Lighthouses Cities Market Introduction Deliverable 6.2.

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GrowSmarter
Transforming cities for a smart, sustainable Europe

Contents

Summary

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GrowSmarter leitmotiv, "Transforming cities for a smart, sustainable Europe", obliges us to observe the BM from different points of view. The first one, is its own sustainability, if it is feasible from a financial point of view. Although the financial data has not been analyzed yet (it will be in Deliverable 6.3), we can already observe some conclusions on that point: especially on measures from WP2 the financial sustainability will be determined by the financial data, but for the rest of measures, what is more important than the economic data is, in the case of measures from WP3, what will be the BM from the Public Sector that are hiring or using the measures, and, for WP4, the capacity to evolve the BM considering the permanent changes in the mobility industry.

Other aspects observed are their value creation, their capacity to create or improve new jobs, the relation with data management, where do citizens stand regarding these BM, and finally, the role of Cities' authorities regarding them.

On general terms, we can consider that the BM shown in the following pages are well focused on creating an added value related to the improvement of a community more environmentally sustainable, thanks to energy improvements, and thanks to a better improvement of public policies due to the knowledge obtained through a correct management of data.

The measures implemented have a positive impact into the job market, as they are allowing the capacity of workers to improve their skills, reinforcing them among other workers.

Thanks to Data Management, the potential success of BM is related to Citizens' decisions, and Local Public Sector appears as a prescriber and "incentivator" of the implementation of the measures rather than to be the actor to develop them with their own resources.

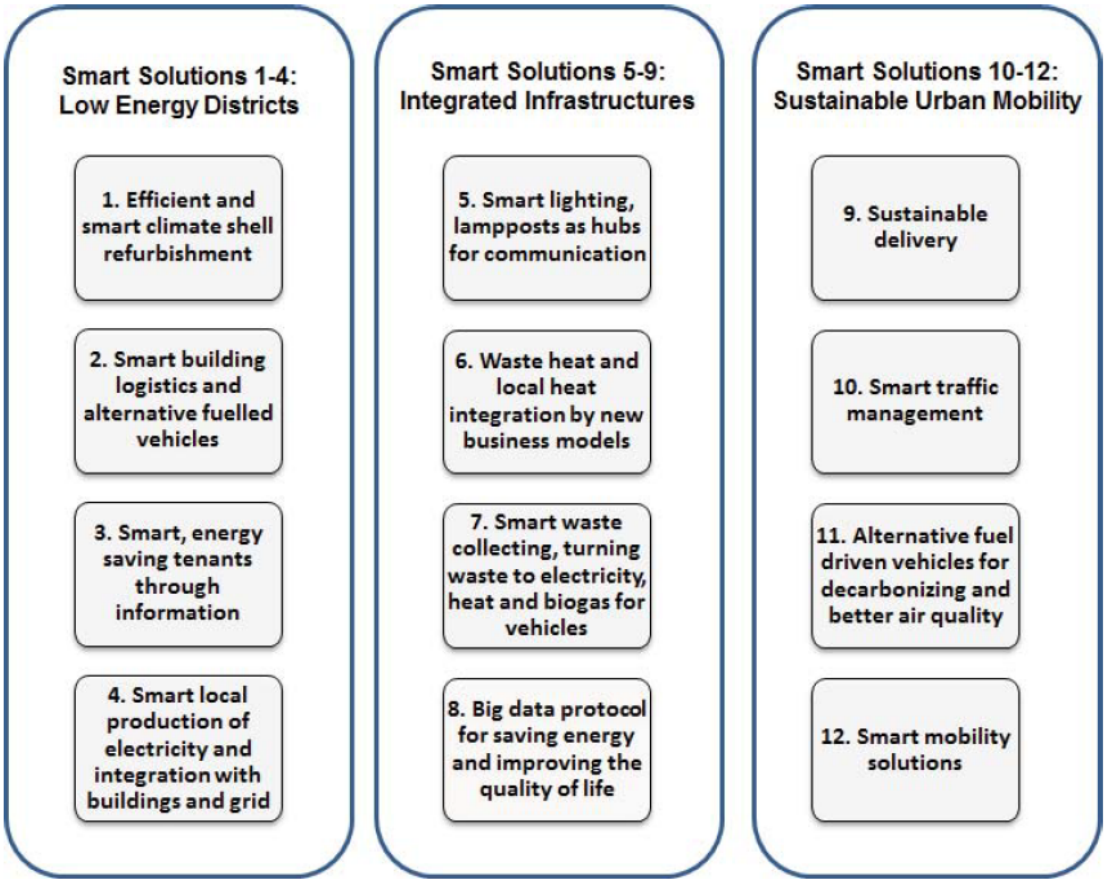
1. Introduction

This report aims to provide specific knowledge about the business models related to the measures being implemented in the GrowSmarter project, together with the presentation of the socio-economic and political context of the Lighthouse Cities.

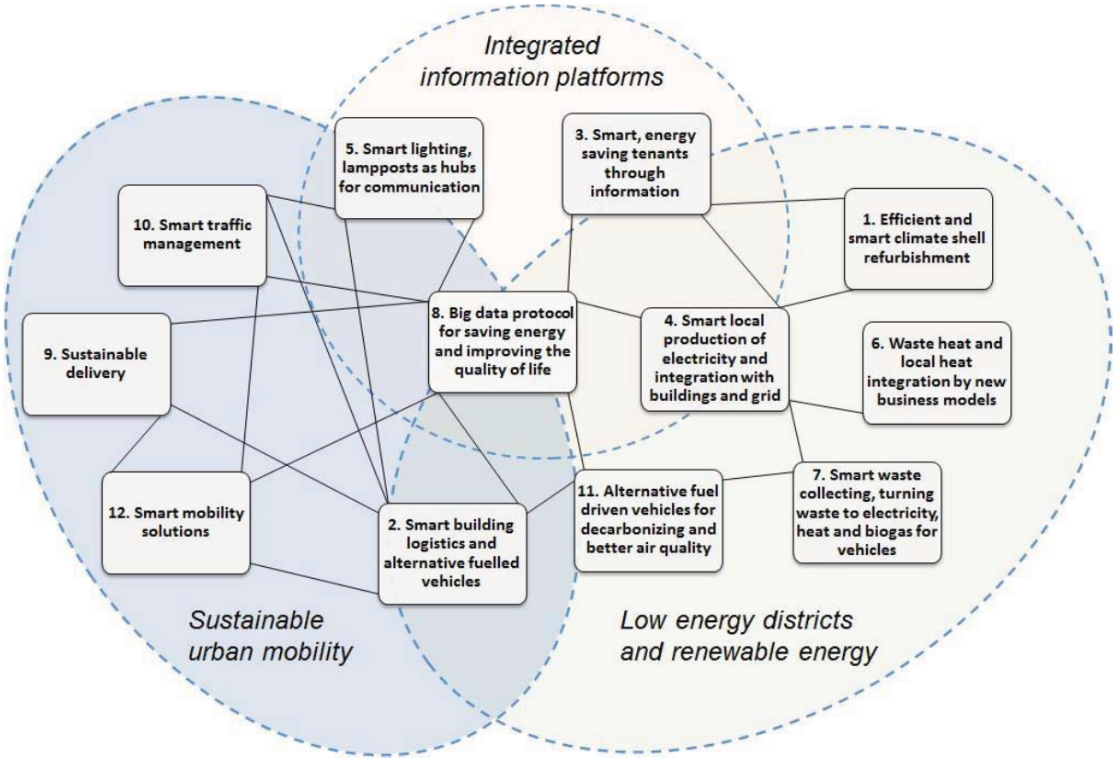
In addition, it aims to provide information not just for technical stakeholders but also to the general public and the European citizenship about the GrowSmarter project scope and the potential scalability of solutions.

By reading this report one can understand the measures under implementation, their business models and their potential scalability from the business point of view. The conclusions presented can be beneficial for real implementation of Smart City solutions behind the typical pilot projects.

The Smart Solutions being implemented during the GrowSmarter project are distributed among three thematic areas:



However, nor the Smart Solutions or the measures are being implemented in isolation nor in closed areas. In fact, the Smart Solutions are integrated solutions with many cross-connections to each other as seen in the next figure:

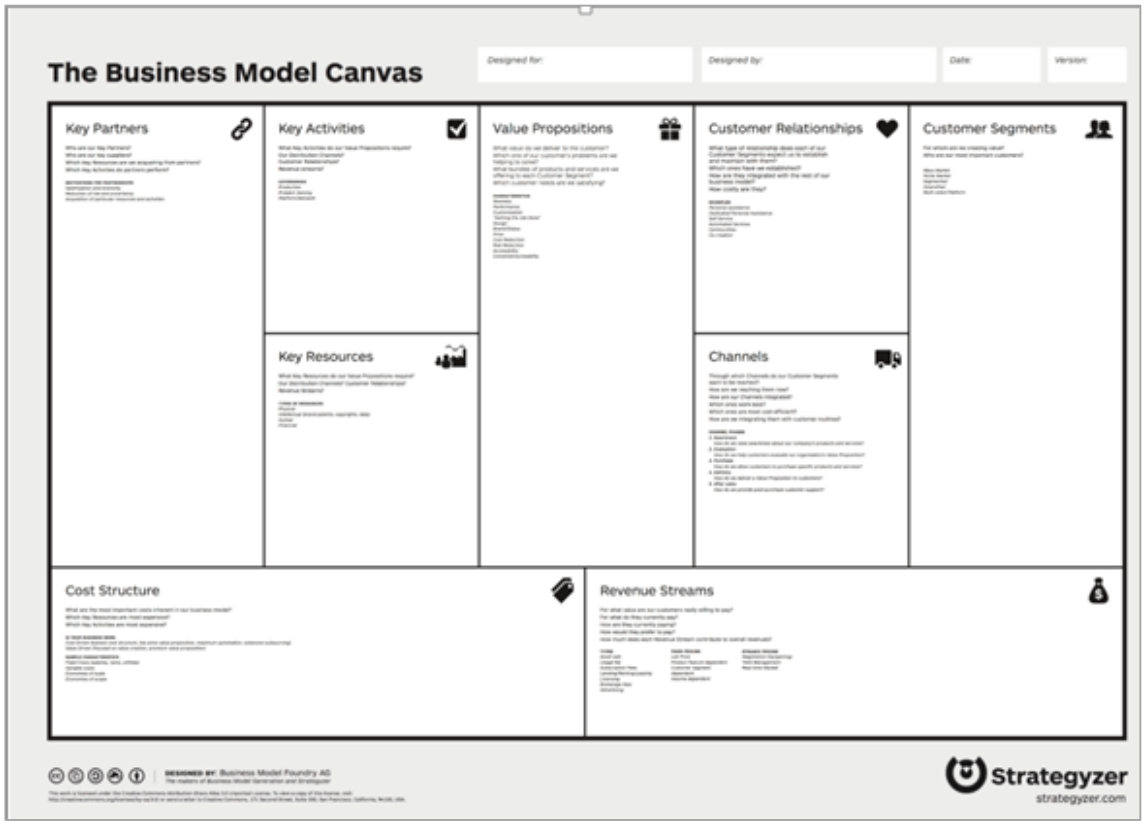


The overall goals of the Smart Solutions are to improve the quality of life and at the same time reduce negative environmental impacts. This will be measured using indicators such as reduced local pollutions, reduced greenhouse gas emissions, energy savings and local energy resource utilization, as well as job creation. The Smart Solutions will also be valued for their potential to be scaled up locally and replicated in other cities.

For the purpose of this document, the Business Models have been presented by groups of measures included in one solution and differentiated between them by Industrial Partners and the kind of Business Model implemented (see Annex 1 for more information).

2. Methodology

To define the BM behind each measure we will use the CANVAS methodology. The BM CANVAS is a strategic process that by means of using a template allows to document existing BM. It is a visual chart with elements describing a firm's or product's value proposition, infrastructure, customers, and finances. It assists firms in aligning their activities by illustrating potential trade-offs.



Since the beginning of the GrowSmarter project, IESE Business School has attended several Technical meetings during the years 2015, 2016 and 2017, in all three lighthouse cities, to understand the measures and the business model behind them.

In these technical meetings IESE Business School has work together with the Industrial partners to explain them and show them how to fulfill their Canvas Document. This has especially done during the General Assembly organized in Cork, in May-June 2017, where IESE organized a Workshop to discuss with all the partners about how to fill out a BM Canvas document.

IESE presented a first draft of Canvas documents for most of the measures, starting from this first draft, the explanations given during the Workshop and by email & through

conference calls in the following days, the Industrial Partners should send to IESE the Canvas documents for their measures.

In the next sections, a relation of all the Business Models related to the measures will be presented. All the business model will be presented under the umbrella of their Working Package (WP 2 Low Energy Districts; WP 3 Integrated Infrastructures; WP 4 Sustainable Urban Mobility) and classified by solutions. The Business models will be differentiated between them depending on who is the Industrial Partners and the kind of business model that it's implemented (B2B, B2C or PPP. See annex 1 for more information).

Moreover, some of the Business models that will be presented in next sections could include more than one measure, as, the business models cannot be understood without the aggregation of different measures developed by the industrial Partners. In those cases, at the end of the Working Package section, a comment regarding this subject will be included.

3. Business Models

This document describes the business models (BM henceforth) related to all the measures implemented in the lighthouse cities participating in the project GrowSmarter. In total, 53 BM have been described, distributed along 3 work packages and 12 solutions. For more statistical details about how the BM are related to the solutions and lighthouse cites, see the table below.

Business Models related to Solutions & Cities

	Barcelona	Cologne	Stockholm	TOTAL
Solution 1	4	1	5	**10**
Solution 2			1	**1**
Solution 3	2	1	3	**6**
Solution 4	2	1	1	**4**
WP 2	**8**	**3**	**10**	**21**
Solution 5	2	2	2	**6**
Solution 6	1		1	**2**
Solution 7			1	**1**
Solution 8	3	2	1	**6**
WP 3	**6**	**4**	**5**	**15**
Solution 9	1		1	**2**
Solution 10	1		3	**4**
Solution 11	3	1	2	**6**
Solution 12	1	2	2	**5**
WP 4	**6**	**3**	**8**	**17**
TOTAL	**20**	**10**	**23**	**53**

GrowSmarter leitmotiv, "Transforming cities for a smart, sustainable Europe", obliges us to observe a BM from different points of view. The first one, is its own sustainability, if it is feasible from a financial point of view. Although the financial data has not been analyzed yet (it will be in Deliverable 6.3), we can already observe some conclusions on that point. Other aspects observed are, the role of Cities' authorities regarding these BM, the capacity of BMs to create or improve new jobs, their value creation, the relation with data management, and finally, where do citizens stand regarding these BM.

Creation of Value

A clear common characteristic of all BM is the kind of value they create. All of them, on a direct or an indirect manner, are creating a more sustainable society, as they increase energy savings, reduce pollution and congestion, or improve public management through insights from managing correctly the data collected, thus allowing to implement more efficient policies.

Job impact

Trying to determine the impact on number of jobs created from these BM is not an obvious think, and it can be affected from different circumstances not all of them related to the measures. Therefore, in this report we don't have enough information to make conclusions about the impact on new jobs creation, but this subject will be deeply

studied in Deliverable 6.3. Regarding the impact of BM on improving the skills of worker, it can be said that this is a common property along all the BM. All the measures presented in GrowSmarter are implementing innovative technologies that the learnings on how to develop, install, maintain or manage them represent clearly an improvement of the skills of the manpower using them. This widespread characteristic gives a strong message to the European labor market: in a Globalized world, where the chains of production of any product can be settled in any region of the world, the implementation of smart solutions is improving European industry and workers, giving them a competitive advantage in front of other worldwide competitors.

Data management

Data is a permanent element to determine the improvement of an existing BM. With Smart Solutions, the data collected is so huge that the management of Big Data allows to customize BM for almost any customer. This reality, already observed in current mature markets, is a common trend for GrowSmarter's measures that has an implication on citizens' position regarding the BM.

Citizens' position

If we take a look on where do citizens stand regarding the BM, the interesting thing is that citizens can be active customers thanks to the measures proposed, and especially thanks to the use of the data related to these measures. Being an active customer is an option, but is a change of point of view on the relation between buyer and seller, where we move to a bidirectional relation, where customers have the power to decide what kind of consumption they want and how does this affect to the environment. That puts citizens in the center of the Business Model.

Financial sustainability

Of course, this new kind of relationship between citizens and companies implies new kinds of BM, and therefore a first question has to be ask regarding them. Are they financially sustainable? Although the economic data hasn't been analyzed, on a first outlook we can differentiate the financial sustainability of BM basically from Work Packages.

In Work Package 2, related to Energy Solutions in Buildings, the BM seem quite sustainable from a financial point of view. The key elements will be who will be collecting the monetarization of the energy savings and if the time of the contract will be enough to recover the investment costs related to the implementation of the measures. Therefore, in this Working Package, the economic data will be crucial to confirm the financial sustainability of the BM.

In Work Package 3, related to integrated infrastructures, the BM stand because the Public Sector is the main customer. Therefore, different models of Public-Private Partnerships can be used to implement the BM. Of course, the economic data will be crucial, but the interesting thing is the position of the Public Sector in those BM. Beside the fact that the Public Sector is the main buyer of the services related to the measures, the data related to them can be considered as a good of public interest, and therefore,

the Public Sector will be who defines the outcomes to be reach, and will determine the economic results of the industrial partner. In this case an interesting dimension to be considered will be the BM of the Public Sector related to those measures (that will be worked on Deliverable 6.4) besides the BM of the Industrial Partner.

In Work Package 4, related to mobility solutions, the key element is the evolution of the business models. They seem financially sustainable, and economic data will be, again, crucial to confirm it. The point is that the sector of mobility is living a deep revolution, with new solutions everywhere, as on the micro-freight distribution market, with start-ups from the Collaborative Economy such as Deliveroo or Glovo, or on the evolution of the auto industry and its impact in the ACES factors (Autonomy, Connectivity, Electrification and Shared mobility) determining the future of mobility. This permanent evolution implies that most of the BM implemented in GrowSmarter might be overcome in the following years with new solutions with new BM. That doesn't mean that the BM proposed are not interesting or sustainable, on the contrary, they are useful, to understand in which direction are trends moving, so it is a way for the Industrial Partners to anticipate into another BM.

The position of the Public Sector

Last, but not least, the position of the Public sector will be determining on the success of the BM. In some cases, as seen in WP3, the Public Sector will be the main contractor, and this happens in some specific measures. But when we talk about the Public Sector we have to consider the different levels of the administration. On the National level, and on the European level, the Public sector will be crucial to review the legislation and harmonize it to guarantee the replication and escalation of the successful BM. On the local level, the Public Sector will be crucial for the implementation of the measures, but not specially by hiring them, but by prescribing them, asking to companies working on products that generate positive externalities, to enhance them by implementing measures such as the GrowSmarter ones.

On general terms, we can consider that the BM shown in the following pages are well focused on creating an added value related to the improvement of a community more environmentally sustainable, thanks to energy improvements, and thanks to a better improvement of public policies due to the knowledge obtained through a correct management of data. The measures implemented have a positive impact into the job market, as they are allowing the capacity of workers to improve their skills, reinforcing them among other workers. Thanks to Data Management, the potential success of BM is related to Citizens' decisions, and Local Public Sector appears as a prescriber and "incentivator" of the implementation of the measures.

Finally, the financial sustainability of the BM will be determined by the financial data, specially on measures from WP2, but for the rest of measures, what is more important than the economic data is, in the case of measures from WP3, what will be the BM from the Public Sector that are hiring or using the measures, and, for WP4, the capacity to evolve the BM considering the permanent changes in the mobility industry.

On the methodological level, a lesson learned is that there isn't a singular way to analyze the BM of Smart solutions. Taking into account that the Canvas Model is a correct way to define Business Models, as it is a worldwide recognized methodology, the point is that if the Smart Solutions involve big data management collected from public spaces or thanks to public assets, the assessment of the BM related to the measure will also need to consider the point of view of the municipal authority. And in some markets inside the Smart solutions cloud, the permanent capacity of innovation and evolution implies that the assessment will have to take into account the capacity of adaption of the BM to these permanent changes.

Work Package 2. Low Energy Districts

The Work Package 2 includes four groups of smart solutions trying to address the current problematics regarding energy, construction and urban infrastructure. The first smart solution of the Work Package 2 is named Low Energy Districts and consists to implement, in different residential and tertiary buildings, some active and passive energy efficiency measures in order to reduce energy consumption and increase the comfortability levels for tenants, owners, managers and users. The second solution is named Smart Building Logistics, and is going to be implemented only for the city of Stockholm. The solution tries to increase the productivity of the construction activities by offering a more efficient method to deliver construction materials on site; while at the same time, increasing the quality of life and reducing the noise and pollution. The third smart solution is named Smart Energy-Saving Tenants, and with the same objective as the previous ones, to increase the quality of life, the solution consists in provide the tools to manage and control energy consumptions in a smart and efficient way. Finally, the fourth smart solution of this Work Package is named Smart Local Electricity Management, and it consists to deploy renewable and sustainable self-consumption energy sources, in order to mitigate the energy deficit of buildings and foment a smart use of energy. This should help to reduce energy consumptions, contaminant emissions and improve the overall quality of life of a neighborhood.

Considering all the projects within Work Package 2, it can be concluded that the majority of investments can be categorized as very important in terms of the amount of money required to deliver the solution, but at the same time, the return on investment, do not seem to compensate the opportunity costs. For this reason, ensuring key resources, something obvious but obligatory in any case, and ensuring a stable legal framework thus reinforcing the need for Public-Private Partnerships, can be one of the main conclusions for the Work Package 2. In addition, Public-Private Partnerships can be the formula to encourage the participation of different entities and institutions, from both, public and private sectors, in a project. Sharing risks and capitalizing benefits, in terms of profitability and return of the investments for the private sector, and positive externalities from the point of view of the public institutions. For example, in the city of

Barcelona, a refurbishment project of residential buildings, is being possible thanks to a partnership of this characteristics, assuming the municipal authority, part of the funding needed to deploy the solution. For the smart solution 1, Public-Private partnerships can be the solution when it comes to compensate the initial investment, since the expected returns on investment can be lower in more temperate climatologies of southern Europe than those of the northern regions of the continent, because the lower demand of heat.

On the other hand, cities with moderate temperatures, can represent an important market for this solutions to be implemented, where said solutions can be though prioritizing thermal comfort as a method to get more quality of life than an integrated actuation for saving large amounts of energy (and improving the quality of life as well).

Public funding should serve as an accelerator for implementing the measures, but we cannot observe a structural dependences from this source of money; without denying the current importance of public administrations. This importance, as mentioned, can be translated in defining the regulation and legal framework for building retrofitting, energy efficiency measures and other related policies. The importance of public funding could depend on the pricing methods and how the industrial partners achieve to capture value in those business models involving energy efficiency measures. The revenue streams of a model, usually determine if a project is financially attractive for a private company, however, there is a difference, in some cases, between who is investing and who is getting the most important revenues (in the form of a fee or savings). If there are discrepancies between who is investing and who is capturing value, the participation of the public sector could be highly recommendable.

A crucial characteristic of these measures is the high labor creation capacity, at least, during the implementation of the measures involving construction and installation stages. In terms of employment, it can be concluded that in the short term the amount of jobs generated thanks to the projects analyzed in this document, are significant, not only during the construction labors but also during the ideation of the solution and the research and development tasks for creating the technology applied within the high added value solutions of the Grow Smarter project.

That being said, afterwards the implementation of these measures, in a growing economic context and having demonstrated the benefits of the Grow Smarter solutions, the proliferation of projects implementing smart solutions similar to those of the business models treated for the lighthouse cities, could ensure to maintain or increase the creation of employment with low added value (construction) and also high added value (research and development of new technologies). In addition, those low added value jobs can become a low-medium or even high added ones, since it could be necessary a certain degree of technical (or management and other) skills and specialization when working in the practical implementation (construction and installation) of these solutions. Hypothesis that still need to be contrasted and that will be subject to analysis for the deliverable 6.3.

The paper of the public authority can be important when it comes to fund the implementation of the measures and defining the regulation related with it. But its importance is also explained by its role as mediator or channel between users (residents, managers and visitors) and the private partners implementing the measures. Something important to point out because as a key activity, in building adequate customer relationships for ensuring a great user engagement and acceptance, public authorities can have a lot to do.

At the end of the day, the final beneficiaries of the works carried out during the implementation of the measures, and its consequences understood as its raison d'être, are the citizens, either residents (customers, owners, visitors…) and the neighborhood and community as a whole (for better quality of live and comfortability, lower energy costs, creation of jobs -less unemployment- and other less evident consequences but positive externalities like a less polluted environment).

The implementation of these smart solutions, for some projects such as the refurbishment of an industrial site and a library, or those of tertiary and residential buildings, are being done combining, for the same project, different solutions of the Work Package 2, and the Smart Solution 6 of the Work Package 3. An example is the incorporation of a Home Energy Management Systems in a residential building subject of refurbishment tasks involving energy efficiency measures; or its connection with a District Heating System.

In summary, the smart solutions related with Low Energy Districts' Work Package, could lay the foundations for a new way to devise new buildings as well as future refurbishment and retrofitting projects in order to achieve a more sustainable and energetically efficient environment.

Solution 1: Low energy districts

The technology to build new near zero-energy houses has developed strongly but most of Europe's buildings are already built and are due for refurbishment. The buildings chosen by GrowSmarter represent common building types for Europe. A special focus has been given to the buildings from the 1950- 1970ies, being the buildings that today count for more than one third of Europe's building stock and accommodate more than 200 million Europeans.

Growsmarter covers different climate conditions and different starting points and needs, and will demonstrate economically sound solutions to reduce energy consumption, increase the use of renewable energy and improved living conditions in all areas, proving the replicability of the solutions all over Europe. Two types of business models will be compared: public private partnership and Energy performance contracting, both to be further developed within the project as a way of overcoming the market obstacles these models face today.

Residential and industrial buildings will be refurbished using both traditional and innovative solutions, like extremely energy efficient windows, ventilation and high performance sewage heat recovery, energy-certified water taps, air tightness and technical insulation. GrowSmarter will renovate 100.000 m2 of residential living and tertiary spaces and decrease the energy consumption in the selected buildings from 150-200 kWh/m2 to in most cases less than 50 kWh/m2. The standards after renovation will be affordable for current tenants thus enable them to move back to the renovated apartments. Depending on the kind of refurbishment, current tenants will be able to stay or will be offered a substitute apartment for a short time, all the time having access to their apartment. In addition, Home Energy Management Systems and basic refurbishment will be offered to all tenants in the Barcelona demo site at a special rate, increasing the number of buildings renovated and the energy saved.

For each lighthouse city it is necessary to include some context focusing the attention on how environmental factor can affect the business models and if the methodologies to deliver similar value propositions can change in this sense. For example it can be argued that in the city of Barcelona, it is more important to achieve thermal comfort than savings but, in the other hand, in the city of Stockholm, the priority can be more focused in achieving savings (optimizing the distribution of heat); both cities with similar value propositions and objectives (improving the quality of life and the environment). Other aspects should be pointed out for each city, for instance, in Stockholm the heating is included in the rent and therefore the business model must be different in this sense.

Conclusions regarding the Business Models related to solution 1

With the smart solution 1, the Grow Smarter project is focused in modernize and actualize private and public buildings with different purposes (residential, tertiary) in order to become more energy efficient. The potential of this measures to be implemented in many other buildings, a part from the ones treated within this project, is immense since a big proportion of the buildings build in Europe, date of 1950-1970.

Some of the measures require the partnership between public and private sector, while other are completely fund by public or private institutions. As happens with those projects basing its revenues on an ESCO contract, if this contract is longer than the operation period awarded to the energy company, some inefficiencies can appear. This inefficiencies can be defined by the lack of incentives in terms of profitability lower than opportunity costs for energy companies willing to refurbish buildings. Since these projects are capital intensive, in terms of financial resources but also in technology. The operation period should take into account, if possible the ESCo contract, and vice versa, if this is not the case, an important barrier for the energy company to implement an ESCo service could appear, since the economic savings (and profits) normally emerge at the end of said contracts. To maintain the project's financial attractiveness, from the energy company point of view, when this is not happening, the implication of the Public

Administration can be crucial. For this reason, has been considered as a key partner, even though its level of presence can be irrelevant for some particular cases.

In conclusion, we can estimate certain dependency with public resources for measures incorporated within the smart solution 1 but not a structural one, as noted when introducing the Work Package 2. This relative dependency (not only considering the funding aspects but also regulation) can change when analyzing the final results for each project. Finally, the costs of implementing these technologies could decrease in the future, requiring a lower fixed costs of implementation (entry costs). If this happens, the implication of public administrations could be less important, erasing an important degree of dependency between Public and Private sectors, since the marginal and the overall costs of said technologies could be reduced in the medium/long term.

Barcelona. Refurbishment of private tertiary buildings

Measures: 1.0; 1.1.9; 1.1.10.1; 1.1.10.2; 1.1.11

<table>
<tr><th>Key Partners</th><th>Key Activities</th><th>Value Propositions</th><th>Customer Relationships</th><th>Customer Segments</th></tr>
<tr><td rowspan="3">1. Equipment manufacturers
2. Engineering firms
3. Construction/ installation firms
4. Public Administrations (PPP)</td><td>1. Energy auditing to evaluate existing building systems and identify potential improvements.
2. Proposal of energy conservation measures, contract negotiation and agreement.
3. Implementation.
4. Exploitation and energy management
5. Energy Savings Measurement & Verification (M&V)</td><td rowspan="3">For the City / Community: reduce energy consumption and increase renewables production (if renewable production is included). Accomplishment of the EU/City Policies.
For building owners: Decrease in energy costs, maintenance costs and equipment breakdown (in case of replacing old equipment), increase in property value, receive turnkey solution with energy management and in some cases guaranteed energy savings. Better image (SCR) for building customers. Avoid up-front investment by the building managers.
For building Users / Costumers: in some cases increased comfort.</td><td rowspan="2">Commercial phase: dedicated personal assistance. A commercial manager is assigned to the customer in the commercial phase.
Construction/exploitation phase: Dedicated personal assistance - interlocutor changes at contract signature and start of works, to a construction/exploitation specialist/ Energy Manager, using BEMS.</td><td rowspan="3">Commercial building owners (hotels, sports centers, public buildings, etc.)
Commercial building managers if different to owners (e.g. publicly owned sports centers).</td></tr>
<tr><td>Key Resources</td></tr>
<tr><td>1. Customer’s building/installations to be refurbished.
2. Technology and construction
3. Platform for customer monitoring and analysis
4. Financial resources for investment
5. Commercial, engineering & management capacity.</td><td>Channels
1. Direct sales to new customers
2. Tenders for public administration or private entities.
3. Sales through equipment manufacturers/distributors/installers. GNF has some agreements with manufacturers/distributors so that they refer their customers to GNF in case they are interested in obtaining the equipment through as an Energy Service.
4. Sales to existing customers, e.g. electricity/gas retail customers, existing ESCo customers.</td></tr>
<tr><td colspan="2">Cost Structure</td><td colspan="3">Revenue Streams</td></tr>
<tr><td colspan="2">Investment costs (equipment and construction), engineering, management and commercial costs, maintenance costs and energy costs (if included in service).</td><td colspan="3">Payment by the customer for Energy Services as agreed by contract. Generally, a fixed and/or variable fee for equipment, energy supply and maintenance (if included), and/or a payment related to savings – see reference (1). Typical options include payments per kWh delivered (Energy Supply Contract – ESC), or payment related to performance or savings (Energy Performance Contract – EPC).</td></tr>
</table>

Industrial Partner: Gas Natural Fenosa
Short Description: A series of individual projects implementing active and passive energy efficiency measures in different tertiary buildings including a sport center, an education center and a hotel. The main goal of this solution is to reduce the combined energy consumption of the refurbished buildings, reduce energy costs and improve the sustainability of the buildings in terms of environment and future construction criteria.

Escola Sert, in Barcelona, is the educational building subject to be refurbished by installing photovoltaic panels and a building energy management system to monitor and control the energy efficiency and the usage levels of energy. The sports center is the CEM Claror Cartagena, with similar measures being implemented during the refurbishment works, and finally, the hotel H10 (Catedral), also a building with tertiary activities and with similar business models to those of the previous two buildings.

The measures implemented, differ from building to building even though we considered to draw a single business model for all three tertiary buildings since all the projects share truncal characteristics when it comes to value propositions and implementation procedures.

The technical details of each individual measure, are described on the technical reports of the Grow Smarter project. On this document, we will relate each type of measure with its place of implementation, to guide the reader, without delving into technical definitions that are not subject of this document. That being pointed out, and starting with the passive energy efficiency measures, in all buildings incorporated, an external thermal insulation composite system is going to be installed. Other measure comprehends the change of windows at the hotel and the education center. At said sport center, there are two measures, one about the insulation of the pool and other about thermal zoning between spaces with different design temperatures.

An active measure implemented in the three refurbishment projects, is the installation of a building energy management system. However, there are independent measures for each project; for instance, the hotel is replacing its existing boilers for others more efficient. Other examples are the replacement of the existing chiller for a high efficiency heat pump jointly with the implementation of an aerothermal heat pumps at the hotel and the sport center; the replacement of the lightning system of the sport center and the education center, and finally, the optimization of the water distribution loop and the installation of dehumidifier with heat recovery in the sport center's swimming pool. For the refurbishment project of the Escola Sert, remark that it has been decided to install photovoltaic panels integrated into the building's facade.

Customer Segments

The measures in these three different buildings, can be replicated in other buildings sharing, some fundamental characteristics. Since this condition can be satisfied by many other buildings, the potential customers can suppose a mass market. However, there

are other conditions to be satisfied, starting by the ownership or managing authorities of the buildings, which have to have the willingness to refurbish the building the facility in property. The building itself, has to accomplish some requirements, mainly technical and demonstrate the possibility to increase its energy efficiency and environmental sustainability. That being said, neighbor communities can be a perfect target, for energy companies, to address this kind of services and refurbishment projects. Other important segment are the public administrations, institutions with high environmental consciousness owning public buildings and facilities where many of the measures can be implemented.

Value Propositions

There are many value propositions that emerge from the three refurbishment projects and define its business model. The main value proposition is the reduction of the energy consumption and the environmental impact. Thanks to the implementation of active and passive energy efficiency measures, it is expected to reduce the energy consumptions significantly for all three buildings. Also thanks to this reduction of the consumption levels, the contaminant emissions should be reduced as well. Other value propositions should be considered afterwards since its level of importance is more subjective than the first one but important nonetheless. For instance, improving the quality of life of the users and people utilizing the buildings in general. The implementation of isolation materials, better lightning systems or a better control of the thermal aspects of the building, should be traduced in a noticeable increase of the comfortability level. This, in turn, could imply an increase of users, which is the same as saying a higher occupancy levels for the hotel, a higher number of students in the case of the Escola Sert, and an increase of users in the case of the sport center. For this reason, this value proposition is linked with the value proposition of increase the profitability of the buildings from the point of view of its exploitation, managing and ownership. Promoting sustainable economic development, is other value proposition closely linked with the previous ones. Increase the attractiveness of the services offered in the building by implementing smart energy efficiency measures, not only helps to boost the economic profitability of the businesses managing the buildings, but also to increase the market value of the building and the market visibility helping to replicate similar business models based in efficient and sustainable buildings.

Channels

The channels used are direct, between the buyer and the seller this is between the energy company and the ownership or managing authority of the building. To reach awareness, the energy company considers to address its awareness campaigns focused in participate in public and private tenders, informing about what the company is offering and the benefits of implementing its solutions. Other channel is the one that comprehends the sales made through equipment manufacturers, distributors or installers. In this regard, the energy company of Barcelona's refurbishment projects regarding these tertiary buildings, Gas Natural Fenosa, has some agreements with

manufacturers and distributors, so that they can refer their customers to the company in case they are interested in obtaining the equipment as an energy service. Finally other channel is the one where the sales are addressed to existing customers, with existing ESCo models or electricity and gas retail customers with more mainstream contracts.

Customer Relationships

The energy company distinguish between two main types of relationship, the one occurring during the commercial phase and other during the construction, implementation and exploitation phase. During the first one, a commercial manager is assigned to the customer, with dedicated personal assistance. In these projects, with similar business models but with different characteristics in terms of type of the building and with some discrepancies regarding the measures implemented, seems necessary to assign a dedicated customer assistance for each building. The same happens during the construction and posterior exploitation phases. However the personnel dedicated to assist the customer might change according to said phase and the needs of the customer. For example, in the case of the hotel H10, the relation between Gas Natural Fenosa incorporates an energy expert, adapting the project to consider energy aspects in the refurbishment stage. In this model, the final customer (in this case the ownerships of the buildings) have a single interlocutor, Gas Natural Fenosa, which manages and coordinates all the agents needed to execute the whole projects.

Revenue Streams

The projects are going to be based in an ESCo model, thus, the initial investment is going to be assumed by the company selling the implementation of the measures for each building. In the case of Barcelona, this company is Gas Natural Fenosa, who has achieved different contracts for each building. In the case of the sport center, due the ownership of the building, a municipal institution property, and the private exploitation of it, the contract conditions can differ from the other two buildings. As has been pointed out, the initial investment is assumed by the energy company, which in turn, in exchange, receives a periodic fee. The saving are guaranteed by definition by the refurbishment project involving the implementation of active and passive energy efficiency measures, and ideally, the saving achieved should be enough to compensate the investment required to develop the implementation of the Grow Smarter solution and the fee charged by the energy company. The more dilated in time is divided this fee (something to consider in the agreement between the industrial and the customer), the broader scope for the refurbishment and implementation project, something that could determine the financial sustainability of the project.

Key Resources

The main resources for these three separate projects to become a reality can be classified between physic, financial, intellectual and human ones. Starting with the first

ones, the buildings or installations to be refurbished are the main physical resource. The equipment to be installed and construction materials are also a key resource to be taken into account. The financial resources, mainly provided by the ESCo company in the case of Barcelona but also in other case when the public sector could have a predominant role in its regard; the intellectual resources, basically considering the technologies (hardware and software) and the licenses and patents to be used, either property of the energy company or from a third party one; and finally the human resources, involving commercial and managing teams, engineers any people required to work in the project.

Key Activities

Before implementing the solutions and starting the refurbishment plan, there are key activities that have to be pointed out. First, the technical reports, analyzing the technical viability of the project and deciding which measures can be and should be implemented on each building. Then it is important, from the point of view of the ESCo company, to convince the ownership to invest in actions with higher payback than the ones they use to accept for investing. To show them the cost of opportunity of not investing in a refurbishment project like this one. With other words, describing the potential benefits of integrating passive and active energy efficient measures into their buildings.

Key Partnerships

The key partners of the business model are the different agents involved in the projects. The main partners are the ESCo Company (the energy company participating is Gas natural Fenosa) and the customers, represented in this case, by the different business managing or owning the buildings. Since some measures are very specific for each type of customer, in the case of the hotel, there are some procedures that could be replicated in other hotels, for these reason, when implementing these measures, owners and hotel industry brands, have to be considered always as a key partner. The same for those measures involving the refurbishment of a swimming pool, considering the sport facilities as a key partner. Other partners, besides the company providing the services and the one requiring it, are the different subcontracted companies or collaborating companies and people involved in the projects. Those are the technic specialists, engineers, architects, manufacturers and distributors of products for the generation, distribution, management and control of the thermal and electric energy and the implementation of the smart solutions.

Cost Structure

There are costs that appear during the construction and installation stages. Since these are the most capital-intensive stages of the project, the importance of the expenditures generated during these periods, in terms of absolute figures, can represent a major part of the total cost structure of each project. The costs generated by commercial activities, have also to be included. The same happens when it comes to the maintenance of the

service. From the point of view of the client, the energy costs (if included in service) are also part of the cost structure, which in turn compensate the energy provider for its services. There are costs that could appear before or during the implementation of the solutions, these costs can be more difficult to determine, for example decision costs or transaction costs, if the ownership of the building or some providers generate some inefficiencies in terms of lack of understanding or a problem in the supply chain.

