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The Rising E-Car industry And the Influence of Car Sharing in the German Market

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Introduction

In 2016, 194 countries and the European Union signed what would pass in history as the first Global commitment to fight the problems associated with Humans' impact on the environment, in particular the global warming effect: The Paris Agreement. This event comes as a result of several decades of debate on the topic, with governments relying on thousands of scientific opinions to take different positions. Eventually, the leaders of most nations embraced the need for a change and a structured plan of action to tackle this existing problem. Thus, they agreed to join resources and efforts to ensure a healthy and long-lasting life on this Planet.

Reaching this important milestone was far from easy due to the high number of different opinions (often influenced by economic or politic interests) and to scepticism that remains widespread and heavy. However, this achievement represents how the majority of the public opinion is aware of this environmental problem and is willing to take action to fix it.

There are several different focus areas on the matter, and different actions are taken in different directions. In this Master Thesis, the focus lies on the automotive industry, which combined with transportation in general, produces the largest share of air pollution due to the use of the combustion engine.

The dangerous impact of Carbon Monoxide (product of any model of gasoline-powered car or transport mean) has been public knowledge since the implementation of the technology at the beginning of the 20th century; however, with the number of vehicles circulating in present-day streets, combined with several other polluting factors, the situation is not sustainable anymore. Mankind cannot continue to poison itself and the world that grants its survival, there is the need for an alternative.

With this in mind, it seems trivial to predict an imminent switch to electric engines, which represent the most advanced and most reliable alternative for the transportation system. However, this is far from obvious. Electric mobility experienced numerous attempts in history to enter the automotive market, and to spread as an alternative motion mean, facing heavy failures each and every time. The technology seems to have reached a competitive level (in comparison with the gas-powered alternative), but several factors intervened and always succeeded in stopping the revolution from happening. The last episode happening at the beginning of the current century.

Nevertheless, the level of hope keeps rising whenever the century-lasting contest between the combustion engine and its electric rival brings a new battle, and there are rational and logic reasons for people to believe that this time electric mobility will actually start taking the space that it deserves and that the Planet needs it to take.

The aim of this Master Thesis is to have an overview of the factors that make it realistic and reasonable to be confident in an imminent rise of the electric mobility, with a particular focus on one reality that is, according to this analysis, increasing the chances of this to happen: The Car Sharing concept.

The essay will dig into the features of the Car Sharing service in order to assess the degree at which the concept is connected to the electric mobility, and the extent of the influence. The sample of interest is identified in the Federal Republic of Germany, as it

represents a very relevant example for the case (on top of being the Country hosting me during the drawing of this Thesis).

The structure of this dissertation was designed to provide a general introductory overview of the current situation, with the first chapter describing the environmental-friendly momentum taking place nowadays. The second and third chapters will introduce respectively the presence of electric mobility, and the concept of Car Sharing (this last moving the focus from Global to the German market). The fourth and fifth chapters represent the core of the findings of this analysis, exposing the correlation between the two concepts and the potential consequences.

Chapter 1:

Environmental

Momentum

1.1. Chapter's Introduction

This first chapter will provide some data regarding the current level of awareness for what concerns environmental subject around the world. The reason why this introduction is needed is to show the cultural shift that is taking place nowadays, which leads people to be more and more aware and interested on the matter.

This is the first crucial factor that can allow the industry under analysis to develop. As a matter of fact, any kind of product introduction or implementation, implies a certain level of effort on many different dimensions. First of all, at a customer level. Customers are those capable of driving the market towards the integration of innovative solutions, and they are empowered to make any kind of new proposal fail if there is no interest.

This Master Thesis is focused on the industry of the electric car, which could represent an impressive disruption of a very well historically established market, the automotive industry. Suppliers and business parts are taking actions to react and change their models according to the increasing demand for such products. This shift in the demand is, as mentioned above, triggered by several factors, but the first and most important is the increasing sensibility of people for the topic of environmental sustainability. People are becoming more conscious about the effects on the environment of what they are using every day. The fight against pollution and waste is at the centre of most people's life, and many companies and industries are taking action to show their effort. Governments are creating campaigns and plans for the improvement of humans' practices in order to tackle Global warming and other kinds of consequences of the poor policies of the last centuries.

Thanks to this, the final customer is re-shaping its preferences integrating a sincere level of sensibility for the topic.

1.2. Environmental Education

One important factor influencing the level of environmental awareness is the implementation of an educational plan that took place after the signing of the Tbilisi Declaration in 1977.

In order to reduce the Human negative impact on the life and coexistence on the planet Earth, the intergovernmental conference on Environmental Education summoned by UNESCO in cooperation with United Nation Environmental Programme (UNEP) in Tbilisi in 1977, recommended the development of school curriculum in Environmental Education. According to the Tbilisi Conference, the goals of environmental education include:

- *“To foster clear awareness of, and concern about, economic social, political and ecological interdependence in urban and rural areas;*
- *To provide every person with opportunities to acquire the knowledge, values, attitudes, commitment and skills needed to protect and improve the environment; and*
- *To create new patterns of behaviour of individuals, groups and society as a whole towards the environment”;* (UNESCO UNEP, 1977).

In support of these goals, the following core objectives of environmental education were proposed:

- Awareness: acquiring an awareness of and sensitivity to the total environment.
- Knowledge: acquiring a basic understanding of the environment
- Attitudes: boosting motivation towards appropriate actions and values
- Skills: Acquiring what is needed in terms of skills and competences to deal with environmental problems
- Participation: Boosting active participation and collaboration

Furthermore, the Conference endorsed the following guiding principles:

- *“Consider the environment in its totality – natural and built, technological and social (economic, political, cultural-historical, ethical, aesthetic);*
- *Be a continuous lifelong process, beginning at the preschool level and continuing through all formal and nonformal stages;*
- *Be interdisciplinary in its approach, drawing on the specific content of each discipline in making possible a holistic and balanced perspective;*
- *Examine major environmental issues from local, national, regional, and international points of view so that students receive insights into environmental conditions in other geographical areas;*
- *Focus on current and potential environmental situations while taking into account the historical perspective;*

- *Promote the value and necessity of local, national, and international cooperation in the prevention and solution of environmental problems;*
- *Explicitly consider environmental aspects in plans for development and growth;*
- *Enable learners to have a role in planning their learning experiences and provide an opportunity for making decisions and accepting their consequences;*
- *Relate environmental sensitivity, knowledge, problem-solving skills, and values clarification to every age, but with special emphasis on environmental sensitivity to the learner's own community in early years;*
- *Help learners discover the symptoms and real causes of environmental problems;*
- *Emphasize the complexity of environmental problems and thus the need to develop critical thinking and problem-solving skills;*
- *Utilize diverse learning environments and a broad array of educational approaches to teaching, learning about and from the environment with due stress on practical activities and first-hand experience. "(UNESCO UNEP, 1977).*

1.3. The Paris Agreement

Another and more recent important event took place in Paris in 2015. During the COP21 World Climate Summit in Paris, 196 countries committed to take actions in order to tackle the climate change problem. In particular, Countries agreed the goal would be to keep the increase in global average temperature to well below 2 °C above pre-industrial levels; and to limit the increase to 1.5 °C, since this would substantially reduce the risks and effects of climate change. This is called The Paris Agreement.

Thanks to this agreement, individual Countries had to go through an internal analysis and verify what actions could be taken to comply with this commitment. In many cases, a critical object was found in the transport industry, which generates a high level of CO₂.

Despite the constant investment on the development of more efficient and less polluting gasoline engines, fuel powered transport means remain among the first causes for air pollution. Therefore, the attention is focusing again on providing an alternative, and the technological advancement is showing how this is possible.

The Agreement is considered as one of the mayor achievements in human history for what concerns the environmental matter. Thanks to it, the subject has become more notorious and many actors, from governments, to business entities and individuals, have begun to take action accordingly.

1.4. The Status

Although still far from globally accepted, the idea that humans have to take action to “save” the Planet Earth is becoming more and more part of common knowledge. This awareness has been growing for about a century, but has picked up momentum in the past decade. A deep level of support for environmental protection is existing since decades in the U.S., Japan and Europe, and as globalization brings together countries and cultures, environmental awareness is increasing worldwide. The following quote from the article “Restore Forest Breathe Life Into Efforts Against Climate Change” shows an example of how the theme is perceived in a developing country.

“Over just a few decades in the mid-20th century, this small country (Costa Rica) chopped down a majority of its ancient forests. But after a huge conservation push and a wave of forest regrowth, trees now blanket more than half of Costa Rica...Over time, humans have cut down or damaged at least three-quarters of the world’s forests...But now, driven by a growing environmental movement in countries that are home to tropical forests, and by mounting pressure from Western consumers who care about sustainable practices, corporate and government leaders are making a fresh push to slow the cutting – and eventually to halt it. In

addition, plans are being made by some of those same leaders to encourage forest regrowth...”
(Gillis, 2014)

Nowadays, business entities and government are constantly asked to pay more attention to the safeguard of the natural environment, and to take seriously the topic of sustainability. This push comes from international organizations as well as activists and individual customers.

While reaching the point of complete sustainable practices implies a long way to go, the mentality of people has shifted.

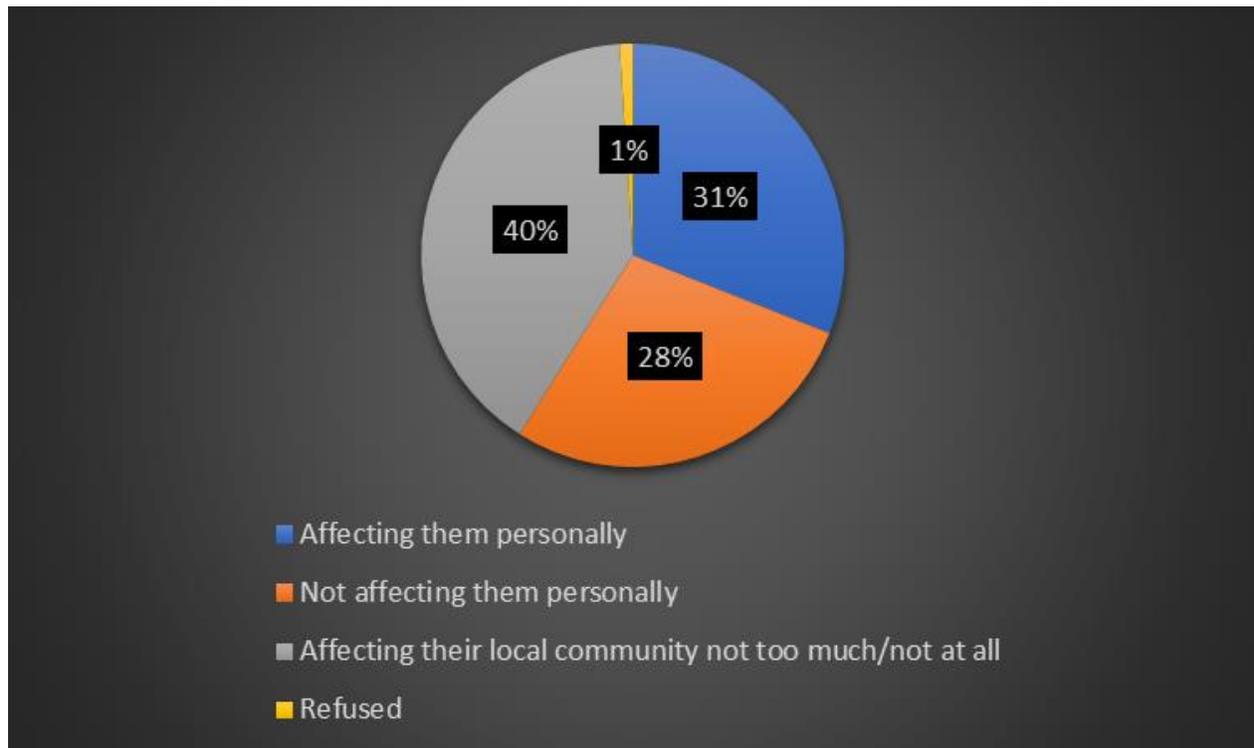
The following quote from an article posted by China Daily in May 2014 gives an interesting example of what populations are asking for.

