ENERGY SYSTEM TRANSITION THROUGH STAKEHOLDER ACTIVATION, EDUCATION AND SKILLS DEVELOPMENT

ENTRUST

Novel business models and main barriers in the EU energy system

Deliverable D2.3

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Acronyms

BMC	Business Model Canvas
C2C	Cradle to Cradle
CMS	Chemical Management Service
DBFO	Design Build Finance and Operate
DECC	Department of Energy and Climate Change
ECM	Energy Management Contracting
EE	Energy Efficiency
EPC	Energy Performance Contract
ESC	Energy Supply Contract
ESCO	Energy Service Company
ETS	Emission Trading System
EV	Electric Vehicle
FT	Framework Tool
FTS	Flexible Transport Services
GDP	Gross Domestic Product
GHG	Green House Gas
GSCM	Green Supply Chain Management
ICT	Information and Communications Technology
IEC	Integrated Energy Contracting
IPD	Integrated Project Delivery
MEEPA	Metered Energy Efficiency Purchase Agreement
PPA	Power Purchase Agreements
PPP	Public Private Partnership
REE	Red Electrica de España
RET	Renewable Energy Technologies
RTE	Le Réseau de l'intelligence électrique
SSA	Shared Saving Agreements
TBM	Take Back Management
OBR	On-bill Repayment

About the ENTRUST Project

ENTRUST is mapping Europe's energy system (key actors and their intersections, technologies, markets, policies, innovations) and aims to achieve an in-depth understanding of how human behaviour around energy is shaped by both technological systems and socio-demographic factors (especially gender, age and socio-economic status). New understandings of energy-related practices and an intersectional approach to the socio-demographic factors in energy use will be deployed to enhance stakeholder engagement in Europe's energy transition.

The role of gender will be illuminated by intersectional analyses of energy-related behaviour and attitudes towards energy technologies, which will assess how multiple identities and social positions, combine to shape practices. These analyses will be integrated within a transitions management framework, which takes account of the complex meshing of human values and identities with technological systems. The third key paradigm informing the research is the concept of energy citizenship, with a key goal of ENTRUST being to enable individuals overcome barriers of gender, age and socio-economic status to become active participants in their own energy transitions.

Central to the project will be an in-depth engagement with five very different communities across Europe that will be invited to be co-designers of their own energy transition. The consortium brings a diverse array of expertise to bear in assisting and reflexively monitoring these communities as they work to transform their energy behaviours, generating innovative transition pathways, and business models capable of being replicated elsewhere in Europe.

For more information, see **http://www.entrust-h2020.eu**

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Executive Summary

The ENTRUST project provides a mapping of the energy system in Europe and aims to achieve an in-depth understanding of how human behaviour around energy is shaped by both technological systems and socio-demographic factors. This report corresponds to the third deliverable foreseen in Work Package 2, which focuses on analysing the role of key actors in the European energy system and characterising the novel technologies and business models emerging in the energy transition.

Within this context, Deliverable 2.3 "Report on novel business models and main barriers in the EU energy system" comprises a mapping of the emerging business models in the energy system as well as a clarification of its elements, sources of innovation, and main barriers.

The first part of the deliverable introduces the game changing scenario taking place and presents the role of business models in the sustainable energy transition. Megatrends – such as energy availability and security, resource depletion, the technological revolution and urban development – affect and challenge the energy value chains in the energy system. These trends and its multiple implications for the energy sector are discussed in this section. The main barriers that slow down the transition towards a more sustainable structure are also presented.

Innovation has played a key role in the energy system but often the term is misunderstood and confused with others like creativity, change, or invention. The next section defines what innovation means for this project and it also gathers the different classifications of innovation found in the literature that help to categorise emerging business models. "Ten types of innovation" and "the business model innovation grid" are two powerful tools that frame different sources of innovation. From them, our own classification of innovation is created to classify the business models we have identified.

Moreover, a review of the three framework tools – Osterwalder & Pigneur's Canvas, IDEO, and Fluidminds – currently applied in the innovation ecosystem to characterise business models was conducted in order to define the most appropriate one for ENTRUST. These framework tools help us to understand how an organisation creates and delivers value, makes money and visualises its structure.

The next part of the report examines the emerging business models that correspond to the four energy-intensive sectors that have been selected in the scope of ENTRUST (buildings, urban transport, energy production and the manufacturing process industries).

For each business model identified an overall description, along with some real cases, and the business model framework created for Entrust are presented. In addition, an analysis has been conducted to identify which type of innovation is occurring in each sector and at what specific stage of the value chain.

A brief overview of the sectors analysis is presented in this Executive Summary.

Energy Production and supply

The value chain of the energy production and supply process is changing due to the entrance of new actors and elements. The existing structure does not fit with the new demands for decentralised generation, electric devices and appliances, or storage requirements, so the structure of this industry and the role of power producers are undergoing fundamental changes.

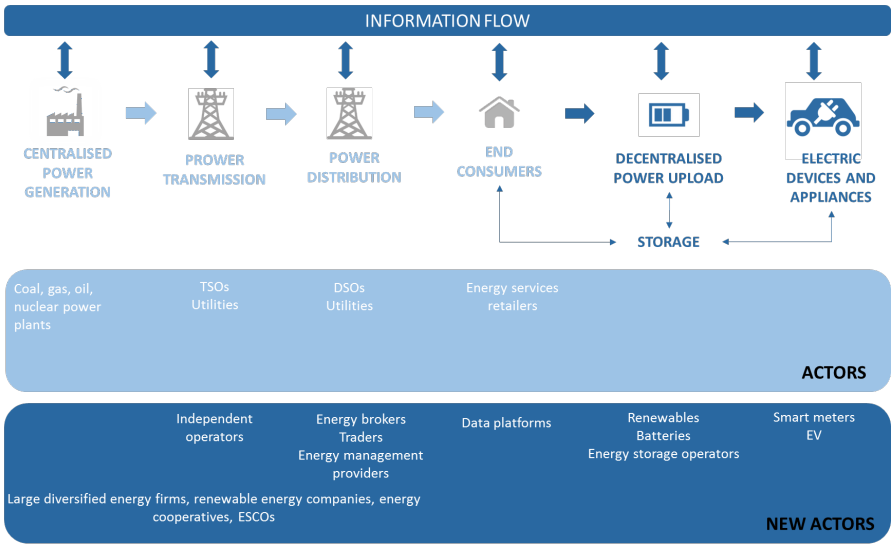

Figure A: Value chain of the energy supply sector and main actors (Swedish Energy Agency, 2014)

Energy supply is changing towards a more decentralised system in which both customers and end-users are playing a fundamental role. Novel models are quite homogenously distributed. However, innovation is mainly positioned at the new stages (decentralised power upload, electric devices and appliances, and storage). Regarding the main innovation types identified, technological and configuration changes are leading the way in the move towards a more sustainable energy system in which interconnection and customer engagement are key.

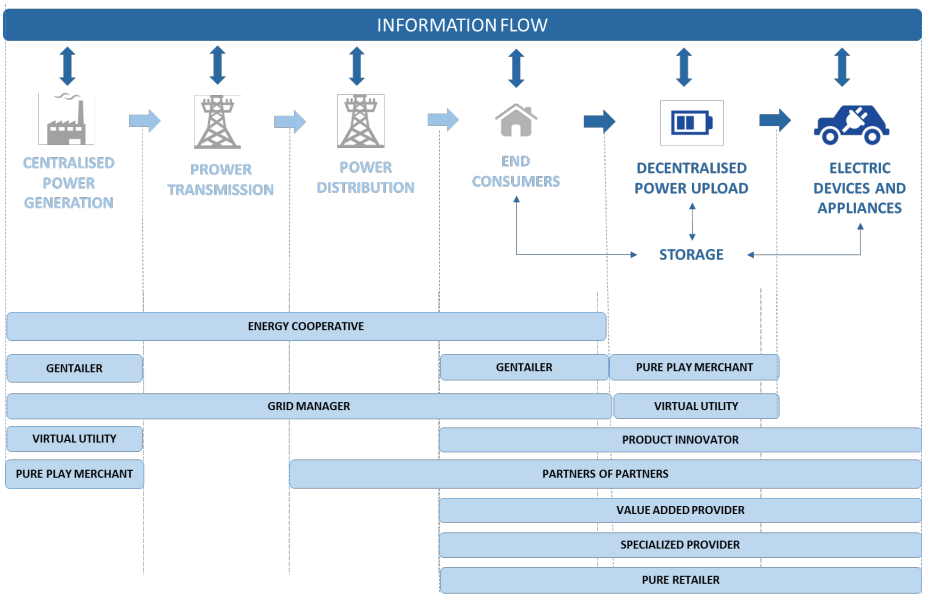

Figure B: Mapping of BMs of the energy supply value chain (Swedish Energy Agency, 2014)

Construction

In the case of the construction value chain, the scenario is highly complex and involves a number of traditional actors – often uncoordinated and with conflicting interests – including contractors, installers, architects and suppliers, as well as new actors emerging from energy related sectors. The traditional structure does not fit with the new demands based on low carbon consumers, increasing interest for existing properties, increasing renewable energy production in buildings or novel interactions of buildings with the energy market (demand response, energy storage and energy production).

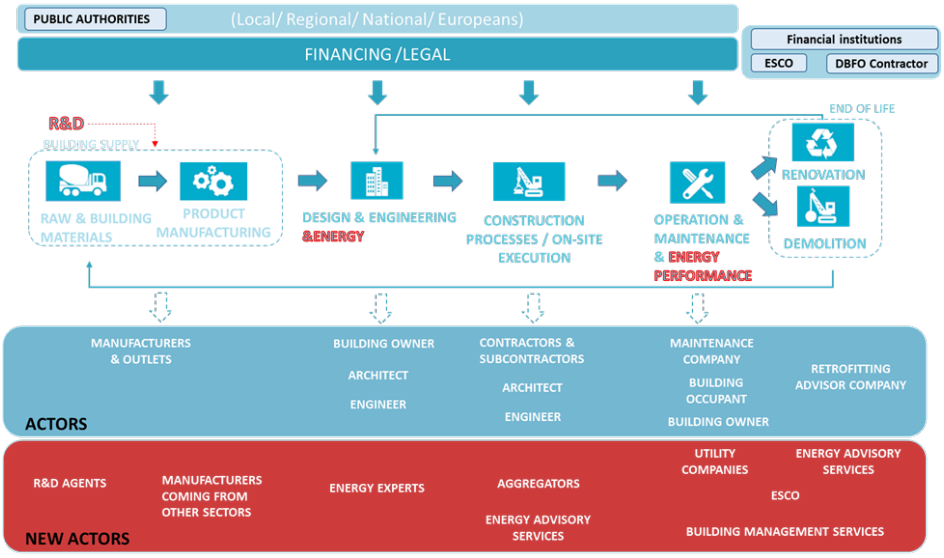

Figure C: Building process and its actors (De Groote & Lefever, 2016)

The greening transformation of the building sector is bringing new market players at public and private levels onto the scene. For instance, utilities are adapting their traditional and long-established business models and focusing on the vertical integration of their businesses, with little or no customer preference considered, to offer comprehensive and integrated services going beyond the mere energy supply (e.g. including home automation, security, and telecommunication services). Business innovation on the building sector is occurring all along the industry value chain, starting with the re-design of project delivery models, energy performance solutions, and leading to deep renovation. The built environment paradigm shift is pulling building users to the centre of the ecosystem and therefore service oriented business models are leading the way towards a greener building industry, in which cross-sectoral collaboration is key.

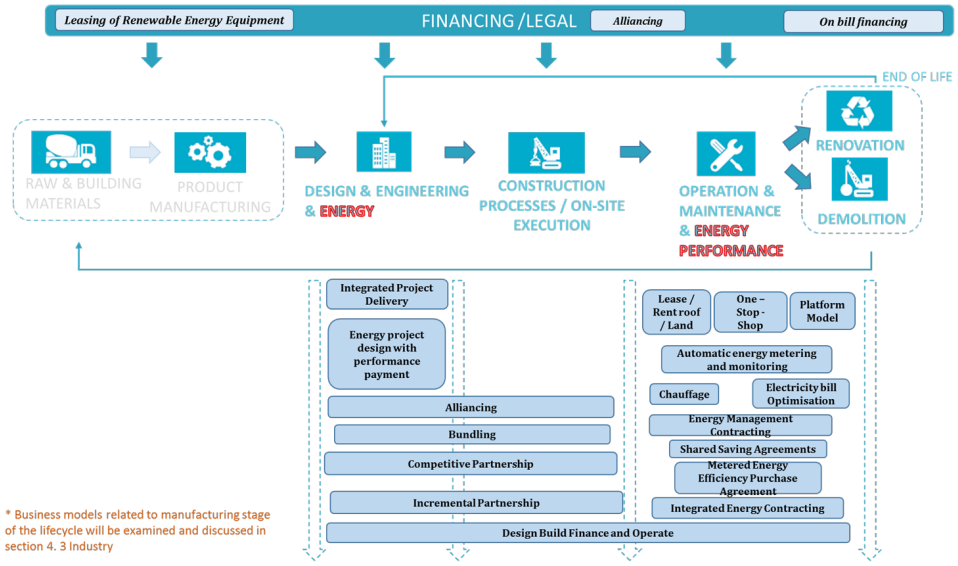

Figure D: Mapping of the business models of the buildings sector (De Groote & Lefever, 2016)

Manufacturing Industry

The traditional structure of the industry, which focused on achieving "maximum gain from minimum capital", does not correspond to an industrial paradigm change based on achieving "maximum added value from a minimum of spent resources". Therefore, the structure of process manufacturing industries and the role of key players within it are evolving. The new scenario is dominated by ICT-supported measures that concern specific domains of manufacturing, including smart monitoring systems that tackle plant energy consumption and valorisation of waste streams, or control algorithms tackling production effectiveness and emissions.

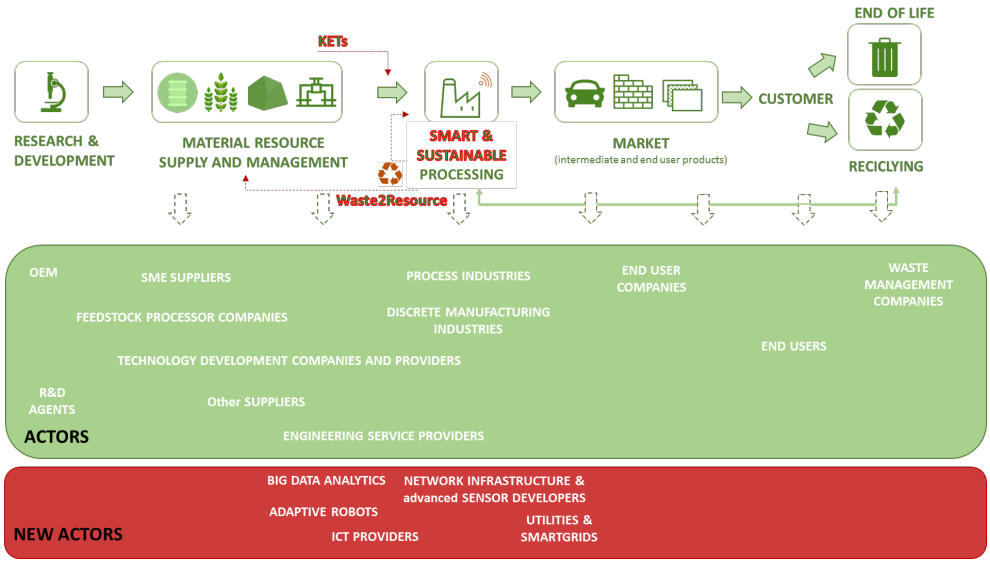

Figure E: Value chain and actors of the manufacturing industry (SPIRE, 2013)

Novel business models are emerging all along the industrial value chain starting with material resource and supply management, and the requisite production systems, and leading to the end of life in the form of

remanufacturing and recycling. This reflects the global commitment of industry/stakeholders to improve the energy, resource, and CO_2 efficiencies operating within these industries. Circularity and optimisation are leading the way in moving us towards a more resource efficient and sustainable industry, with cooperation between stakeholders under various forms being key to this movement.

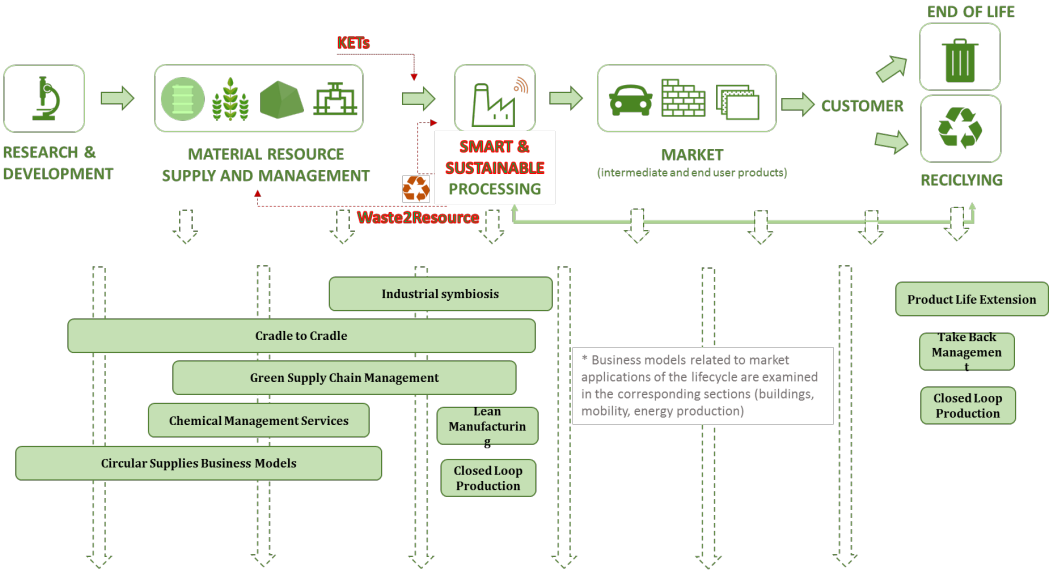

Figure F: Mapping of the business models of the manufacturing industry sector (SPIRE, 2013)

Urban Mobility

The traditional structure of the urban mobility sector, which focused on public transit and car ownership, does not fit with the paradigm shift based on mobility access with a greater emphasis on flexibility, affordability, more vehicle options, and minimal delay. The new cross-sectorial scenario is dominated by non-traditional players such as infrastructure providers (telecom companies, payment systems and parking operators), new transport modes operators (i.e. vehicle owners offering peer-to-peer mobility services or car sharing companies) and local authorities.

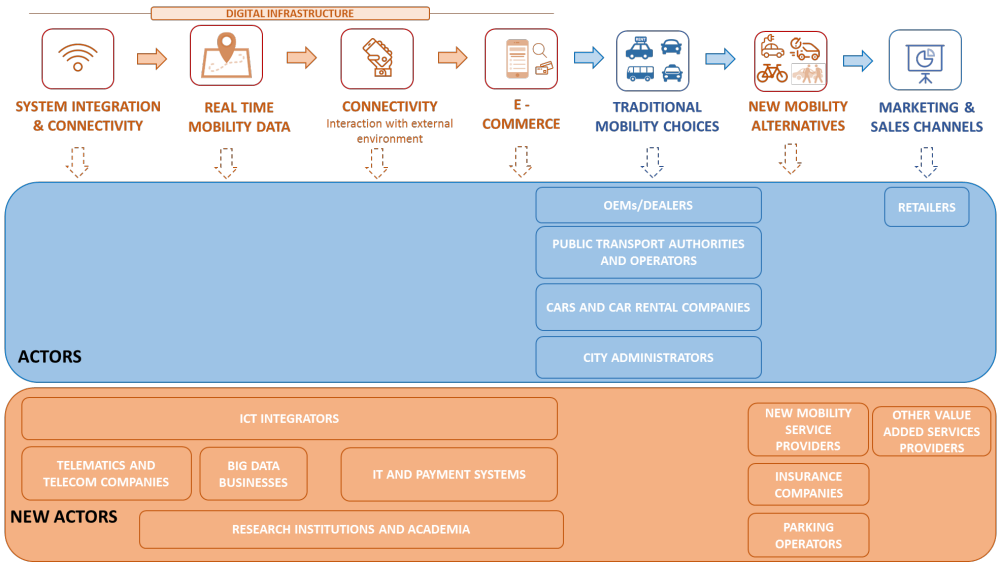

Figure G: Urban mobility ecosystem and actors (Bouton, Knupfer, Mihov, & Swartz, 2015).

Evolving mobility needs, technological advancements and collaborative consumption are disrupting today's urban mobility systems. The rise in smartphone penetration, the ability to process big data, to provide real-time information and the interest of specialised players from other sectors to enter into the extended mobility system value chain, are some of the drivers behind the recent emergence of new business models in the urban mobility sector value chain. Business innovation on the urban mobility ecosystem is mainly centred around developing new mobility alternatives and the digital infrastructure enabling their integration. Improving customer experience and creating new configurations are leading the way to move towards a more flexible, affordable and sustainable urban mobility system, in which partnerships and customer engagement are key.

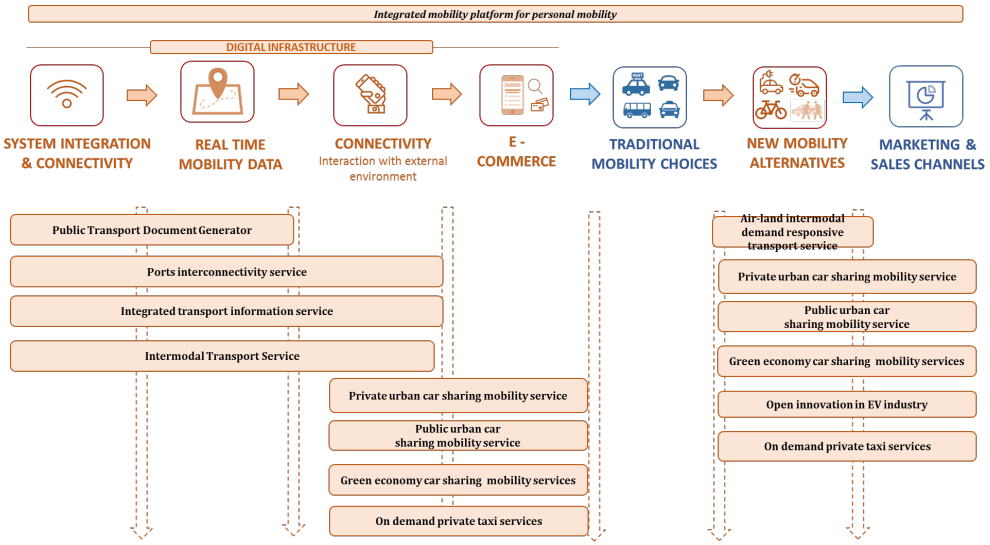

Figure H: Mapping of the BMs of the urban mobility ecosystem (Bouton, Knupfer, Mihov, & Swartz, 2015)

Finally, a global analysis of the innovation trends in all the business models identified is carried out. The whole discussion allows for us to gain a better understanding of the main innovations and emerging business models within the EU energy system. The new scenario brings not only new ways of interaction between companies, customers and all the actors present in the value chain but creates new stages and roles.

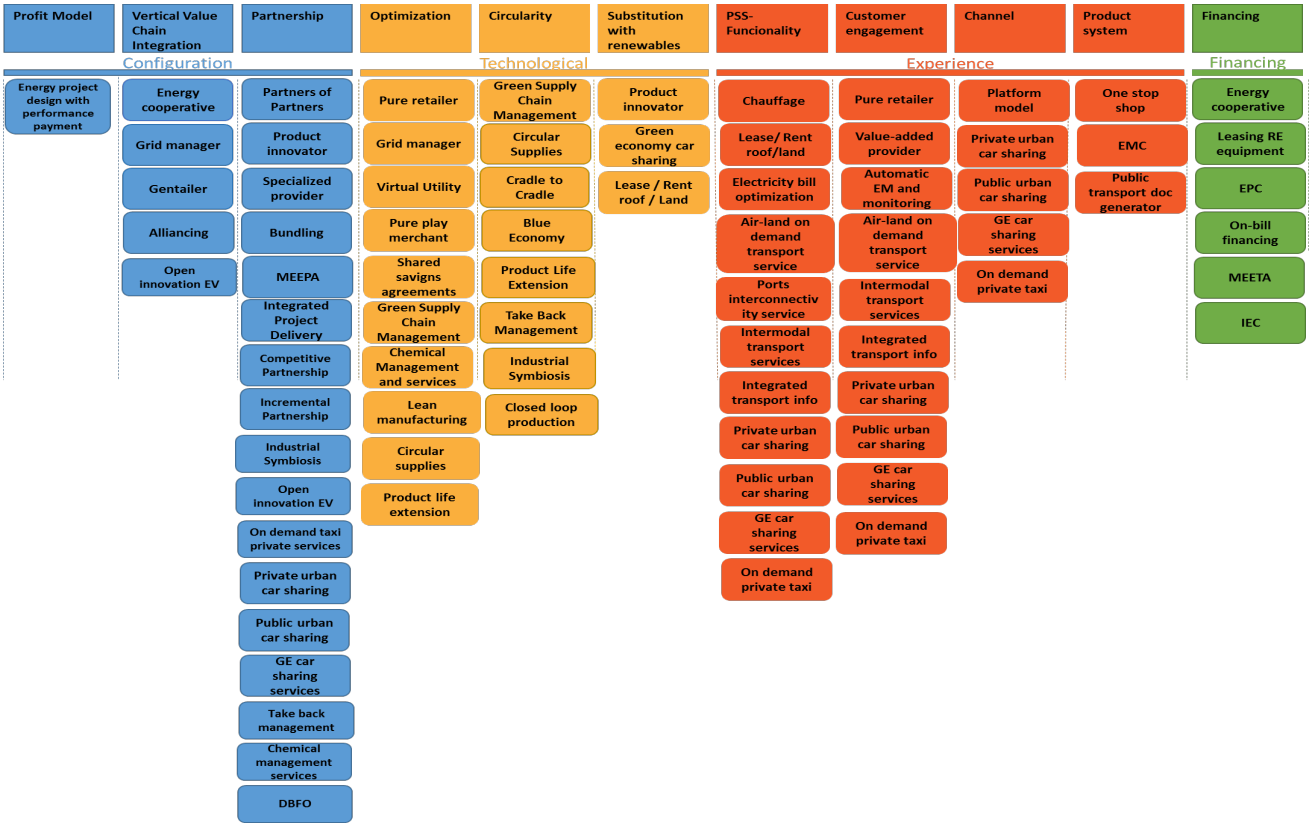

Figure I: Innovation on business models of the energy system (LGI, 2016)

From our analysis, we have concluded that innovative business models are emerging within the four archetypes proposed – configuration, technology, experience, and financing. However, three subtypes stand out; partnerships, PSS-functionality and customer engagement. Partnerships between companies are enabling the development of new offerings to customers. In addition, firms provide more and more services instead of products, including those that encourage correct behaviours and satisfy users' needs. The last trend is customer engagement. Innovative business models attempt to foster greater commitment from customers, making them more conscious of energy usage and consumption.

To sum up, the transition of the energy system is happening now and is being boosted by a suite of innovative business models. These models are not only bringing about new ways of interaction between companies, customers and all the actors present in the value chain but are also creating new stages and roles for all involved. Therefore, the business model mapping and innovation analysis carried out in this deliverable is a useful guide for understanding the main trends currently taking place in the sustainable energy transition.

1 Introduction

1.1 Introduction to the deliverable

The ENTRUST project aims to provide an analysis of the human factor of the European energy system and to achieve a deep understanding of the human and societal aspects of energy. The project uses a mixed-methods approach to address the issue from multiple angles including: policy reviews, social-economic analyses, and extensive qualitative data collection, including interviews with case study communities.

Currently, the energy sector is confronted by challenges from greenhouse gas (GHG) emissions, climate change, and security of supply among others. A transition to a low-carbon energy system is required to overcome these issues, where innovative business models can play an important role. There is a new trend towards implementing new business models that has the potential to transform the energy market, and to deliver new services and benefits to customers (Ofgem, 2015).

The main objective of the Work Package 2 is to provide a mapping of the factors that need to be taken into account to foster a transition in the energy system. Indeed, it also seeks to inform and outline the scope for the following WPs.
Task 2.1 focuses on mapping the actors and their interactions and outlines the capacity of those actors to change the current energy system and its constraints. In addition, Task 2.2 proposes a technological review throughout the energy supply chain in order to understand the possibilities and limitations of the energy system. This task identifies the main technologies from generation, transportation, distribution to the end user. In addition, emerging technologies have been identified through a technological review.

Within this context, Task 2.3 comprises a mapping of emerging business models in the energy system. To do this, it is necessary to clarify the business model canvas that best fits the ENTRUST project, as well as market perceptions, and the main objectives and potential risks. Following previous deliverables, the study looks at four key sectors: energy production, buildings, transport (with a focus on urban mobility), and industry (with a focus on process industries).

It is not possible to have a comprehensive understanding without analysing the evolution of the value chains in the different sectors, that is to say, how the systems are adapting to provide new services to customers.

1.2 Deliverable structure

The deliverable is built as follows:

- **The role of business models in the energy transition**

This part presents an energy system that is continuously changing in terms of key trends and the main barriers towards a sustainable future. Also, how business models are changing the current scenario and why they are important is explored.

- **Business model innovation in the energy system**

In this section, the concept of a business model from different authors is explained to understand better its importance. The main framework tools are presented and a specific canvas for ENTRUST is created from them. All the elements of the canvas are also explained in detail.

The importance of innovation is included in this chapter. A combination of two different classifications of innovation from the literature serve as an input to create a new classification of innovation sources for ENTRUST.

- A **benchmark of innovative business models**

Firstly, for each of the four sectors studied in this deliverable (energy supply and production, buildings, manufacturing process industry, and urban transport) an evolution of the value chain is presented. What the new stages and entrants are and how the new business models can in turn be placed on the value chain. Moreover, a mapping of innovative business models has been carried out, with each business model incorporating a brief description, presenting with some real cases, and explaining what their innovation source is. Also, the canvas created for ENTRUST is included in each business model to frame it. Finally, an analysis of the main trends of innovation in every sector is carried out.

- **Insights and conclusions**

The last part synthesises the work of the deliverable and summarises the main trends in terms of business model innovation in every sector.

2 The role of business models in the energy transition

2.1 An energy system in continuous evolution

Energy is the cornerstone of human live. In the modern economy, almost all goods and services have energy implications, from the buildings we live in to the vehicles we use for transport or the food we eat requires energy. Its extensive scope implies that it both impacts and is affected by social, political, technological and market evolutions.

In Europe, the energy sector is indeed a key component of economic growth and its employment sector. By way of example, the renewable energy sector alone employed over one million people in Europe and created a turnover of around €143.6 billion in 2014 (EurObserv'ER, 2015).

Megatrends– such as energy availability and security, resource depletion, the technological revolution and urban development – affect and challenge the energy value chains in the energy system. These trends and its multiple implications for the energy sector are discussed in this section.

2.1.1 Trends in the energy system

Table 1 provides a summary of the megatrends and drivers of change that are key to understanding the future of the European energy system's functioning.

Table 1: Megatrends and drivers of change of the energy system in Europe

MEGATRENDS	DRIVERS OF CHANGE	EXAMPLES
CLIMATE CHANGE	**Legislation and support measures** to reduce emission from energy intensive sectors (buildings, transport, power generation and industry)	
	Increased **consumer awareness** towards sustainability	
ENERGY SUPPLY	**Legislation and support measures** to reduce energy demand from buildings, transport and industry	
	The **energy market** is **changing**	Growing share of renewables in the energy system, generation is becoming decentralised, distributed and smart
	Grid parity and distributed introduction of renewable energy sources	Reduction of costs through the progress on the learning curve, distributed grid parity of solar for example
	Increased need of flexibility	Distributed energy generation provides a degree of independence to the customer
DIGITAL AND TECHNOLOGY REVOLUTION	**Smarter industrial processes and systems**	ICT related measures implemented: Smart monitoring systems, control algorithms tackling production effectiveness, advanced automation,
	Penetration of smartphone technology and connected devices	Paradigm shift in the mobility and building sector: one stop shop
RESOURCE AND ENVIRONMENTAL DEPLETION	**Legislation and support measures** (EU, national and regional levels) to increase resource efficiency	
	Increased general **consumer awareness** towards energy efficiency	
	New **investments** to enhance energy security	To support interconnections and backup, including energy storage technologies and, increased capacity reserves
URBAN REDEVELOPMENT	**High and increasing degree of urbanisation**	>2/3 of the European population in 2050
DEMOGRAPHIC CHANGE	**Increasing primary energy consumption**	Increase of 33% compared to 1980

These drivers of change are leading to multiple implications for the energy system, drafting completely new scenarios that threaten traditional business models and allow new players to address emerging opportunities all along the value chain from energy generation to consumption.

2.1.2 Barriers for the energy transition

However, the energy system has also to confront several barriers that slow down the implementation towards a more sustainable structure. They can be classified in different groups such as **market and social, financial, regulatory, and innovation barriers** (FORA 2010; Danish Business Authority, 2012; Würtenberger & Bleyl, 2012; Lindgardt *et al*, 2009; Swedish Energy Agency - Growth analysis, 2014).

Market and social barriers

The lack of knowledge, consumer engagement, and trust

Traditional mind-set among consumers and a general lack of awareness on energy alternatives do not benefit the energy transition. End-users and consumers of energy are still largely passive towards the quantity and quality of energy used. The current system structure does not provide enough data to encourage customers to change their behaviours. However, innovative technologies such as smart meters and distributed generation are modifying the passive model and allowing customers to manage their own energy consumption.

Insufficient standards or reference guides to follow

There are insufficient reference cases on new business models and approaches so that the transition towards a new energy system is more challenging. In addition, several new trends are appearing in a short period and there is insufficient knowledge on how to react.

Infrastructure-dependent

New business models face a difficulty in fitting the existing systems. There is a need for supporting infrastructures and technological changes. In addition, the lack of horizontality among different functions in a company reduces the speed of the energy transition. For instance, divisions between product and service developers or those who make investment decisions and those who supervise operations.

Higher risk of Renewables Energy Technologies (RET)

RET projects are seen as a "more risky" investment than conventional ones because they are often considered of high technology or regulatory risk. Consequently, they become less attractive to investors.

Financial barriers

Financial barriers in the low carbon generation still hamper the transition

Technological innovation has brought down the cost of renewable energy generation but further financial innovation would allow the energy system to get more benefits from it. There are inadequacies between the cost and structure of the current fossil fuel industry and the renewable energy sector that hampers a low carbon generation structure. Therefore, the energy industry needs not only to create new financing formulas for RET projects, but also new business and regulatory structures for a cost-effective transition. New financial models have the potential to meet investor needs and open up new pools of low cost funds for energy projects.

High upfront costs

Most of EE measures require more investment than conventional technologies. Decision makers, including small-scale consumers such as private homeowners, might not be willing to make large upfront investments. In addition, it is hard to access the necessary capital especially for homeowners and small businesses that need external funds for financing RET measures. However, once the initial investment is made they are more sheltered from oil price volatility and the revenues are usually guaranteed through power purchase agreements (PPA).

Low return on investment

The compounding effect of both lack of financing and initial high investment costs has curtailed the market performance of RE technologies. This means that many RE technologies are not yet competitive in terms of costs comparing to traditional energy technologies. It is often the case, for example, that customers do not invest in renewable energy projects when the payback time is too long. Sometimes, it can be even longer than the lifetime of the technology itself.

Regulatory barriers

Cumbersome regulation

Restrictive rules prevent companies from taking new approaches. Procurement rules might pose barriers to the development of new technologies. In addition, permits for RE installations are difficult to obtain.

Lack of policies

More public policies are needed to push innovative technologies toward competitiveness. Decision makers and Governments have put in place financial policies that take into account the costs of research, development, and demonstration, and guarantee a reasonable return on investment to technology providers and investors.

Innovation barriers

Focus on ideation in the innovation process

The innovation process is often limited to a focus on the ideation phase, which can potentially result in a large amount of ideas difficult to coordinate. Too many uncoordinated innovations could kill the innovation process as per the limited resources allocated to the process. In the ideation process, it is also easy to focus on pet ideas. These are usually projects that tend not to progress and distract focus from more promising ideas.

Difficulty of scaling up

Once the idea has been accepted and financed for piloting, there is a general decrease of the initial excitement and it can be difficult to motivate the teams and keep the resources for the scaling up process.

Lose the focus on market needs

There is a general tendency, while innovating, to focus on the internal problems and capacities of the company, rather than the real and evolving needs of the clients. Sometimes evolving needs in the market make the traditional model unfeasible, while it can be tough to influence the historical bias of senior management.

2.2 New business models to foster the energy transition

Europe is positioning itself as a leader of the global energy transition after having set ambitious sustainability targets for 2020 and 2050 (European Comission, 2011). Indeed, measures and policies have been deployed to achieve these targets. In particular, the recent adoption of the Energy Union Framework Strategy (European Commission, 2016), with the aim of fully integrate and the redesign the energy market, represents a major step ahead towards the transition to a low-carbon, secure and competitive economy.

Despite these technological advances, the deployment of green tech solutions is not increasing fast enough to meet the EU ambitious goals. This may be explained by the fact that transition towards a more sustainable European energy system, significantly relying on renewable energies and decentralised energy generation systems, energy efficient buildings and low carbon mobility solutions, requires a reorganisation of the energy sector. New market players are emerging from other sectors and global value chains are not yet established. Therefore, the way in which energy services are generated, delivered, and paid is expected to be very different.

As technologies already exist, the success of the energy transition is undoubtedly relying on innovation driven by something else (Boo, Dallamaggiore, Dunphy, & and Morrissey, 2014) Within this changing environment, business model innovation is recognised as a key driver for the successful implementation of the energy turnaround (Steward, 2008; Frei, 2008; Schleicher-Tappeser, 2012).

The reason why innovative business models can lead transition processes towards a more sustainable energy system is due to their performative role. Business models represent active constructs or market devices that are capable of shaping the environment they operate. By playing a performative role, they frame the behaviour of businesses and markets as well as their development and growth (Doganova & Eyquem-Renault, 2009). However, they should support the disruptive change of value proposition and value creation logic required to exploit the emerging business opportunities.

In order to foster greater energy transition, the energy market and related stakeholders need to keep pace with paradigm changes, so that they can have a more proactive role in the generation of sustainable and customer oriented business models addressing the real needs of our society.

In Section 4, we will examine some cross-border and cross-sectoral business models addressing these challenges.

3 Business model innovation in the energy system

3.1 Business model theory

The concept of business model has received increasing attention since the 1990s. At first, it was applied in studies for enterprise classification. Many factors drove its relevance such as emerging business activities, growth of internet and ICT, heterogeneity amongst consumers and producers, and growing competition (Fielt, 2011). Having a well-tailored business model for an innovative technology appears as essential for a successful entering in the market. In the literature, academics have given different definitions of business models; some of them are presented below:

According to (Chesbrough & Rosenbloom, 2002) a business model is "a framework for technological innovation that converts its potentials into economic outputs, that is to say, the business model is conceived as a device that mediates between technology development and economic value creation".

For (Teece, 2010) "it defines how the enterprise creates and delivers value to customers, and then converts payments received to profits". Moreover, David J. Teece emphasises the idea that a business model does not just focus on finance but it is a combination of all value creating theories.

(Johnson, Clayton, & Kagermann, 2008) define The Four-Box Business Model as a "composition of four elements: customer value proposition, profit formula, key resources, and key processes. All together create and deliver value".

According to (Morris, 2005), its "Entrepreneur's business model" is a representation of how an interrelated set of decision variables in the areas of venture strategy, architecture, and economics are addressed to create sustainable competitive advantage in defined markets.

The most widely used definition is the one given by (Osterwalder & Pigneur, 2010). It can be summarised as "the description of how an organisation creates, delivers, and captures value".

All of them have in common the creation of value and most of them the monetisation of this value. Based on the different definitions found in the literature and the objectives of the deliverable, a business model for the ENTRUST project can be defined as:

"The monetisation of how a company creates and delivers value to its customers"

3.1.1 Framework tools for defining business models

There are different tools to describe and think through the business model of an organisation. These framework tools help to understand how an organisation creates and delivers value, makes money and visualises its structure.

The following subsections present a detailed description of three different key frameworks currently used in the innovation ecosystem to characterise business models. From all this analysis emerged the specific framework created for ENTRUST, which is presented at the end of the section.

- **FT1: Osterwalder & Pigneur canvas**

The Business Model Canvas (BMC) is a tool which was developed by the experts on business model innovation (Osterwalder & Pigneur, 2010), and is practised successfully in multiple organisations throughout the world by companies including 3M, IBM, Deloitte, Ericsson, non-profit global organisations in the third world countries and Government Services of Countries like Canada.

In the BMC methodology, a business model can be described through nine basic building blocks: Key Partners, Key Activities, Key Resources, Value Propositions, Customer Relationships, Channels, Customer Segments, Cost structure and Revenue streams. These nine BM Building Blocks cover the four main areas of business in which customers and business partners are involved (customers, offer, infrastructure, and financial viability). Presented in (Figure 1) is the Business Model Canvas design form, which has been analysed and used to define and describe the ENTRUST Canvas.

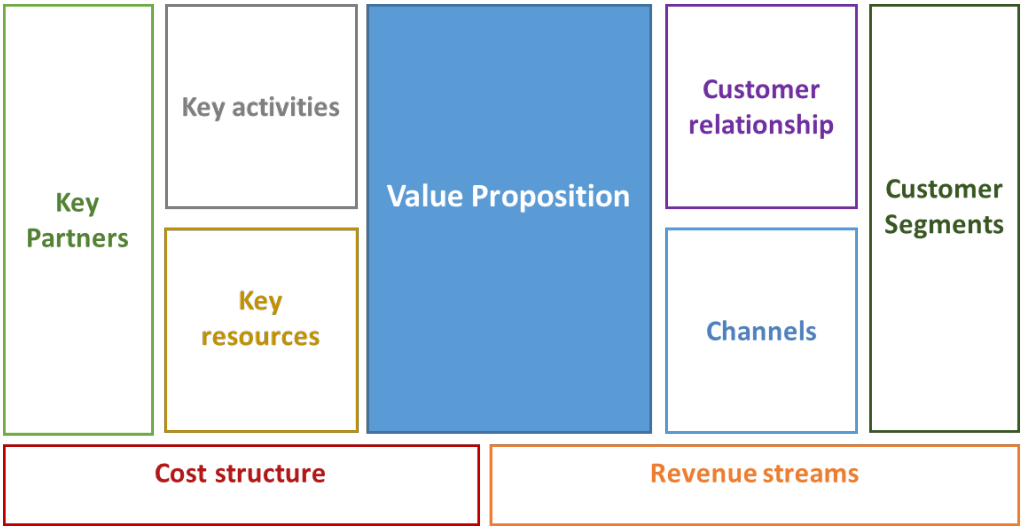

Figure 1: Osterwalder & Pigneur business model: Canvas (2010)

The building blocks are the following:

- **Customer segments** define the groups of people or organisations that a company offer value to.
- **Value proposition** gives an overall view of a company's bundle of products and services that represent value for a specific customer segment and fulfil customer needs.
- **Channels** are the means of getting in touch with the customers. It is the connection between the company value proposition and its target objectives.
- **Customer relationships** are the links a company establishes between its specific customers and itself.
- **Revenue streams** explain how a company makes money through the revenue flows from the value proposition offered to customers.
- **Key activities** are the actions a company performs to make the business model work.
- **Key partnerships** describe the network of suppliers and partners needed to make the business model work.
- **Key resources** correspond to assets required to offer and deliver.
- **Cost structure** is the representation of costs resulting from the operation of the business model.

