Needs, solutions and business model for the supervision, efficiency and energy management of final users in the context of Industry 4.0 and the Internet of Things (IoT)

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Abstract

Companies all around the world are nowadays shifting towards more customer-centered products and services. All those involved in the energy-related sectors are in need of continuously improving productivity and energy efficiency in general in order to comply with growing stricter regulation towards a decarbonized energy transition, where renewable energy sources (RES) and energy storage systems will play a key role in the energy supply side. However, the potential for energy savings on the demand side has also gained ground in the last years and will be key with the electrification and digitalization of all sectors.

Despite the existing potential in demand-side improvements, Energy services companies (ESCos) have not totally established themselves and succeeded in penetrating the European markets as key enablers for energy efficiency measures. Particularly in Spain, where energy prices are remarkably above European average, energy services providers still face several barriers related to the 2008 economic crisis: lack of knowledge and trust in ESCo industry, lack of standardized practices and official certification bodies, inefficient support processes and schemes by the public sector and difficulties to access to finance.

This thesis performs a deep analysis of the energy services Spanish market, key competitors and key enabling technologies in order to provide an innovative business model from the perspective of one established market leader as technology provider in the electrical sector. The proposed business model is aimed to overcome all these barriers, while delivering maximum value to the identified customer segments' needs through a platform as a service model designed for the centralized energy monitoring and energy management of several distributed installations.

Keywords: Energy efficiency; energy management systems; demand-side management; demand response; energy meter; building management system; business model canvas; value proposition canvas; SWOT analysis.

1. Introduction

During the past years, worldwide Green House Gases' (GHG) emissions have stabilized at around 32 billion tons of carbon-dioxide equivalent (GtCO2-eq) since 2014. Decreasing energy intensity is the main factor behind the flattening of global energy-related GHG emissions since 2014, which is in fact driven by energy efficiency improvements, together with the shift to renewables and other low-emission fuels (IEA, 2017). Energy efficiency policies around the world have focused mainly in the building envelope and the supply side, leaving still a lot of room for improvement in cooling, heating, lighting and demand-side measures.

Digitalization, which is defined as the spreading application of information and communication technologies (ICT) across the economy in all sectors, is expected to increasingly enhance the participation of energy efficiency and other demand-side-management applications in electricity markets and energy management systems (EMS). Data are growing at such a high rate that internet traffic has tripled in the past five years (IEA, 2017). Digitalization has the potential to transform totally the current paradigm, breaking down boundaries between energy sectors, increasing suppliers and consumers' flexibility and permitting the better integration of renewable energy sources (RES).

More specifically, the digitalization of the industry (Industry 4.0) and the Internet of Things (IoT) are revolutionizing the business models, the relationship with customers and the energy services market. At ABB Spain, which has been traditionally a technology provider, we are developing a digital cloud-based energy monitoring solution with the integration of the products that we manufacture for the distribution of energy in all types of facilities. This solution -i.e. "Ability"- is a combination of protection switchgear and energy measurement gear, a specific communication architecture and a data management web platform. Although the solution has the potential to cover the requirements of the Spanish market today, we need to understand the transformation, new needs and contribution of the different "players" of the market.

The main purpose of this work is to deeply analyze the energy services market situation in Spain, as well as propose a feasible business model for the successful implementation of ABB solution -that is, from the point of view of an established leader as technology provider-. Several business modelling tools will be used in order to provide a clear picture of how the solution could provide more value for the customers without draining too many resources from ABB.

2. Literature review

Several scientific texts related to these areas of study can be found in the main academic research databases and search engines. In order to narrow the scope, a list of texts have been selected regarding 3 main areas of review:

2.1. General electricity market structure

(Parkkonen & Hyytinen, 2016) include an explanatory overview of the wholesale electricity market (focusing on the Nordic one), as well as a deep dive into demand-side management (DSM) general economics and requirements in different market places. It is complemented with a simulation study in order to discern the relationship between the increased share of RES and DSM on price volatility of the Nordic electricity market. (Batalla-Bejerano & Trujillo-Baute, 2016) perform an empirical analysis by gathering all data from the Spanish electricity market in the period 2011-2014 in order to evaluate the nexus between power system balancing costs evolution and in increasing presence of intermittent renewable energy sources. (Roelich, et al., 2014) take a different approach and focus on a deep analysis of electricity infrastructure, while covering all issues to be addressed to enable the energy transition away from supply of unmanaged demand. Several barriers and challenges for the energy infrastructure and its relationship with the final user through service-oriented operation are tackled.

2.2. Demand-side management

(Albadi & El-Saadany, 2008) perform an extensive classification of all demand-response (DR) related programs, splitting them into two main categories: Incentive Based Programs and Price Based Programs - also called Explicit DR and Implicit DR by other authors, respectively -. Benefits and costs related to these programs are analyzed, from the point of view of both participants and programs' owners. (Apajalahti, Lovio, & Heiskanen, 2015) analyze how one of the largest Finnish electricity retailers struggled in developing business solutions in the field of energy efficiency services, evidencing fundamental challenges for traditional firms in a growing liberalized market. Al last, (Costa-Campi, García-Quevedo, & Segarra, 2015) study from an exhaustive sample of Spanish manufacturing firms which profiles and behaviors are related with investments in energy efficiency solutions and services.

