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Abstract

The objective of this deliverable is to describe the conclusions extracted from the market analysis carried out in Task 7.4. In this sense, the document makes a wider study of the main trends of the market, especially, those that are aligned with the results of GreenSoul project (GreenSoul Smart Meter, Smart Plugs, Interactive Coasters and GreenSoul dimmers) which are analysed in a separate way.

During Task 7.4. *Market Analysis, project sustainability and exploitation plan*, an analysis of the existing market for the project outcomes has been completed, providing qualitative but also quantitative data about the market, the competitors and the competitive advantages of the products. Moreover, a SWOT analysis has been carried out to show the position of the solution in the market, identifying possible threats and opportunities but also the unique selling points and the weakness of the solutions. The result of this study is shown in this deliverable. Then, the information obtained during this study, has been used for achieving the commercial exploitation of the products at a European level. Therefore, a business plan is defined in D7.11.

Changes History

VERSION	DATE	DESCRIPTION	PARTNER
v0.1	15/03/2019	Initial version	WSC
v0.2	21/04/2019	WeSave information added	WSC
V0.3	31/07/2019	New information added	WSC
V0.3	05/08/2019	WeSave Canvas business model	WSC
V0.4	31/10/2019	All contributor's version	All partners
V0.5	10/01/2020	Reviewed version	WSC

List of Definitions and abbreviations

Abbreviation	Description
BMS	Building Management System
HVAC	Heating Ventilation and Air Conditioning
IC	Interactive Coasters
LAN	Local Area Network
SBS	Smart Building System
UMD	Universal Monitoring Device

Executive Summary

The present document is a deliverable of the GreenSoul project, funded by the European Commission's Directorate-General for Research and Innovation (DG RTD), under its Horizon 2020 Research and innovation programme (H2020), reporting the results of the activities carried out by T7.4, namely the "Market analysis, project sustainability and exploitation plan".

During this task, it is demonstrated the results of the study of the existing market for Greensoul solutions. The knowledge acquired during this process is needed in order to design a specific business plan for the GreenSoul system and the associated products. This deliverable contains qualitative and quantitative information about the existing market. Specifically, this report describes the existing competitors and unique selling points of Greensoul products. Moreover, a SWOT analysis is described taking into consideration current situation and future trends, when it is possible. All the knowledge acquired during this study will be used for the description of the specific business plan of the Greensoul products.

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1 Purpose of the document

This document makes an overview of the energy efficiency in the buildings market, as well as, the barriers and business models of each of the results of the GreenSoul project. Thus, this document is highly aligned with D7.11: Exploitation Plan, where each of the different models to exploit the resulting products of GreenSoul project are defined.

2 Introduction

The Smart building concept is defined as a set of communication technologies enabling different objects, sensors and functions within a building to communicate and interact among them. The applied technology allows the control of different subsystems as desktop appliances, lighting, HVAC (Heating, Ventilation, Air Conditioning) or other that originally only could be operated separately [1, 2].

Table 1 Total costs of a building during operation

Total costs of a building during operation
20% Building costs
80% Operating costs
<ul style="list-style-type: none"> ● 40% Energy ● 30% Maintenance ● 10% Other costs

Considering the Operating costs of a building, and being the energy the most relevant concept, the monitoring and potential future automation of the aforementioned systems can generate benefits related to energy efficiency of the buildings, coming to these improvements from:

- **Smart lighting:** this kind of systems adjust the light levels according to occupancy levels or other elements as HVAC systems, windows etc.
- **Smart HVAC:** these systems are linked to other sensors allowing to easily adapt the configuration according to weather forecasts, occupancy etc.

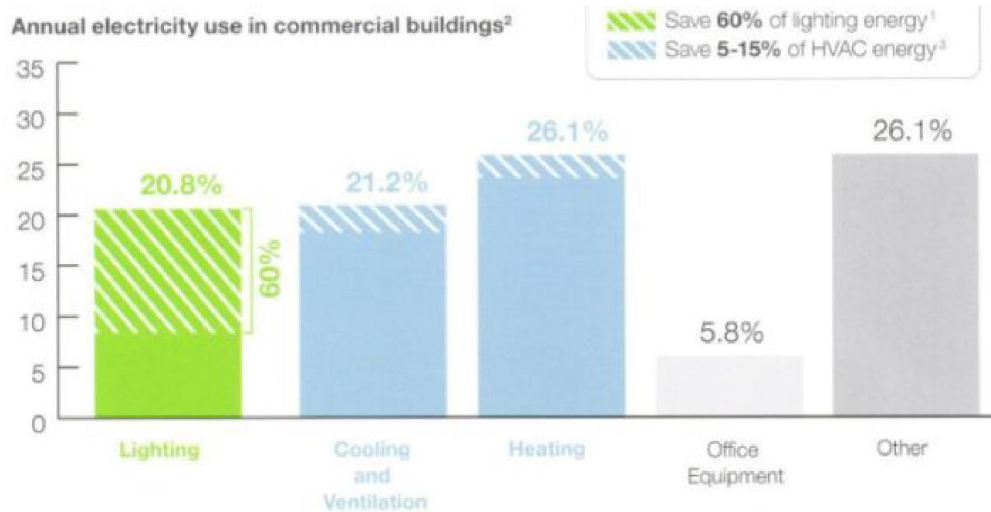


Figure 1 Annual energy use in commercial buildings and potential savings. Source Bonneau et al., 2017 [1]

The cost comparison between the typical Building Management Systems (BMS) and the Smart Building Systems (SBS), enhanced with IoT sensor networks, it would be as following:

Table 2 Cost comparison between BMS and SBS. Source Bonneau et al. 2017 [1]

Cost comparison BMS vs SBS	
BMS: 100 – 250k USD	SBS: 5 – 50k USD

3 Targeted Market

For the market of smart building, it is expected a moderate growth of a 15% until 2025. In volume, the installed devices are expected to grow to 980 million by 2025, when considering the energy management and security-based devices. By product type, the main revenues will come from insulation, HVAC and lighting systems [1]. It is expected that the energy efficient building market will generate revenue around 90.000 million € in Europe in the year 2023 [3].

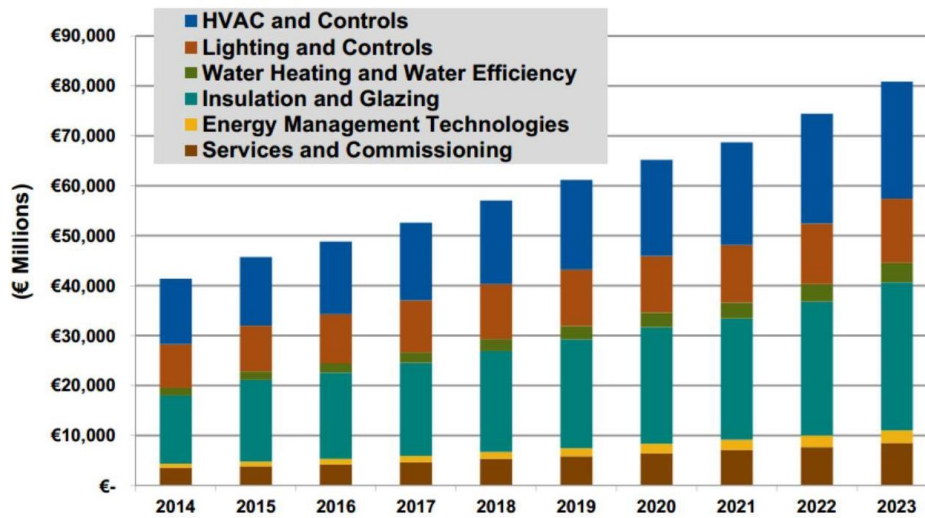


Figure 2 Energy efficient product and services revenue by product type (Europe)

The current situation in the EU reflects that around of a 40% of the energy consumption and a 36% of the CO₂ emissions in the EU come from buildings. Additionally, a 75% of the EU building stock is energy inefficient representing this figure higher costs and a relevant environmental impact due to the linked GHG emissions. Currently, between a 0.4%-1.2% of the EU building stock is renovated each year leading to potential savings in energy consumption of a 5-6% and CO₂ emissions by a 5% [3].