- **FT2: IDEO business model**

The IDEO framework focuses more specifically on the analysis of start-ups. It takes inspiration from different tools such as the Business Model Canvas, combining various elements of the Osterwalder and Pigneur Canvas (such as value proposition, channels, partners, and costs), but also incorporating new ideas (IDEO, 2011). In the IDEO business model methodology, a business model is described through five main building blocks: Market segments, Pricing model, Competitive strategy and Capabilities Growth strategy (Figure 2).

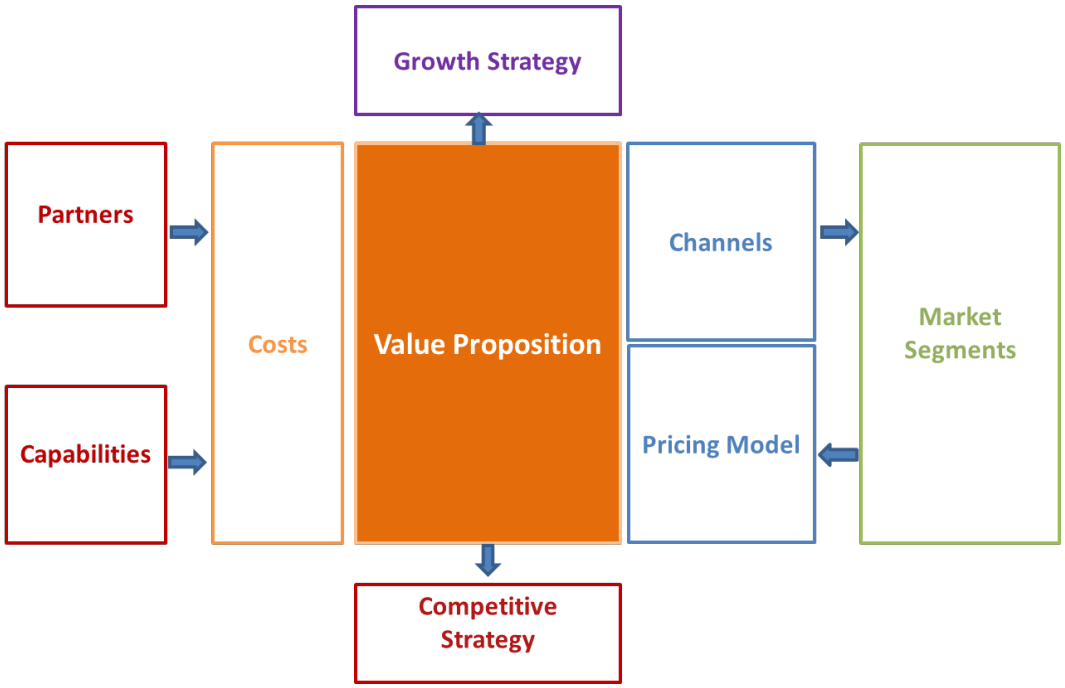

Figure 2: IDEO business model canvas (2011)

The building blocks are the following:

- **Market segments**: the group of people that benefit from the value proposition.
- **Pricing model**: includes the sources of revenue and the price of the products and services.
- **Competitive strategy**: examines the existing competitors.
- **Capabilities**: the skills which are necessary to create value proposition.
- **Growth strategy**: how the company is expected to growth including the sales and organisation strategy.

- ***FT3: Fluidminds business model***

Fluidminds combines analytics and creativity in the rethinking business approach. This innovative methodology was developed by Patrick Stähler at the University of St. Gallen based on design thinking (Stähler, 2001). In the Fluidminds business model methodology, a business model is described through four main building blocks: Value architecture, Value proposition, Revenue model, and Team & Values (see Figure 3).

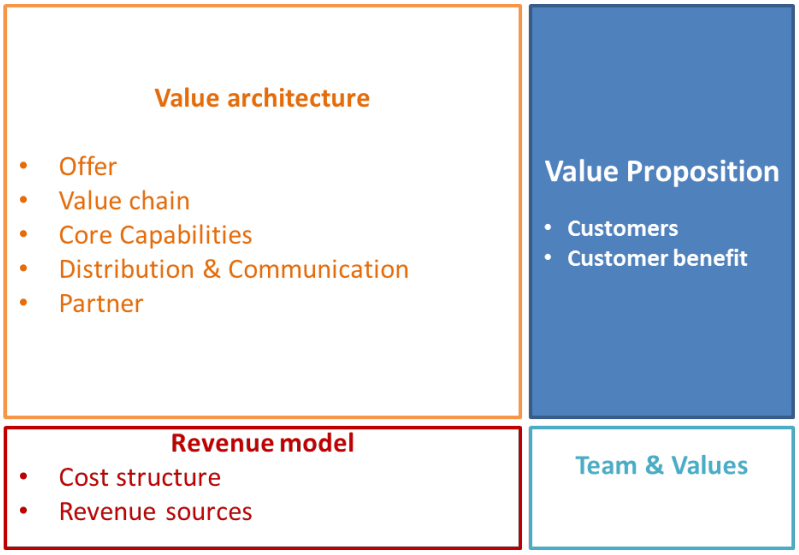

Figure 3: Fluidminds Canvas (2001)

The main elements are the following:

Value architecture

- **Offer:** what is our offer?
- **Value chain:** what are our value creating steps? What is our value chain?
- **Core capabilities:** what core capabilities we need?
- **Distribution & Communication channels:** how can we reach and communicate with our customers?
- **Partner:** which partners do we need?

Value proposition

- **Customers:** who are our customers and what job do we solve for them?
- **Customer benefit:** what benefit do we create for our partners and customers?

Revenue model

- **Cost structure:** it is defined by the value architecture.
- **Revenue sources:** Where do we earn money?

Team & Values

- **Team:** who and what competences have our team.
- **Values:** what value do we pursue? How do we interact with each other and the customers?
- **Our specific framework tool: The ENTRUST Canvas**

The review of the different frameworks for business modelling has provided the key insights to define and describe a specific canvas for the ENTRUST project (Figure 4).

From the Ostelwalder & Pigneur tool, all elements have been selected: **value proposition, cost structure, revenue stream, key partnership, customer segments, channels, key activities, customer relationship, and key resources**. As mentioned before, the Business Model Canvas FT is practised successfully in multiple organisations throughout the world and acknowledges all the concerns about innovative business models.

From the IDEO FT, the **Competitive strategy** element has been selected and added to the ENTRUST Canvas. It describes who the existing competitors are, how new entrants react to them, and how they are positioned to win in the market. It is an interesting element for ENTRUST because it maps the current competitors in the energy sector.

Finally, from Fluidminds FT, the **values** element has been selected and added to the ENTRUST Canvas. This factor defines what are the values pursued and how we can interact with each other. It is an interesting element for ENTRUST because it adds a customer's view (user's view) to the canvas. The ENTRUST Canvas will be used to define and describe each business model of the benchmark undertaken in section 4 of this deliverable.

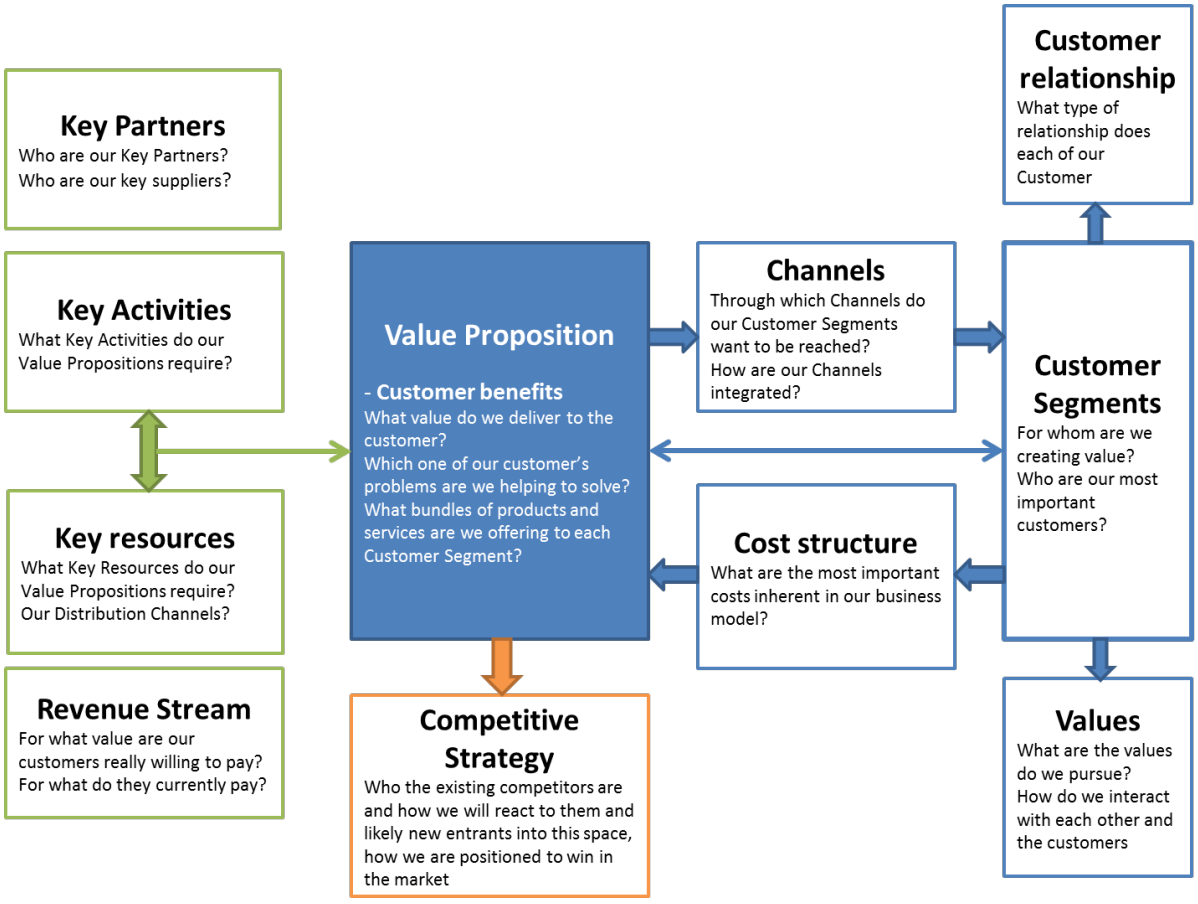

Figure 4: Business Model Canvas for ENTRUST (Osterwalder & Pigneur, 2010; IDEO, 2011; Stähler, 2001)

3.2 Innovation in business models

Innovation has played a key role in the energy system but most of the time the term is misunderstood and confused with others like creativity, change, or invention. There are many definitions of innovation: The Oxford Dictionary of English defines the term innovate as to "make changes in something established, especially by introducing new methods, ideas, or products" (Oxford Dictionary of English, 2016).

If we compare change and innovation, change does not need to have desirability and intentionality (Watson, 1997) and the final result of a change can be positive or negative, while innovation must have a positive outcome, as it is supposed to add value to the customer.

By comparing creativity and innovation, we can claim that creativity is a key part of innovation, as it introduces originality and novelty. However, it is just the first step. Innovation entails the overall process until the final development.

Finally, the difference between invention and innovation is that invention is the process of creating something that has never been made or never existed before (Cambridge Dictionary, 2015) while innovation is related to the introduction of the invention in a market or society.

Innovation is most commonly related to products because it is easier to think of a tangible product. However, it also appears at processes to develop new products or services. A parameter that allows comparing product, process, and service innovation is the degree of tangibility and the degree of interaction with the end user (Figure 5). Product innovation means innovating tangible products, with little interaction with customers, while service innovation normally involves intangible products with a high interaction with customers. Innovation in processes is right in the middle of products and services.

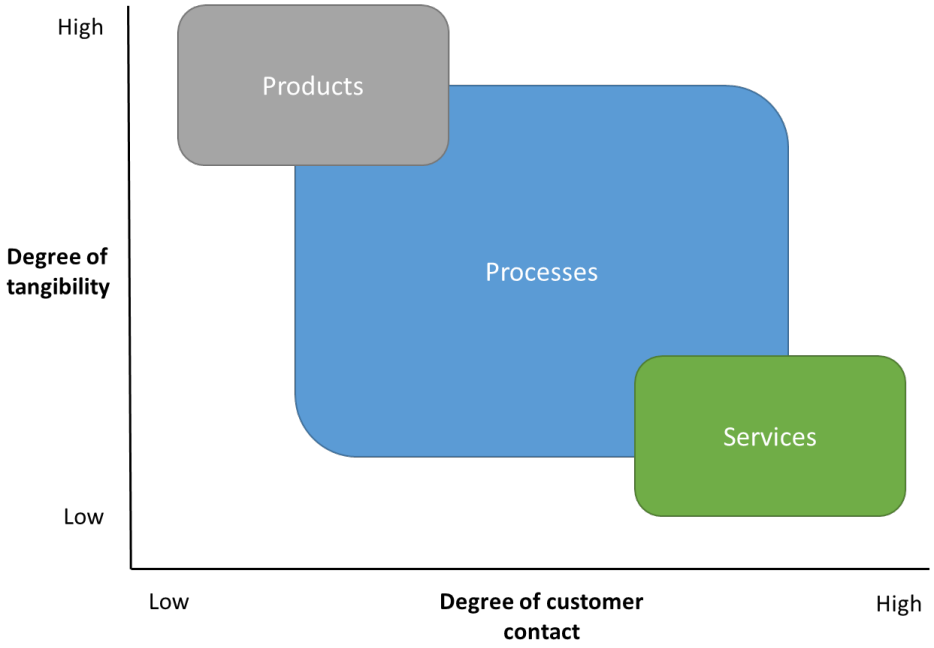

Figure 5: Tangibility and customer contact of different types of innovation (O'Sullivan and Dooley, 2009: 15)

Business model innovation can support the creation of disruptive innovation that generally asks for new competitive approaches, for example, to lower prices or reduce the risks and costs of ownership for customers. In times of instability and crisis, companies generally reinvent themselves, rather than fostering incremental innovation or deploying defensive or reactive tactics in the market (Lindgardt Z. et al, 2009).

Emerging markets for greener products and the rise of sustainability are increasingly leading firms to integrate innovation in their decision-making process. Innovation aims to create both economic and environmental value, by replacing old practices. It allows companies to restructure their value chain and generate new relationships with the customer (Danish Business Authority, 2012).

Value creation is at the heart of the business model, and it is an important factor behind the viability of a new product or service. The target of the value proposition is to fulfil the customer's needs. By innovating in the value of a product or service, the business model of a company moves towards a more sustainability

performance (Danish Business Authority, 2012). Some of the trends while innovating in the value proposition are (FORA 2010)

- **Economic benefits**: innovating also consists on reducing internal costs of a company or producing products more energy-efficient.
- **Offering functionality**: there are some innovative business models that instead of offering the sale of products they offer their functionalities to customers. For instance, car sharing.
- **Comfort and flexibility**: is an added-value that customers acquire from new business models and innovation incorporates.
- **Increased trust and reliability**: some new business models such as functional sales, ESCO, design-build-finance-operate (DBFO) contribute to improve the relationship between the provider and the customer.
- **Brand value and reputation**: adopting new business models might mean a gain in reputation as a socially responsible company.

Another classification of innovation can be made, when the focus is on the reason for the innovation rather than the innovation itself.

A market-driven innovation answers a newly identified need in the market. When the market and society are asking for a new product/service, it is commonly called **market-pull innovation**.

A Knowledge-driven innovation represents a new technology appearing in the market, but not answering to a specific need. Its origin is the research laboratory and the innovation evolves through the natural development of the technology. In this case, it is commonly known as **technology push innovation.**

In this deliverable, all these types of innovations are considered in the research.

3.2.1 Innovation framework for new business models in the energy system

This section gathers different classifications of innovation found in the literature that helps to categorise emerging business models. “Ten types of innovation” and “the business model innovation grid” are two powerful tools that frame different sources of innovation.

From all the analysis, a specific classification of innovation was created for ENTRUST, which is carefully defined at the end of the section. This framework is used in the chapter 4 to categorise all business model identified in every sector – energy supply and production, buildings, transport, and industry. In addition, a final mapping with all the novel business models is done in order to analyse what are the main innovation trends that foster the energy system transition.

Ten types of innovation

"Ten types of innovation" is a framework made by Ryan Pikkel *et al.* that provides a way to identify new business opportunities and develop viable innovative models (Pikkel, Quinn, Walters, & Keeley, 2013). It is structured into three categories: configuration, offering and, experience.

Configuration

- **Profit model:** innovation on the way businesses make money. Profit model challenges the old assumptions about what to offer, charge, or how to collect revenues.
- **Network:** connections between companies make them stronger since they can share risks and take advantage of external offerings, channels, processes, and technologies.
- **Structure:** is focused on organising company assets in unique ways to create added-value.
- **Process:** involves activities and operations that produce primary offerings. It requires a drastic change from "business as usual" and may include patented approaches that yield advantage for years or decades.

Offering

- **Product performance:** entails the development of distinguished features and functionality on new products and line extensions that add value.
- **Product system:** is rooted in how individual products and services are bundled together to create a scalable system.

Experience

- **Service:** is focused on enhancing the utility, performance, and value of an offering. For instance, revealing features or functionalities that customers may overlook.
- **Channel:** creates new connection ways between companies and customers, maximising delight with minimal cost.
- **Brand:** ensures recognition of companies' offerings over competitors. Innovation is based on creating a unique identity that attracts buyers.
- **Customer engagement:** are all about understanding what customers cherish and how to use those insights to create connections between them and companies.

The ten types innovation tool has influenced thousands of companies and has been used to accelerate and amplify existing ideas. It is a good guideline to think about the business transformation of the energy system. Therefore, it was used as a starting point in order to make a new classification of innovation for ENTRUST.

The business model innovation grid

This classification was created by the circular economy hub in Flanders in order to connect and challenge entrepreneurs and organisations (Economy hub in Flanders, 2014). The aim was to inspire businesses on how to become more future resilient. To do so, eight archetypes of innovation are described and emerging business models are placed on the type of innovation that is matched. Moreover, this framework has gathered around 100 real life business cases that help to understand better the insights of every business model and to be able to recognise the innovation source more easily. The eight archetypes of innovation come from three main fields:

- **Technological:** This category includes optimisation of resources, circularity of wastes, and substitution with renewables technologies. The three innovation types address how to overcome resource constrains.
- **Social:** compromises innovation from functionality, not ownership, stewardship – stakeholder engagement – and slow consumption.
- **Organisational:** innovation can also come from co-creation – sharing knowledge, resources, etc. – or social entrepreneurship such as promoting systemic social change.

Our specific classification of innovation

After analysing what are the main innovation sources of our business model mapping and the comparison with the innovation frameworks found in the literature, four main categories and eleven subcategories came up. Innovation can come from configuration of the business, technological advancements, experience, or new financing tools (Figure 6).

From "Ten types of innovation", it was interesting to select a **profit model** category because new ways of making money have been identified as a key to improve the current business models. How incentives are delivered to customers is incredibly changing so **channel**, was another factor taken into account. **Product system** innovation, seen as the integration of complementary products and services has also appeared in the business mapping carried out. Finally, it is important to add **customer engagement** to this framework, since a vast variety of new business models are fostering customer commitment on energy consumption or usage.

On the other hand, using "The business model innovation grid" framework, three social elements were selected: **optimisation**, **circularity**, and **substitution with renewables**. These archetypes were added because it is important to do more with fewer resources, learn how to turn waste streams into new valuable inputs while reducing the environmental impact associated with non-renewable resources. Also, because of the business model transition from product ownership to service provider, **PSS-functionality** is a category that needs to be included in this classification.

The rest of the categories – **vertical value chain**, **partnership**, and **financing** –were identified based on the analysis of the business model mapping carried out for this deliverable.

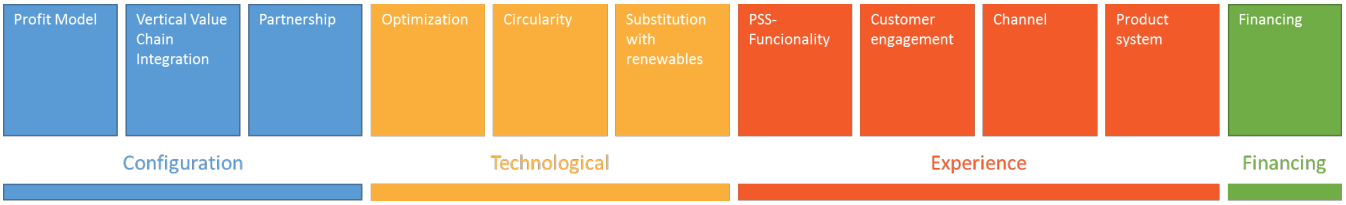

Figure 6: Classification of innovation

- **Configuration**

Innovation in configuration deals with the innermost workings of an enterprise and its business system.

  - **Profit Model**

    Finding a new way to convert a firm's offerings and other sources of value into cash. A good profit model understands what their customers cherish and where new revenues and opportunities are. It is often a challenge for the old assumptions about what to offer, charge, or how to collect revenues.

  - **Vertical Value Chain Integration**

    It is an expansion strategy where a company adds business operations into different steps on the same production path. For instance, a manufacturer that acts as both supplier and distributor. This strategy helps to reduce costs, turnaround time, transportation expenses, and improve efficiencies.

  - **Partnership**

    This type of innovation enables to take advantage of other companies' processes, technologies, offerings, and brands. The risk of the development of new offers is shared between the partners. Also, firms can not only capitalise its own strengths but also exploit the capabilities of others. These collaborations can be formed between competitors or close allies.

- **Technological**

Innovation may also come from the introduction of new technologies in an enterprise. In this case, there are three subcategories.

  - **Optimisation**

    The aim is to do more with fewer resources while generating less waste, emissions, and pollution. Enhancing efficiency and improving resource use.

  - **Circularity**

    The key idea is to turn waste streams into useful and valuable input to other production cycles and making better use of capacity. This innovation includes reduction of waste, creation of new business lines, and revenue streams.

  - **Substitution with Renewables**

    This innovation comes from the reduction of environmental impacts and increase business resilience by addressing resource constraints associated with non-renewable resources. Also, it implies the support on long-term energy supply with renewables and contribution to "green economy".

- **Experience**

These four types of innovation are focused on more customer-facing elements of an enterprise and its business system.

  - **PSS - Functionality**

    Provide services instead of products that satisfy users' needs. It encourages right behaviours with manufacturers and users and potentially reduces the need for physical goods.

  - **Customer engagement**

    Customer engagement innovations are all about understanding the needs of customers and users, and using inputs to develop meaningful relationships between them and companies. Customer engagement innovations improve customers' life, making them more conscious about the current problems of the energy system.

  - **Channel**

    Channel innovations gather all the connections between company's offerings and customers. Although, E-commerce has gained force in recent years, traditional channels such as physical stores are still crucial. It also compromises all the new ways to bring their products and services to customers.

  - **Product system (integration)**

    Product System innovations are focused on how products and services are bundled together to create a strong and scalable system. The aim is to integrate other ways of creating valuable connections between different offerings. Moreover, it fosters the creation of ecosystems that defend customers against competitors.

- **Financing**

The last category refers to the advances over time in the financial instruments and payment schemes used in the development of projects.

Therefore, the definition of innovation for ENTRUST refers to the development of a novel activity that can be achieved by changing the configuration, finance, technology, or experience of the business system. This classification will be used to characterise the business models presented in the section 4.

4 A benchmark of innovative business models in the energy system

This section presents the evolution of the value chains in four energy-intensive sectors – energy supply and production, buildings, industry (focusing on process industries) and transport (focusing on urban mobility) – and a mapping of the novel business models that are emerging in the existing energy system.

For each sector, the structure of the value chain is defined first, together with the identification of the traditional and emerging key actors. Moreover, a description of the emerging business models is included. Finally, a classification of business models based on the type of innovation source is presented and general trends are discussed.

4.1 Energy production and supply

Annual total greenhouse gas (GHG) emissions arising from the energy supply sector continues to increase, while the combustion of fossil fuels is still the leading source for energy production in the market. However, the transition to new energy supply and production has already begun.

Energy sources are moving towards renewables, as can be seen in the (Figure 7). By 2030, renewable sources will account for 26% of electricity generation, while generation based the fossil fuels, coal and oil, will decrease. Moreover, worldwide electricity generation is expected to increase by 67% from 22,126 TWh in 2011, to 37,000 TWh in 2030 (IRENA, 2014).

Achieving a low-carbon energy system requires structural transformation of the electricity sector due to the high penetration of renewables. The current challenge is how to drive innovation in the system itself and address critical issues such as intermittent generation, system capacity, and storage. New regulation, business structures, and market organisation are key to overcome these obstacles (Swedish Energy Agency - Growth analysis, 2014).

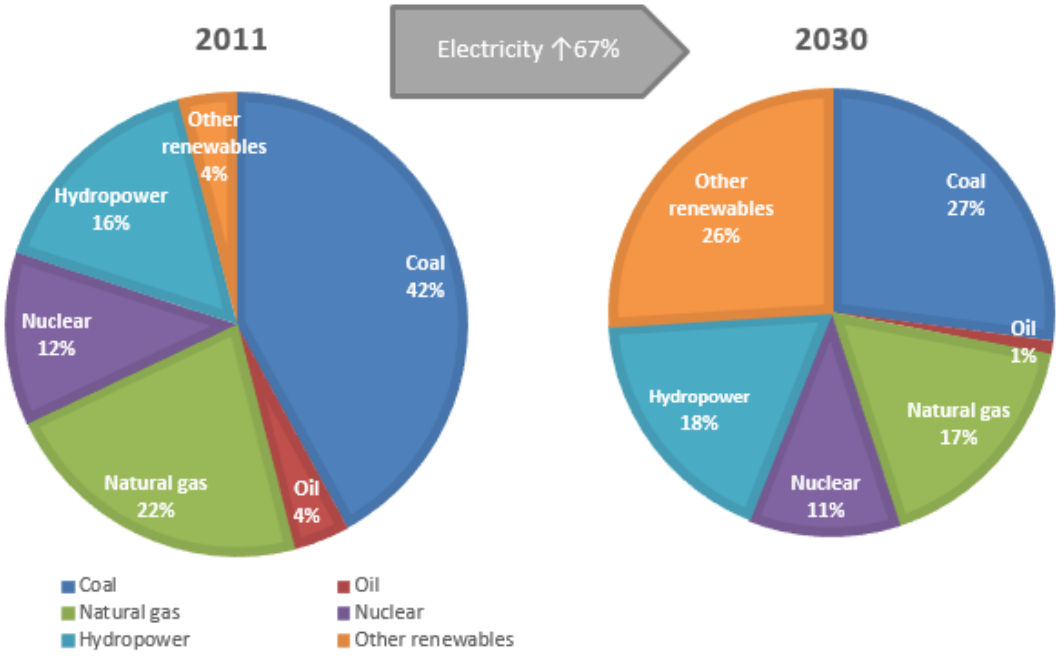

Figure 7: Electricity generation growth (World Bank, 2014)

4.1.1 *Value chain*

The value chain of the energy supply and production is changing because of the entrance of new actors and elements. See Figure 8: Value chain of the energy supply sector and main actors, below. The existing structure does not fit with the new demands based on decentralised generation, electric devices and appliances, or storage requirements, so the structure of this industry and role of power producers are undergoing changes.

The new scenario is dominated by the penetration of renewables and decentralised generation assisted by market-balancing tools. Storage and smart technologies such as batteries and smart meters are trying to solve the problem of intermittency. They also support better demand-side management, and create a continuous information flow through the value chain (IRENA, 2014). Data platforms, energy brokers, and energy management providers will play a role at this new stage.

Flexibility and adaptability are the aim of the next phase where producers and consumers can switch the direction of the energy flow, storing the excess or consuming it directly (Swedish Energy Agency - Growth analysis, 2014). Energy storage operators will be in charge of energy management. In addition, new players will be positioned in generation-transmission-distribution such as energy cooperatives, large energy firms, or new renewable energy companies.

Therefore, the new value chain can be described as a vertically integrated environment of the actors and new stages of the energy supply.

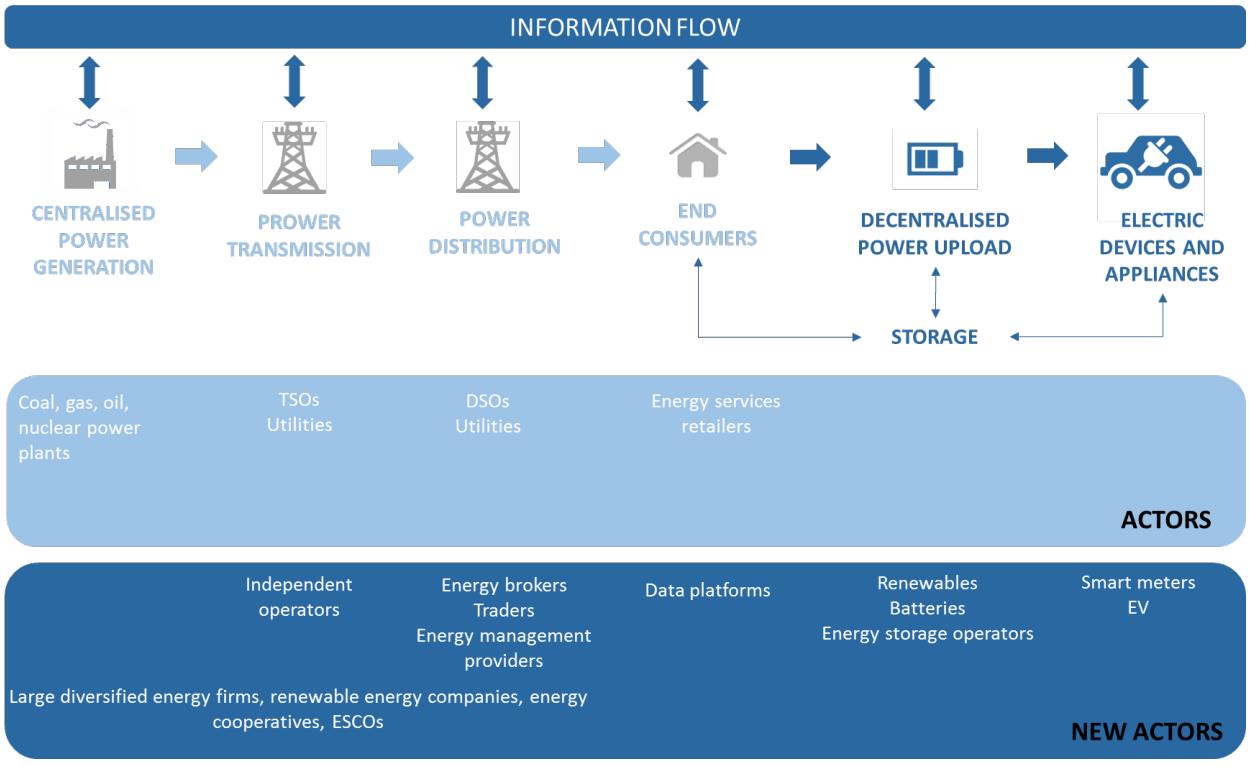

Figure 8: Value chain of the energy supply sector and main actors (Swedish Energy, 2014)

4.1.2 *Mapping of business models*

Novel business models in the energy supply and production sector were examined in this section. Every model includes a description, examples of real cases, and the type of innovation source that accounts.

BM EN 1: Partners of partners

This business model offers not only standard power and gas products, generally through energy supply contracts (ESC), but also an extensive range of other energy-related services. From life-cycle EV battery change out, home-related convenience services like new service set-up coordination, to management of net metering-driven grid sellback, among many others (PwC, 2014).

These services can be provided by utilities, or be part of an expanded relationship with high quality branded providers (Vivint[1], OPower[2], Honeywell[3], GE[4], Tesla[5] or Solar City[6]) in order to gain more customer acceptance (Sioshansi, 2016).

Innovation comes from a partnership approach. Partnership innovations provide a way for firms to take advantage of other companies' processes, technologies, offerings, channels, and brands.

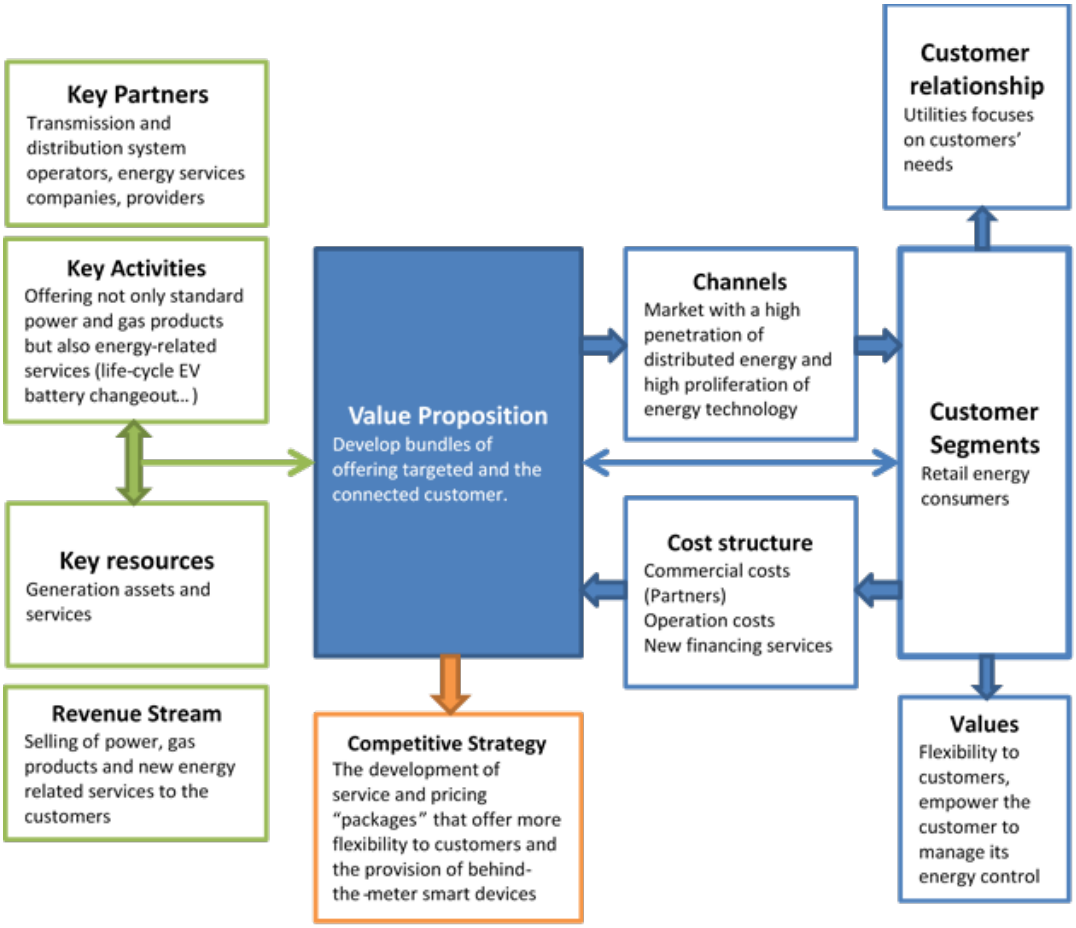

Figure 9: Partners of partners' business model canvas

[1] www.vivint.com
[2] www.opower.com
[3] www.honeywell.com
[4] www.ge.com
[5] www.tesla.com
[6] www.solarcity.com

BM EN 2: Pure retailer

The pure energy retailer only supplies electricity or gas to the end-consumer. The competitiveness of the supply part on the energy chain has increased significantly since the liberalisation of the energy market. Therefore, seeking to stand out from the rest of the retailers, they offer lower prices than their competitors, commercialise only energy that is guaranteed to be 100% renewable, and aim at a closer relationship with the costumer, for a better consumer engagement (PwC, 2014).

Online retailers have been growing across Europe. In Spain, for instance, Nexus[7], Factor Energia[8] and Holaluz[9] are gaining market-share thanks to this business model.

This model seeks to provide an improvement in consumer satisfaction and a better customer service. The innovation of this model resides on the optimisation of resources to deliver a better service, using only online channels that reduce companies' costs.

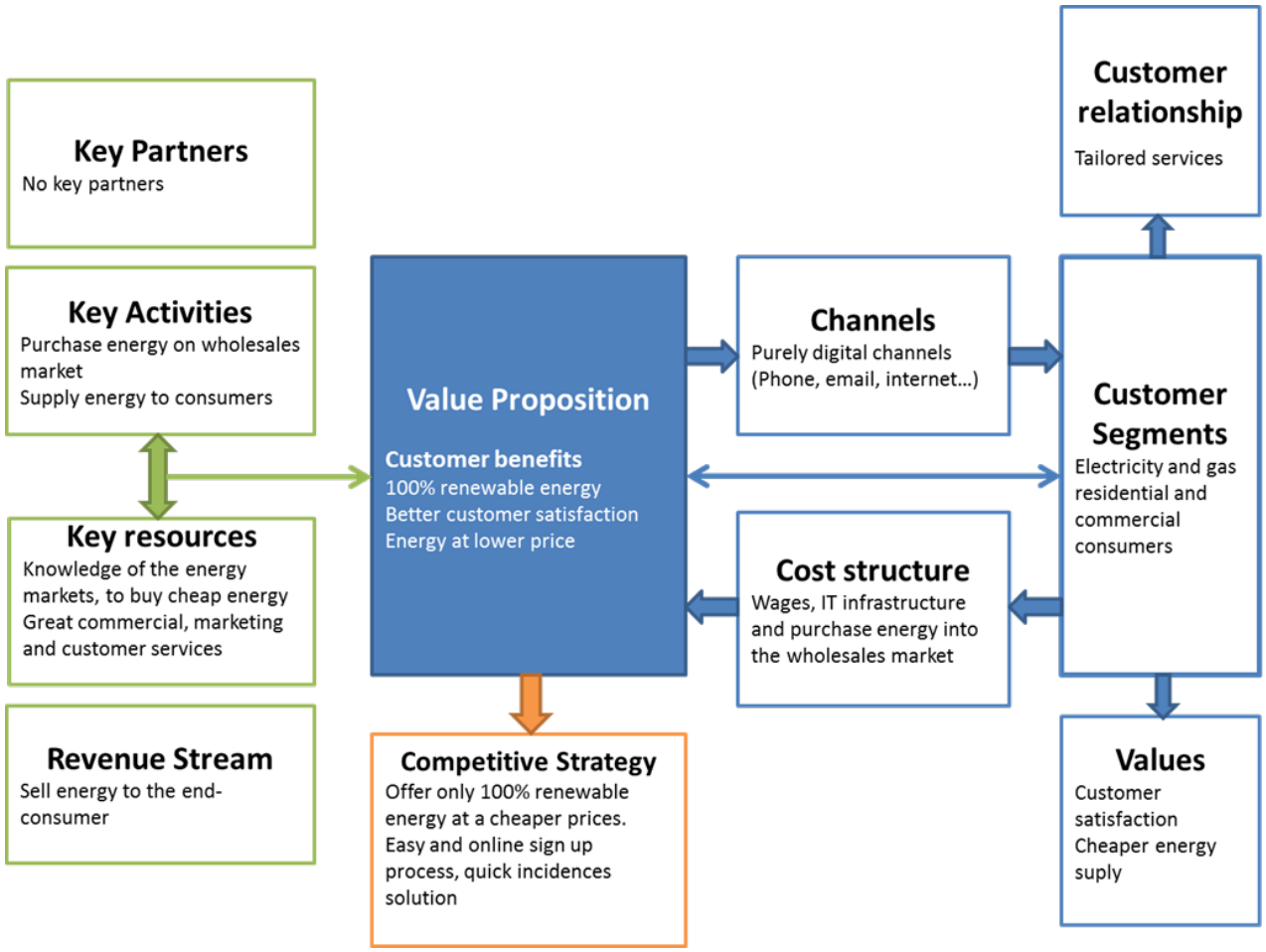

Figure 10: Pure retailer business model canvas

[7] www.nexus.com
[8] www.factorenergia.com
[9] www.holaluz.com

BM EN 3: Energy cooperative

It is a non-profit entity of green energy consumption, which performs the same activities as any other retailer or energy Producer Company. The cooperative is committed to drive a change on the current energy model in order to promote a 100% renewable model. The cooperative only supplies energy to its members, who can participate in financing collective renewable energy projects to produce their own energy, and therefore, helping to democratise it (Heinrich Böll Foundation 2014).

NRECA is the American national service association for almost 900 cooperatives that use this business model. In addition, Som Energia[10] is following the same model in Spain.

On the innovation side, the energy supplier is a cooperative not a company. Consumers are both members and co-owners, integrating various stages of the value chain. On the production side, the cooperative promotes collective financing for renewable energy installations. Thanks to this contribution, members benefit from a yearly discount on their bills.