2.3. Business modelling in energy services market

Several authors have written about business modelling within the scope of electricity markets and DSM in general. However, there is no common classification when it comes to different business models (BM). For example, (Hall & Roelich, 2016) construct four general value propositions based on missed opportunities by a purely national supply market in the UK. From there, they build on eight different business models that may capture the value offered by these propositions and perform a qualitative comparison with the current archetype. (Behrangrad, 2015) focuses the classification on the different actors of the electricity market ecosystem. Besides, all studied business models are grouped into two categories -DR and EE- and further classified depending on the load interruption frequency and duration tolerances. (Burger & Luke, 2017), on the other hand, perform an exhaustive analysis of 144 business models sampled from companies in Europe and USA, classifying them based on customer segments, offered services and revenue streams.

Other authors like (Richter, 2013) and (Shomali & Pinkse, 2015) focus on the utility firms segment in different ways. The former analyzes the existing challenges and opportunities for German utility firms in the RES field by interviewing a sample of them, as well as classifies the different business models into utility-side BM and customer-side BM; whereas the latter provides a deep understanding of the possible impacts that smart grids and the energy transition may trigger from the point of view of the traditional utility company, categorizing them into 3 different categories related with business model innovation.

(Hannon & Bolton, 2014) study the different possible business models in between the public sector in UK and ESCOs by interviewing representatives of both parts. The text describes potential benefits and limitations of each proposed scenario, highlighting the interactions in between all actors.

Similarly to (Behrangrad, 2015), (Hamwia & Lizarralde, 2017) group different business models of their analysis into energy efficiency (EE), DR and RES. However, in this paper, business models are previously grouped based on the ownership of the assets, the place where they are installed and the source of the financial resources, ending up in three main categories: Customer-owned product-centered BM, third party service-centered BM and Energy community BM.

Lastly, (Helms, Loock, & Bohnsack, 2016) conduct a series of interviews to representative companies of the electricity sector and DR activities in general. The final business model identification takes into account the origin of the response -supply or demand- and the number of processes or installations involved -distributed or centralized-, leading to 4 BMs: Power plant optimization, Virtual Power Plant (VPP), Large-scale DR and Small-scale DR.

3. Energy services Spanish market analysis

3.1. General framework

Demand response offerings are not yet developed in Spain. The only focus of the energy services Spanish market is in EE services, which are divided into 2 offerings: Energy Performance Contracting (**EPC**), which is focused on the demand side; and Energy Supply Contracting (**ESC**), focused on the supply side. The EPC market is specially fragmented, with about 7% of large companies having around 50% of market share and the remaining 93% covered by more than 1000 ESCos registered as Small and Medium Enterprises (SMEs). EPC market segments are both public and private, with public segment growing at a constant and accused rate. ESC market is not remarkably divided, with the main segments being municipalities, offices and retail (Espejo Luque & Briano, 2018).

3.2. Legal and regulatory framework

There are 2 key normatives in the energy efficiency framework: **Energy Performance of Buildings Directive (EPBD)** and **Energy Efficiency Directive (EED).** The latter is transposed in Spain into the **Royal Decree 56/2016.**

EPBD 10/31/EU is the main piece of legislation for energy efficiency and energy savings in buildings. Therefore, it helps boosting EE services industry through several public measures. Some of the most important measures covered by EPBD are the mandatory inclusion of energy performance certificates in sales and rental of buildings, the establishment of inspection schemes for heating and air conditioning systems in EU countries, the obligation for all new buildings to be nearly zero emission buildings by December 2020 -December 2018 for public buildings- and the establishment of national financial support schemes to improve EE in buildings, among others (European Parliament and The Council, 2010).

EED 2012/27/UE establishes a common framework of binding and concrete measures to help the EU reach its 20% EE target by 2020. The main covered points are the obligation for EU countries to make energy efficient renovations to at least 3% of buildings owned and occupied by central governments and the enforcement to only purchase highly energy efficient buildings and to draw-up long-term national building renovation strategies which can be included in their National Energy Efficiency Action Plans (European Parliament and the Council, 2012).

Royal Decree 56/2016 is the transposition of **EED** and the key point of interest is the one related to energy audits. It states that big companies, defined as those with more than 250 employees and more than 50M€ of annual sales volume -or the general annual balance exceeds 43 M€-, are obliged to perform an energy audit every 4 years. This energy audit will be performed on-site every 4 year or will be validated through a certified Energy Management System (EMS) according to European and international standards (Government of Spain, 2016).

At last, the article 18 of the EED enforces several obligations on member states in order to support the energy services market. In Spain, the main obligations transposed till the date are the following (Espejo Luque & Briano, 2018):

- Annual contribution to the National Energy Efficiency Fund.
- Plan to Promote Mobility with Alternative Energy Vehicles (Movea Plan).
- Efficient Vehicle Incentive Programs (Plan Pive).
- The Investment Fund for Diversification and Energy Saving (FIDAE).
- Aid Programme to Improve the Energy Efficiency of Existing Buildings (PAREER-CRECE).