“About 60 percent of Chinese want the government to give priority to environmental protection when boosting economic growth... Eighty-three percent of respondents said their cities have smog, and about one-third said that smog is serious. In seven cities - Beijing, Harbin, Hefei, Nanjing, Shanghai, Wuhan and Zhengzhou - up to 60 percent thought the smog in their cities was serious. Regarding its impact on their lives, 63 percent said they reduced unnecessary trips and about 72 percent said they reduced their outdoor activities.” (Hongyi, 2014).

This mentality is consistent with what European and North Americans think, and the sense of urgency reminds what triggered the actions of the United States Environmental Protection Agency in the 1970s. However, this momentum is not caused by a sense of urgency, but rather by a shift in values and an increased awareness on how Planet Earth works. Merit for this can be awarded to the Tbilisi Declaration of 1977, as well as to the increased level of general education and the increased flow of information. These combined with the fact that individuals can often experience the damages mankind is doing to the environment, generates a higher level of concern compared to the one of the previous century.

A survey from Pew Research Center run in the United States of America in March 2018, shows that 59% of respondents believe that climate change is affecting their local community, and 31% believe that this has an impact on their personal life.

Figure 1.1 - % of U.S. adults who feel affected by global climate change



Source: "Majorities See Government Efforts to Protect the Environment as Insufficient" - Survey conducted by Pew Research Centre, 2018

People know that humanity is stressing the planet's finite resources. Young people know it more than old people, since they lived during an era categorized by a higher effort on environmental education. According to a different study conducted in January 2017 by the Pew Research Center, American respondents between 18 and 30 years old are 64% likely to say that protecting the environment should be a top priority, compared to the 48% of people older than 64.

Table 1.2 -Priority for Age Group in the U.S.

AGE	18-29	30-49	50-64	65+	Young-Old Difference
Strengthening the military	33%	38%	51%	58%	-25
Reducing lobbyist influence	31%	36%	51%	56%	-25
Improving transportation	27%	35%	34%	52%	-25
Immigration	36%	39%	45%	56%	-20
Medicare	52%	59%	58%	70%	-18
Social Security	55%	53%	64%	72%	-17
Improving job situation	58%	67%	76%	73%	-15
Terrorism	71%	69%	84%	84%	-13
Tax reform	39%	43%	44%	50%	-11
Health care costs	59%	66%	70%	69%	-10
Drug addiction	35%	33%	35%	44%	-9
Strengthening economy	69%	75%	71%	76%	-7
Reducing budget deficit	47%	50%	61%	53%	-6
Global trade issues	37%	38%	47%	42%	-5
Reducing crime	57%	47%	64%	61%	-4
Education	73%	69%	64%	70%	3
Problems of poor and needy	62%	56%	54%	57%	5
Medical leave	41%	33%	33%	34%	7
Addressing race relations	66%	58%	47%	56%	10
Global climate change	48%	37%	33%	34%	14
Protecting Environment	64%	59%	48%	48%	16

Source: "Older Adults Give Greater Priority to Military, Immigration, and Entitlement" – Survey conducted by Pew Research Centre, 2017

An interesting insight is found in a polling on American attitudes performed by Gallup in 2014, according to which 60% of individuals younger than 30 favour environmental protection over economic growth (against 30% who don't), while only 39% of respondents above 64 years old do the same (against 50% who favour economic growth). This proves again the impact of the educational program, and the change of mentality which is triggering a cultural shift.

It is important to point out how several different factors influence answers in these kinds of surveys and polls, such as education, profession, political inclination, religion, social status...

The impact of this level of sensitivity is considerably strong on business entities, governments and non-profit organizations. All these actors, together with households and communities, are forced to redirect several actions and practices in order to meet population's requirements and preferences. An example of how damaging can be for corporations when they fight against the public opinion on an environmental matter can be found in what happened to Volkswagen in 2015. After a study commissioned by the California Air Resources Board found that VW's vehicles were deliberately cheating emission tests, the Company's stock value dropped by one third in a few days, causing massive problems for the German Carmaker.

Individuals are also putting an effort on changing their behaviours. The topics of water usage, or recycling trash are more sensitive than they used to be. The impact of air conditioning or heating systems usage is public knowledge, and peoples are acting to moderate it.

This change in private behaviours affects the way in which corporations are running businesses too, aligning the research for profit and market share to the appropriate sustainable behaviour pushed from within and from the outside.

The factors driving this cultural shift come from several different directions. Indeed, the investment put into environmental education in the last 5 decades is paying off, as well as the media coverage of the topic, which can be considered as a cause as well as a consequence. On top of this, the fact that people are often capable to observe the damages created by mankind has a strong impact. Whether it is agricultural disasters, or smog in the cities, or pollution related increasing number of diseases, people do not like the idea of approaching a semi-catastrophic future. Moreover, the concept of

wellness intended as health, nutrition, exercise and hygiene is growing in popularity. Since people are putting the effort in taking care of their personal condition, governments and corporations should indeed put the effort in taking care of the Planet and allow its inhabitants to live in a healthy and clean environment.

An article written by Steven Cohen, Professor at Columbia University, shows an interesting opinion on the cultural shift of this period.

“Environmentalism is less a political perspective than a way of understanding how the world works. I frequently compare it to the changing views of gender, race, homosexuality and what we have come to term “parenting.” When I was growing up, being a parent described a stage of your life cycle. Today it is a verb describing the actions involved in raising your children. While racism, sexism, xenophobia and homophobia remain strong forces in American society, they are less tolerated than they once were. Social and cultural changes during the last half-century have created a profound change in how we live and how we interact with each other. This, in turn, has had a deep impact on politics and public policy. The drive for a renewable economy housed on a sustainable and not-deteriorating planet is a key part of the cultural shift I am describing.”
(Cohen, 2014).

The same author writes the year later in 2015:

“As the planet’s population continues to urbanize, and as technology continues to develop, our daily exposure to the natural world will be significantly reduced. Nevertheless, our reliance on those natural systems will continue as long as we need to breathe air, drink water and eat food. If technology someday makes it possible to supplant those natural systems, then we might be able to create a world devoid of nature. We are nowhere near that stage of technological development now, and if we move in the direction of a renewable economy, there will be no reason to develop technologies to do the work now done by natural systems. But there may come a point where the survival of natural systems will depend on our ethical sense of right and wrong and a culture valuing nature for its own sake. Some day we may be able to live without natural systems – but would we want to?” (Cohen, 2015).

While the utopic (or maybe dystopic) scenario in which humanity will be able to support itself without the need for nature is not a point of interest for this master thesis, the parallelism proposed by the author remains extremely interesting. What is happening can indeed be referred to as a cultural shift. Pollution and lack of environmental care is perceived as an evil or bad behaviour by the public opinion, regardless of the context.

1.5. Impact on the theme

As mentioned in the introduction, this insight is extremely important for the topic treated in this Master Thesis. The development of the industry related to the electric mobility represents a big change in people habits and perceptions, and it involves a possible disruption of the industry that is currently very well established and solid. Such level of change cannot be undertaken if the people are not willing to put their entire effort in it, and this can only come as a consequence of the common understanding that actions must be taken in order to improve human's life.

The final consumer is one important actor in the shaping of our future. He/She can direct the demand with his/her preferences and push businesses and industries to change accordingly.

In this case, the push comes from several different directions (governments, international organizations...), but the final consumer is the actor that will finally decide whether the innovation can be introduced, and the new industry can develop.

Chapter 2: A look at the Pioneers

2.1. Chapter's Introduction

This chapter is focused on providing some degree of information regarding the Electric Car. Starting from the history of it, following the different steps that developed into today's reality. It is common assumptions that electric cars have not entered the market yet because of their performance disadvantage with respect to the oil combustion engine driven vehicles, and this is partially true. However, this performance disadvantage is not certainly caused by an objective inferiority of the engine, but it is most likely a consequence of a strong direction of investments and resources towards the oil engine. To understand why this happened, it's very important to have a look at the history.

2.2. Early History

While it is complicated to track down the proper date of invention of a fully functioning electric vehicle, there have been a few recordings of electric carriers or vehicles appearing in Europe already at the end of the 19th century.

Between the 19th and the 20th century, people started to find an alternative to the most common mode of transportation, the horse. This alternative was the engine, which got introduced to the market in three variants depending on different alimentations: steam, electricity and gasoline. The first, quickly disappeared due to the inconvenience of such an engine in a personal vehicle: long starting times and necessity of a big water storage.

The gasoline engine didn't start its life in the easiest way either; while there were promises for this technology, driving it remained quite inconvenient for a long time. Changing the gear required a lot of manual effort, and the noise and pollution coming out of it were of disturb too.

Electric vehicle didn't have these problems, and the short range of their battery was still not a problem since driving was a luxury mainly of the cities. Roads out of the cities where not easy to travel, and they lacked support for travelers driving any kind of engine vehicle.

Many factors seemed to show that electric cars would have been the new mass transportation means. Many investors like Ferdinand Porsche or Thomas Edison focused resources on them (E.g. hybrid Porsche P1 introduced in 1898, Figure 2.1). According to an article published by the New York Times on January 11, 1914, it appears that Henry Ford himself took an interest in the matter, and worked together with Edison to study a possible low-cost electric vehicle (The New York times, 1914).

Figure 2.1 – Porshe P1



Source: www.auto-motor-und-sport.de

However, it was Ford's introduction in the mass market of the Model T that represented the beginning of the decline of the prospect of the electric engine. The Model T changed the conception of personal car by far, it offered a cheap and affordable option for a big part of the American Population. Complementary services such as gasoline stations, appropriate roads, mechanic services... started to fill the country as the new transportation mean spread around.

Figure 2.2 - Ford Model T



Source: www.classicdigest.com

Moreover, the discovery of Texas crude oil at the beginning of 1900 made gasoline price consistently cheap.

At this point, all the resources of the automotive industry focused on the gasoline engine. Technological innovation worked in order to make the product cheaper, more convenient, cleaner and more performant, forgetting in the meanwhile the alternative.

2.3. The 20th Century

After the introduction of the Model T, the gasoline engine kept developing and attracting investments for the whole century. Research and interest on the electric car decreased exponentially and went through a dark period of approximately 40 years without any major innovation.