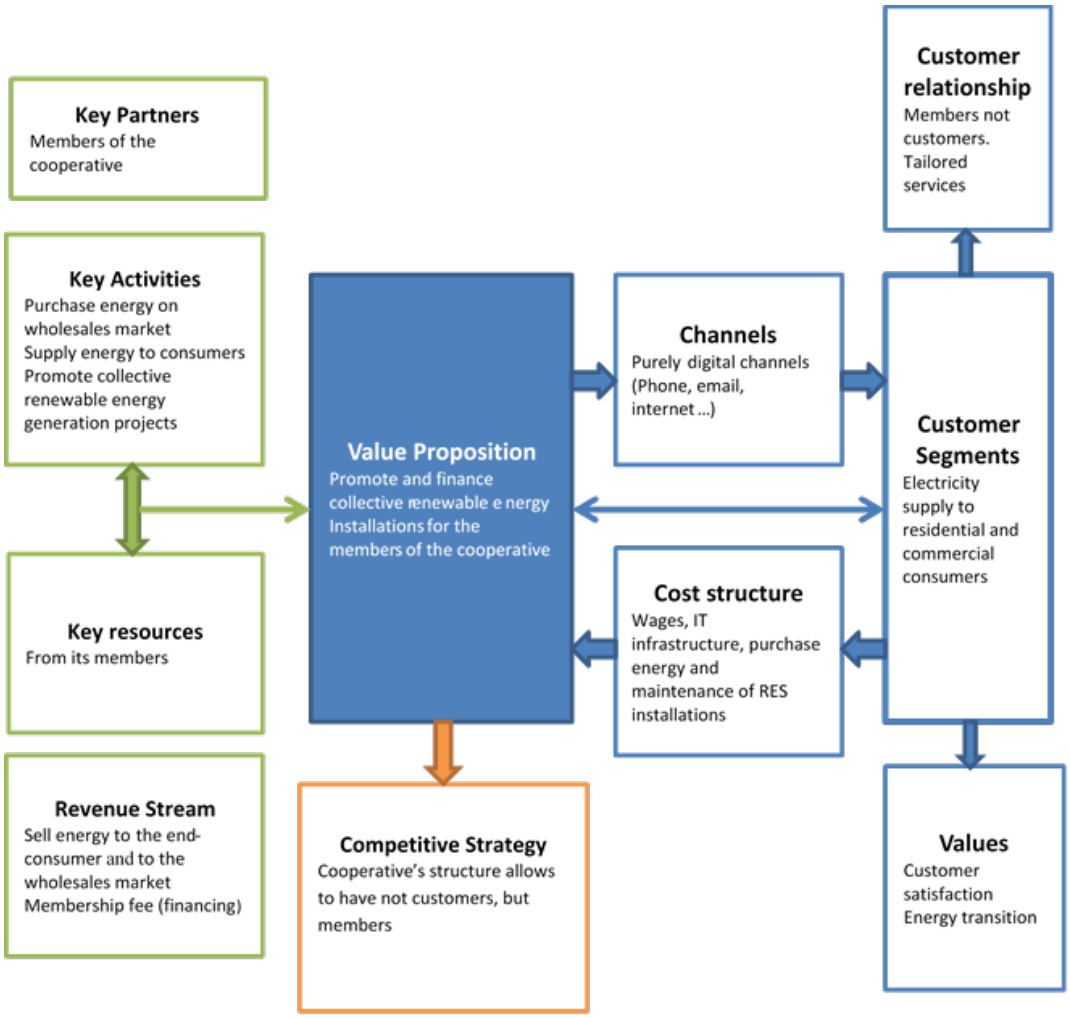

Figure 11: Energy cooperative business model canvas

[10] www.somenergia.coop

BM EN 4: Product innovator

Technological developments have fostered the creation of new companies and products that harvest energy. These innovative products are focused on making energy production more efficient and reducing losses by developing smarter materials such as new PV solar cells (Greentechmedia, 2015). In addition, they are devoted to improving energy harvesting by producing electricity from sources that are different from the traditional ones, such as waves or tidal (Ecowave power, 2016).

In wave energy harvesting, companies such as Smalle Technologies[11], Nautricity[12] or Oscilla Power[13] are doing its way to enhance its technology and market acceptance.

Energy producers are the owners of generation assets and can sign a partnership collaboration with a company that does research and manufactures innovative products, so the energy generation company can take advantage of new technologies. This collaborative partnership for innovation helps new ventures to form future close alliances.

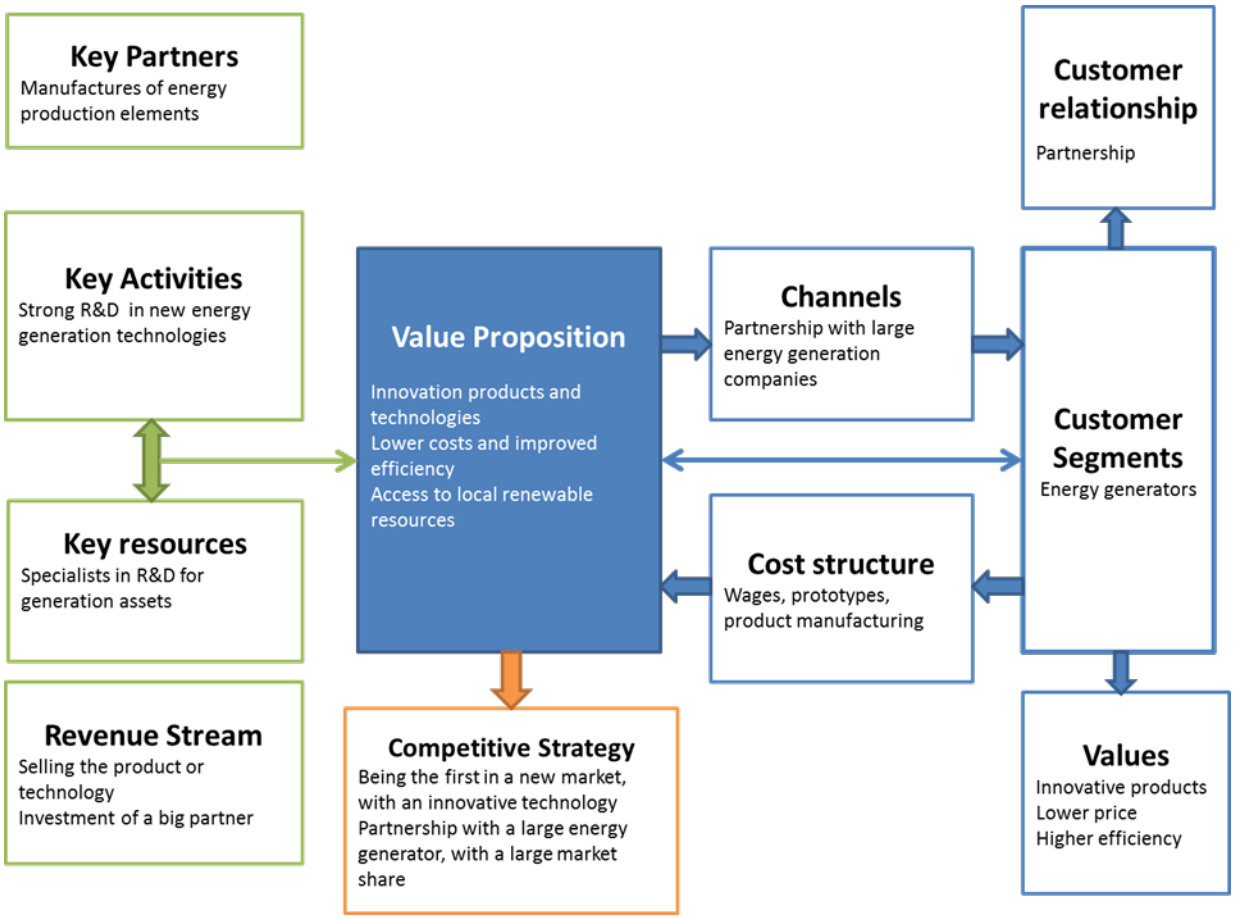

Figure 12: Product innovator business model canvas

[11] www.smalletec.com
[12] www.nautricity.com
[13] www.oscillapower.com

BM EN 5: Grid manager

A network manager operates transmission and distribution assets and provides access to generators and retail service providers. The grid manager is able to optimise and balance electricity demand and supply in real time and integrate power from different central and distributed generation resources. In some cases, the grid operator and the transmission system operator are the same entity, which is also responsible for planning, constructing, and maintaining the grid to ensure the continuous energy supply (PwC, 2014).

Red Eléctrica de España (REE)[14] in Spain and Le réseau de l'intelligence électrique (RTE)[15] in France are two examples of this model.

Innovation resides in the vertical integration of transmission and distribution roles. Grid managers will control segments that are separated on the traditional value chain.

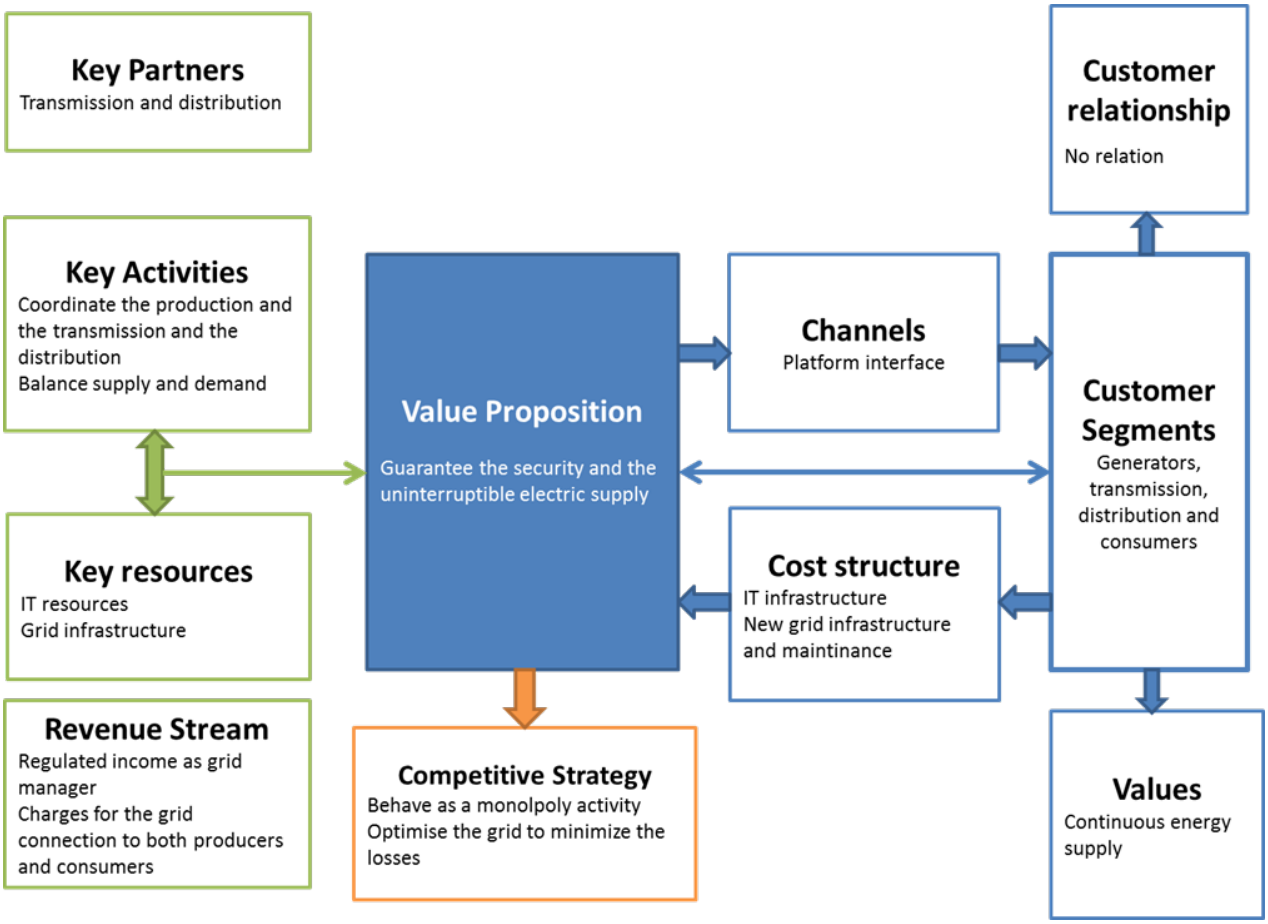

Figure 13: Gird manager business model canvas

[14] www.ree.es
[15] www.rte-france.com

BM EN 6: Value-added provider

This business model aims at enhancing the products or services of a company before offering them to customers. Complementary services increase the value of the energy supply offer. For instance, analysing energy consumption and recommending the most suitable tariff for the customer will increase customer satisfaction while suppliers keep a competitive margin (PwC, 2014).

Lucera[16] is a small electricity retailer in the Spanish market. They analyse the consumption of current and future customers to offer them the most suitable tariff to reduce their costs. They also foster energy efficiency and only provide certified 100% renewable energy.

In this case, the main source of innovation involves customer engagement and PSS-functionality. Providing added-value to the existing services fosters not only the implication of customers on energy usage, but also increases their satisfaction.

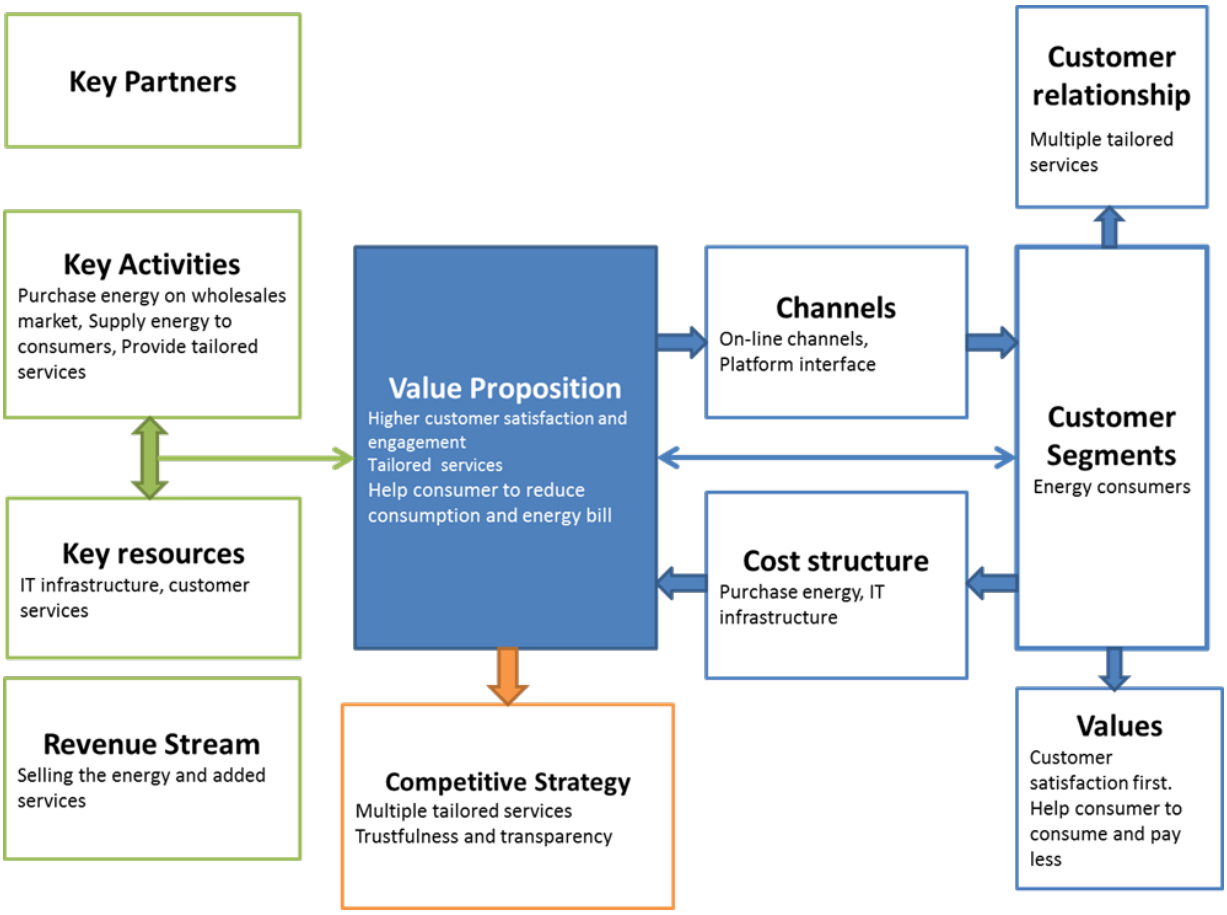

Figure 14: Value added provider business model canvas

[16] www.lucera.es

BM EN 7: Virtual utility

Virtual utilities aggregate energy generation from various distributed systems, (micro CHP, PV, wind, small hydro, batteries, etc.) to deliver a reliable power supply and to act as an intermediary with energy markets (Bayar, 2013). They rely on software systems to remotely dispatch and optimise generation, demand-side, or storage resources (including plug-in electric vehicles and bi-directional inverters) in a single and secure web-connected system.

A recent study of the MIT Energy Initiative (Burger, 2016), points out the German utility Lichtblick[17] and the Danish DONG[18] Powerhub, as two virtual power plant developers. Other examples can be found as well in Germany with the RWE[19]; the AGL Energy[20] in Australia or the Sharyland Utilities[21] in the U.S.

Virtual utilities can replace conventional power plants while providing higher efficiency and more flexibility. Innovation is focused on optimizing resources and performances through online platforms.

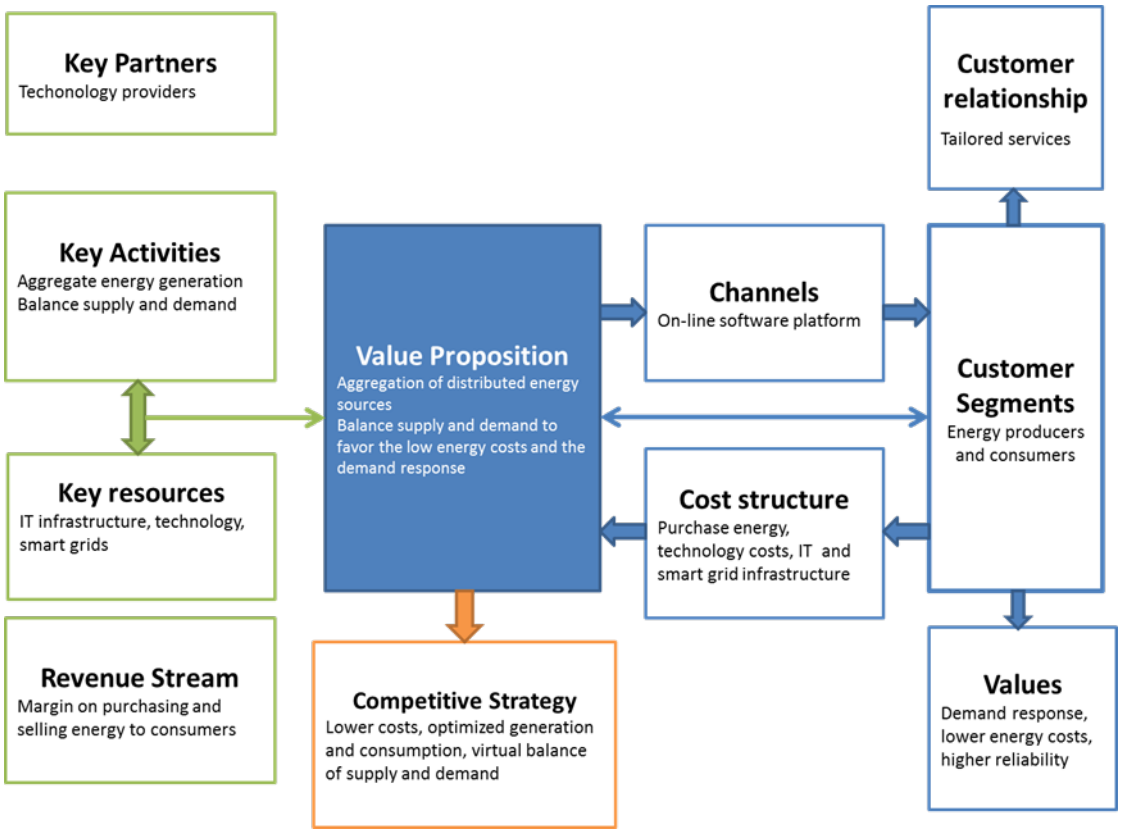

Figure 15: Virtual utility business model canvas

[17] www.lichtblick.de
[18] www.dongenergy.com
[19] www.rwe.com
[20] www.agl.com.au
[21] www.sharyland.com

BM EN 8: Specialised provider

Through dedicated partnerships, the energy retailer will maximise its service orientation and create added value for the end consumer. For instance, the energy supplier can tailor each energy tariff offer to their current or future customers by studying the patterns of their data consumption, providing insights, and valuable information to the customer from sources that the customer cannot access (PwC, 2014).

Utilities such as NationalGrid[22] or E.ON[23] have collaborated with Opower[24] to provide better services to exploit smart meter data. A similar case is the ONZO[25] service in the UK. Also in Spain, larger retailers (Iberdrola[26], Gas Natural Fenosa[27] and Endesa[28]) offer a marketplace where the consumer can directly purchase new appliances (PwC, 2014).

Partnership innovations and agreements give firms a competitive advantage over others. Services can be enhanced by adding layers such as specialised companies of their sector (data provider, software provider, energy efficiency products manufacturer). Also, the collaborative environment allows them to rely on external mature products or services.

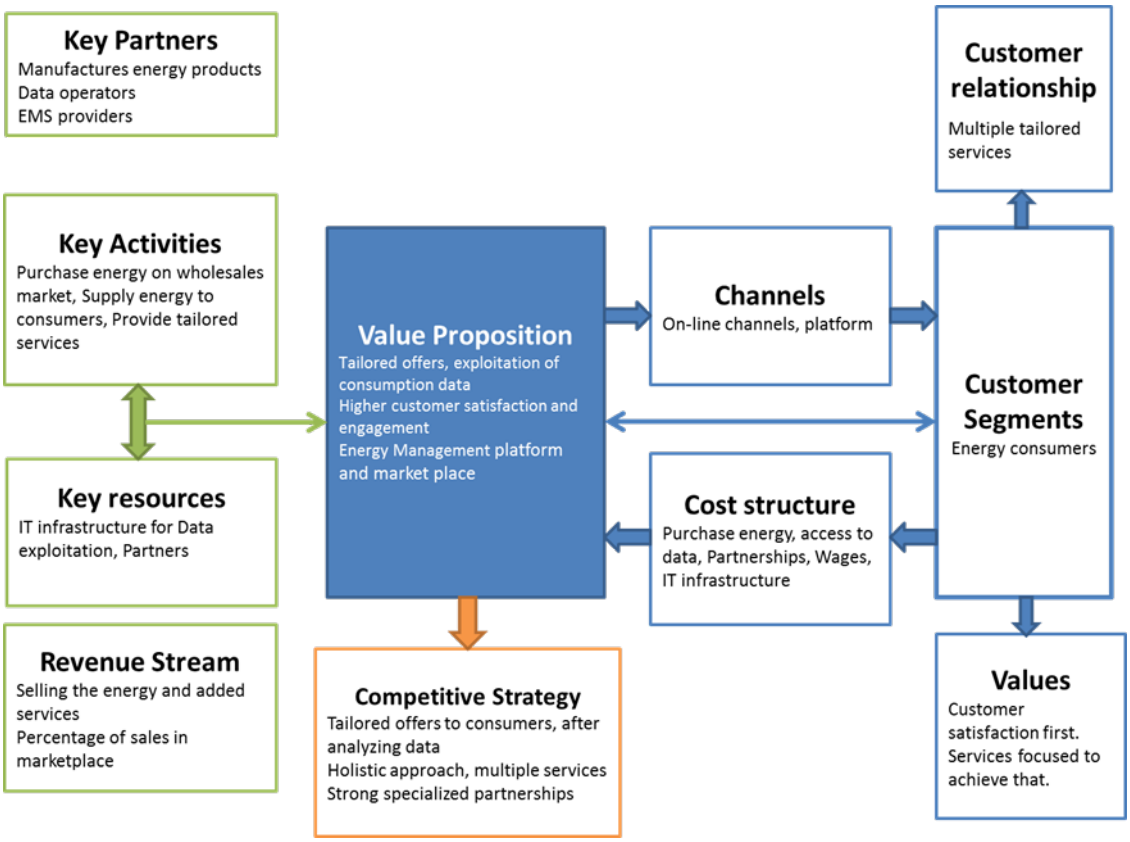

Figure 16: Specialised provider business model canvas

[22] www.nationalgrid.com
[23] www.eon.com
[24] www.opower.com
[25] www.onzo.com
[26] www.iberdrola.es
[27] www.gasnaturalfenosa.com
[28] www.endesa.com

BM EN 9: Pure play merchant

A pure play merchant utility owns and operates generation assets and sells power into competitive wholesale markets at market clearing prices, or through negotiated bilateral contracts with other generators or large industrial consumers. They focus on reducing emissions and pollution using renewable energies, or technologies that are more efficient. Also, the cost reduction obtained will allow them to reduce the energy prices offered to consumers (PwC, 2014).

An example of a pure-play merchant on the generation side could be the energy company Acciona[29]. One of their business lines is devoted to energy generation solely from renewable energy assets.

The pure play merchant optimises the management of generation assets and resources in order to improve resource use; for instance, partnering with high efficiency energy production technologies and choosing the most optimal location for the plant. It focuses on reducing emissions and pollution using renewable energies, or technologies that are more efficient. In addition, the cost reduction obtained will allow it to reduce the energy prices offered to consumers.

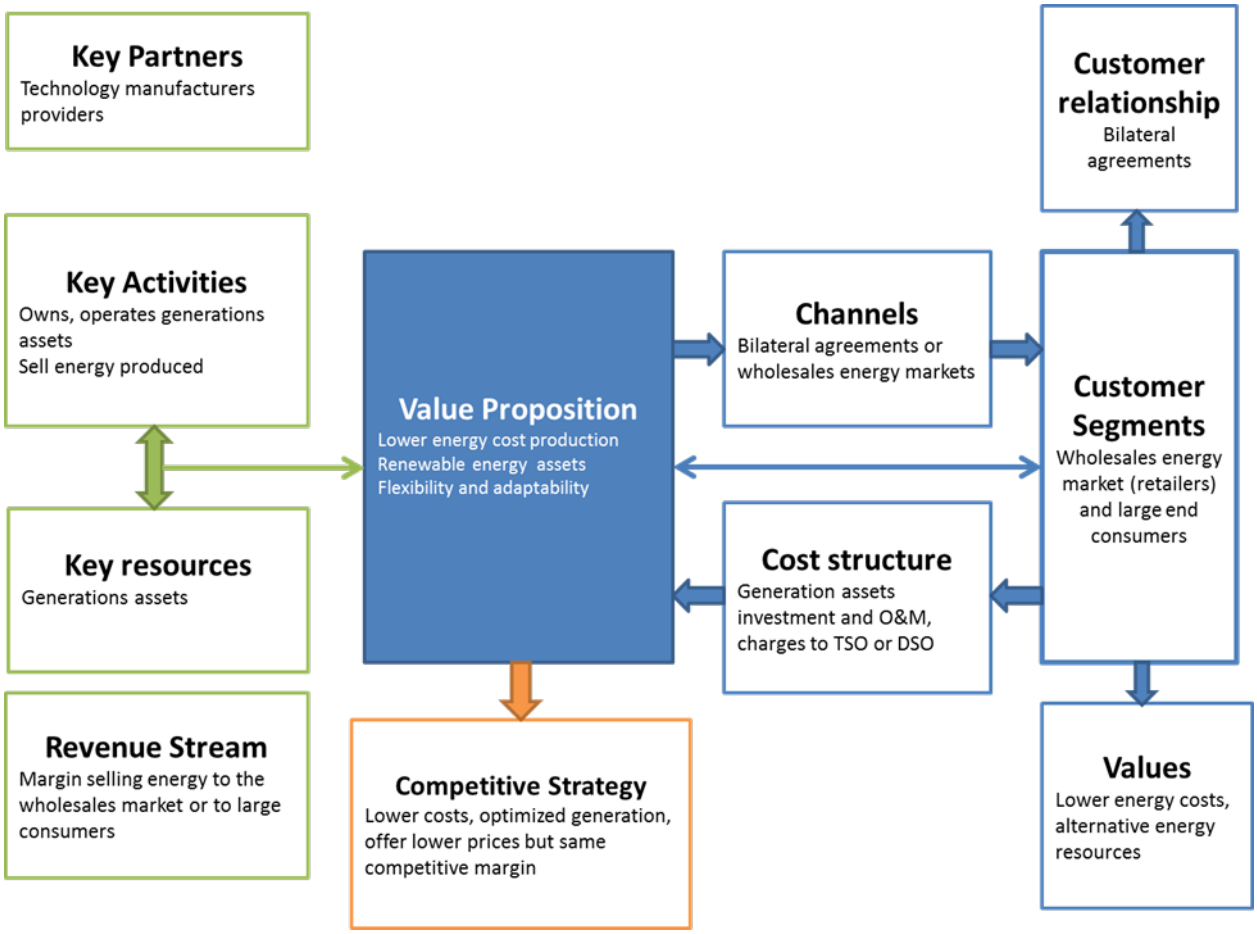

Figure 17: Pure play merchant business model canvas

[29] www.acciona.com

BM EN 10: Gentailer

A gentailer utility operates at both ends of the value chain by owning generation assets and selling retail energy to customers in a competitive market. It seeks to lower generation costs at the same time as increasing customer engagement (PwC, 2014). They also pay a charge to the transmission and distribution system operators in order to deliver the electricity, as part of the regulated market.

Examples of this particular business model can be found in Australia and New Zealand, where the figure of the gentailer is quite extensive. For instance, in Australia, examples are found in Energy Australia[30], Origin Energy[31] or AGL Energy[32]; and in New Zealand, five gentailers are the responsible for the 96% of the total market share (Shen and Yang 2012).

Innovation on vertical chain integration could lead to acquiring and maintaining customers with higher margins. The gentailer has the capacity for energy trading and hedging as it participates on both sides of the energy market; and it also has revenue from selling the energy it produces to the wholesale market, as well as the energy supplied to the end-consumer.

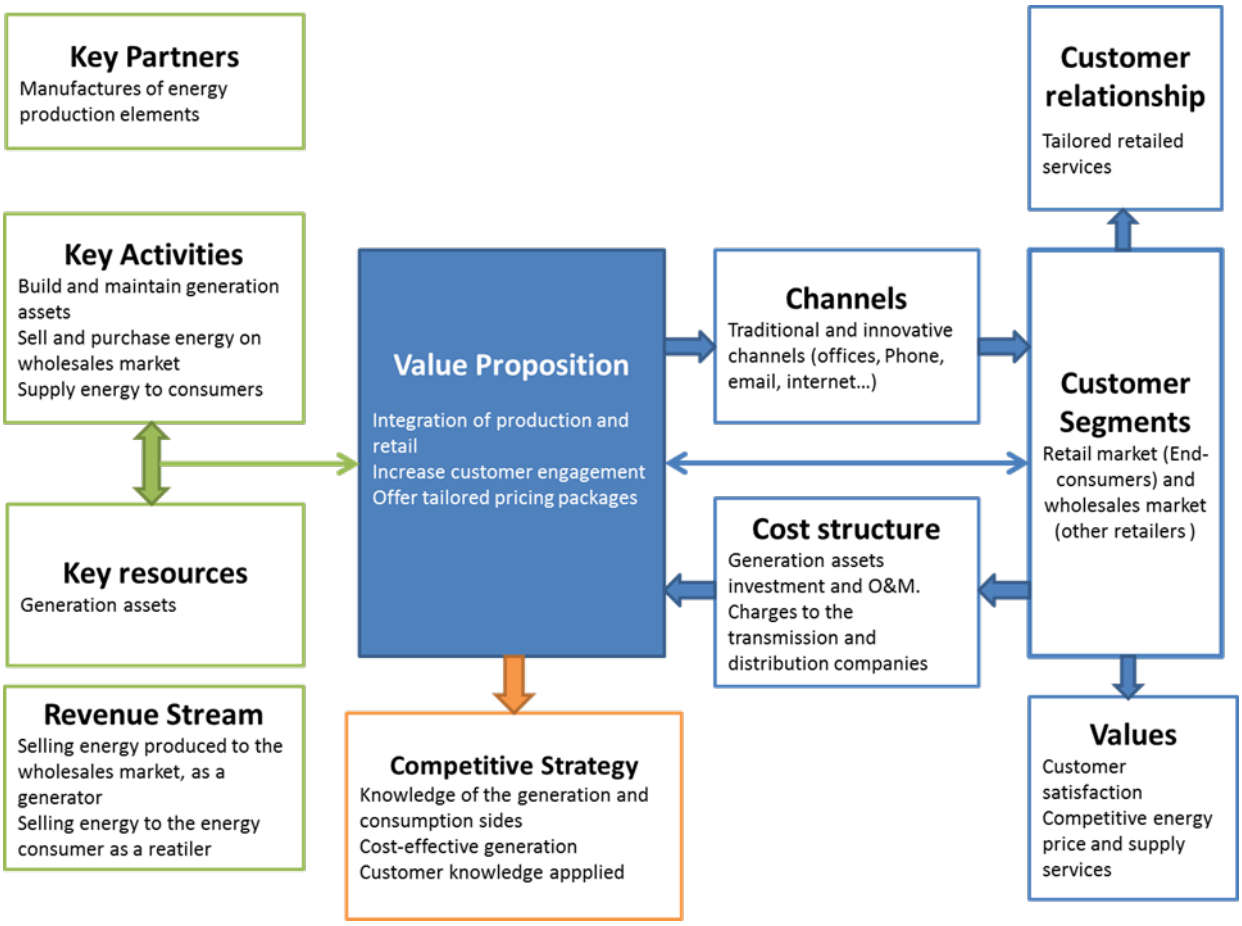

Figure 18: Gentailer business model canvas

[30] www.energyaustralia.com.au
[31] www.originenergy.com.au
[32] www.agl.com.au

4.1.3 *Analysis of the innovation trends and value chain*

New business models are emerging in the energy supply and production value chain. The ones identified for this deliverable appear on Figure 19. As can be observed, novel models are quite homogenously distributed. However, innovation is mainly positioned at the new stages (decentralised power upload, electric devices and appliances, and storage).

Energy supply is changing towards a more decentralised system in which both customers and end-users are playing a fundamental role. A vast number of business models are focused on providing new products and services and creating a continuous information flow throughout the value chain. In addition, power generation models are gaining in flexibility and independency from fossil fuel resources. The new scenario is composed of business models that foster an interconnection between roles and new actors.

Moreover, the analysis presented on Figure 20 shows that innovations are mainly occurring within the **configuration** of businesses and **technological** advancements. Expanding partnerships between different companies are promoting new products and services to customers. In addition, innovation in configuration comes from the vertical integration of different roles of the value chain. Innovation is pushing a more interconnected generation, transmission, and distribution of energy.

In terms of technological innovation, most of the business models pursue the optimisation of resources and the implementation of renewables. Within this archetype, emerging models seek to do more with fewer resources and generate less pollution and waste. Substitution with renewables addresses the constraints related to fossil fuel resources.

Innovation also relates to the engagement of customers in a responsible energy consumption and usage. Two novel business models that provide more data to monitor energy have been identified. They try to create a society that is more conscious about resources and consumption. New channels to connect with consumers are also gaining in importance. In addition, there are new financing schemes that are changing the current scenario, such as the creation of energy cooperatives.

To sum up, the business innovation in the energy supply sector is mainly centred on the new stages of the value chain. Technological and configuration changes are leading the way to move towards a more sustainable energy system in which interconnection and customer engagement are key.

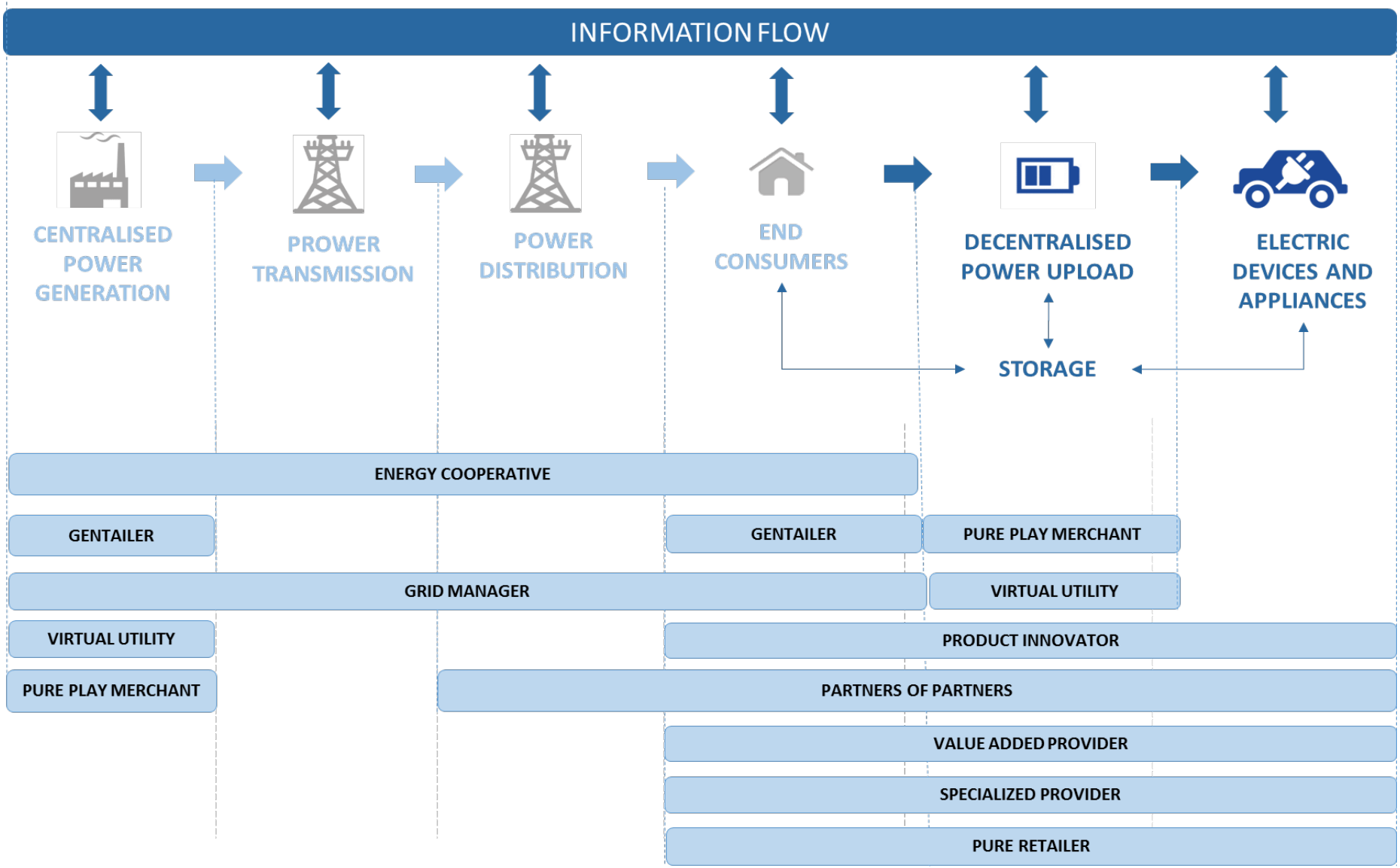

Figure 19: Mapping of BMs of the energy supply value chain (Swedish Energy Agency, 2014)

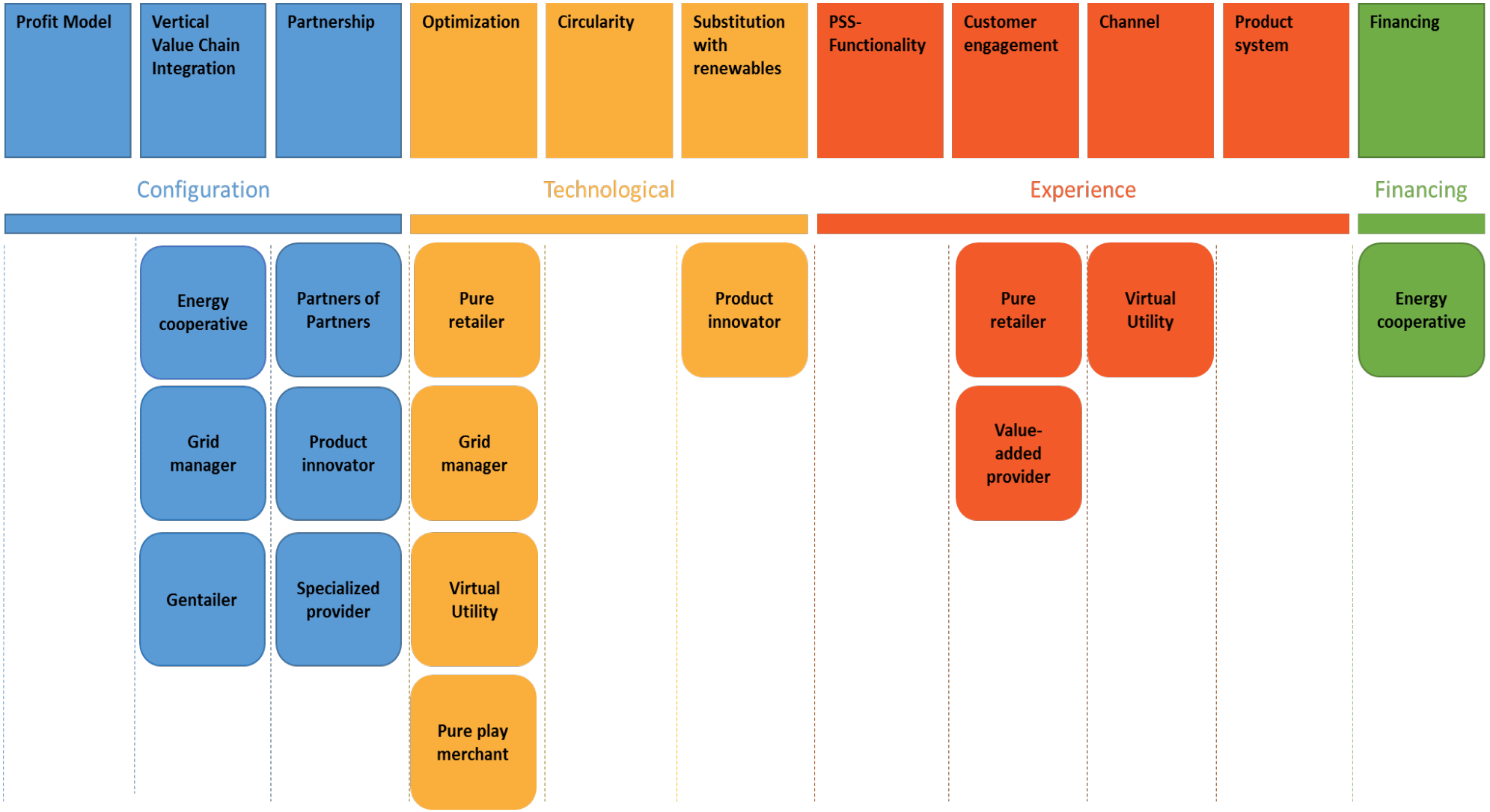

Figure 20: Innovation on business models of the energy supply sector

4.2 Buildings

The construction sector is of vital importance to the European economy and its employment sector. In 2015, it contributed at around 9% to the GDP of the European Union, and over 18 million people were directly employed in the building sector, which makes it the single largest contributor to EU employment (European Comission, 2015).