Currently, public subsidies are not commonly perceived as a driver in the ESCO industry and many times these kind of projects suffer from lack of interest from the public sector, relying most of the times on external or even internal financing -the same ESCO is financing the projects- (Napolitano, 2016) (Espejo Luque & Briano, 2018).

3.3. Market size

According to (ANESE, 2016), energy efficiency sector in Spain represented around 1,8% of Spanish gross domestic product (GPD), which means about 19000M€ in 2011. More specifically, the energy services sector represented 1170M€ turnover in 2016 -about 0,11% of Spanish GPD-. This estimation matches (Boza-Kiss, Bertoldi, & Economidou, 2017) with an estimated annual turnover of 1000M€. In general, all authors agree that the Spanish sector will experience a small and constant growth. The following presented data intends to add some relevant quantitative indicators developed by (Boza-Kiss, Bertoldi, & Economidou, 2017):

- Number of ESCos (2015): +1000 companies registered as “Energy Services Companies”.
- Number of EPC providers (2016): 20-30 companies offering performance-based EE projects.
- Number of EPC projects (2016): 200-3000 performance-based EE developed projects.

3.4. Market sectors

In this section, we will review the main sectors that could mean an important customer segment for the development of energy services. In Figure 1, we can appreciate the distribution by percentage of final energy consumption by sector.

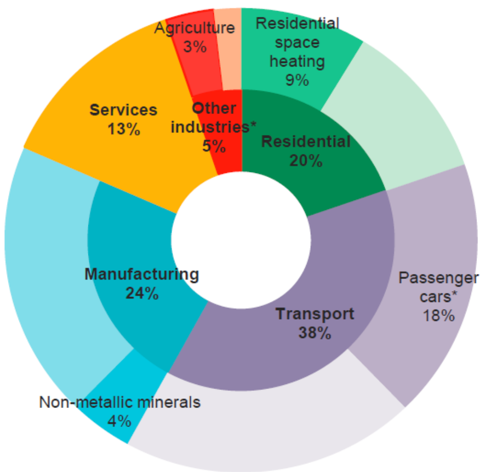

Figure 1.Final energy consumption by end-use sectors in Spain (IEA, 2017)

Even though transport represents a huge percentage of final energy use in Spain, it is mostly covered by fossil-fuels (IEA, 2017). Energy services are not normally related to fossil-fuel consumption on road transport. Although E-mobility will represent a huge opportunity for EE, DR and energy services in the future, we will leave transport out of the scope of this thesis since its development is still in preliminary phases. Therefore, the main studied sectors and the main reasons behind the choice are the following:

Industry

Industry is a very interesting sector due to its energy intensive processes, its advanced knowledge and relationship with energy efficiency and its already established relationship with technology providers as ABB. Industrial manufacturers always seek for processes optimization and will be interested in projects related with energy efficiency. The growing share of electricity in manufacturing industry´s energy mix evidences the huge potential for benefitting from energy services and digitalization in Spain (IEA, 2017).

Tertiary Sector

Tertiary sector differs from industry in several points. Although it is not such an energy intensive sector, it has some potential advantages. Energy in tertiary sector is more dispersed in several installations. However, this fact could represent an opportunity since customers may want to obtain a solution in order to centralize the monitoring and management of much dispersed locations. Moreover, tertiary sector gives usually more importance to its "green image" and uses it as a marketing tool, so an EE service could add value in this way. At last, the share of electricity in the representative tertiary sector energy mix is higher than the one in industry -about 70% of total energy consumption- (Fasolino, 2016).

Public Sector

The public sector is a very important sector to take into account. As we have previously seen in 3.1, EE market volume in public projects is growing at a constant and accused rate (Espejo Luque & Briano, 2018). Also, as seen in 3.2, several European policies -and their transposition in the Spanish framework- are aiming to boost energy services market and will start -and sometimes be more restrictive- in public buildings in order provide visibility and serve as an example. For example, the **Error! Reference source not found.** describes Nearly Zero Emissions Buildings (NZEB) as those with a high energy efficiency level with minimum levels of required energy covered mainly by renewables (Endesa, 2017) and established that all new public buildings must be NZEB by the beginning of 2019.

3.5. Market barriers

Overall, the main barriers in the Spanish market are related to the lack of trust and information in the energy services industry. Spain differs from Europe in several key points (see Figure 2). For example, even though decreasing energy prices are considered as a barrier for several stakeholders, **increasing energy prices** are considered as the main **driver** in Spain (Espejo Luque & Briano, 2018).

Regulatory & Administrative Barriers

In general, local governments in Spain are very inefficient in decision-making processes. Moreover, public procurements are time-consuming and lengthy; public administrative accounting is not used to deal with energy savings.

Informational/Structural Barriers

Several interrelated barriers fall into this category, such as the lack of standardized M&V practices, lack of official certification bodies, lack of information by the public, lack of trust in energy services industry and low demand.

