D 9.1 Business model development for the deployment of the IPT and other technological solutions

WP9 – INSULAE Business Cases and Exploitation Strategies

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EXECUTIVE SUMMARY

This report represents the results of Task 9.1 of work package 9 from the H2020 project INSULAE. In this report an overview is given of the business models that were built around the major use cases stated in the grant agreement.

Each business model is developed by the partner that is the beneficiary of the respective use case and responsible for its implementation, while DNV GL provided the framework and templates for the canvas development.

Business model canvasses were developed for the following use cases and for the investment planning tool (IPT), which is a main deliverable of the project:

UC-1: Joint management of hybridized RES and storage

UC-2: Smart integration and control of water and energy systems

UC-3: Empowerment of islands' energy communities through 5G and IoT technologies for flexibility services

UC-4: Transition to DC grids

UC-5: Local bio-based economies supporting the electrical, thermal and transport systems integrated management

UC-6: Electrification of the islands' transport looking to grid frequency and voltage regulation

UC-7: Storage and power electronics for the stabilization of weak grids and microgrids

IPT: Investment planning tool; an online software and calculation tool, able to give the local island government as well as other stakeholders insight into the optimal opportunities and investments to decarbonize the island.

These model canvasses will give guidance and insight into the main success factors during the implementation of the specific use cases as well as the IPT in the pilots. Moreover, these canvasses will form a reference and placeholder for learning and insights that are gained during the pilots and thus for further exploitation once the project is completed.

This means that while different canvasses can be made for each of the use cases and the IPT tool, instead the different canvasses are treated as living documents that represent the latest choices and insights gained during the project and ensure consistency of the business model. This is especially relevant during the development of the cost benefit analysis.

TABLE OF CONTENTS

1 INTRODUCTION

An increasing number of new concepts and associated business models have recently seen the light in an increasingly competitive energy and utility sector. The percentage of renewable energy supply is set to increase, while reducing carbon emissions to limit climate change. Data analytics and digitalization are positioning themselves as a key factor in the business models relating to the electricity sector. Implementing decarbonization initiatives in insular locations present additional challenges on the operational level as well as the planning and organizational level. To this end, the INSULAE project aims to develop an Investment Planning tool, demonstrating, via its seven use cases, low carbon energy solutions to facilitate the decarbonization of islands.

1.1 Introduction of business models and canvasses

A business model is defined as tool meant to optimize the delivery of value to a defined targeted customer or group of customers. A business model canvas basically summarizes a business model and emphasizes the customer value in question, how to achieve it and how to deliver it. Because of its compactness it is very well suited to analyse the consistency of a business model regarding the optimization towards said customer value and the processes surrounding it. A business case usually is a quantification of a business model.

Even though value is a central concept in a business model, it is important to realize that value is relative to the targeted customer as well as implicitly linked to the cost to the customer of available alternatives. This ‘competition’ is not specifically considered in a canvas and is implicitly reflected in the customer value description. Thus, all other aspects within the canvas should support this value to the customer (customer value). By describing the set of parameters defining the canvas, while keeping the customer value in mind, this value is maximized, as is the chance that the business model described in the canvas will eventually lead to new business with a positive business case.

Therefore, in a business model canvas, the value proposition is positioned in the centre, with a description of the intended customer on the receiving part, surrounded by the description of the key processes, necessary key resources, partners and suppliers, customer relation, channels (to market as well as communication), cost structure and revenue streams. The value proposition, central in the canvas, is supported by all the other elements comprised in the canvas. An effective synergy can lead to a consistent proposition and satisfied customers.

Regarding energy systems, business models can vary drastically when comparing situations for mainland systems and island (or insular) systems. This is mainly because of the different alternative choices customers on islands have compared to customers on the mainland. Business cases for the transition to renewable energy systems need to consider the degree of decarbonization (and reduction in Greenhouse Gas emissions), decentralization (implementation of smart grids), digitalization (regulation through IT systems for example) and democratization. This has proven to be more challenging for insular locations as opposed to mainland situations, which is one of the main reasons the H2020 INSULAE project was set up.

2 OBJECTIVE AND PROCESS OUTLINE

The main objective of the INSULAE project is as follows: **"Maximizing the impact of innovative energy approaches in the EU islands"**. In order to complete this objective, DNV GL has taken on Task 9.1 in Work Package 9 (WP9), pertaining to the validation and refinement of the plans and business models for decarbonization of islands. As a main result of INSULAE an Investment Planning Tool (IPT) is developed. This Investment Planning Tool is designed in order to offer (insight in) solutions and assistance for the implementation of renewable energy systems of a large variety of islands.

WP 9 relates to the implementation of business cases and exploitation strategies for islands. By identifying the most convenient ways for market deployment, result reproducibility can be ensured.
To this end, specific objectives in WP9 are:

- To construct the most suitable business models for decarbonizing geographical islands (this report).
- To reach agreements among the partners for fairly conducting the exploitation of the results while ensuring a fast market uptake.
- To develop and implement a replication roadmap for the deployment of the project solutions on the market.

2.1 Process and methodology

By applying a canvas methodology, the INSULAE consortium establishes a formal procedure for the development of business plans. In turn, this procedure will facilitate the implementation of the innovations developed in INSULAE (technologies, procedures and IPT) by the responsible partners in the decarbonization market. To this end, the aspects relating to the business model canvasses are analysed for various stakeholders and investors. These aspects are customer segmentations, value propositions, distribution channels, partnership agreements, customer relationships, expected revenues streams, financing schemes, resources involved, activities, partnerships and costs structures.

In order to understand the resulting canvasses, it is important to discuss the step after WP 9.1. The next stage flowing from the evaluation of the business cases, is comprised of Cost Benefit Analyses (CBA) of the INSULAE innovations, called Lighthouse Island innovations. Three demo-sites will be used in order to assess the drawbacks and benefits of decarbonization of the islands. The CBA will result in conclusions regarding the large-scale factors presenting an impact on the island. These include economic aspects such as the economic net present value of the islands, as well as the economic internal rate of return, B/C ratio, but also the job impact of such a large-scale transition. Safety and security are essential, but also the environmental impact, social acceptance of the population on the island and the production impacts. Time lost or saved, a valuable factor, will also be assessed in the CBA.

It can be added that a similar methodology will be applied for a Cost Benefit Analysis of the Investment Planning Tool use. During the development of the cost benefit analysis, the business model canvasses will be updated to represent the latest insight and choices and thus ensure consistency of the business model.

2.2 Overview of use cases

Seven innovative use cases (UC) have been identified and will be demonstrated on three Lighthouse islands. All the use cases are meant to tackle challenges common to islands and describe attractive business models. All are related to the decarbonization of energy-related issues of the islands, involving electricity, thermal, water and telecommunication systems in order to exploit synergies contributing to a cost-effective decarbonization. Moreover, innovative energy storage solutions and the deployment of flexible innovative EV charging infrastructure are considered.

These use cases are defined as follows:

- UC-1: Joint management of hybridized RES and storage
- UC-2: Smart integration and control of water and energy systems
- UC-3: Empowerment of islands' energy communities through 5G and IoT technologies for flexibility services
- UC-4: Transition to DC grids
- UC-5: Local bio-based economies supporting the electrical, thermal and transport systems integrated management
- UC-6: Electrification of the islands' transport looking to grid frequency and voltage regulation
- UC-7: Storage and power electronics for the stabilization of weak grids and microgrids

Each of the responsible partners has create a business model canvas of their use case using the description in the next paragraph.

2.3 Implementing the Business Model Canvas

The Use Cases are delivered using the Business Model Canvas and can be divided into 4 key elements. In the centre is the definition of the value that should be delivered. On the left are the most important means to create this value, described by key partners, key activities and key resources; to the right are the interactions with the intended customer, including pre-sales, during sales and after-sales interaction. This is described in the boxes (desired) customer relationships, (sales, marketing and other contact) channels, and a description of the customer segment for which the value is created, preferably describing the customer and his 'problem to be solved'. At the bottom of the canvas the financial structure is presented, both at the cost side as the income side, in the boxes 'Cost structure' and 'Revenue streams'.

Each sub-part of this canvas is designed to answer a specific series of questions which, if answered pertinently, make for a solid business case. Each of these parts will be discussed hereafter.

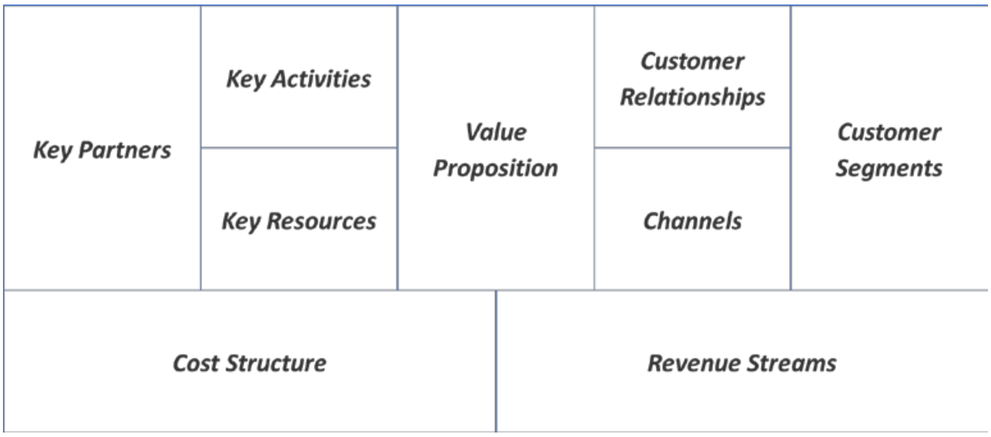


Figure 1, the elements of a business model canvas.

The starting point and most central piece is the **Value proposition**. This key element answers a multitude of questions, such as:

- *What is the added value for the customer?*
- *Which problem is our service solving?*
- *What does the customer want to achieve through the service?*
- *Why does the customer want/need the service?*
- *How does the service (positively) affects the customer life/work/routine?*

Examples of questions that give insight in the necessary partners, resources and activities include:

Key Partners

- *Who are the potential key partners and/or key suppliers?*
- *Which stakeholders are crucial in developing the service?*
- *Which stakeholders are crucial for supplying the needed technology?*
- *Which stakeholders are crucial for delivering (implementation and operation) the service?*

Key Activities

- *What are the actions to be taken to develop the service?*
- *What activities does the organisation need to perform to successfully deliver the service?*
- *Which activities do the key partners perform?*

Key Resources

- *What resources are needed to develop and deliver the desired Value Proposition? This includes but is not limited to physical, intellectual, human and financial assets.*

Questions that help in defining the intended customer and the relation to the customer on the right side of the business model canvas, might include:

Customer Relationships

- *How does the customer perceive the service/the organisation?*
- *How much time/effort has to been spent in establishing and keeping the relationship?*
- *What is the trust level needed for the customer to buy/use the service?*
- *How important is the service for the customer?*
- *Is there any lock-in?*

Channels

- *Through which channels is the service delivered?*
- *Which channels are more cost-effective?*
- *How to take care of the 5 phases of customer engagement (Awareness raising, Evaluation, Purchase, Delivery, After sales)?*
- *Which channels are used for marketing of the service and post-implementation support?*

Customer Segments

- *Who are the customers?*
- *What is the real need of the customer?*
- *What are the worries of the customer in using the service?*
- *What are the interests of the customers in using the service?*
- *Are there other customers that may benefit in different way from the same service?*

Finally, the bottom of the canvas pertains to the cost and revenue. Related questions that guide this section include:

Cost Structure

- *What are the costs related to Key Resources and Key Activities?*
- *What is the initial needed investment?*
- *What are the fixed recurring costs?*
- *What are the variable costs?*
- *Is there an economy of scale?*
- *How is the service financed?*
- *What assets need to be purchased?*

- *What are the risks associated to the investment?*

Revenue Streams

- *Who is paying for the service? (Keep in mind: not always this corresponds to the customer segment/end users)*
- *What payment structure will be implemented? (subscription, pay per use, one-time fee, etc.)*
- *What is the expected revenue stream in time?*
- *How are customers willing to pay?*
- *What is the relative weight of each different revenue stream?*
- *What are the risks associated to revenue streams?*

2.4 Selected islands

The three islands selected for the project and the application of the business cases give a representative view on the whole EU stock of islands.

Interestingly, the selected Lighthouse islands are complementary in many aspects. This allows for a more efficient analysis, where diverse situations can be assessed in a shorter duration, while still presenting a realistic assessment. An overview of the three Lighthouse islands is provided in the table below.

	Unije[1]	**Bornholm**	**Madeira**
Climate	Mediterranean	North Sea	Atlantic
Size	17 km^2/88 inhabitants	589km^2/40,700 inhabitants	828 km^2/270,000 inhabitants
Mainland connection	Weak connection	Strong connection	No connection
Economic development (GDP per capita)	12,436 €	61,600 €	21,200 €
RES Share	57 %	66%	30%
Carbon intensity	327 tCO2/MWh	510 tCO2/MWh	915 tCO2/MWh

Unije island (L-1) in Croatia will be the island used to demonstrate:

- UC-1: Joint management of hybridized RES and storage
- UC-2: Smart integration and control of water and energy systems

[1] For comparison: in 2018 grid electricity from mainland Croatia had a RES share of 48.14% and a specific CO_2 emission of 106 tCO2/MWh (due to the large electricity import to Croatia).

- UC-3: Empowerment of islands' energy communities through 5G and IoT technologies for flexibility services

Bornholm Island (L-2) in Denmark will be used for demonstrating:

- UC-4: Transition to DC grids
- UC-5: Local bio-based economies supporting the electrical, thermal and transport systems integrated management

While Madeira Island (L-3) in Portugal will demonstrate use cases:

- UC-6: Electrification of the islands' transport looking to grid frequency and voltage regulation
- UC-7: Storage and power electronics for the stabilization of weak grids and microgrids

2.5 Investment planning tool (IPT)

The outcome of the various use cases is used as input for the main deliverable of the project: The Investment planning tool (IPT). The role of the IPT is to support the island's decision makers during the selection and design of the Action Plan with highest decarbonization impact, helping to narrow down and fine-tune the options tailormade to the particularities of a specific island. Isolated microsystems can be costly, polluting, inefficient and dependant on external supply, which is where the IPT can present a great added value. Additionally, the IPT will lead to timesaving in finding optimal solutions for specific islands, involving less resources as well as allowing for a deeper, wider and more automated analysis.

