

**POLITECNICO DI MILANO**

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Dipartimento di Ingegneria Gestionale

Polo Territoriale di Milano Bovisa



Master of Science in Management Engineering

**Business models in the electric vehicle charging  
supply chain**

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Academic Year 2019/2020



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# Glossary

BM – Business model

BMC – Business model canvas

CPMS – Charge point management solutions

CP – Charging point

CPO – Charging point operator

EMSP – Electro mobility service provider

ESCo – Energy service company

EV – Electric vehicle

GHG – Green house gasses

HoReCa – Hotellerie-Restaurants-Café

ICE – Internal combustion engine

IoT – Internet of things

O&G – Oil and gas

OEM – Original equipment manufacturer

PA – Public administration

POI – Point of interest



RFID – Radio frequency identification

RES – Renewable energy source

V2G – Vehicle to grid

# Abstract

Electric mobility has been a core topic over the last decades in the wide framework of sustainable development, as in order to meet the decarbonization goals set for the years to come, the support of e-mobility is fundamental. Then again, without an efficient, pervasive, and performant charging infrastructure, reaching the critical mass for the EV market is impossible.

For this reason, the following research has the goal to identify the main business models adopted by the actors along the public and private charging infrastructure value chain, trying to extrapolate valuable information that can be exploited by practitioners, and can bring an apport to the existing literature. The latter is in fact lacking an omni-comprehensive point of view for what concerns the business model as a whole, focusing just on single building blocks, and tends to focus more on the electric vehicle, than on the charging infrastructure itself.

This research is then trying to fill these gaps, exploiting the information gathered through direct interviews to 47 companies playing different roles in the charging infrastructure value chain, in order to draft business models for each one of these categories of actors, identifying potential patterns, disequilibria, or noteworthy aspects. To do so, for each category of actors, different archetypes based on different value propositions or charging destinations – private or public – have been identified.

Starting from the analysis of these archetypes, it has been possible to study the supply chain of the public and private charging infrastructure, in order to assess the level of integration, the roles played by the different companies, and the coverage provided by the latter within the value chain.

Although the following research has no presumption of painting a definitive picture of the market, it is an interesting addition to the lacking literature, putting solid bases for future developments. It is with time that, as players consolidate their business in the EV charging sector, and more data becomes available, the validation of the different business models will be more robust and consistent.

**Keywords:** EV; electric vehicles; e-mobility; charging infrastructure; charging service; charging station; business model; CPO; EMSP; technology provider; utility; electric equipment distributor; car maker; private charging; public charging; destination charging

# 1. Executive summary

The main objective of the present thesis is to investigate the EV charging market, focusing on the different business models adopted by each actor taking part to the public and private charging infrastructure supply chain.

The EV sector is a relatively young market characterized by high uncertainty, represented by an innovative and dynamic environment in terms of technology, regulatory framework, level of competition, and cost structure.

Keeping in mind this premise, the first section of the thesis corresponds to the introduction of the context in which the study takes place. In detail, firstly a brief introduction about the EV sector is provided, addressing the environmental impact of EV, the main vehicle typologies based on the battery installed, and the main barriers to EV adoption. Once set the framework of the e-mobility general environment, the main available technological features of the charging infrastructure are discussed, distinguishing among slow, fast, or rapid charging. Being the EV charging supply chain an extremely heterogenous market, comprehending both well established companies and totally brand-new ones, the description of the main stakeholders is provided, namely automakers, utilities and oil & gas, pure players, technology providers, and general contractors. In the end, private and public charging processes and characteristics are described.

After this contextual section, the master thesis provides a thorough review of the existing literature concerning business models. An extensive review of the literature regarding the business model as a strategic tool was performed, to subsequently narrow the scope in order to dig down into the EV charging market, assessing the existing business models of the charging infrastructure supply chain. This analysis was conducted firstly by taking the broadest perspective possible, hence papers and research projects about comprehensive business models in the EV charging sector were investigated. In a second moment, the single building blocks constituting the business model of each actor of the charging supply chain have been examined. Once extensively investigated the existing literature regarding the EV charging supply chain, some gaps and shadowy aspects emerged. In particular, it became clear that an omni-comprehensive view of the business models adopted by the actors taking part to the EV charging supply chain was not currently available in existing literature. Furthermore, the strong focus on EV drivers, rather than on charging infrastructures, biased the largest part of the documents which, thus, were less interesting for the purpose of this study. This led to the definition of some research questions, i.e. the interrogatives the researcher based the analysis on to furtherly

extend the existing literature. More in detail, these aimed at describing the characteristics, and related differences, of the variegated business models adopted in the EV charging supply chain.

Subsequently, the methodology adopted to answer the research questions is described. In particular, this relies on the framework of *theory building from multiple cases*, which, in the present thesis case, were a sample of small, medium, and large companies occupying different stages within the charging supply chain.

The following chapter aims at providing the empirical analysis of all the companies from which data was collected during the thesis work. The empirical analysis – with reference to multiple case studies – relies on qualitative semi-structured interviews, which allow the interviewer to adjust the questions framework dynamically and flexibly during the interview process.

For each category of actors, all the information gathered before and during the interviews have been collected and presented, trying to identify for each building block a cluster which could aggregate as many answers as possible, without losing in terms of detail and precision. The need of having just a few clusters per each building block, instead of multiple, at times, slightly different answers, is instrumental in order to perform the analysis in the following section.

Once displayed the totality of the answers obtained, *chapter 6 – Results and discussion*, firstly analyses them by drafting the comprehensive business model, including all the information gathered. Secondly, basing on the cluster system explained before, a variability analysis has been performed, identifying those building blocks in which the answers were characterized by a higher or lower level of standardization. These two preliminary steps are instrumental in order to draw the first conclusions and draft the different archetypes for each category of actors. According to the main differences emerged among the different business models of the representative players of the category in terms of value proposition, market addressed, or level of integration of the offer, as many archetypes as necessary have been created. By doing so, it has been possible to delineate different profiles and roles played by actors within the same category.

This representation feeds in turn another analysis which aims at assessing the level of integration and coverage of the private and public supply chains provided by the different archetypes. The relevance of this assessment resides in the identification of synergies or dominant configurations within the value chains, comparing the private and the public infrastructure ones.

Finally, a comparative analysis between the existing literature content and the thesis results has been developed. As already mentioned, the objective of the thesis was to fill the literature gaps in, by drafting an omni-comprehensive view of the business models of the actors present in the EV charging

supply chain. Therefore, the output of the research were thoroughly compared to what emerged from the current literature and practitioners content about the topic.

In conclusion, the research presents some limitations, such as its strongly qualitative nature, the quantitative limit of the sample under scrutiny, and its geographical scope, but it can be considered a significant contribution to both literature and practitioners contents. Among the most crucial issues encountered, which has been validated by a large number of players as well, is the lack of consistent historical data about the market, especially for new entrants. With time, as e-mobility gains momentum, a denser, and more detailed database will make these analyses easier, more accurate, and more solid. The research, nevertheless, clears up the blurry issues emerged from the literature review, such as the latter's main focus on the EV driver, by shifting the focus of the analysis on the charging infrastructure, and the lack of an omni-comprehensive view on the business models within the supply chain, by providing this and a further analysis of the main pattern characterizing the sector.

Moreover, the research presents some implications for practitioners as well. Firstly, it offers an interesting review of the main aspects regarding the EV charging sector for all the actors which want to approach this new market, such as technological features of EV charging, the players involved and related supply chain, and a characterization of private and public charging. Secondly, the thesis work displays an extensive representation of the business models adopted in the EV charging supply chain, highlighting how the various building blocks are intertwined and the existing relationship among each others. Furthermore, it results to be clear that some particular archetypes can be identified for each player category, hence highlighting the different roles that the same typology of actors can play within the supply chain.

## 2. Introduction

### 2.1 Introduction to EV market

The growing concerns arisen in the last 20 years around environmental issues such as climate change, global warming, GHG emissions (Jackson 2018), as well as health issues related to air pollution (Dockery 2009), have pushed international bodies and governments all over the world to undertake actions, at times drastic, to tackle these problems. Regarding GHG emissions, different studies have been developed in order to identify the main causes and acts in order to mitigate the effects, and breaking down these contributions by sector, the following ones have been identified (Newsham and Naess 2018).

#### GHG EMISSIONS BY SECTOR [2014]

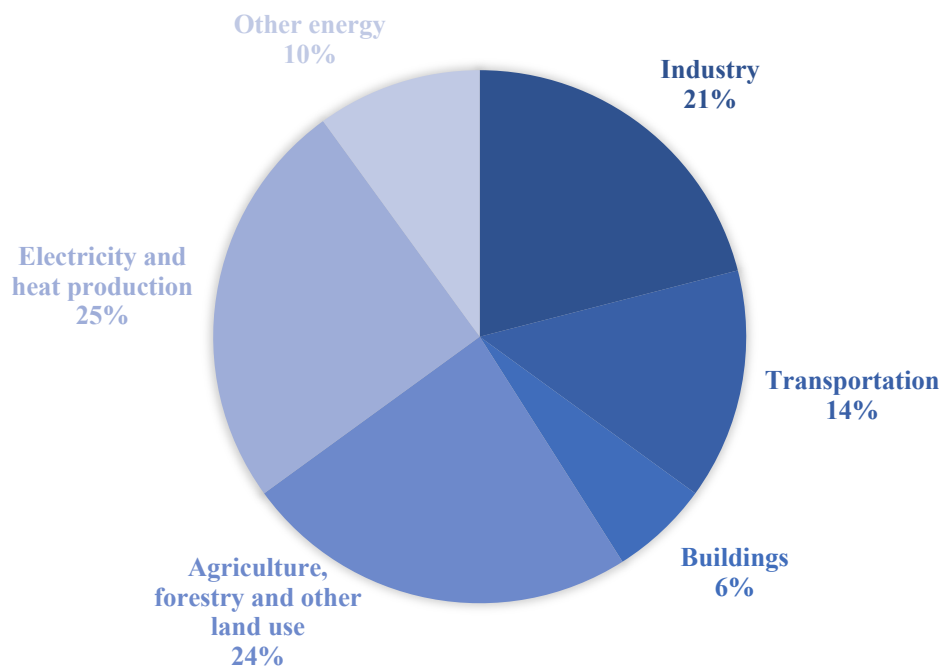


Figure 1 - GHG emissions by sector (2014)

As it can be seen, **transportation plays a huge role in this scenario**, accounting for 14% of the global greenhouse gases emissions in 2014. This weight has been growing steadily, especially because the improvements in terms of efficiency and technological development of the sector was not able to offset the negative effects of a consistently growing demand for transportation (Wang and Ge 2019), and this led to an increased value of about 27% in 2018, equivalent to about 8.47 GtCO<sub>2</sub> (IEA 2020a). Furtherly breaking down this value, **road transportation accounts for more than**

**70% of the overall sector emissions** (Wang and Ge 2019). This relevance has put the whole branch under a public spotlight, requiring all the players involved to rethink their businesses. Among the main trends that are reshaping the industry in order to meet these requirements (Mazzoncini 2020), the focus of this research will be on the electrification of passenger cars.

Playing a fundamental role in reaching the targets set by the Paris Agreement (United Nations 2015), there has been an enormous buzz around the electrification of the transport sector, especially in the last years, entailing different question marks that have slowed down the development and the deployment of electric vehicles. Whereas null tailpipe emissions entail a use-phase which entails considerably lower negative impacts, with respect to conventional ICE vehicles, two main environmental issues arise when considering the whole life cycle of the product: **the impact of the battery pack**, mainly in the production and disposal phases, and the **share of renewable energy sources** in the generation of the electricity required to power the vehicle (Hausfather 2019).

The most adopted battery technology in the automotive sector is by far the Li-ion one, and it is possible to divide EV into three different classes: BEV, PHEV and PHEV-EREV. **BEV** (Battery Electric Vehicles) are also called *pure* EVs, as they do not provide any ICE, but they only exploit the energy stored in the battery pack to move an electric engine. These type of vehicle does not entail any tailpipe emission, being the *cleanest* during the use phase, but so far there are only 28 different models in Europe, and still represent a small share of the global fleet, but forecasts have it that **in 2030 BEV sales will even out the sales of ICE vehicles**, reaching about **50 million units by 2035**. This of course implies that a proper network, made up of both public, private, and mixed charging solutions, will be available. **PHEV** (Plug-in Hybrid Electric Vehicles) represent a combination between ICE vehicles and electric engine. The battery pack can be recharged as a normally BEV through external ad hoc infrastructures, but it can also exploit an ICE to extend its autonomy, and there are 34 different models in Europe. Last and less relevant from a weight point of view, **PHEV-EREV** (Extended Range Electric Vehicles), where there is a small ICE inside the vehicle just to recharge the battery pack and to ensure the autonomy of the vehicle. So far there is just one model, the BMW i3 REX.

If the argument is shifted to the economic and operational levels, the situation becomes sensibly more difficult to handle. For what concerns the economic aspect, different studies have been done, assessing the total cost of ownership (TCO) of electric vehicles and comparing it to the one of traditional ICE ones (Corporate Knights 2019), and the vast majority results in a positive outcome for the former, although the values are highly context-specific, for example depending on incentive schemes, policies, share of RES in the Regional energy mix. With time, as the cost of manufacturing batteries, representing around 30% of the total cost of the car (BloombergNEF 2020), is going down

and new solutions spruce, the initial investment has become more affordable, expected to reach the market parity by the end of the decade. During the last 10 years, scientific and technological development, and an ever-larger market penetration, have in fact driven down the production costs, and consequentially the final price of battery, at an outstanding pace. In 2010, the average price settled around 1.200 €/kWh, decreasing to **156€/kWh in 2019**, a reduction of 87%. The main drivers of this incredibly fast reduction are to be found in the improved production process, the higher capacities achieved and the construction of efficient networks of supply chains (BloombergNEF 2020).

What is mostly interesting are the operational issues, meaning those barriers, real or perceived, that discourage potential drivers from choosing an EV over an ICE vehicle. Consistently topping the list over the years there are, in this order, the so-called *range anxiety*, meaning the fear of running out of energy while driving; the **high list prices**, which have already been mentioned; the **lack of a proper distributed network of charging infrastructures** (Undercoffler 2019).

Here, the focal point of this research is touched. Analysing the first and the last issues, namely the *range anxiety* and the lack of a pervasive charging infrastructure, it is clear that the whole context is entangled in a *chicken-and-egg* paradox, where the demand side (i.e. demand of a charging network) – drivers and car manufacturers above all – are reluctant and are not willing to commit to EVs as long as there is no reliable infrastructure. On the other hand the supply side, whether it's private or public, is waiting for a critical mass of drivers to be reached in order to heavily invest in the development and spread of charging stations (Shi, Hao, Lv, Cipcigan, & Liang 2020).

The perspective from now on will be the one of the charging infrastructures, shifting from the usual driver-centric one.

In order to properly understand the context in which this research takes place, it is fundamental to make some clarifications and discuss the main elements that make up the above-mentioned context. First of all, it is important to acknowledge the available technological solutions. Then it is necessary to identify and describe the actors involved in this ecosystem and, last but not least, it is important to highlight the main features and differences of private and public charging infrastructures.



## 2.2 Technological features of EV charging infrastructures

Focusing on the first point, the main distinctions for what concerns the different available solutions regard the **power output** and the **connector type**, which are anyway intertwined. For what concerns the power output, which is a fundamental value since it is an index of the speed at which the charging process can hypothetically run, the most-widely adopted classification identifies three main classes: **slow**, **fast** and **rapid charging** (Wallbox 2019). It is crucial to stress the importance of these distinctions because the speed of charging can deeply affect, also on a psychological level, the perception of the driver, and can influence the *range anxiety* making up, at least during the transition phase, for the lack of a pervasive network.

On the other hand, there are currently seven different types of connectors used for charging: the main ones, **Type 1** and **Type 2**, but also **Industrial Commando** and **UK 3-pin** for systems running on AC, and **CHAdMo**, **CCS** and **Tesla superchargers' connector** for systems running on DC (Zap Map, 2020). An overview about the specifics and the differences of these available solutions is in order.



Figure 2 - Types of charging connectors

### 2.2.1 Slow charge

Most commonly adopted for household applications, but found also in workplace parking spots, the rated power output range is between 2.3 – 6kW. This very limited value entails a very long charging time: considering a small, 24kWh-battery car, it would still require up to 10 hours to fully recharge. Any of the four AC connectors can be used for this purpose, but Type 1 and Type 2 are the most adopted.

## 2.2.2 Fast charge

Ranging from 7 – 22kW, this group represents the most adopted solution for destination charging, meaning the charging which occurs in parking lots or spots of points of interest such as restaurants, hotels, supermarkets, theatres and so on, where the car is left parked for a reasonably long time. But then again, domestic ad-hoc solutions such as the WallBox fall under this label. Dealing again with an AC solution, Type 1 and Type 2 are the most used connectors worldwide.

## 2.2.3 Rapid charge

Rapid charge entails all powers greater than the ones seen so far. One first, fundamental distinction with slow and fast charging solutions is that rapid charging is mainly performed in DC. This means that there is no need for the presence of a rectifier whether on-board or as part of the cable. 50kW DC rapid chargers are the most commonly spread among the ones in this category, and work with CHAdeMo or CCS connectors. Ultra-rapid DC chargers have rated powers of more than 100kW, and in this group it can also be found Tesla's 150kW supercharger, as well as the 350kW CCS. A last, less diffused solution is the rapid AC 43kW. Although very promising in the near future for their capability to charge 80% of an average battery in less than 20 minutes, not so many vehicles can still benefit from such high power outputs, given their battery capacity limitations.

By the end of 2019, there were **7.3 million electric vehicle chargers installed worldwide**, of which 6.5 million chargers were private light-duty vehicle (LDV) slow or normal chargers, with a stock that had increased by 40% from 5.2 million in 2018 (IEA 2020b).

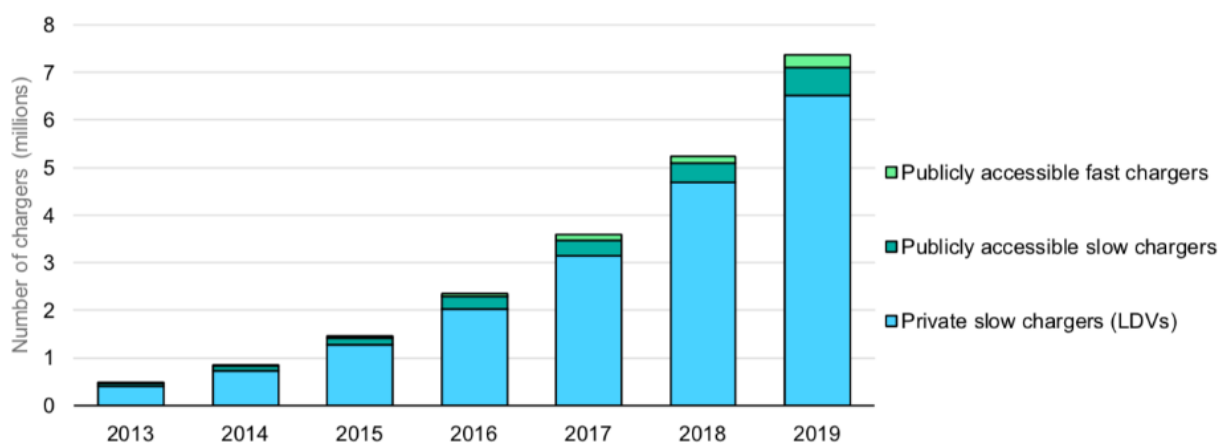


Figure 3 - Number of chargers for private and public charging

As it can be seen, **private slow charge** is by far the largest component, making up about **90% of the total**. This category includes domestic, where possible, and workplace charging, as well as those stations installed in parking lots owned by retailers or stores, accessible only by clients.

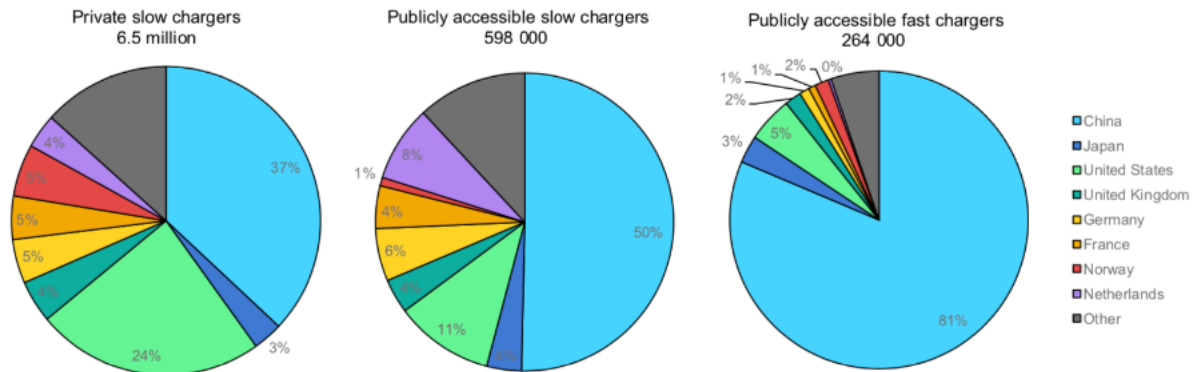


Figure 4 - Number of chargers for private and public charging according to nations

The prevalence of private charging solutions is one of the main reasons behind the fact that the current ratio between number of electric vehicles on the road and charging infrastructures worldwide is very close to 1. The EV stock has in fact reached 7.2 million units in 2019, with a yearly increase of 2.1 million from the previous year. Both the market for the vehicles (47%) and the market for infrastructures is led by China, especially when it comes down to publicly accessible fast chargers, where the country accounts for 81% of the global stock (IEA 2020b).

## 2.3 Players involved

Once described the main technical solutions available for the charging infrastructure, it is interesting to move on to list and describe the main actors involved in this landscape, and how they interact with each other. It is a very delicate point for the sake of this research, since a clear identification of the different roles of the companies along the whole value chain will be one of the pillars on which the whole model will be created.

A very interesting and comprehensive overview is given by the following chart provided by Capgemini (Capgemini 2019), where it is possible to see how companies from different industries and sectors come together and re-design the ecosystem.

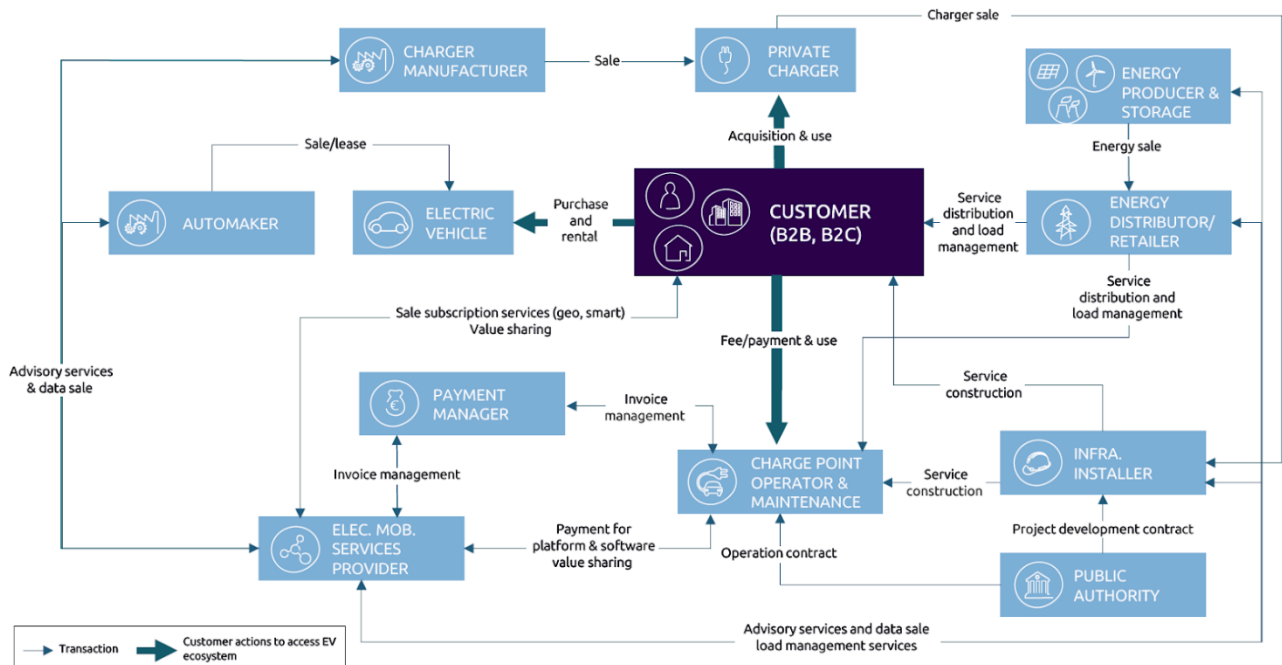


Figure 5 - Actors involved in the charging value chain

Before going any further, it is important to clear that the customer-centric view depicted above revolves around the driver, whilst the main interest of this thesis is not on the driver itself, but on the players involved in the value chain of the infrastructure.

This being said, a brief description of the most important features of the different actors follows.

### **2.3.1 Car makers**

Despite the clear benefits in terms of efficiency and environmental impact provided by EV adoption to the whole society (Bohnsack et al. 2014; Gomez et al. 2011), automakers are now facing some critical challenges that may impede EV adoption, such as the excessive battery price and the inadequacy of car models to satisfy a highly growing and demanding EV buyers segment (McKinsey&Company 2017). A sort of stall has slowed down the development of EVs worldwide, where automakers have been and, to some extent, still are reluctant to add EVs to their portfolio, due to the lack of demand which is, in turn, heavily due to the lack of proper charging infrastructures (Capgemini Invent 2019). For this reason, different solutions have been tested in order to integrate and exploit the skills of this category inside the charging network value chain. Leveraging on the customer relationship expertise and the power of most brands, automakers could tip the balance in the decision process of the final consumer, providing integrated solutions like, for example, bundling the purchase of the car with a package of prepaid kW of charge or integrating solar panels and an additional battery.

### **2.3.2 Utilities and Oil & Gas**

A great advantage of this category is that its players could benefit and play a key role without having to drastically change anything in their businesses (Capgemini Invent 2019). Moreover, being utilities expert of energy market, they know EV customers are energy consumers as well, and they can leverage on strong customer relationship established along the years which make them trustworthy (Accenture 2019). Companies could potentially survive in this dynamic environment relying on the ever-growing electricity demand driven by a constant growth of EV sales, looking to improve their production capacity in order to gain larger market shares. Nonetheless, a mere focus on the energy production might be detrimental, especially in a context in which different players can become competitors within a very short period. Different Oil & Gas giants, in fact, have already started making their way in this new system through mergers and acquisitions, creation of new divisions and huge investments in new businesses (Capgemini Invent 2019). An example is the acquisition of Direct Energie by Total, or Shell's acquisition of Newmotion. These players on their side have an urge to reshape their business, as conventional fuels will play a role more and more marginal with time.

In order to thrive in this ecosystem then, it is important to look towards the integration of mobility services.

### 2.3.3 Pure players

By *pure players*, also referred to as charging service providers, it is meant those roles that have been created expressly for this market. Above all, **Charging Point Operators (CPO)** and **E-Mobility Service Providers (EMSP/EMP/MSP)** are the most relevant ones. Together, these somehow complementary roles make up the charging network.

The CPO is the owner and/or manager of the infrastructure, provides the delivery of the charging points, the installation and maintenance and distribute energy to charge points (Allego 2019). In other words, it deals with the hardware side of the charging point, making sure that the operations are carried out smoothly. CPOs tasks can be divided into technical, which deal with disposition, running and maintenance of the charging point, and financial, which are more focused on marketing and price definition (Arthur D Little 2020).

The EMSP, on the other hand, deals with the service provision, the payment process and the interface with users and providers, hence it is more oriented on the software side of the infrastructure (Arthur D Little 2020; Madina 2016). For example, the EMSP provides the application used to locate, reserve, or monitor the different points, manages the roaming services, and guarantees access to the users. In relation to this last point, one key success factor for EMSP is to make available as many charging points as possible (Arthur D Little 2020).

As it might be easy to understand, the line between these two different roles can be very thin at times, and it is not rare that a company working as a CPO also integrates EMSP activities.

### 2.3.4 Technology providers

This category is very wide and encompasses all those players that contribute to different extents to the realization of the charging points, from electrical components, to software, cables, hardware. This is another example of a cluster which could theoretically thrive without changing too much of their business, but must be flexible enough in order to face potential vertical integrations from other players.

### 2.3.6 General contractors

A further section must be dedicated to another category of actors, namely general contractors. If the players described so far can be seen as the performers of subsequent and interdependent activities, a general contractor offers a *turnkey* solution to the final customer that can integrate potentially all of

these activities. It usually starts off with an ad-hoc counselling phase, where requisites and objectives are identified and set, to then move to the sale of the charging infrastructure, the manufacturing activities of which can be carried out internally or externally. After the sale, the general contractor takes care of installation, testing and tuning of the charging point, and subsequently of planned and extraordinary maintenance. The set of activities performed can be furtherly extended to the provision of energy. It is clear that the figure of a general contractor is very interesting from a value chain point of view, since it is able to cross the borders between one actor and another, specializing in the sector and developing cross-sectorial skills otherwise impossible to acquire and increasing the sprouting of synergies between actors.

## 2.4 EV charging value chain

Summing up the actors afore-mentioned and combining them within the EV charging value chain, this can be delineated as the conjunction of three categories: energy supply, charging infrastructure and add-on services (Capgemini Invent 2019).

The first category comprehends activity as energy production, distribution and retail. The actors belonging to this group are utilities, power companies and companies providing energy services, such as E.On, EDF, Enel and Enel X, Repsol, etc. The second category mainly focuses on the charging equipment, including the charging station development and production, its sale, installation and finally its running and maintenance. Finally, the last category is the one closest to customer segments and it is the one including companies offering purchase and billing, geo-location services, roaming or access to the charging stations, battery management and other additional services.

These last two categories comprehends different actors types: pure players, like Ionty, NewMotion, Allego, and many others; car makers, for instance Nissan, Tesla, Volkswagen, BMW, etc. – manufacturers, such as ABB, Siemens, Bosch, etc. that usually collaborate with IT & Telecom companies, such as Microsoft, Amazon and Waymo, which leverage on their traditional technologies and network to provide add-on services.



Figure 6 - EV charging value chain



## 2.5 Private and public charging infrastructures

### 2.5.1 Private charging

Private charging, as briefly anticipated, refers to those configurations where the access is reserved to the proprietary of the infrastructure or to selected customers. A first example can be found in **domestic and residential** infrastructures. The EV is plugged to the grid through slow AC connectors, usually around 3kW, thus charging at a slow pace. For this reason, night time is usually the period in which the charging occurs, where the electricity price is lower, and the power required by house appliances is at its daily minimum (Sun et al. 2015). Fully charging an average 40kWh battery in this scenario is not feasible, but the concept is thought mainly for daily commuters with contained driven ranges. As this daily requirement increases, complementary solutions like the installation of an auxiliary power supply, for example a 7.4kW WallBox, are usually taken into consideration. These kinds of extensions guarantee the possibility of fully charging the EV, in the face of an initial investment that can heavily vary depending on the rated power and the features included, from as little as about 500€, up to 5.000€ (Perri 2020). Different governments across the world are supporting in many ways the private infrastructure development, like the UK that pays up to 75% of the hardware and installation costs through the Office for Low Emission Vehicles, or various US States that offer incentives or rebates at different rates. Moreover, this solution requires the non-negligible access to a private parking, namely a property garage which, in a lot of cities around Europe, is not very common.

Another very interesting and fast-developing technology that is deeply linked with private charging is the **V2G** (Vehicle-to-Grid). This very fascinating solution provides the integration of the EV with the electric grid, with the flow of energy that is no longer unilateral, but becomes bilateral, so that the vehicle, when physically connected to the grid, can provide electricity in discharge and act as a flexibility measure. V2G is a concept which is strongly connected to the one of smart city, and is hence a hot topic which will definitely help boosting the development of further solutions (Khan et al. 2019).

Residential charging can also be applied to condominiums in a configuration which is exactly like the domestic one previously depicted. An interesting aspect to highlight in this case is the potential integration of two other trends that are reshaping the energy and transportation sectors: energy communities and sharing mobility. The creation of a *residential fleet* available for the different households in a sharing configuration, would combine the benefits of a higher utilization rate with the ones of an integrated, smart community.

A variety of projects have sprout supporting the development of this kind of application in already existing, as well as in under construction buildings, such as *emPower the People* (emPower the People 1990), a program which supports in every step the installation of charging stations in multi-unit dwellings. Nevertheless, studies have been done assessing the economic viability of this solution, and one in particular, carried out by researchers in California, highlighted how the costs compared to the single-household solution can be up to three times higher (Turek and Deshazo 2016).

Moving on from the residential and domestic, another typology that falls under the label of private charging regards **workplace** and exclusive **destination charging**. Workplace charging, which is self-explanatory enough, consists in the possibility for employees to recharge their EV in the parking lot of their workplace (Forth 2019). The terms and conditions, as well as the different possibilities available, are to be analysed on the specific case, but the most widely adopted configuration is in fast charging, with 22kW-AC charging points that are free of charge for the employees. Nonetheless, considering the average 8 hours shifts, the adoption of less powerful systems would in general guarantee a sufficient charge.

For what concerns *exclusive destination charging* the line between private and public becomes a bit thinner. *Destinations* are considered all those places of interest where drivers are expected to stop for a more or less long time. This can vary from tens of minutes, (supermarkets, retail shops, malls), to hours (restaurants, hospitals, cinemas, theatres), to days or even weeks (hotels and resorts). It is evident that according to the average duration of the halt, the configuration adopted will be different. For example, for a hotel could be sufficient to rely on slow charging points, whilst for a supermarket, a fast or even rapid solution would be more suitable. What is important to highlight here is that, in order to be considered as a private infrastructure, the access must be reserved to the accredited clients only.

Different operators across different sectors along the charging value chain already have, or are about, to enter in the private charging business. Car manufacturers, like Tesla obviously but also Volkswagen and BMW for example, have developed their own branded WallBox, but so have done utilities like Enel X and technology providers like Siemens or ABB. This is just to underline how important it is to integrate or at least acknowledge the relevance of private charging in this landscape.

## 2.5.2 Public charging

On the other hand, public charging indicates those infrastructures that can be exploited by any EV driver, a concept that is analogous to the one of gas stations for conventional ICE vehicles drivers. Publicly accessible chargers accounted for 12% (862.000) of global LDV chargers in 2019, of which

598.000, about 70%, were slow (up 47% against 2018) and 263.000 were fast and rapid chargers (almost doubled since 2018) (IEA 2020b).

Globally, the number of publicly accessible charging points, both slow and fast, increased by 60% in 2019 compared with the previous year, with the largest contributor to this growth being China, which continues to lead with the implementation of publicly accessible chargers, accounting for nearly 60% of worldwide publicly accessible chargers installed in 2019, and home to 80% of global publicly accessible fast chargers and 50% of publicly accessible slow chargers installed in 2019. Substantial regional variations exist in the power capacity (kW), as it is possible to identify different Regions showing different preferences: the EU and the US show a strong prevalence of slow-charging stations, whereas China is more fast-oriented.

For what concerns the charging process, there are some different access modalities that mainly depend on the CPO and EMSP's business models. Four most-widely adopted modalities can be identified: **Plug-and-play**, **App enabled**, **RFID card**, **contactless payment card** (PodPoint 2019).

**Plug-and-play** is the simplest among the four, and can be thought as the exact mirror of the gas refuelling process for EV. The driver simply plugs the vehicle without the need of any type of registration nor data collection and access control. This typology can also be found in workplace stations.

**App enabled** requires the user to sign in into the app of the service provider, and this gives him the several benefits, among which the possibility to identify and reserve a charging point and monitor the status of the stations and the history of usage. Any smartphone owner is eligible but a possible drawback regards the areas with poor signal that might compromise the operations.

**RFID card** can be considered as the physical version of the App enabled model, with all the pros and cons that this entails. The driver accesses the charging point using the card and through the interface is able to monitor usage and data, and this time has no problem in areas of poor coverage. On the other hand, this modality requires the presence of a physical device with security issues like cloning or stealing. Moreover, a different card is required for every different network.

**Contactless payment card** is mostly found at rapid charging stations. As in the Plug-and-play modality, no sign up is required, but this coupled with securing the card reading increases the cost adding transaction fees.

Two main concepts are fundamental to consider when talking about the public infrastructure, namely **interoperability** and **the choice of where to locate the stations**. The number of different operators managing and owning different charging stations is already large and steadily growing, with companies vertically integrating and expanding their business in this field as well. A conventional

methodology to access a service from different providers would require a multitude of subscriptions, one every time the driver needs to access a new charging point served by a new company. **Interoperability** means overcoming this huge obstacle, creating platforms that require just a one-time subscription that allows to access a network as large as possible of operators running stations all over the world (Nazih Jreige 2020). Some experiments have already been carried out, especially in the EU where *evRoaming4EU* is trying to create an EU-wide network of providers to gather in a single platform. This simple yet fundamental concept is instrumental in simplifying the whole charging experience of the users. From the point of view of the operators, it is very interesting to notice the presence of the so-called *coopetition* (Walley 2007), where there is the willingness and the interest of every player involved in a collaboration in order to create and develop a solid and widespread infrastructure, keeping their competitiveness in other aspects like pricing, billing, data monitoring and so on.

The **location choice** in turn is another fundamental aspect to consider, mainly in order to overcome the psychological barrier created by the *range anxiety* (Neubauer 2014). Having fast- and rapid-charging stations along highways and motorways, where long-range drivers spend most of their commuting time, would be a safe net ensuring the possibility to charge the vehicle whatever might happen. Each analysis has of course to take into account some elements, like the average stopping time of the driver, the queue that might generate and the required investment. For example, installing a rapid charger in the parking lot of a mall might not be necessary, considering the high investment required and the relatively long average time spent by customers. On the other hand, a slow charger on a highway would probably be a bottleneck, creating long queues of vehicles waiting for their turn to charge.

# 3. Literature review

## 3.1 The business model

### 3.1.1 Introduction

During the last decades, business models have gradually gained more and more attention by both academics and practitioners (Zott et al. 2011). This is due to the fact that whenever an enterprise is founded, it implicitly or explicitly adopts a specific business model that explains the mechanisms underlying value creation, delivery and capture (Teece 2010). Indeed, drafting the business model allows to understand how the company produces value for its customers, convinces them to pay for the afore-mentioned value and finally how it turns this value into profit. Joan Magretta (2002) even defined business modeling as “the managerial equivalent of the scientific method – you start with a hypothesis, which you then test in action and revise when necessary”.

The business model is the conceptual, rather than financial, model of a business (Chesbrough et al. 2002). It describes enterprise’s structure and operation by taking into account both an organizational and economic perspective. Indeed, composing a business model means to answer to Peter Drucker’s critical questions: “*Who is the customer? What does the customer value?*” and also the basilar questions every manager should make: “How does the business make money? What is the economic logic followed to deliver value to the customer with a certain cost?” (Magretta 2002). In other words, business model corresponds to a scheme permitting to design and then realize enterprise apparatus and overall architecture shaping its operational and physical functioning (Osterwalder et al. 2005).

The origins of business model concept are relatively young. Despite its first use in an academic article in 1957 [Bellman, Clark et al. 1957] and its second appearance in the title and abstract of a paper in 1960 [Jones 1960], it gained a distinctive popularity only at the end of the 1990s. This seems to have a strict correlation with the Internet boom, as claimed by Hawkins: “As the dot com bubble grew, the market filled up with books and articles about business models, ranging from the vaguely analytic to the quasi instructional – how to construct viable business models and how to avoid lemons. The business model seemed to fill a niche even if no one could explain exactly what it was” (Hawkins 2004 p. 65).

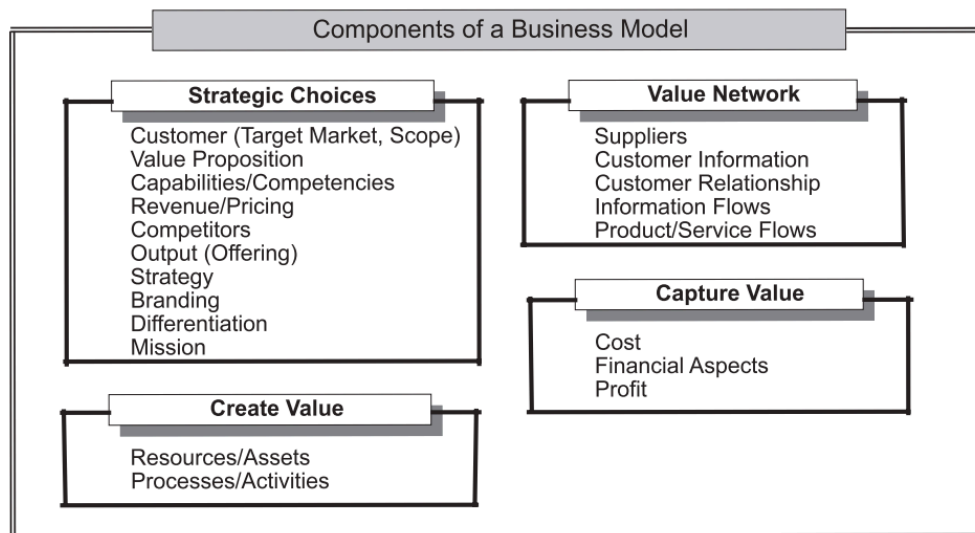
One recurring theme among literature regarding business model is fuzziness. Indeed, researchers have not yet agreed on a common definition of what a business model is and literature results to be

clustering these ones into silos, according to researcher's main perspective (Zott et al. 2011). This is the reason why many definitions and many business model framework exist today.

Aiming at highlighting the wide amount of definitions concerning business model, some of this latter are presented hereafter. Timmers (1998) describes business model as “an architecture for the product, service and information flows, including a description of the various business actors and their roles, a description of the potential benefits for the various business actors, and a description of the sources of revenues” (Timmers, 1998 p. 2). In 2001, Rappa depicts the business model as “the method of doing business by which a company sustains itself, that is, generate revenue” (Rappa, 2001). In 2002, Chesbrough and Rosenbloom defined business model as “the heuristic logic that connects technical potential with the realization of economic value” (Chesbrough and Rosenbloom, 2002 p. 529). In the same year, Magretta stated business models are “stories that explain how enterprises work” (Magretta, 2002). A further definition was provided by Morris et al. in 2005: “business models are a concise 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” (Morris et al., 2005 p. 727). Finally, Teece, in 2010, claimed business model is “the manner by which the enterprise delivers value to customers, entices customers to pay for value, and converts those payments to profit” (Teece, 2010 p.172).

