FLEXI GRID

Business model development – Month 48
Deliverable 8.4
WP8

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ABBREVIATONS

B2B: Business to Business

B2C: Business to Customer

BM: Business Model

BMS: Building Management System

BSP: Balance Service Provider

CA: Consortium Agreement

CAGR: Compound Annual Growth Rate

CC: Communication Committee

DMP: Data Management Plan

DoA: Description of Action

DR: Demand Response

DSO: Distribution System Operator

EC: European Commission

EPC: Energy Performance Contract

ER: Exploitable Result

ESPC: Energy Savings Performance Contracting

ESCO: Energy Services Company

GA: General Assembly

H2020: Horizon 2020

IPR: Intellectual Property Right

KPI: Key Performance Indicator

LV: Low Voltage

M: Month

MV: Medium Voltage

PAC: Provisional Acceptance Certificate

PH: Project Handbook

R&D: Research and Development

RES: Renewable Energy Sources

RTO: Research and Technology Organisations

SC: Steering Committee

SME: Small and Medium Enterprise

TDR: Time Domain Reflectometry

TP: Technical Partner

TSO: Transmission System Operator

VTES: Virtual Thermal Energy Storage

WP: Work Package

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EXECUTIVE SUMMARY

The following deliverable (D8.4) is the direct result of the work carried out during T8.1 (Business models and plan validation and refinement). It is the third update of the business model development report at month 48, and presents the final snapshot of business models for each of FLEXIGRID's exploitable results. It shows the final updates brought to the BM as well as their evaluation to gauge the maturity and efficacy of each BM. The whole document was elaborated thanks to contributions FLEXIGRID partners were able to provide depending on solutions and exploitable results maturity and data.

Thus, this deliverable is made of two parts constituting the main body: The business models of FLEXIGRID exploitable results, and the business model evaluation. The first part is divided into 13 sub-parts each dedicated to a different exploitable result. These sub-parts present the final business model for each FLEXIGRID ER, as well as details and updates regarding the analysis of each block making up the BM according to Osterwalder and Pigneur's methodology. This methodology was used in previous deliverable (D8.2: Business model development – Month 24 and D8.3: Business model development – Month 36) and is here expanded to present the most detailed data possible. Thus, each block detailed analysis was carefully reviewed or given more precisions and the result are presented in the following document. If according to the review supported between D8.3 submission and D8.4 drafting, no updates were made on certain part of the BM blocks then they are not presented once again here to avoid redundant information compared with the data presented in D8.3.

The second part of the main body of this deliverable presents findings and recommendations regarding each of the BM presented in part one. Indeed, thanks to the final BM table presented in each of the fourteen sub-parts making up the business model of FLEXIGRID exploitable result, a self-evaluation was carried out to understand the strength, opportunities, weaknesses, and threats to each BM. FLEXIGRID partners were asked to critically review their ER's BM identify the main characteristics of BM in a SWOT table, as well as grant scores to each block both on an internal and external basis. Thanks to the results drawn from this self-evaluation exercise, an in-depth analysis was carried out to detail weaknesses and threats to the BM, as well as issue recommendations when needed.

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1. INTRODUCTION

The FLEXIGRID project took place from October 2019 to September 2023 and proceeded to commercialise or prepare to the future commercialisation of its Solutions and Exploitable Results during the span of the project.

Therefore, the different tasks within WP8 ensured that the business cases and exploitation strategies were created to identify the most convenient ways for market development and replication of results. The future of FLEXIGRID solutions was supported jointly with the WP7, WP8, and WP9. On its own WP8 delivered analysis and methodological structures to ensure the future of FLEXIGRID solutions.

T8.1 'Business models and plan validation and refinement' structured the development of the most appropriate business models for each one of FLEXIGRID exploitation result. It identified value proposition, and the profit model (originating from the revenue model and the cost structure). Thus, each block making an ER BM: customer segmentations, value propositions, distribution channels, customer relationships, expected revenues streams, resources involved, activities, partnerships and costs structures were analysed.

D8.4 is a direct result of the work carried during the task T8.1. It is the third update of the business model development report at month 48 and was shaped by the methodology and the partners' contributions obtained through the span of the project with the successful submission of previous T8.1 deliverables (D8.1: Business model development – Month 12., D8.2: Business model development – Month 24., and D8.3: Business model development – Month 36.). For this final deliverable, updates thanks to partners' contributions to the previously shaped BMs were made to obtain the final BM for each ER. In addition, as the BM submitted are final and therefore include the most details possible, a BM evaluation was built. Through the self-evaluation of ER leaders, BM were analysed and evaluated to propose recommendations for the future of FLEXIGRID solutions.

2. FLEXIGRID EXPLOITABLE RESULTS BUSINESS MODELS: UPDATES AND FINAL DEVELOPMENTS

As this section updates and present the final result of FLEXIGRID's Business Models, any redundant section which were left presenting the same data than the previous deliverable D8.3 are not present in this deliverable D8.4. Indeed, to make the analysis more readable, only new, or updated data follows in this section. Thus, for example customer segment analysis for ER1a, 2, 3, 4, 5, 6, 7, and 9 as well as the customer journey map of ER1a, 2, 3, 4, 5, 6, 7, 8, and 9 remained identical as previously presented in D8.3. Thus, they are not presented again in the following section. Additionally, in this deliverable the analysis for ER1b, 11, 12, and 13 was finalized. ER1a, 2, 3, 4, 5, 6, 7, 8, 9, and 10 analysis of key activities was done in the previous deliverable and therefore can be consulted in D8.3 (Business model development – Month 36). Indeed, as partners did not update nor make any change for previously established key activities analysis it was deemed unnecessary to present them again in D8.4.

The first part of this section depicts for each of them updates and changes in the overall BM and in the customer segmentation and characteristics. This work on customer segmentation has been used for other deliverables (including D8.12: Exploitation strategy - Month 48 and D8.13: Market opportunities triggered by FLEXIGRID) in order to shape the exploitation strategy and the market outlook analysis, to identify FLEXIGRID future stakeholders.

For ER1b, ER2, ER4, ER5, ER8, ER11, ER12, and ER13 a market and competition analysis was performed to show case an overview of similar available products and services. For other ER (with ER10 being an exception) this market and competition analysis was performed in D8.3 (Business model development – Month 36).

In addition, a value proposition canvas was elaborated for each ER, demonstrating the position of FLEXIGRID's ER compared to the identified customers' values and needs. As the deliverable D8.5 related to FLEXIGRID's solution cost benefit analysis also details a number of value proposition, only ER10, ER11, ER12 and ER13 sections detail a value proposition canvas. Indeed, the first nine ERs canvas proposition correspond to FLEXIGRID's nine solutions value proposition canvas and can be consulted in D8.5.

2.1 ER1a: Secondary substation of the future

2.1.1 Final business model

Business Model Canvas for ER1a – Secondary substation of the future
Lead partner: Ormazabal

KEY PARTNERS	KEY ACTIVITIES	VALUE PROPOSITIONS	CUSTOMER RELATIONSHIPS	CUSTOMER SEGMENTS
- Technological supplier OCT Ormazabal Corporate Technology - Production supplier Tecnichapa Polsa Cotradis	- R&D - Industrial manufacturing - Sales Department	- Service interruption reduction in real time - Tap regulation - Voltage regulation - Safety improvements LVB - Efficiency cost on LV grid	- Service improvement - Control developments: new functionalities - Retrofit on secondary substation	- Distribution System Operators (DSO) - Electrical Energy End Users (E3U) - Renewable Energy manufacturers

KEY RESOURCES

- Human resources (R&D technicians, Production workers)
- Manufacturer infrastructure
- Investment provider (Ormazabal)

- Optimizing grid topologies
- Stabilizing volatile grid
- Reducing consumption

CHANNELS
- Sales services
- Forums
- Public bidding
- Innovation projects

COST STRUCTURE

Opex:
- Manufacturer cost of production
- R&D investment

Capex:
- Marketing cost
- Sales cost

REVENUE STREAMS

Products:
- Smart transformer deployment
- LV board supervised
- MV automation developments

Services:
- Bidding

2.1.2   Customer segment analysis

Three potential customer segments had been identified for the secondary substation of the future in D8.3 (Business model development – Month 36). As those customer segments and their prioritization remained the same, it is irrelevant to present them once again. Customer segments are still expected to be addressed with the following prioritisation: i) DSOs, ii) electrical energy end users, and iii) renewable energy manufacturers.

2.1.3   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. The analysis is presented from table 1 to table 3. The customer journey resulting was presented previously in D8.3 (Business model development – Month 36), as the customer journey map remains unchanged, it was deemed unnecessary to present it in D8.4 again.

Table 1. Customer Segment 1: DSOs

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 2. Customer segment 2: Electrical energy end users

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 3. Customer segment 3: Renewable energy manufacturers

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

2.1.4   Documenting the revenue streams and cost structure

Revenue streams from ER1a would include both products and services. Direct sales would be proposed to DSOs, Electrical energy users, and RE manufacturers. DSOs would represent a bigger part of the expected revenue streams customers as they would need for a higher number of SS of the future and therefore of following services.

Figure 1.   ER1a Revenue streams
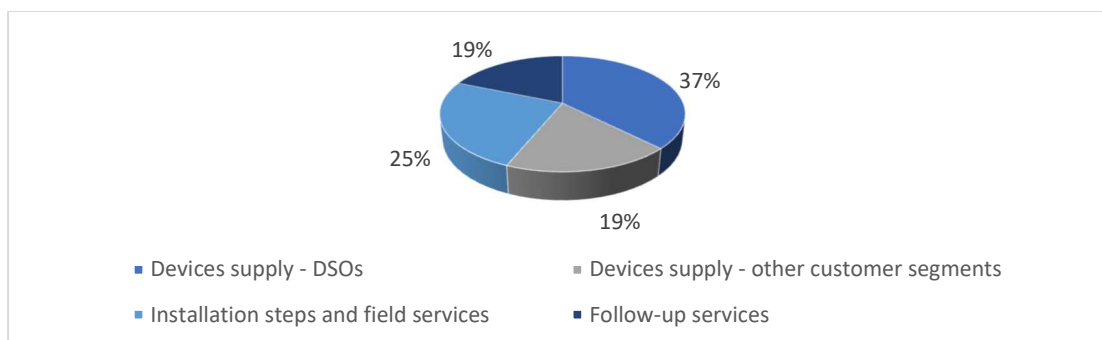
The analysis allowed to specify the variables which are likely to have the most significant impact on revenues. The product portfolio, the offer and fitting for customized solutions, and the investments would have an important impact of the revenue streams block.

Furthermore, the variables which are likely to have the most significant impact on costs would be the technology development and use, the production systems and the producer good cost.

Revenues associated with the Secondary substation of the future will depend on its market positioning (the product portfolio), the customized solutions made available to customers, and the development investments.

As for costs, items related to technology, production systems, and producers' good cost will play a significant role in their evolution.

Figure 2.   ER1a Cost structure
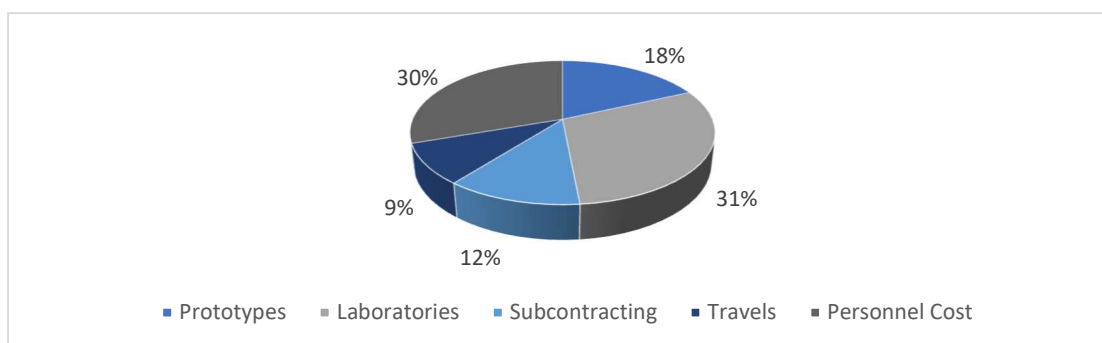
The cost structure of ER1a is mainly divided between external expenses composed of cost issued by prototypes, laboratories, subcontracting, and travels and internal expenses composed of cost issued by laboratories, internal personnel cost.

No alternative option has been considered regarding the revenue streams and cost structure for ER1a.

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

2.2.1   Final business model

Business Model Canvas for ER1b – Secondary substation of the future specially designed for remote isolated areas
Lead partner: SELTA-DP

KEY PARTNERS	KEY ACTIVITIES	VALUE PROPOSITIONS	CUSTOMER RELATIONSHIPS	CUSTOMER SEGMENTS
- SELTA-DP - EDYNA	- Producing / manufacturing - Conducting further R&D - Marketing campaigns - System engineering - Testing and reporting - Sales and distribution management	- 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	Generally: acquisition by the customers DSOs may have partner role in new research pilot projects and field tests.	- DSOs & electrical MV grid managers - BSPs/ Aggregators - RES producers - Industrial customers **Other potential beneficiaries:** - TSOs
	KEY RESOURCES - R&D - Engineering and service - Project management - Marketing management and sale office - Field test by partner EDYNA - Production - Purchasing department	**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.	**CHANNELS** - Marketing - Use cases and publications due to innovative pilot projects - Customer support in design, engineering and management - Service activities, installation and testing phases	

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

2.2.2   Customer segment analysis

Four potential customer segments have been identified for the secondary substation of the future specially designed for remote isolated areas and are expected to be addressed with the following prioritisation: i) DSOs, ii) BSPs, iii) RES producers, and iv) Industrial customers. As a more details analysis has been established for D8.4 than it was for D8.3 (Business model development – Month 36), the following section presents the potential segment analysis. Their analysis is presented in Table 4 to Table 7.

Table 4. Analysis of potential customer segment 1: DSOs

Potential segment 1: DSOs	
Relevant characteristics	Energy infrastructures Utilities
Segment size	Italy and European Union
Hypothesized customer needs and aspirations	Telecontrol and grid observability
Hypotheses about segment purchasing behaviour and criteria	Waiting for reliable solutions on the market
Information and data required to verify these hypotheses	Having direct contact

Table 5. Analysis of potential customer segment 2: BSPs

Potential segment 2: BSPs	
Relevant characteristics	Aggregators of energy producers and traders
Segment size	Italy and European Union
Hypothesised customer needs and aspirations	Telecontrol
Hypotheses about segment purchasing behaviour and criteria	Waiting for cheap and reliable solutions on the market
Information and data required to verify these hypotheses	Having direct contact

Table 6. Analysis of potential customer segment 3: RES producers

Potential segment 3: RES producers	
Relevant characteristics	Owners of power plants from renewable energy sources
Segment size	Italy and European Union
Hypothesised customer needs and aspirations	Telecontrol
Hypotheses about segment purchasing behaviour and criteria	Waiting for cheap and reliable solutions on the market
Information and data required to verify these hypotheses	Having direct contact or information through the DSO

Table 7. Analysis of potential customer segment 4: Industrial customers

Potential segment 4: Industrial customers	
Relevant characteristics	Owners of modulable loads
Segment size	Italy and European Union
Hypothesised customer needs and aspirations	Telecontrol
Hypotheses about segment purchasing behaviour and criteria	Waiting for cheap and reliable solutions on the market
Information and data required to verify these hypotheses	Having direct contact or information through the DSO

2.2.3   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. The analysis is presented from table 8 to 11. The customer journeys resulting are presented in Figure 3 and 4. As the customer journeys were similar, BSPs and DSOs are presented together, just as RES Producers and Industrial customers are.

Table 8.   Customer Segment 1: DSOs

Customer segment 1: DSOs	
Problem faced by the customer	DSOs want to increase the observability of their grid and update the telecontrol potential of their system.
How the customer can **learn** about the product or service	They can learn through customized courses, webinars and physical meetings focused on the solutions.
How the customer can **assess** the product or service's value proposition before the actual purchase	DSOs can evaluate the solution by specific test, in particular about communication issues and electrical details.
How the customer can **purchase** the product or service	They can purchase the product and service by directly contacting the technological provider.
How the customer can **use** the product or service	DSOs can install the product by themselves and ask the provider for assistance. They can also ask for the service during the first installation phases.
How the customer **interacts** with the company after the purchase	DSOs can contact the provider company in order to obtain remote support by their service and engineering departments.

Table 9.   Customer Segment 2: BSPs

Customer segment 2: BSPs	
Problem faced by the customer	BSPs want to update the telecontrol potential of their system that collect a lot of modulable producers and loads. They want to offer to the energy market flexibility and ancillary services for the electrical grid.
How the customer can **learn** about the product or service	BSPs can learn through customized courses, webinars and physical meetings focused on the solutions.
How the customer can **assess** the product or service's value proposition before the actual purchase	They can evaluate the solution by specific test, in particular about communication issues and electrical details.
How the customer can **purchase** the product or service	BSPs can purchase the product and service by directly contacting the technological provider.
How the customer can **use** the product or service	BSPs can install the product by themselves and ask the provider for assistance. They can also ask for the service during the first installation phases.

How the customer **interacts** with the company after the purchase	BSPSs can contact the provider company in order to obtain remote support by their service and engineering departments.

Table 10. Customer Segment 3: RES Producers

Customer segment 3: RES producers	
Problem faced by the customer	RES producers want to update the telecontrol potential of my power plants in order to offer ancillary services to the grid.
How the customer can **learn** about the product or service	They can learn through customized courses or information coming from DSO.
How the customer can **assess** the product or service's value proposition before the actual purchase	BSPs can evaluate the solution by specific test, in particular about communication issues and electrical details.
How the customer can **purchase** the product or service	They can purchase the product and service by directly contacting the technological provider or by asking help to DSO customer care.
How the customer can **use** the product or service	BSPs can install the product within the DSO authorizations. They can ask the provider for assistance. They can also ask for the service during the first installation phases.
How the customer **interacts** with the company after the purchase	BSPs can contact the provider company in order to obtain remote support by their service and engineering departments. They can also turn to DSO customer care.

Table 11. Customer Segment 4: Industrial customers

Customer segment 4: Industrial customers	
Problem faced by the customer	Industrial customers want to update the telecontrol potential of my modulable loads in order to offer ancillary services to the grid.
How the customer can **learn** about the product or service	They can learn through customized courses, webinars and physical meetings focused on the solutions.
How the customer can **assess** the product or service's value proposition before the actual purchase	They can evaluate the solution by specific test, in particular about communication issues and electrical details.
How the customer can **purchase** the product or service	Industrial customers can purchase the product and service by directly contacting the technological provider or by asking help to DSO customer care.
How the customer can **use** the product or service	Industrial customers can install the product within the DSO authorizations. They can ask the provider for assistance. They can also ask for the service during the first installation phases.
How the customer **interacts** with the company after the purchase	Industrial customers can contact the provider company in order to obtain remote support by

	their service and engineering departments. They can also turn to DSO customer care.

Figure 3.   Customer journey analysis for potential customer segment: DSOs, BSPs
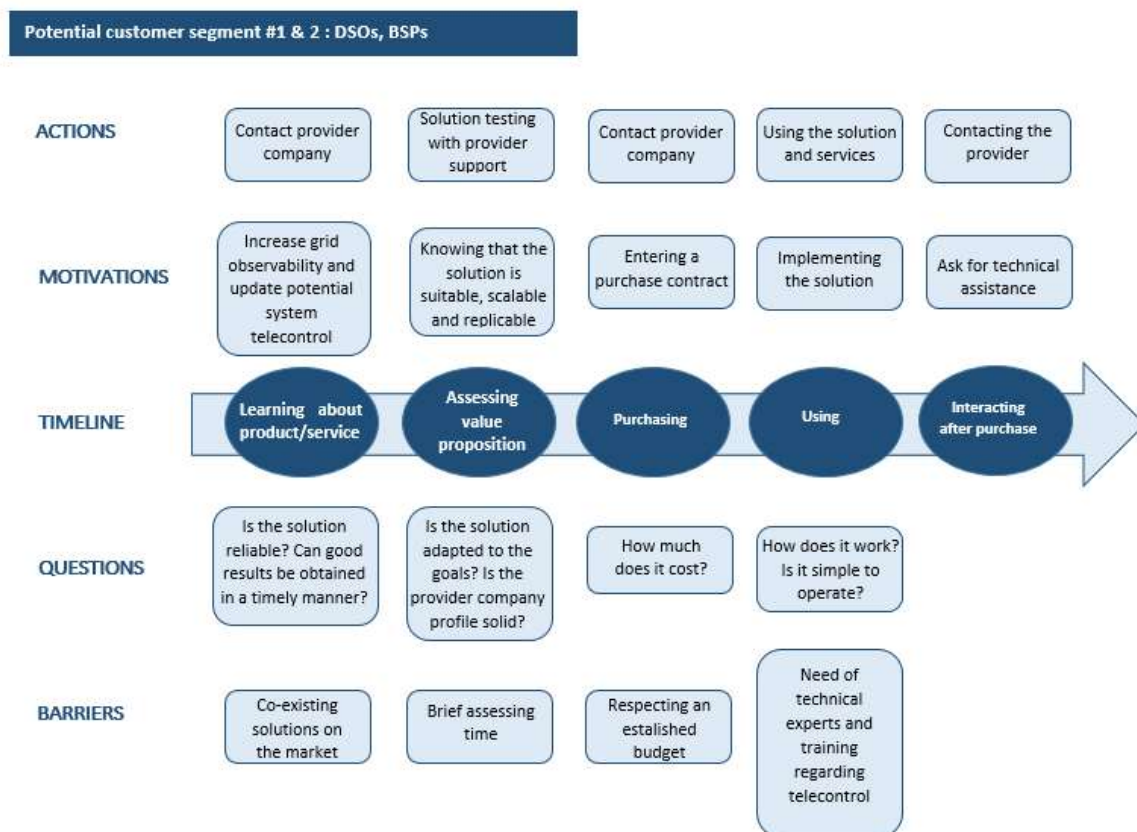
Figure 4.   Customer journey analysis for potential customer segment: RES Producers, Industrial customers
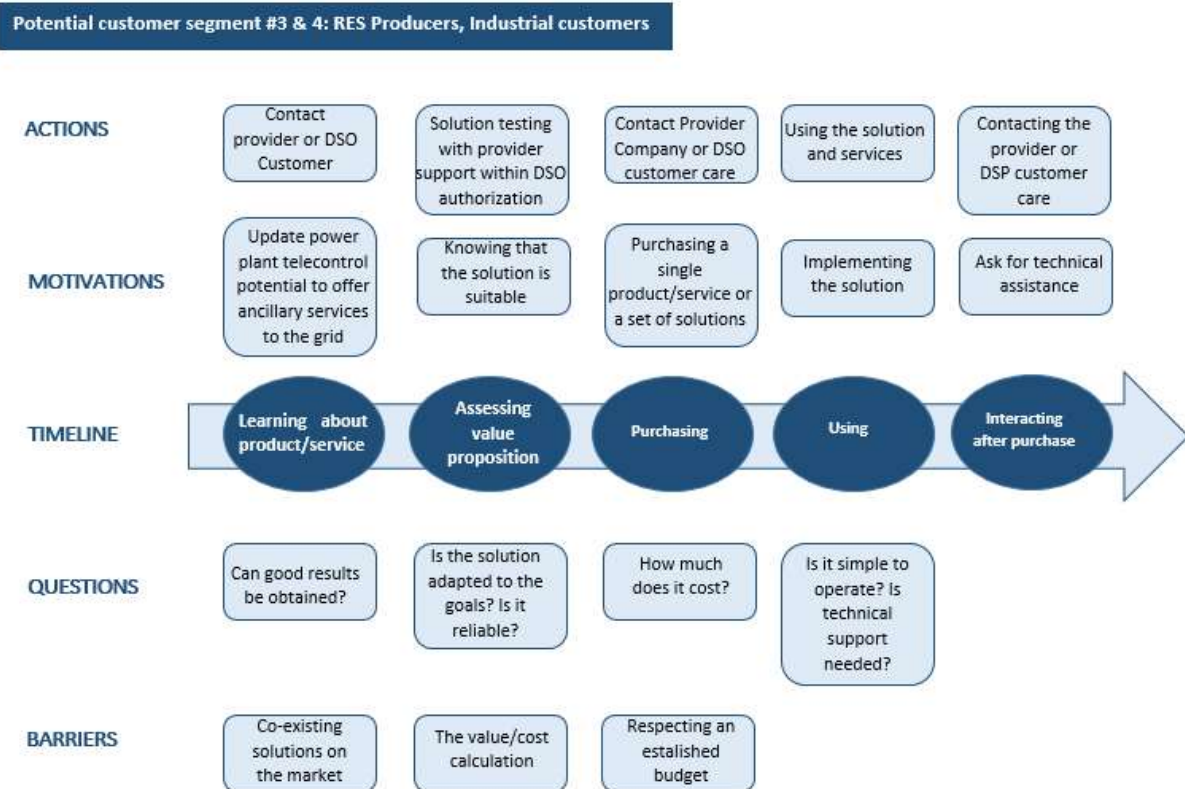
In relation to these customer journey maps, the solution provider's key activities, their output and the extent to which they are assessable, critical and timely have been specified (Table 12). As a result, the different activities presented in the "Key activities" building block of the business model canvas have been finalized as it was not done in the previous deliverable D8.3 (Business model development – Month 36) as it was for the majority of FLEXIGRID ER.

Table 12. Analysis of key activities

Activity	Assessable?	Critical?	Timely?	Output of the activity
Producing/ manufacturing	High	High	High	Products
Conducting further R&D	High	Medium	Medium	Updates
Marketing campaigns	Low	Medium	Low	More customers
System engineering	Medium	High	Medium	System design
Testing and reporting	Medium	Medium	Low	Test reports and certificates
Sale and distribution management	Medium	Medium	Low	Revenue

2.2.4   Market and competition analysis

A market and competition analysis has been performed in order to refine ER1b's value proposition (Table 13).

Table 13. Market and competition analysis for ER1b – Secondary substation of the future specially designed for remote isolated areas – in national markets in Europe

Current competitors

It is possible to identify two typical kinds of competitors:

1. Big multinational corporations: Its main characteristics are the commercial strength and the robust solutions. Otherwise, its prices are higher compared to those of most competitors. Moreover, it usually offers standard solutions instead of customized ones. It belongs to the category: "Competitors that sell to the same users and solve the same problem using the same or similar solution". It puts on the market similar products, with a wide range of choice.

2. Local sectorized companies: Its strengths include an aggressive pricing policy to detriment of quality, robustness and solidity in the proposed solutions. It belongs to the category: "Competitors that sell to the same target user to solve the same problem with a different approach than yours". It puts on the market few products with similar functionalities.

New entrants
Identification of barriers to entry: • Market saturation of similar solutions (only about some functionalities) • Expensive products without appropriate incentives

Substitutes
Technological solutions that are compliant with: • Italian CEI 0-16 standard regulation about the operation of MV grid and renewable energy resources; • IEC-61850 international standard about communication protocols within electrical systems and substations • The Italian authority ARERA (Autorità di regolazione per energia, reti e ambiente)

Suppliers and other actors in the value chain
• Electronical components providers • DSOs that advices the solution to producers and industrial customers • BSPs that aggregates producer and industrial customers

Stakeholders
• EU energy authority • Italian authority ARERA • Ministry of Ecological transition

Within this environment, the competitive advantages of the Secondary substation of the future specially designed for remote isolated areas are expected to rest notably on its advanced functionalities and the innovative equipment for monitoring, controlling and managing the secondary substations of MV electrical grids. In addition, its specific communication system that allows real time information change from control center to peripheral resources and vice versa also bring a competitive advantage to the solution.

SELTA offers its support and experience in the electrical system field. Thanks to SELTA expertise in telecontrol system for electrical utilities, the value of the solution achieves high level in terms of design, customization, technical support and fitting of undesired problems.

2.2.5   Critical success factors for the considered business model

As it was not performed in the previous deliverable D8.3 (Business model development – Month 36), the critical success factors for the business model considered for ER1b have been identified for its final BM analysis. These are evidenced in Table 14.

Table 14. Critical success factors for the business model considered for ER1b

Critical success factor	Key metric	Data to be collected and sources
Price	Price for product/service	Competitors' prices and customers budget
Reliable	Number of service failures	Number of technical support activations
Time to market	Weeks from the peak demand	Requests and activations
Marketing	Number of reached customers	New orders

2.2.6   Documenting the revenue streams and cost structure

Figure 5.   ER1b Revenue streams
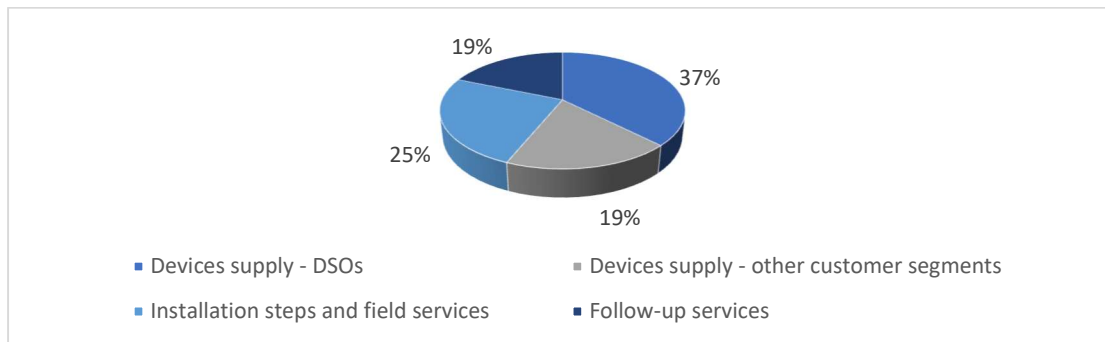
The revenue streams associated with the Secondary substation of the future (specially designed for remote isolated areas) involve both products and services (Figure 5). For DSOs, the supply of the devices would rest on a recurring pricing mechanism related to the portions of the MV grid and the number 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 6.   ER1b Cost structure
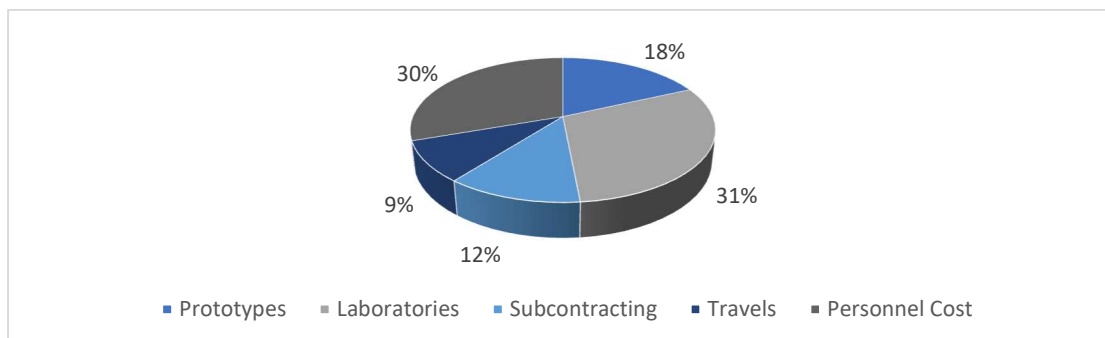
The cost structure associated with this ER involves both variable and fixed costs (Figure 6). All of the variable costs – devices manufacturing and equipment supply (production and manufacturing, project management, purchasing department), as well as R&D, engineering and service activities (system engineering, 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.

2.3 ER2: New generation of smart meters

2.3.1 Final business model

Business Model Canvas for ER2 – New Generation of Smart Meters
Lead partner: ZIV

KEY PARTNERS	**KEY ACTIVITIES**	**VALUE PROPOSITIONS**	**CUSTOMER RELATIONSHIPS**	**CUSTOMER SEGMENTS**
- DSOs - Smart meter manufacturers - Research centers - Laboratories - Big Data/AI software providers - Software providers	**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	- 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	- Setup, maintenance, and technical support - Customer loyalty based on confidence and continuous improvement of the solution	- DSOs - LV customers
	KEY RESOURCES - Application and design engineers - DSOs' Demo sites with multiple feeders - Test sets - Intellectual property - Laboratories for simulation		**CHANNELS** - Direct relationship with DSOs - Utility Tenders	

COST STRUCTURE	**REVENUE STREAMS**
	Products: - Smart meters - Software specifically designed for demand profile analysis for the customer - Software specifically designed for demand profile analysis for DSOs
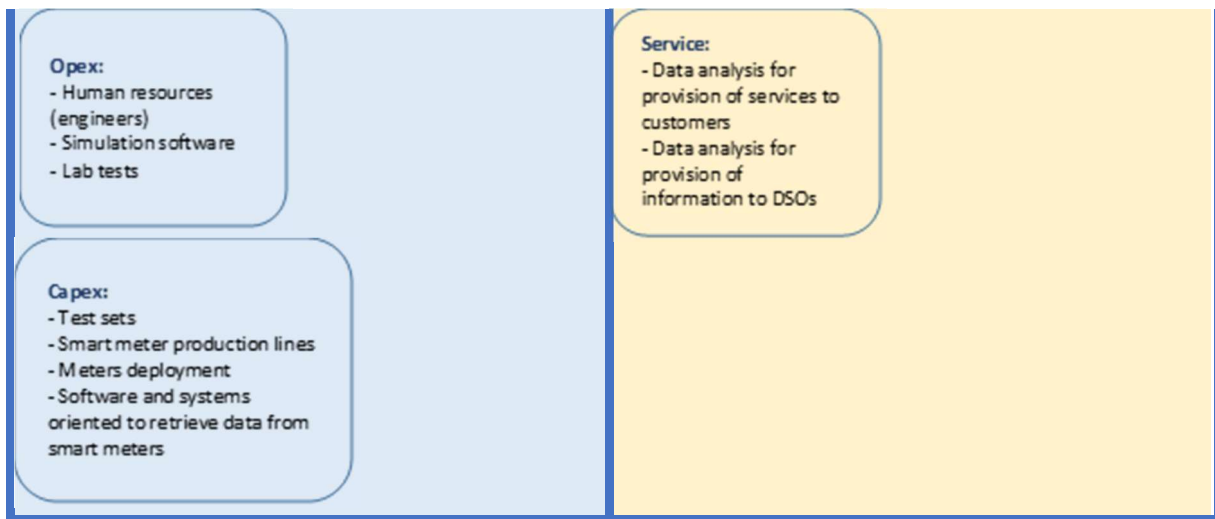
2.3.2   Customer segment analysis

Two potential customer segments had been identified for the New Generation of Smart Meters in D8.3 (Business model development – Month 36). As those customer segments and their prioritization remained the same, it is irrelevant to present them once again. Customer segments are still expected to be addressed with the following prioritisation: i) DSOs, and ii) Industrial and residential customers.

2.3.3   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. The analysis is presented in table 15 and table 16. The customer journey resulting was presented previously in D8.3 (Business model development – Month 36), as the customer journey map remains unchanged, it was deemed unnecessary to present it in D8.4 again.

Table 15. Customer Segment 1: DSOs

Customer segment 1: DSOs	
Problem faced by the customer	With the growth of renewables and the development of local energy initiatives, the DSOs need new elements to monitor and operate the grid.
How the customer can **learn** about the product or service	The products are presented in technical forums or commercial visits.
How the customer can **assess** the product or service's value proposition before the actual purchase	DSOs can assess the product before purchase through pilot tests.
How the customer can **purchase** the product or service	Customers can purchase the smart meters via the manufacturer.
How the customer can **use** the product or service	Installing the products in the grid and integrating them into their existing systems is the way to use the smart meters. The designs are always done in such a way that interoperability is maintained or they are turnkey solutions.
How the customer **interacts** with the company after the purchase	Interaction with the company after purchase can be done through technical support channels.