The IPT will be based on the same platform (Artelys Crystal) as the current mathematical model used by the European Commission for analysing the European energy and climate policies (METIS1, developed by Artelys).

The Investment Planning Tool will be validated using the seven Use Cases on the three Lighthouse islands, and later for an additional four Follower islands. After this step, it is expected that the tool will be ready for islands decision makers and potentially the European Islands Facility.

In a later stage, the IPT and Artelys Crystal Suite would be integrated, where the use cases could be applied to other energy systems such as rural areas or cities, making for a considerable market.

3 USE CASES DEVELOPMENT AND OUTCOME

In order to construct a complete and effective Investment Planning Tool (IPT), seven use cases (UC) are considered, for the three Lighthouse islands. These use cases will reflect on aspects constituting a complete business case, stakeholders, challenges as well as the expected outcome of the use cases. Processing these use cases will be an integral factor for the effectiveness of the IPT. The IPT is the main deliverable of the INSULAE project and this chapter will start with it.

Because of the importance of the IPT in the INSULAE project, we include a more detailed value proposition using a format often used in defining value propositions. This template was used to help the INSULAE partners responsible for developing the use cases to define the value proposition box in the canvas. The value propositions made by the partners that used this help are added in the appendix of this deliverable.

3.1 Business Model Canvas Investment Planning Tool

The Investment Planning Tool (IPT) is an online software and calculation tool, able to give the local island government as well as other stakeholders insight into the optimal opportunities and investments to decarbonize the island. In deliverable '3.1 User needs and IPT specifications' the functionality of the IPT is described in detail. In this deliverable, D9.1, its application and context of use is described using the business model canvas.

For you	Island Authorities or island grid operators
who	have the ambition to decarbonise the island, and
needs	to create a vision, roadmap and action plan, **together** with all involved stakeholders on the island, such as the residents, the grid operator and electricity producers.
The Investment Planning Tool (IPT)	is a software tool to assist island decision-makers in their design of solutions to simulate and plan the development of the energy system of their island
IPT can deliver	long term empowerment of local decision makers in their ability to plan the development of their system, including immediate and specified assessment of developments, plans and ideas in terms of sustainability, security and costs. It delivers a holistic assessment taking into account the whole energy system (from production to consumption through networks) in a multi-energy perspective,
In contrast to	sectorial models quite unsuitable to the deep revolution of energy transition and smart systems,
our solution	gives a clear and unbiased overview of all options for the specific situation on the island, and allows to design the optimal pathway to decarbonization, factoring in local potentialities, economic aspects and stakeholders motivations.

Figure 2. Value proposition of the use of the IPT as a tools to create a—most stakeholders endorsed—decarbonisation strategy

Key Partners	Key Activities	Value propositions	Customer relationships	Customer Segments
Global: - *Info providers for library* - *Tool/algorithm developer (to improve and update tool)* - *...* *Per island:* - *Data/information providers (government, utilities, infrastructure providers)* - *Local support (e.g. technical, possibly licensee consultant)*	*IPT support: documentation, training and advice, software maintenance; technical support.* *IPT development and deployment: Model hosting and administration for each customer, Tool implementation, including integration with (local) data and models; keep IPT and intervention library up to date, incl. per island database;* **Key resources** *Improved Artelys Crystal calculation engine* *Library of possible interventions to draw from for optimal package design* *Model implementation guidebook* *Hosting server*	*Help island stakeholders to make the best decisions for investments for the transition to neutral CO2 emission islands, by:* - *Modelling of multi energy system incl. interactions with other infrastructures* - *Impact evaluation, incl. cost/benefit B analysis (compared to BAU)* - *Propose an optimal package of interventions to reach user objectives.*	*Low cost to free trial demo version: Low entry barrier for use (in terms of time, effort and financial, e.g. without data coupling), no commitment; very loose (almost anonymous) relation.* *Consultancy supported version: for multi year use (e.g. annual policy update support.)* **Channels** *M&S: Insulae follower islands; Mouth to mouth using island networks and communities; Local consultants or universities who are working with more than one island* *Web based demo trial version (with registration?) with little. Creating interest for consultancy supported onsite implementation (with data, model and tool coupling)*	*Island governments/policy makers designing a* ***government policy*** *to reduce CO2 emissions.* *Island utilities, IPP and investors doing long term* ***investment planning*** *to reduce CO2 emissions. Besides individual use, the tool could facilitate communication between said parties.* *Industry and other stakeholders with large demand facing investment decisions* ***Smart grid solution provider*** *wishing to advocate for the benefits of its solution* *Independent parties (e.g. agencies or media)* ***evaluating the effectiveness*** *of policy and/or investment decisions.* *Consultants advising stakeholders.*

Cost structure	Revenue streams
Development cost *Maintenance cost (Keeping tool updated)* *Support cost (documentation, education, technical)* *Per island: One time implementation cost (ICT implementation; data and model coupling; island modelling; advice/consultancy; possible reporting)* *Per island: Recurring costs (hosting and administration, hosting and administration, database maintenance, advice/consultancy)*	*Modelling and implementation services* *License, either perpetual or annual* *Maintenance and support contracts* *Consulting services*

Figure 3. Business model canvas of the IPT.

A number of existing tools can provide insight into the issues of energy and networks of islands, as well as provide solutions in the shape of recommendations and possible roadmaps. The challenges of developing such a tool mainly lies in:

- the ability to provide solutions for small scale as well as large scale locations;
- the accurate representation of multi-energy/multi-network systems;
- the coupling of technical, environmental and economic contexts;
- the user-friendliness.

Insular energy systems face additional challenges compared to large scale systems. Islands struggle with grid stability issues relating to the larger impacts of intermittent energy production, while the security and guarantee of energy supply also remains a challenge. On top of this, the system components (for production, consumption, network flexibility and IT networks) as well as decision processes (operational decisions, but also planning) are much intertwined.

The implementation of the INSULAE IPT tool will provide progress on various areas. The tool will consider the relevant uncertainties affecting the system, modelling variations in climatic evolution with appropriate contingencies. Scenarios are then created based on machine learning, Monte-Carlo and decomposition techniques. The IPT will also account for the latest smart-grid and green technologies for insular systems, considering the surrounding systems as well (telecom, water, transport). Finally, guided optimization techniques will be provided in order to support user friendly scenario definition.

In the canvas described in Figure 3 this problem description is translated into a **value proposition** describing the IPT as a decision support tool that is able to model the energy infrastructure of the island, including interactions with other infrastructures. In this model ideas, decisions and/or solutions can be tested or sized, leading to insight in the system and eventually optimal decision making. In the detailed value proposition shown in Figure 2, this is augmented by the possibility to use the tool to assess ideas and solutions proposed by stakeholders, creating awareness and insight among the involved stakeholders, possibly leading to buy-in for the taken decisions.

In the **Customer relation box** the intended relation with the customers is shown. Depending on the use of the tool, the intended relation is loose, maximizing the possibilities to play and experiment with the tool, without having to invest. Because of its innovativeness, the added value of the tool to island governments or island utilities will be very uncertain, reducing willingness to invest money or time in using the tool. Initially the use of the tool should seek to have very low barriers and be very easy to use. Use for a longer period of time (for example to create the buy-in from stakeholders for the decisions to decarbonize the island), or use for multiple islands by, for example consultants will (by necessity) be much more involved. The (marketing, sales and distribution) **Channels** also reflect this**.**

Possible **Customers** for the tool include any stakeholder that wants to take the lead in decarbonising their island. This could be the local authorities, infrastructure operators or private parties, like a group of inhabitants, a non-profit organisation, a solution provider or even consultants that use the IPT as a consultancy support tool (e.g. for a quick scan). It also might be external (government or private) body, assessing the effectiveness of policy and decision making, such as an audit office.

The key partners, key processes and key resources all need to assure that the quality of the value proposition is ensured. This does not only include the quality of the modelling and results, but also the quality associated with the application of the tool. For example, in addition to user-friendliness, which is key to foster common understanding between several stakeholders, it is essential that the tool can benefit from a solid support and maintenance environment and adequate hosting conditions. In particular, island modelling within the IPT is a difficult step that is key to unlocking the value of the tool. As a consequence, this step should be supported by adequate partners, processes and resources.

The cost to support the tool and keeping it up to date are shown in the **Cost structure** box. These should be covered by the **Revenue streams** in order to create a sustainable business. This holds true independent of the purpose and/or legal structure of the business (private, not-for profit-etc.).

3.2 Use Case 1. Joint management of hybridized RES and storage

When generating renewable energy, one of the key characteristics is the variability of the resource. The sun and wind sometimes generate power when there is no demand for it and sometimes there is demand when there is no solar of wind generation. This can be quite the challenge to tackle, yet an obvious solution is to combine these intermittent energy sources with a form of energy storage, preferably one reactive to day-to-day supply and demand. Use Case 1 explores the possibility of combining management of Renewable Energy Systems (RES) with management of the energy storage. Integrating both would allow the provision of short-term power delivery to and from the grid, preventing power disturbances. Renewable production peaks would be absorbed by the energy storage, and peaks in demand can be minimized due to additional supply from the energy storage. Additionally, this would avoid network failures and renewable energy curtailment. Another opportunity provided by such a combined management system relates to the ancillary systems that storage could provide with RES, such as balancing services, power quality and VAR control.

The envisioned administrator of such a system would be the DSO of the island. After taking care of installation, the DSO would take on the roles of system operator of the island network, as well have a large stake in the operation of the RES plant (either directly or through a service contract with the plant owner). This role would also bring numerous challenges for the DSO, such as increased amount of financing, project complexity requiring technical expertise and the need for improvement of poorly defined regulatory frameworks.

Use case 1, delivered for the island of Unije SVEUCILISTE U ZAGREBU, FAKULTET STROJARSTVA I BRODOGRADNJE (UNIZAG FSB)

<table>
<tr>
<td rowspan="2">Key Partners
- Technical consultants (RINA-C)
- Platform provider (ENT)
- REA Kvarner
- Environmental associations</td>
<td>Key Activities
- Mathematical modelling
- Application for monitoring and management
- Data collection</td>
<td rowspan="2">Value proposition
Optimizing the island energy system offering benefits for relevant stakeholders:
- Security of supply grid stability for the DSO.
- Lower energy costs for utilities
- Energy sector decarbonisation for all stakeholders including the municipality
- New technological solutions that can be applied to other regions by key partners</td>
<td>Customer relationships
Very intimate relation with all stakeholders is required as it touches upon their core processes and responsibilities
- Communication with utilities for meeting their needs
- Communication with islanders for gaining their trust and support</td>
<td rowspan="2">Customer Segments
- Utility companies (HEP DSO, Hep Production, HEP Trgovina, ViOLC)
- Municipality
- Energy cooperatives
- Energy communities
- Permanent and temporary residents
- Industry and economy stakeholders</td>
</tr>
<tr>
<td>Key resources
- PV plant
- Battery system
- Sensors and meters
- Human resources, including technical as stakeholder management</td>
<td>Channels
- Meetings
- Workshops
- Social media
- Website
- Monitoring application</td>
</tr>
<tr>
<td colspan="2">Cost structure
- Application hosting
- Hardware infrastructure
- Marketing
- Maintenance
- Administration</td>
<td colspan="3">Revenue streams
- Monthly fee for grid management (DSO)
- Monthly fee from for utility (production prediction)
- Monthly fee from for real time data monitoring (Municipality)</td>
</tr>
</table>

Figure 4. Business model canvas for use case 1: Joint management of hybridized RES and storage.

Outcome:

A potential result of this system integration can relate to a cost reduction of the overall system by avoiding peaks or upgrades of two individual systems instead of an integrated one. Furthermore, the integration would minimize GHG emissions by avoiding the use of fossil fuel generated electricity as the majority of electricity can be produced by local RES. The frequency regulation of the grid system would be improved, flickering prevented, the grid would be more stable, thereby increasing the overall performance of the installation as a result of system integration.

3.3 Use Case 2. Smart integration and control of water and energy systems

Water supply can be related to energy consumption. People use their shower and cook around the same time as they use electricity. This happens during the morning hours before going to work, as well as the hours right after work. These are the same windows as when the peak energy demands are highest. People will turn their heating on when they wake up and when they come home from work. On top of this, the importance of water and energy is increased on islands due to the inherent scarcity of this resource for remote locations, combined with the need of water for irrigation purposes (farmers). Thus, it would be a viable Use Case to examine the coupling of the water supply and the energy systems. This is the subject of UC 2.

The way islands solve the water scarcity issue nowadays, is by a desalination process. Unfortunately, this is an energy intensive process, which makes smart water management crucial. A smart freshwater consumption could be combined with RES to power desalination plants. Improving the integration can be done by demand management of the desalination plant demand or coordinating irrigation planning for the farmers.

A large variety of stakeholders is involved in such a business case, which can either be the local population and farmers for food production, but also the operators of the water and energy infrastructure. However, some barriers which such an integration could present, relate to conflict of interest between the end-users and a lack of reliable information.

<u>Use case 2, delivered for the island of Unije by SVEUCILISTE U ZAGREBU, FAKULTET STROJARSTVA I BRODOGRADNJE (UNIZAG FSB),</u>

Key Partners
- *Platform provider (ENT)*
- *Municipality*
- *Hardware companies (for measurement devices)*
- *Network provider*

Key Activities
- *Design of water irrigation system and its connection to energy system*
- *Application for monitoring and management*
- *Connection between sensors and 5G network for optimal control*

Key resources
- *Communication protocols and infrastructure*
- *Sensors and meters*
- *IoT platform*
- *Water and waste-water network and other water infrastructure*

Value proposition
- *Creating energy-water nexus for optimal operation of irrigation system*
- *Low cost sustainable usage of water*
- *Increased security of water supply on the island*

Customer relationships

Informing customers about agricultural benefits of such approach

Channels
- *Tourist information center*
- *Workshops*
- *Social media*
- *Website*
- *Monitoring application*

Customer Segments
- *Water system, waste-water treatment company*
- *Islanders (agriculture needs)*
- *Municipality*
- *Visitors*

Cost structure
- *Application hosting*
- *Hardware infrastructure*
- *Marketing*
- *Maintenance*

Revenue streams
- *Monthly fee for energy-water system management (ViOCL)*
- *Monthly from for energy water monitoring (islanders)*
- *Real time monitoring for utility services*
- *Revenue from tourists*

Figure 5. Use case 2: Smart integration and control of water and energy systems.