Indeed, the EU building sector is characterised by a high number of small enterprises, mostly operating at the local level. From the 3 million enterprises participating in building related activities, 96.9% are small and medium-sized enterprises with less than 250 employees that generated the 80% of value added in the EU building sector and employed 83% of the total workforce of the sector (EBC-construction, 2016).

However, the energy consumption of houses and buildings taking into account the whole life cycle is responsible for 40% of total EU energy consumption and is the main contributor to greenhouse gas emissions (about 36% of the EU's total CO_2 emissions and for about half of the CO2 emissions which are not covered by the Emission Trading System, (European Comission, 2015).

Therefore, reducing energy consumption during the whole life cycle of the buildings has become a must action against climate change and will contribute to decreasing the EU's energy import dependence. The following cases of study will illuminate the cross-sectoral approach that the building industry is undertaking to tackling the decarbonisation of the built environment.

4.2.1 Value chain

The construction value chain is complex and involves a number of traditional actors – often uncoordinated and with conflicting interests – including contractors, installers, architects and suppliers, as well as new actors emerging from energy related sectors.

Figure 21 presents a high-level overview of the construction sector from a life cycle perspective, with stages in light blue representing the traditional structure with conventional actors and stages in red representing novel activities involving new market players.

The traditional structure does not fit with the new demands based on low carbon consumers, increasing interest for existing properties, increasing renewable energy production in buildings or novel interaction of buildings with the energy market (demand response, energy storage and energy production), so the structure of this industry and role of players are undergoing change.

The new scenario is dominated by energy players such as utility companies or companies providing energy services to final energy users (ESCOs), and horizontal players such as financial institutions playing a key role in large-scale projects or public authorities driving the decarbonisation of public buildings.

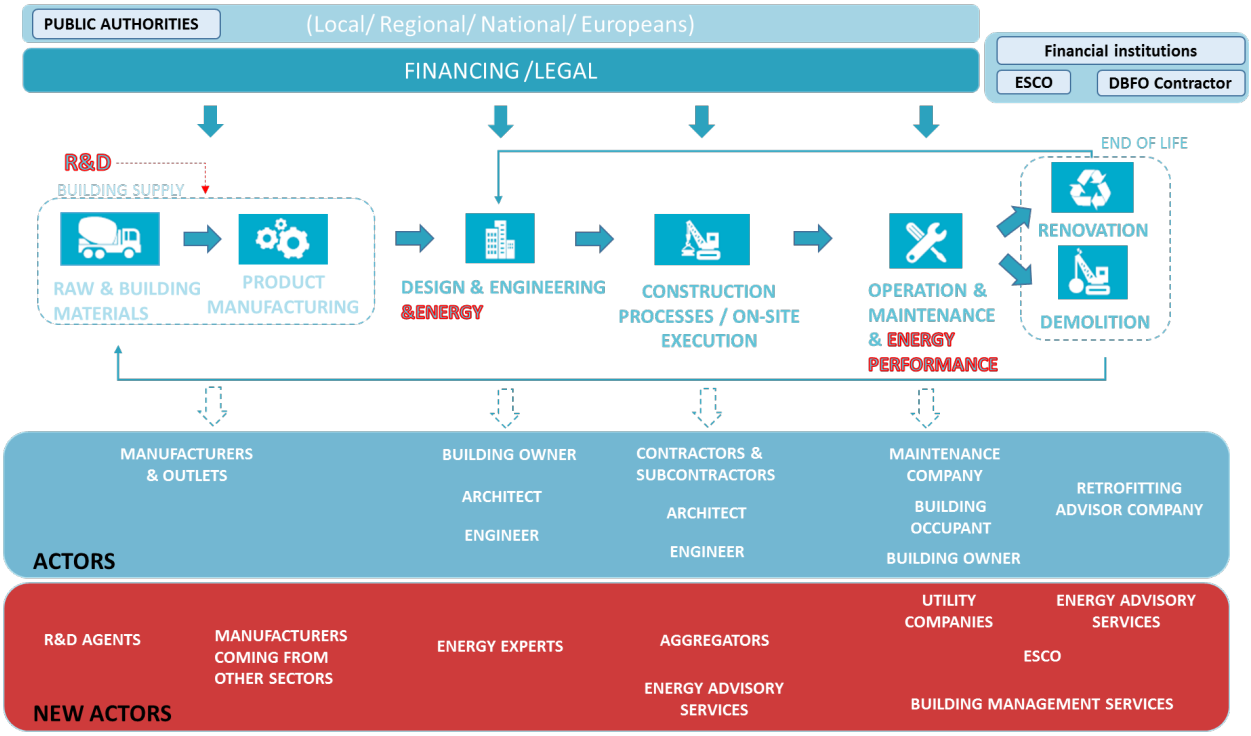

Figure 21: The building process and its actors (De Groote & Lefever, 2016)

4.2.2 Mapping of business models

Twenty novel business models in the built environment sector were examined in this section. Every model includes a description, examples of real cases and the type of innovation source that accounts.

BM BLD 1: Automatic energy metering and monitoring

The Automatic energy metering and monitoring business model refers to a service including the installation of smart meters and controls to allow the client to self-monitor the energy consumption, identify, and quantify energy savings opportunities. Building automation can optimally manage the energy efficiency in climate control, lighting, water conservation, power management.

The industry and service sector are the typical actors implementing this business strategy.

ACEA Spa[33] is an example of a company providing automatic energy metering and monitoring solutions.

This model seeks to engage customers on the self-monitoring of their energy consumption.

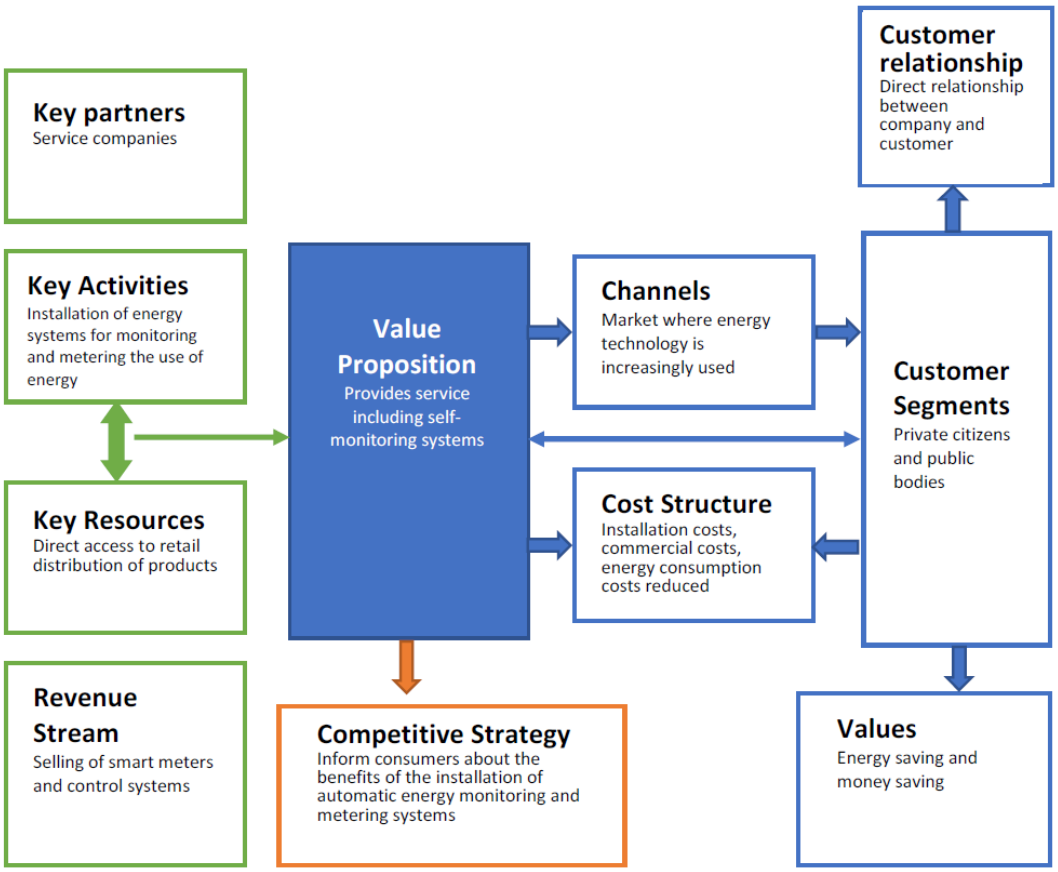

Figure 22: Automatic energy metering and monitoring business model Canvas

[33] http://www.acea.it/Home2.aspx?lang=en

BM BLD 2: Chauffage

A chauffage, also referred to as comfort contracting, is a contract form that is developed to provide a "function" (for example: keeping a room at 21 ºC) and incorporates energy efficiency on both the supply side and the demand side. However, demand-side EE measures are often "light" when compared with and EPC (chauffage does not include comprehensive retrofitting measures or equipment substitution) and are essentially focused on management and optimisation of the building's operational conditions.

An energy service organisation (ESCO) takes over complete responsibility for the provision to the client of an agreed set of energy services (e.g. space heat, lighting, motive power, etc.). This arrangement is an extreme form of energy management outsourcing. Where the energy supply market is competitive, the ESCO in a chauffage arrangement also takes over full responsibility for fuel/electricity purchasing. The fee paid by the client under a chauffage arrangement is calculated based on its existing energy bill minus a percentage saving (often in the range of 5-10 %). Thus, the client is guaranteed an immediate saving user' needs relative to its current bill.

Geet[34] is an example of an Italian company implementing this business model. The service seeks to satisfy user's needs and encourages right behaviours.

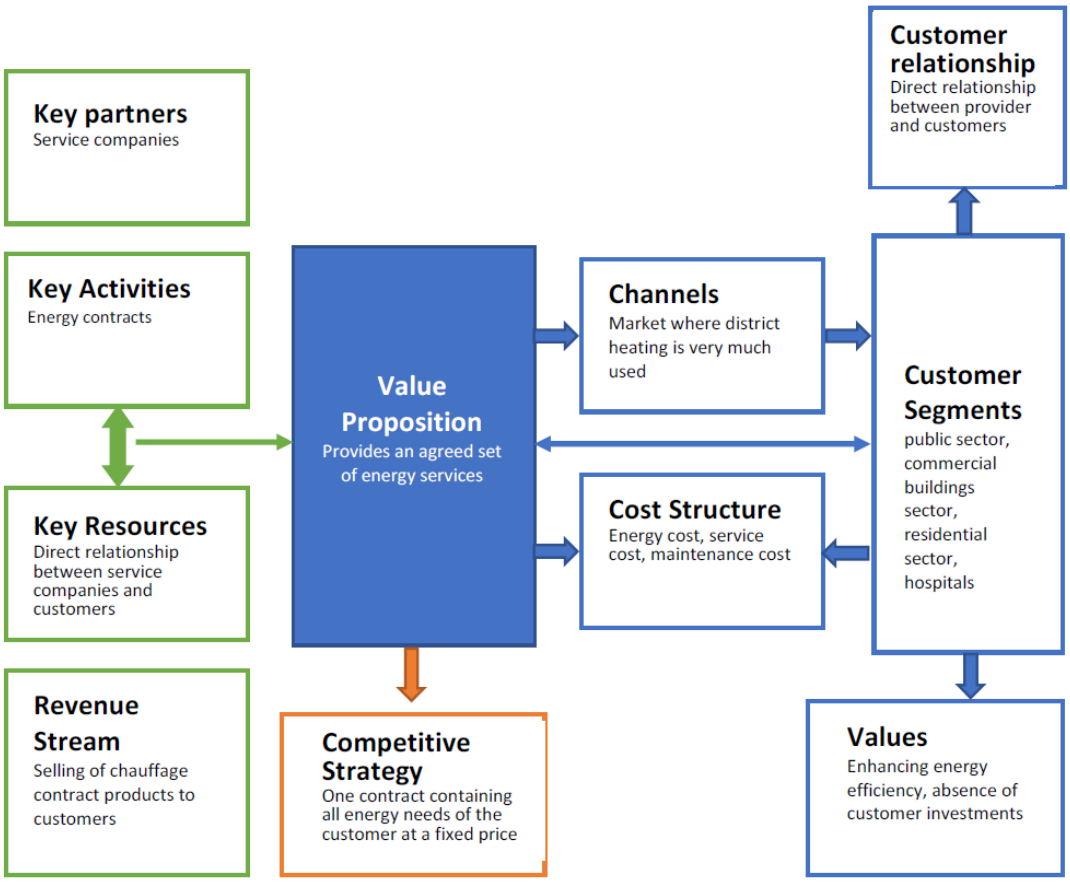

Figure 23: Chauffage business model Canvas

[34] http://www.geet.it/

BM BLD 3: Metered Energy Efficiency Purchase Agreement (MEEPA)

The Metered Energy Efficiency Transaction Structure (MEETS) is an innovative structure that works like the sale of "negawatts" achieved by energy efficiency measures to utilities. It works through new relationships between owner, occupant, investors, and utilities to break down almost every conflict among them. It is a financial transaction structure aiming to satisfy all stakeholders' interests.

MEETS is touted as unique to attract capital for deep energy savings by being able to address investors' uncertainty concerns through standardised measurement as well as the utilities' "death spiral" concern by converting delivery of non-energy into 'generated energy' (negawatts), and therefore revenue

There is a pilot rollout at the Bullitt Center in Seattle, financed by Equilibrium Capital Group, LLC, the Bullitt Foundation is the owner, and the Seattle City Light is the utility.

In this case, the main innovation sources come from financing and partnership.

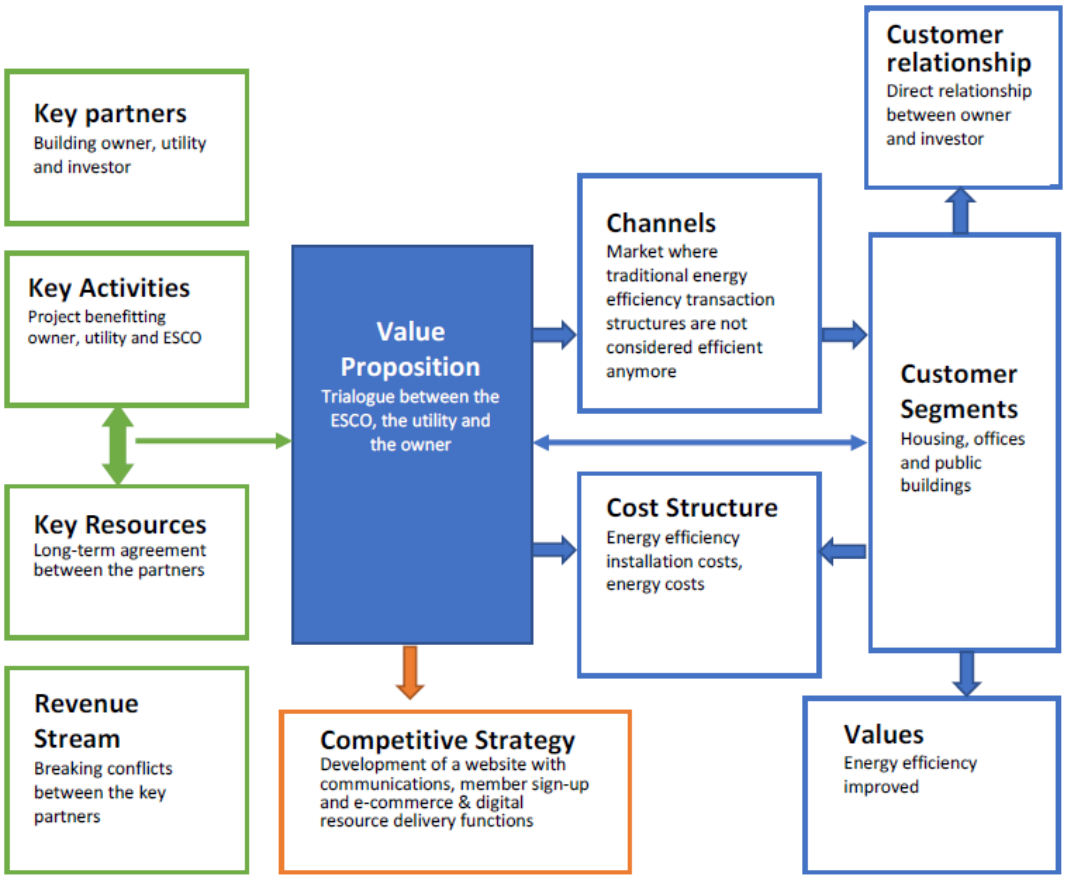

Figure 24: MEEPA Energy Efficiency Purchase Agreement business model Canvas

BM BLD 4: Shared Savings Agreements (SSA)

The shared savings agreement is a type of Energy Performance Contract (EPC) in which an ESCO finances the project for implementation of EE measures at the customer facilities. Then, savings obtained with the project are shared between the client and the ESCO during a period previously determined and with share rates previously agreed.

The ESCO obtains financing as usual for implementing the project. EE measures are generally directed at demand side measures but supply side measures (such as setting up efficient heat boilers) can also be incorporated. The Shared savings model is a win-win situation for both the ESCO and the customer. The ESCO finances the total investment of the project and it is totally responsible for repaying the loan while the customer improves the energy efficiency and reduces its energy consumption.

ENERGIKA[35] is an example of an Italian company providing this kind of business model.

In this BM case, the main innovation sources come from financing and optimisation.

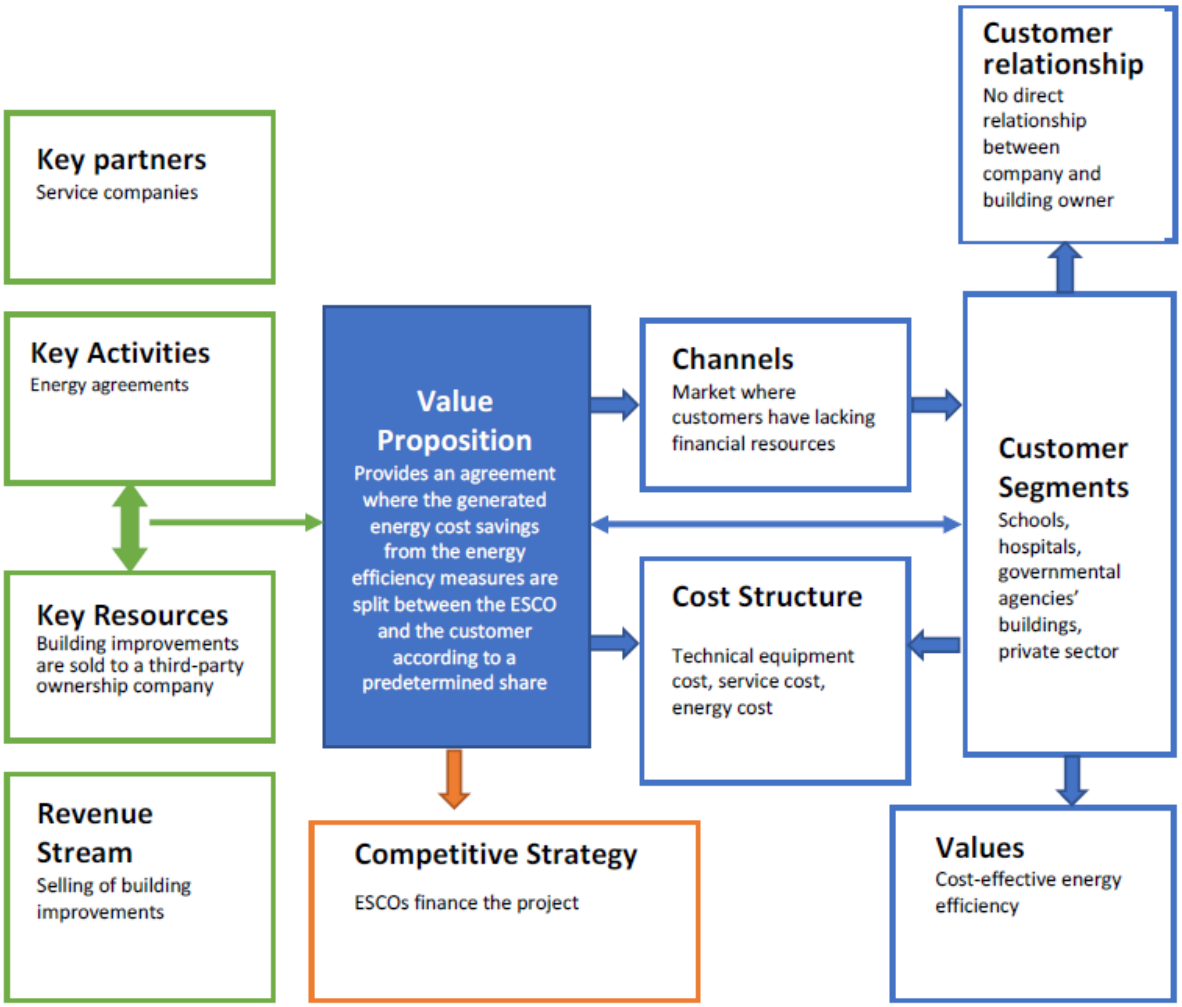

Figure 25: SSA Shared Saving Agreements business model Canvas

[35] ENERGIKA. *Chi siamo.* Available at http://www.energika.it/chi-siamo/

BM BLD 5: Integrated Project Delivery

The Integrated project delivery model refers to a collaborative alliance between stakeholders and is focused at the starting of a project (design phase). The uniting of owner, architect, and contractor is the essence of this project delivery method and ensures maximum efficiency and successful project delivery from all parties involved.

This model combines ideas from integrated practice and lean construction to solve several problems in contemporary construction such as low productivity and waste, time overruns, quality issues, and conflicts during construction among the key stakeholders of owner, architect, and contractor. The growing use of building information modelling in the construction industry is allowing far greater information collaboration between project participants using IPD and considered an important tool to increasing productivity throughout the construction process.

Technital S.p.a[36] has used this business model.

This BM case represents an example of innovation through partnership.

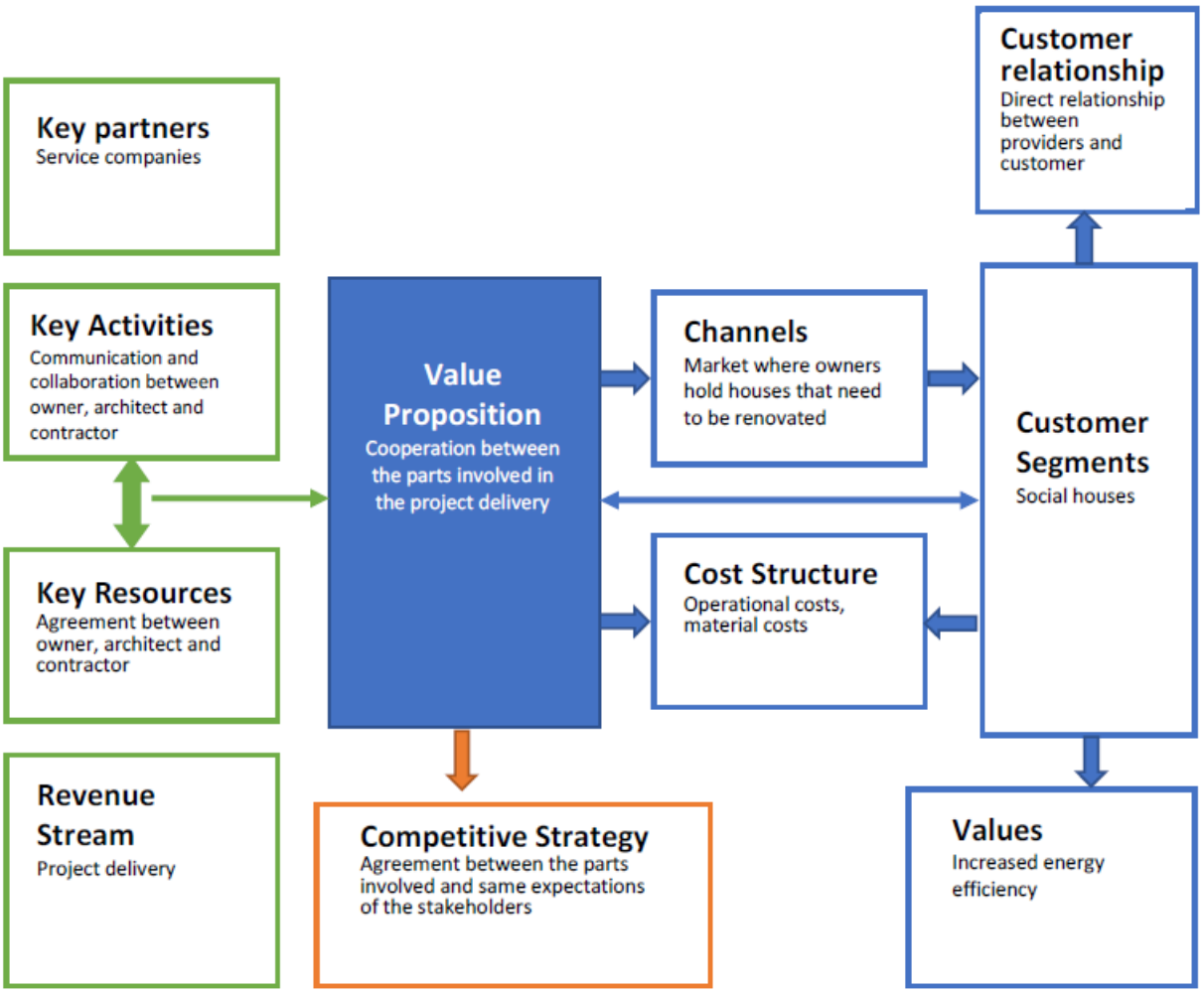

Figure 26: Integrated Project Delivery business model Canvas

[36] Technital, available at http://www.technital.it/en/home-page/1.html

BM BLD 6: Alliancing

The public and private sector agree to jointly design, develop, and finance the project. It is a delivery model for public infrastructure projects, alternative to the conventional procurement ones. In some cases, they also work together to build, maintain, and operate the facility. The alliancing model connects flexibility to effective project implementation to overcome the challenge of joint delivery.

The focus is on encouraging collaboration using payment mechanism that ensures that the interest of all partners is aligned with the project objectives.

NIGRO & Partners uses this business model.[37] In this case, the main innovation comes from vertical value chain integration and partnership.

This model can be used in situations when uncertainty is great. It has been used in the oil and gas sector.

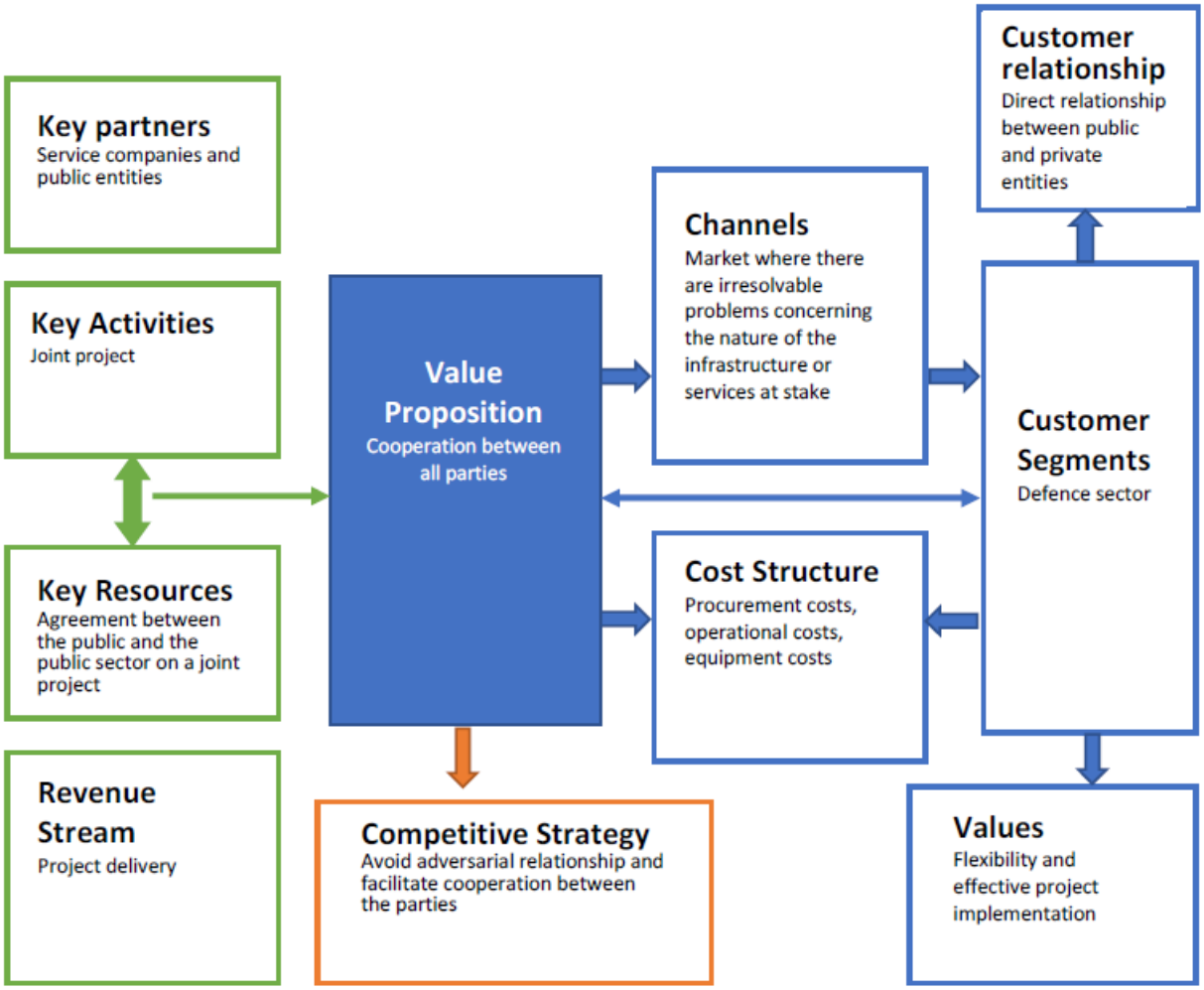

Figure 27: Alliancing business model Canvas

[37] NIGRO & Partners, available at http://www.partenariatopubblicoprivato.it/1/home_328037.html

BM BLD 7: Bundling

It means contracting with one partner to provide several small-scale PPP projects in order to reduce the length of the procurement process as well as transaction costs.

The ELENA-Modena project of the Agenzia per l'Energia e lo Sviluppo Sostenibile (AESS) is an example of a bundling energy project (Agenzia per l'energia e lo sviluppo sostenible, 2016).

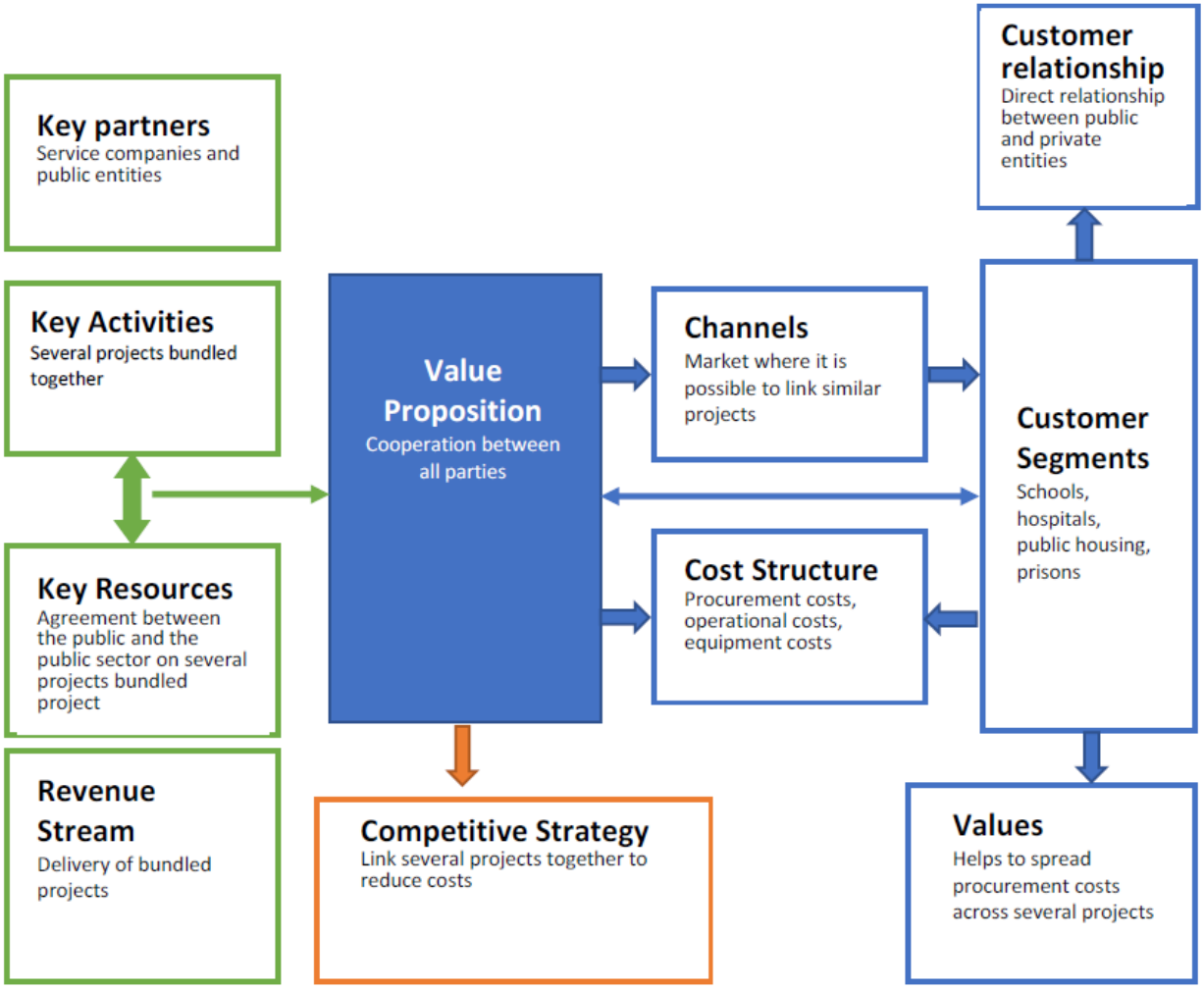

Figure 28: Bundling business model Canvas

BM BLD 8: Competitive partnership

The competitive partnership model is a delivery model for public infrastructure projects in which private partners are selected, in competition with each other, to deliver different aspects of a project. The contract allows the public sector to reallocate projects among partners at a later date, depending upon performance. The public partner can also use the cost and quality of other partners' outputs as a benchmark for all partners.

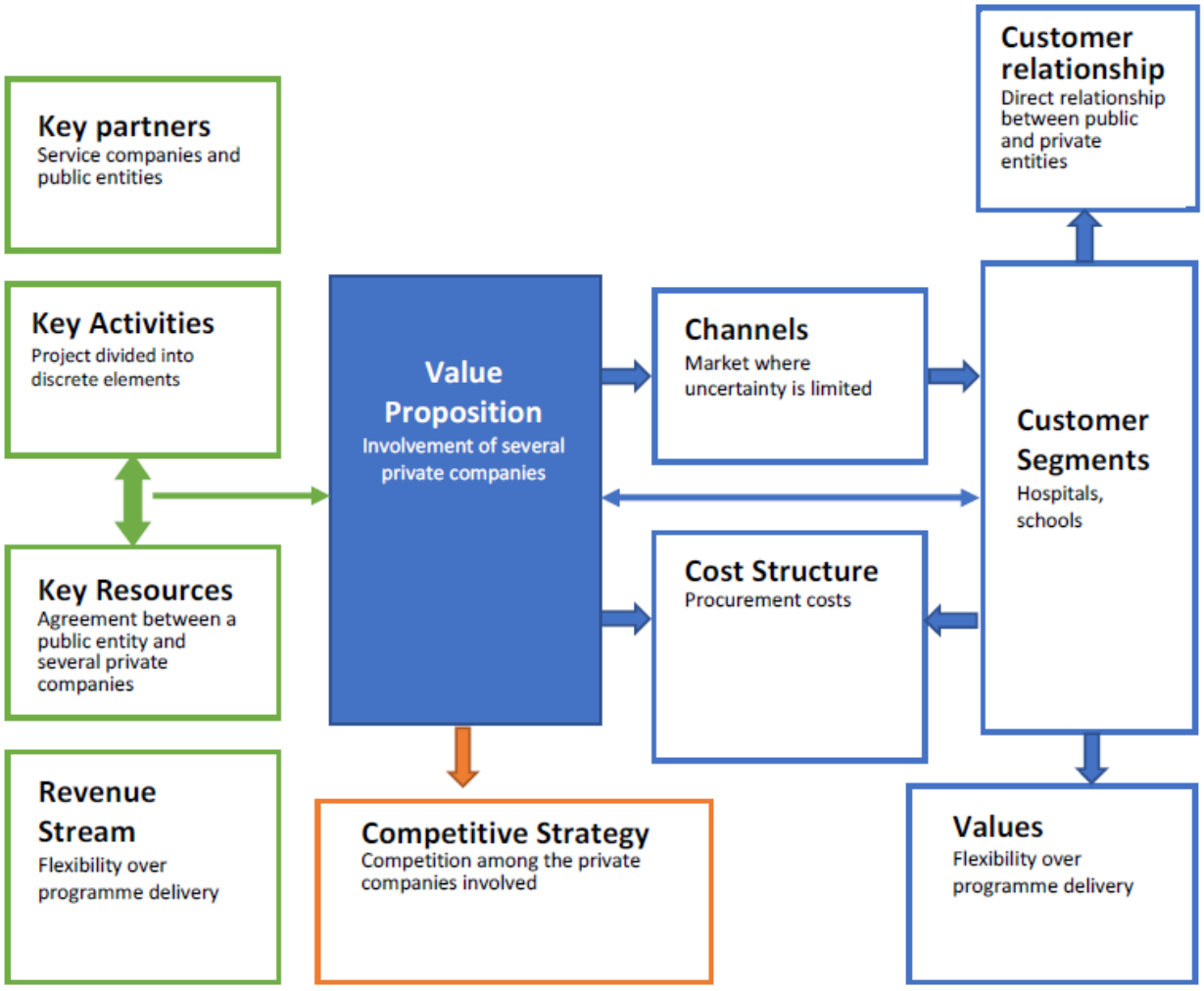

Figure 29: Competitive Partnership business model Canvas

BM BLD 9: Incremental Partnership

The incremental partnership model is a delivery model for public infrastructure projects in the form of a framework agreement between the private sector partners that procures the necessary infrastructure and services on behalf of the public sector. It is an alternative to conventional procurement. This model can be used in situations when uncertainty is great. As its requirements become clearer, the public sector can "call off," or stop specific projects if they appear unproductive. The public sector can commission work incrementally, and it reserves the right to use alternative partners if suitable.

This model is potentially beneficial where the infrastructure in question is divisible and has a short life.

An example of incremental partnership in action is the Greenwich Council ICT project in London. Innovation comes from partnership.

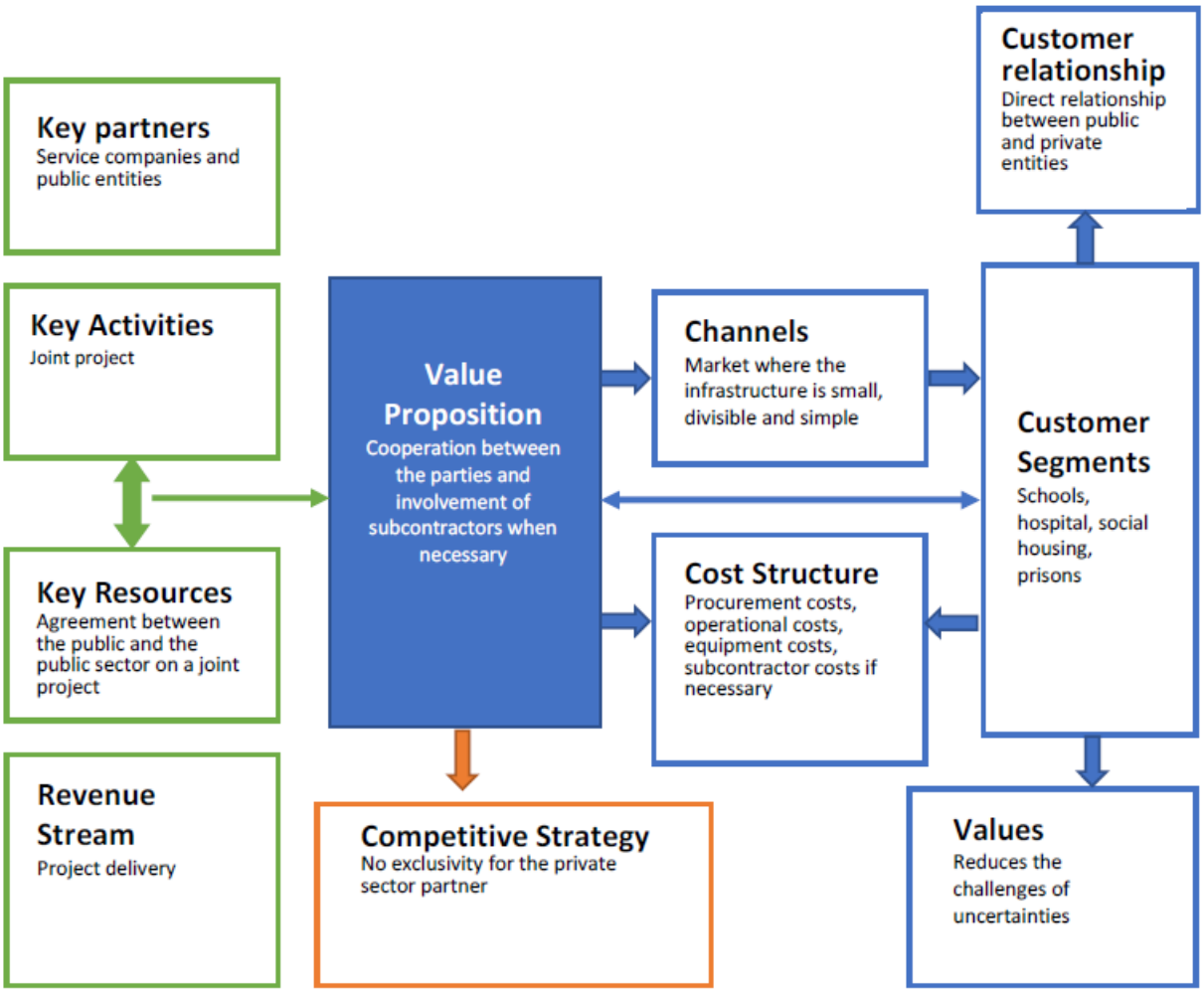

Figure 30: Incremental Partnership business model Canvas

BM BLD 10: Lease/Rent roof/Land

In the Lease/Rent roof/land model the contractor offers to lease the roof for 20-25 years and, in exchange, install and maintain Renewable Energy Sources on it. Building owners do not have upfront investment and they benefit from the free electricity produced by the system. The contractor benefits from the public financing schemes.