However, in the late 60s the common interest on the matter started to rise again. Mainly due to the incremental shortage of oil, which caused an increase in the price of fuel (peaking with the Arab Oil Embargo of 1973), finding an alternative to the dependency on combustible fuel became again a matter of primary interest.

The Electronic and Hybrid Vehicle Research Development and Demonstration act of 1976 officially authorized and boosted the Energy Department in the U.S. to push forward the research on the EV technology. Thanks to this, many actors (like NASA, GM, American Motor Company...) took the interest and brought many improvements to the technology.

Figure 2.3 - NASA Apollo Lunar Rover Lander



Source: www.turbosquid.com

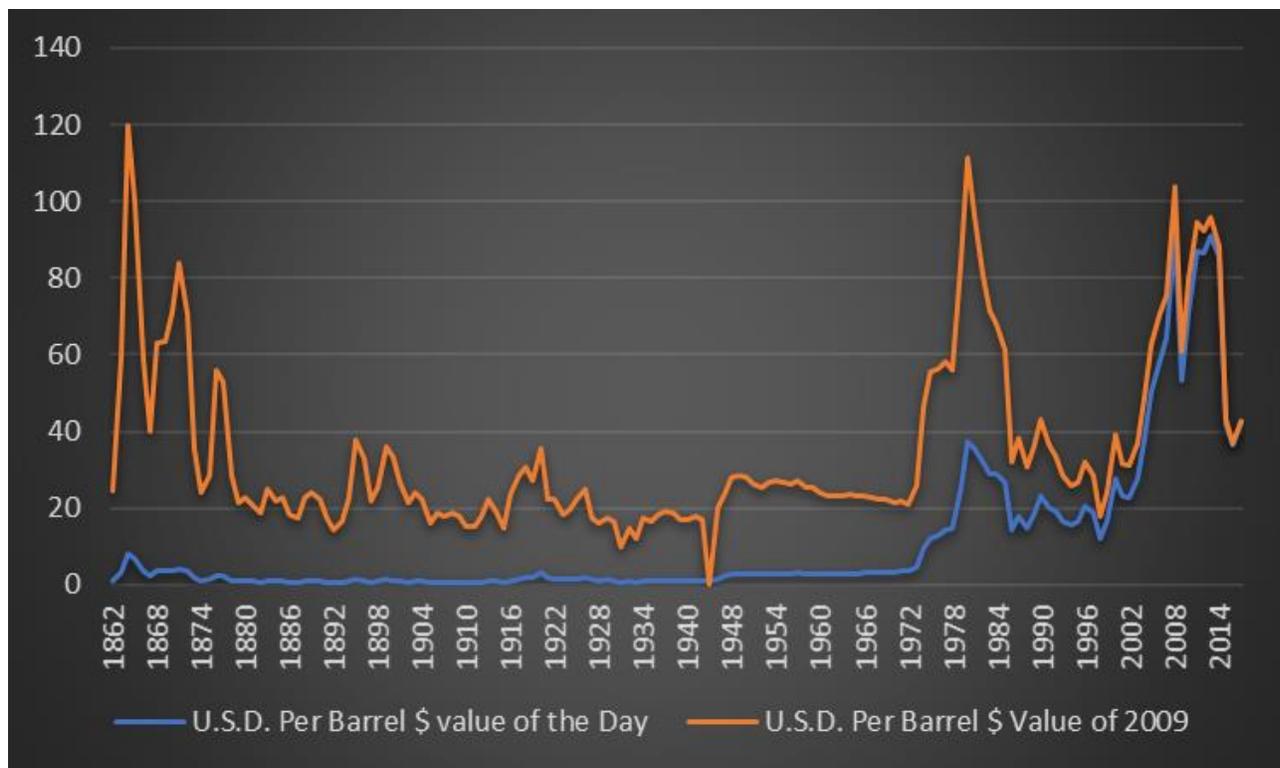
Nevertheless, the electric technology in this period, was found still incredibly inferior to the well-established gasoline engine. For this reason, despite the new wave of interest and investment, electric vehicles remained to be mainly prototypes and ideas till the end of the century.

2.4. Recent History

During the 80s, the electric car industry suffered another period of darkness, without any relevant episode recorded.

In the 90s, also as a consequence of the “Clean Air Act Amendment” (1990) and the “Energy Policy Act” (1992), several manufacturers started to integrate electric engines on already existing and notorious models, spreading once again awareness on the matter (figure 2.3 shows the trend of the price for crude oil from the year 1860 till now).

Figure 2.4 - Historical Crude oil Price from 1860

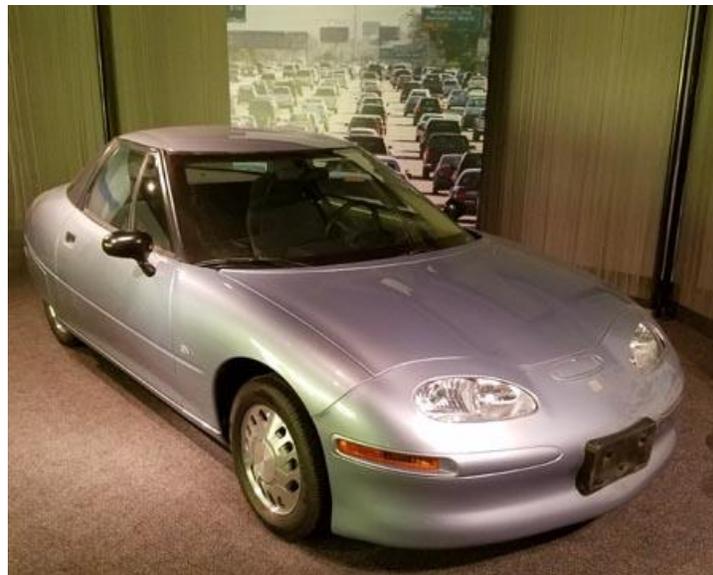


Sources: McMahon, 2017 - Charts Bin, 2009

In 1996, GM started producing the famous EV1: an out of scratch electric vehicle, capable to reach 100 km/h in 9 seconds, and with a battery lasting for nearly 130

kilometres. The model showed to the public the promising advance of the electric car industry and attracted a cult for the product. However, production was put to an end between 1999 and 2000 because of the consistently high costs associated to it, which made it inadequate for the market. It is interesting to have a closer look at what happened around the introduction and withdrawal of the EV1, since some implications are relevant for this research. Therefore, a more detailed explanation is available in the following case study section.

Figure 2.5 - GM EV1



Source: www.pcmag.com

Apart from this, during the late 90s, the interest towards the electric vehicle remained quite low due to the economic boom and the low price of oil. Nevertheless, research and advancement on the matter was being carried out in the background.

The new millennium started positively for the electric car. Two episodes increased exponentially the interest for the industry, increased awareness and attracted great investments. The first one is the introduction worldwide of the TOYOTA Prius in 2000, the first successful hybrid car partially powered by a nickel battery. The Prius model, consequence of the Japanese reaction to the American wave of interest for electric

vehicles, spread extremely quickly (also thanks to notorious influencers and celebrities). It rapidly became the best-selling hybrid car of the first decade of the 21st century worldwide.

Figure 2.6 - Toyota Prius



Source: www.hum3d.com

A few years later, in 2006, Elon Musk's start-up, Tesla, Inc. (formerly Tesla Motors, Inc.), announced its intention to produce a high hand electric car capable to reach extremely high performances in terms of speed, safety and range. Tesla Motors managed to receive a loan of approximately 500 million Dollars from the Department of Energy in 2010, and maintained a strategy based on funding pre-production that guaranteed a fast and successful growth during the last decade (this topic will be further analyzed subsequently).

Figure 2.7 - Tesla Roadster



Source: www.caranddriver.com

Several manufacturers took the challenge and started to invest again on electric vehicles, setting the course towards a more and more diversified and solid market.

The next big challenge to be tackled was the lack of complementary infrastructures; the number of available charging stations and mechanical services was still inadequate to satisfy a successful development of the product in the market. Although investments and plans have been directed to provide a wider cover, as for now this is still probably one of the biggest steps to overtake.

2.5. Case Study: General Motors – EV1

In 1990, as a response to the increasing concern related to smog and air pollution, California Air Resources Board issued the Zero-Emission Vehicle Mandate (ZEV) with the initial obligation for car companies to have 2% of their production specialized on electric vehicles by 1998. General Motors was the first US carmaker able to respond with

a successful solution. The EV1, an entirely electric powered car, was introduced in the streets in 1996 generating a great amount of enthusiasm among users, media and competitors. The car resulted to be market competitive in terms of performance, and capable of lasting approximately 130 kilometres with one charge, much more than what the great majority of car drivers needed in their daily lives. It was possible to charge the car at home, with a common power plug, or at charging stations that quickly started to spread after the introduction of the model.

Although the public reaction stated how this innovation had the potential to become one of the greatest of the time, a time-changing invention, the history proceeded in a very different direction. EV1s never entered the market as a product in sale, between 1999 and 2000 the production was stopped, and shortly after all units in the streets started to be removed and seized by the manufacturer, to be subsequently demolished. By the end of 2003, all EV1s existing were spread around museums, collectors and research entities after being all de-activated by GM in order to make them completely non-functioning.

The case raised great controversy and was analyzed by several experts during the following years. The main claim from General Motors is that, although trying, they were not able to make the product marketable, and had to retire it from the market to avoid future losses. However, external analysis showed how this is by far not the only factor involved in EV1's failure.

Factors of Failure

Starting from the product, the EV1 model presented some technical issues and inferiorities compared to other cars: the initial battery was not as performant as promised, it tended to heat the cabin and became unreliable when air conditioning and other devices were used. Charging stations were not yet frequent enough, and the appropriate charging time was between 5 and 6 hours, not comparable with the 5-10

minutes needed to fuel up a gasoline vehicle. On top of this, GM's car was introduced with a clear limitation since the beginning: the EV1 could drive for a maximum of 130 kilometres, much more than other electric models, but still incomparable to any gasoline competitor.

However, technology needed for battery improvements was soon available, and in the few implementations made, it showed the difference. Moreover, the target of the prototypical vehicle was clear from the beginning: city drivers who needed the car for much less than 130 kilometres per day and were able to recharge it at home during the night, the great majority of urban population.

Thus, it seems that technological issues, considering that the model was a prototype, were minor in relation to the great innovation that was being introduced, and could have attracted further research to improve the technology.

A second factor was the influence of car manufacturing companies, and their strong opposition to the ZEV issued by the California Air Resources Board. Car makers initially responded actively, and proposed several different electric vehicle models, which started to fill California's street together with EV1s. However, they soon took legal action against the CARB, and quickly started to not comply with its obligation anymore.

On top of this, the White House joined the fight against electric cars and took a strong position to disincentivize investments on the technology. The American solution for a cleaner transportation was found in the Hydrogen powered engine, a technology that was (and still is) far less advanced and promising than the other Zero-Emission alternative. It is unclear the influence that the oil industry had on this matter, given the proximity of these parties to the national administration of the time, but allegations were made based on the theory for which several actors had an interest in boosting the hydrogen technology as they were preparing to switch from providing one scarce

resource (oil) to the other (hydrogen) and benefit from a new condition of dependency. What is certain is that oil lobbies financed campaigns to fight the building of charging stations and the expansion of an adequate distribution of complementary services.