Outcome:

Water and energy consumption can be reduced through smart and innovative ICT solutions in combination with an improved water network. Ideally, RES production forecasting would be the backbone of such a coordinated effort, combined with organizing the agricultural needs and water supply.

3.4 Use Case 3. Empowerment of islands' energy communities through 5G and IoT technologies for flexibility services

The transition to a decarbonized island requires coordination and communication, for example coordination between power generation of variable renewable sources and demand and needs to be facilitated through increased flexibility of services relating to telecommunication. By empowering the individual users and local communities, these can contribute to the island's demand management and energy production. This empowerment can be achieved by executing awareness campaigns, developing home automation, and integration with smart devices allowing for interoperability. Data collection, the Internet of Things (IoT), and an information network (5G) result in a more optimal use of variable renewable sources through improved demand response and thus a better energy management system.

An empowered energy community is the result of local groups of citizens striving toward a connected community integrating telecommunication and technology. Therefore, local citizens are the most important stakeholders, facilitated by the DSO in charge of network management, and balancing demand and supply of energy. Port authorities can communicate environmental changes as well as warnings. Tourists would be able to pre-book facilities and reduce their carbon footprint. Airports and transport services will have access to real time information of schedules, passenger counts as well as statistics and security alerts. Improved monitoring and data collection allow for more accurate energy and population flux predictions.

Still, hurdles relating to such an undertaking may appear, such as conflicts of interest, lack of understanding related to such innovative projects, data privacy issues and possibly uncertain regulatory frameworks.

Use Case 3, delivered for the island of Unije, done by ERICSSON NIKOLA TESLA D.D. (ENT),

Key Partners	Key Activities	Value Proposition	Customer Relationships	Customer Segments
HEP – for energy VIOCL – for water facilities A1 –for 5G infrastructure MUNICIPALITY (governance) Content Providers (open data) IoT/Data centre Provider (ENT ?)	1. Establish IoT platform and deploy sensor infrastructure 2. ENT to develop platform, applications and analytics 3. HEP, VIOCL to provide data **Key Resources** 1. IoT cloud infrastructure 2. Energy Homebox 3. Sensors/Data 4. Citizen participation 5. Development resources	Establish a common, flexible, open source based but well defined and secured IoT eco-systems for many different stakeholders and players. Different sensors and smart things are connected through the platform with different applications to the benefit of islanders and visitors Energy/Water sharing community is established to optimize consumption of scares resources and provide additional revenue stream	1. Islanders and Municipality – primary communication channel by project 2. Utility companies – secondary communication **Channels** 1. Direct (project) delivery to islanders 2. Utility companies (?) 3. Website 4. Mobile App	1. Islanders 2. Visitors 3. Port Authority 4. Municipality 5. Airport operator 6. Boat Owners 7. Utility companies(HEP, VIOCL)

Cost Structure	Revenue Streams
1. Data centre/app hosting 2. Communications/telecom infrastructure 3. Marketing 4. Product development/ maintenance 5. Administration	1. Free subscription for islanders 2. Premium paid services (real time, notifications) 3. Utility companies (advanced prediction – statistics) 4. Revenue share with communication provider (telco)

Figure 6. Use case 3: Empowerment of islands' energy communities through 5G and IoT technologies for flexibility services

Outcome:

Social acceptance is necessary for a rapid transition to renewable energy systems. A strong local community can be instrumental in increasing the awareness of the population and the need to improve our energy system. Aside from facilitating the energy demand management and improving the grid, it can also strengthen the island's local economy. A sustainable energy community will improve the quality of life for the islanders as well as the visitor, by improving air quality and the temperature on the long term. Traffic can be regulated, security improved relating to real-time information and communication. Finally, using the 5G and IoT technologies will allow energy and water predictions, leading to utility company services optimization.

3.5 Use Case 4. Transition to DC power grids

The demand for direct current (DC) technology has drastically increased in recent year with the rise of renewable energy generation, as well as the increasing number of electric vehicles (and complementary EV chargers) and integration of electronics in our daily lives. All these technologies use DC and need individual inverters to be connected to the AC (alternating current) power grid. These inverters result in energy losses which can be partly avoided with the use of a DC micro grid.

Transitioning to a DC microgrid is a challenging task for islands, as grids are typically designed for larger scale. The components and infrastructure necessary for a DC power grid also require strict safety aspects (power, fire and structural integrity) which in turn present a higher investment.

DSO's are the main stakeholders and are responsible for the improvement of the distribution grid, and therefore are faced with the challenge of financing the new infrastructure. Balance response parties would be in charge of power delivery to the grid, as well as taking it in when the supply is too great (as a buffer).

<u>Proposed business model for the island of Bornholm, presented by the Technical University of Denmark (DANMARKS TEKNISKE UNIVERSITET, DTU)</u>

Key Partners	*Key Activities*	*Value Proposition*	*Customer Relationships*	*Customer Segments*
Local authorities *Energy companies* *R&D partners (including technology providers)* *BRP (balance response parties)*	*Proof of concept: validate the idea of the DC microgrid vs traditional approach* *Communication with stakeholders.* *Contracts with EV owners* *Planning and project design*	*Support e-mobility via EV fast chargers* *Support energy self-sufficiency (own-production)* *Minimization of energy losses due to reduction of conversion stages.* *Reduction of power electronics investment cost.* *Co-existent of proof of concept of hybrid AC-DC grids* *Provision of ancillary power services*	*Towards private EV owners* *Towards energy companies (BEOF for instance).* *Towards energy-charging providers (EON for example)* *Technology providers (for example NerveSmartSystems)*	*Energy communities* *PV (photovoltaic) prosumers and any behind-the-meter customer* *EV owners* *Energy companies (who would benefit from simpler HW)* *Companies with EV fleet (power peak service)* *Fast chargers on weak grid* *Balance responsible parties able to sell ancillary grid services*
	Key Resources *Technology (battery, chargers)* *Engineering competences to realize the planned control strategies* *Energy company for the reverse power flow (prosumer)*		***Channels*** *Public and individual meetings* *Written material* *Homepage* *Local media, newspaper, radio and TV*	

Cost Structure	***Revenue Streams***
The cost depends on the size of the battery (both power and energy), on the grid connection fee and EV charger power. Rent/purchase of land to place the HW. *O&M cost relates to the cost of electricity, maintenance of the PV and power electronic. Degradation of the battery.* *The cost of money of the initial investment*	*End users/consumers pay for the service. They pay a subscription payment, a pay per use for actual consumption and an initial one time fee.* *Behind the meter application would bring saving rather than revenue* *Ancillary grid services*

Figure 7. Use case 4: Transition to DC power grids

Outcome:

Implementing a DC microgrid also present a great opportunity for a new market penetration, could reduce inefficiencies as well as decarbonizing the energy system. The grid connection cost would decrease for a DC grid, minimize power loss, promote the renewable energy production as well as encourage electric vehicle purchases and enable provision of auxiliary grid services by electrochemical energy storage. Test systems are developed before implementation in order to simulate the dynamics on the scale of an island.

3.6 Use Case 5. Local bio-based economies supporting the electrical, thermal and transport systems integrated management

Transition to renewable energies still proves to be challenging in the sectors of transport, heating and cooling. Considering alternatives to electrification could be key for these sectors, which is why a bio-based economy is examined in this business case. First, it should be noted that this Use case is split up in two parts, the heating sector and the transportation sector. The Use cases are respectively called biomass-based district heating; and the integration and optimization of RES and biomass in the energy and transportation system.

Biomass, biofuels and co-generation can present a valuable asset regarding district heating. Additionally, a hybrid bio-based and electric heat supply to the heat network can provide major flexibility and buffer for the electricity grid, operation alternating between biomass and electricity, depending on the availability of variable renewable electricity sources, that otherwise might have needed to be curtailed.

In this case, local municipalities are the main stakeholders as they need to be the drive for the creation of the bio-based economy. This would require connecting biomass and biofuel suppliers, intermediaries and naturally the end-users. A major requirement for such a market creation, is the need for sufficient supply and demand, making use of effective incentives to stimulate the use of bio-based resources, thereby promoting growth of a bio-based economy. Incentives include for example cheap loans (to repay the initial investment) that district heating companies would receive for setting up and delivering the heating.

Proposed business model for the island of Bornholm, presented by the Technical University of Denmark (DANMARKS TEKNISKE UNIVERSITET, DTU):

5.1 Biomass based district heating

Key Partners	*Key Activities*	*Value Proposition*	*Customer Relationships*	*Customer Segments*
Local authorities *Energy companies* *Local biomass producers, e.g. farmers, forest owners* *Citizens and citizens organizations* *Biogas plant and district heating owner and operator* *(Potentially technology providers)*	*Communication with stakeholders.* *Contracts with customers and biomass suppliers* *Planning and project design: Description of economic consequences for customers and company.* *Economic planning* **Key Resources** *Favourable financing* *Know how about biomass based district heating* *Cooperation with citizens organizations, for customer recruiting*	*Customer= island community and citizens* *A centralized district heating network based on the use of local biomass, e.g. biogas, straw, wood chips, means that the money spent on fuel stays in the island, thus strengthening local economy. The energy production, heat and power, becomes co2-neutral and the emission of particles and gasses is reduced.*	*Entering a contract is voluntary, you can leave, but only after paying your share.* *Initial time consuming effort with public meetings and continuous meetings with citizens organizations.* **Channels** *Public and individual meetings* *Written material* *Homepage* *Local media, newspaper, radio and TV*	*Individual house owners with central heating and oil burners* *Institutions and companies with central heating and oil burners* *The service is chosen because it is affordable and easy to use for the customer.* *The service can compete economically and in easiness to use when compared to other solutions like individual heat pumps, new oil burners etc.*

Cost Structure	*Revenue Streams*
The cost depends on the size of the DH grid and type of the underground, rock, soil or sand. The cost for communication, planning and project design must be part of the budget. Starting up requires a heating plant, a heat storage tank and a grid. The fixed recurring costs are financing cost, O & M. The variable costs are fuel and power. There is an economy in scale in the size of the heating plant, but the size of the grid is proportional with the cost. The service is financed in DK with loans with an interest rate of less than 3% that are guaranteed by the municipality. The risks associated to the investment are rising fuel costs and rising taxes on fuel.	*End users/consumers pay for the service. They pay a subscription payment, a pay per use for actual consumption and an initial one time fee.* *The expected revenue stream in time will pay for the investments and the O & M. There is no profit uncalculated.* *The payment is low risk as it is connected directly to the service – no pay, no heat.* *Possibly a revenue stream on transport fuel production*

Figure 8. Use case 5.1: Local bio-based economies supporting the electrical, thermal and transport systems integrated management: Biomass based district heating.

5.2. Integration and optimization of RES and biomass in the energy and transportation system

Key Partners	*Key Activities*	*Value Proposition*	*Customer Relationships*	*Customer Segments*
R&D partners *Tax Regulation authorities* *Local authorities* *Energy companies: Biogas, district heating and power* *Local biomass producers, e.g. farmers, forest owners,* *Producers of organic waste, e.g. hotels, food industry* *Citizens and citizens organizations* *Waste from road side grass cut and seaweed.*	*Develop and simulate (digital) logic for optimal operation – Virtual Power Plant and P2X* *Demonstrate the integration* *Propose tax regulation improvement to avoid double taxation.* ***Key Resources*** *Existing infrastructure and simulation model* *Funding for developing new technology and solutions* *Participation from R&D institutions and companies* *Local biomass*	*Customer= island community, energy producers, DSO and citizens:* *The energy system is able to use a larger fraction of the produced Renewable Energy.* *Flexibility in the energy system* *Better local economy because (more of) the cost of fuel for heat, power, DH and transportation is spent locally.* *Less use for diesel back up and less emissions from fossil fuels.* *Recirculation of organic waste fractions, as digestate from biogas can be used as fertilizer.*	*Business opportunities, branding, DSO can buy flexibility, Renewable Energy producers can sell more energy. Transport companies can become CO_2-neutral. Municipal visions and policies, local development strategy, attraction of new inhabitants* ***Channels*** *Contracts with DSO, Renewable Energy producers, biomass producers.* *Meetings, public and with stakeholders. Local media and SoMe. Branding activities towards entrepreneurs and companies.*	*Renewable Energy producers* *DSO* *Transport companies* *Citizens who care for low/steady energy price* *Citizens who care for local development* *Citizens who care for green transition* *Local companies who benefit from branding e.g. hotels, tourism companies*

Cost Structure	*Revenue Streams*
The costs related to Key resources and activities are development, HW, cost of land where new power and heat producing facilities can be placed. There is an economy of scale sized according to the power and heat production facilities. The initial needed investment is VE producing facilities or integration of existing facilities. The fixed recurring costs are financing cost, O & M. The variable costs are biomass and power. The risks associated to the investment are rising biomass costs, rising taxes on biomass and the value of flexibility.	*Flexibility: The service is paid for by Renewable Energy producers and DSO. Biomass producers get a revenue. The payment structure and the revenue stream will depend on the development of a new flexibility market and the cost of CO_2 reduction. The expected revenue stream in time will pay for the investments and the O & M. The payment is connected directly to the service – no pay, no flexibility.* *Transportation: P2X is seen as a necessary development in supplying CO_2-neutral fuel for heavy transportation. The economy is not yet known.*

Figure 9. Use case 5.2: Local bio-based economies supporting the electrical, thermal and transport systems integrated management: Integration and Optimization.