It is clear that the literature concerning business model is extensively variegated, but one noteworthy aspect is the underlying and recurring concept of value, which is present in almost every definition of business model, since it represents the core pillar of every enterprise operation.

In addition, many frameworks to build an effective business model were developed through the years. The first one was theorized by Shafer et al. in 2005 and is commonly called *business model affinity diagram*. They firstly analyzed the term business model, thus highlighting that making business regards the ability to generate value and to catch returns from that value, while a model is an illustration of reality. As a consequence, they described the business model as the illustration of the enterprise's basic core logic and strategic choices to generate and catch value within a value network (Shafer et al. 2005).



*Figure 7 - Elements of business model affinity diagram*

In the same year, Morris et al. formulated the so-called *entrepreneur's business model*. This framework is built on six questions, related to the different core aspects underlying companies' operations, such as: factors linked to the offering, to the market, to the internal capability of the company, to the competitive strategy, to economics and to human resources and investors (Morris et al. 2005). By answering to the previous questions, following them as a guideline, managers are able to build the business model.

Six questions that underlie a business model

*Component 1 (factors related to the offering): How do we create value? (select from each set)*

- offering: primarily products/primarily services/heavy mix
- offering: standardized/some customization/high customization
- offering: broad line/medium breadth/narrow line
- offering: deep lines/medium depth/shallow lines
- offering: access to product/ product itself/ product bundled with other firm's product
- offering: internal manufacturing or service delivery/ outsourcing/ licensing/ reselling/ value added reselling
- offering: direct distribution/indirect distribution (if indirect: single or multichannel)

*Component 2 (market factors): Who do we create value for? (select from each set)*

- type of organization: b-to-b/b-to-c/ both
- local/regional/national/international
- where customer is in value chain: upstream supplier/ downstream supplier/ government/ institutional/ wholesaler/ retailer/ service provider/ final consumer
- broad or general market/multiple segment/niche market
- transactional/relational

*Component 3 (internal capability factors): What is our source of competence? (select one or more)*

- production/operating systems
- selling/marketing
- information management/mining/packaging
- technology/R&D/creative or innovative capability/intellectual
- financial transactions/arbitrage
- supply chain management
- networking/resource leveraging

*Component 4 (competitive strategy factors): How do we competitively position ourselves? (select one or more)*

- image of operational excellence/consistency/dependability/speed
- product or service quality/selection/features/availability
- innovation leadership
- low cost/efficiency
- intimate customer relationship/experience

*Component 5 (economic factors): How we make money? (select from each set)*

- pricing and revenue sources: fixed/mixed/flexible
- operating leverage: high/medium/low
- volumes: high/medium/low
- margins: high/medium/low

*Component 6 (personal/investor factors): What are our time, scope, and size ambitions? (select one)*

- subsistence model
- income model
- growth model
- speculative model

*Figure 8 - Entrepreneur's business model*

The subsequent year, in 2006, Lecocq et al. designed the *RCOV framework*, where RCOV indicates the resources and competences to be promoted and combined, the organization of the business within a value network or within the enterprise perimeter, and the value proposition underlying the product or service delivery. This framework represents a dynamic procedure for elaborating business models, suggesting that managers should simultaneously evaluate resources, organization and value offered. In this perspective, the business model represents a picture of the current interplay between these basic elements (Lecocq et al. 2006).

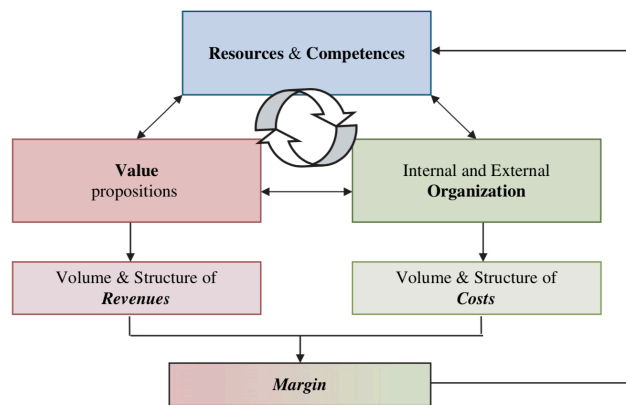


Figure 9 - RCOV framework

In 2008, Richardson developed the *business model framework*, entirely focused on the concept of value. Indeed, the methodology is divided into three parts: the value proposition – what is supplied by the company and the reason why the customer is willing to pay for it; the value creation and delivery system – the basic source of firm’s competitive advantage; the value capture – the transformation of value into revenues (Richardson 2008).

In 2010, Johnson and others reinvented the business model, highlighting the profit formula, the key resources and key processes and adding the customer value proposition (Johnson 2010).

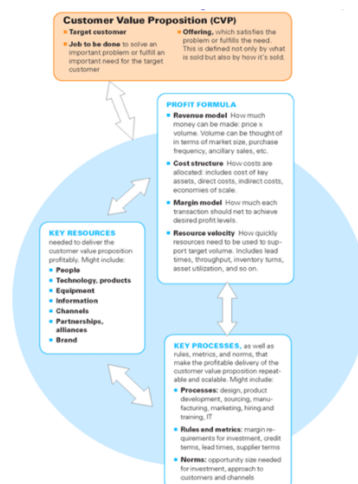


Figure 10 - Reinvented business model



In 2010, Teece theorized the basic steps of business model design, by drafting them as a sequence of activities to be carried out in order to develop value for whom the product represents a benefit and finally to capture this value.

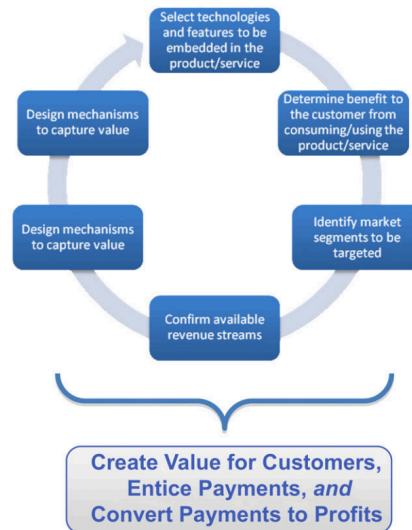


Figure 11 - Elements of business model design

In the same year, Alexander Osterwalder, in his book “Business model generation”, developed the business model canvas, one of the most diffused methods to build business model. This was the result of a deep academic analysis on the business model ontology and its substantial popularity is mainly due to its simplicity, allowing to apply it, intuitively, at every kind of business. For these very reasons, it was the method used throughout this dissertation in order to analyze the business model of the actors involved, hence it will be discussed in depth in the next chapter.

Taking into consideration the fuzziness characterizing business model, one last aspect that deserves attention is what business model is and what it is not (Ghezzi 2014). On the one hand, it serves as a tool to concretize a business idea, thus forcing entrepreneurial creativity in a usable model; as a guideline not to forget any important step in entrepreneurial agenda; as a notion based on value proposition, to embed the concept of value creation and capture in the firm’s strategy; as a model to enhance the realization of the business strategy; and as an enabler of the strategic innovation. On the other hand, it must not be thought as an instrument for business planning, nor as a substitute of internal and external strategic analysis, nor as an instrument for strategy formulation, monitoring and performance measurement. Finally, it cannot for any reason substitute strategy.

### 3.1.2 Business model canvas

As mentioned before, the business model canvas was theorized by Alexander Osterwalder in 2010. The author firstly elaborated his personal definition of business model, describing it as the reasoning of how a company generates, delivers, and captures value” (Osterwalder and Pigneur 2010).

Business model canvas allows to assess the organization both internally and externally in the meantime. For what concerns the external perspective, it focuses on customers and how value is generated. On the other hand, by using an internal look, it highlights the infrastructure constituting the business architecture and how efficiency is created.

The framework developed by Osterwalder is composed of nine building blocks, which can be grouped into three macro-categories: value proposition and customer interface; value network; and economic model.

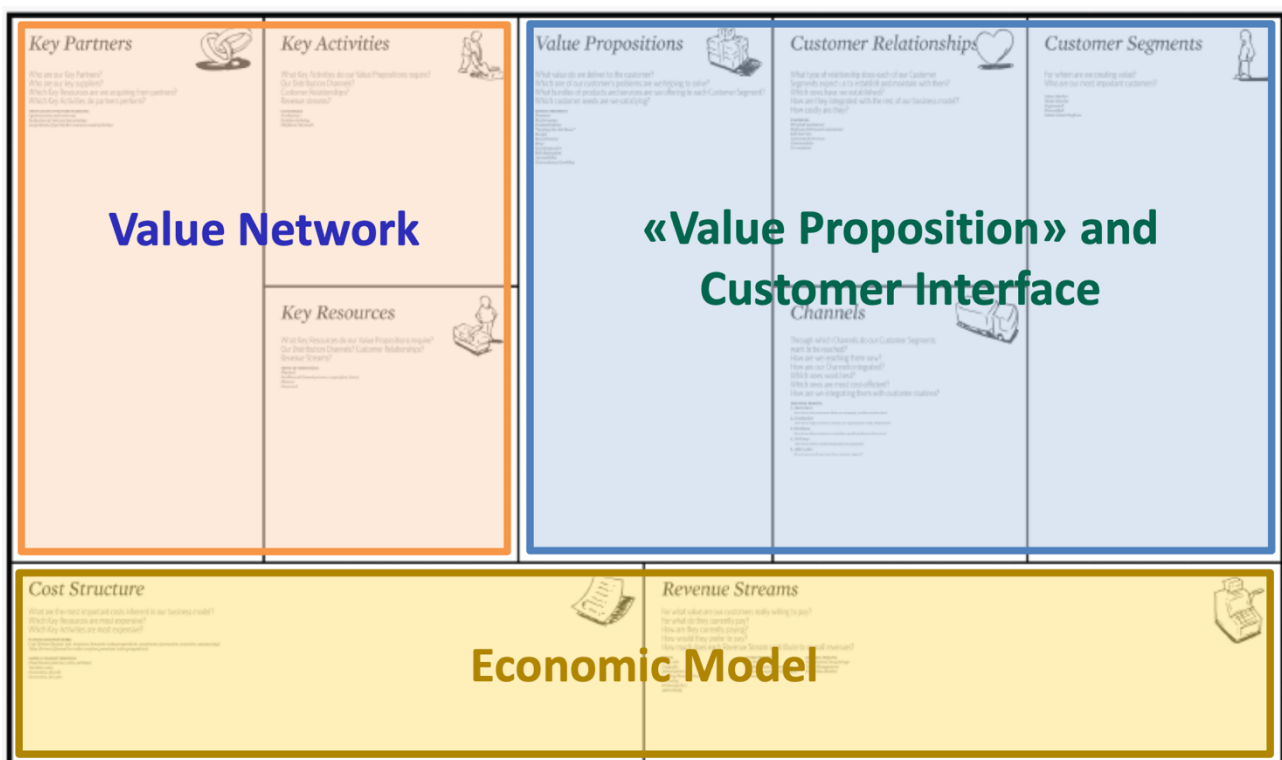


Figure 12 - Business model canvas division into macro-categories

Firstly, the value proposition represents the collection of products or services the company delivers in order to address a specific segment of customers and to satisfy their specific needs. In the same macro-category, the customer interface gathers the channels through which the value proposition reaches customer segments and the kind of relationships that are established between the company and this latter. Secondly, the value network describes the crucial activities, resources and partners necessary for the successful delivery of the value proposition. Finally, the economic model stands for

the monetization of value and it comprehends the revenue streams through which the firm generates its earnings and the related cost structure it must sustain during its life.

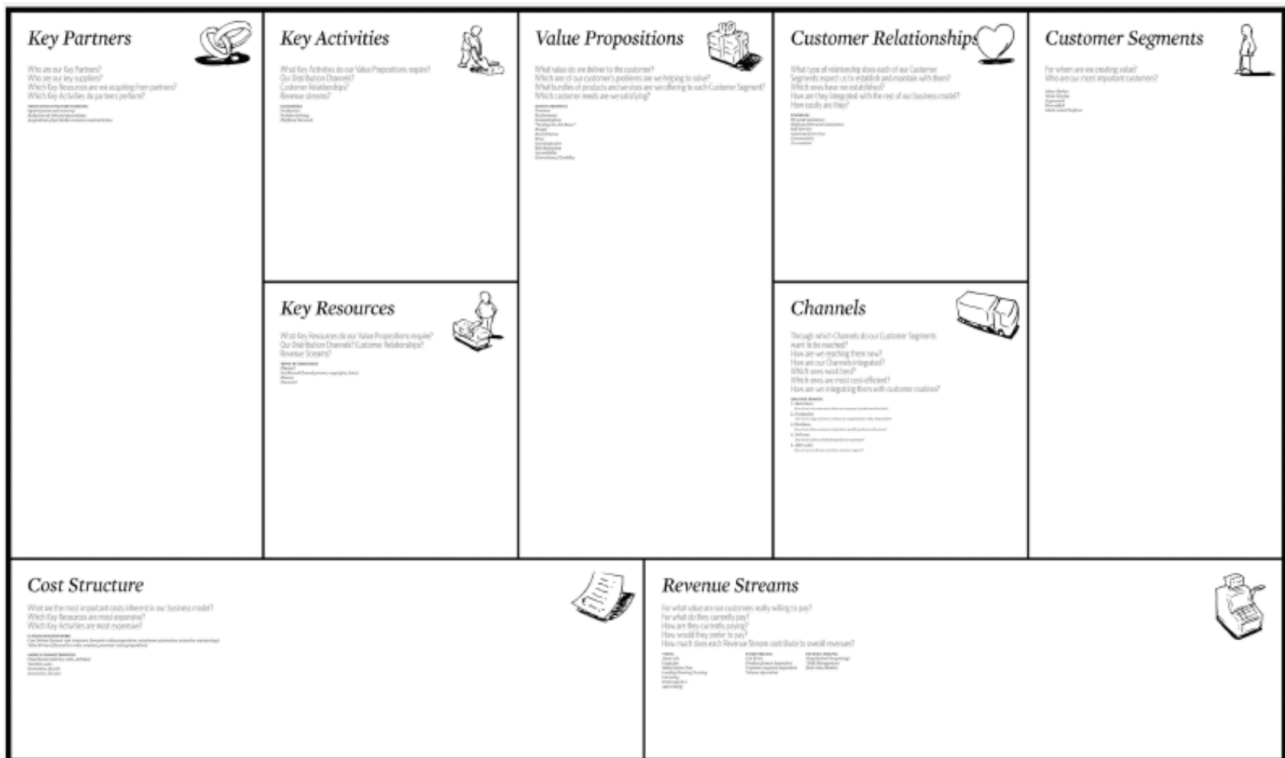


Figure 13 - Business model canvas

Digging down into the nine building blocks, there is a recommended order to fill the business model canvas in.

The first stage concerns the customer segments, in fact they represent the heart of any business operation, and as a consequence of any business model. Indeed, a successful company is able to transform satisfied clients into revenue streams. Some questions are proposed to build this block, such as “who does the company create value for? Can customers be grouped into different categories, according to different aspects, such as diversified offer, distribution channels used to reach them, relationship established with them, etc.” (Strategyzer <sup>1</sup>).

The second step regards the elaboration of the value proposition, assessing the reason why the customer relies on a company instead of another one. The value proposition consists of a bundle of products or services, which may be innovative or well-established ones, able to satisfy the needs of the different customer segments. The potential questions to form this block are: “what does the company offer to the market? What kind of products and services are supplied? What needs do they solve?”. The value creation can be a consequence of different factors, such as originality, performance, customization, design, brand etc.

Thirdly, channels should be considered. In particular, they are the means through which the company reaches each customer segment, thereby they can be distribution or communication channels. They represent a fundamental aspect of business model design, since cost intensive channels should be adopted for high spending customers, while cost efficient ones should be used for unprofitable customers. In order to fill this block in, some questions are recommended: “through which communication and distribution channels does the company reach markets? How well does each channel work? How expensive or cost efficient is each channel?”. Moreover, channels, both direct – sales force or websites – and indirect – owned dealers, dealer of partners and wholesalers – may carry out different functions, such as generating consciousness regarding the company’s offer in the customer, supporting him in offer evaluation, allowing the actual purchase, effectively bringing the value proposition to the customer and supporting him with potential post-sale needs.

The last block constituting the macro-category of the customer interface is constituted of the customer relationship. This last aspect is strictly connected with satisfying customer’s expectations. For instance, customers able to pay high prices for a product or service expects an intimate relationship with the seller, on the contrary, customers looking for low prices expect an automated, yet tailored, relationship. For this reason, the organization must elaborate a consistent strategy for customer relationship. This can be developed by answering to questions such as: “how does the company develop and sustain a relationship with the customer? Is it different according to the customer segment? Is it more or less intense and personal? To what extent the company dedicates time and other resources to build an effective customer relation?”. The customer relationship may range from pure personal assistance – with personnel aiding the client in case of need, to dedicated personal assistance – where one assistant is allocated to a particular customer and is in charge of serving the customer during the whole sale, and post-sale process, self-service – no direct relationship is established between the customer and the company but the former is given the means to freely carry out the purchase, automated service – a particular form of self-service integrated with automated processes, online community – particularly after the raise of social media, companies have set up online communities where customers or users could share knowledge and experiences, and finally co-creation – where companies jointly collaborate with customers in order to create value, clients actively take part in the new products or service design and share their requirements and preferences with the firm.

Moving to the second macro-category, the one referred to the value network, the first block analyzed is the one concerning key resources. Indeed, at the basis of every business there are the crucial asset a company must dispose of to make its business running. Resources may vary from tangible assets, such as machines, equipment, buildings etc., to classical ones like human resources, to intangible

ones, such as brand equity, skills, expertise etc. The key questions necessary to compile this block may be: “what are the key resources the company relies on to run its business model? How is each of these resources related to its value proposition and to the appropriate customer segment, channel or relationship?”.

Subsequently, the key activities to develop a sound business model are assessed. They can be implemented internally or be supplied by a tight network of partners. They can be evaluated by answering to these questions: “what are the main activities the company carries out to run the business model? On which resources are they based? Which value proposition, channel or relationship do they serve?”.

Following, the network of partner is taken into consideration. This is composed of all the actors which stand outside the company but enable business operations and have built a partnership, a joint venture, a cooperation relationship or an alliance with the firm itself. This, of course, is a matter of what a company wants to develop internally and what it wants to obtain from external players. The block can be filled in by asking: “what partners and suppliers does the company work with? What resources do they provide? Which value proposition, channel or relationship do they serve?”. Essentially, three main reasons are pursued when establishing a partnership: to obtain optimization and economy of scale – the most basic relationship aims at optimizing the allocation of resources and activities, it is wise for the enterprise to own and to execute only a limited bundle of resources and activities, because it can leverage on outsourcing or sharing infrastructure to reduce costs; to reduce risks or uncertainty – in an uncertain economy, partnerships can reduce risks; to acquire particular resources and activities – not every company owns all the resources and execute all the activities needed to run the business, but they take advantage of other firms to do so.

Shifting, in conclusion, to the economic model, two building blocks are examined: the revenue streams and the cost structure. The former derives from one or more customer segment that detects a source of value in company’s offer and is willing to pay for it. The earning can come from selling, lending, licensing, commission, transaction or advertising fees. The key questions to compose this block can be: “what are company’s revenue stream? From which market segment do they come from? What is the share of each revenue stream compared to the overall company’s profit?”.

Finally, the cost structure is the immediate consequence of all the other building blocks of business model canvas. Indeed, theoretically it should be possible to trace every cost back at its original building block. The structure of cost can be analyzed by answering to: “what are the most significant cost position? Can these ones be easily linked to one building block of the business model? Are they related to a specific customer segment?”.

### **3.1.3 Business model of charging service**

Moving towards the analysis of the business model of charging infrastructure, this chapter is divided into two main sections. Firstly, a brief description of the already existing and well known business models characterizing the actors in the EV charging value chain is presented. Secondly, the breakdown into the nine business model canvas blocks of the afore-mentioned actors is systematically described.

#### **Existing business models of charging infrastructure**

Since the e-mobility market is slightly growing, the economic sustainability of EV charging infrastructure has become more and more a global interest (Hall and Lutsey 2017). According to a research developed by PwC the main types of business models addressing different customers segments by exploiting different strategies are four (PwC Strategy& 2018).

The first business model is the one of “Portfolio” players, namely those actors ranging different roles in the charging supply chain. It serves all main types of customers segments: home, destination, work place and rapid charging, even if this latter is the least exploited because of its high cost and usage challenges. Moreover, this kind of players leverages on several partners: EV automotive OEMs, destination businesses with long stop time and customers flows, and land owners where to place charging points. This wide business model allows to diversify risks and to access to different and more likely revenue streams – maintenance agreements, advertising and products. On the other hand, it also presents some disadvantages, such as the higher initial investment costs and the need to analyse customer charging behaviours.

Secondly, the “Specialist” player addresses destination, work place and rapid charging. As the name can suggest, this actor focuses on a core capability in only one particular customer segment. This business model requires venture capital funding as partners since it is highly risky but can be potentially very profitable. In addition, it also establishes strategic relationships with partners developing core capabilities. Finally, this kind of business model can take advantage of the chance to apply a premium price and leveraging on uncommon customers charging habits.

Thirdly, the “Network Optimiser” player mainly focuses on aggregating the power capacity of EV batteries and selling this to electricity providers. In particular, the amount of cars involved in the process is fundamental, since to obtain valuable grid revenues many cars’ batteries have to be integrated. In this case, customer segments are represented by generally long-lasting (up to 8 hours) charging, such as home, work place and destination charging (car parks, particularly at airports). This

type of business model requires some partnership and financing: EV OEMs to scale the business, distribution network to increase the market.

Lastly, the “Energy Supplier” player raises the selling of electric energy by integrating the offer of EV charging services. This kind of actors already have a consolidated customer base, which can be exploited to scale the business and create partnership with technology platforms providers, which integrate data deriving from the value chain. Moreover, it can create customized tariffs and charging solutions for home, destination and work place charging.

Once evaluated the literature concerning the whole existing business models of charging infrastructure, it is clear that only few examples of business models are available and that a systematic appraisal of the topic does not exist. For this reason, the literature analysis will proceed, in the following paragraph, by assessing the single blocks constituting the business model canvas of the actors involved in the EV charging supply chain.

## **Business model canvas blocks**

### ***Customer segments***

As explained in the paragraph concerning the business model canvas, the block related to customer segments comprises the target categories of people the company addresses its offer to, i.e. the individuals willing to pay for the product or service supplied by the enterprise (Osterwalder and Pigneur 2010).

Considering the perspective of the Charging Point Operator (CPO), its main customer segment is composed of Electro-Mobility Service Providers (EMSP) (Madina et al. 2016). Indeed, the CPO provides charging services, such as the access to the charging point and the energy provision, to the electro-mobility service provider, thus establishing a Business-to-Business (B2B) relationship with this latter. The relation between these two roles can be either direct or can pass through a third actor, e.g. a marketplace operator, a B2B virtual environment held on the internet on a cloud infrastructure where any business partner can supply its services – such as authentication and approval, charging, charging station booking, routing, clearing services... – which are then bought by another business partner.

Moving to the point of view of the EMSP, its customer segment is mainly represented by end-customers (Madina et al. 2016), i.e. a Business-to-Customer (B2C) relationship. Indeed, the EMSP

is the legal entity that provides a contract to the end consumer for all the services related to the charging of the EV.

Aiming at deeply characterizing the markets of EMSP and considering the existing literature regarding this specific case is scarcely developed, this research assumes the different customer segments of EMSP can be approximated to the category of EV drivers. The classification of EV customer segments is extremely variegated, indeed a myriad of types of consumers can exist, differing for hard or soft characteristics, such as preferences, habits, values (Delta EE 2018). For this reason, the key socio-demographic features and the drivers pushing people towards the purchase of an electric vehicle are explained hereafter.

Irrespectively from geography, literature has highlighted that EVs early adopters correspond to middle to high earnings and aged men, with a high education level – typically graduation or post-graduation – that are willing to purchase electric vehicle for environmental or technological reasons (Zarazua de Rubens 2019). Therefore, early adopters result to be fairly rich drivers inhabiting single-family homes with private garage (Hall and Lutsey 2017).

According to a further research conducted by McKinsey in 2017, the early adopters of EV can be clustered into two different categories: the status and luxury enthusiasts and the risk-averse greens. The former comprises customers with a high purchasing power, looking for luxury trim and distinguishing design and performance, while the latter includes people keen on environment but not willing to spend for a high premium.

A further study carried out by Zarazua de Rubens (2019) shows a pretty similar result. The researcher focused on Nordic countries, namely Denmark, Finland, Iceland, Norway and Sweden, and identified six clusters of EV customers: Petrol Heads, Blue-collar Moderates, Status Seekers, Public Mobiles, Sceptics and Greens. The analysis pointed out that Blue-collar Moderates and Greens represent now the early adopters of EV and will be their potential mainstream adopters.

Firstly, Greens is obviously the cluster comprising customers paying attention to environmental issues. They expect the vehicle to be technically reliable, safe and easy, while acceleration and speed are not considered as necessary characteristics. They present the second (to Status seekers) highest annual mean earning and percentage of postgraduate educated people and the lowest mean age (40 years), mostly they are women.

The Blue-collar Moderates instead is composed of middle age men with a slightly inferior household earning. Indeed, this cluster is sensitive to the initial purchase expenditure of EV and also size, comfort and technological characteristics of the car, instead it is not interested in pursuing good environmental habits. They tend to purchase their personal car and look for the financial savings of



buying and driving an electric vehicle. Both the clusters do not cover long distances per day, stating they drive 20 km/day or less.

An additional classification of customer segments divides them into three categories, according to their driving habits (Delta EE 2018). Indeed, they can be clustered into Suburban Commuters – middle-aged members of a family with possibility of charging at home or at office , Mix-And-Matchers – urbanites staying updated with the newest technologies and expecting less than half of charging takes place at home – and Home Dwellers – sub-urban or rural homeowners expecting almost all of the charging to happen at home.

### ***Value proposition***

The second block of the Business Model Canvas to be analyzed is the one regarding the value proposition of the actors. Keeping in mind what mentioned in the previous chapter, the value proposition represents the bundle of products and services satisfying certain customer needs and for which the customer picks one company instead of another (Osterwalder and Pigneur 2010).

On the one hand, the charging point operator provides the management of the physical infrastructure and of the charging process, by providing the access to the equipment and to energy, and by monitoring, maintaining and controlling the charging point (Madina et al. 2016). CPO's value proposition focuses on providing seamless charging service based on large geographical coverage and easy payment methods (GREAT 2019).

On the other hand, the electro-mobility service provider provides electro-mobility services, such as vehicle charging, search and find of the charging station and routing, either for domestic charging, at the office or at any other place to the end customer (Madina et al. 2016). In particular, according to the location where the charging takes place, four different value propositions can be distinguished (GREAT 2019).

Firstly, the “All Charge” business model aims at establishing and operate a complete charging service both towards private and public market. Fundamental for this kind of business is that its value proposition must offer a complete charging service irrespectively of consumer habits in terms of distance travelled. Both the private and public solutions must be sufficiently established, to cover both long and short distances. Moreover, the private segment represents the pillar of this type of model since it is the source of revenues leveraged on to fund the expensive fast charging in the public market.

Secondly, the “Destination” business model is the business model based on attracting customers to the charging service by placing the charging point at a well-known destination business, such as a

gym, a hotel or a shopping mall. In this case, the destination owner becomes the provider of the charging service and its value proposition totally focuses on offering the opportunity to the customer to exploit the destination service and simultaneously charging the vehicle as an add on service.

Differently, the “Location” business model relies on a different value proposition, i.e. using the public charging to attract customers in tactical locations, thus enabling to collect revenues also from the co-located business, such as restaurants, groceries, etc.

Finally, the “Collective” business model is based on sharing initial investment costs of public fast charging infrastructure by using a collective action. The value proposition of this business model focuses on offering a public fast charging service on highways, that will be scalable enough to meet the higher and higher future customer necessities in terms of charging speed. A classical example of this business model is provided by the joint venture Ionity, whose aim is to build a high power charging infrastructure all along the main European highways, by sharing the initial investment costs.

A further analysis of the existing value propositions underlying the electric vehicle charging supply chain is provided by Capgemini Invent (2019), the digital innovation, consulting and transformation brand of Capgemini Group, global leader for what concerns consulting, technology services and digital transformation. The report classifies the actors, and their consequent value propositions, into four classes, that in turn contain some other sub-categories.

Classification	BM Name	Value proposition
Makers	BM 1: Manufacturing	DESIGN AND PRODUCE CHARGERS that match both regulatory standards and customer needs
Maintainers	BM 2a: Direct Billing	Operate public charging stations and BILL CUSTOMERS FOR THEIR USE THANKS TO AUTHENTICATION METHODS AND SIMPLE PLATFORMS
	BM 2b: Indirect Billing	Operate public charging stations and BILL A THIRD-PARTY WILLING TO ATTRACT CUSTOMERS OR SUPPORT THE DEVELOPMENT OF EV CHARGING STATIONS
	BM 3: Public Private Partnership (PPP)	DEVELOP, MANAGE PUBLIC SERVICES through concessions granted by local authorities with potential delegating after given period
Energy masters	BM 4a: Smart charging	Use data generated by public and semi-public charging TO DEVELOP SMART SOFTWARE and to provide advisory services
	BM 4b: V2X (V2G, V2B,...)	Leverage the potential of EV batteries, ALLOWING BIDIRECTIONAL CHARGING, to provide storage and supply of energy to public or private electricity networks
	BM 5: End-to-End Energy	Propose END-TO-END ENERGY OFFERS and develop smart services thanks to data collection
Seamless E-mobility	BM 6: Interoperability Platform	Aggregate Charge Point Operators (CPO) through interoperability platforms to maximize network coverage and offer unified authentication methods, shortly ENABLING CUSTOMERS TO ACCESS MULTIPLE CHARGING POINTS OPERATED BY DIFFERENT CPOs
	BM 7: Charging-as-a-Service	Offer a SEAMLESS CHARGING OFFER and cover all electric mobility uses in everyday life

Figure 14 - BM classification (Capgemini Invent 2019)

The first class regards the makers, those actors in charge of the design and manufacturing of the charging systems, that must, at the same time, fit with the regulatory frameworks and satisfy customer needs. This business model is already mature and companies adopting it are facing high competition, indeed the players in the market are numerous. Moreover, its growth is stable and commoditization is expected to decrease profits, fostering integration.

The second class includes the so called maintainers and comprises three different categories. Firstly, Direct Billing business model, i.e. those actors which offer public charging stations and invoice customers for the usage of their service through authentication methods and platforms. As for the previous business model, the market is mature and presents a high competition, indeed actors filling these category are several and they leverage on well-established revenue streams. Again, the growth of this business model appears to be steady, but it is not clear what will happen in the future, since profitability cannot be taken for granted.

Secondly, actors can handle public charging points and invoice a third-party for the service offered, applying Indirect Billing business model. Usually, this additional player is interested in being more appealing for customers or in supporting the advancement and establishment of new charging stations. This is a nascent business model and only niche players are present in the market, thus its growth is sharp, being a durable and flexible, although the revenue capability is limited.

Thirdly, the category of public-private partnership (PPP) is examined. Here, private companies receive the authorization from public governance to install and manage the public charging service and can, after a certain period of time, delegate its management. This business model is pretty mature and numerous players have adopted it, its growth is steady.

Moving on to the third class, the energy masters are taken into consideration. Firstly, the smart charging business model leverages on the data obtained through public and semi-public charging in order to create smart software and provide consulting services. This kind of business model is moving towards maturity and is adopted by a limited number of players, even if its growth can be considered exponential. It is obvious that fostering the e-mobility market, both in terms of vehicles and renewables, is essential for the success of this business model, since the more data is collected from the charging services, the more the business model becomes profitable.

Secondly, the so-called V2X category is assessed. V2X stays for Vehicle to Everything and corresponds to the transfer of information from a vehicle to another entity (Grillias 2020). The acronym can be declined according to the receiving entity. For example, vehicle-to-grid (V2G) is becoming increasingly popular thanks to the adoption of electric vehicles (Schram et al. 2020). In particular, V2G is a technology allowing to transfer electricity to the electric car charging points,

mainly for what concerns low voltage grid (Kempton and Tomić 2004), while vehicle-to-building (V2B) is a further possibility to exploit the battery of an electric vehicle to aid the loads in the power network (Pang et al. 2010). This business model is still maturing and only few players have implemented it, still its growth is exponential and related to customers acceptance and the demonstration of the ongoing tests.

Finally, the end-to-end energy business model offers end-to-end energy and elaborates smart services through the gathering of data. This business model is currently maturing with several players implementing it and an exponential growth.

The last class is the one of seamless e-mobility and comprises two different categories. The first one is made of the actors offering interoperability platforms, i.e. platforms offering the aggregation of charge point operators in order to offer to customers the widest network possible and a unified authentication method. This business model is well-established, mature and carried out by a multitude of players. This presents an exponential growth and is fundamental for the uptake of e-mobility.

Finally, the charging-as-a-service business model provides a continuous charging offer and offers all e-mobility uses in everyday life. This is a maturing business model, characterized by an exponential growth and it is adopted by several players.

### ***Customer relationship***

This block of the business model canvas regards the relationship the company establishes with its customers in order to deliver its value proposition. Although its clear relevance in business model design and construction, no information is available in the current literature.

### ***Communication and distribution channels***

Moving on to the communication and distribution channel, these represent the means used by the company to reach each customer segment (Osterwalder and Pigneur 2010).

Unfortunately, the current literature does not provide a clear analysis of the channels adopted by the actors present in the charging supply chain. Nonetheless, it results clear that a channel distinction based on B2B and B2C customer segments exists (GREAT 2019).

Indeed, while addressing business markets, many actors prefer to act through indirect channels relying on third actors, for example by renting some space from partners, such as car dealers. On the

other hand, when it comes to deal with B2C customers it is more likely to act through direct channels. This happens when players decide to rely on physical availability, traditional retail channels and direct selling. The main advantage of this configuration is the creation of a valuable relationship with the end customer, a task which is very hard to accomplish in a business market without establishing a contractual partnership.

### ***Key resources***

The resources instrumental to perform the operations and, more in general, do business, can be considered as physical, financial, intellectual, and human (Osterwalder and Pigneur 2010). Of course, every actor along the infrastructure value chain will need different resources: upstream, utilities and manufacturers will most likely need a relevant component of physical resources, given the asset-intensiveness of their sectors (Crosbie & Short, 2014), while going downstream, towards the end customer, intangible assets like brand reputation become more and more important. A common aspect along the whole supply chain, which anyway intensifies towards its end, is the criticality of **financial and human resources** (PwC Strategy& 2018).

Financial resources are fundamental to sustain this business, since it has to be considered that many country-specific studies addressed the very limited profitability of it, and this makes it difficult especially for pure players to thrive (Schroeder & Traber 2012; Li & Ouyang 2011). Incentives, tax breaks and bonuses are essential to support these businesses, directly involving governments in the conversation. Human resources are again instrumental pretty much throughout the whole value creation, starting from the engineers, designers as well as installers, technicians and salesmen.

### ***Key activities***

The analysis of this block is focused on those actions which are fundamental for the successful running of a company (Osterwalder and Pigneur 2010). Of course, different actors will perform different types of activities in order to create and deliver value (Strategyzer<sup>2</sup>).

As identified by a recent study by Capgemini (Capgemini Invent 2019), the EV charging value chain starts with the category of actors related to **energy supply**. In this case, key activities may comprehend energy production, distribution and retail.

A further study delineated by PwC (PwC Strategy& 2018) states the EV charging value chain can be considered as the sequence and interconnection of six activities, briefly described below.

**Hardware manufacturing** is the first step, and refers to the physical production of the single components and their assembly in order to realize the end product ready to be delivered and installed, and a fundamental role is here played by technology providers. The **sale** is the next activity, and consists first in the identification and characterization of the customer and its requirements. For example, a fundamental distinction must be done between business customers (B2B) and private end-users (B2C). The main actors in this step can be the charging point manufacturer or a third party like a trader, a car dealer, or a retailer.

So far, the activities have been undiversified either they were meant for infrastructures destined to private or public purposes. The next steps, on the other hand, present more differences according to the destination. **Installation**, which immediately follows the sale, is a technical activity carried out by an installer for domestic applications for example, while it can be performed directly by the CPO for what concerns public charging applications. After having physically deployed the hardware, a fundamental step is the **charging network optimisation**. Under this activity fall subsets like monitoring, optimising, load shifting and grid integration, as well as billing and invoicing, which are usually performed by the EMSP. Of course, in order to work properly and smoothly, this activity requires the development of the software side, so there might be actors in this field that are enablers of the service. Strictly related to monitoring and managing the charging point, **maintenance services** are a very important task to plan and perform in order to guarantee a high service level and operational fluidity.

Last but not least, **value added services** play a core role in the value chain, being the most valued by the end users. Such services include data management, user-friendly interfaces, advertisements, and profiling, and it is possible to understand that this array of various activities can easily generate collateral revenue streams. Further activities which represent additional services the customer can benefit from are geo-location services, roaming or access to charging stations, battery management (Capgemini Invent 2019).

After having listed these main activities, it must be kept in mind that the whole market is dynamic and steadily growing and reshaping, and that the actors involved are multiple and doing business in very different sectors. For these reasons, the borders between which role should perform a certain activity are blurred and overlapping, and are constantly evolving (Capgemini Invent 2019).

### ***Key partners***

The definition of what a *partner* is can be a wide concept, indeed different types of partnership exist (Osterwalder and Pigneur 2010). The importance of partnerships that see different actors coming

along in order to create a single point of contact with the final consumer is crucial (Capgemini 2018). First off, there are the **buyer-supplier** relationships that link the different actors upstream and downstream the charging value network, engaging component manufacturers, software developers, energy providers, automakers and car dealers, down to CPO and EMSP (Capgemini 2019). OEMs, utilities, local electricians, roadside breakdowns service providers as well as Local, Regional and National policy makers must come together and ensure a working environment to overcome the fragmentation that characterizes the current context (Wolbertus, Jansen and Kroesen 2020).

As it can be understood, the nature of some of these partnerships is economic and operational, for example between a CPO and an electricity supplier, others have a more strategic imprinting, aiming at a risk reduction, and this is the case of Oil&Gas companies investing in EV charging infrastructure to secure a future-proof business (Capgemini 2019). Others again are partnerships that see one of the parties as an enabler, and this is the case of Local governments which can support the development and deployment of the infrastructure through incentive and grant schemes (PwC Strategy& 2018) .

## ***Revenue streams***

Crucial analysis to be done before taking any business decision regards the economic sustainability of it (Madina et al. 2016). Assessing the revenue and cost drivers and structure is an instrumental step in order to evaluate whether a project is viable or not.

Taking into consideration the perspective of public charging infrastructure, in order to properly assess the revenue streams, it is fundamental to first identify which are the main drivers affecting them as well as how these drivers impact the final value (Zhang et al. 2018). Revenues can be roughly calculated as

$$Revenues = Income - Investment - O\&M$$

These three elements, *income*, *investment*, and *O&M* can furtherly be broken down into less aggregated voices in order to understand which are the more impactful drivers.

Considering the operational revenues, hence coming from the core activity of the company, namely the charging service, income can be considered as the sum of a *charging fee* and a *subsidy*.

$$Income = Charging Fee + Subsidy$$

The latter is not mandatory, but it is present in most countries as a way to incentivize investors in entering the business, and it usually grows proportionally as the number of stations installed grows. In turn, the charging fee is a function of the *charging demand* and the *charging price*.

$$Charging Fee = Charging Demand * Charging Price$$

The investment, which refers to the initial capital expenditure, is made up of *construction cost of charging stations*, under which fall civil and road works, and *cost of charging units*. These drivers are of course highly dependant on the number of units installed.

Moreover, it is noteworthy that two additional voices can be integrated to the income generated by the supply of charging service. Indeed, a further revenue can derive from the **increase of retail sales** (Hall and Lutsey 2017). Since the charging operation is time-consuming and of course requires a stop during any travel, retailers can exploit charging stations to attract new customers, thus increasing their sales. For example, a famous retailer in U.S., after having installed Level 2 charging stations in one of its point of sales in California, discovered that dwell time of those customers charging their vehicles there was 50 minutes longer than average, this resulted to an estimated \$56.000 of additional sales during the next 9 months (ChargePoint 2015). Another demonstration of the profitability of this business model comes from California, where a research showed that when electric vehicle drivers charged their cars to a charging station next to a retailer, 50% of them shopped there with an average expenditure of \$18 (Nicholas and Tal 2017).

Another possible source of revenues for charging stations are **advertising revenues** (Hall and Lutsey 2017). As pumps and signage at gasoline stations often present some advertisement, the same could be done by electric vehicle charging stations. This is recommended for charging points with high visibility and high traffic, for example shopping malls, restaurants and highway stop areas. The simple integration of advertisement to the charging station could help to compensate initial costs.

$$Investment = Construction\ Cost\ of\ Charging\ Stations + Cost\ of\ Charging\ Units$$

Finally, O&M encompasses operational expenses such as *electricity cost*, which is again a function of the *charging demand*, *ground rental*, and *maintenance costs* (Zhang et al. 2018).

$$O\&M = Electricity\ Cost + Ground\ Rental + Maintenance\ Cost$$

An important aspect to highlight is the relevance of the *charging demand* in the calculation of the revenues. This is a function of the *location of the charging infrastructure*, *the behaviour of EV drivers* and the *total number of EVs on the road*, this last one being the most important one. This driver has a complex relation, meaning it is not linear, with the revenue structure and is therefore to be carefully analysed in order to make forecasts and assessments.