The aforementioned situation in the EU has resulted in the addition of new objectives in the concerning building regulations driving the market, in this way, not only by the possible economic savings that can be obtained with the implementation of smart technologies but, also, with the new CO₂ reduction objectives produced by energy efficiencies in buildings.

The regulations that are conducting the strategy of energy efficient buildings are the Energy Performance of Buildings Directive (2010) [4] and the Energy Efficiency Directive (2012) [5]. The latest update (2016) of the Energy Performance of Buildings Directive [6] makes special reference to HVAC control systems and sets minimum requirements in energy performance for building renovation within the EU countries. In this sense, the directive also establishes that *“all new buildings must be nearly zero-energy buildings by 31 December 2020 and by 31 December 2018 for public buildings”*.

There are some barriers already present in the market, one of them is the diversity of communication protocols of HVAC and lighting systems. This fragmentation of protocols used in smart building technology hinder the interoperability among systems and harm a proper synchronization which could allow a higher degree of optimization [1,7].



Figure 3 Protocols used in Smart Buildings

Here we present a product, the GreenSoul System, for reducing energy consumption in buildings based on three elements: Multi-sensorial network, Decision Support System and persuasion mechanisms. There are two **target markets** to which this product would go: the **automation of buildings and offices** and the **smart home market**. In particular, the segment of control and energy saving devices. Both of them are markets in strong growth in the developed world. The main players are positioned in the market of automation and artificial intelligence (Apple, Amazon and Google) and they are trying to centralize all the applications and devices that address it. We also have the leading producers of home electronics (such as Phillips) taking out products every day. The estimated size of this market in 2016 was \$ 13,000M with an estimated annual growth of 12% to \$ 72,000M in 2022 [8]. However, the part related to energy management and savings is smaller, estimated to be about 3,000M \$ in 2022 [9]. Specifically, in the case of building and office automation, something similar happens: the estimated size of this market in 2018 is 44,000M \$ [10]. With an annual growth of 11% in the coming years. The main driver of this growth is energy saving, a sector that precisely affects this product. If we estimate that the proportion of energy savings is similar

to smart homes, we would have another \$ 4,000M in this sector. With an approximate total market of \$ 7,000M. If we take into account that only European markets are going to be addressed at the beginning of this project, we can estimate a potential market of \$ 900M and with an annual growth of more than 10%. This size is very reasonable to give guarantees that with a small market share it could reach very high-income levels reasonable to justify a Venture Capital investment for expansion.

4 GreenSoul Solution

In this section, the GreenSoul System is analysed as a part of a group of different components of the GreenSoul ecosystem (Multi-sensorial layer, Decision Support System and Visualization tools), defining its functionalities, target groups, competition, its corresponding canvas business model and a SWOT analysis. Moreover, for the more commercially-advanced solutions, a specific analysis is provided.

4.1 GreenSoul System

Solution Description

The GreenSoul project has designed, implemented and tested a system for the energy saving of medium and large companies, with the possibility of extending the market to large-sized homes. The system is based on the monitoring of energy consumption and mechanisms to give personalized usage recommendations, taking into consideration the characteristics of the users and adapting to their changes.

The systems make use of energy-related profiles of each user that can be obtained by a previous questionnaire or by other methods. Each profile has an optimal way to receive feedback on their energy consumption and good practices to increase energy performance. The system makes use of this information to show the user how to save energy. This feedback is effective even outside the areas directly controlled by the system.

As an overall system encompasses all of the following features and expands them, even more, offering a complete solution that delivers the objectives of the GreenSoul project. The full detailed description of the GreenSoul system is presented in Deliverable D3.9 [11].

The main problem the GreenSoul system solves is the increase in energy consumption in medium-sized companies and it can be extended to smart homes. Being able to produce savings between 15% and 30% in the best scenario. Savings occur in energy consumption and heating consumption. The fact that the interactions are preferable with the user, allows reducing the cost of installation of an entire smart system in the building. The user will take the pertinent actions, allowing reducing consumption even in HVAC systems where the control of the HVAC is manually actioned. However, to encourage users to reduce energy consumption in public buildings, an additional effort should be included to persuade them to be energy efficient (more than just cost savings). In this case, the solution includes the incorporation of gamification logic as a form of interaction with the user (See [12] for similar cases).

The GreenSoul systems consist of different elements organised in three main blocks:

1. Multi-sensorial network: a set of sensors and adaptors are deployed to optimize efficient usage of individual and collective appliances in specific zones of the building or the entire building.
2. GreenSoul Decision Support System: a software component to provide value to the information retrieved by the network of sensors. This component analyses data and provide autonomous recommendations or even actions (through actuators) to fulfil the GreenSoul energy-efficiency objectives.
3. Visualisation Interfaces: provide useful information to the end-users and buildings managers about energy consumption in the building. This consist of a mobile application for end-users containing information about energy consumption and performance of individual appliances and devices of collective usage (at the office level), and a web-based dashboard with information about the energy performance of the monitored offices of the building for energy managers).

These elements will be supported by the GreenSoul Information Models databases and a middleware based on LinkSmart [11].

The GreenSoul solution is adapted for each specific situation and therefore the solution can be different depending on the specific needs to maximize the energy savings. Below we provide a brief description of the main components that can be installed.

Multi-sensorial network

This network includes the sensors to collect relevant information that will be used for the GreenSoul Decision Support System and that it will be visualised in the mobile app and the web-based dashboard. A variety of sensors and devices are included in the overall GreenSoul Multi-sensorial network, but only some of them will be installed depending on the characteristics of the building and the purposes.

The **smart plug** is one of the main devices to collect information about energy consumption and the status of individual and shared devices. Two different commercial smart plugs are compatible with the solution: TP-Link HS110 [13] and PlugWise Circle Smart Plug [14].

A device for monitoring energy consumption for a shared space is also provided. The proposed solution includes the installation of an **energy monitoring system** by means of mainly a Universal Monitoring Device (UMD), a network analyser and precision transformers. This solution monitors the intensity of the measured circuits and reads the information of the network analyser: active and reactive energy consumption, voltage, current, active and reactive power, power factor, etc. For more details see the description of the GreenSoul System in D3.9 GreenSoul System [11].

Other sensors to monitor **thermal comfort and also presence** inside the building are also installed. With the GreenSoul solution, Wireless Room Transmitter for temperature and humidity (TEFL) and a Wireless Occupancy Detector (LAFL) for occupancy and luminosity is provided [11, 15]. These sensors are attached to the UMD and are compatible with the GreenSoul System.

The **flexibility** of this solution can help to reduce the investment in new devices but also can install GreenSoul compatible solutions to deploy an efficient tool to reduce energy

consumption. In some specific cases, information can be retrieved from existent **Building Management Systems**. However, this specific situation should be analysed before the installation of the system in the building.