Financial Barriers

Due to the public administration inefficiencies, ESCos in Spain had always obtained financing from banks or other entities. However, after the economic crisis, this path has become difficult for many SMEs. Some of these companies have been forced to use own financing in order to reach customers and consequently have lost customer acquisition capabilities.

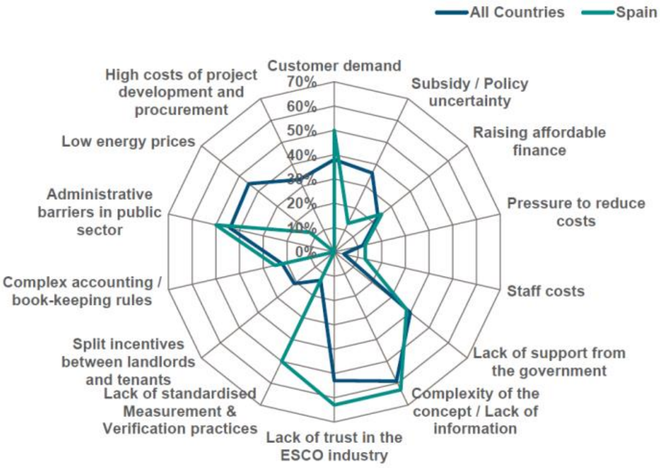

Figure 2. Main barriers to energy services market - EU vs Spain (Garnier & Ltd, 2013) (Espejo Luque & Briano, 2018)

3.6. Financing

As mentioned before, most Spanish companies do not rely on public subsidies for obtaining finance. There are several funds at European level under the scope of EU's Horizon 2020 initiative. The most important would be the European Energy Efficiency Fund (EEF), which is a public-private partnership (PPP) giving support to municipal, local and regional authorities. Other important funds are JESSICA funds and other European PPPs: the European Investment Bank, Private Financing for EE instrument (PF4EE) and European Structural & Investment Funds (ESIF) (Mafra, et al., 2016). In Figure 3, we can appreciate the main financing sources for EE projects at European level. Regarding Spain, the most widespread financing practice is borrowing debt. However, determinant data has not been found (Transparensee, 2015).

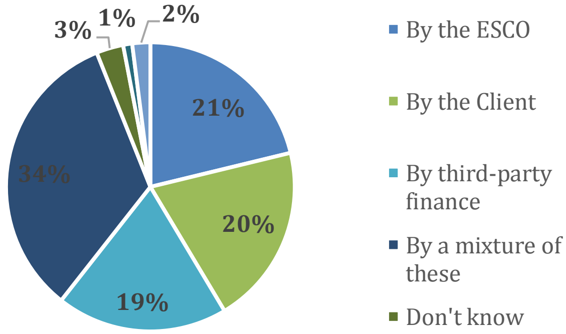

Figure 3. Financing sources for ESCo projects in the EU. (Source: Own elaboration from (Transparensee, 2015))

4. Competitor analysis

4.1. Main players

Due to the vast and diverse products and services offered in demand-side management framework, there are several market players which can be involved in one way or another. These players could not necessarily be specialized in just one service or product category; and therefore, in reality, some of them are normally a bundle of the players described below. For example, some ESCOs are also software developers or some Information and Communications Technologies (ICT) integrators offer also consulting services.

ESCos

An Energy Services Company is a firm providing a range of energy-related solutions including design and implementation of energy savings projects, retrofitting and energy issues (conservation, supply, risk-management and so on). They also develop, implement and facilitate financing for upfront EE investments for its clients. There are +1350 ESCos registered officially in Spain (Institute for Energy Diversification and Saving, 2018). Some examples with important presence in the Spanish market are Creara, iON Smart Energy, Escan or FN Energia.

Technology Suppliers

A technology supplier is any firm providing intelligent energy devices or electronic solutions which incorporate information and communication technologies (ICT). Speaking in general terms, it is the firm that develops and manufactures the hardware that enables energy monitoring and management. Therefore, a technology supplier is normally in a close relationship with ESCos. Some examples are Circutor, Schneider Electric, Carlo Gavazzi, Satel, OpenDomo, Socomec, Cysnergy or Janitza.

Software Developers

A software developer is in charge of the development and integration of the platform or application related with the energy service. An important characteristic of a software development is being brand-agnostic, meaning that it is highly compatible with any hardware brand. The majority of the times, software developers also participate in the development of the gateway. Some examples of important software developers in the Spanish market are Energy Minus, Dexma, Smarkia, Seinon, CO2ST, Kinetic (CISCO), Energisme and Wattics.

Associations

An association joins several energy services companies and other stakeholders and provides additional services such as consulting, training or marketing. Essentially it is a way of providing trust and market presence for those companies offering energy-related services and solutions. In some occasions, public bodies are also members of these associations, providing a link in between public authorities and different stakeholders. The most important are AMI -Association of Comprehensive Maintenance and Energy Service Companies-, ANESE -National Association of Energy Service Companies- and A3e -Association of Energy Efficiency Companies- (Government of Spain, 2017).

Public Bodies

Public bodies are key when it comes to promoting, stimulating and supporting EE or DR initiatives. They can act as customers, partners or representatives of the community. A public body committed to DSM strategies will enhance and boost the general implementation and success of all the stakeholders involved in the value chain. Normally, the aims of a public body are lowering energy consumption and costs, while improving general performance in buildings and districts.