Once highlighted the main general structure, it is important to address the different strategies the players can implement in order to boost their revenues. Pricing is the most direct marketing leverage that companies use to differentiate their services, hence a list of the main pricing models adopted worldwide is in order (GREAT 2019; Bourne 2019). According to the location of the charging station, the power and the number of charging points, one model will be more suitable than another, but in



general six main approaches can be identified. A first, simple and widely adopted one is based on the same concept of gas stations, where the charging price is calculated on a **per kWh-base**, the same way refuelling an ICE vehicle is charged on a €/l base. This value is highly dependant on the Regional electricity price which can be very volatile, but as a general reference public charging can be twice as expensive as domestic charging, as it happens in the UK where charging at home costs on average 13p/kWh, whilst rapid public charging costs around 23p/kWh (PodPoint 2020). A problem faced adopting this strategy regards the so-called “camping” of EV drivers at the charging point, especially when applied in congested areas such as highways, and is referred to the fact that drivers occupy the station for longer than they actually need to, without incurring in further costs. To overcome this barrier, some players adapt a **charging by time** model, in the form of €/hour. This way camping is disincentivized as would entail higher costs, but this way cars with more powerful and faster on-board adapters would be strongly favoured. For this reason, a third model which is simply the **combination of the time- and kWh-based models** has been proposed. Moving away from a proportional model, the **flat rate** model is adopted in different *destination* charging stations, where the cost charged to the different drivers is the same and is independent from the actual charge. This can be managed for example using a “toll” system, where customers pay to access the infrastructure and can then exploit it according to their needs. Again, this strategy does not prevent the “camping” behaviour and can be highly unfair towards those customers that would pay a far lower amount of money if they charge per kWh, but on the other hand is the most transparent pricing model and is easier to control from the point of view of the manager. In order to build and keep strong relationships, another model proposed is the **subscription**, where customers pay a pre-agreed fee, usually monthly, and have unlimited access to a wide network of charging stations (Enel X 2019). The last pricing model identified, which can hardly be considered as a proper revenue model, is the **charge-free** strategy, where drivers are free to access and use the infrastructure as much as they need, without being charged. Given the non-revenue generating aspect of this model, it is usually applied in *workplace* and *destination* charging solutions, where drivers are generating revenues for the owner and/or manager in other ways (working or paying for the destination services), and it is applied also by Tesla for its drivers who want to access the Superchargers network.

Linked to this latter remark, it is interesting to highlight the fact that **collateral revenue streams** can be exploited in this market as well. As previously mentioned, value adding services (PwC Strategy& 2018) like data collection or displaying advertisements can be a further source of revenue for the manager, who can sell these information and ad-spaces to other companies, of course under compliance conditions, and improve their profitability.

## *Cost structure*

As already mentioned when describing the drivers influencing the *revenues* through *investments* and *O&M*, the cost of electricity is a heavy and fundamental item to consider, which is in turn directly affected by the charging demand and consumers' behaviour, but not by these alone (Zhang et al. 2018). Other external factors such as grid stability, the renewable energy sources penetration in the Regional energy mix, partnerships with utilities and governmental supporting schemes have a huge impact on the electricity price. Other relevant operational costs are related to the maintenance, whether predictive or extraordinary, and eventual rent fees to be paid to the land owner.

Digging deeper into the initial investment, which for public, multi-unit points can be very high (Smith and Castellano 2015), it is fundamental to perform an upstream analysis to understand which are the drivers of cost and the trends they are going through. These elements must of course be framed into their context. For example, it has to be considered what type of charging station is being analysed. Fast DC chargers are much more expensive (up to 140.000€ per unit for 350kW stations) than Level 2 ones (up to 3.000€), which in turn are more expensive than Level 1 (usually lower than 1.000€). Then it must be taken into account whether the station is networked or not, a feature which heavily impacts the total cost given the software development, interoperability and connectivity, and user interface activities needed.








Regardless, generally speaking it is possible to identify four main voices of cost: labor, materials, permits, and taxes (Nicholas 2019). Again, the above-mentioned are related to the upstream costs, before the actual enter in operation of the station. **Labor** takes out about half the final installation cost, immediately followed by **materials**, reaching a total share of about 90%. **Permits**, although having a relatively small impact on the total cost, has other burdens, such as the usually long bureaucracy that the installer has to go through in order to get the approval.

Finally, by taking the perspective of car manufactures, it is noteworthy how they can integrate the charging infrastructure within their value proposition, by personally funding the charging points (Hall and Lutsey 2017). Since the charging infrastructure is a fundamental prerequisite for electric vehicle diffusion, car makers have great interest to build a widespread and solid charging network. The example of Tesla is worldwide known. The American company created its proprietary network of Superchargers all around the world. It built more than 2000 Supercharger stations and updates its customers through SMS when a new Supercharger station is installed. However, Tesla is not the only example of car manufacturer having boosted the opening of new charging stations, other companies such as BMW, Ford and Nissan offer subscription to EVgo – a fast-charging provider in U.S., while

in Europe, BMW Group, Ford Motor Company, Mercedes Benz AG and Volkswagen Group have created Ionity, a joint venture aiming at fostering the creation of a high-power charging network.

### ***Information sum up and research questions***

In order to sum up the main takeaways of this section, it can be interesting to present all the information found with reference to all the business model canvas building blocks, by drafting the business model encompassing all the configurations made available by the existing literature.

<p><b>Key Partners</b> </p> <ul style="list-style-type: none"> <li>- suppliers</li> <li>- policy makers</li> <li>- OEM</li> <li>- utilities</li> <li>- technology providers</li> <li>- technical operators</li> </ul>	<p><b>Key Activities</b> </p> <ul style="list-style-type: none"> <li>- energy supply</li> <li>- charging point optimization</li> <li>- maintenance</li> <li>- value-added services</li> </ul>	<p><b>Value Proposition</b> </p> <ul style="list-style-type: none"> <li>- provision of the physical hardware</li> <li>- provision of the charging service, location, reservation, billing, payment</li> </ul>	<p><b>Customer Relationships</b> </p> <p>-</p>	<p><b>Customer Segments</b> </p> <ul style="list-style-type: none"> <li>- B2C</li> <li>- B2B</li> </ul>
<p><b>Cost Structure</b> </p> <ul style="list-style-type: none"> <li>- labour</li> <li>- materials</li> <li>- permits</li> </ul>		<p><b>Revenue Streams</b> </p> <ul style="list-style-type: none"> <li>- service sale (subscription-based; pay-per-kWh; pay-per-time; flat rate)</li> <li>- collateral revenues</li> </ul>		

*Figure 15 - Sum up of business model canvas information derived from literature review*

Thoroughly analyzing the existing literature concerning business models of EV charging infrastructure, it is clear that some aspects have still not been evaluated or present some uncertainties. Firstly, a huge share of the literature puts the spotlight on the EV, rather than on the infrastructure, putting the different charging behaviors of the drivers at the center of the analysis. This focus heavily privileges the “last-mile” of the value chain, neglecting the upstream side, and even when the latter is integrated in the analysis, the approach is more the one of a market analysis, rather than a business model development (PwC Strategy& 2018). Taking the example of the customer segments, different studies have been carried out, but the perspective has mainly been the one of the final customer, namely the driver (Zarazua de Rubens 2019). These analysis had the ultimate goal of identifying the different behaviors of the owners of electric vehicles, which are consequently users of the charging

infrastructure as well, in order to cluster the former and come up with personas useful to understand future developments in the sector. For as important this analysis is, once again the focus is not on the charging infrastructure, but on the vehicle, neglecting all the intermediary steps before the charge happens.

Secondly, the existing literature lacks an encompassing view of the building blocks focusing mainly on the value creation, neglecting value delivery and value capture. For the sake of a reliable and comprehensive depiction of the different business models, at least at a conceptual level, all the building blocks should be considered as equally important. Nevertheless, some of these blocks are scarcely, at times completely not, analyzed and discussed, for instance customer relationship.

Finally, assessing e-mobility business models requires to consider the whole variegated bundle of stakeholders operating in this market, many of which are new ones and do not belong neither to traditional car or electricity provision value chain (Kley et al. 2011). Literature provides studies about the business model of specific actors, such as carmakers (Bohnsack et al. 2014; Kley et al. 2011), or for charging technology developers (Markkula et al. 2013; Schroeder and Traber 2012) and studies focused on single blocks of the business model canvas (Capgemini 2019; GREAT 2019, PwC Strategy& 2018; Zhang et al. 2018). Nevertheless, it is clear that a comprehensive analysis of the business models of the different actors composing the EV charging ecosystem does not currently exist, which could potentially encourage governments towards the development of new regulations boosting EV adoption (Gomez et al. 2011; Kley et al. 2011).

For this reason, the aim of the present thesis is to draw an integrated and comprehensive view of the business models of the actors operating in the fast-growing market of EV charging, by analyzing which business choices result to be the most successful ones.

More in detail, the study aims at answering to the following research questions in order to expand the existing literature concerning EV charging supply chain: What are the characteristics of the business models adopted by the players in the EV charging supply chain? What are the main differences in terms of BM articulation among the categories of actors involved?

Since the output of the present work will be presented in the form of business models, the theoretical framework which has been followed totally corresponds to the Business Model Canvas theorized by Osterwalder and Pigneur in 2010.

It is worth noticing that each company will be anonymously treated, thus not disclosing any sensitive data provided during the interview phase. For this reason, each of them will be depicted by using an acronym deriving from the name of the category accompanied by a number following an increasing order.

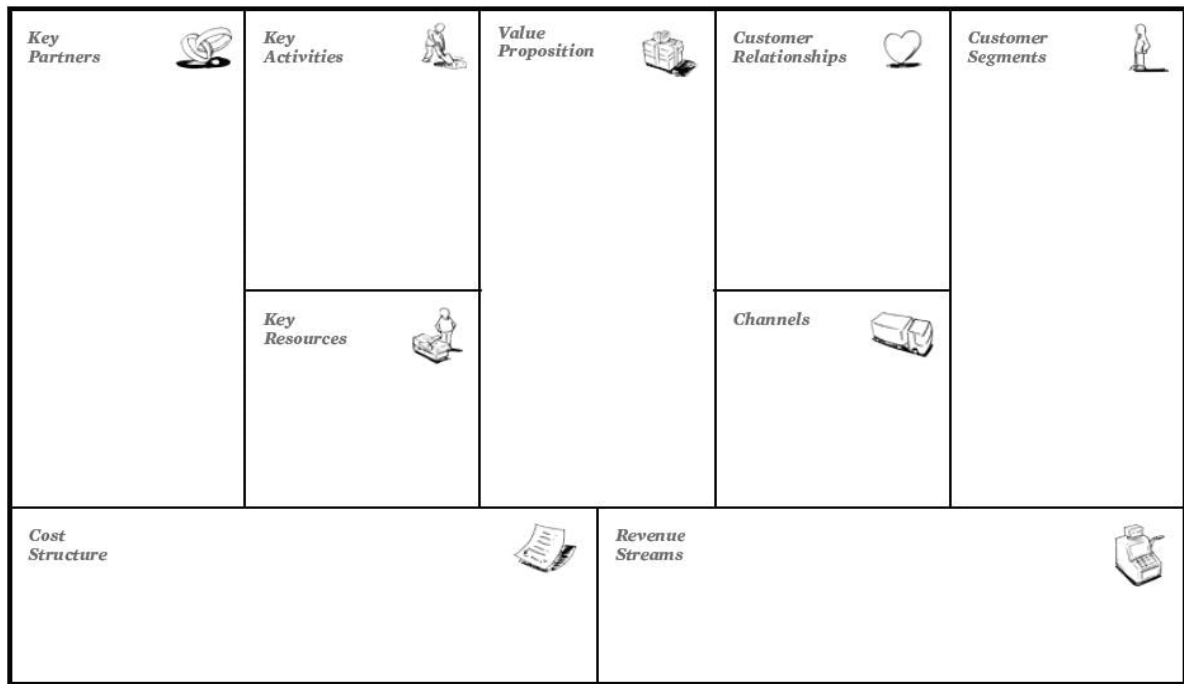


Figure 16 - Business model canvas by Osterwalder and Pigneur

In addition, seeking to raise the level of abstraction of the resulting models, for each block of the BM of each category of actors, the process was not to simply include in each of them all the answers provided by the interviewees. Indeed, by clustering these different answers increasing the level of aggregation, without losing any conceptual level of detail for the sake of the research, it has been possible to identify and address the variability within the business models of the actors of the same category, in order to draft an according number of archetypes, so that all the different configurations have been encompassed.

# 4. Objectives and research methodology

## 4.1 Objectives and research questions

The objective of the present thesis is to provide a deep investigation of the business models of each category of player composing the EV charging supply chain, for what concerns both public and private charging methods.

The existing literature concerning pure business models is extremely variegated and fully explains what a BM is and how it can improve companies process of value creation, distribution and capture (Teece 2010).

Putting the spotlight on EV market, reviewing literature has highlighted a first critical point, i.e. the main focus generally resides on the driver and his general behaviors, such as driving methods, buying attitudes, range anxiety etc.

Moreover, during the literature review section, a first business model analysis has been done on a broad level, to then move and furtherly breakdown the canvas in each one of the nine building blocks. These blocks, for the sake of a solid and reliable description, are, at least conceptually, equally important. Nevertheless, what most of the literature focused on was mainly the value proposition, extended to customer segments at times, but usually going no further. Indeed, for some blocks few or no information could be found since literature totally lacked them.

The thorough analysis of the present literature regarding the business model of the EV charging infrastructure has underlined that an omni-comprehensive presentation and description of the business models of each player composing the charging supply chain is not currently available (Gomez et al. 2011; Kley et al. 2011). Indeed, there is no elaborate analysis that takes into consideration the whole charging infrastructure value chain, taking the perspective of all the different actors concurring in the value creation.

For this reason, the present thesis aims at filling this literature gap in, by elaborating a systematic and synoptic view of the business model characterizing the actors which take part to the EV charging supply. Moreover, the thesis aspires to identify the main trends and patterns that distinguish each player, and at highlighting their potential differences and similarities in terms of business models, both within the same role category and among different roles in the supply chain.

Keeping in mind the afore-discussed objectives, the current thesis finds its roots in the qualitative empirical analysis of a sample of companies, belonging to different sectors but which all converge in the EV charging market.

In conclusion, this master thesis strives to answer to the following research questions: What are the characteristics of the business models adopted by the players in the EV charging supply chain? What are the main differences in terms of BM articulation among the categories of actors involved?

By answering to these questions, the work aims at providing a fully understanding and categorization of the specific EV charging market, by starting from the analysis of case studies deriving from the wide sample of companies that have been interviewed.

## **4.2 Instruments and methodologies**

Before entering in the detail of the methodology adopted, the review of the existing literature concerning interview is provided, being the interview the technique exploited to collect information. This section firstly presents a brief examination of qualitative research, since this is the umbrella research type encompassing also interviews, and then it moves to the deep analysis of interviews general development rules, advantages and disadvantages, and different types.

### **4.2.1 Qualitative research**

A straightforward definition of qualitative research is not available in the current literature, indeed this term results to be an umbrella expression encompassing many different methodologies and reasoning (Hennink et al. 2020). Generally speaking, qualitative research is a technique to investigate people's experiences by exploiting some consolidated approaches such as interview, focus group, observation, content analysis, visual methods, and life histories or biographies.

The most diffused definition of qualitative research is the one provided by Denzin and Lincoln (1994), stating qualitative research is a multi-method research type elaborating information through an interpretative and naturalistic approach to the object of interest. Every phenomenon is evaluated in its natural context and the qualitative researcher tries to provide an interpretation to the meaning individuals attribute to a specific thing.

The representation of reality deriving from qualitative research is often complex and highly rich of details, for this reason it cannot be thought as a simple description of the phenomena happened characterized by a narrow number of variables (Gephart 2004).

The comparison between qualitative and quantitative research can help in understanding even more characteristics of the former technique. Qualitative research applies an interpretive or critical approach to social science, following the so-called “logic in practice” and a non-linear research method (Choy 2014). Qualitative researchers carry out an extensive investigation of the natural situations of social life. On the contrary, quantitative research leverages on positivists techniques and exploit “reconstructed logic”, following a linear method. It focuses on appraising parameters and testing the hypotheses that are expected to be the causes of a situation (Neuman 2006). Another significant difference between the two kinds of research is the nature of data. Indeed, the qualitative research relies on soft data, such as terms, sentences, pictures, feelings, instead of hard data, such as numerical measures, as the quantitative research does (Neuman 2006).

In addition, qualitative research presents some strengths and some weaknesses. On the one hand, it allows to assess the differing views of homogeneous and heterogeneous groups of people (Dudwick, Kurhnast, Jones and Woolcock 2006), also it permits the researcher to discover the issues he is mostly interested in thanks to general and open interrogation (Yauch and Steudel 2003), and, finally, it allows to reach a deep understanding of values, convictions and assumptions underlying people behaviors (Yauch and Steudel 2003). On the other hand, the interviewing process results to be time-consuming and some significant themes may be under-noticed, indeed the researcher is influenced by his personal experience and knowledge, thus his findings and impressions may be biased (Yauch and Steudel 2003). Finally, another disadvantage regards the fact that data is not objectively provable (ACAPS 2012).

Qualitative research may be executed leveraging on different techniques, hereafter the main ones are explained (Hennink et al. 2020).

Firstly, *participant observation* is a data collection approach appropriate for assessing natural behaviors in people usual context (Mack et al. 2005). This basically consists in observing how people behave and interact in social contexts and has the advantages of not being intrusive, of providing a lot of contextual data and supporting data from other sources, of spotting people real behavior and to be conductible in different scenarios (Hennink et al. 2020). On the contrary, the interpretation of the observation is highly personal and the differentiation between participants and observers is necessary. Another technique is the *focus group discussion*. This consists in pinpointing some community norms or a series of opinions concerning a certain topic (Hennink et al. 2020). The group interaction allows to arise a wide range of thoughts and views, obtaining details, explanation and refinement. The



information collection is rapid, key issues easily emerge and participants highly feel emancipated. On the other hand, information is not deeply assessed, indeed personal experiences are not shared and group dynamics must be handled.

Finally, *in-depth interviews* involve the identification of people perception, beliefs, feelings and experiences (Hennink et al. 2020). This technique allows to obtain deep information about interviewees and the context they live in, digging into personal experiences and touching even sensitive issues. Unfortunately, this technique is not a group discussion, thus no interplay nor comments nor responses from other people are present. Finally, it allows to identify an exhaustive bundle of issues only after a considerable number of interviews.

## 4.2.2 Interviews

The purpose of interviews is understanding the opinions, the experiences, creed and motivation of people about specific topics (Gill et al. 2008). Interviews are expected to offer a more profound comprehension of social event, than the one that would be reached by exploiting quantitative techniques, such as questionnaires (Silverman, 2000).

People involved in the interview process actively contribute to construct knowledge through questions and answers (Holstein and Gubrium, 1995). Indeed, interviews result to be particularly appropriate when little information about a specific topic is available, or when a specific theme needs to be analyzed in detail or even when sensitive issues are taken into consideration, indeed interviewees may feel freer to touch certain topics in a peer-to-peer context (Gill et al., 2008).

The interview is a conversation arisen by the interviewer and addressed to a consistent number of interviewees with a cognitive aim and relying on a flexible and non-standardized inquiry schema (Corbetta, 1999). The conversation cannot be compared to a traditional one, indeed the participants perform highly different roles: the interviewer leads the interview, by always respecting interviewee's freedom, indeed he must feel free to express his thoughts.

In the design phase, interviewers must focus on elaborating questions able to obtain as much information as possible and to fulfill research aims (Gill et al. 2008). For this reason, questions should be open (implying more than a yes or no answer), neutral, kind and clear, starting from easy ones and getting gradually to the most complicated ones (Britten 1999). This stratagem helps in creating confidence between the interview participants, thus interviewees feel comfortable and share detailed data which enriches the whole interview (Gill et al., 2008).

Moreover, it is prudent to experiment the interview framework effectiveness on many people, before starting the actual interview phase (Pontin, 2000). This step is extremely relevant to assess the clarity of the interview schedule and potential changes needed.

Once proven the understandability of interview questions and before the actual interview starts, interviewers should inform the interviewees about ethical principles, such as anonymity and privacy (Britten 1999). This introduces respondents to the actual interview and enhances the probability they will be honest while answering.

In addition to this last point, even conducting the interview in a familiar environment, far from distraction and establishing a relationship with the interviewees may help them in relaxing and increase interview yield (Kvale, 1996).

Furthermore, it is wise for the interviewer to acquaint with the interview framework, thus avoiding the process to be a rigid sequence of questions, but being more natural and relaxed (Hammersley and Atkinson, 1995). In fact, to obtain a good interview yield from the point of view of data collection, it is appropriate interviewer owns a range of skills and methods, such as the listening ability, allowing the respondent to freely tell his experience, without unpleasant stoppages.

Besides, to assume a neutral body language and gesture, appearing interested in what the interviewee is saying, to nod and to smile can foster the interview yield (Britten 1999). Even the use of silence can be strategic, indeed it can push respondents to wonder about their answer and enrich them with further details.

At the end of the interview, it is extremely important to thank the participant and ask him if there is anything he thinks that deserves more attention (Gill et al. 2008). This allows respondents to share issues they have taken into consideration but were not explicitly asked by the interviewer, thus stressing some points the interviewer may not have taken into consideration yet (Kvale, 1996).

Finally, the researcher should entirely tape and transcribe the conversation, as this prevents from any distortion and constitute a permanent transcript of what has been said (Gill et al. 2008). It can also be useful to draft “field notes” during and after the conversation, since this may be helpful in data analysis process (May 1991).

Considering the wide application field of interviews, it may be useful to classify them according to the flexibility degree of the interview protocol (Fontana and Frey 2005). Indeed, it is possible to distinguish among structured, unstructured and semi-structured interviews (Edwards & Holland 2013; Stuckey 2013; Gill et al. 2008; Jamshed 2014; DiCicco-Bloom and Crabtree 2006). Analysts agree that no type of interview totally lacks a structure (Jamshed 2014), but the degree of rigidity of the three types strongly varies.

### 4.2.3 Semi-structured interviews

Semi-structured interviews have a higher degree of flexibility. A schema, composed both of closed-ended and open-ended question, is followed for the interview, but during the process the interviewer can spontaneously add new questions and change questions orders (Zhang and Wildemuth 2009).

This type of interview is composed of different key questions that delimit the area to be examined but, at the same time, lead the interviewer or the interviewees to move in flexible directions, pursuing other topics or adding more details to a topic previously treated (Britten 1999). The high flexibility of semi-structured interviews lead the interviewer to get new insights from the interviewee, that may uncover topics the researcher had not considered before.

A very significant benefit of semi-structured interview is the reciprocity they allow to build between the interviewer and the interviewee (Galletta 2012), indeed the former can freely express additional questions arisen from the latter's responses (Hardon *et al.* 2004; Rubin & Rubin 2005).

The semi-structured interview is the most diffused inquiry method used in qualitative research: firstly, because it can be used for both individual and group interviews (DiCicco-Broom and Crabtree 2006) and, secondly, because its flexibility degree and its consequent rigidity may be varied according to the aim of the research and the specific questions (Kelly 2010).

Developing this kind of interview has some knowledge prerequisites (Wengraf 2001), indeed questions are elaborated basing on a certain knowledge about the subject of interest. Questions are decided in advance, by leveraging on the interview guide (Mason 2004), that highlights the main themes of the search and provides an architecture for the execution of the interview but it must not be adhered to rigidly. Indeed, the aim is to test the subject of interest by flexibly moving among the concepts expressed by the participants (Holloway and Wheeler 2010).

Finally, even if this interview method is considered an easy way to collect data (Wengraf 2001), the interviewer faces one main issue when setting the interview up and this regards the depth level he wants to reach. It is true that qualitative research aims at gaining a rich comprehension of the area of interest (Polit and Beck 2010), but the data collection should follow an ethical code, i.e. only the data required for the study should be gathered (Gibbs *et al.* 2007). Semi-structured interviews result to be time-consuming, laborious and need a certain degree of sophistication from the interviewer, indeed he should be intelligent, agile, prepared but also delicate and sensitive (Adams 2015). The preparation to the interview may be long and complex, the administration of the interview can require time and effort as well, finally the analysis of all the detailed information obtained from the interview can be difficult.

## 4.2.4 Methodology

Moving towards the methodology adopted to reach the research objectives, the underlying theoretical framework which has been followed was theory building from case studies (Eisenhardt 1989). Starting from the definition of research questions, the method accomplishes a series of steps, such as case selection, instruments and protocols creation, data gathering and analysis, until coming to the iterative phase of hypothesis validation, literature analysis and the final extraction of a theoretical explanation of the process under scrutiny.

As mentioned before, the focus of the present thesis is represented by the EV charging supply chain. For this reason, the work studies all the companies which concur, by adding a contribute, at different stages, to this value chain and aims at answering to the afore-mentioned research questions.

Companies involved came from different countries, mainly European, but particular attention was addressed to the Italian ones, in order to understand how these are moving in this fast-growing market and how they are positioned compared to other European actors.

Thanks to online researches and personal knowledges, the work started from drafting the categories of actors composing the charging supply chain and fill them in with as many representative companies as possible, thus increasing the sample under study and, as a consequence, the research reliability. The initial company sample included 97 players, which could be grouped into six categories, namely carmakers, electric equipment distributors, charging technology providers, oil & gas, service providers and utilities. Subsequently, all the companies belonging to the sample were contacted in order to understand if they actually implemented products, services or solutions for EV charging, and, in this case, if they were available for being interviewed. Different companies haven't returned our mails or direct messages, others have explicitly answered that the charging infrastructure business was not (or not yet) part of the portfolio. In conclusion, after this step, the total sample decreased to 48 companies.

Seeking to reinforce the grounding of the theory itself, the thesis relied on different methods for data collection (Eisenhardt 1989), in particular, online research and semi-structured interviews.

Firstly, material for each company was obtained by analysing their websites and online articles, in order to get a preliminary knowledge of the firms, thus being able to better administer the future interview where this information would have been confirmed or confuted.

Then, the qualitative method of semi-structured interviews was designated for data collection leveraging on the flexibility degree it provides. Indeed, the inquiry followed the interview framework

(see Appendix 1) but could freely and spontaneously expand to additional questions, from the point of view of the interviewer, and to additional insights, from the point of view of the interviewee.

Unfortunately, due to the current pandemic situation caused by Covid-19, the interviews could not take place in person and all of them were carried out by telephone or by using *Microsoft Teams* calls and videocalls. This inevitable way to manage interviews assuredly presented some advantages, but even some disadvantages. For what concerns the former, it allowed a faster gathering of information, allowing not to waste time in physically moving from one location to another, thus being able to arrange many different interviews with very few minutes in between them. Moreover, a call is much easier to be organized for both the participants, so the respondent usually is more willing to participate to the research. Finally, even if this could seem trivial, it allows to directly take notes on the PC while listening to answers, thereby reducing the post-interview work for the researcher. On the other hand, it has many drawbacks, such as the lower commitment of the interviewer that could be disincentivized from giving honest and exhaustive answers, the rapid decay of the relationship between the characters taking part to the interview because of the lack of contact between them and the unfeasibility to collect non-verbal data. Moreover, the possibility to visit the companies and, to some extent, see the working environment, would have been not only interesting, but also formative.

However, interviews duration ranged from thirty minutes to about one hour, and this phase of the study lasted approximately four months, taking place mostly from June to late September.

A further step was using both within-case data analysis and cross-case pattern research, as the framework developed by Eisenhardt (1989) theorizes.

The first method of data analysis provided a great aid in dealing with the huge amount of data gained, which, according to Pettigrew (1988) represents an ever-present danger. Particularly, a case study for each company information, deriving both from digital research and interview process, was developed.

The second move was to develop a cross-case analysis, in order to understand if common patterns could characterize the various actors belonging to the same category, and the players part of different categories as well.

The analysis did not start from an *ex ante* hypothesis, but it aimed at constructing a business model for each category of actors from scratch, thus being able, later, to make a cross-sectorial comparison within the EV charging market. Nevertheless, while the data collection process went on, some recurring patterns in each category became more and more evident, hence some hypothetical labels for each block of the business model canvas started to emerge.

While developing the analysis, data was continuously compared to what emerged from the existing literature, both in case of conflicting information or validating one. Of course, this was done when

the literature provided some insights, while this was impossible for those blocks for which information was totally missing. In this case, the information was overlapped with the previously acquired, in order to identify early signals of potential patterns.

Finally, theoretical saturation was reached when the incremental learning due to the further addition of another company and its related information was minimal (Glaser and Strauss 1967), i.e. when answers provided during interviews did not advance the research but simply confirmed the already consolidated model, which is proposed in Chapter 6.

### 4.3 Players classification

As already explained, the empirical analysis was rooted on the qualitative method of semi-structured interviews, carried out either at the telephone or through the videocall platform Microsoft Teams with one or many members of the company under scrutiny which were keen on EV charging products, services and solutions.

The first step was to draft the list of categories of players converging in the EV charging supply chain and then categorize each player related to this sector within one of these categories. Subsequently, a database including companies names and their specific representative, comprehensive of working role and different contact methods, such as telephone or mail address, was developed.

The following table represents the categories of actors involved in the analysis and the amount of each one of them that were successfully reached and interviewed.

<i>Category</i>	<i>Number of players involved</i>
<i>Car makers</i>	<i>6</i>
<i>Electric equipment distributors</i>	<i>3</i>
<i>Oil &amp; Gas</i>	<i>1</i>
<i>Charging service providers</i>	<i>14</i>
<i>Technology providers</i>	<i>15</i>
<i>Utilities</i>	<i>9</i>

*Table 1 - Research sample split for categories*

Even if the extensive explanation of each actor category will be provided in the next chapter, they will be briefly described hereafter.

*Car makers* are a branch of manufacturing industry which has as core activities the design, fabrication, commercialization and sale of vehicles. The connection with the sector under research is trivial, indeed they represent one of the main stakeholders enabling the outbreak of EV sale. One innovative aspect instead is that they integrated to the sale of the car itself even additional services for charging, e.g. the provision of the charging cables or the WallBox to install either at home or at the office.

*Electric equipment distributors* represent companies active in the manufacturing or commercialization of electric products, which are then supplied to different stakeholders of the EV charging supply chain, such as charging technology providers, car dealers, technicians and construction companies.

*Oil and Gas* comprehend those companies which have founded their business on the provision of energy derived from petrol or gas and that, for this reason, are the most undermined by the fast growth of EV market. However, many of the actors active in this business have started to consider the chance of including in their offer the charging service itself, by implementing M&A with leading companies in this sector. These players often have the required assets and availability of soil, but lack competences.

*Charging service providers* are the brand-new companies which enable the physical process of charging. They can play different roles, by being CPO, EMSP or by carrying out both the functions. As explained in the first chapter, CPO provides mainly the hardware side, while EMSP is more focused on the software and service side. Indeed, the CPO takes care of the charging point delivery, operation and maintenance, whereas the EMSP is in charge of the service provision, the payment of the charging and acts as the interface between EV drivers and the providers.

*Technology providers* consist in companies which are responsible of the fabrication or commercialization of the charging points, for what concerns both the hardware and software side. Moreover, putting the spotlight on the hardware part, they can provide the charging infrastructure itself, such as cables, WallBoxes and charging stations, or connectors, cables, etc.

Finally, *utilities* represent the category of actors whose business is centered on the provision of electric energy. Trivially, they can benefit of the increase of electric energy consumption due to the ever-growing EV adoption, but they even integrated the charging service in their current offer as well, by becoming concurrently energy suppliers and CPO or EMSP or both.

# 5. Empirical analysis

Before starting the empirical analysis, it is worth noticing two aspects. Firstly, the companies will be dealt with in a blind form for confidentiality reasons, i.e. in order not to disclose any sensitive data collected during the interviews. Therefore, each company will be anonymously treated. For this reason, each of them will be depicted using an acronym deriving from the name of the category accompanied by a number following an increasing order. Moreover, some specific information was not presented in the current chapter for sensitivity reasons or because of the explicit request of certain companies not to do so. For this reason, the afore mentioned information will be disclosed in the next chapter – *Results and discussion*, in an aggregated form.

## 5.1 Car makers

### Car maker 1 – CM1

Even though the interview has heavily revolved around the portfolio of EV available, and no significant information about the charging infrastructure has emerged neither during nor before the interview, some interesting aspects are worth to be noted. First of all, the EV-related revenues account for about 10% in the European market, slightly below the 12% in the US one, hence representing an interesting and promising share. CM1 has always been a premium car manufacturer, with a brand reputation that immediately recalls quality and a certain status-quo, and has produced the first premium car 100% electric. The customer segments identified in the EV market are **equally split** between B2C and B2B, and the channels exploited for these customers engagement are likely to be the same used to convey the charging products and services. The division follows an **indistinct** strategy, without any preference between push and pull techniques, using as indirect channels mainly car dealers through long-term rentals and leasing options. The loyalty is built starting from the customer, which can decide whether to enter the loyalty program or not and, according to that, the **customer relationship varies**.

The key resources strictly required by the EV business are strongly oriented toward the design, materials, and performance, but it can be assumed that **quality and brand reputation** play a fundamental role in the charging business as well. The company is, to some extent indirectly, **supporting the development** of the charging infrastructure, contributing with leasing options to the abatement of the final price for the drivers, in order to spread the adoption of EVs. The key partners



block is a very interesting one, in fact the company has connections **both upstream and downstream**. In Germany for example, a partnership with a leader manufacturer lead to free bundle of a WallBox with the seeded EV, whilst partnerships with CPO and EMSP have created efficient platforms for the charging service, boosting interoperability between the main operators.

Together with an important EMSP, CM1 has developed an extended package in which the car is sold with a **monthly subscription** to a charging service at a fixed price per kWh. No information is available about the most important cost items.

## Car maker 2 – CM2

Relying on quality and design, CM2 is constantly working in order to improve the performance of its EV, with a particular attention to the range, which has doubled in the last 6 years. The company offer **both private charging products and public infrastructure**. The WallBox is coupled with additional services, such as the billing and management software, installation, flexible chargers, or a special offer for *green* energy supply. The absence of a consistent history makes it difficult to precisely identify the customer segments, but on a qualitative level, pure private clients make up about 40% of the total, whilst **professionals, fleet operators, and dealers about 60%**, with a consistent and significant growth of the leasing and rental configurations. The channels used to reach the drivers are **heterogeneous**, with direct channels mainly digital, whereas indirect rely on dealers. The customer relationship strategy is not differentiated, and the guideline is set at a corporate level, since there is no distinction neither between traditional vehicles and EV. This is based on transparency and **pre-sale** consultancy, a service provided by dealers.

**Human resources** are the most important among the assets, whereas at a corporate level all the physical resources related to the production have a relevant role. The dealers are trained with corporate directives in order to perform activities of **awareness-raising**, considered by the company a fundamental action, since consumers are usually confused when it comes to the charging environment, with constantly changing regulations and innovations. One of the leaders in the EV-charging business is involved in providing an integrated mobility service, and different big upstream players are involved in the installation of the WallBox.

The main revenue streams are related to the **product sale**, comprehensive of components and setup, whereas the cost structure has been deliberately not disclosed, although the numerous projects and joint ventures to boost the development leads to think that different investments aiming at **supporting the infrastructure** represent a significant share.

## Car maker 3 – CM3

CM3 entered the EV business early in 2010, and the volume sales account nowadays for about 5% of the total. The value proposition of the company is to offer a car which fills a gap between city cars and premium cars, without giving up quality and range. For what concerns the charging infrastructure, it is **more oriented towards the product**, bundling the private station with the car, but providing charging simplifications, like easy location and access to the property infrastructures installed at the dealerships. The customers are **equally split** between B2B and B2C. The former used to represent about 80% of the total market up until a few years ago, but domestic charge has gained a lot of momentum and is steadily increasing, to the point that the company has progressively abandoned the public infrastructure business. Through a developed CRM and a service of consultancy (offered to the bigger B2B clients), the company offers **both pre- and post-sale services**. Even though dealers are an important indirect channel, **direct channels are preferred**, both digital and physical, being present for example in universities, targeting a medium-high culture segment of potential buyers.

A **balance in resource term** between human and financial assets emerged during the interview. Outsourcing most of the production of electrical components, the main activities carried out by the company are **the spread of information and lobbying** towards a fast and effective implementation of regulations supporting the development of a pervasive infrastructure. Whereas no particular partnership is in place concerning the operations carried out in the car manufacturing, strong partnerships exist in the charging value chain. Historically siding by a leading utility for private WallBox, CM3 has now its stronger partner in a **technology provider**.

The main revenue streams are related to the **product sale**, since the WallBox is offered in bundled with the vehicle, but revenues also stem from the charging process in dealerships. A collaboration with a leading utility in order to use batteries at their end of life, than turned into a more economical solution of internal recycling, entails costs which are, indirectly, related to the **support of the technology**.

## Car maker 4 – CM4

A premium car maker, CM4 has entered the e-mobility market in the last years and has currently no real competitor in the light-duty vehicles. Innovation, safety, flexibility, and reliability are the key concepts behind the company, with an offer concerning the charging infrastructure that includes **not only a labelled 22kW WallBox**, but also easier accessibility to charging stations by the company's dealerships, and the possibility to locate and reserve charging points through an integrated on-board software. Addressing **mainly a B2B market**, since the focus of the company is mainly on commercial and light-duty vehicles, fleet managers of companies, hotels, and rentals, are the most targeted segments. The B2C market is a niche where customers are high-income clients, driven by innovation and sustainability. Commercial relationships are **mainly pre-sale**, managed by the network of internal key account managers, which have to deal mainly with leasing or long-term rentals. Key account managers represent the most used channel to engage customers in a direct way, even though **indirect channels exist [2]** in the figure of dealers, which organize events in order to solve the customers' doubts. Broadcast communication is usually carried out in a *one-to-many*, digital, configuration.

**Key account managers** are the key resource, having to deal with the scepticism of the customers which is usually what discourages the sale, especially for range anxiety matters. The main activities are related to the **R&D department**, supporting the spread of EVs in order to drive down the costs. Among the key partners, the support mainly comes **downstream**, relying on a big utility for installation and consultancy of charging points both for private owners, and fleet managers, but also being part of an important joint venture in order to develop a pervasive infrastructure.

The economic model mainly refers to the corporate level, but for what concerns the revenues, it is possible to identify very marginal streams, coming **both from the WallBox and the charging services**. Whereas production costs and R&D are by far the biggest items at a corporate level, **marketing and communication** plays a more important role for the charging infrastructure market.

## Car maker 5 – CM5

One of the earliest car makers to test next-generation EV, CM5 is a world leader in the sector. Nevertheless, as little as 3% of the total sales come from electric vehicles, highlighting that there is still a long way to go, as the company itself underlined. Even though the focus is still on the vehicles, trying to reach the critical mass of drivers in order to trigger a self-sustaining growth, CM5 is already offering the possibility to buy, together with the car, **a private branded WallBox**. Moreover, the company is developing an *ad hoc* solution for workplace charging, contemporaneously helping the development of a pan-European network through a charging service platform. Working predominantly in a **B2C market**, the company does not address business customers, relying mainly on **direct channels** for the engagement, exploiting both digital and physical channels, from social media and dedicated website, to conferences and summits, leveraging on the customers' desires and needs of security, cheapness, and innovation.

The main resources employed in the value creation are human, especially in the **marketing and commercial** development, in order to improve the **support to the development of the infrastructure**, partaking in consortiums, creating institutional relationships, and helping to spread the benefits of e-mobility. With the main partners for the electronic components of the car being Asiatic, other partnerships are mainly on the **charging side**, especially CPO and EMSP, but also sharing and leasing companies, and a high-tech start-up developing an e-roaming platform for charging stations location and reservation.

No consistent information has been found nor disclosed about the revenue streams, but for what concerns the costs, so far the **marketing expenses** are more relevant.

## Car maker 6 – CM6

Probably the most representative company in the pool for what concerns e-mobility, CM6 entered the business in 2003. The strength of the brand is reflected in the value proposition, which is the research of top quality for the driver, in order to have the latter interface with the company and the company alone, without any intermediary along the whole process, from pre-sale, to assistance and maintenance, to charging issues. Offering **both products and services**, namely the domestic charging point and a branded network of public infrastructure appositely designed for the company's cars, as well as the app to monitor and manage the charging process. The ultimate goal is to abate the range anxiety providing the driver with the possibility to charge whenever needed. As the car market, also the charging infrastructure one has started, and is still dominated, by customers mainly in the **B2C market**, with a growing component of destination charging (hotels, restaurants, retailers that manage the charging stations as EMSP), and a share of B2B which needs to be furtherly supported by incentives. As CM6 underlined, the line between private and public charging is sometimes blurry, as it is the example of semi-public configurations. Adopting the strategic decision to not have an advertisement department, the company has never invested in sponsorships nor endorsements, and the mission of the company is spread to the customers mainly through word of mouth, especially due to the notoriety of the brand and the figure behind it. Since the goal is to have customers which are not just drivers, but share the vision of the company, the relationship kept is **very tight** both pre-sales, with consultancy and test drives, and post-sales, with constant updates of the on-board software and of the app.

As it emerged frequently during the interview, the **company's culture**, the enthusiasm, the willing to share the vision, is the key resource. Questioning everything is incentivized and being bold is a pre-requisite, keeping as guidelines the goal of reducing to the minimum scraps and wastes, setting short-term goals in order to guarantee flexibility and responsiveness. First company to develop a completely-connected car, the ultimate goal is to **support the development of e-mobility** through its activities. At a strategic level, the decision not to have the company's name associated with any other brand leads to partnership which are only functional, in a supplier-buyer configuration with **components manufacturers**.

Although services are a fundamental component of the offer, the main revenue stream stems from **domestic charging stations**. On the other hand, the main cost items are related to **production and installation** make up the main part of the cost structure.

## Car makers recap

Playing an undeniably fundamental role in the e-mobility sector, different car makers have expanded their influence and their operations to the charging infrastructure as well. Leveraging consolidated brand reputations and loyal customer bases, these companies started to vertically integrate some activities and to partner-up with players along the value chain in order to maximize the overall network efficiency. With an expected 500 different models of EVs available by 2022, historic incumbents in the automotive industry have expanded, or are planning to expand, their portfolio in order to include this segment, while new companies are sprouting, especially in East-Asia, specifically to address the EV market.

Some considerations have to be done in order to properly frame the analysis. The six interviewed companies are among the most important and revenue-generating worldwide, specifically in the Western world, with four of them accounting for more than 100B\$ in revenues each, and the remaining two settling for lower revenues due to the niche market addressed. Not to alter the outcome of the study, other companies that had been engaged and that specifically expressed no business in the charging infrastructure sector have not been interviewed.