Many commercial, industrial, and retail buildings can provide the real estate needed for these systems, and are subsequently viewed as excellent candidates for roof rental.

Sunerg Solar Energy is an example of a company in Italy using this business model.[38]

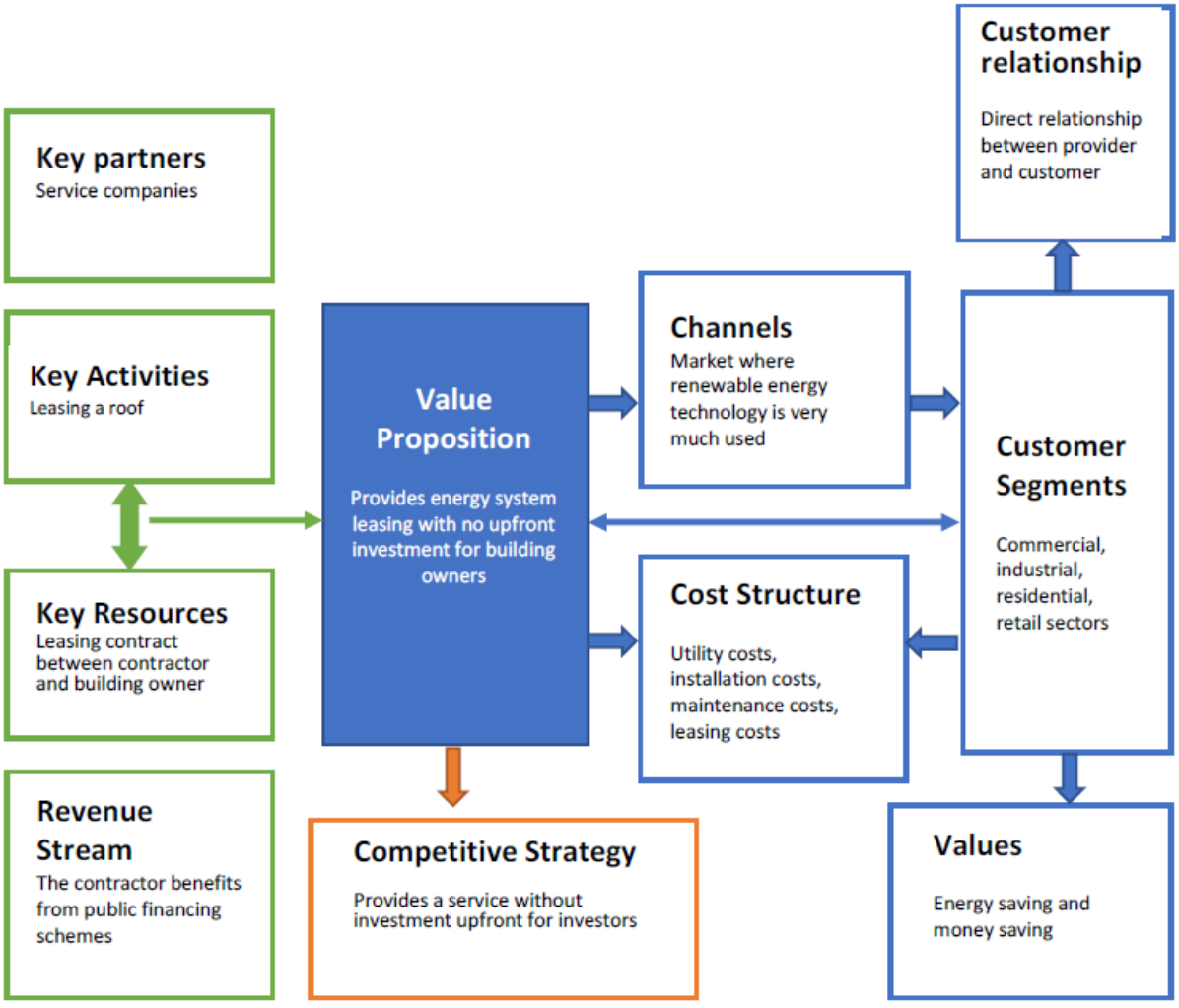

Figure 31: Lease/Rent Roof/Land business model Canvas

[38] Sunerg Solar Energy, http://www.sunergsolar.com/it/prodotti/fotovoltaico/moduli-solari-fotovoltaici/moduli-uni-solar

BM BLD 11: Leasing of Renewable Energy Equipment

Leasing enables a building owner to use a renewable energy installation without having to buy it. The installation is owned or invested by another party, usually a financial institution. The building owner pays a periodic lease payment to that party (Würtenberger & Bleyl, 2012). Leasing energy-related improvements is a common and cost-effective way for state and local governments to finance upgrades and then use the energy savings to pay the investments. Leases often have slightly higher rates than bond financing.

Belectric Group[39] is a leader in the development, installation, and maintenance of solar photovoltaic systems in the UK. They are supported by a financial scheme that enables them to offer leasing contracts to customers (Siemens, 2016).

Leasing RE equipment is a new financing way to innovate on business models. This financial instrument prevents customers from making an up-front investment.

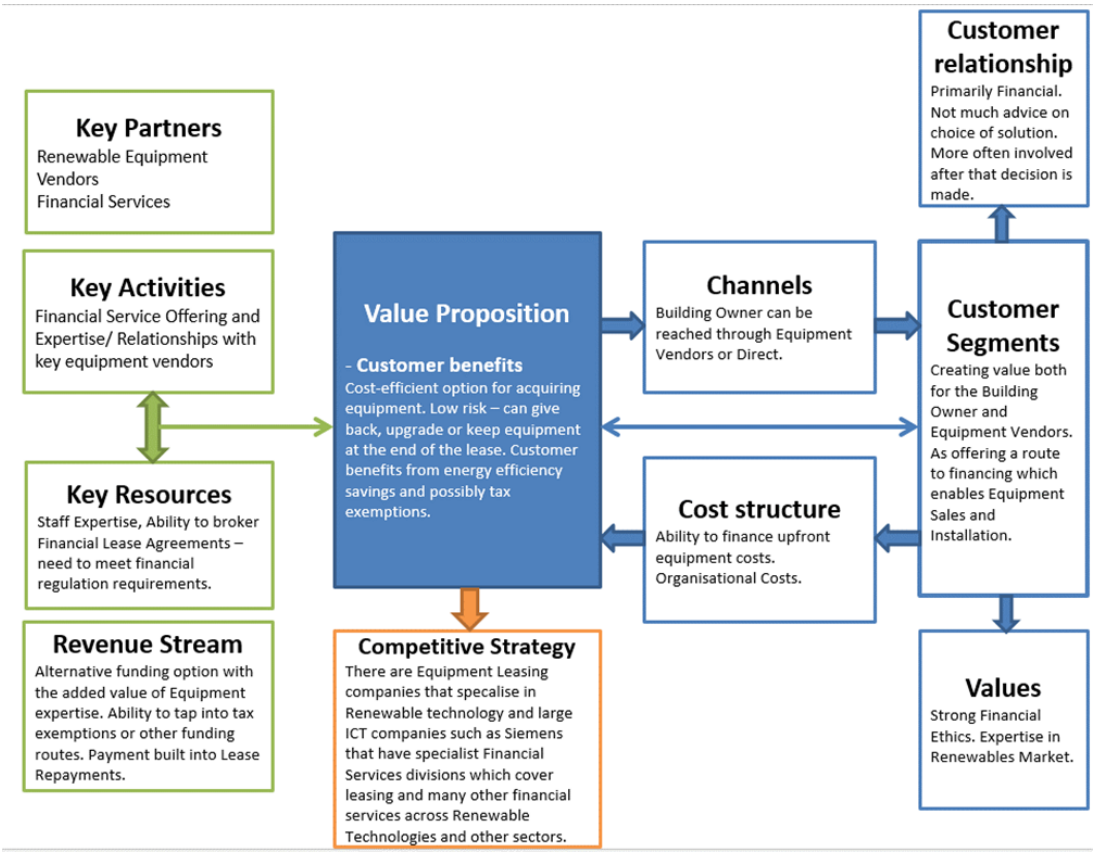

Figure 32: Leasing of Renewable Energy Equipment model canvas

[39] www.belectric.com

BM BLD 12: Platform Model

A platform is a business model that creates value by facilitating exchanges between two or more interdependent groups, usually consumers, and producers. Successful platforms facilitate exchanges by reducing transaction costs and/or by enabling externalised innovation. As a by-product, platforms also create ecosystems and leverage their inherent network effects (Moazed, 2016).

Moxia Technology[40] is a company focused on innovative thinking that was founded in 2010. Their main aim is to be a leader in customer product design, creating products using modern technology, which not only satisfy customers' needs, but are also energy efficient. One of their products is Maslow, a smart energy storage system, which has been produced for residential/commercial use (Moxia Technology, 2016).

Platform models are a new channel to deliver product and services to customers. The innovation resides on the way users get what they cherish.

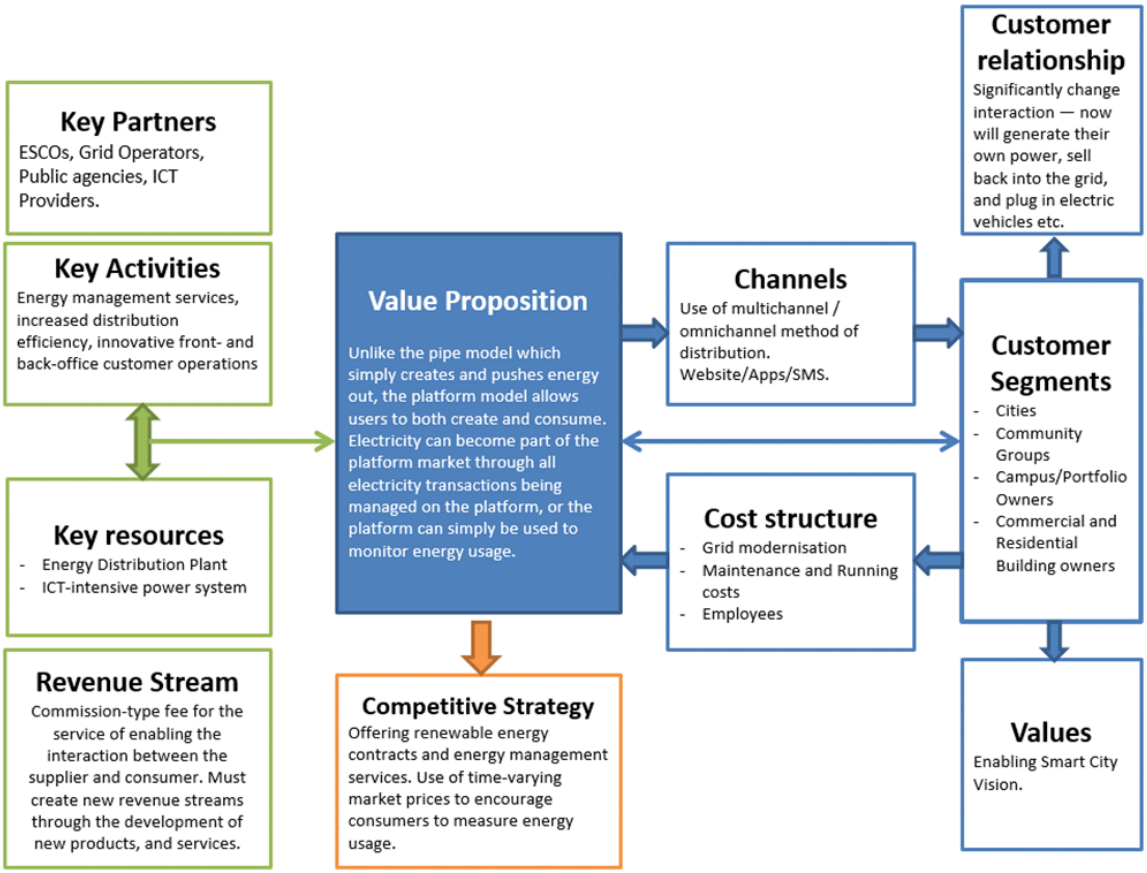

Figure 33: Platform Model Business Canvas

[40] www.moxia.com

BM BLD 13: Energy Performance Contracting (EPC)

Energy Performance Contracting (EPC) is a form of "creative financing" for capital improvement which allows funding energy upgrades from cost reductions. Under an EPC arrangement an external organisation (Energy Service Company - ESCO) implements a project to deliver energy efficiency, and uses the stream of income from the cost savings, to repay the costs of the project, including the costs of the investment. Essentially the ESCO will not receive its payment unless the project delivers energy savings as expected (European Comission, 2016).

Energy companies such as Iberdrola[41] in Spain or EDF[42] in France deliver energy following EPC contracts.

This business model introduces a new financing scheme in construction projects. It is an innovative way for ESCOs to implement energy efficient measures within buildings.

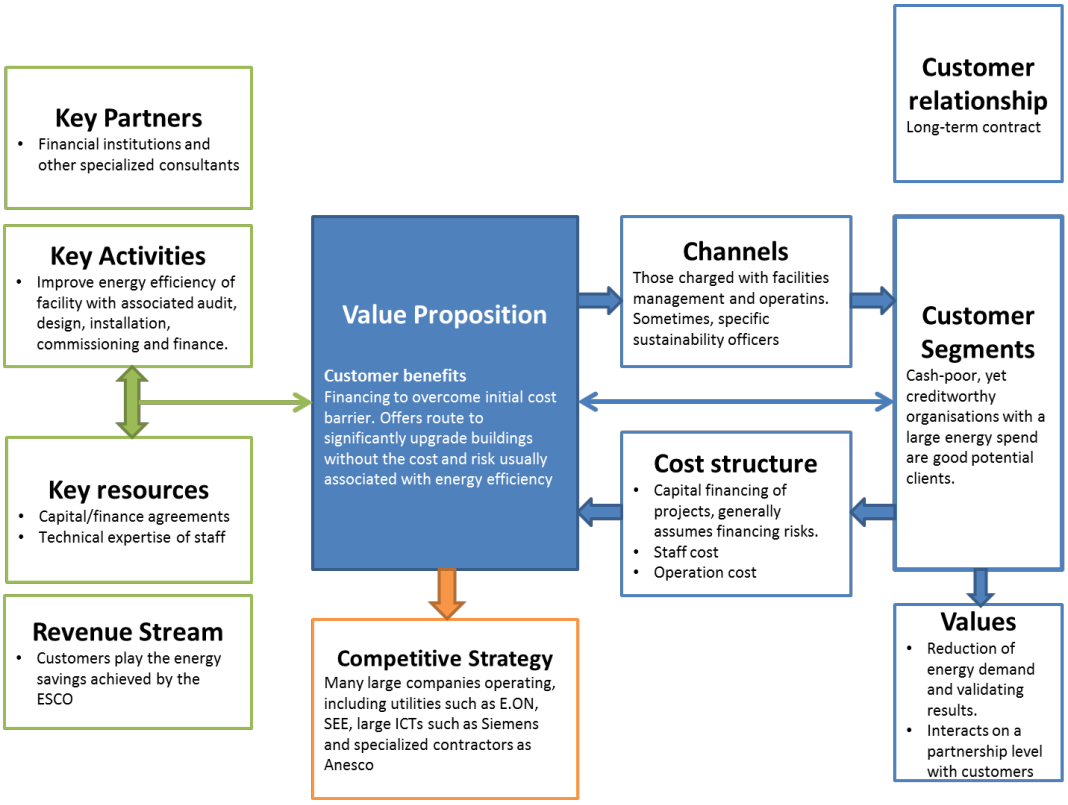

Figure 34: The energy performance contracting model canvas

[41] www.iberdrola.es
[42] www.edf.fr

BM BLD 14: Integrated Energy Contracting (IEC)

The Integrated Energy Contracting (IEC) model is a mix of an Energy Performance Contract with an Energy Supply Contract. It aims at reducing energy consumption through both energy efficient measures and efficient energy supply. The owner will assign an ESCO to do the work, supply energy, and guarantee energy performance.

Within an IEC, ESCO delivers a certain quantity of energy at a fixed cost, contractually defined. The remuneration of the ESCO is bound to the energy demand measures implemented. In order to make sure savings will be achieved, a quality assurance will be provided, and measures and verification procedures will be implemented (The Umbrella project, 2013).

LIG[43] is the first institutional building owner that has systematically applied the concept of IEC. In 2007, they made the first call for tenders for five buildings with a net floor area of 11 000 m^2. The Retzhof project is another example of LIG. It is a complex of buildings that are used as a hotel and a seminar house (Würtenberger & Bleyl, 2012).

Innovation comes from a new way of financing energy projects in the building environment.

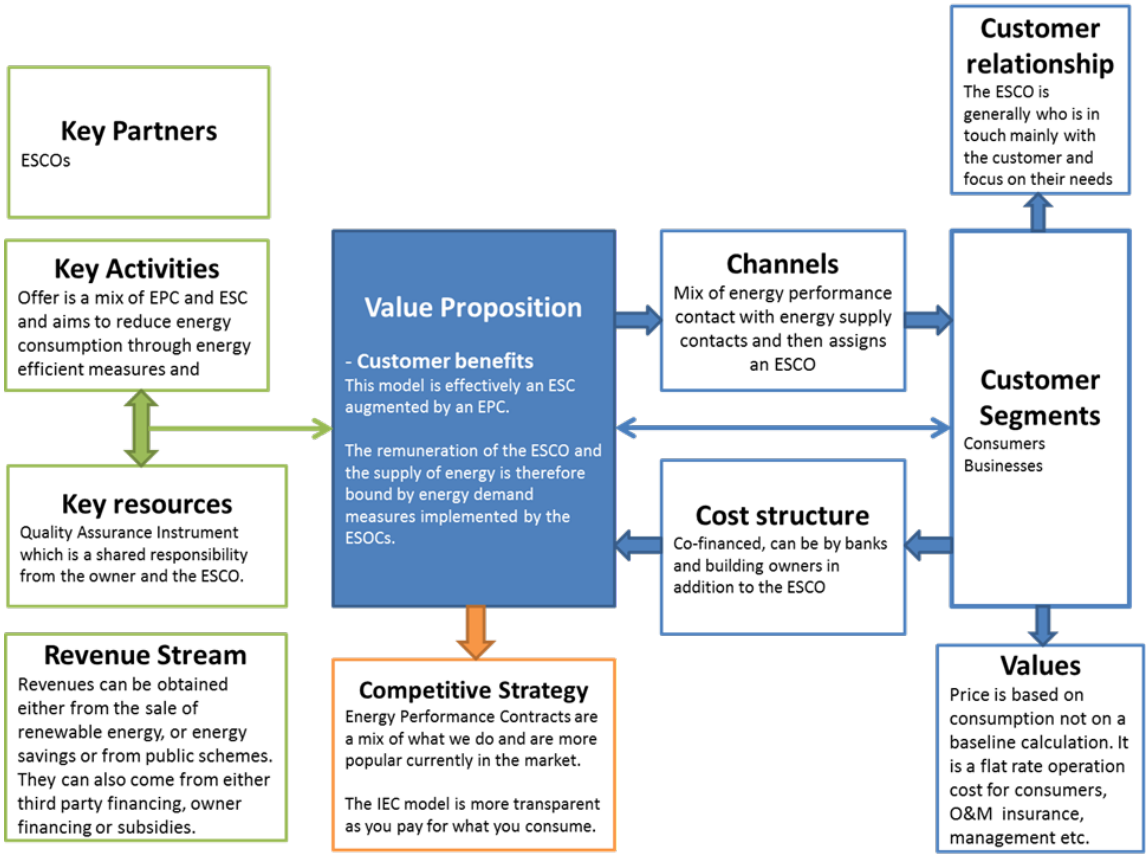

Figure 35: IEC business model canvas

[43] www.lig-stmk.at

BM BLD 15: Design Build Finance and Operate (DBFO)

The contractor finances and constructs the asset, which gives him the incentive to complete on time and within budget. The responsibilities for designing, building, financing and operating are bundled together and transferred to a contractor. After the fixed term, the building is transferred to the client. This delivery approach increases incentives for overall value-for-money consideration, because the contractor assumes a combined responsibility in finance, construction, operation (The Umbrella project, 2013).

The Highways Agency[44] in the UK used a DBFO model in 13 projects that involved 36 construction schemes.

Through partnerships between the different stages of the value chain such as design, build, finance, and operation, this business model brings innovation to this sector.

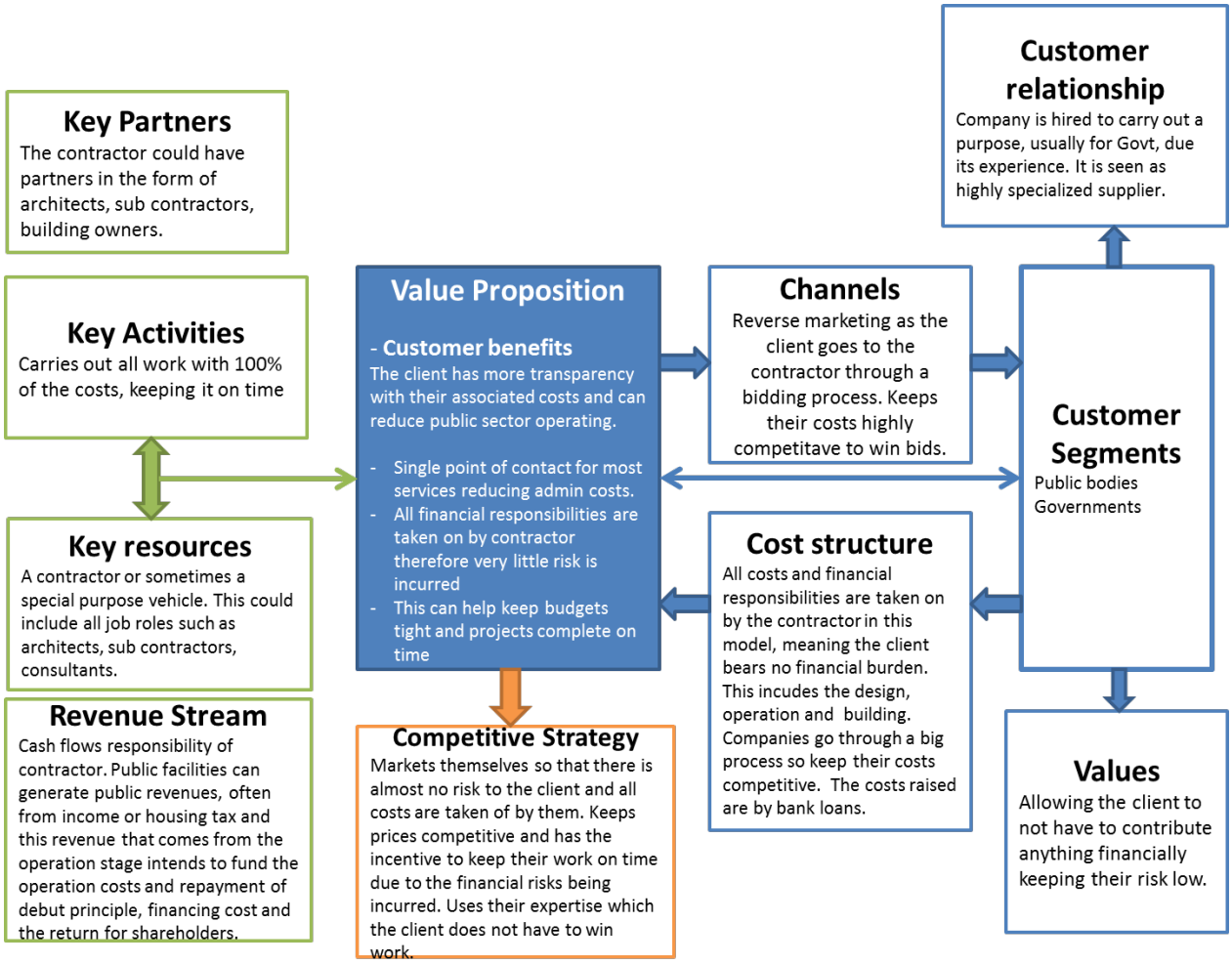

Figure 36: The Design Build Finance and Operate business model canvas

[44] www.highways.gov.uk

BM BLD 16: One-Stop-Shop

The one-stop-shop business model aims at overcoming fragmentation in the building works process. It provides the building owner or decision-maker with a single contact point for implementing energy efficiency works. Services provided span from all types of individual energy efficiency services to full retrofit packages. Another version of one-stop-shop is represented by web-based platforms, where preliminary services are provided online (The Umbrella project, 2013).

Ameresco[45] is an example of a one-stop-shop model. They provided a contract including full services for the largest military base installation in the U.S. Ameresco reduced 60% of overall emissions by converting the primary heating system fuel from coal to natural gas (Ameresco, 2016).

This model pursues to bundle different services together in the building environment. Therefore, innovation resides on product system or how to create valuable connections between disparate offerings.

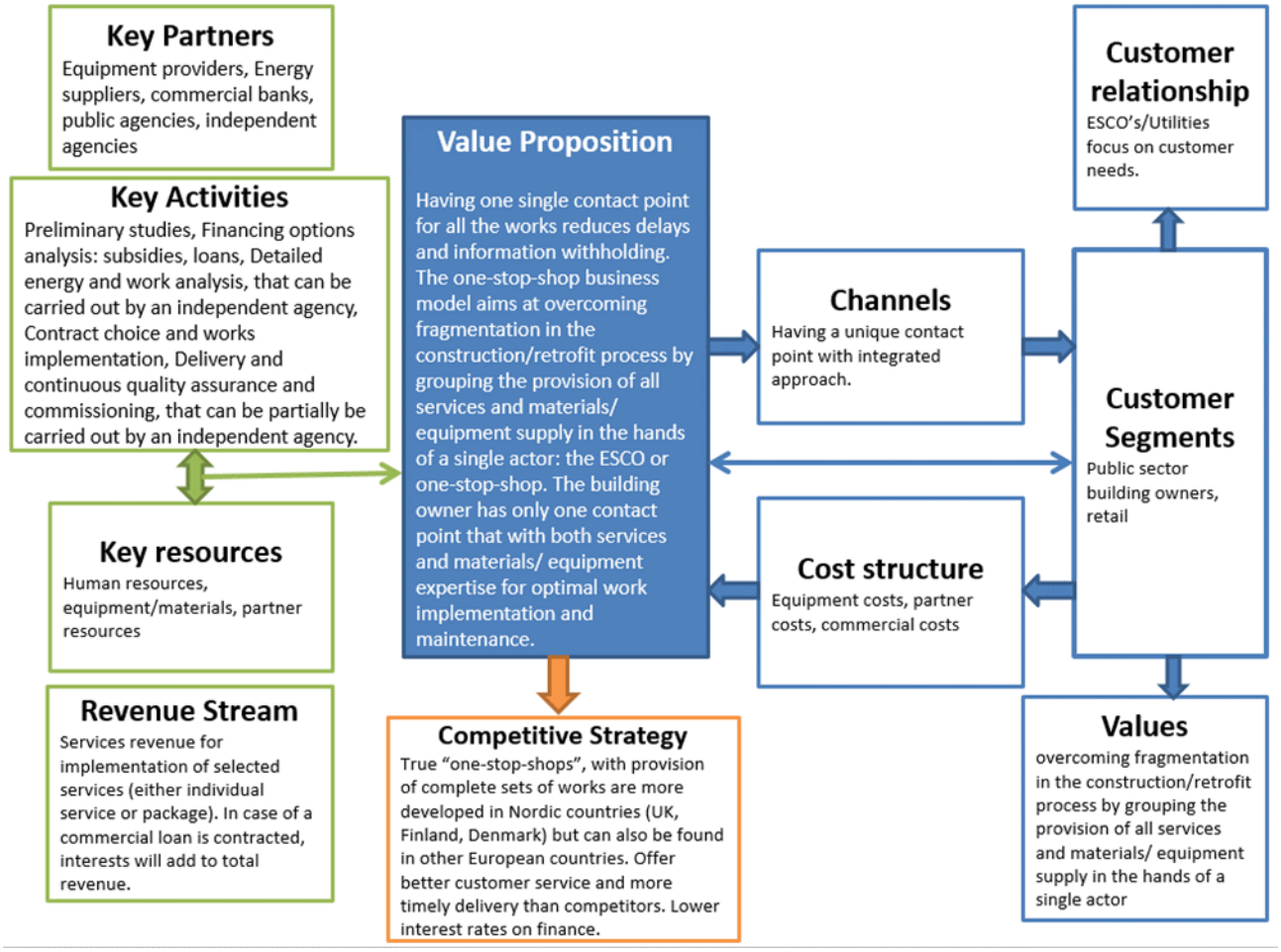

Figure 37: The one-stop-shop model canvas

[45] www.ameresco.com

BM BLD 17: On-bill Financing

On-bill financing is a financial collection mechanism that aims at reducing first-cost barriers in several buildings markets, some of which have traditionally been underserved by energy efficiency finance. On-bill financing generally refers to a financial product that is serviced by, or in partnership with, a utility company for energy efficiency improvements in a building, and repaid by the building owner on its monthly utility bill. Programs can be tailored to the industrial, commercial, and residential sectors (ACEEE, 2011).

Real cases can be found, for instance, in the UK. In 2013, the department of energy and climate change (DECC) launched the "Green Deal" program (Department of Energy & Climate Change, 2013). Under the proposed scheme called on-bill Repayment (OBR) financing structures, the government offered loans for EE improvements that are repaid on customers' utility bills. 1 173 financing plans had been signed through this program with an approximate value of £4.5 million.

This innovative financing scheme provides financing to RE and EE projects within buildings. For the building owner there is a guarantee of the installed equipment meanwhile the utility takes care of technical problems and meets targets sets under energy savings obligations.

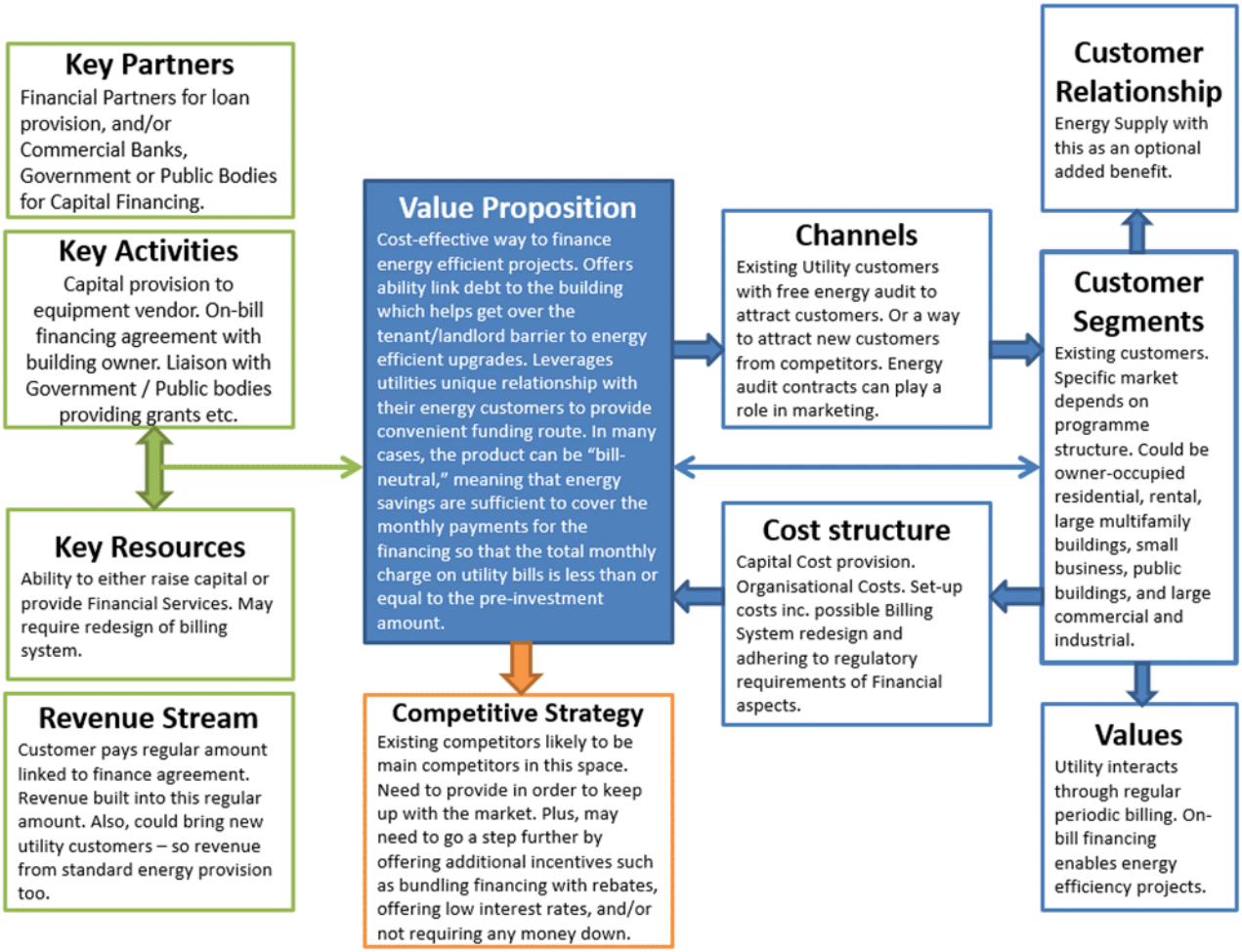

Figure 38: The on-bill financing model canvas

BM BLD 18: Energy project design with performance payment

Energy project design with performance payment is a service found in projects that take a holistic approach to construction meaning that the design team will take a systemic view of the building project to consider integrated energy efficiency solutions. With this service, the purpose is to incentivise the design team to design a project that maximises energy savings (The Umbrella project, 2013).

Under this contract model, 38 energy conservation measures were implemented at the University of Massachusetts, U.S. Improvements include adding electric cogeneration at the power plant, installing electrical infrastructure upgrades, adding variable speed drives to motors, and upgrading fume hoods. Another example is the Wyandotte Public School district that allowed significant building EE improvements while saving $6.9 million in cost to the district (Davis, 2013).

Product system is the main innovation source in this business model. The design team bundles different EE solutions together to implement them in buildings.

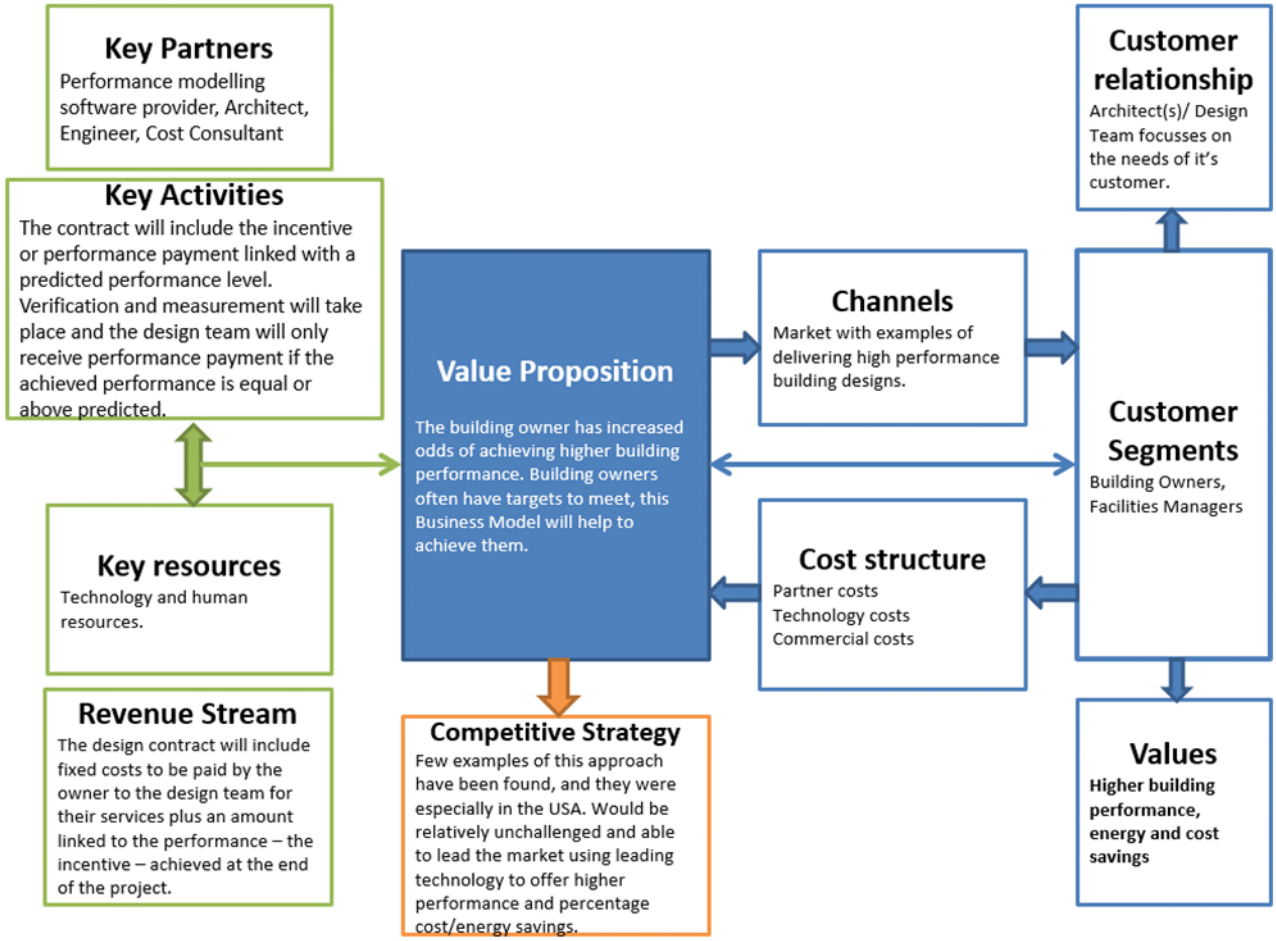

Figure 39: The energy project design with performance payment model canvas

BM BLD 19: Electricity bill Optimisation

Contractors analyse the electricity bill and optimise it. The energy savings are shared during an agreed period of time, after which the savings are entirely benefitting the client (The Umbrella project, 2013).

St Albans is one of Europe's oldest schools in the UK and during its 1000 year's history the school has constantly developed, always looking with confidence to the future. In the space of 5 years, savings of nearly £70,000 on electricity and gas expenditure were obtained by Utilitas Solutions[46].

This business model provides services that satisfies user's needs (electricity bill) without owning physical products so that the source of innovation comes from PSS-functionality.

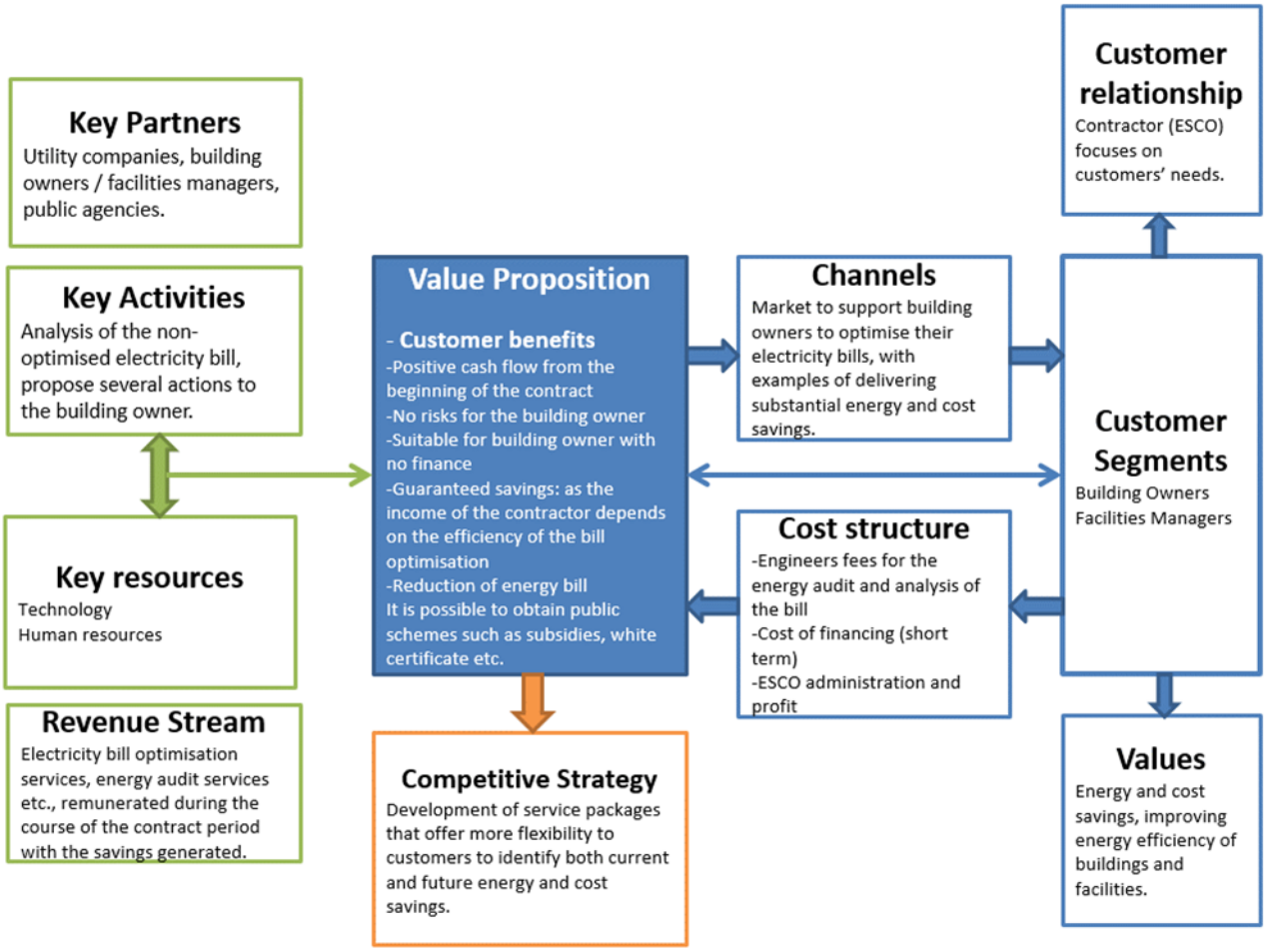

Figure 40: The electricity bill optimisation model canvas

[46] www.utilitas-solutions.co.uk

BM BLD 20: Energy Management Contracting

An energy management contract or EMC is a turnkey contract by which the contractor undertakes energy efficient upgrades creating a sustainable energy system and guaranteeing the supply of heating, cooling and hot water according to the owner needs (The Umbrella project, 2013).