Outcome:

By implementing these Use Cases on islands, several impacts can be distinguished. The decrease of fossil fuel consumption will improve the air quality (and reduce detrimental emissions), as well as stimulate the local economy due to the implementation of the technological advancements relating to the bio-based economy. Regulatory and policy improvements will also happen on the long term. Islands will gain independence because they would not have to rely on the importation of fuels. Finally, a well-guided bio-based economy would improve the local ecosystems

3.7 Use Case 6. Electrification of the islands' transport looking to grid frequency and voltage regulation

Decarbonising the energy carrier in the transport sector is an integral part of the transition to a sustainable future. To this end, electric mobility is the most likely to succeed in replacing fossil fuels. However, in order to power the island's transportation with electricity, charging stations need to be installed to recharge the batteries from cars (and trucks and busses). Many challenges appear when assessing the requirements of such a transition, relating to electric mobility, storage and energy management. The major ones are the power grid limitations (constrains and instabilities) in combination with current mobility flows that require effective demand management strategies. Electric vehicles (EVs) could potentially be used as buffer to contribute to grid stability instead of impeding it. One solution is to avoid the periods of high demand peaks related to the other electricity demands of the island, seeing as EV charging is also a large load on the grid.

DSO's are usually in charge of the grid management and the related charging stations. Additional stakeholders are aggregators and obviously the end-users of the electricity grid. Aside from technical and energy managements matters, regulatory issues may arise due to the emerging market related to the grid.

Proposed business case for the island of Madeira, presented by the Empresa de Electricade da Madeira (EEM) and EFACEC Electric Mobility (EFACEC)

Key Partners	***Key Activities***	***Value Proposition***	***Customer Relationships***	***Customer Segments***
EEM (grid operator) *EFACEC (technology provider)* *CIRCE (control management system of the new charging stations)* *ACIF (dissemination and user engagement)*	*Installation of new charging stations with smart and bidirectional charging capabilities* ***Key Resources*** *EVs* *Charging stations* *Management system*	*Transport electrification (electric mobility) to assist the management of the isolated electrical system*	*Bilateral contracts* ***Channels*** *Public charging stations with smart charging* *Private charging stations with bidirectional (smart) charging*	*EV users* *Grid operators* *Prosumers*

Cost Structure	***Revenue Streams***
Installation (civil + electrical) costs *Product development costs* *Assets management costs* *User engagement costs*	*Ancillary services provisions* *Increase in RES penetration* *EV (dis)charging revenue*

Figure 10. Use case 6: Electrification of the islands' transport looking to grid frequency and voltage regulation

Outcome:

Islands generally present a strong presence of the service sector, where transport account for more than half of the energy consumption, as well as a third of the Greenhouse gas (GHG) emissions. If the electricity is generated in a sustainable manner (with low GHG emissions), this will have a huge impact for the decarbonization of islands. On top of this, considering that EVs are potential mobile storage systems, they could provide an additional source of stability as well as flexibility for the power system.

Besides the obvious advantages for reducing GHG emissions, the electrification of mobility on islands hold many benefits for the stakeholders, provided it is done smartly and especially when also considering discharging (vehicle to grid: V2G). These benefits include better use of renewable variable power generation and possibly avoiding curtailment of wind and solar energy generation altogether; avoiding congestion problems in the power infrastructure; provide power quality support, such as voltage management and balancing services for the TSO/DSO, thus avoiding unnecessary investments in the grid and provide better grid management. For the EV owner these benefits translate into lower grid tariffs and lower (average) energy prices, possibly through dynamic tariffs depending on the availability of variable renewable power.

3.8 Use Case 7. Storage and power electronics for the stabilization of weak grids and microgrids

As previously mentioned, grid stabilization can be a major issue, even at large scale. Instabilities are even more likely to appear at smaller scale, for islands for example. A small disturbance has a much greater impact at the island scale than for larger networks. On top of this, intermittent energy generation such as renewables add to this instability risk, thereby increasing the need for improved grid assets like storage systems and overall improved power electronics. Peak generation of renewable energy, as well as peak electricity demands needs to be accommodated by the grid. Integrating automation, smart energy management and additional grid protection are needed, as well as supervision and control of the electric flows (frequency or peak demands). Finally, interconnections might be necessary in order to allow the grid to cope with larger supply and demand fluctuations.

Regarding the contributions to the microgrid, stakeholders range from DSO's to private investors, but include also public investors and municipalities. The necessary investments form considerable hurdle with a considerable risk, considering grid stability issues pose challenges that have not been tackled before. When developing a microgrid the technical complexity can present challenges with unforeseen costs. On top of this, local investors are often hard to find on islands, and the implementation of new infrastructure with lack of guarantees can be a cause of protest from the local population.

Proposed business case for the island of Madeira, presented by the Empresa de Electricade da Madeira (EEM) and EFACEC Electric Mobility (EFACEC)

Key Partners	Key Activities	Value Proposition	Customer Relationships	Customer Segments
EEM (DSO) *Energy Storage (Battery) provider* *EFACEC (Battery inverter)*	*Installation of BESS in a less resilient micro-grid* ***Key Resources*** *Battery Energy Storage System (BESS)*	*Storage and power electronics for the stabilization of weak grids and microgrids*	*Self consumption from RES;* *New prosumers contracts (when available)* ***Channels*** *Distribution network* *(MV and LV)*	*DSOs* *Local consumers and prosumers (if possible)*

Cost Structure	Revenue Streams
The cost depends on the size of the battery (both power and energy), on the grid connection fee and EV charger power. Rent/purchase of land to place the HW. *O&M cost relates to the cost of electricity, maintenance of the PV and power electronic. Degradation of the battery.* *The cost of money of the initial investment*	*End users/consumers pay for the service. They pay a subscription payment, a pay per use for actual consumption and an initial one time fee.* *Behind the meter application would bring saving rather than revenue* *Ancillary grid services*

Figure 11. Use case 7: Storage and power electronics for the stabilization of weak grids and microgrids

Outcome:

Implementing a grid with smart energy management, interconnections to mitigate large fluctuations, and infrastructure to prevent instabilities, will make for a stable electricity supply. A technical stable electricity supply is a prerequisite for demand response and flexibility services that are able to provide stability on longer time scales (balancing). This is achieved through the installation of a BESS in low-voltage substations in order to store the surplus of energy generated during off-peak hours, also prevent the flow from Low Voltage to Medium Voltage. The stored energy can later be consumed (shifting) in order to maximize the renewable energy supply. Providing a safe and guaranteed energy supply will open the doors to new business opportunities that increase employment and will stimulate the further development of sustainable energy on the island.

4 CONCLUSIONS

In Work Package 9.1, Use cases have been developed by the beneficiary partners in order to form a basis for the Investment Planning Tool (IPT) and the use cases defined by the INSULAE consortium. The Business model canvas of the IPT is designed to form the basis for the decision making on decarbonization of insular locations, starting with islands. By assessing several islands with key parameters, most island variations and scenarios are covered. This will provide valuable information for the development of an investment tool able to assess a large number of cases for various island scales, population densities and mainland dependence.

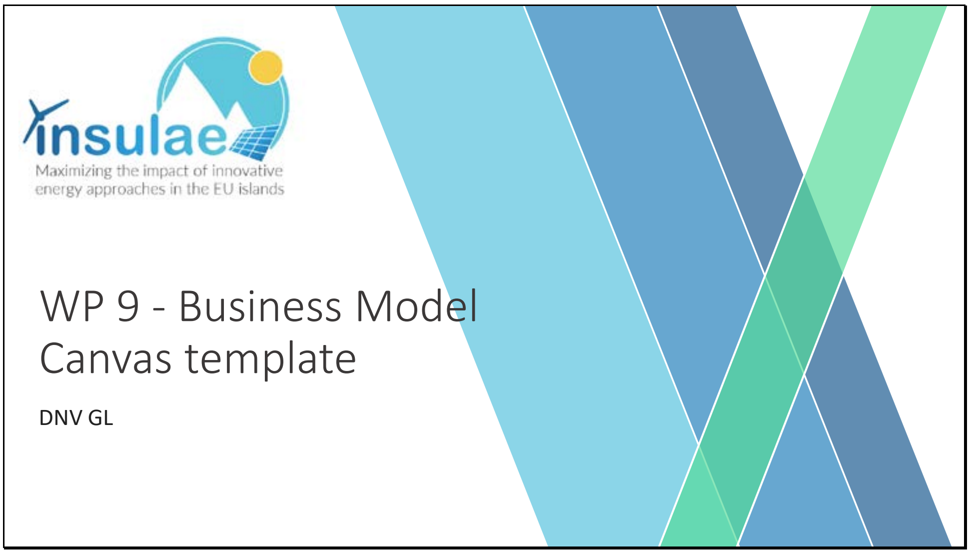
The business model canvasses of the defined use cases facilitation the decarbonisation of islands will provide a sound foundation for the consistent development and implementation of the associated business models.

The IPT, the use cases and the INSULAE project in general has multiple intended impacts to speed up the reduction of green-house gas emissions by European islands. Aside from reducing the fossil fuel consumption and dependence of islands, the INSULAE project wants to implement solutions meant to facilitate the integration of RES without compromising security and stability of the grid. The IPT will assist in this by providing recommendations, action plans and roadmaps for the installation of RES capacity, replicating solutions applied to various islands with similar problems, and provide independence by implementing a microgrid separate from the mainland connections. The INSULAE use cases inform the IPT and ensure the quality of the recommendations, as well as provide the tools to facilitate their implementation.

During the development of the project these use cases are meant to provide guidelines and ensure consistency during the further development of the business models. This means that they are meant to be living documents to be updated to represent the latest choices and insight. This is especially important in the next steps during the development of the cost benefit analysis.

APPENDIX A: SLIDE DECK USED TO INTRODUCE BUSINESS MODEL CANVAS

Slide 1



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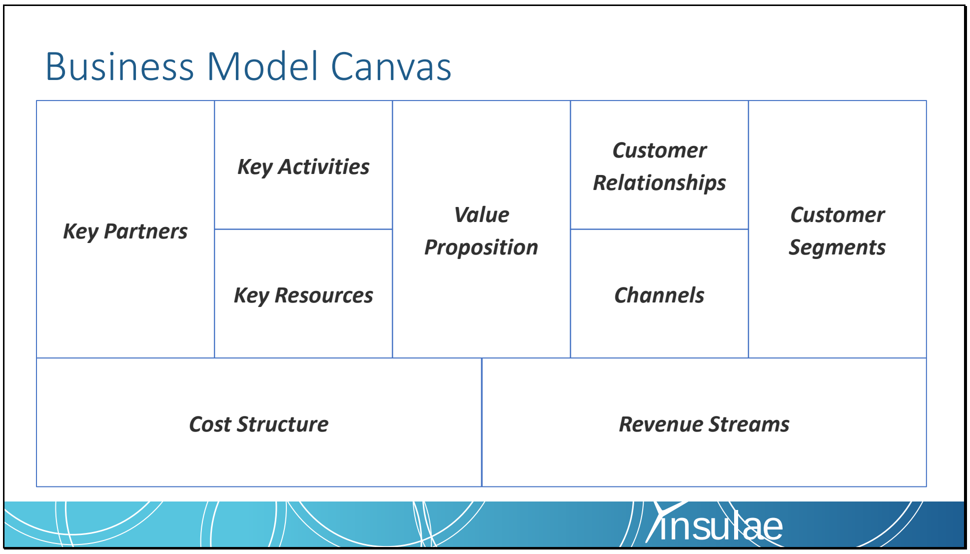

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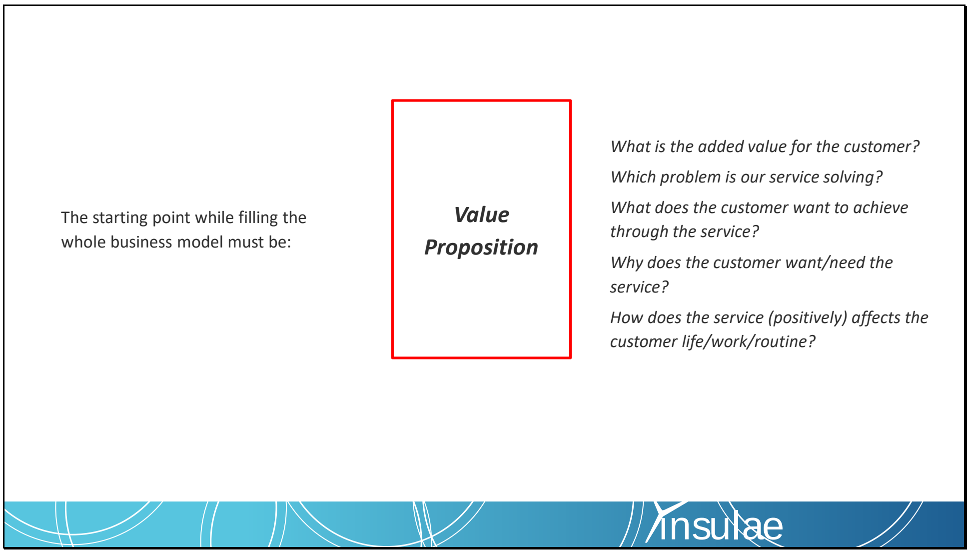