Table 16. Customer Segment 2: Industrial and residential customers

Customer segment 2: Industrial and residential customers	
Problem faced by the customer	Industrial and residential customers need active demand management.
How the customer can **learn** about the product or service	This customer segment can learn about the new generation of smart meters through information on the web, and distributors.
How the customer can **assess** the product or service's value proposition before the actual purchase	Industrial and residential customers can assess the product before purchase through feedback from the utility.
How the customer can **purchase** the product or service	Customers can purchase the smart meters through manufacturer or distributors.
How the customer can **use** the product or service	Installing the meter and reading tools offered by utilities is the way to use the smart meters.
How the customer **interacts** with the company after the purchase	Interaction with the company after purchase can be done through technical support channels.

2.3.4   Market and competition analysis

A market and competition analysis has been performed in order to refine ER2's value proposition (Table 17).

Table 17. 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 tenders or 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 willstem from the fact that their provider is a known meter manufacturing company, with a strongexpertise 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.

2.3.5   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 andon the tenders' volume, while product certifications and development will have the most significant impact on costs.

The revenue streams associated with the new generation of smart meters is entirely dependent on unit prices and the number of units sold. In the meter market, the variable that has an impact on revenues is the number of units as the price of this type of product is marginal. However, large-scale and automated manufacturing makes the difference.

Figure 7.   ER2 Project cost structure
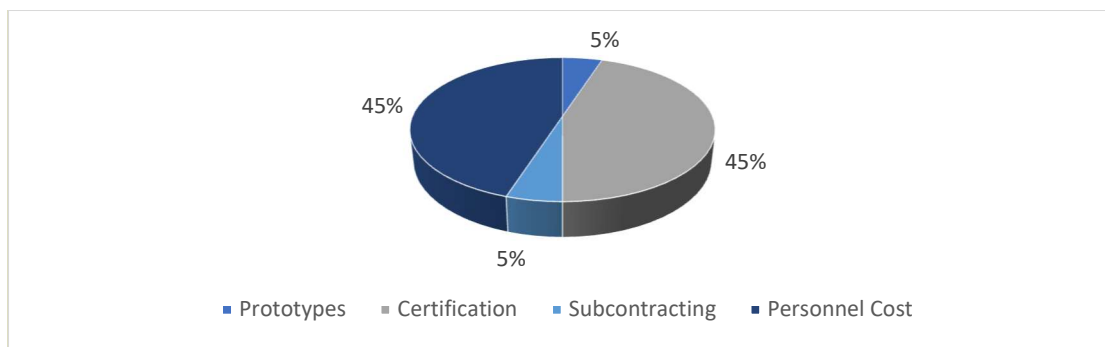
The cost structure associated with ER2 has been analyzed both on the project level and on the product level (Figure 7 and 8). One of the variables with the most impact on project cost is the certification, as meters are subject to legal control and therefore to extensive certification processes at high cost.

Figure 8.   ER2 Product cost structure
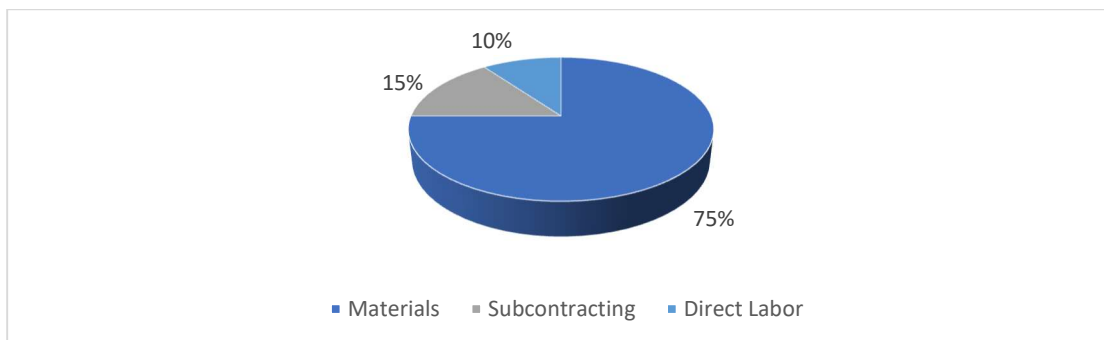
Materials and their acquisition price, mostly affect the costs related to the product itself. Demand and material prices increase in tandem. However, purchasing on a large scale can help reduce this cost.

2.4 ER3: Protections for high RES penetration

2.4.1   Final business model

Business Model Canvas for ER3 – Protections for high RES penetration
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 penetration - Testing - Field installation	Improved performance of the protection system	- Setup, maintenance and technical support - Customer loyalty based on confidence and continuous improvement of solution	- TSOs - Industrial and other MV customers - Generators owners - Switchgear manufacturers - Integrators and EPCs
	KEY RESOURCES - Application and design engineers - Simulation tools - Test-sets - Demonstration 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: -Human resources (engineers) -Simulation software -Lab tests **Capex:** -Test sets	**Products:** -Protection IEDs and fault detector sales **Services:** Setting studies sales

2.4.2   Customer segment analysis

Six potential customer segments had been identified for the Protection for high RES penetration in D8.3 (Business model development – Month 36). As those customer segments and their prioritization remained the same, it is irrelevant to present them once again. Customer segments are still expected to be addressed with the following prioritisation: i) DSOs, ii) TSOs, iii) Industrial and other MV customers, iv) Generators owner, v) switchgear manufacturers, and vi) Integrators and EPCs.

2.4.3   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. The analysis is presented in table 18. ZIV observed that identified customer segment characteristics were coinciding, thus the subsequent customer characteristics to prepare the customer journey map were rather similar. As a result, only one table summarizing relevant customer characteristics for all the identified customer segments is presented below. The customer journey resulting was presented previously in D8.3 (Business model development – Month 36), as the customer journey map remains unchanged, it was deemed unnecessary to present it in D8.4 again.

Table 18. Customer Segment 1, 2, 3, 4 , 5, and 6: DSOs, TSOs, MV customers, Generator owners, Switchgear manufacturers, and Integrators and EPCs

Potential customer segment 1, 2, 3, 4 , 5, and 6: DSOs TSOs, MV customers, Generator owners, Switchgear manufacturers, and 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 sales representatives, 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

2.4.4   Documenting the revenue streams and cost structure

The revenue streams from ER3 relies solely on unit prices. Those prices in turn are impacted by several variables which can create fluctuations. Firstly, the geographical area of a sale, and thus the market chosen to further sales can impact unit prices. The market price in some countries can be much lower, and the penetration of renewable generation will determine the interest on the product. In addition, the size of customers will impact directly on the sales volume. The use of a relay model affects revenue streams. Indeed, a feeder relay with few requirements will be much cheaper than more complex relays, such as line differential and distance. Finally, the last variable identified to have an impact upon revenue streams will be the type of sale performed. A loose equipment or system, a frame agreement, or a sale through a local agent will not bring the same revenue.

Costs have been estimated by ZIV to be divided differently to produce ER3 and to prepare ER3 during the FLEXIGRID project. Thus, the two figures below (figure 9 and 10) illustrate those estimations. It is demonstrated that throughout the project the highest cost was human resources, representing 75% of the overall budget. However, after the end of the project, to produce ER3, direct labour percentage on the overall budget will be reduced to 5% while materials will take the highest share of the estimated costs, representing 80% of the overall budget.

Figure 9.   ER3 Project costs
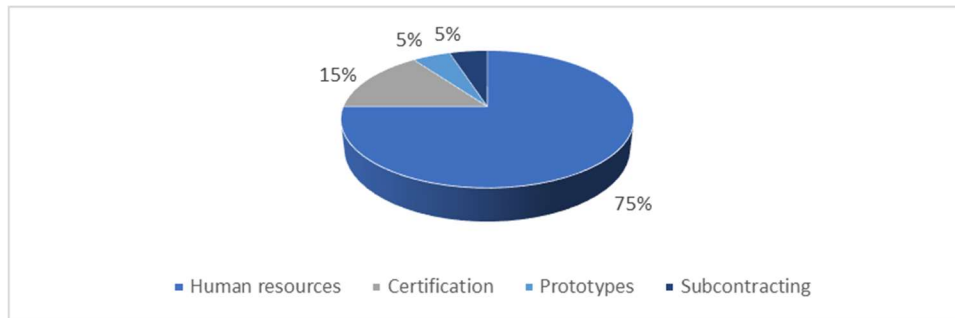
Figure 10.   ER3 estimated product costs
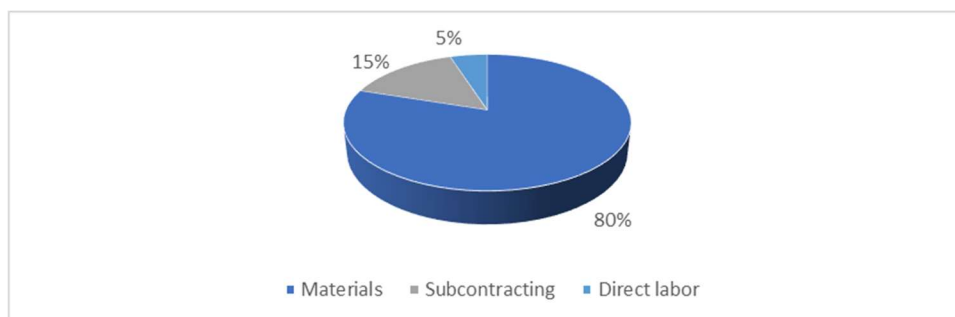
The analysis allowed to specify the variables which are likely to have the most significant impact on costs. As it is demonstrated through figure 10, material will make out the majority of the cost of the product? Then, materials cost and subcontracting cost will impact costs. The volume in total determines the majority of ER3 cost and any fluctuation in their cost will directly impact ER3 cost. This material costs can be fluctuated for a number of reasons. Geopolitical issues as the instability of certain regions in the world influence the cost of electronic components, as well as their availability. The geographical area of a customer can also have consequences upon costs. Import taxes increase the costs in certain countries with barriers for non-local manufacturers, making competitiveness with local stakeholders harder. Finally, the functionalities required by customers can weight on ER3 price. Certain functionalities require special hardware (Field-Programmable Gate Array circuit for example, or more powerful uP) increasing the product cost.

Alternatives have been considered regarding ER3 BM. Indeed, protective relays can be sold in different ways:

- As loose equipment
- Or as systems that include the equipment, panels, engineering, commissioning, training, settings calculation, etc.

Depending on the BM chosen, the contribution margin and revenues will be different. The contribution margin when selling loose equipment is normally higher but selling systems has the advantage of providing other services, such as the mentioned ones. Some of the services provided can be outsourced. Both alternatives (loose equipment and systems) can be sold directly to the DSO, TSO, generator owner, MV customer or through EPCs or switchgear manufacturers. Local agents can also

be involved in the business. Frame agreements for a period of time can also be considered. These frame agreements assure a certain volume at the cost of reducing the contribution margin.

2.5 ER 4: Energy Box

2.5.1   Final business model

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 - Local authorities in charge of the management of social housing
	KEY RESOURCES - 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	**CHANNELS** - Distribution at demonstration sites - Dedicated website (giving access to relevant non-IP sensitive results) - Media, conferences, workshops and events - Innovation forum	

COST STRUCTURE	REVENUE STREAMS
Opex: - Human resources - Manufacturing - Hardware components costs - I&D activities - Marketing costs - Sales costs **Capex:** - Aggregation and transmission hardware infrastructure	- Direct sales - Sales through intermediaries - Technology transfers

2.5.2   Customer segment analysis

Four potential customer segments had been identified for the Energy Box in D8.3 (Business model development – Month 36). As those customer segments and their prioritization remained the same, it is irrelevant to present them once again. Customer segments are still expected to be addressed with the following prioritisation: i) DSOs, ii) aggregators, iii) renewable energy producers, and iv) industrial, commercial, and residential customers and energy communities.

2.5.3   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. The

analysis is presented from table 19 to table 21. The customer journey resulting was presented previously in D8.3 (Business model development – Month 36), as the customer journey map remains unchanged, it was deemed unnecessary to present it in D8.4 again.

Table 19. Customer Segment 1: DSOs

Potential customer segment 1: DSOs	
Problem faced by the customer	Need for an enabler for advanced systems such as prediction and optimization algorithms, since without an intelligent element in the field they would not be able to perform the calculated control
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 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 proposition before the actual purchase	Showing them the results obtained in the validations and tests on site of other companies that work as DSOs
How the customer can **purchase** the product or service	Licensing, selling, creating a joint venture
How the customer can **use** the product or service	Adoption of the solution in the customer facilities.
How the customer **interacts** with the company after the purchase	Once data can be extracted, the algorithmic system can be updated and improved according to the user's needs. Maintenance service for troubleshooting, software updates can be done remotely via OTA (Over The Air). For the initial configuration, there should be a user manual.

Table 20. Customer Segment 2: Aggregators

Potential customer segment 2: Aggregators	
Problem faced by the customer	Need of a controller able to manage the energy intelligent devices in several environments to keep control of minimum communication requirements, reducing the number of ports and that are easy to manage in the industrial environment.
How the customer can **learn** about the product or service	Through the European Commission, project website, events where the project / result is presented, press, articles, business website, list of clienteles.
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 on site through the project's lifetime.
How the customer can **purchase** the product or service	Licensing, selling, creating a joint venture
How the customer can **use** the product or service	Adoption of the solution in the customer facilities.

How the customer **interacts** with the company after the purchase	Once data can be extracted, the algorithmic system can be updated and improved according to the user's needs. Maintenance service for troubleshooting, software updates can be done remotely via OTA (Over The Air). For the initial configuration, there should be a user manual.

<p style="text-align:center">Table 21. Customer Segment 3: Industrial, commercial and residential consumers</p>

Potential customer segment 3: Industrial, commercial and residential consumers	
Problem faced by the customer	The 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.
How the customer can **learn** about the product or service	Company website, project's website, CIRCE's list of clients, PR, social media, marketing.
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 on site through the project's lifetime.
How the customer can **purchase** the product or service	Licensing, selling, depending on if the customer is a company or a direct user.
How the customer can **use** the product or service	Installing the solution in the customer facilities or homes.
How the customer **interacts** with the company after the purchase	Maintenance service for troubleshooting, software updates can be done remotely via OTA (Over The Air). For the initial configuration, there should be a user manual. Surveys to measure customer satisfaction

2.5.4   Market and competition analysis

A market and competition analysis has been performed in order to refine ER4's value proposition (Table 22).

<p style="text-align:center">Table 22. Market and competition analysis for ER4 – Energy Box</p>

Current competitors
The main competitors identified for the for the demonstration and launch of the Spanish demo are the following: • Schweitzer Engineering Laboratories (SEL): They owned the powerMAX for Mobile Microgrids a system that allows the upgrade existing assets incrementally and integrate dispersed generation and loads in stages without the need for large procurement budgets. • Opus One Solutions: they have the GridOS™, a smart grid system that deploys advanced power system analytics throughout the grid, from utility control room to substation to customer microgrid. It enables power engineering to emerge from utility planning environments into real-time operations and grid automation. • S&C Electric: with their technology The GridMaster Microgrid Control System that integrates and communicates with hosts of different energy assets. The system is embedded with a military-grade cybersecurity protocol to mitigate the growing threat of cyberattacks and offers an intuitive user interface and the flexibility to scale as your needs change. • Other competitors: ABB, Schneider Electric, Power Secure, Emerson, Clean Spark, OATI,

General Electric, Eaton.
- Research Centres and Universities (at Spanish level): IREC, CENER, TECNALIA, CARTIF, CIEMA

For the international demo there is no direct competition, however, we add the following solution for reference:
- Revolution PI: Revolution Pi is an open, modular and inexpensive industrial PC based on the well-known Raspberry Pi. Housed in a slim DIN-rail housing, the three available base modules can be seamlessly expanded by a variety of suitable I/O modules and fieldbus gateways. The 24V powered modules are connected via an overhead connector in seconds and can be easily configured via a graphical configuration tool.

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

The key substitute products or services identified for the demonstration and launch of the Spanish demo Energy Box are the following:
- Merytronic: A Spanish technology company that owns a Low Voltage Network Monitoring system that serves as a data concentrator in charge of processing the information coming from the smart use switches.

- Socomec: A multinational technology company that offers the service of protection, distribution, measuring and monitoring of the LV electrical grid with the aim of securing the electrical supply and minimising maintenance.
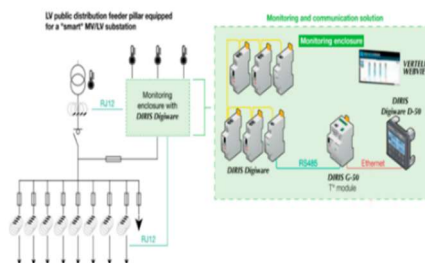
- Embedded Monitoring System (EMSNI): owns the product Sub.net-SLV a specific instrument for logging the real and reactive power on each phase of each feeder from a substation as well as the voltages, currents and relevant power quality (PQ) parameters like harmonics and flicker. Their market sectors are divided in: renewable, distribution, low voltage, industrial, generation and transmission.

Internationally since the year 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: Printed Circuit Board (PCB) maker; • LTP Atelier Plastique: all plastic components; • RS components: additional components (microSD memory, 3V battery, WIFI, etc).

Stakeholders
• Components manufacturers; • Installers; • Maintenance entity.

Within this environment, the competitive advantages of the Energy Box are expected to rest notably on its very diverse and complete value proposition, which includes:

- 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.

Indeed, the value proposition of this hardware and software solution, aiming to solve the field level communication and management, employs key features setting it apart from competitors. ER4 displays a compact, light-weight and modern design, its fanless design that ensures quite operation in small office spaces and living rooms, its high-level services and monitoring can be performed remotely whereas local services can be processed locally, which improves service quality, security and efficiency, it exhibit low power consumption, and finally its uses a Debian-based computer operating system.

In addition, customers benefit from its autonomous real-time management features, its high interoperability when using standard protocols, its adaption capacity to each specific scenario for improving management, its passive cooling by operating in silence, and its competitive price.

Finally, the Energy Box capacity to adapt to different physical communication interfaces (modules) as Ethernet, ZigBee, Wi-Fi, is also an important competitive advantage to take into account in ER4 value proposition.

2.5.5   Documenting the revenue streams and cost structure

The revenue streams from ER4 could be defined as meeting the needs of new generations of Smart Grid control, demand management, DER or intelligent micro-networks. Thus, CIRCE has developed 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, optimization algorithms, etc.). Although leading companies in the sector have been mentioned previously as possible competition in the market, this solution can also be placed in a selling position. The companies considered as potential CIRCE clients with their annual turnover level (year 2020) are listed as follows:

Table 23. ER4 Potential customers revenues

Company	Revenue
ABB	12.700.000
EDF	71.860.000
NextEra Energy	19.200.000
GE	15.340.000
Vestas	12.150.000
Siemens Gamesa	10.200.000
Orsted	10.170.000
Electrobras	6.100.500
Canadian Solar	3.744.000
First Solar	3.300.000
Suzlon	1.200.000
Schneider	27.200.000
Itron	2.500.000
Landis&Gyr	1.765.000

Figure 11.   ER4 Potential customers
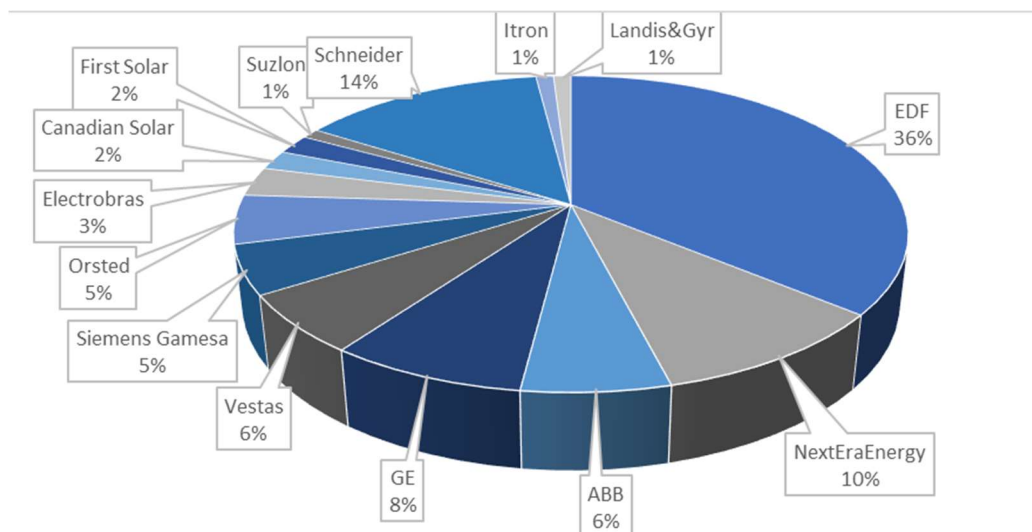
Revenue streams from ER4 would include both products and services. Direct sales would be proposed to DSOs, and RES producers. In addition, licenses and transfer technology also take part of the revenue stream scheme. The components that have the greatest impact on the receipt of benefits and revenues through the different selling processes are the components that provide the greatest added value to the final product: the compute module and the communication modules of 2G, WIFI and Bluetooth.

The analysis allowed to specify the variables which are likely to have the most significant impact on costs. As is observed for most hardware products, components are the most impactful expense. Figure 12 details the estimated cost of the Energy Box. In addition, the digitalization of the LV network in secondary substations low voltage remote terminal units can be used and can also thoroughly impact costs. Its prices, according to several providers range from 180 to 400 €. Overall, the estimated production cost per unit would be comprised between 300 and 500 euros, while the estimated selling price would stand somewhere between 500 and 800 euros.

Figure 12.   ER4 estimated component costs
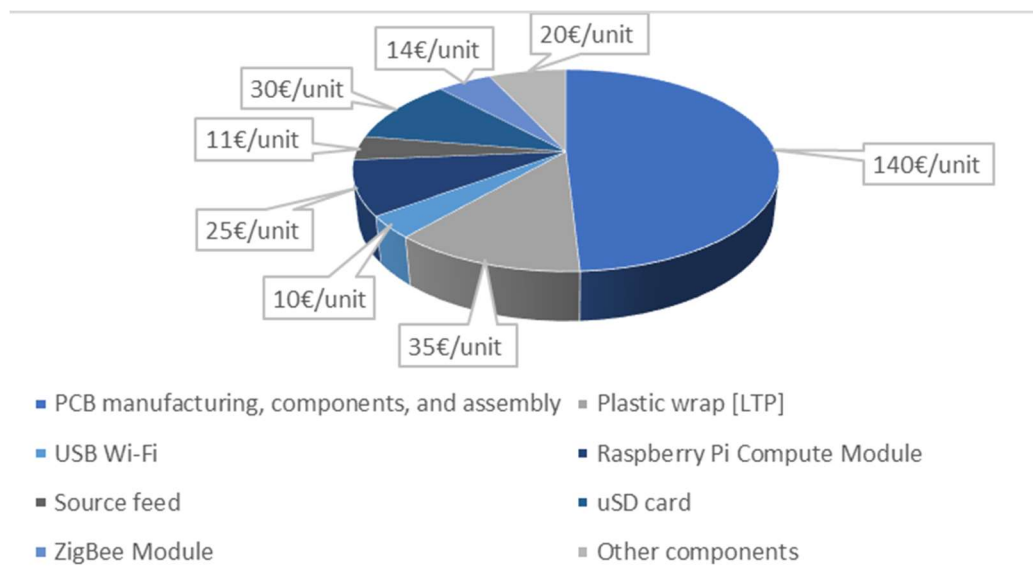
2.6 ER 5: Software module for fault location and self-healing

2.6.1   Final business model

Business Model Canvas for ER5 – Software module for fault location and self-healing
Lead partner: CIRCE

KEY PARTNERS	KEY ACTIVITIES	VALUE PROPOSITIONS	CUSTOMER RELATIONSHIPS	CUSTOMER SEGMENTS
- 2 RTOs (CIRCE, LINKS) - 2 universities (UNIZG-FER, UNICAN) - 5 technology providers: 3 large	- 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,	- 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	- Customer and maintenance services - Customer service call center - Press media, conferences, workshops and	- DSOs - Energy Communities

companies (ATOS, OPA, ZIV))+ 2 SMEs (HYPERTECH TECH, SELTA) - 2 large companies - 2 associations - 3 DSOs (VIESGO, HEP-ODS, EDYNA)	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	- Fault detection/location software and energy supply restoration through self-healing algorithms: • Detection of faults in the distribution grid • Orders to open/close the relevant breakers to isolate the affected area in a milliseconds range	events- to promote the solution	
	KEY RESOURCES - Developers and other human resources - 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 - Company website - Social media B2B and/or bilateral multiservice offerings using existing clientele channels	
COST STRUCTURE - Human resources - Testing lab - Marketing costs - Sales costs		**REVENUE STREAMS** - Licenses - Technology transfers - Service: self-healing software		

2.6.2   Customer segment analysis

Two potential customer segments had been identified for the software module for fault location and self-healing in D8.3 (Business model development – Month 36). As those customer segments and their prioritization remained the same, it is irrelevant to present them once again. Customer segments are still expected to be addressed with the following prioritisation: i) DSOs, and ii) energy communities.

2.6.3   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. The customer journey resulting was presented previously in D8.3 (Business model development – Month 36), as the customer journey map remains unchanged, it was deemed unnecessary to present it in D8.4 again.

Table 24. Customer Segment 1: DSOs

Customer segment 1: DSO	
Problem faced by the customer	• Need for an enabler for advanced systems such as prediction and optimization algorithms, since without an intelligent element in the field they would not be able to perform the calculated control. • Long network recovery time. • Long time in the detection and isolation of the fault.

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 that are not part of the consortium but with whom CIRCE has previously worked or already has commercial relationships. Channels: CIRCE's website; publications on social media ; networking that takes place at events and fairs ; through referrals from satisfied customers.
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 on site of other companies that work as DSOs. CIRCE can implement a demo in a simulated network and a general or ad hoc workshop so that the client understands the concept of what we offer and how the software would solve some of their problems.
How the customer can **purchase** the product or service	Software as a service
How the customer can **use** the product or service	Two modes of operation: 1. Influence on the client's assets, isolating the failure zone so that the rest that are not affected could continue their operation. 2. Recognition of the failure zone and generation of recommendations.
How the customer **interacts** with the company after the purchase	Within the framework of the project, this solution will not reach the customer's hands, so for the moment: does not apply If a commercial solution were achieved: Technical support and maintenance of servers and associated licenses.

Table 25. Customer segment 2: Energy communities

Potential customer segment 2: Energy communities	
Problem faced by the customer	Making energy more accessible to the consumers of the community. Because the communities are not greatly funded, the networks may have failures that affect supply.
How the customer can **learn** about the product or service	Through the European Commission, project website, events where the project / result is presented, press, articles, business website, list of clienteles.
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 on site through the project's lifetime.
How the customer can **purchase** the product or service	Licensing, selling, creating a joint venture
How the customer can **use** the product or service	Adoption of the solution in the customer facilities.
How the customer **interacts** with the company after the purchase	Within the framework of the project, this solution will not reach the customer's hands, so for the moment: does not apply

2.6.4   Market and competition analysis

A market and competition analysis has been performed in order to refine ER1a's value proposition (Table 26).

Table 26. Market and competition analysis for ER5 – Software module for fault location and self-healing –in the European market

Current competitors
The main competitors identified for the solution are the following: • technology manufacturers for the energy sector • manufacturers of protection technologies and network analysis Some examples in the market are: • SIEMENS: Low voltage distribution and technology for electrical installations for constant, safe, and intelligent networks. • SCHENEIDER: They drive digital transformation by integrating world-leading energy and process technologies, cloud endpoint connection products, controls, software and services across the entire lifecycle, enabling integrated management for businesses, homes, buildings, data centers, infrastructure and industries. • Technological Centres that develop technological 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
At the moment, no identical solution for networks with isolated neutrals, mostly owned by DSOs, were found on the market.

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

Stakeholders
• Components manufacturers • Installers • Maintenance entity

2.6.5   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. The precision of the software to detect faults and solve them will have the most impact as it will set it apart from competing solutions. The second variable which will have impact revenues the most could be the appearance of new competition in the market, impacting the number of customers,

or new and more efficient assets with better characteristics appearing on the market, competing with ER5.

Furthermore, the variables which are likely to have the most significant impact on costs would be the price of necessary resources prices and personnel salaries, their increase will have a negative impact on costs. An important variable is also identified in the costs of licenses and servers and their possible modification, impacting in turn ER5 costs.

No alternative option has been considered regarding the revenue streams and cost structure for ER5.

2.7 ER 6: Software module for forecasting and grid operation

2.7.1 Final business model

Business Model Canvas for ER6 – Software module for forecasting and grid operation
Lead partner: MOH (formerly VERD)

KEY PARTNERS	KEY ACTIVITIES	VALUE PROPOSITIONS	CUSTOMER RELATIONSHIPS	CUSTOMER SEGMENTS
- Software developers - Hardware developers - Commercial & Industrial customers	- 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 from PV installations, demand and electricity price	- 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	- DOSs, TSOs - 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** - 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	REVENUE STREAMS
- Human resources - License for a specific software - Testing lab - Marketing costs - Sales costs	- Direct sales for standalone PV forecasting services to interested parties (e.g. aggregators, producers etc.) - Indirect sales through the combined solution of ER6 & ER7 to customers interested in congestion management solution

2.7.2   Customer segment analysis

Four potential customer segments had been identified for the software module for forecasting and grid operation in D8.3 (Business model development – Month 36). As those customer segments and their prioritization remained the same, it is irrelevant to present them once again. Customer segments are still expected to be addressed with the following prioritisation: i) network operators (TSOs, DSOs), ii) aggregators/energy service companies (ESCOs) and energy retailers, iii) renewable energy producers, and iv) commercial and industrial customers.

2.7.3   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. The customer journey resulting was presented previously in D8.3 (Business model development – Month 36), as the customer journey map remains unchanged, it was deemed unnecessary to present it in D8.4 again.

Table 27. Customer segment 1: Network operators

Customer segment 1: Network operators	
Problem faced by the customer	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 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	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 28. Customer segment 2: Aggregators/ESCOs, retailers

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 licence 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 29. Customer segment 3: RES producers

Customer segment 3: RES 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 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	RES energy producers would use this product 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.

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 30. Customer segment 3: Commercial & industrial customers

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 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	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

2.7.4   Critical success factors for the considered business model

As it was not performed in the previous deliverable D8.3 (Business model development – Month 36), the critical success factors for the business model considered for ER6 have been identified for its final BM analysis. They are evidenced in Table 31.

Table 31. Critical success factors for the business model considered for ER6

Critical success factor	Key metric	Data to be collected and sources
Forecast accuracy	9% average error during high significance times	PV production and load demand from demonstration site in Greece
Reliability/Uptime	90%	PV production 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

2.7.5   Documenting the revenue streams and cost structure

The revenue streams and cost structure identified in D8.3 (Business model development – Month 36) remain unchanged and are presented again in the following paragraph. Indeed, MOH (formerly VERD) estimated that those previously identified characteristics were still up to date with ER6 BM.

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.

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

2.8 ER 7: Software module for congestion management

2.8.1   Final business model

Business Model Canvas for ER7 – Software module for congestion management
Lead partner: MOH (formerly VERD)

KEY PARTNERS	KEY ACTIVITIES	VALUE PROPOSITIONS	CUSTOMER RELATIONSHIPS	CUSTOMER SEGMENTS
-Software developers - Hardware developers - C&I customers to test the solution	-Business development and marketing -Development, adaptation and customisation of turn-key solutions -Continuous updating to comply with market rules and tariff structure	**DSOs:** establishing an integration layer with load-intensive customers, facilitating the exploitation of their flexibility and thereby creating shared benefits **Aggregators:** one-stop solution for setting-up developing and exploiting flexible energy provisioning from the customer to the DSO **Commercial customers:** harvesting the full potential of their energy assets to reduce network and energy charges while potentially providing services to the grid	- 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	**Primary** -Aggregators / ESCOs -Commercial and industrial customers **Secondary** -Residential customers
	KEY RESOURCES - Historical consumption and generation data to feed the forecasting algorithm that will facilitate the scheduling **Technology provider's assets :** Expertise in energy management Software engineering personnel Aggregators' asset: Communications Smart Box **Commercial customers' assets:** PV infrastructure Batteries EV chargers Communications local backbone infrastructure Local energy and communications O&M personnel		**CHANNELS** -Awareness raised by government and regulations promoting new policies and market schemes -Networks of DSOs -Workshops conducted by network operators on new markets' design and operation -Direct customer support by DSOs and aggregators	

COST STRUCTURE	REVENUE STREAMS
	- Licencing

Capex:	Opex:	Payments for level of support (ESCO model) - alternatively yearly licencing linked to end-user's benefits
- Hardware and software infrastructure development and integration	-Hardware and software infrastructure maintenance -Human resources	

2.8.2   Customer segment analysis

Three potential customer segments had been identified for the software module for congestion management in D8.3 (Business model development – Month 36). As those customer segments and their prioritization remained the same, it is irrelevant to present them once again. Customer segments are still expected to be addressed with the following prioritisation: i) aggregators/ESCOs, ii) commercial and industrial customers, and iii) residential customers.

2.8.3   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. The analysis is presented in table 32 to table 34. The customer journey resulting was presented previously in D8.3 (Business model development – Month 36), as the customer journey map remains unchanged, it was deemed unnecessary to present it in D8.4 again.

Table 32. Customer segment 1: Aggregators/ESCOs

Customer segment 1: Aggregators/ESCOs	
Problem faced by the customer	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 financial profitability as well as local network and equipment resilience.
How the customer can **learn** about the product or service	Workshops conducted with aggregators by the solution provider could promote the new product and/or service
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 licence for using the product (e.g. one-year licence) 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 service could be a one-stop solution for setting up, developing and exploiting flexible energy provisioning from the aggregators' customers to the DSO
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 and during the time using the service on a regular basis for questions and issues that may arise and/or for updates or adjustments needed to the software in order to customise it specifically addressing their needs

Table 33. Customer segment 2: Commercial customers

Customer segment 2: Commercial customers	
Problem faced by the customer	Commercial customers might want to reduce their environmental footprint by introducing RES into their systems. However, complex control technologies might also be needed in order to effectively manage those resources and increase their potential, allowing for the deployment of a congestion management software in their facilities
How the customer can **learn** about the product or service	Commercial 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 licence for using the product (e.g. one-year licence) or agree with the solution provider on specific payments depending on the level of support (ESCO model)
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 and during the time using the service on a regular basis for questions and issues that may arise and/or for updates or adjustments needed to the software in order to customise it specifically addressing their needs

Table 34. Customer segment 3: Residential customers

Customer segment 3: 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 licence for using the product (e.g. one-year licence) or agree with the solution provider on specific payments depending on the level of support (ESCO model)
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 licence 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)

2.8.4   Critical success factors for the considered business model

As it was not performed in the previous deliverable D8.3 (Business model development – Month 36), the critical success factors for the business model considered for ER7 have been identified for its final BM analysis. They are evidenced in Table 35.

Table 35. 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 resources and personnel	Resources used in FUSE (data storage, interface) and average time to maintain after the demonstration in the demonstration site in Greece. Energy Box and FUSE platform downtime/availability
In the case of commercial and industrial customers: availability of data on the evolution of electricity and CO$_2$ costs, reliability indices	Number of sales of battery systems, electricity and carbon prices	Average electricity cost

2.8.5   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 Software module for congestion management will depend on it's the number of customer reached and adopting ER7.

As for costs, the development and integration of the platform needed for solutions' integration and data management and storage for the customer will account for approximately 50% of the total costs. Thus it will play the most significant role in ER7 cost evolution.