Guy's and St Thomas' NHS Foundation Trust[47] in the UK, is developing a long-term energy management contract that guarantees energy savings of at least 11% a year by installing new equipment, as well as upgrading and fine-tuning existing plant and building services.

In this case, innovation comes from product system because different energy services are connected together and delivered to customers. This business models helps to build environments that delights customers while keeping competitors away.

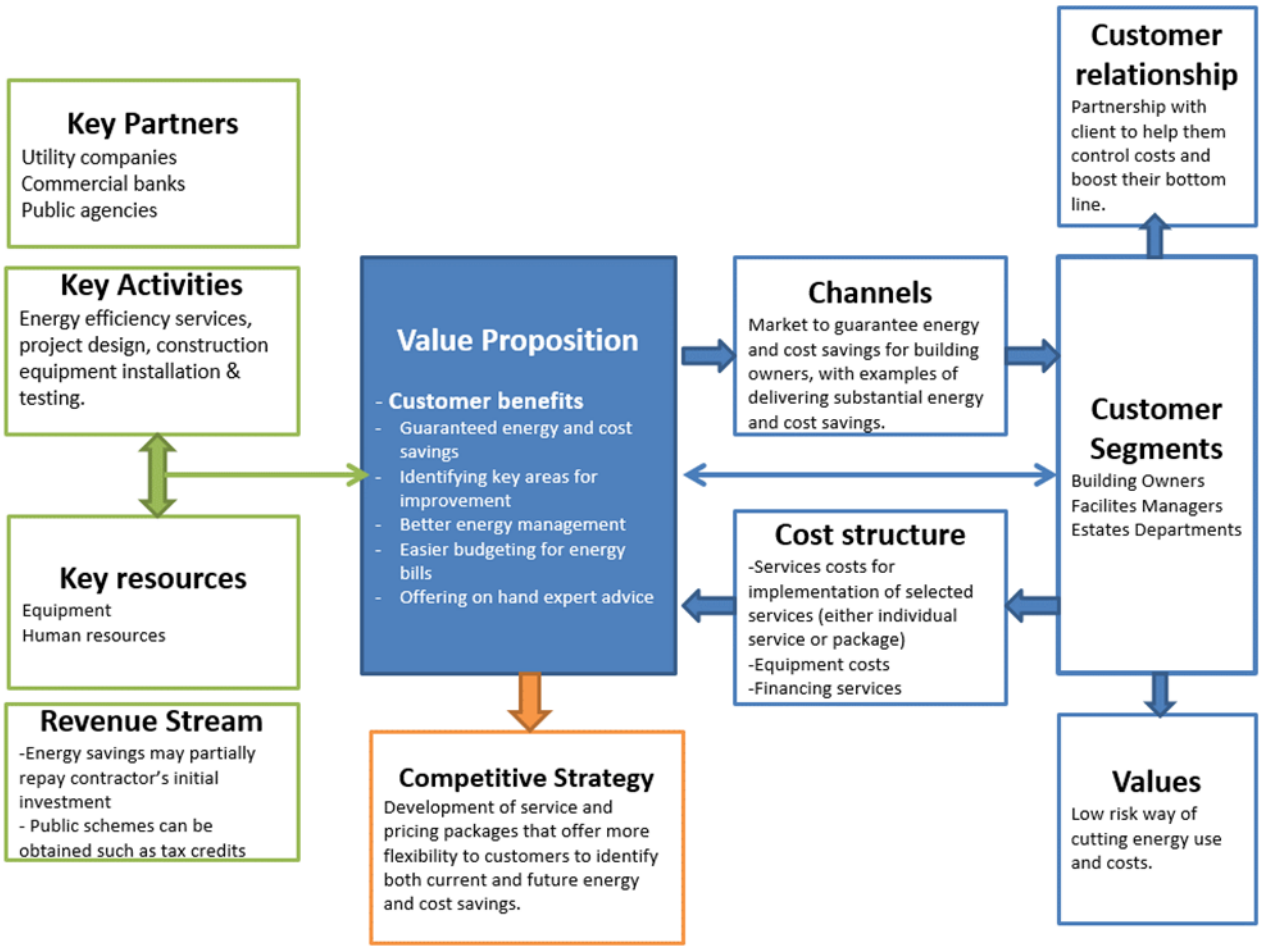

Figure 41: The energy management contracting model canvas

[47] http://www.guysandstthomas.nhs.uk

4.2.3 *Analysis of the innovation*

The greening transformation of the building sector is bringing into scene new market players at public and private levels. For instance, utilities are adapting their traditional and long established business models focusing on the vertical integration of the business and with little or no customer preference consideration, to offer comprehensive and integrated services going beyond the mere energy supply (e.g. including home automation, security, and telecommunication services). Moreover, new companies providing energy services to final energy users (ESCOs), including the supply and installations of energy efficient equipment, are acquiring an important market place on Europe. Finally, it is worth mentioning the key role that both financial institutions and public authorities are playing at regional, national, and European level.

Figure 42 shows the different business models reviewed in this section, mapped along the building value chain. It can be observed that **novel business models are emerging all along the industrial value chain**, starting with the design, construction and leading to the operational phase, end of life in the form of renovating. This reflects the global commitment of building/players to increase the energy efficiency and reduce the environmental impact of this sector.

On the other hand, the analysis presented in Figure 43 shows that innovation in the building value chain is occurring within the **configuration of business systems** and is especially focusing on **customer facing elements**. Innovation is also occurring within the creation of new **financing instruments** and **new partnership models for the delivery of project infrastructure projects**.

In the Design and Construction phases, for example, various forms of collaboration models and methods between architects, contractors, and investors are emerging. By applying a broader range of collaboration and project delivery models in the right circumstances, public sector organisations can improve the likelihood of achieving the Energy Performance Building Directive's goals for 2020[48] and project teams ensure maximum efficiency and successful project delivery from all parties involved.

In the operation and maintenance phase, on the other hand, new service-oriented business models are appearing to address customer's needs in terms of comfort, energy consumption, and cost of the electricity bill. Deep renovation is presented as a key opportunity for the sector.

To sum up, business innovation on the building sector is occurring all along the industry value chain, starting with the re-design of project delivery models, energy performance solutions, and leading to deep renovation. The built environment paradigm shift is pulling building users at the centre of the ecosystem and therefore service oriented business models are leading the way towards a greener building industry, in which cross-sectoral collaboration is key.

[48] https://ec.europa.eu/energy/en/topics/energy-efficiency/buildings/nearly-zero-energy-buildings

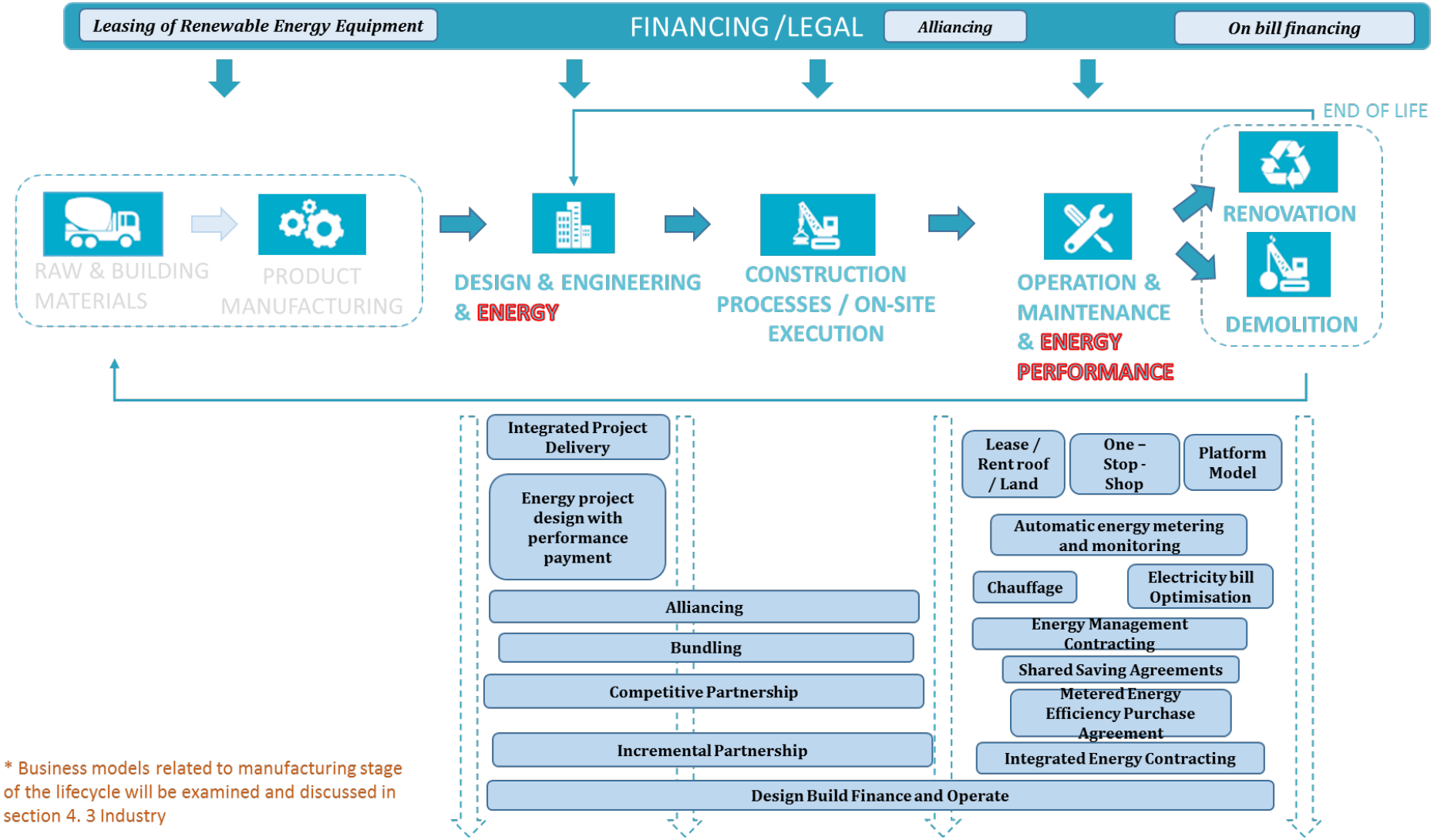

Figure 42: Mapping of the business models of the buildings sector (De Groote & Lefever, 2016)

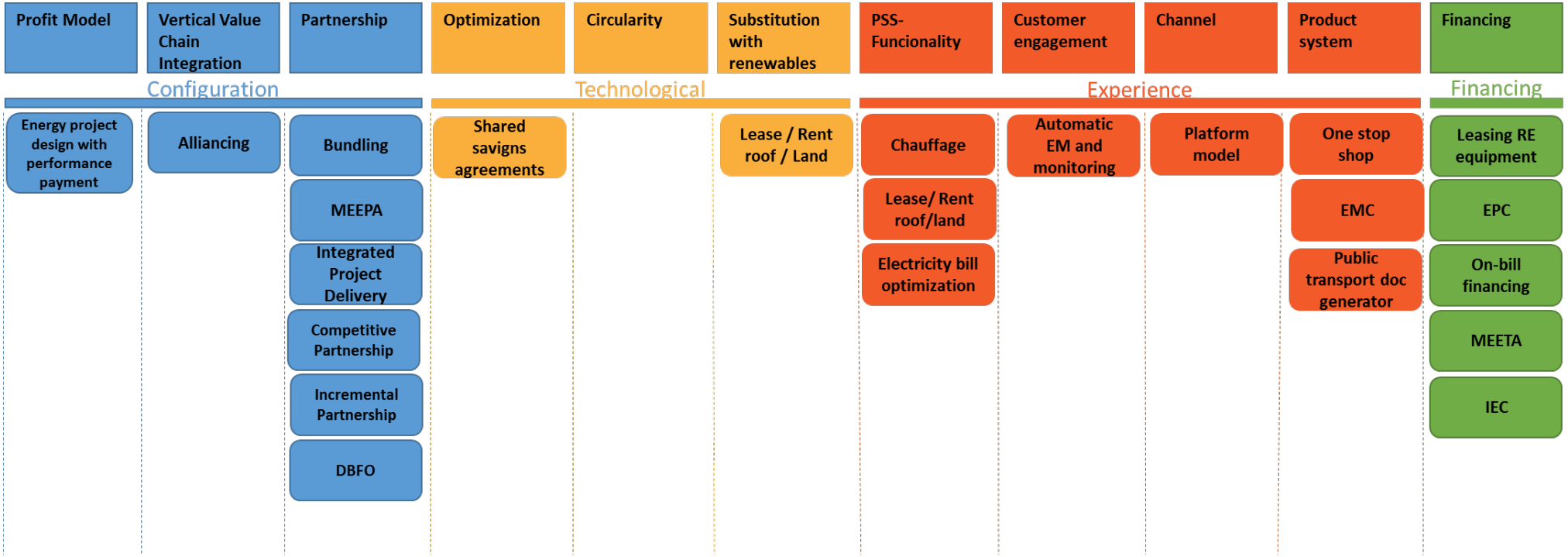

Figure 43: Innovation on business models of the building sector

4.3 Manufacturing Industry

When speaking about manufacturing industry, we essentially classify it into two main categories: process manufacturing and discrete manufacturing.

Process manufacturing is a part of industry that transforms material resources supply (raw materials, feedstock) into intermediate and end-user products, involving continuous flow production. This is the case for the production of cement, ceramics, chemicals, mineral, non-ferrous metals, water, and steel.

According to SPIRE,[49] the process industry represents 20% of total European manufacturing. In 2013, some 6.8 million workers were employed in 450,000 companies, generating 1600 billion euro in annual turnover (EFFRA, 2013).

However, manufacturing industries in Europe are highly dependent on resources in their production (energy and raw materials). For example, in 2014 manufacturing industries were responsible for 25.9% of the total EU energy consumption (Eurostat, 2014) and is one of the main contributors to global CO_2 emissions (about 20%). Other notable contributors are steel (6%), cement (5%), and chemicals (3%) which are also significant sources of CO_2 emissions (SPIRE, 2013).

Therefore, process manufacturing fulfils an enabling role for improved competitiveness, whilst drastically reducing resources and the environmental footprint of our industrial activities. The following case studies will illuminate the cross-sectoral approach that European processing industries are undertaking to tackle the energy related challenges.

4.3.1 Value chain

Figure 44 presents a high-level overview of process manufacturing from a life cycle perspective, with stages in light green representing traditional structures, and conventional actors and stages in red representing novel activities involving new market players.

The traditional structure of the industry, which focused on achieving “maximum gain from minimum capital”, does not fit with an industrial paradigm change based on achieving “maximum added value from a minimum of spent resources”. Therefore, the structure of process manufacturing industries and the role of key players within it are undergoing change.

The new scenario is dominated by ICT-supported measures that concern specific domains of manufacturing, including smart monitoring systems that tackle plant energy consumption and valorisation of waste streams, or control algorithms tackling production effectiveness and emissions. An emphasis has also been placed on manufacturing as a whole including supply chains and suppliers. Given the nature of these process industry sectors, global players are dominant in the supply chain.

[49] SPIRE is a contractual Public-Private Partnership dedicated to innovation in resource and energy efficiency enabled by the process industries < https://www.spire2030.eu/>

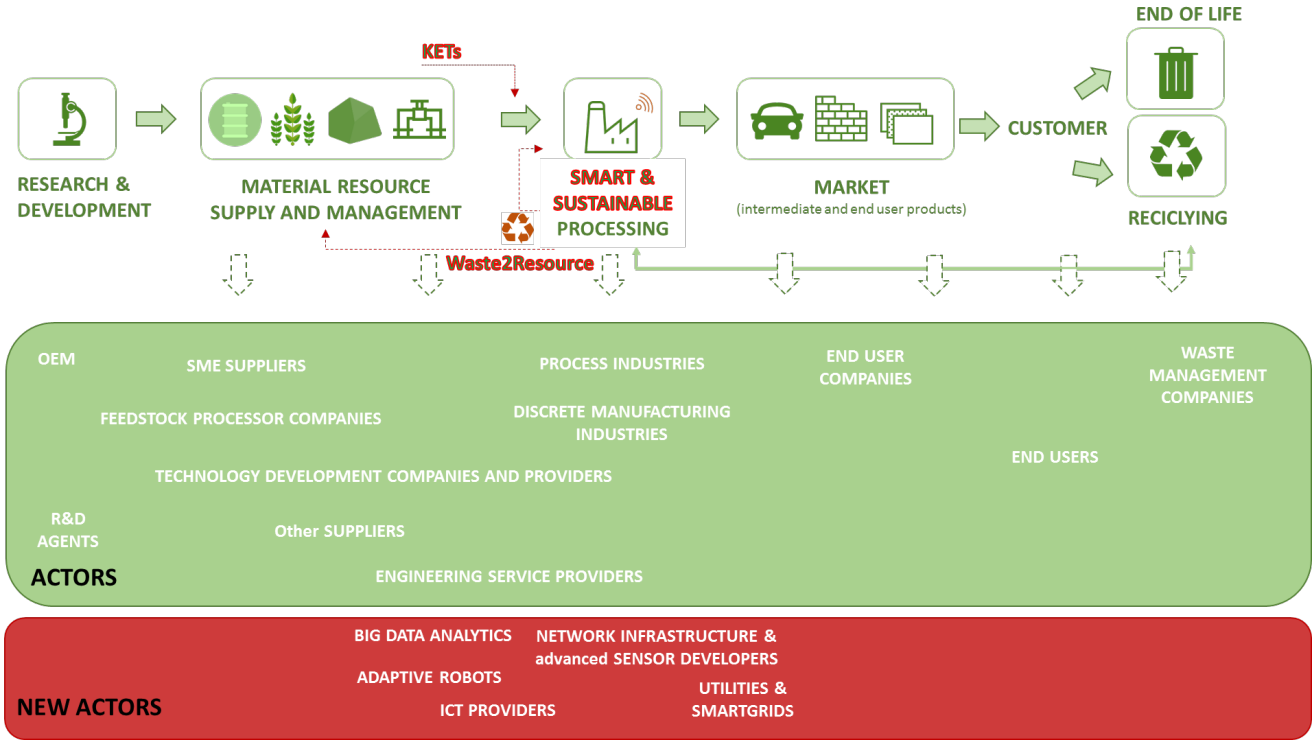

Figure 44: Value chain and actors of the manufacturing industry (SPIRE, 2013)

4.3.2 Mapping of business models

Nine novel business models (BMs) in the industry sector are examined in this section. Every model includes a description, along with examples of real cases and the type of innovation source that comprise each case study.

BM MFG 1: Industrial symbiosis

The symbiosis BM represents a network of different organisations, made in order to create eco innovation and long-term culture change by sharing knowledge, values, and transactions between organisations. This business model seeks local collaboration where public and private enterprises buy and sell residual products, resulting in mutual economic and environmental benefits.

The typical actors implementing this business strategy include industrial parks and municipalities.

The Kalundborg Symbiosis[50], near Copenhagen, Denmark, is the world's first working industrial symbiosis. It is an industrial ecosystem, where the by-product or residual product of one enterprise is used as a resource by another enterprise, in a closed cycle.

In this case, the main innovation sources come from circularity and partnership. Industrial symbiosis represents a circular ecosystem of economy and one of the key elements is good cooperation between the participants.

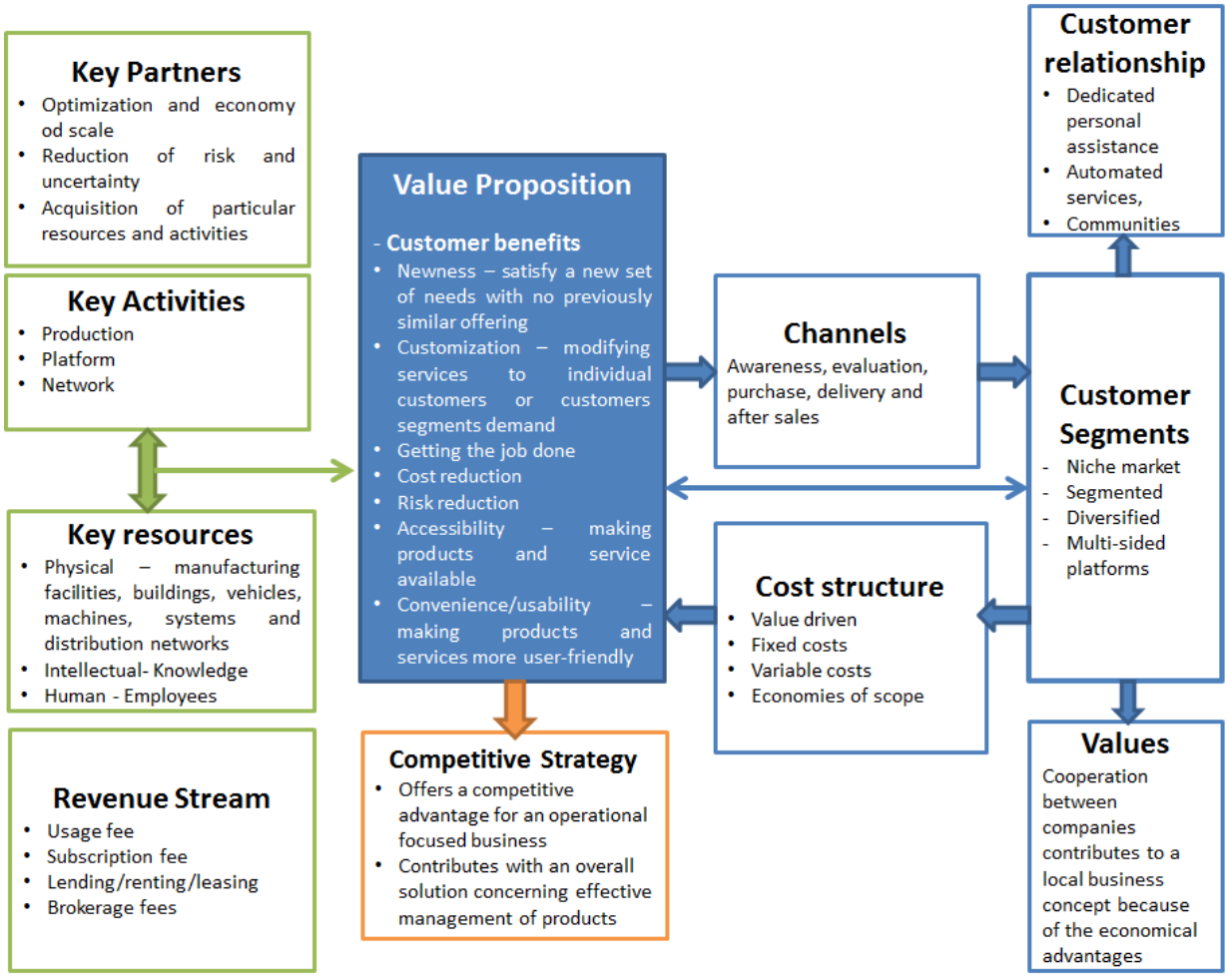

Figure 45: Industrial Symbiosis Business Model canvas

[50] For more information, please go to http://www.symbiosis.dk/en.

BM MFG 2: Chemical Management Service (CMS)

The Chemical Management Systems (CMS) business model focuses on the long-term engagement of a company having chemical processes in their production cycle with a supplier to supply and manage the customer's chemicals and related services. Thus, the relationship changes from a traditional customer-supplier relation to a strategic partnership regarding a certain service. The supplier to some extent becomes an imbedded part of the customer's production system. From an environmental point of view, this business model reduces the number of chemicals used and creates a stronger focus on substituting hazardous chemicals, which contribute to improvements in health and safety issues.

SAFECHEM[51], a subsidiary of The Dow Chemical Company ("Dow"), represents an example of a company implementing this strategy. The company provides customers with a complete solvent cleaning solution service instead of selling chemical cleaning products. The service is based on a closed-loop system where solvents are delivered, used, and taken back. Customers are invoiced monthly and the fee is based on product performance (e.g. chemicals used per m^2) instead of per product used.

From a business model point of view, the main innovation sources come from optimisation and partnership.

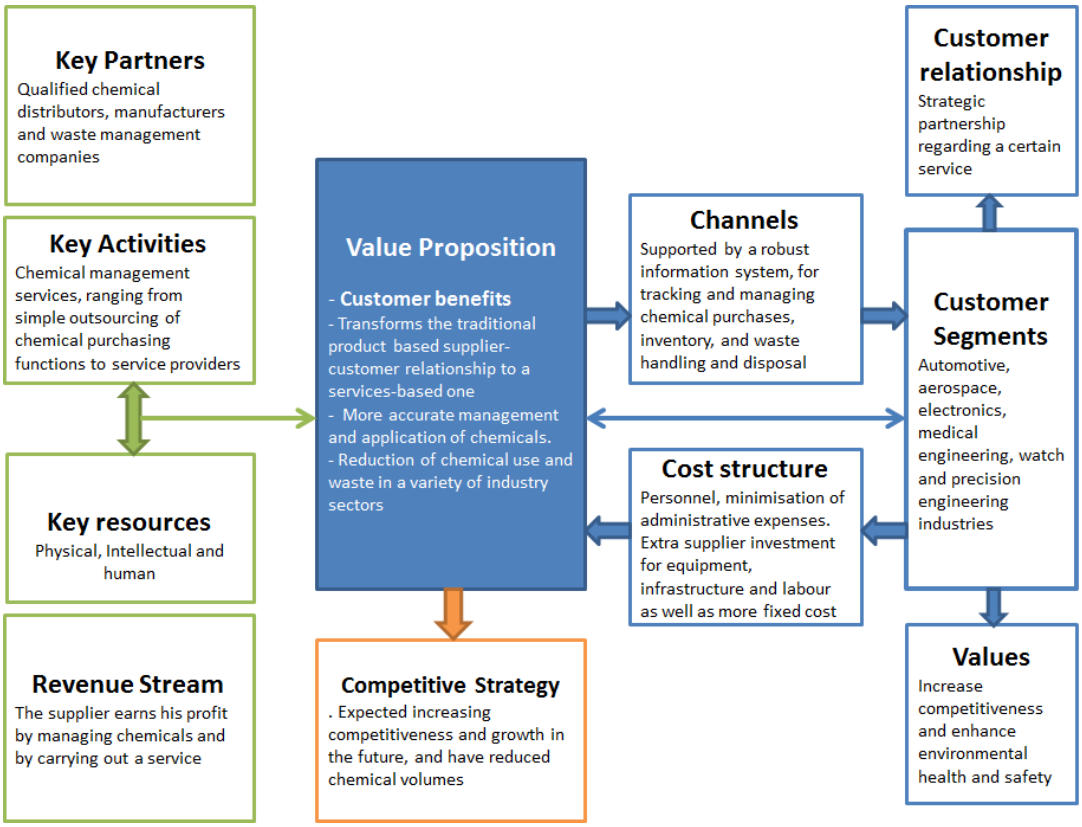

Figure 46: Chemical Management Service (CMS) Business Model canvas

[51] For more information, please go to http://www.dow.com/safechem/eu/en///.

BM MFG 3: Cradle to cradle

The Cradle to cradle (C2C) is a green business model focusing on the way we design products and systems. It is a holistic economic, industrial, and social framework that seeks to create systems that are not only efficient but also essentially waste free. The cradle-to-cradle concept is based on a bio-inspired approach to the design of products and systems where nature is seen as a closed loop production system with solar energy as the only external input (FORA 2010).

The Dutch manufacturer of carpets, Desso[52], is a clear example of Cradle-to-Cradle company. It has become the first carpet tile manufacturer in the world to achieve Gold level certification for a new carpet tile collection. The Gold certification is the culmination of seven years of hard work and effort, inspired by the goal of transitioning to the circular economy, based on C2C® principles.

This BM case is a clear example of innovation driven by circularity.

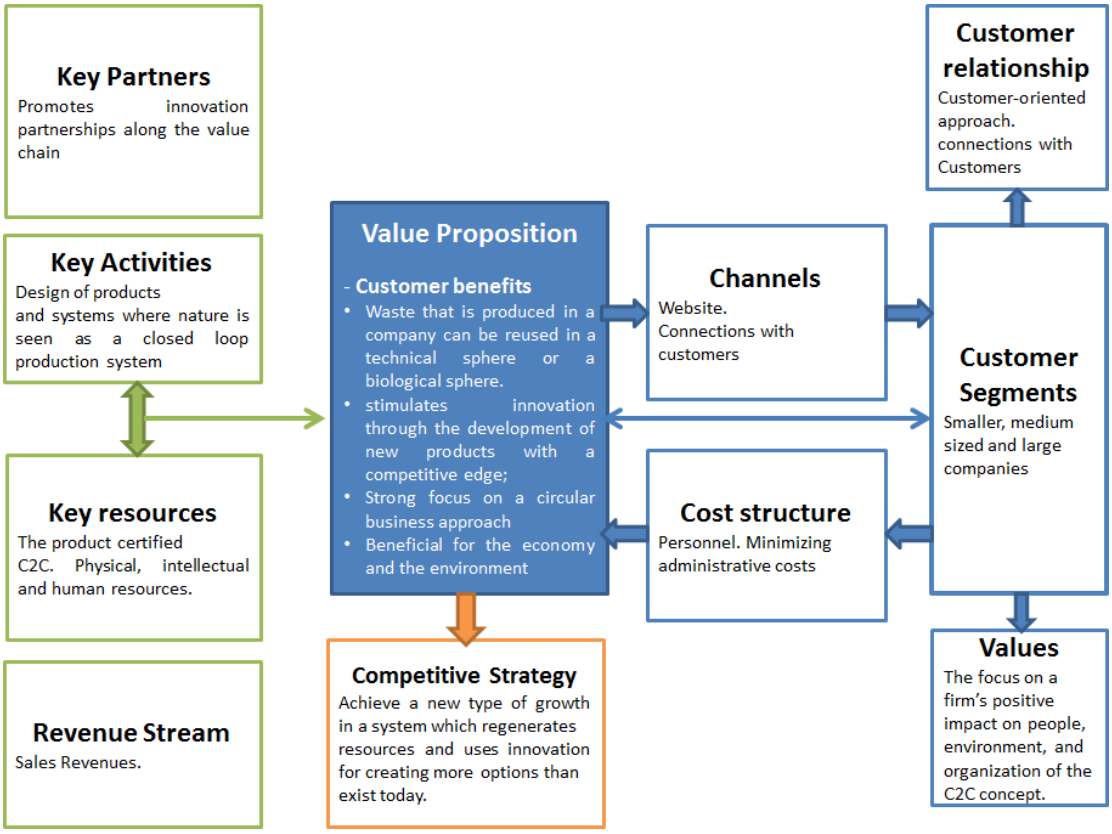

Figure 47: Cradle to Cradle Business Model canvas

[52] For more information, please go to http://www.desso.com///.

BM MFG 4: Green Supply Chain Management (GSCM)

Green Supply Chain Management is a comprehensive approach developed in recent years to support companies and governments to improve their environmental sustainability strategies. This business model is an integrated concept of greening activities in the supply chain focusing on upstream flow. Raw materials and components are sourced as sustainably as possible, while toxic content is minimised and eliminated where possible. Demands are also placed on suppliers providing products and services to ensure they meet the requirements of environmentally sustainable behaviour. The process of greening the supply chain may leave companies to discover alternative inputs and consequently reduce costs FORA (2010).

The well-known Swedish company, IKEA, has developed and implemented a green supply chain management solution known as IWAY. IKEA has developed their own company Way on Purchasing Products, Materials, and Services – which is the company's convener of its Code of Conduct. The company has systemised and formalised social and environmental standards, which are met in the sourcing of raw materials and core services throughout the entire company.

From a business model point of view, the main innovation sources come from optimisation and circularity.

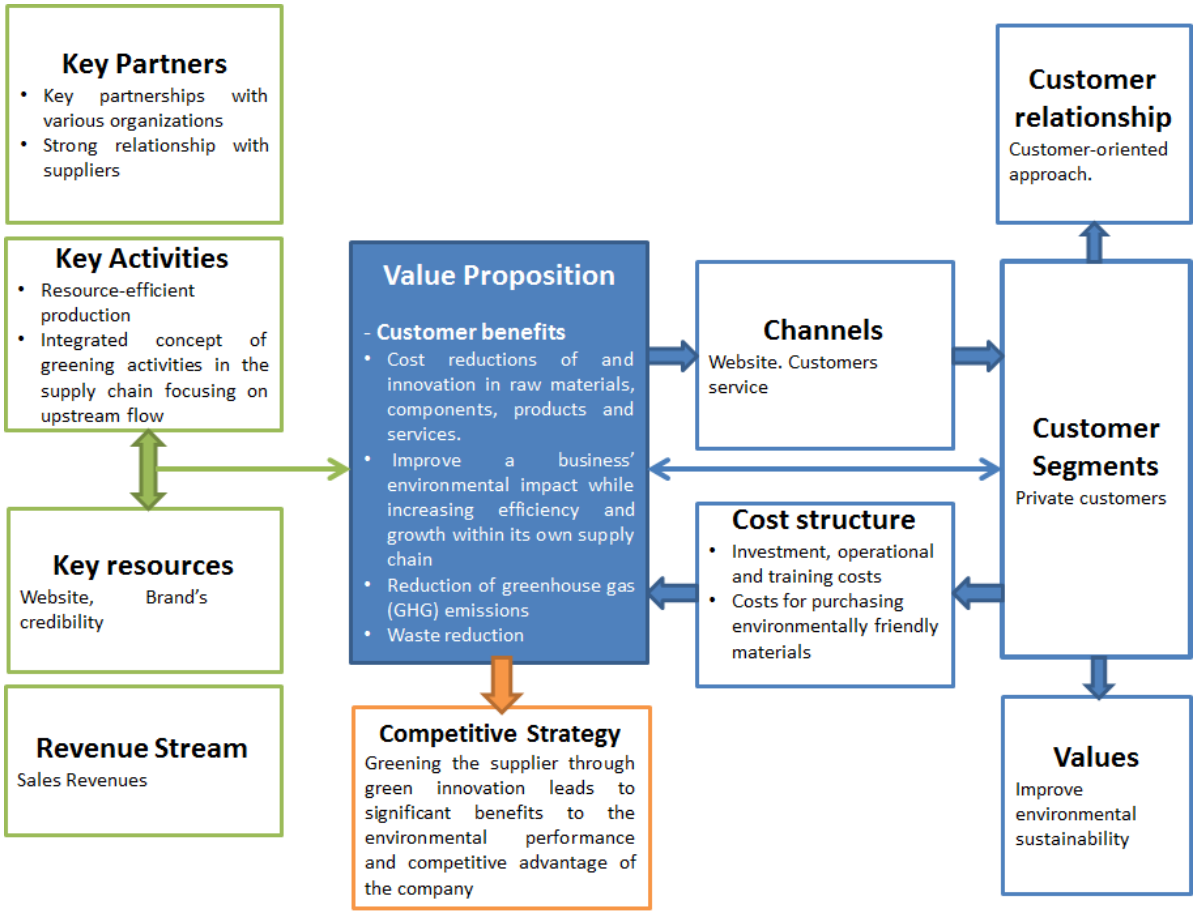

Figure 48: Green Supply Chain Management (GSCM) Business Model canvas

BM MFG 5: Circular Supplies business model

The Circular Supplies business model is based on supplying fully renewable, recyclable, or biodegradable resource inputs that underpin circular production and consumption systems. Through it, companies replace linear resource approaches and phase out the use of scarce resources while cutting waste, and removing inefficiencies. This business model embraces a social and environmentally friendly attitude towards doing business and is the most powerful for companies dealing with scarce commodities or ones with a major environmental footprint (Accenture, 2014).

Patagonia, Inc.[53] is a global producer of high-quality environmentally friendly outdoor apparel and represents an example of a company embracing a socially and environmentally friendly attitude towards doing business. The company relies on a number of different activities throughout its value chain to design out waste. Finding more ecological materials starts with research that is shared freely on its website. It then sources materials that are durable, traceable, and ecologically sound from suppliers that have good environmental and chemical management processes (Poutiainen, 2015).

From a business model point of view, the main innovation sources come from optimisation and circularity.

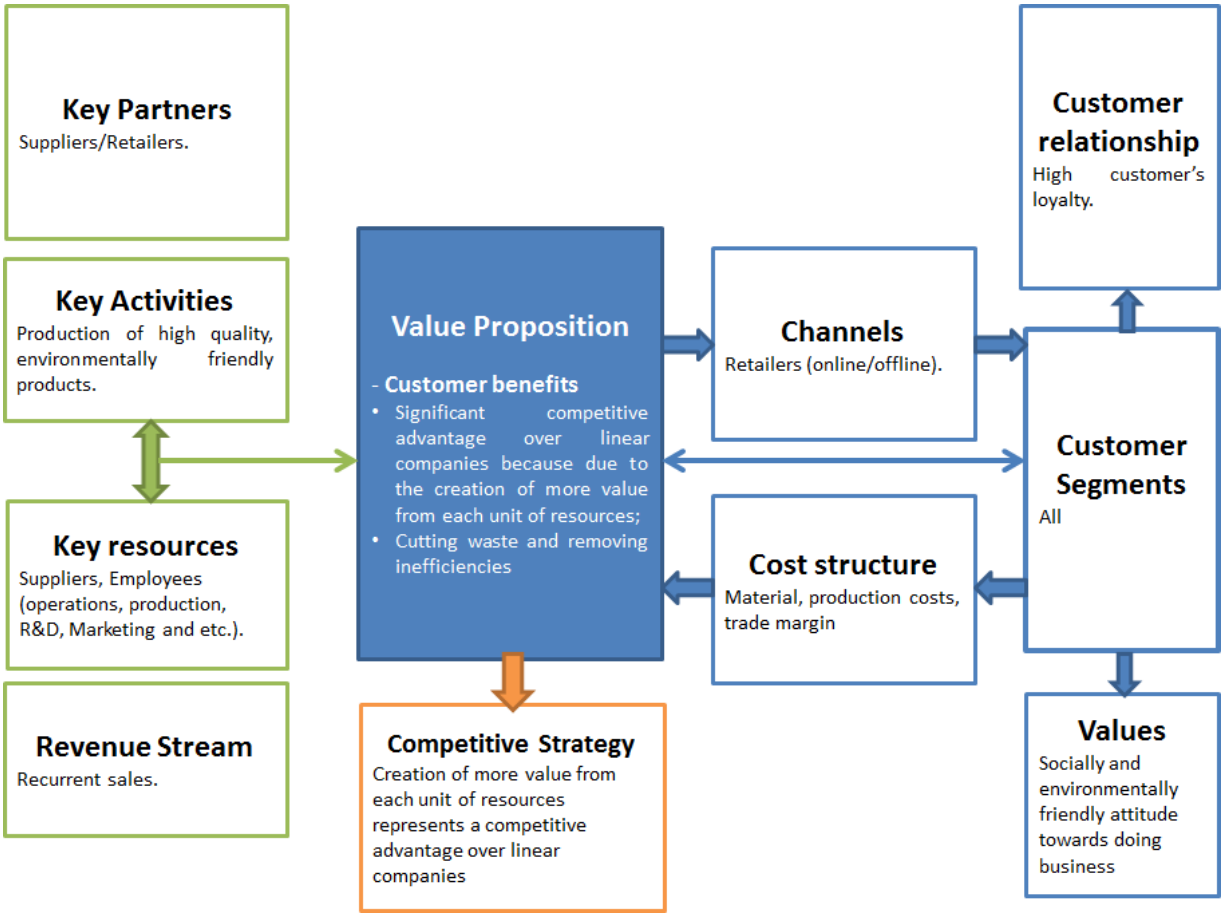

Figure 49: Circular Supplies Business Model canvas

[53] This major international outdoor clothing alludes to its corporate responsibilities on it website: http://eu.patagonia.com/frFR/home.

BM MFG 6: Product Life Extension

This business model's proposed aim is to extend the working lifecycle of products and components by repairing, upgrading and reselling. Product life extension represents, therefore, an increase in the utilisation period of products. The process is implemented through a dual perspective and requires strategic management preparedness. Longer lasting product feasibility is not only about changing the product characteristics, but also the consumer behaviour needs to be changed through the product design (Buivydaite, 2013).

Rype Office[54] is a UK-based furniture producer, which specialises in remaking office furniture and an example of a company implementing this business strategy. The new furniture is remade by using a mixture of modern technology and traditional upholstery craftsmanship. By remaking furniture, it can save money, create local (UK) jobs, reduce landfill waste, reduce biodiversity damage, preserve finite resources, and lower GHG emissions.

This BM case is an example of innovation driven by circularity and optimisation.