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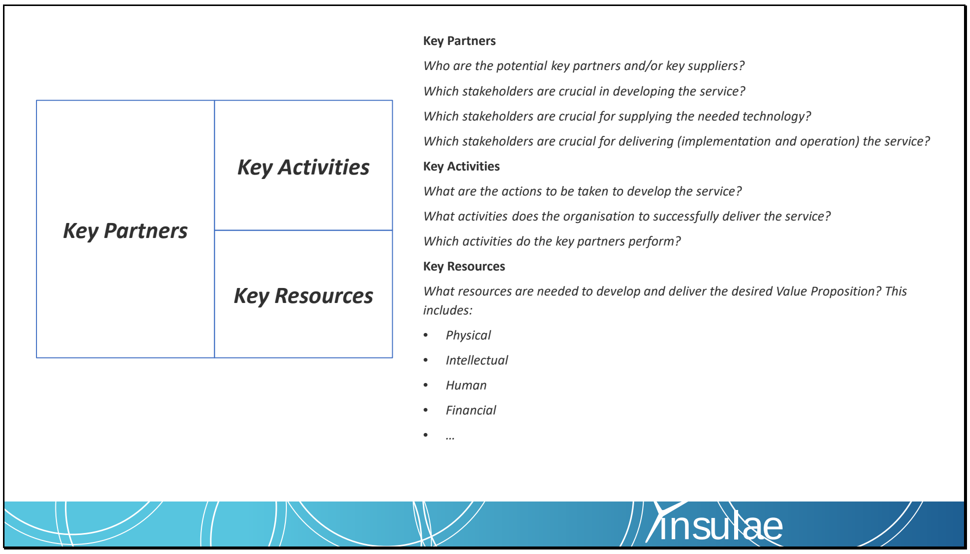

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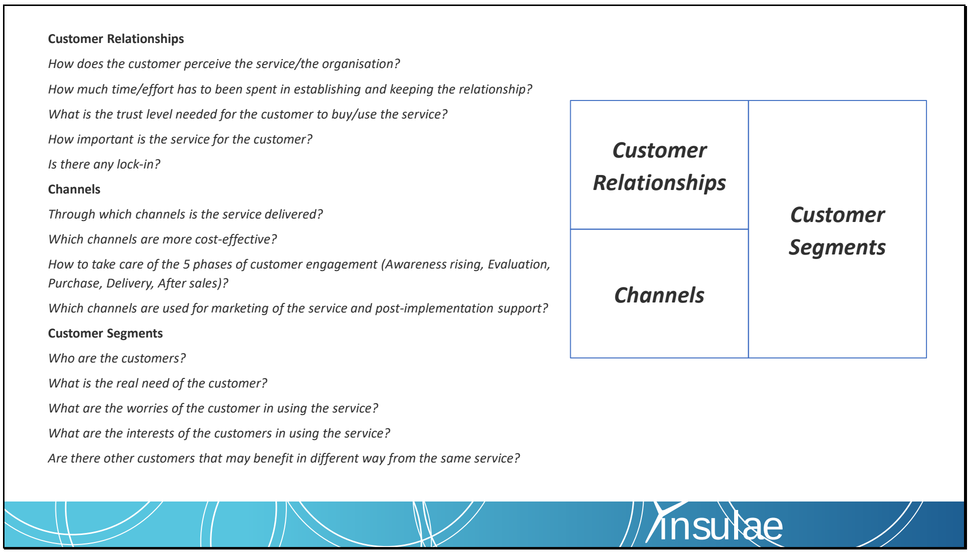

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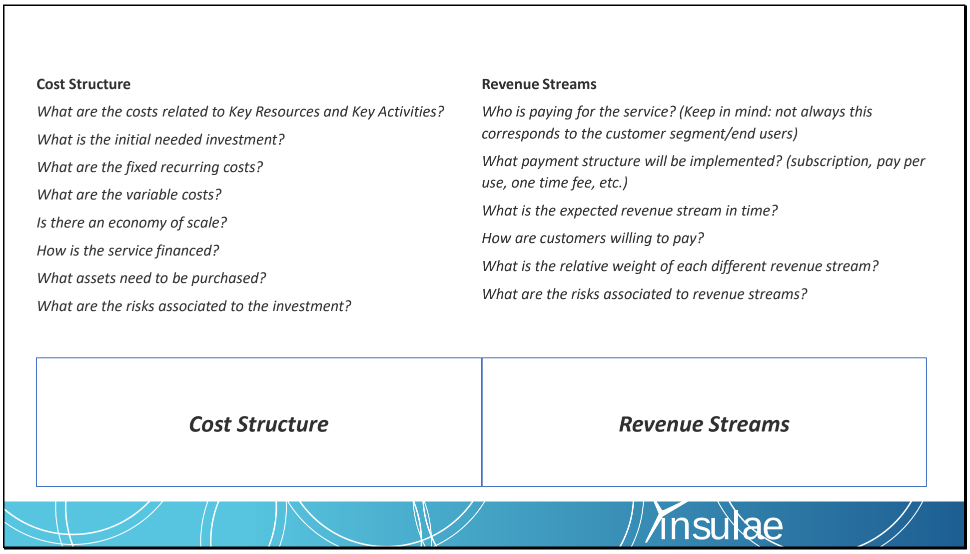

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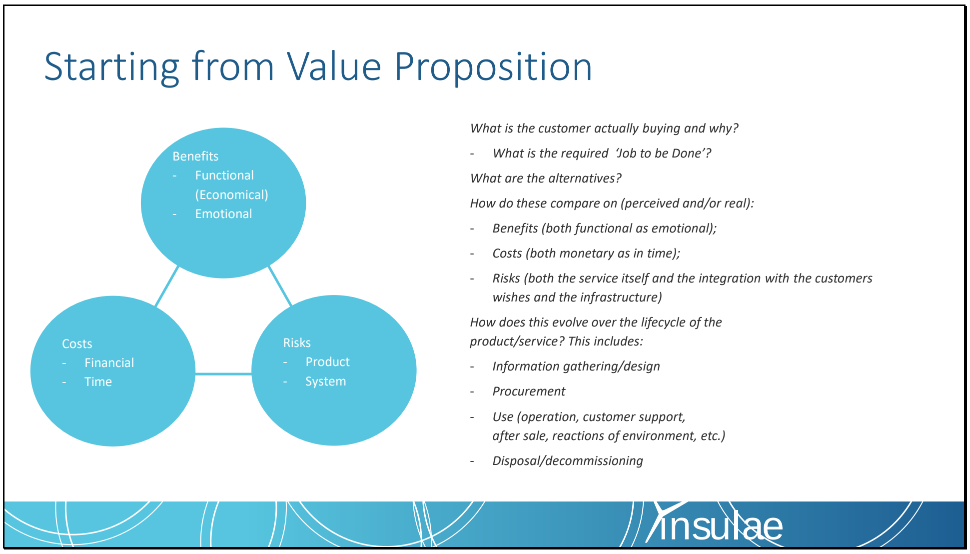

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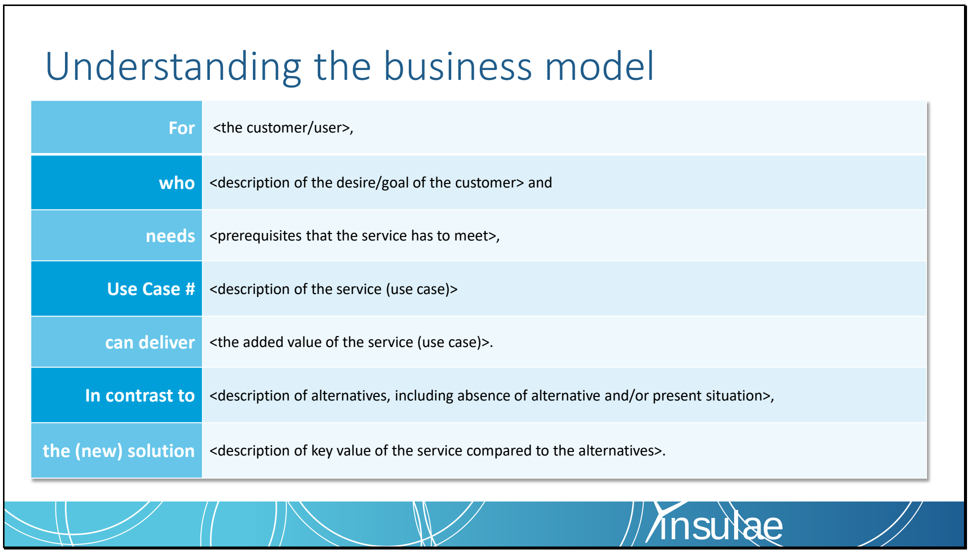

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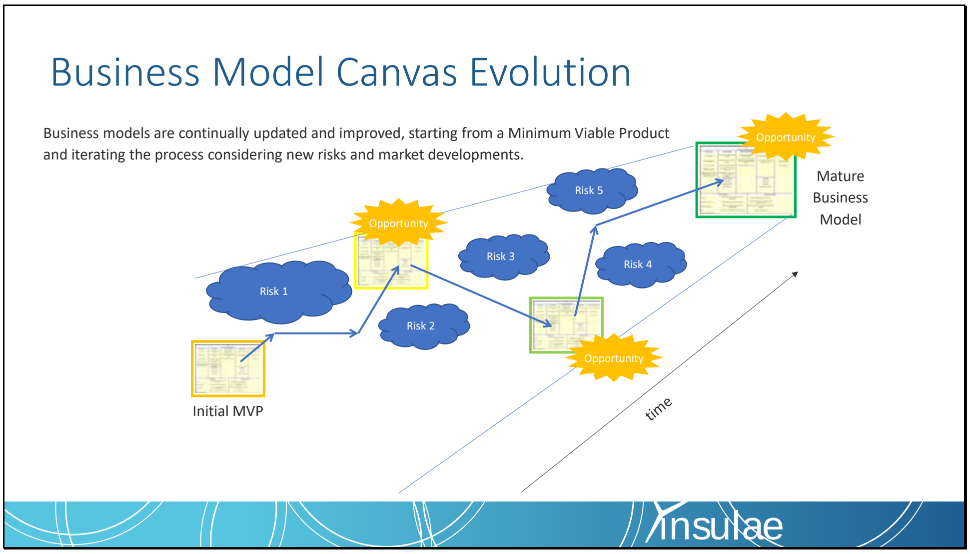

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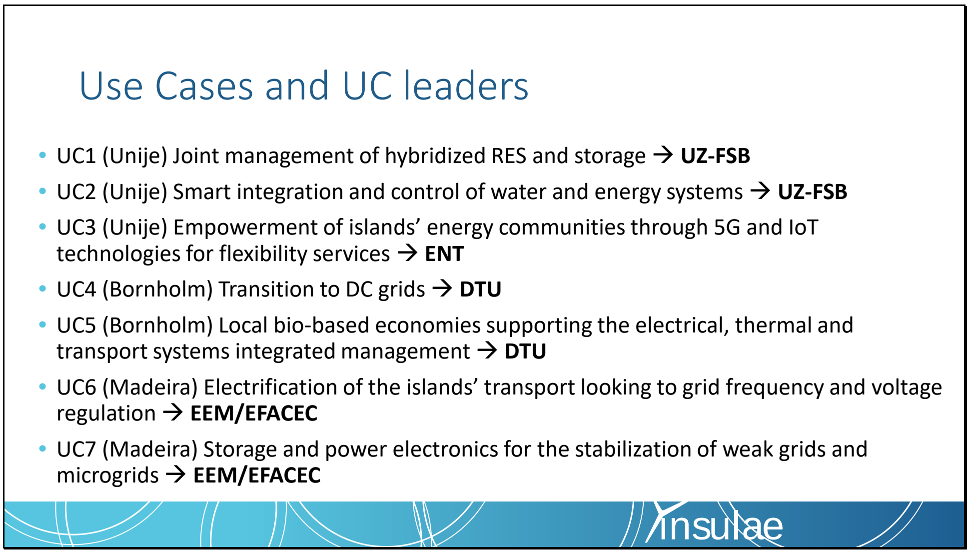

Use Cases and UC leaders
UC1 (Unije) Joint management of hybridized RES and storage → UZ-FSB
UC2 (Unije) Smart integration and control of water and energy systems → UZ-FSB
UC3 (Unije) Empowerment of islands' energy communities through 5G and IoT technologies for flexibility services → ENT
UC4 (Bornholm) Transition to DC grids → DTU
UC5 (Bornholm) Local bio-based economies supporting the electrical, thermal and transport systems integrated management → DTU
UC6 (Madeira) Electrification of the islands' transport looking to grid frequency and voltage regulation → EEM/EFACEC
UC7 (Madeira) Storage and power electronics for the stabilization of weak grids and microgrids → EEM/EFACEC
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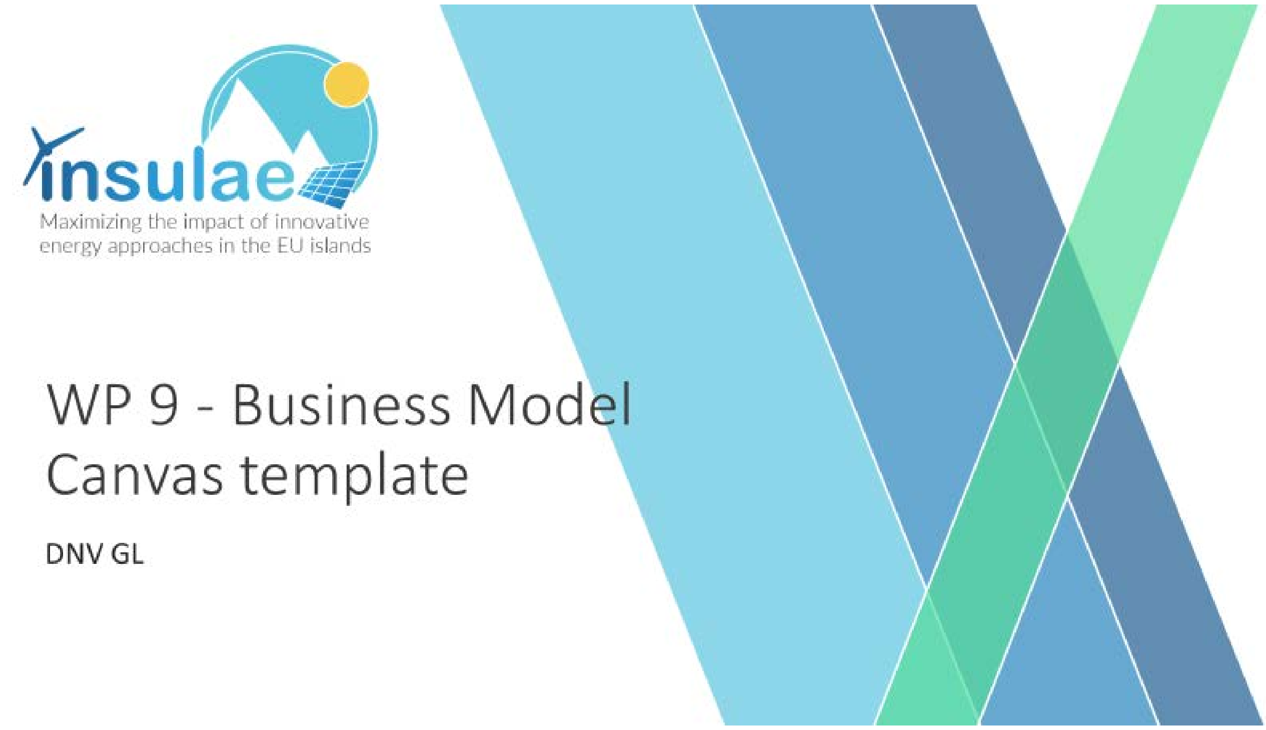
APPENDIX B: BUSINESS MODEL CANVASSES AND VALUE PROPOSITIONS