Barcelona. Refurbishment of private residential buildings

Industrial Partner: Gas Natural Fenosa**. Measures: 1.0; 1.1.10.1; 1.1.10.2**

<table>
<tr><th>Key Partners</th><th>Key Activities</th><th>Value Propositions</th><th>Customer Relationships</th><th>Customer Segments</th></tr>
<tr><td rowspan="4">1. Architects
2. Engineers
3. Constructors
4. Installer
5. Departments of the company itself
6. Community social workers
7. President of the neighbor community
8. Neighbor community itself
9. Investor
10. Public administration (urban landscape department and responsible for subsidies)
11. Public administration, in the case of public private partnership (PPP)</td><td>1. Managing the works from the beginning of the project. 2. Exhaustive and detailed calculation of costs. 3. Choosing the team and coordinating the activities: architecture, engineering, constructor, installer, security manager, quality manager. 4. Contracts with strict conditions on quality, timings and penalties. 5. Participatory process with the community. 6. Construction and commissioning. 7. Construction and commissioning</td><td>For the neighbors' communities: guarantee of quality of works, better comfort and quality of life at home, guarantee of energy savings, guarantee of energy efficiency, only one interlocutor for every problem, increasing of the property value. For investors: reduction of initial investment (only buying the building), fractionating of the investment in refurbishment, guarantee of quality of works, guarantee of energy efficiency, only one interlocutor for every problem, less pain for the management of neighbor's community, increasing of the property value. For public administration: fractionating of the investment in refurbishment, guarantee of quality of works, guarantee of energy efficiency, only one interlocutor for every problem, less pain for the management of neighbor's community, increasing of the property value.</td><td>One by One
Marketing & Publicity
Public relations</td><td rowspan="4">Neighbors' communities (BTC)
or
Investors (BTB)
or
Public administration (BTB-PPP)</td></tr>
<tr><td colspan="2">Key Resources</td><td colspan="2">Channels</td></tr>
<tr><td colspan="2">(1) Funds to invest (2) Community manager (3)Administration manager for bureaucracy management (4)Technology, coordination and management capability (5) Human resources (6)Monitoring platform for customer monitoring, analysis and loyalty.</td><td colspan="2">Direct sales
Advertising campaign door to door
Advertising campaign via website
Advertising campaign via TV, radio, letter box, mailbox
Home Energy Management System: service of energy advisor for customer loyalty
Public procurement (in case the public administration wants to make a public procurement before to execute refurbishment works in a building)</td></tr>
<tr><td colspan="3"></td></tr>
<tr><td colspan="2">Cost Structure</td><td colspan="3">Revenue Streams</td></tr>
<tr><td colspan="2">Fixed costs (Negotiation of contracts, project development, legalization process, construction, commissioning, salaries, technological infrastructure, participatory process with the community, monitoring and analysis, maintenance)
Variable costs (marketing, incidentals and delays, change of lack of human resources, energy cost if supplied)</td><td colspan="3">1. Energy supply, if included in contract
2. Payments by the customer (include energy supply, investment, maintenance, interests return on investment, and energy savings, for a fixed period). See (1) for reference).
3. Advertising on the scaffold (if possible)</td></tr>
</table>

Solution consisting in implementing passive and active energy efficiency measures in four residential buildings in the city of Barcelona with the purpose of reducing the energy costs and increase the environmental sustainability of the buildings. This business model is applicable for a series of individual projects sharing some of the measures englobed within the smart solution 1 of the Grow Smarter project. Admitting the inconsistency of joining all the projects in a same business model, since the measures implemented are not the same in many cases, we can identify points in common for all the buildings, achieving a common denominator when it comes to value propositions, revenue streams and customer segments.

Customer Segments

The type of measures considered with this smart solution include the implementation of passive energy efficiency measures such as the insulation of the facade, change of windows and remove of the cold bridge between windows and facade, installation of blinds and also, the implementation of active measures, such as the change of boilers, the connection with the district heating system, the installation of efficient water taps or a Home Energy Management system. These measures, or some of them, cannot only be implemented in a residential building, but also in other type of buildings or facilities with similar refurbishment necessities and energy policies. In summary the smart solution 1 by Gas Natural can be implemented via business to customer, business to business or via public private partnership models (including residential and tertiary buildings). However, as a whole, the main customer segment for the industrial partner (ESCo) in case of replicate the model (Public-Private partnership), are the resident type of buildings.

Value propositions

The implementation of passive energy efficiency measures aims to increase the comfortability levels of the buildings by implementing insulation solutions. We understand as a passive measure those involving facade insulation, roof insulation, replacing the windows and removing the cold bridge between windows and the facade itself and installation of blinds. On the other hand, the implementation of active energy efficiency measures aims to reduce the consumption of energy thus reducing the contaminant emissions by using more efficient systems and, if it is the case, using renewable energy. For active energy measures, these projects could incorporate the change of boilers, the connection with a district heating system, installation of efficient water taps and the implementation of a home energy management system (HEMS); all provided by a single industrial partner, in the case of Barcelona, Gas Natural Fenosa. For them, as an energy provider, the implementation of active and passive energy efficiency solutions has supposed the possibility to test an ESCo model in the city of Barcelona and for residential buildings.

Key Resources

The key resources of the projects are divided within four subgroups of resources. The physic assets and resources include the buildings where the different measures are going to be implemented. The equipment and materials needed to implement the solutions and other physical assets mandatory when it comes to refurbish a building. The financial resources can also be categorized as key ones. This is because it is necessary to count on an investor (public administrations, energy companies, or banking institutions) to fund other key resources and, at the end, to make plausible the implementation of the smart solutions. Said other key resources involve all human capital required during the different stages of the implementation, this is the previous works (technical reports or solving legal issues), construction and installation of the measures and finally, monitor, maintenance and verification tasks.

Key Partners

The key partners of these projects are basically the public administrations and its departments involved with each project. This definition includes the department in charge of assigning the public funds (public subsidies, in case the projects were funded in part by the municipality or in a public private partnership considering other aspects besides the funding) and the urban landscape department. Other partners are the companies, in many cases subcontracted, offering constructing services, delivering of materials, architects, engineers, installers, and minor investors. From the perspective of the final beneficiaries of the smart solutions, the neighborhoods and the residents of the buildings, it is important to consider those agents represented by the president of the neighbor community or the neighbor assembly. Returning with the public administrations, these institutions also serve as a key partner when it comes to stablish a channel between the ESCo company and the residents.

Key Activities

Key activities include the managing of the project since the beginning of it. The elaboration of technical studies to determine the viability of the refurbishment project from the technical point of view and also to elaborate an exhaustive and detailed calculation of costs study. Choosing the team and coordinating the activities in the fields of architecture, engineering, construction, installation, security and quality. Also important to draw a contract where timings, quality conditions and penalties are determined, for eliminating any uncertainty and inefficiency if any problem emerges. Other key activities include the monitoring, managing and control of the energy consumptions. In addition, from the point of view of the residents, is important to stablish participation processes with the communities where public administrations could participate as well.

Customer Relationships

Customer relationships are mainly focused to satisfy the residents when any problem appears basically occasioned by a lack of information (asymmetries between residents and energy providers), or for some other problem (as has been detailed later in its

corresponding section, the public administrations can be a fundamental part to make possible a relationship between residents and ESCo companies). Relationships with customers can be reached also using a one by one methodology or via other type of practices, such as via corporate websites and public relationship personnel.

Revenue streams

Besides the external funding of the project (flux of revenues coming from supra-governmental European institutions), the investments are thought to be compensated via the energy bills (depending on consumption and energy prices) if included in the contract, and other payments by the customers (tenants or residents).

Cost Structure

The cost of the investment is shared by the industrial partner, Gas Natural acting as an energy provider company, and public institutions (grants from the council and European funds). The fixed costs, since these are intensive capital projects, represents an important part of the cost structure. Fixed costs, basically in equipment and in construction works are the most important. Also, in this category, negotiation costs (decision making costs (either with the community/public administrations or with the providers and transaction costs), managing and legal consultancy costs or maintenance costs, represent part of the cost structure. For variable costs, to highlight the importance of the marketing strategy and those unexpected costs appearing due to incidents and delays occasioned by providers or lack of human resources in a certain moment.

Channel

The model is being tested in the city of Barcelona for different residential buildings. In this regard, the industrial partner has achieved an agreement with the municipal authorities of Barcelona, serving as a channel between Gas Natural Fenosa and neighbors and residents of the buildings. The channel provided via Ajuntament de Barcelona, serves as a very efficient tool for engaging the residential building owners with the project and at the same time, this Public-Private partnership has created, in parallel, a Task Force to improve the engagement process incorporating experts in refurbishment and in engagement procedures and methods for encouraging residential owners to participate into Public-Private refurbishment projects.

For reaching awareness, in the case of the main industrial partner in Barcelona, it has specified that its main direct channels are basically the advertisement campaigns. (Door-to-door, via corporate website or internet advertisements, campaigns via TV, radio, letter box or mailbox, and when it comes to the home energy management system, a service of energy advisor for customer loyalty has been though if it is the case. Finally, in case the public administration wants to make a public procurement before executing the refurbishment works, the public procurement becomes a great channel to establish a contractual agreement with a public institution.

Barcelona. Refurbishment of public tertiary buildings

<table>
<tr><th>Key Partners</th><th>Key Activities</th><th>Value Propositions</th><th>Customer Relationships</th><th>Customer Segments</th></tr>
<tr><td rowspan="3">(1) Public administration (BIMSA)
(2) Business private investor (CISCO)
(3) Private companies: construction company, engineering company, monitoring system provider
(4) Facility managers
(5) Barcelona Energy Agency (for the monitoring of the building)
IREC</td><td>Building works combined with the development of Building Energy Management System to optimize energy and water consumption while reducing the energy cost for companies doing activities related to R&D.</td><td rowspan="3">(1) To demonstrate the possibility to build net zero energy buildings (NZEB) through a public – private partnership by retrofitting a historic industrial building.
(2) To create a Technology Hub in the district based on low-energy site (innovative ecosystem)</td><td>(1) Communications with architects specialized on building refurbishment, urbanism professionals to renew industrial areas of the city
(2) Communications with different Public administration bodies
(3) Grow Smarter impact. Demonstration site
(4) Workshops to explain building characteristics once operative</td><td rowspan="3">(1) Public administration:
a. Organizations within public administration (Barcelona Institute of Technology foundation for the Habitat (BIT HABITAT))
b. Districts (District of Poblenou)

(2) Private sector:
a. Technological multinational companies (CISCO)
b. Start-ups and other companies

(3) Citizens</td></tr>
<tr><td>Key Resources</td><td>Channels</td></tr>
<tr><td>(1) Financial resources from Barcelona Municipality (annual budget)
(2) Technological software: Smart Energy Management System
(3) Construction materials and equipment
(4) Personnel from public administration to manage project (BIMSA)
(5) SENTILO public database to guarantee an open building operation's follow-up
(6) LEED certification</td><td>(1) the building itself will be used as a showroom for future developments
(2) Screens in the building for energy/comfort data monitoring display
(3) press, media</td></tr>
<tr><td colspan="2">Cost Structure</td><td colspan="3">Revenue Streams</td></tr>
<tr><td colspan="2">Capex: (i) Hardware/software related costs: procurement of materials and equipment
(ii) Engineering company
(iii) Staff from public administration
Opex: (i) Maintenance and reposition costs
(ii) Monitoring and maintenance staff
(iii) Energy supply</td><td colspan="3">(1) Indirect benefits such as free rental space for a period of time for the actors in the PPP in exchange for the investment provided.
(2) Energy costs savings thanks to energy efficiency measures.
(3) Rentals from start-ups and other companies renting offices in the retrofitted building.</td></tr>
</table>

Measures: 1.0; 1.1; 1.1.6; 1.1.9; 1.1.10.1; 1.1.10.2
Industrial Partners: IREC, CISCO & Barcelona City Council
Rehabilitation and integral refurbishment projects of two buildings following energy efficiency criteria to reduce environmental impact. The renovation of Ca l'Alier seeks to satisfy the necessity for a Public-Private relation to establish a center or a hub for developing, ideating, creating and fomenting the apparition of new startups or new ideas related with the Smart Cities context. The other refurbishment project takes places in a municipality-owned previous textile factory and it will be a library, also with a nearly zero net energy building NZEB criterion. Both projects use a Public–Private Partnership framework and they should be a reference for industrial and public-owned building's refurbishments in the city.

Customer Segments

In the case of the industrial site, the necessity of this type of collaboration (Public-Private partnerships), describes both customers of this project. From the public side, the public institution is the municipality of Barcelona, and from the private side, CISCO a technology conglomerate specialized in telecommunications infrastructure. In a more general sense, this type of project could be attractive for:

Public administrations:

a) Transformation of an old industrial site owned by the City Council into a center of innovation and excellence on smart cities using private financial resources.
b) District transformation, from an old industrial district to an innovative one.

Private sector:

a) Corporate buildings: expected reduction on final energy consumption levels compared to an average (with similar characteristics) corporate building.
b) Technological and multinational companies: Availability of office space in an innovative environment.

That being said, considering the activities that are being carried out into this building, Ca l'Alier; another type of customer segments could be interested with this project by weighing the importance of each possible value propositions in a different manner. For this reason, nearly every type of building could be subject to a similar action. Buildings' owners, managers and neighborhood communities are potential customers. Since the sample of buildings is gigantic, we could be dealing with a mass market in terms of customer segments. The same could be argued for the refurbishment project of the library, implementing important measures that could be of interest for other buildings, including residential ones.

In the case of the library, these types of measures can be addressed to any commercial, residential or tertiary building owner and manager who aims to increase the efficiency levels of a building among other kind of value propositions that could attract these types of customers. That being said, note that the library project is specifically designed for a historical building, being public institutions such as the district or the library network of the city, the clients.

Value propositions

There are two projects sharing similar value propositions when it comes to achieve energetic and monetary savings and increase the environmental sustainability of the buildings and also boosting the Public-Private partnerships in the field of energy efficiency and refurbishment projects. However, in particular for Ca l'Alier, since this project is funded thanks to a Public-Private partnership, the main value proposition is the recovery by the Municipality of an abandoned space and a historic building to establish an innovation center in the district and foster entrepreneurship in the city (by renting out offices space in the building to start-ups). That being pointed out, a secondary value proposition is to establish a hub for the promotion of activities related to entrepreneurship and Smart Cities. Other value proposition is to increase the indoor comfortability of the building for the users.

The building where it will be located, Ca l'Alier, pretends to be a demonstration of nearly zero emissions building, (nZEB). To meet this proposal, a series of measures related with increasing the energy efficiency levels are included in the project, for instance, the connection with Districlima. The consecution of a NZEB building could serve as an example for other potentially refurbishable buildings, public or private. In this sense, Ca l'Alier has to be considered as a pilot project.

The library project is also based in a Public-Private partnership, where public administration acts as a funding partner and also as a client, in this regard, similar necessities are going to be fulfilled by similar value propositions as Ca l'Alier, the most important one is to demonstrate the possibility to build a high-performance building for public tertiary uses by retrofitting a historic industrial building thus implementing some measures (active and passive energy efficiency ones) to achieve lower consumptions and better environmental sustainability is what this project is all about. The typology of the buildings (NZEB), should be translated in a decrease in energy costs, maintenance costs and equipment breakdown. Also, it should imply an increase in property value and to meet with environmental regulations.

Besides the actual buildings, we can identify an inherent value proposition that affects their surroundings. Since these measures should improve the environmental sustainability of a building, the nearer urban area where it is located, receives positive externalities, benefiting the people living in the same area. So, there is an inherent value capture by the city where the refurbishment project is taking place.

Key Activities

In the case of Ca l'Alier, the project consists in a bundle of key activities that comprehend the implementation of many measures. The list of measures for this precise project include active energy efficiency and passive energy efficiency related measures, among other type of actions such us the refurbishment works of Ca l'Alier for the Smart local thermal district. Ca l'Alier is an old industrial building that will be re-built into a nearly net zero energy building thanks to being connected to the existing district heating and

cooling network called Districlima. The works related with this measure are key activities in that sense, for example, the technical study or the construction process. When specifying the key activities for the library's refurbishment project, the inherent activities of this type of project could be divided into two main groups. The first one could be defined by those activities generated thanks to the ideation and auditing processes where the measures might be implemented and also those activities that happen during the construction process and installation of the measures. As mentioned in other business models, a key transversal activity when we try to renovate and remodel different aspects of a building is the technical report; the technical evaluation plan. This will necessarily result in a proposals list of energy conservation measures, a subsequent contract negotiation and an agreement (if it is achieved). The next activities are the particular ones of this business model, the ones that are being considered to implement into library Les Corts (BIMSA): façade and ground floor insulation; glazing: implementation of an efficient radiant floor system; installation of an efficient lighting system and, regarding the active energy efficient measures, the installation of a PV system and a LED and natural lightning exploitation. (The energy management system is also included in that category).

The second group of activities are those key activities related with the implementation of a Building Energy Management System (BEMS). The following are the ones that should be considered into this group: For instance, defining the best mechanism/process to choose the BEMS system that fits perfectly considering the building's characteristics, and choosing the best provider regarding the previous process thus the equipment and installation. Normally, a tendering process should take place, choosing between different options. However, in some cases this process has only one option. In the case of Biblioteca Les Corts, a public building, the chosen organization to manage the BEMS system is the municipality's own energetic agency.

Finally, the activities of monitoring, managing and controlling energy consumptions; the supervision of the system, to detect any security or health issues that should be solved, and supervising the engineering / technical aspects of the installed system as well (maintenance activities).

Key Partners

The two main partners involved in the refurbishment of Ca l'Alier from the point of view of ownership and exploitation of the building are Ajuntament de Barcelona and CISCO respectively (the Barcelona Institute of Technology (BIT) will have its headquarters located in Ca l'Alier. In the case of the library Les Corts, also a PPP, the key partners are the public administration funding the investment through BIMSA, a municipal instrument for managing investments in municipal infrastructures, and the owner of the building, also the municipality through Districte Les Corts.

That being said, the implementation of all the measures incorporated within these projects, implies the participation of third- party agents and subcontracted companies.

Those are constructing and installing companies but technology providers. For the monitoring and control part, the company in charge to do this job has yet to be determined but is expected that the maintenance personnel will be in charge, learning how to control and monitor the data collected. The Barcelona Energy Agency will receive the data collected as well but without having to control the data itself. The software needed to control and monitor the data, is provided by a private company.

Key Resources

The buildings itself are the main resource, but besides this key element, for Ca l'Alier a project this big, has to count with strong financial resources. In this respect, the financial resources come from the municipality of Barcelona, assuming around 70 per cent of the total cost being CISCO the private company paying the remaining costs of construction and habilitation of the building to operate properly. The financial resources are equally important for the case of the library, also counting on public administrations to funding it.

Other resources that should be pointed out are the technological resources, for instance the software needed to implement the BEMS measure. Having a Smart Energy Management System allows optimizing consumption and forecasting the future building energy consumption. ICT (Information and Communications Technology) management helps saving energy and reducing carbon emissions by showcasing the development and replication of smart cities' solutions for low energy districts.

Considering only the construction, the equipment and materials are crucial. The same happens when we consider the efficient lighting system, an efficient light bulbs and LEDs are mandatory. Finally, highlight the importance of having adequate personnel, from the public administration to the subcontracted companies in charge of the execution phase of the project. At the end, a LEED certification should be achieved, proving all the measures carried out.

Customer Relationships

(1) Architects specialized on industrial refurbishment areas and professionals specialized in urbanism, working jointly with the customer, and adapting each stage of the project and the procedures to the customer. Since the measures are applied in a different manner for each building (taking into account the different factors including orientation, geography, and the city context), the industrial partner implementing the measure, has to consider a dedicated customer relationship for each customer.
(2) Relationships with public administrations.
(3) Considering the Grow Smarter project, and its impact, as a channel to publicize the project.
(4) Through workshops to describe the buildings' characteristics once operative.

Channels

The main channels are the facilities itself which incorporates all the available technology to promote the concept of net zero energy buildings (NZEB). To reach that, the buildings uses advanced infrastructures related to Information and Communication Technologies (ICT) and advanced control of facilities. Both buildings can become a showroom about the potential of new technologies and ICT on energy consumption and therefor carbon emissions reduction.

The buildings itself will be used as showrooms for future developments. Screens inside both buildings, displaying energy monitoring data with informational purposes are going to be installed. Press and media are also considered when listing the channels used. In the case of the library, the channel towards public organizations is based on internal meetings among public bodies of the city. And towards the users of the library, internet tools such as e-mails are the main channel when it comes to inform them.

The projects show practically the potential of using particular technologies in a building refurbishment to achieve energy consumption reduction. That becomes the best marketing strategy to show the benefits of installing those solutions and selling them to new customers. These are benchmark projects in the field of public and private cooperation that can be replicated in other areas of the city of Barcelona and other cities around the world. In this regard, a good communication strategy can be useful to reach those cities willing to regenerate a district or those companies willing to use the most advanced technologies to reduce energy consumption.

Revenue Streams

While Ca l'Alier do not generate direct revenue streams as it will be devoted to host companies' R + D activities, the PPP framework used for the refurbishment of the building and its comprehended technologies, generate important benefits for both the public and the private sector. For the first actor, in the form of positive externalities, for the citizens (the benefits of having a smart hub and a public library) and for the city itself in terms of using these projects as a showroom for future ones and the reduction of pollution generated by the buildings, as described before. From the point of view of the private firms, in the case of Ca l'Alier, there will be positive benefits, reducing energy costs so potentially increasing the profits. A revenue stream for them is the free rental obtained by the private stakeholder in the PPP in exchange of participating in the investment. For the public stakeholder of the PPP, there will be revenues from renting out offices within the building to start-ups.

Costs Structure

All the costs generated throughout the project of Ca l'Alier have to be considered. Mainly, the most important costs are the financial ones, the costs of an investment to refurbish an industrial building, its construction (procurement of materials…) and the

equipment required to operate the site, including the software needed to become a building energetically managed and controlled. It is necessary to reckon on an important financial muscle to complete this or a similar project. Other costs, arguably secondary ones, are those related with the managing and control of the building, including the personnel and human capital, the commercial costs, the maintenance and energy costs (if included). Also, the payment for the district heating and cooling (DHC) network.

The costs structure of the library is similar to other refurbishment projects included in this document. There are inherent costs which appear since the ideation of the project and the technical study of the building where some measures may be applied. This type of costs, typically fixed ones, also include the costs for negotiating the contracts. Other fixed costs when executing the project are the ones derived from the construction and installation process. The costs of the equipment, salaries, legalization process and, since this is a public building with many kind of externalities and a local forum for the neighborhood, the costs that inevitably could appear during the participatory process with the community.

Barcelona. Efficient and Smart Climate Shell and Equipment Refurbishment project (public residential building)

Industrial Partners: IREC & Barcelona City Council
Measures: 1.0; 1.1.10.1
Short description: The municipality implements simultaneously the required structural renovation of a municipality-owned social housing building (Big Blue, Passeig Santa Coloma), and the energy retrofitting of such building (renovates a building, via passive energy efficiency measures) to achieve an increase of both the security and the overall energy efficiency of the building. This leads to an, increase of the indoor comfort and generating monetary savings for the residents (Social housing).

<table>
<tr><th>Key Partners</th><th>Key Activities</th><th>Value Propositions</th><th>Customer Relationships</th><th>Customer Segments</th></tr>
<tr><td rowspan="3">(1) The Housing Agency of Barcelona
(2) Tenants association
(3) Private companies: construction company, engineering company, monitoring system provider</td><td>(1) Façade retrofitting works and blinds replacement
(2) Energy consumption and indoor temperature monitoring of 5 dwellings</td><td rowspan="3">Retrofit the building external insulation and replace the blinds to protect indoor spaces from weather conditions and increase security and comfort while reducing energy consumption and CO2 emissions in the city</td><td>(1) meetings between owner (Housing Agency of Barcelona) and representative persons from the tenants association
(2) meetings with all the interested neighbors</td><td rowspan="3">(1) Public sector: Other public housing administration bodies

(2) Private sector: Tenants of social housing</td></tr>
<tr><td>Key Resources</td><td>Channels</td></tr>
<tr><td>(1) Personnel from Housing Agency of Barcelona
(2) SENTILO public database for building operation's follow-up
(3) Financial resources from Barcelona Municipality (annual budget)</td><td>(1) The building itself will be used as a showroom for future developments. Dissemination activities
(2) Phone calls, e-mail, concerted interviews, signs/posters on the building</td></tr>
<tr><td colspan="2">Cost Structure</td><td colspan="3">Revenue Streams</td></tr>
<tr><td colspan="2">(1) Hardware related costs: materials and devices for the insulation and the monitoring equipment
(2) Personnel related cost: installation of the materials and monitoring systems and personnel for communication with residents</td><td colspan="3">(1) Rentals paid by the tenants
(2) The retrofitting works should lead to a reduction in the households' electricity and natural gas consumption (this is not a revenue for the Barcelona Municipality but for the tenants)
(3) Non-monetary revenue: increase thermal comfort and reduce noise for the tenants</td></tr>
</table>

Customer Segments

Due to the nature of the project, the measures applied on this building could be implemented in other buildings with the same type of refurbishment needs. The project could be attractive to some building's owners and managers willing to increase the efficiency levels of their buildings in terms of sustainability and energy consumption.

Value Propositions

The main value proposition consists in increasing the indoor comfort of the tenants in the building while reducing the energy costs for them. This is done through increasing the levels of efficiency by implementing some passive energy efficiency measures (i.e. thermal insulation of the façade and replacement of blinds). This value proposition has an importance that could explain the reason of an investment like that, since the type of residents in the building come from a low-income stratum of the city.

Other value propositions that should be mentioned, and appear as positive externalities, are the increasing of property's value and the benefits in terms of less pollution generated by the building favoring the neighborhood and the communities living in the surroundings.

Key Activities

Compared with other projects incorporated in this document, Big Blue's (Passeig Santa Coloma) isolation of the facade and the blinds replacement, represents a minor project in terms of number of measures implemented but a bigger one in terms of number of dwellings affected, over 200. All of these measures are considered passive energy efficiency measures. The monitoring of the energy consumption and indoor temperature in 5 dwellings is also a key activity to be able to follow-up the impact of the energy retrofitting measure.

To draw a right path for these measures to be implemented, a key activity of a project like that, is the technical evaluation. If that technical evaluation plan certifies and agrees that such measures are the correct ones, and that can be implemented, a public bidding process, has to be considered as a Key activity. If there is an agreement between the parts involved in the project, the construction / installing phase and maintenance activities are the ones that will follow.

Key Partners

The Barcelona city council through its Social Housing Institute is the public administration in charge of funding the project. Besides the contracting party, the companies contracted to execute the project, are also key partners, these are the constructor company in charge of installing the thermal insulation of the façade and the company replacing the blinds. The monitoring equipment installer is also a key partner.

Obviously, mention one of the most important participants in this project, which is the neighbor's community, the people who reside in the building.

Customer Relationships

Patronat Municipal de l'Habitatge (Social Housing Institute) and the municipality of Barcelona schedules meetings with the tenants association and all the interested neighbors of the building and also has a "business-client relationship" with the companies involved in the implementation of the measures.

Key Resources

Financial Resources (via public institutions); Intellectual Resources: patents and technologies used to implement the measures; human resources: form the people working in the construction to the people managing or investigating the technology needed to be implemented in the project. Also, important to take into account the physical assets such as the building, the construction materials, the equipment, and the logistics infrastructure, instance the storage space of said material.

Channels

The channels used to gain more customers for a project with these characteristics, will depend on the company willing to sell the services regarding the implementation of the measures. Typically, for a company specialized in those activities, a way to interact with the customers, is directly selling to new customers. Other methodology are the public tenders in case of public administrations / public properties, or private ones in case of private entities. Sales through equipment manufacturers/distributors so that they refer their customers to the industrial company in case they are interested in the installation of the isolating materials onto the façade or replacing the blinds.

Revenue Streams

The parts admitted that financially, as it is thought, this project has no sustainability from the point of view of the investor, nor the construction company. However, it is sustained by the positive social externalities justifying the public investment that is being made by the administrations. In this regard, the project could reach sustainability, also for the institution investing in those measures, by increasing the rental prices for living in the building. As has been highlighted, the tenants will capture the savings achieved thanks to the facade renewal and blinds replacement, assuming, the city council, all the costs of it. The tenants will continue paying the same amount to the building owner, but capturing the value created, seeing how the energy costs are

reduced thanks to the investment made by others (Municipality of Barcelona in the case of the Big Blue project).

Additionally, there exist another business models of Public-Private partnership that can incentivize energy refurbishment in the residential sector in which the Energy Service Company (ESCO) guarantees the energy savings and assumes the maintenance costs. In this case the owners of the building pay the investment in monthly installments during the ESCO contract.

Cost Structure

The main costs are those derived from the installation and constructing process. Note that the installation costs, also include the costs of the equipment. In this sense, the investment costs are very important. Other costs, such as maintaining the measures implemented are noteworthy. A specific cost for this measure is the personnel cost of the Social Housing Institute for the communication with residents (critical factor for this kind of measure).

Cologne. Climate shell refurbishment (Low Energy Districts)

Measure: 1.1
Industrial Partners: Dewog
Short description: Building refurbishment project consisting of the implementation of energy efficiency measures with the aim of reducing energy costs and the harmful impact on the environment.

By refurbishing the building (thermal insulation measures), and installing new and connected devices including a self-regulating decentralized energy management system (to monitor the electricity and heat production), it will be possible to make a more efficient energy use reducing greenhouse emissions and the consumption of primary energy.

<table>
<tr><th>Key Partners</th><th>Key Activities</th><th>Value Propositions</th><th>Customer Relationships</th><th>Customer Segments</th></tr>
<tr><td rowspan="4">Industrial partners: Dewog
Technical partner: RheinEnergie
Technology providers (DEWOG), virtual power plant (RheinEnergie), private sector and building owners; public authorities to incentivize collaboration. Cologne: DEWOG, providing the buildings and RheinEnergie providing the technology</td><td>decentralized management system (installed in each building) to monitor the electricity and heat production through the sensors available in the building</td><td rowspan="4">isolation of the building, to reduce energy consumption</td><td>Owners' communities or companies. The communication between industry partners and the tenants started in order to provide the possibility of co-creation with the tenants.</td><td rowspan="4">(1) Private sector:
a. Housing buildings
b. Corporate buildings
c. Malls and stores
(2) Public administration:
a. Internal use: Public buildings (City Councils buildings, public libraries, hospitals, etc.)
b. External use: public housing</td></tr>
<tr><th>Key Resources</th><th>Channels</th></tr>
<tr><td>Construction materials; financial resources, human resources, technology</td><td>real estate companies, architects and construction companies</td></tr>
<tr><td colspan="2"></td></tr>
<tr><th colspan="2">Cost Structure</th><th colspan="3">Revenue Streams</th></tr>
<tr><td colspan="2">- Hardware related costs: façade, roof and ceiling insulation products, triple glazed windows, high efficiency circulation pumps, lifts with energy recovery, LED lamps, building devices (PLC), and photovoltaic panels
- Software related costs: self-regulating decentralized energy management system for each building</td><td colspan="3">Modernize the infrastructure implies a reduction in energy costs, generating savings. The energy provider charges a periodic fee for implementing the measure, plus the cost of energy.</td></tr>
</table>

Customer segments

- Private sector:
  - **a.** Housing buildings
  - **b.** Corporate buildings
  - **c.** Malls and stores
- Public administration:
  - **a.** Internal use: Public buildings (City Councils buildings, public libraries, hospitals, etc.)
  - **b.** External use: public housing

Any kind of building fulfilling the technical requirements for being subject of this type of refurbishment projects

Value propositions

The value proposition of the project is to improve the isolation of the building, make a more efficient use of energy, and install devices to reduce energy consumption that will lead to a reduction in the energy consumption potentially reducing energy bills. The monitoring of the electricity and heat production will additionally add value to the service provided by the energy company. Additional value can be obtained at social level with the reduction of greenhouse gas emissions.

Channels

The solution is offered by real estate companies (in new developments) or architects and construction companies (in brownfield projects) as an added value to final customers (either households or companies) to reduce their energy bills, improve service, increase wellbeing or adopt an environmentally friendly approach in the energy use.

Customer relationship

Business model should be oriented at targeting real estate companies, construction or architects to offer solutions to their costumers (final users) such as owners' communities or companies. The tenants can request the owners to apply measures to make a more efficient use of the energy, leading to a reduction in the energy use.

Revenue streams

The solution should lead to a reduction in energy costs for final users. The savings for customers derived from the reduction in the energy consumption should pay-off for the additional cost the final customers should face to modernize the infrastructure. The up-front payment can be however burdensome for some households that without the support of the administration will not be able to face it. Public administrations should encourage final customers to implement these measures through subventions to reach the climate objectives that should be fulfilled before 2025.

Key resources

The key elements of the project can be separated in two areas:

(1) Improvements in building insulation will reduce the energy waste by keeping the energy within the buildings

(2) Modernize the energetic infrastructures by using LED lights and photovoltaic panels and use a decentralized management system to make the most efficient use of the energy.

The first one proposes to overcome this problem the improvement in the insulation of the building (facade, basement ceiling and roof) and installation of triple glazed windows. The second key resource is the use the most advance technology to efficiently use the energy (LED lighting or modern –heat pumps) and a system to monitor the electricity and heat production that will be connected to the "virtual power plant" of the utility.

Key activities

The key activities are related to the decentralized management system (installed in each building) to monitor the electricity and heat production through the sensors available in the building. For this reason, the previous implementation to a centralized heating system in the buildings, is a key activity, because is essential to enable the measurement of heat production for each building. The data is obtained with the programmable logic controller (PLC) installed in the building, which collects data using sensors with the purpose of using energy according to the requirements.

Key partnerships

The project requires the collaboration of different stakeholders: technology providers (RheinEnergie) and the buildings (DEWOG); also public authorities to incentivize collaboration between private sector. In this regard, Public-Private partnerships are convenient.

Cost structure

Hardware related costs: façade, roof and ceiling insulation products, triple glazed windows, high efficiency circulation pumps; lifts with energy recovery technology, LED lamps, heat pumps; PLC devices and photovoltaic panels.
External costs (Software related costs -RheinEnergy-): self-regulating decentralized energy management system for each building.
Implementation (subcontracted companies) and personnel costs (salaries).

Stockholm. A Smart Ventilation Control

Measure: 1.1.6
Main industrial partner: L&T
This measure consists in implementing a ventilation control system with efficient heat recovery for achieve a more stable environment in terms of comfortability.

<table>
<tr><th>Key Partners</th><th>Key Activities</th><th>Value Propositions</th><th>Customer Relationships</th><th>Customer Segments</th></tr>
<tr><td rowspan="3">Companies that are specialized in installing meters</td><td>1. Detection of separate garage ventilation systems
2. Investigate need for complementary control such as PPM, moisture, presence on existing system.
3. Installation of new optional control system added to the existing one.</td><td rowspan="3">For the owner:
Less energy used for heating of garage (kitchen…other rooms can be studied)

For tenants:
More stable climate

For us all:
Less CO2 footprint</td><td>One by One
Marketing & Publicity
Public Procurement</td><td rowspan="3">1. Every existing garage with a separate ventilation system
2. Owned by all kind of property owner</td></tr>
<tr><th>Key Resources</th><th>Channels</th></tr>
<tr><td>1. Human resources for installation.
2. Software and hardware for adaptive control</td><td>B2B
B2C</td></tr>
<tr><th colspan="2">Cost Structure</th><th colspan="3">Revenue Streams</th></tr>
<tr><td colspan="2">Fixed Costs:
1. Installation cost covered by house owner.
2. Supervision normally NOT needed.
Variable cost:
1. Installation cost
2. Marketing and communication to persons making decision</td><td colspan="3">Cost reduction in energy used goes directly to property owner.</td></tr>
</table>

Customer Segments

The potential customers could be the residents with some difficulties in keeping the heat inside their residence. For customers with some insulating deficiencies and need for refurbishing the building or the apartment. This measure can be included in some major refurbishment projects, which involve the implementation of other measures, including a smart ventilation control. But we consider to describe it separately because it can be implemented apart from other measures on places with this very specific needs.

Key activities

Technical studies for determining the weak points in terms of heat loss and from where the heat should be extracted, and therefore, how to implement the measure.
Other key activities include the agreement with the different partners and the residents.

Value Proposition

For the owner: Less energy used for heating of garage (kitchen…other rooms can be studied). For tenants: More stable climate. For us all: Less CO2 footprint.

Key Resources

Financial Resources
Human resources
Physical/intellectual resources: equipment and technology (licenses and patents).

Key Partners

The energy provider for offering this solution to its customers. The technology provider, for selling this technology to the energy provider (in case it is not the same company), the residents, the company in charge of installing the measure and/or technically analyzing the building.

Customer Relationship

Directly to the customer, providing specialized attention, the same as the value proposition delivered.

Channels

It can be addressed from business to Business companies. For instance, a company offering a smart ventilation control to energy companies for their respective customers. Or on the other hand, from business to final customers, for example an energy company offering the implementation of energy efficiency measures, including this one, to a building. Finally, the technology provider offering it directly to a customer.

Revenue Streams

Cost reduction in used energy goes directly to property owner.

Cost structure

Fixed Costs: 1. Installation cost covered by house owner.
2. Supervision normally NOT needed.
Variable cost: 1. Installation cost
2. Marketing and communication to people involved in the making-decision process of implementing the measure.

Stockholm. An Energy Quality Assurance

Industrial partners: L&T
Measures: 1.1.7
Short description: By appointing and Energy Coordinator to follow the building construction or refurbishment, energy savings can be achieved by avoiding errors and delays result of staff changes. Errors during planning and construction can result in 10-20% extra energy consumption.

<table>
<tr><th>Key Partners</th><th>Key Activities</th><th>Value Propositions</th><th>Customer Relationships</th><th>Customer Segments</th></tr>
<tr><td rowspan="3">Energy Coordinator, the Project Manager (Construction company)</td><td>Detailed plan about the expected energy savings and key areas to tackle the energy wasting; a common working schedule with the project manager and the energy coordinator</td><td rowspan="3">To offer an advisory service to the site Project Manager to ensure that the right techniques are used during the building process</td><td>construction companies and engineering companies</td><td rowspan="3">Private sector:
a. Construction companies
b. Engineering companies</td></tr>
<tr><td>Key Resources</td><td>Channels</td></tr>
<tr><td>a professional and experienced firm in energy consumptions

communication plan between the firm and the Project Manager</td><td>Project Manager & the Hubgrade-Energy Saving Centre</td></tr>
<tr><th colspan="2">Cost Structure</th><th colspan="3">Revenue Streams</th></tr>
<tr><td colspan="2">Personnel related costs: Energy Coordinator salary</td><td colspan="3">does not directly generate revenue streams, but it should allow for a reduction around 10 – 20 % of the energy consumption costs during the construction period</td></tr>
</table>

Customer segments

Private sector:

- Construction companies
- Engineering companies

Energy savings that reduce construction costs and increase companies' competitiveness or alternatively increase firms' margins.

Value propositions

The value proposition of the solution is offering an advisory service to the site Project Manager to ensure that the right techniques are used during the building process from its planning to its implementation phase focusing on energy savings.

Channels

The Energy Coordinator should work closely with the Project Manager along the building process to implement the energy saving measures alongside the Hubgrade - Energy Saving Centre ensuring that the calculated energy use matches actual consumption.

Customer relationship

The solution should target construction companies and engineering companies that can capture the value derived from energy savings during the construction process.

Revenue streams

The solution proposed does not directly generate revenue streams but it should allow for a reduction around 10 – 20 % of the energy consumption costs during the construction period that can be captured by the constructing firm.

Key resources

The key issue is appointing as energy advisor a professional and experienced firm that brings to the project innovative ideas to minimize the energy consumptions. It is also required a good communication plan with the Project Manager to successfully coordinate the measures to reduce energy consumption while not interfering in the construction process path.

Key activities

The initial stage should include a detailed plan about the expected energy savings during the process and the key areas to tackle the problem of energy wasting. The Energy Coordinator should also ensure that installed products are individually tested in order to ensure that they are operating efficiently.
Project Manager and Energy Coordinator should have a fluent communication with a high degree of information sharing and design a common working schedule.

Key partnerships

The task of the Energy Coordinator consists on working together with the Project Manager to reduce the waste of energy that should finally result in cost savings for the construction company. A good design of the incentives structure should result in a successful cooperation.

Cost structure

Personnel related costs: Energy Coordinator salary that includes planning and monitoring.

PRICING: Energy Coordinator feed should have a fixed pay and variable pay according to the energy savings achieved in the project.

Stockholm. Energy efficient refurbishment project in residential buildings

Measure: 1.1 (1.1.3; 1.1.4; 1.1.5)
Industrial Partner: Skanska
Project consisting in implementing a series of energy efficiency measures and a home energy management system to increase the overall consumption levels of the buildings

<table>
<tr><th>Key Partners</th><th>Key Activities</th><th>Value Propositions</th><th>Customer Relationships</th><th>Customer Segments</th></tr>
<tr><td rowspan="3">Construction companies; technology providers, energy suppliers, managing and monitoring companies, residents, public administrations</td><td>(Depending on the measure). In a nutshell: previous measures, construction works, coordination, measurement and monitor; getting approvals from the tenants and dwelling owners.</td><td rowspan="3">For the people living in the building: lower energy costs, more comfortability
For the owner: high property value
For the environment: lower contaminant emissions.
For the city: implementation of measures, which benefits the neighborhood, and could serve as a model for future projects.
For the industrial partners: promoting their value propositions and making them financially sustainable in the long term (if they were not already)</td><td>In some cases, using corporate webpages, staff exclusively dedicated to the client. For instance: involving a customer representative to the residents. //
B2B and B2C</td><td rowspan="3">No special customer segments, but always to people (owners/managers/ municipalities/ companies) willing to implement energy efficiency measures, and improve the sustainability levels of a building. Also different actors with social and environmental awareness.</td></tr>
<tr><td>Key Resources</td><td>Channels</td></tr>
<tr><td>Financial Resources: important fixed costs because the equipment required and the construction works; Human Resources: important amount of jobs created during the implementation. Physical resources: material and equipment. Intellectual resources: high added value in some measures with important amount of technology factor.</td><td>Depending on the measure and the industrial partner (some measures are delivered through the implementation of different technologies, others by offering face to face services…). In some cases, corporate webpages serve as a channel during the implementation stages or in an after-sale situation.</td></tr>
<tr><td colspan="3">Cost Structure</td><td colspan="2">Revenue Streams</td></tr>
<tr><td colspan="3">Prior the implementation: technical studies and salaries
During the implementation: construction costs and implementation (equipment + technology + salaries)
After the implementation: maintenance costs and monitoring services</td><td colspan="2">There are revenues for some industrial partners during the implementation phase and depending of the measure. From the point of view of the building's users (residents…) there are no incremental costs because of the project. On the contrary, the users capture the savings.</td></tr>
</table>

(Valla Torg) and capture savings for the people living in it.