As an innovation of the GreenSoul Systems, two different elements are installed to make high energy consumption devices able to interact with users to increase energy awareness and efficiency. These two elements are called adaptors and change a common device to a **GreenSoul-ed Thing**. The idea is to enhance the common devices (coffee-makers, printers, desk's power strips, lightings, HVAC systems) with local intelligence and remote actuation mechanisms (if it is required), and persuasive interfaces for user interaction to increase user behaviours towards the reduction of energy consumption. To achieve this goal, the GreenSoul System includes two different elements, the Interactive Coasters and the GreenSoul dimmers that are part of the Multi-sensorial network.

- **Interactive Coasters:** this element allows the users to become aware of the energy that they are currently consuming and his or her behaviour for saving energy. This device displays the energy consumption of the electronic appliances in a workspace or for shared appliances in common areas (e.g. lighting, printer). This device displays the energy consumption of the user during the current day, compared to the average consumption for the previous ten days, using a colour code. But also, the user can see the energy consumption of the previous day, and current week, month and year [11, 16].
- **GreenSoul Dimmers:** this element allows to improve the visual comfort in a common area on a desirable level reducing the energy consumption for lighting. This consist of a Wi-Fi-enabled device that can be configured for the user defining a preferable luminance and automatically adjust the lighting sources so as to achieve the desired visual comfort according to the user preferences. If there is enough natural luminance in the room the dimmer will dim down the lights to achieve the value set in the dimmer [11, 16, 17].

Other **ancillary components** are installed to make the system interoperable (gateways) and to ensure communications (networks). Gateways are needed to abstract all the different

communication channels and the applications protocols. Therefore, in all the pilots, devices capable to run an instance of the middleware used (LinkSmart) are installed. Moreover, this is complemented with other gateways needed when legacy devices are connected [11]. Moreover, an isolated LAN is deployed in order to connect the Smart Plugs and Interactive Coasters to the gateways (i.e. Raspberry Pi), using a Dual-Band Wi-Fi Router. In case that there are restrictions to have access to the internet through the current physical infrastructure in the building (in terms of security reasons), an LTE Mobile Wi-Fi combined with a 4G SIM card, to provide a connection to the internet through Wi-Fi access point.

GreenSoul Decision Support System

The GreenSoul Decision Support System and the **databases** created for collecting information are responsible for providing value and meaning to the information gathered with the Multi-sensor network. For data storage, the GreenSoul system has adopted a hybrid database scheme for static and dynamic information (MongoDB and InfluxDB). The access to them was through a web-based API. This information was protected using different mechanisms (HTTPS, local data storage, encryption and end-user passwords). For further details, see D3.9. GreenSoul System [11].

Specifically, the **GreenSoul Decision Support System** evaluates in real-time information collected by the Multi-sensor network (such as occupancy, thermal and visual comfort, environmental conditions, energy consumption) and then provide, taking into consideration the comfort and potential energy savings, the optimal control actions. Then, a persuasion engine finds the means that will motivate each individual user or group of users to take actions and reduce energy consumption. Moreover, the GreenSoul Decision Support System provides dynamically and in an adaptive manner recommendation to the pilot end-users while also evaluating their performance and awarding them with points, following a gamified approach. Then, the users will receive a notification through the mobile app. The user or group of users will receive some points according to the actions taken and the savings accomplished [11, 18].

Visualization interfaces

Two different visualisation interfaces can be provided with the GreenSoul System a mobile app for end-users and a web-based dashboard for managers.

- **GreenSoul Mobile App:** The GreenSoul Mobile Application (GS App) is, as its very name suggests, the mobile application for presenting to and communicating to the building users the results of their energy behaviour in their place of work. Available in the Android mobile operating systems and on web-based access, the GreenSoul Mobile App is connected to all GreenSoul components to retrieve information from the Multi-sensor network and the recommendations from the GreenSoul Decision Support System.

The GS App uses gamification logic to communicate energy use to individual users and to provide them with alerts about their energy consumption behaviour along with suggestions on how to reduce energy consumption. This defines watt-hours as a measure of electrical energy equivalent to a power consumption of one watt for one hour. Average desktop and monitor consumption is about 400 watts per hour and a typical desk-lamp about 60 watts an hour. So, turning off a desk-top and desk-lap one hour more per day will save approximately 460 watt-hour per day and therefore earn the participating user 4,600 points (called eco-points). Users are not competing with each other: the eco-points are for users to monitor themselves and compare in a collegiate manner with other users. Eco-point scores will be displayed daily, weekly and monthly.

The GreenSoul App also can provide information about the user energy consumption of personal items in his/her workspace, but also can provide information and recommendations for an entire office, taking into consideration data collected from the energy consumption of the office or room they share. The mobile app also permits users to publish their individual energy savings on social media.

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- Web-based dashboard (WeSave): The GreenSoul System includes a visualization tool that allows showing data collected by the Universal Monitoring Device on energy consumption and other variables such as presence, luminance, temperature and humidity. The final user of this platform is the building manager or a person who manages the energy consumption in the building. However, other profiles have been designed for tenants and other staff or maintenance services. This dashboard allows accessing instantly to energy consumption information over time. The information is visualized through graphical representation of data but also monitoring reports can be produced.

The platform is accessible through a web browser and provides visual information for the entire building, separating the information by electrical circuits. The information that can be visualised is active power, comparison, apparent power, reactive power, intensity, voltage, power factor and frequency. But also, other variables related to the building performance can be visualized (indoor and outdoor temperature, humidity, luminance, etc.). A specific section for management is included. This section allows managing the incidences registered in the building by the maintenance services.

An important feature of this visualization tool is reporting. The monitoring report gathers all the information collected by the GreenSoul System and that can be visualized by building managers or personnel of the building (personal and protected information cannot be showed). Moreover, a comparison with previous information and the deviation in the consumption can be reported. Finally, with the information from the billing, a comparison between the consumption measured with the expected and billed consumption can be shown. For more information see D3.8 GreenSoul Platform [19] and D3.9 GreenSoul System [11].

The potential GreenSoul System will have at least two versions. The first version (GreenSoul API) will be a version to be integrated into a standard energy monitoring system, containing the interfaces (APIs) necessary to interact with it. The second version (GreenSoul Premium)

can be installed autonomously in a home or business. It will have all the necessary elements to operate in a medium environment. Some of the components may be manufactured by third parties, as it was shown before, but they are integrated into GreenSoul Premium for operation. Under some circumstances, a mix between both versions would be possible including a detailed analysis of the requirement and objectives.

Components of the GreenSoul API System:

1. Support System Decision (DSS). Control and intelligence software for all the system. It will reside in the cloud or optionally on the client's servers. It will interact with:
 - a. Methods for feedback: apps, gadgets, home assistants, etc. through the use of the API.
 - b. Sensors: energy meters (smart plugs and network analysers), presence sensors, temperature sensors.
 - c. Third-party dashboards.
 - d. Systems for acquiring user profiles and updating them
2. Own applications, interfaces for interaction with home attendants, and own gadgets to give dynamic feedback
3. Software for the acquisition of user profiles on mobile or web systems

Components of the GreenSoul Premium System:

1. Support System Decision (DSS). Control and intelligence software for all the system. It will reside in the cloud or optionally on the client's servers. It will interact with the multi-sensor network, the visualisation tools (GreenSoul Mobile App and GreenSoul Web-based dashboard).
2. Multi-sensor network: energy meters (smart plugs and network analysers), presence sensors, temperature sensors, GreenSoul-ed Things adaptors (dimmers and interactive coasters) and other ancillary material for a correct functioning (gateway and network components).
3. Visualisation tools: mobile app for end-users (Energy-consumers) and web-based dashboard (for managers or maintenance services).

4. A system for acquiring user profiles and updating them

A product developed would not require much support to start working. Installation and commissioning could be done by the user or with a minimum integration service if required. It would only be necessary to train the partners that Integrate into their systems. It is, therefore, a software product with some hardware components, that is easily scalable.