Aggregator

The DSM aggregator acts as an energy manager in between the utilities and the consumers/prosumers. Aggregators gather diverse end users at their portfolios to form a single market participant. This way, they enable end users flexibility, which is offered to utilities or other market actors in order to obtain benefits through the participation in explicit DR programs.

Even though explicit DR programs are not widespread in Spain (Smart Energy Demand Coalition, 2017), DSM aggregators are a key figure to take into account in the near future, since they will enable RES integration to the grid and new business models for utilities and end customers' interaction.

Utilities

Utilities have a key role in DSM markets, especially in liberalized energy markets, since they are the energy producers and they charge for the costs associated with energy consumption. As mentioned above, new relationships and stakeholders are appearing between end consumers and utilities. Therefore, they are also a key player in the energy value chain to keep in mind. In Spain, the main dominants of the market are Endesa, Iberdrola, Unión Fenosa and E.ON.

Consulting Firms, System Integrators and Engineering Firms

Even though consulting firms, systems integrators and engineering firms perform different jobs, they all have in common that they prescribe or recommend the final solution adopted by the end customer. This will include, in many cases, the hardware, the software and the energy services. Therefore, these players are also crucial in DSM markets and should be taken into account.

4.2. Key competitors analysis

Keeping in mind that ABB has traditionally been a technology supplier, we will now deeply analyze three selected players that represent a main threat, due to their recent activities related with **digitalization and energy management solutions and services**.

For a deeper dive into each of the competitor's analysis, consult the source master thesis on which this document is based.

Emerson

Emerson is a global technology and engineering company, with a strong presence in process industries, utilities, transport and infrastructure. ABB has strong overlap with one Emerson main segment: Automation solutions.

The following Table 1 shows a summary of the key strengths and weaknesses deduced a deep analysis focused in 3 key points: key segments with digital focus, portfolio analysis and investments and acquisitions efforts' analysis. All relevant information has been extracted from (Emerson) (Emerson, n.d.) (Emerson, 2018).

Strengths	Weaknesses
- Very complete portfolio and industry expertise - Ability to deliver "full-package" services & products without the need of 3rd parties - 40 billion $ installed base - n. 1 ranked company for control systems in several industries -chemicals, power, oil & gas...-, software solutions -advanced process control, asset management, simulation software- and industrial wireless infrastructure	- Lack of strong capital arm may limit purchasing ability for investments and acquisitions - Plantweb digital ecosystem is not open for 3rd party developers, which could result in fewer and slower applications' development and due to reduced key partnerships' participation - Intense focus in industry reduces reach to other market segments and other potential revenues

Table 1. Emerson general evaluation (own elaboration)

Schneider Electric

Schneider has always been a traditional competitor for ABB, especially in industrial sector and low voltage switchgear. They claim to be ahead in the learning curve of industrial IoT and digital offerings in terms of investment and maturity of offerings. Global specialists in energy management, automation and software, their 4 focus segments that strongly overlap with ABB are: Buildings; Industry; Infrastructure; IT.

The following Table 2 shows a summary of the key strengths and weaknesses deduced a deep analysis focused in 4 key points: key segments with digital focus, portfolio analysis, partners' ecosystem and investments and acquisitions efforts' analysis. All relevant information has been extracted from (Schneider, 2017) (Schneider, 2017) (Schneider).

Strengths	Weaknesses
- Installed base plus openness for 3rd party devices: +1,5M connected assets, +20% FY16-F17 growth 480K installed sites w/ 20K SI's and developers - Strong Capital arm (Aspen) - Really strong and extensive partners ecosystem - Strong presence in renewables and EV charging - Software important acquisitions - Close relationship with big players (Accenture, Microsoft, Intel, Cisto, Enel)	- The provided solutions are very verticalized --> need for horizontal communication and marketing between verticals - The vast range of specific offerings may overwhelm customers' profiles seeking for more horizontal and general solutions

Table 2. Schneider Electric general evaluation (own elaboration)

Siemens

Siemens is a global technology company with core activities in electrification, automation, digitalization and a strong presence in wind and solar generation. A deeper review of segments with digital focus shows us the 6 main segments that overlap with ABB ones: Digital factory; Building technology; Mobility; Process industries and drives; Power and gas; Energy management.

The following Table 3 shows a summary of the key strengths and weaknesses deduced a deep analysis focused in 4 key points: key segments with digital focus, portfolio analysis, partners' ecosystem and investments and acquisitions efforts' analysis. All relevant information has been extracted from (Siemens, 2017) (Siemens, 2017) (Siemens, 2018) (Siemens, 2017).