Industrial partner: Skanska (the project is linked with the construction consolidation centre (solution 2) and with the Hubgrade (L&T) and the Active house (Fortum) (solution 3).

Customer Segments

The measures implemented in Valla Torg Buildings can be applied in other buildings not necessarily of the residential type. However, there are some specific measures, particularly the home energy management system, which fits in a better in building of the residential type (condominiums) since the building is strictly divided in different units or habitable departments where common areas are reduced to only the indispensable ones. That being said, similar systems can be applied, maybe not focusing in a single habitable unit but more with the building as a whole. The building energy managements systems or BEMS are these type of solutions.

The selling companies offering these services can be either energy companies, to its customers, or construction companies, technological companies offering its solutions to energy companies or other industries that could demand this type of measures.

Value proposition

For the people living in the building: lower energy costs, more comfortability.
For the owner: high property value
For the environment: lower contaminant emissions.
For the city: implementation of measures, which benefits the neighborhood, and could serve as a model for future projects.
For the industrial partners: promoting their value propositions and making them financially sustainable in the long term (if they were not already). The measure 2 (described in the following section) should help to increase their efficiency when implementing the measures.

Key Activities

One of the most important key activities of a project of this typology, as has been highlighted in other business models, is the mandatory technical analysis for ensuring what are the most optimal measures to implement and what is the best way for doing it. For instance, some previous unrecognized heat losses have proven to come from an inefficient hot water circulation.

The implementation itself, the construction works, and the installation procedures are also an obvious key activity. The same applies when it comes to ensure the funds, necessary to permit to acquire the equipment for the project and paying salaries.

Key Partners

Key partners are the construction companies, the energy companies, the subcontracted companies, technology providers, engineers, and the different participants of the city; neighbors and the residents.

Key Resources

Financial Resources
Human Resources: during all the phases of implementation (study, installation, measurements).
Physical and intellectual resources: equipment and technology

Customer Relationships

In some cases, using corporate webpages, staff exclusively dedicated to the client. For instance: involving a customer representative to the residents.

Channels

Depending on the measure and the industrial partner (some measures are delivered through the implementation of different technologies, others by offering face to face services…). In some cases, corporate webpages serve as a channel during the implementation stages or in an after-sale situation.

Revenue Streams

There are revenues for some industrial partners during the implementation phase and depending of the measure. From the point of view of the building's users (residents…) there are no incremental costs because of the project. On the contrary, the users capture the savings.

Cost Structure

Prior the implementation: technical studies and salaries.
During the implementation: construction costs and implementation (equipment + technology + salaries).
After the implementation: maintenance costs and monitoring services.

Stockholm. Slakthusarea refurbishment plan including air tightness tests. (Tertiary - city owned buildings)

Measures: 1.1 (1.1.5, 1.1.8)
Project defined by the implementation of active and passive energy efficiency measures, an energy saving center and other sub-measures with the purpose of reducing the consumptions and costs and at the same time lower the contaminant emissions from the building. This project will serve to describe the Stockholm's GrowSmarter measure regarding the Air tightness measurement tests.

<table>
<tr><th>Key Partners</th><th>Key Activities</th><th>Value Propositions</th><th>Customer Relationships</th><th>Customer Segments</th></tr>
<tr><td rowspan="3">Building company
Architects
Energy consultant</td><td>Putting separate floor, separate apartments or the whole house under controlled overpressure in order to detect any unwanted leakage in wall, around windows etc.</td><td rowspan="3">For the building company: To achieve theoretical values for energy consumption

For the owner: Less energy used for heating of building.

For tenants: Lower energy cost, more stable indoor climate

For us all: Less CO2 footprint</td><td>One by One
Marketing & Publicity</td><td rowspan="3">1. Every existing building using its own central heating system

2. Owned by all kind of property owner</td></tr>
<tr><th>Key Resources</th><th>Channels</th></tr>
<tr><td>1. Equipment to thoroughly seal selected space.
2. Equipment to achieve overpressure.
3. Thermographic camera to visualize temperature drop, e.g. around windows</td><td>B2B
B2C</td></tr>
<tr><th colspan="2">Cost Structure</th><th colspan="3">Revenue Streams</th></tr>
<tr><td colspan="2">Fixed Costs:
1. Technical equipment
Variable cost:
1. Installation cost depending on selected area.
2. Salaries & Labor cost
3. Marketing and communication</td><td colspan="3">1. More efficient inspection after finishing building process

2. Fulfillment of theoretical values

3. Cost reduction in € (kWh and kW) goes direct to property owner.</td></tr>
</table>

Customer Segments

The potential customers are the different ownerships willing to implement this type of measures to its buildings or dwellings. The solution regarding the implementation of PV, is thought for refurbishment projects of entire buildings, so potential customers should represent a building or a whole community. In particular, for Stockholm, the solution is going to be implemented in public owned buildings, first two historic ones and later, due to budget restrictions, to other two buildings meeting the technical requirements for being refurbished. The type of ownership or purpose of the building should not determine whether a building represents a potential customer or not, however, the implementation of this solution in this lighthouse city, is designed under a Public-Private partnership framework.

Key Activities

To make previous studies of the area. (This was proved to be important to determine that there was enough waste heat from the nearby Sports arena and a Data Center to heat up the two buildings involved in this project. Other previous studies are required to determine the best energy efficiency measures for reaching the energy targets of the buildings, considering that the first ones to be refurbished were two historic buildings with cultural historic value. For the actual refurbishment projects (Slakthus 8 and Kylhuset) those previous studies have to be done too. Analyzing each building as part of its surroundings are important.

The methodology that will be used for implementing the solution consists in installing exhaust air heat pumps for recovering the heat in the ventilation exhaust air. For doing that, some mechanical exhaust air ventilation and a central heating system for the building to use the recovered energy for heating purposes, including the domestic hot water. Other implementations are also considered for the final two options considered to refurbish, for this reason, other key activities have to be mentioned, ensuring the supply chain, determining the construction and implementation methods and other activities related with installing active and passive energy efficiency measures.

Value Propositions

To achieve certain levels of energy efficiency while respecting the historic value of the buildings when the measure was first contemplated for two 1910's buildings. Afterwards, to provide a solution to the implementation of an adaptive control system for heating and ventilation purposes, heat recovery in the ventilation system, utilize the excess of heat from the kitchen to heat hot water (sub-measures related with the air tightness control), and other measures such as installation of PV with battery storage and LED lighting systems.

Key Partners

Fortum, construction companies, energy companies, Real Estate Administration, The city of Stockholm, subcontracted companies and providers.

Key Resources

Financial resources: for funding the Project
Human Resources: the necessary working force for installing the solution, engineers, managers and other human capital involved directly or indirectly.
Material resources/equipment: implementing the needed infrastructure.

Channels

About the air tightness measure, to achieve an awareness level about what this measure is all about, it is necessary to stablish different type of channels, in terms of marketing with potential customers. A fundamental part of the implementation, is the evaluation, for determining the effects and if it is economically sustainable according to the savings achieved. Taking this into account, the implementation itself needs to be easy to install, for making the project, more attractive and reduce its opportunity costs. As mentioned above, the project will need previous installations.

For other important measures implemented in Slakthusarea, we refer the lector to other Business models of the Work Package 2, specifically the Brf Årstakrönet building and the energy saving center project and measure.

Customer Relationships

The implementation of the air tightness measure along with the other measures, is a project, specifically designed for the buildings we are treating here. For implementing the same measure into other buildings, the project should be adjusted to those other buildings since the characteristics and circumstances change more or less on each building. In this regard, the customer relationship has to be adjusted according to the individual ownership of each building, with dedicated personal answering and collaborating with the customer.

Stream Revenues

The revenues come from the savings generated thanks to the implementation of these measures. The refurbishment measures, in aggregated terms, have a pay-back times of around 10 years, so at the end of this estimated period, the investment should be compensated; entirely justifying the investment from the financial point of view.

Cost Structure

Fixed Costs:

1. Technical equipment, costs of developing the technology

Variable cost:

1. Installation cost depending on selected area.
2. Salaries & Labor cost
3. Marketing and communication

Stockholm. Brf Årstakrönet residential buildings

Measures: 1.1
Main industrial partner: L&T FM AB
Implementation of energy efficiency measures for optimize energy consumptions and lower the contaminant emissions of a private condominium.

<table>
<tr><th>Key Partners</th><th>Key Activities</th><th>Value Propositions</th><th>Customer Relationships</th><th>Customer Segments</th></tr>
<tr><td rowspan="3">Construction companies; technology providers, energy suppliers, managing and monitoring companies, residents, public administrations</td><td>(Depending on the measure). In a nutshell: previous measures, construction works, coordination, measurement and monitor</td><td rowspan="3">For the people living in the building: lower energy costs, more comfortability
For the owner: high property value
For the environment: lower contaminant emissions.
For the city: implementation of measures, which benefits the neighborhood, and could serve as a model for future projects.
For the industrial partners: promoting their value propositions and making them financially sustainable in the long term (if they were not already)</td><td>In some cases, using corporate webpages, staff exclusively dedicated to the client. For instance: involving a customer representative to the residents. //
B2B and B2C</td><td rowspan="3">No special customer segments, but always to people (owners/managers/ municipalities/ companies) willing to implement energy efficiency measures, and improve the sustainability levels of a building. Also different actors with social and environmental awareness.</td></tr>
<tr><td>Key Resources</td><td>Channels</td></tr>
<tr><td>Financial Resources: important fixed costs because the equipment required and the construction works;
Human Resources: important amount of jobs created during the implementation.
Physical resources: material and equipment. Intellectual resources: high added value in some measures with important amount of technology factor.</td><td>Depending on the measure and the industrial partner (some measures are delivered through the implementation of different technologies, others by offering face to face services…). In some cases, corporate webpages serve as a channel during the implementation stages or in an after-sale situation.</td></tr>
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<tr><td colspan="3">Prior the implementation: technical studies and salaries
During the implementation: construction costs and implementation (equipment + technology + salaries)
After the implementation: maintenance costs and monitoring services.</td><td colspan="2">There are revenues for some industrial partners during the implementation phase and depending of the measure. From the point of view of the building's users (residents…) there are no incremental costs because of the project. On the contrary, the users capture the savings.</td></tr>
</table>

This project includes the implementation of different type of measures included in the Work Package 2 of the GrowSmarter Project. These measures, relate energy

optimization and buildings through the implementation of active and passive energy efficiency measures, efficient lighting systems, a Virtual Power Plant (EnergyHub) and a Smart Home System.

Key activities

The key activities consider all absolutely necessary activities, for the project to be done. This definition also includes the activities prior to the project, without which it would not be possible to implement all the measures into the buildings we are studying in these lines.

That being said, because this project has to satisfy different customer segments and many necessities with many value propositions, the list of key activities is very long. Next, we will list all the key activities, grouping them according to the measures that this project incorporates.

Starting with the active and passive energy measures, the most important activities are the implementation of sensors inside the building in a number of apartments and also outside the building for weather forecasting.

The key activities involved within the solution 3 can be divided between the Active House project (Fortum) and the Energy saving center (adaptive temperature control system by L&T). Starting with the first sub-measure, the key activities consider the implementation of different type of devices, including water and electricity meters, sensors, tablets and dimmers.

Continuing with the second sub-measure, for the implementation of the adaptive temperature control system, it is required to study in detail the characteristics of the building. Because this sub-measure is also implemented in other projects, the methodology of implementation could vary substantially depending on the structure of each building. In this sense, it is important to analyze technically the structural elements of the condominium. The energy saving center uses the Hubgrade solution, which is a technological innovation provided by one of the GrowSmarter's partners in Stockholm, L&T.

The key activities involving the measure of the Virtual Power Plant (balancing demand with supply), the activities regarding the technical evaluation and studies have to be done in order to implement this measure. Since this measure is heavily related with the implementation of other measure, the implementation of PV on the building, the key activities about said measure, are also key activities of the measure 4.1. The Virtual Power Plant tries to adjust and optimize the energy generation of these PV installations. Basically, it consists in implementing the EnergyHub system.
Other key activity included in the project is the measure about Energy Quality assurance of the GrowSmarter project (L&T), which in turn fulfills the coordination necessities of every project, including BRF Årstakrönet, and serves as a value proposition for some

industrial partners. In the case of Stockholm projects, the industrial partner which provides the energy coordinator services, is L&T (we refer to measure "Energy Quality Assurance"). As a matter of fact, the measure "energy saving center" is strictly related with this measure, both measure's value propositions consist in manage and control different aspects of the project.

Customer segments

The potential customers that could fit in a project like this one, with a large amount of measures are all those buildings (more precisely, the ownership and the people managing the facilities), aiming to improve the levels of efficiency in terms of energy consumption, environment, financial resources and also to be a future proof building from the point of view of regulations. Potential refurbishable buildings should match the technical requirements for having implemented the solutions that this project represents.

Key Resources

The importance of the material equipment required for implementing and installing the VPP via the EnergyHub, is crucial. For doing it, is necessary a Power Module, a 3 x 5 A (3.5kW) three phase, scalable bi-directional power inverter. The amount of technological resources is very high, not only in terms of hardware, but also in terms of software. A system called ACE is necessary to equalize the current.
As has been mentioned, the implementation of the virtual power plant, follow other measure, the installation of photovoltaic panels. For this reason, we consider these PV systems and its batteries, as key resources, without which it would not be possible to implement the Virtual Power Plant
For active and passive energy measures, the equipment and the whole in restructure that has to be implemented in the building is a key resource, in addition of the personnel required for these measures to be implemented without which, it would not be possible to move forward with the project.
For the measure "Active House" and its sub-measures, the key resources are the same described in the business model referring the named "Active House" and "energy saving center".

Value propositions

The implementation of active and passive measures aims to satisfy the necessity of having a more sustainable building, in terms of energy consumptions and environmental sustainability. This will benefit the residents of the condominium (by reducing energy costs and optimizing the consumptions) and also the entire community (city and neighbors), since the pollution generated by the building itself, should represent a noticeably smaller amount than that of a building without that kind of measures implemented. Some value propositions that emerge with this type of projects, the same

happens in the other two lighthouse cities, are the potential increase of the property's value.
The Value proposition for having an energy saving center is to save energy and reduce the cost generated for using it. By reducing the total amount of energy, the energy costs should be reduced too. The theoretical value proposition is to manage in a much efficient manner, the energetic consumptions and L&T's solutions aims to achieve this goal. According to previous data, this is a reality, since the system has been proven satisfactorily in the past. The energy saving center could be analyzed in a separate Business Model, to describe in a more precise way, independently, this value propositions and the overall sustainability and methods used to implement this particular measure.
With the Virtual Power Plant and the EnergyHub system, there are different value propositions, benefiting the people living in the condominium:

- Possibility to reduce the main fuse getting a lower fix fee in several applications
- Reduced distribution losses
- Simple installation
- Transparent to existing loads
- Prevents over currents from all loads in the installation.

The most important is to program how to use the stored energy (into the batteries) to adjust the utilization of this stored energy when it is more beneficial for the residents. This will depend on the weather conditions (the functionality of the PV will depend on that), and also the price of energy (depending on the aggregated demand at a certain point).

Key Partnerships

The following are the key partnerships of the project: construction companies; technology providers, energy suppliers, managing and monitoring companies, residents, and public administrations. The GrowSmarter project, englobed under the horizon 2020 objectives, tries to determine whether or not some of the projects can be independently sustainable from the public founding and the public subsidizes and other type of dependences. Taking this into account, the refurbishment project of the condominium, can be financially sustainable as long as, in addition to the benefits of the project, the costs are borne by the direct beneficiaries. That is residents and owners.

Customer Relationships

Considering the typology of the project, with intensive construction works, and a project specifically designed for the condominium, the relationships between the industrial partners and the customer, are recommended to be based in a dedicated and designed to be adjusted to the customer's necessities. This implies the existence of assisting personnel for attending the customer. Considering there are many sub-measures being

implemented in the condominium, is important to recommend a managing authority, coordinating the project (solution 1 “energy quality assurance”), and also in charge of stablishing the relationships with the customer.

Revenue Streams

For the type of project like that, there are different revenue streams that can be considered. Depending on the funding sources, the implementation of the measures can be subsidized by the public administration, supposing no additional cost for the owners of the condominium and the people living in it. In case there are not public funding or if there is one, do not suppose a direct subsidize for the residents and the ownership of the building, the costs might be rebounded entirely by the ownership and direct beneficiaries of the project. In this regard, the cost of the investment could be covered by an increase of the rental prices, and a periodic fee to the energy company. The revenue streams, will also depend on the type of measure, analyzed separately from the rest of the project, because each measure, at the end, represents an individual business model from the point of view of the industrial partners.

Cost Structure

The cost structure of this model, focuses more in providing to the building with numerous value propositions with high value in terms of utility for the customers (returns, savings, technology), and not driving its costs strategy in reducing the costs. This can be explained by the high investment costs, needed for affording the expensive equipment, technology and the connection with the energy saving center, required for implementation of the project.

Channels

How is thought to provide the value proposition? To answer this question is necessary to refer to the technical report of the GrowSmarter project where specifies that the system generates a more stable indoor temperature and benefit better from internal heat sources and heating from the sun. The way in which the virtual power plant is going to work, consists in optimizing the supply according to the energy demand. The value propositions are going to be delivered through by specific technical teams and construction works carried out by subcontracted companies (construction, and engineering firms). The measures consisting in offering verifying the consumptions and monitoring said consumption behaviors and related services, are going to be provided, physically and virtually, since it is not necessary to monitor the data and consumption figures being present, on site, in the building.

Solution 2: Smart building logistics

Europe's cities are growing and the materials used in construction of buildings and infrastructure accounts for up to 30-40 % of the goods moved in a modern city. Reducing unnecessary freight by consolidation will lead to improved quality of life through reductions in noise, emissions and traffic hazard. This will also lead to a reduction of construction costs.
Typically, a consignment is moved four times before it is put in place at a construction site. An estimated 25 % of construction labor time is used for looking for the material or moving material being in the way.
Building on previous experience Carrier will establish a building logistics center will in Årsta, to handle goods arriving to the construction site. Construction material deliveries are directed to the center, where they are stored in a secure, weather-protected environment, awaiting delivery to the site just-in-time, using renewably fueled trucks. Hybrid-electric and ethanol (ED95) trucks will be used. Fully loaded trucks will receive a fitting slot-time in advance and go directly to the constructions site. Suitable goods will be delivered to the center by rail – saving even more energy and climate emissions. When the Årsta area is developing with more construction sites, the center will be scaled-up to serve also these.
Some specific context of Stockholm is needed, mainly about the place where current logistic center is located (if it is convenient and what are the conditions imposed by the public municipality when choosing a location.

Conclusions regarding the Business Models related to solution 2

This solution is only being contemplated for the lighthouse city of Stockholm, however, it can be replicated in other places since the value propositions could satisfy necessities from all over the world regarding the optimization of the supplying chain for construction sites. It has to be pointed out that the role of the public administrations, public institutions and regional and municipal authorities, in a more general definition, is strategic since those institutions are the first ones to be interested in reduce the pollution and congestion rates inside cities. What is really important to note is that public administrations tend to identify positive externalities and this solution generates many of them. Not only the reduction of those taxes but also the generation of new jobs through the optimization of the supply chain, the gains in efficiency for those companies involved in building tasks and therefore the gain in productivity throughout all the industry. Public administrations can help to make possible these kind of solutions by offering areas where the logistic centers could be settled and after determining the localization, a public procurement for managing the logistics activities could be optimal as is being done in Stockholm. The financial sustainability depends on reducing the marginal costs for operating. For this reason, the more the logistics center is used, the more sustainable it is in these terms. The variable costs should not increase proportionally, since only depend on increasing the number of trucks needed at certain point. However, the fixed costs (the center itself – building and managing it - , most part of the salaries) can only be justified, from the financial point of view, by increasing the operability of the logistics center. In summary, is a model based in a cost structure

focused in being compensate by taking advantage of economies of scale. As being highlighted, the more deliveries, the lower it costs, in average, to make the next delivery.

Stockholm. Construction Consolidation Centre: An Integrated Multi-modal transport for construction materials/logistics center in Årsta

Measure: 2.1
Industrial Partner: Carrier Transport and Info 24
The Construction Consolidation Centre (CCC) is a logistical set-up to improve the conditions for construction projects such as new developments or refurbishments.

<table>
<tr><th>Key Partners</th><th>Key Activities</th><th>Value Propositions</th><th>Customer Relationships</th><th>Customer Segments</th></tr>
<tr><td rowspan="3">1. Logistics companies (& similar)
2. City authority (in non-commercial projects)
3. Construction Companies
4. Third party companies</td><td>Deliver material to construction site via a logistic center in order to get assembled deliveries</td><td rowspan="3">For the City: Less traffic jam. Less pollution, less noise.
For Construction site: Fewer deliveries, better coordination, less damaged gods, more value adding activities</td><td>One by One Marketing & Publicity
Public Procurement</td><td rowspan="3">Construction sites (and the companies managing and executing construction projects)</td></tr>
<tr><td>Key Resources</td><td>Channels</td></tr>
<tr><td>Trucks, forklifts
Storage terminal
Human Resources
Location
Software & Hardware</td><td>Trucks</td></tr>
<tr><th colspan="2">Cost Structure</th><th colspan="3">Revenue Streams</th></tr>
<tr><td colspan="2">Fixed Costs:
Trucks and forklifts
Salaries & Labor costs
Location (now free)
Storage
Hardware & Software</td><td colspan="3">1. Fee charge to construction site
2. Fee charge to subcontractor on construction site</td></tr>
</table>

By planning the material flow and steering inbound deliveries to the CCC, it is possible to increase the efficiency of the building process. Possible savings are measured in reduced time, as well as damage to material during deliveries and handling, and waste. This can contribute to a major reduction in the environmental impact of a construction project.

Customer segments

Since there is the necessity to offer a platform to plan and in a simpler and more efficient way the transportation of the project's materials to the construction sites, the construction and transportation companies could represent the most important customer segment and the more direct type of the customer, understanding that the final customer could be either a third-party company, a private customer or a public administration.

Value propositions

The value proposition tries to satisfy the transportation needs of the customers and optimize the number of material deliveries to construction/refurbishment sites. This is the most important value proposition, reduce the total number of deliveries and also, by depending only form one source for the construction material, optimize truck loads helping to meet the goal of less deliveries. In consequence, a value proposition appears in a form of a positive externality which is to reduce the contaminant emissions generated by, for instance, truck trips or for having separate providers with contaminant facilities.

Channels

We could consider different channels according to the different phases of the project. At first, when a certain project is under ideation stages and planning works, the managing companies of the project has to receive awareness that there is a solution which could help to optimize its operations by relying to a construction logistics center. In this sense, a communication strategy, via public fairs, construction and transportation fairs, advertisements, through partner channels, or other type of channels, the service should be known among the construction sector.

When a construction company uses the logistics center, when a truck leaves the facilities, it would be convenient for the client to track in real time where the truck is. In terms of the delivery service, when a company needs construction material or equipment, contacts directly to the consolidated center, and this one manages to send the material or equipment in an efficiency way that it can reduce the number of deliveries.

Customer relationships

Probably a dedicated personal assistance for each client, would not be necessary, since many companies can use the center, however, for the biggest projects, it could be convenient to dedicate full-time staff to particular customers or particular projects. That being said, customer relationships when it comes to tracking the deliveries, could be based on automated services through, for instance, a mobile application.

Revenue streams

For the customer, using the logistic facilities, the revenues come from the savings generated by the reduction in time of the transportation activity. Thanks to this, consequently, the waiting times, can be reduced if not eliminated. Other savings come from the reduction in energy costs and time of workers waiting, energy consumption and stolen material in the construction site, because the fact of not having to stock materials in the construction sites, and leaving it in the hands of the logistics center, erases the potential losses due to theft or deterioration of the material. Following we present some figures regarding the savings generated.

Revenues to the logistics center are thought to come from construction companies and other customers using this solution by paying a fee for use.

- It is estimated a reduction of number of deliveries by 40-60%
- It will reduce environmental impact due to a reduction of deliveries and the use of Biofuels or electric vehicles for the transportation of the materials.
- It will improve the efficiency of the building process.

There are two kinds of incomes:

The savings guaranteed by the efficient distribution of the materials can be payed to the Construction Consolidation Center.

A high demand of transport of materials to construction sites can allow to the CCC to buy the materials at a large scale and have unitary cost of the materials cheaper thanks to the scales economies. Part of these savings in the unitary cost can be another income for the CCC.

Key resources

The assets required in this solution are:

1. Land to settle the Construction Consolidation Center (CCC) (logistics center from construction material et al.)
2. Electric or biofuels vehicles to transport the material from the CCC to the Construction site, or trucks.
3. Basic software to manage the demands and deliveries of materials and optimize operations.

Key activities

Achieve agreements with customers.
If the CCC plans to use only environmental friendly transportation vehicles, in turn, a key activity of having support from the local authorities, not allowing the transit of non-biofuels or electric vehicles inside the city, can help to develop the measure in an easier way from the legal and competency point of view.

Key partnerships

(1) Construction companies
(2) Transport companies
(3) Public Administration

Cost structure

The cost structure includes:

- Material, passive measures
- Equipment, active measures
- Vehicles
- Construction
- Maintenance

Solution 3: Smart energy-saving tenants

Tenants' behavior influences the energy consumption in buildings up to 10 % through e.g. their use of electricity gadgets, hot water or opening windows in cold conditions. Behavior can furthermore help to even out peak loads. The way to influence tenants is relatively cheap and the business case is hence good. In many countries, the energy cost is not included in the rent so there is a strong incentive for the tenants themselves to reduce their energy bill, thus making the business case to provide accurate energy information stronger. As residential buildings grow more energy efficient, the role of the tenants will be even greater regarding energy savings, as they may affect a bigger share of the total energy use.

By deploying sensors in buildings, it is possible to bring information on real-time energy use to the tenants who in turn can monitor the energy consumption and find ways to reduce it. Home Energy Management Systems will be installed in all three Light House cities, visualizing and manage energy consumption. New solutions will be used to automatically steer household appliances, minimizing energy consumption and avoid wasting energy. To further motivate the tenants, dynamic pricing will be tested, raising the price of electricity at peak times and lowering it when the demand is lower.

GrowSmarter will also introduce measurement of the amount of waste each household throws away. By billing according to the waste sorting rate, it is possible to encourage increased rate of recycling and hence save energy.

Conclusions regarding the Business Models related to solution 3

The main purpose of this smart solution is to provide on real-time information about energy usage, in terms of energy consumption and tenants' consumption behavior (how consumption levels are distributed during a period. Knowing this information the consumer should condition its consumption behavior accordingly, reducing it if possible and therefore increasing the efficiency levels in terms of energy consumption. It can be concluded that smart solution 3, of the Grow Smarter project, complements previous smart solutions of the Work Package 3, regarding the implementation of active and passive energy efficiency measures. We understand that the implementation of home energy management systems serve for analyze the benefits of those previous implementations. As happens in other topics, the interpretation of the results are nearly as important than obtaining them, this solution brings to the customers, an opportunity to read the data obtained and interpret it acting in consequence.

An energy saving center, to being operate does not require an important financial effort compared to other solutions incorporated in this document. However, since it functions as a complementary solution for other type of actuations, it can be incorporated within business models with bigger costs structures. Regarding the inherent costs of the solution, its high added value, demands, as a key resource, of high qualified personnel, not only to develop the energy management systems and platforms but also, if needed, to analyze the collected data for making decisions for future actions.

Barcelona. Home Energy Management System

Industrial Partner: Gas Natural Fenosa. **Measure: 3.1.3**

<table>
<tr><th>Key Partners</th><th>Key Activities</th><th>Value Propositions</th><th>Customer Relationships</th><th>Customer Segments</th></tr>
<tr><td rowspan="4">1. Departments of the company itself: marketing, residential, IT, innovation, administration, legal and security
2. Fabricant
3. Installer
4. External consultancy, especially for IoT market and innovation, telecommunication, big data
5. Customer itself</td><td>1. Choice of the fabricant of the HEMS equipment
2. Definition of contract and conditions for the development of new functionalities, for the use and property of the data, for the image rights and logo
3. Development of an engaging visualization of the information
5. Advanced technological and telecommunication development
6. Data analysis and processing
7. Track the behavioral changes and inform the customer about them.
8. Communication oriented to customer engagement</td><td>Empowering sensation for the customer as regard energy consumption:
• they can visualize their behavioral patterns,
• they can control and schedule the use of some equipment,
• they are informed about their inefficient behavior
• they receive personalized advice and can decide to change their behavior in order to reduce energy expenses
• they can act to have a better thermal comfort at home
The customer feels cared for by who gives the service and acquires/maintain confidence, solving the tendency/desire to change continuously for better services.</td><td>One by One Marketing & Publicity</td><td rowspan="4">Residential customers with a minimum technological background (mainly owners)</td></tr>
<tr><th>Key Resources</th><th colspan="2">Channels</th></tr>
<tr><td>1. Funds to invest
2. Human resources for marketing, visualization, IT, data analysis and processing
3. Dialogue with the business orientation of residential department of the company
4. Monitoring platform for big data storage and analysis</td><td colspan="2">- Direct sales to existing customer (offering of the additional service)
- Advertising campaign door to door
- Advertising campaign via TV, radio, letter box, mailbox
- Advertising campaign via website</td></tr>
<tr><th colspan="2">Cost Structure</th><th colspan="3">Revenue Streams</th></tr>
<tr><td colspan="2">- Consultancy on IoT market and innovation, telecommunication, big data
- Purchase of equipment
- Redesign of equipment, if necessary
- Visualization development
- IT development
- Data analysis and processing
- Legal aspects
- Installation and customer care
- Maintenance of the monitoring platform</td><td colspan="3">1. Monthly payment by the customer, included in the contract of energy supply
2. Selling of other services: data of the client allows to identify personalized services, with a higher possibility to conclude the sale; furthermore, customer's loyalty is an added help.
3. Selling of other products: data of the client allows to identify personalized products, with a higher possibility to conclude the sale; furthermore, customer's loyalty is an added help.
4. Growth of customers, due to the good feedback of the loyal customers</td></tr>
</table>

This solution aims to install a home energy management system in some residential buildings considered in refurbishment projects of residential buildings, specifically listed in smart solution 1 among other residential buildings regarding solutions about Smart Energy and Self-sufficient blocks.

Customer Segments

Home Energy Management Systems are addressed to be installed in residences to provide a managing system to control their energy consumptions and patterns. For this reason, since the measure is addressed to particular users and their residences, it is not addressed to a mass market and is not designed to be installed in tertiary purposed buildings or any other facilities.

Value Propositions

The most important value proposition of this solution is to improve the quality of life of the residents living in the buildings. This improvement in the quality of life should be ensured by remotely controlling the monitored systems of the dwellings thus the residents could have the possibility to adapt the dwelling's conditions, (in terms of internal temperature) to their own comfort standards. Empower the consumer in a sense of giving him a tool to control its consumptions more precisely. With the implementation of a Home Energy Management System, now the user can visualize their behavioral patterns, control and schedule the use of some equipment, be informed about their inefficient behavior, receive personalized advice and decide whether or not change it in order to reduce energy expenses.

Since this is a management system of the energy, this implies that any change in consumptions can be detected. In this regard, if an excess of energy consumption appears, automatically, can be neutralized by optimizing it. If the measure is proven to be financially sustainable, it could serve as a useful tool for promoting sustainable economic development and raising awareness among other residential building ownerships.

Customer Relationships

Individualized care to attention and care to each customer, since the product is sold individually for each customer (one by one relationship).

Channels

It is important to reach awareness among the main customer segment (residential buildings) in order to promote the measure in a greater scale. The channels used by the energy company are based in advertise the measure via TV, radio, letter box and mailbox; and via corporate website and other sites on the internet. An own and direct

channel of the energy company, is the door to door channel, offering the service to existing customers as an additional one.

Revenue Streams

The most important revenue stream is based in a monthly payment by the customer (included in the contract of energy supply). Other revenues could come from using the data obtained by the measurement system (HEMS) by helping to offer other products adjusted to a specific customer (based on the data). Or anonymous data used to design products or services for other markets or customers (regulation about the usage of data could determine the potential of this source of revenues). Thanks to the scalability of the measure, and its easy replicability it is expected a growth of customers due to the good feedback of the loyal customers.

Key Activities

Key activities for this solution are the ones absolutely mandatory for delivering the service of a HEMS system to customers in a satisfactory way. For the HEMS system to work properly, the activity of collecting and provision dwelling's energy data is fundamental in this solution. Other important activities are the ones involving the installation of the solution, achieving agreements with each individual neighbors, inform about the solution, collaborating with other industrial partners or public institutions, stablishing contracts for sharing anonymous data if the regulation allows it, or building big data bases for improving the solution and designing other smart solutions, and previously of the implementation of the system, to ensure the resources to develop the technology needed by the HEMS system (hardware and software). Other key activities are listed in the Canvas model of the solution.

Key Resources

As with other business models, key resources can be divided in different category according to its typology. If we consider the financial resources, these are not of the same importance of the intellectual or human resources, however, in previous stages, before implementing the HEMS, it is required to invest in research and development of the technology required for the HEMS to become a reality. In terms of technology, it is necessary a software to storage the data and visualize consumptions. Important key resources are those included within the human capital category, for example human teams installing and monitoring the data, which is important form the point of view of the ESCo Company. Also people from the marketing division of the company, visualization, IT and data analysts, and finally other internal specialists. In terms of technology

Key Partners

The key partners are the residents of the dwellings where the HEMS systems are going to be implemented and the energy company selling the service; in particular, the different departments of the ESCo company such as marketing, residential, IT, innovation, administration legal and security departments. Other key partners can be the public administrations (as it is the case of Barcelona), the manufacturers of the equipment, installers, external advisors and consulters (especially for IoT market and innovation, telecommunications and big data).

Costs Structure

The installation of a HEMS system does not require a huge amount of financial resources and does not require specific pre-conditions before implementing it. In this regard the main costs for implementing the measure satisfactorily in many places depend on the marketing campaigns and the level of awareness among potential customers regarding energy efficiency systems and residential properties. The costs structure can be listed as follows; the costs of developing the technology, consultancy on IoT market, about innovation, telecommunications and big data; costs of purchasing the equipment and/or redesigning it if necessary; costs from visualization development, data analysis and processing costs, expenditures from legal partners, and maintenance of the monitoring platform.

Barcelona. Virtual Energy Advisor

Industrial partners in Barcelona: IREC, Barcelona Municipality (PPP)
Measure: 3.1.3
The Virtual Energy Advisor aims to reduce household electricity consumption by a minimum of 10% by influencing consumers' behavior showing electricity consumption data obtained from smart meters and giving tips to reduce it.

<table>
<tr><th>Key Partners</th><th>Key Activities</th><th>Value Propositions</th><th>Customer Relationships</th><th>Customer Segments</th></tr>
<tr><td rowspan="4">(1) Barcelona Energy Agency (promoter of the business)
(2) Software developer (platform, mobile app)
(2) Hardware manufacturer (smart meters)
(3) Electricity DSO</td><td>(1) Development of the software to provide information on efficiency in electricity consumption in the residential sector to encourage behavioral changes among citizens
(2) Installation of smart meter
(3) Platform upgrading</td><td rowspan="4">To offer more information on the electricity consumption patterns to the citizens and give advice on strategies to save electricity in the household (aim: 10% electricity savings on average)</td><td>(1) Information on energy consumption and advices about energy efficiency through the web platform and mobile app
(2) Information exchange with other members through the Community forum
(3) Communications with the platform operator
(4) Communications with Public administrations. Workshops in every district
(5) Information campaigns on the media</td><td rowspan="4">Private sector: citizens of Barcelona</td></tr>
<tr><th>Key Resources</th><th>Channels</th></tr>
<tr><td>(1) Personnel from Barcelona Energy Agency and IREC
(2) Financial resources of Barcelona Municipality (annual budget)
(3) Smart meter (optional)
(4) Smartphone, tablet or PC from user's side to access the platform</td><td>(1) Sales channels: media, press, Municipality homepage, e-mail
(2) Service channels: Web platform, Mobile App, calls, e-mail</td></tr>
<tr><th colspan="2">Cost Structure</th><th colspan="3">Revenue Streams</th></tr>
<tr><td colspan="2">(1) Software related costs: development of the platform
(2) Hardware related costs: smart meters
(3) Maintenance costs: smart meter maintenance, platform maintenance</td><td colspan="3">(1) Non-monetary revenue: Data on Electricity consumption by the residential sector of the city as a revenue for the public administration
(2) The use of the platform should lead to a reduction in the household electricity consumption (this is not a revenue for the Barcelona Municipality but for the customer/citizen)</td></tr>
</table>

Customer segments

This measure can be implemented in many places since it only consists in a user-friendly virtual energy advisor. However, since it uses the data collected by smart meters, this measure has to be addressed to those customers with this type of infrastructure installed in the building. The customers having smart meters thus, the data needed to implement a virtual energy advisor for displaying in a straightforward way, are the most important potential ones. In general, the measure could be attractive for any customer with inquietudes regarding a better environment and a sustainability. The measure could be linked with other measures, wading the sample of potential customers, taking into account a project involving different measures of the Grow Smarter project. In this manner, this measure can be linked with the platform "Resource Advisor"; measure 4.2 Energy providers can be potential customers, if this is the case, the model would change from a business to customer to a business to business approach, where the energy provider becomes the company finally selling the product to the final customer (tenants and residents in general).

As happens with the case of IREC at Barcelona, the measure is really attractive for the municipal authorities, funding the project for helping, not only to be a reality but also to bring this solution to the final customers, since the positive externalities are attractive from the governance and social/economic point of view. For this reason, this case could be considered a Public-Private partnership.

Value propositions

The value proposition of the platform is offering more information about the inefficiency encouraging behavioral change amongst tenants. The information is obtained using an intelligent back-end based on algorithms that use data from smart meters and it is presented using user-friendly front-end which can be viewed from a number of devices.

The expected impact on user behavior is mainly related to the following topics: active reduction of electricity consumption during the night, purchase of devices with high energy efficiency label, use of LED light bulbs with the aim for 10% electricity savings on average.

Channels

(1) Sales channels: media, press, Municipality homepage, e-mail.
(2) Service channels: Web platform, Mobile App, calls, e-mail.

Customer relationship

The information is provided to tenants in real-time through a Wi-Fi connection on web or via the mobile app available for download on smartphone devices, tablets or PCs. Emphasis is put on the direct interaction between the user and the platform to follow-

up and compare the level of efficiency of the current energy consumptions with previous year ones.

The platform allows to contact exchange expertise with other members of the community, discuss energy-related topics and work towards achieving energy efficiency goals in order to become as energy-efficient as the other tenants with a similar profile. Communications between the Public administration and citizens through workshops in every district.

Revenue streams

Revenues for the citizens: This platform aims to reduce household electricity consumption by a minimum of 10% on a yearly basis by changing consumer's behavior, thus electricity cost reduction is expected for the users. Another revenue is the externalities created for the city, i.e. city energy and emissions reduction due to lower electricity consumption in the residential sector. A non-monetary revenue is the collection of electricity consumption data by the Municipality, which may help in the promotion of new energy policies.

Key resources

Personnel from Barcelona Energy Agency to promote and manage the deployment of the tool. Financial resources of Barcelona Municipality (annual budget). Wi-fi connection at the dwellings.
It is highly recommended to have a smart meter in order to take full advantage of The Virtual Energy Advisor by receiving real-time information. However, tenants may still use the tool with monthly data from their utility bills. Additionally, users need a smartphone, tablet, or PC to access the data and the analysis generated by the platform.

Key activities

A key activity is the development of an intelligent back-end based on algorithms that use data from smart meters that allows informing customer about energy consumption inefficiencies and encouraging behavioral change amongst tenants.
Installation of smart meter and Platform development and upgrading.

Key partnerships

The platform hosts a community of users who exchange expertise, discuss energy-related topics and work towards achieving energy efficiency goals in order to become as energy-efficient as the other tenants with a similar profile. It is important to gather a big number of users in order to receive as many inputs as possible.

The key partners, besides users are also the Energy Agency as a promoter of the measure, the subcontracted company that has developed the algorithm (platform), the manufacturing company of the smart meters and the installers.

Cost structure

- Software related costs: development of the platform requires a team of programmers and energy experts to analyze the most adequate indicators.
- Hardware related costs: smart meters.
- Maintenance costs: smart meter maintenance, platform maintenance.

Cologne. Home Energy Management System

Measure: 3.1
Industrial Partners: Rhein Energie
Short description: Implementation of a Home Energy Management system with the purpose of monitoring and visualizing the consumption behavior of different departments, optimize said consumptions and achieve lower energy costs.

A number of apartments in Cologne will receive SmartHome equipment which enables them to save electricity and warm water required by radiators. Via smartphone, tablet or PC, consumers will be able to track their energy consumption of the chosen connected devices, allowing them to remotely turn off all electrical appliances and lights at any time. Furthermore, the data acquired could be available to both the public administration, the private sector. Due to data protection, data from the smart home systems will only be available for tenants and residents, in Cologne's project.