2.9 ER 8: Virtual Thermal Energy Storage Module

2.9.1   Final business model

Business Model Canvas for ER8 – Virtual Thermal Energy Storage Module
Lead partner: HYPERTECH

KEY PARTNERS	KEY ACTIVITIES	VALUE PROPOSITIONS	CUSTOMER RELATIONSHIPS	CUSTOMER SEGMENTS
-European TSOs/DSOs - Energy retailers/suppliers - Aggregators - ESCOs/ESPCs - Microgrid operators - Energy communities - Certified installers - Smart home solutions / BMS providers - Cloud computing service providers - IoT devices / platforms providers - FLEXIGRID project partners - Open source initiative - Website developers	- Marketing of the solution - Training of installers / commissioners (B2B scenario) - Installation / commissioning (B2C scenario) - Creation of necessary documentation to address issues and concerns of users - Measurement of customer satisfaction - Website and online shop development - Development of commercial products and service offerings - Development of consumer / end-customer interfaces - Networking activities - Provision of technical support	- Comfort-based flexibility offering -Data driven thermal comfort profiling - Participation in explicit demand response programs -Delivery of dynamic energy tariffs (implicit demand response) - Monitoring, programming and configuration of smart energy appliances	- Training of certified installers and commissioners - Product self-learning - Troubleshooting manual - Customer support team - Web platform and customer app - Social media	- Energy retailers - Aggregators - ESCOs / ESPCs - BMS providers - Residential customers - Energy communities - Local authorities
	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 - Technical support team - IT infrastructure		**CHANNELS** - Stakeholder ecosystem - B2B collaboration (especially with actors seeking to offer demand response smart services, certified installers, ESCOs and energy product retailers - Targeted communication with existing customers - Website (with online shopping platform) / 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.)	

COST STRUCTURE		REVENUE STREAMS	
Opex: -Human Resources (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)	**Option 1:** - Smart Box purchases - Licenses for software products	**Option 2:** - Software-as-a-service

2.9.2   Customer segment analysis

Seven potential customer segments had been identified for the virtual thermal energy storage module in D8.3 (Business model development – Month 36). However, the customer analysis as well as the priority order has been reviewed this year. Hence, they will be exposed below. The potential customer

segments are expected to be addressed with the following prioritisation: i) Energy retailers, ii) ESCOS / ESPCs, and iii) Energy communities, iv) BMS providers, v) Aggregators, vi) Local authorities, and vii) Residential customers. Priority of potential customer segments was 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). Their analysis is presented from Table 36 to Table 42.

Residential customers, although making the largest segment in size, are more difficult to approach on an individual level, so targeting them through retailers, ESCOs, etc. seems like a more reasonable approach. HYPERTECH assumes it 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.

Table 36. 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 this is feasible.
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 20173 and 201820. We expect that a similar growth rate will continue for countries with still 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 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 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	No energy retailer is participating in the FLEXIGRID project, hence, external feedback on the hypotheses would be useful.

Table 37. Analysis of potential customer segment 2: ESCOs / ESPCs

Potential segment 2: ESCOs / ESPCs	
Relevant characteristics	ESCOs that want to augment their traditional products with human-centric demand-side management offerings.
Segment size (current size and expected growth)	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 slow until 2025 (JRC, 2017a).
Hypothesised customer needs and aspirations	• Improve their public image by demonstrating ways of promoting energy efficiency;

	• Offer ways to improve the comfort of building occupants; • Find ways to increase the loyalty of current customers, but also 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 several of the aforementioned aspirations and needs of ESCOs and ESPCs.
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 38. Analysis of potential customer segment 3: Energy communities

Potential segment 3: Energy communities	
Relevant characteristics	The term "energy community" is used here to describe any collective action that enables the active participation of citizens to the energy transition. Energy communities may act as retailers, aggregators and/or ESCOs; as such, the relevant characteristics mentioned in the tables above are valid here according to the case at hand.
Segment size (current size and expected growth)	At the moment, as previously mentioned, there are approximately 3,5007,700 energy communities in Europe. 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 verify these hypotheses	No energy community is participating in the FLEXIGRID project, hence, external feedback on the hypotheses would be useful.

Table 39. 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 (current size and expected growth)	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 greater energy performance in buildings and energy efficiency.
Hypothesised customer needs and aspirations	• 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 use of BMSs the most; • Solutions that require low implementation costs.
Hypotheses about segment purchasing behaviour 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 energy consumption and generation of a building without compromising 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 40. Analysis of potential customer segment 5: Aggergators

Potential segment 5: Aggregators	
Relevant characteristics	All aggregators active in explicit demand response markets where Direct Load Control (DLC) is needed. The solution may also be useful for the implementation of implicit demand response and recommendation services.
Segment size (current size and expected growth)	There were about 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 aim at 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	No aggregator is participating in the FLEXIGRID project, trialling the ER8, hence, external feedback on the hypotheses would be useful.

Table 41. Analysis of potential customer segment 6: Local authorities

Potential segment 6: Local authorities	
Relevant characteristics	Local authorities interested in or required to participate in green energy initiatives and decarbonation activities.
Segment size (current size and expected growth)	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 public buildings 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	No local authority is participating in the FLEXIGRID project, hence, external feedback on the hypotheses would be useful.

Table 42. Analysis of potential customer segment 7: Residential customers

Potential segment 7: Residential customers	
Relevant characteristics	Small energy consumers that want to become active energy market players through an aggregator or are interested in energy automation for efficiency and comfort.
Segment size (current size and expected growth)	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). At the 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 achieve energy, 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 of 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.

2.9.3   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. The analysis is presented in table 43 to table 49. The customer journey resulting was presented previously in D8.3 (Business model development – Month 36), as the customer journey map remains unchanged, it was deemed unnecessary to present it in D8.4 again.

Table 43. Customer Segment 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 HYPERTECHand 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 44. Customer segment 2: ESCOs/ESCPs

Potential segment 2: 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	• Participation in demonstration campaigns at pilot sites.

Potential segment 2: ESCOs/ESCPs	
service's value proposition before the actual purchase	• 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 45. Customer Segment 3: Energy communities

Potential customer segment 3: 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.
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 46. Customer segment 4: BMS providers

Potential 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 47. Customer segment 5: Aggregators

Potential customer segment 5: 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	• Participation in demonstration campaigns at pilot sites. • Evidence from the validation activities and demonstration campaigns carried out in EU-funded projects.

service's value proposition before the actual purchase	• 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 48. Customer Segment 6: Local authorities

Potential customer segment 6: Local authorities	
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 49. Customer segment 7: Residential customers

Potential segment 7: 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.

2.9.4   Market and competition analysis

A market and competition analysis has been performed in order to refine ER8's value proposition (Table 50).

Table 50. Market and competition analysis for ER8 – Virtual Thermal Energy Storage 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.

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 CO_2 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

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.

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 incentives to network operators for a higher uptake of demand-response schemes (as an alternative to costly and time-consuming network upgrades).

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 incentives to network operators for a higher uptake of demand-response schemes (as an alternative to costly and time-consuming network upgrades).

2.9.5   Documenting the revenue streams and cost structure

Revenues associated with the virtual thermal energy storage module will depend on the purchase option chosen. Identically the cost structure is dependent from the same choice in options.

For both options (Software-as-a-Service and Smart box purchases, or Licenses for software products), the analysis below (table 51) considers that a B2B approach will be followed, meaning that a smaller pool of customers (retailers, aggregators, ESCOs, BMS providers etc.) will be reselling HYPERTECHtech's products to their customers under a different commercial arrangement.

Table 51. ER8 Revenue streams and cost items

	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

Then the variables that will have the most significant impact on revenues for ER8 are displayed in the following list:

- 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)

Finally, the variables that will have the most significant impact on costs have also been identified and are related to user's requirements for solution (especially in cases where personalisation or customisation of solution is requested), as well as cost of necessary equipment (increased prices due to unforeseen factors).

2.10   ER 9: FUSE platform

2.10.1   Final business model

Business Model Canvas for ER9 – Fuse Platform
Lead partner: ATOS

KEY PARTNERS	KEY ACTIVITIES	VALUE PROPOSITIONS	CUSTOMER RELATIONSHIPS	CUSTOMER SEGMENTS
-Traditional energy stakeholder: TSOs, DSOs, retailers, large generators - New energy stakeholders: aggregators, traders, ESCOs	- Digitalisation of energy assets - Data processing - Monitoring - Data analytics - Forecasting - Harmonisation	Open source framework that enable the integration of devices at the edge by fully exploiting the available data from local and distributes energy resources to build value-added services for the different user profiles	- Enhancing the portfolio of solutions already offered to large utilities - Reaching new customers for new energy stakeholders	**Medium complexity:** - Energy communities - Aggregators - Building operators **High complexity:** - Large utilities(TSOs, DSOs, retailers)
	KEY RESOURCES - FUSE maintenance and technical manager - IT support team		**CHANNELS** Business personnel in charge of establishing the commercial relationship with customers	

COST STRUCTURE	REVENUE STREAMS
- Technical development and maturity - Marketing and promotional costs - Commercial actions - Customer support	- To be commercialized as a product license and its maintenance - According to specific offerings: ad hoc services, adaptations, tenders, etc.

2.10.2   Customer segment analysis

Two potential customer segments had been identified for the FUSE platform in D8.3 (Business model development – Month 36). As those customer segments and their prioritization remained the same, it is irrelevant to present them once again. Customer segments are still expected to be addressed with the following prioritisation: i) Energy utilities, ii) Energy communities, building managers and aggregators.

2.10.3   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. The customer journey resulting was presented previously in D8.3 (Business model development – Month 36), as the customer journey map remains unchanged, it was deemed unnecessary to present it in D8.4 again.

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.

2.10.4   Critical success factors for the considered business model

As it was not performed in the previous deliverable D8.3 (Business model development – Month 36), the critical success factors for the business model considered for ER9 have been identified for its final BM analysis. They are evidenced in Table 52.

Table 52. 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 served by the solution	Acceptance surveys	User feedback about usability and results
Income streams	Licensing fees	Sells performed by Atos and other partners. Data should be provided by financial department along with sales department.
Technology infrastructure	Number of new systems that could be managed by FUSE	Projects sold that require a development in the customer side integrate their systems with FUSE. Data should be provided by presales area along with sales area.
Proven scalability	Number of new modules integrated Replication in different countries and/or use cases	Development projects for new modules. Data should be provided by development area. Countries in which solution is deployed provided by sales area.

2.10.5   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 53).

Table 53. Frequency vs. ownership matrix of revenue streams

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.

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

2.11.1   Final business model

Business Model Canvas for ER10 – Software module for sizing and siting of the battery storage system
Lead partner: LINKS

KEY PARTNERS	KEY ACTIVITIES	VALUE PROPOSITIONS	CUSTOMER RELATIONSHIPS	CUSTOMER SEGMENTS
- TSOs - DSOs - Aggregators/ESCOs - Energy retailers - Ancillary services providers - Microgrid operators - Energy communities - Research institutions	Algorithm development for optimisation of the size and location of the battery storage system and development of back-end	-Maximising economic benefit from storage system investment - Opening space for more RES hosting in the energy system	Introduction and instructions for the interested parties	- DSOs - Aggregators/ESCOs - Ancillary services providers - Energy communities - Research entities
	KEY RESOURCES - Development team -Webservice and computation capacity provider		**CHANNELS** - Stakeholders - Project partners - Direct contacts with potential targets - Website, social media - Public repository - Dissemination activities	

COST STRUCTURE	REVENUE STREAMS
Development Team	None, the software will be exposed as an open-source tool

2.11.2 Customer segment analysis

As mentioned in D8.3 (Business model development – Month 36), 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). 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.

As a more detailed analysis for potential target user has been established for D8.4 than it was for D8.3 (Business model development – Month 36), the following section presents the potential segment analysis.

Table 54. Analysis of potential target user: DSOs and ESCO

Segment 1: DSO/ESCO	
Relevant characteristics	Distribution System Operators.
Hypothesised customer needs and aspirations	Alternative solutions for the upgrade, optimization or reinforcement of the managed distribution system. This could be done by the use of electrical storage systems able to better balance the network. In this context, the potential customers would have the need to know how to better exploit its investments in terms of sizing and siting of storage infrastructures.
Hypotheses about segment purchasing behaviour and criteria	N/A – as ER10 will be an open source product
Information and data required to verify these hypotheses	N/A

2.11.3 Customer journey analysis

Since this product is published on a public repository (GitHub) as an open-source tool, the customer journey analysis is irrelevant. However, a summary of customer's interaction with ER10 can be found below in table 55 as it refines the analysis of the channels and key activities segments.

Table 55. Customer Segments

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 product or service's value proposition before the actual purchase	The software can be accessed and used freely.
How the customer can **purchase** the product or service	Users will get the software from a public repository: no transaction is required.
How the customer can **use** the product or service	The software will be standalone and will be released on the public repository.
How the customer **interacts** with the company after the purchase	Interactions can be done by email to the author of the software, or by creating a new issue on GitHub.

2.11.4 Market and competition analysis

A market and competition analysis has been performed in order to refine ER10's value proposition (Table 56). However as listed below, the market and competition analysis is rather lacking as ER10 is designed as an open source software. As a result, the market per say does not exist as no customers exist (only potential users), and no competitors (selling products or services) can be identified.

Table 56. Market and competition analysis for ER10 – Software module for sizing and siting of the battery storage system

Current competitors
No competitors can be identified because the tool is open source

New entrants
There is not explicit market for such software.

Substitutes
Unknown – since the software is open source, we have not developed a market analysis

Suppliers and other actors in the value chain
No other actors involved (just provider and user)

Stakeholders

This software is a tool for assisting user's decision making, no legislation issues can be identified as obstacle. Therefore, there is no need to involve public decision makers.

2.11.5   Critical success factors for the considered business model

As it was not performed in the previous deliverable D8.3 (Business model development – Month 36), the critical success factors for the business model considered for ER10 have been identified for its final BM analysis. They are evidenced in Table 57.

Table 57. Critical success factors for the business model considered for ER10

Critical success factor	Key metric	Data to be collected and sources
Difficulties to configure the software	Number of occurrence the users asks for assistance for the first use	The key metric will be collected through mails.

2.11.6   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.

Figure 13.   Value proposition canvas for ER10 – Software module for sizing and siting of the battery storage system
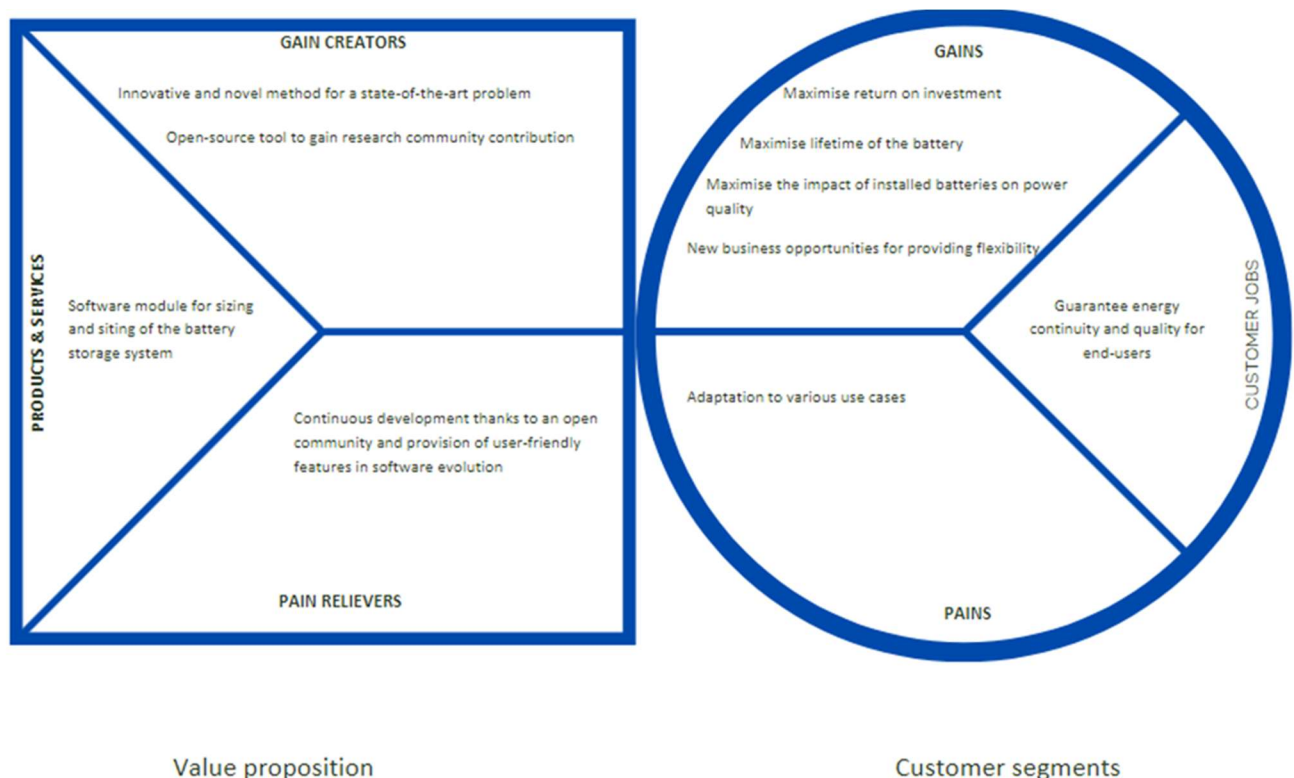
2.11.7   Documenting the revenue streams and cost structure

No revenue stream is expected, as the software will be released as an open-source tool. ER10 will be provided to potential users as an open-source tool without expectation of payment from users.

The cost structure during the FLEXIGRID project involved operating expenses associated with the development team, i.e. human resources. After the end of the project, ER10 is not expected to generate anymore costs.

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

2.12.1   Final business model

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	*KEY ACTIVITIES*	*VALUE PROPOSITIONS*	*CUSTOMER RELATIONSHIPS*	*CUSTOMER SEGMENTS*
- TSOs and DSOs - Power electronic manufactures - Relay manufactures -Laboratories - Technology developers	- Application and design engineering - Simulation of networks with high RES - Testing - Field installation **KEY RESOURCES** - Application and design engineers - Simulation tools - Tests sets - Intellectual property - Demonstration sites	Improved performance of the protection system and the grid by algorithms that improve network behaviour.	- 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	- TSOs - DSOs - Renewable energy producers - Industrial and other MV customers - Switchgear manufacturers, integrators and EPCs - Relay manufacturers

COST STRUCTURE	*REVENUE STREAMS*

Opex:
 	
- Human resources
- Software simulation   **Capex:**
 	
     - Demonstration sites
     - Lab testing
	Products:
	
	Direct Sales **Services:**
	
	     Money savings by the upgrades

2.12.2   Customer segment analysis

Two potential customer segments have been identified for the protection algorithm development to improve current protections used in distribution grids with high RES penetration and are expected to be addressed with the following prioritisation: i) DSOs and TSOs, and ii) Switchgear and protection relays manufacturers. As a more details analysis has been established for D8.4 than it was for D8.3 (Business model development – Month 36), the following section presents the potential segment analysis. Their analysis is presented in Table 58 and Table 59.

Table 58. Analysis of potential customer segment 1: DSOs & TSOs

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 59. 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.

2.12.3   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. The analysis is presented in tables 60 and 61. The customer journeys resulting are presented in Figure 14. As the customer journeys were similar, BSPs and DSOs are presented together, just as RES Producers and Industrial customers are.

Table 60. Customer Segment 1: DSOs & TSOs

Customer segment 1: DSOs	
Problem faced by the customer	DSOs want to increase the observability of their grid and update the telecontrol potential of their system.
How the customer can **learn** about the product or service	They can learn through customized courses, webinars and physical meetings focused on the solutions.
How the customer can **assess** the product or service's value proposition before the actual purchase	DSOs can evaluate the solution by specific test, in particular about communication issues and electrical details.
How the customer can **purchase** the product or service	They can purchase the product and service by directly contacting the technological provider.
How the customer can **use** the product or service	DSOs can install the product by themselves and ask the provider for assistance. They can also ask for the service during the first installation phases.

How the customer **interacts** with the company after the purchase	DSOs can contact the provider company in order to obtain remote support by their service and engineering departments.

Table 61. Customer Segment 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.

Figure 14.   Customer journey analysis for potential customer segment: DSOs & TSOs, Switchgear and protection relays manufacturers
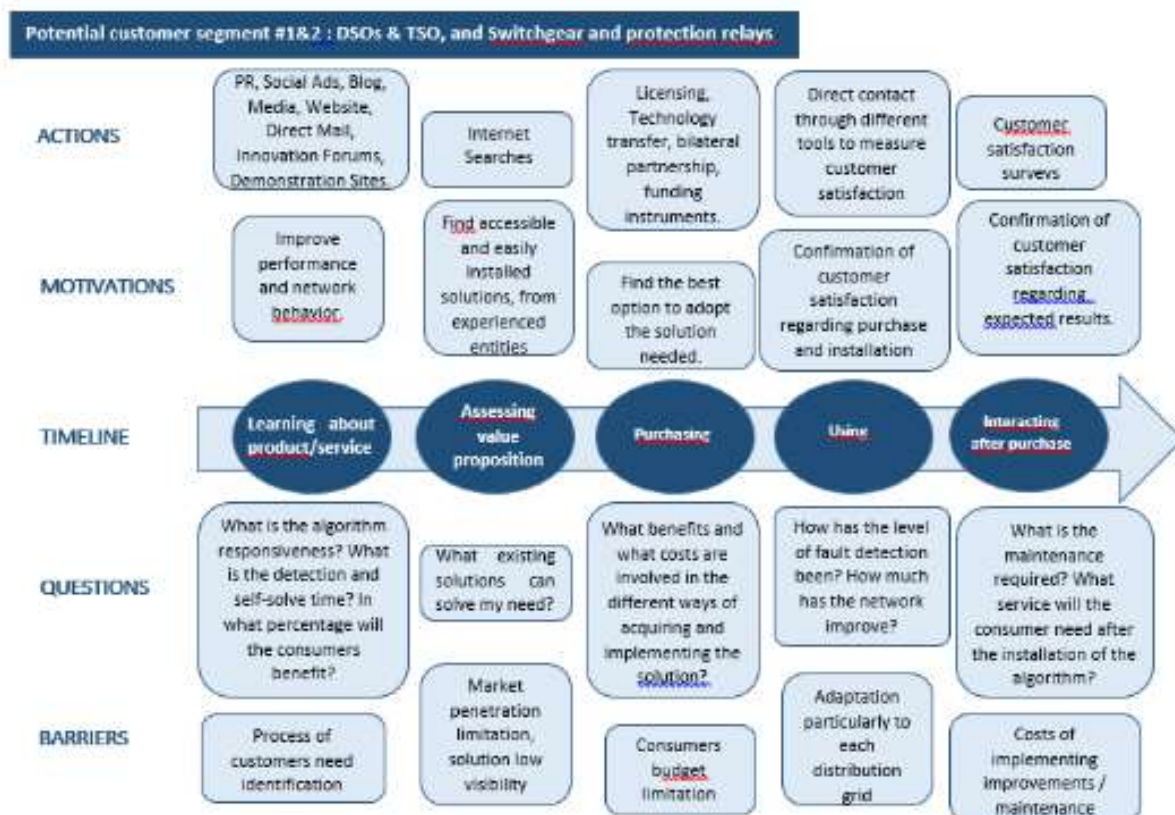
In relation with these customer journey maps, the solution provider's key activities, their output and the extent to which they are assessable, critical and timely have been specified (Table 62). As a result, the different activities presented in the "Key activities" building block of the business model canvas have been finalized.

Table 62. 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.

2.12.4   Market and competition analysis

A market and competition analysis has been performed in order to refine ER11's value proposition (Table 63).

Table 63. Market and competition analysis for ER11 – Protection algorithm development to improve current protections used in distribution grids with high RES penetration

Current competitors
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
Dependency of the manufacturer. The service is always offered through some type of licensing with a manufacturer of protection systems.

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
• Power electronic manufacturers • Laboratories • Technology developers

Within this environment, the competitive advantages of the protection algorithm development to improve current protections used in distribution grids with high RES penetration are expected to rest notably on its services such as field installation, testing, and customer training.

2.12.5   Critical success factors for the considered business model

As it was not performed in the previous deliverable D8.3 (Business model development – Month 36), the critical success factors for the business model considered for ER11 have been identified for its final BM analysis. They are evidenced in Table 64.

Table 64. Critical success factors for the business model considered for ER11

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 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.

2.12.6   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.

Figure 15.   Value proposition canvas for ER11 – Protection algorithm development to improve current protections used in distribution grids with high RES penetration

Value proposition   Customer segments
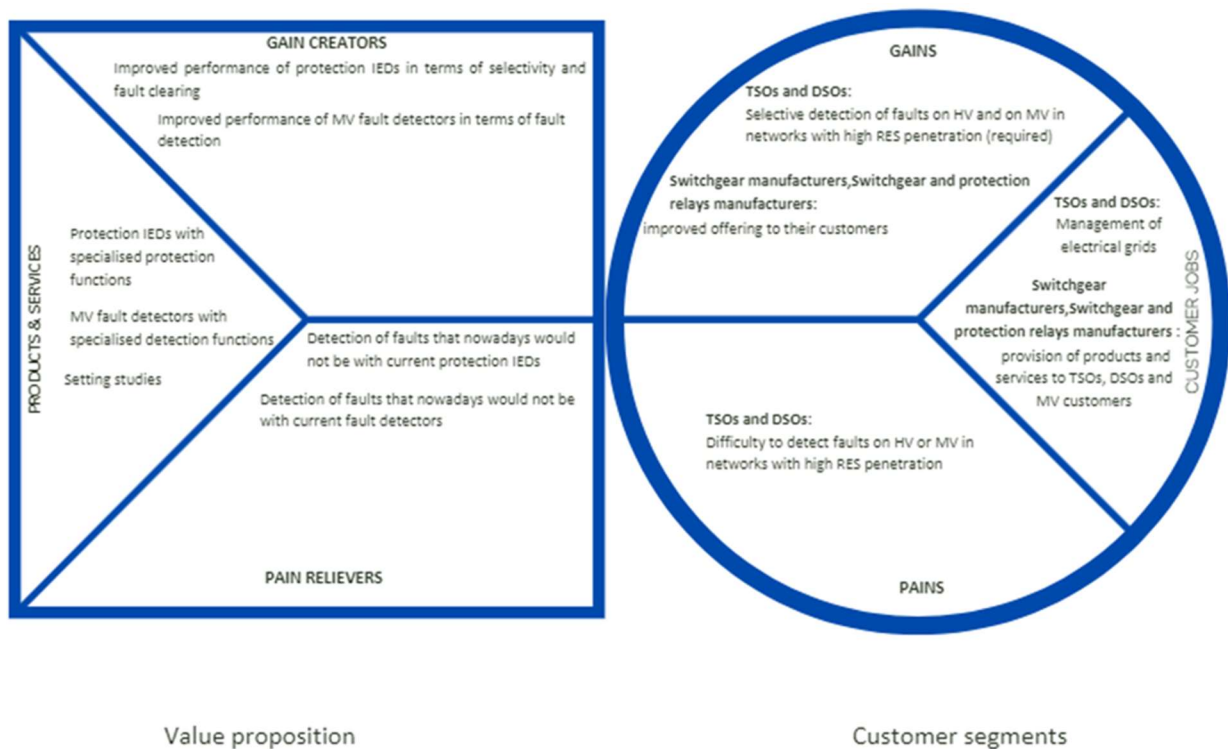
2.12.7   Documenting the revenue streams and cost structure

Revenue streams from ER11 would be dependent from direct sales and licensing. Thus, direct sales of a software that improves performance of protection systems and the behaviours of the protection relays will have the most impact on revenues. It includes both products and services. The software algorithm would be sold directly to the different customer segments identified above.

Figure 16.   ER 11 – Protection algorithm development to improve current protections used in distribution grids with high RES penetration – Cost structure: OPEX
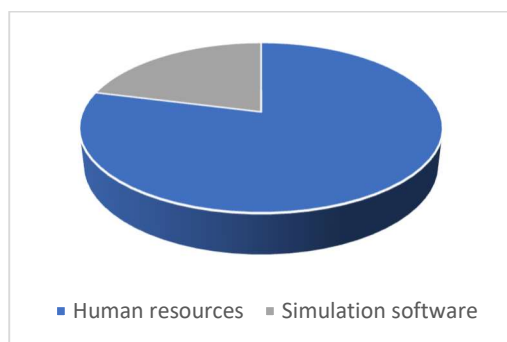
Figure 17.   ER 11 – Protection algorithm development to improve current protections used in distributiongrids with high RES penetration – Cost structure: CAPEX
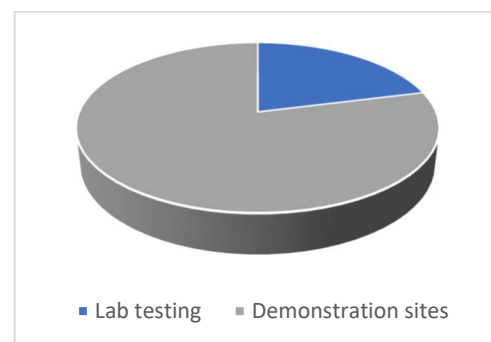
The costs related to ER11 would include both OPEX (Figure 16) and CAPEX (Figure 17). Along with human resources, OPEX would be associated with the simulation software used for validation. CAPEX

would consist in lab testing, as well as in demonstration sites that could be arranged after the FLEXIGRID project implementation. While the cost will be dependent on customers' needs, the variable which will have the most impact on it will be human resources and demo sites.

2.13   ER 12: Software module for flexibility assets emergency operation

2.13.1   Final business model

Business Model Canvas for ER12 – Software module for flexibility assets emergency operations
Lead partner: CIRCE

KEY PARTNERS	KEY ACTIVITIES	VALUE PROPOSITIONS	CUSTOMER RELATIONSHIPS	CUSTOMER SEGMENTS
- DSOs - European Commission - Universities -Technology Providers	- 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	Algorithms to evaluate the network status (with or without network issues like over/under voltage problems or overloaded lines), allowing sending specific set points to avoid the issues previously anticipated through a flexibility assets operation algorithm.	B2B demonstrations and bilateral multiservice offerings to new and existing customers	- DSOs - Aggregators
	KEY RESOURCES - Researchers and developers -Gathered data - Technical knowledge - Local and international market knowledge - Presence in the electricity market		**CHANNELS** - Sales representatives/ market developers - Company website, social medial, PR and a dedicated website to demonstrate non-IP sensitive information and results - Media and workshops, scientific journals, etc. - Other marketing tools	

COST STRUCTURE	REVENUE STREAMS	
- Human Resources - Tests, simulation and software licenses - Marketing costs - Sales costs	**Products:** Direct Sales and licenses	**Services:** Optimised participation in energy markets

2.13.2   Customer segment analysis

Two potential customer segments have been identified for the software module for flexibility assets emergency operation and are expected to be addressed with the following prioritisation: i) DSOs, and ii) Aggregators. As a more details analysis has been established for D8.4 than it was for D8.3 (Business model development – Month 36), the following section presents the potential segment analysis. Their analysis is presented in Table 65 to Table 66.

Table 65. 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.
Hypothesized 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. If the assets to be managed are from the DSO, they can be controlled directly with the software. If they are not from the DSO, a third-party controller (energy community or aggregator) would have to intervene to manage that flexibility and how it is distributed among users.
Information and data required to verify these 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.

Table 66. Analysis of potential customer segment 2: Aggergators

Potential segment 2: Aggregators

Relevant characteristics	The energy aggregators are a new type of energy service provider, which can increase or moderate the electricity consumption and/or generation of a group of prosumers according to the demand on the grid.
Segment size (current size and expected growth)	France, Switzerland, Austria and Slovenia, Northern Italy, UK, Germany, Greece, Spain. In Spain there is no regulation that defines the mechanisms that allow demand aggregators to participate in the wholesale electricity market.
Hypothesised customer needs and aspirations	The software module may enable them to expand their activities on the consumption and production sides.
Hypotheses about segment purchasing behaviour and criteria	Customers need a technology that gives them information to know what action to take at different moments. This software is able to provide the necessary architecture to organize assets in a coherent way and bring flexibility for users to know when to reduce/increase/produce depending on the grid demand. This software service is good for costs reduction and improves the environmental impact.
Information and data required to verify these hypotheses	Thanks to this software, aggregators will be able to get the most out of their resources and increase efficiency at an economic and environmental level. A relevant measurable data will be the reduction in energy consumption from non-renewable sources.

2.13.3   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. The analysis is presented in table 67 and 68. The customer journey resulting for both customer segments is presented in Figure 18.

Table 67. Customer Segment 1: DSOs

Potential customer segment 1: DSO	
Problem faced by the customer	Need for an enabler for advanced systems such as prediction and optimization algorithms, since without an intelligent element in the field they would not be able to perform the calculated control.
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 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 proposition before the actual purchase	Showing them the results obtained in the validations and tests on site of other companies that work as DSOs.
How the customer can **purchase** the product or service	Software As a Service. Selling, licencing, start-upping, for policy making use and/or licencing to a spin-out.
How the customer can **use** the product or service	Adoption of the solution through CIRCE's servers.
How the customer **interacts** with the company after the purchase	Maintenance and solution of possible errors related to the installed software.

Table 68. Customer segment 2: Aggregators

Potential customer segment 2: Aggregators	
Problem faced by the customer	Aggregators do not have network status information. They need to know if what they are doing is convenient or not and in general, they do not have a unifying architecture.
How the customer can **learn** about the product or service	Advice/ counselling on equipment and operations would be provided.
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.
How the customer can **purchase** the product or service	Software As a Service. Selling, licencing, start-upping, for policy making use and/or licencing to a spin-out.
How the customer can **use** the product or service	Adoption of the solution through CIRCE's servers.
How the customer **interacts** with the company after the purchase	Maintenance of the service.

Figure 18.   Customer journey analysis for potential customer segment: DSOs and Aggregators
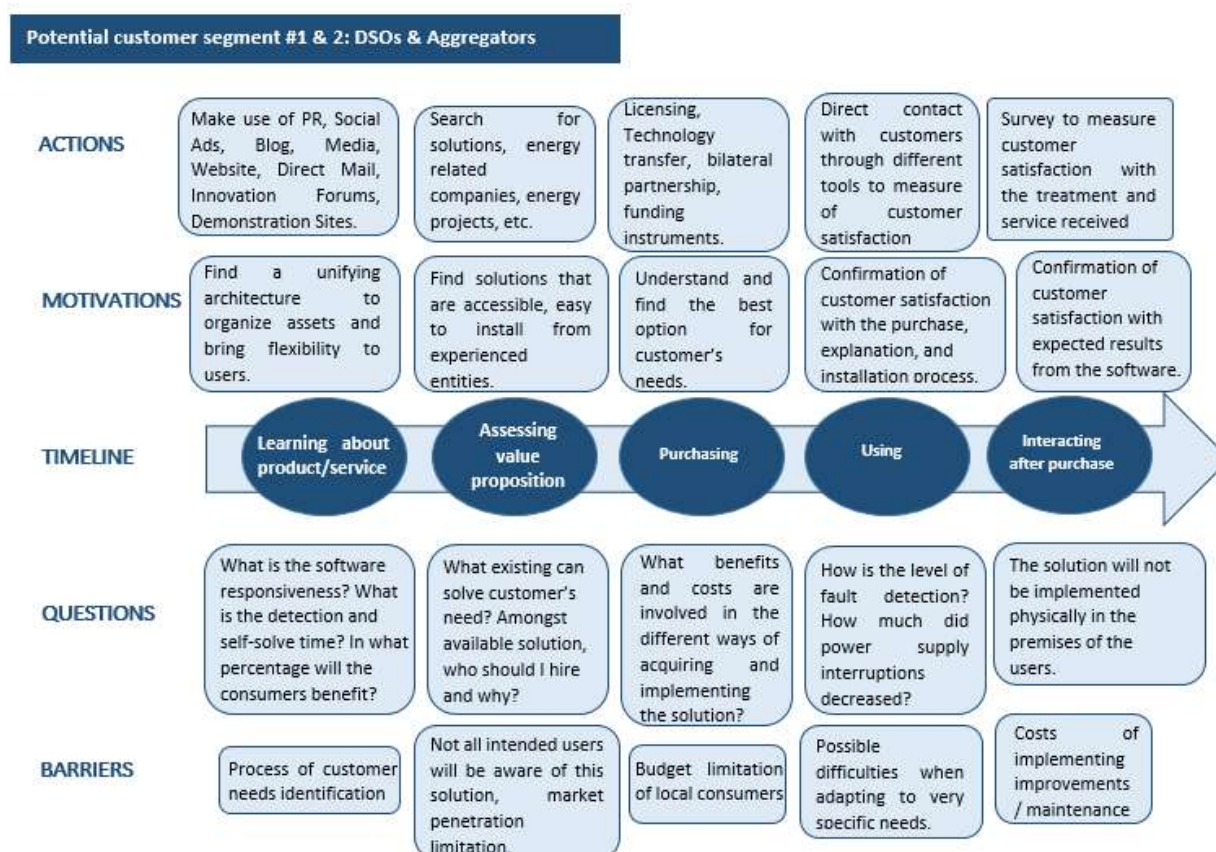
In relation with these customer journey maps, the solution provider's key activities, their output and the extent to which they are assessable, critical and timely have been specified (Table 69). As a result, the different activities presented in the "Key activities" building block of the business model canvas have been finalized.