Slide 1



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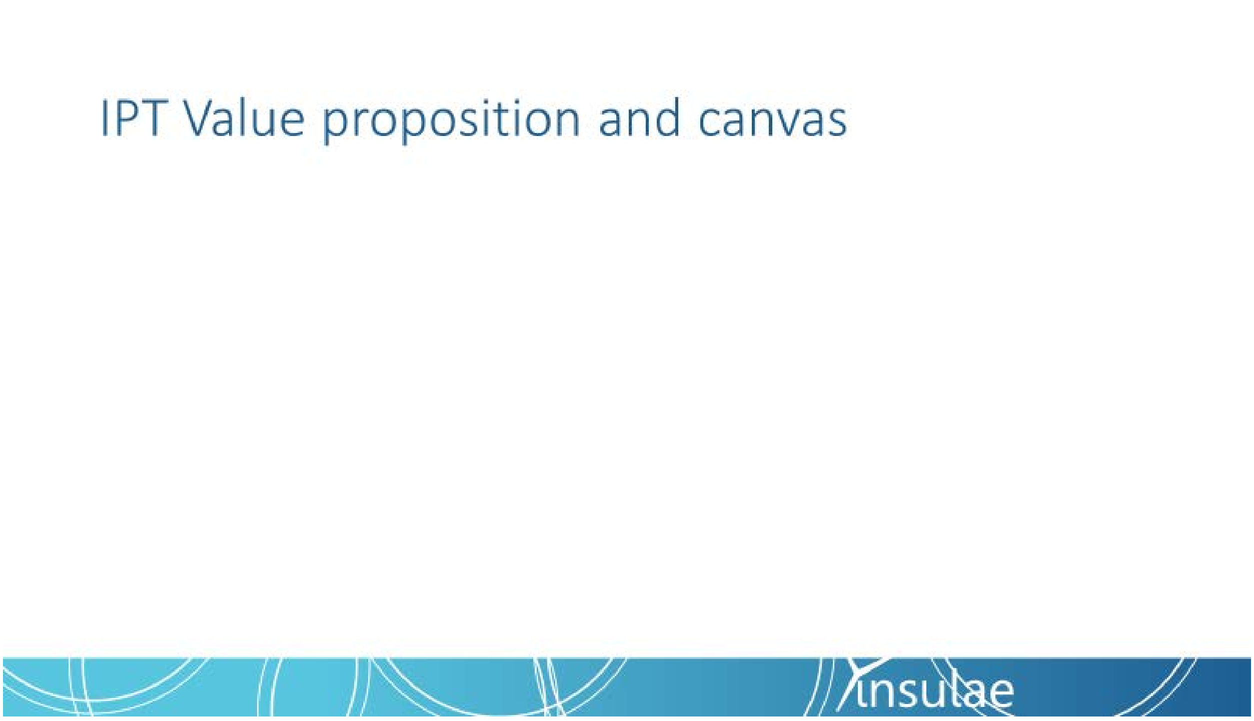

Slide 3

USE case IPT: Defining the customer value: value proposition

For you	Island Authorities or island grid operators
who	have the ambition to decarbonise the island, and
needs	to create a vision, roadmap and action plan, **together** with all involved stakeholders on the island, such as the residents, the grid operator and electricity producers.
The Investment Planning Tool (IPT)	is a software tool to assist island decision-makers in their design of solutions to simulate and plan the development of the energy system of their island
IPT can deliver	long term empowerment of local decision makers in their ability to plan the development of their system, including immediate and specified assessment of developments, plans and ideas in terms of sustainability, security and costs. It delivers a holistic assessment taking into account the whole energy system (from production to consumption through networks) in a multi-energy perspective,
In contrast to	sectorial models quite unsuitable to the deep revolution of energy transition and smart systems,
our solution	gives a clear and unbiased overview of all options for the specific situation on the island, and allows to design the optimal pathway to decarbonization, factoring in local potentialities, economic aspects and stakeholders motivations.

Slide 4

Business Model Canvas Investment Planning Tool

Key Partners	*Key Activities*	*Value propositions*	*Customer relationships*	*Customer Segments*
Global: - *Info providers for library* - *Tool/algorithm developer (to improve and update tool)* - *...* *Per island:* - *Data/information providers (government, utilities, infrastructure providers)* - *Local support (e.g. technical, possibly licensee consultant)*	*IPT support: documentation, training and advice, software maintenance; technical support.* *IPT development and deployment: Model hosting and administration for each customer, Tool implementation, including integration with (local) data and models; keep IPT and intervention library up to date, incl. per island database;* ***Key resources*** *Improved Artelys Crystal calculation engine* *Library of possible interventions to draw from for optimal package design* *Model implementation guidebook* *Hosting server*	*Help island stakeholders to make the best decisions for investments for the transition to neutral CO2 emission islands, by:* - *Modelling of multi energy system incl. interactions with other infrastructures* - *Impact evaluation, incl. cost/benefit B analysis (compared to BAU)* - *Propose an optimal package of interventions to reach user objectives.*	*Low cost to free trial demo version: Low entry barrier for use (in terms of time, effort and financial, e.g. without data coupling), no commitment; very loose (almost anonymous) relation.* *Consultancy supported version: for multi year use (e.g. annual policy update support.)* ***Channels*** *M&S: Insulae follower islands; Mouth to mouth using island networks and communities; Local consultants or universities who are working with more than one island* *Web based demo trial version (with registration?) with little. Creating interest for consultancy supported onsite implementation (with data, model and tool coupling)*	*Island governments/policy makers designing a **government policy** to reduce CO2 emissions.* *Island utilities, IPP and investors doing long term **investment planning** to reduce CO2 emissions. Besides individual use, the tool could facilitate communication between said parties.* *Industry and other stakeholders with large demand facing investment decisions* ***Smart grid solution provider*** *wishing to advocate for the benefits of its solution* *Independent parties (e.g. agencies or media) **evaluating the effectiveness** of policy and/or investment decisions.* *Consultants advising stakeholders.*

Cost structure	*Revenue streams*
Development cost *Maintenance cost (Keeping tool updated)* *Support cost (documentation, education, technical)* *Per island: One time implementation cost (ICT implementation; data and model coupling; island modelling; advice/consultancy; possible reporting)* *Per island: Recurring costs (hosting and administration, hosting and administration, database maintenance, advice/consultancy)*	*Modelling and implementation services* *License, either perpetual or annual* *Maintenance and support contracts* *Consulting services*

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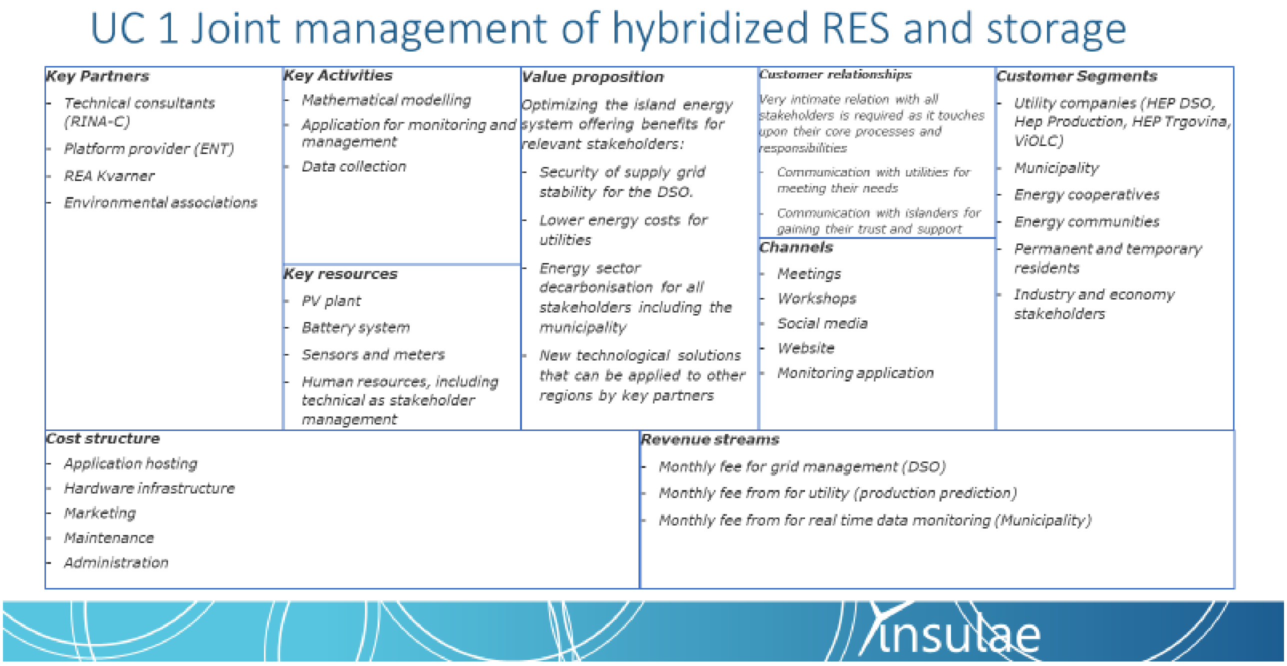
Slide 5 UC 1



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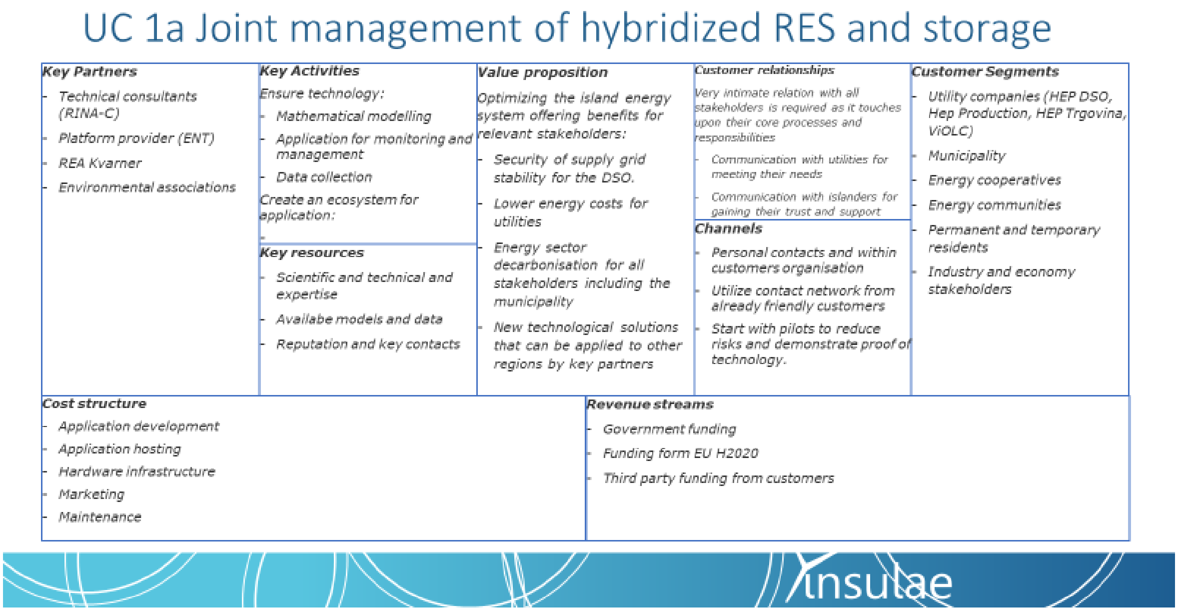

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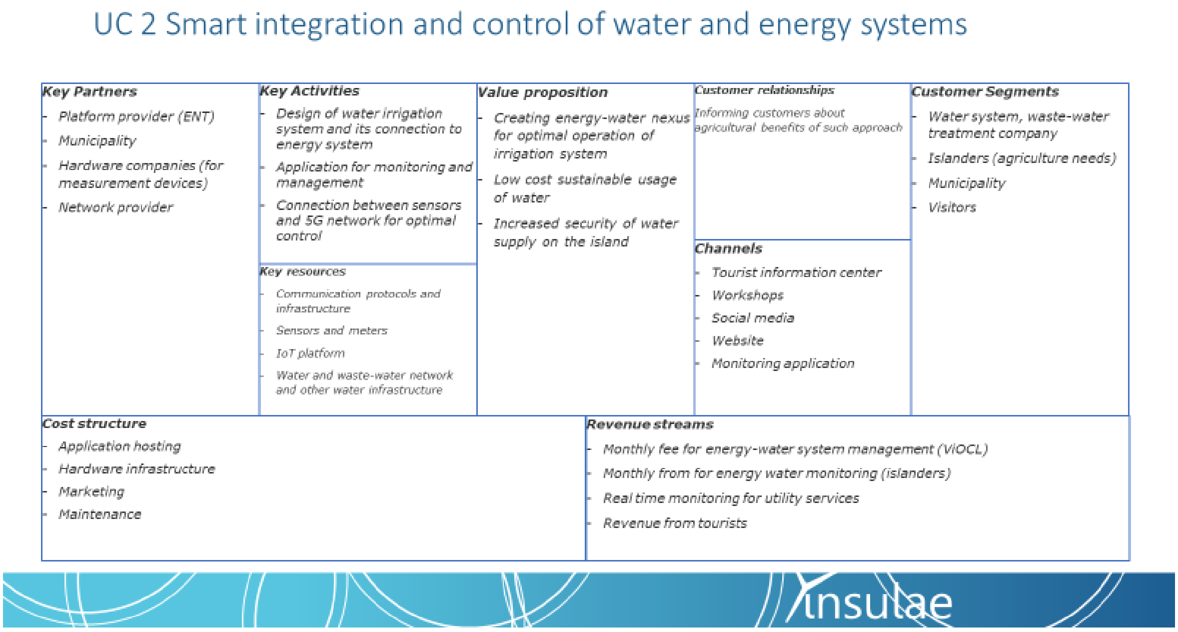