Unique Selling Proposition

The GreenSoul System provides an innovative product compared with competitors in the market. Most of the home automation systems for energy saving are based on a consumption monitoring using various methods (current meters, temperature sensors, etc.) and a more or less smart and programmable system that turns off or on the devices based on some basic rules.

The GreenSoul System includes these characteristics but it is branded by the main innovative aspect, i.e. the interaction with users in a smart way to induce them to energy-saving behaviours. The intelligence of the system is not only the ability to anticipate the best use of energy according to the habitual behaviours of the users but its way of making them collaborate smartly using their feedback reaction profiles. The system cooperates with the user and does not act for him. This allows, among other things, to have what is called the spill-over effect, i.e. the possibility that these saving behaviours go beyond GreenSoul-controlled systems. The user will become accustomed to saving measures in other places and with other devices, expanding their impact beyond the systems strictly controlled by it.

The system can also evolve as the client profile evolves. It is expected that continued feedback can produce changes in the user's response and therefore in the ideal method to give feedback. Finally, the incorporation of gamification as a form of interaction with the user, similar to other existing cases [12], will be included as an option.

The GreenSoul App is unique in that it has been built for monitoring specific devices within a specific building and is entirely dependent on the intelligence of the GIM. The Decision Support System analyses all the information and provide specific recommendations based on persuasion strategies and mechanisms to create a change in the habit of the user to achieve a reduction in energy consumption. There are energy saving and monitoring applications available from both the Apple Store and GooglePlay Store the vast majority of which have either been developed by regional, national and international energy distribution companies. The purpose of those applications is to foster social outreach to energy company customers, analyse customer energy consumption, report meter readings and generally provide a communication channel with consumers. Here we provide a solution to achieve an increase in energy efficiency providing specific recommendations and/or actions based on real time data and specific criteria (comfort, consumption, persuasion strategies).

Competition

The competition for this product includes all companies that provide monitoring and energy saving systems for homes and small business. According to the research performed, there is no company that uses the original GreenSoul system described previously. However, some products are incorporating artificial intelligence to optimize savings by learning the habits of the energy-users. And it is expected that they will increase in the future. The best known in the market is Nest [20], although in this case it only refers to heating savings and does not include electricity savings. Additionally, there are products that use artificial intelligence to manage energy consumption and provide feedback on the use of electrical devices by connecting to the house's central power system and identifying the type of appliance in use. One of the products is Wattcost [21] that it was released in February 2019 only in Australia and includes an energy meter connected to a central system that alerts customers when they leave something on to reduce the bill. Another product is Verv [22], which is being developed in the United Kingdom and has a similar base. However, these products only address homes (houses and apartments) where the reduction in the bill encourages the users to be more energy-conscious. They do not seem to have the sophistication of GS for selective feed-backs,

and gamification logic. However, they are very close to it and could include something similar characteristics in the future.

Canvas Business Model

Figure 4 includes the Canvas Business Model for the WeSave System.

1. Key Partners

There are three different types of partners:

Technological partners: the full solution (Premium version) of the GreenSoul System include some components from third parties. The Multi-sensorial network includes sensors to collect relevant information that is used for the GreenSoul Decision Support System and that it will be visualised in the mobile app and the web-based dashboard. The presence sensors, and also sensors for luminance and temperature are from third-parties. The best option is to search partners that can help to collaborate in the full solution making some agreements to co-design and develop specific products for GreenSoul. For instance, a component that specifically detect the type of device connected to the network or a presence sensor attached to the Interactive Coaster. For example, potential partners such as TP-Link or Wattio has been identified and previous contact has been carried out during the pilot phase.

Integrator partners: The GreenSoul API System would be integrated into building management systems to provide a more comprehensive and complete service and to be able to use it as a sales channel. In this version, the different components are delivered together with the API to be integrated in the own system of the client. To increase this sale channel, a smart agreement with integrators could help to gain market quickly initially and reach clients that otherwise would not buy the API version of the GreenSoul System. We refer to partners such as Minion or Tricklesta, with whom the integration of GS API and its subsequent commercialization could be negotiated. Moreover, the integration with virtual home assistants of Amazon, Google, Apple, Philips HueBridge, can rise in sales of the product and create new sale channels.

Commercial partners: For a rapid entering in the market, the identification of potential partners that, although they do not add technological value, they will help mass marketing.

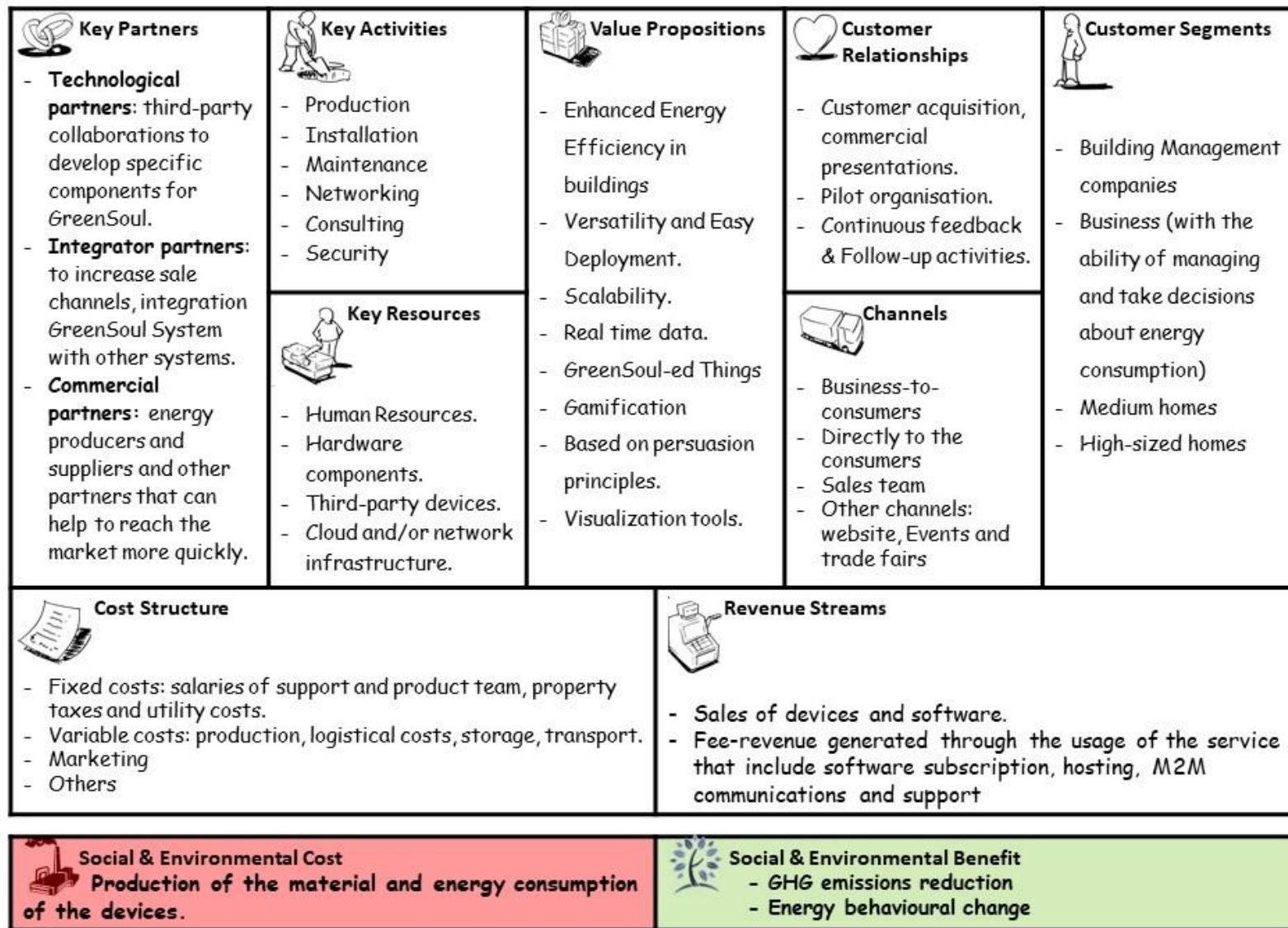


Figure 4 Canvas Business Model for the GreenSoul System

The natural way to do this is to see the sales channels currently used by integrator companies and competing partners. Agreements with energy producers and suppliers must also be considered. Within their saving promotion plans, they could include the dissemination and even total or partial financing of this type of products among their customers.