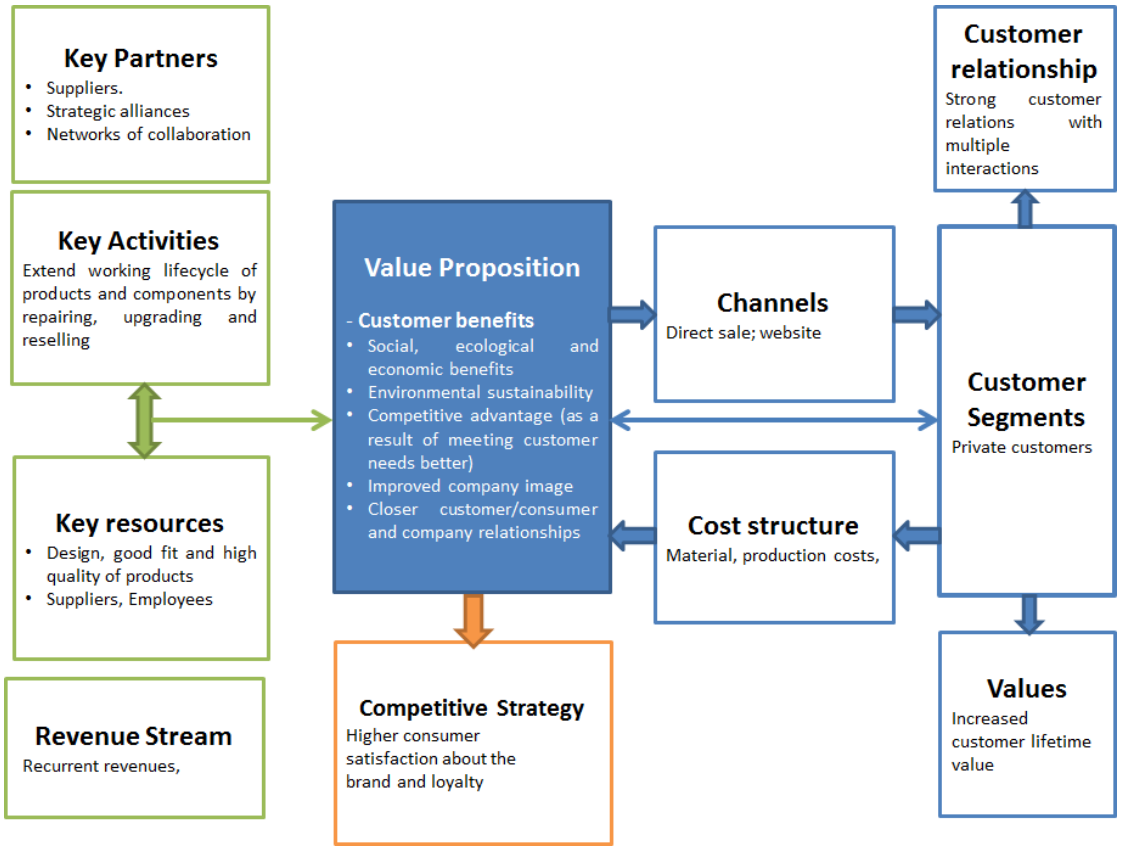

Figure 50: Product Life Extension Business Model canvas

[54] http://www.rypeoffice.com/

BM MFG 7: Lean manufacturing

Lean manufacturing refers to a production methodology for products and services that focuses on eliminating waste and improving customer experience, rather than just reducing production costs. The goal is to become more profitable by creating more value using fewer resources.

For example, eliminating waste along entire value streams, instead of at isolated points, creates processes that require less human effort, less space, less capital, and less time to make products and services at far less costs and with much fewer defects, when compared with traditional business systems (Le Enterprise Institute, 2000).

The Japanese car manufacturer, Toyota, is today's example of a company implementing this business strategy. Their production control system has been established over many years of continuous improvements, with the stated objective of "making the vehicles ordered by customers in the quickest and most efficient way, in order to deliver the vehicles as quickly as possible" (Global Manufacturing, 2014).

This BM case is the clear example of innovation driven optimisation.

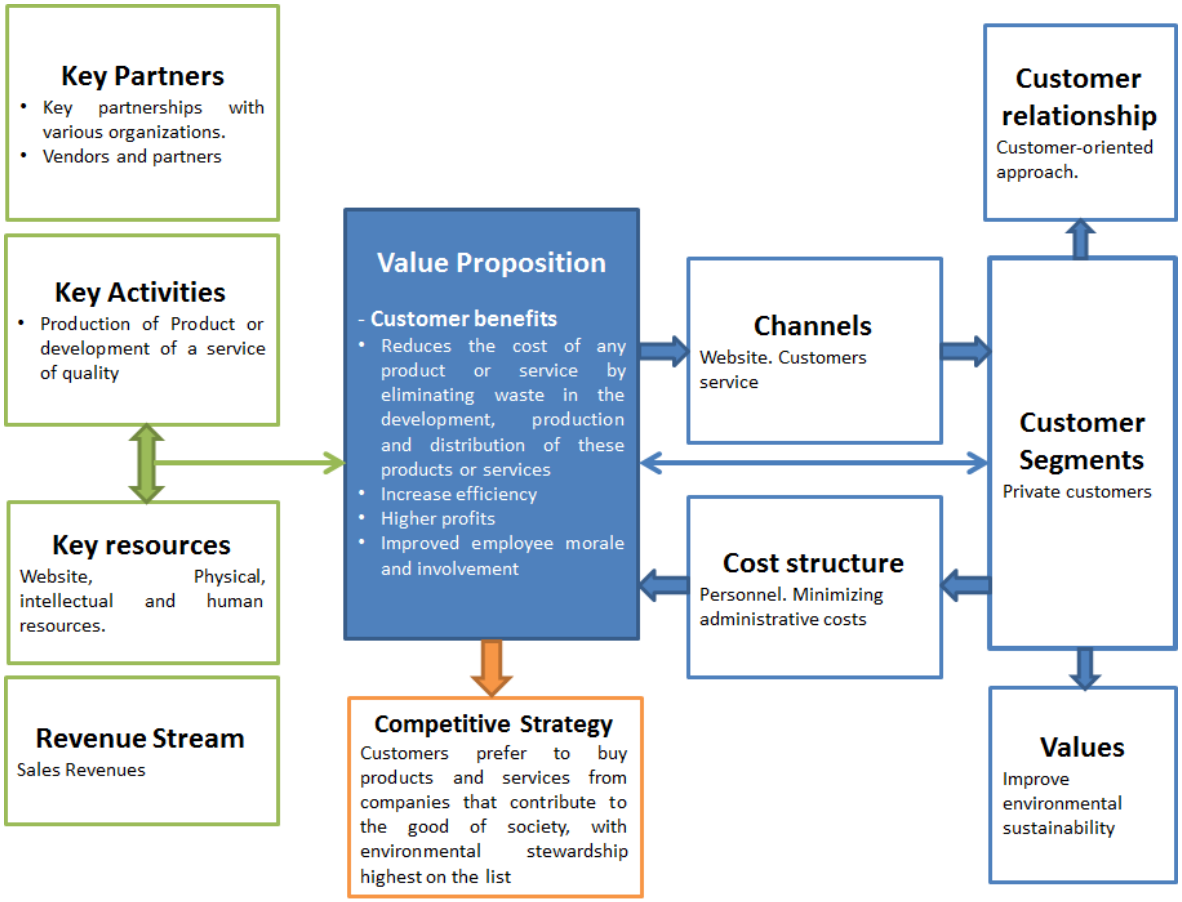

Figure 51: Lean manufacturing Business Model canvas

BM MFG 8: Closed loop production

Close loop production refers to a process in which post-consumer waste is collected, recycled, and used to make new products. For the closed loop system to function properly, consumers, recyclers and manufacturers must work together to reclaim valuable materials from our waste stream and use them to make new products.

BMA Ergonomics[55] focuses on design that incorporates the disassembly, re-use and recycling of their products. Old chairs are collected by BMA Ergonomics usually after ten years. Customers receive a fixed remuneration in return, which it is then used as a discount on their next chair. The old chair is taken to the disassembly station of B ergonomics where it is taken apart. Parts suitable for re-use are put directly back into service. All other parts are returned to the suppliers where they are recycled. So each BMA chair is made with an informed focus on environmental concerns.

Closed-loop production systems are mainly driven by circularity.

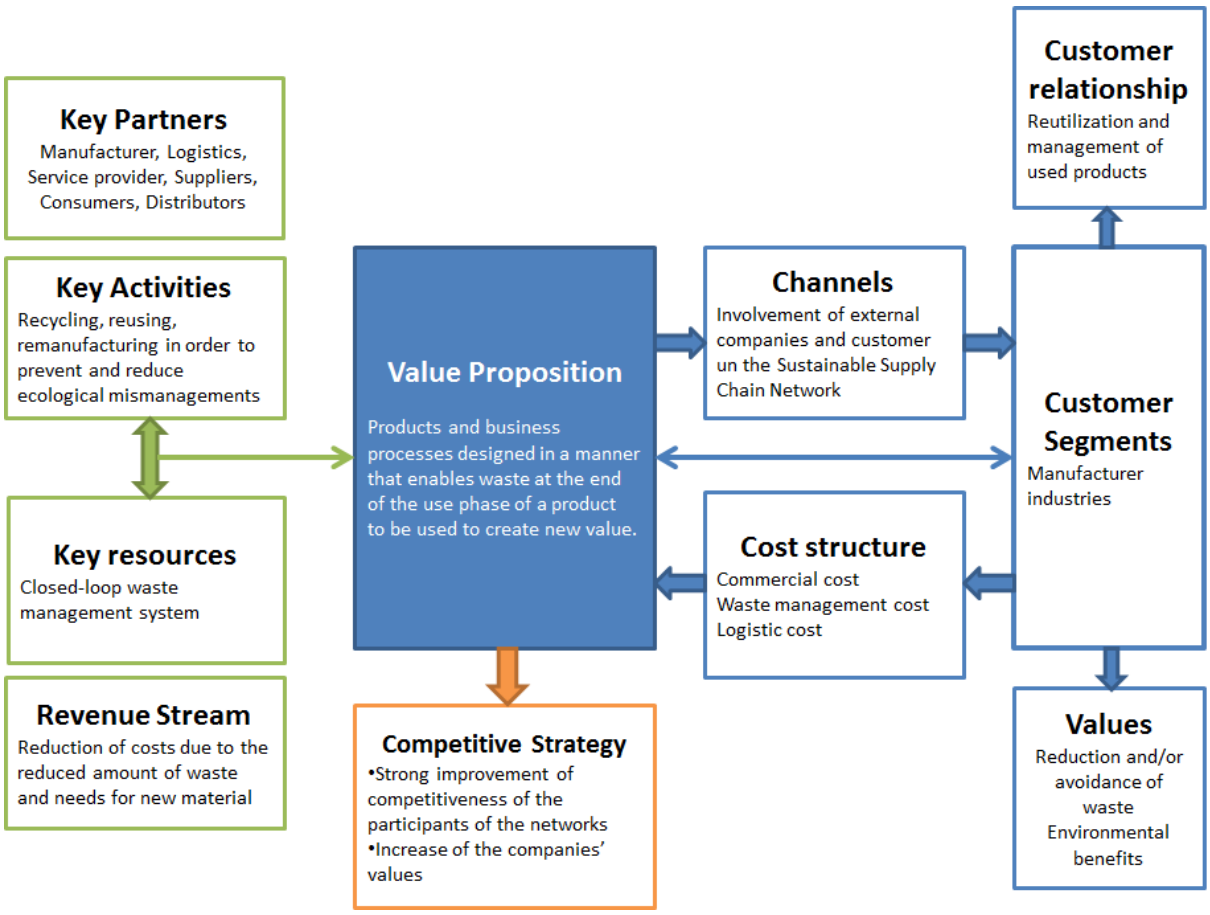

Figure 52: Closed loop production Business Model canvas

[55] For an example of a BMA Ergonomics product go to: https://www.bma-ergonomics.com/en/durable-office-chair/

BM MFG 9: Take Back Management (TBM)

This business model responds to the growing problem of excessive waste and extends the producers' responsibility of waste management through to the take back mechanisms of the down-stream use of the product (Rose and Stevels 2000). This model can guarantee advantages both for companies (who can become more sustainable and environment-friendly) and for customers (who can receive benefits by giving back products at the end of their lives).

Manufacturers and other organisations are the typical actors implementing this business strategy.

Derbigum is a company that provides customised innovative and sustainable recycled solutions for roofs and buildings and represents an example of the Take Back management challenge. Derbigum has invested considerably in a recycling process for old roofing and cutting waste. Each year the company recycles 4000 tons of bitumen. That is more than a quarter of its required resources. Derbigum cooperates with demolition firms and waste collectors to get this resource to their plant.

In this case, the main innovation sources come from circularity and partnership. Take Back management logistics represent a circular ecosystem and one of the key elements is cooperation between the different stakeholders.

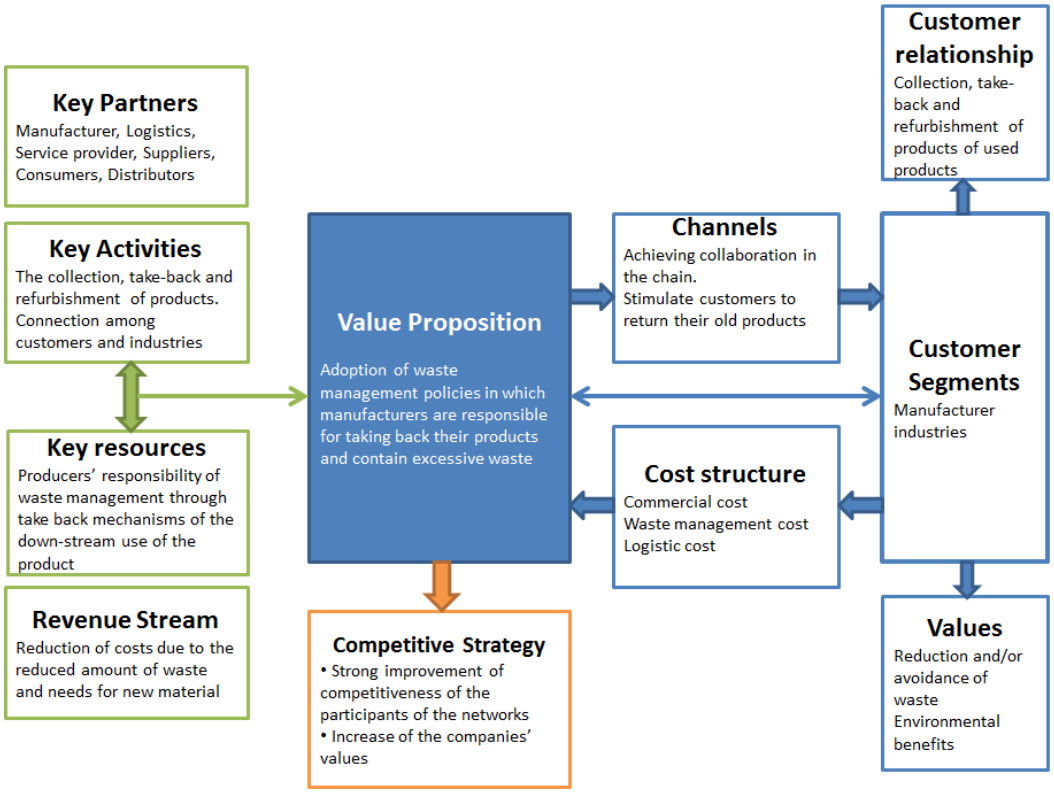

Figure 53: Take Back Management Business Model canvas

4.3.3 *Analysis of the innovation trends and value chain*

As was seen in the section above, new business strategies are emerging on both the supply and demand side to close the resource and energy use cycle in manufacturing.

Figure 54 shows the different business models reviewed in this section, mapped along the process industry value chain. It can be observed that **novel business models are emerging all along the industrial value chain** starting with material resource and supply management, and the requisite production systems, and leading to the end of life in the form of remanufacturing and recycling. This reflects the global commitment of industry/stakeholders to improve the energy, resource, and CO_2 efficiencies operating within these industries.

On the other hand, the analysis presented in Figure 55 shows that innovation in industrial value chains is especially focused on **circularity and optimisation**. Innovation is also occurring within the **configuration of business systems**. At present, developing new processes is often too costly and risky for a single company and sharing costs. Therefore, value chain stages between industries are likely to result in mutually beneficial economic and environmental rewards. This is the case of the industry symbiosis business model.

Moreover, based on the short review conducted, we have identified four technology-oriented business strategy variants that are emerging in the different stages of the manufacturing life cycle:

- **Re-design of sustainable products**: this business strategy refers to reinvent materials and products to have a significantly increased impact on resource and energy efficiency over the whole value chain as a result of for example, integration of recycled materials, easy recyclability, and re-usability.
- **Energy and resource efficient production systems:** this business strategy refers to the efficient use of energy and resources within the existing installed base of industrial processes, and it is linked to optimisation.
- **Re-use waste streams and energy:** this business strategy refers to the optimal valorisation of heat waste, waste and residue streams within and between different sectors, including recovery, recycling and re-use of post-consumer waste;
- **Remanufacturing and recycling**: this business strategy refers to extended producer responsibility in the form of remanufacturing and recycling of products.

To sum up, business innovation in the industrial sector is occurring all along the industry value chain, starting with the re-design of sustainable products and greater energy and resource efficient production systems, and then leading to extended producer responsibility in the form of remanufacturing and recycling. Circularity and optimisation are leading the way in moving us towards a more resource efficient and sustainable industry, with cooperation between stakeholders under various different forms being key to this movement.

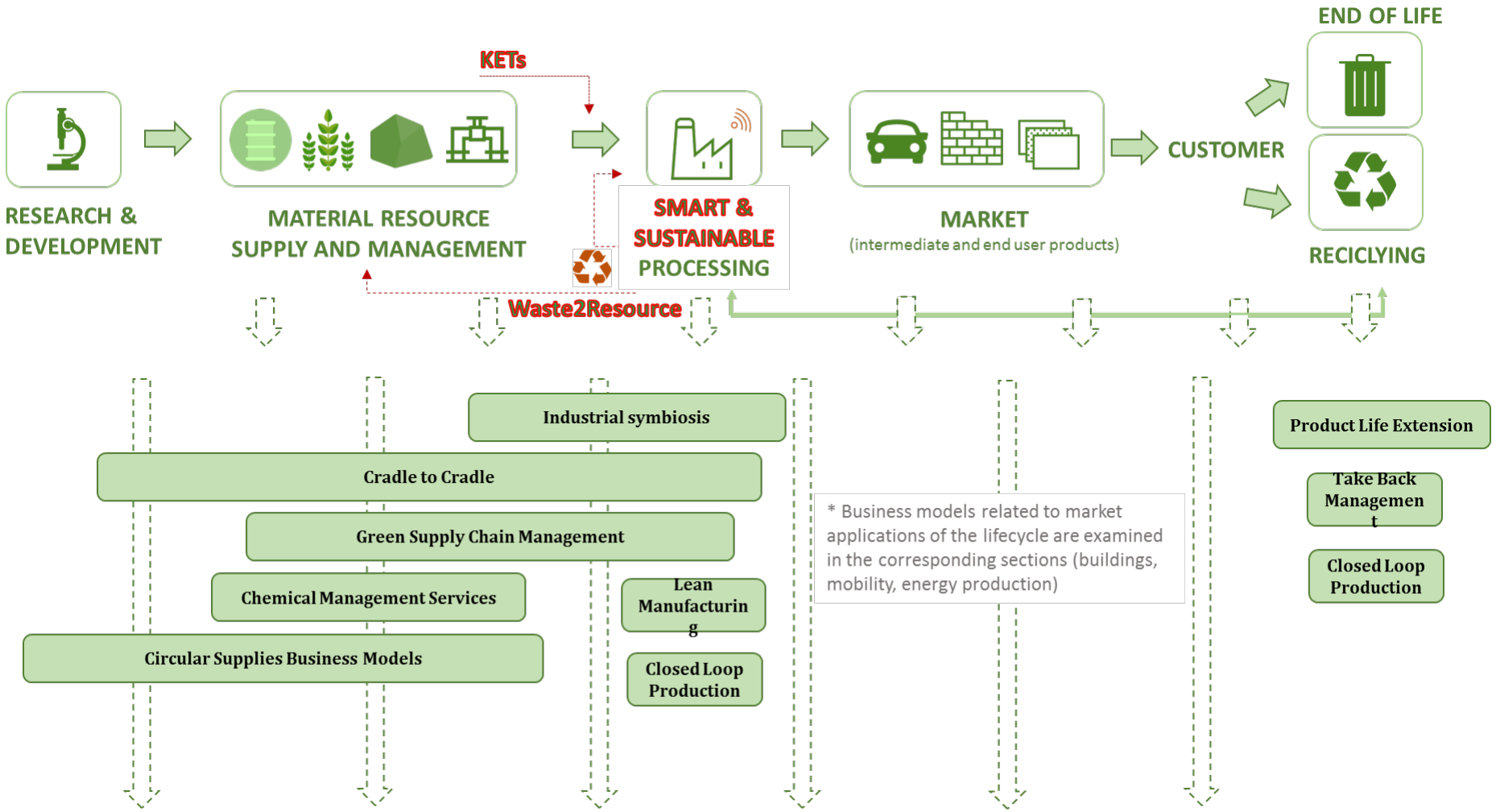

Figure 54: Mapping of the business models of the manufacturing industry sector (SPIRE, 2013)

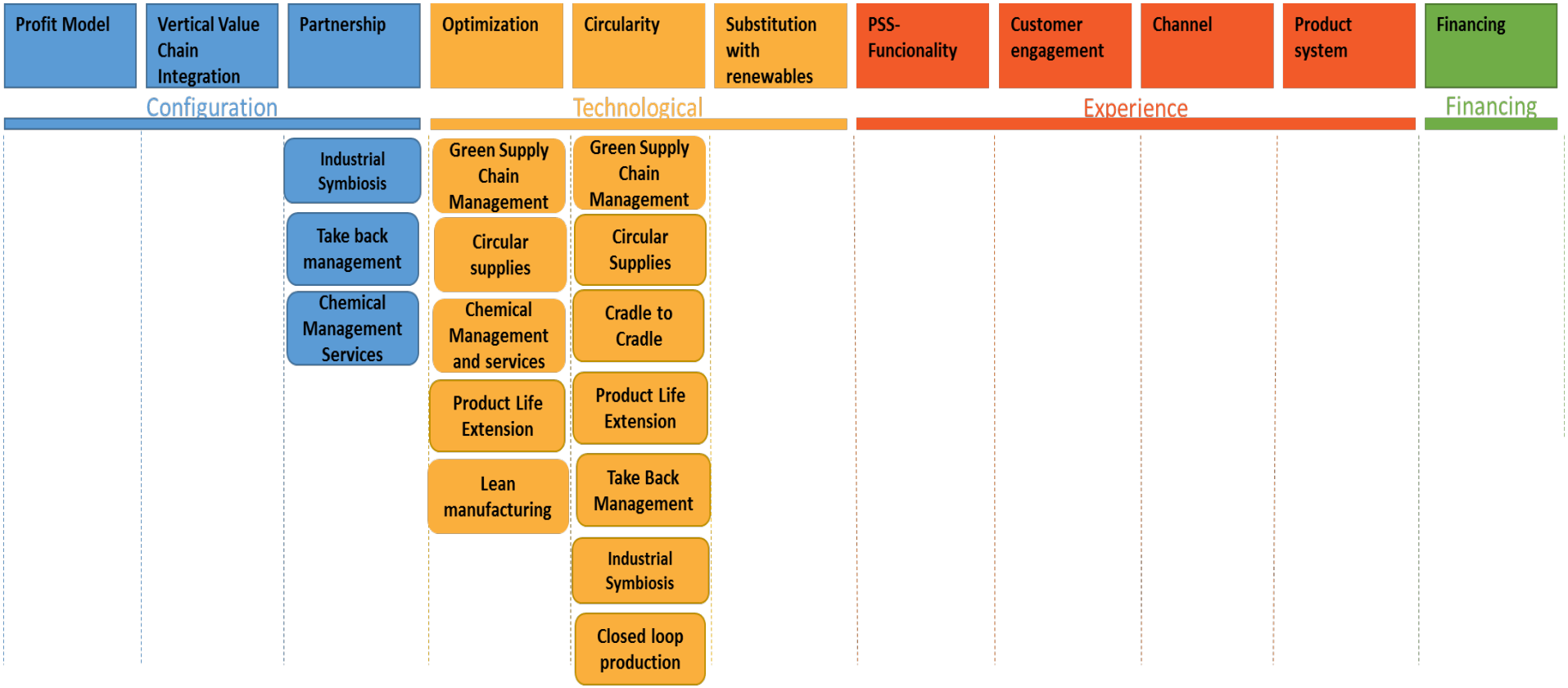

Figure 55: Innovation on business models of the manufacturing industry sector

4.4 Transport - Urban mobility

By 2050, 70% of the global population will live in urban areas (compared to 51% in 2010). This will be accompanied by massive growth in the commuting distances and the number of individual journeys taken daily, leading to increasing demand for both passengers and goods mobility, which is expected to triple by 2050. It is already evident that traditional urban ecosystems (infrastructure and traditional services) cannot support such megatrends of rapid urbanisation and megacity population growth. Indeed, transport is a large source of CO_2 emissions (about 23% of the total) and has very high-energy consumption levels (about 19% of the total)[56].

It is clear then that evolving mobility needs require a more extensive mobility service extension.

Digitalisation, technological advances, and business model innovation are the major driving forces behind the recent emergence of mobility alternatives and new mobility-on-demand models. However, solving the mobility challenge in urban areas requires coordinated actions from the public and private sectors along all the value chain. The key is to align mobility priorities and investment.

The following business strategies will illuminate the cross-sectoral approach that the mobility stakeholders are undertaking to tackle the urban mobility related challenges and opportunities.

4.4.1 Value chain

The traditional structure of the urban mobility sector, which focused on public transit and car ownership, does not fit with the paradigm shift based on mobility access –flexibility, affordability, more vehicle options, and minimal delay. Therefore, the mobility services for end-users, the infrastructure that enables integration, and the stakeholders that deliver these services are undergoing change.

Figure 56 presents a high-level overview of the urban mobility from an ecosystem perspective, with stages in blue representing the traditional mobility services and actors, and stages in orange representing the new mobility platform and market players.

The new cross-sectorial scenario is dominated by non-traditional players such as infrastructure providers (telecom companies, payment systems and parking operators), new transport modes operators (i.e. vehicle owners offering peer-to-peer mobility services or car sharing companies) and local authorities (i.e. implementing incentives for low-emission vehicles or encouraging alternative schemes to reduce congestion and pollution).

[56] International Energy Agency

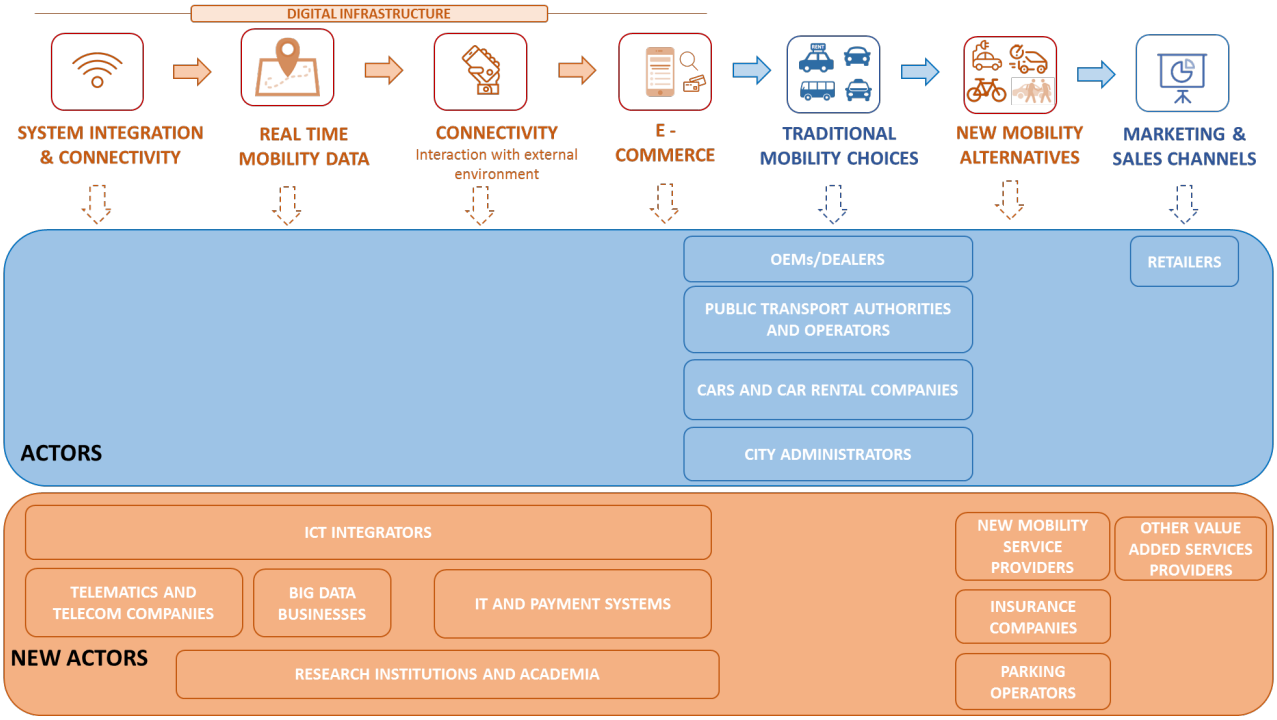

Figure 56: urban mobility ecosystem and actors (Bouton, Knupfer, Mihov, & Swartz, 2015)

4.4.2 Mapping of business models

Ten novel business models in the urban mobility ecosystem were examined in this section. Every model includes a description, examples of real cases and the type of innovation source that accounts.

BM TR 1: Air-land intermodal demand responsive transport service

This business model is a subcategory of the Flexible Transport Services model, which is the aggregation of different types of flexible services created by different possible combinations that the variation of level of flexibility of each dimension permits. Particularly, the Air-land intermodal demand responsive transport service concerns the implementation of an intermodal shared transport service without fixed routes, without fixed schedules and is a shared transport, presenting similar characteristics to the taxi and the shuttle services, but with lower costs. The integration with air transport is possible at ticketing level and luggage handling.

Transportation service providers in cooperation with airports may be the typical actors implementing this business strategy. The airport of FARO57, in the South of Portugal, represents an example of a business implementing this strategy to meet the passenger demand, especially over the summer period (between May and October), when the number of passengers triples.

In this case, the main innovation sources come from customer engagement and PSS-functionality. Provide added-value to the existing services of the airport fosters not only the transport options of the airport, but also increases the satisfaction of customers and improves their experience.

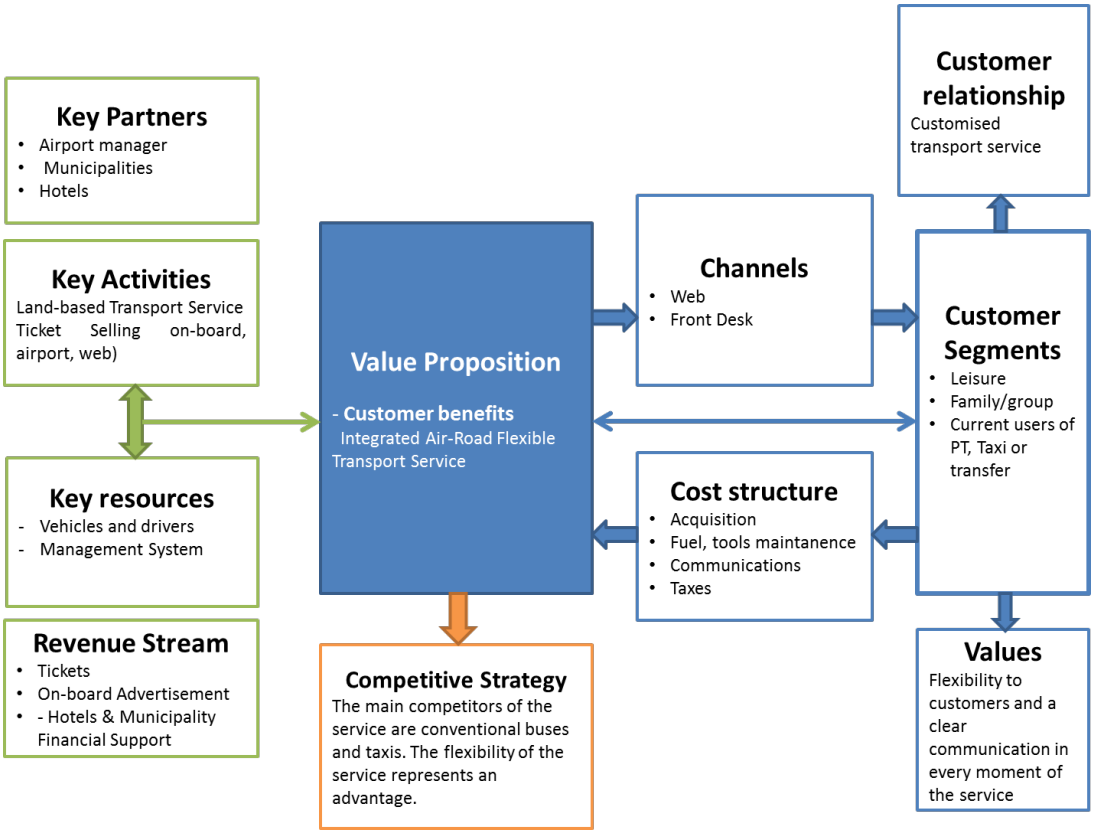

Figure 57: Air-land intermodal transport service Business model canvas

[57] http://www.faro-airport.com/

BM TR 2: Integrated traffic information service

This business model focuses on integrating traffic information on various transport services provided by different transport operators and make this information available to customers. This can be achieved by introducing a new agent at the Central Station. These new agents are called “Traffic Information Brokers” and their task should be to create a new and innovative way to integrate and distribute traffic information.

Central stations in cooperation with transport operators may be the typical actors implementing this business strategy. The Central Station of Gothenburg is the major transport hub for passenger transportation in the South West of Sweden and represents an example implementing this business strategy.

In this case, the main innovation sources come from customer engagement and PSS-functionality. Providing coordinated accurate information to passengers, especially in wintertime, when snow delays services continuously, will improve the interconnectivity and increase the satisfaction of customers.

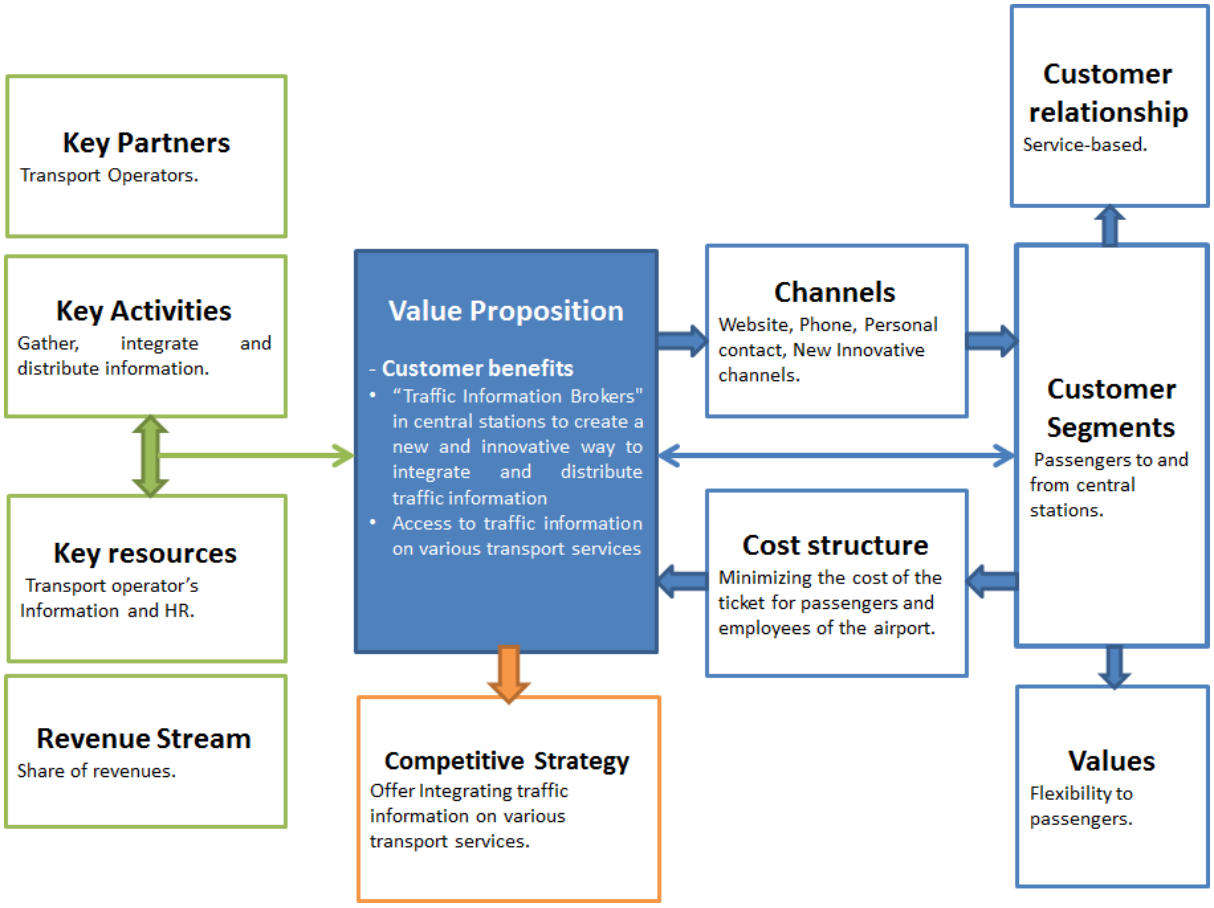

Figure 58: Integrated traffic information service Business Model canvas

BM TR 3: Intermodal transport service

This business model aims at providing three different types of improvements to passenger's quality of services in central stations. The first improvement is "physical" and refers to passenger's corridors implementation coupled to signage improvement and to an increase of waiting time areas. The second improvement is technological and/or technical and is related to a real-time information system for passengers, transport operators, and terminal manager. The third improvement refers to transport system organisation through a timetable for interconnected modes, mainly for short and long distances rail modes (Jelcic & Vizgaitis, 2012).

Terminal managers in cooperation with transport operators may be the typical actors implementing this business strategy. The station of Part Dieu, in Lyon (France), applied this business model in order to improve passenger's quality of services such as passenger's information, signage improvement, safety, modal, intermodal transfer time improvement, facilities development, cleaning, hygiene, and improvement in waiting areas.

In this case, the main innovation sources come from customer engagement and PSS-functionality. Providing all these added value services to passengers, will improve the interconnectivity, their quality of life, and their satisfaction.

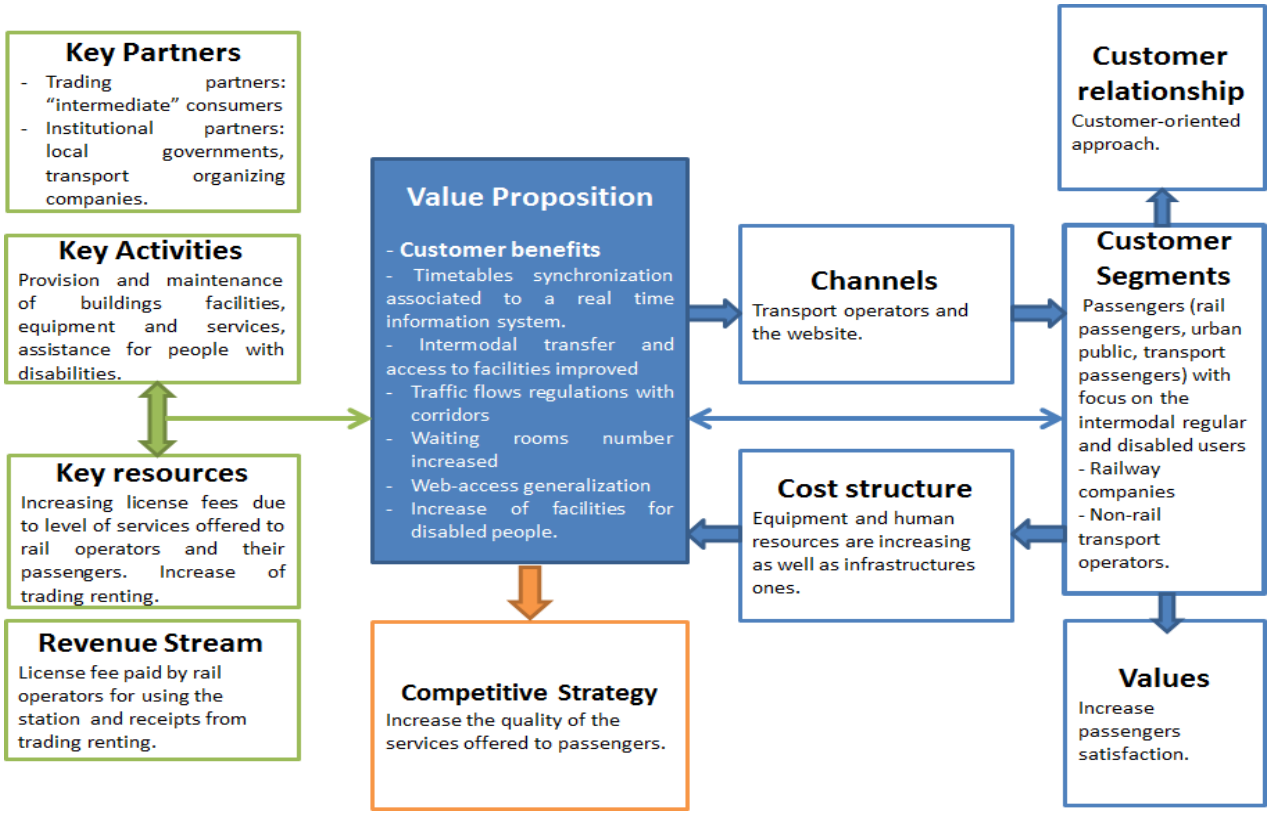

Figure 59: Intermodal transport service Business Model canvas

BM TR 4: Ports Interconnectivity Service

The Ports Interconnectivity Service business model aims at achieving a well-organised intermodal environment in order to respond more efficiently to customer's needs. The objective is basically to increase passenger's interconnectivity as far as regards the following attributes: The adequate signposting and information displays, transfer to the platforms of passengers and luggage, integrated ticketing via the port's webpage (one shop stop) and coordinated timetables of alternative modes (ship and bus) (Jelcic & Vizgaitis, 2012).