Reacting to the pressure, the CARB finally turned its back on electric vehicles towards the alternative technology, making the EV1 and similar products difficult to market.

One last factor was the lack of interest from the customer side. Although GM's EV1 inspired a loyal cult among the few that had the chance to drive one, the majority of the American population remained sceptic towards the innovation. The perception of the ideal car remained to be the classic gasoline driven car, with its power, reliability and durability. As an example of this, General Motor released in the same years the Hummer, a 3.5 tons gasoline powered SUV.

All 2500 produced EV1s were retired from the streets and destroyed or deactivated by the end of 2003, raising protests and polemics. Although on a matter of official records, this is to be related to the impossibility of a profitable market integration, it seems quite clear that several different interests were conflicting, and many actors played a role to hibernate the raise of this technology.

2.6. Case Study: Tesla

The second case study worth exploring involves the US based company Tesla, Inc.

Founded in California, as a start-up in 2003 by Martin Eberhard and Marc Tarpinning, with the support of the current CEO Elon Musk and JB Straubel. The Company's goal has always been to show the world that electric vehicles can be better, faster and more convenient than gasoline powered vehicles, and eventually to deliver electric cars to the mass market.

“Our goal when we created Tesla a decade ago was the same as it is today: to accelerate the advent of sustainable transport by bringing compelling mass market electric cars to market as soon as possible...” (Musk, 2013).

What is particularly interesting about the development of Tesla, Inc. is, apart from the technological features of its products, the business model and the peculiar strategy implemented to reach their goal.

As stated above, many attempts to launch electric vehicles have been made in history, but none of them really succeeded. For this reason, Tesla’s management decided to adopt a different approach.

Musk’s Master Plan

The first important factor in Tesla’s strategy was what is known as “Master Plan”. In practice the implementation of a price skimming-like marketing approach. The Company recognized the impossibility of delivering from the beginning a model capable of competing in terms of performance and price at the same time with the oil dependent competitor. Moreover, Tesla was initially not capable of producing at a scale able to serve the mass market. Thus, their initial product, the Roadster model, released in 2008, was a luxury car.

The Roadster managed to impress the public opinion, by being totally capable of competing with other supercars in the market. Thanks to its high hand engineering, the model could reach 100 km/h in less than 4 second, had a maximum speed of more than 200 km/h, and, mostly important, could be driven for almost 400 kilometres with a single charge. The price of approximately 100.000 USD, was entirely fitting the competition in the sector. Tesla sold around 2.500 Roadsters around the world.

The idea behind it, was to first show the world how electric vehicles can compete, and perhaps win, the gasoline powered car. Thus, attract market interest and investment in order to move towards the implementation of a mass market model.

"...If we could have done that with our first product, we would have, but that was simply impossible to achieve for a start-up company that had never built a car and that had one technology iteration and no economies of scale. Our first product was going to be expensive no matter what it looked like, so we decided to build a sports car, as that seemed like it had the best chance of being competitive with its gasoline alternatives..." (Musk, 2013).

Second step of the Master Plan was to use the profits from the sale of the Roadster to develop a more affordable, medium-performance model, which Tesla did in 2012, with the commercialization of the Model S, for a price of approximately 60.000 to 70.000 USD, and in 2015 with the Model X (approximately 90.00 USD).

Third step is delivering a model for the mass market: affordable by many, and highly competitive compared to gasoline models. In the current year, Tesla, Inc. is starting to deliver the Model 3, starting from 35.000 USD. According to the Company, the car should have a range of 500 kilometres, and a top speed of almost 250 km/h.

On top of their performance, Tesla's cars offer higher inhabitable space in the cabin, and all other advantages of an electric car (lack of noise, lack of CO2 emissions, and non-dependency on oil combustible).

Funding in Advance

Thanks to its vision and culture, Tesla, Inc. managed to receive several different investments from private entities and institutions (E.g. the above-mentioned loan from the Department of Energies in 2010). The Company has built a positive, environment friendly and futuristic image. Tesla's mission could be interpreted as an attempt to

create a better and healthier future, and this, together with the reputation of the CEO Elon Musk, is indeed increasing the appreciation in terms of public opinion.

However, there is another interesting strategy that Tesla is using to raise capital: a sale-on-order approach according to which the common customer would literally order a model before this is produced and wait until the car is delivered. In this way, the Company is capable of collecting money before production has started, and logically invest this capital in the next process.

Creating a Network of Complementary Products and Services

One of the constant issues occurring whenever an electric car manufacturer tries to enter the market, is the lack of an appropriate network of complementary products and services related to the industry itself. A big advantage of the gasoline-powered vehicle is the possibility to fill the tank in about 5-10 minutes, and be able to drive for hundreds of kilometres with this quick action.

To tackle this issue, Tesla, Inc. invested in providing a great number of supercharging stations, that allow customers to charge their car for free in about half an hour. These stations are automatically connected to the panel and navigation system of the car, to make it very easy for drivers to find the closest station when needed. The navigation system is also capable of automatically designing routes taking into consideration the need for charging.

At the moment, Tesla has built 1.422 charging stations around the world, with more than 12.000 superchargers. According to official statements and news reports, the Company is constantly striving to increase this number.

Moreover, Tesla, Inc. has taken a Silicon Valley like approach to customer service. Products are sold only through direct sales, avoiding those conflicts of interests that populate car dealers. On top of that, an extremely prepared group of technicians,

named Tesla Rangers, is always available to support the customer. What is interestingly innovative, is that, due to the high technological composition of the Tesla models, in many cases technicians are capable of solving technical problems wirelessly and without the need to see or touch the car.

A visionary Company

As briefly mentioned above, it is important to dive in the topic of the brand image a bit more in detail, because this is indeed a great success of Elon Musk and his colleagues. Tesla is associated to a group of businesses that act as visionaries, promising a great degree of development in different sectors of the economy, all linked by the topic of environmental sustainability and human's life improvement. The most famous of these is Musk's Space Exploration Technologies Corporation (commonly known as SpaceX): The Company's mission, as reported in the official website, is to "*...revolutionize space technology, with the ultimate goal of enabling people to live on other planets*". (SpaceX, 2019)

On top of Elon Musk's reputation, Tesla itself is marketed as a forward oriented, futuristic and environment friendly Company. The non-mentioned above 4th step of the master plan is, as a matter of fact, to provide solar power.

"...The overarching purpose of Tesla Motors (and the reason I am funding the company) is to help expedite the move from a mine-and-burn hydrocarbon economy towards a solar electric economy, which I believe to be the primary, but not exclusive, sustainable solution..." (Musk, 2006).

Among the several different prototypes, ideas and promises from Tesla's management there are fully solar power-driven trucks and trains, self-driving cars, solar plants capable of powering entire buildings at all time...

Elon Musk is becoming the symbol of the future, and has inspired hope, adoration and loyalty from many people around the world.

The Delivery Problem

The whole strategy of Tesla, together with the extremely high growth rate of the demand, triggered a logistic problem that has caused, and is still causing a high degree of malcontent among Tesla's fans: the frequent delayed delivery.

The Company, since the beginning, pursued its forward oriented policy: factories, plants, machineries and technology have always been extremely advanced and brand new. In practice, Tesla built all its infrastructures and immovable assets from scratch. On top of that, these constructions have often been planned and performed at the last possible moment. The logical consequence is a logistic issue that impacted production times.

Moreover, as mentioned, the Company would collect orders before even starting the production. An action that has proven to be quite bold. Tesla stumbled across unexpectedly high demands for both Model S and Model 3, which evolved in bottlenecks and further production delays.

Regardless of the size, brand image and resources, Tesla, Inc. remains a young company, and this, at the moment, is risking to undermine the reputation and the value critically. This, considering the growing level of the competition, could seriously affect Tesla's future.

2.7. Competition

The combination of the increasing awareness for environmental concerns, the will of the public to get away from oil dependency, and the promising success of the pioneers, is concretely bringing this industry up to speed.

Most car makers around the world embraced the reality and acted accordingly. New electric prototypes started to pop up and soon were introduced to the market. A U.S. News analysis shows how Tesla Model S takes the second spot among the Best Electric Vehicle in 2018, preceded by the Chevrolet Bolt EV. Other spots are occupied by Hyundai Ioniq EV, Tesla Model X, Volkswagen e-Golf, Nissan Leaf, BMW i3, and Kia Soul EV. This proves how the competition is already reaching the pioneer and using the capital and historically affirmed structure and image to get their solution to the market and avoid Tesla's monopoly. (U.S. News, 2018)

2.8. A look in the future

As the next chapters will show more in detail, the industry is indeed becoming more powerful and successful. Still many factors are limiting the adoption of electric cars: lack of charging stations and services, a spread skepticism against the swift, the common perception of car as a gasoline powered vehicle (noise, mechanical gear and manual driving features still represent the concept of driving a car), and the conflicting interests of extremely powerful organizations involved in the oil business. However, the route is being designed, and going backward now would be simply impossible. Most studies predict an exponential increase in the demand that will eventually bring to a complete market adoption.

Chapter 3: Car Sharing

3.1. About Car Sharing

Car Sharing is an innovative mobility service that grants the possibility to rent cars in many different locations within an urban centre for a very short period of time, with a simple procedure and for an affordable price.

How does Car Sharing work?

Nowadays, in most developed countries, an individual living in a city where the Car Sharing option is available, can register in one of the several different providers' platforms, often paying a limited membership fee. These providers are mostly highly digitalized and offer a customer interface based on a mobile app or website. Once a customer is registered and the account has been activated (the provider checks the authenticity and legitimacy of the documents provided and the driving license), the

interface helps him/her to find the closest available vehicle and allow him/her to activate the renting.

Providers spread a fleet of vehicles around the city, so that customers can often find an option a few minutes away walking, and they are allowed to park the car, at the end of the trip, wherever they want within the dedicated area (which usually corresponds to the urban area of the city), respecting of course the parking rules of the city, but without worrying about paying a parking fee, since the great majority of these organizations have agreements with municipalities that grant free of charge parking.

The interface calculates automatically the cost of the rent based on time and range of the ride, and subsequently bills the customer (monthly or after each ride). The service is available for different kinds of vehicles and also motorbikes or scooters.

The system described so far is called Free-floating, for which cars are available spread around a city, without any fixed location. The customer can pick up the car and leave it in a different random location (within the permitted area). The alternative, called Station-based system, is composed by different stations in which the car can be picked up and returned afterwards. Of course, the price range of this option tends to be quite lower due to the lower level of flexibility and freedom for the customer. Basically, this works as an automated, cheap short term, and spread car rental. It is important to point out that several studies from the Bundesverband CarSharing (German Car Sharing Association) state how this is the type of Car Sharing that actually has an impact on traffic, while the pure Free-Floating doesn't seem to have relevant or measurable effects (Bundesverband CarSharing, 2018).