This relevance in the industry makes the sample strongly representative of the category. Nonetheless, during the interviews, the topic has often been shifted more on the EV *per se*, rather than on the role of the company in the development of the charging infrastructure. For this reason, some information might be related to the wider market of EVs and, when this happens, it was specified. Anyway, it is reasonable to assume that some features related to the electric vehicles can be applied to the charging infrastructure business as well. For example, since the product or service is usually sold together with the car (or with the rental contract), it can be assumed that customer segments, channel, and customer relationships will not be far from the ones constituting the building blocks of EV-makers business models.

In the *value proposition* block, taking into consideration that every company sells cars, it is analysed the relation with the charging infrastructure. A company that couples the sale of the car with a WallBox, for example, or that directly installs charging stations, will be **product-oriented**, whilst a company more inclined to the provision of apps to locate charging points or to maximize the charging experience will be service-oriented in order to improve the **accessibility** to charging points for the drivers.

*Customer segments* are divided between **B2B** and **B2C**. The first one refers to business customers, namely fleet managers, commercial operators, professionals, or *POI* owners that want to provide property fleet. B2C on the other hand is related to private EV drivers.

*Customer relationship* ranges between **pre-sale** services, such as consultancy and assistance for administrative and technical aspects, or **post-sale**, concerning road assistance, call centres and CRM.

*Channels* can be **direct**, including marketing and communication direct efforts, or **indirect**, leaning on third parties or partners in order to reach the customers.

*Key resources* are mainly referring to **culture & know-how**, focused on the product development or on the company's vision, or **commercial**, related to marketing and sales activities mainly.

Concerning the *key activities* these can be **development support**, where the support is to be intended as the spread of an integrated and pervasive charging infrastructure, hence it is an activity which is both financial, through investments, and communication-related, spreading knowledge. On the other hand, they can be focused on **product sale**, i.e. the sale of the private charging station to the customer.

*Key partners* work both upstream, such as **manufacturers** of charging stations, and downstream, such as **charging service** providers towards the end customers, which perform activities of integration, location and, in general, these are represented by CPO and EMSP.

The main *revenue stream* is, of course, the car sale, but in order to enter more in the detail of the charging infrastructure, they can be classified into **product sale**, referring to the sale of the charging station coupled with the car, or **charging services**, representing the additional sale of pre-agreed charging packages.

The *cost structure* can be on the other hand considered as distributed among **support** and **marketing** costs. The first one includes investments in communication, joint ventures, and spreading awareness in order to lobby towards a faster development, whilst the second refer mainly to marketing and clients identification.

## 5.2 Electric equipment distributors

### Electric equipment distributor 1 – EED1

EED1 is a company specialized in the provision of **hi-tech components** for on-board and off-board charging, such as cables, controllers, connectors, monitoring devices, and other safety-related products. The product does not come alone, but is bundled with a deep and thorough **consultancy** phase. Seeking constant evolution and innovation, having as the utmost target safety and security, the company provides products which are constantly updated. The software installed on the controllers for example, is updated quarterly free of charge. Addressing a clientele which is **only business**, mainly WallBox or charging stations manufacturers, the company engages through **direct**, mostly physical channels, organizing about one conference or event per month, relying on wholesalers or traders for less than 1% of their customers. Once the relationship is set, EED1 looks to build **loyalty and mutually-beneficial partnerships**, providing updates, counselling, and training to its customers. Pluriannual experience in the industry have created an **internal know-how** which is core to the company's activities. About 150 engineers work on R&D projects, but a profound knowledge about the products available on the market as well as of the regulatory framework is fundamental too. For as important as the R&D division is, especially concerning the software development for controlling systems, it is **equally important** that the counselling service to the client, as well as the commercial activities of identification and engagement with the latter, are thoroughly carried out. In order to do so, no stable partnership exists, even though it sometimes happens that occasional joint efforts are carried out with engineering and design firms.

Even though the sources of revenue differ from one Region to another, in general **product sale** plays a bigger role. In some countries, nonetheless, counselling in the design and engineering phase is a non-negligible source of income. Less geography-dependant, the cost structure is **evenly distributed** between R&D and marketing efforts, both for internal purposes (personnel training) and for external (fairs and events).



## Electric equipment distributor 2 – EED2

EED2 has been in the charging infrastructure business for 5 years now, and sells all the products necessary to operate charging stations. The product is **coupled with an *all-around* support** that guarantees expertise and availability. Addressing **a B2B market**, mainly installers and construction companies, EED2 hardly knows the final customer of its products, but on a qualitative approach, about 70% of them ends up for public charging, and only 30% for private. Being the network of clients a crucial resource in general for distributors, the relationship which is established is **strong and durable**, based on consultancy, empathy, and constant updates. In order to reach these customers, a capillary commercial agents network has been developed, **directly addressing** the potential clients. Moreover, sometimes the latter engage with the company, having known about its services through the website or the installers network.

**Human resources** are the core resource, developing internal experts providing **training** in order to develop know-how both for the internal and external commercial agents. In order to provide the service, EED2 relies on big **manufacturers and suppliers**.

For what concerns the main revenues, the **product sale** is the principal source. Although the cost structure has not been disclosed, the interviewed has often pointed out that the **marketing efforts** to train commercial agents is crucial to the company, hence it is reasonable to assume that it makes up a substantial part of the total costs.

## Electric equipment distributor 3 – EED3

EED3 offers a **complete package [5]** product, bundled with the application (with the main feature of location and monitoring of the charging point) and a site inspection consultancy by the installers. The market is **completely B2B**, made up of installers, car dealers and, representing a minor share, utilities. Being a B2B-dominated, the client requires **continuative and durable** relationships. The channels used are **mainly direct**, with website and e-commerce accounting for about 14% of the revenues, thus being more dependent on physical channels, such as key account managers for big clients and point of sales.

Technical **know-how and expertise** are the key resources of the dedicated personnel, with a non-negligible impact of financial resources for communication and advertisement. R&D activities both to develop the portal and to train the internal knowledge are **as important** as marketing efforts. Communication and commercial activities are carried out sided by **manufacturers**.

The **product sale** makes up the larger share of revenues, especially for the residential destination, whilst for small industrial sector companies additional services contribute to the stream. The cost structure is concentrated on human resources and **product-related** items, such as technology acquisition and stock costs.

## Electric equipment distributors recap

Electrical equipment distributors are a category playing a fundamental role as upstream suppliers, providing not only components, but extended solutions including services and consultancy. It is important to underline that the pool of interviewed companies is very small, counting only three different players. Nonetheless, the relevance in the e-mobility sector of these companies makes them a potentially interesting proxy of the whole category, hence the decision to proceed with the analysis even though the sample is not wide enough to guarantee statistical robustness.

For what concerns the *value proposition*, the solutions offered by the players range from **product-oriented** ones, which means the hardware alone, up to the provision of a wider package including some kind of **services**, which can include the bundle of a software, consultancy, or post-sale assistance.

The *customer segments* block mainly sees a distinction between **business customers (B2B)** and **end consumers (B2C)**. The first category includes utilities, installers, dealers, and charging point manufacturers. For the B2C segment it is intended a customer segment made of domestic and residential charging stations. Moreover, when information is available, it will be specified whether the charging stations are meant to be *public* or *private*, even though being this category usually not close to the final customer, the destination is hardly known.

*Customer relationship* strongly depends on the target market, and ranges from a simple form of **assistance**, mainly technical, to a **durable partnership** where training and continuative updates, and at times, co-design and ad-hoc solutions are provided to the customer.

The *channels* on which distributors mainly rely to reach their customers can be clustered as **direct** and **indirect**. To clarify, direct channels means that no intermediary is involved between the company under analysis and its customers. Whereas this does not happen, it is the case of indirect channels, of which some examples can be the presence of wholesalers, traders, or dealers. Another interesting distinction that will be done where possible, will be between physical and digital channels. Digital include website, social media, webinars, and other online portals, whilst physical channels are related to the participation to fairs and events, to service centres. An important channel which is difficult to be systematically labelled as either digital or physical is the *word of mouth*.

Moving to the value network, the *key resources* block sees configurations ranging from **human**, meaning skilled and trained personnel, salesmen, technicians, and engineers and designers, to the **financial** resources required to conduct business.

The *key activities* performed can be considered as more internally oriented, including **research and development** activities, that can be related both to the development of the product, the platform, or the personnel *know-how*, or more externally oriented. This is the case of the **sales and services**, which deals with customer-centric operations, from marketing, to the identification of customers, to pre- and post-sales services to the latter.

The *key partners* sees on one side the partners for the **design** phase, meaning designers, engineering firms, software and hardware developers, with which happens. On the other hand, **manufacturers** identify a partnership which is usually based on a supplier-customer relationship, thus being more relevant on a functional level.

Analysing the last two blocks, the main *revenue streams* come from either the **product sale** or a **service sale**. The latter refers to additional services such as separated consultancy or add-on, since the main services are usually coupled with the product, hence considered as product sale.

Last, the *cost structure* ranges from **product development** costs, mainly related to R&D expenditures, to **marketing expenditures**, which include the commercial network and the costs to be sustained in order to train the marketing personnel. Logistic costs, such as raw materials supply or stock-related costs, are given an intermediate score.

## 5.3 Charging service providers

### Charging service provider 1 – S1

S1 is a CPO founded in 2017 as a joint venture of different car manufacturing companies, which aimed at creating a high power charging station network in the European area, thus guaranteeing long distance trips around this territory. Being the geographical scope of the company so wide, the statistics concerning the average usage of charging stations sharply varies according to different countries. For instance, company states in Italy each charging point is exploited twice or three times a day, while in Norway, these are used more than ten times a day.

As mentioned before, S1 proposes a fast and intuitive charging network based on renewable energy in order to defeat one of the main barriers to electric vehicles adoption, i.e. range anxiety. One of the pillars underlying its offer is **service availability**, e.g. stations present multiple charging points and they are characterized by high efficiency of back-end services: intervention should be potentially taken on real time, in case of necessity. For this reason, S1 develops a precise **maintenance program** and constantly seeks operations optimization, with the ultimate goal to offer a positive experience to customers, even integrating **optional services** during the charging to involve the customer while waiting. S1 provides services to both **EMSP** and indirectly end users equipped with CCS connectors, which are direct clients of EMSP but indirectly of S1 as well. Moreover, clients can benefit from **customer assistance 24/7** provided in seven different languages, while, taking into consideration the channels, the company **mainly** relies on **digital channels**, for instance car manufacturers platforms, and only secondary on traditional **press** channels.

Shifting then to the resources S1 believes as the most relevant to run its business, it lists **skills, human resources**, such as specialized electricians and analysts to run the monitoring and maintenance, and **funds**, since investment require a long time before providing a payback. Leveraging on the afore mentioned resources to develop a pervasive charging network, S1 focuses its activities on charging points **design, installation, maintenance** and **monitoring**, besides customer **assistance**. The company relies on several external partners: firstly companies which provide the **design, realization, installation** and **certification** of charging points technology; secondly, **Oil & Gas** and **utility** companies which are expert in the refueling sector and in the consequent activities and customer experience related to this; finally, **shopping malls** and other **area managers** providing the space where to locate charging points.

Finally, analyzing the economic model, revenue streams derive from the sale of **charging sessions**, which are recorded basing on **kWh supplied**. In this case, the charging for users who have subscribed a contract with an EMSP is more convenient than charging directly from S1, who obtain the charging for 0,79€/kWh. On the other hand, for what concerns the cost structure characterizing S1 business, this is divided into CAPEX, such as the investment for each **charging station**, approximately 1 Million € (comprising the transformation cabin, the charging points, the cooling system etc.), the **installation** and **wiring**, and the **authorization issue**, which can extremely vary from region to region, from 30 days to even 8 months. Operational expenditures are still not well defined due to the fact that other operators are quite young in the market, but they mainly refer to Operation & Maintenance.

## Charging service provider 2 – S2

The second charging service provider is an ESCo and makes its enter in EV market between 2017 and 2018. The company presents in 2019 a turnover of 1.6 Million € and states that around 10-20% of it can be attributed to e-mobility.

What the company aims to reach is to substitute the physical access to charging service, namely through RFID card, with a totally digital access through its app. In other words, it aspires at creating a network **easily accessible** by all customers but maintaining the individuality of charging stations managers. Taking into consideration the typologies of customers that S2 addresses its offer to, it mainly serves the B2B market: it offers a platform for the remote real time management and monitoring of the charging stations to **CPOs**, allowing them to be autonomous in their operations and planning maintenance; secondly it addresses its offer to **large-scale distribution**, such as supermarkets and electronic retailers; thirdly, to **petrol stations**, usually in urban or extra-urban areas; to **camper areas**; finally, to **companies** owning electric vehicles fleet. Moreover, S2 states its customer base is indirectly composed of end users, which actually are clients of CPOs, and of **PAs** as well. For what concerns the relationship the company maintain with its customers, it interacts through the **app**, by which the customer can have access to his historical data and statistics based on his profile, but mainly through **administrative personnel** for B2B market, which represent the greater segment. The company exploits both digital and physical channels, with a slightly higher inclination towards the latter: it participates to fairs and events, it exploits technology and electric equipment distributors which have a direct contact with technicians, besides companies active in innovative business, such as energetic efficiency companies, that allow S2 to reach customers from crossing sectors and word of mouth.

Shifting then to the left side of business model canvas, the company totally relies on tangible resources, such as **human resources**, both internal (75%) and external (25%) to the company itself for the development of the managing software, the **software** itself and finally **financial resources**, allowing investments on R&D. For what concerns the activities crucial for the running of the business, S2 states these correspond to the **delivery of the platform** and potential **customization services** for specific clients. To obtain and to carry out the afore mentioned key resources and key activities, S2 leverages on some crucial partners: **hardware developers**, namely electric equipment distributors and technicians, and **software developers**.

Moving to the economic model, the company gets a **fixed income** for charging points synchronization and the annual subscription, while it does not get any fee based on payments. For what concerns costs

instead, these mainly correspond to the **software development and management**, for which the company relies for 75% on internal resources and the remaining part on external ones. Particularly, the company explains in 2019 it spent 130 000 € for software development and management, and 40% of it was dedicated to R&D.



## Charging service provider 3 – S3

The third company interviewed appears in the EV charging market in 2016 as a general contractor, offering a complete range of products, services and solutions for the electric charging. The charging technology is supplied by external providers, with whom the company has established advantageous agreements to then sell them in a white labelled way, i.e. no logo is present on the products, thus the customer can customize the charging point with its personal symbols.

As already said, the company aims at being a general contractor serving as a **full service provider**: its offer starts with customers' requirements analysis, moving to the selection and provision of customized charging systems, which are internally and remotely managed by a team of specialized technicians. In other words, S3 takes care of planning, design, selection, supply, installation and maintenance of charging infrastructures, besides the management of the charging roaming thanks to its cloud platform and mobile app, leveraging on competitive prices due to its presence on different geographical areas, allowing it to acquire sizeable product quantities that are later distributed. Shifting to the customer segments the company seeks to satisfy the needs, these are highly unbalanced on the B2B market, indeed the company addresses its offer towards **corporates** (50%), car **manufacturers** (20%), **utilities** (20%), and **real estates** (10%), i.e. owner of different buildings. In addition, the publicly accessible charging is privately owned in 85% of the cases, while in the remaining part it is even owned by PAs. The second customer segment, namely B2C, is only a small part of S3 customer base and it is composed of **end users** which are offered ready to use solutions. For what concerns the customer relationship S3 establishes with its customers, this is based on **dedicated personal assistance**, indeed each customer is looked after by a dedicated representative of S3 and he is offered 24h customer care.

S3 takes advantage of a consolidated **experience** in the energy market, a sound **technological know how** and strong **analysis capabilities**, besides **human resources**, who carry out the preventive analysis of the customer in order to understand which is the best solution to offer to him. Leveraging on these resources, S3 develops the initial **consultation** to the customer – concerning for instance which charging points to install, how many of them and with which power– and solution **customization**, both from hardware and software side. Regarding the partners, S3 has built a partnership with **car manufacturers** – that commercialize its products, **charging systems constructors** – which launch new products that are then sold by S3 on the market, and **companies renting vehicles fleet** – to which S3 offers the charging service and assistance.

Concluding with the economic model, S3 offers different payment modalities: a **fixed rate subscription to the service**, the **service payment** or the product payment. For what concerns the cost structure, the company must sustain the **internal development** of the software, leveraging on about one hundred employees, and the **external network of technicians** which manage customer requests.

## Charging service provider 4 – S4

Charging service provider number four makes its enter in the Italian EV business in 2020, having installed more or less one hundred charging points on this area. As the previous company, S4 aims at providing a 360 degrees service, by providing the hardware, the network of charging points and advanced services, such as the billing. The company acts both as provider of the charging infrastructure, namely as CPO, and as EMSP, supplying the charging service through a card which is used to identify the specific user.

Company's value resides in taking care of every customer requirement with a high quality hardware and offering an **all inclusive service**: since the purchase of the EV, the car dealer can directly activate or send customers' documents to S4, from this moment on, the company takes contact with the customer, carries out the inspection, develops a personalized offer, computes the billing, assists the client from remote by using a call center and in case of move, it even deals with the move of the charging point, besides providing interoperability between different CPOs. Regarding customer segments, the company slightly serves B2C market, indeed only 20% of its customer base is composed of end users, while **80%** of it is made of **long term car rental companies and businesses**. In relation to this latter, companies provide a card to their employees which is used to bill every charging and, later, allows them to obtain their refund. Shifting to the channels used to reach customers, in particular the prevalent B2B market, the company relies on the **commercial network**, while the company does not rely on television for advertisement. In particular, the commercial network is based on contacts which take place in the central European venue and that are then passed to different nations.

Considering then the resources S4 considers to be critical for the proposal of its offer, these are the **hardware**, owned by the company itself, and the **infrastructural network**, besides the **local network of technicians**, through which the company is able to **design, build and maintain** smart charging solutions for each kind of location (at home, at the office or while travelling) and to **integrate information systems** to manage the billing system. As concerns partners, S4 leverages on some **trustworthy commercial partners** and on an external network of **technicians**, one for the business segment, since this requires heavy structural interventions and excavations, and one for consumers, which is more used to work in condominiums and private houses.

Finally, S4 gets its revenue streams from the sale of the **charging point**, its **installation**, and the **sale of the charging service**.

## Charging service provider 5 – S5

S5 pursues to provide a rapid, technologically advanced, reliable and accessible infrastructure. It mainly serves **B2C customers**, i.e. end users driving EV, while **B2B** share is **negligible**, represented by vehicle fleets and legal subjects. The goal of S5 is to offer the **charging wherever**, so implementing a widespread charging network, besides increasing the flow of customers towards companies which host S5. The channels exploited to reach end users are **corporate communication**, communication through **hosting partners**, **targeted campaigns** in areas where many customers are present, and digital channels, such as **newsletter** and social **networks**.

Considering the key resources block, S5 states these are the **technical competences**, namely the platform for infrastructures management and the software for what concerns the CPO role, while for both CPO and EMSP roles, the app to interact with customers; in addition, even the **charging equipment** outsourced, the **financial resources** and **human resources** – for the management from remote, the central venue and teams for maintenance, installations and inspections, are fundamental as well. For what concerns the activities the company develops, they differ considering its different roles. Acting as a CPO, S5 must identify the **best location** for charging points, carry out **commercial activities**, both internally and through partners, **obtain authorizations**, **procure** and then **install** the charging point, **make construction works**, **conduct administrative activities** and take care of **software communication** to aggregate all the infrastructure of other players too. On the other side, considering S5 as an EMSP, it must take care of **customer subscriptions**, provide a **tool to make the infrastructures available**, namely the app, have a **relationship** with **different CPOs** minimizing financial risks, and **manage non-proprietary infrastructure**. In addition, S5 has built strong relationships with **car sharing companies**, **charging technology providers** and **hosting structures** too, such as PA authorizing it to exploit public land, or private companies providing public charging, namely shopping malls, restaurants etc.

Concluding with the economic model, the distinction between the two roles is still present. As a CPO, S5 earns from the **price of the charging** and from the **usage of software** by third parties, while it must sustain CAPEX, related to the **charging point**, the **hosting structure**, the **connection**, the **excavation** and the **development**; OPEX, which are operative fixed costs to manage the charging points, such as **insurance**, **parking cost**, **TOSAP** (the tax for public land occupation), **internet connection** costs and **energy costs**; **marketing costs**; **software development costs**. Shifting then to the EMSP role, S5 revenues streams derive from the difference between end user price and the cost for the CPO, besides inflows generated by the partnership with car makers and from the app. Considering instead the costs, these are due to the platform development and marketing costs.

## Charging service provider 6 – S6

The sixth company interviewed enters the EV business in 2013 and, thus far, it has installed about six hundred charging points: five hundreds privately owned but with public access, fifty on public land and fifty for domestic charging.

The company offers advanced solutions for the charging of cars, bikes and motorbikes. It seeks to guarantee to its app users to easily have access to a platform aggregating different charging point operators. In addition, it guarantees the **identification** and **renting** of the charging point, **remote payment** and the **interoperability** of the service, besides post-sale services, such as **assistance** and **maintenance**. This offer is mainly addressed to B2B market, where it installed five hundred charging points in businesses such as **restaurants, swimming pools, gyms, hotels**, and in minor parts to public administrations (fifty charging points) and private for **private use** charging (fifty charging points). The relationship established between S6 and customers is a long term **consulting** one to support them with their needs, while the company relies on a direct network of **industrial subjects** and **investment funds**, on an indirect network of **technicians** and **designer**, and on demonstrative **events** about products functioning and features.

The company presents a strong **know how, project management** and **customer assistance**, and what is crucial for the company is the **supply** of the **hardware**, with different powers, and the **participation** to **events** for technicians and suppliers. As concerns partners, the company relies on **investments funds, technology providers, brokers, agents** and **technicians**.

Finally, the company is able to sustain its activities thanks to revenues deriving from **the sale of charging points**, from the **managing fee**, i.e. a **fixed** annual cost for guaranteeing to customers the analysis of any problem, and from the **charging fee**, which is recorded basing on the transaction, not on the energy provided. Considering the cost side, S6 mainly pays for **human resources wages** and for **hardware purchase**.

## Charging service provider 7 – S7

In 2019, S7 introduces in its business portfolio a competitive offer of private charging points, thus making its entrance in the EV charging market.

The company defines itself as a retailer and its offer is based on providing a **complete service**, comprehensive of inspection of the charging locations for feasibility analysis, consultation, estimate, installation, management and even the chance of including energy supply, besides the installation of a software to manage the charging points and payments, and an app for the smartphone. In addition, one very peculiar offer that S7 proposes is the long-term rental of WallBoxes, based on an all-inclusive fee, including insurance, the equipment itself, a dedicated energy counter and even energy consumed by the EV. For what concerns S7 clients, 80% of its customer base corresponds to B2B, namely **small and medium industries, restaurants, hotels, parking garages**, in other words places where access is public but it is controlled and reserved. The remaining share of customers is composed of manufacturers of WallBoxes and charging stations, both in AC and DC. Customers are followed by **skilled consultants** which provide their support by telephone or video for the whole duration of the service provision. Moreover, the company is developing a strong campaign of lead generation, i.e. the marketing technique to identify customers based on online data analysis, but currently, it only exploits **telephonic channels** and its **website**, hoping to move to in person meeting, in future.

Considering S7 key resources, it states that **technical skills, financial resources**, and the sound **experience** in light & gas services provision are the most crucial ones. Furthermore, company's operations are mainly based on **marketing**, focusing on customers identification and contact establishment, and **commercial activities**, such as the sale of the charging point and the drafting of the long term rental contract, besides **consultation** and **assistance**. As concerns partners, S7 is almost independent, by having established a partnership only with two external certified **technicians**.

Concluding with the economic model, S7 earns a fee for each **charging point sold or rented**, while it must pay for the **purchase of materials** and for the **installation**, which is outsourced.

## Charging service provider 8 – S8

The eighth charging service provider interviewed deals with EV-chargers since 2018, and acts as a technology provider and CPMS.

The company proposes different types of offer: from the **pure sale** of the hardware, often white-labelled, to the provision of the **hardware**, its **installation**, and the provision of a **software** for the management of the charging point. The company has strong customization skills and proposes high quality solutions, with at relatively low prices. The main customer segment served by S8 is B2B, which is composed by **big companies**, **utilities**, **car dealers** and **car rentals**, while only a small part is represented by private end users. The customer relationship is maintained by providing **consulting services** and software updates. For what concerns channels, the company is physically participating to **events** and **fairs** and exploits **sale department** for specific customers, such as retailers and HoReCa.

The company states the most critical resources on which it leverages are the **hardware**, **human resources** – in particular sales department and key accounts, and **project management**, while, as key activities, it believes these are **product commercialization** and post-sale **customization** and **assistance** to customers. Finally, S8 outsources some aspects of **software development**, particularly the ones related to CCP protocol.

In conclusion, S8 main sources of revenues derive from the **sale** of the **hardware** and **installation services**, on the other hand, it sustains significant costs for **customers research**, for **hardware purchase**, for **sale personnel wages** and for **partners payment**.

## Charging service provider 9 – S9

Three years ago, charging service provider 9 integrated to its business, mainly based on photovoltaic market, the e-mobility one, focusing on private segments.

Indeed, the customer segments touched by the company are **domestic users** and **businesses**, i.e. respectively, B2C and B2B. In relation to businesses, it serves big multinational corporations which are fascinated by S9 knowledge about progressive technologies, such as renewable energy, cyber security, IoT and computer science, which represent real advantages integrated to charging points. Indeed, S9 value added resides in being a technical company, both from electric side and information technology one, and being able to leverage on these skills while delivering its offer. The company aims at **selling the charging points**, potentially, combined with **photovoltaic panels**, thus offering a turnkey solution. The company offers smart charging points **manageable from remote**, which may also be **labelled with brand logos**. By doing so, it wants to communicate, particularly to its business customers, that, implementing their solutions, they will be able to increase customer loyalty by providing a service towards their customers and guests, to motivate their employees, and to transmit an image of innovative and progressive company. Moreover, the company offers technical and **consulting support**, and leverages on **employees** for commercial proposition, not agents, since the former believes in company's value and transmits them more effectively. Digital channels are little used, indeed the company states telemarketing, website and social media are a minor part of their communication channels, while what is crucial is word of mouth, among customers but even among different stakeholders of the company.

S9 has a strong **information technology know how** and specialized **human resources**, such as sale personnel, engineers, architects, designers, and technicians. Benefitting of these resources, the company is able to provide **technical support** and **consultation**, while marketing is only a minor part of its key activities. For what concerns partners, the company has established a relationship with technology providers, such as SCAME and Fimer, and Eni motion.

Concluding by analyzing revenue streams and cost structure, the company sells the charging service and gets a marginality on each cost voice it must sustain, namely **hardware cost, wiring, installation and design**.



## Charging service provider 10 – S10

The tenth company interviewed accesses the e-mobility market in 2013, by focusing on technological development and on the provision of management and payment services.

S10 primarily focuses on the **supply of a software**, for the management and control of charging points, which is independent from the hardware on which it is installed. Relying on it, it provides a platform and an app for the **identification, booking, and payment** on the charging point. Furthermore, it also designs turnkey solutions, including the provision of the charging point and the analysis and selection of charging price, with possible smart pricing solutions too, i.e. private customers can make their charging points accessible by external people in a specific time interval with an agreed price. In particular, S10 product addresses B2B customers owning charging points, namely CPOs, EMSP, parking garages, companies, retailers, hospitals, utilities, car dealers and petrol stations, besides end users who charge at home and PAs. The software is accompanied by structured assistance through chatbot and communication passes through **digital channels**.

S10 states strategic resources are internal ones, i.e. **human resources** and technological resources related to **software development**, which also represent company's core activity. In addition, S10 depends on external partners for **payments** and **transactions** and even on a strategic partner providing **equity**.

Shifting to the economic perspective, revenue streams derive from the **sale** of the **platform** alone, or from the **sale** of the **turnkey solution**, that's to say the offer of hardware and software together, which is addressed to customers who do not have sufficient knowledge about technical features of charging points, and finally even **V2G research projects**. On the other hand, the main cost item for S10 is represented by the development of the software for the platform.

## Charging service provider 11 – S11

S11 launches the first prototypes for EV charging in 2004 but evolves in the market only in 2017, acting as both CPO and EMSP. In 2019, the portion of turnover dedicated to this new market is more or less 1% of the global revenue of S11.

Considering the bundle of products the company offers on the market, they slightly differ considering the afore mentioned roles. As a CPO, S11 offers **diagnostics, maintenance, charging price identification** and **data management**. As an EMSP, S11 takes care of the **commercial aspects** of EV charging. Nevertheless, the general aim is to offer a **complete service**, both for domestic charging and for businesses, starting from the analysis of customer needs, and reaching the definition of the whole electrification plan for users cars or company's fleet. Moreover, the company particularly stresses the importance of its app for the management of the charging point, that provides reports about the delivered service, for instance the counting of kWh supplied, or the takings achieved. The main customer segments addressed by the company are **businesses** and public institutions. The former comprehends **private corporations, workers with VAT number, hotels and restaurants**, for which the company designs, installs and manages charging points and WallBoxes. Furthermore, the company highly invests in public tenders, in order to award them and getting big public projects. Only a little share of its customer base is represented by domestic charging. In addition, the company maintains a relationship with customers through **direct agents**, which follow the whole installation. As concerns the channels, for sure the **sale agents** and **word of mouth** are crucial, besides other digital channels, such as **company's website** and **social media**.

Concerning key resources, S11 states the **technical skills** and **department** – which deals with key activities like **public tenders**, charging points projects **design, authorization, installation** and **management**, besides **commercial department** and in general **human resources** are critical. Moreover, the company relies on some key partners to convey its value proposition, such as **charging points providers, partners guaranteeing the interoperability** of the app, thus the user can have access to the charging points of different providers, and commercial partners, such as **long term renting car companies**.

Shifting finally to the economic model, the company earns proportionally to the **kWh supplied**, on the other hand, it must sustain the **purchase of charging points**, the **cost of personnel**, namely technical, commercial, accounting and administration department, besides the huge investment for **software development** and **app programming**.

## Charging service provider 12 – S12

Relatively young, S12 is an American company which makes its enter in the e-mobility business in 2019. For this reason in the same year, it presents a null turnover, having sustained mainly costs due to R&D and customer research.

Company's activity rotates around the **provision of a cloud-based software** to create and manage a charging stations network, thus allowing the customers to become players in the EV charging market, to operate and to invoice in the charging market. S12 bundle of products is characterized by modularity, in order to be able to easily satisfy personalized requests of the different typologies of customers, e.g. utilities, energy management companies, restaurants, retailers, large-scale distribution, car makers and OEM. The relationship the company establishes with these different customers is based on the involvement of S12 in companies development plans, since the former constantly updates its products. Furthermore, the company reaches a wider number of customers mainly thanks to **word of mouth, direct sale** and **physical participation to fairs and events**, besides the minor contribution of its **website** and **social network**.

For what concerns the resources the company believes that are the most critical for its operations, these are the **sale force** and the developers of **software** and **business plan**, besides **energetic, financial** and **telecommunication skills**, based on a sound international experience. Based on these resources, the company mainly relies on **marketing** activities and **customers identification**, and it has established a relationship with **commercial partners** for system integration, service management, the retail and funding.

To conclude, company economic model is totally based on the platform, indeed it earns from subscriptions and pays for its development.

## Charging service provider 13 – S13

S13 becomes a CPO in 2013 and focuses on Europe, mainly in central and western areas. Today, it is not present in Italy, but the company expects to expand its geographical scope to this area too.

The company presents a wide bundle of products – such as high power, fast, smart or regular charging, and services – such as an app, the 24/7 helpdesk and the cloud platform, which provides insights and analytics for EV drivers. S13 aims at providing an integrated turnkey solution, indeed the company does not only provide the hardware but even the software, which guarantees a correct running of operations, accessibility, monitoring, billing and interoperability. The customer segment is mainly represented by **B2B** market (60%), i.e. destinations charging – such as hotels, large-scale distribution, hospitals, offices, oil & gas companies, leasing firms, besides municipalities. The various customer segments can rely on 24/7 assistance in case of emergency, which is provided by a call center. In addition, S13 exploits both digital, like **website, social media, newsletter, call centers** and physical channels, such as the **24/7 help desk** for emergencies and the **network of suppliers and technicians** who sponsor S13, hence to increase the e-mobility market.

For what concerns the key resources, the company leverages on its sound **experience** in the European market, on **financial resources** provided by a shareholder who has acquired S13 three years ago, and the extremely complicated **algorithm** developed by an internal department for load forecast until 2040. Basing on these resources, the key activities S13 develops are the **platform development** and **operations management**. The afore-mentioned key activities are strictly related to S13 key partners, which are **installation and maintenance companies, call centers, hardware providers** and a **computer science company** for platform development.

Concluding with the economic model, the company earns from the **sale of CPO services** for charging, where fast and ultra-fast businesses are the most profitable one but require at least 10-years-lasting contracts for the customer to be able to pay the investment back. On the other hand, the company must sustain the **development** and **installation** of charging points and it states the ultrafast charging point costs approximately between 20 and 100 thousand Euros.

## Charging service provider 14 – S14

S14 is a company focusing on energetic efficiency and photovoltaic technology, but it added to this traditional business the EV charging sector, by becoming a CPO. Its offer is composed of the **sale and installation** of the charging point, **24/7 assistance, energy provision, monitoring from remote and the app**. In particular, this latter allows the customer to know where the next charging station is and how long it will take to obtain 85-100% of charging level, by simply registering the car through its license plate. The final aim of the company is to be able to compare the duration of an EV charging to the refuel of an ICE vehicle. Moreover, the company mainly addresses its offer towards B2C market, having installed 300 charging stations inside condominiums, while B2B is a smaller share of its customer base and it comprehends more or less 100 charging points among manufacturing companies, sport centers, hotels, cinemas, retailers, supermarkets, car dealer. For what concerns the relationship established with customers, the company relies on **direct consultation** to offer a customized service, while it mainly reaches its clients through digital channels, such as **social network** and the **app**, besides **press releases**.

Considering key resources, the company presents **strong engineering skills, 70 employees and industrial resources**, i.e. both technologies and incentives management provided by the State. In addition, the company relies on some key activities, such as the **monitoring of charging points** and the **development of the software for the application**, which must be able to face with different hardware. To do so, S14 leverages on partnership with **universities** for innovative development, besides industrial partners, such as **technology providers**.

In conclusion, the economic model relies on **kWh supplied**, which has a different price according to supply speed – ranging from 0,25€/kWh to 1€/kWh. On the other hand, the company pays for the **charging technology purchase** from third parties and the **realization of the charging system**.

## Charging service provider recap

Charging service providers mainly encompass two typologies of actors. Firstly, a significant portion of this category is represented by pure players, i.e. those companies specifically born for and focused on the EV market, aiming to provide and manage the charging infrastructure (namely CPOs) or, as EMSP, to supply the charging and related services, such as billing, facility location and interoperability. It is noteworthy that these two complementary roles – CPO and EMSP – are two sides of the same coin, representing respectively the hardware side and the software side, and for this reason some firms have integrated both the roles in their operations. Secondly, even companies which have extended their current business to this new market exist. For instance, a company selling photovoltaic panels can include in its offer both the solar plants and the infrastructure and services for the charging of electric vehicles.

Starting from the *value proposition*, one interesting aspect is the integration level of the bundle of products and services that the company offers. Companies proceed from providing the pure sale of the product, to adding to their proposition even additional pre- and post-sale services. In other words, firm's offer may range from simply **selling its product** – which may be the charging point itself, the charging service or a software to manage and control the charging, all characterized by different features, such as accessibility, ease and advanced technology, to integrate the product sale with a **design phase** and **consultation services**, to additional **extra services**, such as charging point location, booking and billing, often developed through an app, to the inclusion in the offer of **customer assistance** and **maintenance**, and finally to provide an all inclusive service, including even **interoperability** among different actors.

Shifting then to *customer segments*, these can be characterized by considering the type of market the company addresses its offer to: **B2B** or **B2C** segments.

The *customer relationship* depends on the type and intensity of relationship established. They can range between: the **self service**, where the customer is provided the tools to make its purchase but he is basically left free in the process; the **automated service**, where the client has access to customized services based on his personal information but he is however left free in the process; **co-creation**, where customers and companies have a collaboration relationship; **personal assistance**, in case the client is followed by a physical person which provides different types of support; and **dedicated personal assistance**, where the customer is looked after by a reference person which takes care of him from the beginning to the end of the commercial relationship.

Considering the channels exploited by companies to reach the different customers segments, these can be classified basing on their nature, being them **physical** or **digital** ones. Classical examples of the former category are physical participation to events and fairs, press releases, sales agents, while digital ones can be website, social media, online newsletters. One channel voice which does not perfectly fit any of the two labels and that has been mentioned by the actors interviewed is word of mouth.

Moving to *key resources*, these can be divided into **tangible** and **intangible**, and they can be for instance human or financial resources, software, customer assistance, skills, experience, know how, project management.

The two blocks of key activities and key partners can be similarly characterized. They can be related to **operations**, i.e. the installation and design of charging points, technical support and consultation, electric plant analysis, projects, platform and software development, monitoring etc. On the other hand, they can be focused on **marketing**, i.e. all the activities and partners which are fundamental for the commercialization of charging products and solutions.

Considering the economic model, revenue streams can be evaluated basing on their variability along time. Some companies earn from **fixed fees**, like the sale of the charging point and its installation, consultation etc., while others get **variable fees**, such as the sale of the service, the electric energy supplied etc. It is noteworthy that here the distinction between variable and fixed revenues is not the traditional one considering the variability based on the sale volumes, but this is assessed considering the *time*, in order to understand if these revenues represent a well-established inflow for the company, or if they represent an earning which can vary along time.

Finally, the analysis of the cost structure distinguishes between expenditures which are **internal** and **external** to the company, hence understanding what kind of activities the companies of this specific category tend to keep internal and what they are willing to outsource. Some classical examples of internal costs are human resources wages, clients research, and other activity specifically developed inside the firm boundaries; while some examples of external costs can be the purchase of technological equipment from a supplier, relying on external companies for software development, buying consultation services, etc.

## 5.4 Technology providers

### Technology provider 1 – TP1

Born in 2009, the company is structured in three divisions: energy, energy efficiency, and mobility. The latter accounts for about 20% of the total revenues, and out of this share, around 20% comes from e-mobility. TP1 has decided to address **only the B2B market**, directly interfacing with CPOs, EMSPs, and fleet managers. The service it offers ranges from the **installation** of the charging point, to the **management of the platform** of the latter, or the **management of the fleet**, in case the customer is a fleet manager. Being completely focused on the business market, TP1 is able to effectively target each different segment in a different way, tailoring each offer on the customers' needs. Moreover, the clear positioning and the **direct presence to fairs and events**, either physical or not (e.g. webinars), has strengthened the company's reputation, allowing it to leverage on direct channels such as the *1-to-1*, also conducting **profiling campaigns** on social media, through which it reaches and communicates with its customers. Once engaged the customer, TP1 adopts a push strategy, offering the different, targeted solutions, trying to create a **strong relationship**.

In order to provide these solutions, TP1 internally relies on **human resources** that have developed specific and relevant *know-how*, especially in the digital field, to conduct **research and development campaigns**, and on technical skills to perform all the **installation activities**. Externally, TP1 can leverage the afore-mentioned **strong reputation** to work on an effective **communication and promotion of the software**, instrumental to its portfolio of activities. Moreover, in order to deliver value, the company relies on external partners for the **hardware manufacturing**, and have developed a **synergetic network together with big utilities**.

Analysing the economic model, the main sources of revenue are the **sale or rental** (in the form of a subscription-like monthly fee) **of the service to access the platform**, and on the other side the **service to manage fleets**, even though the latter is still in its trial phase. Moving to the other face of the model, the main cost items are related to the **human resources** and the relative training, and to the **asset-side** necessary for the **production** and **testing** of the hardware platforms.



## Technology provider 2 – TP2

TP2 was born in 2010 and has steadily grown in terms of revenues throughout the years, up to the 37M€ registered in 2019. The company is strongly oriented on the **hardware provision**, in a quality-first approach with a strong focus on innovation. The market they address is strictly the **business** one, mainly consisting of automakers and charging point manufacturers, supplying on- and off-board equipment such as plugs, cables, monitoring devices, controllers, and management software. TP2 relies on a deep network of clients with which it has developed **strong relationships**, up to the point where products are co-designed with the customers. The latter are reached relying **both on direct and indirect channels**, participating to events, webinars, targeting potential new customers through social media, and using both digital and physical channels.

**Know-how and the engineering department** are by far the most important resources inside the company, fundamental in performing the **counselling and co-designing phases** to identify ad-hoc solutions for the customers. The main partner on which the company relies is an external IATF-certified body that offer support in the **testing activity**.

For what concerns revenues, the **product sale**, either directly or through an intermediary, is by far the main source, whilst **internal logistics** make up a large part of the total costs that TP2 has to sustain.

## Technology provider 3 – TP3

TP3 is leader society in **technical counselling and testing** on charging infrastructures and on the impact of EVs on the grid. This offer does not strongly belong to neither a hardware- nor software-oriented approach, since it is the provision of a service more than a product. For this reason, the score assigned is 3, being it more similar to an integrated solution. Strongly **B2B-focused**, the company mainly addresses CPOs and EMSPs, but also grid operators like TSOs and DSOs, engaging mainly through **direct channels** and also leveraging their reputation through the *word of mouth*, even though some indirect strategies are exploited, through the main shareholders' channels.

The key resources are **evenly balanced** between the personnel know-how and the infrastructures and assets necessary to run the tests. The activities TP3 performs are, as previously specified, **counselling**, requiring human skills and expertise, but also **testing**, which requires machinery and physical assets, but also software and algorithm development. There is no key partner in the daily business, but seldomly happens that a customer requires an integrated package, which calls for the need of an external **strategic counselling company** to perform a complete analysis.

The **service sale**, whether it is a counselling or testing one, is the source of revenues, whereas **personnel costs** take away the main share of the cost structure, performing post-sales counselling, even though there is a non-negligible component of asset maintenance and update for what concerns the testing activities.