<table>
<tr><th>Key Partners</th><th>Key Activities</th><th>Value Propositions</th><th>Customer Relationships</th><th>Customer Segments</th></tr>
<tr><td rowspan="3">1. Cologne's city council
2 Private Partners in Cologne: AGT International & RheinEnergie
2. Companies that might want to create new businesses that depend on the data generated
3. Third party technical companies</td><td>Installing smart-plugs, acquiring and managing data from household energy consumption.</td><td rowspan="3">1. Reduce the energy consumption costs, Become more energy efficient
2. New business opportunities and business models (data)
3. Reduce greenhouse emissions at the city level
4. Understand more in depth household consumption patterns by having access to data</td><td>1. Advertisement
2. Recommendations from utilities companies
3. Recommendations of City Council, or other government authorities</td><td rowspan="3">• Private sector
• Utilities
• Public administration
• Households</td></tr>
<tr><td>Key Resources</td><td>Channels</td></tr>
<tr><td>1. Infrastructure (Smart plugs, Internet, Energy Infrastructure)
2. Technology/apps
3. IT knowledge
4. Human resources (Technical/Customer/General Operations staff, R&D)</td><td>1. SmartHome app and website
2. Website</td></tr>
<tr><td colspan="2">Cost Structure</td><td colspan="3">Revenue Streams</td></tr>
<tr><td colspan="2">1. Hardware related costs: smart plugs
2. Software related costs: maintenance of app, technological infrastructure related products, and maintenance of data.
3. Personnel related costs: customer support, maintenance and R&D</td><td colspan="3">Energy companies will be able to better understand households' consumption patterns. Indeed, public and private decision-makers can reduce the risks associated with their operational or strategic decisions.</td></tr>
</table>

Customer segments

If the regulation allows it (in terms of data protection), the public administration and the private sectors would be potential customers. However, it is not the case for Cologne:

- Public administration (not applicable for this case:
    - **a.** The data on energy consumption will be given to the City of Cologne's Open Data-Platform, and thus allow public administration to forecast energy consumption and understand better household consumption patterns.
- Private sector:
    - **a.** Enhancing strategy by analyzing more and better data
    - **b.** Improving operational analysis by using more and better data
    - **c.** New business models using new available data

In a real scenario:

Households, the main customer segment are the citizens who want to optimize their utilities' consumption.

Value propositions

For households:

1. Reduce their energy consumption costs
2. Become more energy efficient
3. Give them a tool to understand their energy consumption patterns and be able to turn on and off their home lights and appliances.

For private sector (regulation do no permit this in Cologne's case, but should be included in a generic Business model when it comes to implement similar solutions in different regulation environments):

1. Access to data that could give access to new business opportunities and business models.

For public administration and city at large:

1. Reduce greenhouse emissions at the city level (independently of the laws, this is a positive externality.
2. Understand more in depth household consumption patterns by having access to data (regulation do no permit this in Cologne's case due to data protection laws)

Channels

1. SmartHome app and website
2. Website

Customer relationship

The platform allows for different ways of communicating with customers – they provide directly a customer service platform, both via internet and call-centers, as well as allow for direct contact with the company via social networks.

Revenue streams

No usage fee is charged for the use of the app for customers. However, energy companies will be able to better understand households' consumption patterns, and thus will allow for a more efficient supply of energy in urban areas, reducing costs. Indeed, due to more informed decisions, public and private decision-makers can reduce the risks associated with their operational or strategic decisions.

Key resources

1. Infrastructure:
    a. Smart plugs (i.e. SmartMeter)
    b. Internet
    c. Energy Infrastructure
2. Technology/apps (SmartHome app)
3. IT knowledge
4. Human resources:
    a. Technical support staff
    b. Customer service staff
    c. General operations staff

Key activities

Installing smart-plugs, acquiring and managing data from household energy consumption, and technological support in case of problems both in SmartHome app and physical installation /repairing of smart meters. Transferring and managing the city data from the SmartHome app to the City of Cologne's Open Data Platform.

Key partnerships

Energy provider: Partnering with the software company that is providing the smart home app for Rheinenergie.
Also important the (relation) partnership with residents/tenants/owners where this solution is going to be implemented.

Cost structure

1. Hardware related costs: smart plugs
2. Software related costs: maintenance of app, technological infrastructure related products, and maintenance of data.
3. Personnel related costs: customer support, maintenance and R&D

Stockholm. The Active House project in Stockholm

Measure: 3.1.1
Main ndustrial Partner: Fortum
Implementation of active housing measures to improve the efficiency levels in terms in energy and achieve a decrease in energy costs in Årsta, Stockholm. Also, the solution on an adaptive control system has been implemented in Valla Torg.

<table>
<tr><th>Key Partners</th><th>Key Activities</th><th>Value Propositions</th><th>Customer Relationships</th><th>Customer Segments</th></tr>
<tr><td rowspan="3">Tingcore (Fortum): product development and technical delivery partner
Bravida: Technical commissioning and on-site support
Property owner: including the subcontractors</td><td>Development, sales, installation, commissioning, support and maintenance of Active House solution</td><td rowspan="3">For tenants: increase awareness, reducing energy consumption, convenience and simplifying the life
For property owner: increase marketing and sales value, fulfill environmental requirements
For society: positive environmental effects</td><td>B2B: Through large property owners
B2C: direct sales to villa/apartment owners</td><td rowspan="3">Construction companies, property owners/developers and villa/apartment owners</td></tr>
<tr><td>Key Resources</td><td>Channels</td></tr>
<tr><td>Technical components
Human resources
Software</td><td>B2B2C</td></tr>
<tr><th colspan="2">Cost Structure</th><th colspan="3">Revenue Streams</th></tr>
<tr><td colspan="2">Hardware and software costs
Salaries
Support and maintenance cost</td><td colspan="3">Platform price plus monthly service fee (not valid for Grow Smarter project)</td></tr>
</table>

Key Activities

This project requires a previous stage of studying the area and determining how this measure should be implemented on each building. This phase is defined by a technical report signaling, as its name indicates, any technical detail that has to be mentioned in

a project like this. It is important to highlight that the buildings where these measures are going to be installed, differ from one to another. There are buildings form different years, there are different types of buildings, thus different type of materials as well. This require a previous measurement to find out how the buildings are reacting to changes in temperature.

Regarding the implementation phase, in our case, Fortum implements its solution in 54 apartments in Årsta. The implementation of Active Housing measures such as install water and electricity meters, sensorize the buildings and deployment of tablets and dimmers, are key activities that take part during that stage of the project, the construction phase. It is crucial to include the connection between the data collecting infrastructure (sensors…) with the energy saving center, where all the measuring activity will take part, and in fact, is ongoing. Finally, other key activities like maintenance or the managing part, are also important.

Customer Segments

This type of active housing measures, can attract any household or building owner / manager, wanting to achieve a major degree in energy efficiency, by implementing a building energy management system to measure and condition the energy consumption behavior of a building. Construction companies or urban developers are an important potential segment of customers.

Value Propositions

There are different value propositions regarding this project. Some of them could be more addressed to the tenants of the buildings where a BEMS system is being deployed. This action, could help to ensure an increase of the awareness levels in terms of energy consumption an environmental sustainability of the residents. At the same time, the value proposition of reducing the energy consumptions is more realistic. Other approach to consider as a value proposition, is the simplification and convenience proposal. To easier the procedures for monitor the consumption levels, simplifying the life of the tenants.
Other value propositions are more addressed to satisfy some necessities of the owners of the properties in terms of increasing the marketing and sales value, and fulfill the environmental regulations and local requirements in this regard.
In a more collective approach, mention the positive externalities that occur when measures like this one, are being implemented. The value proposition of reducing the overall pollution, could be achieved thanks of measures like that.

Key Partners

Fortum, as the main industrial partner (Energy Company); Skanska, in charge of the construction plan; Tingcore as product developer and technical delivery partner (Tingcore merged with Fortum in June 2017); and Bravidia, as a technical commissioner

and on-site support responsible. Also note the importance of the property owner of the building. And finally, the subcontracted companies which participate in any part of the implementation and measuring process.

Customer Relationships

The customer relationships are being established differentiating between those involving Fortum and a large property owners / urban developers / construction companies; and through direct sales to owners of a building.

Channels

The channels used to reach new customers (final users and industrial clients) represent the most efficient way to be connected with said customers. In a project like that, those channels are direct ones. Since Fortum is a well-known company in the Scandinavian countries, also among other industries related with Fortum's market, the channels used, favor business-to-business relationships. Fortum sells this measures to other related industries, for instance, construction companies. Afterwards, a business-to-costumer type of relationship has to occur, because, the final users will be the tenants or the residents of the buildings. In this context, the channels can be defined as a B2B followed by a B2C situations. At the end, there are more asymmetric information between the construction company (convinced via capturing value) and the final user (convinced via marketing), the residents.

Key Resources

To implement a BEMS in a neighborhood, starting in Årsta, requires some financial resources, considered key for such a project. Part of this funds, comes from the GrowSmarter project, other form the industrial partners.
The technical components (sensors, electricity meters…) have to be considered crucial, a key resource for this project. The same applies for the software needed to manage all the data, detecting trends, and take conclusions for improving the consumptions.

Revenue Streams

The industrial partner charges a price for the software platform. In addition, a monthly usage fee is required to utilize the system. So, the revenues structure is divided in two parts, a fixed amount for the platform and a variable amount for the time utilizing it. (This revenue streams are not valid for the Grow Smarter project, since it is a subsidized project).

Cost Structure

The main costs are those generated during the implementation phases and the costs originated during the maintenance of the technical components and also the energy management system. During the implementation, all the equipment and the installation needed supposes a relevant expenditure in terms of monetary costs, but should be considered as an investment (with amortization costs). As mentioned, there are also costs that appear for supporting and maintaining the system. In summary, a project like this require a considerable investment, in the form of fixed costs since it is a capital-intensive project. However, the variable costs are also important, depending on the number of flats and departments finally incorporated in the sample of the project.

Stockholm. Low Energy Districts Solution

Industry partners: Fortum & Info24
Measure: 3.1.1
Short description:
Provide a 'state of the art' graphical user interface that gives households real-time information on electricity, hot water and apartment heating consumption patterns. Moreover, customers can track how much money they are spending and CO_2 they are emitting with their energy consumption, potentially having an effect in their consumption patterns and allowing them to change their behavior.

Among other things, this project will also give the tenants the ability to remotely control the lights, charging of electric and hybrid vehicles, and control of radiator thermostats in the house. It will also give tenants the opportunity to monitor the usefulness of locally produced renewable energy such as solar energy in the house, as the app integrates such sources of energy in the energy information tracker of the house.

<table>
<tr><th>Key Partners</th><th>Key Activities</th><th>Value Propositions</th><th>Customer Relationships</th><th>Customer Segments</th></tr>
<tr><td rowspan="2">1. Local authorities / city managers and administrators
2. Utilities' companies
3. Third party technical companies</td><td>Installing smart-plugs, acquiring and managing data from household energy consumption</td><td rowspan="2">Households: Tracking of energy consumption in the house, to control remotely the lights and thermostats in the house, allow individuals to see and manage when to charge the vehicle
City council: Propelling a behavioural change from households' energy consumption
Private sector: Access to new business opportunities and business models</td><td>1. Advertisement on webpages
2. Recommendations from utilities companies interested in offering better services to their users</td><td rowspan="2">1. Tenants / citizens
2. Private sector
3. Public administration / municipalities</td></tr>
<tr><td>Key Resources
1. Physical assets (Smart Meters, Internet, Energy Services and Apps)
2. Human resources (technical knowledge and expertise)</td><td>Channels
1. Energy consumption tracking app
2. Website of firm (Fortum)</td></tr>
<tr><th colspan="2">Cost Structure</th><th colspan="3">Revenue Streams</th></tr>
<tr><td colspan="2">(1) Fixed costs: a. Servers and physical infrastructure; b. Platform maintenance and data management; c. Salaries
(2) Variable costs: a. Sales and marketing, b. Research and development costs</td><td colspan="3">To charge some cost for the smart meters and sensors and their installation and maintenance. To charge more flexible tariff structures.</td></tr>
</table>

Customer segments

1. Public administration / municipalities that want to improve the efficiency of their infrastructures
2. Tenants / citizens who want to spend less in energy and become more energy-friendly
3. Private sector / with the information acquired from the project, businesses can get more in depth knowledge of consumption patterns from households.

Value propositions

Households:

1. Tracking of energy consumption in the house, giving tenants information about how costly it is for them to consume energy at a specific moment in time, as well

as how much greenhouse gasses the household would emit by consuming energy.

2. The app also allows individuals to control remotely the lights and thermostats in the house, making it easier for them to cut their consumption if they considered to do so.
3. In terms of electric vehicle charging, which is becoming more and more important every day, the app will allow individuals to see and manage when to charge the vehicle. In this way, households will be able to charge their vehicles when energy is the cheapest, having an effect in the energy bill that they will have to pay.

City council:

1. Propelling a behavioural change from households' energy consumption will contribute to the city's development in energy efficiency.

Private sector:

1. Better understanding of households' consumption patterns can give access to new business opportunities and business models, as well as allow to reduce the risks associated with operational and strategic business decisions. Moreover, more information can propel more efficient energy supply systems, and thus reducing the costs and increasing profits of utility companies.

Channels

1. Energy consumption tracking app
2. Corporate website (Fortum)

Customer relationship

The new energy services and apps offer the opportunity to have a more direct consumer-oriented business model and redefine the utility/customer relationship with a closer relationship between utility companies and their customers.

Revenue streams

Smart meters and the integration and optimization of the infrastructure of different utilities offers several opportunities to create new revenue streams. First, they can charge some cost for the smart meters and sensors and their installation and maintenance. It can either be a one-time sale or through a renting/leasing scheme that will allow customers to use the smart meters (which will in turn allow customers to reduce their energy consumption and cost). Second, the new integrated infrastructure and more accurate information on energy consumption will allow utilities to charge more flexible tariff structures. In this sense, the benefits in terms of energy efficiency and climate change mitigation thanks to a better integration of energy demand and

energy generation can bring important efficiencies to municipalities, tenants and the society as a whole.

Moreover, as mentioned previously, energy companies will be able to better understand households' consumption patterns, and thus will allow for a more efficient supply of energy in urban areas, reducing costs. Indeed, due to more informed decisions, public and private decision-makers can reduce the risks associated with their operational or strategic decisions.

Key resources

1. Physical assets, including technological infrastructure and software
    a. Smart Meters (electrical, gas, water, heating, cooling)
    b. Internet
    c. Energy Services and Apps
2. Human resources (technical knowledge and expertise):
    a. Technical support staff
    b. Customer service staff
    c. General operations staff
    d. R&D, data-analysis and technology research team

Key activities

Installing smart-plugs, acquiring and managing data from household energy consumption, and technological support in case of problems both in SmartHome app and physical installation /repairing of smart meters.

Key partnerships

1. Local authorities / city managers and administrators
2. Utilities' companies
3. Third party technical companies

Cost structure

(1) Fixed costs:
    a. Hardware related costs: servers and physical infrastructure maintenance
    b. Software related costs: platform maintenance and data management
    c. Personnel related costs: salaries
(2) Variable costs:
    a. Sales and marketing
    b. Research and development costs

Stockholm. Hubgrade - Energy Saving Centre

Industrial partners: L&T
Measure: 3.1.1
The Hubgrade software complements the Energy Quality Assurance measure.
Short description:
Hubgrade combines a number of energy-saving measures:

- Adaptive Temperature control system
- Water saving Equipment
- Adaptive Current Equalization

<table>
<tr><th>Key Partners</th><th>Key Activities</th><th>Value Propositions</th><th>Customer Relationships</th><th>Customer Segments</th></tr>
<tr><td rowspan="4">1. Local authorities / city managers and administrators
2. Utilities' companies
3. Third party technical companies</td><td>Adaptive Temperature control system, water saving Equipment, Adaptive Current Equalization</td><td rowspan="4">• Households: Energy saving, Enables better usage of PV solar investment, Reduces stress on a building's electrical system, Incentivizes a more cost-efficient use of energy
• Utilities: Reduces stress on electrical distribution systems, repair the energy industry for new business models, Encourage a smoother energy consumption pattern
• Public sector: Encourages a more energy-efficient economy, Reduces negative environmental impact</td><td>Customers can contact the provider, L&T, through their website.</td><td rowspan="4">Private sector:
1. Property owners
2. Building managing companies
3. Residential compounds</td></tr>
<tr><td>Key Resources</td><td>Channels</td></tr>
<tr><td rowspan="2">Hardware (Building's control systems, sensors, district Heating Network, ACE, Photovoltaic panels, energy storage
Software (EnergyHub cloud platform)</td><td rowspan="2">Solution provider's website: L&T</td></tr>
<tr></tr>
<tr><th colspan="2">Cost Structure</th><th colspan="3">Revenue Streams</th></tr>
<tr><td colspan="2">(1) Hardware related costs
(2) Software related costs
(3) Personnel related costs</td><td colspan="3">The most efficient outgoing temperature to the heating system generating energy savings, water saving.</td></tr>
</table>

The prime objective of these measures is to reduce energy costs and integrate renewable energy systems efficiently in the energy consumption and production of households. The project is based on three main ideas for reducing energy: putting

forward the right technique, change consumption behavior for the better and ensure the right maintenance over the long-term.

Customer segments

Private sector:

1. Property owners
2. Building managing companies
3. Residential compounds

Value propositions

- **Households**

(1) Energy saving potential is increased from 5% to 35%
(2) Enables better usage of PV solar investment
(3) Reduces stress on a building's electrical system with increased EV charging
(4) Incentivizes a more cost-efficient use of energy, consuming more energy when energy tariffs are lower, and organizing energy consumption in between seasons of the year

- **Utilities**

(1) Reduces stress on electrical distribution systems through local production – storage – load control
(2) Prepare the energy industry for new business models and smart grid support functions
(3) Encourage a smoother energy consumption pattern at the macro-level by making customers consume more in hours where energy is more abundant and demand is lower

- **Public sector**

(1) Encourages a more energy-efficient economy
(2) Reduces negative environmental impact

Channels

L&T's corporate website which is the provider of the solution.

Customer relationship

Customers can contact the provider, L&T, through their website. In case they have any technical problem or a question about the service, they can contact the customer service of L&T.

In terms of maintenance and installation of equipment, workers from the company will go to the respective houses and installations, creating a face-to-face relationship with customers.

Revenue streams

- The Adaptive Temperature control system can avoid unnecessary increases in water temperature due to sudden changes of outdoor temperatures. The system continuously provides the most efficient outgoing temperature to the heating system generating energy savings (from 5% to 15%), reducing moreover environmental impact. The system is managed and controlled through a cloud making it easy to follow the energy saving results.

- Water saving Equipment. Up to 60% water savings on individual taps. Target to save 20-30% of overall water consumption

Those savings should compensate for the initial investment and maintenance cost paid to the managing company, L&T.

Key resources

Hardware:

- Building's control systems connected to the Hubgrade software.
- Indoor temperature sensors
- District Heating Network to collect data
- Water sensors and electrical sensors through automatic meter readings
- ACE (Adaptive Current Equalization -part of the Energy Hub-) function is achieve a more efficient use of the three phase supply.
- Photovoltaic panels
- Energy storage, that can be charged from the grid at night at lower cost if low PV production is expected in order to manage power capacity peaks

Software:

- EnergyHub cloud platform that analyses the collected data. The system combines the building's load profile with electricity prices and the weather forecast to create a basis for efficient system control.
- Moreover, the smart meter and automatic energy analysis work with a self-learning algorithm that ensures that the most optimal use of harvested PV energy for energy storage is put in place.

Key activities

- Adaptive Temperature control system: A normal controlling system uses outdoor temperature to adjust the outgoing water temperature to the heating system. This system constantly monitors the indoor temperature to influence the existing controlling system for heating. Building's own inertia (as using a buildings basic construction, possible insulation and activities inside, to keep indoor temperature at wished level without unnecessary raise of water temperature) can be used in view of including solar radiation, various activities in the property etc.

- Water saving Equipment installed on standard taps: kitchen, sink, and shower.

- Adaptive Current Equalization. EnergyHub is an electrical Hub controlling photovoltaic solar harvest, energy storage and electrical consumption analysis in one system. The EnergyHub consists of modular, distributed power electronics managing energy flow between PV production, energy storage and local consumption/grid export. The smart meter and automatic energy analysis ensure optimal usage of the harvested PV energy with energy storage and self-learning algorithms. The EnergyHub system operates as a PV system during day time, storing excess PV in energy storage for use during the night and winter months.

Key partnerships

1. Local authorities / city managers and administrators
2. Utilities' companies
3. Third party technical companies

Cost structure

d. Hardware related costs:
    i. Sensors, technical equipment, cables, etc.
e. Software related costs:
    i. All the necessary equipment to ensure that the software works properly and there are no bugs in the system that might not allow customers to effectively make use of the service
f. Personnel related costs:
    i. Technical personnel:
    ii. Customer service personnel
    iii. R&D personnel

Solution 4: Smart local electricity management

Europe is increasing its use of renewable electricity but electricity production from sun and wind is intermittent and causes local deficits and surplus that sometimes cannot be balanced as some regional and national grids are not capable of fast distribution at long distances, or there is a lack of fast acting balancing power. Hence demand and supply may need to be balanced locally and combined with storage.

Thinks to consider by each lighthouse city and should be described in this document:

- Regulation related with self-consumption sources of electricity and if it is possible to connect this sources to the grid (taking advantage of energy surpluses).
- If there are significant interruptions in the production of energy using these sources of energy, how can affect the viability of the solution. (For example in deficit of sun hours in the winter of Stockholm.

Conclusions regarding the Business Models related to solution 4

This solution gains its importance when ensuring the maximization of profits generated by the refurbishment projects of the smart solution 1, and the implementation of energy management systems of the smart solution 3. The effectiveness of the smart solution 4 will depend on each refurbishment project, or the environment and conditions of the building where the solution is going to be implemented. For those buildings with extreme climatology (lower minimum temperature levels like Stockholm) where a smart local electricity management system is installed, the benefits of managing in a more efficient way, the optimization in consumptions, could represent a major proportion than cities where weather conditions are not that extreme (for example Barcelona).

There are different regulations depending on the country, affecting the viability of the project in some cases. In some countries, feeding the greed with the excess of electricity generated by self-consumption installations, typically photovoltaic solar panels, is not allowed yet. In said countries, regulation takes into account these other sources of energy, and making possible the apparition of new smart solutions like smart local electricity management systems. With a more favorable regulation, these type of solutions do not require of public funding, since the savings generated should be enough to compensate the investment in a relatively short period of time. For this reason, with favorable regulations, public funding or intervention might not be needed.

Something deserved to be noted here is that the proliferation of self-consumption energy power plants require other technologies to appear in order to manage this type of energy sources. Some of the proposals of this document, serve as a solution on this regard, for instance, a software developed by Schneider Electric, implemented in Barcelona; or L&T, implementing other solution for the case of Stockholm. RheinEnergie is also implementing similar proposals in the city of Cologne. Finally, considering the importance of having a better environment by reducing the pollution, sustainable production of energy will become a trend, inevitably, in a medium or long term being able to solve the energetic deficit of the cities. If these hypothetical trend demonstrates

to be constant in time, the generation of high added value jobs (research and development of newer and more efficient technologies) and construction might also be noticeable.

Barcelona. Smart energy and self-sufficient block

Measure: 4.2.1
Industrial Partner: Gas Natural Fenosa

<table>
<tr><th>Key Partners</th><th>Key Activities</th><th>Value Propositions</th><th>Customer Relationships</th><th>Customer Segments</th></tr>
<tr><td rowspan="3">- Manufacturers
- Engineers
- Constructors
- Installers
- Departments of the company itself
- Community social workers
- President of the neighbor community
- The neighbor community
- Investors
- Public administration (urban landscape department and responsible for subsidies).
- Public administration, in the case of public private partnership (PPP).</td><td>Public administrations should promote the use of renewable energy and self-generation of it to feed the grid. Other key activities are the technic reports before implementing the measures, organization of meetings with all the parts, construction, monitoring and maintenance.</td><td rowspan="3">Optimization of the energy consumption levels of the buildings, increase their efficiency and the value of the property. Also, to reach a self-sufficiency ratios at a city level. Summarizing, to improve the quality of life of the citizens.</td><td>Relationship between energy provider (acting as a single interlocutor with all the parts) Important also the relationships with public institutions</td><td rowspan="3">Neighbor communities (BTC) or Contractors (BTB) or Public administration (PPP)</td></tr>
<tr><td>Key Resources</td><td>Channels</td></tr>
<tr><td>Funds to invest; Community manager; Administration manager for bureaucracy management; other human resources Technology; Monitoring platform for customers</td><td>- With neighbor communities: Various advertising campaigns (TV, social media, website among others).
- With companies: Direct sales.
- With public administration: Direct sales.</td></tr>
<tr><th colspan="2">Cost Structure</th><th colspan="3">Revenue Streams</th></tr>
<tr><td colspan="2">Fixed costs (Negotiation of contracts, project development, legalization process, construction, commissioning, salaries, technological infrastructure, participatory process with the community, monitoring and analysis, maintenance). Variable costs (marketing, incidents and delays, energy cost if supplied, lack of human resources)</td><td colspan="3">Saving coming from the optimization on consumptions. And from the energy company point of view, revenues coming from the maintenance services and also for offering the service based on future savings.</td></tr>
</table>

Customer Segments

In Barcelona, the solution is being implemented in both, tertiary and residential buildings. Some sub-measures differentiate between the uses of each building, for instance, on residential buildings, photovoltaic power plants with energy storage will be installed in order to supply community residential consumption. However, finally, this particular sub-measure is being implemented virtually since the present conditions, in terms of production of electricity for self-consumption and in terms of feeding the greed with said energy, do not permit to deliver the solution in a more practical way. That being said, this solution is addressed to any block with energy-efficiency necessities and owned or managed by people willing to achieve better sustainable levels and lower consumptions if possible. The role of public administrations has to be considered, helping to implement the solution on private buildings or implementing it on public owned buildings.

Value Propositions.

For the residents and the neighbor communities, the value proposition of improving their quality of life. Furthermore, the relative easy replicability of the solution, could extent this value proposition to other resident or tertiary blocks. Other value proposition to highlight is to increase the energy independence of these communities by implementing renewable sources of it. These should also help to improve the sustainability levels of the buildings and also, electricity utility bills are lowered due to the self-consumption of electricity, the energy arbitrage and the minimization of peaks. From the point of view of the contractor/investor, it can be predicted an increase of the building's energy efficiency labels, hence a major property value. From the technical point of view, a value proposition consisting in delivering an integrated solution of renewable generation including equipment, installation and maintenance procurement, easing other value propositions to become a reality. Finally for public administrations, to help them to reach their self-sufficiency ratios at city level.

Customer Relationships

Relationships with neighbor communities: neighbors meetings and via the Building Administration.
For contractor: One by one, specialized attention according to each implementation of the measure, the same for public administrations.

Channels

The in which the solution going to be delivered, note that the production and consumption systems installed in the buildings will be managed "virtually" in order to analyze possible scenarios for electric grid at island level, particularly in cases of complementary consumption profiles.

To reach awareness among potential customers, different channels are being contemplated by the industrial partner. For the neighbor communities, advertising campaigns (TV, social media, website among others), are the option to stablish a channel with these potential customers. For other industries or companies (contractors), also potential customers of the service, direct and own channels are the primary channel option according to the energy company. The same happens with public administrations.

Revenue Streams

The revenue streams, from the point of view of the energy supplier, are based on those external resources (coming from the Grow Smarter project and European institutions, public administrations) and those revenues coming from the contractual agreement between the parts, the energy company and the energy demander. A brokerage fee on the savings due to building's energy optimization, is contemplated. In addition, revenues may also come from the contract of maintenance between parts. From the point of view of the final customer, some revenues should appear (justifying the smart solution in terms of sustainability and positive externalities) supposing in some way, a revenue stream if renewable sources of energy are installed. Those saving should be present during accordingly to the lifetime of said installation.

Key Activities

A participatory process within the neighbor community (and tertiary building's ownership) to involve all parts into the decision-making process. This participatory process has to include private investors (energy companies) and also public administrations when it is necessary.

Other key activities are the design and installation works, to define the size of the project and the implementation methodology, always considering the consumption data; and the tendering processes regarding the equipment providers and the installation company. The work supervision, taking into account health and safety issues and also the detailed engineering activities, are fundamental ones, mandatory to be included in here. At the same category of importance we should include the activities related with the planning, commissioning, managing, maintenance and control of the consumption levels.

Key Resources

Previous resources (before implementing the solution) are the existence of blocks with minimal requirement for photovoltaic installation in terms of surface availability, good orientation towards the sun cycle or high electric consumption for common zones, and also the existence of urban islands, more specifically, sets of annexed blocks with

complementary consumption profiles (for the application of the "smart-grid" solution and because the supply-demand reason.
That being said, the key resources, as other cases, can be divided between financial, physical, human and intellectual. Starting with the first one, the paper of the industrial partners and public administrations are crucial when it comes to ensure these type of resources, even more important since the implementation of some of the sub-measures require to fund the purchase of expensive assets and technological equipment for instance. Not to mention the importance of the whole investment, counting salaries and other aspects of the cost structure. Physical resources, are already been mentioned, giving importance to the equipment required. Finally human and intellectual resources, not only to install the equipment but also to research and investigate the solutions during previous stages. In this regard, some examples are the administration manager for bureaucracy management, and the technic works for reporting the adequate procedures for implementing the solution. Referring to intellectual resources, we have to mention the licenses utilized and technologies developed, very important when applying a monitoring platform for customers, to permit them to analyze their behaviors and to achieve their loyalty in a sense of a seller-customer relationship.

Key partners

The partners involved with the implementation of the solution are numerous since there are many buildings subject of said implementation. Each of the ownerships are a fundamental part for this solution to be executed. For this reason, owners of the dwellings, and the overall properties of the residential buildings, have to be included when listing the key partners. The same can be applied on the ownership of the tertiary buildings, key partners as well. The promoter of the solution, the energy company delivering the service, is the other half of the story regarding fundamental partners. In between, also considered key partners, are those other parties involved in some way with the implementation, manufacturing of the technologies, developing them, installing or managing. With this regard, manufacturers and third-party companies (for example providers or transporters) are also included in the list. Finally, do not underestimate the role of public administrations and public companies, developing an important paper, not only to fund (if it is the case) but also to ensure a channel between the private industries and final customers, sometimes being part of them.

Costs structure

Fixed costs (Negotiation of contracts, project development, legalization process, construction, commissioning, salaries, technological infrastructure, participatory process with the community, monitoring and analysis, maintenance).
Variable costs (marketing, incidentals and delays, change of lack of human resources, energy cost, if supplied).

Barcelona. A Management and Control Software: A visualisation platform to assess the impact of energy retrofitting measures

Measure: 4.2.1
Industrial Partner: Schneider Electric
This project comprehends only one measure, consisting in a software for data visualization for a BEM system to minimize consumptions of fossil fuels and electricity.

<table>
<tr><th>Key Partners</th><th>Key Activities</th><th>Value Propositions</th><th>Customer Relationships</th><th>Customer Segments</th></tr>
<tr><td rowspan="2">Public and private actors. Mainly private actors willing to implement the measure in their buildings or willing to resell the product to a final customer. Schneider sells a software that other companies could incorporate in their projects. (Refurbishment of buildings / new installations)</td><td>Monitor the energy consumption to optimize energy management. Data visualization. The software is strictly related to the BEM system.</td><td rowspan="2">(1) Tracking energy consumption in buildings and calculation of carbon and energy savings compared to baseline.
(2) Validation and verification of energy and carbon emissions due to buildings' performance.
(3) Clear communications and comparison of results across various Energy Efficiency Projects.
(4) The previous resumed in reducing the consumptions and increase energy efficiency</td><td>Public sector
Private sector:
• Building refurbishment and Construction companies
• Architects/ engineering/ energy companies</td><td rowspan="2">(1) Private sector: offices, malls, shops
(2) Public sector, hospitals, schools, ministries, City Hall…</td></tr>
<tr><td>Key Resources
•Communication module
• Counters
• Sensors
• EMS
• Internet connected server
• Internet connected devices to visualize service functionalities</td><td>Channels
Specialized contractors, IT specialized company. It is mainly a B2B model. Final users with a BEM system could require the software as well (B2C)</td></tr>
<tr><th colspan="2">Cost Structure</th><th colspan="3">Revenue Streams</th></tr>
<tr><td colspan="2">Investment costs: Development the software and licenses.
This Software increases the cost of the Energy Management System EMS platform.</td><td colspan="3">The EMS is sold to final customers who are expected to recover the cost of the solution by stopping unnecessary energy consumption identified during the monitoring process. The system REQUIRES a software the customer pays for the licenses.</td></tr>
</table>

Customer Segments

This product aims to satisfy the necessities of those customers needing a software capable to visualize the data collected through a BEM system. In this regard, any customer of a BEM system, needs this software to be implemented within their

installation. For this reason, private manufacturers of energy management systems, energy providers or related industries, could be potential customers of this product. Public administrations have also their own buildings with BEM systems implemented, being potential customers as well.

Value Proposition

To bring a tool via software for optimizing operations of the building management systems. This is a data visualization software. Make a software for GNF and IREC in the case of Barcelona, but in other places as well for evaluate and follow the projects and measures related with consumptions. The main objective of the solution is to reduce consumptions (up to almost 10%) by optimizing energy management and, at the same time, and to evaluate the energy savings obtained thanks to these refurbishment actions. Other value proposition recalls in the new opportunities that can be generated thanks of it, new opportunities in optimization and consumptions.

Key Activities

Developing the software, keep improving it to maintain competitiveness in front of other similar software. In addition, the activities involved with the customer relationship, in order to keep a satisfactory relation with the customer, sometimes indispensable for improving the application itself. Finally, the selling process of the app. is crucial to extend its effectiveness and market share, giving it a mainstream use and reducing its marginal costs. The more installations, the more sustainable is the implementation of the measure.

Key Resources

Financial resources to cover the development and research costs necessary for having a robust software. And for the devolving phases, human resources with engineering and informatics/developer specializations. Other human capital is also required, in terms of managing people, administration and marketing. Finally, also considered as a key resource, is the physical assets. The ones required to monitor energy consumption are:

- Communication module
- Counters
- Sensors
- EMS (Energy Management System)
- Internet connected server
- Internet connected devices (PC, tablet or cell phone) to visualize service functionalities

Key Partnerships

The industrial technological company developer of the software, and the industries that require to implement it. For instance, in the case of Barcelona, Schneider. Also important to consider the final beneficiaries for having the visualization tool besides the energy companies (final users understood as residents).

Public and private actors should cooperate to increase the awareness about importance of reducing the energy footprint. While the public administration should try to reduce energy consumption fostering an efficient use of energy through building refurbishment to achieve environmental safe standards, private firms are willing to reduce their energy cost to increase their competitiveness.

Cost structure

Since these measures must always be companied by other measures, basically, a BEMS or a HEMS, the costs of implementing this product should be added when a project considers to implement said related measures. From the point of view of the company in charge to develop and sell the product, the main costs will be those originated for creating the software: investment costs (developing it, paying licenses if they were, salaries and minor related costs). The measure could be implemented separately or afterwards when other measures are already been implemented. If this is the case, are considered individually for this measure, being the most important ones, the costs of developing the app and selling it. Since other measures (hardware related ones) are previously required, the costs of said measures are also important to be highlighted in this lines: Hardware related costs: communication module, counters, sensors and internet connected server.

Revenue Streams

Revenues that come from selling the software. The product can be sold through a subscription fee or, more normally, with a single payment without any time limit for using the software.

The Energy Management System is sold to advanced users (companies) who are expected to recover the cost of the solution by stopping unnecessary energy consumption identified during the monitoring process. The system can lead to an almost 10% reduction in the energy consumption of the building. Those savings should pay-off for the cost of BEMS services.

Customer Relationships

Advice and constant customer service before and after purchasing the software (in case there is any problem in a post-purchase implementation phase.

Channels

Channels based in a Business to Business Environment. The Building Energy Management System (including communication module, counters, sensors and the Energy Management System) is installed by specialized contractors during refurbishment of the building and monitorized by IT specialized company. The system will allow comparing energy consumptions of fossil fuels before and after the refurbishment of a tertiary building.

Cologne. Residential Estate Management

City: Cologne
Measure: 4.1
Industrial Partners: Rhein Energie
Short description: The solution consists of a virtual power plant (intelligent management system) which connects local photovoltaic production, heat pumps and batteries. The system optimizes energy and heat consumption by interconnecting internal (photovoltaic, heat pumps, battery storage) and external (district heat) energy producers.

Additionally the project includes also the integration within the system of a charging station for electric vehicles (cars and pedal vehicles).

The project leads to a partly self-sufficient energy supply that result in less pressure on energy grids, lower carbon emissions, and finally better air quality.

<table>
<tr><th>Key Partners</th><th>Key Activities</th><th>Value Propositions</th><th>Customer Relationships</th><th>Customer Segments</th></tr>
<tr><td rowspan="3">(Cologne's main industrial partners: RheinEnergie); also consider equipment and software providers, public grid</td><td>The gathering of information though meters installation</td><td rowspan="3">To optimize the energy production and consumption in order to reduce the need for external energy from the grid</td><td>firms offering the service should contact and approach firms offering services to final clients</td><td rowspan="3">(1) Private sector:
a. Real Estate developers
b. Construction companies
c. Architects and engineering companies offering turnkey projects.
d. Dwellings community owners
(2) Public sector</td></tr>
<tr><th>Key Resources</th><th>Channels</th></tr>
<tr><td>(1) Virtual power plant
(2) External and Internal energy producers
(3) Smart meters to gather info.
(4) Batteries for energy storage</td><td>contractors, architects or engineering companies</td></tr>
<tr><th colspan="2">Cost Structure</th><th colspan="3">Revenue Streams</th></tr>
<tr><td colspan="2">1. Hardware related costs: meters
2. Software related costs: intelligent management system
3. Personnel costs: monitoring of service and maintenance of the equipment</td><td colspan="3">(1) Revenues from selling the service to dwellings
(2) Increase in the energy self-supply reducing the need for external energy
(3) Revenues coming from the fed into the public grid of the excess current that is remunerated through the German renewable energy act EEG
(4) Less pressure on energy grids for utilities</td></tr>
</table>

Customer segments

- Private sector:
    - **a.** Real Estate developers (they can add value to their developments)
    - **b.** Construction companies
    - **c.** Architects and engineering companies offering turnkey projects.
    - **d.** Dwellings community owners
- Public sector: Reduces carbon emissions and improves air quality

In both cases tenants can benefit from an increase in self-sufficient energy supply and reduction in energy consumption and therefore in the energy bill.

Value propositions

The value proposition of the service is offering optimizing energy and heat consumption by interconnecting internal (photovoltaic, heat pumps, battery storage) and external (district heat) energy producers. The system measure what energy is currently being used within each apartment and can predict future energy consumption. It uses this information to optimize the energy production and consumption in order to reduce the need for external energy from the grid. The excess current can be saved in storage or fed into the public grid being remunerated through the German renewable energy act EEG.

Channels

Intelligent management system (or virtual power plants), smart meters, batteries and internal energy producers should be installed in dwellings or buildings by contractors under requirements of the main contractor, architect or engineering company. The control and monitoring of the system should be done by the provider of the virtual power plant.
Alternatively a private firm can offer turnkey project to final customer and provide them the required equipment to offer the service.

Customer relationship

The business model consists on offering a service to final customers rather than selling the equipment itself, as the main added value is found on the intelligent management system. For that reason firms offering the service should contact and approach firms offering services to final clients in whom they can include energetic services to add value to their developments or refurbishments projects.

Revenue streams

The revenues in the project are obtained from:

(1) Revenues from selling the service to dwellings
(2) Increase in the energy self-supply reducing the need for external energy from the grid and consequently reducing energy cost for households
(3) Revenues coming from the fed into the public grid of the excess current that is remunerated through the German renewable energy act EEG
(4) Less pressure on energy grids for utilities, reducing maintenance costs for the companies

Key resources

The assets required to make the solution work are the following:

(1) Virtual power plant to optimize energy and heat consumption
(2) External energy producers: photovoltaic, heat pumps, battery storage
(3) Internal energy producers: district heat
(4) Smart meters to gather information in the building
(5) Batteries for energy storage

Key activities

The gathering of information though meters installation in the building to measure what energy is currently being used within each apartment to predict and optimize future energy consumption reducing the need for external energy from the grid.

Key partnerships

The firm offering the service should cooperate with equipment and software providers for a proper functioning of the service. It is also necessary to have a good connection with the public grid to feed it with the excess of electric energy. Another key issue is to provide users with detailed information about the benefits and cost reduction obtained resulting from the service.

Cost structure

- Hardware related costs: meters,
- Software related costs: intelligent management system
- Personnel costs: monitoring of service and maintenance of the equipment

Revenue streams

The company charges the customers for the provision of service that includes the leasing of all required equipment, maintenance and monitoring energy management system.

Stockholm. EnergyHub by L&T (Electrical Hub)

Measure: 4.1
Industrial Partner: L&T
The project consists is similar to those of the other two lighthouse cities, installing an energy management system to maximize the investment in solar power installations in previous described buildings in the city of Stockholm

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<tr><th>Key Partners</th><th>Key Activities</th><th>Value Propositions</th><th>Customer Relationships</th><th>Customer Segments</th></tr>
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(2) Validation and verification of energy and carbon emissions due to buildings' performance.
(3) Clear communications and comparison of results across various Energy Efficiency Projects.
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Customer segments

Any building with energy efficiency measures and the necessary infrastructure required to monitor and implement a software like this. In this regard, it does not matter the typology of the building, whether it is public or private.