It is important to differentiate Car Sharing from Car Pooling: whereas the first is, as described, a rental service for low-rate users with flexible features, the second refers to a sharing of the expenses arising from a car ride. The perfect and most known example is surely BlaBlaCar, a platform that, through the interface provided by an app, allows

drivers and car owners to fill the car with other individuals that share the same route, and divide the cost of the trip with them. Basically, it works like a taxi ride, with the divergences that, at least in theory, the driver and poster of the trip should not gain any profit, but only share expenses; and that the route is not decided by the customer (in this case the passenger) but by the driver.

3.2. The history behind Car Sharing

The concept of Car Sharing started to develop in the 1940s Switzerland: private individuals tackled the problem derived from the environmental and financial impact of owning a vehicle, by buying cars in shared-property with neighbours, colleagues, relatives or friends. Between the '80s and the '90s, small businesses started to build around the concept of Car Sharing, and bring it to the market as an entrepreneurial novelty.

Although the industry remained quite underdeveloped and low in terms of profits and investments until the late '90s, the implementation of GPS technology allowed the industry to boom. A further exponential increase happened with the combination of mobile internet, which allowed the service to be extremely practical and easily accessible by everyone.

Together with Car Sharing, other vehicle sharing concepts took place, as the above-mentioned motorbike sharing, scooter sharing and, the first of them all, bike sharing.

3.3. The benefits of Car Sharing

The condition allowing Car Sharing to succeed is to be found in the low flexibility of the automotive industry. This provides a wide choice in terms of models and brands, but it doesn't take into consideration those consumers that have a limited need for the use of a vehicle: mostly people living in a city, who need a car for not longer than a few minutes a day, or young individuals who cannot afford the burden of owning a car which includes the cost of the vehicle itself, maintenance, insurance, taxes, parking etc. Car Sharing targets exactly these users.

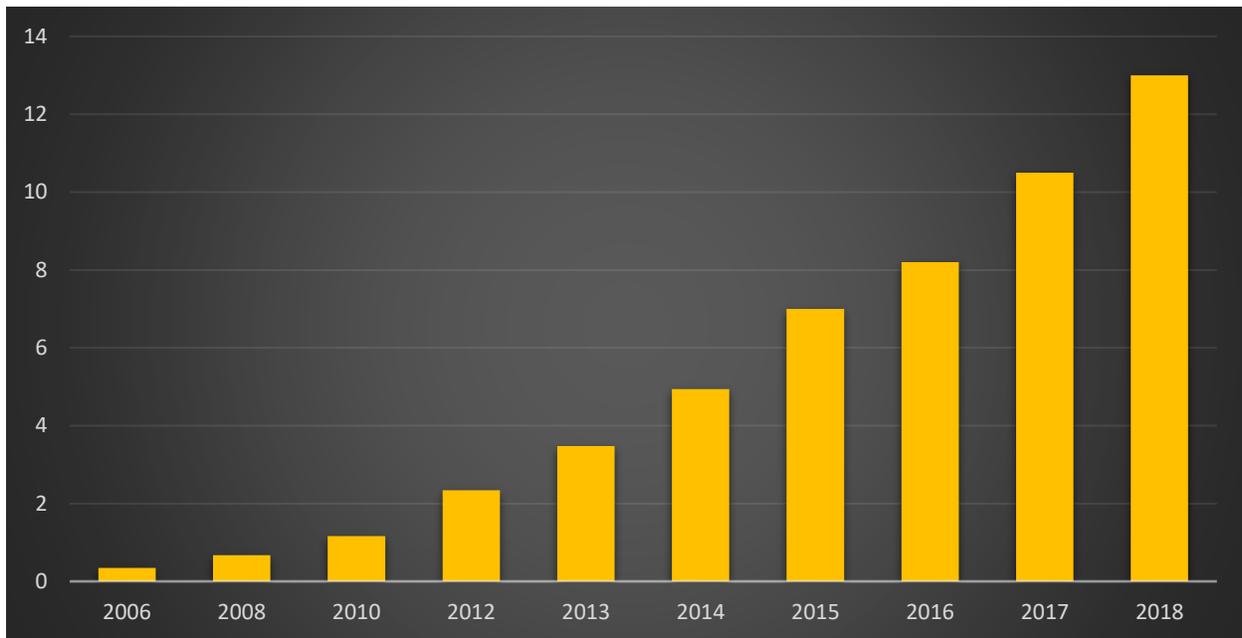
Moreover, the recent digital revolution and the commercialization of the smartphone, set out a social trend, mainly among young people, for which consumers prefer to share certain items rather than owning them. The car, in particular, is becoming more of a burden, given the high expenses associated to something that is used for just a few minutes a day, mainly in big urban centres.

On top of this, the service triggers environmentally friendly consequences: from the decrease of the congestion level, to the sensibilization of the population towards a more responsible usage of the car; and all these result in a consequential decrease of pollution.

3.4. Car Sharing Today

The Car Sharing movement and practice has been taking quite some space lately and becoming more notorious and profitable as a business. The chart below (figure 3.1) shows the rapid growth of the industry since the early 2000s. Approximately an average constant 60% of these users are located in Europe. (Le Vine Zolfaghari Polak, 2014)

Figure 3.1 - Millions of Car Sharing Users Worldwide



Source: www.statista.com

The automotive players are facing constant pressure due to the reducing car ownership. This is boosting them to enter the Car Sharing industry either by forming partnerships with the existing players, or by establishing subsidiaries that provide Car Sharing services. For instance, in October 2016, Toyota Motor Corporation announced a partnership with Getaround, leveraging their technology platform to provide peer-to-peer services and enable future mobility services. BMW launched DriveNow in 2011, Car Sharing services for their BMW-i, SIXT, and MINI series.

Competent industry-level bodies are emerging as a consequence to this expansion. They act as mediators between companies and local governments. Among these, there are Car Sharing Association, BCS, and Car Plus; which set principles and rules to define and guide the relationship between the government and the operators. This should harmonize and make the operations of the stakeholders in the Car Sharing market smoother.

Between 2010 and 2011, when the total number of Car Sharing users exceeded 1 million, the market began to rapidly grow and develop. This number became 10 million in 2017, and, according to a study from Frost & Sullivan, it will grow to 36 million by 2025, maintaining an annual growth rate of 16.4%. (Frost & Sullivan, 2016)

Global Market Insights forecasts the value of the global Car Sharing market in 2024 at USD 11 billion. At present, the leading shared mobility markets are Western Europe and the US, while experts predict that Asia will experience the fastest growth in this field. (Bhutani Bhardwaj, 2018)

3.5. Car Sharing in Germany

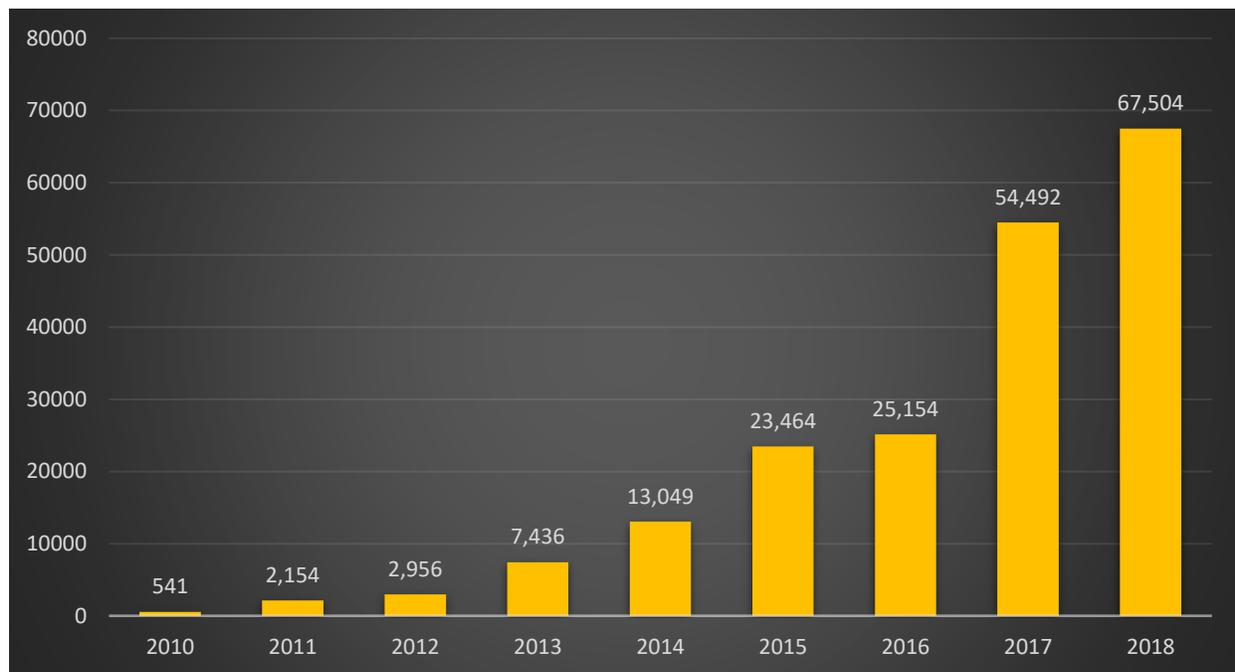
There are three drivers for my decision to focus this essay and analysis on the German market:

The first is to be associated to a pure logistic convenience. As I am currently living in the City of Hamburg, in Northern Germany, and I'm writing this Master Thesis here, it is indeed much easier to access data and to observe the reality of Germany.

The second is connected to the fact that Germany is by far Europe's market leader in the context of Car Sharing. The Country has been since the beginning a great promoter of the movement, and the population has embraced this practice with high enthusiasm.

At last, Germany's Car Sharing industry currently employs a 10% rate of electric or plug-in hybrid vehicles, compared to the 1.6% in the overall car market. This is indeed very interesting for the scope of this analysis. On top of that, Germany is becoming an important ambassador in the commercialization of electric cars. As figure 3.2 shows, the number of sold electric vehicles is growing rapidly, especially in the last couple of years.