## Technology provider 4 – TP4

TP4 was born in 2016 as start-up, later in 2019 acquired by an affirmed company in the power electronics sector. The company presents itself as an **integrated provider**, including in its portfolio both hardware and software, seeking for innovation and cutting-edge solutions not only in the e-mobility sector. Up until 2019, TP4 addressed both B2C and B2B markets, but nowadays the focus is only on the **B2B**, mainly made up of multi-utilities and oil companies, which have space and resources, but lack competencies. The scope enlarges if the perspective is taken at a corporate level, and not only at company level. Customers are mainly reached through digital channels **via marketing and communication campaigns**, leveraging the reputation of the group the company belongs to in order to increase their exposure, but also adopting a **push strategy** to engage the customer. In order to do so, usually **functional relationships** with distributors are stipulated.

The resources necessary to do business are **both technical and technological**, as deep and strong knowledge about charging stations and control systems is required, but also materials and components, especially imported batteries, are instrumental. The integrated solution offered by TP4 consists in both the **production and customization, and the installation** of the final product. At times, the product is acquired from an external supplier in order to be customized, so the process is not constant. The network of suppliers is what comes closer to the key partners, but for the sake of this analysis it is not relevant.

Acting as a general contractor, TP4 is heavily **service-oriented** for what regards the sources of revenue. To the sale of the integrated solution, other recurrent activities such as software-maintenance fees, general maintenance or monitoring make up about 10-15% of the total revenues, being this a relatively new approach. Costs are accounted mostly for personnel, raw materials, and R&D in an **even way**, although TP4 clarified that another important voice of cost is related to approvals and administrative expenses, which sometimes are as high as product development costs.

## Technology provider 5 – TP5

TP5 is a very young company, born in 2019, specialized in the **provision of components** such as charge regulators, cables, and testers, but with a particular attention on the design and the integration of the management software on the charging point. The latter is the leverage the company uses to affirm itself, betting on the simplicity of the interface, without neglecting the functionality. The customers the company addresses are mainly electric materials distributors and installers, working in a **B2B-dominated** environment. Mostly through **direct participation**, partaking at fairs and events, advertising on magazines and organizing direct informative meetings TP5 engages its customers. This choice of not having indirect channels is somewhat constrained by the fact that, being so young, the company does not have yet a strong network on which it can rely. The relationship the company seeks is a mutually beneficial one, where TP5 offers both pre-sale and post-sale services, like training in the field of e-mobility and its infrastructure to installers, aiming at the creation of a **durable partnership**.

**Human resources** are by far the most important ones, especially concerning commercial activities of product presentation and technical definitions. Through its skilled personnel, the company performs essentially two branches of activities: **development and sale**, in configurations which differ whether the destination of the infrastructure is public or private. The marketing activities are carried out relying on another company which provides the platform to manage the charging point, whilst the **development of the hardware and the software are separated**.

**Product sales** are the source of income, given that software updates are free, and the installation is a burden of the installer. For what concerns costs, **development costs** are the most relevant, especially concerning the cost of the hardware and R&D expenditures. Nonetheless, considering the provisions and fees that TP5 owes intermediaries and agencies, as well as marketing expenditures required by the distributors, often downstream items become highly relevant.

## Technology provider 6 – TP6

TP6 is a world leader in the sector in terms of dimensions and reputation. It entered the e-mobility market in 2009, in a pioneer collaboration with another important company in order to develop a monitoring and control system for the charging points. The e-mobility division has been created and split into different functions (hardware, software, components, and diagnostics). TP6's dimensions and internal competencies put the company in the position of being able to offer **tailor-made solutions** ranging from the sole hardware or software, to a complete *turnkey* solution, seeking flexibility, excellence, and easiness of interface. This portfolio depth allows TP6 to address a very large customer-base, which is anyway strongly leaning towards the **B2B market**, which is made up of utilities and CPO (40%), retailers and installers (30%), and *POI managers and owners* (30%), like superstores, parking lots, malls, hospitality managers, to which the company usually offers a *turnkey* package. Once the customers are engaged, TP6 consolidates the relationship with constant and omnicomprehensive feedbacks, in a sort of **continuous counselling**. Combining push and pull approaches, the company can leverage the strong reputation built throughout the years, and a solid network of salesmen and customers, and a developed and cutting-edge communication strategy, which allow it to be effective on **both direct and indirect channels**.

Different resources are required in order to run such a complex business, but there is an **equilibrium** between human resources, highly trained both from a commercial and a technical point of view, and technological resources, especially linked with components and state-of-the-art grid connection. Moreover, financial resources are fundamental to thrive in a business which has started to become profitable in the last couple of years. The continuous evolution of products and services portfolio is a direct consequence of the huge investments in **R&D activities**, to which it is added a counselling phase done by the engineering team, strongly innovation-oriented. These activities are usually carried out with other players help. Customers for big projects are engaged in the design phase, but more in general, **software services, grid operations and installation** are outsourced features.

The economic model can be easily split into hardware- and software-related. As concerns revenues, these come **both from product and service sale**, even though the hardware-side plays the bigger role. The latter is sold coupled with all the support necessary, starting from the prototyping, down to the bureaucratic path. On the software-side, TP6 collects fees from each charging point for the service provided by the app, in case the client is an EMSP, making extra-margin with consultancy. Also the cost structure leans more towards the product development, with very **high R&D expenditures** both from a technological point of view, especially for what concerns rapid-charging stations, and from a human point of view, linked to software platform development, update, and innovation.

## Technology provider 7 – TP7

TP7 is another very important player in the electronic components industry, specialized in the production and commercialization of charging stations which have to provide quality and reliability, in a final product which is highly complex. The company provides **both the hardware and the software** to its customers which are mostly **business clients**. Among them, Oil&Gas companies, highway dealership and service sub-dealerships like Autogrill, retailers and POI managers, but also car makers and utilities, play the major roles. Using mainly **indirect physical channels**, namely wholesalers of electric material components and intermediary societies or technicians, TP7 tries to create a **continuous interface** with the clients, especially in the budgeting and project definition phases.

**Human resources** are the most important asset for their core roles related to marketing and sales, whereas financial instruments are less relevant. The importance of a trained and skilled personnel is to be found in the fact that the key activities are related to **marketing and sales campaigns**, for example the identification of clients and project managers, the provision of the components and their sale. Since the design of the solution is not core for the company, this activity is carried out with the support of **engineering firms** as well as of big construction companies.

The contribution to the margin is mainly due to the **product sale**, with a contribution of about 50% of components, 10% of automation and control systems, and a last 40% of design and support to installation. The large contribution given by the product entails **high product costs**, both hardware and software.

## Technology provider 8 – TP8

Among the most important players in the industry, TP8 entered the e-mobility charging sector in 2010 with DC, and later in 2014 with AC solutions. Right now, the segment revenues account for less than 5% of the total of the company, but the trend is steeply growing. The keywords are integration, interoperability, modularity, and scalability, in order to provide **complete solutions**. The customer they address are various and range from residential clients, with WallBox both in DC and AC for households, condos, and smart districts, to business clients. The **B2B is the biggest market**, including retail shops and hospitality, mainly restaurants, superstores, and hotels, to which TP8 provides both slow and fast charging stations, but it also includes refuelling stations both urban, in AC, and extra-urban, in DC. The company also serves fleet managers both for commercial and non-commercial vehicles. In general, the clients can be split as 70% public and 30% private, with a gap destined to grow in the near future due to the investments in public urban and extra-urban infrastructures. The reputation and historical incumbency of the company in the sector has created a strong network along the value chain, on which TP8 relies in order to engage its customers in an **indirect way**. Regarding residential and domestic solutions, the company mainly relies on wholesalers and installers. Wholesalers are again involved, together with CPO and EMSP, in order to deliver solutions to fleet managers. Moving to retailers, hospitality and refuelling stations, the channel goes through installers, general contractors, and system integrators. Last but not least, when addressing public infrastructures, the main intermediaries are local utilities and service providers. The clients are provided with **training** about the product, as well as with a platform for the management of the charging components.

Both on a corporate and on the e-mobility division level, **human resources** are by far the most important resource, in order to perform all the core activities of training, **R&D, production and pre- and post-sale counselling services**. From an innovation point of view, TP8 is always looking for new partners in order to open up on new business segments, but for what concerns the daily business, utilities, EMSPs and system integrators are involved to provide a solution which is aligned with the concepts of interoperability and effectiveness.

The company can leverage different sources of revenues, as **both products and services are sold**: charging stations, WallBox, single components and secondary products, but also digital services or maintenance and post-sale services in the form of annual fee. The costs can be clustered in **labour and purchasing** costs, related to the personnel and to the payments to suppliers for the components.

## Technology provider 9 – TP9

An innovative start-up born in 2017, TP9's profile is that of a **general contractor** that offers a *turnkey* solution to its customers. Every charging station is coupled with a management service, and the customer is the owner of the infrastructure, thus having the rights on the charging revenues. Addressing both private and public segments, the target is more focused on the **B2B market**, like parking lots, hospitality, workplace charging spots, but also garages and dealers. Nevertheless, multi-unit households are targeted for private charging solutions. Working in direct contact with important municipalities, TP9 partakes in calls in order to get pluriannual concessions for public land usage. **Direct channels** are the most exploited means in order to reach the customers, both via website, social media and targeted mailing, and via call centres. The **engagement is not very high** once the transaction is done, since besides the assistance in order to download and get confident with the app, the only interactions occur to inform the user when updates take place.

Keeping in mind that TP9 is a very young company, financial resources are fundamental in order to cover the huge expenditures required especially for the installation on public soil. Besides this aspect, **both infrastructural and human resources** are important. Technological assets are instrumental in delivering a reliable management system, and solid and operational hardware. Nonetheless, software and electrical expertise in order to provide prompt assistance to the customers are crucial to the company. The main activities performed are currently heavily **marketing-oriented** in order to create a strong brand awareness and a reliable network, but also to promote the solutions offered through the company's salesforce spread across the territory. **Distribution** activities are often performed leaning on external partners such as retailers, garages, and car repairers, which put a mark-up on the product in order to promote it on-site.

The **integrated service sale** is the only source of revenues, since as previously said, charging fees and payments are rights of the customer. The cost structure is strongly unbalanced towards **product development** items, mainly the development of the software and the CAPEX required to obtain the concessions and build on public soil.



## Technology provider 10 – TP10

TP10 enters the e-mobility market in 2018, after signing a partnership with a hardware provider that had matured an important experience in Europe, and this joint effort has reshaped the offer of both the companies, (hereafter referred to as just “the company” or “TP10”). The company now acts as a **general contractor** which is able to provide integrated solutions along the whole supply chain, from counselling and field analysis, up to installation and maintenance. The market it addresses is **almost only B2B**, reserving the consumer one just for product testing, although it is developing a portable private WallBox to be delivered in the near future. In order to engage the customers, the company adopts a **mixed push-pull** marketing approach: from one side, innovative products and solutions directly attract new clients, whilst from the other, the previous European experience of the partner company makes it possible to rely on an already-consolidated downstream network. Although it has been said that the market is mainly focused on the business segment, the consumer market is fundamental for its *trial nature*, and it is then very important to keep a strong connection with clients in order to create **reliable feedback loops**.

The turnkey solution offer calls for **deep know-how** of the matter, since TP10 considers the counselling phase as the most important to get to know the clients’ needs and desires, in order to then translate them into a final product. For what concerns the main activities, the focus is heavily on the **marketing effort**, both in the phase of identification and engagement of potential B2B clients, and in the sales and post-sales one. This service orientation has made it necessary for TP10 to rely on external partners in different steps along the value chain, some for installation and hardware provision, others in order to implement the pull strategy (residential managers, garages, EV importers).

The main revenue source is the **service provision**, as it often occurs when the actor serves as a general contractor, although the main costs to be sustained are related to **product purchasing and development**, with marketing costs which are contained.

## Technology provider 11 – TP11

A historic incumbent in the electric components industry, the value proposition of TP11 is crystal clear, offering a **premium product**, coming with the best quality and performance, in the face of a higher market price. Besides selling charging points, the application required to manage both the charging and the electric consumption is provided. On request, the company also delivers training courses, both digital and physical, for distributors, installers, and designers. The latter make up a large share of the customer base, which is **mainly business** clientele. Other important segments are the Public Administration, utilities, destination charging, and refuelling stations for what concerns the BB market. In the consumer's market, on the other hand, TP11 addresses households and multi-unit buildings, with different products and different components. Part of a holding, and leader in an important European region, the company can leverage a very strong brand reputation in order to communicate through **both direct and indirect channels** due to a strong network of clients and suppliers. The relationship with the customers is an **instrumental** part in delivering the high-quality service the company seeks, providing free price quotation, client support, training, technical assistance and access to the commercial network. Starting 2018, add-on services have been added for the design analysis of projects, such as configuration, programming, and start-up.

Technological, financial, and commercial **know-how** are instrumental in delivering performant solutions, which orients the company towards a **balanced** approach to its activities, focussed both on the development of the products, comprehensive of engineering analysis, and on the commercial and marketing side, especially for what concerns the customization of the offer.

**Product sale** is the main source of revenues, with collateral streams coming from post-sale add-on services. Cost-wise, **R&D and product development** represent the largest items, due to the infrastructural and technical assets required, followed by labour costs related to training and skilled personnel.

## Technology provider 12 – TP12

Entering the business just in order to provide engineering assistance to a leader utility in the charging infrastructure ecosystem, the company has since developed internal skills and consolidated processes that allowed it to be able to become a relevant player. TP12 knows that the market is growing and changing very fast, and customers are requiring more and more flexibility and reliability, and it addresses these requests providing a **complete product**, internally realizing both the hardware and the electronic components. Dedicating 5 different production lines to e-mobility, the company is able to address both private and public charging configurations, from WallBox and AC stations for residential use, to AC and DC charging stations for public installations. Nevertheless, the direct clients of the company are **distributors and other big players**, that will then convey the product to the end customer adopting mainly mark-up pricing strategies. The identification of potential clients is done through **direct market analysis** in order to target the right clients which are investing in e-mobility, to establish a **strong relationship** that will bring to sustainable and durable economic benefits to both the parties.

**Human resources** are instrumental, since most of the activities are carried out internally. Country account managers are, in specific, the key figure inside the company. Among the activities internally performed, **engineering and production** are the ones on which the greatest attention is put, providing assistance along the process like, for example, the location of spare parts. Even if TP12 does not perform activities of installation and maintenance, there is **no key partner** that takes care of such operations, as it is left as a burden of the client to do it internally or to identify specialized third parties.

The **complete product sale** guarantees TP12 steady revenues, whilst **training and marketing expenses** represent a large share of the cost structure, in order to develop internal know-how and engage with big customers.

## Technology provider 13 – TP13

One of the first technology providers to enter the WallBox market in 2011, TP13 registered revenues for 700M€ in 2019, out of which only the 0,5% attributable to e-mobility. With a complete product portfolio both in AC and DC, ranging from the domestic WallBox to high-power machines of 300-400kW, the company offers a solution which **couples hardware and software**. The main market is among retailers, hospitality, superstores, utilities and multi-utilities, making the **B2B market** by far the largest segment. Nevertheless, the B2C market is expected to grow as soon as the product with which this segment will be addressed will be considered ready. The engagement of potential customers is centralized on a corporate level, hence it is sometimes difficult to manage smaller regional clients, and as a strategy the company **privileges direct channels**, mainly through digital publications or social media campaigns, even though about 30% of their clients are reached through CPOs. Since the engagement is no easy task, once the contact is established, the company aims at creating a **solid relationship** based on fidelity, both through final product customization and technical training.

The long experience acquired by the company in the photovoltaic sector has created both a solid technical know-how and a developed commercial network, making **human resources** the core of the company. The development of both the hardware and the software, internally performed, as well as marketing and post-sales services (such as configuration and setting of DC charging stations, or technical support), are **equally important** in creating value for the final customer. TP13 does not perform installation, so it relies on an **external network of installers** and maintenance companies, often part of the larger photovoltaic network created in the years, while also outsourcing large WallBox production volumes to a third party.

With the main revenues stemming from the **hardware sale**, the service contribution is far from negligible, being the leverage on which the company tries to gain a competitive edge over its multiple competitors, providing different tiers of warranty and add-on customization services. The cost structure is **evenly balanced** between the R&D expenditures, with more than 30 people working on this business unit, and the commercial network.

## Technology provider 14 – TP14

Among the very first companies to enter the charging infrastructure market in the 90's, TP14 now counts more than 20.000 charging points installed. The core business of the company is set on **the hardware**, with the willingness to dominate in the design, engineering, and production processes, being able to act for customization along the whole chain. TP14 still has the ability to act as a general contractor, extending its offer to warranty, installation, and maintenance, but these are added services which are not part of the value proposition. Their customers are **mainly businesses**, like electrical material distributors (60% of the total market), installers, multi-utilities, car-makers, fleet managers, CPOs, and hospitality, and to have a qualitative idea about the destination of the final product, about 65% ends up in industrial installations, 35% in households. The channels through which the company is able to meet the customers are **various and very effective**. For example, electrical material distributors are engaged directly, whilst installers, fleet managers, or hospitality managers are contacted indirectly, leveraging marketing and promotions. Moreover, the constant presence of the company in fairs, events, and conferences, as well as its digital channels, has helped keeping it under the spotlight. The customer relationship is different according to the client under analysis, but in general terms TP14 offers **assistance and training**, which is at times automated through a company's software, and, as it happens for the installers network, also complementary specific products.

**Human resources** are fundamental in relation to expertise, both technical, to perform R&D activities e technological breakthroughs (not only electric know-how, but also electronic about software and firmware), and financial, in order to invest in the right direction. As mentioned, **R&D activities** are crucial (and have been carried out thoroughly for more than 50 years), as well as all the production process up to raw materials, but marketing and sales campaigns have become more and more important with the growing number of players in the market. TP14 relies on **established external partners** both on the design and engineering stage, working with design studios for aesthetic purposes and with universities on large European projects, and on the commercial phase, leveraging the brand reputation with agencies.

**Product sale** is undisputedly the biggest contributor to the revenue streams, being the product the core business. Add-on services such as maintenance, configuration, warranty, play a very marginal role. The focus on the manufacturing side explains the cost structure which is unbalanced towards the **product development**, with raw materials and dedicated personnel being the main items, even though marketing activities are not a negligible contributor.

## Technology provider 15 – TP15

Very interesting to analyse since it has entered the e-mobility market during the first months of 2020, with a freshly-new business model that is still in its early stages, TP15 positions itself as a **service provider**, putting the customer in contact with the hardware provider. The value proposition is then understanding the needs of the client and identify the most suitable solution. These clients are found **both in B2B and B2C markets**. For example, electricians that need counselling to install WallBox, building administrators, SMEs both private and semi-public (like supermarkets, are among the most targeted segments. There are obviously distinctions in the way business and private customers are dealt with, about the tracking systems for payment needed in the B2B market, about the continuous monitoring of the charging station and the location service, or the fact that the installation of a station for a business requires further geometrical and technical analysis. Although no customer has yet been engaged, but the planned strategy will be the one currently used at corporate level, which relies on **direct channels** mainly, through e-commerce, call centres, mailing lists, and assistance points. The relationship with the client is **fundamental**, since the solution is found in a somewhat joint effort during the design phase and the post-design one.

In order to provide the service, **skilled and specialized human resources** are instrumental and must have a deep knowledge about all the aspects of the products available, the market, and must be able to translate the customers' requirements into an offer. Training the personnel in order to perform the **counselling services** is then fundamental, and to do this, TP15 relies on the network of **suppliers**, which provide their solutions and features. Having a broad knowledge of the charging infrastructure market, the company has stated that from a technological point of view, charging stations are pretty simple, and what gives the edge nowadays is customization, both about aesthetics, and about the integrated services of monitoring, management, and customer interface.

The ability of the company to **deliver the service** is what pushes customers to pay a premium price. Considering that the marketing function is yet to be developed, the main costs are related to the personnel involved in the **service development** and provision, throughout the whole counselling activity.

## Technology providers recap

The following section will highlight the main features characterizing the business models of **technology providers**, a profile which has a fundamental role in the upstream value chain, providing all the components necessary in order to manufacture the hardware and, depending on the configuration of the business models, managing the installation and maintenance of it, or again working on the software side to provide the operational platform to the operators. Fifteen different companies have been interviewed in order to collect a relevant amount of data, making it the most populous category under analysis. Given the asset intensity of the sector, being this strongly manufacture-oriented, different companies have been around for quite a long time, re-designing their processes and product portfolio in order to exploit the charging infrastructure business.

For what concerns the *value proposition*, the solutions offered by the players range from **product-oriented** ones, which means the hardware alone, up to completely **integrated solutions**, presented in the form of a service. Between these two configurations there are various intermediate ones, as it is the case of providers who decide to integrate a **software platform to the hardware**, or just some upstream or downstream activities like installation or maintenance, without resulting as a turnkey solution provider.

The *customer segments* block mainly sees a distinction between **business customers (B2B)** and **end consumers (B2C)**. The first category includes utilities, CPO and EMSP, *POI* owners and managers, retailers, dealers, and wholesalers among the most diffused. For the B2C segment it is intended a customer segment made of domestic and residential charging stations. Moreover, when information is available, it will be specified whether the charging stations are meant to be *public* or *private*, and to which extent. Intermediate solutions, the so-called *semi-public*, are configurations such as the *workplace charging*, or in some cases supermarkets or hospitality-located charging stations, where the access is reserved to enabled users like employees or clients.

*Customer relationship* strongly depends on the target market of the TP, and ranges from a simple form of **assistance**, mainly technical, to a **strong partnership** where training and constant updates, and, at times, co-design and ad-hoc solutions are provided to the customer.

The *channels* on which providers mainly rely to reach their customers can be clustered as **direct** and **indirect**. To clarify, direct channels mean that no intermediary is involved between the company under analysis and its customers. Whereas this does not happen, it is the case of indirect channels, of which some examples can be the presence of wholesalers, traders, or dealers. Another interesting distinction that will be done where possible, will be between physical and digital channels. Digital

include website, social media, webinars, and other online portals, whilst physical channels are related to the participation to fairs and events, to service centres. An important channel which is difficult to be systematically labelled as either digital or physical is the *word of mouth*.

Moving to the value network, the *key resources* block sees configurations ranging from **human**, meaning skilled and trained personnel, salesmen, technicians, and engineers and designers, to what has been called **tangible assets**. The latter includes machinery and production plants, fundamental in a strongly manufacture-oriented sector.

The *key activities* performed can be considered as more internally oriented, including **research and development** activities, or more externally oriented. This is the case of the **sales and services**, which deals with customer-centric operations, from marketing, to installation, to the management of the software.

The *key partners* block is delicate to be analysed. On one side there are the partners for the design phase, meaning designers, engineers, software and hardware developers, with which **co-design** happens. On the other hand, **disjointed** partners identify those actors that perform their business in a separate way, but are instrumental in order to complete the product or service. This type of partners are usually less more than suppliers or buyers.

Analysing the last two blocks, the main *revenue streams* come from either the **product sale** or a **service sale**. The latter includes ancillary services related to post-sale assistance, or simply the contract under the form of a fee in a *pay-per-period* configuration.

Last, the *cost structure* ranges from **product development** costs, mainly related to R&D expenditures, production, machinery, and raw materials, to **marketing expenditures**, which include both salesmen and the commercial network. Administrative costs, such as concessions for land and soil usage, are to be considered in each specific case.



## 5.5 Utilities

### Utility 1 – U1

U1 enters in the EV charging sector in 2017, serving both as CPO and EMSP. For this reason, it will be treated firstly for the former role, then for the latter one.

Considering its CPO function, U1 addresses its proposal towards PAs and **B2B**, like OEMs, utilities, O&G, companies using fleets, EMSPs. Its offer mainly focuses on providing **public charging**, by not serving as an asset owner but providing the **installation** and **management** of the asset. The relationship established with the customer mainly resides in the **pre-sale** engagement and mainly passes through company **website** and **media**, besides the participation to popular **events**.

For what concerns the resources on which U1 leverages, the technical aspect provided by **human resources** carrying out the inspection and installation of the charging point is crucial. In addition, the **software** for the monitoring, management and territorial coverage of the charging point is relevant as well, and whose **development** represents the key activity U1 carries out for the success of its business. Moreover, it builds partnerships with **retailers** and **commercial partners**, with whom it establishes usage agreements.

Finally, analysing the economic model, U1's revenue streams are proportional to the charging **volumes** sold to EMSP and to the installation and operation **fee** it obtains by working as a CPO as a service. On the other hand, as a CPO as a service its main cost coincides with the cost of maintaining a **care relationship** with the customer, while as an asset owner, it must pay for the **hardware** itself, its **installation**, its **functioning** and the potential cost for **land** concession.

Shifting then to the EMSP role, U1 provides the charging service to **end users**, to PAs, to other **EMSP** and to **businesses**, offering **equally private** and **public** charging. Besides the pure **sale of charging services** offered both to B2B and B2C, to the former segment, it provides also white label solutions, i.e. a logo-free charging platform allowing these customers to offer the charging service exploiting their brand; while to the latter, it gives the access to its application for EV charging. The company **continuously** takes care of its customers, even in the **after-sale** phase, and **periodically** updates the app. Moreover, U1 leverages on a **strong online presence**, e.g. on its website, social media and by using newsletter and the app, and a **wide physical sale network**.

For what concerns the resources that U1 owns, it mainly relies on the **software** it develops for the platform management and the app. This fundamental resource is strictly related to the key activities U1 needs to carry out, indeed it states the **app design** and the **software development** are the key activities of its business, besides the **commercial agreements** needed to get access at a wider network.

In conclusion, U1 earns revenues **proportionally** to the **charging volumes** it provides and, for what concerns B2B, also from the **service fee** for the acquisition of the white label app. On the other hand, the main cost U1 has to sustain is linked to the **software development** and to **integrated services** it provides, such as root assistance, charging point booking, plugs visualization, etc.

## Utility 2 – U2

The second utility dedicates its offer to **end users**, such as people installing the charging at home or workers with VAT number, and to **small and medium industries** and **PAs**. For what concerns the value proposition it pursues, it totally relies on offering an **all-inclusive service** to the customer. On the one hand, U2's end users offer includes the rented car and an app to manage the charging, thus providing an easy energy top up both at home and outside. On the other hand, the B2B market receives a technical and economical consultation – encompassing also the customization of the charging infrastructure sized on the plant itself and the analysis of possible energy distribution interferences – the design, the installation, the trial, the web-based platform, 24h remote technical assistance, the chance to leverage on long-term rented cars, and loans. Finally, the company offers an all-inclusive service to PAs too, by funding the entire project and getting back a compensation during the next ten or fifteen years. Moreover, U2 leverages on distinct channels for what concerns B2C and B2B markets. Indeed, the former is reached by using **both digital**, such as company website and landing page, and **physical channels**, such as indirect selling channels. On the contrary, the B2B market is **mainly** achieved by exploiting **physical channels**, both direct and indirect, such as sales accounts proposing products to companies.

Shifting to the value network area of the business model canvas, U2 carries out many fundamental activities, such as the **installation** and **provision** of the **domestic charging**, the **supply** of the **electrical system** and the check of its operating compliance, the **long-term car rental**, the provision of the **app** to manage the public charging and **other integrated solutions** related to the management platform and the hardware itself. To do so, U2 mainly leverages on **human resources**, both the ones dedicated to products sale and the ones dedicated to the engineering of the new projects, besides an **international know-how**. Moreover, U2 presents many different partnership, such as, the **charging technology providers**, the companies providing the **long-term car rental**, the **car makers** and **car dealers**, where to install charging points for public charging, and, finally, partners supporting the **software development** and **hardware assessment**.

Lastly, moving to the economic model, U2 obtains its revenues streams from the **sale** of the aforementioned products and **services** and from the **public charging stations**, besides the **consultation** service offered to business customers. On the other hand, the costs it sustains are several: firstly, it **pays back** a fixed amount of money on electric bills; being the **hardware outsourced**, this represents a cost as well; the **energy cost**, which is internally managed; fixed costs for **business management**, such as marketing campaigns, the platform management cost, human resources; the **consultation** operations offered to business customers.

## Utility 3 – U3

Utility 3 enters the business of EV charging in 2011, serving both as CPO, being a technology provider, and EMSP, providing location and charging services.

For what concerns the customer segment U3 is directed to, it touches both **B2C** market, domestic end users and workers with VAT number, and **B2B** market, serving small, medium and top businesses. U3's value proposition focuses on supplying a **wide range** of standardized products and services: it offers agreements for **public charging** through RFID card or the app, including the charging cost in the domestic electricity bill; for the **private charging**, it **sells** the technological infrastructure, such as WallBox, charging stations, accessories, cables, etc. The relationship established with the customer is **highly intensive**, indeed U3 offers 24/7 technical assistance through a high-level call center, offering to the client a potential daily relationship. Moreover, the channels exploited are several, including **telephonic calls** and **physical branches**, and also vary according to the target customer, indeed top business clients are addressed through **direct sales representatives**, while **agencies** take care of domestic users and private workers.

The company stated the key resources it leverages on correspond to its **long-lasting know how** and the choice of a **wide range of charging stations** to offer on the market, while the key activities it develops are this latter **commercialization** and even the **competitive procedures** and **tenders** to become technology providers. For what concerns the partners, U3 relies on **charging points providers** and long-lasting car rentals as **commercial partners** for top business customers that need electric cars fleets.

Finally, the main source of revenue derives from the **selling** of charging services and products, while the cost structure comprehends the **personnel** providing assistance, the **app software development**, the **outsourced charging point** cost, the **electric energy cost**, the **maintenance**, **operative costs** and **depreciation**.

## Utility 4 – U4

In 2013, utility 4 was born as an EMSP startup. The value it aims at proposing to its customers – coming in **equal** shares from **B2C** and **B2B** markets – is based on creating an **all-inclusive** service. Indeed, **private customers** get the installation and maintenance of the charging point, unlimited charging, and an app to manage the charging at the lowest price possible; while, for **public charging**, U4 offers installation and maintenance of the charging points to B2B markets, namely general companies, hotels, shopping malls. U4 value proposition also resides in identifying third players, that could physically host them and with whom to share benefits. The communication channel U4 exploits to get its value proposition to its customers is based on its **website** and **call center**, besides its solid and experienced **network** of accommodation facilities and GDO, that allow it to be well known by many businesses for energy distribution, that later require also the charging service.

In addition, U4 key activities, and the corresponding resources, are the **evaluation** and **choice** of **reliable hardware**, the **development** of the **service platform**, the **realization** of both **installation** and **after-sale services**, and the **availability** of the **call center** as well. In order to carry out these crucial activities, U4 leverages on several partners, such as **hardware and technology providers**, **technician** and **local partners** as municipalities, provinces and trade associations.

In the end, considering the economic model, U4 main revenue stream derives from the agreements built on the service it offers – the **activation cost**, the **installation price**, the **monthly fee** and the **charging itself**, while the hardware side is not significantly profitable. Of course, U4 sustains different costs, such as **human resource** costs – for employees, the technician network and the call center – and it also **invests** to enlarge its partnerships and consequently the public charging.

## Utility 5 – U5

U5 bases its business on responsibility, ethics, safety and transparency. These are the values it transmits to every segment it serves: **70%** of its customer base is composed of **household and domestic charging**, in particular customers that already had signed a contract with U5 for electric energy and gas supply and that extended their request also to charging services; **15%** is made of **B2B**, such as OEM, dealers and workplaces; finally, **15%** is represented by **public administrations**. For each customer segment, U5 aims at offering the **most complete service as possible**: the domestic customer receives consultation before the sale, the installation of the charging point and the electric energy supply; the private workplace gets the installation, charging point operation and maintenance and the electric energy supply. Moreover, the client receives **technical assistance** both **remotely** and **at home**, thus ensuring high interaction and customer loyalty, and he is reached by using **mainly physical** channels, such as flagship stores, car dealers and OEMs, but also **digital** channels, as its website.

U5 resources and activities are strictly connected. Indeed the company mainly relies on **human resources**, as different sales representatives for the **identification, inspection and evaluation of the charging point investment**, and engineers as well, for the **feasibility check** of the project, the **sizing** of the charging point and to obtain **licenses**, for its business running. Moreover, **financial resources** and administrative partnership are crucial as well, to ease and **accelerate authorization processes**. Assessing the partner block of business model canvas, U5 relies on **investment funds, retailers, restaurants, parking** and **hotels** as areas that can benefit from the increase of customer in-flow due to the charging possibility, **gas stations, local administrations, car dealers** and **OEMs**.

To conclude, the revenue stream trivially derives from the **electric energy provision** and **WallBox sales**, while costs are due to the medium- and long-term **agreements with land dealers**, to the **purchase of charging points** and **connectors**, and to **installation** and **operations**.

## Utility 6 – U6

U6 is a utility company mainly active in Lombardy, particularly in Milan area. It enters the EV business in 2010 by arranging some pilot projects regarding EV charging. Its customer segments range from **private customers**, both **B2C** and **B2B**, with access to private or public charging, such as companies' fleets, parking, retailers, and HoReCa, to **PAs**. In particular, to the former it offers the WallBox, the agreement for electric energy provision, the app for the monitoring and management of the charging and even the possibility to rent a vehicle with a long-term car rental company. For all the customer segments, U6 aims at **completing** its offer with **services**, such as technical and economical consultation, charging point installation and maintenance, and electric energy provision. The pillar U6 bases its offer on is providing a high quality and high flexibility service with a competitive price on the market. Moreover, the company **mainly** exploits **digital** channels, for instance its website and its app, to reach customers, with whom it establishes a value-added relationship based on **assistance** and **reports**.

Thanks to its long-lasting **know-how**, U6 is able to provide projects **consulting** and **analysis**, the **installation** of charging systems and to develop their planned **maintenance** and **management** program. The only partners U6 collaborates with are the companies conducting the **excavating** and **placing of power grids**.

Finally, U6 economically relies on the provision of the **charging infrastructure** and **electric energy supply**, but has to sustain both CAPEX, such as **land acquisitions** and **installations**, and OPEX, as the **energy cost**.

## Utility 7 – U7

U7 presents an extremely variegated offer, composed of the **hardware** accompanied by **additional services**, such as its installation and monitoring, a web platform, specialized remote technical assistance, access to roaming stations and even the possible integration with solar power panels. These products and services are all characterized by simplicity, indeed the management of the access to charging stations and its billing must be easy, adjustable according to customer needs and safe, for this reason products are accurately tested and inspected, guarantying high reliability. In addition, the software is periodically updated from remote, thus avoiding the charging point to become obsolete over the years. For what concerns the target customer segment, U7 addressed its bundle of products and services towards B2B, which represents 60% of its customer base and is composed of accommodation facilities, companies and hotels, while the B2C market only represents 40% of U7 customer segment and is mainly composed of users that got in contact with the company at work place and desire to install the charging station even at home. It is noteworthy that the company states its public charging is almost nonexistent in Italy today. Moreover, the company reaches its customers by exploiting **digital channels**, e.g. its web site, and offer dedicated and specialized technician for customers assistance, even for **after sale** needs.

Moving to the key resources U7 leverages on, **personnel** assuredly represents one of these, both for the commercialization of products and for the development of new products and services. Besides, even **technological skills**, in particular the **internal laboratory** for testing hardware components, are crucial as well. Considering the activities U7 considers to be fundamental for the running of the business, these are the **charging balancing**, especially for semi-public loading, the specialized **consulting**, the **installation**, **management** and **maintenance** of charging stations. The only partners U7 has established a relationship with are companies with **business electric fleet**.

Lastly, the underlying economic model is based on the selling of **products** and **services**, besides the **electric energy**.



## Utility 8 – U8

Utility 8 started its path in the EV market at the end of 2017, when it substituted a portion of its fleet with electric cars and created the corresponding charging infrastructure. Two years later, it also founded a division entirely dedicated to e-mobility.

The charging service offered is divided into **private** charging (more or less one hundred and twenty charging points installed in **B2B** and **B2C**), i.e. dwellings, condominiums, companies and other places where authentication is not required but charging is free, and **public** charging (more or less 50 charging points), such as common areas provided by PAs and private or business parking where authentication is necessary. By being consistent with its values of safety, flexibility and simplicity for the customer, U8 supplies both the infrastructure, i.e. WallBox for private and public charging, and additional services, such as consultation, maintenance, and in future also an app for the management of the charging. Leveraging on this last aspect, the **consulting** side especially for B2B market, and the user friendliness of the **app**, the company creates a value-added relationship with the customer. This latter is reached by different communication channels according to its nature: business customers are reached through a direct and **physical** interaction, while end users are targeted by exploiting **digital** channels, such as U8's website and social network.

The most critical resource for the company resides in **human resources**, both belonging to the e-mobility division and those outside it, thanks to the synergies they have developed through the years. For this reason, one of the key activities U8 carries out is **personnel training**, besides **commercialization** and **promotion** of the offer, **sale**, **installation** and **maintenance** of the charging stations and the supply of **impeccable after sale services**. Being the hardware outsourced, one of the key partners of U8 surely are **technology providers**, beyond **car dealers** with whom they developed turnkey solutions for long-term rented cars.

Finally, the economic model mirrors what before mentioned: the revenues mainly derive from the **selling** and **installation of charging points**, while costs reside in **personnel training** and other **indirect costs**.

## Utility 9 – U9

The last utility that was interviewed was recently born (2019) and its geographic scope is mainly concentrated on Rome. Being them quite young in this growing market, U9's value proposition resides in offering a service comparable to the one of competitors, differentiating later in the next years. The current customer segments it serves are **domestic charging, small businesses**, such as hotels and supermarket, and **PAs**. By digging down in the B2B market, they establish with 80% of retailers the loan for use, i.e. U9 obtains an area of their parking for free, installs and maintains the charging point, and revenues are totally earned by it. Another option is profit sharing: the customer pays for electric energy and then has a payback on the charging. The last possibility is the most used by medium industries, which buy and install the charging points from U9 but then manage them by their own. Considering the relationship established with customer segments, this varies: retailers enjoy a personalized relationship obtained through **key account managers** and **consultants**, while domestic clients are reached through **digital channels** (website and social networks). Moreover, U9 participates to **events** and **fairs** to increase customer awareness, and exploits stores to sponsor WallBoxes.

Shifting to the means U9 takes advantage of, the company leverages on **human resources**, with marketing and technical skills. These are basically the pillars of its key activities: **business development**, by analyzing the market and its future trends, **marketing** and **communication, operations** – infrastructure and platform management, **participation** to **public auditions** to obtain funds, resources and facilitations for e-mobility development. In addition, U9 states its key partners are **technology providers**, for the charging stations and WallBox supply, **external technician** for the installation of charging points and other secondary **companies** to establish partnership with to oppose the market leader.

Lastly, U9 gets its revenues from the **sale** of **WallBoxes** and **contracts** for **electric energy supply**, besides from **interoperability agreements** with other CPOs. Considering the cost structure, it sustains the **purchase** of **charging points**, the **platform** management, the **call center** management, the **electric energy supply** and **communication** and **marketing**.

## Utilities recap

Utilities is the category of players comprehending all the actors having as core business the supply of electric energy. Evidently, this group significantly benefits from the outbreak of EV market: on the one hand, the increase of EV sales requires more and more charging infrastructure, both private and public, that in turn require more and more electric energy; on the other hand, the actors of this category can expand their core business by integrating the selling of charging infrastructure – becoming a CPO – or charging services – serving as an EMSP, without applying drastic changes to their operations. Indeed, this category mainly includes actors traditionally involved in the energy supply businesses that have benefitted from the increase of electric energy selling and that have added the charging service to their current offer.

The *value proposition* block can be classified according to the integration level of company's offer. In particular, this ranges from the pure **design** of the charging service and some **consultancy service**, to an **all-inclusive service**, comprising all the activities of **sale, installation, management, and maintenance**.

For what concerns the *customer segments*, it is interesting to distinguish both between the typology of customers (**B2B** or **B2C**) and the typology of access to charging (**public** or **private**) to characterize the market and how this is expected to evolve in future.

Moving to *customer relationship*, this is assessed by taking into consideration its duration, i.e. **one-shot interactions** totally focused on the pre-sale stage, or **long-lasting relationship** going on even after sale.

*Channels* can be distinguished between **physical** and **digital**, being the former stores, branches, sales representatives, key account managers, etc., while the latter websites, social media, call centres.

Moving then to the *key resources* these utilities leverage on to make their business profitable, these can be labelled as **tangible** or **intangible**. Human resources, software, financial resources, skills, experience, know-how and patents can be considered appropriate examples.

*Key activities* are divided according to their nature into **operations** and **marketing** ones. These classification results to be useful in order to understand whether the utility mainly focuses on internal development, management and functioning, or on the external commercialization of products and services.

*Key partners* are similar to the previous category; indeed they are divided into **installation** or **marketing**. In this case, the aim is to categorize what the utility decides to internalize and what to

outsource, e.g. whether the utility relies on partnership for charging point installation and development or if it requires commercial partners, helping in locating the products on the market.

*Revenues streams* are divided according to their variability degree, into **fixed fees** and **variable fees**. It is interesting to understand whether utilities rely on fixed one-shot – like the sale of the charging point, its installation or the sale of the consultation service – monthly or annual incomes, or if they provide a service and have a proportional turnover, based for instance on the electric energy supplied or the service offered.

Finally, *costs* may be **internal** or **external**, where the former comprehends all the costs the company has to internally sustain to run the business, such as human resources payment, software development costs, marketing expenses etc., while external costs are the costs sustained by the company towards external environment, e.g. the purchase of outsourced hardware or an external network of technician for the installation of charging stations.

# 6. Results and discussion

## 6.1 EV charging business analysis

Once conducted the empirical analysis, i.e. the detailed description of the integrated information derived from the interview process and the online research, the present chapter aims at analyzing the resulting business model of each category of actors involved in the EV charging supply chain. In particular, for each class of companies, the research outputs will be displayed as follows.

Firstly, a business model comprehensive of all the answers received is shown. This aims at including in the thesis work every possible insight obtained from the empirical analysis and not exclude any potential important answer, besides providing a comprehensive view of every method exploited by different company to administer the various pillars of their businesses.