Value proposition

The main value proposition is to provide and build a software capable of displaying, through different manners, the information about an energy management system installed in a building and crucial to maximize the profits or saving generated by installing solar photovoltaic panels equipped with batteries (ElectricalHub) and other solutions. The software is required to maximize the flow between solar panels, energy storage systems and the grid. In summary, the value proposition is to offer a tool for analyse, simulate and control a local electricity management system, for shaving consumption peeks, optimize consumptions and implement an adaptive current equalization

Channels

The main tool to promote this solution consists in using the data collected and the results obtained for the first buildings where the solutions is being implemented (Brf Årstakrönet) to extrapolate them to other similar buildings, allowing this to define some previous conclusions about the benefits of implementing energy efficiency measures and how to optimize the consumptions and the generation of electricity (photovoltaic panels) for each type of building.

Key Activities

Developing the software, keep improving it to maintain competitiveness in front of other similar softwares. In addition, the activities involved with the customer relationship, in order to keep a satisfactory relation with the customer, sometimes indispensable for improving the application itself. Finally, the selling process of the app. is crucial to extend its effectiveness and market share, giving it a mainstream use and reducing its marginal costs. The more installations, the more sustainable is the implementation of the measure.

Key Resources

Financial resources to cover the development and research costs necessary for having a robust software. And for the devolving phases, human resources with engineering and informatics/developer specializations. Other human capital is also required, in terms of managing people, administration and marketing. Finally, also considered as a key resource, is the physical assets. The ones required to monitor energy consumption are:

- Communication module
- Counters
- Sensors
- EMS (Energy Management System)
- Internet connected server
- Internet connected devices (PC, tablet or cell phone) to visualize service functionalities

Key Partnerships

The industrial technological company developer of the software, and the industries that require to implement it. In the case of Stockholm the developer of the EnergyHub is the start-up company FerroAmp and the company responsible of installing the software is L&T being the main industrial partner since is the one implementing the solution for other projects where it is involved. In addition, is the company promoting and boosting the implementation of the solution in the city of Stockholm. Finally note the importance of the final beneficiaries for having the visualization tool besides the energy companies (final users understood as residents or managers of tertiary buildings).

Cost structure

Since these measures must always be companied by other measures, for example an energy management system, the costs of implementing this solution should be added to those when a project considers to implement said related measures, and it is what happens in the case of Stockholm and L&T. From the point of view of the company in charge to develop and sell the product, the main costs will be those originated for creating the software: investment costs (developing it, paying licenses if they were, salaries and minor related costs). However, the measure could be implemented separately or afterwards other measures. If this is the case, the costs structure has to be considered individually for this measure, being the most important, as mentioned, the costs of developing the app and selling it.

Since other measures (hardware related ones) are previously required, the costs of said measures are also important to be highlighted in these lines (communication module, counters, sensors and internet connected server).

Revenue Streams

Revenues that come from selling the software. The product can be sold through a subscription fee or, more normally, with a single payment without any time limit for using the software. If the developer of the software is a different company than the one installing and implementing it, the company developing the solution could sell it entirely to the installing company (to construction or energy companies), trespassing the intellectual property and licenses.

The Energy Management System is sold to advanced users (companies) who are expected to recover the cost of the solution by stopping unnecessary energy consumption identified during the monitoring process.

From the point of view of the customers, in Stockholm, the idea is that the cost of the Hubgrade solution is going to be fully compensated by the energy and power savings achieved.

Customer Relationships

Advice and constant customer service before and after purchasing/installing the software (in case there is any problem in a post-purchase or implementation and monitoring phase).

Work Package 3. Integrated infrastructures

The main conclusions from Work Package 3 – Integrated Infrastructures depend on two main groups of solutions. The first one involves interventions with physical infrastructure and the second one with data infrastructures.
Solutions with physical infrastructure interventions (Solutions 5 to 7) have the following potentialities and challenges ahead:

(1) **Huge potential for energy, economic savings and creation of new markets.** With potentials ranging between 20 to 50% of energy savings, new lighting systems can reduce public expenditure while offering better services. In addition, these solutions can be implemented using public-private-partnerships that reduce risks and initial investment for the public sector. Regarding heat recovery and district the potential for energy saving is also very high (around 0.5 TWh annually in the case of Stockholm). Furthermore, the business model of letting the district heating operator buy excess heat through a plug- and play heat pump solution, and then sell it to the customers needing heat is a completely new business model that could open up the district heating systems to an open market of heat exchange.

(2) **Hard infrastructure, hard challenges ahead.** The majority of the solutions require big interventions in public space, which rises two main challenges. The first one is dealing with public sector requirements regarding permits or aesthetical norms. The second one deals with potentially high initial investment costs, especially when the solution has to be escalated at the city level after the demonstration phase. This second challenge can be mitigated by following a public-private partnership schema where the risk and initial investments are transferred to the private sector in exchange of the exploitation or duration of the contract.

(3) **High potential for better quality of life.** From the social point of view, all the solution can foster better quality of life in European cities. Ranging from better and more efficient lighting, to retrofitting of District Heating systems and less waste trucks in the street, all the solutions contribute to less noise and less pollution (both in emission, noise and luminesce terms).

(4) **Medium potential for job creation.** Since all the measures in this group need to deal with physical infrastructure, they will create jobs during implementation phases. However, they will also create more specialized jobs to main and solve problems with the deployed infrastructure.

Regarding the second group of interventions (Solutions 8), this are our main conclusions:

(1) **Data is one of the main disruptions in our times.** The availability of data, the availability of new methodologies and the computational capacity available today offers a huge amount of opportunities both for cities and companies or citizens. Thanks to the ubiquity of sensors and data produced by public workflows, cities have huge amount of data that can be extremely useful for them –in terms of internal use- but also for

companies and citizens –both in economic terms and in fostering transparency of public administrations-.

(2) **Big Data and Bad Data**. We have concerns with data quality or ineffective data governance as an obstacle. While having plenty of data is good news, in some cases the quality and accuracy of the data can lead to bad decisions if it is not taken into account. In a similar way, if companies or citizens access public data through Open Data websites that is not good enough, they will probably not do anything with it.

(3) **Data is not the biggest obstacle**. While technology or data can seem the main barrier or obstacle to the effective implementation of these measures, the reality is that getting it done is not the main challenge. The adoption barriers that organizations in the private and public sector are facing –in other words, the human factor- is the biggest obstacle for the full potential deployment of these measures. The lack of understanding on how to use this data, the bureaucratic workflow or the organization culture need to be adapted to the new data paradigm.

(4) **Low potential for (direct) job creation.** Data and software related industries are not job-intensive. In that sense, the potential for unemployment reduction through the massive implementation of these measures is dubious, at least directly. We say so because the quality of jobs in the data industry tend to be higher than in other sectors, which means that the whole economy can be benefited by creating jobs in related industries or other services that will leverage on more skilled and better payed workforce.

Solution 5. Smart Street Lightning

Street lighting keeps urban centers safe, but traditional lampposts consume huge amounts of energy. Combining energy efficient LED bulbs with motion sensors will allow lampposts to dim when nobody is around and brighten up as people approach. What's more, by using lampposts as communications hubs and EV charging points, the lighthouse cities will get more for their money.

Public space is one of the main resources available to citizens in cities all over the world. Public space is key for people and goods transportation, socialization or recreation. However, cities are constrained by their physical dimension and thus public space is a scarce resource with competing uses. At the same time, lighting is one of the main services provided by cities. Lighting allows us to enjoy and use public space on a 24h basis and provides security during dark hours.

As a counterpart, providing lighting to an entire city has big implications in terms of energy and space consumption. The measures included in this smart solution deal with both problems: saving public space and reduce energy consumption. Since this problematic is transversal to all cities, a proper implementation of these kind of solutions could deliver good results both in terms of energy consumption reduction and public space saving.

In Barcelona, municipal services aim to create an image of the city at night that strikes a balance between function and style. In order to move towards a more sustainable and efficient city, they are incorporating new lighting technology, such as LED, but also management elements such as regulation, the possibility of remote control, and new technological solutions in general. The current lighting criteria are aimed at caring for pedestrians, integrating sustainable mobility, reconsidering the urban green infrastructure and enhancing classic or iconographic architectural values. Barcelona has more than 146,000 points of light, including street and artistic lighting; an unbalanced distribution which is the fruit of urban renovations and isolated maintenance, leading to a wide variety of criteria, models and results.

Projects with smart street lighting are ongoing in several parts of the City of Stockholm. The goal is to halve the cost of electricity for lighting using LED technology and motion sensors which allow light at full strength when someone approaches. The Traffic and Waste Management Administration have also initiated tests to control the lighting where each lamp is wirelessly connected via a so-called mesh network.

Conclusions regarding the Business Models related to solution 5.

The majority of measures implemented under the Solution 5 – Smart Street Lighting umbrella rely on public space interventions. This means that the industrial partners need a close relationship with the public sector (the ultimate owner of public space). This fact presents a two-sided situation. In the first place, to deliver their value propositions, this business models need to interact with public sector authorities and be adapted to local regulations regarding public space and design.

By providing integrated solutions cities can save space by leveraging on hardware and lamppost designed to provide multiple services in one single location, avoiding the spread-out of different public space interventions for each purpose.
At the same time, the introduction of new lighting technologies –LEDs, sensors, etc.- can derive in energy savings by a better managing of the system. This benefits are provided by low-energy lighting provision, remote control of the infrastructure for interaction and incidences track and adaptive lighting to specific conditions.
In terms of scalability and replication the fact that industrial partners need to have a close relationship with the public sector will trigger the implementation process as negotiations with the City Councils need to be carried out city by city to adapt the product to local specificities. On the other side, the positive comment is that once this initial barrier is solved, the solution can be implemented in a massive way by changing the lighting systems in big areas or even entire cities.
Another important take-away from these measures is that they can be delivered through public-private partnerships. Thanks to the energy savings produced by the technology implemented in these measures, private partners can internalize investments costs and recover it (plus profits) via energy savings.
Regarding job creation, this types of measures have the potential to create many jobs – especially during the implementation phase and the public space intervention-. In addition, the lighting system also requires human intervention for maintenance and control.

Stockholm Smart LED street lighting

Measure related: 5.1
Industrial partners: City of Stockholm, Traffic Administration

Measures included: 5.1.1; 5.1.2 and 5.1.3

Summary of Business Model:
Sensor controlled LED lighting for pedestrian and bicycle paths (Sensor controlled LED lighting for pedestrian and bicycle paths to enable the lights to provide base lighting to satisfy the feeling of security at all times and increase the level of lighting when someone approaches). Self-controlled LED street lighting (Self-controlled LED street lighting with pre-set lighting schemes based on levels of traffic has the potential to saving energy compared to regular LED light). Remote controlled LED street lighting (Remote controlled LED Street lighting which can be controlled from a distance).

<table>
<tr><th>Key Partners</th><th>Key Activities</th><th>Value Propositions</th><th>Customer Relationships</th><th>Customer Segments</th></tr>
<tr><td rowspan="3">Energy Providers
Public Sector
Hardware providers</td><td>Installing and maintainnig lighting infrastructure
Managing the lighting control system</td><td rowspan="3">Saving energy by better management of the lighting system</td><td>Close contact throught email and telephone</td><td rowspan="3">Public Sector</td></tr>
<tr><th>Key Resources</th><th>Channels</th></tr>
<tr><td>Physical assets (lighting pole and sensors)
Human resources
Digital IOT Platform</td><td>Control System Software</td></tr>
<tr><th colspan="2">Cost Structure</th><th colspan="3">Revenue Streams</th></tr>
<tr><td colspan="2">Hardware maintenance
Deployment costs</td><td colspan="3">Direct purchase
Maintenance fee</td></tr>
</table>

Customer segments

The Smart LED street lighting main customer segment is the public sector (City Council or the specific department in charge of the city lighting system).

Value propositions

The value proposition of this measure is to save energy by managing better the lighting system of the city. Thanks to the sensors deployed and LED technology, city managers can optimize the lighting power based on external conditions like climate or pedestrians passing-by.

Channels

The system deployed has a control system software to manage the power and situation of each lighting pole.

Customer relationship

The customer relationship is based on email connections and telephone calls for maintenance and problem solving.

Revenue streams

This measure can be monetized both by direct purchase of technology or by paying a fee for system deployment and maintenance.

Key resources

- Physical assets (sensors and lighting pole)
- Human resources (for managing the control system)
- Digital IOT platform (for interacting with deployed infrastructure)

Key activities

- Installing and maintaining lighting infrastructure
- Managing the lighting control system

Key partnerships

- Energy Providers
- Public Sector
- Hardware providers

Cost structure

- Hardware maintenance
- Deployment costs

Barcelona Smart Multifunctional Tower

Measure related: 5.2
Industrial Partners: Cellnex

Summary of Business Model
Solution to save energy & rationalize the use of public space by the integration of lighting, environmental sensors and communications devices in a single lighting pole.

<table>
<tr><th>Key Partners</th><th>Key Activities</th><th>Value Propositions</th><th>Customer Relationships</th><th>Customer Segments</th></tr>
<tr><td rowspan="3">Public Sector - Connected Services</td><td>Lighting provision
Environmental sensors information delivery
Communication services provision</td><td rowspan="3">Telecommunication infrastructure reduction by integrating hardware and connectivity services into one single pole to save public space.</td><td>Via e-mail</td><td rowspan="3">Public Sector
Private Sector</td></tr>
<tr><td>Key Resources</td><td>Channels</td></tr>
<tr><td>LPWA and Wi-Fi networks
APIs for Big Consolidated Open Data Platform connection</td><td>API interface</td></tr>
<tr><th colspan="2">Cost Structure</th><th colspan="3">Revenue Streams</th></tr>
<tr><td colspan="2">Infrastructure
Maintenance</td><td colspan="3">Public contract
Connectivity as a Service</td></tr>
</table>

Customer segments

- Public administration / municipalities that want to improve the efficiency of their infrastructures
- Connected Services: private companies that want to optimize their operations and hardware deployment by leveraging on existing infrastructure and connectivity services integrated into the Smart Multifunctional Tower.

Value propositions

The value proposition of the Smart Multifunctional Tower is to optimize public space by integrating different services (mainly lighting, sensoring and connectivity) into one single pole.

Channels

The main communication channel will be an API interface (measure 8.5 integrated into measure 8.1) to remotely control the lighting pole and their connected devices.

Customer relationship

The customer relationship will be through email and the usual channels for infrastructure providers.

Revenue streams

The Smart Multifunctional Tower has two main revenue streams: public contract and connectivity as a service. The first one, is the usual public contract for infrastructure and hardware provision to the public sector. In addition, once the pole has been deployed, the industrial partner can leverage on another revenue stream: connectivity as a service. Thanks to the connectivity possibilities of the lighting pole, it can be use by third parties to connect their devices (mainly sensors) without deploying new connectivity infrastructure.

Key resources

Physical assets like LPWA and Wi-Fi connectivity devices or the lighting pole.

Key activities

- Lighting provision
- Transferring and managing data obtained by environmental sensors
- Connectivity provision

Key partnerships

- Local authorities / city managers and administrators
- Third party technical companies with connection needs

Cost structure

(1) Fixed costs:
- Hardware related costs: lighting pole and connectivity devices
(2) Variable costs:
- Physical maintenance of the pole

Cologne Combined electrical charging and street lighting poles + Wifi-to-grid connection

Measure related: 5.2
Industry partners: RheinEnergie

Summary of Business Model
Solution to save energy & rationalize the use of public space by the integration of lighting, electrical charging and communications devices in a single lighting pole.

<table>
<tr><th>Key Partners</th><th>Key Activities</th><th>Value Propositions</th><th>Customer Relationships</th><th>Customer Segments</th></tr>
<tr><td rowspan="3">Public Sector - Connected Services</td><td>Lighting provision
Electrical charging
Communication services provision</td><td rowspan="3">Telecommunication infrastructure reduction by integrating hardware and connectivity services into one single pole to save public space.</td><td>Via e-mail</td><td rowspan="3">Public Sector
Private Sector</td></tr>
<tr><th>Key Resources</th><th>Channels</th></tr>
<tr><td>Electric Connection
Wi-Fi Connection</td><td>API interface for lighting and Wi-Fi services
Direct provision for electrical charging services</td></tr>
<tr><th colspan="2">Cost Structure</th><th colspan="3">Revenue Streams</th></tr>
<tr><td colspan="2">Infrastructure
Maintenance</td><td colspan="3">Public contract
Pay per Use</td></tr>
</table>

Customer segments

- Public administration / municipalities that want to improve the efficiency of their infrastructures
- Private users: electrical vehicle users
- Connected Services: private companies that want to optimize their operations and hardware deployment by leveraging on existing infrastructure and connectivity services integrated into the Smart Multifunctional Tower.

Value propositions

The value proposition of the combined electrical charging and street lighting poles + Wifi-to-grid connection is to optimize public space by integrating different services (mainly lighting, electrical charging and connectivity) into one single pole.

Channels

The main communication channel will be an API interface for lighting and Wi-Fi services and a direct provision for electrical charging services.

Customer relationship

The customer relationship will be through email and the usual channels for infrastructure providers and service providers (electrical charging).

Revenue streams

The combined electrical charging and street lighting poles + Wifi-to-grid connection has two main revenue streams: public contract and service provision (pay per use). The first one, is the usual public contract for infrastructure and hardware provision to the public sector. In addition, once the pole has been deployed, the industrial partner can leverage on another revenue stream: pay per use. Thanks to the capability for providing electrical charging, the pole can be monetized by user payments every time they charge their electrical vehicles.

Key resources

Physical assets like the lighting pole, connectivity to Wi-Fi network and connectivity to the electrical grid.

Key activities

- Lighting provision
- Electrical charging station
- Connectivity provision

Key partnerships

- Local authorities / city managers and administrators
- Energy providers for electrical charging
- Third party technical companies with connection needs

Cost structure

(1) Fixed costs:
- Hardware related costs: lighting pole, energy grid connection and connectivity devices
(2) Variable costs:
- Physical maintenance of the pole

Stockholm Smart Connected City Environment

Measures related: 5.2
Industrial partners: City of Stockholm, IBM

Short Description:
The Smart Connected Street Environment is a process that involves the following steps:

- Define users and their needs for data collection and adaptive steering in City environments
- Analyse the existence of optical fibre and electricity
- Procure sensors and Internet of Things (IOT) platform to be able to both collect data, but also for applications and adaptive steering of street environments
- Install and connect the sensors to an IOT platform
- Analyse data and develop applications/solutions in the platform
- Test and evaluate applications in the connected street environment to get instant feedback on their performance

In this context:

- 10 sensors for collecting vehicle flow data is implemented in Slakthus/Globenarea. These sensors are connected to the existing optical fiber network in streets.
- 45 sensors for collecting pedestrian and bicycle flow data is implemented in the Slakthus/Globenarea. These sensors are connected to existing optical fiber in city owned buildings.
- Real-time data from the sensors are integrated into IBM's IOT Watson platform.
- Other data sources such as weather data can be integrated in the same platform
- The city functions addressed is first limited to transport related issues, such as traffic analytics, predictions, pedestrian, bicyclist street lights steering, maintenance of streets, traffic light steering

The optical fiber network company Stokab is first locating possible points for sensors, based on existing fiber network (in street or building). The need and use of sensor data is defined by the Traffic Administration, which procures the sensors. Stokab and the Traffic Administration prepare for installations.
The procured company install the sensors and make sure that data transfer and integration is successful into the IBM IOT Watson platform.
Realtime data is used to analyse transport emissions in area.
Active measures and steering of for instance street lights, traffic lights, street maintenance, parking is performed based on the real-time data to reduce transport emissions and increase people flow in the area.

Key Partners	Key Activities	Value Propositions	Customer Relationships	Customer Segments
1. Stokab 2. City authority (user) 3. Technology providers (sensors, platforms) 4. Municipal government (policy decision to traffic planning)	1. Select and implement sensors for traffic and people flow data collection 2. Integrate and secure data transfer to IOT platform 3. Analyse traffic and people flows, 4. Select, test and evaluate methods to reduce transport emissions 5. Steer street lights, traffic lights and maintenance to secure good and secure flow of traffic/people.	For the city / community: The sensor data as well as IOT platform can be used for many functions, will increase insight of traffic and people flow, give exact baselines for transport emissions, give a good base for problem analysis as well as for testing and evaluation methods to reduce transport emissions traffic congestion. For real estate owners: will give information about people flow in and out of buildings, but also if certain streets or areas are more favoured than others, give a good base for finding solutions to increase attractiveness and people flow in and out of buildings. For service providers: Gives information about people flow, and how different factors are affecting it (such as weather, street maintenance, well lit environments) but also how reachable the location is, how easy it is to access by different modes of transport, this information will help the service provider in making sure that resources and opening hours as well as service quality is kept on a optimal level.	City Interest Groups, study visits. Marketing & Publicity (events, media etc.). Workshops.	City Administrations Public Administrations Cities / Communities Real Estate Owners Service Providers
	Key Resources		**Channels**	
	1. Physical assets (optical fiber network, wireless network, electricity, sensors) 2. Human resources 3. Digital IOT Platform 4. Technology capability		Website	
Cost Structure		**Revenue Streams**		
1. Fixed costs (depreciation of fixed assets, salaries, technological infrastructure and running (overhead-)costs, maintenance) 2. Variable costs (marketing, energy,)		No Revenue Streams as the data collected by the city will be open data free to use by private actors.		

Customer segments

- City Administrations
- Public administrations
- Cities / communities
- Real estate owners
- Service providers for whom accurate information about people flow is essential for the business

Value propositions

- For the city / community: The sensor data as well as IOT platform can be used for many functions, will increase insight of traffic and people flow, give exact baselines for transport emissions, give a good base for problem analysis as well as for testing and evaluation methods to reduce transport emissions traffic congestion
- For real estate owners: will give information about people flow in and out of buildings, but also if certain streets or areas are more favoured than others, give a good base for finding solutions to increase attractiveness and people flow in and out of buildings
- For service providers: Gives information about people flow, and how different factors are affecting it (such as weather, street maintenance, well-lit environments) but also how reachable the location is, how easy it is to access by different modes of transport, this information will help the service provider in making sure that resources and opening hours as well as service quality is kept on an optimal level.

Channels

The main communication channel will be a website.

Customer relationship

The customer relationship will be through city interest groups, marketing and events, and workshops.

Revenue streams

The Smart Connected City Environment will have no revenue streams as the data collected by the city will be open data free to use by private actors.

Key resources

- Physical assets (optical fiber network, wireless network, electricity, sensors)
- Human resources
- Digital IOT Platform
- Technology capability

Key activities

- Select and implement sensors for traffic and people flow data collection
- Integrate and secure data transfer to IOT platform
- Analyse traffic and people flows,
- Select, test and evaluate methods to reduce transport emissions
- Steer street lights, traffic lights and maintenance to secure good and secure flow of traffic/people.

Key partnerships

- Stokab
- City authority (user)
- Technology providers (sensors, platforms)
- Municipal government (policy decision to traffic planning)

Cost structure

- Fixed costs (depreciation of fixed assets, salaries, technological infrastructure and running (overhead-)costs, maintenance)
- Variable costs (marketing, energy, etc.)

Barcelona Smart meter information analysis and actuators

Measure related: 5.3
Industry partners: Endesa
Summary of Business Model:
The creation of a "Data Hub", named Multiservice Concentrator (MSC), which will serve as a data node collecting and managing city data. The data will be used to integrate and optimise several utilities, to obtain increased efficiency in infrastructures, and to create new smart grid services.

<table>
<tr><th>Key Partners</th><th>Key Activities</th><th>Value Propositions</th><th>Customer Relationships</th><th>Customer Segments</th></tr>
<tr><td rowspan="3">1. Local authorities / city managers and administrators
2. Utilities' companies
3. Third party technical companies</td><td>Collecting and updating data to the platform and transferring and managing the city data from the MSC to the platform and from the platform to the Smart city Apps and Services</td><td rowspan="3">(1) to contribute to the city's development in energy efficiency
(2) to provide greater awareness of energy consumption and enabling tenants to manage their own consumption
(3) the development of new added value energy services and apps using the information collected</td><td>The new energy services and apps offer the opportunity to have a more direct consumer-oriented business model and redefine the utility/customer relationship</td><td rowspan="3">(1) Public administration / municipalities
(2) Tenants / citizens
(3) Private sector / third parties</td></tr>
<tr><th>Key Resources</th><th>Channels</th></tr>
<tr><td>(1) Physical assets (including technological infrastructure and software)
(2) Human resources (technical knowledge and expertise)</td><td>City Platform GrowSmarter</td></tr>
<tr><th colspan="2">Cost Structure</th><th colspan="3">Revenue Streams</th></tr>
<tr><td colspan="2">(1) Fixed costs: Hardware related costs (servers and physical infrastructure maintenance), Software related costs (platform maintenance and data management), Personnel related costs (salaries)
(2) Variable costs: Sales and marketing</td><td colspan="3">To charge some cost for the smart meters and sensors and their installation and maintenance. To charge more flexible tariff structures. The data collected can be expanded into other applications and services</td></tr>
</table>

Customer segments

- Public administration / municipalities that want to improve the efficiency of their infrastructures
- Tenants / citizens who want to optimise their utilities' consumption
- Private sector / third parties that want to develop new business model development using the data collected

Value propositions

The value proposition of the Data Hub is threefold:

- to contribute to the city's development in energy efficiency
- to provide greater awareness of energy consumption and enabling tenants to manage their own consumption
- the development of new added value energy services and apps using the information collected

Channels

The main communication channel will be the City Platform, called GrowSmarter Platform, which will provide direct access to the energy data. The MSC, installed at the secondary substation, collects data from the different field components and then transfers it to the GrowSmarter Platform through a central system (Endesa Platform). The main communication technologies are: Radiofrequency (RF) and PLC (Power Line Communication).

Customer relationship

The new energy services and apps offer the opportunity to have a more direct consumer-oriented business model and redefine the utility/customer relationship with a closer relationship between utility companies and their customers.

Revenue streams

Smart meters and the integration and optimization of the infrastructure of different utilities offers several opportunities to create new revenue streams. First, they can charge some cost for the smart meters and sensors and their installation and maintenance. It can either be a one-time sale or through a renting/leasing scheme that will allow customers to use the smart meters (which will in turn allow customers to reduce their energy consumption and cost). Second, the new integrated infrastructure and more accurate information on energy consumption will allow utilities to charge more flexible tariff structures. In this sense, the benefits in terms of energy efficiency and climate change mitigation thanks to a better integration of energy demand and energy generation can bring important efficiencies to municipalities, tenants and the society as a whole. Lastly, the data collected by the Data Hub can be expanded into other applications and services, which will allow utility companies to have additional revenue streams.

Key resources

(1) Physical assets, including technological infrastructure and software:
a. Smart Meters (electrical, gas, water, heating, cooling)
b. Urban and environmental sensors and actuators
c. Data Hub, composed of an MSC installed at the secondary substation
d. Platform
e. Energy Services and Apps

(2) Human resources (technical knowledge and expertise)

Key activities

- Collecting and updating data to the platform
- Transferring and managing the city data from the MSC to the platform and from the platform to the Smart City Apps and Services

Key partnerships

- Local authorities / city managers and administrators
- Utilities' companies and third party technical companies

Cost structure

(1) Fixed costs:
- Hardware related costs: servers and physical infrastructure maintenance
- Software related costs: platform maintenance and data management
- Personnel related costs: salaries

(2) Variable costs:
- Sales and marketing

Cologne Smart Meters and Actuator

Measures related: 5.3
Industry partners: AGT, RheinEnergie

Summary of Business Model:
Many of resident houses or flats will be equipped with Smart Meters or even with SmartPlugs measuring the power and heat / cooling consumption. This will inform the tenants about their consumptions and foster their awareness for energy consumption reduction.

<table>
<tr><th>Key Partners</th><th>Key Activities</th><th>Value Propositions</th><th>Customer Relationships</th><th>Customer Segments</th></tr>
<tr><td rowspan="3">Local authorities
Utilities' companies
Private users</td><td>Collecting, updating and analyzing data on energy consumption</td><td rowspan="3">Contribute to the city's development in energy efficiency.

Provide greater awareness of energy consumption to tenants.</td><td>New utility/customer relationship based on more consumer-oriented products and information</td><td rowspan="3">Public Administration

Tenants / Citizens

Utility Companies</td></tr>
<tr><th>Key Resources</th><th>Channels</th></tr>
<tr><td>Data provided by hardware deployed at different homes</td><td>Email
Thelephone</td></tr>
<tr><th colspan="2">Cost Structure</th><th colspan="3">Revenue Streams</th></tr>
<tr><td colspan="2">Software related costs: servers, maintenance, innovation and problem solving</td><td colspan="3">Direct fee to tenants

Service provision to utility companies</td></tr>
</table>

Customer segments

- Public administration / municipalities that want to improve the efficiency of their infrastructures
- Tenants / citizens who want to optimise their energy consumption
- Private sector / third parties that want to develop new business models development using the data collected

Value propositions

The value proposition of the Smart Meters and Actuator is twofold:

- to contribute to the city's development in energy efficiency
- to provide greater awareness of energy consumption and enabling tenants to manage their own consumption

Channels

The main communication channel will be email and telephone. Directly to the service providers or to the utility company (depending on the business model specification).

Customer relationship

The new energy services and apps offer the opportunity to have a more direct consumer-oriented business model and redefine the utility/customer relationship with a closer relationship between utility companies and their customers.

Revenue streams

The new information on energy consumption will allow utilities to charge more flexible tariff structures. In this sense, the benefits in terms of energy efficiency and climate change mitigation thanks to a better integration of energy demand and energy generation can bring important efficiencies to municipalities, tenants and the society as a whole. Lastly, the data collected is expected to reduce tenants' energy consumption by giving awareness of their consumption patterns and comparisons with others.

Key resources

(1) Data provided by hardware deployed at homes

(2) Human resources (technical knowledge and expertise)

Key activities

- Collecting and updating data to the platform
- Transferring the information to tenants and/or utility companies

Key partnerships

- Local authorities / city managers and administrators
- Utilities' companies and third party technical companies
- Private users: tenants and/or citizens

Cost structure

(1) Fixed costs:
- Hardware related costs: servers and physical infrastructure maintenance
- Software related costs: platform maintenance and data management
- Personnel related costs: salaries

(2) Variable costs:
- Sales and marketing

Solution 6. Waste Heat Recovery

Cities consume over two-thirds of the world's energy for feeding their economic, social and human activity. Moreover, especially in cold weather locations, energy consumption spikes during fall and winter periods. At the same time, several human activities produce excess heat while operating. However, this heat excess is rarely used because the distribution grids are too small or because the heat provider has a monopoly.

Open District Heating is a concept for energy re-use to a district heating network or a district cooling network. The Open District Heating concept makes it possible to recover waste heat (for example from Datacenters and Supermarkets) that otherwise would be lost via cooling towers to the atmosphere. In this solution, waste heat is being recovered from a range of different sources and delivered to the district heating system to provide heat to warm up buildings.

In the case of Stockholm, the District Heating system supplies centrally-heated water to properties. Hot water is transported in a system of well-insulated, high-pressure pipes. The water is between 65 and 120 degrees, depending on the time of year and weather, and is supplied to substations in each property. These units are fitted with heat pumps that use the hot water to heat buildings' radiators and hot water supply. District heating currently supplies half of Sweden's total heating requirement and it continues to expand. Fortum supplies some 90 percent of greater Stockholm's heating needs with district heating.

As for Barcelona, the District Heating system is called Districlima. And operates in the Forum and 22@ districts. Districlima has one production plant in the Forum area -that uses steam coming from a urban waste to energy plant and refrigerates the equipments with sea water- and a second production plant in the 22@ district. It provides heat to more than 90 buildings, saving more than 17,500 annual tons of CO2 and this about 60% by reducing the consumption of fossil energies. Nowadays over 870,000 m2 of roof are heated with contracted power over 55 MW to 80 MW for heat and cold.

Conclusions regarding the Business Models related to solution 6.

Cities have plenty of heat excess sources, from supermarkets to data centers or industrial activity. In fact, many of these activities pay to get rid of the extra heat. This traditional model can be challenged and improved by using the extra heat to retrofit the existing District Heating system. The business model of letting the district heating operator buy excess heat through a plug- and play heat pump solution, and then sell it to the customers needing heat is a completely new business model that could open up the district heating systems to an open market of heat exchange. This will allow to transform cooling costs into revenue streams from heat recovery. The business case will improve further in the near future when freezers are renewed, using CO2-technology, which delivers waste heat at 80° C. This heat can be fed directly into the outward stream. This system can help achieving environmental goals by leveraging on existing heat excess and recovering it to feed the heating system.

Regarding the scalability and replicability of the solution, we should mention some challenges ahead. While it is true that the majority of cities around the world have the necessity of providing heat for housing and water supply, the solution faces two challenges. First of all, there is the possibility that new and future low-energy buildings will be completely independent from heat grids. By investing in more isolated structures and hyperlocal energy production (e.g. solar panels), buildings could generate enough heat for themselves. On the other side, if the previous statement is not a possibility –for example, due to extreme weather conditions- there is another challenge to be solved: the existence of a District Heating system. This fact implies that the replicability will depend on the existence –or not- of a District Heating to leverage on heat excess produced near enough to be economically viable to inject into the system.
Finally, in terms of job creation, Solution 6 - Waste heat recovery can be beneficial. Since the implementation of the solution requires physical infrastructure, work places will be created during the implementation face. Besides, the system will need specific maintenance that will derive in more job creation.

Stockholm Open district heating using waste heat

Measures related: 6.1.1 and 6.1.2
Industrial partners: Fortum

Short Description:
Waste heat will be recovered from data centers (Installation of heat recovery equipment in order to recover heat from the cooling process of a datacenter to the district heating/cooling system) and fridges and freezers in supermarkets (Installation of heat recovery equipment in order to recover heat from the cooling process of a supermarket to the district heating/cooling system).

<table>
<tr><th>Key Partners</th><th>Key Activities</th><th>Value Propositions</th><th>Customer Relationships</th><th>Customer Segments</th></tr>
<tr><td rowspan="2">1. Frame agreements / partners for constructing pipes
2. Permits and usufruct agreements towards the city and facility owners
3. Data center cooling equipment suppliers (reseller of Open District Heating)
4. District heating and cooling customers</td><td>(1) Installation of production unit at the supplier(often heat pumps)
(2) Building pipes to connect production unit to the district heating network
(3) Start operation
(4) Deliver heat (Supplier)
(5) Payment to the supplier for delivered heat (Fortum Värme)</td><td rowspan="2">For the City / Community: Heating for the citizens is provided from recovered heat

For Costumers (heat suppliers):
- Improved OPEX for cooling and gain revenue for excess heat
- Improved cooling standard and redundancy (often the case since heat pump investment is an add on to existing cooling park)
- Environmental profiling and contribution to a more sustainable city</td><td>One by One
Marketing & Publicity</td><td rowspan="2">B2B /(PPP)
-Data centers
-Supermarkets
-Switch gear substations
-Other business etc.</td></tr>
<tr><td>Key Resources
(1) Physical assets in form of Dictrict Heating network
(2) Human resources in form internal knowledge where and how to connect a production unit to D.H. network
(3) Cost efficient process to construct of pipes
(4) Transparent and saleable business model and price structure to the market</td><td>Channels
Direct sales
Website
Existing District heating/cooling customers
Data center cooling equipment suppliers (reseller of Open District Heating)
Data center networks</td></tr>
<tr><th colspan="3">Cost Structure</th><th colspan="2">Revenue Streams</th></tr>
<tr><td colspan="3">Depreciation of pipe investment
Payment for delivered heat
Administration costs</td><td colspan="2">1. District heating sale
2. Avoided other heat production in our own plants
3. Monthly connection fee to the District Heating network (due to our pipe investments)
4. (Marketing, to recover heat in big scale strengthen the profile of the Company)</td></tr>
</table>

Customer segments

- Data centers
- Supermarkets
- Switch gear substations
- Other business etc.

Value propositions

- For the City / Community: Heating for the citizens is provided from recovered heat
- For Customers (heat suppliers):
  - Improved OPEX for cooling and gain revenue for excess heat
  - Improved cooling standard and redundancy (often the case since heat pump investment is an add on to existing cooling park)
  - Environmental profiling and contribution to a more sustainable city

Channels

- Direct sales
- Website
- Existing District heating/cooling customers
- Data center cooling equipment suppliers (reseller of Open District Heating)
- Data center networks

Customer relationship

- One by One
- Marketing & Publicity

Revenue streams

- District heating sale
- Avoided other heat production in our own plants
- Monthly connection fee to the District Heating network (due to our pipe investments)
- Marketing, to recover heat in big scale strengthen the profile of the Company

Key resources

- Physical assets in form of Dictrict Heating network
- Human resources in form internal knowledge where and how to connect a production unit to D.H. network
- Cost efficient process to construct of pipes
- Transparent and saleable business model and price structure to the market

Key activities

- Installation of production unit at the supplier(often heat pumps)
- Building pipes to connect production unit to the district heating network
- Start operation
- Deliver heat (Supplier)
- Payment to the supplier for delivered heat (Fortum Värme)

Key partnerships

- Frame agreements / partners for constructing pipes
- Permits and usufruct agreements towards the city and facility owners
- Data center cooling equipment suppliers (reseller of Open District Heating)
- District heating and cooling customers

Cost structure

- Depreciation of pipe investment
- Payment for delivered heat
- Administration costs

Barcelona Smart local thermal districts

Measures related: 6.3
Industrial partners: Irec, Barcelona City Council
Short description:
Re-designation of an industrial building (Ca lAlier) into an innovation center with a nearly zero net energy building (NZEB) criterion. This facility will use:

- On-site electricity generation. Photovoltaic power (85kWp)
- Connection to the district heating and cooling (DHC) network that recovers heat from urban solid waste treatment plant
- Installation of an energy management system that is capable of optimizing consumption as well as forecasting the building load

The project uses a Public – Private Partnership framework industrial building refurbishment in the city and it should be a reference for industrial building refurbishment in the city.

<table>
<tr><th>Key Partners</th><th>Key Activities</th><th>Value Propositions</th><th>Customer Relationships</th><th>Customer Segments</th></tr>
<tr><td rowspan="3">(1) Building owners
(2) Facility managers
(3) City managing the district heating system
(4) Electricity retailers
(5) Construction company
(6) Architects and engineers</td><td>the completion of the whole project and a perfect coordination of the whole system in the facility</td><td rowspan="3">to achieve a nearly zero net energy building (NZEB) by using photovoltaic panels, connection to District Heating and Cooling network, and energy management system.</td><td>(1) Private sector:
• Real estate companies
• Construction companies
• Architects and engineering companies
(2) Public administration</td><td rowspan="3">• Private buildings
(1) Factories
(2) Office buildings
(3) Shopping malls
(4) Schools
• Public buildings
(1) Ministries
(2) Hospitals
(3) Schools</td></tr>
<tr><td>Key Resources</td><td>Channels</td></tr>
<tr><td>• Energy meter
• Distribution network for heating & cooling
• Connections to the primary circuit of the Districlima network
• DHC network
• Electric chiller machines cooled by seawater
• Buffer tank of cold water</td><td>manufacturers' distributors, contractors and architects</td></tr>
<tr><td colspan="2">Cost Structure</td><td colspan="3">Revenue Streams</td></tr>
<tr><td colspan="2">• Hardware related costs
• Personnel: Installation and supervision</td><td colspan="3">The reduction in energy consumption should lead to reductions in the energy bill that should compensate for the investment payments</td></tr>
</table>

Customer segments

Besides refurbished industrial buildings this solution can also be implemented at:

- Private buildings
  - Factories
  - Office buildings
  - Shopping malls
  - Schools

- Public buildings
  - Ministries
  - Hospitals
  - Schools

Using this solution installation of cooling towers is avoided a subsequently eliminating the risk of Legionnaires' disease.

Value propositions

This solution aim is to achieve a nearly zero net energy building (NZEB) by using photovoltaic panels, connection to District Heating and Cooling network (that recovers heat from urban solid waste treatment plant), and energy management system.

Channels

The procurement of the materials and equipment is done through the manufacturers' distributors in the country and installed by contractors working under supervision of the main contractor and architect.

Customer relationship

- Private sector:
  - Real estate and construction companies
  - Architects and engineering companies
- Public administration

These firms can promote the installation of this solution also among final users as it will reduce energy consumption and therefore energy associated costs. It is however necessary that facilities have some requirements such as being in a district with DHC and close to the enough to the sea for water cooling.

Revenue streams

The reduction in energy consumption should lead to reductions in the energy bill that should compensate for the investment payments for equipment, engineering services, construction, and works.

Key resources

- Photovoltaic generator installed on the rooftop, trying maximize architectural integration with minimal loss of system performance
- Energy meter will be installed at the entrance of the photovoltaic system in order to deduct any energy generated which could be consumed by the conventional grid.
- Distribution network for heating & cooling will be installed beneath the street adjacent to the building
- Connections to the primary circuit of the Districlima network
- The DHC network will satisfy the heating and cooling demands of the building (cooling capacity of 31 MW and a heating capacity of 20 MW). Districlima uses mainly the steam produced from the incineration of municipal waste (MSW) in the nearby treatment plant TERSA.
- Electric chiller machines cooled by seawater
- Buffer tank of cold water of 5,000 m3 which stores cold overnight and disperses it throughout the day. Hot water is supplied at temperatures over 90ºC and returns at 60ºC, while cold water is supplied at a temperature between 4 and 5°C and returns at about 14°C.

Key activities

To achieve the desired early zero net energy building (NZEB) is necessary the completion of the whole project and a perfect coordination of the whole system in the facility.