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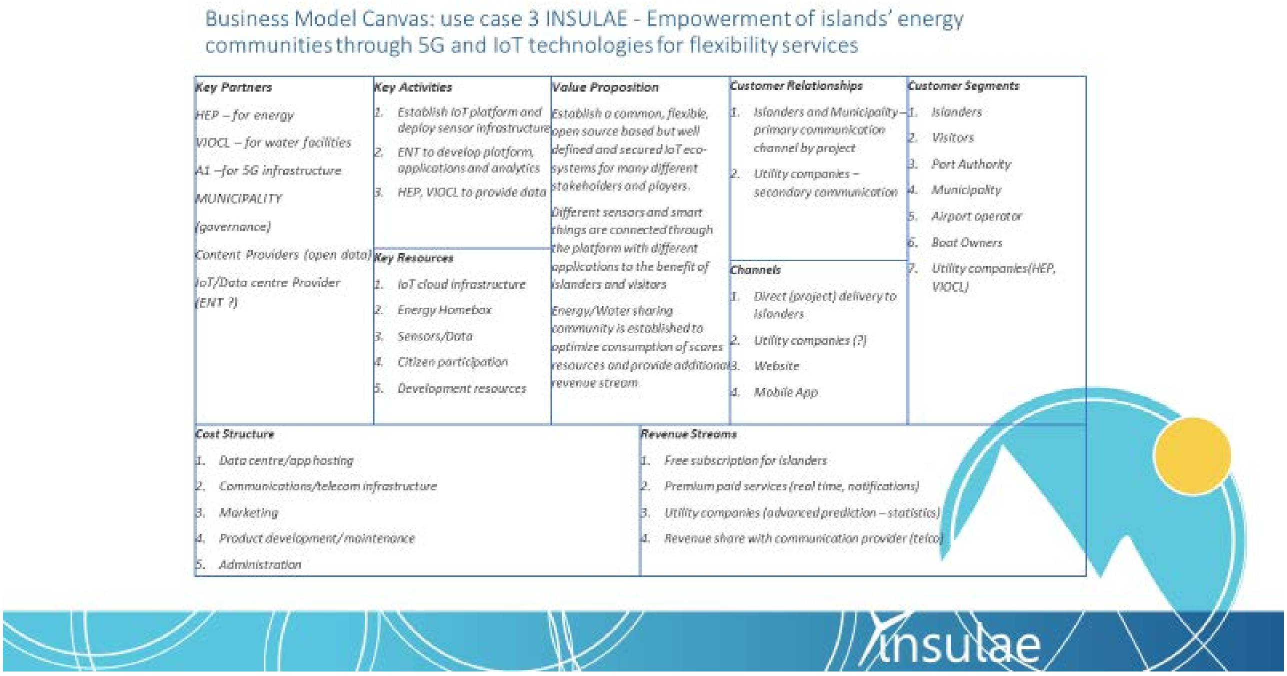

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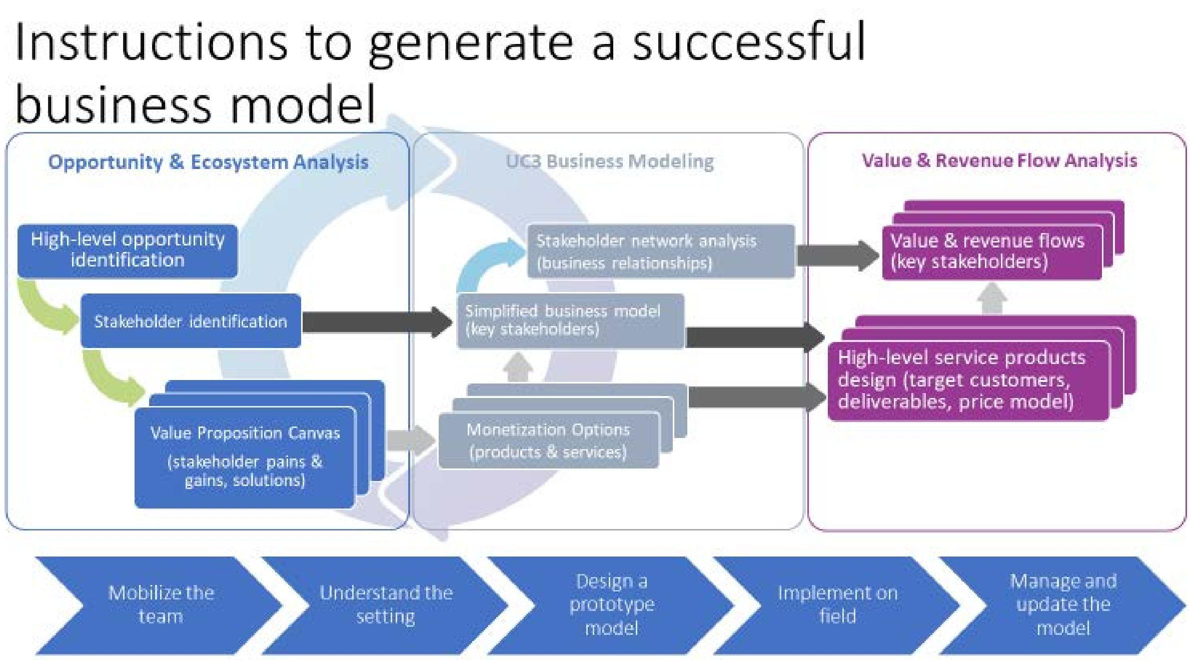


Slide 10

UC3 Unije

Empowerment of the islands energy communities trough 5G and IoT technologies for flexibility services

Quality of life & Enviroment (islanders & visitors):

- Sea water quality / temperature
- Air quality / temperature / humidity / pressure
- Air pressure trend (short term (e.g. 15 min.) / mid term (e.g. 6 hours)

Optimizing traffic and security on island

- Counting of persons at harbor or passengers enter boat
- Real time information for municipality regarding number of visitors on island
- Increasing security, e-health and emergency services

Citizen wellbeing & utility companies services optimization:

- Optimizing energy & water consumption for citizens
- Predicting energy & water consumption for utilities
- Introducing community based energy/water trade

Slide 11

UC3 Unije Stakeholders

Slide 12

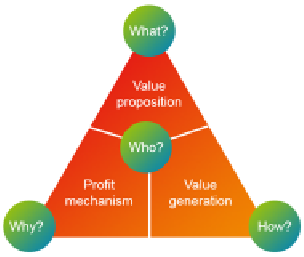
UC3 Unije - Simplified Business Model

Customer Definition

- Islanders
- Visitors
- Municipality
- Utilities

Value Propositions

- Smart home system for islanders/visitors with Mobile app for real time consumption monitoring with integrated security
- Dasboard for municipality/utilities with aggregate statistical informations (people on island, boats in port) and consumption (energy, water, waste) predictions…



Profit Mechanism

- Free and paid subscriptions
- Energy and water exchange tracking system with external monetisation services

Value Creation

- Introducing IoT, Big data, AI platform
- Connecting energy boxes (and utilities infrastructure) with 5G technology
- Visualizing data with Mobile application and dashboards

Slide 13

Understanding the business model

For	Islanders or Visitors
who	would like to reduce carbon footprint/ save on energy and water consumption and
needs	are willing to convert their home to **smart one** by installing **Energy Box** device and subscribe to offered cloud base services,
Use Case #	IoT 5G conneected Smart Home
can deliver	real time monitoring of energy and water consumption, add security and remote control of home appliances, optimizing consumption and reducing risks of energy or water spills
In contrast to	non existing similar service provided by utilities, no real time monitoring of energy and water consumption
the (new) solution	will provide that missing service in affordable and cost effective way.

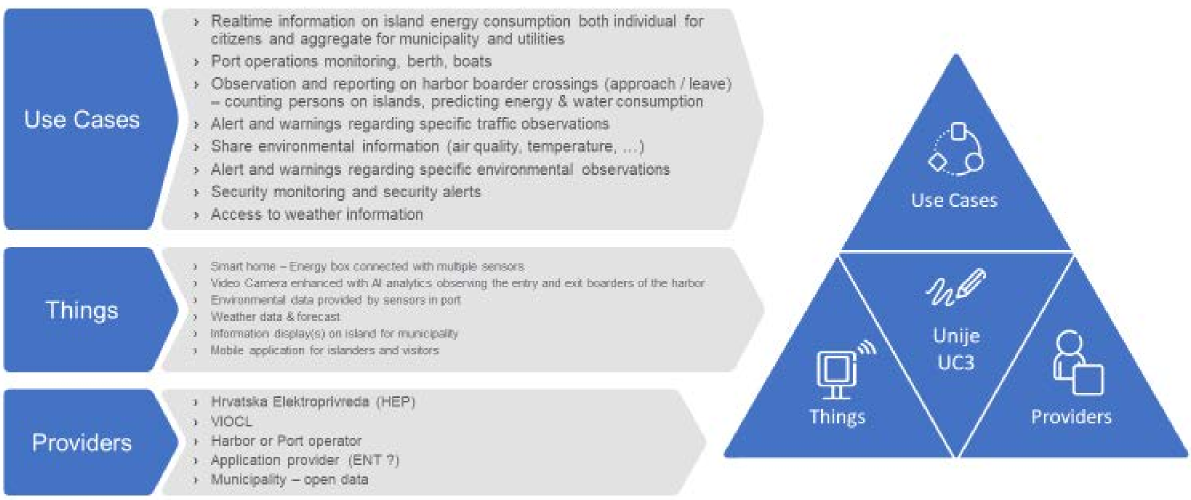
Slide 14

Understanding the business model cont.

For	Municipalities or Utility companies
who	would like to optimize field operations/ save on energy and water losses on islands premises, get better insight on total number of people living or visiting islands, bring more order in port facilities
needs	are willing to share their open data informations to community and get in back pecise consumer data, or eventually ability to control consumer behaviour with beter predictions
Use Case #	IoT 5G conneected Smart Home & Smart Island
can deliver	real time monitoring of energy and water consumption to utilities, add security and remote control of public infrastructure, optimizing consumption and reducing risks of energy or water spills
In contrast to	non existing similar service provided by utilities, no real time monitoring of energy and water consumption
the (new) solution	will provide that missing service in affordable and cost effective way.

Slide 15

UC3 – Unije Island



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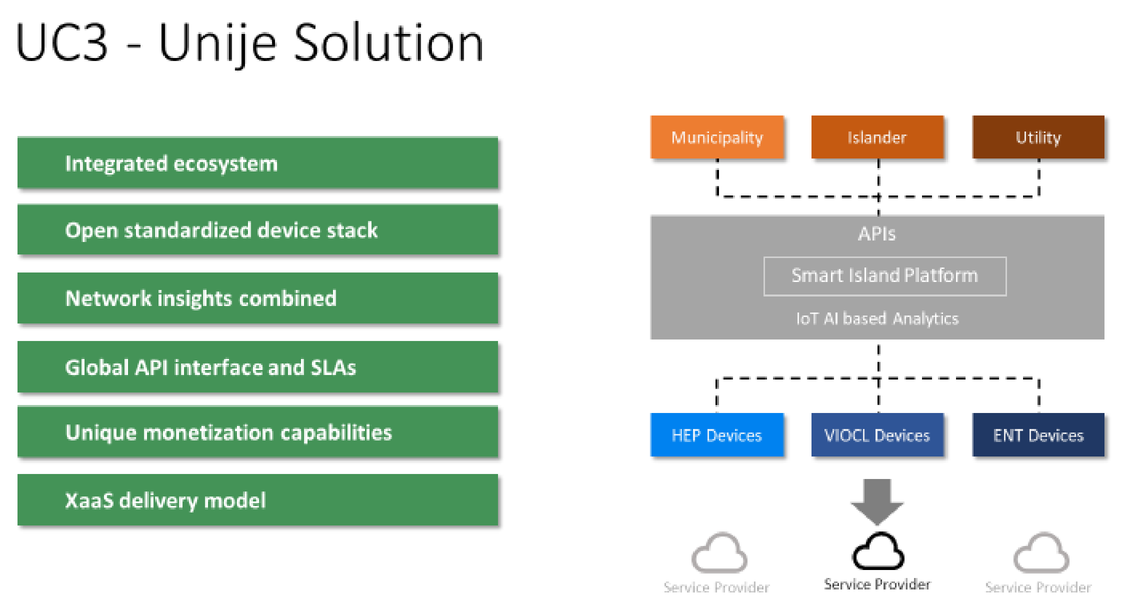