Once depicted an overview of all the possible answers, a further analysis will take into consideration the variability of the single blocks constituting the overall business model. In particular, this analysis will assess which blocks of the business model canvas present a higher, and which a lower, level of alignment, thus extrapolating, if they exist, the patterns followed by the higher number of companies for a specific pillar of their business. In order to qualitatively compute this variability, the different answers collected have been considered at a higher level of aggregation, making it possible to identify some sort of clusters. An example might help to understand the concept: a company that mainly leverages on conventions and events to reach the final customer, will present a *channels* block in which the cluster will be “direct physical channels”. In the same way, a company that exploits intermediaries such as dealers, or wholesalers, will present an “indirect channels” cluster. This way, the number of different configurations decreases and it is then possible to identify the most recurrent ones.

Finally, a deep analysis will be performed in order to identify some archetypes, meaning some recurring business models within the same category of actors. The identification of these archetypes has been done starting from the definition of common and recurring features among the business models of the different companies composing each category. These features could be the offering, residing in the value proposition, or the typologies of segments or destinations addressed, for example a public- or private-oriented BM. For some categories, only one archetype has been identified, while for others, sitting on a wider sample, it has been possible to draft multiple business models.

## 6.1.1 Car makers – CM

### Comprehensive business model of car makers

In this chapter, the answers of each car maker interviewed are presented following the business model canvas provided by Osterwalder and Pigneur.

As already explained, every answer provided during the interview process and every information derived from online research is displayed in this business model, thus including all the possible strategic choices exploited by the company for each block. Nevertheless, it is noteworthy that exclusively the answers related to specific EV charging market were taken into consideration, thus the traditional activities such as vehicle design, fabrication and commercialization were excluded from the model, since they did not represent added value for the objective of the research.

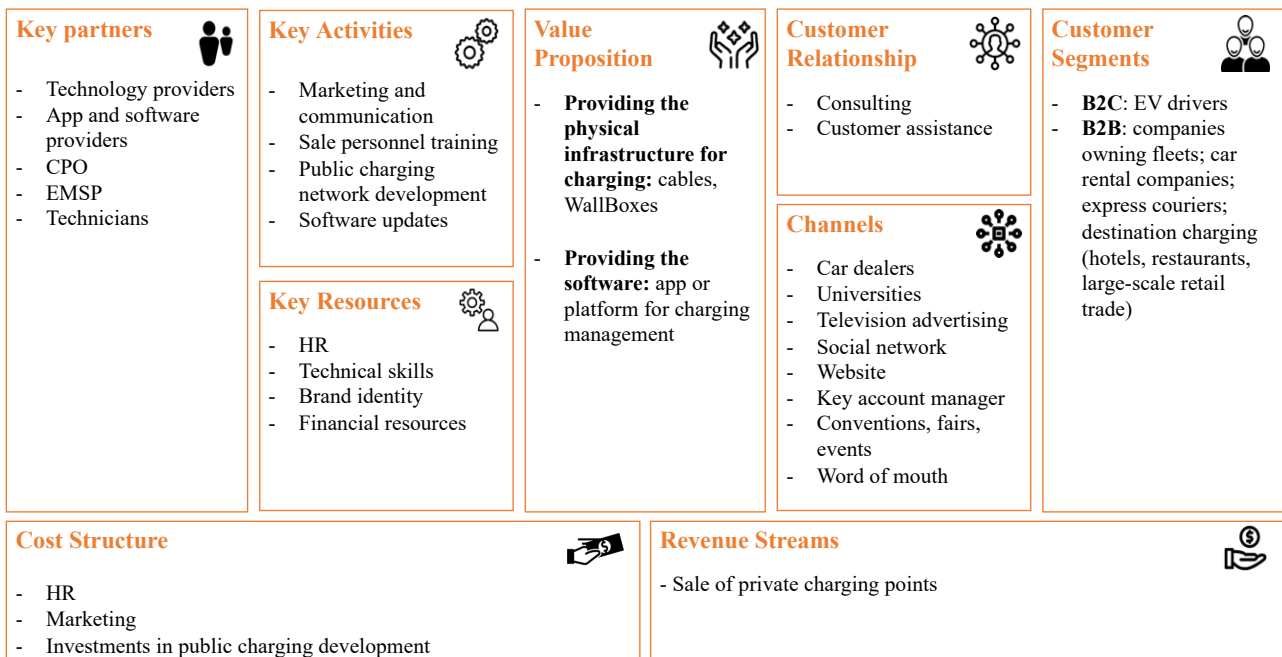


Figure 17 - Comprehensive BMC of car makers

Starting the analysis from customer segments, these are divided into B2C and B2B. The first category includes EV drivers, which are consequently clients of the charging infrastructure as well. The latter, on the other hand, comprehends different categories of businesses: companies which have electrified their vehicle fleets; companies providing car rental; logistics operators such as express couriers; and finally all businesses which are classified as destination charging, such as hotels, restaurants, retailers.

Moving to the value proposition, car makers may operate in two different ways. They can provide the physical infrastructure for charging, namely charging cables and WallBoxes, or the software side of the product, thus providing access to platforms or mobile applications which allow the

management of the charging process, considering both private charging or public ones. For instance, private services for WallBoxes are the energy consumption monitoring, or the state of charge of the car, whilst public infrastructure services are related mainly to platform management, billing and payment, and charging point location and reservation.

For what concerns the customer relationship, car makers state they establish pre-sale consulting and also post-sale technical assistance. In comparison with the traditional ICE market, sale personnel must have much more technical knowledge, since they must be able to provide specific information related to the charging infrastructure, about which the customer often is not totally and exhaustively informed, a situation that often leads to opt for other solutions.

In relation to channels exploited by car makers to deliver their value proposition regarding the EV charging, these involve both the most traditional and more innovative ones, moving from classical car dealers, television advertising, key account managers who are in charge of the sale process, convention, fairs and events, even within universities, to which they take part, and digital channels, such as the company's website and social media.

Furthermore, car manufacturers stated they mainly leverage on four types of resources, such as human and financial ones, besides technical skills which must be enlarged to tackle the new requirements due to the new EV business and the consolidated brand identity.

As concerns the key activities, surely marketing and communication are crucial to increase customer awareness of the new charging offer. Besides, as already mentioned, the personnel must be trained to be able to convey the new features regarding the charging infrastructure, such as connector types, power supplied, charging duration etc. Further key activities regard the investments in the development of the public charging infrastructure, of which car makers would of course benefit, and the release of software updates.

In addition, key partners include the providers of both the charging infrastructure side, software and platform, besides CPO and EMSP, and finally technicians which usually take care of the installation of charging points in customer places.

Finally, considering the economic model, revenue streams trivially derive from the sale of private charging points integrated to the sale or rental of the car itself, while costs mainly derive from marketing and sale personnel wages, necessary for the commercialization of charging infrastructure, besides the investments for public charging development.

## **Blocks variability analysis of car makers**

Moving to the analysis of blocks variability, key activities present the lowest, with more than 80% of the companies totally focused on development support, with the remaining part still highly focused on this aspect, but carrying out product sale activities, which are anyway marginal. Analyzing value proposition, customer segments and customer relationship, it is possible to see that the variability is still very low, with the answers received revolving around the most frequent configuration. Moreover, a perfect match correlates the customer segments block with the customer relationship one, giving the hint that a pattern might exist when it comes to establish a contact with a client. This might be due to the fact that the automotive sector has always been one in which customer loyalty and brand affection played a fundamental role, leading to consolidated engagement strategies widely adopted.

Channels, key resources, and cost structure have a lower level of standardization, which is due to the fact that no strongly dominant configuration emerged, with an almost equal distribution among the ones identified. Again, it is important to underline the fact that the information available was often referred to the EV market, and not directly to the charging infrastructure one, thus requiring to infer, where possible, if that information could fit also for the purpose of this analysis.

The economic model is yet another set of blocks presenting an equally spread distribution, thus making it difficult to identify a pattern or to draw conclusions merely looking at the data.

## **CM archetype identification**

Even though the sample of analysis is not wide, an interesting distinction has emerged between the players which are more focused on supporting **the development of the public infrastructure**, installing charging points in publicly accessible locations such as dealerships, and players which offer mainly **domestic charging points**. Again, it has to be kept in mind that most of the information gathered about this category is deeply related to the core business of the players, car manufacturing and sale, thus making it difficult to properly identify features directly related to the charging infrastructure. Nonetheless, the main findings are reported below.



# Public-enabler CM

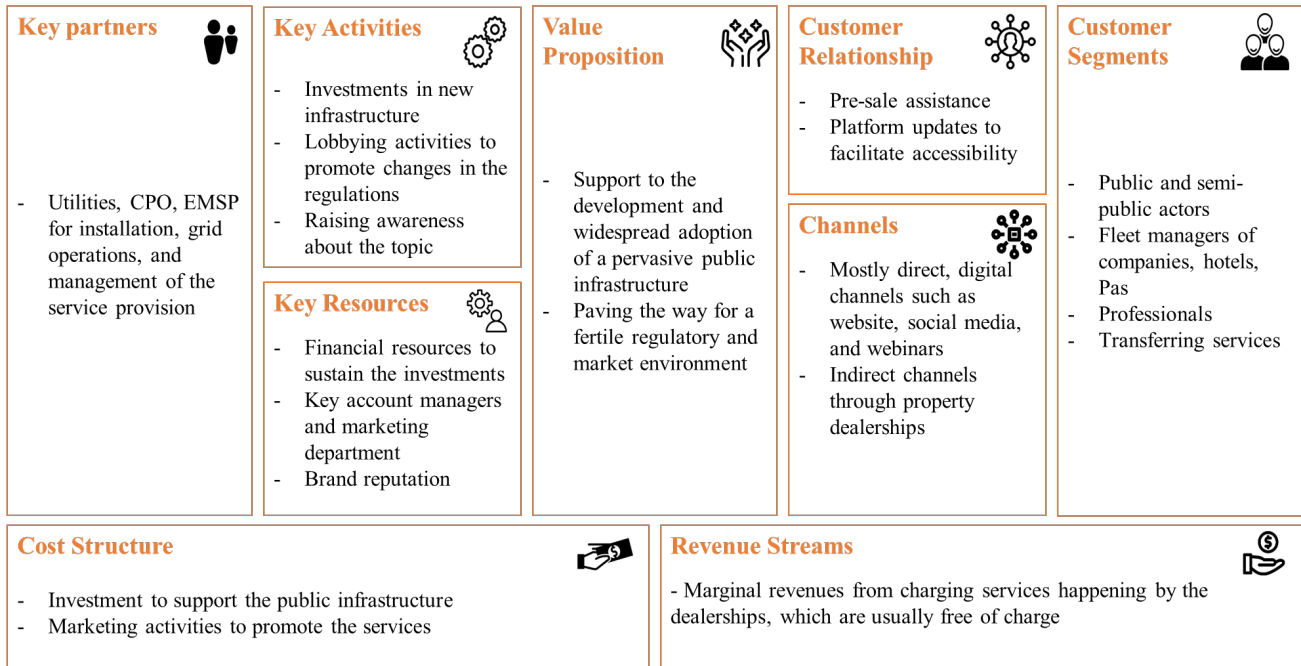


Figure 18 - Archetype of public-enabler CM

This archetype of car makers has the ultimate goal of improving the accessibility to a widespread and pervasive public charging infrastructure, in order to ignite a virtuous cycle that can boost a massive adoption of electric vehicles. Although private domestic products might be provided, these come in as an added solution to the sale of the car, thus not properly representing a value proposition.

The key activities performed are aligned with this target and are mainly related to raising awareness about the importance of having a proper infrastructure, but also practically supporting the cause installing charging stations and lobbying in order to shape a fertile regulatory environment. At times, labelled applications are developed or integrated in e-roaming platforms in order to facilitate interoperability and connection.

The customer base is made up of both public and semi-public actors, namely managers of companies willing to electrify their commercial or logistic fleet, fleet managers of hotels and transferring services, but also professionals.

With the exception of TP6, which has a very peculiar communication strategy which is based only on the brand reputation, recording no advertisement investments, the other players clustered within this archetype rely on direct, mostly digital channels, in order to establish a 1-to-1 connection, even though dealers represent an important intermediary in reaching especially the share of private customers. The customer relationship is mostly related to the pre-sale assistance, deeply intertwined

with the one provided for the purchase of the car, although again TP6 presents a strong relationship established with the client, providing constant updates of the platform, enhancing the accessibility.

Aligned with the goal of spreading the development of a public infrastructure, financial resources are fundamental in a stage which is not yet profitable, hence requiring high upfront investments. Human resources are very important too, especially in the figure of the key account manager, who has the burden of overcoming the customers' skepticism and provide all the information and tools necessary to fulfill the needs.

Downstream players, such as utilities, CPO, and EMSP are involved in the implementation of the solutions, performing installation, grid operations, and management of the charging points.

The economic model, as TP2 highlighted, *“suffers the lack of consistent historical records on which esteems and specific accounting operations could be done”*, addressing one of the main issues related to the low maturity level of the industry. As above specified, the sector is still unprofitable, and this archetype in particular has yet to identify a clear revenues and costs structure. In fact, charging services are often provided as free of charge for the owners of a company's car. Whereas revenues are difficult to address, the main cost items are related, as above-mentioned, mainly to direct investments in infrastructures, and marketing and communication efforts in order to promote the development of the technology.

## Private-oriented CM

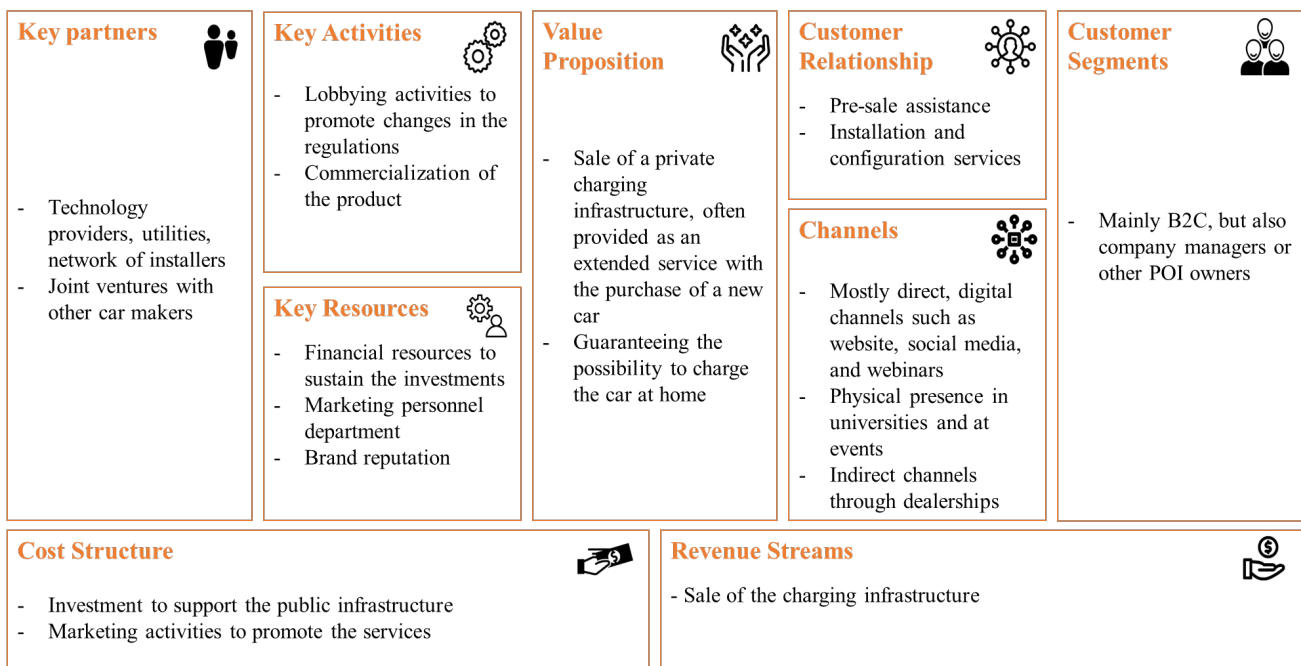


Figure 19 - Archetype of private-oriented CM

As opposed to the previous archetype, the following section describes those players whose emphasis is put in providing the drivers with a private charging point for domestic use. The latter is in the large majority of the cases sold in bundle with the car as part of a premium package. Again, as it was true for public-oriented CM that this very same offer was provided, it is true here that private-oriented CM concur, to some extent, in supporting the development of the public infrastructure, but on a lower level. CM3, for example, which is completely focused on the B2C market, performs lobbying activities and is part of joint ventures in order to empower the different stakeholders and help the development gaining momentum.

Dealing mainly with private customers, these companies have to be highly responsive to the market requests, highlighting the importance of a trained marketing personnel. In order to reach these customers, both direct and indirect channels are exploited, with a higher relevance of the former in its digital and physical configurations.

In the words of CM3, *“understanding our customer, its characteristics, and its desires, is fundamental in order to draw an effective communication strategy”*, and that translated in the decision of promoting the products within universities for example. The relationship with the final user is mainly a pre-sale assistance, helping the customer to understand the features and the technological implications associated to the product, but also post-sales services of installation, performed by electricians or an external network of installers.

Among the key resources, the brand reputation is very important, as it has historically been in the automotive sector, but financial assets, required to invest in marketing and promotion activities, are core as well.

The main partnerships are carried out with technology providers, in order not to have to vertically integrate the production of the WallBox within the company, with other car makers, joining efforts, and with utilities.

The most important revenue source is this time easily identifiable, and it is the sale of the product, which might come with a pre-paid set of charges. Costs, on the other hand, are difficult to be allocated to the charging infrastructure business, with marketing efforts and investments being the only items which can be traced back to it.

## 6.1.2 Electric equipment distributors – EED

### Comprehensive business model of electric equipment distributors

Following, the comprehensive business model of this category of actors coming from all the answers received is presented.

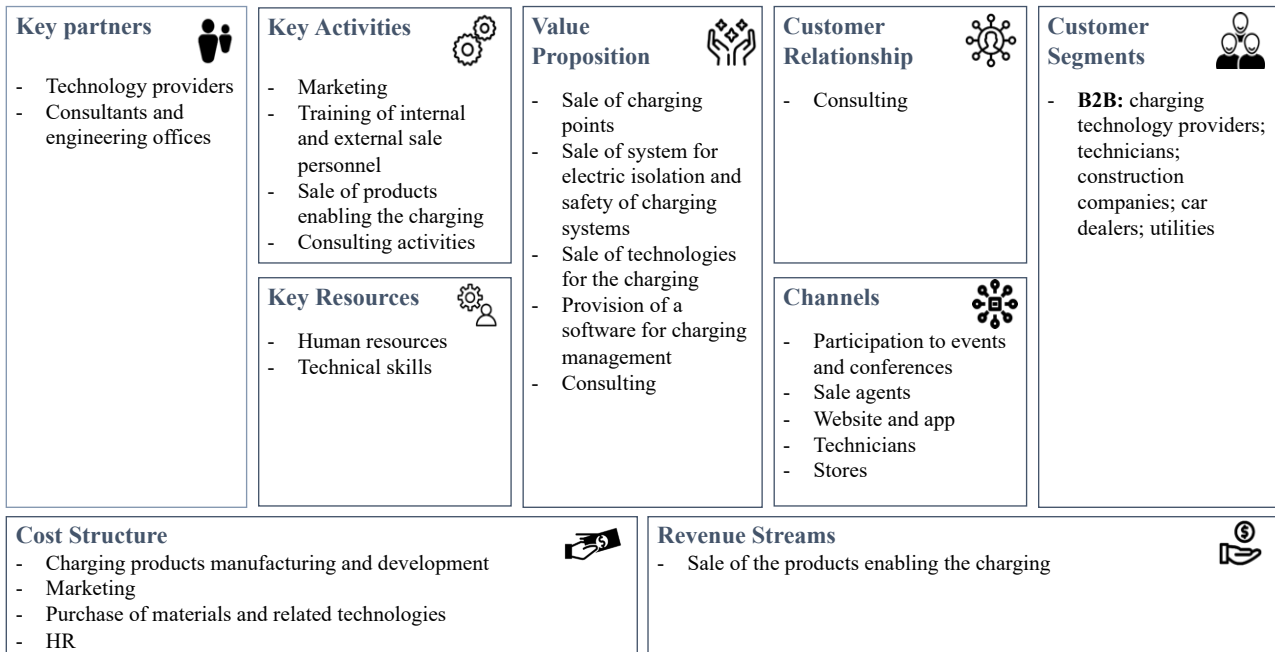


Figure 20 - Comprehensive BMC of electric equipment distributors

Following the same procedure of the previous category, hereafter all the blocks will be deeply described.

Firstly, the value proposition of these actors may vary according to the typology of products they produce or sell and the additional services they include in their offer. Indeed, their value proposition can range from selling pure electric technologies enabling the charging, for instance cables and controllers, systems to ensure the safety and isolation of the charging during the whole process, the charging point itself, or even software to control the charging process and consulting services for customers, to consultancy throughout the whole solution development.

The customer segment is totally represented by B2B customers. In general, these are all the companies which require electric equipment to manufacture or install the charging points, such as technology manufacturers and providers, technicians and construction companies, besides car dealers and sometimes utilities as well.

For what concerns the customer relationship, this is a long-lasting consulting one. Indeed, the distributor must educate the client on how to use the charging products and, by doing so, it allows to establish customer loyalty. Requests may strongly vary from client to client and even in pre- and post-sale phases. However, the relationship results to be continuative.

Concerning the key resources, all the companies interviewed stated human resources are fundamental. Moreover, technical skills about the products, often built from long-lasting experience in the sector, and ever-updated knowledge about the in-force regulations are crucial as well.

For sure, marketing represents one of the key activities of these retail companies. Nonetheless, this is not the only one. Indeed, the training of external sale agents and of internal commercial department, the consultation which precedes and follows the sale of the products and the final sale itself are primary.

Considering the key partners, companies collaborate with technology providers, consultants, and engineering offices to develop new complex technologies.

Shifting in the end to the economic structure of this category of players, revenue streams derive from the sale of these electric technologies enabling the charging process, while the costs are due to the purchase of technologies and of raw materials, to human resources, both for production and sale departments, and finally marketing expenses for products promotion.

## **Blocks variability analysis of EED**

Keeping in mind that this section digs into single blocks of the business model, instead of taking the perspective of the actors, it is interesting to analyze which are the blocks which present a higher and a lower variability in the category in order to characterize the entire market.

In the case of electric equipment distributors, the majority of the blocks present extremely low or even null variability. Of course, this is partially due to the fact that the pool of interviewed companies is very limited, nonetheless, some conclusions can be drawn. Firstly, the blocks of *customer segments*, *key activities* and *key partners* are completely aligned, which means that all the information collected for each company is consistent. The companies present in fact a strong orientation towards the B2B market, performing both marketing and R&D activities, and relying mainly on hardware manufacturers. On the contrary, the block of *customer relationship* and *cost structure* show the lowest alignment, indeed all the companies provided different answers, showing that a consolidated univocal strategy on how to establish a connection with customers and which costs to sustain does not exist.

The first one is unbalanced on establishing durable partnership with customers, including training and updates, co-design and ad-hoc solutions. The cost structure, on the other hand, is more balanced, with configurations which are more or less a combination of marketing and product development expenditures. Finally, *channels* as well present a high variability, with very polarized answers in hard contrast with each other.

## **EED archetypes identification**

The extremely small sample pool dimension of this category drives a forced identification of just one archetype. Based on the offerings proposed by the different companies, it has emerged that the market is inclined towards the provision of a wide variety of performant products and components, often bundled with post-sales services and monitoring software. Being this archetype only one, it is clear that it will perfectly match the omni-comprehensive one described above.

### 6.1.3 Charging service providers – S

This paragraph presents the results obtained for the category of service providers, which include all the companies which are active in the provision of the pure charging, supplying both the physical infrastructure and its management or the charging process itself. Being their offer so different, they will be treated separately.

### Comprehensive business model of CPOs

Below, the business model canvas comprehensive of all the answers is presented.

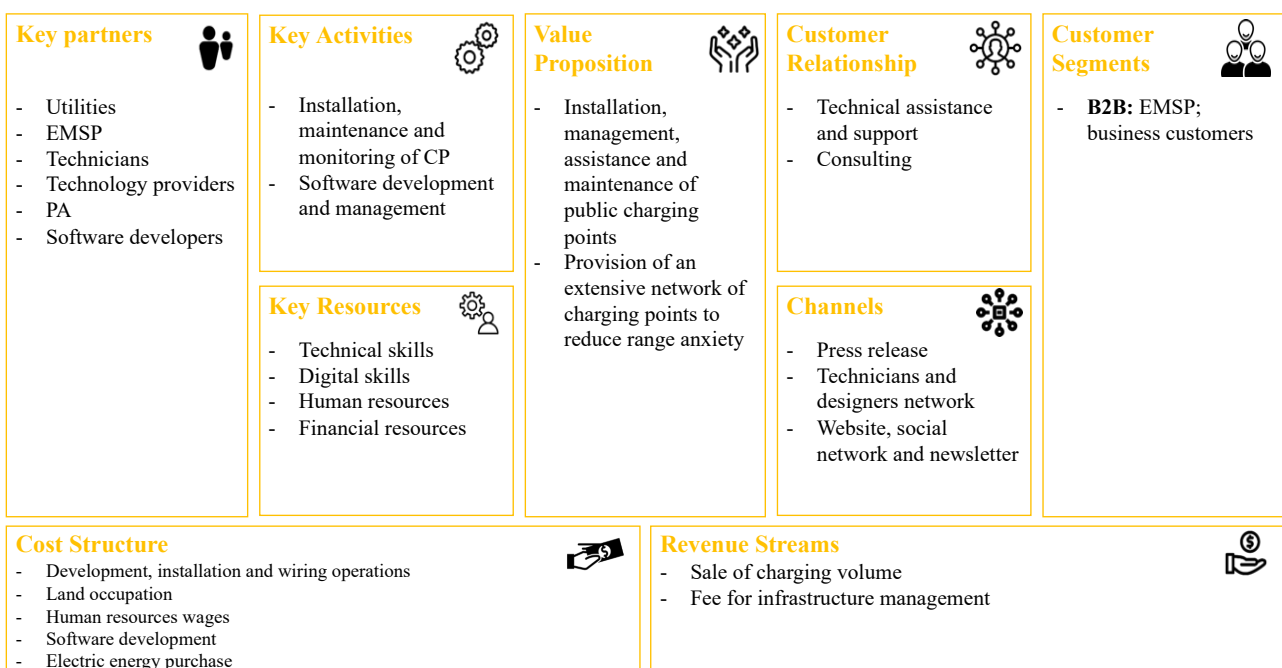


Figure 21 – Comprehensive BMC of service providers: CPOs

Starting from customer segments served by this category of actors, they totally correspond to B2B segment, including EMSP, car dealers, destination charging such as hotels and restaurants, car rental companies, oil & gas companies, and just in minor parts to public administrations.

Shifting then to the bundle of products and services delivered by the company which push a customer to choose that specific company instead of another one, these can be classified into two macro-categories: firstly, the installation, management and maintenance of public charging points, which specifically include diagnostic processes, data management and even the provision of the software that guarantees operation management, accessibility, monitoring; secondly, the creation of an extensive network, allowing the customer to have access to the charging infrastructure easily and everywhere.

For what concerns the customer relationship, this ranges from providing technical assistance and support to long term personalized consulting.

CPOs' channels include both physical ones, such as press releases and the network of technicians and designers, and digital ones, namely websites, social network and newsletters.

As concerns key resources, CPO require well developed technical skills for technologies installation and maintenance and related human resources, digital skills for the development of the software which manage charging points and financial resources since investment have a very long payback.

Considering key activities, CPO's ones start with the installation, monitoring and maintenance of CP, besides the development of the software to manage CPs.

CPOs establish partnership with different categories of players, among which Oil & Gas companies, utilities and EMSP, technology providers, which are expert CP manufacturers, technicians which take care of the installation process, Pas, and software developers with whom they collaborate for the development of applications and platforms.

Finally, as concerns the economic model, CPOs mainly get their source of revenues from the sale of charging volume and from fees due to infrastructure management. The former can correspond to different prices based on client subscription to the EMSP platform and, obviously, fast and ultra-fast charging are more expensive. In relation to this latter point, S13 stated: *"The businesses of fast and ultra-fast are definitely the most profitable ones"*.

Shifting to costs, these are due to the development and installation of the charging infrastructure, the cost of the authorizations to occupy public land and software development costs, besides the wages for company personnel, both technical and commercial one.

## **Blocks variability analysis of CPOs**

This paragraph aims at qualitatively analyzing which blocks present the highest and lowest variability, thus identifying the mostly adopted strategies which could represent a pattern for the category.

Firstly, it is interesting that the totality of the companies exploit personal assistance to build their *customer relationship*, highlighting how this highly technical sector requires to establish a personal relationship with the customer in order to explain the technical features of products and to provide consulting and assistance.



Moreover, *value proposition* block is interesting as well: the very big majority of answers included offering an all-inclusive charging solution that could include CP design and consulting, and extra services such as diagnostics, maintenance, assistance, data managements and interoperability features as well. This underlines that CPOs do not want to act as simple retailer and technician of the charging technology but aim at offering the most complete service possible, thus gaining competitive advantage.

Even the *customer segment* block is quite uniform. Indeed the big majority of the companies state they mainly serve the B2B market.

The same conformity is found among the *key resources*, which are for the largest majority of the companies represented by tangible assets, such as financial and human resources, related to technological and digital skills.

Again, even *key activities* are almost uniformly represented by operations, such as installation, maintenance, and monitoring procedures, besides software development and management.

Finally, blocks related to the economic model present the highest variability, stating a unique strategy for the economic sustainability of these businesses do not exist, displaying very polarized answers for the *revenue streams*.

## **CPOs archetype**

The only archetype identified to describe the business model of CPOs is presented above. Indeed, the variability analysis of the single building blocks of this category of actors has highlighted quite aligned results.

CPOs offer is totally addressed towards public or private-with-public-access charging.

Moreover, the development of the software used to manage the charging point represents a fundamental activity. As stated by S13: “*we do not ever sell the hardware alone, but this is always accompanied by the software, that guarantees the correct running of operations, accessibility, monitoring and billing platform*”.

In general CPOs focus on offering the technical installation and management of CP, which is integrated of additional services in order to “*create a positive experience for the user by integrating additional services to spend the charging duration*”, as explained by S1.

# Comprehensive business model of EMSPs

Below, the business model canvas comprehensive of all the answers for EMSPs is presented.

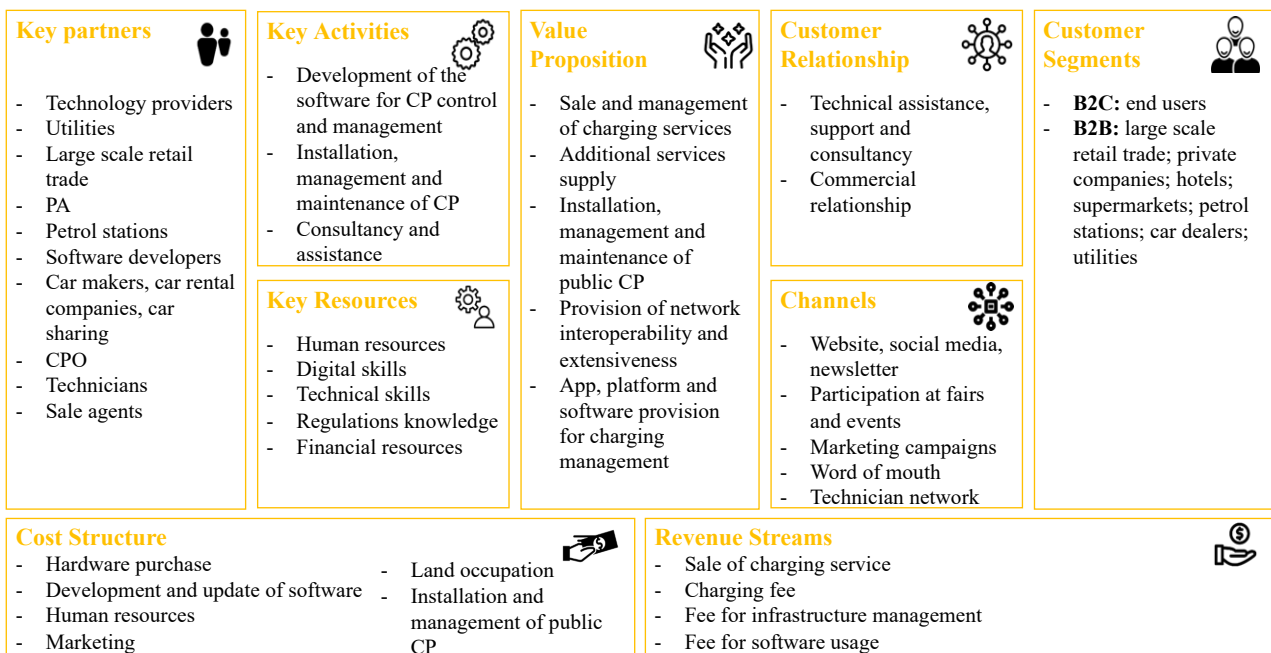


Figure 22 – Comprehensive BMC of service providers: EMSP

Considering the business model of EMSP, the customer segment differs from the previous one since it includes both EV drivers and business customers such as large scale retail trade, private companies, destination charging points such as hotels and supermarkets, petrol stations, car dealers and utilities.

The value proposition is based on the sale of the charging service itself, that may include its design, installation, maintenance and management. Besides, value proposition may also comprehend all the potential services that could gravitate around the charging, namely charging point location, booking and billing. Moreover, EMSPs seek to guarantee the wider network possible, thus including in their offer interoperability among different CPOs.

The customer relationship established with the client can vary from pure administrative relationship to consulting services, which may be carried out by a dedicated reference person within the company, by different assistants or even by impersonal chatbots.

EMSP relies on different typologies of channels: they participate at fairs and events, they exploit digital channels such as their websites, social media and newsletters, marketing campaigns including advertisement by commercial partners or the usage of sale personnel, in some cases, they even benefit of word of mouth.

For what concerns key resources, EMSP leverages on human resources – architects, engineers, designers and sale personnel – financial ones, which allow significant investments in R&D, technical

and digital skills for software development, and skills concerning new regulations for charging point installation, operations, incentives etc.

Key activities mainly are the development of the software which is used to manage CP, in some cases the installation and management of the CP, and the provision of consultancy and assistance to clients in case of need.

Shifting to EMSP partners, these are petrol stations, large scale retail trade, and PAs for CP location, car makers, car sharing and car rental companies through which EMSP is able to get its value proposition to many customers, external network of technicians for CP installation, and sale agents for CP commercialization, technology providers, software developers, utilities and even universities which provide development contributions.

Concluding with the economic model, EMSP source of revenues may differ. Some players prefer to get revenues proportional to the charging volume, others get a periodical fee for obtaining the charging service. Besides, some require fees for infrastructure management or for software utilization. Finally, the costs sustained by EMSP correspond to software development and its continuative updates, the wages of human resources, both external technicians and sale department, marketing costs and all the costs related to the provision of the CP itself, such as technology purchase, land occupation costs, installation and management.

## **Blocks variability analysis of EMSPs**

Moving to the assessment of the variability characterizing the blocks of the BMC of EMSPs, this is important to understand if some strategic patterns exist in the category.

*Customer segment* is the block characterized by the lowest variability, indeed a considerable number of companies recognize it as composed by both B2C and B2B, but strongly unbalanced on the latter. The same happens for *customer relationship*, which is almost universally established through personal assistance. However, all the other blocks present high variability values, starting from *value proposition*. Indeed, two main strategies are followed: the former focuses on the charging service, by providing the charging itself and different ancillary services to charging; the latter instead also focuses on the provision of the hardware side, its installation and management, besides its maintenance.

In addition, *key partners* extremely vary from company to company, thus emphasizing the fact that according to the firm under scrutiny, this may have decided to internalize or outsource different kind of activities, ranging from operational ones to commercial ones.

## EMSPs archetypes

As briefly introduced in the variability analysis, two main archetypes of EMSP can be delineated. The distinction between the two resides in their value proposition and these can be categorized as *pure EMSP* and *integrated EMSP*.

Starting from the pure EMSP, its offer totally focuses on the provision of the charging service and the additional services which gravitate around this.

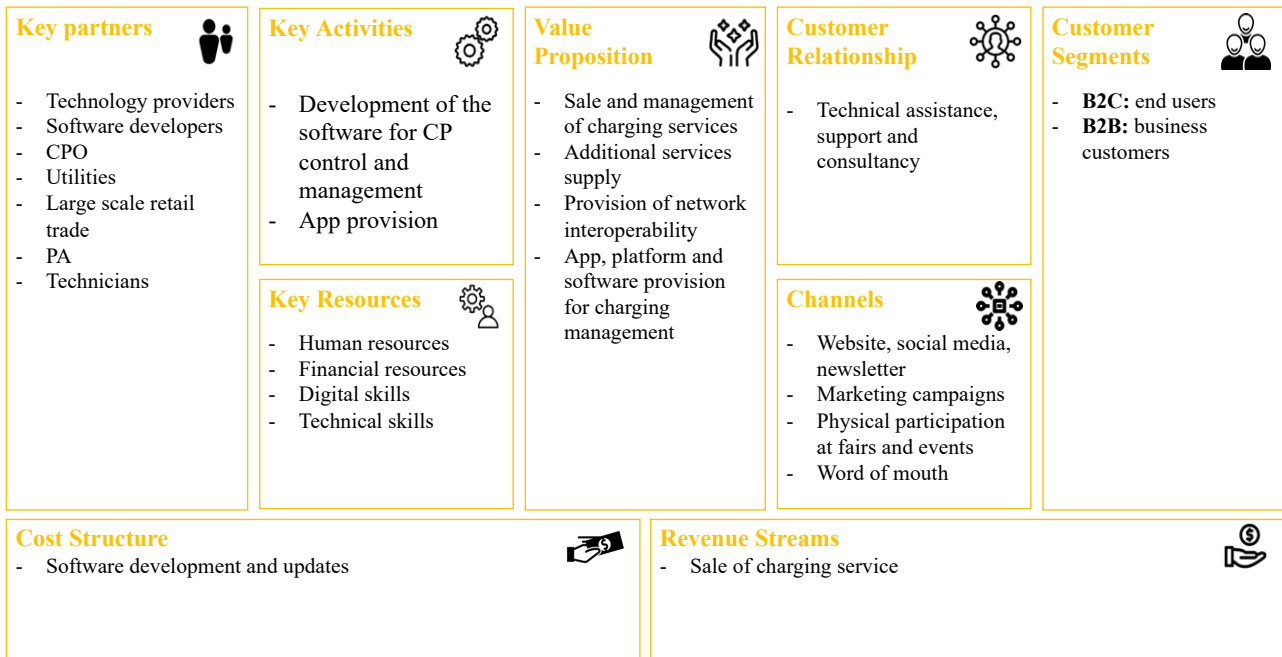


Figure 23 - Archetype of pure EMSPs

As it is clear from the value proposition, the main aim of this category of actors is to supply the charging service, accompanied by additional services, such as remote CP identification, booking and payment. Moreover, an additional value that pure EMSP seek to deliver to their clients is the interoperability of the offer, i.e. the chance to have access to charging points administered by different CPOs, thus guaranteeing the access to the widest network possible. This often passes through an app that allows all the afore-mentioned charging services and features.

For what concerns the customer segments served, they belong both to B2C and B2B segments, being them end users or businesses, such as destination charging places, oil & gas companies, firms owning electric vehicles fleet or that aim at offering the charging service to their employees, large scale retail trade, car dealers, camper areas, besides CPOs, to which they offer the platform for real time remote monitoring and control of charging points. As company S10 states: “B2B customers operating as CPOs often rely on us as providers of software for CP management and control”.

The customer relationship totally relies on personal assistance, which offers technical support, assistance and consultancy.

One significant aspect, that is reflected by both key resources and key activities, is the software side of pure EMSP's offer. Indeed, this represents an additional value they deliver to their customers and that requires considerable resources – human and financial ones, besides digital skills and know how – and related digital activities.

Finally, for what concerns the costs, again, they are strictly related to software development, management and update. S2 has witnessed: *“in 2019, we spent 130 000 € for software development and management and between 50 000 € and 60 000 € for R&D”*.

On the other hand, revenues derive from the sale of the charging service. Different billing typologies exist, they can be fixed or variable in terms of time, this depends on the company under scrutiny. For instance, S2 declared: *“we do not get any fee on payments. Our revenue streams totally derive from the initial fee for CP synchronization and the consequent annual subscription for each charging station”*.

Moving to the role of integrated EMSP, this presents slight differences in the building blocks of business model canvas.