Table 69. 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	Medium	Medium	High	Constant improvement of the software once needs are identified after launching in user / client facilities.

2.13.4   Market and competition analysis

A market and competition analysis has been performed in order to refine ER12's value proposition (Table 70).

Table 70. Market and competition analysis for ER12 – Software module for flexibility assets emergency operations

Current competitors
There is no fully unified solution that delivers the same results as this software. However, there are certain competitors that carry out similar technologies: • Other technology centers. • Companies specialized in energy management. Examples in the sector: • SCHENEIDER: They drive digital transformation by integrating world-leading energy and process technologies, cloud endpoint connection products, controls, software and services across the entire lifecycle, enabling integrated management for businesses, homes, buildings, data centers, infrastructure and industries. • HYPERTECH: they manage the use of heating or air conditioning at the domestic level. The effect of their technologies on the distribution network is similar although the execution of assets is different.

New entrants
• Regulatory barriers • Adaptation of solutions to different customer needs. • Need to know very specific data of the networks to be able to demonstrate to the clients the functionality of the software.

Substitutes

At the moment, no identical solutions were found on the market. There are certain assets that manage energy and resource information but none that integrate the complete architecture as the Software module for flexibility assets emergency operation.

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

Stakeholders
• Components manufacturers • Installers • Energy industries

Within this environment, the competitive advantages of the Software module for flexibility assets emergency operations are expected to rest notably on its value proposition. Indeed, the algorithms to evaluate the network status (with or without network issues like over/under voltage problems or overloaded lines), allows to send specific set points to avoid the issues previously anticipated through a flexibility assets operation algorithm.

2.13.5   Critical success factors for the considered business model

As it was not performed in the previous deliverable D8.3 (Business model development – Month 36), the critical success factors for the business model considered for ER12 have been identified for its final BM analysis. They are evidenced in Table 71.

Table 71. Critical success factors for the business model considered for ER12

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 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 evaluation	Company's reputation.
Success	Software as a Service metrics	Customer lifetime value, Customer Churn Rate, Monthly Recurring Revenue, Customer retention rate.

2.13.6   Value Proposition Canvas

The Value Proposition Canvas demonstrates the similarities and differences observable regarding the different customer segments. DSOs aim to manage the electrical grid, they need to control the grid and improve its performance in view of future challenges. Aggregators on the other hand need to improve operation performance and optimise performance to satisfy their customers.

Figure 19. Value proposition canvas for ER12 – Software module for flexibility assets emergency operations

Value proposition

Customer segments
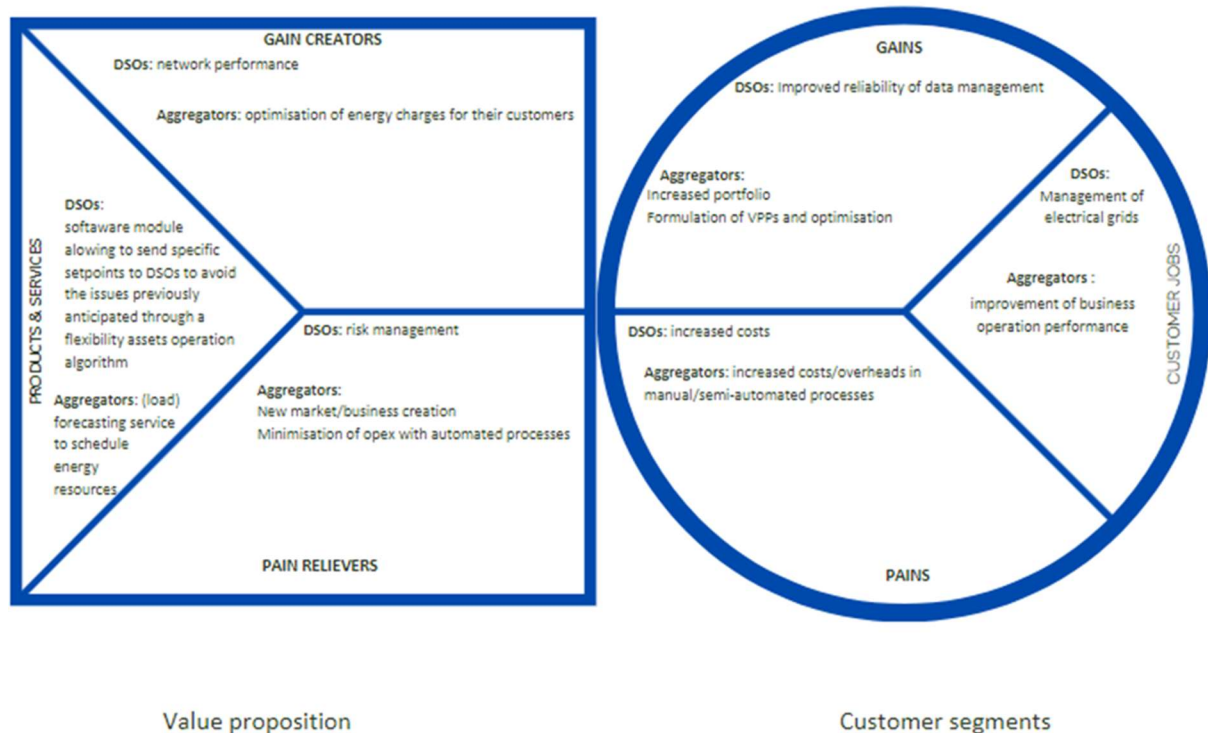
2.13.7 Documenting the revenue streams and cost structure

Revenues associated with the Software module for flexibility assets emergency operations will consist in direct sales or licensing to DSOs. Besides, for aggregators, the software module will allow an optimized participation in energy markets and help them to reach energy communities and other potential customers. The revenue streams for ER12 should be equally split between DSOs and aggregators. In addition, the variable which will have the most significant impact on revenues, is the capacity of the software to provide flexibility to users so that they have the power to decide what to do in relation to the grid. It also avoids issues previously anticipated through a flexibility assets operation algorithm.

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 licensing, maintenance, as well as sales and marketing costs. The estimated costs are yet to be calculated. However, it has been identified that the variable which will have the most significant impact on costs is the qualified personnel for software development.

2.14 ER 13: Fault location TDR prototype

2.14.1 Final business model

Business Model Canvas for ER13 – Fault location TDR prototype
Lead partner: CIRCE

KEY PARTNERS	*KEY ACTIVITIES* - Strengthening the algorithms and the prototype	*VALUE PROPOSITIONS*	*CUSTOMER RELATIONSHIPS*	*CUSTOMER SEGMENTS*

| -Technology Providers
- Hardware manufacturers
- RTOs | - 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 | - Estimation of a distance between the fault point and the place where the locator is installed, using a special approach of the time domain reflectometry technique
-Upgrade of this prototype, as well as location algorithm (ER5), in order to fix previously detected problems regarding range and accuracy. | - Direct sale of hardware in connection with the manufacturer
- Customer and maintenance services
- Inclusion in promotional activities and customer relations of ER5 | - DSOs
- Hardware manufacturers
- Aggregators
- RES producers
- Other energy actors (electricity retailers and utilities)
- Industrial and other MV customers
- Software module for fault location (ER5) customers |
| | **KEY RESOURCES**
- Developers and other staff
- Technical knowledge
- Electricity market knowledge
- Close knowledge of consumers and local markets
- Gathered data | | **CHANNELS**
- B2B and/or bilateral multiservice offerings using existing channels
- Direct sales, specific magazines
- Company website
- Conferences, workshops, energy fairs. | |

COST STRUCTURE
- Human Resources
- Tests, simulation and software licenses
- 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

2.14.2   Customer segment analysis

Three potential customer segments have been identified for the fault location TDR prototype and are expected to be addressed with the following prioritisation: i) DSOs, ii) Aggregators, and iii) Hardware manufacturers. As a more details analysis has been established for D8.4 than it was for D8.3 (Business model development – Month 36), the following section presents the potential segment analysis. Their analysis is presented in Table 72 to Table 74.

Table 72. Analysis of potential customer segment 1: DSOs

Potential segment 1: DSO	
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.
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 a given locality. 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. The need related to the Fault location TDR prototype lies in the possibility of detecting the specific place of the fault to correct it and return the network to operation effectively and quickly.
Hypotheses about segment purchasing behaviour and criteria	This software gives them the possibility to detect the exact point where the fault occurs and thus improve the state of the network, be more efficient in the control of faults and in the solution of the problems detected.
Information and data required to verify these hypotheses	Data that allows knowing the difficulties that DSOs have to detect the precise place of the fault. It will be confirmed that after detecting the exact place where a fault occurred, the network can be put into service quickly generating savings in time and money.

Table 73. Analysis of potential customer segment 2: Aggregators

Potential segment 2: Aggregators	
Relevant characteristics	The energy aggregators are a new type of energy service provider, which can increase or moderate the electricity consumption and/or generation of a group of prosumers according to the demand on the grid. Its appearance opens up new business opportunities and encourages the technological development necessary to undertake the energy transition.
Segment size (current size and expected growth)	France, Switzerland, Austria and Slovenia, Northern Italy, UK, Germany, Greece, Spain. In Spain there is no regulation that defines the mechanisms that allow demand aggregators to participate in the wholesale electricity market.
Hypothesised customer needs and aspirations	The figure of the aggregator shows that tools are needed to automate demand management. Also, demand forecasts with renewable production forecasts will be necessary together with self-consumption to allow the monitoring and optimization of the aggregator's management. The need related to the Fault location TDR prototype lies in the possibility of detecting the specific place of the fault to correct it and return the network to operation effectively and quickly.
Hypotheses about segment purchasing behaviour and criteria	This software gives them the possibility to detect the exact point where the fault occurs and thus improve the state of the network, be more efficient in the control of faults and in the solution of the problems detected.
Information and data required to verify these hypotheses	After detecting the exact place where a fault occurred, the network can be put into service quickly generating savings in time and money.

Table 74. Analysis of potential customer segment 3: Hardware manufacturers

Potential segment 3: Hardware manufacturers	
Relevant characteristics	The hardware industry is highly automated. This means an opportunity to reduce time to get a commercial product in the market and reduce costs, even with low number of sales. Moreover, each manufacturer is specialized in his product and the challenge is to assemble whole components.
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.

2.14.3   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. The analysis is presented from table 75 to 77. The customer journey resulting for all customer segments is presented in Figure 20.

Table 75. Customer Segment 1: DSOs

Potential customer segment 1: DSO	
Problem faced by the customer	The user usually knows in which section of the line the fault has occurred because some fault passage detector has warned of the event. The problem is that the section line may be several km long and, to find the fault and solve it, they have to go through the whole line. This is an ineffective and time-consuming process.
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 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 proposition before the actual purchase	Showing them the results obtained in the validations and tests on site of other companies that work as DSOs.

How the customer can **purchase** the product or service	Direct sales, Selling, licencing.
How the customer can **use** the product or service	Installing a TDR in each section of the line strategically in those areas with many faults. Each TDR would cover a range of km (for example about 10 km)
How the customer **interacts** with the company after the purchase	This service is being developed and is currently in the prototype phase. After installation, periodic software maintenance/update should be done.

Table 76. Customer segment 2: Aggregators

Potential customer segment 2: Aggregators	
Problem faced by the customer	The user usually knows in which section of the line the fault has occurred because some fault passage detector has warned of the event, but the section of the fault line may be several km long and to find the fault and solve it, you have to go going through the whole line until you find the fault.
How the customer can **learn** about the product or service	Advice/ counselling on equipment and operations would be provided. In addition, it would be advisable to carry out an ad-hoc training action
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.
How the customer can **purchase** the product or service	Direct sales, Selling, licencing.
How the customer can **use** the product or service	Adoption of the solution through CIRCE's servers.
How the customer **interacts** with the company after the purchase	This service is being developed and is currently in the prototype phase. After installation, periodic software maintenance/update should be done.

Table 77. Customer segment 2: Hardware manufacturers

Potential segment 3: Hardware manufacturers	
Problem faced by the customer	Long production lead times
How the customer can **learn** about the product or service	Datasheets would be provided to teach how to implement the technology in their grids. Information papers to show how it works and which problems can be solved with the product. Demonstration videos explaining how it work. 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.

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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.

Figure 20.   Customer journey analysis for potential customer segment: DSOs, Aggregators, and Hardware manufacturers
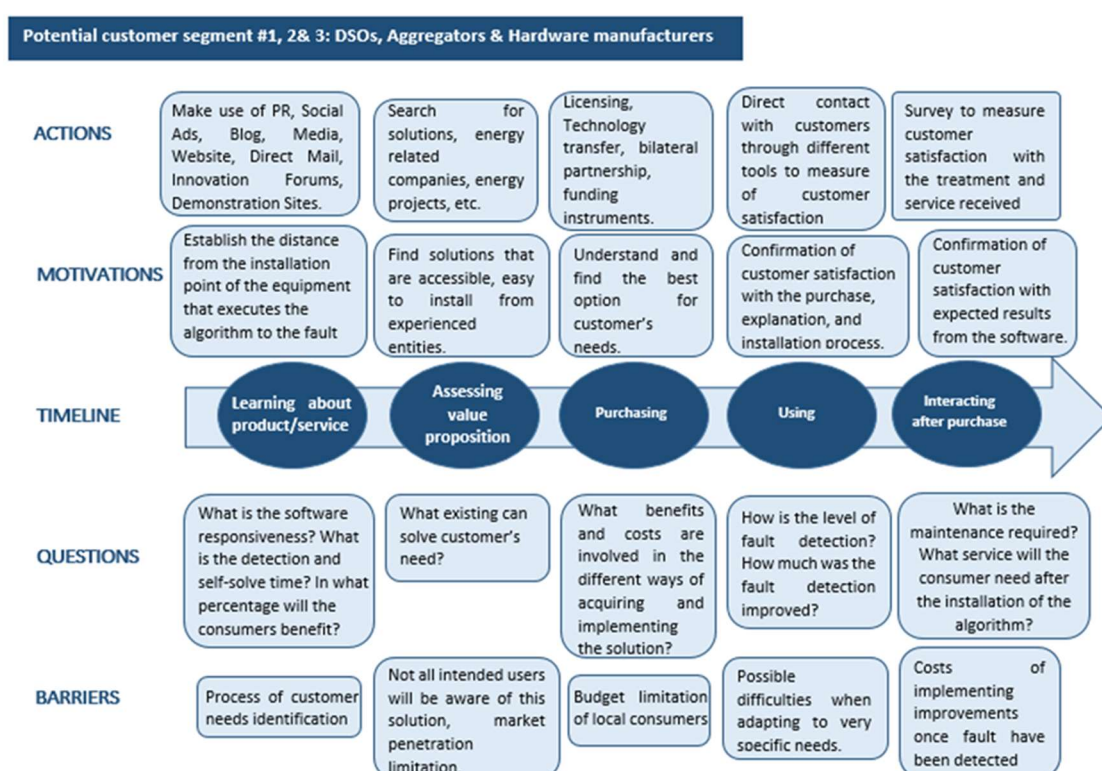
In relation with these customer journey maps, the solution provider's key activities, their output and the extent to which they are assessable, critical and timely have been specified (Table 78). As a result, the different activities presented in the "Key activities" building block of the business model canvas have been finalized.

Table 78. 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	Medium	Medium	High	Constant improvement of the software once needs are identified after launching in user / client facilities.

2.14.4   Market and competition analysis

A market and competition analysis has been performed in order to refine ER13's value proposition (Table 79).

Table 79. Market and competition analysis for ER13 – Fault location TDR prototype

Current competitors
• High Voltage inc. (USA): HVI has extensive knowledge and field experience in fault locating and cable testing along with the best tools for the job. Fault locating requires more than just a thumper. Efficient fault locating requires the convergence of knowledge, methodology, and the right hardware. A total approach is needed to get the job done quickly to minimize customer outage time and prevent further damage to the cable system. Cable Fault Locators | High Voltage Inc (hvinc.com)
• TECSIS (Chile): The 5250 Primary Cable Fault Location System meets the demanding needs of electrical utilities, electrical contractors, or any company testing medium to high voltage cables that require a highly portable and easy-to-use connection system to quickly restore power. electric service. The innovative Time Domain Reflectometer (TDR) coupled with the highest energy battery on the market. The 5250 will reduce cable fault location time by up to 80%.
• SIEMENS (Germany): FAULT RECORDER: The fault recorder is for use in medium, high and extra-high voltage systems and in power plants with comprehensive trigger and record functions. With the SIPROTEC 7KE85 fault recorder, you receive clearly organized and event-related evaluation and documentation of your power system processes. In this way, you can analyze faults in a specific way and optimize your power system.
• SENTER (China): Cable fault locator ST612 takes Time Domain Reflector (TDR) meter to measure exact fault location such as dashed line, cross faults, grounding, poor insulation and poor contact of lead covered wires as well as cables of plastic.

New entrants
Possible regulatory barriers to the implementation of new technologies, installation costs could be high for some sectors of customers. In addition, the owner of the line will need to trust the service and allow external equipment to inject pulses from outside the network.

Substitutes
This fault location technique developed by CIRCE is the first that only needs to install a device that will be independent from the rest of the network devices. There are other TDR (pulse injection) type locators on the market, but as far as we know, none are fully automatic: most of them inject pulses but need an expert to interpret the response and locate the fault.

Suppliers and other actors in the value chain
Our main suppliers are manufacturers of electronic components and the Printed Circuit Boards's.

Stakeholders
• Technology providers • RTOs

Within this environment, the competitive advantages of the Fault location TDR prototype are expected to rest notably on its value proposition. Indeed, this prototype is set apart from competitors, as it is the first to only require the installation of an independent device, which will be fully automatic and detect network issues without need for interpretation.

2.14.5   Critical success factors for the considered business model

As it was not performed in the previous deliverable D8.3 (Business model development – Month 36), the critical success factors for the business model considered for ER13 have been identified for its final BM analysis. They are evidenced in Table 80.

Table 80. Critical success factors for the business model considered for ER13

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 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.

2.14.6   Value Proposition Canvas

The Value Proposition Canvas demonstrates the similarities and differences observable regarding the different customer segments. DSOs aim to manage the electrical grid, they need to control the grid and improve its performance in view of future challenges, which ER13 can help manage. Aggregators on the other hand need to improve operation performance and optimise performance to satisfy their customers, which is also in part helped by ER13. Finally, CIRCE identified hardware manufacturers as potential customer segments for ER13. Indeed, this sector needs to adapt its protection systems to customers' needs as well as incorporate new solutions to answer to the changing energy demand.

Figure 21.   Value proposition canvas for ER13 – Fault location TDR prototype
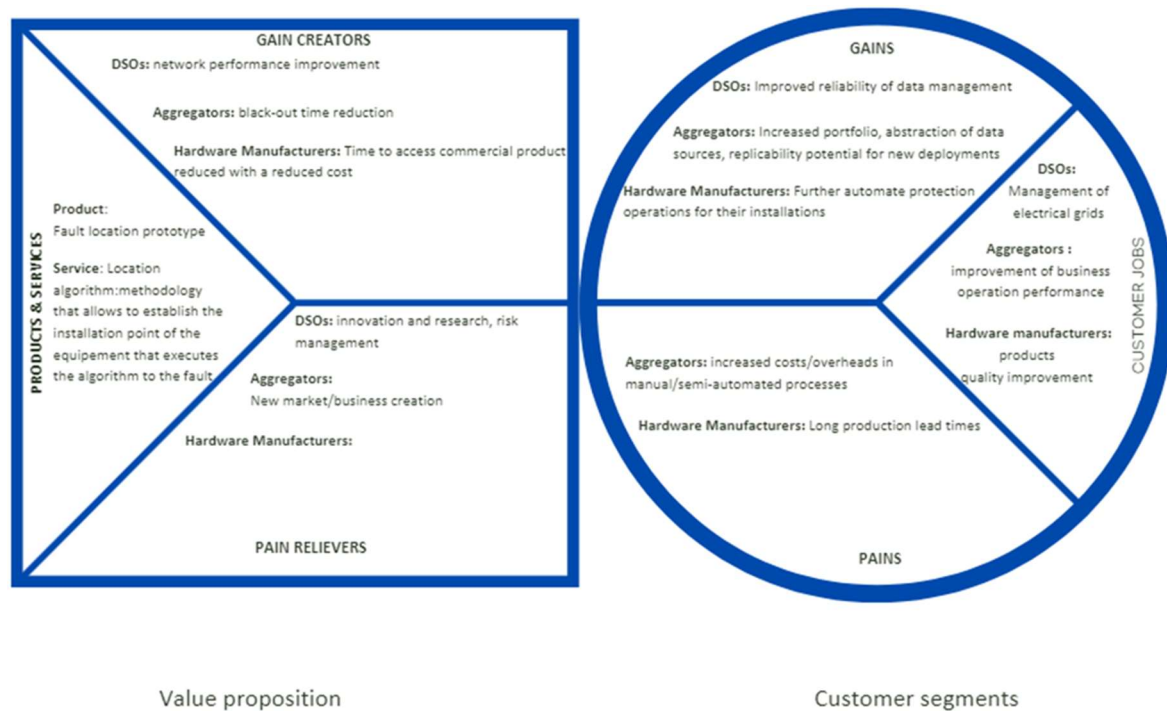
2.14.7   Documenting the revenue streams and cost structure

Revenues associated with the Fault location TDR include both products and services. Direct sales would be proposed to DSOs, aggregators and hardware manufacturers. 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. CIRCE estimates that the most impactful variable for revenues would be the possibility to detect the specific point where the fault occurred.

The costs related to the software module will include costs derived from the development of the Hardware (the physical equipment of the fault detector) and the detection software (algorithm). In the operation, they will be those derived from the maintenance of the equipment, similar to any equipment that operates on an electrical network and those derived from the personnel who monitor the equipment. CIRCE estimates the cost of the hardware and software to reach 20 000 EUR. In addition, the most impactful variable for costs would be personnel costs as well as testing and on-site demonstrations.

3. BUSINESS MODELS EVALUATION

Following the establishment of final Business Models in the previous section allowed partners to identify the business models for each of FLEXIGRID ERs. To complete their analysis, the following section deals with their evaluation, completed thanks to self-reflection provided by ER leaders as well as a further analysis to identify BM's strength and weaknesses.

Thus, partners were asked to first identify through a SWOT analysis for their BM models to identify broadly strengths, weaknesses, opportunities and threats. The table was built to accommodate the data as follows:

- in the left column, the elements with a positive effect on the business model described in the Business Model development template

- in the right column, the elements with a negative impact on the business model described in the Business Model development template

- in the upper line, the elements with an internal origin to the business model described in the Business Model development template. These elements, as they are internal to the strategy surrounding the BM are amenable.

- in the lower line, the elements with an external origin to the business model described in the Business Model development template. These elements should be common to other solutions evolving in the same environment. As these elements have external origins, they are not amenable.

For an overall analysis of the BM, it was suggested that the elements used to fill the table be drawn from different sections of the Business Model template filled along the project (lastly updated in section 2 of D8.4). The following figure shows the most likely position for an answer to the SWOT analysis in the BM template (A. Osterwalder and Y. Pigneur, 2011).

Figure 22.   SWOT Analysis placement by A. Osterwalder and Y. Pigneur
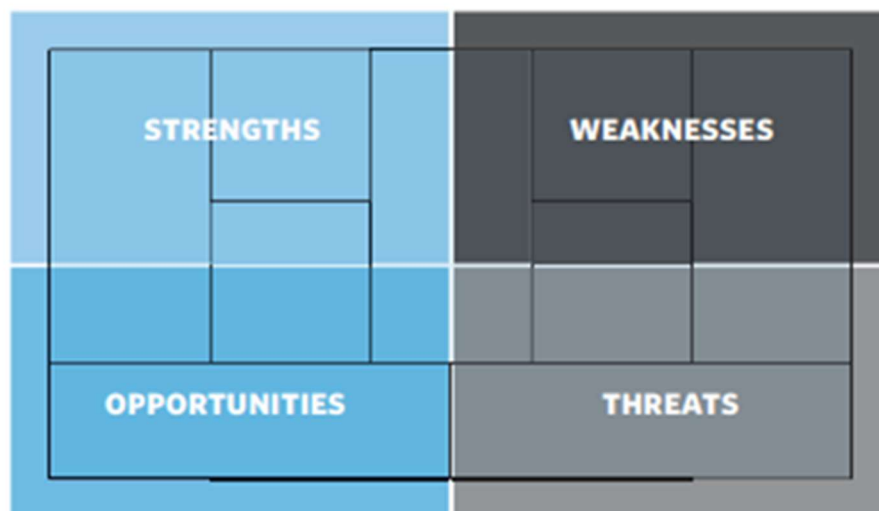
Then, after this overall analysis of the BM, a deeper and more detailed analysis was carried regarding the different blocks: key partners, key activities, key resources, cost structure, value propositions, customer relationships, channels, customer segments, and revenue streams. Partners were provided a list of questions to rank each block and help chose appropriate scores. These questions were adapted from Osterwalder and Pigneur's methodology (2011).

Each internal and external block was attributed a score from 1 to 10 (1 for a very weak block and 10 for a very strong block) by partners. An analysis using these scores follows to understand how the BM could be improved. Indeed, 'looking at its components in detail can also reveal interesting paths to innovation and renewal', as well as provide 'a good basis for further discussions, decision-making, and ultimately innovation around business models' (Osterwalder and Pigneur, 2011).

3.1 ER1a: Secondary substation of the future

3.1.1   Overall BM SWOT Analysis

Table 81. ER1a SWOT Analysis

	Positive *(to reach the goals)*	Negative *(to reach the goals)*
Internal Origins *(in the organization)*	**STRENGTHS** 1. The main strengths of ER1a BM resides in the years of MV Grid experience setting apart the ER thanks to a recognized expertise. 2. In addition, the current sensor production capacity is made with a higher precision than competitors'. 3. Finally, programming and functionalities are based on the studies carried out, improving the ER.	**WEAKNESSES** 1. The overall cost remains an obstacle to the ER development. 2. Finding financing sources can also be a weakness impeding ER1a development.
External Origins *(environment)*	**OPPORTUNITIES** 1. The main opportunity for ER1a is future communications improvements (4G, 5G) in place. Indeed, they would shine positively on ER1a business model. 2. In addition, development of electronics and miniaturization is also an opportunity, which could help ER1a future business model development.	**THREATS** 1. In the future, laws, both on the European level and national level might become threats to ER1a development. 2. Finding financing sources can also be a threat to ER1a business models. As financing sources can be both external and internal. This negative influence can be classed as both a weakness and a threat. 3. Finally, the lack of investments in development and more specifically the lack of thereof can become a hindrance on the long run for ER1a development.

This SWOT table constructed thanks to partner's self-analysis of their BM provides a snapshot of the current BM status (strengths and weaknesses). It also suggests some future trajectories (opportunities and threats).

Thus, the strength of ER1a business model resides in the expertise acquired through the years regarding MV grids, the current sensor production capacity being highly precise and setting apart the ER, and the programming and functionalities studies advancing the singularity of the ER compared to competitors. For the future, opportunities related to communication improvements, and the development of electronics and miniaturisation could advance ER1a BM.

However, overall ER1a BM also considers weaknesses. Indeed, the overall development cost, and the struggle to find financing sources can be weaknesses to ER1a BM impeding its launch and development. On the other hand, for the future, threats such as the evolution of the legal landscape, the continued struggle to find financing sources, and to invest in the development of the ER can hinder its future.

3.1.2   Blocks Analysis

Each Business model block presented in section 2.1 for the ER1a is the subject of a self-evaluation from OP&A both on an internal and external basis. Thus, the scores of each block is available in the following graph (Figure 23).

Figure 23.   ER1a BM Internal and External block evaluation
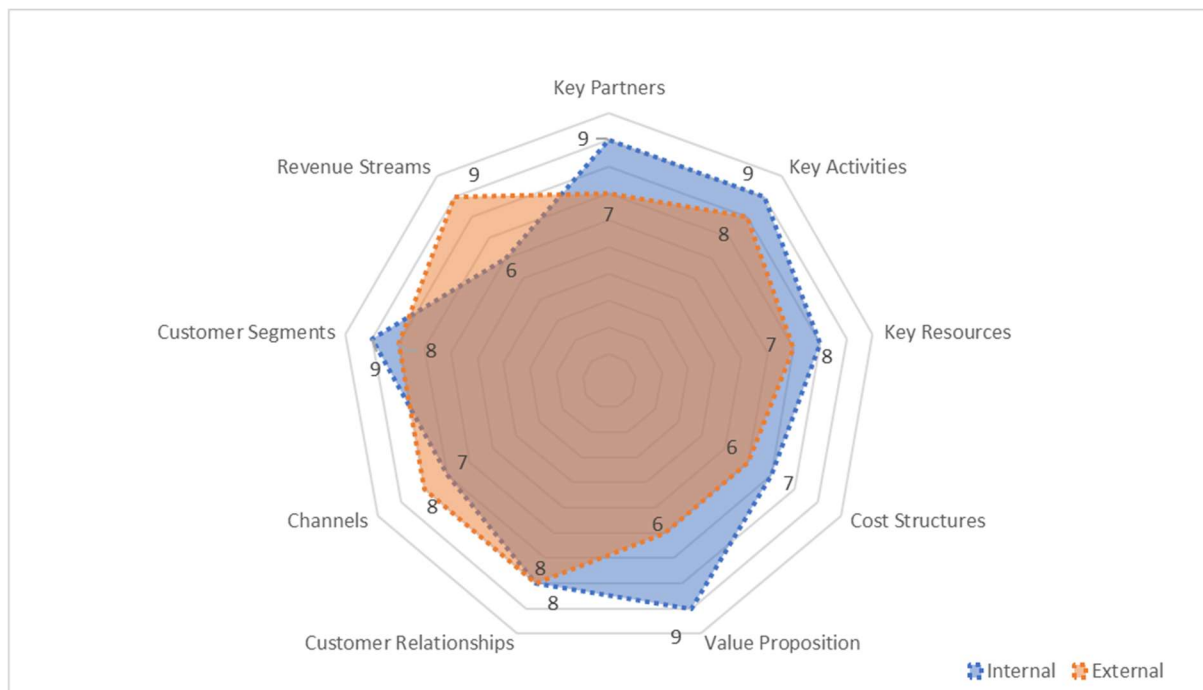
Overall, ER1a BM blocks seem to perform better on an internal basis. Indeed, as control over internal elements is higher than over external elements.

The self-evaluation assesses high scores in regards the BM position within its environment in the revenue streams, customer segments, key activities, customer relationships, and channels categories.

Similarly, high scores were granted in regard to its internal organization related to key partners, key activities, key resources, value proposition, customer relationships, and customer segments categories.

However, a lower score was obtained regarding the revenue stream category on an internal basis. Indeed, as per the answers given by OP&A, an improvement to enhance revenue streams performance and ER1a BM would be to improve revenue collection revenue mechanisms. Currently, high cost expenses are incurred both before and after collecting revenues. Strictly, collecting revenues before incurring expenses would strengthen the revenue stream block. In addition, pricing mechanisms could also be improved by strictly capturing customer's full willingness to pay.

Moreover, lower scores were also expressed due to two blocks interaction within their environment. Firstly, the cost structures block is deemed weaker because of the electronic components and batteries unpredictable and growing cost. As stated by OP&A, standardization of the cost structure could help reduce cost and be revealed as an opportunity for the business model.

Secondly, the value proposition block is also regarded as a weaker block for ER1a BM. Indeed, substitute products and services are available to customers and competitors threaten to offer better price of value. To strengthen the block and convert it into an opportunity for the future of ER1a BM, Functionality and management of devices could be offered to customers as well as services to complement or extend the value proposition.

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

3.2.1   Overall BM SWOT Analysis

Table 82. ER1b SWOT Analysis

	Positive *(to reach the goals)*	Negative *(to reach the goals)*
Internal Origins *(in the organization)*	**STRENGTHS** 1. The main strength of ER1b business model resides in the innovation capacity of the company in terms of R&D activities.	**WEAKNESSES** 1. The main internal weakness for ER1b BM is the major effort in terms of cost for example, required in R&D activities.
External Origins *(environment)*	**OPPORTUNITIES** 1. One of the opportunities available to ER1b's future is the possibility to further test functionalities of the technology on different environment.	**THREATS** 1. The rapidly changing legal framework and regulations might become threats to ER1b's future.

This SWOT table constructed thanks to partner's self-analysis of their BM provides a snapshot of the current BM status (strengths and weaknesses). It also suggests some future trajectories (opportunities and threats).

Thus, the strength of ER1b business model resides in SELTA's capacity to innovate on the research and development level. For the future, opportunities related to testing ER7 in different environment and further develop the solution could advance ER1b BM.

However, overall ER1b BM also considers weaknesses. Indeed, the overall development cost required for research and development activities can be a weakness to ER1b BM. On the other hand, for the

future, threats such as the changing legal framework in energy and electrical networks can hinder ER1b's future.

3.2.2   Blocks Analysis

Each Business model block presented in section 2.2 for the ER1b is the subject of a self-evaluation from SELTA both on an internal and external basis. Thus, the scores of each block is available in the following graph (Figure 24).

Figure 24.   ER1b BM Internal and External block evaluation

Overall, ER1b BM blocks seem to perform better on an internal basis. Indeed, as control over internal elements is higher than over external ones.

The self-evaluation assesses high scores in regards the BM position within its environment in the revenue streams, customer segments, key activities, value propositions, key resources, key activities, and channels categories.

Similarly, high scores were granted in regard to its internal organization related to all the blocks categories.

Moreover, lower scores were also expressed due to three blocks interaction within their environment. Firstly, the key partners block is deemed weaker as the proposed solution is similar to other competitor's equipment. Thus, key partners will be free to choose the best solution for their infrastructure, weakening ER1b BM. In the meantime, collaboration with the key partners has helped to improve the quality of the technological solution which was beneficial to the BM.

Secondly, the cost structures block is also regarded as a weaker block for ER1b BM. Indeed, the costs related to R&D development and post-sale service increased dramatically. To hinder this weakness, the solution adopted is to have large market of this kind of devices for any purposes.

Thirdly, the customer relationships block can be considered as an opportunity to increase the market. On the other hand, the pre and post-sale activities can become stressful, hindering ER1b BM.

Finally, the revenue streams block was the last to be considered weaker on an external basis. The market for this kind of solution is competitive, which will induce lower profit margins in a couple of years.