Strengths	Weaknesses
- Installed base plus openness for 3rd party devices - 1M+ connected assets, +20% 2016-2017 growth from SW and digital services - Deep know-how in a broad range of markets and industries - Powerful partners and solutions joint collaboration ecosystem - Vast digital portfolio: MindSphere –cloud –based IoT operating system-, Software, Services, Security - Perceived as a reliable, trustworthy and high quality brand - Extensive experience in industrial automation - Powerful capital arm (Nexus47) - Focus in software	- Competition for highly qualified personnel with "digital talents" remains intense - Lack of openness for hardware and devices of other brands than Siemens - MindSphere considered not mature and with limitations (e.g. too specific to Siemens)

Table 3.Siemens general evaluation (own elaboration)

5. Business model generation

In this section, we will firstly review the main business models used by companies offering energy services in Spain. Afterwards, we will use several business modelling tools in order to evaluate which business model will provide more potential value to our solution.

5.1. Main business models

There are two main business models used in Spain regarding energy use: Energy Supply Contracting (ESC) and Energy Performance Contracting (EPC). Energy supply contractors' workspace focuses on the useful energy delivered to the customer, such as electricity, hot water and coolant. Energy performance contractors' workspace, however, goes to the end of the energy delivery value chain and focuses on the final energy services delivered, such as ventilation, space heating, lighting, refrigeration and so on.

Energy Performance Contracting

An energy services company using and EPC arrangement delivers a project to the customer so he or she can improve the energy efficiency on the demand-side of the facilities. The savings obtained will proportionally serve as remuneration for the energy services company and to help finance the projects. Therefore, this is a performance-based business model. After having completed the contract period, the customer will continue obtaining savings from the measures implemented.

EPC is the most widespread business model used by ESCos (Espejo Luque & Briano, 2018). However, it is better suited for larger projects, since there are high transaction costs associated to the complexity of the contracts and the measurement and verification of savings. There two main EPC types that generally stand out: Shared savings EPCs and guaranteed savings EPCs:

- **Shared Savings EPC**

In a shared savings energy performance contract, the ESCo obtains financing for the EE implementation project, which is normally focused on demand-side measures -although it can also include supply side EE measures-. The savings obtained from the implementation are then shared in between the ESCo and the customer, according to the period and sharing rates contractually agreed (Boo, et al., 2016).

As an advantage, this model attracts customers since they can implement EE measures without any prior investment, share risks and repay the debt based on the performance of the project. On the other hand, ESCos using this model may be limited to a number of customers since they have to consume their own resources in order to obtain finance.

- **Guaranteed Savings EPC**

In this model, the ESCo assumes the risk of project's performance by guaranteeing a previously defined minimum amount of energy savings. If this minimum is not reached, the ESCo will be penalized and pay the difference. If savings are above the determined level, the ESCo may receive the extra benefits or they may be shared in between ESCo and customer, depending on the contract (Olschewski & Fragidis, 2014).

As main advantages, the ESCo does not need to dedicate so many resources -since the customer looks for finance- and may obtain extra benefits if the savings exceed the agreed minimum. As main disadvantage, the ESCo assumes all performance risks and may be penalized if the savings do not reach the established minimum.

- **Variable Contract Term EPC**

The ESCo finances the project as in a shared savings model. However, if the savings obtained do not reach the expected value, contract length can be extended until the customer has repaid the ESCo. In some cases, ESCos use a variation of this model called "First out", where all savings obtained from the project go straight to the ESCo until the payment is totally completed -the savings are not shared-.

Energy Supply Contracting

In an energy supply contract, the ESCo assumes responsibility of providing secure supply of useful energy, which the customer pays for. In general, the ESCo is in charge of operation and maintenance and the ownership of the equipment -such as photovoltaics, combined heat and power or biomass equipment- remains with the client. Therefore, the ESCo is focused on improving EE of the supply side in order to maximize its revenues.

As main advantages, the customer does not need to worry about the supply of energy for a monthly fee and the ESCO can maximize benefits by the reduction of energy costs. The main disadvantage is that the ESCo is contractually obliged to provide secured energy supply, which implies risk.

Chauffage

Also called comfort contract, a *Chauffage* is a contract aiming to provide a certain operational condition demanded by the customer -for example, maintaining a certain room at 21ºC or a refrigeration chamber at a certain temperature and ventilation conditions-. It is a form of outsourcing energy management and the measures implemented by the ESCo can be on both the supply side and the demand side, although demand-side measures are less complex than the ones implemented in EPCs and do not include retrofitting or equipment substitution. The customer normally pays a monthly or yearly fee.

As a main advantage, the complexity of a *Chauffage* contract is less accused than that of EPCs. Similarly than in shared savings EPCs, the disadvantage is that ESCo companies normally finance the projects and assume the operation and maintenance costs –although they are relatively lower-.

Integral Energy Contracting

An integral energy contract (IEC) is basically a combination of an ESC and an EPC. Therefore, the ESCo will implement EE measures in both supply and demand side. Measures from demand side are normally prioritized due to higher economic costs associated with supply side improvements. IECs are therefore more complex and suited for larger projects. The ESCo normally obtains financing and the revenues come from the project's savings.

As a clear advantage, an IEC has more potential for EE implementations since it covers a broader scope. However, the high transaction costs associated with the complexity of the contract, measurement and verification of savings may translate into a barrier for smaller projects.