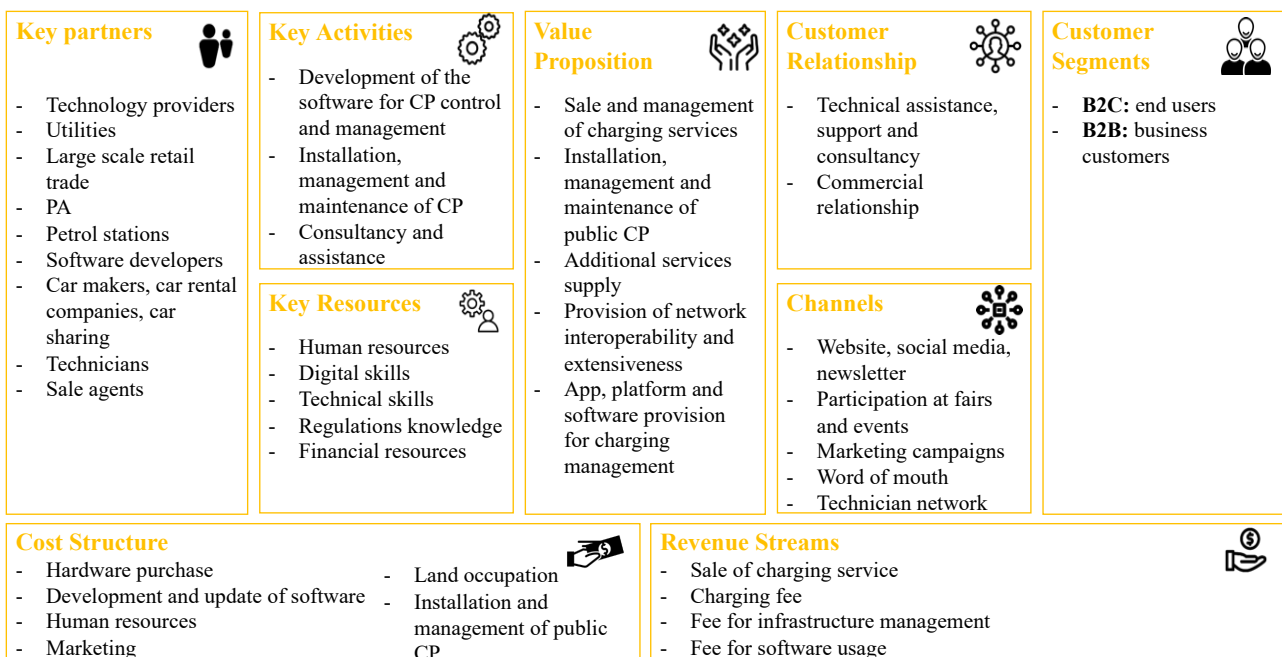


Figure 24 - Archetype of integrated EMSPs

Firstly, for what concerns the value proposition, this slightly differs from the previous model since integrated EMSP do not only provide the charging services, but they combine in their offer the installation, management and maintenance of the CP itself. In other words, this category encompasses EMSP which have expanded their operations to the role of CPOs. Many companies have witnessed this. For instance, S3 stated:

*“We aim at being a general contractor offering a complete range of products, services and solutions in order to act as a full service provider. We firstly analyze customer requirements. On the basis of this latter, we then select and provide a customized charging system, that we subsequently remotely manage”.*

As S22 specified:

*“We both serve as CPO and EMSP. As CPO, we are responsible of CP diagnostics, maintenance, charging price setting and data management. On the other side, acting as EMSP, we are in charge of the management of commercial aspects related to EV charging. Moreover, the pillar of our offer is our app because this allows customers, both private or public, to follow the management of the CP. I make a practical example: customers can have access to reports on the kWh sold and on the basis of these ones they can provide free or discounted charging services to some customers”.*

S4 explained:

*“Our value added is being able to take care of everything. Once the car dealer has sold the EV, this directly activates us. From that moment on, we take care of everything: we get in contact with the client, we carry out the inspection, we develop a personalized offer, we provide the billing and remote assistance through call centers. Even, in case of moving, we are in charge of moving the CP as well”.*

S5 declared:

*“The infrastructure must be fast, technologically advanced, reliable, easy to be used and accessible”.*

This was confirmed by S6 as well:

*“We aim at offering an easy service, which is remotely identifiable by all app user. Interoperability is crucial to guarantee customer loyalty”.*

Moving to the customer segments, these correspond to the same market mentioned for pure EMSP: on the one hand, there are end users, belonging to B2C segment; on the other hand, there are businesses which are focused on delivering both public and private charging, such as destination

charging, car dealers, utilities private companies with EV or offering charging service to their employees.

The customer relationship generally relies on tight customers engagement, which is based on consultancy, technical support and assistance. For instance, S3 relies on dedicated personal assistance and declares:

*“Every customer is followed by a reference person from our company, with whom he builds a long lasting relationship and assistance for the whole duration of the charging service provision, by proposing intuitive and customized solutions based on efficiency and flexibility”.*

Moreover, an interesting aspect is related to commercial proposition. S9 explains:

*“The core underlying value characterizing our customer relationship is trust. This is translated into the commercial proposition, which relies on our employees and not external sales agents. The reason of this choice resides in the higher engagement of our employees in the vision and values of our company which is then conceived to the customer as well. Employees actions are led by the belief in the firm and in its values, not by the simple commission on the sale”.*

The channels exploited by integrated EMSP range from physical ones to more digital ones. The only difference, if compared to pure actors, resides in the exploitation of technicians network which act as communication channel for company’s offer.

For what concerns the key resources and activities on which integrated EMSPs leverage, they are similar to the ones adopted by pure players, but in this case the focus is not singularly on the software development, but it resides also on the operative aspects of CP installation, maintenance and management, besides the related consultancy services. For instance, S9 states:

*“We have a strong computer science know how which is transmitted into the software development, but our key resources are human ones as well. Indeed, we leverage on a strong network of sales agents, engineers and designers which work as a team to transmit our values”.*

One singular aspect that was mentioned by S11 is the updated knowledge in terms of regulatory framework:

*“Our technical department takes care of public tender to win the installation of the CP on public land. Moreover, it has the appropriate knowledge about current regulations, especially in terms of safety and EV regulations.”*

Talking of key activities, S4 said:

*“Our key activities are to design, to build and to support smart charging solutions for offices, houses and during travels”.*

S7 explained:

*“Getting in contact with the client surely represents a key activity, besides the consultancy and assistance service we provide and the final sale of the CP”.*

As concerns the key partners, these mainly coincide with all the actors which can make available their parking lots for the installation of a CP, i.e. destination charging, such as HoReCa and large scale retail trade, PAs, petrol stations, car dealers, car rental companies and car sharing, besides those actors which provide the hardware and software side, and the installation and the commercialization of charging services.

Concluding with the economic model, the revenue streams do not only derive from the sale of charging service, as in pure EMSP case, but these can be expanded to the sale of the software for CP management, to the management fee, i.e. a fixed annual cost for problems analysis, to charging fee.

For instance, S6 explained:

*“We have several sources of revenues: we sell the CP, we get a management fee that represents an annual fixed cost for the customer to provide him the solving of potential problems, the charging fee, which does not derive from the sale of electric energy but it depends on the transition. This latter price ranges from 50 cents€ to 1€”.*

On the contrary, S11 declared:

*“Our revenue streams are proportional to the electric energy supplied. The price can range from 29cents€/kWh to 42-45cents€/kWh, obviously basing on the charging power”.*

Finally, the cost structure ranges from the costs of software development, to human resources – both commercial and operative ones, such as technicians – the hardware purchase and its installation and management, the cost for land occupation, besides marketing expenses to identify potential customers.



## 6.1.4 Technology providers – TP

### Comprehensive business model of technology providers

First off, the comprehensive business model for the category will be presented, developing a canvas which encompasses all the main information gathered both before and during the interviews.

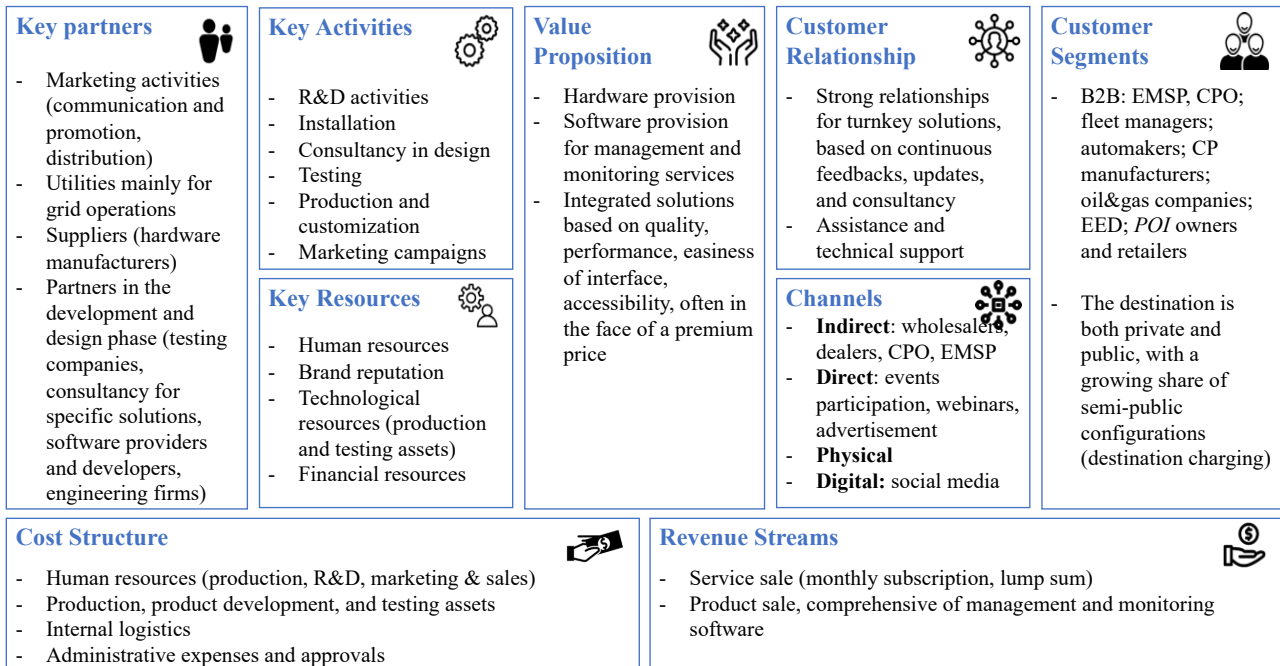


Figure 25 - BMC of technology providers

As it can be seen, there is different and heterogeneous information available for each block. This is due to the fact that the category fits a role in the value chain which can perform a wide variety of activities, easily extending both upstream and downstream, with all the consequences that this entails. Below, the information will be furtherly examined analysing each building block in detail.

The value proposition reflects this intermediate position of the category, ranging from the mere provision of the infrastructure, comprehensive of the software to operate it, to an integrated solution in a turnkey configuration. In the latter, the company takes care of all the upstream and downstream activities, lifting the customer from the burden of having to deal with multiple actors, thus providing a complete package which couples the hardware provision with activities of installation, maintenance, and management. Some key concepts that emerged were those of quality, performance, and easiness of interface. The interviewees often stressed the importance of this last one, reason behind the fact that the user-friendliness of the charging points, both from the EMSP side and the driver side, is a fundamental value driver.

For as various as they are, the main customer segments are all mainly business clients, ranging from CPO and EMSP, so charging service providers, to *POI* owners and managers, willing to implement charging stations by their business in a configuration which is semi-public. The hospitality and retail

sectors were by far the most cited, with hotels, restaurants, and superstores being the most-widely addressed destinations. But again, customers can also be intermediaries and not directly the final one, and this is the case of automakers willing to include the charging station in a bundle with the car, or electric equipment distributors acting as resellers.

The engagement of these customers can happen through direct or indirect channels, both physical and digital. Direct channels are preferred, leveraging the company's reputation, a consolidated network of commercial force, or a strong communication strategy deployed via social media, website, or magazines. Partaking in events, fairs, and summits, is one of the most widely exploited direct channel. Indirect channels, although seldomly heavily exploited, mainly refer to push strategies that leverage downstream players' network of customers, such as wholesalers or dealers.

Once engaged, the customers can experience different levels of relationships, starting from just the technical assistance and support to installation, configuration, or software settings, up to the building of a consolidated relationship, where the provider keeps the client informed through consultancy, provides new updates and creates a mutually-beneficial feedback loop.

Among the key resources, human capital is by far the most important, with know-how and expertise about both the technical aspects, and the market and regulatory aspects, being the most valuable. Training the personnel and keeping it updated about the ever-changing environment is core. Nevertheless, financial assets are instrumental in supporting the expenses in a context where profitability is still low. Brand reputation is leveraged especially in the engagement with both customers and suppliers, and is seen as a core resource in a market where competition is fierce and can also come from players outside the value chain. Infrastructures and physical assets, such as plants and machineries, are important but are usually considered less crucial than human resources and intangibles such as internal knowledge.

According to the offer provided by the company, the activities performed by the company vary, ranging from internal activities, namely research and development, production, and testing, to more externally-oriented ones. The latter include installation, co-design and co-engineering, and marketing campaigns aiming at a deep understanding of the market.

The partners involved are both players upstream and downstream, engaged for example for the design of a tailor-made solution, for product testing and customization, software provision, or for marketing and communication purposes. Other partnership with a more functional and buyer-supplier-like configuration are represented by the links with hardware and components manufacturers, and utilities for the grid operations.

The economic model is essentially split for what concerns the main revenue streams between service sale and product sale. With the latter, it is usually meant not only the hardware, but also the software installed, which in turn can be an additional revenue source if sold separately. Service sale refers to the possibility to exploit the product, the software, or both, in a subscription-like configuration which is usually paid through a monthly fee.

The main cost items are related to human resources, including not only the direct cost of personnel, but also training expenses in order to consolidate the know-how. R&D and marketing divisions are the ones in which these expenditures are higher. Another important voice regards tangible assets such as machineries and production plants, but a very interesting one that emerged was related to the concessions and administrative procedures required.

## **Blocks variability analysis of technology providers**

The following section will try to furtherly explain, whenever possible, the reasons behind the levels of alignment that the different blocks present. Low variability blocks include *customer segments*, *key activities*, and *cost structure*. Where customer segments and cost structure present a strongly dominant configuration, key activities see the main answers gravitating around an intermediate solution, and this is explained by an interesting correlation between this block and the *value proposition* one. It is in fact understandable that in order to provide the same offer, the core activities performed by different companies are alike. The *value proposition* block is, in fact, characterized by a relatively low variability, which anyway entails interesting distinctions between the configuration, as it will be later explained.

Medium levels of variability include *customer relationship*, *channels*, and *key resources*. It is worth to notice that the key resources block present a defined dominant preference in human resources, with a recurrence which is very high. The variability analysis is, in fact, a tool which is not exhaustive and does not provide a complete snapshot of the actual situation, but is nevertheless very interesting to apply. Customer relationship presents a similar issue. If two similar configurations, namely “strong partnership” and “feedback-based relationship” were merged into an even more aggregated cluster, identifiable as “recurrent interactions”, a strongly dominant arrangement would emerge. The highly qualitative nature of this block makes it fairly difficult to definitely create clusters, and for this reason it is more interesting here to look at the concentration of the answers at the highest possible level of aggregation, in order not to let personal judgement affect the information.

Finally, the blocks presenting the highest level of variability include *key partners* and *revenue streams*, which display an almost evenly-spread distribution of answers among the possible

configurations. The decision of relying on partnerships is at times almost a forced choice, especially for new entrants which have not yet integrated, or are not willing to, all the different activities to offer the solution.

## TP archetypes identification

The different business models provided by the fifteen players in this category can be clustered into three main archetypes, which differ on a higher level on the value proposition. It has been possible to identify companies which are more *hardware-oriented*, others which are more *software-oriented*, and finally other which offer a *turnkey solution* which includes both hardware, software, and value-adding services. Whereas some building blocks do not present significant variations, like the customer segments, channels, and customer relationship, others sensibly vary according to the adopted BM. In the following sections each one of these business models will be analysed in detail.

## Hardware-oriented TP

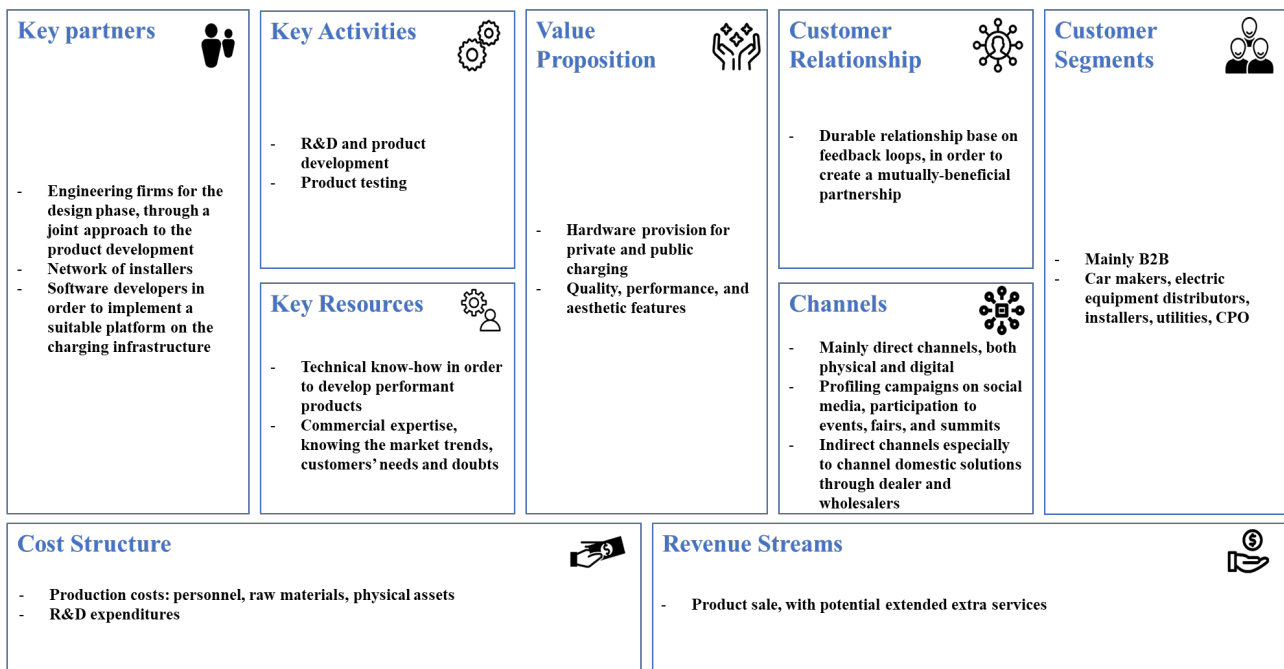


Figure 26 - Archetype of Hardware-oriented TP

Hardware-oriented providers focus their business on the provision of the charging infrastructure, thus presenting a profile which has a huge manufacturing component, with all the implications this entails. The main cost items are, for example, related to production, R&D, and raw materials supply, whereas the main activities are related to the product development and testing.

Among the business customers, since the market is totally dominated by the B2B, the most recurrent ones are car makers, EEDs, installers, utilities, and CPOs. In order to reach these clients, a mixed approach of mainly direct, but also indirect channels is exploited, leveraging an internal network of distributors, as well as profiling campaigns on social media, advertisement on magazines, and physical presence to events, fairs, and summits. Indirect channels are especially exploited in order to promote the products destined to domestic charging. Once engaged, the relationship established with these customers is a mutually-beneficial one, where a continuous feedback loop is created in order to improve from both ends.

The key resources are deeply linked to the know-how of the personnel, which has to be able to be effective both from a technical point of view, knowing the products, their features, and the relative innovations, and from a commercial point of view, having to know the market dynamics, the competitors' offers, and the customer's needs.

In order to provide the service, external partners are involved at different stages of the process, starting from the design phase, where engineering firm are engaged in a co-design process, down to installers, on which the providers rely in order to integrate an added service to their offer. Or again software developers, so that a software can be coupled with the product, providing an enhanced, more integrated solution to the final customer.

For what concerns the main revenue streams, a coherent finding identifies the product sale as the main source of income. An example of a company presenting such a business model is TP5, which nonetheless underlined the importance of the software side, especially the easiness of the interface, as a value driver in order to sell the product.

## Software-oriented TP

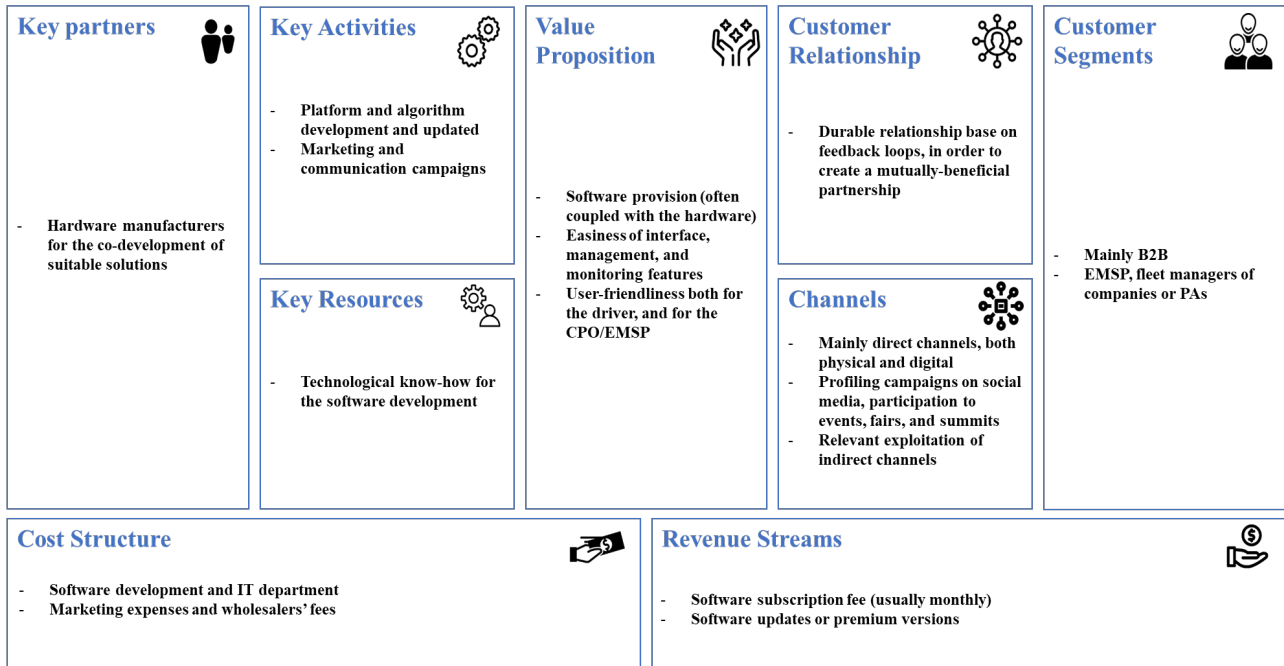


Figure 27 - Archetype of software-oriented TP

A second archetype that can be identified gathers the software-oriented providers. An important clarification has to be done: the orientation towards the software side takes into consideration those players which give a higher importance to the latter over the hardware but, nonetheless, might (and usually do) provide both.

As TP1 clearly expressed, *“the management and monitoring platforms are the field on which the customer is secured”*, representing a tool which can deeply facilitate both the driver’s experience, and the manager’s.

Bundling the sale of the hardware with the management software, seldomly separately sold, the companies traceable as software-oriented leverage the same channels as the hardware-oriented, with stronger exploitation of indirect digital channels, in order to establish again a value adding relationship. The latter is maintained providing, for example, continuous updates of the management platform, especially for what concerns the user interface, the location services, and the payment and billing operations.

The clients are still represented by businesses, although the main players addressed are now service providers, such as EMSP, or fleet managers of companies and public administrations.

Relying heavily on human resources, especially on technological know-how and algorithm development, software-oriented TPs have as core activities the development of the platform, its

constant updates, and the communication campaigns in order to get the customers to know the product.

Third parties, especially hardware manufacturers, are involved in order to co-develop the software so that it suits the charging station best, enhancing the charging experience.

The economic model sees a relevant share of the cost structure being taken away by the software development, personnel costs, mainly the IT department involved in the algorithm development and software updates, and, although less relevant, marketing expenses in order to sell the product through direct and indirect channels. On the other hand, the main sources of revenues are related to the sale of the software and its updates. The latter can be provided in different forms, but the most widely spread is through a subscription fee, usually monthly, paid by the customer to the provider. Or again, if the product is sold as a bundle, the software price could be not explicit, and might provide future cash flows due to charged updates.

## Turnkey solution TP

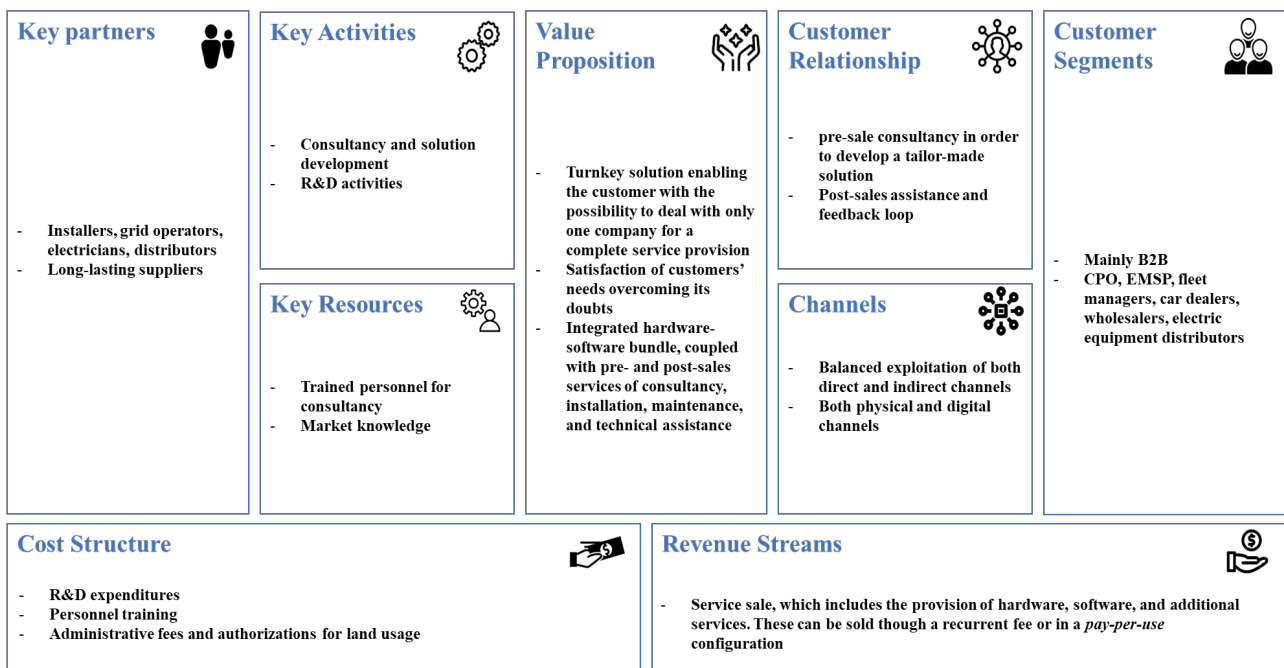


Figure 28 - Turnkey solution TP

Providing a solution over a product, this category of TP integrates upstream and downstream activities in order to provide an all-inclusive offer, for both the private and public charging, to the customer. As TP6 and TP8, leaders in the sector, have remarked, the dynamism of the market and a customer base which is easily scared off by the number of options available in a context which is very difficult to keep up with, makes providing a turnkey solution, where the clients have to deal with only

one provider, the most important source of competitiveness. This archetype relies on flexibility, quality, and performance, coming usually with a premium price to be paid in the face of a much easier purchasing experience.

The customers served are all the downstream players in direct contact with the drivers, namely CPO, EMSP, fleet managers, car dealers, but also wholesalers and distributors that will later on pass down the product.

Although no clear pattern could be identified for what concerns the channels exploited, direct ones have a slight edge. Both physical and digital channels drive the engagement of the final customer, who is supported along the whole process, starting from pre-sale consultancy, in order to identify the client's needs and act accordingly, down to the installation and post-sales assistance.

Among the key activities performed by these players, consultancy is probably the most important one. Being able to identify needs, desires, and doubts of the customer, addressing them in an effective way and then designing a suitable solution is the ultimate goal of these businesses. Then again, R&D activities represent an important competitive lever. In order to carry out these activities, a trained and cross-functional personnel must be present both at a technical level, providing the customer with consultancy, and at a strategic level, being able to vertically integrate or implement all the required steps along the supply chain. Whereas this integration is not possible or not economically viable, external suppliers must be involved. These are usually downstream players performing installation, grid operations, or distribution, or upstream players engaged in a buyer-supplier configuration.

The sale of the service, which includes the hardware, the software, and the service package which can be more or less extended, represent the main source of revenue. The configuration of the sale is usually made up of a one-time component for the product and the pre-sale activities, and a recurring fee for the platform utilization. Additional services, such as maintenance and post-sales assistance, when provided, can be either free of charge (but here the product price is higher), or paid as extra-services. On the other hand, R&D expenditures, personnel training, and administrative costs represent the main items making up the cost structure.



## 6.1.5 Utilities – U

### Comprehensive business model of utilities

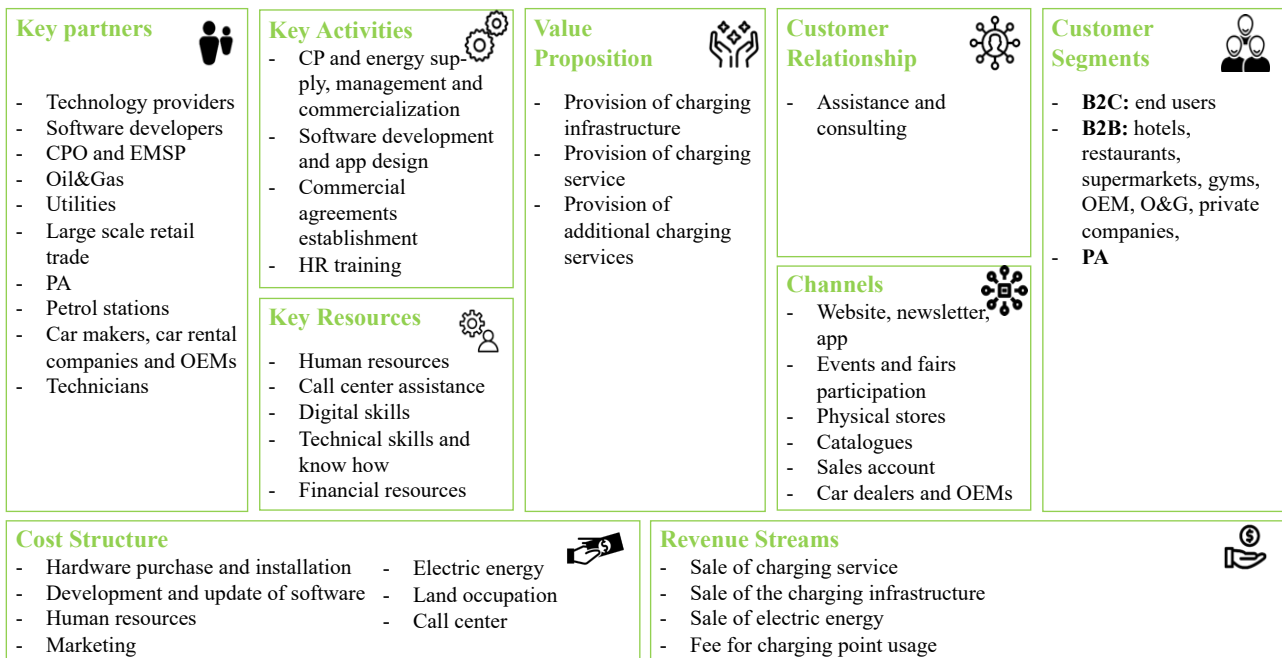


Figure 29 - Comprehensive BMC of utilities

Starting from the value proposition, this may include different typologies of offer. Generally speaking, it always consists in the provision of electric energy plus the sale of the charging infrastructure and or service. Moreover, additional services can be added to company's proposal, such as apps for public charging point identification and booking, RFID card for the access, remote payment, and interoperability of the service. In addition, utilities can supply even CP installation, management, and maintenance, besides offering consulting and assistance to customers.

Moving to customer segments, utilities serve a large variety of markets, including B2C, namely EV drivers, B2B, such as businesses allowing destination charging, like restaurants, hotels, gyms, supermarkets and large scale retail trade, besides O&G, original equipment manufacturers and general companies which allow their employees to charge the vehicle at workplace or companies which have electrified their vehicle fleet. In addition, even public administrations represent a customer segment for utilities, indeed they usually require the installation and provision of the charging infrastructure and consequent service integrated of the electric energy supply.

As concerns customer relationship, this focuses on technical assistance and consulting, which can be provided pre- or post-sale, from remote or in presence, and can include diagnostic and statistics.

Channels are extremely variegated, they range from strong online presence, through websites, newsletters, apps and call centers, to physical participation to events and fairs, catalogues, stores and flagship stores, and indirect channels such as sale agents, car dealers, OEMs.

Again, even key resources result to widely vary, from human resources both for charging solution commercialization and for installation assessment, to technical, digital and marketing skills and know how, and financial resources. Some companies consider crucial call centers as well.

The previous key resources are intrinsically related to key activities. In particular, these are software development, app design, commercial agreements establishment to take part at the widest charging network possible and competitive procedures to win public tenders, CP and electric energy supply, management, and commercialization. Moreover, some companies state they consider consulting a key activity as well, in order to provide ad hoc customized charging solutions. For this reason, personnel must be highly trained, which, in turn, represents a core activity.

Shifting to key partners, these may be on the installation or on the marketing side, namely technology providers, car makers, software and hardware developers, CPO and EMSP, technicians, investment funds, long term car rentals, hotels, restaurants, shopping malls, large scale retail trade, petrol stations, OEM and car dealers. Moreover, some companies collaborate with other utilities which are active in the charging market since long time, thus sharing knowledge.

Finally, concluding with the economic model, revenues derive from different sources: the sale of the charging service and of the CP itself, the fees for installing, activating and running the CP, besides additional services and electric energy supply. Considering the cost structure, software development and platform management, hardware purchase and related installation, marketing, human resources and their training and electric energy represent significant cost items. Some companies have also to sustain costs for the call center to provide assistance to customers and, as CAPEX, the acquisition of the land on which to install charging points.

## Blocks variability analysis of utilities

Moving to the assessment of blocks variability, the answers regarding utilities building blocks slightly vary. Nonetheless, a strongly dominant configuration emerged in nearly each one of the blocks, making this category counterintuitively among the most reliable when it comes to identify patterns. This assumption is also validated by the fact that the sample is large enough and representative of the category. The only two blocks which are more or less uniformly distributed are *customer segments* and *channels*, which comprehend both traditional methods and new innovative ones. The former is very interesting to be analyzed. As it has been noted when assessing the car makers' business models, the relevance of the B2C market is very low among the different categories, with the exception of two figures, namely car makers and utilities. These two actors are the only ones, in fact, with whom the end customer has direct contacts more or less often. So utilities are again a junction between the charging infrastructure value chain and the end user, the driver, thus playing an important role in addressing also the private sector.

Observing the frequency of the answers in the *key partners* and *key activities* blocks, it is possible to identify an absolute prioritization of operations and internal activities, whereas marketing plays a way less relevant role. This outcome can be explained considering that utilities are cross-industry players, with a network of different customers which are usually long-lasting clients, thus requiring a lower marketing effort.

*Value proposition* and *customer relationship* both present a dominant configuration that points towards turnkey solutions in which the customer is supported along the whole process, whether business or consumer it might be.

The economic model presents again a tricky section to be evaluated. For what concerns the *revenue streams*, the answers highlight that the direction towards which the category is going is the one of a pay-per-use approach, which is aligned with the daily business of utilities, billing on an energy-consumption basis.

The *cost structure* is heavily leaning towards internal costs, and this is reasonable given the asset intensity of utilities, especially the ones integrating activities which are not part of their core business.

## Utilities archetype

In this paragraph, the only archetype regarding the utilities will be described.

The choice of adopting one only archetype is due to the fact that, despite some differences related to value proposition configuration exist, the remaining blocks slightly differ one from the others.

Digging down into the value proposition, it is necessary to premise that all the utilities do not limit their offer to the sale of electric energy but they have integrated it with additional products and services, seeking to act as full service providers. In particular, the block presents two main configurations.

Firstly, some companies concentrate their offer on the sale of charging products and related services, namely the initial consultancy for CP design, its installation, maintenance and technical assistance. This offer may be also expanded by providing the contact with long term car rental. In this case, the utility provides the customer with a turnkey solution, which is subsequently managed by the customer himself or by third parties.

On the other hand, other companies' offer lasts even after the sale of charging products and related services. In this case, utilities offer is more focused on the provision of the CP and related charging service, acting both as an EMSP and a CPO.

The second business model results to be an extension of the first one, i.e. it expands the only sale of the charging products and related services, and provides the management of the charging infrastructure and charging services. The provision of an extended service entails the integration of further resources, activities and partners.

One direct consequence of this aspect is reflected in collateral revenue streams, stemming from service provision and charging point utilization fees. The cost structure as well reflects the aforementioned condition, indeed it does not only reside in the pure charging technology purchase and commercialization, but it also involves the land occupation costs, the software and platform development, and update expenditures.

## **6.2 Discussion**

Once thoroughly displayed the results obtained, the following section aims at providing a deep discussion and comment on this data. In particular, the previous section was organized taking the perspective of each player which contribute, to some extent and in different phases, to the creation and delivery of value in EV charging supply chain. Here, the level of abstraction will furtherly raise. Indeed, the first part of this section will take two separate perspectives, namely the one of the public charging infrastructure and the one of the private one. For each one of these, the relative supply chains will be analyzed through the lens of its representative players, computing the level of coverage provided by companies presenting the same business model archetype. The goal of this analysis is to assess the level of integration, or fragmentation, of these two different yet intertwined supply chains, highlighting the differences and peculiarities emerged.

The second section aims at drawing first conclusions about the alignment between the empirical information acquired and the existing literature about the topic. By doing so, the chapter even aims at extrapolating an answer to the research questions defined in section 3: What are the characteristics of business models adopted by players in the EV charging supply chain? What are the main differences in terms of BM articulation among the categories of actors involved?

### **6.2.1 Public and private charging supply chains features**

The following section will try to come up with a general review of the findings deriving from the previous one, furtherly elevating the aggregation level of analysis.

As a first, broad distinction, this will be performed splitting the archetypes according to the destination of the charging process, namely private or public. This has the goal to identify whether relevant distinctions exist in the approach adopted for each one of the latter.

For some categories, this analysis is easy: car makers, for example, present consistent differences between the public-oriented and private-oriented business models, or again service providers are definitely more interesting to be analyzed in their public roles of CPO and EMSP. For other archetypes, nevertheless, it is not as easy to discern the information related to one destination or the other, and this is the case of upstream players such as technology providers or electric equipment distributors, which are often unaware of the actual destination of the product they sell or distribute.

The focus will be on the supply chain, in order to identify synergies or patterns among the categories concurring both in the private and the public charging value chain, so that the different configurations of the latter can be analyzed.

## Public charging

Starting from the actors which are more oriented towards the development of a wide, pervasive, and connected public infrastructure, the first thing to do is identifying which among the archetypes built in the previous section concur to this goal.

Starting, as mentioned above, from the analysis of the supply chain, the first actors encountered are the **technology providers**. For this category, the three identified archetypes provide some interesting insights, showing that these players can perform all the upstream activities of production, software development and implementation, installation, and maintenance, but go no further. The *turnkey-solution* archetype, which presents the highest level of vertical integration, still needs other downstream actors to perform the charging operations, namely the CPO and the EMSP. As it has already been noted, technology providers hardly know the destination of their products, and this is both a cause and an effect of the choice of not integrating the downstream activities, which would require a complete reshape of the business, the internalization of activities and know-how which would entail huge efforts and investments.

Sitting in another upstream position, **electric equipment distributors** represent a category of players which acts mainly as a supplier, providing functional and instrumental equipment, both horizontally to technology providers, and vertically, addressing downstream players such as car dealers or charging service providers. The role of these players is less extended than the one of the technology providers, being limited to the components supply, coupled with extra services which, nonetheless, do not encompass other steps along the supply chain.

Moving downstream, **utilities** are established players in the energy supply industry, have usually consolidated loyal customer bases, and have cross-sectorial knowledge that can be applicable to different businesses. Although only one archetype has been drafted, there are actually two different profiles describing this category, differing on the integration level of the service provided: some of these players play a role which covers all the upstream steps along the value chain before the charging service provision, in a similar configuration to the one of the *integrated* technology providers, even though the hardware production and software development are usually outsourced. Other players take a step further, vertically integrating downstream activities, also playing the roles of CPO and EMSP. This configuration covers the whole value chain, even though the support of external partners is still

required, especially for upstream activities such as the charging point manufacturing, making this a truly all-inclusive charging offer.

**Car makers** have been divided into public- and private-oriented, hence making the identification of the ones to analyze in this section easier. *Public-oriented* car makers play a role which mostly resides beyond the borders of the charging infrastructure supply chain, supporting its development through investments, lobbying activities, and indirect economic beneficial actions, driving down the costs of electric vehicles. Within the charging value chain, anyway, the role of these players is mainly the one of distributors or resellers, channeling the offer of upstream players such as the technology providers. To conclude this classification, the last category of players is the **charging service providers**, pure players in the public infrastructure, representing the connection between the supply chain and the final consumer, the driver. Among the three archetypes identified, *pure CPO*, *pure EMSP*, and *integrated EMSP*, the latter is the one covering a larger ground in the value chain, performing not only the activities of CPO and EMSP, but often integrating backwards other valuable activities such as the software development.

The following table sums up the findings of this section, identifying the level of integration along the value chain. The green icon means that the particular activity is always performed within the archetype under analysis, representing the core business. Yellow icons, on the other hand, represent those activities that can be integrated, or are provided as additional services, but are not considered as core. Looking at the utilities, for example, it has been said that only one archetype has been created. Nevertheless, within this category it has been identified a profile able to integrate downstream activities such as the ones performed by CPO and EMSP, hence the choice to opt for a yellow icon.

	HW manufacture	SW development	Distribution / Installation	CPO	EMSP	All-inclusive offer
HW-oriented TP	✓	✓	✓			
SW-oriented TP	✓	✓	✓			
Turnkey solution TP	✓	✓	✓			
EED		✓	✓			
Utilities			✓	✓	✓	✓
Public-oriented CM			✓			
Pure CPO		✓	✓	✓		
Pure EMSP		✓	✓		✓	
Integrated EMSP		✓	✓	✓	✓	✓

Table 2 - Public charging supply chain coverage

What emerges from the public infrastructure supply chain analysis, is that the upstream activities, concerning the hardware manufacturing and software development, are highly concentrated in the hands of the technology providers, which represent a fundamental player, performing activities that would otherwise require a very difficult, in terms of time and investments, vertical integration. The distribution and installation stage is dense and is, or can be, covered by every player. This might be a signal that this kind of service is easily integrated, even though the empirical analysis highlighted how the network of installers is among the most relied-on partners.

Downstream activities, like the management of the charging station, the provision of the service, as well as billing, payment, location, and all the other ancillary services, see two main categories competing, namely utilities and pure players. Among the latter, *integrated EMSP* is the archetype representing the most comprehensive set of downstream services. A very interesting finding resides in the fact that all-inclusive offers are provided only by these two categories of players. On a wider scope, the supply chain has a high level of integration, although there is still no player able to internally perform all the activities, providing a completely *home-made* solution to the end customer. This means that at least two actors have to be involved in the service provision, one of which has to be a technology provider, whilst the other can be a utility or a pure player. In order to further reduce the number of steps, two solutions can be adopted: an upward integration by the technology providers,



or a backward integration by utilities or service providers. The latter would probably turn out to be more inefficient, since high investments in production plants, machinery, and technical personnel would be required. The former, although still requiring costly training, deep market knowledge, and know-how development, would probably be a more interesting way to deal with this topic.