3.3 ER2: New generation of smart meters

3.3.1   Overall BM SWOT Analysis

Table 83. ER2 SWOT Analysis

	Positive *(to reach the goals)*	Negative *(to reach the goals)*
Internal Origins *(in the organization)*	**STRENGTHS** 1. The main strengths of ER2 BM resides in the experience gathered by ZIV as an established meter manufacturer in the market with a big volume of devices deployed in the field. 2. In addition, ZIV has a sound technical knowledge of the LV grid and its supervision adding to its expertise in manufacturing smart devices.	**WEAKNESSES** 1. ZIV is not familiar with business model for marketing the algorithm which can be a hindrance ER2 development.
External Origins *(environment)*	**OPPORTUNITIES** 1. The main opportunity for ER2 is the smart meter deployment campaigns in the EU that could be using the ER2 approach or a similar one. 2. In addition, the possibility of monitoring the LV distribution networks is seen as a key driver for decarbonization, making ER2 a key component for the future of electricity grids.	**THREATS** 1. The main threat identified for ER2 is the existence of other approaches for the same objective, some already in the market for several years, creating a difficult competition for ER2.

This SWOT table constructed thanks to partner's self-analysis of their BM provides a snapshot of the current BM status (strengths and weaknesses). It also suggests some future trajectories (opportunities and threats).

Thus, the strength of ER2 business model resides in the experience and expertise acquired through the years regarding the manufacturing process of smart meter and LV grids advancing the singularity of ZIV compared to competitors. For the future, opportunities related to deployment campaigns for smart meters in the EU, and the identification of smart meters as key component of decarbonisation politics could advance ER2 BM.

However, overall ER2BM also considers weaknesses. Indeed, ZIV unfamiliarity with business model marketing can be a weakness to ER2 BM impeding its development. On the other hand, for the future, threats such as the existence of other approaches similar to ER2's and their market presence can hinder ER2 future.

3.3.2   Blocks Analysis

Each Business model block presented in section 2.3 for the ER2 is the subject of a self-evaluation from ZIV both on an internal and external basis. Thus, the scores of each block is available in the following graph (Figure 25).

Figure 25.   ER2 BM Internal and External block evaluation
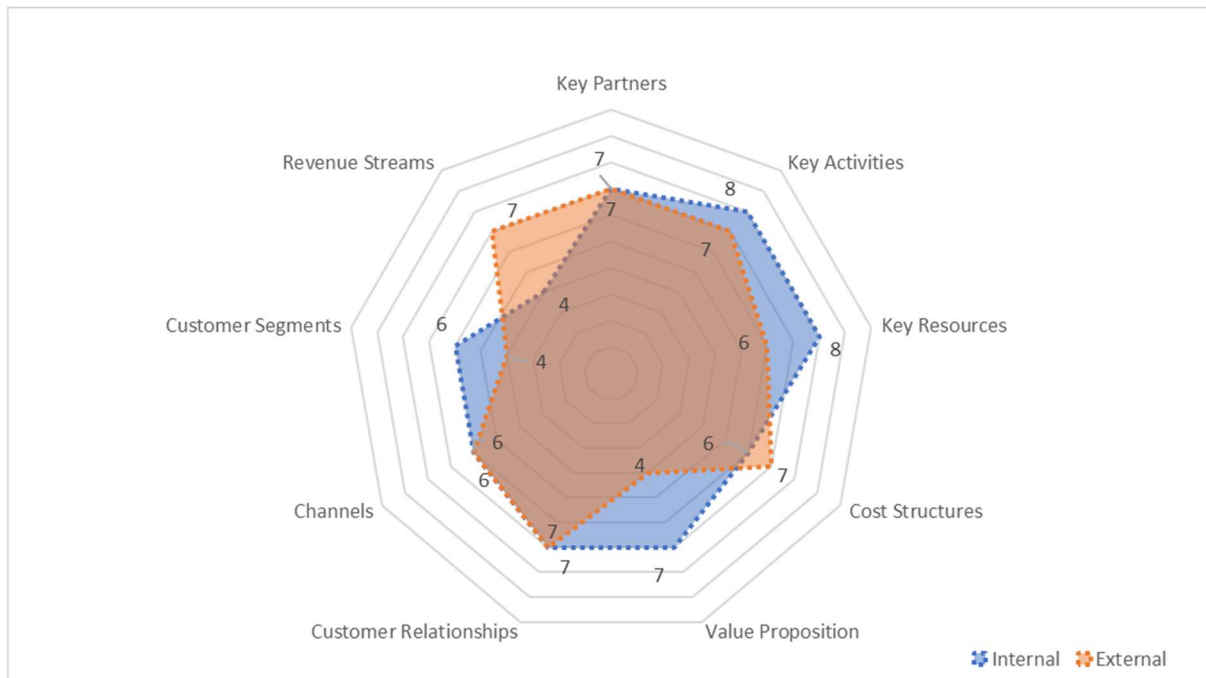
Overall, ER2 BM blocks seem to perform better on an internal basis. Indeed, as control over internal elements is higher than over external ones.

The self-evaluation assesses high scores in regards the BM position within its internal organization in the key activities, and key resources categories.

Among all FLEXIGRID ERs business models, ER2 displays the lowest and weakest scores overall. Indeed, a lower score was obtained regarding the key partners category on an internal basis. As per the answers given by ZIV, the metering sector, particularly in the realm of smart meters, present unique complexities due to varying regulations across different countries. While, partnerships play a crucial role in ensuring interoperability and facilitating market entry, the regulatory landscape specific to smart meters can pose challenges to maintaining and consolidating a wide network of partners. These challenges may arise due to differing regulations, standards, and requirements that govern smart meter deployment and operations in different countries. Thus, to effectively navigate these challenges, it becomes essential to work closely with partners who have expertise and experience in the specific regulatory frameworks of each country. Building strong relationships with such key partners can help overcome obstacles and enable successful deployment and operation of smart metering solutions. Overall, it is convenient for meter manufacturers to maintain good relationship with different partners, and they are usually so, but they are rarely long-term agreements. One company can be a partner in one market and part of the competence in the adjacent one, due to historical links that tie them. Then the key partners block for ER2 overall is well adjusted to the reality of the sector even if it was not granted a higher score.

In addition, the cost structures block was also granted a lower score on an internal basis. According to ZIV, the metering business is an economy of scale. Big volumes are at stake in the different deployments and operations must be cost efficient for a long-term profitability. However, as in any economy of scale, cost is the greater driver of the market, and the added value of the R&D is only considered at the beginning of a deployment. Once the value of the innovation has been amortized in a market, competition is strictly done in cost dimension, and even service is seldom taken into account in the procurement phase of utilities. Therefore, it is necessary for Smart Meter Manufacturers to constantly evolve their technological platforms to anticipate a drop in the price of the product and lean down the costs of the materials. Thus, ER2 as it is still in the early stages of its development with activities concentrated in R&D has not reached its full potential regarding the cost structure, which will evolve in the next stages.

The value proposition block and the customer relationship block both obtained a lower score regarding its interaction with internal elements. The alignment with customers is very dependent on the characteristics of the Utilities that will use the smart meters. Smaller utilities or those without a big technical companies will choose on the shelf meters already existing in the market and release tenders that will be decided exclusively on price. If a Smart Meter manufacturer is not compliant in an extensive degree to the product requested, with the effort to develop and qualify a meter, will generally not be able to respond to the request. On the other hand, other utilities, with sufficient critical mass or needing to take part into the definition and implementation of their requirements in the meters, are willing to establish a collaborative project. This second type of customers is target for ER2. These customers value ZIV's technological expertise and know how, and also in-field service that helps them to deploy with warranties. On the other hand, once a collaboration is established with a customer, the switching costs are high in relation to the knowledge about the systems and the time-to-market of the different products, strengthening ER2 BM. Moreover, ZIV is a respected company in the Smart Metering sector, especially renowned for its PLC know-how and expertise, its brand is strong and contributes to the ER2 BM strength. Thus, the value proposition block while not as strong as it could be if addressing a larger range of customer specific profiles within customer segments.

The channels block along with the previous mentioned blocks acquired a lower score within its internal environment. ZIV customers for the metering business are Utilities. With the already existing customers, the communications channels are good and strong. However, when entering new markets, difficulty to access the adequate key persons can be experienced, as the metering projects influence not only the technical resources of the utility but much higher levels, given the expense level that these projects imply for the utilities and its high impact on reputational level. Thus, the channel block is to be strengthened but remains at an adequate level for the development status of ER2.

The customer segments block was granted a lower score on an internal basis in ZIV's self-evaluation of ER2 BM. Indeed, customers are well segmented and the churn rates are low. However, acquiring new customers is difficult and requires long timeframes and an important strategic focus, which weaken ER2 BM.

Finally, the revenue streams block is the last of the block to obtain a low score on an internal basis. It is worth noting that its score is alarming low compared to other ER BM and the overall scores in ER2.

Moreover, lower scores were also expressed for all the blocks interaction within their environment. As previously mentioned, Smart Metering is a high-volume market with low margins. In addition, revenues depend on specific projects which once they finish will not need to be repeated after at least

15 years? Thus, new and different projects have to be selected and developed continuously to ensure that there is a steady revenue stream. Additionally, innovation is a value which is depreciated once the first phases of deployment are completed, altering decision making to price competition.

Regarding interaction with the external environment for each of the BM blocks, ER2 is deemed weak by ZIV's self-evaluation. Firstly, the key partners block is deemed weaker because as mentioned before, partnership relationships are established on a market basis. Partners raise some opportunities wherever an integrated solution package is requested by the utilities. However, few cross-selling opportunities with partners arise, weakening ER2 BM.

Secondly, the key activities block is also regarded as a weaker block for ER2 BM. Indeed, Smart Metering is fundamentally based in the use of several communication standards allowing interoperability and generating opportunities in other markets, as minimizing the gaps. However, each country has its own specificities above these standards, and the technology requirements change regularly, challenging manufacturers to keep up to date material with the regulations. The bigger threat for European manufacturing comes from Asian companies with lower product costs due to lower manufacturing standard requirements. Thus, key activities weaken ER2 BM due to competitors' threats and the rapidly changing quality needed in Europe.

The key resources block as well as the cost structure block obtained weaker scores on an external basis. Indeed, Smart Meters depend strongly on electronic components. Any variation in the availability or cost of these materials, and on the currency (many components are procured in US Dollars or fixed to its exchange ratio), has a big impact on the cost of the product. Thus, the disruption of this particular material supply is dangerous to the overall BM of ER2, and the fluctuation of its cost highly impacts ER2 costs, explaining the weaker score.

The value proposition block is one of the two blocks to be granted a very low score on an external basis. Indeed, the main threat is due to the number of aggressive competitors existing in the smart meter market. Being innovative, adapting to new technologies with agility, and offering additional functionality adds value to the customer needs. However, as it is not feasible to convert products into services nor extend the value proposition with the price limitation.

The customer relationships block low score is due to the fact that personalisation is not easy as contacts in utilities are constantly changing, making customer relationship uneasy. However, ZIV estimates that its relationships with customers are healthy. Following up with them to update on new technological innovations and new requirements is standard procedure. In addition, unprofitable market where value added by ZIV is not considered are usually dismissed strengthening the block within ER2 BM.

The channels block low score within its external interactions was granted a low score as channel partners are not used generally for Smart Metering, as the relationship is centered on the final consumer. Even when channels are selected, they are only marketing partners, and the relation is directly established with the final consumer. Therefore, as channels are not efficient nor effective to target customers which weakens ER2 BM.

The customer segments block is the second block with a very low score on an external basis for ER2 BM. While the market is not saturated for smart meters, when the solution is already deployed new ones are used as substitute until the need for a new deployment arises. Additionally, the

decarbonization of the society, its electrification and the need to monitor distribution grids generates new opportunities. However, competition is high and has to be overcome with constant innovation. This overall difficulty to oversee the future of the market existing and the creation of a new one and the high competition existing make segmenting customer difficult.

Finally, the revenue streams is the last of ER2 BM block with a lower score on an external basis. As alluded to before, Smart Metering deployments are cyclic, when one ends other starts. Thus revenue streams are not a continuous flow. However, opportunities could rise from new services like SaaS for new functionalities that the meters could serve. Furthermore, as mentioned before, margins are threatened by high Asian competitors and by the situation with the electronic material market situation.

3.4 ER3: Protections for high RES penetration

3.4.1 Overall BM SWOT Analysis

Table 84. ER3 SWOT Analysis

	Positive *(to reach the goals)*	Negative *(to reach the goals)*
Internal Origins *(in the organization)*	**STRENGTHS** 1. The main strength of ER3 resides in ZIV's reputation as a manufacturer of protection relays and its 30 years experience in the area. 2. In addition, ZIV's deep knowledge on protection algorithms for Distribution Networks also contributes to ER3 strength. 3. Finally, ZIV's size allows developing customized products for DSOs / TSOs while bigger companies cannot provide this service, setting it apart from competitors.	**WEAKNESSES** 1. One of ER3 main weaknesses is the lower availability of resources ZIV is able to advance compared to bigger companies. Therefore, difficulty to keep up to date in technology and market trends might arise. 2. In addition, ZIV has but a limited access to DSOs & TSOs worldwide to test in field, which could weaken ER3 overall value proposition compared to competitors.
External Origins *(environment)*	**OPPORTUNITIES** 1. The main opportunity for ER3 future is related to the upcoming increase of Renewable Energy Sources in the Transmission and Distribution networks. In turn, it will increase the demand of protection relays with new algorithms and create an opportunity for ER3.	**THREATS** 1. In the future, TSOs and DSOs conservative positions might threaten ER3. Indeed, the introduction of new protection relays is a slow and costly process, which frighten TSOs and DSOs, and might delay ER3 expansion. 2. Moreover, several competitors are adapting their protection relays to networks with high RES penetration, competing on the market with ER3.

This SWOT table constructed thanks to partner's self-analysis of their BM provides a snapshot of the current BM status (strengths and weaknesses). It also suggests some future trajectories (opportunities and threats).

Thus, the strength of ER3 business model resides in ZIV's expertise acquired through the years regarding protection algorithms fitted for distribution networks, its reputation as a manufacturer of protection relays, as well as its ability to customize products for DSOs and TSOs customers. For the future, opportunities related to the development of renewable energy sources into electricity networks could advance ER3 BM, as protection will be necessary to ensure the security of the network.

However, overall ER3 BM also considers weaknesses. Indeed, while ZIV's size allows easier response for customer needs, it also infers less resources available for market monitoring and technology trends. In addition, ZIV size also limits its access to DSOs and TSOs on a global level compared to its bigger competitors, which can be weaknesses to ER3 BM impeding its development. On the other hand, for the future, threats such as overall conservative positions from customers and competitor's progress can hinder ER3 future.

3.4.2   Blocks Analysis

Each Business model block presented in section 2.4 for the ER3 is the subject of a self-evaluation from ZIV both on an internal and external basis. Thus, the scores of each block is available in the following graph (Figure 26).

Figure 26.   ER3 BM Internal and External block evaluation
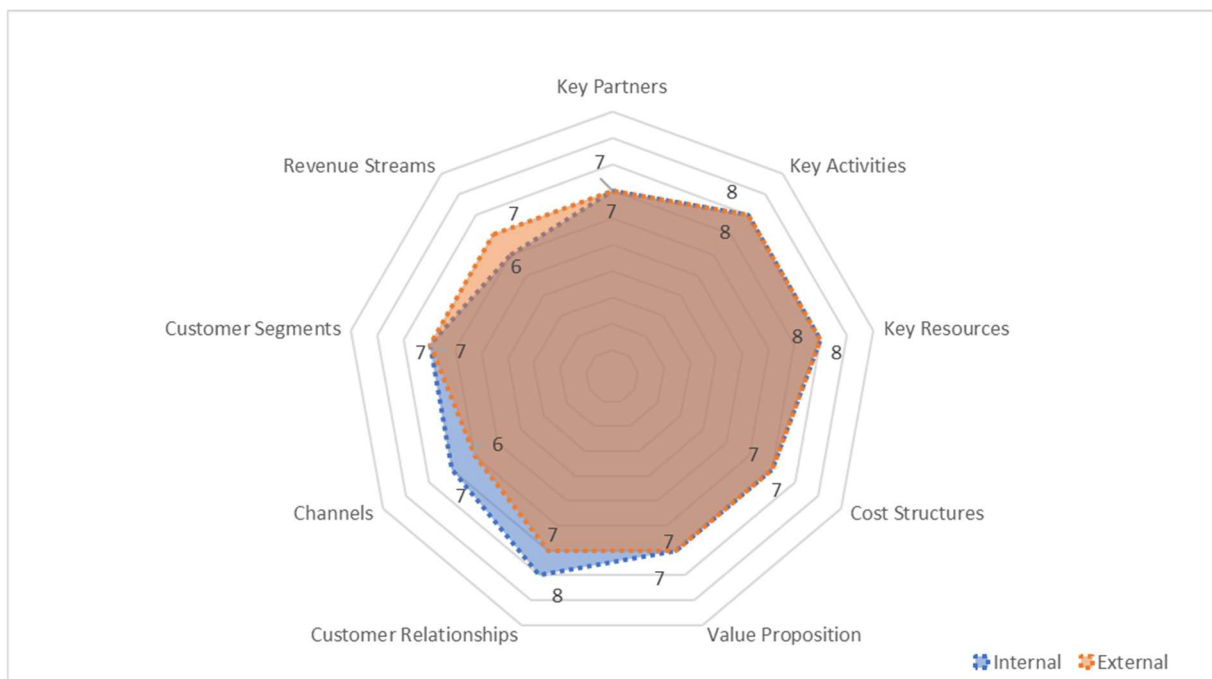
Overall, ER3 BM blocks seem to perform slightly better on an internal basis. Indeed, control over internal elements is higher than over external ones.

The self-evaluation assesses high scores in regards the BM position within its internal organization in the key activities, key resources, and customer relationships categories.

However, a lower score was obtained regarding the key partners category on an internal basis. Indeed, while ZIV relationship with key partners is good, especially with DSOs, TSOs, technological centers and laboratories, relationships with power electronic manufacturers can be difficult. This is explained as those power electronic can be competitors, straining relations. In addition, the converter control implemented is a confidential information that is rarely shared which contributes to these described relationship.

Secondly, the cost structure segment was also granted a lower score. Product cost (materials, outsourcing, etc.) and project cost (development hours, certifications, prototypes, outsourcing, etc.) are key variables that ZIV is continuously monitoring. Therefore, while costs are unpredictable, weakening ER3 BM, actions to mitigate this weakness.

Thirdly, the value proposition block was granted a lower score on an internal basis. The target market of ZIV protection relays is wide, therefore customer requirements can be very different. ZIV engaged with close work with customers since the project start, however, it remains difficult to work similarly with all customers. On the other hand, sometimes the technical knowledge, support provided, or algorithms implemented in the relays, are deemed less important than the product price.

Moreover, channels is also a block which was deemed less strong than the rest of the BM on an internal basis. As mentioned above, the wide target market of ZIV protection relays can hinder ER3 BM. Indeed, with a large target market, good channels worldwide can be hard to create and maintain.

The low score given to the customer segments block is once again justified by the intense competition in the MV area. Thus, accessing new customers is not easy, as long approval processes have to be passed. Segmentation is important, indeed, as mentioned above, the product cost is becoming more and more important. Then, certain functions, not required for all the customers, can be removed to reduce the cost. However, a compromise solution must be found as an increase in the number of product models will also increase the cost, weakening ER3 BM.

Finally, the revenue streams block is the last of the blocks to be given a lower score on an internal basis. The increasingly competitive protection relay market has once again been identified as the determinant lowering the BM strength. Thus, margins are getting lower impacting revenue streams.

Moreover, lower scores were also expressed due to seven blocks interaction within their environment. Firstly, the key partners block is deemed weaker as key partners are liable to collaborate with competitors. Key partners considered in ER3 where the ones that could collaborate in the development of new algorithms for the protection relays: laboratories and technological centers (to do simulations and testing), DSOs / TSOs (key partners and customers, to provide network information, real records, demo-sites, etc) and power electronic vendors (to provide information about the converter control). In addition to their potential work with competitors, those key partners could also become competitors themselves and develop new algorithms in their protection relays. However, the reliability of these algorithms mostly depend on the protection relay vendor, therefore the level of this threat can be considered low. The collaboration with the mentioned key partners and the description of all the work done is important to reach new customers. But their channels will be rarely used as their customers can be different. This is an opportunity that does not apply to ER3 and cannot strengthen its BM. Regarding the focus on ZIV's core business, the key partners, especially laboratories and technological centers, have helped ZIV to focus on the development of protection relay algorithms (core activity), letting partners to do all the simulations and testing which benefit ER3 overall BM.

Secondly, the cost structures block is also regarded as a weaker block for ER3 BM. Indeed, Competition within the protection relay market has increased in the last years and dragging prices down drastically, especially in the MV area. In addition, Chinese and Indian manufacturers are entering the market further impacting prices. On the other hand, the shortage of electronic components caused by the COVID-19 crisis is making the chip vendors accelerate obsolescence of certain components which requires hardware redesigns to avoid cost increases. Therefore, cost reduction in certain platforms must be analyzed continuously.

The value proposition block was also deemed weaker on an external basis according to ZIV's self-evaluation. Indeed, some competitors are also working on new algorithms for protection relays in networks with high RES penetration but these developments are not deeply tested in real networks. Thus, substitutes might become available in the future, weakening ER3 BM, to a degree as those algorithms might present new advantages. Price may be an issue, especially in the MV area. Therefore complements creating an opportunity for ER3 BM have been identified: an efficient technical support, complete instruction books and application notes, user friendly tool, easy SAS integration, trainings, are additional points to complement price. Furthermore, the integration of products and services is something common, especially in turn key projects in which not only protection relays are sold, but also the electrical engineering, setting calculation, commissioning, training, SAS integration, control configurations, panels, are provided. ZIV provides all the aforementioned services. This settles ER3 value proposition future opportunities and strengthen its BM.

Moreover, the customer relationships block was also granted a lower score on an external basis. As customer relationships are based on many factors such as compliance of requirements, product quality, delivery dates, technical support, consistent documentation, services, the prioritisation of customers according to their volume, margins, payment method, is essential. This was especially important during the COVID-19 pandemic in which the delivery dates were very affected by the electronic components shortage. In addition personalization is carried out with certain strategic customers, creating additional value. But it cannot be done with every customers, as management of many product models is complex and business cases are not viable.

The channels block as well was deemed weaker on an external basis according to ZIV's self-evaluation. Indeed, the channels network worldwide can be improved. However, it is a rather long endeavour, as partners must have good knowledge about the products and services. ZIV is currently taking actions to solve this weakness of ER3 BM, such as training sessions with international partners, tools improvement, or clearer price lists.

The customer segments block was also granted a lower score on an external basis. As mentioned before, competition in the MV area is quite intense. In addition, accessing new customers might prove difficult, as approval processes are rather long. Segmentation is important as the product cost is becoming more and more important, and could be improved. Certain functions, not required for all the customers, can be removed to reduce the cost but a compromise solution must be found as an increase in the number of product models will also increase the cost.

Finally, the revenue streams blocks is the last to be granted a lower score. In the future protection relays will be PC-based platforms and the PAC vendors will sell Apps. So the revenue coming from selling hardware may disappear. Thus, the future of the BM might need to be secured. However, at the moment, revenue streams are still secure. ZIV protection relay product range is quite wide, and many services are provided, therefore several revenue streams are considered. In addition, as it was

mentioned before, due to the intense competition, margins are getting lower. Eventually, systems, instead of loose equipment, are the most common way used by customers to buy products, so services are really important and strengthening ER3 BM.

3.5 ER 4: Energy Box

3.5.1   Overall BM SWOT Analysis

Table 85. ER4 SWOT Analysis

	Positive *(to reach the goals)*	Negative *(to reach the goals)*
Internal Origins *(in the organization)*	**STRENGTHS** 1. The main strengths of ER4 BM resides in the powerful knowledge of the technologies involved in the exploitable result. 2. Furthermore, the direct contact with relevant stakeholders of the sector obtained has a positive effect on ER4 BM.	**WEAKNESSES** 1. The difficulties to reach the commercialization level due to the nature of CIRCE's organization (foundation, not a regular company) is weakness stalling the Business Model
External Origins *(environment)*	**OPPORTUNITIES** 1. The high demand of grid smartening in the next years is one of the biggest opportunity for the Energy Box's future. 2. In addition, the high sensitivity of the market and its needs makes it sensitive to ER4 value.	**THREATS** 1. The commercialization of similar solutions from competitors can be a threat to the Energy Box business development. 2. Moreover, currently a gap exists in the market that will be filled in the next years; the short market window leaves ER4 vulnerable to the development of the market.

This SWOT table constructed thanks to partner's self-analysis of their BM provides a snapshot of the current BM status (strengths and weaknesses). It also suggests some future trajectories (opportunities and threats).

Thus, the strength of ER4 business model reside in the quality and innovative technologies involved in its making as well as the direct contact with stakeholders from the sector. For the future, opportunities related to the market demand to further smarten the electricity sector, and the sensitivity of the market toward such technologies could advance ER4 BM.

However, overall ER4 BM also considers weaknesses. Indeed, the difficulties to reach the commercialisation stage due to CIRCE's nature as a foundation can be weakness to ER4 BM impeding its development toward the market. On the other hand, threats such as the commercialisation of similar solutions by competitors overflowing the market, and the short market window leaving little time to launch a solution on the market can hinder ER4's future.

3.5.2 Blocks Analysis

Each Business model block presented in section 2.5 for the ER4 is the subject of a self-evaluation from CIRCE both on an internal and external basis. Thus, the scores of each block is available in the following graph (Figure 27).

Figure 27.   ER4 BM Internal and External block evaluation
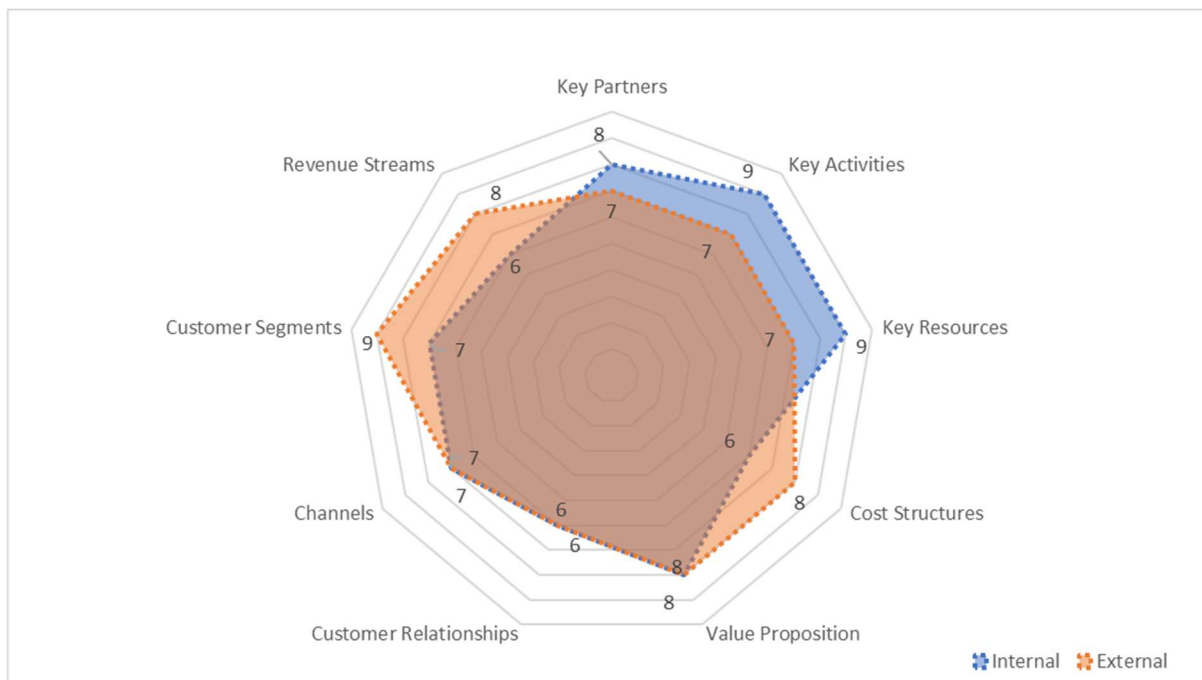
Overall, ER4 BM blocks seem to perform slightly better on an internal basis. Indeed, as control over internal elements is higher than over external ones. However, the results reveal some weaknesses of internal origins in the Business Models on several blocks. This observation is not alarming, as it remains possible to improve the scores through small improvements.

The self-evaluation assesses high scores in regards the BM position within its environment in the cost structures, value propositions, customer segments, and revenue streams categories.

Similarly, high scores were granted in regard to its internal organization related to key partners, key activities, key resources, and value proposition categories.

However, a lower score was obtained regarding the cost structure category on an internal basis. Indeed, as per the answers given by CIRCE, while costs are currently predictable, manufacturing materials tend to increase and could therefore change the costs. Then, the Energy Box could become too expensive for some potential customers leading them to more accessible solutions with less functionalities. Finding alternative manufacturing materials, if possible, could curve the cost structure weakness.

The lower score granted to the customer relationship block on an internal basis is merely due to the few contacts with customers, that has been established at the moment. Indeed, as the Energy Box is currently available but has only been for a short time.

The channel block has also been deemed weaker on an internal basis. Indeed, according to CIRCE, its channels are efficient and CIRCE's specialized team is dedicated to conducting market analysis to identify potential customers and establish a direct link with them. However, as tests and improvements continue to be made in the Energy Box installation, the marketing channels are still not being fully exploited. The newly accessible status of ER4 is again the cause for such as score.

Similarly, the customer segment block obtained a weaker score as work continues on the identification of potential clients and their segmentation to further develop the Energy Box opportunities. This block will be strengthened with time.

Finally on the internal level, the revenue streams block was also a concerning weaker block. Again, the commercialisation status of the solution is the reason for it. It is not possible to define how strong the predictability of revenue is. CIRCE also mentions that some customers might find the Energy Box more economically straining, for example residential customers or companies needing to install multiple Energy Box in their plant, making it more expensive. However, due to the functionalities and benefits of ER4, it is considered an asset that can provide the expected profit and for which customers would be willing to pay for.

Moreover, lower scores were also expressed due to three blocks interaction within their environment. Firstly, the key partners block is deemed weaker as CIRCE depends on the Energy Box manufacturers. In addition, it is considered that there may be valuable opportunities for collaboration and improvement of the value proposition.

Secondly, the key activities block is also regarded as a weaker block for ER4 BM. Indeed, while key activities are defined and no threat has been identified to carrying them out, the standardization and definition of the expected result remain to be done once the marketing actions have been carried out. The strengthening of the block and its conversion into an opportunity for the future of ER4 BM, is underway.

Lastly, the customer relationship block is last of the weaker external blocks to be analyzed. Again, the strengthening of this block is to be carried out in ulterior times as it weaker status is due to the current timeline of the BM evaluation. Indeed, not all the expected contacts have yet been made. CIRCE expects to finish with the improvements of the Energy Box to continue deepening the personalization in customer relationship and considers that there is high potential to improve customer follow-up.

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

3.6.1   Overall BM SWOT Analysis

Table 86. ER5 SWOT Analysis

	Positive *(to reach the goals)*	Negative *(to reach the goals)*
Internal Origins *(in the organization)*	**STRENGTHS** 1. The main strengths of ER5 BM resides in the high adaptability of the software to different assets and different network topologies. In addition, it can be compatible with different technologies and components brands. This virtually makes it accessible to all customer.	**WEAKNESSES** 1. The possible difficulty in horizontal scalability and applicability in different instances can be an obstacle to ER5 development.

External Origins *(environment)*	**OPPORTUNITIES** 1. The main opportunity for ER5 BM is located in the DSO market segment as its interest in the software regards the automatic guarantee in the continuity of supply. The software is very useful for critical loads as hospitals, or military zones.	**THREATS** 1. The external threat to ER5 BM is related to the appearance of competitors' systems using artificial intelligence, which could make the implementation in the network faster. 2. In addition, backend service defined as dependency on third-party licenses, server space, and availability is one of the weaknesses hindering ER5 BM.

This SWOT table constructed thanks to partner's self-analysis of their BM provides a snapshot of the current BM status (strengths and weaknesses). It also suggests some future trajectories (opportunities and threats).

Thus, the strength of ER5 business model reside in the software adaptability and compatibility to customer needs and existing infrastructures and processes. It makes the software module enviable by potential customer segments and easy to use. For the future, opportunities related to the DSO market segment and its interest in the automatic guarantees of supply continuity. This could advance ER5 BM.

However, overall ER5 BM also considers weaknesses. Indeed, the possible difficulties in horizontal scalability and applicability, can be a weakness to ER5 BM impeding its launch and development. On the other hand, for the future, threats such as the appearance on the market of competitors' systems based on AI to make the implementation in the network faster, and the backend service dependency, can hinder its future, making the software less competitive.

3.6.2   Blocks Analysis

Each Business model block presented in section 2.6 for the ER5 is the subject of a self-evaluation from CIRCE both on an internal and external basis. Thus, the scores of each block is available in the following graph (Figure 28).

Figure 28.   ER5 BM Internal and External block evaluation
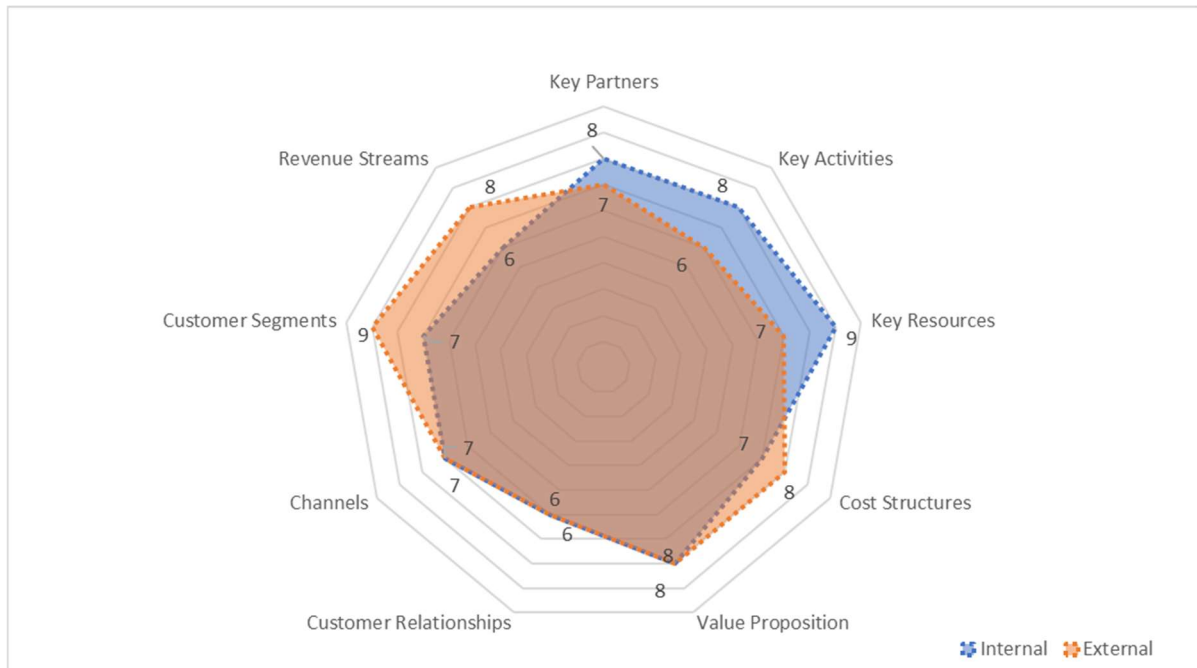
Overall, ER5 BM blocks seem to perform just as well on an internal or an external basis.

The self-evaluation assesses high scores in regards the BM position within its environment in the cost structures, value propositions, customer segments, and revenue streams categories.

Similarly, high scores were granted in regard to its internal organization related to key partners, key activities, key resources, and value proposition categories.