Figure 3.2 - Registration of Plug-in Electric Cars in Germany



Source: www.autobild.de

The numbers are quite impressive: in 2018, more than 2 million people used Car Sharing in Germany, with an increase of approximately 20% compared to the previous year. Station-based providers hold around 550.000 customers, while Free-floating around 1.600.000. (Bundesverband CarSharing, 2018)

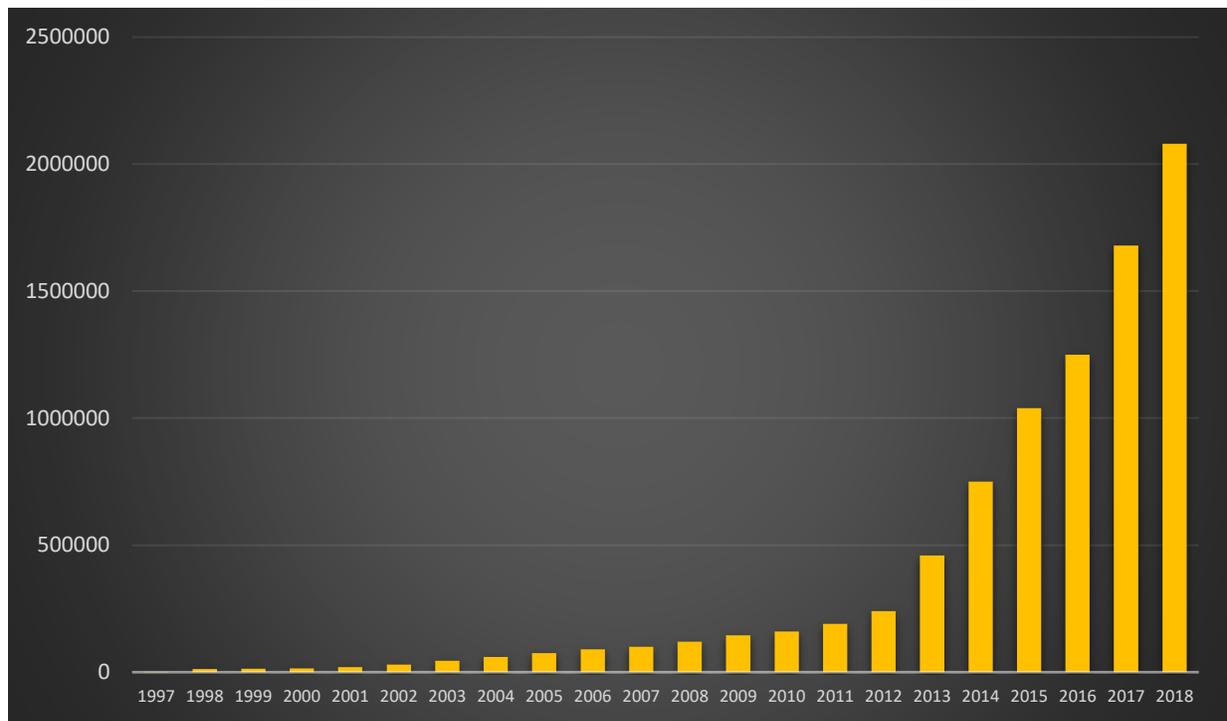
Regarding the available Car Sharing fleet, the number of vehicles increased by almost 5%, reaching 18.000 cars in 2018.

The service is present in 677 German cities, 80 more than 2017. (Bundesverband CarSharing, 2018)

Figure 3.3 and Figure 3.4 represent respectively the evolutions in terms of number of Car Sharing users, and number of vehicles dedicated to Car Sharing. It is quite intuitive how the industry has been evolving, mainly in the past few years, with the

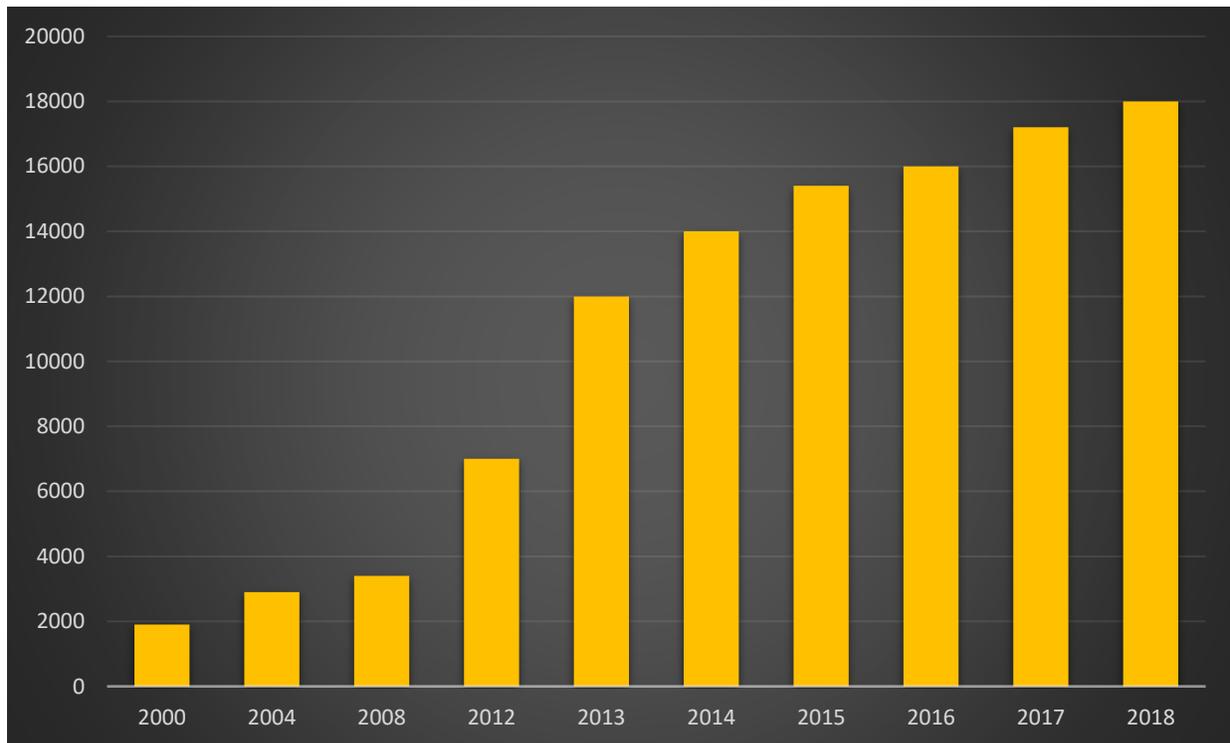
implementation of the mobile internet technology. This shows how the industry is moving from a niche market to a more established mass service.

Figure 3.3 - Car Sharing users in Germany



Source: www.carsharing.de

Figure 3.4 - Car Sharing Cars in Germany



Source: www.carsharing.de

3.6. The Actors in Germany

All 165 Car Sharing companies in Germany together provide 17,950 vehicles for their customers.

Station-based providers have stationed a total of 10,050 Car Sharing vehicles spread among 5,000 stations throughout Germany. Free-floating providers offer 7,900 vehicles, especially in large urban centres.

Station-based providers, which added 650 vehicles to their fleets, representing a 6.9% growth, clearly outperform free-floating providers (which added 100 vehicles,

representing a 1.3% growth), both in terms of absolute figures and vehicle growth. (Bundesverband CarSharing, 2018)

This is also due to the dynamic expansion of station-based services in the area.

580 of the 7,900 vehicles in the free-floating market segment are provided by originally purely station-based providers as part of combined free-floating/station-based offerings. Such systems exist, for example, in the Rhine-Main region, in Mannheim, Heidelberg, Hanover, Osnabrück, Essen and Kiel. (Bundesverband CarSharing, 2018)

The biggest operators in these industries are those that allow the collection of most reliable data, and therefore constitute the greater portion of the literature of this Master Thesis. In particular, regarding the free-floating system:

Car2go

Founded in Ulm in 2008. It's a subsidiary of Daimler AG (holding company which, among other brands, owns Mercedes-Benz).

Figure 3.5 - Car2go Corporate Logo



Source: www.car2go.com

DriveNow

Founded in Munich in 2011, it's a joint venture between BMW and Sixt SE (car rental company)

Figure 3.6 - DriveNow Corporate logo



Source: www.drivenow.com

Book-n-Drive

Founded in the Rhine-Main area in 2000, originally Gründung der Rhein Main mobil GmbH.

Figure 3.7 - Book-n-Drive corporate Logo



Source: www.book-n-drive.de

Stadtmobil

Group of the Car Sharing companies Stadtmobil Berlin GmbH, Stadtmobil Hannover GmbH, Stadtmobil Karlsruhe GmbH & Co. KG, Stadtmobil Rhein-Neckar AG, Stadtmobil Rhein-Main GmbH, Stadtmobil Rhein-Ruhr GmbH, Stadtmobil Stuttgart AG and stadtmobil Trier.

Figure 3.8 - Stadtmobil Corporate Logo



Source: www.stadtmobil.de

And respectively for the Station-based system:

Stadtmobil

Figure 3.9 - Stadtmobil Corporate Logo



Source: www.stadtmobil.de

Cambio

Founded in Bremen in 2000 through a merger of several different smaller Car Sharing companies.

Figure 3.10 - Cambio Corporate Logo



Source: www.cambio-carsharing.de

TeilAuto

Founded in Halle, 1992. Current Head quarter in Leipzig, Germany

Figure 3.11 - TeilAuto Corporate Logo



Source: www.teilauto.net

Flinkster

Car Sharing operator owned and managed by the Deutsche Bahn AG, the main logistic and transport company in Germany.

Figure 3.12 - Flinkster Corporate Logo



Source: www.flinkster.de

3.7. Chapter's Conclusion

The German market constitutes, thus, a great sample for this analysis, as there are many active players, and the government policy is highly supporting electric mobility (as the Chapter 4 will show more in detail).

Moreover, the two main players of the free-floating system, Car2go and DriveNow, represent probably the most interesting cases for what regards the scope of this Thesis. As the next chapters will further explain, these Companies seem to be adopting a business model for which, through the Car Sharing channel, the notorious owners (respectively Daimler and BMW) are lunching and testing their e-vehicles.

Chapter 4: E-Car Sharing

4.1. Chapter's Introduction

The main focus of this Master Thesis is to provide a correlation between the Car Sharing business, and the expansion of the electric vehicle industry. Indeed, the two concepts are highly aligned and share a great number of objectives and motivation behind them. On top of this, there are several insights that prove how these two industries can grow together, benefiting from one-another.

Car Sharing is a rising industry, which is experiencing promising levels of growth and is reaching the phase of not being a niche market anymore. As mentioned, the concept started as a solution to decrease the cost of owning a car, and to maximize the investment by reducing the time in which the vehicle is unused. However, the environmental implications of Car Sharing were identified soon after the practice began to become commercialised. The system simply reduces the number of cars that are used

in a city, and more than that, it educates drivers towards a more efficient and responsible usage of the transport mean.

For this reason, many players in the industry adopted the policy of acting as green companies, fighting for a more sustainable and practical transportation system. Car Sharing, together with an appropriate public transport network, has the potential of exponentially reducing the number of cars owned and driven in cities.

According to this environmentally friendly culture and image, using the system to boost and accelerate the integration in the market of the electric and emission-free mobility is a rational step that Car Sharing players can take into consideration.

The following chapter will explain more in detail how these two concepts are aligned. And, in particular, how Car Sharing could boost the integration of electric mobility and help generate a revolution in the transportation industry.

4.2. Electric Fleets in Germany

At the beginning of January 2018 there were, according to Kraftfahrt-Bundesamt (KBA), 98,280 electric vehicles and plug-in hybrids registered in the Federal German car stock. This represents only 0.21 percent of the total car market.

In Car Sharing fleets, 1,772 battery-electric electric vehicles and plug-in hybrids were in operation at the beginning of 2018. They accounted for 10.3 percent of all Car Sharing vehicles in Germany. Even if the number of electric vehicles in Car Sharing fleets still represents the minority, Car Sharing providers operate a significantly higher proportion of electric vehicles in their fleets than private owners or companies. (Kraftfahrt-Bundesamt, 2018)

There are three main categories of Car Sharing operators that adopt electric mobility in Germany:

- Pure electric Car Sharing deals: Companies that emerged by adopting a complete green policy, and built their fleet with 100% electric vehicles from different manufacturers (for example Bosh launched its 100% electric Car Sharing service in December 2018).
- Cars Manufacturers Fleets: Established Car manufacturers launching their own Car Sharing subsidiaries (E.g. BMW with DriveNow or Daimler with Car2go). The integration of electric vehicles in these cases represents a very important and promising insight, which will be properly explained in the next paragraphs.
- Manufacturer-independent Car Sharing providers: These have been operating Car Sharing for more than twenty years. The majority of them have their electric vehicles usually in smaller quantities as part of federal or state funded projects (E.g. Cambio).