Build-Own-Operate-Transfer (BOOT)

A BOOT contract is typically used in supply-side measures. The ESCo designs, builds and operates the energy supply installation until the end of the contract, where it is transferred to the customer. BOOT contracts are mainly long term and customers pay a monthly fee that will cover initial investment, operation costs and profits.

As a main advantage, this arrangement offers great value to customers since ESCos deal with all the investment and the entire projects. However, this could also mean a disadvantage from ESCos' perspective.

5.2. Customer needs – Value proposition

Besides from the performed market research, we will use the Value Proposition Canvas (VPC) tool (Osterwalder, Pigneur, Bernarda, & Smith, 2014) in order to have a better perspective from the customer segments mentioned in 3.4 and better design a solution that adjusts to their main needs. The conclusions obtained from this process will be integrated into 2 building blocks of the Business Model Canvas developed in 5.3: **Customer Segments** block and **Value Proposition** block.

The VPC is split into two parts: The right side of the canvas represents the **Customer Profile**, which describes the customer segment we are trying to address in a more detailed and structured way; meanwhile the left side of the canvas represents the **Value Map**, which describes the set of features of a value proposition that targets a specific customer segment.

In our case, for the value proposition design, we have used the value proposition canvas tool with the 3 proposed customer segments: Industry, tertiary sector and public sector. At ABB, we are looking for a general solution that can be used by any customer regardless of the sector and that aims to be established as a cross-divisional tool in all ABB verticals. Therefore, we have merged all 3 developed value proposition canvas into a general one that addresses the main customer jobs, pains and gains in all 3 segments (see Figure 5).

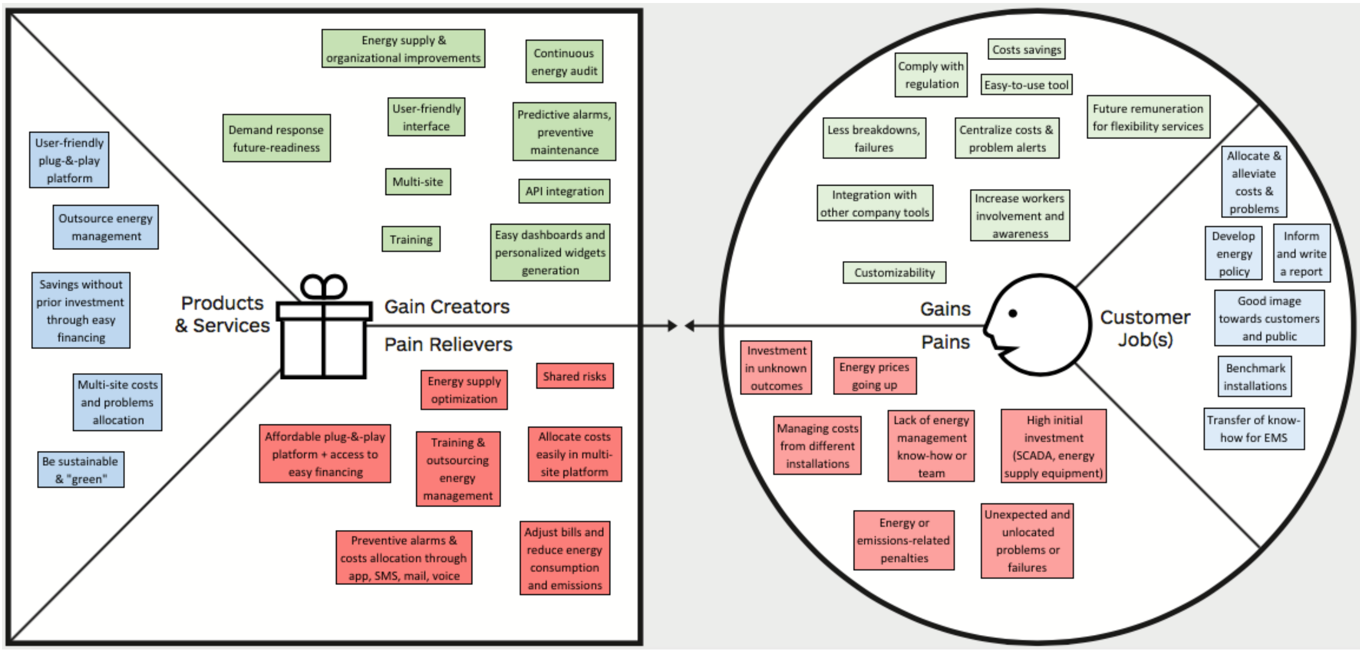

Figure 4. Value Proposition Canvas Proposal (own elaboration)

5.3. Business model proposal

After having designed the value proposition targeting our customer segments, we will zoom out from the value proposition canvas in order to fit these two blocks into the 9 building blocks of the Business Model Canvas (BMC) tool. The BMC is a tool designed to picture a general overview of how a business works. It is summarized in 9 building blocks pictured in Figure 6: the 4 on the right side represent the customer side, whereas the 4 on the left represent the company side. Finally, the value proposition is placed on the center in order to connect company and customer.