Port authorities in cooperation with transport operators may be the typical actors implementing this business strategy. The port of Patras, in Greece, which handles an important part of the total passenger's sea traffic between Greece and other countries, represents an example implementing this business strategy.

In this case, the main innovation sources come from PSS-functionality. Providing all these added-value services to passengers, will help to increase passenger's interconnectivity, which in turn will improve their quality of life and their satisfaction.

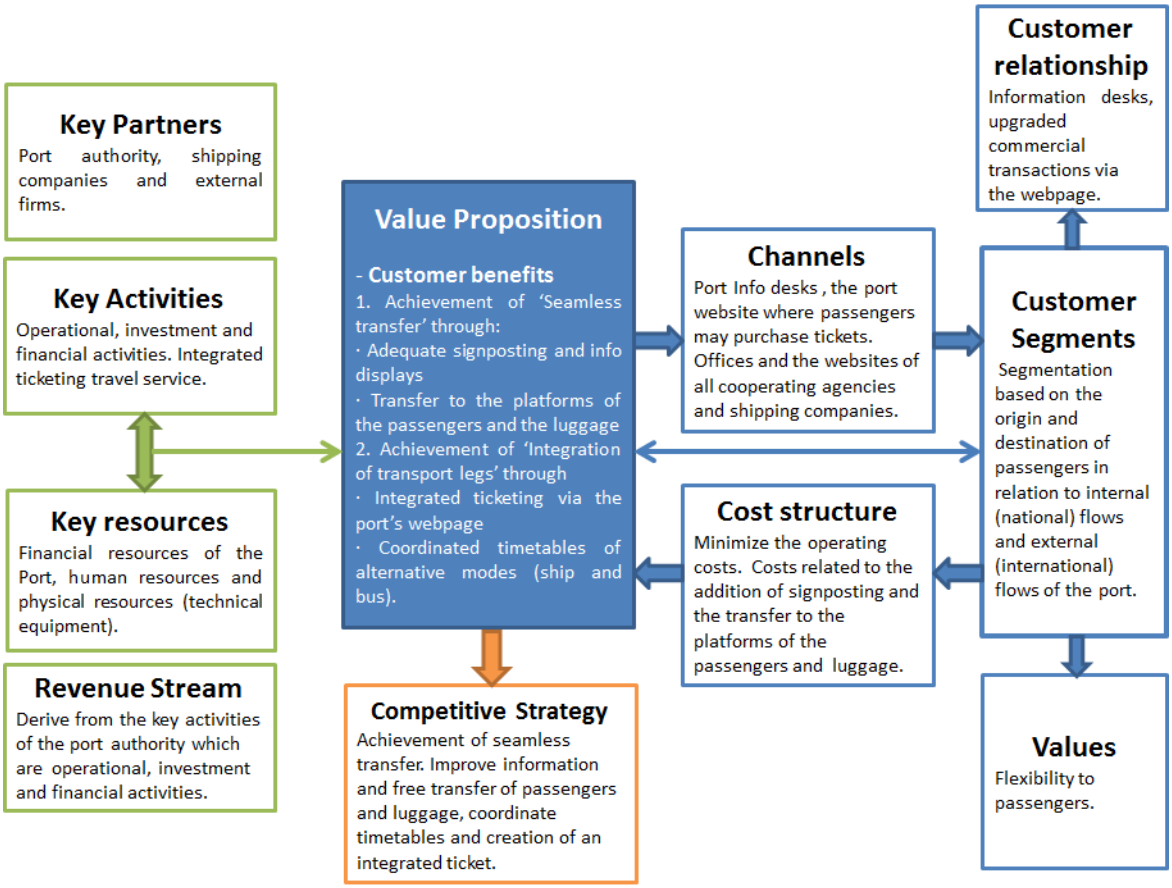

Figure 60: Ports interconnectivity service Business Model canvas

BM TR 5: Private urban car sharing mobility service

This business model aims at providing an innovative and environmental friendly transportation service in order to complement available transportation alternatives and meet customers' demands that are not satisfied with public transportation services or with the use of private vehicles. This mobility alternative corresponds to on-demand short-term car rentals with the vehicle owned and managed by a private fleet operator, and with large fleets completely composed by vehicles painted with the company name, logo, and slogans to create a strong visual identity that allows the vehicle to serve as a marketing channel, increasing brand recognition.

Car rental companies are the typical actors implementing the car sharing business strategy. The German company Car2Go[58], a subsidiary of Daimler AG currently offers car-sharing service and it is one of the biggest players in the market worldwide in this mobility alternative. It employs about 100 people and currently operates car sharing in 10 cities, covering the US, Canada, the Netherlands, Germany, Austria, and France. The Car2Go car sharing mobility concept originally grew out of the Smart Fortwo product development, but was not applicable at the time due to a lack of appropriate technology and consumer interest.

In this case, the main innovation sources come from customer facing elements and partnership. It focuses on creating a new customer experience in the car rental sector. It develops a new way for customers to reserve and pay for the short-term car rentals.

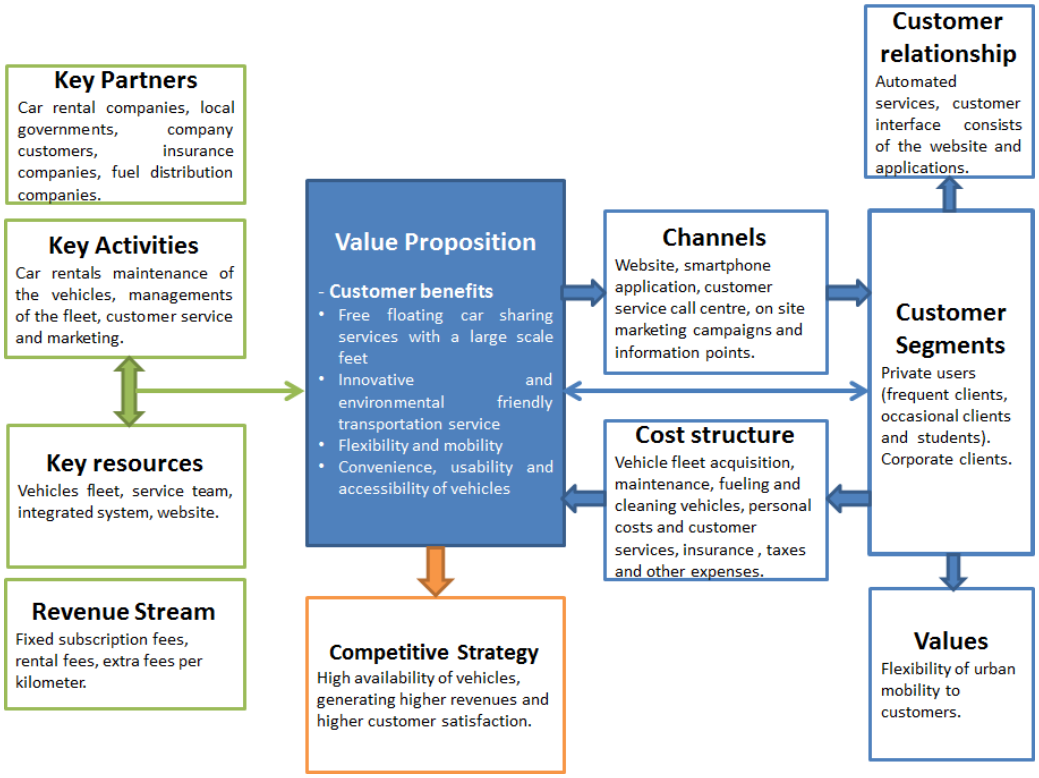

Figure 61: Urban Mobility Services Business Model canvas

[58] https://www.car2go.com/DE/en/berlin/

BM TR 6: Public urban car-sharing mobility services

As an alternative of public transit, this business model aims at providing on demand short-term car-sharing services managed by municipalities. The service operates in small scale and offers a choice of different vehicle types, ranging from compact cars to sport utility vehicles and cargo vans in order to be able to respond to different customer needs. The business model offers two different rental possibilities: the classic modality, in which customers must deliver the car in the same parking area where they started the rental, and the one-way rental, in which the customer can deliver the car in a parking area where the journey was started.

Municipalities are the most common actors implementing the car sharing business strategy. The Italian company IoGuido[59], is a car-sharing company managed by the city municipalities; it is an associate member of the car-sharing initiative (ICS), a national coordination structure promoted by the Italian Ministry of the Environment, which offers support to local municipalities interested in developing local car-sharing services, stimulating the creation of a national car-sharing network and promoting sustainable mobility policies. The service operates in a smaller scale and offers a choice of different vehicle types, ranging from compact cars to sport utility vehicles and cargo vans meeting different customer needs.

In this case, the main innovation sources come from partnership and focuses on improving customer experience. It focuses on creating a new customer experience in the car rental sector and driven by the public sector. It develops a new way for customers to reserve and pay for the short-term car rentals.

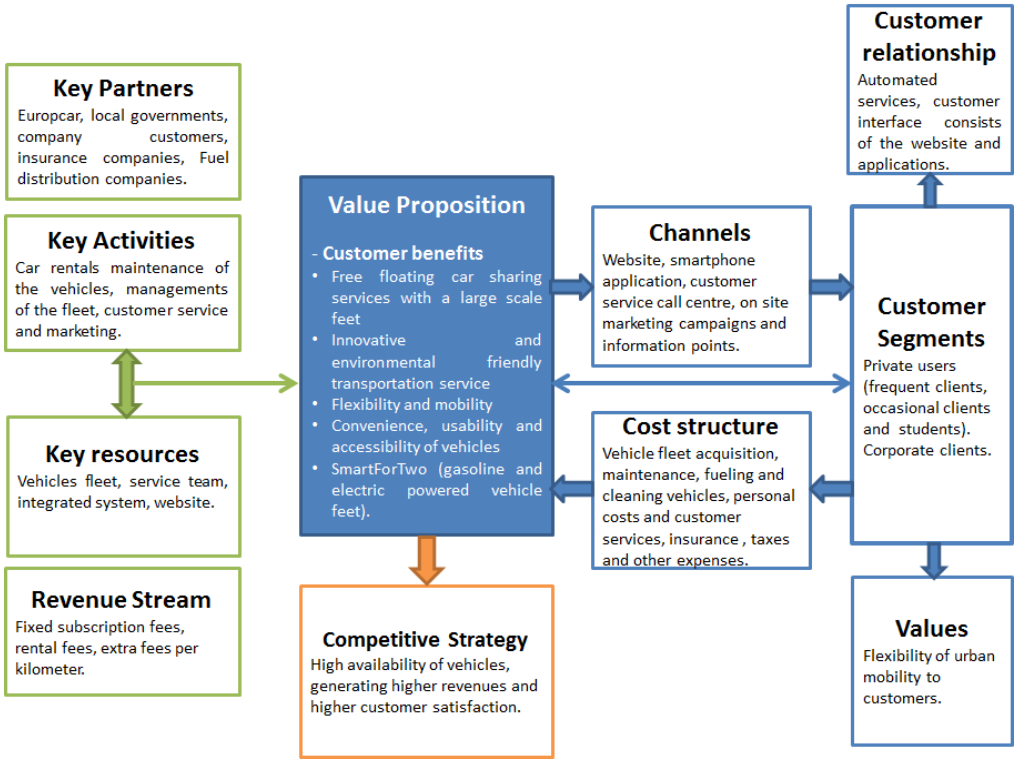

Figure 62: Public Urban mobility services Business Model canvas

[59] http://carsharingtorino.it/

BM TR 7: Green economy car sharing mobility services

This business model aims at providing an efficient and low environmental impact mobility alternative through a car-sharing service using electric vehicles. The service operates with a fleet of vehicles, powered by an electric motor, with a range of 80 km per battery charge and capacity for two people. The service operates in a small scale with the free- floating mode, which represent the maximum flexibility for customers among the existing operation models. Basically customers can start and end their rentals in standard parking spots on the streets inside the free-floating area, without the obligation of parking in the proprietary parking spots.

Bee represents an example of car sharing services using electric vehicles. Created by NHP ESCo, a company that operates in the green economy sector, it started operating in 2013 in the city of Naples, in Italy, as the first electric car-sharing company in Italy. The usage of electric vehicles is a key to the company strategy of offering a low environmental impact mobility alternative, in line with its creator company business philosophy.

In this case, the kind of innovation come from partnership and focuses on improving customer experience but also on contributing to a greener economy by using electric cars.

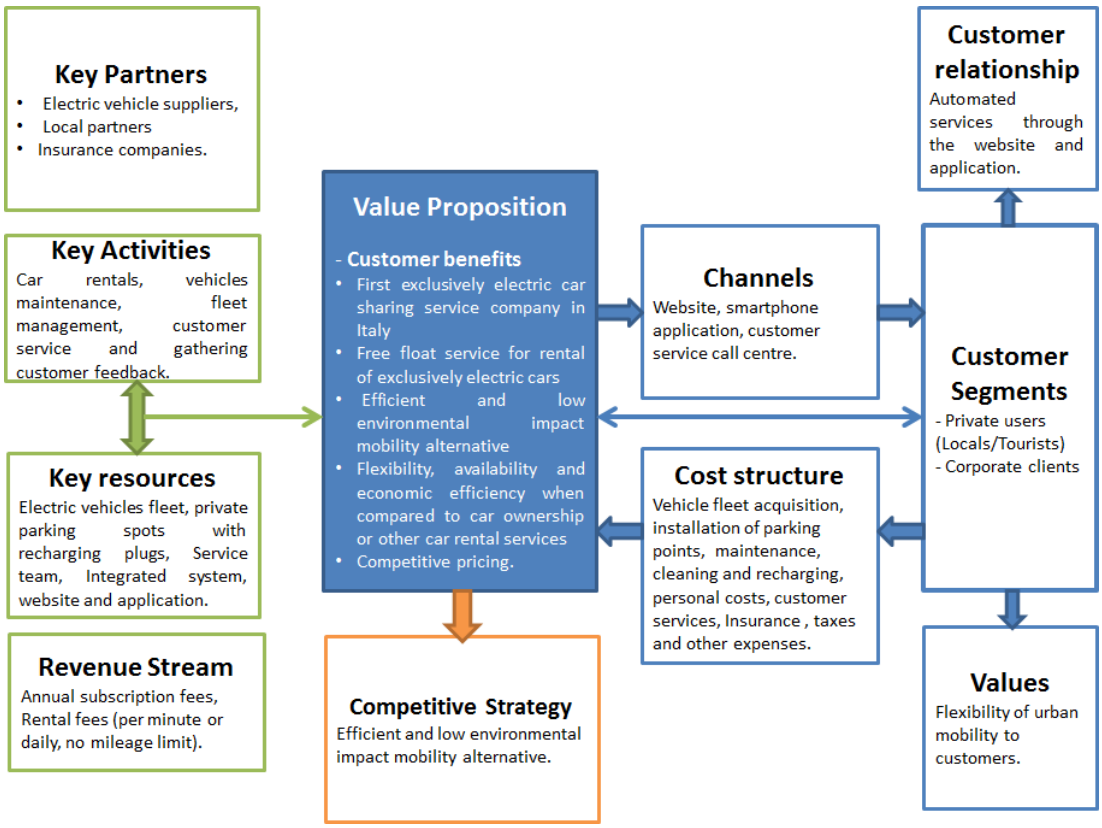

Figure 63: Green economy mobility services Business Model canvas

BM TR 8: Public Transport Document Generator

The objective of this business model is to provide an application service provider platform in order to generate a static or dynamic information about public transport. The platform produces a graphic documentation with advanced design, which adapts to the data contents by generator application. A desktop-based public transport document generator allows the public to access the transport information and uses the internet as support in the system infrastructure as a service application provider. The clients, which consist of transport companies, can use the service provider platform to provide transport information to public in the form of document.

Optimização e Planeamento de Transportes[60] represents an example of a company implementing this business strategy. SA (OPT) is the first company in Portugal to develop intelligent and automatic solutions for decision support in transport planning. The company developed InfoPub, an application service provider platform, to generate a static or dynamic information about public transport. It produces a graphic documentation with advanced design which adapts to the data contents by generator application such as BusMap and BusSched. InfoPub is developed in desktop-based environment using client-server architecture.

In this case, the main innovation source comes from product system. This platform provides coordinated information from different public transports in an integrated way.

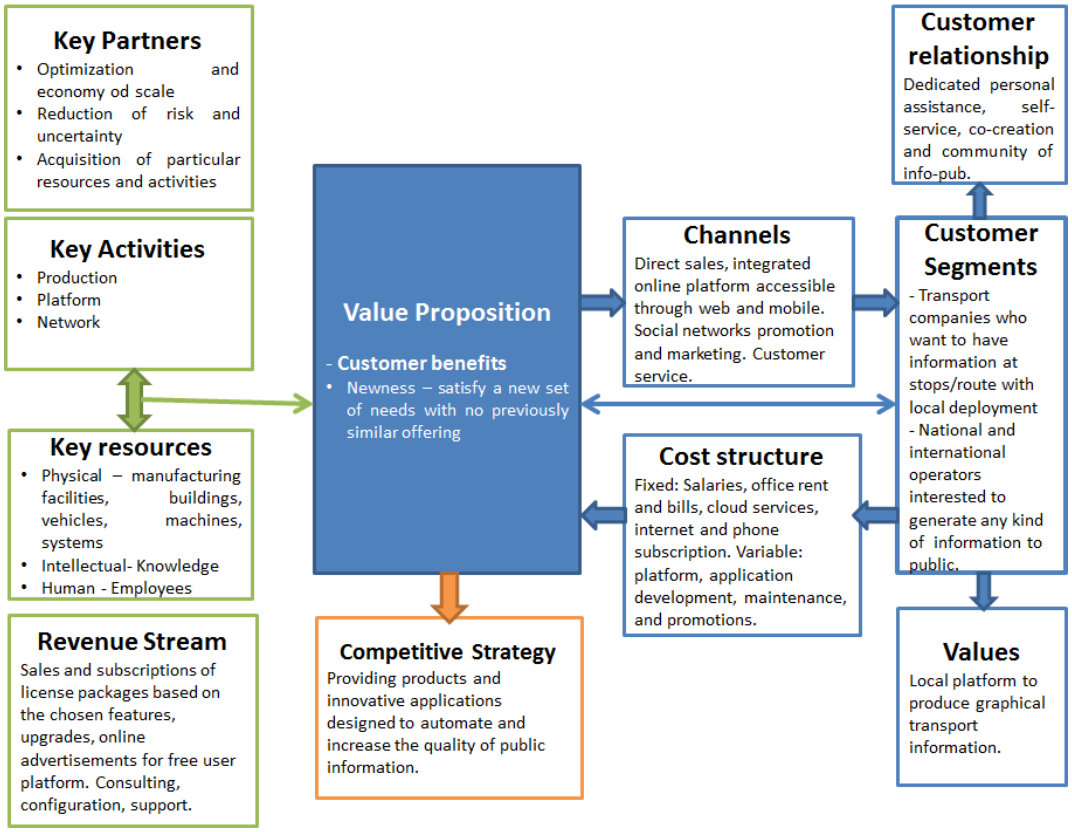

Figure 64: Public Transport Document Generator Business Model canvas

[60] http://www.op.pt/

BM TR 9: On demand private taxi services

This business model allows people to simply tap their smartphone and have a cab arrive at their location in the minimum time possible. The APP matches rider with driver and handles payment. By using real time metrics, it is possible to see what demand is like and then as demand starts to exceed available capacity to is able to reduce demand by introducing surge pricing which increases prices where demand is higher. At the same time, the increased fares encourage more drivers to work and thus increases supply. This is possible because the drivers are owner operators. The service does not own the assets and operates on surge price incentives to individual drivers and thus it can flex capacity within minutes, whereas a traditional taxi company takes months or years to achieve the same results.

Uber[61] is an on-demand transportation service which has brought a revolution in the taxi industry all across the world. The business model of Uber has made it possible for people to simply tap their smartphone and have a cab arrive at their location in the minimum possible time. Uber app was officially launched in 2010 and soon became extremely popular due to the value it provided to people.

In this case, the main innovation source comes from partnership and focuses on customer experience.

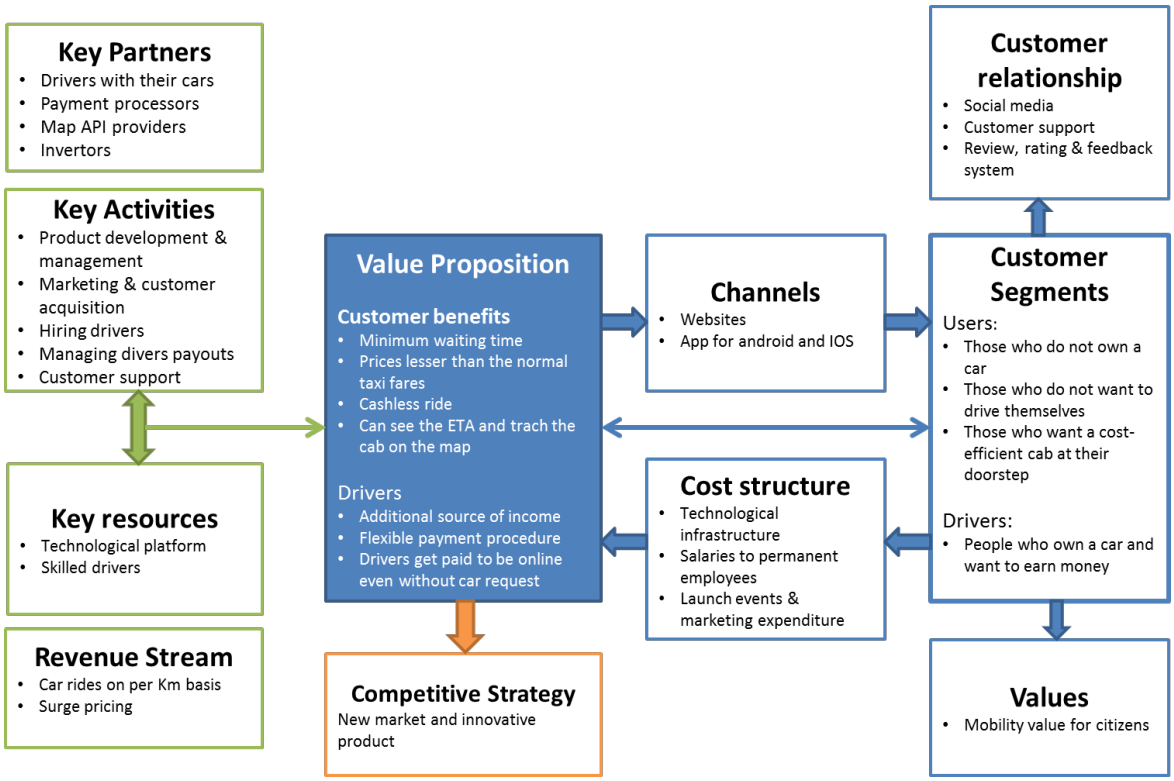

Figure 65: On-demand private taxi services Business Model canvas

[61] www.uber.com

BM TR 10: Open Innovation in EV industry

Open Innovation is now playing a crucial role in electric vehicle industry as a variety of innovators and companies work to develop the industry, which is still considered a niche industry. This industry requires an ecosystem to support the shift from standard mobility systems to electric vehicles, and companies cannot rely on their own efforts to develop it.

An organisation cannot rely on its own innovation and develop all these technologies by itself. Developing the industry is the main goal for those companies.

The use of patents in a defensive way does not really seem to benefit the industry: as long as the industry is small and is lacking in the necessary infrastructure (from standard technologies to an effective charging infrastructure and consumers' education), the growth of the industry should be a major focus for the players operating in EVs.

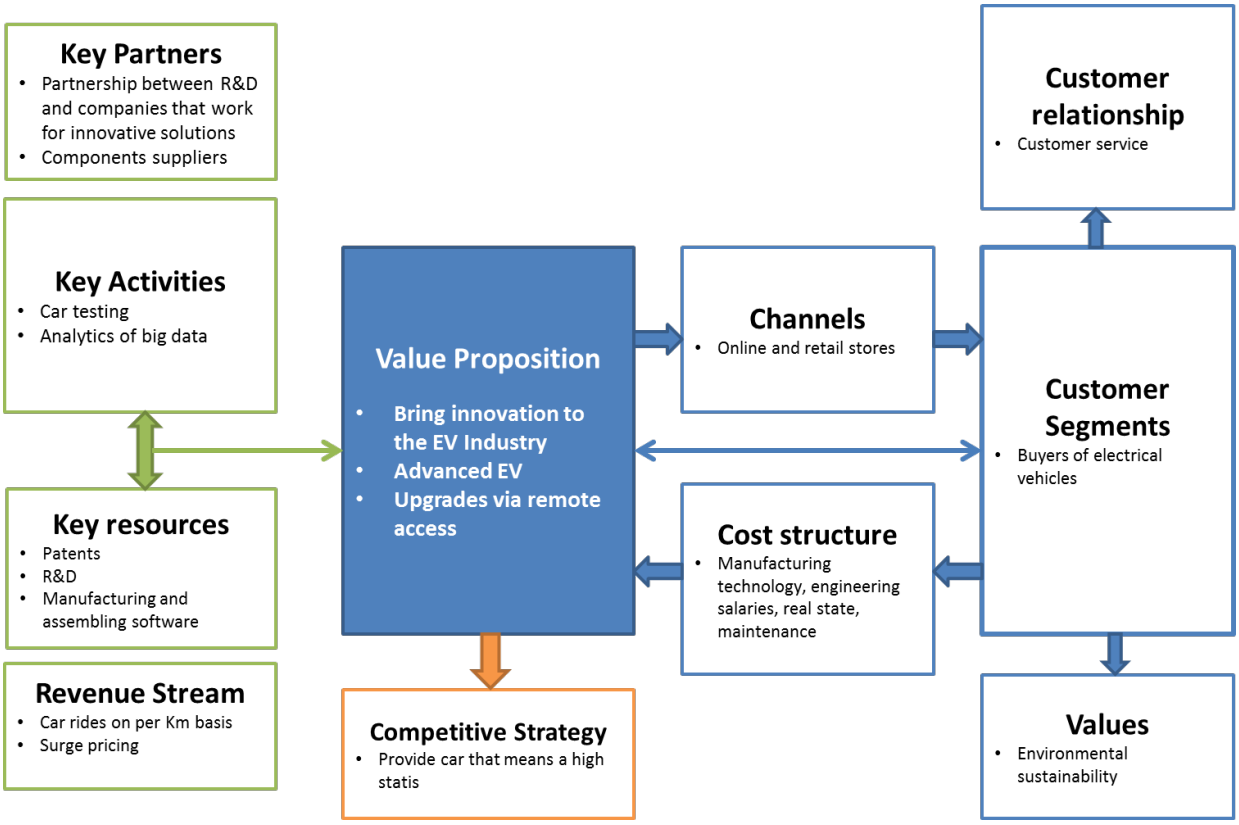

Figure 66: Open Innovation in EV industry Business Model canvas

4.4.3 *Analysis of the innovations trends and value chain*

Evolving mobility needs, technological advancements and collaborative consumption are disrupting today's urban mobility systems. The smartphone penetration, the ability to process big data to provide real-time information and the interest of specialised players from other sectors to enter into the extended mobility system value chain, are some of the drivers behind the recent emergence of new business models in the urban mobility sector value chain.

Figure 67 shows the urban mobility business models reviewed in this section, mapped along the urban mobility value chain. It can be seen that **novel business models are specially emerging around the creation of new mobility alternatives and the digital infrastructure** enabling their integration in the mobility ecosystem. On the other hand, the analysis presented in Figure 68 shows that innovation in the urban mobility value chain is occurring within the **configuration of business systems** and is especially focused on **customer facing elements**.

Expanding partnerships between different companies are pushing the development of new products and services in this sector. This is the case of car manufacturers together with technology providers to develop the EV industry and the most innovative car sharing systems, for example.

New and improved mobility services are making transportation in urban areas even more multimodal, on-demand, and shared, increasing customer choice and convenience. The mobility paradigm shift is pulling end users at the centre of the ecosystem and therefore business models driven by customer experience are succeeding.

Based on the short review conducted, we have identified three customer oriented business strategy variants that are emerging.

- **Interconnecting navigator**: providing real time transport information on mobile and other devices.
- **On demand personal mobility provider**: providing on demand shared transport solutions, with real time mobility data available and with one stop payment systems.
- **Multi modal public transporter**: a facilitator for integration of the multi-modal passenger transport (private and public) network with real time mobility data available and with one stop payment systems.

To sum up, business innovation on the urban mobility ecosystem is mainly centred around developing new mobility alternatives and the digital infrastructure enabling their integration. Improving customer experience and creating new configurations are leading the way to move towards a more flexible, affordable and sustainable urban mobility system, in which partnerships and customer engagement are key.

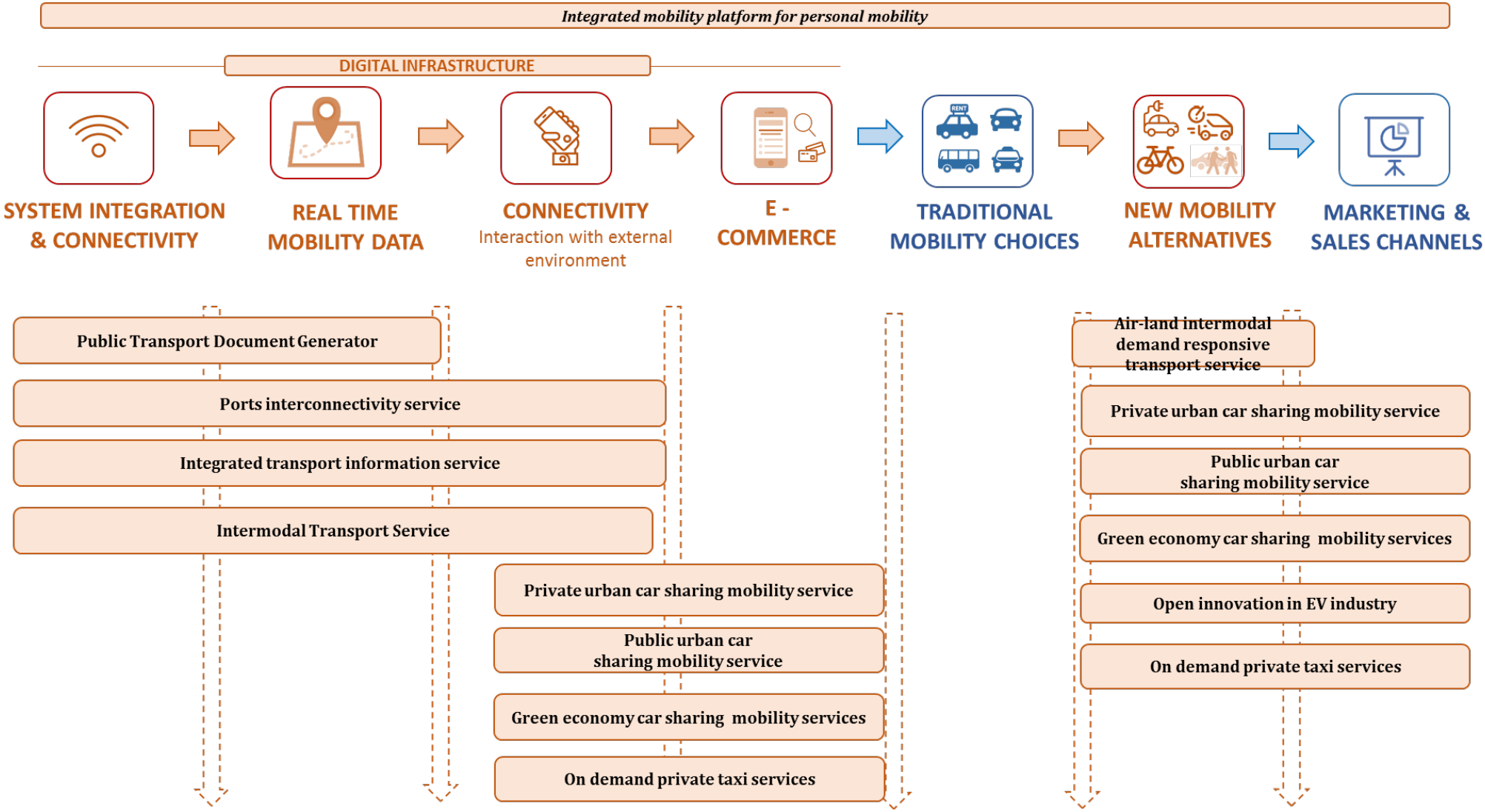

Figure 67: Mapping of the BMs of the urban mobility ecosystem (Bouton, Knupfer, Mihov, & Swartz, 2015)

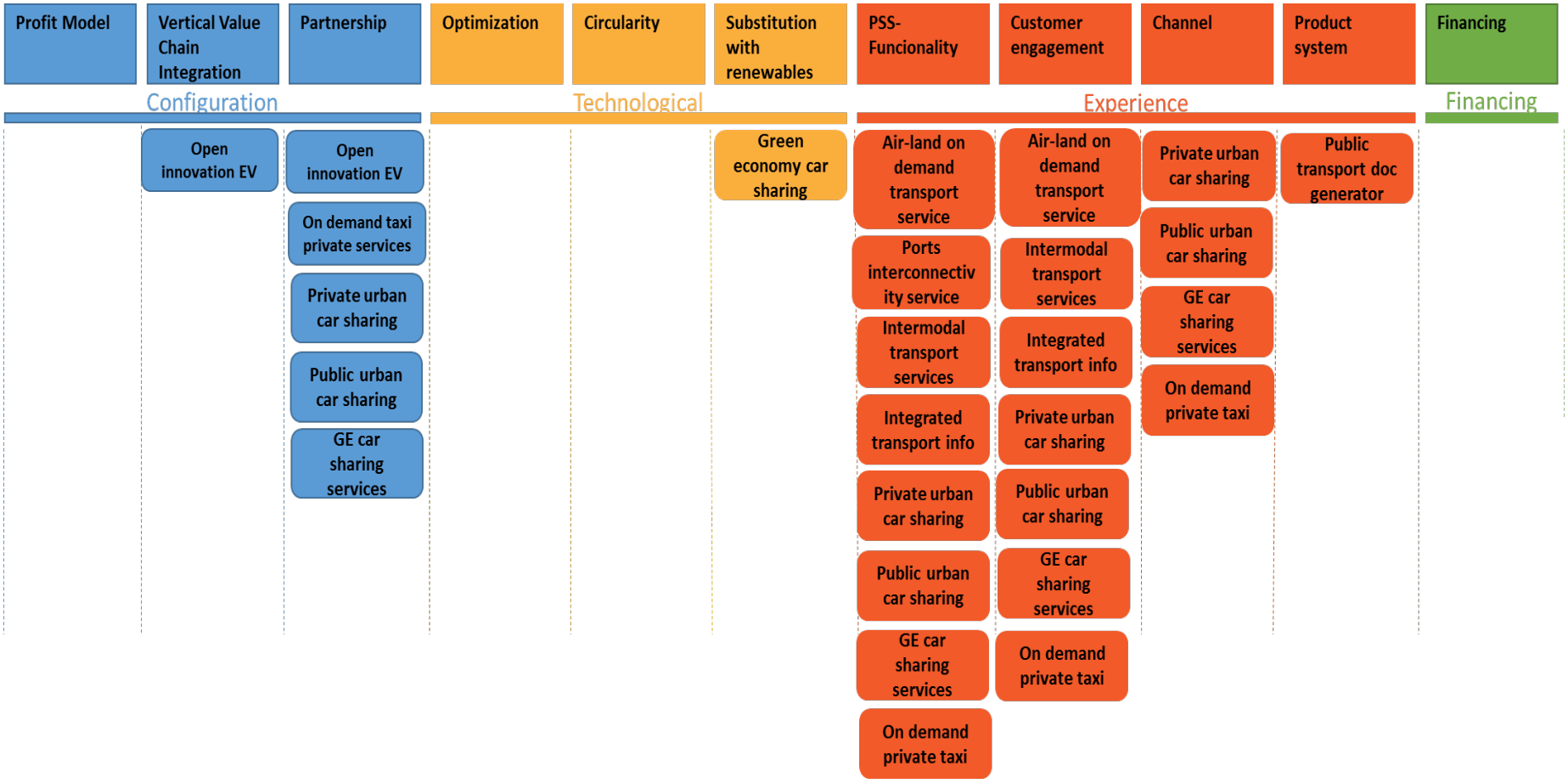

Figure 68: Innovation on business models of the urban mobility sector

5 Insights and conclusion

The European energy system is moving towards a more sustainable structure. To achieve this goal, changes in the value chain of the four sectors studied – energy supply and production, buildings, industry, and transport – are currently happening. From our innovation analysis, some trends stand out:

Energy supply and production is mainly innovating at the new stages of the value chain such as storage and electric devices and appliances. Technological and configuration changes are the main trends that are shaping the current business models, in which interconnection and customer engagement are key. The main barriers that the sector has to confront are related to the intermittency of renewables, balance of supply and demand, and the necessity of energy storage.

Business innovation on **the building sector** is occurring all along the industry value chain, starting with the re-design of project delivery models, energy performance solutions, and leading to deep renovation. The built environment paradigm shift is pulling building users at the centre of the ecosystem and therefore, service oriented business models are leading the way towards a greener building industry, in which cross sectoral collaboration is considerable.

In **the industry sector**, innovation is focusing on re-designing energy and resource efficient production systems and leading to extended producer responsibility in the form of remanufacturing, and recycling. In addition, circularity and optimisation are the main innovation sources.

Concerning **transport or urban mobility,** the aim is at developing new mobility alternatives and digital infrastructure that enables their integration. Improving customer experience and creating new configurations are playing a fundamental role to achieve an affordable and sustainable urban mobility system, in which partnerships and customer engagement are also significant.

Moreover, all the business models identified were placed on the innovation source that they account, as Figure 69 shows. From the analysis, it is concluded that emerging business models are innovating within the four archetypes proposed – configuration, technology, experience, and financing. However, three subtypes stand out over others (partnerships, PSS-functionality and customer engagement). Partnerships between companies are enabling the developing of new offerings for customers. In addition, firms provide more and more services instead of products, encouraging right behaviours and satisfaction of users' needs. The last trend is customer engagement. Innovative business models foster the commitment of customers, making them more conscious about energy usage and consumption.

To sum up, the transition of the energy system is happening now, and is being boosted by the innovation on business models. It brings not only new ways of interaction between companies, customers and all the actors present in the value chain but creating new stages and roles. Therefore, the business model mapping and innovation analysis carried out in this deliverable is a useful guideline to understand the main trends that push a sustainable energy transition.

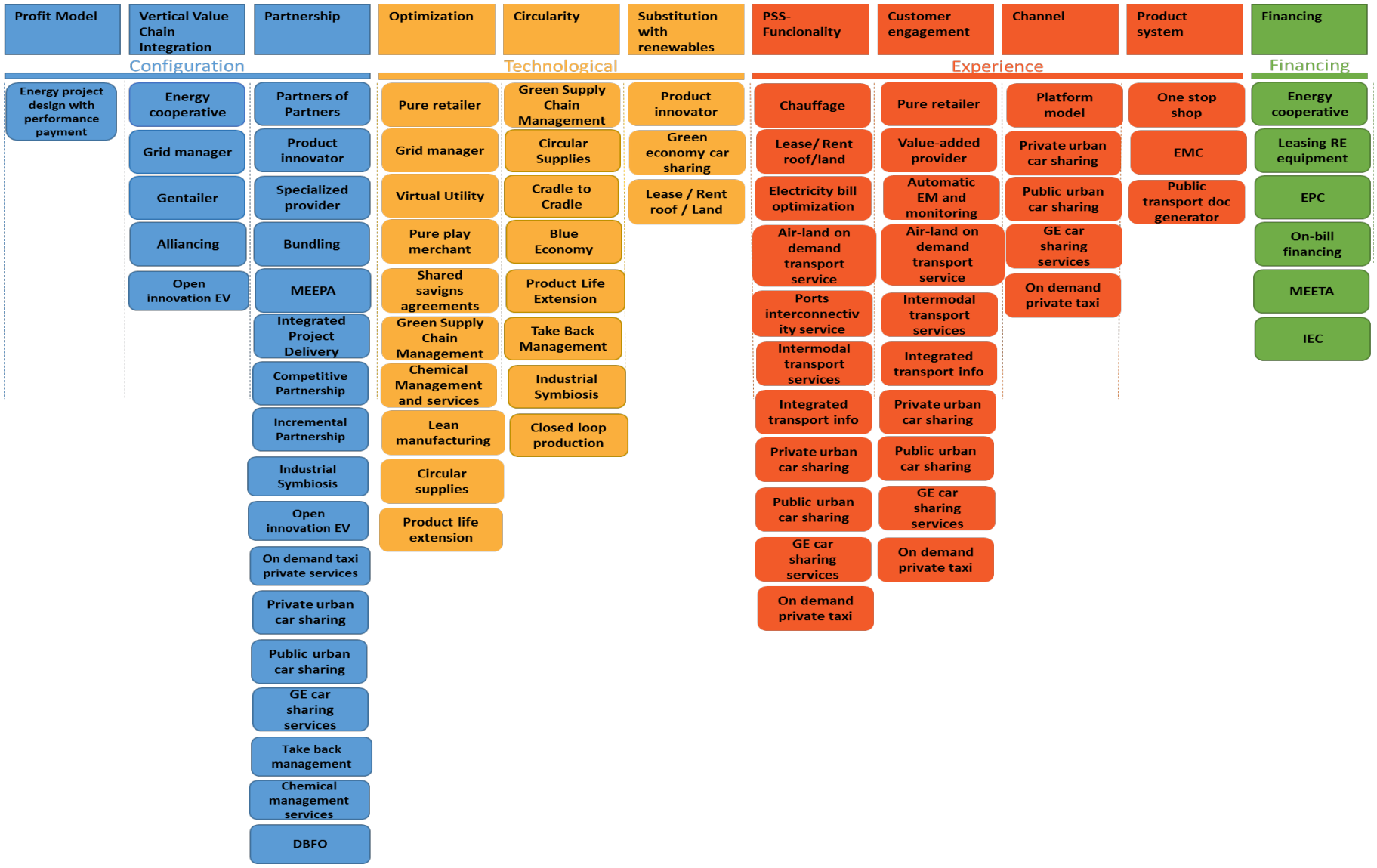

Figure 69: Innovation on business models of the energy system

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