However, a lower score was obtained regarding the cost structure category on an internal basis. Indeed, as per the answers given by CIRCE, the costs are relatively predictable but will depend on different variables such as the salaries of the engineers. In addition, as the software as not yet been launched, all cost concepts have not yet been fully defined to determine whether or not operations are cost-efficient.

The lower score granted to the customer relationship block on an internal basis is also due to ER5 unlaunched status. Indeed, as the tests and validations of the software and algorithms have not yet been completed, potential clients outside the project have not yet been contacted.

Similarly, the customer segment block scores is explained by the ongoing test and validation stage, which means that potential customers have not been contacted. However, expectations are encouraging.

Finally, on the internal block basis for the BM evaluation the last of the weaker blocks is related to revenue streams. While the developed software has advantages bringing great value to potential customers, the cost and price remain to be defined and clear revenues are not determined yet. The following year after the project will be determining the revenue streams to be expected for ER5.

Moreover, lower scores were also expressed due to two blocks interaction within their environment. Firstly, the key resources block is deemed weaker even if the key resources are deemed by CIRCE as

well defined and well exploited. However, some resources still need to be put into operation for the exploitation of this result. Opportunities could be explored later on regarding ER5 key resources.

Secondly, the customer relationship block is also regarded as a weaker block for ER5 BM. Indeed, once again the maturity of the software is not yet enough to evaluate customer relationships. However, it is expected that CIRCE will work with a specialized market team to achieve a good segmentation of the target audience and potential clients.

3.7 ER 6: Software module for forecasting and grid operation

3.7.1   Overall BM SWOT Analysis

Table 87. ER6 SWOT Analysis

	Positive *(to reach the goals)*	Negative *(to reach the goals)*
Internal Origins *(in the organization)*	**STRENGTHS** 1. The main strengths of ER6 BM resides in the easy replication of the solution in different environment. 2. In addition, the good technical knowledge of personnel working on ER6 strengthen it. 3. Moreover, as the value proposition is well-aligned with customer needs, ER6 BM is stronger for it. 4. Finally, the strong synergy it displays with ER7	**WEAKNESSES** 1. As the solution has only been tested in the Greek demo site (and on the Spanish site with modifications and trained with different data, the adaptability to new environment could be questioned; therefore, this remains a weakness for ER6 development.
External Origins *(environment)*	**OPPORTUNITIES** 1. The main opportunity for ER6's future is the large number of potential customers, which would purchase the solution. 2. Furthermore, the growing market on forecasting, driven by the need for decarbonized energy is an opportunity for ER6 development in the future. 3. In addition, ER6 key activities could be standardized, which marks an important opportunity in the future for the business model. 4. Finally, the dissemination activities throughout the project promoted the solution, creating opportunities for ER6 future.	**THREATS** 1. The multiple competitors existing could lead to an imminent saturated market and impact negatively ER6 future. 2. Related to the above-mentioned threat, the numerous BMS (Building Management System) companies, might develop and integrate their own solutions for RES forecasting in their in-house BMS platforms as opposed to making commercial agreements with 3rd parties. Thus, the need for ER6 for BMS companies would be rendered obsolete. This situation in turn would be a threat to ER6 BM.

This SWOT table constructed thanks to partner's self-analysis of their BM provides a snapshot of the current BM status (strengths and weaknesses). It also suggests some future trajectories (opportunities and threats).

Thus, the strengths of ER6 business model reside in the easy replication of the ER in different environment, the technical knowledge of workers, the strong value proposition segment of the BM as well, as the strong synergy it displays with ER7. For the future, opportunities related to the growing forecasting market, the large number of potential customers, the possible standardisation of key activities and the current dissemination of ER6 through FLEXIGRID could advance ER6 BM.

However, overall ER6 BM also considers weaknesses. Indeed, the lack of thorough testing in other FLEXIGRID demo-sites besides Greece (with the exception of some simple tests conducted in the Spanish demo sites) can be a weakness to ER6 BM impeding its launch and development. On the other hand, for the future, threats such as the large number of competitors and the possible choice of one of the identified customer segments to develop the software internally rather than to purchase it externally can hinder ER6 future.

3.7.2   Blocks Analysis

Each Business model block presented in section 2.7 for the ER6 is the subject of a self-evaluation from MOH (formerly VERD) both on an internal and external basis. Thus, the score of each block is available in the following graph (Figure 29).

Figure 29.   ER6 BM Internal and External block evaluation
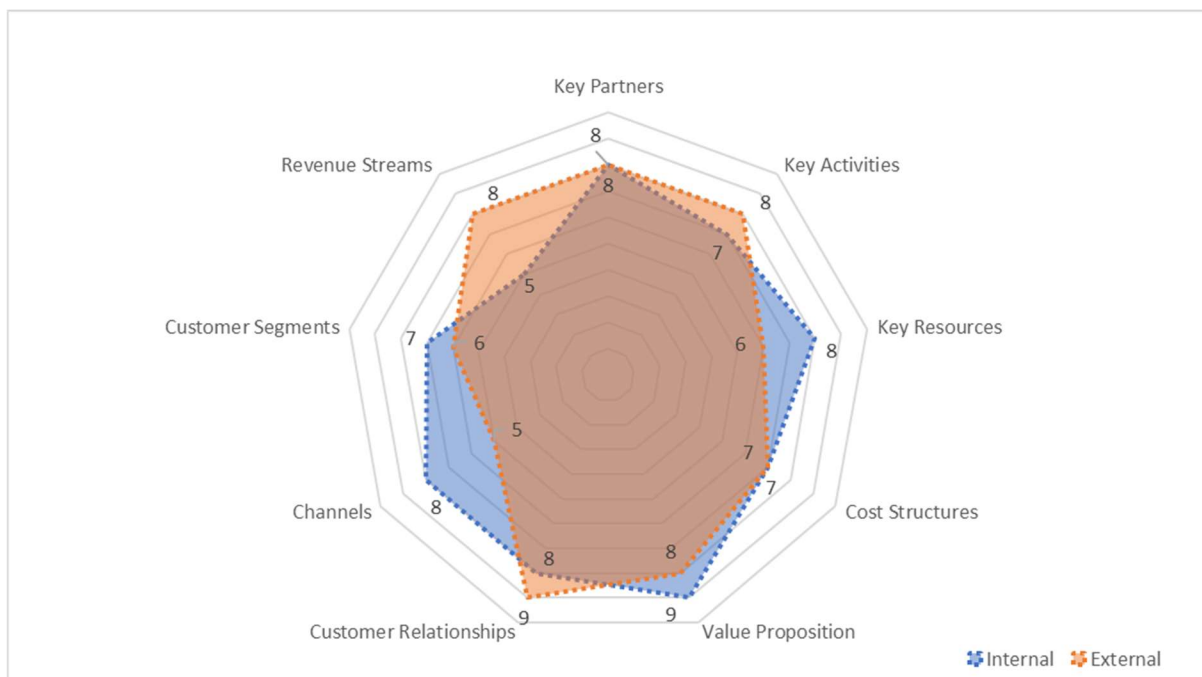
Overall, ER6 BM blocks seem to perform better on an external basis. Indeed, the results reveal some weaknesses of internal origins in the Business Models. This observation is not alarming, as it remains possible to improve the scores through small improvements related to the organization of the BM which is easier to control than external elements.

The self-evaluation assesses high scores in regards the BM position within its environment in the key partners, key activities, value proposition, customer relationships, and revenue streams categories.

Similarly, high scores were granted in regard to its internal organization related to key partners, key resources, value proposition and customer relationships categories.

However, a lower score was obtained regarding the key activities category on an internal basis. Indeed, as per the answers given by MOH (formerly VERD), while the execution of key activities has been very efficient throughout the project within the FLEXIGRID consortium some minor delays we experienced with partner's change of personnel, however activities quickly resumed at their original pace with the training of staff being up to date. In addition, while key activities are easy to replicate in terms of workflows, inputs to the algorithms need to be adjusted depending on the activity we are performing. This is due to the dependence of key activities to their specific use case. Finally, the strong execution quality is mostly done in-house (in terms of the FLEXIGRID consortium) but multiple partners are needed for the deployment of the solution, making it for some part outsourced.

The cost structures segment was also given a lower score on an internal basis. Indeed, ER6 costs are predictable and operation are cost-efficient. However, the cost structure match with the business model took some time. As the participation from other partners was needed in order to sell the complete solution to customers and since the algorithms are now open-source, the match was not immediately found.

The customer segments section has not been evaluated at its highest potential on an internal basis. Indeed, as ER6 has not been launched yet, customer churn rates or new customer acquisition cannot be properly evaluated. However, customer base are deemed well segmented as of today.

Finally, the revenue streams segment was given a low score in MOH (formerly VERD) self-evaluation on an internal basis. While the revenue streams are sustainable, other characteristics weaken the overall BM. A single revenue stream has been identified, which is not recurrent, costs are incurred before collecting revenues, and the price customers are willing to pay for such a service has not been identified yet as a thorough market research is yet to be conducted.

Moreover, lower scores were also expressed due to four blocks interaction within their environment. Firstly, the key resources block is deemed weaker by MOH (formerly VERD) but could still bring opportunities to ER6 BM. Indeed, less costly resources to achieve the same result could be used, unused intellectual property of value could be exploited, and disruption in the supply of certain resources could be faced. However, the quality of resources can be threatened by a change of staff, making the BM vulnerable to external threat.

Secondly, the cost structures block is also regarded as a weaker block for ER6 BM. Indeed, cost integration depending on the customer could be unpredictable as the ER is adapted to customer needs. In addition, hardware cost threatens to grow more quickly than the consultancy revenues they support. To strengthen ER6 BM, reducing costs could be beneficial, thus, a replication model adapted to multiple customers could become an opportunity for the overall BM.

In addition, the channels section was granted a lower score on an external basis. While no opportunity has been clearly identified by MOH (formerly VERD) regarding channels, threats are clearly excluded by the self-evaluation conducted. ER6 BM channels are not in danger of becoming irrelevant to customers, nor do competitors threaten said channels.

Finally, the customer segments section is the last of ER6 BM to have been granted a lower score in MOH's (formerly VERD) self-evaluation. Indeed, as stated in the SWOT, competitors are threatening ER6 market shares and the market could be saturated soon especially if equipment manufacturers produce their own management software as some already do. Such a situation could encourage customers to defect or not purchase ER6 as it would be easier for them to buy two products from the same provider (the equipment as well as the software). Then overall, the customer segment section of ER6 BM is threatened. However, opportunities do exist: finer segmentation could better serve customers, new customer segments could be served, and the growing market can also be beneficial.

3.8 ER 7: Software module for congestion management

Table 88. ER7 SWOT Analysis

	Positive *(to reach the goals)*	Negative *(to reach the goals)*
Internal Origins *(in the organization)*	**STRENGTHS** 1. The main strengths of ER7 BM resides in the good technical knowledge of MOH's (formerly VERD) workers 2. In addition, the strong synergy with ER6, an internally developed solution is also a strength for ER7 as it implies less dependencies to external products and services.	**WEAKNESSES** 1. The solution needs to be adapted for each individual customer. Thus, resources are needed for configuration which weakens ER7 overall BM.
External Origins *(environment)*	**OPPORTUNITIES** 1. The main opportunity for ER7's future is the large number of potential customers 2. Moreover, the growing market on congestion management is also an opportunity in the development of ER7's BM 3. Finally, the dissemination activities which took place through the FLEXIGRID project can promoted the solution, which implies more opportunities for ER7.	**THREATS** 1. The main threat identified for ER7 is the multiple competitors present on the market which hinders ER7 BM. 2. In addition, the continuously changing regulatory environment implies frequent updates to the solution, which hinders ER7 development as it requires both time and resources 3. The fact that the Demand Response market does not exist and that regulatory barrier to exporting energy to the grid exists will pose a limitation the potential of ER7 4. Finally, Commercial and Industrial customers would need a stable and profitable business model and would be looking for a payback period lower than 5 years in order to invest, this cautiousness could hinder ER7 launch and development.

This SWOT table constructed thanks to partner's self-analysis of their BM provides a snapshot of the current BM status (strengths and weaknesses). It also suggests some future trajectories (opportunities and threats).

Thus, the strength of ER7 business model reside in the technical expertise of MOH's (formerly VERD) workers, as well as in the synergy ER7 and ER6 present allowing for independency from external services and products. For the future, opportunities related to the large number of potential customers, the growing congestion management market, and the dissemination activities carried out during the FLEXIGRID project could advance ER7 BM.

However, overall ER7 BM also considers weaknesses. Indeed, the adaptation to each customer needs can be weaknesses to ER7 BM impeding its development as such customisation is resource-intensive. On the other hand, for the future, threats such as the high number of competitors, the rapidly changing regulations, the non-existent demand-response market, the regulatory barriers, and customers cautiousness can hinder ER7 future.

3.8.1   Blocks Analysis

Each Business model block presented in section 2.8 for the ER7 is the subject of a self-evaluation from MOH (formerly VERD) both on an internal and external basis. Thus, the scores of each block is available in the following graph (Figure 30).

Figure 30.   ER7 BM Internal and External block evaluation
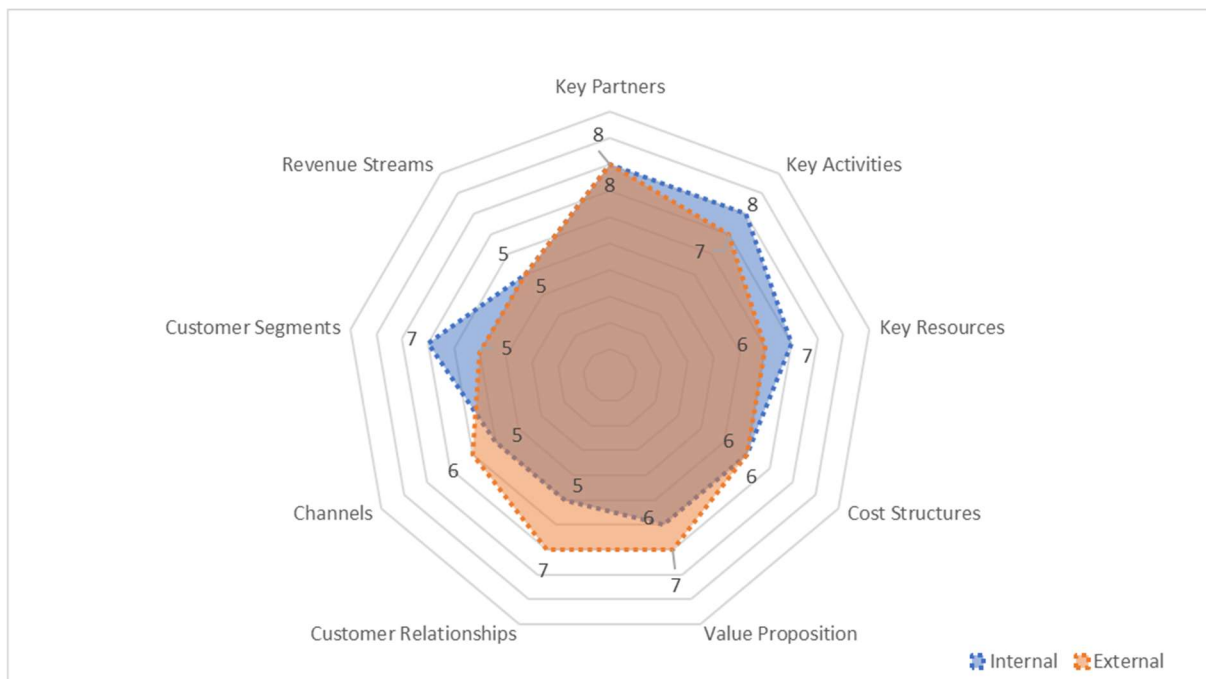
Overall, ER7 BM blocks seem to perform better on an external basis. Indeed, the results reveal some weaknesses of internal origins in the Business Models. This observation is not alarming, as it remains possible to improve the scores through small improvements related to the organization of the BM which is easier to control than external elements.

The self-evaluation assesses a high score in regards the BM position within its environment in the key partners category.

Similarly, high scores were granted in regard to its internal organization related to key partners, and key resources categories.

However, a lower score was obtained regarding the key resources category on an internal basis. Indeed, as per the answers given by MOH (formerly VERD), ER7 key resources are rather difficult to be replicated and resources needs are predictable. Then the score for ER7 key resources block is higher but could be ameliorated by an improved management of key resources deployment.

Secondly, the cost structures block was also granted a lower score on an internal basis. While MOH (formerly VERD) considers costs predictable and operations to be cost-efficient, the cost structure was not immediately matched to ER7 BM, which weakened it. Matching the cost structure to the BM was delayed since participation from other partners was needed in order to be able to sell the complete solution to customers. In addition, since the algorithms are now open-source, he BM and cost structure had to be adapted anew. Once ER7 is launched a strength which could be explored would be the possibility to benefit from economies of scale as customers could be displaying the same needs. Thus, customization which as established is resources-intensive could be by passed.

In addition, the value propositions block was also evaluated by MOH (formerly VERD) as a weaker block on an internal basis. Customer satisfaction, the strong network effects and the strong synergies between product and services strengthen ER7 BM. However, while ER7 value proposition is well-aligned with customers' needs, it cannot be supported by a standalone solution. Rather, the combination of multiple solutions integrated into one system is necessary to answer comprehensively to customer needs.

Furthermore, the customer relationships segment was granted a lower score in MOH's (formerly VERD) self-evaluation analysis. MOH's (formerly VERD) brand is strong, strengthening in turn ER7 BM, but it can struggle with matching relationship with customer segments. MOH (formerly VERD) states that due to the number of different customer types makes it harder to identify the right customer relationship to adopt and match.

The channels block was granted a lower score mainly as a result of the above-mentioned weakness in the customer relationship block. Otherwise, channels are reported to be efficient and effective which can make it a strength to ER7 BM.

The customer segments evaluation is incomplete at the moment because of the market status of ER7. Thus, a further analysis could re-evaluate this block current score after ER7 launch. As of the current analysis, MOH (formerly VERD) stated that customer base is rather well segmented strengthening ER7 BM.

Finally, the revenue streams block is also a factor in the weaknesses observable in ER7 BM on an internal basis. While revenue streams are expected to sustainable, no recurring revenue streams have been identified, a single revenue stream has been identified, and costs are incurred before collecting revenues. In addition, ER7 BM suggests a 'consultancy' type of project: margin rates could be high but only once the solution is fully developed and replicable and only if other partners also contribute with their solutions. Thus revenues are expected to be low at this stage and the overall revenue stream block could be improved later.

Moreover, lower scores were also expressed due to eight blocks interaction within their environment. Firstly, the key activities block has been evaluated as a weaker block on an external basis. While the

quality of key activities is not threatened in any way and it would be possible to standardize some key activities, opportunities for ER7 futures are not fully clear. Indeed, MOH's (formerly VERD) intention is to explore a "consultancy" type revenue stream for a holistic congestion management approach, which would require the participation of several other partners and solutions. Then, the overall efficiency of the activities would be slightly reduced at least in the beginning of any exploitation activities.

Secondly, the key resources block is also regarded as a weaker block for ER7 BM on an external basis. Indeed, the quality of resources could be threatened by a change of staff holding the knowledge strengthening ER7 overall BM. However, MOH (formerly VERD) states that disruption in the supply of certain resources could be faced, less costly resources could be used to achieve the same result, and ER7 IP is of value to others. Thus, while this block score could be improved by training new staff onto key activities for ER7, the overall BM still benefits from the opportunities brought forward by the key resources block.

The cost structures block is also deemed weaker due to the current uncertainty regarding ER7 cost structure. On the basis of the above-mentioned strategy intending to set up a consultancy type revenue stream, the costs of the offering became slightly unpredictable due to the number of partners involved. Hence, MOH (formerly VERD) would need solid internal agreements before going to market with its product. However, once the plan is finalized and settled, opportunities could arise as costs could be reduced thanks to economies of scale and replicability of the offering to multiple customers.

The value proposition block was granted a lower score on an external basis. This score is slightly reduced as an opportunity to convert the product to a service exists. However, it is only viable with the inclusion of other solutions in the offer. Hence, the integration of the product would require more effort, but customers would get additional value by not only buying the congestion management product but also having it integrated to their site and tailored to their need.

Furthermore, the customer relationships block was also deemed weaker than other by MOH (formerly VERD) on an external basis. Indeed, personalization for each customer cannot be improved, and relationship automation is not needed which hinders ER7 future opportunities. However, threats are blunted as customer relationships are in no danger of deteriorating. An opportunity for ER7 has also been identified, as customer follow-up can potentially be improved by offering an assessment of the operation of the solution after a certain period (e.g. after the 1st year of operation).

The channels block is also part of the weaker block on an external basis according to MOH's (formerly VERD) self-evaluation. While threats are not impeding ER7 BM, as competitors do not threaten ER7 channels and channels are not in danger of becoming irrelevant to customers, the lack of opportunities explains such as score. Once ER7 is launched and a better view of channels is obtained, their efficiency and effectiveness could be revaluated and improved.

The customer segments section of ER7 BM was also granted a lower score. The market could be saturated soon, which poses a threat to ER7 BM. In addition, ER7 market shares are also threatens by competitors, as stated in the overall SWOT analysis, if equipment manufacturers produce their own management software (as some of them do already), the number of potential customer would be reduced. Opportunities are missed for ER7 future as finer customer segmentation would not help to better serve customers, but are grasped as new customer segments could be served and the growing market in the next few years involves a growing number of customers.

Lastly, the revenue streams block is the final block in ER7 BM to be evaluated as weaker on an external basis. Some opportunities have been identified such as the willingness of customers to pay for integration elements, and the cross-selling opportunities for the integration with other systems. However, threats have also been identified as revenue streams depend excessively on integration consultancy, threatening the balance of the revenue stream block, and one-time transaction cannot be easily be replaced by recurring revenues.

3.9 ER 8: Virtual Thermal Energy Storage Module

3.9.1 Overall BM SWOT Analysis

Table 89. ER8 SWOT Analysis

	Positive *(to reach the goals)*	Negative *(to reach the goals)*
Internal Origins *(in the organization)*	**STRENGTHS** 1. The main strengths of ER8 BM resides in the big pool of potential customer segments already available, which would make revenue stacking possible. 2. In addition, the versatile business model covering both B2B and B2C cases put in place is also a strength for the overall ER8 BM.	**WEAKNESSES** 1. One of the main weaknesses for ER8 BM is the need for upfront investment cost, which can be difficult to maintain and acquire. 2. Furthermore, the high operational cost, particularly in personnel, also weakens the overall BM for ER8.
External Origins *(environment)*	**OPPORTUNITIES** 1. The energy transition and its associated legislation in Europe will expend the need for ER8 solution, making it an opportunity for ER8 future's. 2. In addition, the increasing citizen awareness on environmental issues and energy transition will also expanding the desire for such solution strengthening the overall BM. 3. This second point is linked to the increased citizen demand for smart energy automation and cost saving technologies. Thus, opportunities to expand ER8 market in the future are available.	**THREATS** 1. In the future, competition from established companies could hinder ER8 BM. 2. Moreover, dependency on external equipment suppliers can also be considered a threat for ER8 BM.

This SWOT table constructed thanks to partner's self-analysis of their BM provides a snapshot of the current BM status (strengths and weaknesses). It also suggests some future trajectories (opportunities and threats).

Thus, the strength of ER8 business model reside in the extensive pool of potential customers already available to sell the solution to and attain a revenue-stacking situation. In addition, the versatility of ER8 BM covering B2B and B2C interactions extends this pool of customers even more. For the future, opportunities related to the increase need of solutions related to the energy transition because of the

legislation development in the EU, the increase awareness and demand by citizen for a technological energy transition could advance ER8 BM.

However, overall ER8 BM also considers weaknesses. Indeed, the upfront investment cost, and the high operational cost can be weaknesses to ER8 BM impeding its launch and development. On the other hand, for the future, threats such as the established competitor's advance on the market, and the dependency of external equipment suppliers can hinder ER8 future's.

3.9.2   Blocks Analysis

Each Business model block presented in section 2.9 for the ER8 is the subject of a self-evaluation from HYPERTECH both on an internal and external basis. Thus, the scores of each block is available in the following graph (Figure 31).

Figure 31.   ER8 BM Internal and External block evaluation
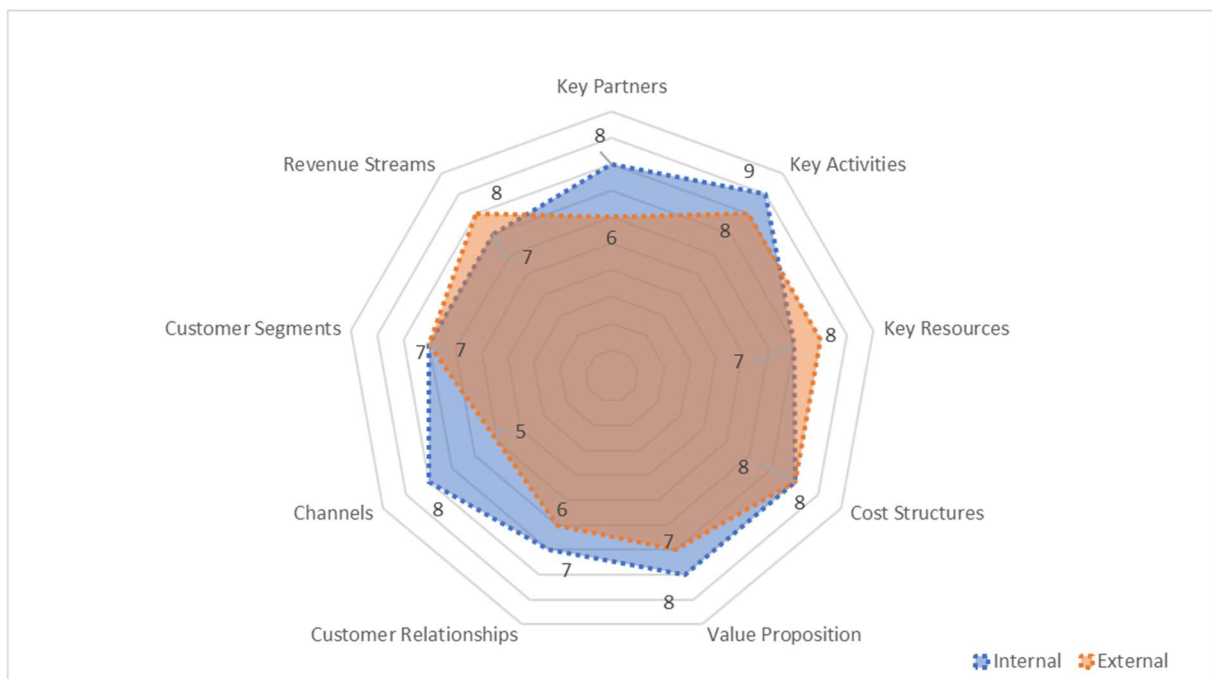
Overall, ER8 BM blocks seem to perform better on an internal basis. Indeed, control over internal elements is higher than over external ones.

The self-evaluation assesses high scores in regards the BM position within its internal organization in the key partners, key activities, cost structures, value proposition, and channels categories.

Similarly, high scores were granted in regard to its internal organization related to key activities, key resources, cost structures, and revenue streams categories.

However, a lower score was obtained regarding the key resources category on an internal basis. Indeed, as per the answers given by HYPERTECH, key resources are somewhat difficult to replicate for competitors, and resources needs are rather predictable and contribute effective planning, which strengthens ER8 BM. However, the weakness mostly resides in the deployment timeline of key resources. HYPERTECH still endeavours to deploy key resources in the right amount at the right time so improvements in this branch of the block can be achieved.

In addition, the customer relationships block was also granted a comparatively lower score on an internal basis. The relationships strongly match with the customer segments, and the overall relationship is qualified as strong according to HYPERTECH, which indicates a strong block. Yet, weaknesses are observable in the block in particular in the lack of switching costs, therefore, the customer is not bound to ER8. The weaker brand also does not favor a strong customer relationship block.

Moreover, the customer segments block was scored a lower result on an internal basis. While the customer base is very well segmented, and the company is continuously acquiring new customers, these customers tend to be all part of the same segment. In addition, customer turn rates are rather high which tends to lower the strength of the BM.

The revenue streams block is also classified as a weaker block with a lower score. Its stronger points are due to the predictability of revenues and their recurrence with frequent repeat purchases. In addition, revenues are deemed sustainable and pricing mechanisms capture full willingness to pay from customers, charging what customers are willing to pay for. While the previous mentioned characteristics of the block demonstrate a strong block, other characteristics justify the score given. Namely, margins are poor which does not benefit the block, revenue streams are rather not diversified, and costs are mostly incurred before collecting revenues. Thus because of the latest characteristics, ER8 BM cannot yet score higher. To improve it score, a mechanism to ensure revenues streams are more diversified (proposing additional services and maintenance for example), or to ensure costs are incurred after collecting revenue could be helpful.

Furthermore, lower scores were also expressed due to five blocks interaction within their environment. Firstly, the key partners block is deemed weaker because partners might be inclined to collaborate with competitors, and partners might be lost because of the existing competition in the market. Outsourcing opportunities exist but are not preferable due to their negative influence on profit margins. As stated by HYPERTECH, the block still displays strength in different areas. Dependence to partners is not yet an issue (even if in the future dependence to equipment suppliers should be considered). Opportunities thanks to other blocks can also be identified, in particular thanks to channels to improve customers reach, and value proposition improved thanks to partners complementarity.

Secondly, the value proposition block is also regarded as a weaker block for ER8 BM. Its strength resides mostly other jobs could be offered on behalf of customers such as amenity-as-a-service, cost minimization, or energy efficiency services; this would complement and extend the value proposition and create an opportunity for ER8 BM. However, the integration of product and services is rather challenging. Moreover, competitors such as Siemens threaten the BM by offering better price or better value. It is difficult to compete with bigger player with bigger infrastructure and bigger investments. The substitute products while available are slightly different as they are less user-centric that ER8 solution, making it stand out among its competition. One way to strengthen ER8 BM, which is already explored by HYPERTECH, is to generate recurring revenues by converting products into services. This model is expressed as the desired model to be pursued.

Thirdly, the customer relationships block was granted a lower score in the self-evaluation of ER8 BM. The solution offers high personalization, considering and respecting customer's preferences and habits, which testifies to a strong customer relationships block on an external basis. However, relationships with customers could be tightened according to HYPERTECH by building evidence for the

value adding nature of the product and a better marketing. Then, this tightening of relationships could be established through improvement of existing channels and the creation of new ones, which would in turn strengthen ER8 BM.

In addition, the channels block is lowly scored on an external basis for different reasons. Competitors threaten the B2B channels established and the overall channels block is in danger of becoming irrelevant (as the website or social media for example) and work on keeping it relevant is to be sustained. To keep the channels efficient and effective this work will be crucial. Then, work on aligning customer segments with channels could also improve the block.

Finally, the customer segments block is the last to be analyzed on an external basis. Again, as mentioned previously competitors and especially big technology providers are threatening ER8's market share. In addition, market is not yet saturated, competition will intensify quickly in the next decade, threatening the customer segment block. However, the growing market can become an opportunity for ER8 BM as number of potential customers would increase, and in turn customer benefits would be higher as the service offered is based on business cases evidence gathered through customer experience.

3.10   ER 9: FUSE platform

Table 90. ER9 SWOT Analysis

	Positive *(to reach the goals)*	Negative *(to reach the goals)*
Internal Origins *(in the organization)*	**STRENGTHS** 1. The main strengths of FUSE BM is its qualitative maintenance and technical management, setting it apart from other similar solutions. 2. In addition, its IT support team available to solve issues, and the digitalization of energy assets it allows strengthen ER9 BM.	**WEAKNESSES** 1. At the moment, a limited amount of customer segments were reached. If this situation does not change, it could become an obstacle to the ER development. 2. Moreover, FUSE is a flexible solution that implies customization for each customer. The amount of time dedicated to customization to each customer could become an obstacle to the development of ER9, as time is spent on the customization and not elsewhere.
External Origins *(environment)*	**OPPORTUNITIES** 1. Traditional energy stakeholders (TSOs, DSOs, retailers, large generators) will need to update their network solutions, thus making them potential FUSE customers, a clear opportunity for ER9 future. 2. In addition new energy stakeholders (aggregators, traders. ESCOs) are emerging and in need of such solutions. Thus, they could also become potential customers and	**THREATS** 1. In relation to a weakness described above, reaching new customers for new energy stakeholders could be difficult and the lack of new customers in external stakeholder BM can in turn hinder ER9 BM. 2. Finally, commercialization of FUSE as a product license and its maintenance could become a threat in itself as it would maintain a high level of maintenance from FLEXIGRID partners to satisfy customers.

create an opportunity for ER9 future and its BM.	

This SWOT table constructed thanks to partner's self-analysis of their BM provides a snapshot of the current BM status (strengths and weaknesses). It also suggests some future trajectories (opportunities and threats).

Thus, the strengths of ER9 business model reside in in FUSE's qualitative maintenance and technical management advancing the singularity of the ER compared to competitors. In addition, the IT support team linked to the maintenance allows for the digitalisation of energy assets, strengthening ER9 BM. For the future, opportunities related to the need for traditional energy stakeholder to update their network solutions, and the emergence of new energy stakeholder could advance ER9 BM and extend its pool of customers.

However, overall ER9 BM also considers weaknesses. Indeed, limited amount of customer segments reached as of today, and the customization proposed for each new customer implying time spent on each new customer can be weaknesses to ER9 BM impeding its development. On the other hand, for the future, threats such as the difficulty to reach new customers and the maintenance of FUSE for customer satisfaction can hinder ER9 future.

3.10.1   Blocks Analysis

Each Business model block presented in section 2.10 for the ER9 is the subject of a self-evaluation from ATOS both on an internal and external basis. Thus, the scores of each block is available in the following graph (Figure 32).

Figure 32.   ER9 BM Internal and External block evaluation
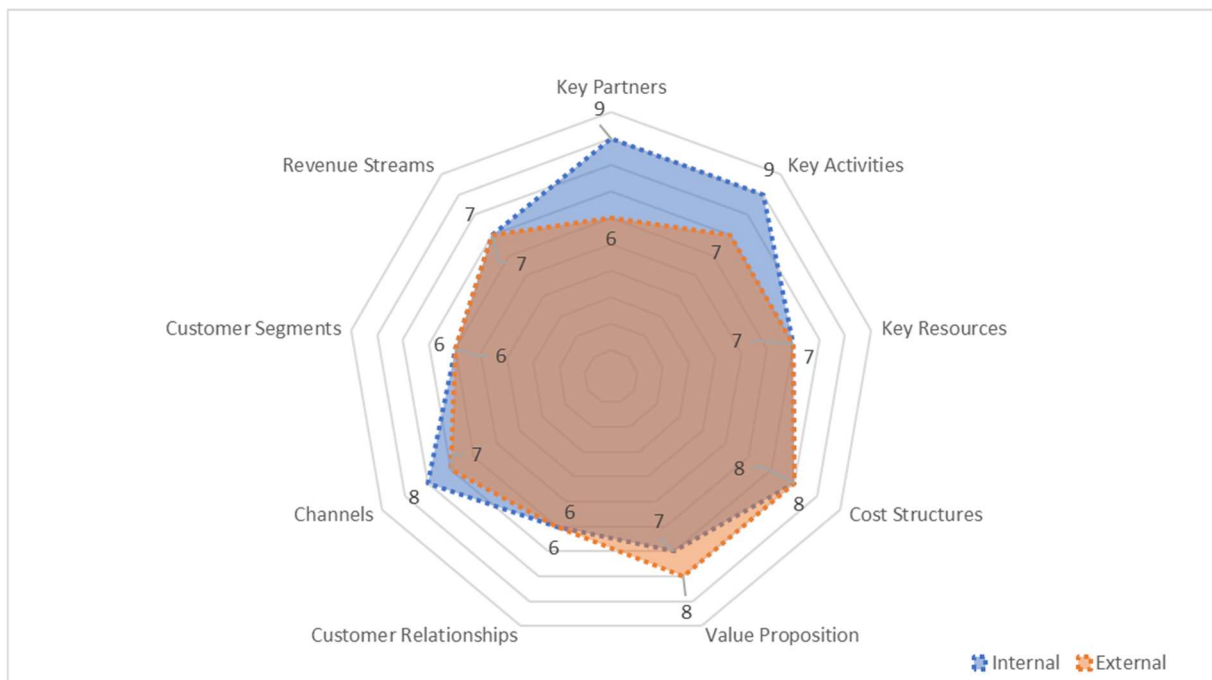
Overall, ER9 BM blocks seem to perform better on an internal basis. Indeed, as control over internal elements is higher than over external elements.