Key partnerships[1]

The solution needs the collaboration of:

- Building owners
- Facility managers
- City managing the district heating system
- Electricity retailers
- Construction company
- Architects and engineers

[1] So far the owner of the business is not yet defined so it is not clear which company or agent will lead the business investing trying to capture the value.

Cost structure

- Hardware related costs
- Personnel: Installation and supervision

Solution 7. Smart Waste Collection

Waste handling in residential areas and dense inner cities is a growing challenge to all cities. Most cities still collect waste using trucks picking up bins or bags in close proximity to residential buildings, causing noise and emissions. Sorting and recycling are often difficult. Using different colored bags for different fractions, thrown in the same bin makes sorting easy and reduces need for storing waste at home. The bags are then sorted automatically.

This reduces the number of bins, the driving and also improves the sorting. The system can easily be developed to include all kinds of waste, thus reducing the need for special bins for paper, metal, plastic and improve the sorting as citizens do not need to go to different collecting bins.

In addition, a Smart Waste Collection system can dramatically reduce the number of trucks for waste collection. Different fractions of waste are put in bags with different colors in the same collection bin. It is then transported to a sorting facility where the different fractions are separated. Since the automated waste collection system uses vacuum to transport the bags through underground pipes, there is no need for further usage of trucks. Obviously, it has environmental implications (reduction of polluting vehicles), but also for life quality (less noise in the street, especially at night).

As for the context, at the start of the 20th century, each person in Sweden threw away 25-30 kg of waste per year; today that figure has risen to 500 kg. In Stockholm, the area of waste management is regulated and guided by laws, plans and strategies at EU, national, regional and local levels. This waste management legislation may have an impact on the waste management plan. This may have great significance for the fulfilment and follow-up of the set objectives, particularly if the distribution of responsibility for waste changes.

Conclusions regarding the Business Models related to solution 7.

One of the most interesting features and benefits of this solution is the ability to personalize the information and nudging more sustainable behaviors by putting incentives on citizens. Using smart keys together with color sensors and scales, it is possible to register down to individual households the amount and type of waste thrown at any given moment. This offers the opportunity to present statistics for individual households, buildings or clusters of buildings, visualized in the Active house /Home Energy Management Systems/Smart home system in Smart Solution 2. It can also be used as a basis for payment.

Regarding the scalability and replicability of the solution, automated waste collecting systems are more easily installed in new built residential areas as the costs can be included in overall infrastructure costs. Automated Waste Collection systems are initially more expensive than traditional waste handling systems but offer significant advantages when in place. The traffic for collecting waste can be reduced with 90 % and space can be cleared in neighborhoods as there is no longer a need for storing garbage in many different places in the area. All waste is transported underground in pipelines to a

collecting station located in the residential area with easy access to collection vehicles. In addition, the needs a mature market in terms of recycling industry. They depend on the city having a recycling plant to send the separated garbage bags.
Finally, in terms of job creation, Solution 7 - Smart Waste Collection is job intensive, especially during implementation works for deploying the necessary infrastructure.

Stockholm Automated waste collection, monitoring and reuse

Industrial partners: Envac
Measures related: 7.1; 7.2 and 7.3.
Short description:
Residents separate their waste into separate colour-coded bags. When the resident puts his/her waste into the Envac waste inlet, the user is identified alongside the type (by colour of bag) and weight of waste being deposited. The different waste streams are then transported using suction through an underground pipe network to a collection station located outside the central city area.

The system will be able to identify the amount and type of waste thrown away by individual users. This information could be used to provide feedback to the user, for instance, on individual recycling patterns.

<table>
<tr><th>Key Partners</th><th>Key Activities</th><th>Value Propositions</th><th>Customer Relationships</th><th>Customer Segments</th></tr>
<tr><td rowspan="3">(1) City Council
(2) Residents
(3) Company</td><td>To separate correctly their waste into separate colour-coded bags.</td><td rowspan="3">• Improves quality of life limiting the use of inner and/or outer surfaces for waste bins and containers.
• Reduces environmental impact.
• Promotes sustainable economic development. The system will provide data to users in order to improve environmental behavior</td><td>(1) Public local administrations</td><td rowspan="3">Public administration: City Councils</td></tr>
<tr><th>Key Resources</th><th>Channels</th></tr>
<tr><td>• Waste inlet, underground waste transportation, optical sorting technologies, smart metering, identification sensors, separate colour-coded bags
•Software management, analytic to provide feedback to end-users</td><td>public procurement long-term Company with a long-term contract</td></tr>
<tr><th colspan="2">Cost Structure</th><th colspan="3">Revenue Streams</th></tr>
<tr><td colspan="2">• Hardware related costs: waste inlets, colour-coded bags, etc.
• Software related cost: software programmers
• Personnel: waste collectors</td><td colspan="3">The only potential source of revenues can be biogas selling to be used to fuel public transportation.</td></tr>
</table>

Customer segments

- Public administration: City Councils

Value propositions

The solution:

- Improves quality of life limiting the use of inner and/or outer surfaces for waste bins and containers.
- Reduces environmental impact. Waste collection traffic will be reduced by 90% with an accompanying reduction in CO2 emissions, noise and pollution. Underground waste transportation reduces emissions of CO, HC (hydrocarbons), NOx, particles and SO2 compared to the conventional bin collection using rear loading lorry.
  Processing collected food waste as biogas will greatly reduce GHG emissions from the waste.
- Promotes sustainable economic development. The system will provide data to users in order to improve environmental behavior

Moreover any food waste collected will be processed as biogas. That besides greatly reducing GHG emissions from the waste it will in turn be used to fuel public transportation.

Channels

The procurement of the service should be done through a public procurement long-term contract with one company to provide:

- Engineering
- Construction
- Equipment installation
- Management of the system
- Waste management
- Biogas production with processed food waste.

That will require collaboration between equipment manufacturer, engineering companies, architects, construction companies, energy companies, etc.

Customer relationship

- Public local administrations

Revenue streams

The only potential source of revenues can be biogas selling to be used to fuel public transportation.

Key resources

The required resources are:

- Hardware: waste inlet, underground waste transportation, optical sorting technologies, smart metering, identification sensors, separate color-coded bags
- Software: software management, analytic to provide feedback to end-users on their waste segregation habits

Key activities

For a proper functioning of the system is key that residents separate correctly their waste into separate color-coded bags.

Key partnerships

The solution needs the collaboration of:

- City Council, the client that has to offer waste collection management to the residents of the city
- Residents, who should separate waste in different colored bags
- Company, in charge of carrying out the works providing a service to the City Council

Cost structure

- Hardware related costs: waste inlets, color-coded bags, etc.
- Software related cost: software programmers
- Personnel: waste collectors,

Solution 8. Big Data Management

Building an open data integration platform for all types of city related data (from sensors, mobile devices, and other city data) offers a unique opportunity to interrelate concepts and extract knowledge that is not always apparent without crossing vertical domain frontiers. Being able to openly access this raw or aggregated data is invaluable as it creates new business opportunities; it optimizes the operational cost and resource allocation for companies that make use of it, and fosters the appearance of better services for all city stakeholders.

Traffic and communication of people, goods, and values is crucial for the city and its growth. Management, planning, and control of physical infrastructure and buildings are critical for citizens in particular and the economy in general, and are part of what will make a city smart and attractive for living, working, and investing. A better and more careful management of the effects of city activities on the environment and climate is one of the most important dimensions for the sustainability and resilience of our cities. These are just a few examples of complex processes that can be more deeply understood, analyzed, and optimized based on integrated and openly available information.

Recently, Stockholm's City Council formally adopted a strategy for the city to become the smartest and most connected city in the world. The strategy involves a unique focus on sustainability. The goal is for Stockholm to become economically, ecologically, democratically and socially sustainable through innovative digital services, transparency and connectivity. The strategy's main focus is to fully take advantage of the opportunities that arises with development in areas such as the Internet of Things and big data analysis, as well as to take the City's work with open data to the next level.

The city of Cologne has provided open data since 2012 and was able to gather extensive experience in the technical provision of public databases during this time. In order to meet future and growing requirements, the city of Cologne decided in 2016 to implement the experience acquired so far in two update cycles. The city of Cologne believes data is a source of massive potential value for cities to enable sustainable growth and tackle environmental and economic challenges. By technologically enabling the city we hope to tap into this potential value to create a fully-integrated, strategically-designed smart city.

In 2017, Barcelona launched the "Barcelona, Digital City" plan. The aim behind the plan is to develop an open and accessible public city-data infrastructure which allows enterprises to network, where privacy and self-determination of data are protected and academia, industry and citizenship involved, making Barcelona inclusive, ethical and technically sustainable. It is currently possible to measure and obtain quantitative data on many aspects of Barcelona in order to complement existing views on the city, using a quantitative approach. The objective is to promote an internal cultural change in the City Council and to start using technology for managing large (and small) volumes of data to inform decision-making by the municipal organizational structure. This type of data should help the city council to face challenges such as access to housing, mobility, pollution and city-resident participation in municipal political life, with first-hand, up-to-date knowledge of the city.

Conclusions regarding the Business Models related to solution 8.

While the power of Big Data, Open Data and Data science is widely acknowledged across industries –including the public sector- it is also true that many organizations are facing several challenges to derive real value from data. The benefits arising from Big Data is hugely dependent not just on how the outputs of data analysis are used but also if the outputs are used at all.

The fact that an organization has a Big Data platform, dashboards, analytics team or specific software is useless if decisions are taken the same way there were taken before the explosion of data. In that sense, the business models in this solution will produce benefits only if humans change their decision making culture. Therefore, technology or operations is not the main problem from the business model point of view but the human factor is.

Barcelona Big Consolidated Open Data Platform

Measures related: 8.1.; 8.2.; 8.3 and 8.4.
Industrial partners: Barcelona Supercomputing Center, Cellnex

Short description:
Fast and easy overview of the current situation in your city concerning traffic, energy and environment. Data and information can be used for city planning, traffic and energy management, and environmental monitoring. Data can also be provided on open data platforms of cities. All urban data can be included independently of the manufacturer of the data provider. It also includes an API (Application Programming Interface) for smart lighting systems implemented by measure 5.2 able to communicate the lighting management system with other applications (e.g. traffic management, weather systems) and software platforms in order to exchange data between systems).
Measures 8.2 and 8.3 are technically tied together, given that translating a query from SPARQL to the correct API calls requires knowing the correct mapping between the Urban Model and the concrete data schema. Conceptually nevertheless, the SPARQL query generated by the exploration and query tool could be translated to any other data repository (or multiple repositories), not only to a REST API as in this case through measure 8.4. Evidently the part of the Semantic Access Layer that accesses the actual data would need to be modified depending on the storage type and access modes. This means that, while 8.1, 8.2, 8.3 and 8.4 are presented together, 8.4 can be implemented all alone the same way 8.1-to-8.3 can.
The intended users of the solution implemented by Measures 8.2 and 8.3 are specialists in the modeled domains, in this case mobility, energy, and integrated infrastructure experts. The user profiles is intended to be specialists and decision makers mostly from the public administration, but also from large enterprises whose business spans, or relies on input from, more than one vertical domain. An urban planner or the electricity company would need to understand about mobility, traffic, energy, and urban structures, to make the best decision in terms of, for instance, where to place electric charging stations.

<table>
<tr><th>Key Partners</th><th>Key Activities</th><th>Value Propositions</th><th>Customer Relationships</th><th>Customer Segments</th></tr>
<tr><td rowspan="3">Public authorities, service for other domain specialists.</td><td>Development of the ontology. Development of the semantic access to data integrated in 8.4 via a Web-based exploration and query tool. Development of an efficient semi-automatic mapping tool that recommends data to model mappings.</td><td rowspan="3">Offering integrated data access and semantic query for heterogeneous data ssets. Offering a general semantic model to which data from other cities could be more easily mapped to for integration purposes.</td><td>E-mail issues about tool malfunctioning.</td><td rowspan="3">Public Sector - Private Sector</td></tr>
<tr><th>Key Resources</th><th>Channels</th></tr>
<tr><td>Server to host the model and the exploration and query tools. The implementation uses open source software.</td><td>Web-based tool can be freely accessed. Semantic model available for download and use.</td></tr>
<tr><th colspan="3">Cost Structure</th><th colspan="2">Revenue Streams</th></tr>
<tr><td colspan="3">Hardware related costs: servers and physical infrastructure for value proposition delivery.
Software related costs: platform maintenance and dataset management.
Personnel related costs: interaction with internal and external users and dataset-updating processes.</td><td colspan="2">The platform can be licensed both to City Councils and urban management companies.</td></tr>
</table>

Customer segments

- Public administration:
  - **a.** Internal use (City Councils owning the platform)
  - **b.** External use (other City Councils)
- Private sector:
  - **a.** Enhancing strategy by analyzing more and better data
  - **b.** Improving operational analysis by using more and better data
  - **c.** New business models using new available data

Value propositions

The value proposition of the Big Consolidated Open Data Platform is to offer a fast and easy overview of the current situation of the city to improve decision-making. Offering integrated data access and semantic query for heterogeneous data sets. Offering a general semantic model to which data from other cities could be more easily mapped to for integration purposes.

Channels

The main channel is a website that serves as a centralized visualization tool for different datasets. Web-based tool can be freely accessed. Semantic model available for download and use.

Customer relationship

The industry partner covers the relationship with the usual channels: mainly email and telephone.

Revenue streams

The platform can be licensed both to City Councils and urban management companies.

Key resources

The assets required to make the platform work can be separated in three areas: hardware, software and personnel. Server to host the model and the exploration and query tools. The implementation uses open source software.

Key activities

Internal process for validating and assessing the accuracy and quality of datasets. Secondly, a specific process for uploading and updating existing data in the platform repository. Thirdly, potential interaction with the customer to derive specific insights. Development of the ontology. Development of the semantic access to data integrated in 8.4 via a Web-based exploration and query tool. Development of an efficient semi-automatic mapping tool that recommends data to model mappings.

Key partnerships

The platform can be hosted inside the organization servers or outsourced to third-party cloud hosting providers. In addition, the platform needs a strong commitment of internal managers from the City Council that should provide their siloed information for visualization and analysis purposes.

Cost structure

- Hardware related costs: servers and physical infrastructure for value proposition delivery.
- Software related costs: platform maintenance and dataset management.
- Personnel related costs: interaction with internal and external users and dataset-updating processes.

Cologne Urban Cockpit

Measures related: 8.1, 8.2 and 8.3
Industrial partners: [ui!] - The Urban Institute, AGT, Ampido, Cambio, Dewog, KVB, RheinEnergie

Short description:
Fast and easy overview of the current situation in your city concerning traffic, energy, environment and what is the impact of smart measures concerning the 20/20/20 climate protection objectives. The Web-Application gathers its data from the UrbanPULSE data backend but could also be combined with other urban big data backends. Data and information can be used for city planning, traffic and energy management, and environmental monitoring and for optimization by exploiting historical data and to detect unusual situations. All urban data can be included independently of the manufacturer of the data provider. The Traffic part provides real time information about current traffic flow in the city. It gathers its data from the UrbanPULSE data backend and traffic sensors installed around the city which capture the current traffic flow.

<table>
<tr><th>Key Partners</th><th>Key Activities</th><th>Value Propositions</th><th>Customer Relationships</th><th>Customer Segments</th></tr>
<tr><td rowspan="4">technology providers and data providers, public authorities to incentivize collaboration, private re-users of data.</td><td>Internal process for validating/assessing datasets.
Specific process for uploading and updating data.
Potential interaction with the customer.</td><td rowspan="4">to offer a fast and easy overview of the current situation of the city to improve decision-making</td><td>The industry partner covers the relationship with the usual channels: mainly email and telephone</td><td rowspan="4">Public sector

Private sector</td></tr>
<tr><th>Key Resources</th><th>Channels</th></tr>
<tr><td>Hardware
Software
Personnel</td><td>website that serves as a centralized visualization tool for different datasets.</td></tr>
<tr><th colspan="3">Cost Structure</th><th colspan="2">Revenue Streams</th></tr>
<tr><td colspan="3">- Hardware related costs: servers and physical infrastructure for value proposition delivery.
- Software related costs: platform maintenance and dataset management.
- Personnel related costs: interaction with internal and external users and dataset-updating processes.</td><td colspan="2">The platform can be licensed both to City Councils and urban management companies</td></tr>
</table>

Customer segments

- Public administration:
  - **a.** Internal use (City Councils owning the platform)
  - **b.** External use (other City Councils)
- Private sector:
  - **a.** Enhancing strategy by analyzing more and better data
  - **b.** Improving operational analysis by using more and better data

c. New business models using new available data

Value propositions

The value proposition of the Urban COCKPIT is to offer a fast and easy overview of the current situation of the city to improve decision-making and to monitor the impact of smart city measures on the climate protection objectives.

Channels

The main channel is a website that serves as a centralized visualization tool for different datasets.

Customer relationship

The industry partner covers the relationship with the usual channels: mainly email and telephone.

Revenue streams

The web-application can be licensed both to City Councils and urban management companies. It is used only in combination with an urban big data backend like the UrbanPULSE.

Key resources

The assets required to make the web-application work can be separated in three areas: (virtual) hardware, software and personnel.

Key activities

Internal process for validating and assessing the accuracy and quality of datasets. Secondly, a specific process for uploading and updating existing data in the platform repository. Thirdly, potential interaction with the customer to derive specific insights.

Key partnerships

The web-application could be hosted inside the organization servers or can be outsourced to third-party cloud hosting providers. Usually it is hosted on a cloud solution. In addition, the platform needs a strong commitment of internal managers from the City Council that should provide their siloed information for visualization and analysis purposes.

Cost structure

- (Virtual) Hardware related costs: servers and physical infrastructure for value proposition delivery.
- Software related costs: platform maintenance and dataset management.

- Personnel related costs: interaction with internal and external users and dataset-updating processes.

Stockholm Big Consolidated Open Data Platform

Measures related: 8.1
Industrial partners: IBM
Short description:
By consolidating, aggregating and using existing mobile phone data the platform will generate a new base for innovation to support a new generation of management, control and policies.

<table>
<tr><th>Key Partners</th><th>Key Activities</th><th>Value Propositions</th><th>Customer Relationships</th><th>Customer Segments</th></tr>
<tr><td rowspan="3">Technology providers and data providers, public authorities to incentivize collaboration, private re-users of data.</td><td>Internal process for validating/assessing datasets.
Specific process for uploading and updating data.
Potential interaction with the customer.</td><td rowspan="3">Offering more information about the city in reusable data formats. The datasets are offered for free and can be reutilized by both customer segments (public and private).</td><td>Contact form with different options for communicating: from asking for new datasets to report errors and problems with the website or the available data.
E-mail
Social Networks</td><td rowspan="3">Public sector

Private sector</td></tr>
<tr><td>Key Resources</td><td>Channels</td></tr>
<tr><td>Hardware
Software
Personnel</td><td>Open website that serves as a centralized repository for all datasets.</td></tr>
<tr><th colspan="3">Cost Structure</th><th colspan="2">Revenue Streams</th></tr>
<tr><td colspan="3">- Hardware related costs: servers and physical infrastructure for value proposition delivery.
- Software related costs: platform maintenance and dataset management.
- Personnel related costs: interaction with internal and external users and dataset-updating processes.</td><td colspan="2">By definition, Open Data platforms are free for usage. However, one can take into account the increased efficiency in service and value proposition delivery as a source of revenue through savings in time and money. public and private decision-makers can reduce risks associated with their operational or strategic decisions and thus increasing profits by better targeting and reduced costs.</td></tr>
</table>

Customer segments

- Public administration:
  - **a.** Internal use (City Councils owning the platform
  - **b.** External use (other City Councils)
- Private sector:
  - **a.** Enhancing strategy by analyzing more and better data
  - **b.** Improving operational analysis by using more and better data
  - **c.** New business models using new available data

Value propositions

The value proposition of the platform is offering more information about the city and how people move around it.

Channels

The main channel is an open website that serves as a centralized repository for the datasets. The datasets can be downloaded in several formats or served through APIs to connect directly to applications.

Customer relationship

Mainly through email and periodic meetings for improvements and innovation development.

Revenue streams

Bluemix is available for purchase through the following options:

- Pay-as-you-go
  – No upfront payment
  – No long-term commitment
  – Pay only for what you use
  – Usage charges that are billed monthly in arrears

- Platform usage subscription
  – Discounted charges as compared to pay-as-you-go term
  – Savings that are based on level of usage and length of commitment

- Platform support plans
  – All users to receive access to forum support
  – Optional purchase for access to IBM technical staff
  – Ticketing system with defined responsiveness levels
  – Support charges that are based on platform usage charges
  – Minimum monthly fee applies
  – Support access that is available in selected time zones and languages

- Key prerequisites:
  - Bluemix requires an Internet connection and browser.

The developers are shielded from the underlying infrastructure. Bluemix can be accessed and used as a Public PaaS, a Private PaaS or installed on premise by the customer.

Key resources

The assets required to make the platform work can be separated in three areas: hardware, software and personnel. The first one deals with the physical needs of the platform like servers for storage and data delivery. We should take into account that the physical infrastructure can be internally assumed by the City Council (using their private servers and storage capacity) or by third party cloud solutions. The second key resource is software. In this case this is the more visible resource of the measure and one of the critical determinants of success.

Key activities

As mentioned before, several key activities are related to data management processes. First of all, an internal process for validating and assessing the accuracy and quality of datasets. Secondly, a specific process for uploading and updating existing data in the platform repository.

Key partnerships

As described in key resources, the platform can be hosted inside the organization servers or outsourced to third-party cloud hosting providers. As a way of nurturing the platform with usage information and promote the reutilization of the available data, the City Council should promote some kind of partnership with data users. In that sense, having a close contact with them to assess their needs and successes is vital for keep providing the value propositions and increase their engagement with the platform.

Cost structure

- Hardware related costs: servers and physical infrastructure for value proposition delivery.
- Software related costs: platform maintenance and dataset management.
- Personnel related costs: interaction with internal and external users and dataset-updating processes.

Cologne Big Consolidated Open Data Platform

Measures related: 8.4
Industrial partners: [ui!]: UrbanPULSE
Short description:
By consolidating, aggregating and using existing and new sensor data from infrastructure, traffic and users will generate a new base for innovation to support a new generation of management, control and policies.

<table>
<tr><th>Key Partners</th><th>Key Activities</th><th>Value Propositions</th><th>Customer Relationships</th><th>Customer Segments</th></tr>
<tr><td rowspan="3">Technology providers and data providers, public authorities to incentivize collaboration, private re-users of data.</td><td>Internal process for validating/assessing datasets.
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</table>

Customer segments

- Public administration:
  - **a.** Internal use (City Councils owning the platform
  - **b.** External use (other City Councils)
- Private sector:
  - **a.** Enhancing strategy by analyzing more and better data
  - **b.** Improving operational analysis by using more and better data
  - **c.** New business models using new available data

Value propositions

The value proposition of the platform is offering more information about the city in reusable data formats. The datasets are offered for free and can be reutilized by both customer segments (public and private).

Channels

The main channel is an open website that serves as a centralized repository for all datasets. The datasets can be downloaded in several formats or served through APIs to connect directly to applications. In addition, the City Council will evangelize about the use of the platform through communication activities (general media and specialized media), directly to incumbents (reaching through email) and organizing public events (for example, hackatons).

Customer relationship

The platform has a contact form with different options for communicating: from asking for new datasets to report errors and problems with the website or the available data. In addition, it offers several ways to communicate with the City Council: email or social networks, mainly. All the communications (without source restrictions) are centralized to the designated unit that deals with the platform and then distributed to the person in charge of the specific topic (for example, the unit/department manager in case of new datasets).

Revenue streams

By definition, Open Data platforms are free for usage. However, one can take into account the increased efficiency in service and value proposition delivery as a source of revenue through savings in time and money. Thanks to more informed decisions, public and private decision-makers can reduce risks associated with their operational or strategic decisions and thus increasing profits by better targeting (better and more tailored outcomes) and reduced costs (both cost related to data acquisition and cost related to failed implementations).

Key resources

The assets required to make the platform work can be separated in three areas: hardware, software and personnel. The first one deals with the physical needs of the platform like servers for storage and data delivery. We should take into account that the physical infrastructure can be internally assumed by the City Council (using their private servers and storage capacity) or by third party cloud solutions. The second key resource is software. In this case this is the more visible resource of the measure and one of the critical determinants of success. At the same time, software resources can be split in two main sub-resources: the user interface and the datasets. User interface is an important factor of success since it can help or obstruct the finding and reusability of data. Providing a good user experience is mandatory to properly deliver the value proposition of offering information in reusable data formats: the availability of metadata associated with each dataset, the organization of datasets in the repository or a search box are some examples of specific issues to take into account when dealing with the user interface. In addition, datasets are the key resource of the platform

because without them the platform cannot deliver its value proposition. It is also important to mention the fact that the success of the platform is not only determined by the absolute number of datasets available but also by its quality. In that sense, quality can be assessed from multiple perspectives: from the methodological point of view (aggregation level, granularity of the data, accuracy of the data and so on) to the availability point of view (is the dataset updated regularly? Is it in a reusable format?). Finally, another key resource is the personnel dedicated to the management of the platform. At least one person has to be designated as responsible for managing the platform in terms of uploading new datasets and responding to inquiries from users.

Key activities

As mentioned before, several key activities are related to data management processes. First of all, an internal process for validating and assessing the accuracy and quality of datasets. Secondly, a specific process for uploading and updating existing data in the platform repository.

Key partnerships

As described in key resources, the platform can be hosted inside the organization servers or outsourced to third-party cloud hosting providers. In addition, the platform needs a strong commitment of internal managers from the City Council that should provide their siloed information for open sharing purposes. Since several challenges and barriers are expected to appear, having political commitment as a key partnership can help outpace this potential problems. As a way of nurturing the platform with usage information and promote the reutilization of the available data, the City Council should promote some kind of partnership with data users. In that sense, having a close contact with them to assess their needs and successes is vital for keep providing the value propositions and increase their engagement with the platform.

Cost structure

- Hardware related costs: servers and physical infrastructure for value proposition delivery.
- Software related costs: platform maintenance and dataset management.
- Personnel related costs: interaction with internal and external users and dataset-updating processes.

PRICING:

Pricing Bluemix

Bluemix is available for purchase through the following options:

• Pay-as-you-go
– No upfront payment
– No long-term commitment
– Pay only for what you use
– Usage charges that are billed monthly in arrears

• Platform usage subscription
– Discounted charges as compared to pay-as-you-go term
– Savings that are based on level of usage and length of commitment

• Platform support plans
– All users to receive access to forum support
– Optional purchase for access to IBM technical staff
– Ticketing system with defined responsiveness levels
– Support charges that are based on platform usage charges
– Minimum monthly fee applies
– Support access that is available in selected time zones and languages

• Key prerequisites:
- Bluemix requires an Internet connection and browser.

The developers are shielded from the underlying infrastructure. Bluemix can be accessed and used as a Public PaaS, a Private PaaS or installed on premise by the customer.

Pricing UrbanPULSE

UrbanPULSE is available for purchase through the following options:

- Monthly / yearly payment for the platform
- Payment for adaptions and extensions

The developers are shielded from the underlying infrastructure. UrbanPULSE can be accessed and used as a Public PaaS or as a Private PaaS.

Work Package 4. Sustainable Mobility Solutions

Regarding the Business models related to Work Package 4, these are the main conclusions:

The Public Authority is not crucial for the implementation of the measures. Except for the case of traffic management measures, for the rest of measures, the public authority is not a key partner, meaning that without the municipality, the measure can be implemented. But, as said, in the case of Traffic management measures, without a strong partnership with the public authority, the business models can be hard to be implemented, as the public authority will be the one authorizing the use of traffic data. For the rest of the measures, of course, the public authority is important, because it helps the settlement of some of the measures, but as said, once this is done, the activity runs without having the public authority as a frequent partner.

Data as a main vector adding value. From different points of view, data is crucial in the value proposition of the different Business Models. In some cases, data is the main driver to the value proposition of the measure, as it is the case of all the traffic management measures and the sharing vehicles measures. In other cases, data can be important to improve the value proposition of the measures, as in the transport of Freight measures and in the charging vehicles measures. In those two cases, data fuels of information the operation and with a good management of this information, it can create knowledge, improve the operation, and therefore, it might create even more added value to the Industrial Partner.

Facilitators as a key activity. In all the mobility measures, the key activity can be understood as to be a facilitator between different agents. Comparing with the measures related to the buildings (Work Package 2), where the activity is to act in the structure of the buildings or to advice the tenants to act differently, in the measures related to mobility, all of them can be seen as helping or improving other activities that are already done by others.

Citizens as clear beneficiaries. In all the mobility measures, citizens appear as beneficiaries of the measures. Sometimes not as the direct customer (like in measures 9.2 in Barcelona or in the traffic management measures, where they benefit from them thanks to an improvement of the mobility, and therefore, it is deduced that it reduces the pollution), but basically, they appear as the last beneficiaries of the measures.

Low capacity of creation of new jobs. For the Traffic measures, the Charging vehicles measures and the sharing pool measures, there seems to be a low capacity of creation of employment, as they are measures with a low intensity of manpower. The exception is the transport of Freight measures, where there is a need of transporters to do the work. This conclusion will be proved in the Deliverable 6.3, where the number of creation of employment will be seen.

Solution 9. Sustainable delivery

Online shopping is increasing rapidly which threatens to increase the total amount of freight movements, leading to increased emissions and of mobility congestion.

Beside this observation, in **Barcelona**, the restrictions of driving into different areas of the city and at specific hours implies a reduction of the quality of the delivery services for private costumers. This restriction also represents that the delivery services are concentrated in specific hours in the morning or the afternoon, increasing acoustic pollution and mobility congestion when it happens, annoying neighbors. Therefore, this solution can be an interesting alternative to improve the quality of the service and to reduce the number of vehicles delivering freight concentrating their activity in specific hours.

On the other hand, in **Stockholm**, the reality that retailers cannot confirm the times of the deliveries, and therefore, implying the need for the citizens to either be at home half a day to meet with an unpredictable delivery time or travel to a certain delivery agent to collect purchases. This results on a decrease of the quality of this service. Therefore, the solution proposed, where carriers bring in a delivery room the different goods purchased online by the neighbors.

Conclusions regarding the Business Models related to solution 9.

The Public sector is a prescriber to impulse the business models (BM henceforth), in the sense that the City Council can stimulated the creation of these BM by giving some direct or indirect subsidies (or reduction of taxes) to the Industrial Partner (in the case of Barcelona, the City Council is offering the space of the Urban Consolidation Center for free). The prescription can also be indirect, by prohibiting the distribution service in some hours and in some specific places of the city, arguing an improvement of quality of the air, acoustics and mobility.

The capacity of success of these BM is related to the levels of private consumption of citizens, and related to the improvement of trade sector. The pedestrianization of commercial streets can improve these kinds of BM, as it has been proven that this kind of local policy improves private consumption (see XXX).

In another sense, the BM seem to have a high potentiality of replication, as they are not seen as being having a sustainable competitive advantage, meaning that they are not rare, hard to imitate and without substitutes, so, they can be replicated in other cities.

Regarding job creation, there is a job market related to these BM, as there is a need of manpower regarding the last mile distribution with e-bikes or e-tricycles, although it doesn't seem very intensive in manpower. But no new skills can be observed related to these job positions.

The results of the management of the data collected from these BM, can increase the implementation of more incentives from the City Council to improve the use of EV for last mile distribution services.

Finally, the BM presented in this solution can be merge with the BM of other solutions, such as 11, related to the implementation of batteries for EV, specifically, e-bikes or e-tricycles (see measure 11.3, in Barcelona).

Barcelona Micro-distribution of freight

Measure related: 9.2
Industry partners in Barcelona: i2Cat, CENIT
Third partners: Vanapedal

Summary of Business Model
The Company *Vanapedal* created an Urban Consolidation Center (UCC), i.e., a last mile distribution service using electric tricycles (measure 9.2). with specific charging points (measure 11.3).

<table>
<tr><th>Key Partners</th><th>Key Activities</th><th>Value Propositions</th><th>Customer Relationships</th><th>Customer Segments</th></tr>
<tr><td rowspan="3">(1) carriers/Transportation companies
(2) City council/Local governments</td><td>(1) Reception and consolidation of goods into the consolidation center
(2) Operating the micro distribution center
(3) Delivery to their final destination using tricycles
(4) The Workshop</td><td rowspan="3">(1) Customers/citizens: increased time frame to perform deliveries and extended delivery coverage
(2) Traditional carriers: they avoid entering the limited access and pedestrianized areas of the city center and costs savings. The sensors in the tricycles can help optimizing delivery routes, and to make it more competitive for the last-mile operator.
(4) Community: reduced environmental and noise impact
(5) City Council: to monitor the noise and pollution levels in that area</td><td>(1) Customer support
(2) Personal assistance</td><td rowspan="3">(1) Users / customers
(2) Carriers / Transportation
(3) City Councils / Municipalities</td></tr>
<tr><td>Key Resources</td><td>Channels</td></tr>
<tr><td>(1) Physical assets (UCC construction and maintenance, Electric tricycles)
(2) Human resources (Delivery staff, operations staff at the consolidation center)
(3) Technology
(4) Public Financing</td><td>(1) With users/customers: Website and Mobile phone apps
(2) With City Councils: WLAN communications
(3) With carriers: Sales force and web sales</td></tr>
<tr><th colspan="2">Cost Structure</th><th colspan="3">Revenue Streams</th></tr>
<tr><td colspan="2">(1) Fixed costs (Running costs, Salaries, Tricycles)
(2) Variable costs (Costs of operating the micro distribution center)</td><td colspan="3">(1) Fee charged from carriers
(2) Delivery fee charged from customer</td></tr>
</table>

The last mile distribution service is used as a hub for carriers that cannot access the center of the city in specific hours due to restrains to fuel vehicles, therefore, giving the chance to consumers to receive their goods in a wider time slot than with the traditional carriers, beside the fact that the use of e-tricycles diminishes CO2 emissions.

The installation of an urban consolidation center (UCC) for the last-mile delivery of goods in a centrally located area of Barcelona., reducing congestion in pedestrianized and/or highly populated areas, diminishing emissions, and lowering delivery times and costs for conventional carriers. Additionally, the electric tricycles will be equipped with sensors

Key activities

The UCC principal activity is operating a micro distribution center where the UCC receptions the packages brought by the carriers and deliver it to their final destination using electrical tricycles. This activity works as follows: at the beginning of the day, the principal provider of courier, mail or parcel service arrives at the facilities of the company, where it leaves the freight that should be delivered during that working day. At this moment, the protagonist company of this measure, through the use of electric-motorized tricycles, delivers the freight to the final customer, either a particular or a company. The deliveryman wears the same corporate clothing of the client company, and the tricycle is painted and themed with the same corporate colors and symbols of said bigger transportation company. Currently this value proposition is already being implemented, working for DHL express and DHL *terrestre*.

The UCC is also a reparation center for transportation tricycles from other companies. The workshop facilities are already offering the repair service for other companies such as MRW, however, the mobile-workshop vehicles do not exist yet even though being designed.

Finally, the UCC is also a storage & deliverable center for small companies nearby. An example of this activity is a client company specialized in selling mattresses that were vacuum-packed to reduce the storage space required for a normal sized mattress. Said company requested to have stored a copy of each model which the company manufactured, and in a case that a customer of this third-party company, would have needed the product, could have it quickly and comfortably.

Key resources

Physical Assets: Urban Consolidation Center (UCC) construction and maintenance in a warehouse. Also, we should include the electric tricycles (currently working with 15 units).
Human capital: Delivery staff and operations staff at the consolidation centre (eight people delivering, and two at the consolidation centre, one at the workshop and one in the administration department. At peak demand times, in Christmas, the total amount of workforce reaches twenty persons.
Technology: PDA, electric engines (functioning with batteries), charging points for the batteries and sensors providing environmental information such as CO2 concentration, temperature, etc.
Financial resources: private financing, and public financing.

Key partnerships

Normally the key partners will be carriers / transportation companies (such as DHL, MRW, FedEx and TNT).

Final customers could be considered also as Key partners, as *Vanapedal* is thinking to start its own delivery services beside the last mile service they offer to carriers.

But in this case another Key partner is the City council, as it has facilitated the use of a space as a warehouse for the company. This warehouse has been given for a limit time (not specified) for free.

Customer Segments

This company (*Vanapedal*) aims to satisfy any kind of customer who needs a last-mile transportation service. In this sense, in the long term, it addressed its services to a mass market without distinguishing between typologies of customers nor industrial clients. However, on its first stages of operability, the customer segments can be listed as follows:

Users/Customers: Who live in urban centers where the conditions for the distribution with traditional transportation vehicles are not the most convenient.

Carriers/Transportation: Transportation companies for which is difficult to deliver efficiently in the last-mile of city centers. Other subcontracted transportation companies working for big logistics chains and require reparation services.

Citi Councils and Municipalities (citizens included): Municipalities that will make use of the environmental information tracked by the sensors embedded into the tricycles.

Value Propositions

The first value proposition consists in integrating the business activities into the logistics chain of a large transport company, offering the last mile delivery service of freight. The level of integration is complete since the image and technological methods are the same as the main operator, as seen in the “Key activities” section.

The second value proposition can be defined as an extension of the first one, adding value by also offering the collection of merchandise to the particular user or a third-party company. In order, for this proposal, to be carried out, the deliveryman must have a PDA owned by the bigger transportation company. The model is based on not having storage costs, all packages returned or not sent (due to some kind of incident in the logistics of operations), are collected, at the end of the day, by the partner transportation company. Currently this value proposition is being carried out for FedEx.

The third value proposition can be described as a storage and delivery service for companies that need to deliver the product to the buyer in a rapid way. The proposal is based on renting storage space and transporting the freight when is needed.

A forth proposal (not already implemented) is to offer an independent service of transportation, not depending of any other transport operator. It consists of a "From Point to Point" model in the same city or urban district, in our case, at Ciutat Vella in Barcelona. This model is currently has not been implemented yet, being under ideation phases.

The added value proposed for the companies requesting the courier service, is to generate savings in the delivery process through increasing efficiency thanks to the more flexibility in the delivery service. This flexibility is achieved thanks to a series of 15 tricycle vehicles that can operate in pedestrian zones.

Complementarily, there is a fifth value proposition that consists in offering a maintenance service for vehicles of the same type as those used by the company for the last-mile distribution of freight, the motorized tricycles. This service, besides taking advantage of the workshop used at the company's headquarters to self-repair their own vehicles, also contemplates a travelling workshop service. In this manner, companies can save themselves the fixed costs generated by the maintenance of the fleet of tricycles.

From the point of view of the city, the benefit obtained lies in reducing, a priori, the level of pollution generated by the distribution process, more precisely in substituting polluting vehicles for other more environmentally sustainable. Furthermore, the company is opting for the transportation service between libraries of the city. The company wants to participate in the public tender to exploit this kind of service.

For the City Council, the environmental information provided by the sensors in the tricycles (such as CO2 concentration, temperature, humidity, noise level, etc.) has the potential to be used by municipalities so as to monitor the noise and pollution levels in that area of the city and take action in order to improve it.

Lastly, the sensors in the tricycles provide real-time tracking information on the tricycles' journey, which can help optimizing delivery routes, to improve the service, and to make it more competitive for the last-mile operator.

Channels

With the big logistic companies via e-mail, PDA and WhatsApp.

With the final customer: telephone, App or SMS.

With City Councils: WLAN communications: the sensor in the tricycles will support mobile (GPRS/UMTS) and WLAN communications to transmit the monitored

information to a Smart City platform, where it will be processed and made available for the city services.

Customer Relationships

Although the relationship with the final customer is assumed by the carrier companies, Vanapedal has a direct contact basically related to delivering the packages.

The main relationship of Vanapedal is with the Carrier companies, where the communication is direct and frequent, and basically related to the packages delivered or not (because the final customer wasn't at the place of delivery. In these last cases, the communication with the carrier companies is to decide when it will be deliberated again.

Revenue Streams

Fee charged from carriers. The fee paid to the last-mile operator for its services should be competitive for carriers since it needs to provide a cheaper alternative than delivering the items themselves. The revenues of the last-mile operator need to be sufficient to cover the costs of operating.

There is a second type of revenues, those that can be generated by working directly with a final customer, without depending of a big major transportation company.

A third type of revenue is that generated by the workshop service, the revenues comes from other last-mile transportation companies that require a facility equipped with the tools to repair their own tricycles. A big revenue stream that should be taken into account is the public contribution, currently subsidizing the bill of the light, the rent and part of the salaries.

Cost structure

Building or renting the space of the consolidation centre and running costs (assumed by the City Hall).
Salaries of employees (delivery staff and staff at the UCC).
Tricycles: amortization.
Costs of operating the micro distribution centre.
Taxes: (municipal taxes and IBI (in case of renting the UCC).
Utilities cost (included in the operating costs): communications, heating, electricity. The Charging devices do not consume a high intensity of electric power.

Stockholm. Delivery room for sustainable deliveries

Measures related: 9.1
Industry partners: Carrier, Stockholmshem
Third partners: Qlocx, Move-By-Bike

Short description:
A delivery room will be installed in communal area within a residential building, providing 24h accessibility to all tenants, and allowing the consolidation of all home deliveries for one area and the use of electric powered cargo bicycles for the "last mile" of the delivery. The fixed delivery room allows a wider range of parcels, as the full space of a room can be used for storage.

