current size and expected growth)	France, Switzerland, Austria and Slovenia, Northern Italy, UK, Germany, Greece, Spain
Hypothesised customer needs and aspirations	The ability to manage a portion of the grid in island mode gives the OSs the ability to solve many problems in the event of a failure: avoid the use of generators, to be faster in reenergizing the grid
Hypotheses about segment purchasing behaviour and criteria	In the last years the dispersed generation connected to MV grid had a big increase, so in a lot of portions of the grid there is a MV power plant
Information and data required to verify these hypotheses	Not all the generators are able to maintain the grid in islanded mode. It is necessary to verify each generator to see its specific characteristic. Furthermore, it is necessary to verify the economic convenience of the islanded mode

Table 212. Analysis of potential customer segment #2: Aggregators

Potential segment #2: Agreggators	
Relevant characteristics	Entity that groups the energy consumption and/or generation of various consumers/prosumers
Segment size (current size and expected growth)	France, Switzerland, Austria and Slovenia, Northern Italy, UK, Germany, Greece, Spain
Hypothesised customer needs and aspirations	The aggregator could sell a service and make a profit.
Hypotheses about segment purchasing behaviour and criteria	It should have a market for this service. The regulation should give a profit to aggregator
Information and data required to verify these hypotheses	The profit for the aggregator should justify the cost for this service

Table 213. Analysis of potential customer segment #3: RES producers

Potential segment #3: RES producers	
Relevant characteristics	Companies or different associations, even countries
Segment size (current size and expected growth)	France, Switzerland, Austria and Slovenia, Northern Italy, UK, Germany, Greece, Spain
Hypothesised customer needs and aspirations	The producer could sell a service and make a profit. It does not lose its production in case of black-out (a lot of MV producers are not programmable, e.g., flowing water)
Hypotheses about segment purchasing behaviour and criteria	It should have a market for this service. The non-loss of production could yield a sufficient profit.
Information and data required to verify these hypotheses	The cost for the modification of the plant to adapt it for the islanded mode must be lower than the future profit, also taking into account the number of times that the system could be called to work on an island.

Table 214. Analysis of customer journey #1: DSOs

Potential customer segment #1: DSOs	
Problem faced by the customer	*The DSO wants to improve the quality of its service, decreasing the power outages following faults. The islanded mode could be a solution*
How the customer can **learn** about the product or service	*Customers could learn about the product through dissemination activities such as articles, conferences and events or by looking at their competitors' activities and replicating strategies*
How the customer can **assess** the product or service's value proposition before the actual purchase	*A trial version of the product could be available in order for the customers to be able to assess its capabilities for a specific period of time (e.g., 3 months) before purchasing it*
How the customer can **purchase** the product or service	*The product/service can be purchased either by being given access to the service or the product using a license on a monthly/yearly fee or by an one-off payment to purchase the product from the developer*
How the customer can **use** the product or service	*Network operators can use the dispersed generation to have a help to give energy to its customers in case of fault in the grid.*
How the customer **interacts** with the company after the purchase	*Interaction with the company post-purchase could be done through emails in order to ensure support is provided for any technical issues that may arise.* *Contract for O&M of the product could also be provided to the customer by the company developing the product*

Table 215. Analysis of customer journey #2: Aggregators

Potential customer segment #2: Agreggators	
Problem faced by the customer	*For the aggregator there is not a problem, but a new service to have profit*
How the customer can **learn** about the product or service	*Customers could learn about the product through dissemination activities such as articles, conferences and events or by looking at their competitors' activities and replicating strategies*

How the customer can **assess** the product or service's value proposition before the actual purchase	*A trial version of the product could be available in order for the customers to be able to assess its capabilities for a specific period of time (e.g., 3 months) before purchasing it*
How the customer can **purchase** the product or service	*The product/service can be purchased either by being given access to the service or the product using a license on a monthly/yearly fee or by a one-off payment to purchase the product from the developer*
How the customer can **use** the product or service	*The aggregator could be use the product to manage some plants in its availability to offer a service to DSOs*
How the customer **interacts** with the company after the purchase	*Interaction with the company post-purchase could be done through emails in order to ensure support is provided for any technical issues that may arise.* *Contract for O&M of the product could also be provided to the customer by the company developing the product*

Table 216. Analysis of customer journey #3: RES Producers

Potential customer segment #3: RES Producers	
Problem faced by the customer	*For the majority of MV power plants a power outage means a loss of profit, because they are not programmable. Furthermore, they could give a service and to be paid for it*
How the customer can **learn** about the product or service	*Customers could learn about the product through dissemination activities such as articles, conferences and events or by looking at their competitors' activities and replicating strategies*
How the customer can **assess** the product or service's value proposition before the actual purchase	*A trial version of the product could be available in order for the customers to be able to assess its capabilities for a specific period of time (e.g., 3 months) before purchasing it*
How the customer can **purchase** the product or service	*The product/service can be purchased either by being given access to the service or the product using a license on a monthly/yearly fee or by a one-off payment to purchase the product from the developer*
How the customer can **use** the product or service	*In agreement to DSO it can make available its generator to manage a portion of public grid in islanded mode.*
How the customer **interacts** with the company after the purchase	*Interaction with the company post-purchase could be done through emails in order to ensure support is provided for any technical issues that may arise.* *Contract for O&M of the product could also be provided to the customer by the company developing the product*