The self-evaluation assesses high scores in regards the BM position within its environment in the cost structures and value proposition categories.

Similarly, high scores were granted in regard to its internal organization related to key partners, key activities, cost structures, and channels categories.

However, a lower score was obtained regarding the key resources category on an internal basis. Indeed, as per the answers given by ATOS, the resources required to develop ER9 includes technical skill, which is common and thus easily replicable by competitors. However, resources are deployed in an affordable time in the right amount strengthening the BM.

The value proposition block was also identified as a weaker block thanks to the weaker score self-attributed by ATOS. Indeed, ATOS being a technological company, customers belong to a broad variety of markets. Therefore, while customer satisfaction ratios are high, research products aligning with company portfolio takes time. Extra time might be required to prepare solutions for the customers.

The customer relationship block was also granted a weaker score. Indeed, while customer relationship is deemed strong by ATOS, companies relate to the energy sector are but a subset of the customer range for ATOS. Thus, the relationship with them is not on the center stage for the company, in addition to the contracts with this subset of customers currently being attached to other activities in ATOS. While the relationship with these customers is important for ATOS, it is currently not the most developed relationship. Thus, developing this relationship will be advantageous for FLEXIGRID's future.

Similarly, the customer segments block is also deemed a weaker block. Being a bigger company, churn rates in ATOS are low as the contract and engagement with customers are strong. In addition, processes to acquire new customers and the requirements in the size and characteristics of the contracts increase the difficulty of acquiring new customers, weakening the customer segments block and ER9 BM.

Finally, the last weaker block identified on an internal basis is the revenue streams block. While the revenues and margins for the different contracts are aligns with ATOS' strategy, the main weak point is linked to the time of collection of revenues. Namely, for some contracts, the revenue is collected after incurring the costs as the billing process could not be aligned both for the company and the customers.

Moreover, lower scores were also expressed due to seven blocks interaction within their environment. Firstly, the key partners block is deemed weaker because of ATOS' strategy to mainly deliver project and services without collaborating with external partners. As stated by ATOS, collaborations typically take place in the initial phases of the proposals to provide the best solutions to customers' needs, and act as an expert level support. While the block is weaker because of the lesser collaboration rate incurring, the independence toward external partners is a strategy on its own and can compensate threat to ER9 BM.

Secondly, the key activities block is also regarded as a weaker block for ER9 BM on an external basis. Indeed, as activities for ER9 are concentrated on research and innovation, standardizing key activities is difficult. However, the quality and efficiency of activities is deemed by ATOS as highly assured.

Thirdly, key resources have also been identified as a weaker block on an external basis. Indeed, it would be difficult to face a disruption in the supply of resources. The main resource are experts in mainstream

technologies thus the replacement can be done in an affordable amount of time. In addition, the level of expertise required is high and as a result, the cost of the resource is high and cannot be reduced without impacting on the quality of the ER. The key resource block could be reinforced by strengthening against the disruption of supply.

The customer relationship block is also found weak on an external basis. While the customer relationship is deemed strong and solid by ATOS, the capability to automate relationships or increase the switching costs is low. ATOS has a dedicated commercial department and mostly deals with bigger companies. As a result, possibilities to personalize relationships is reduced.

The channels block was granted a weaker score on an external basis. Channels are identified as the business personnel in the commercial department, thus, competitors are deemed a threat because of their attractive power and capability to hire the personnel. In addition, acquiring new complementary channels is deemed difficult due to ATOS' internal structure.

The customer segments block was granted a weaker score. While the market currently identified for ER9 customer segment is a consolidated market which is witnessing several emerging areas and should not be saturated on neither short nor medium term. Thus, the threat to ER9 BM is identified elsewhere. Indeed, the main threat resides in the competence in this market, making market share difficult to guarantee. In addition, the internal process to increase customers numbers, reach new markets or serve new customer segments is rather stiff. Therefore, the capacity to serve new customer segments is reduced, threatening the overall BM.

Finally, the revenue streams block is last of the weaker block on an external basis. While ATOS states that the revenue streams identified for ER9 are stable and a variety of different revenues are available to the company to avoid depending excessively on few revenue streams, competitors are to be taken into account regarding revenue streams. Indeed, the market houses a number of competitors with similar characteristics to ATOS, which is obligated to adapt its margins to the market. However, ATOS is confident in the business team in charge of such subjects and estimates that their knowledge can compensate for weaknesses found in the revenue stream block.

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

Table 91. ER10 SWOT Analysis

	Positive *(to reach the goals)*	Negative *(to reach the goals)*
Internal Origins *(in the organization)*	**STRENGTHS** 1. The main strengths of ER10 BM resides in its Open source multicriteria optimization tool which set it apart from similar software. 2. In addition, ER10 supports the needs of different target users such as DSO and ESCO, customers looking into bettering their systems.	**WEAKNESSES** 1. The lack of proof of concept tool, due to LINKS not being a software house, remains an obstacle to the ER development. 2. The lack of customization made accessible to users can also be listed as a weakness for ER10. 4. In addition, ER10 can be considered difficult to use. Indeed, it is not a user-friendly tool. This could hinder ER10 image to potential users.

External Origins (environment)	**OPPORTUNITIES** 1. The main opportunity for ER10 is related to the fast grow of Renewable energy sources integration on the networks. While this phenomenon is bringing a lot of advantages but also some issues that require appropriate choices from DSO/ESCO to adapt.	**THREATS** 1. In the future the weaknesses listed above could become threats to ER10 BM. Indeed, as DSO/ESCO may need more customized tools that better comply with their requirements, ER10 might become unpopular.

This SWOT table constructed thanks to partner's self-analysis of their BM provides a snapshot of the current BM status (strengths and weaknesses). It also suggests some future trajectories (opportunities and threats).

Thus, the strength of ER10 business model reside in both its open source multicriteria optimisation tool and the supports granted to the needs of potential users. For the future, opportunities related to the continuous grow of RE integration into electricity networks could advance ER10 BM as supports from software to support battery systems will become crucial to manage the intermittent nature of renewables.

However, overall ER10 BM also considers weaknesses. Indeed, the lack of proof of concept tool, the lack of available customisation for user's needs, and the overall difficulty users face in using the software can be weaknesses to ER10 BM impeding its development. On the other hand, for the future, threats such as the lack of compliance to user's custom needs and requirements can hinder its future.

3.11.1   Blocks Analysis

Each Business model block presented in section 2.11 for the ER10 is the subject of a self-evaluation from LINKS both on an internal and external basis. Thus, the scores of each block is available in the following graph (Figure 33)

Figure 33.   ER10 BM Internal and External block evaluation
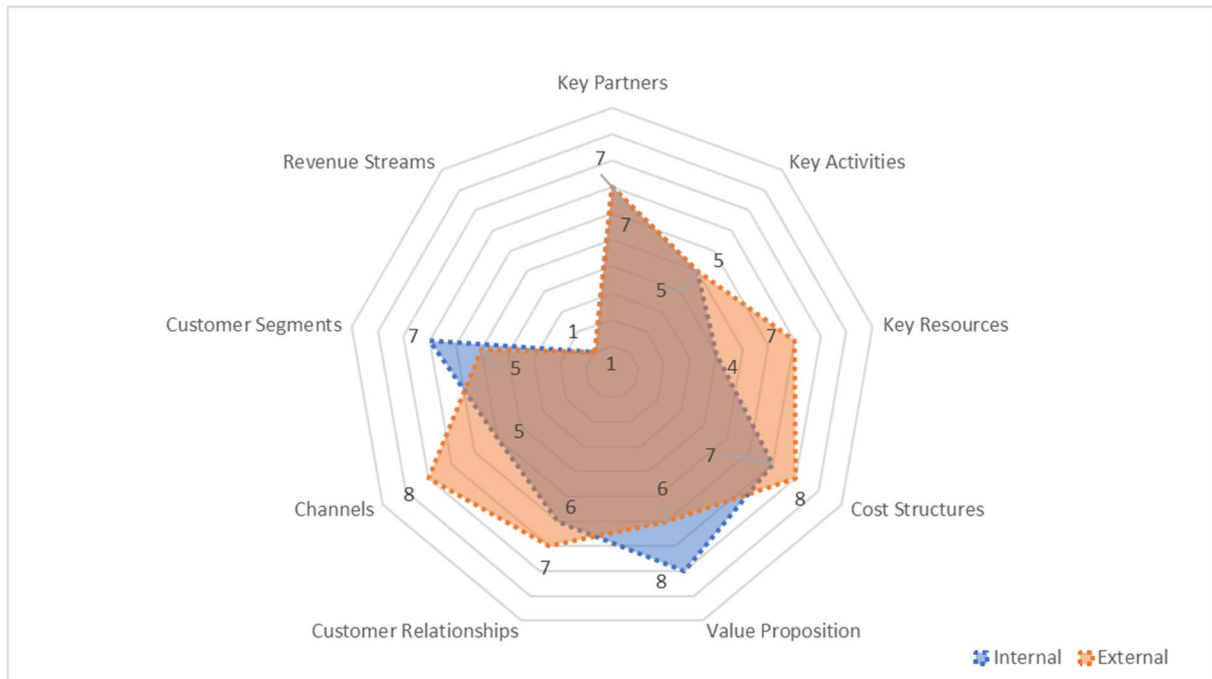
Overall, ER10 BM blocks seem to perform better on an external basis. Indeed, the results reveal some weaknesses of internal origins in the Business Models. This observation is not alarming, as it remains possible to improve the scores through small improvements related to the organization of the BM which is easier to control than external elements.

The self-evaluation assesses a high score in regards the BM position within its environment in the cost structures, and channels categories.

Similarly, high scores were granted in regard to its internal organization related to the value proposition category.

Nonetheless, a lower score was granted to the key partners section on an internal basis. Indeed, LINKS states that they generally work well with their partners, and a good working relationship was established throughout the project with key partner. However, ER10 was developed without any contributions from FLEXIGRID partners, thus the strength of the BM cannot be counted on this specific characteristic.

Secondly, a lower score was obtained by the key activities category on an internal basis. Indeed, as per the answers given by LINKS, ER 10 key activities could easily be copied. Indeed, the open-source nature of the ER makes it open to replicate by competitors and other entities. No simple solution exists to protect the key activities from this issue, as the open-source status is precisely the reason for it.

Moreover, the key resources category was also granted a lower score on an internal basis. As LINKS is not specialized in software, the right resources are not always deployed at the right time by lack of expertise on the subject. Further knowledge acquired through time could benefit such BM segment.

The internal cost structure score can be justified by the predictability of costs. Indeed, while cost are predictable the open source status of ER10 does not allow putting cost in perspective of revenues. As

no revenues are expected from ER10, the score cannot really be evaluated accurately, nor improved easily.

In addition, the customer relationships also obtained a lower score on an internal basis through ER10 BM self-evaluation by LINKS. Although LINKS reports a good relationship with potential ER10 users and enjoys the advantages of a strong brand as recognized research institute in Italy, potential users are not bound to ER10 through high switching costs, which could weaken ER10 BM. Also, while LINKS established some contacts with other research institute working in the energy field and is enlarging relationships in this branch, TSO/DSO and ESCO are not yet main partners. Thus, relationships are not exactly correctly matched yet with customers (or in this case users) segments, weakening ER10 BM.

The channels segment was also evaluated as weaker on an internal basis by LINKS self-evaluation. Indeed, as the ER10 is to be accessible as an open-source tool, marketing channels are not numerous. In effect, LINKS's experience in research and past collaborations in the energy sector created effective word of mouth channels. LINKS stated it goal to improve this section of the BM in the future. As of today, new potential users can use LINKS's website as a channel. While only competences are described there and no products are advertised, the improvement could be centered on the integration of the products and services developed or in development.

The customer segments section was also evaluated as rather weaker than other section on an internal basis. Indeed, LINKS worked in the research field for the last twenty years and thus collaborated with many partners leading to long lasting collaborations. With specific regards to the energy sector LINKS aims to further increase the number and the segments of customers in the next few years. Thus, while the customer segment section of ER10 BM is not at an ideal place, it can and will be improved.

Finally, in regard to both internal and external basis, the score granted to the revenue scores segment is justified as ER10 is not expected to bring any revenues due to its open-source status. Thus, this particular segment of ER10 is not applicable to an evaluation.

Moreover, lower scores were also expressed due to six blocks interaction within their environment. Firstly, the key partners block is deemed weaker because greater opportunities could be reached, through the reach of customer through partner channels, or outsourcing thanks to collaboration with other partners. However, the current status of this section within ER10 BM presents opportunities on its own. Indeed, LINKS enjoys strong relationships with its partners, collaboration with partners could be considered, the dependence to partners is manageable, and partners can and are invited to complement ER10 value proposition.

Secondly, the key activities block is also regarded as a weaker block for ER10 BM. Indeed, reducing documentation and bureaucracy has been identified by LINKS as one of the means, which could improve efficiency in general and therefore create opportunities for ER10 BM. In addition, bettering the methodology in place for future projects and generating assets to be used as a basis for new proposals and offers could standardize some key activities and therefore strengthen the BM. Overall, while the efficiency is not currently at its full potential, means to improve exists which establishes opportunities for ER10's future.

Thirdly, on an external basis, key resources is also a segment which was granted a lower score. While resources are partners, staff and knowledge, less costly resources are not findable nor usable. Indeed,

disruption in the supply of certain resources could not be faced in the current state of the BM. However, the quality of resources threatened in any way.

The value proposition section is also the subject of a lower score. Keeping in mind that ER10 will be available as an open-access software, competition threat, and revenue recurrence does not apply to the BM evaluation. However, complements to the value propositions as well as additional customer needs could be satisfied. LINKS could extend the study in ICT for energy as requested by the possible future partners, as well as extend its value proposition by making available decision-making tools, electricity market analysis, or even smart charging algorithms.

Furthermore, the customer relationships section was granted a lower score on an external basis due to the opportunities missed for ER10 BM. Indeed, relationships cannot be automated. However, customer relationships are in no danger of deteriorating, and the strong relationship can be assigned to the supply of interesting competences which means ER10 BM is protected from this type of threat. Opportunities are still existing for ER10: revenues do not depend on customers as the project funded ER10, and personalization would be available upon request to users.

Finally, the customer segments section is the last of the sections to have been granted a lower score on an external basis. While market saturation is not relevant for ER10 BM as the product is only at its research phase now and will not be launched on the market as a proper product but as an open-source material. As stated before, customization to better addressed customer needs and serve finer customer segmentation could be requested and made accessible. The score on this particular section as for above-mentioned section is mostly due to the fact that ER10 will not be commercialized properly. Thus, the overall BM is not the strongest amongst FLEXIGRID's ERs.

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

Table 92. ER11 SWOT Analysis

	Positive *(to reach the goals)*	Negative *(to reach the goals)*
Internal Origins *(in the organization)*	**STRENGTHS** 1. The main strengths of ER11 BM resides in its capacity to improve the operation of protection algorithms that use faulted phase selection for their operation such as distance protection. Therefore, the reliability and safety of the network is improved.	**WEAKNESSES** 1. The limitations to incorporate the algorithm it into hardware can be an obstacle to ER11 development. 2. Moreover, the project is at laboratory scale, and not mature enough to be launched. Additional tests are needed in network configurations.
External Origins *(environment)*	**OPPORTUNITIES** 1. While these algorithms can fail in renewable scenarios ER11 is developing a solutions to that problem (ZIV on the KER 3)	**THREATS** 1. Appearance of new algorithms for the same application can be a threat to the protection algorithm development to improve current protections used in distributions grids with high RES penetration business development.

		2. In addition, the obligation to partner with a relay manufacturer hinder the BM and independence of the Exploitable result.

This SWOT table constructed thanks to partner's self-analysis of their BM provides a snapshot of the current BM status (strengths and weaknesses). It also suggests some future trajectories (opportunities and threats).

Thus, the strength of ER11 business model resides in the improvement it brings to the network reliability and safety. Indeed, as it improves the operation of protection algorithms using faulted phase selection for their operation (as distance protection) it sets ER11 apart and strengthen its business model as a whole. For the future, opportunities related to solving the specific problem regarding failure in renewable scenarios could advance ER11 BM.

However, overall ER11 BM also considers weaknesses. Indeed, the limitation in the algorithm implementation into hardware elements, and the laboratory scale of the ER can be weaknesses to ER11 BM impeding its launch and development. On the other hand, for the future, threats such as the appearance of competitors' algorithms with similar applications, and the dependence from a relay manufacturer, can hinder ER11 future and improvement.

3.12.1   Blocks Analysis

Each Business model block presented in section 2.12 for the ER11 is the subject of a self-evaluation from CIRCE both on an internal and external basis. Thus, the scores of each block is available in the following graph (Figure 34).

Figure 34.   ER11 BM Internal and External block evaluation
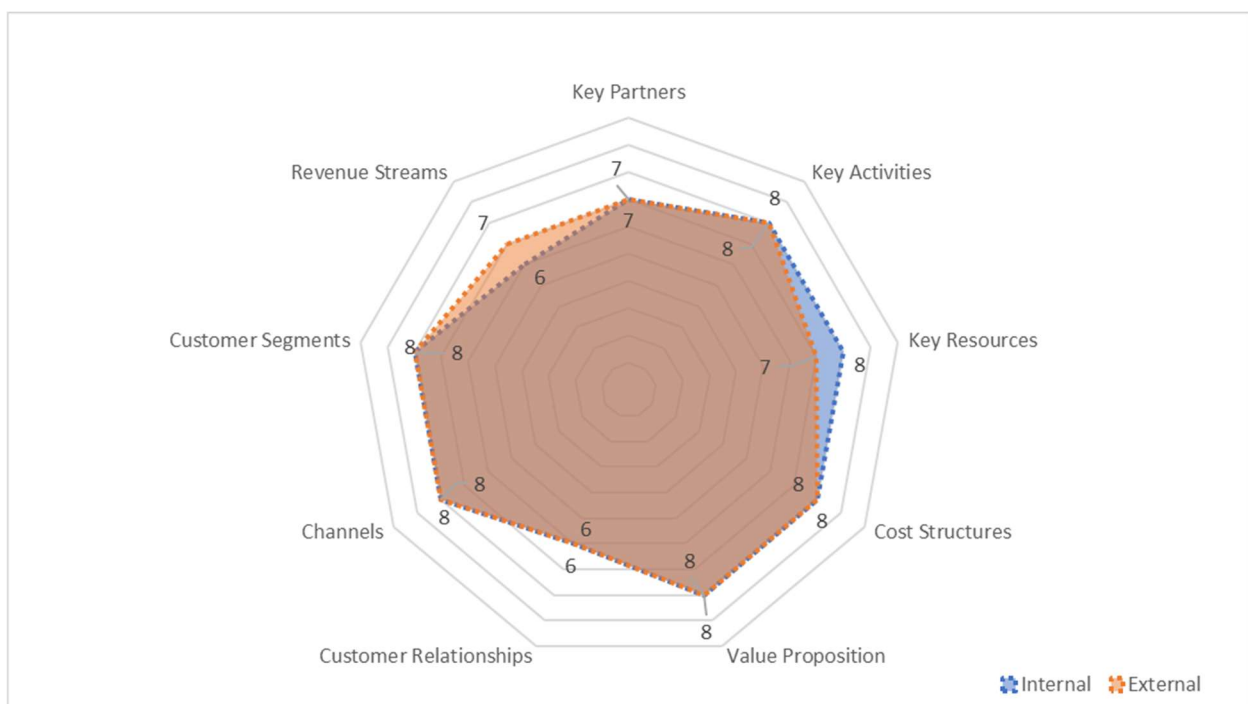
Overall, ER11 BM blocks seem to perform better on an internal basis. Indeed, as control over internal elements is higher than over external elements.

The self-evaluation assesses a high score in regards the BM position within its environment in the key activities, cost structures, value proposition, channels, and customer segments categories.

Similarly, high scores were granted in regard to its internal organization related to key activities, key resources, cost structures, value proposition, channels, and customer segments categories.

However, a lower score was obtained regarding the key partners category on an internal basis. Indeed, as per the answers given by CIRCE, dependence to manufacturers is a weakness. The difficulty in finding a manufacturer interested in collaborating with CIRCE for the development of the technology might hinder the development of the algorithm. In addition, the dependence to a single manufacturer could also happen, making the key partners block just as weak. However, CIRCE already started contacting market analysis and potential partners to begin collaborations when the project ends.

The customer relationships block was also the object of a lower score on an internal basis. Indeed, as mentioned above the unlaunched status of the algorithm is to be kept in mind. As the tests and validations of the algorithms have not been completed yet, no potential customers outside of the project have been contacted yet.

Finally, the revenue streams block in relation to the internal organization of the business model scored a lower grade. It can be explained again by ER11 lack of maturity. While the algorithms should bring great value to customers, the costs and price have not been defined yet, and thus revenues remain to be calculated. CIRCE is currently working on the business model and the forms of exploitation to be finalized after the end of the project.

Moreover, lower scores were also expressed due to four blocks interaction within their environment. Firstly, the key partners block is deemed weaker because of the potential dependency to manufacturers helping to achieve exploitation goals. As stated by CIRCE, Collaboration with partners could complement the value proposition and become an opportunity for ER11, but the risk of not finding a manufacturer exists and it cannot be stated it has been curved yet because of ER11 Business Model lack of maturity.

Secondly, the key resources block is also regarded as a weaker block for ER11 BM. Again, while key resources are defined and considered as well exploited, some of the resources still need to be put into operation for the exploitation of this result. Then other opportunities remain to be explored and the score could potentially be higher when ER11 BM is more mature.

Thirdly, the customer relationships block can be listed as one of the weaker blocks for ER11 BM regarding the external analysis. Potential customers have not yet been contacted outside the project. A clear score cannot yet be given but, it is expected that CIRCE works with a specialized market team to achieve a good segmentation of the target audience and potential customers.

To conclude, the revenue streams block is the last one to achieve a weaker score under the external analysis. The revenue opportunities are high because as the solution can be interesting for potential customers. In addition, since the exploitation objective is linked to establishing a partnership with a manufacturer, it is possible that the market will open up to new potential customers, which the manufacturer company would already hold in its customer portfolio.

3.13   ER 12: Software module for flexibility assets emergency operation

Table 93. ER12 SWOT Analysis

	Positive *(to reach the goals)*	Negative *(to reach the goals)*
Internal Origins *(in the organization)*	**STRENGTHS** 1. The main strengths of ER12 BM resides in high adaptability of the software to different assets and different network topologies*.* 2. In addition, the software can also be compatible with different technologies and components brands. 3. ER 12 BM is also reinforced by its value to DSOs, indeed, it reduces their line reinforcement costs. 4. Finally, thanks to the software module for flexibility assets emergency operation, the network is capable of managing larger energy flows	**WEAKNESSES** 1. The possible difficulty in horizontal scalability and applicability in different instances could become an obstacle to the ER development.
External Origins *(environment)*	**OPPORTUNITIES** 1. As RES penetration trends favor the implementation of this type of flexibility software, future opportunities could be identified for ER12. 2. ER12 also promotes the implementation of DERs in the network making it indispensable in future networks.	**THREATS** 1. The appearance of competitors' systems that use artificial intelligence and that could make the implementation in the network faster could be a threat to ER12 BM. 2. In addition, backend service defined as dependency on third-party licenses, server space, and availability is one of the weaknesses hindering ER12 BM.

This SWOT table constructed thanks to partner's self-analysis of their BM provides a snapshot of the current BM status (strengths and weaknesses). It also suggests some future trajectories (opportunities and threats).

Thus, the strength of ER12 business model reside in the adaptability and compatibility of the software, its ability to reduce line reinforcement cost for DSOs, as well as enabling the network to manage larger energy flows. For the future, opportunities related to the RES penetration trends, and to the promotion of DERs implementation in the network, could advance ER12 BM.

However, overall ER12 BM also considers weaknesses. Indeed, the possible difficulty in horizontal scalability and applicability in different instances can be a weakness to ER12 BM impeding its launch and development. On the other hand, for the future, threats such as the appearance of competitors'

systems using AI, which could make the implementation in the network faster, and the dependency from third parties can hinder ER12 future.

3.13.1   Blocks Analysis

Each Business model block presented in section 2.13 for the ER12 is the subject of a self-evaluation from CIRCE both on an internal and external basis. Thus, the scores of each block is available in the following graph (Figure 35)

Figure 35.   ER12 BM Internal and External block evaluation
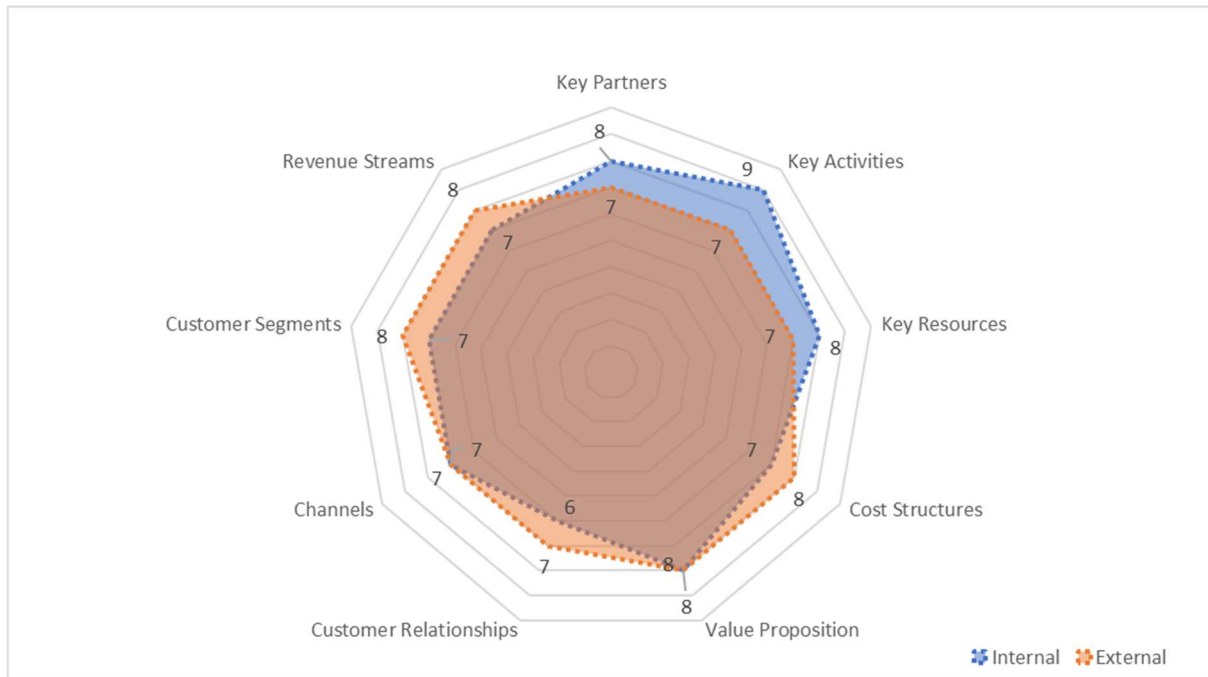
Overall, ER12 BM blocks seem to perform better on an external basis. Indeed, the results reveal some weaknesses of internal origins in the Business Models. This observation is not alarming, as it remains possible to improve the scores through improvements related to the organization of the BM which is easier to control than external elements.

The self-evaluation assesses high scores in regards the BM position within its environment in the cost structures, value proposition, customer segments, and revenue streams categories.

Similarly, high scores were granted in regard to its internal organization related to key partners, key activities, key resources, and value propositions categories.

However, a lower score was obtained regarding the cost structure category on an internal basis. Indeed, as per the answers given by CIRCE, while the costs are relatively predictable, they will depend on different variables such as engineers' wages. In addition, all cost concepts have not yet been fully defined to determine operations cost-efficiency as the solution is not yet launched.

The customer relationships block was also granted a weaker score on the internal level as the tests and validations have not been completed yet. Thus, potential clients outside the project have not been contacted yet.

In addition, the customer segments obtained a lower score due to similar reasons. As the solution has not been launched yet, the BM is not yet complete. Potential customers outside the project have not been contacted yet, however, expectations good.

Finally, the last of the block to be granted a lower score on an internal basis is related to revenue streams. The developed software has advantages bringing great value to potential customers. Nevertheless, as the costs and the price have not yet been fully defined, therefore clear revenue has not been defined either. CIRCE is currently working on the business model and the forms of exploitation to be chosen once the project is over.

Moreover, lower scores were also expressed due to two blocks interaction within their environment. Firstly, the key resources block is deemed weaker because of ER12 current maturity. As stated by CIRCE, the key resources are defined and are considered to be well exploited. Some of the resources still need to be put into operation for the exploitation of this result and therefore there are still opportunities to be explored.

Lastly, the customer relationships block is also regarded as a weaker block for ER12 BM. Indeed, once again the test and validation completion status means that potential customers have not yet been contacted. CIRCE states that future work related to customer relationship will be achieved with a specialized market team to obtain good segmentation of the target audience and potential customers.

3.14   ER 13: Fault location TDR prototype

Table 94. ER13 SWOT Analysis

	Positive *(to reach the goals)*	Negative *(to reach the goals)*
Internal Origins *(in the organization)*	**STRENGTHS** 1. The main strengths of ER12 BM resides in it simple installation. Indeed, it only requires the installation of a single asset, and no previous knowledge of network topology (mapping) is required to use the fault location TDR prototype. 2. In addition, the hardware part of the solution is adaptable to any location, which sets it apart from other similar solutions. 3. In addition, ER13 is cheaper than current traveling wave method systems, making it advantageous and appealing to potential customers.	**WEAKNESSES** 1. The sampling rate is very high and does not allow continuous recording (real time), this could become an obstacle to the ER13 development. 2. In addition, to achieve location fault accuracy, knowledge about pulse propagation speed is necessary. This dependency could become an obstacle to the ER13 development. 3. Similarly the dependency is carried out in the need for treatment of received signals to determine the fault location (coupling signal by the injector). 4. Furthermore, signal synchronization between fault and pre fault is needed, the complex set up necessary for the solution to function and the dependency from them could hinder its development.

		5. The high development costs could be a weakness of ER13 BM and hinder its launch and development. 6. The final weakness which could be identified is related to the detection range distance limitation (to ensure accuracy), making it potentially less effective and efficient than other similar solutions.
External Origins *(environment)*	**OPPORTUNITIES** 1. There is no other asset on the market for distribution networks (medium voltage), marking a clear opportunity for ER13 future. 2. Moreover, still on the economic topic, reducing the fault detection time allows savings for the DSOs who would have to pay for the time to recover the energy service. 4. Finally the increasing implementation of RES creates an opportunity for ER13 and this MV lines type will have more impact in the electrical network thanks to ER13.	**THREATS** 1. To determine the exact location, another asset is needed that can identify the network line in which the fault has occurred, making ER13 dependent to another solution which might become a threat.

This SWOT table constructed thanks to partner's self-analysis of their BM provides a snapshot of the current BM status (strengths and weaknesses). It also suggests some future trajectories (opportunities and threats).

Thus, the strength of ER13 business model reside in its simple installation, its good price point, and adaptability to chosen implementation location. For the future, opportunities related to its uniqueness as an asset for distribution networks, its value proposition, the savings it could facilitate for DSOs, and the change of the market fostering RES implementation in MV lines could advance ER13 BM.

However, overall ER13 BM also considers weaknesses. Indeed, the high dependency to exterior data and its treatment, as well as the complexity of gathering and treating said data, the limited detection range distance, and the high development costs can be weaknesses to ER13 BM impeding its launch and development. On the other hand, for the future, threats such as the dependency to another solution can hinder ER13 future.

3.14.1   Blocks Analysis

Each Business model block presented in section 2.14 for the ER13 is the subject of a self-evaluation from CIRCE both on an internal and external basis. Thus, the scores of each block is available in the following graph (Figure 36).

Figure 36. *ER13 BM Internal and External block evaluation*
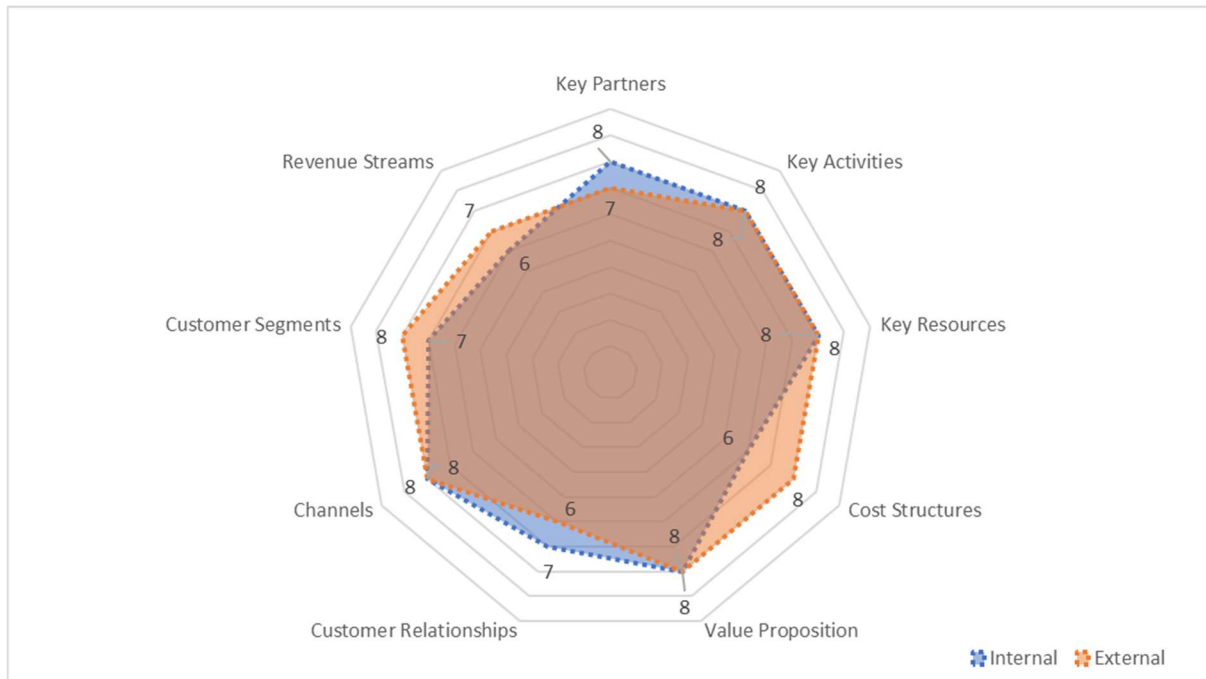
Overall, ER13 BM blocks seem to perform better on an external basis. Indeed, the results reveal some weaknesses of internal origins in the Business Models. This observation is not alarming, as it remains possible to improve the scores through improvements related to the organization of the BM which is easier to control than external elements.

The self-evaluation assesses high scores in regards the BM position within its environment in the key partners, key activities, key resources, value proposition, channels, and customer segments categories.

Similarly, high scores were granted in regard to its internal organization related to kay activities, key resources, cost structures, value proposition, and channels categories.

However, a lower score was obtained regarding the cost structure category on an internal basis. Indeed, as per the answers given by CIRCE, while costs are predictable, and concepts have been identified on the business model canvas, it cannot yet be determines how efficient the operation is in comparison with the costs. Further work before the solution launch is needed to ensure a strong cost structure block.