Nonetheless, this topic is not considered as a real issue, since a two-steps supply chain is still short and, if well integrated through partnerships and co-design approaches, highly responsive.

A fragmented configuration, although possible, consisting in the interaction of four different players in order to reach the market, would turn out to be highly inefficient in terms of flexibility, customer experience, and integration issues. It has become less rare, in fact, to see EMSP integrating backwards, performing the activities of a CPO, or vice versa, in order to reduce the length of the chain.

## Private charging

The private charging supply chain is shorter than the public one, since it ends with the sale of the charging point, which is then managed by the owner, i.e. the driver. The steps are limited to the production, namely the hardware manufacturing and the software development, the distribution, the installation, and eventual service provisions, such as platform to monitor and manage the charging process.

**Technology providers** are again involved in this supply chain, being the players responsible for the hardware production and software development. Although the latter is way less relevant in the private market than it is in the public one, since it is used by CPO and EMSP, some models of domestic charging points have integrated platforms with a user-friendly interface, that the driver can exploit in order to get information about the state of charge, the potential V2G interactions, and energy usage. The product is usually distributed down to the end customer using indirect channels, such as **electric equipment distributors, car makers** (through dealerships, in their *private-oriented* archetype). The latter usually take care of the installation in order to consolidate the relationship with the final customer, but this is not always provided.

The role played by the **utilities** is again the one that gets closer to an all-inclusive service provider, covering all the downstream activities of commercialization, installation, as well as charging services. The latter can include energy provision contracts, pre-paid charging packages, maintenance, monitoring and management platforms, or long-term car rentals.

**Charging service providers**, as previously mentioned, are players which are mostly active in the public charging supply chain. Nevertheless, some of these companies provide services which enable

the end user to manage the private charging station. This role is expected to grow exponentially once the grid integration with EV spreads.

The table below sums up the findings.

	HW manufacture	SW development	Distribution	Installation	Service provision	All-inclusive offer
HW-oriented TP	✓	✓				
SW-oriented TP	✓					
Turnkey solution TP	✓	✓	✓			
EED			✓	✓		
Utilities			✓	✓	✓	✓
Private-oriented CM			✓	✓		
Integrated EMSP		✓			✓	

Table 3 - Private charging supply chain coverage

Although being shorter, the private infrastructure supply chain still presents a certain degree of fragmentation. As it emerged analyzing the public infrastructure, technology providers play again a crucial role in the production of the charging points, a step where they have no competition. Downstream, distributors tend to integrate the installation of the CP, given the importance in providing a seamless experience to B2C customers.

A category which has understood this need is the one of the car makers, incumbents in an industry in which the customer relationship is fundamental, which has begun to include the sale of domestic charging points bundled with the sale of the vehicle, performing the installation and configuration activities.

Again, the required steps to reach the end user are at least, and usually limited to, two. As for the public infrastructure analysis, a very interesting figure is the one of the utilities, which can leverage a broad knowledge about the energy market and the customers' profiles, in order to provide value-adding services, while integrating upstream activities of distribution and installation.

In general, it can be said that the level of integration of these two supply chain is, at least on a hypothetical level, very high, requiring an efficient two-steps length where the upstream activities are dominated by the technology providers which present a *turnkey solution* provision archetype, whilst

the downstream side will probably see a prevailing archetype emerge in the next years, as the market settles and the players find their dimension. It is the case of utilities, which are expanding along the value chain covering all the activities up to the production excluded, and the *integrated EMSP* profile, which will either have to co-exist with the latter, or find a way to provide value-adding services, in order not to lose market shares.

## 6.2.2 Business model in the EV charging supply chain

This chapter aims at providing a comparative analysis of the results emerged from the present thesis and what was previously extracted from the extensive review of nowadays existing literature.

Firstly, in order to recap the information collected from literature analysis the summarizing business model is presented below.









<p><b>Key Partners</b> </p> <ul style="list-style-type: none"> <li>- suppliers</li> <li>- policy makers</li> <li>- OEM</li> <li>- utilities</li> <li>- technology providers</li> <li>- technical operators</li> </ul>	<p><b>Key Activities</b> </p> <ul style="list-style-type: none"> <li>- energy supply</li> <li>- charging point optimization</li> <li>- maintenance</li> <li>- value-added services</li> </ul>	<p><b>Value Proposition</b> </p> <ul style="list-style-type: none"> <li>- provision of the physical hardware</li> <li>- provision of the charging service, location, reservation, billing, payment</li> </ul>	<p><b>Customer Relationships</b> </p> <p>-</p>	<p><b>Customer Segments</b> </p> <ul style="list-style-type: none"> <li>- B2C</li> <li>- B2B</li> </ul>
<p><b>Cost Structure</b> </p> <ul style="list-style-type: none"> <li>- labour</li> <li>- materials</li> <li>- permits</li> </ul>	<p><b>Revenue Streams</b> </p> <ul style="list-style-type: none"> <li>- service sale (subscription-based; pay-per-kWh; pay-per-time; flat rate)</li> <li>- collateral revenues</li> </ul>		<p><b>Channels</b> </p> <ul style="list-style-type: none"> <li>- direct channels (service centres)</li> <li>- indirect</li> </ul>	

Figure 30 - Sum up of business model canvas information derived from literature review

The first significant aspect to mention is neither literature nor practitioner contests included an omni-comprehensive review of the business model canvas of the actors present in the EV charging supply chain. Indeed, as emerged from the gap analysis, the EV sector is widely treated, but the focus resides mainly on the EV itself or the EV driver, instead of on the charging infrastructure.

Moreover, the information collected for each block in many cases were highly general, resulting to be inadequate to offer a precise characterization of businesses, or biased by geographical scope. For instance, the information concerning revenue streams are mainly valid in UK and US, while some of them are totally absent in Italy, where the pay-per-time and the flat rate are not adopted. Indeed, the main revenue stream adopted in the Italian EV charging supply chain are subscription-based or kWh consumption based.

As explained in the previous chapters, the objective of the present thesis was to provide a systematic and synoptic review of the afore mentioned business model, thus identifying possible patterns characterizing the actors involved in the EV charging value chain.

The main categories of actors taken into consideration were five, namely car makers, electric equipment distributors, service providers – including both CPOs and EMSPs, technology providers and utilities. For each one of them, at least one archetype was identified in order to identify the underlying BM of the category as a whole.

## **Car makers**

Starting this comparative analysis with car makers, these were divided into public- and private-oriented ones. Both the two archetypes validate the first point of the value proposition block afore described and furtherly expand it. The former aims at providing the physical infrastructure in order to support the development and the spread of an extensive public infrastructure, besides boosting the regulatory and economic EV environment. The latter's value proposition includes the expansion of the EV sale with the provision of a private charging infrastructure. For what concerns instead the provision of charging services, neither of the two archetypes of car makers include in their offer the real charging services.

The second block analyzed is the one regarding customer segments and even in this case both the archetypes prove what emerged from the literature review. Indeed both the configurations serve both B2C and B2B customers.

The block of the customer relationship resulted to be totally missing from the analysis of the existing literature. For this reason, the analysis of car makers' one expanded the current research material. The public oriented car makers relationship are based on pre-sale assistance and platform updates, thus increasing CP accessibility, while the private-oriented ones rely on pre-sale assistance and services for CPs installation and configuration.

Moving to the distribution and communication channels adopted, the literature categorization was highly general and only included the distinction between direct and indirect ones. Both the car maker archetypes adopted the same distinction, including in the direct channels digital ones, such as website, social media and webinars, while in the indirect channels property dealership. Moreover, the private-oriented ones also exploit physical presence in universities and at fairs and public events.

The key resources block was divided into human, financial and physical assets. The two CM archetypes slightly differ from these ones, indeed they leverage on financial resources to sustain the

investments, marketing personnel and finally brand reputation, that is extremely consolidate in the automotive sector.

Shifting on the key activities, they totally differ from the ones introduced by literature and practitioners contents. Indeed, public-enabler CM strongly invest in new infrastructure, lobby to promote changes in the regulations and raise awareness about the topic. On the other hand, private-oriented CM again lobby to promote changes in regulations, but they also state products commercialization is a core activity. In this case, the existing literature focused on the operative aspects related to the CP, while the car makers key activities are mainly based on supporting the market outbreak of the charging infrastructure, since they have understood this is a prerequisite for the EV adoption as well, which is strongly hindered by range anxiety.

Considering the list of possible partners in the EV charging supply chain, these highly differ considering the two archetypes but they almost coincide with the list provided above. Indeed, if public-oriented car makers exploit utilities, CPOs and EMSPs for installation, grid operations and management of the service provision, the private-oriented ones mainly rely on technology providers and installers, besides utilities, and they build joint ventures with other car makers.

Finally, the cost structure was categorized into labor, materials and permits costs. Actually the public-enabler CM sustain significant investments to support the spread of the public infrastructure, and marketing activities to promote services. On the other hand, revenue streams coming from the charging happening at dealerships are negligible, since they are mainly free of charge.

## **Electric equipment distributor**

This section aims at providing the same comparative analysis for the electric equipment distributors. As underlined above, only one archetype was identified for this category, hence this corresponds to the so called comprehensive business model.

Similarly to the case of car manufacturers, the value proposition is validated only for what concerns the provision of the physical hardware, while electric equipment distributors do not provide charging services. Deep diving into the physical asset supply, companies' offer usually include not only the CP itself, but also specific technologies, such as safety and electric isolation systems, software for the charging management and consultancy services. Consulting also represents the key method on which EED build customer relationship.

Moreover, the customer segment is only the B2B one, made up of charging technology providers, technicians, construction companies, car dealers and utilities.

For what concerns channels, EEDs match only the direct ones. Indeed, they participate to events and conferences, they exploit sale agents, website, app technicians and stores.

Of the three categories of resources depicted by literature review, electric equipment distributors mainly leverage on human resources and technical skills, which are exploited to carry out key activities such as, marketing campaigns, the sale of products enabling the charging and consultancy. Another crucial activity is the training of both internal and external personnel sale. Again, the activities deriving from literature analysis totally focused on operations related to CP, while the main business of this category of actors resides in the commercialization of electric products.

Considering the key partners, the list is significantly limited in respect to the one provided in literature. Indeed, electric equipment distributors leverage on technology providers and on consultants and engineering offices.

As concerns the cost structure, EED costs almost correspond to the one proposed by literature, except for permits. They mainly focus on the development and manufacturing of products and related materials and technologies purchase, besides marketing costs.

Finally, the revenue streams focuses on the sale of products, instead of the charging service.

## **Charging point operators**

By following the same procedure exploited in the previous case, the only archetype identified for this category of actors coincides with the so called comprehensive business model of CPOs.

For what concerns the value proposition, information gathered from the empirical analysis totally confirm the one obtained by reviewing the existing literature. Indeed, CPOs are in charge of the installation, management and maintenance of public charging points. Moreover, their final aim is the provision of the largest and most extensive network of CPs possible, thus reducing one of the strongest barrier to EV adoption, i.e. range anxiety.

Even the customer segments served by this category of actors confirm what emerged from literature, being them B2B customers, such as EMSP or business customers.

The block of the customer relationship was totally lacking in the existing literature, but this thesis work assessed this is represented by technical assistance and support, provided through consulting relationship.

Distribution and communication channels are both direct – such as press release, website, social network and newsletter – and indirect ones, such as technicians and designers network.

For what concerns the key activities, key resources and key partners, these strongly validate what provided by literature. Indeed, the focus for this category is on the CP itself, e.g. its installation, maintenance and monitoring, besides the provision of additional services such as software development and management. In order to carry out these activities, CPOs rely on human resources with strong technical and digital expertise, besides financial resources.

For what concerns the cost structure, labor, materials and permits were confirmed by the research, while additional aspects were the operations for development, installation and wiring of CPs and the software development.

Finally, even revenue streams confirm what emerged from literature review, indeed in CPOs case they correspond to charging volume sale and infrastructure management fees.

## **Electro mobility service providers**

The archetypes identified for this category are basically two: pure EMSP and integrated EMSP.

For what concerns the value proposition, they both confirm what provided by the existing literature. Indeed, EMSP's offer include the provision of the charging service, comprehensive of CP localization, reservation, billing and payment, and sometimes expand to the provision of the physical hardware as well and its management (in the case of integrated EMSP).

The customer segments confirm literature as well. Indeed both EMSP archetypes provide services to both B2C and B2B segments, with whom they create a value added relationship based on technical assistance, support and consultancy, besides commercial relationship only in the case of integrated EMSP.

Even channels are aligned to what provided in the literature review, being them direct, e.g. website, social media, newsletter, participation at fairs and events, marketing campaigns, or indirect, such as word of mouth, or technician network exploited by EMSP.



The key resources almost confirm the cruciality of highly skilled personnel, both in terms of digital, technical and regulatory skills, besides of considerable financial resources.

The key activities as well fit in the business model displayed above. These correspond to the development of the software for CP control and management and the app provision, in case of pure EMSP, and this one integrated of installation, management and maintenance of CP, besides consultancy and assistance for integrated EMSP.

The list of partners provided by the empirical analysis is consistent to the one provided by literature. In general, these corresponds to suppliers, of both hardware and software parts, technicians, destination charging and sale agents for offer commercialization.

The cost structure of pure EMSP totally differs from the one provided by literature. Indeed the main costs sustained by this category of actors is software development and update. On the other hand, the cost structure of integrated EMSP coherently represent what emerged from literature, by encompassing permits costs, such as land occupation, materials costs, such as hardware purchase and labor costs, such as HR. Moreover, other cost items are represented by the development and update of the software, marketing expenses and operations costs for CP installation and management.

## **Technology providers**

This category of actors is divided into three archetypes, namely hardware-oriented, software-oriented and turnkey solution TP. As it emerged from the analysis provided in the EV charging business analysis, the three archetype differ in terms of value proposition. However, this chapter aims at analyzing the consistency with the information extracted from literature review and in this case this is totally confirmed. Indeed the three archetype's offer respectively coincide with the provision of hardware for both private and public charging, characterized by high quality, performance and aesthetic features; the software provision, which enable easy interface, management and monitoring of the charging technology, besides the user-friendliness for both the end user and for business customers; and finally the provision of turnkey solutions, thus being the only interface with customers which provides both the hardware and software side of the charging technology, integrating even pre- and post-sale services, such as consultancy, installation, maintenance and technical assistance.

The customer segments served by these kinds of companies totally focus on B2B segments, that can encompass different clients depending on the archetype considered.

The customer relationship block, as already mentioned, was not even presented by the existing literature. This research thesis found out that the three archetypes develop long-lasting relationship with customers, which allow to create mutually-beneficial feedback loops for product innovation. In addition, turnkey solution TP also provide pre- and post-sale consultancy, hence providing a customized technological solution.

For what concerns the channel blocks, the distinction into direct and indirect channels was confirmed. For instance, hardware-oriented TP mainly exploit direct channels, both physical and digital ones, such as profiling campaigns on social media, participation to events and fairs, and summits release. On the other hand, they exploit dealers and wholesalers as indirect channels as well.

The key activities building block sharply varies according to the archetype under scrutiny and they all differ from the information gathered from literature, where the focus was mainly on the CP optimization, maintenance and value-added services, besides energy supply. Indeed, the hardware-oriented TP trivially concentrate on R&D and product development and testing; the software-oriented companies focus on platform and algorithm development and update, besides marketing and communication campaigns; and finally, turnkey solutions TP carry out consultancy and solution development, besides R&D activities.

For what concerns the key resources instead, these are more aligned to the information collected from literature review. Indeed, depending on the archetype, they encompass technical know-how used to develop performant products or software development, human resources with high commercial expertise and market knowledge.

Again, the list of partnership established by the three archetypes of TP fits with the one provided by the existing literature, encompassing engineers, installers and software developers for hardware-oriented TP; the only hardware manufacturers for the co-development of suitable solutions for software-oriented TP; and installers, technical operators and long-lasting suppliers for turnkey solution TP.

Concluding with the economic model, the cost structure perfectly fits with the distinction provided in the current literature, but the three different archetypes's cost structure slightly differ. Indeed, hardware-oriented TP sustain production costs, including personnel, raw materials and physical assets, besides R&D expenditures; the software-oriented TP's costs instead mainly reside in the software development and related IT departments, besides marketing expenses and wholesalers' fees; finally turnkey solution TP sustain R&D expenditures, personnel training and administrative fees and authorization for land usage.

For what concerns, finally, the revenue streams these are not related to the provision of charging service but it is more focused on the technology provided by the specific archetype, these can be the product sale and potential extended services, the software subscription fee, updates and premium versions, or the sale of the service, intended as the provision of the hardware, the software and additional services, which can be billed on a pay-per-use configuration or through a recurrent fee.

## **Utilities**

Finally, as done before, the comprehensive business model of utilities will be used for the comparative analysis of empirical research and existing literature.

The archetype identified through the empirical analysis was only one, presenting almost uniform building blocks, except for the value proposition, which diverged into two different configurations.

Starting from this very block the analysis of consistency between literature review and empirical analysis, this can encompass both the aspects provided in the former data source. Indeed, some companies offer a bundle of products and additional services which serve as turnkey solution for the customer that then is in charge of the management of the charging point. On the other hand, some companies provide the charging infrastructure, comprehensive of installation, maintenance and management, besides the charging service itself.

Customer segments are aligned with what emerged from literature review, including both B2C and B2B segments, besides PAs, which allow the occupation of public land.

The block of customer relationship, previously lacking, was completed by mentioning assistance and consulting as principal method to build a value added engagement with the customer.

For what concerns the channels, again it is possible to distinguish between direct, such as website, newsletters, apps, events and fairs participation, physical stores, catalogues and sales account, and indirect channels, such as car dealers and OEMs.

The key resources exploited by utilities confirm what emerged from the literature review, indeed they correspond to HR and related digital and technical skills, financial resources and call center assistance.

The key activities slightly expand the focus on the CP itself by adding the software development, the commercial agreements establishment and the human resources training.

The list of key partners instead confirm the large variety provided in the literature review, by encompassing both technology and software providers, destination charging, oil & gas companies, PAs, technicians, CPOs and EMSPs.

Finally, considering the cost structure two cost items totally correspond between utilities empirical analysis and the existing literature, i.e. human resource costs and hardware purchase. Moreover, additional costs are represented by the development and update of the software and marketing costs.

On the other hand, the revenue stream does not only encompass the sale of the services, but it also includes the sale of the charging infrastructures and electric energy, and the fee for infrastructure installation and usage.

In conclusion, the empirical analysis has generally confirmed what emerged from the analysis of the existing literature and practitioner contents, in many cases expanding the pool of available knowledge. Indeed, for some blocks of the business model canvas data was extremely generic or even missing, as in the case of channels or customer relationship. Moreover, what emerged from the current literature was, in some cases, focused on the EV driver, rather than on the charging infrastructure itself, or on a specific category of actors, such as cost structure and revenue streams, which mainly took into consideration CPOs and EMSPs, and biased by geographical scope.

Furthermore, the huge differences emerged among the different categories, and among the archetypes within these, highlight the fact that it is impossible, besides useless, to try and summarize the entire charging infrastructure supply chain in one single business model. Of course, similarities between building blocks can be found, identifying recurrent patterns such as the inclusion of installation services or consultancy in the pre-sale stage, but at a general level, in order to have a clear picture of the value chain, a synoptic view of all the business models must be provided. It makes no sense, for example, to try and get valuable information looking at a single category, if the expected outcome is to have a broad perspective.

For this reason the present thesis work can be considered as a significant contribution to literature analysis by having confirmed, confuted and expanded the existing scientific literature and by having provided an omni-comprehensive review of all the business model archetypes present in the EV charging supply chain.

# 7. Conclusion

As largely discussed in the previous chapters, the objective of the thesis was to investigate the market of EV charging infrastructure with a particular focus on the business models adopted by each player taking part to the supply chain.

The EV market for sure represents an innovative, evolving technical market. For this reason, the very first section of this master thesis aims at setting the empirical context. In particular, after a brief introduction about EV market, including the description of vehicles typologies based on the battery installed and the main barriers to electric car adoption, the technological features of the EV charging infrastructure were presented, namely connectors types and related charging speed. The EV charging supply chain is extremely heterogeneous in terms of players involved, for this reason a brief description of the main ones was provided, i.e. automakers, utilities and oil & gas, pure players, technology providers and general contractors. Finally, the distinction between private and public charging was described.

Once set the context, the actual thesis work began from a thorough review of the existing literature. Considering thesis objectives, two main topics were investigated.

Firstly, an extensive analysis of general business models was carried out. Secondly, by digging down into the EV market, the specific business model of the charging infrastructure supply chain was assessed. The first attempt was to focus on the research of a comprehensive business model, but it was immediately clear that this would have not been an easy task. Indeed, valuable papers, journals and scientific reports resulted to be highly specific in terms of geographical scope, charging typology or case study analyzed. For this reason, the research shifted the perspective from a comprehensive one to a block-specific one. By doing so, much information was recovered, but still the focus of analysis did not comprehend the whole totality of the actors present in the EV charging supply chain, but mainly put the spotlight on pure charging players, namely CPOs and EMSPs. In addition, it is noteworthy that in some cases information was extremely generic, while in others it was totally lacking.

For this reason, the work proceeded with the definition of the method to collect further empirical data, namely semi-structured interviews. Being this the tool on which information gathering was based, even the literature analysis regarding it was developed, in order to understand which main strong points and criticalities characterize it.

Finally, the literature review highlighted different emerging gaps. Firstly, the large majority of documents retrieved were totally unbalanced on the perspective of the EV driver and its behaviors. For as important this analysis is, the aim of the present thesis is to focus on the whole EV charging infrastructure supply chain, instead of focusing on the last-mile stages. In addition, despite the presence of some highly specific actor-based papers, an omni-comprehensive analysis of the EV charging value chain did not exist in literature. Together with the gap analysis, the research framework followed during the empirical analysis was presented. In relation to this last point, it was decided to exploit the business model canvas, theorized by Osterwalder and Pigneur because this is an intuitive but complete model providing an overview on companies' process of value creation, delivery and capture. The level of granularity corresponds to nine building blocks which represent the main aspects to take into consideration when analyzing a business.

Once conducted an extensive analysis of the current literature regarding the topic, the main methodology adopted to fill the literature gaps in and to develop new knowledge was presented. In particular, *theory building from case study* was the theoretical framework adopted. The starting point of this latter corresponds to the draft of research questions, which represent the base to develop a new theoretical model. Furtherly in the same chapter, the sample of players interviewed and analyzed is described.

On the basis of the afore mentioned theoretical framework, the subsequent chapter was drafted. Chapter 5 indeed provides the empirical analysis of the complete sample under scrutiny. For each company, all the answers provided in the semi-structured interview and during a preliminary online research phase are described in detail.

For each category of actors, the aggregation level of all the answer has been raised in order to create a set of clusters for each building block. The higher aggregation level of the answer allowed to perform the analysis provided in the following chapter. These sets of clusters have been used in order to perform the variability analysis of each BMC block, on which the archetype definition is based. By doing so, it has been possible to delineate different profiles and roles played by actors within the same category.

This representation feeds in turn another analysis which aims at assessing the level of integration and coverage of the private and public supply chains provided by the different archetypes. The relevance of this assessment resides in the identification of synergies or dominant configurations within the value chains, comparing the private and the public infrastructure ones.

Both the private and public infrastructure supply chain present a high level of integration, due to the fact that all the activities can be performed by two players alone: technology providers, for what

concerns the production and development of the product, and a downstream player which has integrated the required activities. Among these, utilities and EMSP presenting an integrated archetype are the only ones able to perform such activities.

Finally, in the discussion chapter the comparative analysis between the contents provided by literature review, practitioners study and the empirical analysis has been carried out. In particular, this further analysis confirmed almost all the information contained in the building blocks which emerged from the analysis of the existing literature, and, in some cases, expanded the data source.

## **7.1 Answer to research questions and implications for scholars**

Below, the present paragraph will provide the answers to research questions depicted in *chapter 4*.

*What are the characteristics of the business models adopted by the players in the EV charging supply chain?*

The answer to this question resides in the block variability analysis conducted for each category of actors (*Chapter 6*). It is important to remember that by analysing blocks variability, it is possible to identify which pattern are currently shaping one specific block of the business model.

Starting by considering car makers, they present a common and almost univocal trend for what concerns key activities which are focused on supporting the EV charging infrastructure market development. The reason to this may be straightforwardly found in the fact that EV sales are strongly impacted by the advancement, both in terms of technology, extensiveness, and cost structure, of the charging infrastructure. In other words, car manufacturers have understood the fundamental necessity of creating and establishing a solid charging infrastructure for both private and public charging, thus they highly invest into this very aspect. In addition, even the value proposition, customer segments and customer relationship blocks show low variability. Indeed, the largest majority of car makers leverage on intensive engagement strategies with the customer, which, by providing its feedbacks through doubts and requests, may represent a significant source of innovation for the company.

Moving to electric equipment distributors, one premise is necessary: the sample under scrutiny was extremely tiny. For this reason, further empirical analysis would be necessary to improve the reliability of these results. This said, the overall variability levels are extremely low, and even the blocks of customer segments, key activities and key partners presented coincide. This may be due to

the fact that the electric equipment distributors category involves incumbents of the sector which leverage on their consolidated expertise and customer base and, for this reason, they did not have to radically reshape their business models after the introduction of charging products.

Putting the spotlight on charging service providers, the analysis separated the two main roles constituting this category, namely CPOs and EMSPs. Both the players present interesting variability values in terms of customer relationship, which are universally attributable to establishing a personal engagement with the customer in order to offer him an adequate assistance and support service. In this type of sector, leaving the customer without the charging infrastructure functioning is not an option, for this reason companies, in the large majority of the cases, provide a 24/7 customer assistance. Moreover, focusing on CPOs, the customer is almost univocally unbalanced on B2B, which is consistent with the CPO definition present in academic studies and with the charging scope underlying CPOs. Indeed, they were specifically born for public charging, which cannot be strictly associated to B2B market – since this latter involves for instance private businesses which offer the charging service to their employees or which have decided to electrify their vehicles fleet as well – but that involves a great share of destination charging which represent public charging spots. For what concerns instead electro mobility service providers, again the customer segment shows the lowest variability, hence validating the knowledge proposed in the literature review.

With regard to technology providers, this category presents low variability levels in terms of value proposition, customer segments, key activities and cost structure. In general, it can be said that technology providers offer their charging products and related services to B2B customers, by focusing on R&D activities and investing on product development. Similarly to electric equipment distributors, this category is mainly formed by incumbents which leverage on technical electrical skills and expertise, besides a consolidated customer base. As it has emerged from the coverage analysis, the strongly dominant presence in the B2B market is due to the fact that technology providers play a fundamental role in the upstream stages of the value chain, serving the players downstream.

Finally, concluding with utilities analysis, the category presents the lowest overall variability, with interesting values in terms of customer segments, which comprehend both B2B and B2C markets. Indeed, utilities act, together with car makers, as the junction point between the private charging infrastructure and the end users. In addition, the value proposition is universally organized to offer both the electric energy, the charging service and additional extra services for maximizing customer experience.

Moreover, it results clear that it is possible to identify a business model which is almost applicable to an entire category of actors. This is represented by the so called archetype of the category. Archetypes



can range from one to many, indeed not all the actors belonging to the same category offer the same kind of products and services. However, the system of archetypes allow to raise the abstraction level of the analysis by exploiting building blocks clusters.

Going further in the archetype analysis, the five categories of actors were furtherly declined into several archetypes. In particular, car makers present two different business models, according they are public or private oriented. The service providers can be distinguished into pure CPOs and EMSPs, this latter are furtherly expanded into pure and integrated ones. Finally, the utilities are categorized into a single archetype, which anyway presents slight differences within itself in terms of value proposition, which can be focused on the provision of a solution, i.e. the initial consultancy, installation, maintenance and technical assistance, where the operative and technical management are charged to the customer, or to the provision of charging services and infrastructures.

Furthermore, different general trends have emerged in the EV charging supply chain. Firstly, every typology of actor has decided to include in its value proposition the sale of auxiliary services to charging. On the other hand, the necessity of a widespread and extensive charging infrastructure was demonstrated by the predominance of destination charging as B2B customer segments. Moreover, being the EV market an innovative and highly technological and technical sector, assistance, support and consultancy to customers play a crucial role, for what concerns both customer relationship established, channels exploited, key resources leveraged and key activities carried out. Operational aspects, such as product and software development, CP design and installation, management and monitoring, are mainly outsourced to, or developed in collaboration with, partners which are expert of the electric technical aspects related to CP, such as technician networks, technology providers and manufacturers. Furthermore, operational aspects, such as CP design, installation and maintenance, represent, together with marketing efforts significant activities in this sector type and they can be associated to the struggle towards charging market development. Finally, the economic model has highlighted a univocal strategy for revenue generation is not applied, potentially due to the very different nature of the actors in the value chain. Nevertheless, the tendency is not to drastically reshape companies' traditional business models but applying their conventional practices for income generation. On the other hand, cost structure has highlighted the general effort to enhance EV charging infrastructure development, both with R&D, production and purchase costs – concentrated on both products, services and integrated solutions – and clients analysis and marketing campaign to increase customer awareness.

*What are the main differences in terms of BM articulation among the categories of actors involved?*

The main differences among the BM formulation have to be found in two main characteristics: the orientation, which can be pointing towards the public or private infrastructure (or show no preference), and the archetype, which mostly represents the different value propositions, and which has been thoroughly afore explained.

Another important factor influencing this process is the extent to which the charging business affects the overall business of the company. Car makers, for example, are deeply focused on the EV market, including charging solutions only to a marginal extent. For this reason, a precise and articulated business model is still yet to be developed, even though some first distinctions can be done in terms of destination of the charging infrastructures.

Technology providers, that as it has emerged sit on a dominant position in the value chain, playing an instrumental role which is virtually unthreatened, display a clear and homogeneous business model formulation within the same archetype. This might be due to the fact that the market dynamics, and the high extent to which the downstream players rely on this category, make it easier to find a definitive positioning.

The competition which characterizes the downstream activities, on the other hand, requires dynamic and flexible business models. This means that, in a heterogeneous market, the business model formulation process is a continuous and adapting loop, requiring constant benchmarking activities and market analysis. This is the case of integrated EMSP and utilities, which present the most over-encompassing business models, integrating different stages along the value chain. This, according to the researchers, will bring to an eventual halt, where one category will emerge as a dominant figure that might end up representing the whole value chain, and the other playing a specialized role.

Despite the differences displayed above, what it seems to be a peculiar trend which is supported both by the presence of numerous joint ventures, and by the information provided by the players themselves, the charging infrastructure supply chain is characterized by a high level of coepetition, rather than competition, in order to create the required momentum that will push a sustainable development and create a market where pure competition will then flourish, allowing profitability and new approaches to the market. This trend deeply affects the way companies are formulating their business models, since the latter are usually the outcome of joint processes with other players along the supply chain or within the same stage. For instance, technology providers usually have strong partnerships with utilities and car makers in order to leverage the latter's distribution channels, which are more consolidated and performant.

To sum up, the main differences in the process formulation are due to the level of competition and density of players within the stage of the supply chain under scrutiny, requiring more or less flexible approaches accordingly. Nevertheless, as long as the uncertainty of this environment remains high, and companies struggle to find a defined position, this formulation process does not present several differences since, as explained in the paragraph above, co-developed business models and competition are driving the players' choices.

After having answered to the research questions, it is interesting to investigate which can be the implications for scholars. Indeed, the present master thesis represents a significant contribution for research concerning the EV market, with a particular attention on the private and public charging infrastructure.

In particular, the research expands the literature state of the art, which presents numerous gaps and shadowy points. Indeed, the main perspective analyzed by the existing literature and practitioners research projects, mainly focused the attention on the EV driver, his socio-demographic features, driving behaviors and barriers to EV adoption like range anxiety. Retrieving useful papers and journals about the EV charging infrastructure was not an easy task. Here the perspective is shifted: the present research focus does not reside in the end user but on the charging infrastructure itself.

Furthermore, the thorough and extensive research allowed to extrapolate an omni-comprehensive sight of business models characterizing the extended EV charging supply chain, considering all its different stages and consequent actors. This was done firstly taking the perspective of the singular actor category and secondly, considering the main patterns and trends of action for each block of the business model, thus identifying categories' archetypes.

What seems to be a pervasive and underlying trend which crosses the borders between the different categories, is the integration of different activities related to the relationship with the customer, and making the latter's experience seamless. As emerged analyzing the public charging supply chain coverage, installation activities are offered by every player as an additional service, but this is not the only one, since more and more companies are providing consultancy and both pre-sales and post-sales support to the final customer. This turbulent stage in which each category is still trying to find a perfect fit in a dynamic and heterogeneous environment, will definitely bring to a further reshape of the existing business models. Some companies will find their roles as niche players, others, such as the utilities, might end up integrating backwards up to covering the whole supply chain.

This level of uncertainty makes the business model definition process very fluid, in order to be ready to adapt to rapid changes. This need of flexibility is reflected for example in the BM of service

providers such as pure EMSP. As a trend is suggesting, the integration of the service provision with the activities usually carried out by the CPO is pushing pure EMSP to rethink their business, probably also threatened by the constantly growing coverage of utilities which are drastically reshaping the value chain.

Other categories, such as car makers, or electric equipment distributors, are still trying to figure out the most suitable configuration, and a hint to this is given by the fact that several building blocks are still poorly covered and defined. On the other hand, technology providers, sitting on a strong position which does not seem to be threatened, at least in the near future, have more well-defined and coherent business models, a fact which made it possible to identify three different archetypes, each one presenting its own peculiarities and level of coverage.

Considering the geographical scope of analysis is primarily focused on Italy, with few exceptional European actors, it would be interesting to expand the scope of the research to other countries as well. This would allow to compare the impact of different regulatory framework and social, demographic and economic country-specific features, on the development of the charging infrastructure, hence identifying with a certain robustness degree which are the main drivers and barriers that enhance or hinder the spread of this market.

## **7.2 Implications for practitioners**

The present thesis work has implications on practitioners as well.

Firstly, the thesis presents the business model of all the actors which are active in the EV charging supply chain, by evaluating how the different building blocks of BMC are intertwined and the mutual relationship among each others. This results to be interesting from a practitioner point of view because it represents a thorough analysis of all the strategic decisions adopted by each player in the value chain, because it can be the starting point for a benchmarking analysis. This can be performed both horizontally, comparing the business model of competitors at the same stage of the value chain, or vertically, assessing the competition on particular activities which can derive both from upstream and downstream. For instance, CPOs, conscious of the backward integration trend performed by other players, namely EMSP and utilities, might take corrective strategic actions.

Moreover, the second analysis provided shows the complete assessment of the different roles taken in charge by the different actors. Indeed, not all the actors belonging to the same category provide the same kind of products or services, and these were classified into different archetypes. This may result

to be useful for practitioner for the same motivation explained above, indeed the archetypes characterization allows to carry out a comparative analysis towards competitors.

Finally, the focus was moved from the actors themselves, to charging point destination, considering both private and public charging. In particular, the EV charging supply chain was declined firstly in public and secondly in private charging. This further analysis highlighted some interesting points. Distinguishing between private and public charging allows to perform the analysis of the EV charging supply chain as a whole and in particular its integration degree. This, from the point of view of a practitioner, is significant because it provides insights about the level of competition at each stage and density of players, allowing to take strategic decisions such as partners choice, merger and acquisitions or leaving a business.

### **7.3 Limitations and future developments**

The present master thesis surely provides some limitations.

Firstly, the sample under scrutiny is limited because of the research qualitative nature and duration. Indeed, the actual initial number of companies was ninety-seven, which later reduced to the only ones which positively answered to interview requests, namely forty-eight companies occupying all the stages of the EV charging supply chain. Because of this, results are not characterized by a robust statistical reliability, and additional empirical research should be developed in order to increase the sample under study.

In relation to the previous aspect, it is worth noticing the sample of electric equipment distributors was extremely narrow, indeed only three companies accepted to take part to the interview. On the other hand the sample regarding the oil & gas companies involved only one actor. For this reason, it was decided not to include this one in the thesis work since it would have been senseless for the analysis framework developed. This surely represents a point which could be tackled by developing additional empirical analysis, expanding the sample pool.

Moreover, data gathered are extremely qualitative in their nature. Moreover, in some cases, certain companies willingly or unwillingly did not provide any answer to some questions. For instance, the economic model of the largest majority of the companies relies on partial or highly abstract and general answers.

Another strong limit to the model provided is its geographical scope: the model is mainly focused on Italy. This represents a perfect starting point for future developments. Indeed, verifying the

truthfulness of the model in other countries as well would allow to develop a comparison enabling to infer the main barriers and drivers of the EV charging market spread.

A further limit of the analysis is represented by the fact this is totally based on the charging infrastructure for cars. An interesting future development would be applying the research framework not only to cars but even to other typologies of vehicles, such as motor-scooter, public transportation busses, push scooters.

A last huge limitation resides in the fact that the market is still characterized by high uncertainty, due to changing regulations, new companies entering this business and bringing innovation and raising the competition, and incumbents having to reshape their business models. This, coupled with the lack of significant historical datasets, makes it difficult to precisely account resources, revenues, costs, and liabilities to the charging sector, especially for companies for which the charging service is not a core business. This problem will be overcome with time, as the market grows stronger and more data is made available.

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# Appendix 1

## QUESTIONNAIRE STRUCTURE

It is important to say that the interview framework and the consequent process was developed in collaboration with the *Energy&Strategy Group* from Politecnico di Milano, which was engaged in the draft of the Smart Mobility Report 2020 and partially investigated the same topic of the present thesis.

The interview framework is divided into three sections. Firstly, the **General data** section presents some general questions, aiming at getting some clues about the experience degree of the specific company in offering products and services in the charging sector. Secondly, the interview framework adheres to the nine building blocks of **Business Model Canvas**, thus getting deep and precise answers about all the aspects concerning company's business. Finally, the last section investigates interviewee's opinion about the **Competitive Environment** they currently operate in and how this will evolve in the future years, even considering legislative aspects and the present pandemic situation. Hereafter, the questions are presented:

### Section 1 – General data

1. How long have you been active in the sector of EV charging?
2. What was the turnover linked to the selling or supply of products, services or solutions for EV charging in 2019?
3. What is the geographical scope of your company? Do you operate only in Italy or also in the international market? How is your turnover divided into these different markets? Will this percentages change over time: increasing, decreasing or staying steady in the next five years?
4. How is your turnover divided into private and public charging? How do you expect these two markets to grow in the next five years?
5. How many charging points have you installed in Italy until now? How many do you expect to install in 2020 and in the next three years?
6. What is the percentage of private and public charging points you have installed?
7. Dividing the charging supply chain in three categories: energy – generation, transmission and supply; charging infrastructure – building, sale, installation and maintenance; charging services – energy selling, geo-location, battery management etc. In which of the three



categories, are you currently operating? Are you considering to expand to different categories or segments you are not currently covering?

8. How did you structure your company to supply products, services or solutions for EV charging? Are they in your current offer? Have you built a team or a dedicated business unit? Do you think to develop these products, services or solutions through partnership or acquisitions? Why?

## **Section 2 – Business model canvas**

### *CUSTOMER SEGMENT*

1. What are the main customer segments you address your products, services or solutions for the EV charging?
2. Which products, services or solutions do you offer in each segment?
3. Are there any distinctions for public and private charging sectors?
4. Are there any distinctions for B2B and B2C markets?

### *VALUE PROPOSITION*

1. What is the bundle of products, services or solutions for the EV charging that you currently offer to the market?
2. What is the value proposition underlying the offering of these products, services or solutions?
3. Are there any distinctions for public and private charging sectors?

### *CUSTOMER RELATIONSHIP*

1. How do you build a value added relationship with your target customers and markets?

### *CHANNELS*

1. Through which communication channels do you reach your target customer segments and markets?
2. Are there any distinctions for B2B and B2C markets?

### *KEY RESOURCES*

1. What are the key resources you need to deliver your value proposition and reach the target sales and margins you have planned in the different customer segments and markets you address to? For example, human resources, technologies, financial resources, etc. ...

### *KEY PARTNERS*

1. Who are the main partners with whom you collaborate in the development and commercialization of your products, services or solutions for the EV charging? Are they

actors traditionally involved in the charging sectors or are they new comers? For example, shopping malls, hotels, restaurants, etc.

2. What fundamental contribution do these partners offer? Why are they essential to deliver your value proposition towards different customer segments and markets?
3. Are there any distinctions for public and private charging sectors?

#### *KEY ACTIVITIES*

1. What are the key activities you carry out internally for the development and commercialization of your products, services or solutions for the EV charging?
2. Are there any distinctions for public and private charging sectors?

#### *REVENUE STREAMS*

1. Through which channels do you generate revenues streams from the sale of your products, services or solutions for the EV charging? For example, sale of the product, service or solution; variable or fixed fee for product, service or solution usage; sharing of the benefits deriving from the adoption of the product, service or solution.
2. Which pricing modality do you adopt for the charging service? For example, €/kWh, €/minute, €/charging. Are there any monthly subscriptions?
3. What is the weight of each channel on the total revenues you generate through your products, services or solution for the EV charging?

#### *COST STRUCTURE*

1. What are the main cost items you have to sustain in order to support your business model?

### ***Section 3 – Competitive environment***

1. Who are the main direct and indirect competitors you struggle with in Italy? What is your opinion about their current business models? What are their advantages and disadvantages compared to your business model? How do you think competitors' business model will evolve? And why?
2. Do you believe, in the next five years, you will grow in the EV charging market internally or through partnerships and acquisitions? In the latter case, which players do you think you can establish partnerships or acquisition with?
3. In your opinion, what are the main barriers to the development of EV market in Italy? How do you think your business model will evolve in the next five years?
4. What are the main drivers and criticalities for the evolution of the market? What will be their impact on the Italian market in the next five years?

5. In your opinion, what are the main regulations, incentive systems and obligations that are impacting or promoting the development of EV market in Italy? Are there different perspectives for what concerns private and public charging?
6. Do you expect Covid-19 will have an impact on your business model? What building blocks do you think will be mostly impacted?

It is important to remember that because of the decision to adopt a semi-structured technique, not all the questions were actually explored with each company, indeed the researcher could flexibly adapt the framework basing on the answers provided by the interviewee, thus understanding the area of competence of these subjects and avoiding to deep dive into certain topics.