2. Key Activities

The main activities related to this product are production, installation (or installation support), maintenance, networking, consulting and also security. Production is a pivotal activity for this solution, and this is key to ensure that this solution is feasible for the market as well as the correct design for the partners and the target market, as this will dictate the success of this product. Installation and maintenance are key aspects, as we provide information regarding our solution to ensure that our customers are confident of the usability of our solution, to support this we have a committed team who will provide maintenance guidance post purchase. Consultancy ultimately underpins this aspect as we advise our customers about the best use of the solution.

3. Key Resources

Employees are the most important resource for this solution, but usually, they are the most easily overlooked assets of an organization. The key resources are mainly the human resources with the know-how to develop this solution but also to adapt it to specific circumstances for big customers if needed. In this case, human resources such as customer service representatives and hardware and software engineers are pivotal. However, other resources are also key, as the supplier of material for the production of the own devices (dimmers, interactive coasters and UMDs) but also the third-party devices or cloud and network infrastructures.

4. Value Proposition

The main characteristics of the product are:

Energy Savings: The GS system can offer energy savings with a Decision Support System that make use of the real-time information of the building and user behaviour to make recommendations or actions that result in a reduction in energy consumption.

Versatility and Easy Deployment: the GS system is very easy to be deployed either as a stand-alone local instance or as a cloud service, with or without the GS-ed hardware solutions, meeting customer needs and market challenges.

Scalable: the GreenSoul system offers a modular approach that covers a variety of hardware deployments. From simple smart plugs to complex BMS solutions, it can offer a variety of different services to the facility manager and the building occupants.

GreenSoul-ed Things: beyond simple software solutions, a diverse list of hardware components can also be deployed, covering different customer needs and on-site technical requirements, thus enabling energy efficiency engagement and raising awareness.

5. Customer Relationships

For the business companies, the strategy seeks to enter large clients through piloting in a headquarters to subsequently grow based on extensions to other locations. Key account managers will be assigned to each account that will take both the acquisition and the future development of the business within a customer. In these cases, the commercial activities are the following. First, the acquisition of targeted customers will be performed followed by commercial presentations. Then, an organization of the pilot in the headquarters will be promoted. For the first clients, a reduced margin is expected, but this will speed up the entering in the market. The relationship with the client will be based on continuous request and follow-up of offers and the review with the customer of the satisfaction with the product once operational. A follow-up of the installation will be performed with the customer. For homes, the customer will be able to install themselves the product. However, continuous feedback and relationship with the customer are expected to ensure the success of the user experience.

6. Customers Segments

The customer of this product will be the business managing their energy contracts in their offices but also medium and high-sized homes. The Premium product will be installed in homes by the users themselves, or sold as part of energy monitoring products. Installation in companies will not be done in the central energy management systems but will be distributed by departments or workspaces. Due to its own philosophy of giving feedback to users who are responsible (in whole or in part) for savings actions, the system will have to measure and feedback in each workspace, not at the building level.

7. Channels

In the first version, it would be a business-to-consumers, selling directly to the consumer or through sales channels and integrators. In the second case, it is fundamentally business-to-consumers. In order to establish a relationship with the customers, and a deeper insight into their preferences, a sales team will be dedicated to promote the product and reach potential consumers.

8. Cost Structure

Among fixed costs, the most important are salaries, property taxes and also utilities. Regarding variable costs, they include material, logistical costs for the production of the devices or the purchase of third-parties devices, storage, transport and the transfer of finished solution to the final customer. As we explained before, a collaborative relationship will be carried out with our suppliers to achieve a cost reduction, but also for maintaining an efficient supply chain.

9. Revenue Streams

The revenue streams will be mainly two: the sales of the system (devices and software), and through the subscription fee generated by using the system. This fee will include software subscription, hosting and M2M communications and support. In complex projects, some engineering services will be needed with tasks related to project management, the initial configuration of the devices and remote help for installation.

10. Social and Environmental benefits and costs

Just like any GreenSoul solution proposed, two main benefits are identified:

- GHG emissions reduction, thanks to efficient energy management achieved.
- Behavioural change, jointly with other solutions it is possible to raise awareness about the energy consumption of each individual, or group of individuals.

The costs of this solution are related to the minimum consumption of energy of the equipment and the costs of the production of the devices in terms of raw materials.

SWOT Analysis

1. Strengths

- Scalable & Modular
- Easy to deploy
- Services Versions to cover different customer needs
- Easy to adapt to user preferences
- Easy to integrate with multiple hardware solutions

2. Weakness

- As a complete suite, the GreenSoul system is still far from stable and robust
- Further deployment is required to validate performance
- Lack of industrial partner

3. Opportunities

- Non-intrusive Load Monitoring is rapidly evolving
- Limited competition as a whole suite

-
- Public use buildings are required by law to be nearly-Zero energy buildings (nZEB)

4. Threats

- Large competition for certain components
- Limited uptake from public use buildings
- Lack of confidence in technology
- Lack of knowledge by users

4.2 Other solutions

During the market analysis, we have replicated the same effort for other two products that can be sold separately from the entire GreenSoul system. One of them is WeSave, an energy management system that consists of a remote monitoring controller and network analyser together with a web-based dashboard for monitoring purposes. The other is the GreenSoul Dimmer or Smart Lighting, that consists of a dimmer that can adapt the light taking into consideration the real-time luminance of the room and the preferences of the user. Below we provide a description of the solution, the presentation of the unique selling points and competitors. We also completed this analysis with a SWOT and Business Model Canvas.

4.2.1 WeSave

Solution description

The actions addressed to reduce the energy consumption in buildings requires of a different investment depending on the type of action. Thus, the decision making about energy efficiency actions should be based on an exhaustive analysis of the context where it will be applied. In this sense, to count on information about the distribution of the energy consumption according to its use (HVAC systems, lighting, computers etc.) will support the

decision making regarding which systems should be renovated or which energy efficiency policies are a priority.

Within this context, during this project, a solution for energy monitoring (WeSave) has been developed from a previous version, addressed to gather the consumption/saving data of the different energy-consuming systems deployed in a building. In this way, WeSave eases the evaluation of the different energy saving measures to be applied.

WeSave gathers different type of energy consumption data, as well as, other external parameters (temperature, humidity, people counting) which can help to define if the energy is being used efficiently. WeSave combines all the gathered data with information related to the building (schedules ... etc.) creating alerts which can allow reducing the energy consumption of the building.

Unique Selling Proposition

- **Versatility:** WT development capabilities allow to have a product highly aligned to the customer needs and the different market demands.
- **Real time information:** WeSave provides information about energy consumption and other additional environmental parameters, occupancy, etc.
- **Competitive SaaS:** It is, also, remarkable the provision of a SaaS without any additional license or infrastructure cost as the other competence companies.
- **Energy efficient habits:** Customers could identify inefficient habits and, also, foster energy consumption awareness policies.