<table>
<tr><th>Key Partners</th><th>Key Activities</th><th>Value Propositions</th><th>Customer Relationships</th><th>Customer Segments</th></tr>
<tr><td rowspan="3">(1) Local governments
(2) Technology companies</td><td>(1) Managing orders and processing them
(2) Delivery of the goods
(3) Creating and managing the infrastructure
(4) Supply chain and logistics optimisation</td><td rowspan="3">Increased service and comfort for tenants. Extended customer base. Reduced environmental and noise impact</td><td>Direct customer support (through email, telephone, social media, etc.)</td><td rowspan="3">(1) Users / customers
(2) Retail stores
(3) Cities / communities</td></tr>
<tr><td>Key Resources</td><td>Channels</td></tr>
<tr><td>(1) Physical assets (Services boxes in residential buildings' halls and Electric powered cargo bicycles)
(2) Human resources
(3) Technology capability</td><td>(1) Direct sales
(2) Website
(3) Mobile phones (apps and SMS)</td></tr>
<tr><th colspan="2">Cost Structure</th><th colspan="3">Revenue Streams</th></tr>
<tr><td colspan="2">Fixed costs (Service boxes, Salaries, technological infrastructure and running costs, warehouse)
Variable costs (marketing, Salaries to temporary delivery staff)</td><td colspan="3">(1) Delivery fee charged from customers / tenants
(2) Commission charged from retail companies</td></tr>
</table>

Key activities

The citizens can buy online and their freight are send by the Retail Store to Carrier's depot. From here, Move-By-Bike will transport, by bike (ebike?), the freights into the delivery room where citizens, after being warned via app, will collect their parcel.

Key resources

(1) Physical assets:
a. a delivery room with enough space to serve different buildings and to storage different size of parcel.
b. Bicycles or Electric powered cargo bicycles (to confirm)
(2) Human resources:
a. Delivery staff
b. Administrative staff
(3) Technology capability (Software and apps development)

Key partnerships

The Key partners are the following:

(1) Retail stores willing to use the delivery room services offered by Carrier. They have to have an incentive to use it, that can be by one side, the need to outsource the delivery services, and by another side, the need to improve the quality of the delivery services by using the delivery room. Finally, they have to have an economic incentive, where the use of the delivery room reduces their cost or increases their revenues.
(2) Citizens, that feel that by using the delivery room they have a better service regarding the delivery of the parcel bought online.
(3) Technology companies, willing to improve an App that will manage the information related to the deliveries.
(4) Bike company, willing to make the last-mile trip from Carrier's depot to the delivery room
(5) Cities/Communities, willing to reduce the air and acoustic pollution in neighborhoods.

Value propositions

- For users / customers: increased service and comfort for tenants, including flexibility in time for deliveries.
- For retail stores: extended customer base, since they can reach more areas in less time.
- For the society / community: reduced environmental and noise impact due to reduction of fossil fueled vehicles, both from residents that are going to pick up their freights and from delivery services that concentrate their routs to the delivery room, which will be replaced by electric cargo bicycles.

Customer segments

The relation of Customers is the following:

- Citizens who don't want to go to a store and prefer online shopping
- Retail stores that don't have their own home delivery services or that prefer to consolidate their deliveries and reduce costs
- Cities / communities can also be considered customers as they can also might use the services to send some documents to the citizens. Although this option is not considered right now.

Channels

The Channel used with residents is an app, where they have to register as users of the delivery room (the security system is provided by a third party, Qlocx). They then receive sms notifications with a pin code when a parcel is delivered, which they use to enter the room and collect their parcels. Residents will also be able to register parcels for return and leave these in the delivery room for collection.

The Channels with the retail stores will be the traditional ones, i.e., Website, phone, and maybe apps if they have one on their own.

Customer relationship

- With residents, an online customer support (through app).
- With retail stores, a direct company support (through email, telephone, social media, etc.)

Revenue streams

For Carrier the revenues can come from:

- Delivery fee charged from customers
- Commission charged from retail companies

Cost structure:

(1) Fixed costs:
    a. Delivery room installation
    b. Salaries to permanent delivery staff and administrative personnel
    c. Creation of the technological infrastructure and running costs
    d. Warehouses
(2) Variable costs:
    a. Salaries to temporary delivery staff (specially the bike service for the last mile) & Marketing
    b. Maintenance of the Delivery room.

Solution 10. Smart traffic management

Congestion and traffic accidents causes significant loss of time and money in Europe's cities. Using smart technology to even out traffic flows and avoid unnecessary stops will reduce emissions and also traffic accidents. Giving real-time information on e.g. travel time may also redirect citizens from car to public transport or other modes, or to make their journeys at another time. Once the infrastructure is in place it opens up for many business applications.

With the help of a range of different sensors, traffic patterns will be analyzed in a new way in Cologne. This will create a good picture of current traffic flows in the city and form a basis for a multi-mode travel planner. A similar system will be implemented in Stockholm together with a vehicle manufacturer, also testing the smart communication between the traffic lights system and vehicles GPS systems to guide those vehicles through green lights and to where traffic is less dense. In this regard, the synchronization of traffic signals to prioritize the movement of goods and distribution vehicles to minimize starts and stops, resulting in a more effective movement of goods with lower emissions, noise and improved junction safety. Finally, in the case of Barcelona, a software will be developed to simulate a correct synchronization of traffic signals in a specific area of Barcelona. The future implementation of this software might allow a more efficient traffic flow.
It will be interesting to have some data on traffic congestion in the three lighthouse cities.

Conclusions regarding the Business Models related to solution 10.

The Public sector has a crucial role in the business models (BM henceforth) related to this solution, as they are the owners of the assets (traffic lights) or the ones that authorize the changes in the management of the traffic lights. Therefore, the City Council, or one of its public companies, can hire the companies that are developing the measures or they can be prescribers, meaning that they can ask the companies they hire to manage the traffic lights to include these measures, therefore, these traffic light companies will hire the companies implementing the measures detailed in solution 10.

The capacity of success of these BM is related to the capacity to prove the improvements in traffic flow and reduction of congestion, gas emissions and acoustic emissions. Therefore, the capacity to manage the data collected will be crucial for the success of these BM. Again, the Public Sector might be crucial for the data collection, as they might have the rights related to the use of data.

In another sense, the BM seem to have a high potentiality of replication, as they are not seen as being having a sustainable competitive advantage, meaning that they are not rare, hard to imitate and without substitutes, so, they can be replicated in other cities.
Regarding job creation, there is a job market related to these BM, not very intensive in manpower, but interesting on the sense that it will improve new skills, related to digital economy and data management.

Barcelona. Smart traffic signals

Measure related: 10.1
Industry partners: CENIT

This is a theoretical measure that will not be implemented.

Summary of Business Model
A software company (in this case a Research Center, CENIT) management system that allows a better management of traffic lights improving the traffic flows.

The company offering this service could be hired by the Local Traffic Authority of by the Private firm operating the traffic lights. This company could be a spin-off from the Research Center (for this business model definition we will assume that the company will be CENIT).

<table>
<tr><th>Key Partners</th><th>Key Activities</th><th>Value Propositions</th><th>Customer Relationships</th><th>Customer Segments</th></tr>
<tr><td rowspan="2">Municipalities
Traffic management companies</td><td>To calculate the macro fundamental diagram of traffic flow of a district (Sant Martí)
Study how to manage traffic lights in the perimeter area in order to change the traffic states and improve traffic flows.</td><td rowspan="2">For the city hall: to improve the traffic density.
For the traffic light company: to improve the use of the traffic lights, and their maintenance.
For the final customers (the drivers): to improve the traffic flow and therefore the time of travel.</td><td>Contract relation with the hire (Municipality or Traffic management company)</td><td rowspan="2">Public administrations/Municipalities
Traffic light companies</td></tr>
<tr><td>Key Resources
Physical Assets: Traffic lights (already existing).
Human capital: engineer or application developers programing the software and following up regularly its implementation.
Technology: stations collecting the data related to traffic flow and a software for managing the traffic system and semaphores.
Financial resources: private</td><td>Channels
With the traffic Light Company, by traditional channels of communication

With the City Hall, by communicating regularly the situation of the traffic flow.</td></tr>
<tr><th colspan="2">T</th><th colspan="3">Revenue Streams</th></tr>
<tr><td colspan="2">Staff salaries
Sensors installation and reposition / maintenance
Data structure and storage
Software development and operation costs</td><td colspan="3">Revenues that come directly from the municipality (or Traffic management Company) that is paying for this software.</td></tr>
</table>

Key activities

The aim of this measure is to calculate the macro fundamental diagram of traffic flow of the district of Sant Martí (Barcelona) and study how to manage traffic lights in the perimeter area in order to change the traffic states and improve traffic flows. This measure is stagnant in the ideation process and is based in the fundamental diagram of traffic flow relating between the traffic flux and the traffic density.

A hypothetical implementation of the measure will be the installation of several stations to control the traffic flow, and connecting those stations to the traffic lights

management system, that will adapt the frequency of those traffic lights to the intensity of the traffic flow.

Key Resources

Physical Assets: Traffic lights (already existing).

Human capital: engineer or application developers programing the software and following up regularly its implementation.

Technology: stations collecting the data related to traffic flow and a software for managing the traffic system and semaphores.

Financial resources: private financing.

Key partnerships

The Key partners are Municipalities and traffic management companies. Depending on the contracting conditions, those partners can have a different level of relation with CENIT.
The main partner will be the one hiring CENIT.

Customer Segments

Public administrations / Municipalities who want to improve the traffic in their cities and achieve smoother traffic flows and the company that manages the semaphores in a certain area.

Value Propositions

For the city hall, the goal is, using the macroscopic fundamental diagram theory and some active traffic lights systems, to improve the traffic density or rather the aggregate journey times and therefore the pollution levels in a city.

For the traffic light company, if it is the one hiring CENIT, it will improve the use of the traffic lights, and will allow to improve the maintenance of the traffic lights, thanks to their constant surveillance by the software.

For the final customers (the drivers), it will improve the traffic flow and therefore the time of travel.

Channels

With the traffic Light Company, by traditional channels of communication between a contractor and a service company, with probably, sharing information about the status of the traffic lights.

With the City Hall, by communicating regularly the situation of the traffic flow.

Customer relationship

As said in the Key partnership, the relation will depend on who is hiring CENIT.
The contractor will have a regular relation, following up the evolution of the implementation of the software system.

Revenue streams

Revenues that come directly from the municipality that is paying you for this software, or the revenues that come from a third-party company, for instance, the one that manages the traffic light system, and is required by the municipality, to implement a solution that needs this type of software. In both ways, the revenue structure is nearly the same. However, our company could have fixed revenues, for instance selling the product with fixed prices (developing costs + a margin) or having variable revenues depending on the final empirical benefits of the software. On this case, the revenues should depend on the results obtained by the entity to whom it sold the software. A third scenario is the one that combines the two revenue streams (fix + variable revenues).

Cost structure

Software license, salaries, investments required to adapt the dynamic regulation of traffic lights. Software maintenance costs (the software required to develop this project is not the same as the software required to implement it, for this reason the final software requires a maintenance price)

Stockholm. Travel demand Management & Smart guiding to alternative fuel stations and fast charging

Measures related: 10.3 & 11.5
Industry partners: KTH & the City of Stockholm
Short description:
After deciding to merge measures 10.3 & 11.5, KTH & the City of Stockholm decide to develop an integrated multi-modal portal promoting sustainable travel choices available from a smart phone application, with the goal to improve changes in travel behavior in a way that is more effective, sustainable. It also allows to the 36,000 cars and light duty transport vehicles operating on renewable fuels in Stockholm to have updated information on where each alternative fuel can be filled up, together with most recent prices. Finally, this will improve the travel demand management measures.

<table>
<tr><th>Key Partners</th><th>Key Activities</th><th>Value Propositions</th><th>Customer Relationships</th><th>Customer Segments</th></tr>
<tr><td rowspan="3">1. Owners of vehicles powered with renewal energy
2. Citizens/drivers with a High awareness of a need of a more sustainable mobility
3. Municipality willing to improve the mobility in their streets.
4. Fuel stations offering renewal energy</td><td>a smart phone application that will inform about:
actualized information of prices of renewal energy in fuel stations.
offering alternative travel choices more sustainable</td><td rowspan="3">• For Drivers, the improvement of their own private mobility, by reducing the time of travel and the fuel consumption.
• For EV Drivers, to improve the use of renewal energy by having a better information on where to fuel vehicles powered with renewal energy.
• For citizens with a high sustainable consciousness and for municipalities, the capacity to reduce the pollution in cities</td><td>• One by one, challenging each other to reduce emissions and energy consumption, using techniques of gamification of users' behavior</td><td rowspan="3">Residents aware of a need to improve a more sustainable mobility in urban areas.
Citizens / drivers who own an electric vehicle or are interested in buying one
Municipalities that want to promote clean vehicles and more sustainable modes of transportation.</td></tr>
<tr><th>Key Resources</th><th>Channels</th></tr>
<tr><td>• Website / Smart phone application
• Maintenance of the website / Smart phone application
• Information from the fuel stations</td><td>Through the use of Mobile</td></tr>
<tr><th colspan="2">Cost Structure</th><th colspan="3">Revenue Streams</th></tr>
<tr><td colspan="2">Cost of developing the App: Salaries & Labor Costs related to design the App and actualize the information.
Cost of actualizing the information from the fuel stations.</td><td colspan="3">(1) The Application can receive revenues from publicity included in the Application
(2) Fuel stations might be interested to pay a fee to guarantee to be in the application (or to be on "top positions") and to share actualized information
(3) Municipalities might be interested in support this measures as it can improve the reduction of pollution in its streets.
(4) Renewal Car Companies could be interested to promote this APP so they can get aggregate data to learn about user's behavior.</td></tr>
</table>

Key activities

The main activity is a smart phone application that will inform about:

Actualized information of prices of renewal energy in fuel stations.
Offering alternative travel choices more sustainable.

Key resources

The key resources are:

- Website / Smart phone application
- Maintenance of the website / Smart phone application
- Information from the fuel stations

Key partnerships

The partners are the following ones:

1. Owners of vehicles powered with renewal energy
2. Citizens/drivers with a High awareness of a need of a more sustainable mobility
3. Municipality willing to improve the mobility in their streets.
4. Fuel stations offering renewal energy

Customer segments

The customers could be the following ones:

Residents aware of a need to improve a more sustainable mobility in urban areas.
Citizens / drivers who own an electric vehicle or are interested in buying one
Municipalities that want to promote clean vehicles and more sustainable modes of transportation.

Value propositions

The main value propositions are:

- For Drivers, the improvement of their own private mobility, by reducing the time of travel and the fuel consumption.
- For EV Drivers, to improve the use of renewal energy by having a better information on where to fuel vehicles powered with renewal energy.
- For citizens with a high sustainable consciousness and for municipalities, the capacity to reduce the pollution in cities

Channels

- Through mobile phones & websites

Customer relationship

The relation with the customer will be the following:

- One by one, challenging each other to reduce emissions and energy consumption, using techniques of gamification of users' behavior.

Revenue streams

Four are the alternative revenues detected for this measure:

(1) The Application can receive revenues from publicity included in the Application
(2) Fuel stations might be interested to pay a fee to guarantee to be in the application (or to be on "top positions") and to share actualized information
(3) Municipalities might be interested in support this measures as it can improve the reduction of pollution in its streets.
(4) Renewal Car Companies could be interested to promote this APP so they can get aggregate data to learn about user's behavior.

Cost structure

Cost of developing the App: Salaries & Labor Costs related to design the App and actualize the information.
Cost of actualizing the information from the fuel stations.

Stockholm. Smart traffic signals

Measure related: 10.4
Industry partners: City of Stockholm (measure 10.4).
Third partners: Swarco

Short description:
Different smart management traffic signal lights solutions will be tested in order to improve traffic flow and decrease congestion:

(A) two solutions will be tested:

A.1: A limited number of traffic lights will be equipped with specialized software so that cars with the right equipment can get information and adapt their speed to be able to reach the green lights.

A.2: A signal priority system will give certain vehicles (clean vehicles, in particular electric and renewable fueled delivery trucks) a green light faster than others, reducing their travel time.

<table>
<tr><th>Key Partners</th><th>Key Activities</th><th>Value Propositions</th><th>Customer Relationships</th><th>Customer Segments</th></tr>
<tr><td rowspan="3">(1) City council/Municipalities
(2) Third parties in the automobile industry that want to advance in autonomous car
(3) Other technology companies</td><td>(1) Software and hardware development and management
(2) Customised information for some drivers to reduce travel times
(3) Engaging with partners</td><td rowspan="3">To manage city traffic more efficiently and smoothly, reduce traffic congestion, and lessen energy consumption and emissions, noise and risk of accidents</td><td>(1) Technical assistance
(2) Self-service</td><td rowspan="3">Public administrations/Municipalities
Citizens/Drivers
Private sector</td></tr>
<tr><td>Key Resources</td><td>Channels</td></tr>
<tr><td>a.Hardware gathering and delivering information to traffic signals
b.Software in traffic lights and a car’s on board software
c.Human resources</td><td>(1) Website
(2) Direct Sales to cities / automobile companies</td></tr>
<tr><th colspan="2">Cost Structure</th><th colspan="3">Revenue Streams</th></tr>
<tr><td colspan="2">(1) Fixed costs: Software/Hardware development and maintenance, salaries of employees
(2) Variable costs: Marketing and operations</td><td colspan="3">(1) Traffic Signals: public license to municipalities
(2) Car's on board software: it may be sold to the car industry as an asset sale or as a special device directly to car owners for a fixed price
(3) Signal priority for clean vehicles may be sold to electric and renewable fuelled trucks that operate in smart logistic solutions.</td></tr>
</table>

Key activities

The Key activity is to develop a software and to manage it to synchronize traffic lights to improve traffic flows.

Key resources

(1) Physical assets/Technology:
- a. Hardware gathering and delivering information to traffic signals
- b. Software: software in traffic lights and in some cars (see solution A1)

(2) Human resources to develop & manage the software.

Key partnerships

The key partners are the following:

(1) City council / Municipalities that desire to improve their mobility and therefore, reduce congestion and pollution.
(2) Citizens/Drivers who want to reduce their travelling times.
(3) Third parties in the automobile industry that want to advance in renewal and EV car
(4) Other technology companies

Customer segments

The customers that will use this software will be:

- Citizens / Drivers who want to reduce their travelling times
- Automobile industry solution A.1 can be sold to the automobile industry as a special device.
- Public administrations / Municipalities that want to improve the traffic flow in their streets.

Value propositions

There are several value propositions, depending on the specific solution:

- For citizens: Reduction of travel time and enhanced drivers' experience
- For cities: Improved traffic flows and Reduced energy consumption, emissions, noise and risk of accidents
- Encourages the use of cleaner vehicles, which is good for the environment

Channels

- Smart Phone applications or Website
- Direct Sales to cities / automobile companies.

Customer relationship

- Technical assistance
- Self-service

Revenue streams

(1) For the system that gives the driver information about what speed to adopt in order to reach a green light at the next traffic light:
    a. it may be sold to the car industry as an asset sale.
    b. it could also be sold as a special device directly to car owners for a fixed price.

(2) Signal priority for clean vehicles may be sold to electric and renewable fueled trucks that operate in smart logistic solutions. Benefits like this could make up for the extra cost of the vehicles.
(3) Usage fee from municipalities

Cost structure

(1) Fixed costs:
    a. Software development and maintenance
    b. Hardware development and maintenance
    c. Salaries of employees
(2) Variable costs:
    a. Marketing and operations

Stockholm. Traffic signals synchronized to prioritize certain vehicles movement of goods

Measure related: 10.5
Industry partners: Carrier (measure 10.5).

Short description:
A smart management traffic signal lights solutions will be tested in order to improve traffic flow and decrease congestion. Concretely, traffic signals in and around Årsta will be re-programmed and synchronized to prioritize the movement of goods distribution vehicles to minimize starts and stops, resulting in more effective goods movements with lower emissions, noise and improved junction safety.

<table>
<tr><th>Key Partners</th><th>Key Activities</th><th>Value Propositions</th><th>Customer Relationships</th><th>Customer Segments</th></tr>
<tr><td rowspan="3">(1) City council/Municipalities
(2) Third parties in the automobile industry that want to advance in autonomous car
(3) Other technology companies</td><td>(1) Software and hardware development and management
(2) Customised information for some drivers to reduce travel times
(3) Engaging with partners</td><td rowspan="3">To manage city traffic more efficiently and smoothly, reduce traffic congestion, and lessen energy consumption and emissions, noise and risk of accidents</td><td>(1) Technical assistance
(2) Self-service</td><td rowspan="3">Public administrations/Municipalities
Citizens/Drivers
Private sector</td></tr>
<tr><th>Key Resources</th><th>Channels</th></tr>
<tr><td>a.Hardware gathering and delivering information to traffic signals
b.Software in traffic lights and a car's on board software
c.Human resources</td><td>(1) Website
(2) Direct Sales to cities / automobile companies</td></tr>
<tr><th colspan="2">Cost Structure</th><th colspan="3">Revenue Streams</th></tr>
<tr><td colspan="2">(1) Fixed costs: Software/Hardware development and maintenance, salaries of employees
(2) Variable costs: Marketing and operations</td><td colspan="3">(1) Traffic Signals: public license to municipalities
(2) Car's on board software: it may be sold to the car industry as an asset sale or as a special device directly to car owners for a fixed price
(3) Signal priority for clean vehicles may be sold to electric and renewable fuelled trucks that operate in smart logistic solutions.</td></tr>
</table>

Key activities

- Software and hardware development and management
- Customized information for freight drivers to reduce travel times

Key resources

(1) Physical assets/Technology:
  a. Hardware gathering and delivering information to traffic signals
  b. Software: software in traffic lights and maybe also a vehicle onboard software
(2) Human resources to develop and manage the software.

Key partnerships

The key partners are the following:

(1) City council / Municipalities who want to improve traffic flows.
(2) Freight/carriers companies who want to improve the time of their deliveries and the fuel consumption of their vehicles.
(3) Third parties in the automobile industry that want to improve the mobility of freight vehicles
(4) Other technology companies

Customer segments

The customers that will use this software will be:

- Carriers companies who want to reduce their travelling times and their vehicles fuel consumption.
- Automobile industry interested to develop this software as a special device for its vehicles.
- Public administrations / Municipalities that want to improve the traffic flow in their streets.

Value propositions

There are several value propositions, depending on the specific solution:

- For cities: Improve traffic flows and reduce energy consumption, emissions, noise and risk of accidents
- For carrier companies: to improve time of deliver and fuel consumption.

Channels

- Direct sales to carriers, cities / automobile companies.

Customer relationship

- Technical assistance
- Self-service

Revenue streams

The revenue for this measure can come from:
Selling the device to automotive industry
Selling the device to carriers.
Usage fee from municipalities

Cost structure

(1) Fixed costs:
   a. Software development and maintenance
   b. Hardware development and maintenance
   c. Salaries of employees
(2) Variable costs:
   a. Marketing and operations

Solution 11. Alternative fuel driven vehicles for decarbonizing and better air quality

There is no single propulsion technology that alone can replace today's fossil fueled vehicles, the solution must be a combination of smarter mobility running on both electricity and sustainable biofuels.

While the market development is a bit on its way for light duty vehicles and buses, distribution trucks which are so important for cities still have just started to develop.

For electrical vehicles, the access to charging facilities may be a concern, and in some cities also the impact on the local grid, as they are expected to load at about the same time. Initially there will not be charging posts everywhere and there is a need for the drivers to know where they are located and if they are occupied. This is an essential part for the wider uptake of EVs.

GrowSmarter will demonstrate how the uptake of these vehicles can be speeded up by an integrated approach combining better charging and fueling facilities, information helping effect the choice of vehicle users and buyers and the use of these vehicles in the different mobility measures in the project.

The main implementation challenge for charging infrastructure on public land is, in all the lighthouse cities, related to the planning processes and permits required to install privately-operated infrastructure. In addition, Cologne is exploring the possibility of using existing traffic light systems to install charging points. In Barcelona, this option, is legally unavailable. Beside this general challenge, there are some specific realities from city to city, such as in the case of Barcelona, where recently the City Council has approved an order where vehicles with a specific level of emission will not be allow to circulate in the Barcelona Ring Roads. This policy is accompanied with a two years free ride on public transports for all the citizens that retire these kinds of vehicles. This policy can be a stimulus to increase the use of EV for citizens and companies in Barcelona.
On its side, Stockholm can benefit from the recent decision from Swedish Government to subsidise consumer purchases of electric cycles and electric cargo bikes with a 25% rebate. This reality can improve the use of Ecycles in Stockholm.

Conclusions regarding the Business Models related to solution 11.

The Public sector is a prescriber to impulse the business models (BM henceforth), in the sense that the City Council can stimulated the creation of these BM by giving some direct or indirect subsidies (or reduction of taxes) to the Industrial Partner. The prescription can also be indirect, by prohibiting the use of fueled vehicles in some specific areas of the city and in some specific climate conditions.

The capacity of success of these BM is related to the levels of use of EVs, by private owners, car-sharing companies or different transport services.

In another sense, the BM seem to have a high potentiality of replication, as they are not seen as being having a sustainable competitive advantage, meaning that they are not rare, hard to imitate and without substitutes, so, they can be replicated in other cities.

Regarding job creation, there is a job market related to these BM, as there is a need of manpower regarding the management of the charging stations, although it might include some new skills, not too many, and the intensity of use of manpower will be low. It seems that there is a possibility of reconversion of traditional Fuel Stations.

The results of the management of the data collected from these BM, can improve the management of the charging stations, and also can be an argument to increase the implementation of more incentives from the City Council to improve the use of EV.

Finally, the BM presented in this solution can be merge with the BM of other solutions, such as 9, related to the implementation of the use of e-bikes or e-tricycles (see measure 9.1, in Barcelona).

Barcelona. E-mobility charging system Software

Measures related: 11.1 & 11.2.e
Main industrial Partner: ENDESA Distribución

Summary of the Business Model:

5 charging "towers" available for electric cars (measure 11.1), and fast chargers for electric vehicles (measure 11.2.e). ENDESA Distribución (henceforth Endesa) offers this service free of charge, and the City Hall pays the bill of the Electric cost.

Key Partners	Key Activities	Value Propositions	Customer Relationships	Customer Segments
City council **E-Vehicles drivers**	Installation and operation of charging infrastrucutre Data aquisition and data management of charging points **Key Resources** Electric Vehicle Chargers Human Resources IT System and infrastrucutre	**For EV drivers:** easier access to charging stations **For municipality** : fulfill enviromental requirements **For society:** positive enviromental effects	**With the final customers, B2C.** **With the Municipality, PPP.** **Channels** The contractor (city council) will have a regular relation, following up the evolution of the implementation of the charging towers.	Electric Vehicle drivers Organizations with Electric Vehicles Municipality
Cost Structure		**Revenue Streams**		
Staff salaries Charging towers installation and reposition / maintenance Data structure and storage Marketing and communications Software development and operation costs		Revenues could come from the energy supplied to the e-vehicles, however, in these measures, the energy cost is subsidized by the City council The company could have fixed revenues, for instance selling the product with fixed prices (developing costs + a margin) or having variable revenues depending on the final empirical benefits of the charging towers. A third scenario is the one that combines the two revenue streams (fix + variable revenues).		

Key activities

Installation of charging towers available for charging electric vehicles. Endesa installs the charging towers, and the City hall assumes the electric cost of the charges.

There is also a software related to that electric chargers.

Once installed, and these charging stations are available for any electric vehicle, those can use them for free, since currently at this moment, it is subsidized by the City hall.

Key Resources

Physical Assets: Charging towers.
Human capital: engineers & workers. The first designing the towers and controlling their activity and the last installing them and keeping their maintenance.
Technology: sensors collecting the data related to the status of charging towers.
Financial resources.

Key partnerships

The Key partner is the City Council that authorises the installation of the Charging towers and also subsidises the cost of charging the vehicles.

Customer Segments

Municipality who want to improve the use of electric vehicles, and therefore, the reduction of pollution generated by traditional vehicles

Users that can have an incentive to have a electric vehicle, as the cost of charging them is subsidized.

Value Propositions

For the city hall, the goal is to reduce the pollution by incentivising the use of electric vehicles.

For Endesa, the goal is to observe the operability and the financial balance of the charging towers.

For the final customers (the citizens) the goal is to reduce the emission of CO2 and NOx by using electric vehicles and easier access to charging stations.

For the society, the goal is to have positive environmental effects.

Channels

The contractor (city council) will have a regular relation, following up the evolution of the implementation of the charging towers.

Customer relationship

With the final customers, B2C.

With the Municipality, PPP.

Revenue streams

Revenues could come from the energy supplied to the e-vehicles, however, in these measures, the energy cost is subsidized by the City council

The company could have fixed revenues, for instance selling the product with fixed prices (developing costs + a margin) or having variable revenues depending on the final empirical benefits of the charging towers. A third scenario is the one that combines the two revenue streams (fix + variable revenues).

Cost structure

Staff salaries
Charging towers installation and reposition / maintenance
Data structure and storage
Marketing and communications
Software development and operation costs

Cologne. eTankE electric charging

Industry partners in Cologne: RheinEnergie
Third Partners: Cambio and Ampido.
Measures related: 11.1

Short description:
Installation of several charging infrastructures for tenants to charge their electric vehicles. It is a solution in cooperation with KVB, the car-sharing company Cambio and the carpark-sharing company Ampido.

<table>
<tr><th>Key Partners</th><th>Key Activities</th><th>Value Propositions</th><th>Customer Relationships</th><th>Customer Segments</th></tr>
<tr><td rowspan="3">(1) Other companies in the e-mobility sector
(2) City council / Municipalities
(3) Other clean energy technology companies</td><td>(1) Electrical vehicles charging
(2) Software and hardware development and management
(3) Network planning
(4) Energy data analytics
(5) Engaging with partners</td><td rowspan="3">(1) Promotion of plug-in hybrid-electric and electric vehicles
(2) It discourages the unnecessary use of private cars and reduces traffic congestion
(3) The system will also collect data and help forecasting the demand for electricity, improving energy efficiency</td><td>(1) Free charging
(2) Customer services
(3) Self-service</td><td rowspan="3">(1) Citizens/users
(2) Municipalities</td></tr>
<tr><th>Key Resources</th><th>Channels</th></tr>
<tr><td>(1) Physical assets / infrastructure
(2) Technology / R&D
(3) Software
(4) Human resources (5) Brand</td><td>(1) Ccharging stations
(2) Website
(3) Mobile phones
(4) Partner programs</td></tr>
<tr><th colspan="2">Cost Structure</th><th colspan="3">Revenue Streams</th></tr>
<tr><td colspan="2">(1) Provision and maintenance of infrastructure
(2) Development and hosting of the website
(3) Salaries of employees
(4) Variable costs (Electricity, Marketing and operations)</td><td colspan="3">(1) During an introductory period, charging is provided free of charge (the only cost for the user is the price of the SMS that they need to send)
(2) After that a usage fee might be charged
(3) Potential partnerships with municipalities</td></tr>
</table>

Key activities

The key activity is:

- Electrical vehicles charging stations.

To reach it there will be a need to implement other activities such as:

- Software and hardware development and management
- Network planning and adaptation to decide where to most efficiently implement the charging stations

There are some indirect activities derived from the key one:

- Energy data analytics
- The capacity to use the EV as energy storage devices balancing peak loads and making optimal use of renewable energy, and part of the city's Mobility Hub concept (see Measure 12.3 in Cologne).

Key resources

The Key resources needed:

- Physical assets / infrastructure: charging stations
- Technology / R&D
- Software to manage the charging process
- Human resources (technical knowledge)
- Brand

Key partnerships

The Key partners are:

(1) Companies in the e-mobility sector: the solution is implemented in cooperation with KVB, the car-sharing company Cambio and the carpark-sharing company Ampido.
(2) City council / Municipalities that wants to improve the use of EV
(3) Other clean energy technology companies

Customer segments

The customers will be:

- Citizens / users who want to use more sustainable modes of transportation
- Municipalities that wants to improve the use of EV

Value propositions

- For citizens / cities: promotion of plug-in hybrid-electric and electric vehicles in opposition to fossil fueled vehicles, which lowers carbon emissions and pollution, resulting in a better air quality
- For EV Car Sharing and carpark Sharing companies: it stimulates the use of their services as they will have more charging points in the city.
- For electric companies /public minister of energy or similar: The system will also collect data about the public and private charging stations and help forecasting the demand for electricity, improving energy efficiency

Channels

- Direct physical location: charging stations
- Website: users / customers are required to register at tankE website to use the charging stations
- Mobile phones: to start or stop the charging process you have to send a text message via mobile phone
- Partner programs

Customer relationship

- Free charging (for a period of time)
- Customer services (email, website, phone)
- Self-service

Revenue streams

(1) During an introductory period, charging is provided free of charge (the only cost for the user is the price of the SMS that they need to send)
(2) After that a usage fee might be charged
(3) Potential partnerships with municipalities and with Carsharing companies.

Cost structure

- Charging stations: provision and maintenance of infrastructure
- Development and hosting of the website
- Salaries of employees (engineering and technical staff)
- Variable costs:
    a. Electricity: cost of electricity depends on the current status of the electricity grid
    b. Marketing and operations

Stockholm. Fast and normal charging infrastructure for EVs

Measures related: 11.1 & 11.3
Industry partners: Fortum

Short description:
One rapid (measure 11.1) and eight normal (measure 11.3) charging points have been implemented by Fortum. The rapid charging point was installed at a roadside McDonald's. Fast charging stations provide electric vehicles with fully charged batteries in less than 30 minutes. The eight normal charging points at located at Valla Torg and consist of four poles each equipped with two connections. These charging points will serve users of the car pool service (measure 12.1) and smart home application, along with the general public.

<table>
<tr><th>Key Partners</th><th>Key Activities</th><th>Value Propositions</th><th>Customer Relationships</th><th>Customer Segments</th></tr>
<tr><td rowspan="3">(1) Other companies in the e-mobility sector
(2) City Councils / Municipalities
(3) Taxis and Courier companies
(3) Other clean energy technology companies</td><td>(1) Electrical vehicles charging
(2) Power supply
(3) Fast charging stations installation and maintenance
(4) Energy data analytics</td><td rowspan="3">(1) Fast charging high power charging-stations offer the possibility to fully charge an almost empty battery in less than half an hour
(2) Promotes the use of electric vehicles
(3) For the city councils: allows them better understand citizens' behavior and to develop more tailored policies towards e-mobility</td><td>(1) Free charging to early adopters until 2017
(2) Self-service
(3) Free parking while charging</td><td rowspan="3">(1) Citizens / drivers
(2) Courier companies
(3) Electric taxis
(4) Municipalities</td></tr>
<tr><td>Key Resources</td><td>Channels</td></tr>
<tr><td>(1) Physical Infrastructure
(2) Technology / R&D
(3) Energy / Power lines
(4) Human resources</td><td>(1) Direct physical location: charging stations.
(2) Partner programs (City Council or private sector partners)</td></tr>
<tr><th colspan="2">Cost Structure</th><th colspan="3">Revenue Streams</th></tr>
<tr><td colspan="2">(1) Provision and maintenance of infrastructure and equipment
(2) Signage and marking-out the area
(3) Salaries of employees
(4) Variable costs: Electricity and Marketing and operations</td><td colspan="3">(1) During a period charging is provided free of charge. The Council will analyse different business models and pricing mechanisms that could be implemented after the initial period of free charge
(1) Stockholm: The operator may charge for the service. The price in Stockholm is currently between 0.20 - 0.25 €/minute with no special parking fee for the fast chargers.</td></tr>
</table>

Key activities

The key activities are:

- Installation of 9 charging points offering normal and fast charging to Electrical vehicles.
- Maintenance of the charging points
- Collection and management of energy data analytics

Key resources

- Physical Infrastructure: charging stations
- Technology / R&D
- Energy / Power lines
- Human resources (technical knowledge)

Key partnerships

The Key partners are:

(1) Drivers of EV
(2) Companies in the e-mobility sector
(2) City Councils / Municipalities
(3) Taxis and Courier companies
(3) Other clean energy technology companies

Customer segments

- Citizens / drivers who own an electric vehicle or are interested in buying one
- Courier companies that want to use EV, and therefore reduce energy costs.
- Taxis (electric taxis).
- Municipalities that want to promote clean vehicles and more sustainable modes of transportation
- Car Sharing Companies that want to offer a better service to their clients thanks to offering more charging points.

Value propositions

The main value propositions are:

- Plug-in hybrid-electric vehicles usually charge their batteries over a long period of time at a low current. Fast charging high power charging-stations offer the possibility to fully charge an almost empty battery in less than half an hour, allowing for greater convenience, speed and availability.
- Promotes the use of electric vehicles in opposition to fossil fueled vehicles, which lowers carbon emissions, noise and air pollution, and results in a better air quality, while facilitating the future implementation of e-mobility.
- For the city councils: they receive data from the usage and operation of the fast charging stations, which allows them better understand citizens' behavior and to develop more tailored policies towards e-mobility.
- For Car-sharing companies offering EV, allows them to give more charging points to their customers.
- For EV companies, the option to have more charging points in the city is an incentive to future customers.
- For EV drivers, it allows free parking while charging

Channels

- Direct physical location: charging stations. The fast chargers are located on public land, for which the suppliers have been granted access rights by the City of Stockholm. Additionally, there are other fast chargers that have also been established on private land. In these cases, other types of agreements have been signed between the operator and the land owner without any involvement from the city, such as the fast charging station by Fortum together with McDonald's at the parking facility by McDonald's restaurant.
- Partner programs (City Council or private sector partners, such as car-Sharing companies)

Customer relationship

- Self-service

Revenue streams

(5) Usage fee: The operator may charge for the service. The price in Stockholm is currently between 0.20 - 0.25 €/minute with no special parking fee for the fast chargers. There can be different fees depending on who is charging, if it is a private driver, or a user of a Car-Sharing service. Part of the fee can be paid by the City Council, to encourage the use of EV.

Cost structure

- Charging stations: provision and maintenance of infrastructure and equipment
- Signage and marking-out the area
- Salaries of employees (engineering and technical staff)
- Variable costs:
    - **a.** Electricity / Power supply: cost of electricity depends on the current status of the electricity grid
    - **b.** Marketing and operations

Barcelona Charging batteries for e-tricycles and e-bikes.

Measure related: 11.3
Industry partners in Barcelona: i2Cat, CENIT
Third partners: Vanapedal

Summary of Business Model
CENIT and i2Cat are improving some charging batteries for e-tricycles and e-bikes that are being steted by *Vanapedal* in the measure 9.2.

<table>
<tr><th>Key Partners</th><th>Key Activities</th><th>Value Propositions</th><th>Customer Relationships</th><th>Customer Segments</th></tr>
<tr><td rowspan="3">(1) carriers/Transportation companies
(2) Citizens
(3) City council/Local governments</td><td>(1) Charging e-bikes and e-tricycles.</td><td rowspan="3">(1) Traditional carriers: increase the use of e-bikes or e-tricycles for the last-mile delivery.
(2) Citizens: increase the use of e-bikes or e-tricycles
(3) Community: reduced environmental and noise impact
(4) City Council: to monitor the noise and pollution levels in that area</td><td>(1) Customer support
(2) Personal assistance</td><td rowspan="3">(1) Citizens
(2) Carriers / Transportation
(3) City Councils / Municipalities</td></tr>
<tr><th>Key Resources</th><th>Channels</th></tr>
<tr><td>(1) Physical assets (charging stations, and batteries).
(2) Human resources (operations staff of the charging stations and replacement of batteries)</td><td>(1) With citizens: Website and Mobile phone apps
(2) With carriers: Sales force and web sales</td></tr>
<tr><th colspan="2">Cost Structure</th><th colspan="3">Revenue Streams</th></tr>
<tr><td colspan="2">(1) Fixed costs (Running costs, Salaries, Charging stations and charging assets)
(2) Variable costs (Costs of managing the Charging stations)</td><td colspan="3">(1) Fee charged to carriers
(2) Fee charged to citizens</td></tr>
</table>

Key activities

The activity is to create charging stations for e-bike & e-tricycles. The measure is centered to be used by the e-tricycles from the Urban Consolidation Center in Barcelona (see measure 9.1), but it can be used for private owners of e-bike & e-tricycles.

Key resources

The key resources are:

(1) Physical assets: charging stations, and batteries.

(2) Human resources: operations staff of the charging stations and replacement of batteries.

Key partnerships

Normally the key partners will be carriers / transportation companies interested to use EV for the last mile distribution. But citizens using e-bikes or e-tricycles can also be partners, as City Councils, that might wish to promote the use of these kinds of vehicles.

Customer Segments

The customer segments can be listed as follows:

Citizens: Who live in urban centers and use e-bikes or similar EV.

Carriers/Transportation: Transportation companies for which is difficult to deliver efficiently in the last-mile of city centers, and therefore use e-bikes or similar EV.

Citi Councils and Municipalities (citizens included): Municipalities that will like to improve the use of e-bikes or similar EV.

Value Propositions

The value proposition for the users of the charging stations is an improvement of the energy consumption and of time consumption, for carrier companies.

From the point of view of the city, the benefit obtained lies in reducing, a priori, the level of pollution generated by the use of e-bikes or similar EV, more precisely in substituting polluting vehicles for other more environmentally sustainable.

Channels

With citizens: Website and Mobile phone apps
With carriers: Sales force and web sales

Customer Relationships

The relation with the final user will be by gibing a customer support and personal assistance if needed.