The customer relationship block was also granted a lower score. Indeed, the Fault location TDR is currently being tested and validated in the FLEXIGRID demo-sites and their environment. As the solution is not mature enough yet to be launched, no customers outside the project have been contacted nor have any customer relationship been established.

Similarly, the customer segments block follows the same scoring pattern for the same reasons. As tests and validations are currently being completed, potential customers have not been contacted. Although CIRCE expectations are good it is not certain that, a great success will be encountered nor that new customers will be acquired.

The last of the block to obtain a lower score on the internal basis analysis is related to revenue streams. According to CIRCE, ER13 will surely bring great value to potential customers. However, due to the current maturity status of the solution, the cost and price have not yet been fully defined. Thus, clear revenue is yet to be determined. Further work on the business model and on the exploitation forms is to be fulfilled once the project is finished.

Moreover, lower scores were also expressed due to three blocks interaction within their environment. Firstly, the key partners block is deemed weaker because the dependence on manufacturers for ER13 could weaken the business model. Indeed, collaboration with partners could complement the value proposition. In addition, a higher score can be granted if the risk of not finding a manufacturer to help meeting exploitation goals can be dismissed.

Secondly, the customer relationships block is also regarded as a weaker block for ER13 BM. Much like the same block on an internal basis, the external analysis is incomplete as the tests and validation processes are yet to be completed. Indeed, no potential customers have been contacted yet outside the project. Although a clear score cannot be given yet regarding the customer relationship block, CIRCE expects to work with a specialized market team to achieve a good segmentation of the target audience and potential customers.

Finally, the revenue stream block is the last of the blocks to have been granted a weaker score on an external basis. The revenue opportunities are high according to the market analysis carried out, and the solution is interesting to potential customers. In addition, the relationship to be established with a manufacturer could become an opportunity for the Fault location TDR prototype business model. Indeed, it is possible that the market will open up to potential clients that this company already has in its customer portfolio.

4. CONCLUSIONS AND RECOMENDATIONS

To conclude, this document presents FLEXIGRID final BM for each exploitable result, as well as an evaluation of FLEXIGRID BM.

4.1 Overall analysis of revenue streams and cost structures impactful variables

As the last sub-part of this first part of the document, a presentation of available data regarding both revenue streams and costs was performed for each ER, detailing the variables with the most impact on costs and revenues.

4.1.1   Impactful variables on FLEXIGRID exploitable results

Thus, it has been recognised that revenue streams variables with the most impacts for the solutions is split in three main categories which are detailed in table 95.

Table 95. Analysis of variables impacting FLEXIGRID revenue streams the most

ER Variables impacting revenue streams	ER1a	ER1b	ER2	ER3	ER4	ER5	ER6	ER7	ER8	ER9	ER10	ER11	ER12	ER13
ERs Value proposition		✔				✔			✔				✔	✔
Units prices			✔	✔	✔									
Number of customers							✔	✔				✔		

Firstly, the value proposition of the exploitable results has been identified as an impactful variable for revenue streams. Indeed, the product or solution offer, setting it apart from competition, as well as the solution acceptability by customers will play an important part in the success of the BM and in turn determine the revenue streams flow heaviness.

Secondly, ER2, ER3, and ER4, all hardware solutions, will see their revenue streams most impacted by the unit prices. Indeed, for each of them the price chosen to sell their item will be an important playing factor in the success of the business model as it will make out most (if not all) of the revenue streams for the exploitable result. Different strategies of price setting are available to reflect different revenue streams strategies, once one is chosen companies need to stick to it. The five most commonly used are:

- *Price-skimming* (unit prices are set high to reflect the quality of the product or service, margins are wider which allows to alleviate potential threats and risks to adapt to the market).
- *Price dominance strategy or alternatively penetration pricing* (unit prices are set low to dominate the market and install rapidly and permanently a leader position to attain a negotiation strength. However, the low cash flows make it difficult to adapt to change. In the case of penetration pricing, prices are set low at first to enter the market before being raised later).
- *Competitive pricing* (unit prices are set according to competitors' prices, this alignment strategy is only coherent if an established market already exists. This strategy necessity a carefully shaped cost structure, as the BM will be vulnerable to changes in the market).

- *Cost-plus pricing* (unit prices are made of the costs with an added mark up. This strategy allows prices to take into consideration costs as well as save time, but it might leave the BM vulnerable to the reality and changes in the market).
- *Value-based pricing* (unit prices are set according to customers' belief in the product or service worth. This strategy implies a strong value proposition from other competing products. If customization or a strong differentiation are not available then this strategy is not adapted).

Thirdly, revenue streams can be most impacted by the number of customers purchasing the developed FLEXIGRID solution. Those software exploitable results will find customer quantity and their satisfaction to be the most important variable in the success of their BM. Thus, for those, customer segmentation and relationship, as well as channels will be the blocks to be the most determining in the ERs success.

Finally, ER1a, ER9, and ER10 have variables impacting revenue streams that are different from other solutions. ER1a determined that the product portfolio and the customisation of the solution to customer needs will have the most impact on revenue streams, linking it to the previously mentioned ER most impacted by customer quantity and satisfaction, recommendations to refine customer segmentation, customer relationship, and channels is once again applicable. The appearance of tender where ER9 could be offered will be determining in its revenue streams success, therefore brand strength and reputation is to be carefully harvested. Lastly, ER10 inexistent of revenue streams after the end of the FLEXIGRID project due to its open-source status explain the lack of analysis regarding impactful variables on ER10 BM success.

4.1.2   Impactful variables on FLEXIGRID cost structures

In addition, variables impacting the most each ER cost structures have also been identified in table 96.

Table 96. Analysis of variables impacting FLEXIGRID cost structures the most

ER / Variables impacting cost structures	ER1a	ER1b	ER2	ER3	ER4	ER5	ER6	ER7	ER8	ER9	ER10	ER11	ER12	ER13
Human resources		✔	✔ (during the project)	✔ (during the project)		✔					✔ (during the project)	✔	✔	✔
Material costs			✔	✔	✔	✔								
Solution integration costs							✔	✔	✔					

ER1b, ER2, ER3, ER5, ER10, ER11, ER12, and ER13 have in common the variable with the most impact on cost structures being human resources. Indeed, personnel costs have been determined as the biggest part of the cost structure to develop and manufacture these FLEXIGRID exploitation results. In particular for ER2, ER3 and ER10, this variable has been determined as the most impactful at the project stage of the ER.

When talking about the product itself, ER2 and ER3 cost structures are most impacted by material costs, as ER4, and ER5 are. Material resources and their accessibility can become a threat or an opportunity to those ERs future, impacting in turn their overall BM and prices.

ER6, ER7, and ER8 solution integration costs, which can be associated to customisation to customer needs, will have the most impact on the cost structure of each ER BM. As each customer could potentially display different needs, customisation is a resource-hungry activity impacting the cost structure.

Finally, ER1a, and ER9 cost impactful variables are from each other as well as from the rest of FLEXIGRID ERs. While ER1a's technology development and use would be the variable with the most impact of its BM cost structures, ER9 maintenance solutions available to customers would also be impacting strongly its cost structures.

The second part of the main body of the document displays a self-evaluation work which has been demanded of FLEXIGRID partners. Thanks to the final BM table presented in the beginning of each sub part in the first part of the document, FLEXIGRID partners where able to address the overall BM for each ER and determine their strengths, weaknesses, as well as the opportunities and threats for their futures.

4.2 Overall summary of BM SWOT analysis

Thanks to the SWOT analysis carried out by FLEXIGRID partners for each exploitable result, a clear comparison of similarities and differences between the different business models characteristics is observable. Findings are resumed in tables 95, 96, 97 and 98. It depicts the strengths, weaknesses, opportunities and threats of FLEXIGRID business model, and issues recommendations for the main weaknesses and threats identified. Thus, on an internal basis, it is observed that the most common strength in FLEXIGRID ERs resides in ERs specific characteristics, the main weakness is related to partner structural weaknesses. On an external basis, the most common opportunity amongst FLEXIGRID ERs is the societal decarbonisation efforts, and the main identified threat is competitors offering similar technologies, products or services.

4.2.1   Strengths

Firstly, the table 97 is highlighting the four main strengths that have been identified by FLEXIGRID partners in their self-evaluation. Partners experience and expertise strengthen both the services and products proposed as well as the brand image of companies. ER specific characteristics are different for each ER but overall set the solution apart from competitor's solutions. Lastly, the value proposition of the ER strengthens its BM by being well adjusted to customers' needs and values.

Table 97. Analysis of FLEXIGRID business models strengths

ER / Elements strengthening the BM	ER1a	ER1b	ER2	ER3	ER4	ER5	ER6	ER7	ER8	ER9	ER10	ER11	ER12	ER13
Partner's experience	✔		✔	✔										
Partner's expertise	✔		✔	✔	✔		✔	✔						
ER specific characteristic	✔	✔		✔		✔	✔			✔	✔	✔	✔	✔
ER Value proposition							✔			✔			✔	

In addition to the above-mentioned strengths that have been identified for a number of FLEXIGRID ERs, six more specific strengths have been exposed on specific ERs. ER1b for example is also strengthened by its innovative design making it mostly unique on the market. ER4 is strengthened by

the stakeholder contact it established during the FLEXIGRID project, which will be carried out beyond it. ER7 is strengthened by it synergy with ER6, making the overall solution stronger. ER8 presents to specific elements: the versatility of the BM and the number of already available customers, overall strengthening its business model. Finally, ER13 cost structures allowing a competitive cost to emerge benefits its BM and more particularly its value proposition, as well as its revenue streams.

4.2.2   Weaknesses

Secondly, table 98 is highlighting the six main weaknesses that have been identified by FLEXIGRID partners in their self-evaluation. Costs in the development and manufacture of ERs hinder BMs. Costs structures can be impactful on a number of BM blocks such as the value proposition (making the ER unaffordable to customers), cost structures and revenue streams, refining and following up on those blocks can help the overall impact of this weakness. Partner structural weaknesses can range from a lack of market expertise and the need for important efforts to reach commercialisation phases (ER2, ER10 and ER4), or a lack of resource availability within the company (ER3). These weaknesses are hard to overcome as a restructuration of the company is an important endeavour. A review of resource management and organisation can be helpful activities to prevail over this weakness. The adaptation of the ER to its environment or to customer needs have also been identified as main weakness for FLEXIGRID ERs. Linked to this, the customisation and its resource-hungry nature or the lack of available customisation making the value proposition less strong can play important parts on BMs. The lack of test opportunities to test ERs in new environment can also weaken the value proposition and enticement of customers toward the solution. Thus, working on showing of knowledge, expertise and experience in the field can help counter such weaknesses. As established above some ERs benefit from partners image and knowledge. The difficulties in horizontal scalability have also been identified as a weakness for ER5 and ER12. While scaling out can be costly in terms of space and resources required, an alternative could be scaling up, increasing cost-efficiency, management ease, and flexibility. While limits are observed to vertical scalability as well, it remains an available a mid-term solution. Lastly, solution characteristics while representing strength before, can also hinder ERs BM. The difficulty of use (ER10), internal limitation (ER11 and ER13) are characteristics than research and development activities can improve, with further models to be developed later.

Table 98. Analysis of FLEXIGRID business models weaknesses

ER Elements weakening the BM	ER1a	ER1b	ER2	ER3	ER4	ER5	ER6	ER7	ER8	ER9	ER10	ER11	ER12	ER13
Costs	✔	✔							✔					✔
Partners structural weakness			✔	✔	✔						✔			
Adaptability to a new environment				✔			✔							
Adaptability of the solution (customisation or lack of thereof)								✔		✔	✔			
Difficulties in horizontal scalability						✔							✔	
Solution characteristic											✔	✔		✔

In addition to the above-mentioned weaknesses that have been identified for a number of FLEXIGRID

ERs, three more specific weaknesses have been exposed on specific ERs. ER8 and ER13 for example are also weakened by it's a BM structural issue marking the ER as less competitive or dependent on upfront investments. This could be improved through a restructuration of the business model. ER9 is weakened by the limited customer reach it is currently experiencing, adaptation of channels and refined customer segmentation is needed to strengthen the BM. ER11 is currently lacking maturity to ensure a successful market launch, only further development activities can then strengthen it BM.

4.2.3   Opportunities

Thirdly, table 99 is highlighting the four main opportunities that have been identified by FLEXIGRID partners in their self-evaluation. The societal decarbonisation efforts encourage de adoption of solutions adapting the electrical network to upcoming changes, making FLEXIGRID ERs solutions for electricity stakeholders advantageous. Similarly, the important market needs currently displayed or to be displayed boost the previously presented BMs as FLEXIGRID solutions are needed on the market. The number of potential customers, directly linked to market and customer needs also improved ERs BM as they prove to be externally needed. Lastly, the communication and dissemination activities engaged throughout the FLEXIGRID project have been identified as opportunities for future ERs. Communicating and targeting potential stakeholders is to be helpful to promote FLEXIGRID solutions.

Table 99. Analysis of FLEXIGRID business models opportunities

Elements offering an opportunity to the BM	ER1a	ER1b	ER2	ER3	ER4	ER5	ER6	ER7	ER8	ER9	ER10	ER11	ER12	ER13
Decarbonisation efforts			✔	✔	✔		✔	✔	✔		✔		✔	✔
Market needs (current or future)					✔	✔			✔	✔			✔	✔
Number of potential customers							✔	✔						
Communication during FLEXIGRID							✔	✔						

In addition to the above-mentioned opportunities that have been identified for a number of FLEXIGRID ERs, four more specific opportunities have been exposed on specific ERs. ER1a identified oncoming market changes such as communication improvements and development of electronics and miniaturization as opportunities. Indeed, it would improve a number of the BM blocks such as the value proposition, key activities, key resources, cost structures, and revenue streams. ER1b's possibility to be tested in different environment has also been identified as an opportunity for its BM. While it would further improve its value proposition it would also strengthen it experience and expertise and therefore benefit to customer trust in both the ER and the company. The ability to standardize ER6 key activities is also a boost to its BM, benefiting it resource management and usage which will in turn benefit cost structures and revenue streams. Finally, ER 11 identified the research potential to improve the value proposition as an opportunity for its BM future.

4.2.4   Threats

Lastly, table 100 is highlighting the five main threats that have been identified by FLEXIGRID partners in their self-evaluation. The rapidly changing legal framework at the European and national level

threatens FLEXIGRID ERs BM as rapid adaptability and changes might be required to follow new regulation. Overcoming such a broad threat is difficult at company's level. Adapting practises on short notice by demonstrating adaptability and planning alternative solutions thanks to careful monitoring the legislative environment remains the safest option to compensate this threat. Alternatively, if resources can be spared to operate lobbying activities, the threat could also be eluded. If such activities are successful, while the legal framework might change, it would not threaten companies' interests. Similarly, the threat of market change is difficult to foresee and surmount. As for the legal framework threat, adaptability and preparation, while not erasing the threat, would attenuate its blow upon the ERs BM. The presence of successful competitors offering similar technologies, as products or services has been identified as a main threat to FLEXIGRID ERs BM. An overall strong BM, value proposition, and an established excellent image thanks to experience and expertise would prevail upon this threat. Carefully cultivated customer relationship and customer satisfaction is also essential. Customer behaviour might prove a threat to FLEXIGRID BMs. Indeed, customers might decide to forego FLEXIGRID solutions, to develop them internally, or their need might change and in turn their need for the solution. Customer segmentation refinement would benefit the BM and diminish the likelihood of this particular threat to happen. Finally, the dependency to external stakeholders (third-party licenses, server space, equipment suppliers, stakeholders' customers, manufacturers, or stakeholders' solutions) is an important threat to FLEXIGRID BMs. The lack of autonomy due to the need to outsource some activities, lack of resources, or the lack of knowledge is degrading BMs. Two solutions can be considered to offset this threat: internally rehabilitate strategic key activities or key resources or expand key partners profile to avoid dependency to a single stakeholder.

Table 100.   Analysis of FLEXIGRID business models threats

ER Elements threatening the BM	ER1a	ER1b	ER2	ER3	ER4	ER5	ER6	ER7	ER8	ER9	ER10	ER11	ER12	ER13
Legal framework	✔	✔						✔						
Market change					✔		✔	✔						
Competitors			✔	✔	✔	✔	✔	✔	✔			✔	✔	
Customer behaviour				✔				✔			✔			
Dependency to external stakeholders						✔			✔	✔		✔	✔	✔

In addition to the above-mentioned threats that have been identified for a number of FLEXIGRID ERs, three more specific threats have been exposed on specific ERs. ER1a financing difficulties is identified as a threat to its BM, as financing can be both external and internal. Likewise, difficulties to attract investment can be classified as a threat to ER1a BM. Different financing and investment strategies exist and can be explored to overcome these threats. The high-level maintenance expected from customers for ER9 is identified as a threat to its BM. Indeed, to maintain customer satisfaction, skilled and satisfying maintenance is expected which would request much needed resources. Automation of certain parts of the maintenance procedure would alleviate the hit of this threat, as well reduce costs, instigate a regularly and efficient customer follow-up.

4.3 Business models individual blocks analysis

Overall, each business model blocks have been analysed in this deliverable (section 3). As a result, strength have been highlighted and weaker block have been identified and recommendations have been issued, when possible, for each individual BM block. As an overall analysis and conclusion to this document, the figure 37 presented below proposes an overall analysis of the average scores granted to FLEXIGRID ERs.

Figure 37.   Overall FLEXIGRID business models evaluation
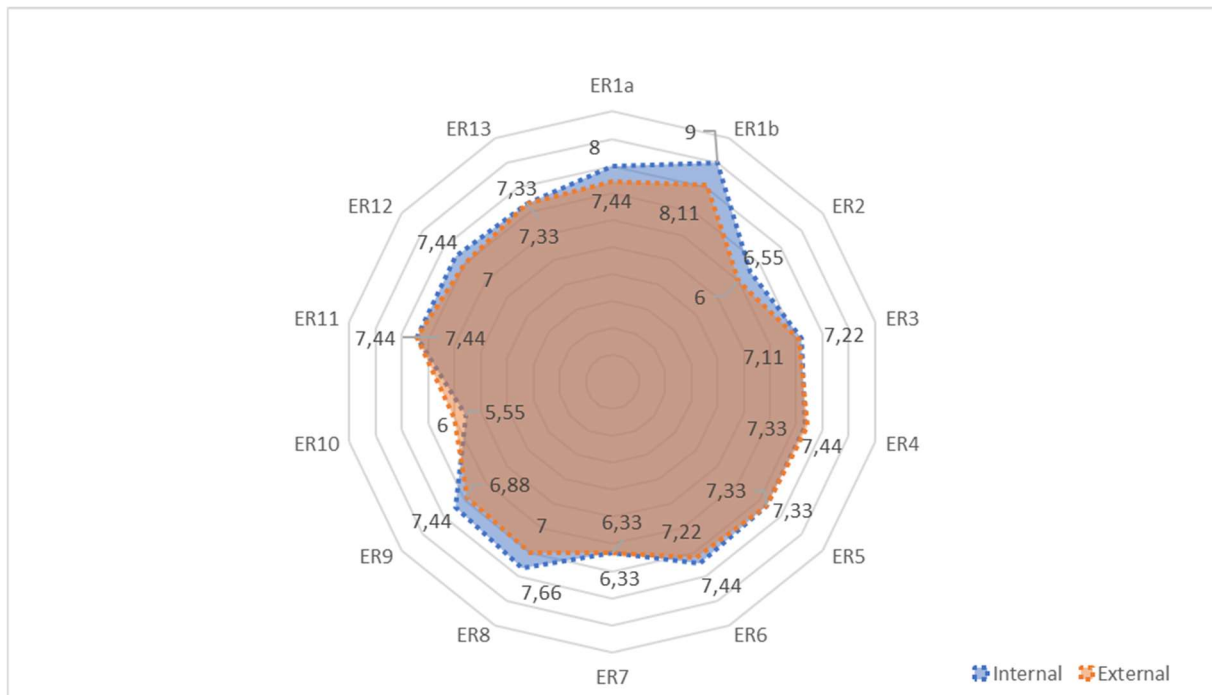
Figure 37 was constructed by calculating the average score given to all of the exploitable results both on an internal and then on an external basis. Thus, the average internal score depicted for is made of the score granted to all the BM blocks, just like the average external score.

Overall, FLEXIGRID ERs BM were given satisfactory scores. While most BMs obtained higher scores on an internal basis, it is to be expected since control over internal elements is easier to obtain and maintain than over external elements. In addition, it needs to be mentioned that ER10 BM seems to be the weakest, it is to be expected as it is the least developed business model, due to the decision to let this ER remain an open-source exploitable result.

5. REFERENCES

Books:

Adam J. Bock and Gerard George, *The Business Model Book: Design, Build and Adapt Business Ideas that Drive Business Growth*, Pearson (2018)

Alexander Osterwalder and Yves Pigneur, *Business Model nouvelle génération, Un guide pour visionnaires, révolutionnaires et challengers*, Pearson Education France, Paris (2011)

6. APPENDIX

6.1 Annex 1: BM Evaluation Template for Partner Contributions

Below is an example of the methodology template used to help partners self-evaluate their ER BM.

6.1.1   SWOT Analysis

FLEXIGRID partners are asked to fill the following table by listing:

- in the left column, the elements with a positive effect on the business model described in the Business Model development template
- in the right column, the elements with a negative impact on the business model described in the Business Model development template
- in the upper line, the elements with an internal origin to the business model described in the Business Model development template. These elements, as they are internal to the strategy surrounding the BM are amenable.
- in the lower line, the elements with an external origin to the business model described in the Business Model development template. These elements should be common to other solutions evolving in the same environment. As these elements have external origins, they are not amenable.

Table 101.   SWOT Analysis Template

	Positive *(to reach the goals)*	Negative *(to reach the goals)*
Internal Origins *(in the organization)*	**STRENGTHS** *(Elements should be listed from the stronger to the weaker in this case)*	**WEAKNESSES** *(Elements should be listed from the bigger weakness to the lesser in this case)*
External Origins *(environment)*	**OPPORTUNITIES** *(Elements should be listed from the stronger to the weaker in this case)*	**THREATS** *(Elements should be listed from the bigger weakness to the lesser in this case)*

For an overall analysis of the BM, it is suggested that the elements used to fill the table be drawn from different sections of the Business Model template filled along the project. Indeed, the following figure shows the most likely position for an answer to the SWOT analysis in the BM template (A. Osterwalder and Y. Pigneur, 2011).

Table 102.   SWOT Analysis placement by A. Osterwalder and Y. Pigneur
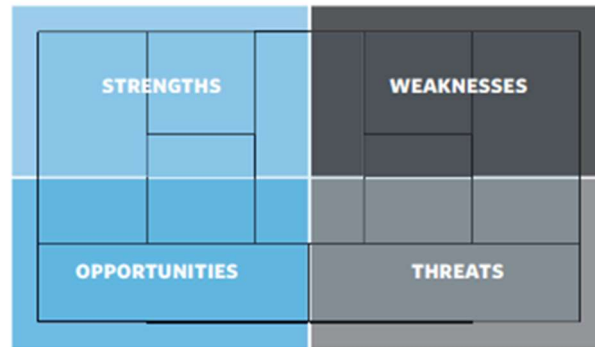
Then, after this overall analysis of the BM, a deeper and more detailed analysis is to be carried regarding the different blocks: key partners, key activities, key resources, cost structure, value propositions, customer relationships, channels, customer segments, and revenue streams. The following question to rank each block have been adapted from Osterwalder and Pigneur's methodology (2011).

6.1.2 Internal Blocks Analysis

Firstly, each block will be attributed a score from 1 to 10 (1 for a very weak block and 10 for a very strong block). A list of question which FLEXIGRID partners can use to guide their answer regarding the score which should be given to the block is available below. An analysis using these scores will be made to understand how the BM could be improved. Indeed, 'looking at its components in detail can also reveal interesting paths to innovation and renewal', as well as provide 'a good basis for further discussions, decision-making, and ultimately innovation around business models' (Osterwalder and Pigneur, 2011).

KEY PARTNERS

Please Color the appropriate cell

Very Weak	1	2	3	4	5	6	7	8	9	10	Very Strong

Non-exhaustive list of questions to help chose the appropriate score for the KEY PARTNERS block (adapted from Osterwalder and Pigneur, 2011):

- Are you rather focused and work well (strong) or unfocused and fail to work (weak) with partners when necessary?
- Do you rather enjoy a good working relationship (strong) or have a conflict-ridden work relationship (weak) with key partners?

KEY ACTIVITIES

Please Color the appropriate cell

Very Weak	1	2	3	4	5	6	7	8	9	10	Very Strong

Non-exhaustive list of questions to help chose the appropriate score for the KEY ACTIVITIES block (adapted from Osterwalder and Pigneur, 2011):
- Do you rather efficiently execute (strong) or inefficiently execute (weak) key activities?
- Are your key activities rather difficult to copy (strong) or easily copied (weak)?
- Is your execution quality high (strong) or low (weak)?
- Is the balance of in-house/outsourced execution rather ideal (strong) or asymmetric (weak)?

KEY RESOURCES

Please Color the appropriate cell

Very Weak	1	2	3	4	5	6	7	8	9	10	Very Strong

Non-exhaustive list of questions to help chose the appropriate score for the KEY RESOURCES block (adapted from Osterwalder and Pigneur, 2011):

- Are your key resources rather difficult for you competitors to replicate (strong) or easily replicated (weak)?
- Are your resources needs rather predictable (strong) or unpredictable (weak)?
- Do you rather deploy your key resources in the right amount at the right time (strong) or have trouble deploying the right resources at the right time (weak)?

COST STRUCTURE

Please Color the appropriate cell

Very Weak	1	2	3	4	5	6	7	8	9	10	Very Strong

Non-exhaustive list of questions to help chose the appropriate score for the COST STRUCTURE block (adapted from Osterwalder and Pigneur, 2011):

- Are you costs predictable (strong) or unpredictable (weak)?
- Is you Cost Structure is correctly matched to your business model (strong) or are your Cost Structure and business model are poorly matched (weak)?
- Are your operations are cost-efficient (strong) or are your operations are cost-inefficient (weak)?
- Do you benefit from economies of scale (strong) or not (weak)?

VALUE PROPOSITIONS

Please Color the appropriate cell

Very Weak	1	2	3	4	5	6	7	8	9	10	Very Strong

Non-exhaustive list of questions to help chose the appropriate score for the VALUE PROPOSITIONS block (adapted from Osterwalder and Pigneur, 2011):

- Are your value proposition rather well aligned with customers needs (strong) or rather misaligned (weak)?

- Do your value propositions have rather strong network effects (strong) or have rather no network effect (weak)?
- Is there rather strong synergies between your products and services (strong) or is there no synergies between your products and services (weak)?
- Are your customers rather very satisfied (strong) or have rather frequent complaints (weak)?

CUSTOMER RELATIONSHIPS

Please Color the appropriate cell

Very Weak	1	2	3	4	5	6	7	8	9	10	Very Strong

Non-exhaustive list of questions to help chose the appropriate score for the CUSTOMER RELATIONSHIPS block (adapted from Osterwalder and Pigneur, 2011):

- Do you have rather strong or weak customer relationships?
- Does your relationship matches correctly the customer segments (strong) or matches it poorly (weak)?
- Is your relationship binding customers through high switching costs (strong) or are the customer switching costs low (weak)?
- Is your brand strong or weak ?

CHANNELS

Please Color the appropriate cell

Very Weak	1	2	3	4	5	6	7	8	9	10	Very Strong

Non-exhaustive list of questions to help chose the appropriate score for the CHANNELS block (adapted from Osterwalder and Pigneur, 2011):

- Are your channels very efficient (strong) or inefficient (weak)?
- Are your channels very effective (strong) or ineffective (weak)?
- Are your channels reach strong among customers (strong) or are channels reach among prospects weak (weak)?
- Can customers easily see your channels (strong) or do prospects fail to notice your channels (weak)?
- Are your channels strongly integrated (strong) or poorly integrated (weak)?
- Do your channels provide economies of scope (strong) or do they provide no economies of scope (weak)?
- Are your channels well matched to customer segments (strong) or poorly matched to customer segments (weak)?

CUSTOMER SEGMENTS

Please Color the appropriate cell

Very Weak	1	2	3	4	5	6	7	8	9	10	Very Strong

Non-exhaustive list of questions to help chose the appropriate score for the CUSTOMER SEGMENTS block (adapted from Osterwalder and Pigneur, 2011):

- Are customer churn rates low (strong) or high (weak)?
- Is the customer base rather well segmented (strong) or unsegmented (weak)?
- Are you continuously acquiring new customers (strong) or are you failing to acquire new customers (weak)?

REVENUE STREAMS

<div align="center">Please Color the appropriate cell</div>

Very Weak	1	2	3	4	5	6	7	8	9	10	Very Strong

Non-exhaustive list of questions to help chose the appropriate score for the REVENUE STREAMS block (adapted from Osterwalder and Pigneur, 2011):

- Do you benefit from strong margins (strong), or are your margins poor (weak)?
- Are your revenues predictable (strong) or unpredictable (weak)?
- Do you have recurring revenue streams and frequent repeat purchases (strong) or are revenues transactional with few repeat purchases (weak)?
- Are your revenues streams diversified (strong) or do you depend on a sing revenue stream (weak)?
- Are your revenues streams sustainable (strong) or unstainable (weak)?
- Do you collect revenues before you incur expenses (strong) or do you incur high costs before you collect revenues (weak)?
- Do you charge for what customers are really willing to pay for (strong) or do you fail to charge for things customers are willing to pay for (weak)?
- Does your pricing mechanisms capture full willingness to pay (strong) or does your pricing mechanisms leave money on the table (weak)?

6.1.3   External Blocks Analysis

Secondly, each block will be attributed a score from 1 to 10 (1 for a block subjected to external threat and 10 for a block subjected to external opportunity). A list of question which FLEXIGRID partners can use to guide their answer regarding the score which should be given to the block is available below. An analysis using these scores will be made to understand how the BM could be improved. Indeed, 'looking at its components in detail can also reveal interesting paths to innovation and renewal', as well as provide 'a good basis for further discussions, decision-making, and ultimately innovation around business models' (Osterwalder and Pigneur, 2011).

KEY PARTNERS

<div align="center">Please Color the appropriate cell</div>

Threat	1	2	3	4	5	6	7	8	9	10	Opportunity

Non-exhaustive list of questions to help chose the appropriate score for the KEY PARTNERS block (adapted from Osterwalder and Pigneur, 2011):

- Are you in danger of losing any partners (threat)?
- Might your partners collaborate with competitors (threat)?
- Are you too dependent on certain partners (threat)?
- Could partners complement your Value Proposition (opportunity)?
- Could partner Channels help you better reach customers (opportunity)?
- Are there cross-selling opportunities with partners (opportunity)?
- Could greater collaboration with partners help you focus on your core business (opportunity)?
- Are there outsourcing opportunities (opportunity)?

KEY ACTIVITIES

Please Color the appropriate cell

Threat	1	2	3	4	5	6	7	8	9	10	Opportunity

Non-exhaustive list of questions to help chose the appropriate score for the KEY ACTIVITIES block (adapted from Osterwalder and Pigneur, 2011):

- Is the quality of your activities threatened in any way (threat)?
- Could you standardize some Key Activities (opportunity)?
- How could you improve efficiency in general (opportunity)?
- Would IT support boost efficiency (opportunity)?

KEY RESOURCES

Please Color the appropriate cell

Threat	1	2	3	4	5	6	7	8	9	10	Opportunity

Non-exhaustive list of questions to help chose the appropriate score for the KEY RESOURCES block (adapted from Osterwalder and Pigneur, 2011):

- Could you face a disruption in the supply of certain resources (threat)?
- Is the quality of our resources threatened in any way (threat)?
- Could you use less costly resources to achieve the same result (opportunity)?
- Which Key Resources could be better sourced from partners (opportunity)?
- Which Key Resources are under-exploited (opportunity)?
- Do you have unused intellectual property of value to others (opportunity)?

COST STRUCTURE

Please Color the appropriate cell

Threat	1	2	3	4	5	6	7	8	9	10	Opportunity

Non-exhaustive list of questions to help chose the appropriate score for the COST STRUCTURE block (adapted from Osterwalder and Pigneur, 2011):

- Which costs threaten to become unpredictable (threat)?

- Which costs threaten to grow more quickly than the revenues they support (threat)?
- Where can you reduce costs (opportunity)?

VALUE PROPOSITIONS

Please Color the appropriate cell

Threat	1	2	3	4	5	6	7	8	9	10	Opportunity

Non-exhaustive list of questions to help chose the appropriate score for the VALUE PROPOSITIONS block (adapted from Osterwalder and Pigneur, 2011):

- Are substitute products and services available (threat)?
- Are competitors threatening to offer better price or value (threat)?
- What other jobs could you do on behalf of customers (opportunity)?
- What complements to or extensions of your Value Proposition are possible (opportunity)?
- Which additional customer needs could you satisfy (opportunity)?
- Could you better integrate your products or services (opportunity)?
- Could you generate recurring revenues by converting products into services (opportunity)?

CUSTOMER RELATIONSHIPS

Please Color the appropriate cell

Threat	1	2	3	4	5	6	7	8	9	10	Opportunity

Non-exhaustive list of questions to help chose the appropriate score for the CUSTOMER RELATIONSHIPS block (adapted from Osterwalder and Pigneur, 2011):

- Are any of your customer relationships in danger of deteriorating (threat)?
- Do you need to automate some relationships (opportunity)?
- Have you identified and "fired" unprofitable customers? If not, why not (opportunity)?
- How could you increase switching costs (opportunity)?
- Could you improve personalization (opportunity)?
- How could you tighten your relationships with customers (opportunity)?
- Is there potential to improve customer follow-up (opportunity)?

CHANNELS

Please Color the appropriate cell

Threat	1	2	3	4	5	6	7	8	9	10	Opportunity

Non-exhaustive list of questions to help chose the appropriate score for the CHANNELS block (adapted from Osterwalder and Pigneur, 2011):

- Do competitors threaten you channels (threat)?
- Are you channels in danger of becoming irrelevant to customers (threat)?
- Could you better align Channels with Customer Segments (opportunity)?

- Could you increase margins by directly serving customers (opportunity)?
- Could you find new complementary partner Channels (opportunity)?
- Could you integrate your Channels better (opportunity)?
- How could you improve channel efficiency or effectiveness (opportunity)?

CUSTOMER SEGMENTS

<div align="center">Please Color the appropriate cell</div>

Threat	1	2	3	4	5	6	7	8	9	10	Opportunity

Non-exhaustive list of questions to help chose the appropriate score for the CUSTOMER SEGMENTS block (adapted from Osterwalder and Pigneur, 2011):

- Could your market be saturated soon (threat)?
- Are competitors threatening your market share (threat)?
- How likely are customers to defect (threat)?
- How quickly will competition in your market intensify (threat)?
- Could you better serve your customers through finer segmentation (opportunity)?
- Could you serve new Customer Segments (opportunity)?
- How can you benefit from a growing market (opportunity)?

REVENUE STREAMS

<div align="center">Please Color the appropriate cell</div>

Threat	1	2	3	4	5	6	7	8	9	10	Opportunity

Non-exhaustive list of questions to help chose the appropriate score for the REVENUE STREAMS block (adapted from Osterwalder and Pigneur, 2011):

- Which Revenue Streams are likely to disappear in the future (threat)?
- Do you depend excessively on one or more Revenue Streams (threat)?
- Are your margins threatened by competitors? By technology (threat)?
- Can you replace one-time transaction revenues with recurring revenues (opportunity)?
- What other elements would customers be willing to pay for (opportunity)?
- Do you have cross-selling opportunities either internally or with partners (opportunity)?
- What other Revenue Streams could you add or create (opportunity)?
- Can you increase prices (opportunity)?