Competition

The competition is segmented into two major types of products (See Table 3 and Table 4). On the one hand, the classic BMS designed for the general control of all types of variables and actuators, which can support a certain degree of energy analysis, or develop specific modules for this purpose. This family of solutions usually has its own bus for communications, in the case of a high but necessary investment in new construction of buildings mainly administrative or service buildings. The main references in this field are large manufacturers such as Siemens, Schneider Electric or Johnson Controls.

On the other hand, energy monitoring platforms such as DexCell or N2S, have a concept similar to WeSave. In the case of DexCell, the most significant, they have a greater number of integrated devices, and the manufacturer is oblivious to the electrical measurement equipment, so they have a strategy more based on a very specialized channel, although they lack the necessary versatility to meet a large number of customer needs (for example, they do not have the option to deploy locally).

Table 3 Competitors for WeSave

Company	Product	Technologies	Participants	Main advances/disadvantages
C+ IDEA ENERGY LAB	Smart Jumper 3.0	WIFI 3G	Unknown	Do not include reporting and billing system. Own system, lack of interoperability.
Itron	Centron residential meter OpenWay residential meter	GPRS ZigBee WiFi CDMA WiMAX	Italgas Vodafone Avista Spirae SCE SDG&E CenterPoint Energy DTE	It is not clear its capacity for action, apart from networks, in devices as HVAC systems.
Sensus	FlexNet AMI system	GSM GPRS Zigbee	Lakeland Electric PECO Southern Company PGE Hawaiian Energy	Their metrology products look not to have action capacity over other devices.
Elster	REX meter and REX2-EA METER	GSM, GPRS, ZigBee	Arizona Public Service Toronto Hydro Electric Cleveland Utilities	

Table 4 Competitors for WeSave (cont.)

Company	Product	Technologies	Participants	Main advances/disadvantages
Landis+Gyr	Grindstream SG solution	RF technology GSM GPRS PLC	PG&E ONCOR PEPCO Texas Austin Energy CPS Energy	No possibilities of actuation.
General Electric	I-210+c smart meters	GSM GPRS ZigBee PLC	AEP FPL PG&E	A versatile electric meter for energy-only advanced smart meter solutions. Do not include a dashboard and should be integrated with other software or BMS.

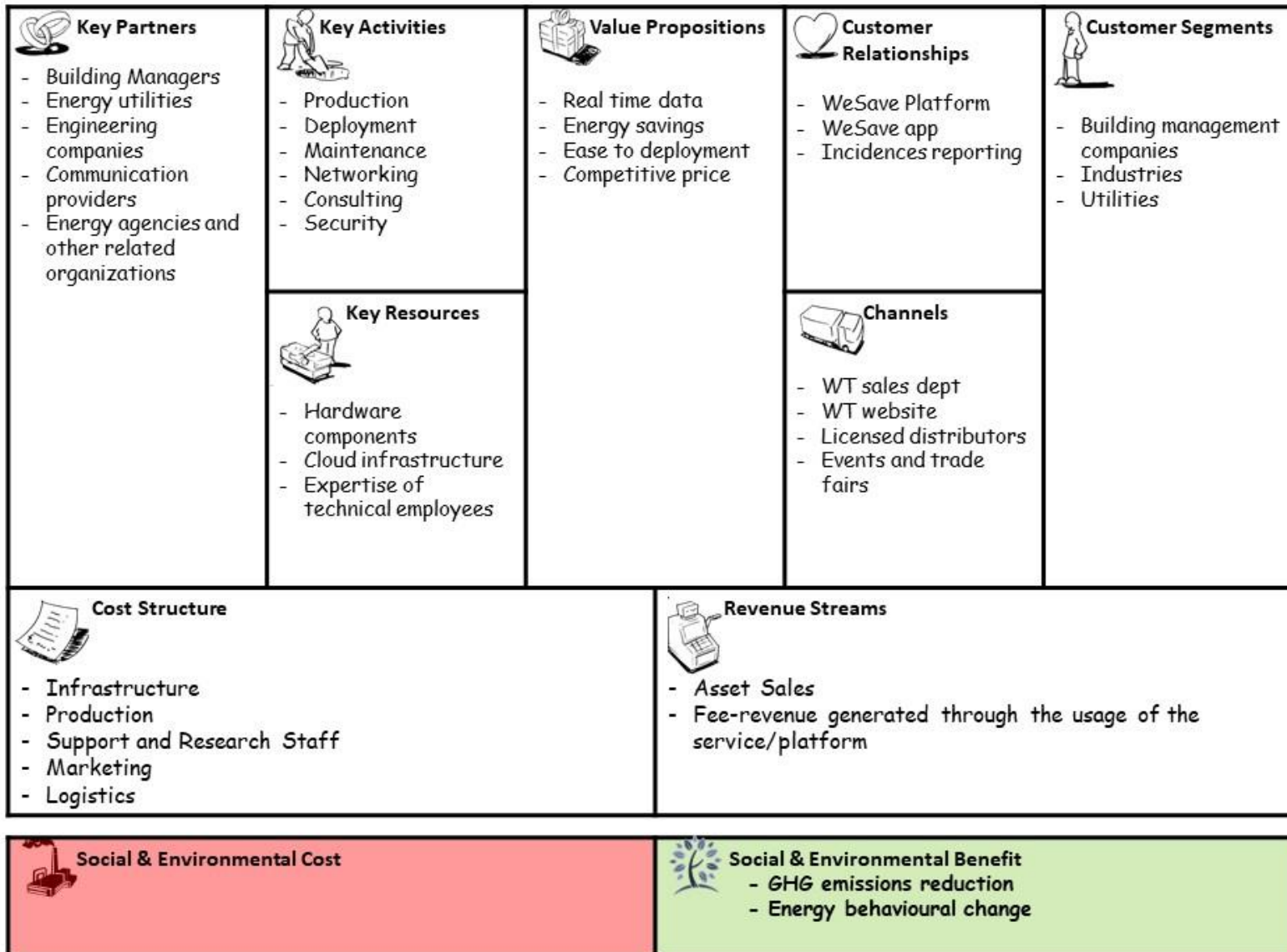


Figure 5 Canvas Business Model for WeSave

Canvas Business Model

Figure 5 shows the Canvas Business Model for WeSave.

1. Key Partners

In order to optimize WeSave business model, a network of potential business partners has been identified to acquire their relevant expertise and resources for the future exploitation of the product. The key partners for our solution are building managers, energy utilities, engineering companies, communication providers and energy related organizations. Building managers are a key partner, these represent the main target group of the solution. Engineering companies are a relevant partner for the future development of the solution. We require the knowledge of communication providers due to the capabilities and functions of our solution.

2. Key Activities

The key activities of our solution are organised at the same level than for the entire GreenSoul solution: production, installation, maintenance, networking, consulting and also security.

3. Key Resources

In order to carry out the key activities which have been outlined above, Intellectual resources such as partners and infrastructure are the underpinning resources that support our activities, as well as our talent pool. In reference to the business model, components have to be acquired for the hardware production, as well as Cloud infrastructure such as servers, storage, networking and virtualization software which are a necessity for our solution. It must be noted that the creativity and extensive knowledge of the employees are pivotal for the commercialization of WeSave solution.

4. Value Proposition

The added value that WeSave provides has been aforementioned in the sections “Solution description” and “Unique Selling Proposition”, but these can be summarized as follows:

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- Real time data, about the building energy consumptions.
 - Enhanced energy efficiency in buildings, detecting rooms for improvement and supporting better energy management.
 - Ease of deployment, being the interaction with other elements minimal.
 - Competitive price, in comparison to similar solutions already present in the market (at software and hardware level).