Revenue Streams

(1) Fee charged to carriers
(2) Fee charged to citizens

Cost structure

(1) Fixed costs (Running costs, Salaries, Charging stations and charging assets)
(2) Variable costs (Costs of managing the Charging stations)

Stockholm. Renewable fuels for heavy duty vehicles

Measure related: 11.4
Industry partners: Stockholm
Third partners: Gasnät AB, OKQ8, ST1 (Shell), Statoil

Short description:
10 new fueling stations for alternative fuels – biogas, ED 95, HVO and RME – for heavy vehicles will be provided in order to increase the number of heavy vehicles operating on biofuels in Stockholm.

<table>
<tr><th>Key Partners</th><th>Key Activities</th><th>Value Propositions</th><th>Customer Relationships</th><th>Customer Segments</th></tr>
<tr><td rowspan="2">(1) City Councils / Municipalities
(2) Swedish Transportation Agency
(3) Fuel companies
(4) Freight and transportation companies
(5) Companies in the automotive industry</td><td>(1) Energy supply
(2) Installing new fuelling stations for alternative fuels and adding alternative fuels to existing diesel stations</td><td rowspan="2">(1) It reduces the negative impacts of transportation
(2) It incentives the use of heavy AFVs and promotes sustainable economic development.</td><td>(1) Consumer assistance
(2) Self-service in fuelling stations</td><td rowspan="2">(1) Drivers / freight companies using heavy vehicles, such as distribution trucks.
(2) Municipalities / local governments.</td></tr>
<tr><td>Key Resources
(1) Physical Infrastructure: filling stations
(2) Technology / R&D
(3) Biofuels
(4) Human resources</td><td>Channels
(1) Direct physical location
(2) Indirect: referrals through other users
(3) Partner programs</td></tr>
<tr><th colspan="2">Cost Structure</th><th colspan="3">Revenue Streams</th></tr>
<tr><td colspan="2">(1) Provision and maintenance of infrastructure and equipment
(2) Biofuels/Power supply
(3) Salaries of employees
(4) Variable costs (Marketing and operations)</td><td colspan="3">(1) Usage fee: Users / freight companies pay a price per quantity of biofuel</td></tr>
</table>

Key activities

The key activities are:

- Installing new fueling stations for alternative fuels and adding alternative fuels to existing diesel stations
- Energy supply: provision of biofuels
- Data management: Management of data collected from the fuel stations will allow an improvement of those fuel stations.

Key partnerships

The Key partners are:

(1) City Councils / Municipalities
(2) Swedish Transportation Agency
(3) Companies in the energy sector / Energy suppliers (fuel companies)
(4) Freight and transportation companies

(5) Companies in the automotive industry

Key resources

- Physical Infrastructure: filling stations
- Technology / R&D
- Biofuels (Biogas, ED95, HVO, RME)
- Human resources (technical knowledge)

Customer segments

- Drivers / freight companies using heavy vehicles, such as distribution trucks.
- Municipalities / local governments.

Value propositions

The main value propositions are:

- Bio-fueled trucks reduce both local emissions and carbon dioxide emissions and thus reduce the negative impacts of transportation. In some cases, noise levels will also decrease.
- The market for alternative-fuel cars is already developed, but not so much for heavy vehicles. This solution focuses on incentivizing the use of heavy AFVs and promotes sustainable economic development. The establishment of fuel stations for renewable fuels accelerates technology development and the transition to fossil free freight traffic.
- Cargo transportation is expected to increase in the upcoming years in Sweden and Stockholm and therefore it is key to replace fossil fueled vehicles both with electric and sustainable biofuels.

Channels

- Direct physical location: fueling stations
- Indirect: referrals through other users
- Partner programs

Customer relationship

- Consumer assistance
- Self-service in fueling stations

Revenue streams

- Usage fee: Users / freight companies pay a price per quantity of biofuel. Part of the fee can be assumed by the city council willing to improve the use of heavy EV.

Cost structure

- Fuelling stations: provision and maintenance of infrastructure and equipment. The City is responsible for finding and renting the land, which is leased to filling station operators at a standard price, on the condition that at least two different biofuels are supplied at each station. Private companies are responsible for the rest of the investment.
- Biofuels / Power supply
- Salaries of employees
- Variable costs:

Marketing and operations

Barcelona. Small distributed Compressed Natural Gas filling station

Measure related. 11.6
Main industrial Partner: Gas Natural Fenosa

Summary of the Business Model

Setting one small Compressed Natural Gas (henceforth CNG) filling station giving service to CNG vehicles.

<table>
<tr><th>Key Partners</th><th>Key Activities</th><th>Value Propositions</th><th>Customer Relationships</th><th>Customer Segments</th></tr>
<tr><td rowspan="3">Engineers
Suppliers
Installers
Departments of the company itself and business areas
Public administration (urban landscape department, mobility, district,among others)
Installation company
Distribution System Operator (DSO)
Municipality or lander owner
Electricity retail company</td><td>Technical specifications definition (basic engineering)
Site location of the filling station
Design and size Installation: optimization of public surface space
Equipment and Installation tendering process
Work Supervision including health and safety issues, detailed engineering, among others.
Works planning and commissioning.
Monitoring, managing and control
Maintenance and data collection</td><td rowspan="3">For the City: CNG filling stations grid (only two in the city), less pollution, less noise.
For Carriers: Last mile more economic service compared with petrol or diesel.

For municipality/propoerty owner: fulfill enviromental requirements and make use of the space by renting that
For society: positive enviromental effects</td><td rowspan="2">Customers (B2C)
Vehicle fleets or taxis (B2B)</td><td rowspan="3">Private customers
Companies’ and city vehicle fleets
Taxis

Organizations with Electric Vehicles</td></tr>
<tr><th>Key Resources</th><th>Channels</th></tr>
<tr><td>Funds to invest
Sustainable Mobility Department
Administration manager for bureaucracy management
Technology, coordination and management capability
Human resources
Monitoring platform for customer monitoring, analysis and loyalty</td><td>Direct sales
Car dealers
Advertising campaign via website
Personalized commercial campaigns for key customers or companies</td></tr>
<tr><th colspan="3">Cost Structure</th><th colspan="2">Revenue Streams</th></tr>
<tr><td colspan="3">Fixed costs (equipment, engineering, construction, maintenance, council taxes)
Variable costs (energy supply infrastructure)</td><td colspan="2">Natural gas sales on dispenser (€/kilo)</td></tr>
</table>

Key activities

Installation of the CNG filling station. They tried to install them in the street but after having several difficulties to do so, they decide to include them in a standard Gas station.

To install the CNG filling station they had to define technical specifications, decide the site location, define the size of the installation. Once all the design was settled, GNF started a tender process to do the installation. One the CNG filling station was installed, it needs maintenance, and therefore monitoring it, and managing the data collection.

Key Resources

Physical Assets: CNG filling station.

Human capital: engineers & workers. The first designing the filling stations and controlling their activity and the last installing them and keeping their maintenance.

Technology: monitoring platform for customer monitoring, analysis and loyalty.

Financial resources. Private fundings

Key partnerships

The Key partner are the following:

The City Council that authorises the installation of the CNG filling stations in the street, although this option hasn't succeeded so, this partner might not be crucial anymore, beside the fact that it is the authority that allows installing the CNG in the fuel stations.

The engineers, suppliers and installers needed to install the CNG filling station

The Departments of the company itself and business areas

The fuel station where the CNG filling station will be install.

The final clients (citizens, companies' vehicle fleets & taxis) that will us the CNG filling station.

Customer Segments

Private customers, Companies' and city vehicle fleets & Taxis that want to fulfill their vehicles.

Value Propositions

For the City council: CNG filling stations will reduce pollution and noise.

For carriers: Last mile more economic service compared with petrol or diesel.

For final customers, the goal is to be able to fulfil their vehicles and reduce pollution.

Channels

Direct sales, advertising campaign via website and Personalized commercial campaigns for key customers or companies.

Customer relationship

There is a B2C relation with citizens and a B2B with Vehicle fleets or taxis.

Revenue streams

Revenues could come the Natural Gas sales on dispensers.

Cost structure

Fixed costs (equipment, engineering, construction, maintenance, council taxes)
Variable costs (energy supply infrastructure).

Solution 12. Smart mobility solutions

Public transport is a good alternative to personal cars for regular trips to school and work, and the Light House cities in GrowSmarter already have a relatively good share of Public Transport for these trips. The big challenge is hence to substitute the car in other trips that are less regular and more individual. Statistics about CarSharing, BikeSharing, different vehicles Pools in the lighthouse cities might offer a good dimension of the reality and therefore of the problem to overcome.

GrowSmarter will launch a range of different solutions completing the existing public transport network. This includes bike pools, cargo bikes, e-bikes, EV-pools and improved shuttling to bus hubs, and improved taxi service thus providing the choice of the best option for each individual trip.

There are some specific realities from city to city that have to be known, to see the potential of some of the measures. It is the case of Barcelona, where recently the City Council has approved an order where vehicles with a specific level of emission will not be allow to circulate in the Barcelona Ring Roads. This policy is accompanied with a two years free ride on public transports for all the citizens that retire these kinds of vehicles. This policy can be a stimulus to increase the use of EV for citizens and companies in Barcelona.
On its side, Stockholm can benefit from the recent decision from Swedish Government to subsidise consumer purchases of electric cycles and electric cargo bikes with a 25% rebate. This reality can improve the use of Ecycles in Stockholm.

Conclusions regarding the Business Models related to solution 12.

For the BM related to this solution, the public sector although it can be a prescriber to impulse them, it might have a more active position in some measures, than in other solutions related to the WP 4. The reason for this more active position can be found in the fact that some of the measures need the use of public land owned by the City Council, or in other cases, the measures are related to the legal reality of the city.

The capacity of success of these BM is related to the levels of use of the different measures proposed.

In another sense, the BM seem to have a high potentiality of replication, as they are not seen as being having a sustainable competitive advantage, meaning that they are not rare, hard to imitate and without substitutes, so, they can be replicated in other cities.

Regarding job creation, the BM related to this solution seem to have a low need of manpower, although, they will be new jobs, related to the sharing economy or the digital economy, so it can be an opportunity of reconversion for long-term unemployed or for young workers.

The results of the management of the data collected from these BM, can improve the management of the measures, and also can be an argument to increase the implementation of more incentives from the City Council to improve the use of EV, Car Sharing or other aspects related to the measures.

Finally, some of the BM presented in this solution can be merge with the BM of other solutions, such as 11, related to the installation se of Charging Stations.

Barcelona. Smart taxi stand system in Barcelona

Measure related: 12.6
Main industrial Partner: CENIT

Summary of Business Model
A mobile application that will serve for both, taxi drivers and users, informing of real time situation about occupancy levels of the taxi stands.

The company offering this service could be hired by the Taxi Authority. This company could be a spin-off from the Research Center (for this business model definition we will assume that the company will be CENIT).

<table>
<tr><th>Key Partners</th><th>Key Activities</th><th>Value Propositions</th><th>Customer Relationships</th><th>Customer Segments</th></tr>
<tr><td rowspan="2">Municipal taxi authorities (or the City Council)
Taxi Associations
technological partner implementing the sensors (in this case Cellnex Telecom).</td><td>search and finding of the appropriate taxi ranks
install the technology to monitor vehicles
Install the wireless communication systems and the final installation of the sensors.
Development of an App to be use by Taxis and Users</td><td rowspan="2">For the city hall: to improve the traffic flow and reduce the pollution.
For the Taxi Authority: offer a better service to both taxis and citizens.
For the taxis companies: to reduce the fuel consumption and also to offer a better service to their clients.
For the final customers (the citizens): to recive a better services from taxi companies and also improve their quality of life</td><td>The contractor (City Council) or Taxi Authority will hire the service (PPP)</td><td rowspan="2">Public administrations/Municipalities
Taxis
Users</td></tr>
<tr><td>Key Resources
Physical Assets: Taxi stands (public).
Human capital: engineer or application developers programing the software and following up regularly its implementation.
Technology: sensors collecting the data related to the status of the taxi ranks</td><td>Channels
With the taxis & citizens, by the mobile application

With the taxi authority, the City hall and the IT company, by traditional communication systems, informing the evolution of the mobile application.</td></tr>
<tr><th colspan="2">Cost Structure</th><th colspan="3">Revenue Streams</th></tr>
<tr><td colspan="2">Staff salaries
Sensors installation and reposition / maintenance
Data structure and storage
Marketing and communications
Software development and operation costs</td><td colspan="3">Revenues that come directly from the municipality (or taxi authority) that is paying for this software.

The company could have fixed revenues, for instance selling the product with fixed prices (developing costs + a margin) or having variable revenues depending on the final empirical benefits of the software. On this case, the revenues should depend on the results obtained by the entity to whom it sold the software. A third scenario is the one that combines the two revenue streams (fix + variable revenues).</td></tr>
</table>

Key activities

The main tasks carried out have been the search and finding of the appropriate taxi ranks to install the technology to monitor vehicles and the review of all technologies available to monitor vehicle presence as well as the wireless communication systems and the final installation of the sensors. In collaboration with the Taxi Authority and Cellnex Telecom, three taxi ranks were selected in the area of Sant Martí.

A hypothetical implementation of the measure will be the installation of several sensors in the taxi ranks and the development of an APP used by both citizens & taxi drivers that will indicate which taxi ranks are empty and, therefore, improve the efficiency of taxi's mobility.

Key Resources

Physical Assets: Taxi stands (public).

Human capital: engineer or application developers programing the software and following up regularly its implementation.

Technology: sensors collecting the data related to the status of the taxi ranks.

Financial resources.

Key partnerships

The Key partners are Municipal taxi authorities (or the City Council), Taxi Associations and a technological partner implementing the sensors (in this case Cellnex Telecom).

Customer Segments

Public administrations / Municipalities who want to improve the taxi services, the traffic in their cities and reduce the pollution generated by taxis rides without passengers.

Taxis who want to reduce the time of riding wihout passengers, and therefore reduce the fuel consumption and that also want to reduce pollution and improve the services to their customers.

Users that can have a more efficient Taxi services.

Value Propositions

For the city hall, the goal is to improve the traffic flow and reduce the pollution by reducing the time & number of Taxis riding without passengers.

For the Taxi Authority, the goal is to offer a better service to both taxis and citizens.

For the taxis companies, the goal is to reduce the fuel consumption thanks to a reduction of taxis riding without passengers, and also to offer a better service to their clients.

For the final customers (the citizens) the goal is to recive a better services from taxi companies and also improve their quality of life thanks to a reduction of pollution and an improvement of traffic flow thanks to a reduction of taxis riding without passengers.

Channels

With the taxis & citizens, by the mobile application

With the taxi authority, the City hall and the IT company, by traditional communication systems, informing the evolution of the mobile application.

Customer relationship

The contractor (city hall or Taxy authority) will have a regular relation, following up the evolution of the implementation of the software system

Revenue streams

Revenues that come directly from the municipality (or taxi authority) that is paying for this software.

The company could have fixed revenues, for instance selling the product with fixed prices (developing costs + a margin) or having variable revenues depending on the final empirical benefits of the software. On this case, the revenues should depend on the results obtained by the entity to whom it sold the software. A third scenario is the one that combines the two revenue streams (fix + variable revenues).

Cost structure

Staff salaries
Sensors installation and reposition / maintenance
Data structure and storage
Marketing and communications
Software development and operation costs

Cologne. Mobility hub

Measure related: 12.3
Industry partners in Cologne: Cambio, Ampido, KVB, Rhein Energie
Short description:
Mobility hubs will provide commuters and residents with a location, where you can easily find various kinds of transport, such as trams, trains, buses, taxis, (e-)Car-sharing, (e-)Bike-Sharing and parking lots with online management of parking spaces. There will be the possibility for the urban administration to regulate inner-city traffic by adjusting prices according to the demand and capacity.

***Note*: this is more infrastructure provision with different business models on the side (such as char-sharing, bike-sharing, management of parking spaces, etc.)

<table>
<tr><th>Key Partners</th><th>Key Activities</th><th>Value Propositions</th><th>Customer Relationships</th><th>Customer Segments</th></tr>
<tr><td rowspan="2">(1) City council / Municipalities
(2) Private building, construction and transportation companies
(3) Bike sharing companies
(4) Car sharing companies</td><td>1)Provision and development of a wide range of mobility and transportation options
2)Software development for the online management
3)Engaging with partners
4)Promotion of the mobility hubs</td><td rowspan="2">(1) More and better connected mobility options, less traffic congestion and less air and noise pollution, reduction of the need for private car ownership
(2) Increases the demand for electric vehicles and bikes (jobs), reduction in inner-city traffic</td><td>(1) Long-term contracts with local governments
(2) Self-service and automated services with the residents / commuters</td><td rowspan="2">(1) Residents / commuters
(2) Local administrators</td></tr>
<tr><td>Key Resources
(1) Physical locations
(2) Public Transport
(3) Bicycle and Car sharing system
(4) Technology
(5) Human resources</td><td>Channels
(1) Website
(2) Mobile apps
(3) B2C sales</td></tr>
<tr><th colspan="2">Cost Structure</th><th colspan="3">Revenue Streams</th></tr>
<tr><td colspan="2">(1) Infrastructure costs and maintenance
(2) Software development and operation costs
(3) Staff salaries</td><td colspan="3">(1) For the parking spaces: usage fee. Prices can be adjusted according to demand and capacity.
(2) For (e-)Carsharing and (e-)Bike-Sharing: usage fee</td></tr>
</table>

Key activities

- The provision and development of a wide range of mobility and transportation options and infrastructure
- Platform and software development for the online management of parking spaces, adjusting prices according to the demand and capacity, and for the car-sharing and bike-sharing systems
- Engaging with partners
- Promotion of the mobility hubs

Key partnerships

(1) City council / Municipalities
(2) Private building, construction and transportation companies
(3) Bike sharing companies

(4) Car sharing companies

Key resources

- Physical location for parking lots, Car-sharing and Bike-sharing spaces
- Public Transport (trams, trains, buses, taxis)
- Bicycle sharing systems and Car-sharing systems
- Technology / Software for online management and pre-booking of parking spaces and bikes and cars in bike-sharing and car-sharing systems
- Human resources

Customer segments

- Residents / commuters
- Local administrators

Value propositions

The value propositions are:

(1) For commuters:
   a. more and better-connected mobility options, improving the flexibility of urban mobility
   b. less traffic congestion and less air and noise pollution (you can pre-book parking spaces reducing inner city traffic, since you do not need to drive around looking for a parking spot)
   c. reduction of the need for private car ownership (less costs)

(2) For the city:
   a. Increases the demand for electric vehicles and bikes, which could help create jobs and improve quality of life of citizens.
   b. Mobility Hubs are expected to lead to a 60% reduction in CO_2 emissions
   c. Urban administration can regulate inner-city traffic by adjusting prices according to the demand and capacity: it is expected a 40% reduction in inner-city traffic

Channels

- Website
- Mobile apps
- B2C sales

Customer relationship

- Long-term contracts with local governments
- Self-service and automated services with the residents / commuters

Revenue streams

- For the parking spaces: usage fee. Prices can be adjusted according to demand and capacity.
- For (e-)Carsharing and (e-)Bike-Sharing: usage fee

Cost structure

- Infrastructure costs and maintenance
- Software development and operation costs
- Staff salaries

Cologne. Electrical and conventional car sharing

Measures related: 12.4
Industry partners: Cambio, KVB

Short description:
The measure is composed of the following activities:

1. A car sharing service will be set up with a range of different cars to be able to cater to everybody's need in different situations. To completely be able not owning your own car it is necessary that car pools can offer different cars for different needs. An electric vehicle might be suitable for shorter trips in the city but when travelling longer distances with a big family an electric vehicle might not fit the needs and it is therefore important to offer alternatives. This offer will be put together by Cambio.
2. Users of public transport must have the possibility to use bus, tram (light-rail), bicycles and passenger cars with one ticket. Cambio and KVB are currently developing a so called "Mobilticket", an enhancement of the already existing subscription ticket. With this "Mobilticket" travelers will be able to use bus, trams, bicycles and carsharing-cars with their normal season ticket.

<table>
<tr><th>Key Partners</th><th>Key Activities</th><th>Value Propositions</th><th>Customer Relationships</th><th>Customer Segments</th></tr>
<tr><td rowspan="2">1. car dealerships
2. City authority (providing the parking space for vehicles and bicycles)
3. Nextbike (third party for logistic of bicycles)
4. Garage owners, private house owners (providing the parking Space for Cambio and KVB)
5. Municipal government (policy decision to traffic planning of the city of Cologne)</td><td>1. Managing orders and processing them (online registration = signing of a contract)
2. Provision of cars, e-cars, bicycles and e-bicycles
3. Creating and managing the infrastructure of cars and bikes
4. Supply chain and logistics optimization</td><td rowspan="2">1. for the city / community: Less traffic problems, less costs for general maintenance street work, less pollution, less noise, more "space" in the street
2. for users / costumers / local firms: no need of own cars, bicycles or vehicle fleets
3. for home owner: if they offer car sharing, they can build less parking space for the tenants</td><td>1. One by One
2. Marketing & Publicity (events, sales drive etc.)
3. customer recommendation
4. word-of-mouth recommendation to customers (very important!)
5. long term contracts for the parking space</td><td rowspan="2">private customers
2. company's / local firms / church administration
3. cities / communities</td></tr>
<tr><td>Key Resources
1. Physical assets (passenger cars, passenger e-cars, transport vehicles, bicycles, e-bicycles)
2. Human resources
3. Technology capability</td><td>Channels
1. Phone booking
2. Website
3. Mobile phones (apps and SMS)
4. customer office
5. hotline</td></tr>
<tr><td colspan="2">Cost Structure
1. Fixed costs (depreciation of fixed assets, salaries, technological infrastructure and running (overhead-)costs, maintenance, rent of parking spaces)
2. Variable costs (marketing, energy)</td><td colspan="3">Revenue Streams
1. Fee charge to customer by season tickets
2. Fee charge to costumer
3. Basic fees
4. Extra Services (insurance etc.)</td></tr>
</table>

Key activities

- Managing orders and processing them (online registration = signing of a contract)
- Provision of cars, e-cars, bicycles and e-bicycles
- Creating and managing the infrastructure of cars and bikes
- Supply chain and logistics optimization

Key resources

- Physical assets (passenger cars, passenger e-cars, transport vehicles, bicycles, e-bicycles)
- Human resources
- Technology capability

Key partnerships

- car dealerships
- City authority (providing the parking space for vehicles and bicycles)
- Nextbike (third party for logistic of bicycles)
- Garage owners, private house owners (providing the parking Space for Cambio and KVB)
- Municipal government (policy decision to traffic planning of the city of Cologne)

Customer segments

- private customers
- company's / local firms / church administration
- cities / communities

Value propositions

The value propositions are:

1) for the city / community:
    - less traffic problems, less congestion
    - less costs for general maintenance street work
    - less pollution, less noise
    - more "space" in the street
2) for Users / Costumers / local firms:
    - no need of own cars, bicycles or vehicle fleets
    - less costs
3) for home owner:
    - if they offer car sharing, they can build less parking space for the tenants
    - less costs

Channels

- Phone booking of cars
- Bicycle booking direct on the bike
- Website
- Mobile phones (apps and SMS)

Customer relationship

- One by One
- Marketing & Publicity (events, sales drive etc.)
- customer recommendation
- word-of-mouth recommendation to customers (very important for car sharing)
- long term contracts for the parking space

Revenue streams

- Fee charge to customer by season tickets
- Fee charge to costumer
- Basic fees
- Fee for extra Services (insurance etc.)

Cost structure

- Fixed costs
    - depreciation of fixed assets
    - Staff salaries
    - technological infrastructure
    - running (overhead-)costs
    - maintenance
    - rent of parking spaces

- Variable costs
    - marketing
    - energy
    - maintenance repairs

Stockholm. Green parking index

Measure related 12.1.
Industry partners: Stockholmhelm
Third partner: MoveAbout.

Short description:
According to Swedish legislation, the construction of new buildings, as well as when renovating old ones, requires the provision of a number of parking places per apartment. With the aim to reduce the demand for private parking and encourage alternative forms of transport, the Green parking index was created. The index reduces the number of parking spaces required per apartment, while rewards developers who offer alternative forms of transport to their residents (bicycle parking, car sharing, etc.) by reducing the required parking provision by 10 to 25 percent. Less parking reduces the price for the building and lowers production costs for contractors.

* *Note*: This is more a legislation.

<table>
<tr><th>Key Partners</th><th>Key Activities</th><th>Value Propositions</th><th>Customer Relationships</th><th>Customer Segments</th></tr>
<tr><td rowspan="2">1. Stockholmshem
2. Fortum
3. Move About
4. Potential supplier of E-cargo bikes
5. Residents</td><td>Changing to less car dependecy and electic vehicles</td><td rowspan="2">For the City and the residents: Less pollution, less noice, more "space" in the street.
For Fortum & Move About: New customers and visability.
For Stockholmshem: visability and added value for the tenants</td><td>Direct communication
Marketing & Publicity</td><td rowspan="2">Stockholmshems tenants
Other households in the area
EV-drivers getting the possibility to charge</td></tr>
<tr><td>Key Resources
Parking space
Charging equipment and electricity
EV car sharing pool
Electrik cargo bike pool</td><td>Channels
Newsletters
Webb
Social media</td></tr>
<tr><th colspan="2">Cost Structure</th><th colspan="3">Revenue Streams</th></tr>
<tr><td colspan="2">Fixed Costs:
Buying the services (EV car sharing pool & Electrik cargo bike pool)
Installing the infrastructure
Location (lost revenue)</td><td colspan="3">Not applicable for Stockholmshem, the revenues goes to the providers of the pool services.</td></tr>
</table>

Customer segments

- Stockholmshems tenants
- Other households in the area
- EV-drivers getting the possibility to charge

Value propositions

The value propositions are:

a. For the City and the residents: Less pollution, less noice, more "space" in the street.
b. For Fortum & Move About: New customers and visability.
c. For Stockholmshem: visability and added value for the tenants

Channels

Newsletters
Webb
Social media

Customer relationship

Direct communication
Marketing & Publicity

Revenue streams

The revenues go to the providers of the pool services.

Key resources

Parking space
Charging equipment and electricity
EV car sharing pool
Electric cargo bike pool

Key activities

Changing to less car dependecy and electic vehicles

Key partnerships

1. Stockholmshem
2. Fortum
3. Move About
4. Potential supplier of E-cargo bikes
5. Residents

Cost structure

Fixed Costs:
Buying the services (EV car sharing pool &
Electrik cargo bike pool)
Installing the infrastructure
Location (lost revenue)

Stockholm. Electric & cargo bike Pool

Measure related 12.2.
Industry partners: Stockholmshem
Third partner: MoveAbout.

Short description:
Creation of a Mobility Hub with e-bikes and E-cargo Bikes, offered by the company MoveAbout.

<table>
<tr><th>Key Partners</th><th>Key Activities</th><th>Value Propositions</th><th>Customer Relationships</th><th>Customer Segments</th></tr>
<tr><td rowspan="3">(1) carriers/Transportation companies
(3) Citizens
(3) City council/Local governments</td><td>create a e-bike & e-cargo bike pool.</td><td rowspan="3">(1) Traditional carriers: increase the use of e-bikes or e-tricycles for the last-mile delivery.
(2) Citizens: increase the use of e-bikes
(3) Community: reduced environmental and noise impact
(4) City Council: to monitor the noise and pollution levels in that area</td><td>(1) Customer support
(2) Personal assistance</td><td rowspan="3">(1) Citizens
(2) Carriers / Transportation
(3) City Councils / Municipalities</td></tr>
<tr><td>Key Resources</td><td>Channels</td></tr>
<tr><td>(1) Physical assets (charging stations, and batteries).
(2) Human resources (operations staff of the charging stations and replacement of batteries)</td><td>(1) With citizens: Website and Mobile phone apps
(2) With carriers: Sales force and web sales</td></tr>
<tr><th colspan="3">Cost Structure</th><th colspan="2">Revenue Streams</th></tr>
<tr><td colspan="3">(1) Fixed costs (Running costs, Salaries, e-bikes and e-cargo bikes)
(2) Variable costs (Costs of managing the pool station and maintenance of the e-bikes and e-cargo bikes)</td><td colspan="2">(1) Fee charged to carriers
(2) Fee charged to citizens</td></tr>
</table>

Key activities

The activity is to create a e-bike & e-cargo bike pool. The measure is centered to be used by citizens and carrier companies.

Key resources

The key resources are:

(3) Physical assets: e-bikes and e-cargo bikes.
(4) Human resources: operations staff of the pool station and maintenance of the vehicles.

Key partnerships

Normally the key partners will be carriers / transportation companies interested to use EV for the last mile distribution. But citizens using e-bikes or e-tricycles can also be partners, as City Councils, that might wish to promote the use of these kinds of vehicles.

Customer Segments

The customer segments can be listed as follows:

Citizens: Who live in urban centers and use e-bikes or similar EV.

Carriers/Transportation: Transportation companies for which is difficult to deliver efficiently in the last-mile of city centers, and therefore use e-bikes or similar EV.

Citi Councils and Municipalities (citizens included): Municipalities that will like to improve the use of e-bikes or similar EV.

Value Propositions

The value proposition for the users is an improvement of the energy consumption and of time consumption, for carrier companies.

From the point of view of the city, the benefit obtained lies in reducing, a priori, the level of pollution generated by the use of e-bikes or similar EV, more precisely in substituting polluting vehicles for other more environmentally sustainable.

Channels

With citizens: Website and Mobile phone apps
With carriers: Sales force and web sales

Customer Relationships

The relation with the final user will be by gibing a customer support and personal assistance if needed.

Revenue Streams

(3) Fee charged to carriers
(4) Fee charged to citizens

Cost structure

(1) Fixed costs (Running costs, Salaries, e-bikes and e-cargo bikes)
(2) Variable costs (Costs of managing the pool station and maintenance of the e-bikes and e-cargo bikes

4. About GrowSmarter

GrowSmarter (www.grow-smarter.eu) brings together cities and industry to integrate, demonstrate and stimulate the uptake of '12 smart city solutions' in energy, infrastructure and transport, to provide other European cities with insights and create a ready market to support the transition to a smart, sustainable Europe.

5. GrowSmarter project partners

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Annex 1. Business Models and Scalability

Strategy has been the primary building block of competitiveness over the past three decades, but in the future, the quest for sustainable advantage may well begin with the business model.

The pressure to crack open markets in developing countries, particularly those at the middle and bottom of the pyramid, is driving a surge in business-model innovation. The economic slowdown in the developed world is forcing companies to modify their business models or create new ones. In addition, the rise of new technology-based and low-cost rivals is threatening incumbents, reshaping industries, and redistributing profits. Indeed, the ways by which companies create and capture value through their business models is undergoing a radical transformation worldwide.

What is a business model?

Everyone agrees that executives must know how business models work if their organizations are to thrive, yet there continues to be little agreement on an operating definition. Management writer Joan Magretta defined a business model as "the story that explains how an enterprise works," harking back to Peter Drucker, who described it as the answer to the questions: Who is your customer, what does the customer value, and how do you deliver value at an appropriate cost?

Other experts define a business model by specifying the main characteristics of a good one. For example, Harvard Business School's Clay Christensen suggests that a business model should consist of four elements: a customer value proposition, a profit formula, key resources, and key processes. Such descriptions undoubtedly help executives evaluate business models, but they impose preconceptions about what they should look like and may constrain the development of radically different ones.

Our studies suggest that one component of a business model must be the choices that executives make about how the organization should operate—choices such as compensation practices, procurement contracts, location of facilities, extent of vertical integration, sales and marketing initiatives, and so on. Managerial choices, of course, have consequences. For instance, pricing (a choice) affects sales volume, which, in turn, shapes the company's scale economies and bargaining power (both consequences). These consequences influence the company's logic of value creation and value capture, so they too must have a place in the definition. In its simplest conceptualization, therefore, a business model consists of a set of managerial choices and the consequences of those choices.

Companies make three types of choices when creating business models. Policy choices determine the actions a organization takes across all its operations (such as using

nonunion workers, locating plants in rural areas, or encouraging employees to fly coach class). Asset choices pertain to the tangible resources a company deploys (manufacturing facilities or satellite communication systems, for instance). And governance choices refer to how a company arranges decision-making rights over the other two (should we own or lease machinery?). Seemingly innocuous differences in the governance of policies and assets influence their effectiveness a great deal.

Data and Information for Business Model Evaluation

The starting point is to define some concepts that will allow us to describe what a business model actually is. To do so, we will use the nine basic building blocks described in the business model canvas (Osterwalder & Pigneur, 2010). More specifically:

- Customer segments
- Value propositions
- Channels
- Customer relationship
- Revenue streams
- Key resources
- Key activities
- Key partnerships
- Cost structure

The definition of each building block for the presentation of business models are:

Customer segments

The customer segments define the different groups of people or organizations an enterprise aims to reach and serve.

Value propositions

This block describes the bundle of products and services that create value for a specific customer segment. Value propositions are delivered to customers through communication, distribution and sales channels.

Channels

This block describes how a company communicates with and reaches its customer segments to deliver value propositions.

Customer relationship

Customer relationships are established and maintained with each customer segment. This block describes the types of relationships a company establishes with specific customer segments.

Revenue streams

Revenue streams result from value propositions successfully offered to customers. This block represents the cash a company generates from each customer segment – costs must be subtracted from revenues to create earnings.

Key resources

Key resources are the assets required to make a business model work.

Key activities

These work by performing a number of key activities. This block describes the most important things a company must do to make its business model work.

Key partnerships

Some activities are outsourced and some resources are acquired outside the enterprise. This block describes the network of suppliers and partners that make the business model work.

Cost structure

The business model elements result in the cost structure.

Evaluation and Assessment of Business Models

How can you tell if a business model will be effective? A good one will meet three criteria.

1. Is it aligned with company goals?

The choices made while designing a business model should deliver consequences that enable an organization to achieve its goals. This may seem obvious until you consider a counterexample. In the 1970s, Xerox set up Xerox PARC, which spawned technological innovations such as laser printing, Ethernet, the graphical user interface, and very large scale integration for semiconductors. However, Xerox PARC was notoriously unable to spawn new businesses or capture value from its innovations for the parent due to a distressing lack of alignment with Xerox's goals.

2. Is it self-reinforcing?

The choices that executives make while creating a business model should complement one another; there must be internal consistency. If, ceteris paribus, a low-cost airline were to decide to provide a level of comfort comparable to that offered by a full-fare carrier such as British Airways, the change would require reducing the number of seats on each plane and offering food and coffee. These choices would undermine the airline's low-cost structure and wreck its profits. When there's a lack of reinforcement, it's possible to refine the business model by abandoning some choices and making new ones.

3. Is it robust?

A good business model should be able to sustain its effectiveness over time by fending off four threats, identified by Pankaj Ghemawat. They are imitation (can competitors replicate your business model?); holdup (can customers, suppliers, or other players capture the value you create by flexing their bargaining power?); slack (organizational complacency); and substitution (can new products decrease the value customers perceive in your products or services?). Although the period of effectiveness may be shorter nowadays than it once was, robustness is still a critical parameter.

In order to assess the business models for each solution or measure, we will combine the data and information collected through the business model canvas with a classic strengths, weaknesses, opportunities and threats (SWOT) analysis.

The SWOT analysis is commonly used in business environments and it is used to analyze an organization's strengths and weaknesses and identify potential opportunities and threats. It is an attractive tool because of its simplicity but in combination with the business model canvas enables a focused assessment and evaluation of an organization's business model.

SWOT analysis asks four big, simple questions:

- What are your organization's strength and weaknesses? The first two assess the organization internally.

- What opportunities does your organization have and what potential threats does it face? The second two asses the organization position within its environment.

To provide a good basis for discussion, decision-making and ultimately innovation, we will ask these four questions with respect to both the overall business model and each of its nine concepts described before.

The data collection will be conducted through questionnaires and interviews with partners. These questionnaires and interviews will allow us to conduct a structured SWOT assessment of the business model yielding to two results:

- A snapshot of where they are now (strengths and weaknesses)
- Suggestions for future trajectories (opportunities and threats)

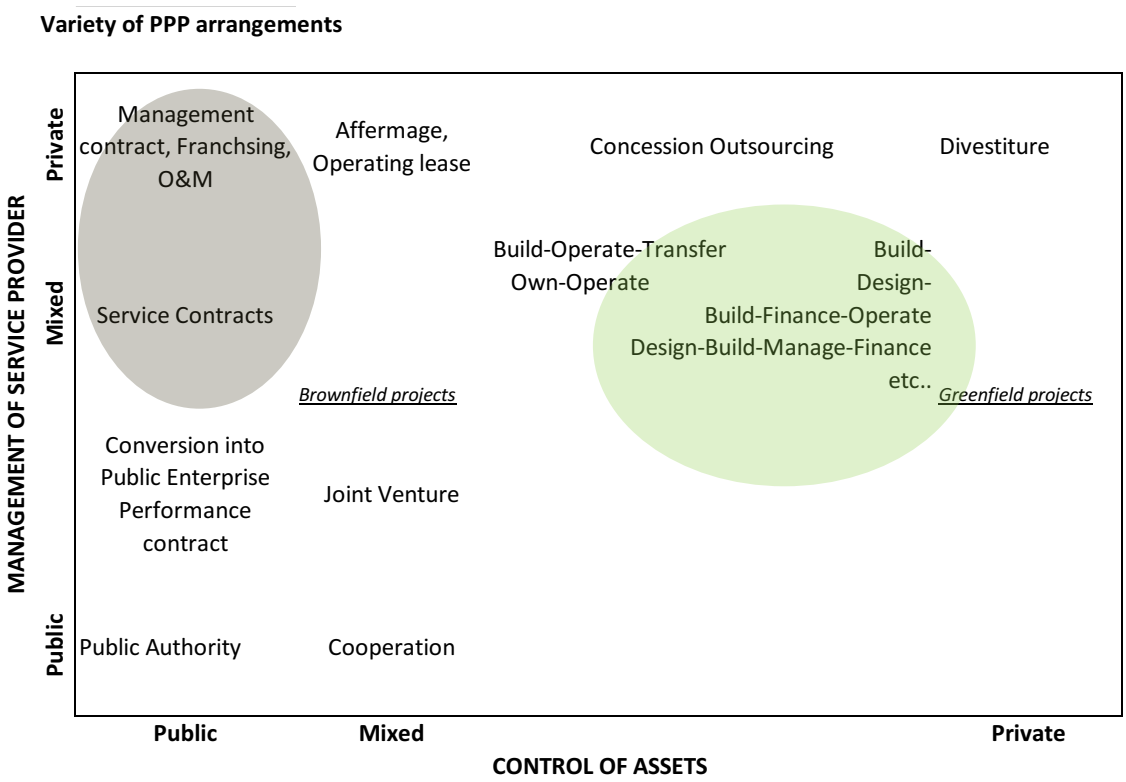
This valuable input will help us to design new business model options and suggestions for replicability and scalability of the measures and solutions implemented.

Public-Private Partnerships

An important part of the analysis will be based on providing tools to assess the financial sustainability of the different solutions implemented. In this regard the systematic identification and evaluation of different options to implement the measures must be carried out with rigor. In an environment of supply of partly public goods and partly individual goods, which can be financed with public or private contributions, directly (usage fees or contributions to investments) or indirectly (shadow tolls, savings, advertising, ...) and generate significant positive economic, social or environmental externalities is essential to consider all possibilities, both at the time of diagnosis and execution of different financial scenarios.

In this sense, the so-called Public-Private continuum, and that in a more sophisticated manner can be shown in a two-dimensional matrix of the possibilities of Public-Private partnership both in the ownership of the asset and service management, is a rigorous way to present this panoply of possibilities for PPPs to develop the actions[2].

[2] See for example: Delmon, J. (2010), Understanding Options for Public Private Partnerships in Infrastructure, Policy research Working Paper 5173, The World Bank.



When choosing what are the best alternatives within this two-dimensional public-choice scenario, there are different tools developed from academia and from the own government (Public Sector Comparator, etc.) to perform these assessments. What is needed is to determine which of these tools are the best for the different situations and evaluate this complex context of different alternatives.

Furthermore, the different forms of PPP can generate additional political problems of acceptance of private participation in the solutions because it could be interpreted both as a privatization of profits or a socialization of losses. In this case, in alignment with the objectives of the project, we propose to introduce the concept of P4 where the organized participation of different stakeholders in the processes of P3 (Public-Private partnerships) can be a strategic element to help ensure the general success of the actions. The methodology to add the fourth "P" to the strategy should be discussed and agreed with the different municipalities involved regarding its participation culture (open government, participative processes with citizens, etc…).
To make or propose the right combination of Public-Private partnerships for each solution we should make an assessment of the following dimensions: (+) indicates most favorable to transfer to private sector and (-) indicates less favorable:

- **Transferring assets:**
  1. The **specificity** of investments (+)
  2. The **control of the quality** of the provision (+)
- **Outsourcing provision:**
  1. The **specificity** of investments (-)

2. The **control of the quality** of the provision (+)
3. **Uncertainties** in income, costs and service quality (-) **Completeness** of the contract (+)
4. **Extra-contractual** responsiveness and low execution risk (+)
5. **Internal** capacity to manage outsourcing (+)
6. Existence of **effective competition** before the award and during the execution (+)

Each of these variables should be evaluated in order to get a relative value that rank the solution in terms of a major opportunity to be supplied by public, private or PPP (there is not an absolute value, so we can observe in the real world several solutions to the same problem).

Secondly, PPP in times of budget constraint allows public sector to make investments that it could not afford without private support. But this also could generate other kind of problems as white elephants or pork barrels. So it's necessary to develop a clear decision method to avoid these risks and also transfer efficiently the risks and benefits between public and private partners. If PPP are made for the right reasons they could be a good alternative to public finance and obtain positive social and economic results.