Table 4-1 - Electric Cars in car Sharing Fleets in Germany

PROVIDERS	Number of electric vehicles in Car Sharing fleets	Proportion of electric vehicles in the Car Sharing Fleets
Car Sharing offers with only electric vehicles	432	100%
Car Sharing fleets of automakers	1020	13.50%
Manufacturer Independent Car Sharing providers	321	2%
Total	1772	10.30%

Source: Bunderverband Carsharing, 2018

One big advantage of Car Sharing is that the customers can choose the right vehicle for each trip. This is also the case for what concerns the choice between electric vehicles and conventional motorized vehicles.

Car Sharing providers are already having proportionately more electric vehicles in their fleets than car owners and companies. However, a significantly higher share is only to be expected if the battery costs of electric vehicles noticeably decrease and, thus, the vehicles become comparable in terms of price with gasoline-powered cars. Also, the management of the charging procedure has to become more trouble-free. Balanced burden sharing in the financing of charging infrastructure in public roads for station-based Car Sharing offers between the providers and the local governments is essential.

The Technology advancement is, however, making the price difference less and less relevant, and the following part of this chapter will also explain how Car Sharing can be a solution to the lack of an appropriate network of charging stations and services, as well as to other problems associated to the electric mobility.

4.3. Building the Network

As mentioned in Chapter 2, many times history has seen attempts from individual innovators, or well-established car companies to commercialize an electric option in the automotive market. However, besides several different obstacles, one factor constantly hampered the process: the lack of an appropriate and reliable network of services necessary for electric vehicles, in particular the equivalent of a gas station, the charging station.

One advantage of owning an electric car, is the possibility to charge it from home, while the car is not being used, through a standard voltage house plug. However, a great disadvantage with respect to the competitive gasoline-powered vehicle, is that the last

grants the possibility to completely refurnish the car, and getting it ready for hundreds of kilometres, with a simple and quick procedure, refilling at a gas station. The driver of a car powered by gas rarely has to worry about being left without fuel in the middle of the day, and can almost always rely on a gas station in the proximity, where in just a few minutes the vehicle can be filled completely.

Electric cars are already in a position of disadvantage on this matter, because despite the technological advancements (Tesla's superchargers are now capable of granting enough power with a 30/40 minutes charge), re-charging a car takes much longer than re-filling a fuel tank. If, on top of this, the environment doesn't offer these stations when needed, the user is of course encountering troubles.

However, with an appropriate number of well-located charging stations, at least in a city environment, the issue would be limited and would allow electric car users to feel safe using their vehicle without having to worry about finding a charging point when parking.

When the topic of whom should be responsible for providing this network of charging stations is faced, a chicken-and-egg problem arises:

From the point of view of the municipality and administration of a city, the development of an appropriate charging infrastructure is an economically unfavourable option. Building hundreds of stations and providing the space in terms of reserved parking spaces is expensive, and the return is almost inexistent. This is because there isn't a number of customers sufficient enough to financially justify the investment, meaning that there are not enough electric car users using and paying for the service.

On the other hand, the customer is not willing to buy an electric vehicle if there is not this infrastructure that allow him/her to take advantage of the benefits without having to worry all the time about the charging of the car.

To some extent, some electric cars suppliers stepped into this problem and acted towards the implementation of an infrastructure (Tesla, Inc. built more than 12.000 superchargers around the world), but the creation of a network capable of sustaining the whole potential electric car market is a too heavy burden for single companies without the involvement of the government or of specialised businesses.

Solution

Car Sharing can indeed provide a solution to this problem: as a matter of fact, if the companies are capable of providing a fleet of electric cars that justifies the investment, municipalities could undertake this challenge and build the network, with the insurance of having a consistent pool of users from the beginning. On top of that, Car Sharing companies, thanks to the huge amount of information to which they have access, can provide data and features that can guarantee a proper spread of charging stations in the locations where it's most needed.

The Car Sharing industry has already acknowledged this opportunity and is taking action to implement this kind of cooperation. On the matter, the city of Hamburg represents a pioneer thanks to an agreement with Daimler AG (parent Company of Car2go) signed in May 2017 that is serving as example to several cities and Car Sharing companies around the world.

The aim of the cooperation is to promote the nationwide expansion of electromobility and digital mobility services. The city of Hamburg will gradually provide a total of 1,000 public charging points for electric vehicles (plus 150 exclusively for car-sharing vehicles) in the urban area by 2019, and it will be the first city in Germany to offer car parking and electric vehicles to a significant extent.

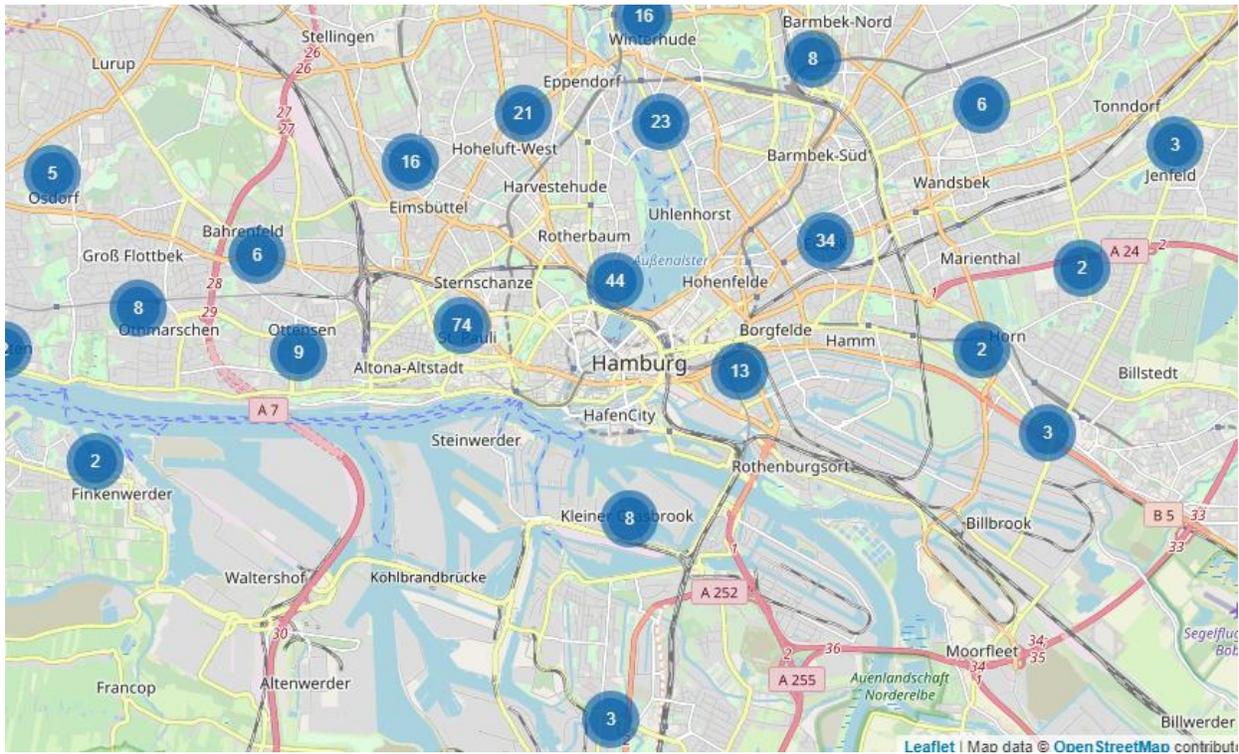
Daimler AG is investing in the expansion of its electric fleet. By 2022, the company will be bringing more than 10 new electric car models into production. In addition, the Company is gradually electrifying the smart vehicles in the Car Sharing fleet of Car2go

in Hamburg, since mid-2018 until the end of 2019. This currently corresponds to a number of 400 vehicles. In addition, the integration of Car Sharing offers into the urban mobility platform will be performed in order to offer Hamburgers the use of the HVV means (public transportation), car and bike sharing from a single source. Furthermore, a partnership with Moovel app, which provides offers of public transport, carsharing, taxis, bicycles and Deutsche Bahn (Metropolitan and railway services) is intended. In addition, close cooperation in other fields is planned (such as emission-free busses and trucks). The former Mayor of the Free and Hanseatic City of Hamburg said:

"We need forward-looking innovations and a customer-oriented range of sustainable mobility services to be able to shape the urban mobility of tomorrow. If we want to cope with the challenges of the future, we must promote the urgently needed expansion of electric mobility and support the introduction of alternative types of propulsion such as fuel cells. And we also want to make sure that the use of very different means of transport, from bus, bicycle to e-car sharing works well. Daimler offers comprehensive know-how when it comes to sustainability in urban transport. "(Olaf Scholz, 2017).

Figure 4.1 shows an approximated distribution of charging stations in Hamburg.

Figure 4.2 - Charging Stations in Hamburg



Source: www.stromnetz-hamburg.de

This agreement triggered similar actions of competitors and other cities. In Stuttgart, a network of 380 charging stations is one of the densest in Germany; and Amsterdam, with over 1,000 charging stations, has the densest worldwide. In Madrid, Car2go has installed a unique central system with its own fast charging stations, so that the use of electric cars, despite a less developed charging infrastructure, is still consistently reliable.

On top of this, Car Sharing vehicles often connect the users to a GPS system where the available charging stations are displayed, so that the driver does not have to physically look for the appropriate parking space. Many GPS providers have included this feature in their products, and looking for a charging column is now extremely easy and completely digital.

4.4. Educating the Population

Despite the rising level of enthusiasm for environment friendly solutions, and for green electric mobility, another problem encountered by the technology is the still high scepticism of populations for the E-car. Most people do not have access to electric vehicles, and did not have a chance to even try one. In the automotive industry, being able to properly try a product requires a great commitment, meaning that (apart from short and often non-sufficient test drives) an individual would have to buy a car in order to have the possibility to drive it for the right amount of time that could make him/her feel confident and familiar.

Car Sharing can again provide a solution to this problem, by making electric vehicles easily accessible without the commitment. As the providers are increasing the electric proportion in their fleets, it is becoming more and more common for customers to find themselves inside an electric car without even realizing it. Car Sharing users in cities where electric fleets are available have the chance to drive these cars and to live the experience on their own, without the burden to buy a car, or even to apply for a test drive.

According to Car2go's press, feedback is positive. People are becoming aware of the availability of a reliable alternative to gasoline engines. The range of the cars is more than enough for the great majority of the reasons for vehicle's usage in urban areas. The cars are practical and very suitable with the stop-and-go drive style of an urban centre. They are silent and release no emission at all.

On top of all this, electric cars are perceived as "fun" to drive, with extremely high acceleration, and competitive performances.