5. Customer Relationships

In order to ensure a proper customer service, two methods were defined. In an initial stage of purchase, the support staff is addressed to assist, and verify, an adequate deployment of the solution is involved in order to guarantee the customer satisfaction and providing confidence in the performance of WeSave since the beginning. Additionally, manuals, support documents and tools will be provided jointly with technical assistance, if required.

6. Customers

Building management companies, industries and utilities are the main target groups of WeSave. However, the solution is not only limited to this kind of companies but also aimed IT companies which operate in the engineering sector such as ERP, due to the real time data collected via our solution.

7. Channels

It is planned to use the website as one of the main channels to promote and gain awareness of our solution, which highlight the core benefits of the solution, as well as outlining how the solution works. In order to establish a relationship with our customers, and a deeper insight to their preferences WT will have a strong sales team dedicated to promote the product and reach potential customers using the company network.

8. Cost Structure

For the creation of our solution and to fulfil the services which were identified in our 'Value Propositions' we have focused on the value of the solution as well as its costs. For example,

regarding fixed costs, we have taken into account factors such as salaries, property taxes and also utilities. In addition, variable costs will include logistical costs for the production of our solutions materials, storage, transport and the transfer of finished solution to the final customer. Finally, we foresee to reach certain savings in costs, gained by the increase in the production of our solution. We establish a collaborative relationship with our suppliers to achieve this, whilst maintaining an efficient supply chain.

9. Revenue Streams

The two main avenues for revenues include the sales of the device, and through the subscription fee generated by using the platform.

10. Social and Environmental benefits

Two main benefits are identified:

- GHG emissions reduction, thanks to efficient energy management achieved through the application of WeSave.
- Behavioural change, jointly with other solutions it is possible to raise the awareness about the energy consumption of each individual.

SWOT Analysis

1. Strengths

- Flexible technology solution for monitoring energy consumption and other environmental parameters in buildings or industrial settings.
- Ability to monitor saving policies and user impact based on consumption.
- Customizable and modular platform
- Integrated in the GreenSoul system
- Fully integrable with existing systems
- Having real-time information of the impact of users, their consumption and their causes and effects.

2. Weakness

- Lack of predictable module for energy consumption based on historic and current data.
- More graphics with correlation between variables.
- Reduced functionalities to be applicable to different use-cases, types of buildings or specific circuits.
- Reduced capacities of control

3. Opportunities

- Emerging market, the interest will grow with legislation and awareness in big companies.
- Maximize the value of investments
- Optimize system operations
- Early adopters that integrate pilots with our solution
- Commercial synergies between products that make leverages

4. Threats

- Small Market and poorly defined model
- Remote management is currently not a priority in the buildings sector
- The expansion of the market is drawn out over time or the market will not take off
- Changing market
- Entrance of big actors (manufacturers, big companies)
- Large service providers with no defined role

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- Lack of confidence in technology
 - Lack of knowledge by users

4.2.2 GreenSoul Dimmers

Solution Description

The GreenSoul Dimmer is a fog-enabled device that has been designed and developed towards making the end-user more energy aware while also empowering him/her with additional capabilities in terms of lighting control.

Unique Selling Proposition

- **All in one hardware:** with the luminance sensor embedded to the provided solution the GreenSoul Dimmer covers all needed hardware requirements without needing additional equipment or pairing with other devices/frameworks. Nevertheless, the GreenSoul Dimmer can be coupled with other systems (e.g. BMS) towards complementing existing installations.
- **Real time information:** the GreenSoul Dimmer provides real time information to the end-user without needing any additional frameworks (mobile apps, web-based dashboards, etc.). Dimming level, consumption and luminance are all given to the user so as to facilitate monitoring and control, and improve engagement.
- **Edge/Fog Computing:** the GreenSoul Dimmer has the capability of decision making based on user preferences. Following the time and luminance constraints set by the user, it can dynamically and unobtrusively adjust dimming levels.
- **Energy Savings:** By dimming the lights with different profiles (i.e. day, night), schedule and luminance preferences the GreenSoul-Dimmer can offer energy savings.

Competition

The market has a wide variety of “smart” dimming devices, employing a lot of different wired and wireless topologies, although most of them (if not all) doesn’t support fog computing. Some indicative examples are presented in the Table 5 and Table 6.

Table 5 Competitors for GreenSoul Dimmer

Company	Product	Technologies	Main advances/disadvantages
Eltako	FSG71/1-10V	EnOcean	Eltako has a wide range of products for light dimming. Most of them however support dimming via a rotary switch. The dimmer can be configured for the maximum and minimum brightness level that the lights can deliver and also the dimming speed. These hardware components by themselves do not offer any smart solution like remote control via smartphone or PC, nor automatic control of the lights based on schedule. Additional hardware/software is required to support extra functionalities.
Fibaro	Dimmer 2	Z-Wave	The solution can replace an existing light switch. The device is capable of toggling on/off and changing the brightness of the lights via an Android/iOS app. It also supports voice control. It does not feature a luminance sensor and thus a closed loop control of the lights based on ambient light is not possible. The user must use an external device to control the lights. Dimmer-2 support incandescent, halogen and dimmable LEDlamps but it does not support 1-10V dimming protocol for use with an external ballast. Schedule based turn on/off the lights is also not supported.

Table 6 Competitors for GreenSoul Dimmer (cont.)

Company	Product	Technologies	Main advances/disadvantages
Belkin	WeMo	WiFi	<p>Control over voice or through a mobile application. It supports schedules so as to turn ON/OFF the lights at sunrise/sunset and night mode operation for dimming the lights during specific times.</p> <p>The physical user interface of the device supports only turning ON/OFF lights or dim them to a selected value. It does not display the luminance of the room nor the power consumption, while user profiles are not supported.</p>
Leviton	Devora	WiFi	Same with WeMo.
Koogeek	KH03	WiFi	Same with WeMo. In addition, scheduling for turning the lights ON/OFF is not supported.
TP-LINK	HS220	WiFi	<p>LED lights dimming capabilities, scheduling, 3button input interface and 7 LED used as brightness indicators.</p> <p>The device can be controlled also via an Android/iOS app. There is also the "gentle off" functionality that will fade the lights for a configured duration of time.</p>