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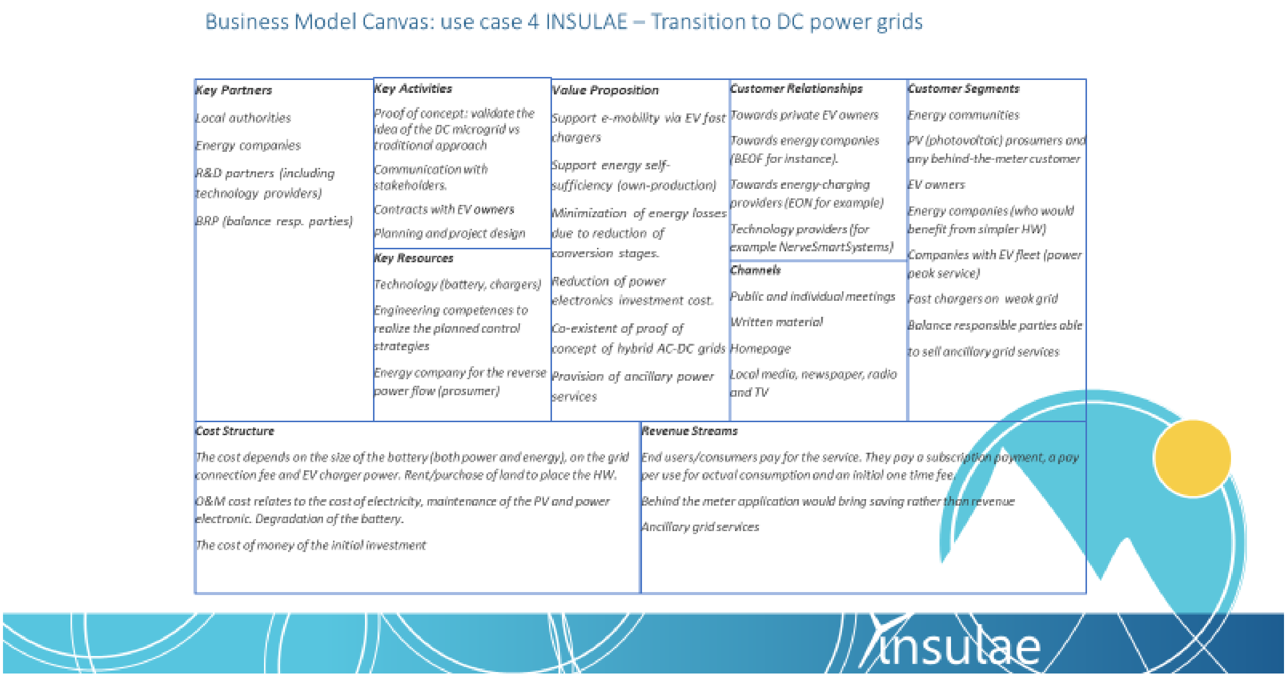
Slide 18UC 4



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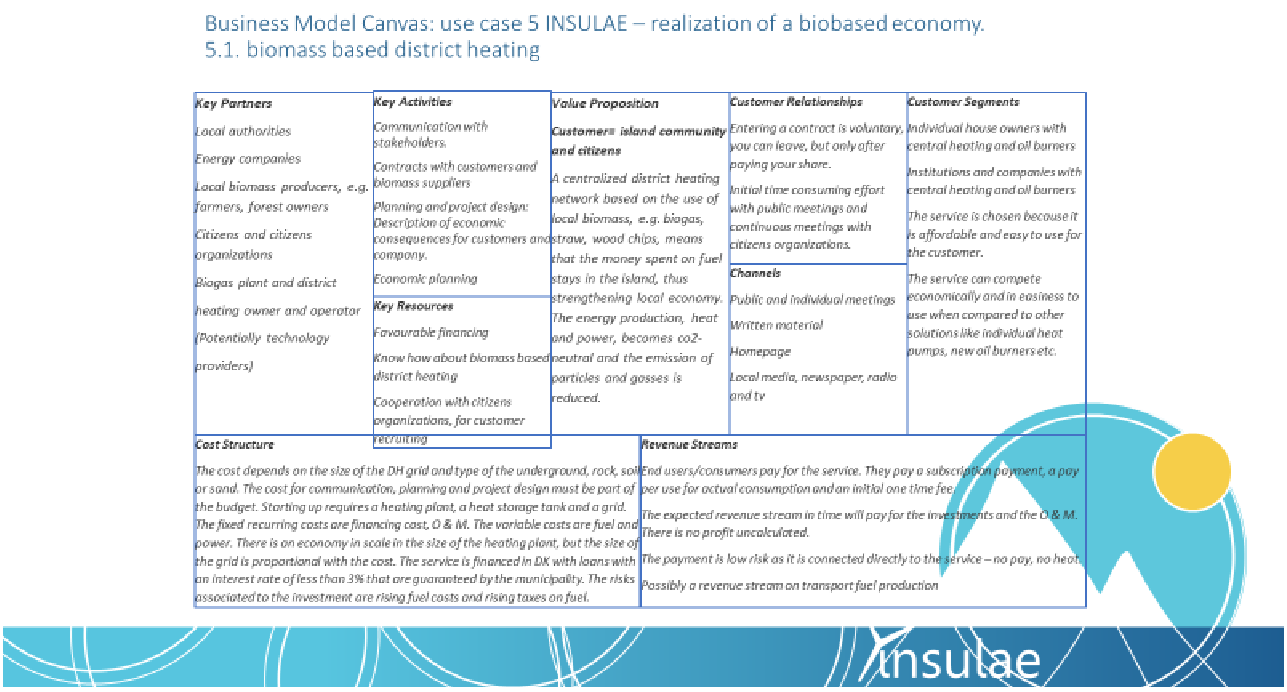

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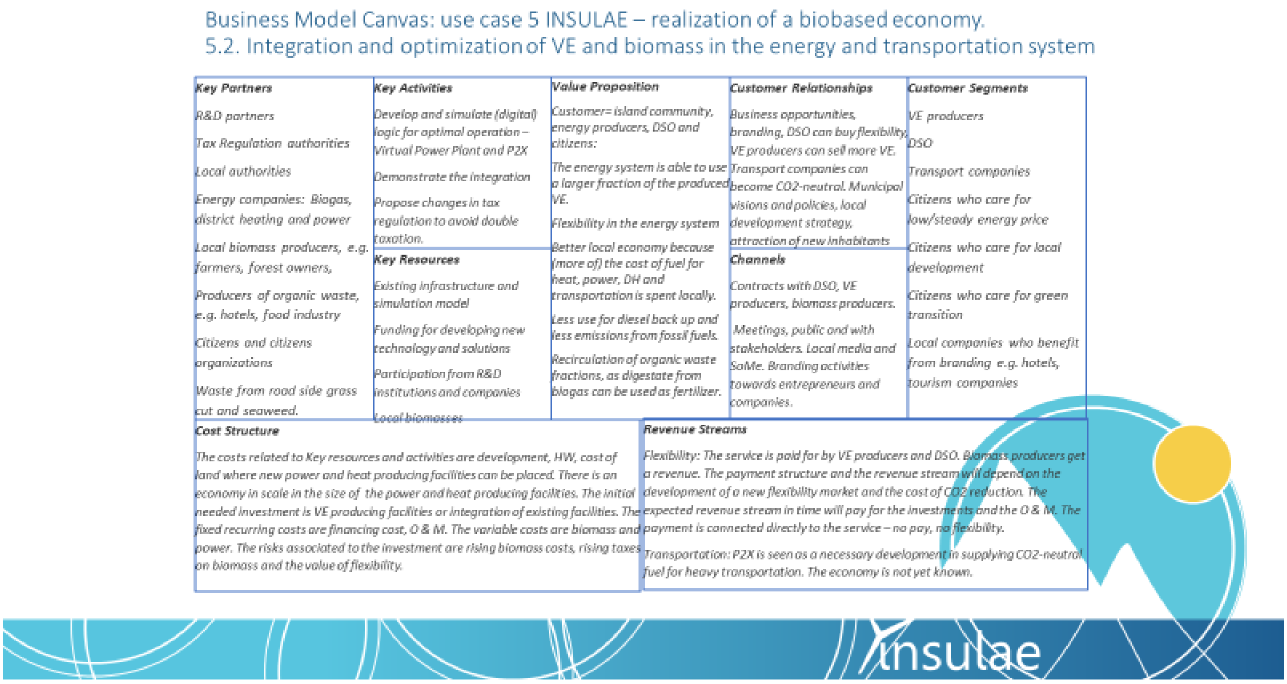

Slide 21 UC6

Understanding the business model

For	EV users and DSOs.
who	Electrification of transport (electric mobility) to assist the management of the island isolated electrical system.
needs	EVs and charging infrastructure.
Use Case #	UC 6 – Electrification of the islands' transport looking to grid frequency and voltage regulation.
can deliver	New charging functionalities (smart and bidirectional charging) will help: • Regulate the grid frequency and voltage; • Enhance grid quality of service; • Increase RES penetration; • Support the grid in fault scenarios.
In contrast to	Investments to reinforce the distribution grid and power generation from fossil fuels.
the (new) solution	EVs as mobile energy storage units (batteries) will be able to provide new flexibility services assisting RES integration and enhance electrical grid stability.

insulae

Slide 22

Business Model Canvas: use case 6 INSULAE - Electrification of the islands' transport looking to grid frequency and voltage regulation

Key Partners	*Key Activities*	*Value Proposition*	*Customer Relationships*	*Customer Segments*
EEM (grid operator) *EFACEC (technology provider)* *CIRCE (control management system of the new charging stations)* *ACIF (dissemination and user engagement)*	*Installation of new charging stations with smart and bidirectional charging capabilities* ***Key Resources*** *EVs* *Charging stations* *Management system*	*Transport electrification (electric mobility) to assist the management of the isolated electrical system*	*Bilateral contracts* ***Channels*** *Public charging stations with smart charging* *Private charging stations with bidirectional (smart) charging*	*EV users* *Grid operators* *Prosumers*

Cost Structure	*Revenue Streams*
Installation (civil + electrical) costs *Product development costs* *Assets management costs* *User engagement costs*	*Ancillary services provisions* *Increase in RES penetration* *EV (dis)charging revenue*

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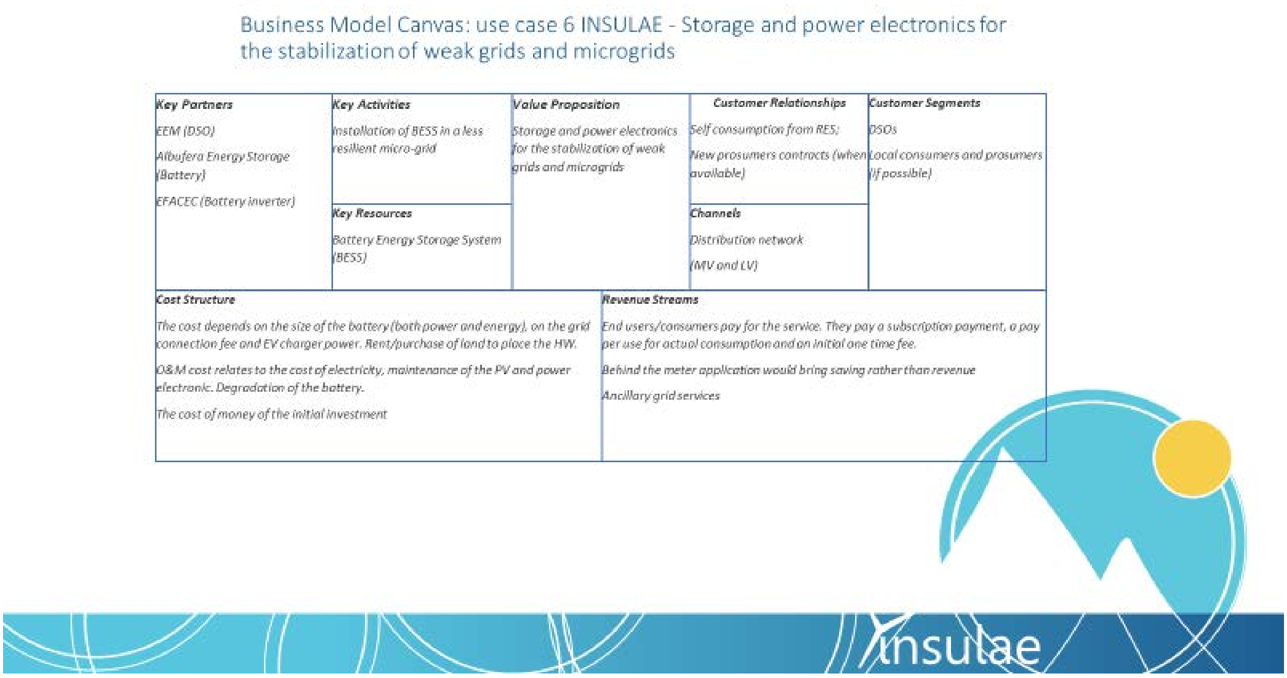
Slide 23 UC 7

Understanding the business model

For	DSO, microgrid consumers and future prosumers.
who	Energy storage and power electronics to stabilize less resilient micro-grids
needs	Battery energy storage system (BESS)
Use Case #	UC 7 – Storage and power electronics for the stabilization of weak grids and microgrids.
can deliver	The battery energy storage system will: • Stabilize the voltage of the micro-grid; • Increase RES penetration; • Decrease energy losses.
In contrast to	Investments to reinforce the distribution network.
the (new) solution	The energy storage system will assure a safer and more stable supply of electricity. Also it will allow a smarter and automated management of the grid, enabling the provision of demand response and flexibility services, thus balancing the production coming from RES.

Slide 24



Business Model Canvas: use case 6 INSULAE - Storage and power electronics for the stabilization of weak grids and microgrids

Key Partners	Key Activities / Key Resources	Value Proposition	Customer Relationships / Channels	Customer Segments
EEM (DSO) Albufera Energy Storage (Battery) EFACEC (Battery inverter)	**Key Activities** Installation of BESS in a less resilient micro-grid **Key Resources** Battery Energy Storage System (BESS)	Storage and power electronics for the stabilization of weak grids and microgrids	**Customer Relationships** Self consumption from RES; New prosumers contracts (when available) **Channels** Distribution network (MV and LV)	DSOs Local consumers and prosumers (if possible)

Cost Structure	Revenue Streams
The cost depends on the size of the battery (both power and energy), on the grid connection fee and EV charger power. Rent/purchase of land to place the HW. O&M cost relates to the cost of electricity, maintenance of the PV and power electronic. Degradation of the battery. The cost of money of the initial investment	End users/consumers pay for the service. They pay a subscription payment, a pay per use for actual consumption and an initial one time fee. Behind the meter application would bring saving rather than revenue Ancillary grid services