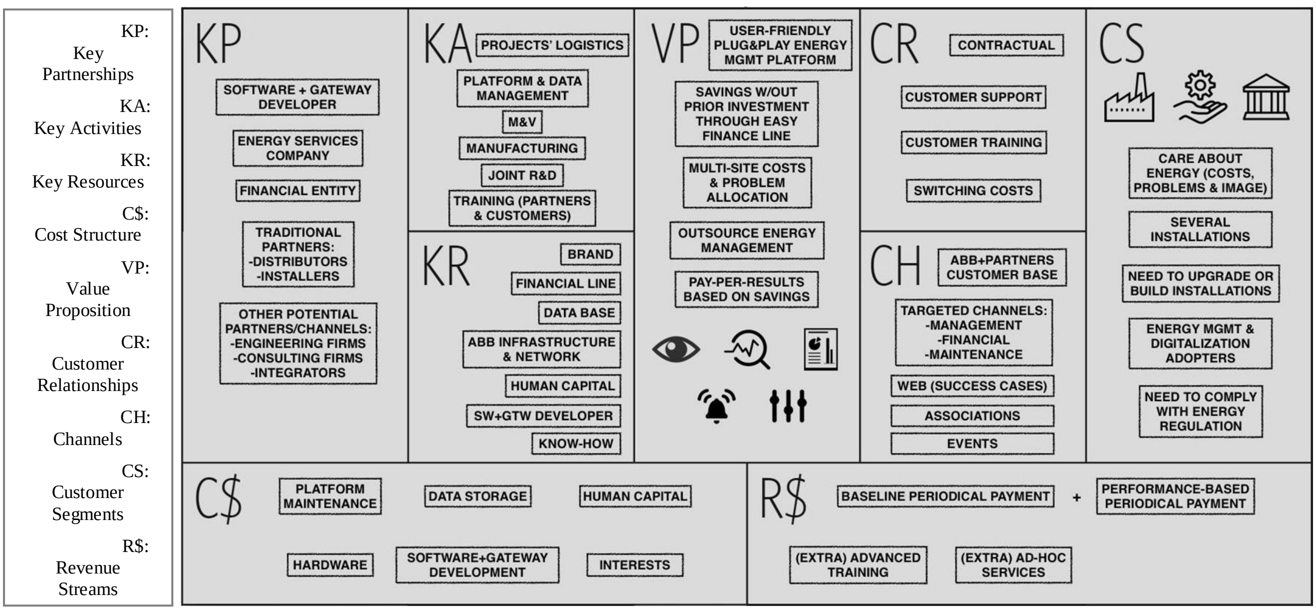

Figure 5. Business Model Canvas proposal (own elaboration)

6. Conclusions – Next Steps

Spain remains behind leading European countries when it comes to energy efficiency, renewables and energy storage implementation and integration into the grid. In particular, even though energy prices in Spain are way above the European average, the energy services market remains unexploited due to several key barriers: lack of knowledge and trust in ESCo industry, difficult access to financing sources and time-consuming and complex processes and contracts.

With the help of several business modelling tools, such as the value proposition canvas or the business model canvas, we have analyzed market needs from the perspective of each of the targeted customer segment -industry, tertiary sector and public sector- and designed a value proposition aligned with those needs and embedded in a business model that has the potential of overcoming all mentioned barriers.

ABB will be the center piece of the model and will demonstrate the viability of the solution with real success cases and a powerful platform for the clear valorization of the outcomes, providing trust in between customers and energy services providers and a clear display of information that helps different stakeholders perform their jobs in an easier way -or even be used for marketing purposes-. In other words, ABB brand will be used as the quality assurance for the projects.

At the same time, the provided financing line by ABB and the proposed revenues model -where a part of the re-payment is based on the customer's performance- will ensure that the customer does not face any economic barrier related to the higher initial investment usually associated to the projects. The financing process is intended to be standardized in order to reduce implementation times.

At last, with ABB as a nexus and catalyzer in between the other involved parties, the capacity of offering an end-to-end solution -initial audit, financing, installation and commissioning of hardware and software, training and customer support- provides us with the opportunity of reducing the complexity of the processes involved in an energy efficiency project, where normally a customer has to be in contact with several stakeholders instead of just one intermediary.

The proposed business model, together with the used technology, is expected to deliver maximum value to the customers and provide ABB with a competitive advantage over other market players. However, although we have performed an initial evaluation with feedback from people involved in the project -and an established know-how in energy services market-, it is key to validate all the assumptions proposed in the business model canvas in order to totally fit our value proposition with the customer segments. We are working on several demonstration cases in each of the 3 mentioned segments in order to validate the business model -or pivot to a new iteration in case it is not validated-.

This study could be continued or extended in many ways. We think the most important **next steps** -apart from the validation of the business model- could be:

- Study of the integration of hardware from other ABB divisions into the platform, such as drives, industrial automation key performance indicators (KPIs) and products from medium and high voltage.
- Study of future revenue streams for customer retention. For example, implement RES or energy storage systems as an upgrade -since the previous stage of these implementations is an energy audit, which is continuously done in the platform-. Also, the platform could serve as an enabler for future participation of the customers in the electricity market through explicit demand response programs, acquiring and validating data about the energy trades.

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