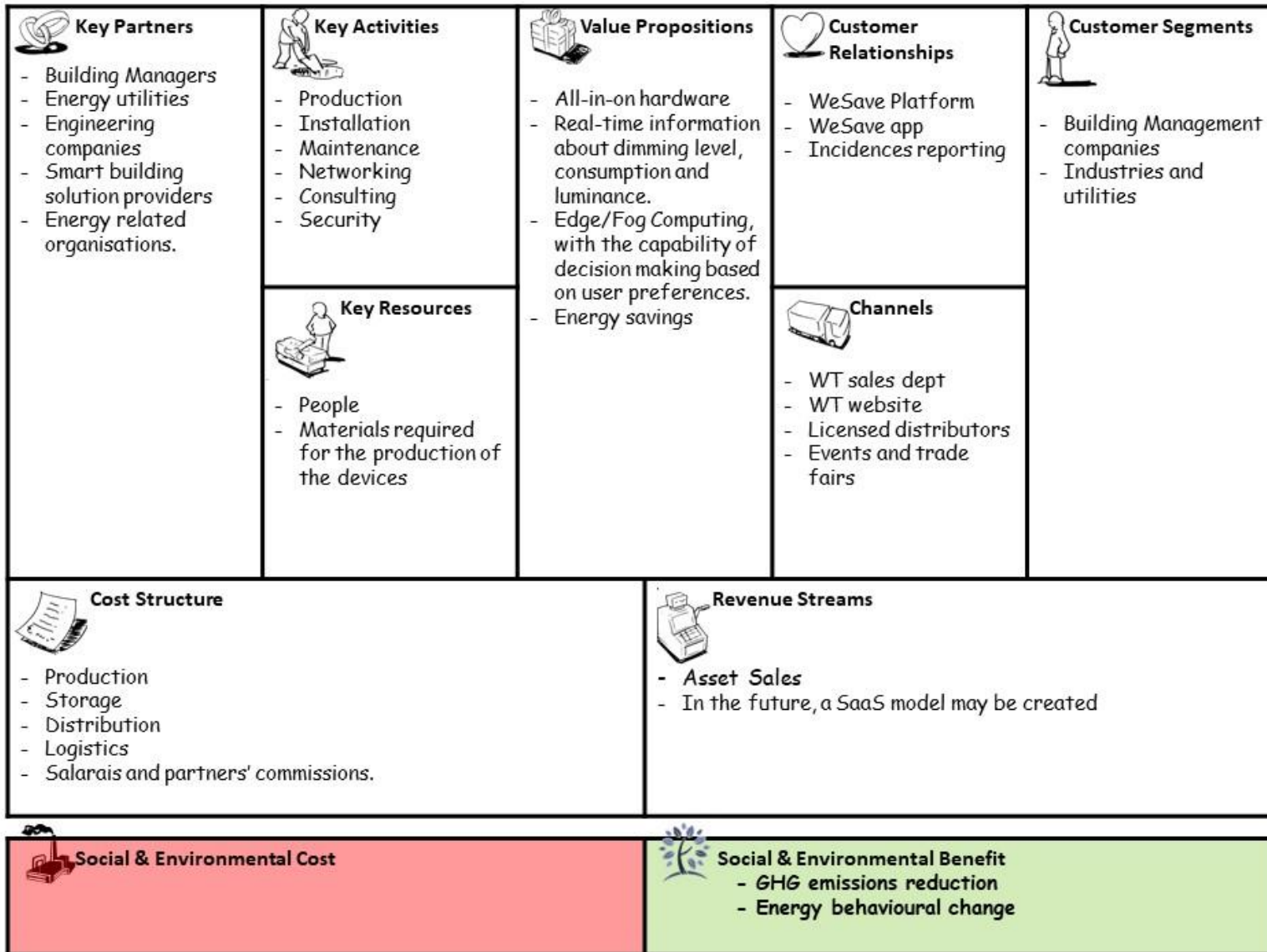


Figure 6 Canvas Business Model for GreenSoul Dimmers

Canvas Business Model

1. Key Partners

For the GreenSoul Dimmer certain key partners have been identified to acquire their relevant expertise and resources for the future exploitation of the product. The key partners for our solution are: building managers, energy utilities, engineering companies, smart building solutions providers and energy related organizations.

2. Key Activities

Similarly with the GreenSoul solution, the key activities of our solution include the production, installation, maintenance, networking, consulting and also security.

3. Key Resources

The key resources for the GreenSoul Dimmer are mainly the people and the materials required for its production. Beyond that, resources are also needed for promotion, transport, storage, etc. which are the case for any hardware commercial product.

4. Value Proposition

The added value that GreenSoul Dimmer provides has been aforementioned in the sections "Solution description" and "Unique Selling Proposition".

5. Customer Relationships

In order to ensure a proper customer service two methods were defined. In an initial stage of purchase, support staff is addressed to assist, and verify, an adequate deployment of the solution is involved in order to guarantee the customer satisfaction and providing confidence in the performance of WeSave since the beginning. Additionally, manuals, support documents and tools will be provided jointly with technical assistance, if required.

6. Customers

Building management companies, industries, and utilities are also the main target groups of the GreenSoul Dimmer.

7. Channels

It is planned to use the website as one of the main channels to promote and gain awareness of the GreenSoul Dimmer. After the project completion a market-oriented product leaflet will be created and based on the market interest in this product, the GreenSoul Dimmer will either be made available through a spin-off company, or it will be provided to another company as a “buy-in” product. As such, the channels may change entirely based on the future market uptake of this product.

8. Cost Structure

For enabling the key resources, i.e. production, storage, distribution, etc. all logistic costs need to be taken into account along with salaries and partners’ commissions.

9. Revenue Streams

The main revenue stream of this device constitutes its sales. In addition, and based on the market uptake, a SaaS model may be created and delivered for data handling.

10. Social and Environmental benefits and costs

Just like any GS solution proposed, two main benefits are identified:

- GHG emissions reduction, thanks to an efficient energy management achieved.
- Behavioural change, jointly with other solutions it is possible to raise awareness about the energy consumption of each individual, or group of individuals.

SWOT Analysis

1. Strengths

- All in one stand-alone hardware solution-embedded luminance sensor
- Direct control through WiFi access to the device or physical buttons
- Multiple extra functionalities supported: Scheduling and Profiling
- Multiple lighting control types supported (i.e. 1-10V, 0-230V phase cut) as well as light technologies (LED, CFL, etc.)
- Easy to use
- Easy to install
- Cost similar to other less sophisticated solutions

2. Weakness

- Not very user-friendly design
- Needs a lot of volume
- The luminance from the embedded sensor highly depends on the installation position
- Requires a lot of time to configure and to understand how to use.

3. Opportunities

- Smart hardware for Smart Buildings/Homes is rapidly evolving
- The market is in need of all-in-one stand-alone solutions

4. Threats

- Small to none market uptake
- No investors found
- Huge Competition
- Lack of confidence in technology
- Lack of knowledge by users
- Lack of user awareness on the product

Conclusions

This deliverable provided an analysis of the market for the GreenSoul Solution. Here we presented a product that has been designed for energy savings of shared buildings and homes. It is based on based on the monitoring of energy consumption and mechanisms to give personalized usage recommendations, taking into consideration the characteristics of the users and adapting to their changes. The market analysis has detected he main trends of the related market of energy-efficiency in smart building and automation of buildings. This market covers all products related to the application of technology to allow the control of different subsystems as desktop appliances, lighting, HVAC (Heating, Ventilation, Air Conditioning) or other that originally only could be operated separately. Understanding the energy consumption of these devices, an increase in energy efficiency of buildings is possible. The market of energy-efficiency is expected for a moderate growth, with a generation of around 90.000 million € just in Europe in the year 2023. The size of the market will bring good opportunities for a product as it is presented here. In this document, a description of the solution is presented, including the main characteristics and advantages and an analysis with competitors.

The GreenSoul System provides an innovative product compared with competitors in the market. One of the main innovative aspect is the interaction with users in a smart way to induce them to energy-saving behaviours. This is an important characteristic that has not been found in competitors, that are more focused on applying artificial intelligence to detect and analyse energy consumption patterns.

This document also proposed a Canvas Business Model for the exploitation of the solution. Here we have identified value proposition together with the key partners, activities and resources, and the relationship and description of customer segments and sale channels. Moreover, an analysis of cost structure and revenue streams are analysed. This Canvas business model is accompanied by a SWOT analysis. This SWOT showed the strength of a scalable and interoperable solution with high opportunities as a consequence of the limited competition as an entire solution. But also, the solution needs an effort to increase the stability and robustness of the product and the reliability by the client.

The main advantages among competitors we have detected.

Finally, the same effort has been performed for other two products, that can be sold separately from the entire GreenSoul Solution: WeSave and GreenSoul Dimmers. All the knowledge acquired during this study will be used for the description of the business plan of the GreenSoul system.

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