Thanks to E-car Sharing, an increasing proportion of the population is breaking the scepticism and getting confident with the technology, understanding that the future is likely to at least include this new mean for transportation.

4.5. Serving as a Test Environment

Car Sharing represents another opportunity for electric cars which is potentially very important and could shape the way in which this technology enters the market. As a matter of fact, thanks to Car Sharing, thousands of electric vehicles are driven every day all around the world, and in this way, they are also being tested.

Whenever a new technology is introduced, there is an adaptation period in which the technology is continuously tested and improved. However, this condition in the automotive industry cannot usually happen on a mass market level. As a matter of fact, most car producers would keep the testing inside the research and development team, and would deliver a product with a high risk of dissatisfaction, or anyway, with the certainty of collecting new problems discovered by the users themselves or by the product analysis once it has been implemented.

Car Sharing creates an environment in which vehicles are daily heavily tested before many of these have actually entered the private market, or before mass production has started. Thanks to Car Sharing, data and feedback on vehicles performance is flowing to the car producers, which can apply changes, modifications, corrections and improvements to their vehicles before selling them.

In Germany, there are two examples of how car makers could exploit this opportunity. As a matter of fact, Daimler AG (parent of Mercedes Benz) and BMW funded their own subsidiary Car Sharing companies, through which they have created, among other benefits, a huge testing environment for their new models, and in particular, for their

electric vehicles. Following these two, the Volkswagen brand is about to launch an extensive all-electric Car Sharing offering in selected major cities under its “We Share” sub-brand. The first fleet of vehicles will be rolled out in the German Capital Berlin and will comprise 1,500 e-Golf when the service begins operating in the second quarter of 2019, with an additional 500 e-up! following later.

Instead of designing a prototype and trying to sell it to the market (strategy followed by most electric cars producers, above all Tesla, Inc.), these car manufacturers are using the Car Sharing service to optimize their own version of the future electric vehicle, by studying the driver behaviour, collecting feedback, and tackling minor or major problems that the highly intensive testing is showing. This strategy could indeed be another dominant factor on the decision of whom will take the market leadership once the e-car industry will finally take off.

4.6. The Opportunity

Car Sharing is offering an important opportunity for several car manufacturers, which is the possibility to go back on the original idea of starting the commercialization of electric cars for the urban usage.

Tesla, Inc. is nowadays considered the most notorious ambassador of electric mobility, and the most promising producer for the next future. However, if Tesla’s launching strategy proved to be successful in the short run by establishing an extremely favourable brand image, it also showed what many competitors were predicting after the Roadster model was launched: the difficulty of actually bringing cars to the mass market. Tesla keeps missing delivery deadlines and encountering production issues. On top of that, Tesla’s models are still too expensive for being considered affordable for the mass market. The strategy was to show the world how electric engines can compete at

the maximum level with gasoline, and to do so the first milestone was to deliver a Supercar. Following this, the Company proceeded downwards, designing and offering cheaper and cheaper models, that are still not what most people can or want to buy. Moreover, Tesla's cars are designed to satisfy a long-distance driver first: they are big, they are fast, and they can last long: it seems that Tesla's strategy is taking too long to reach the big market share composed by urban inhabitants.

Companies like BMW or Daimler have the opportunity to do the opposite. Thanks to Car Sharing they are filling the cities with cheaper and more agile models, which might actually become the most favourable driving option in the city. The amount of analysable data gathered through Car Sharing is used to enhance and optimize urban electric mobility. And the users are becoming more and more familiar with these models, starting to understand the benefits of an e-car compared to a gasoline-powered one.

German car makers can aspire to beat Tesla in the mass market, thanks to their scale as established car producers, they are more likely to reach the appropriate production capacity, and exploiting the test environment offered by Car Sharing they can quickly design the vehicle that the customer needs.

A similar strategy is being pursued by Chinese SAIC Group, through their Car Sharing subsidiary EvCard, which offers entirely electric vehicles in different models, among which the SAIC's owned Roewe e50.

4.7. Green Germany

In order to fully explain why Germany was chosen as the main example in this Master Thesis, it is important to provide some information about the policy the Country is using for what concerns the environmental topic. As a matter of fact, the rise of the Car

Sharing and the electric mobility industries are just consequences of a series of principles that identify the mentality of the government and the people.

4.7.1. The Renewable Energy Act

In the last decade, Germany started to invest in the implementation of renewable energy plants with the aim to convert the Country to 100% sustainable. However, the fast and disorganized expansion of this industry, posed a challenge to the stability of electricity grids and security of supply.

Therefore, in August 2014, the Erneuerbare Energien-Gesetz (EEG, Renewable Energy Act) was emanated to grant a more organized plan. Thanks to this, the expansion of the renewable energy industry has developed exponentially, representing an approximated 25% of German supply of electricity.

The EEG was needed in order to decelerate the further increase in production cost, handle the expansion in a planned and organized manner, and bring renewable energies better in the market.

Electricity price is indeed a crucial competitive factor for energy-intensive businesses, and this sector, which already encountered high prices compared to the international competition, had to be protected. Germany finds one of its strengths in the prosperity of its professional environment and employment rate, and the implementation of switch towards renewable energies could not damage this core value of the Country.

The reorientation of the EEG was an important first step in restarting the energy transition.

4.7.2. Nuclear Power

According to the German mentality of nowadays, Nuclear power is considered incompatible with the energy strategy based on renewable alternatives. As a

consequence to this, German government planned to dismantle all its 17 nuclear plants (present in the country in 2011) by the end of 2022. The gaps in power production will be entirely substituted with renewables, gas turbines and conservation.

4.7.3. The Renewable Heat Act

Approximately 40% of all energy consumed in Germany is dedicated to power buildings, in particular to heat them. For this reason, in 2008 the Renewable Heat Act was emanated, aiming to increase renewable heating sources by 15% by the end of 2020. The construction of new building is carried out respecting the norms and practices stated in the Act, and an incentive program is offered to individuals to facilitate and boost renovations.

4.7.4. Energy Conservation

Germany is fighting to reduce energy loss. On this matter, old buildings are being renovated and an efficient new building strategy is being implemented. The goal is to achieve an acceptable level of energy conservation and efficiency in the usage of it. In 2002, the Energy Conservation Ordinance was emanated in order to improve buildings' energy efficiency. The aim is to have all buildings renovated by 2035.

Another law was introduced in 2002, the Cogeneration Act, aiming at having 25% of the Country's power supply coming from cogeneration by 2020. Cogeneration is a process through which the heat that is usually wasted, is collected, recovered and used again.

Moreover, pushed by the Ecodesign Directive emanated by the European Parliament in 2009, Germany is regulating products with worst environmental impact. The Directive involves consumer electronics, refrigerators and other appliances (not vehicles or buildings), and it aims for a 12% decrease in European power consumption by 2020.

4.7.5. Recycling

German culture in terms of waste management is quite impressive. The complicated recycling system is highly adopted. Citizens simply believe that part of civilization is to take proper care of the garbage they produce, and whomever doesn't do so, is considered extremely unpolite and uncivilized.

To give an example of this, in Germany most bottles and cans are sold with a deposit fee included for the empty package. This deposit can be collected by bringing these empty bottles and cans to any supermarket and feeding them to a machine that will provide a coupon that can be either used in the supermarket or exchanged for money. This system, not only forces people to properly recycle these materials, but it triggers the phenomenon for which homeless or poor people put the effort on cleaning streets and public spaces from bottles or cans to collect the deposit associated to it.

Since unrecycled trash is usually burned, an appropriate waste management has a huge impact on the environment.

4.7.6. Alternative Transportation

For what concerns the main topic of this Master Thesis, Germany is heavily investing into sensitizing the population to reduce the environmental impact associated to the transport industry. Car Sharing is just one way in which this is happening. Public transportation is extremely advanced in Germany, with the majority of the population living near a bus or train stop.

Electric mobility is boosted as well, the Elektromobilitätsgesetz (Electric Mobility Act) of 2015 grants special rights and privileges to e-car users, and enables investments into making the public transportation system as electric and emission-free as possible. The City of Hamburg can again serve as example on the matter, since it is the first city in the world that managed to build charging stations capable of functioning with e-buses from

different manufacturers. This is a necessary step to reach a completely electric-based public transportation network. Again, In Hamburg, delivery company DPD will electrify their entire fleet by summer 2019, meaning they will operate with zero local emissions in the city centre. DPD will incorporate a mix of electric vans and trucks and smaller light electric vehicles such as scooters and bikes.

Another way in which the German Government is boosting alternative transportation to the private owned car, is by advertising a bicycle-based culture, by providing approximately 70.000 kilometres of maintained bike trails in the Country, and investing in the Bike Sharing concept inside the cities.

Chapter 5: The New e-Car Business

5.1. Chapter's Introduction

In order to be able to generate a rational prediction of what might happen in the automotive industry, it is important to recall some of the themes treated during this Thesis.

History has seen several attempts to introduce electric models in the market, which ended up being all unsuccessful due to factors associated to the single case, as well as factors that maintained common elements through the years. Thus, the question to be answered in this chapter is: why should we expect a successful outcome this time?

5.2. Failure Factors

To begin with, it is important to have a look at those elements that negatively affected the integration of electric mobility in different times during history. These will be

followed by a confrontation with the current reality, in order to assess whether these factors can still remain relevant.

5.2.1. Performance Inferiority

It was thanks to Henry Ford's mass commercialization of the Model T that this problem started to exist. As far as the gasoline engine as well as the electric engine were studied, developed and improved at a niche scale, both variants were advancing slowly with few performance disparities. However, when Ford succeeded to provide most American citizens with an oil-powered vehicle, the dimension of the industry quickly outgrew and overpowered the electric alternative. The gasoline engine became the standard of a huge market at once, attracting businesses and investors from everywhere. During the 20th century, the focus was extremely unbalanced towards the fuel-powered engine's development. Any investment in research and development for the electric alternative was basically uneconomical and produced results that remained unused for decades.

The electric engine always had supporters which put their effort into trying to develop a valuable technology (and therefore product), but the lack of balance in the overall distribution of resources was too heavy. If electric engine moved one step forward, the gasoline engine would have moved 10 steps.

Whenever an attempt was shown to the public, the electric vehicle had to go through the tough and unfair comparison with the extremely well-established gasoline vehicle, and this comparison was always tragic.

What about now

Since the end of the 20th century, environmental concerns grew exponentially, leading to a push from governments to invest in renewable and clean energies. This triggered a series of projects with the aim of developing a competitive electric alternative to the

standard engine. Although these projects were often segmented and not constantly valued, the technology grew in performance, reliability and notoriety.

Nowadays, in terms of performance, electric vehicles are little or not at all inferior to the gasoline ones. Thanks to Tesla, Inc. and its Roadster, this lack of difference was advertised and presented to the people. Musk's first car represented a very important milestone in the history of the automotive industry, as it proved to the public that an electric car could actually compete with a gasoline car in absolute terms (i.e. by comparing Supercar to Supercar instead of proposing the electric vehicle as a low-power alternative).

5.2.2. Price

Most electric models were presented and remained in the stage of prototypes, and those which made it to the market in recent history, bore the problem of being too expensive and not really affordable for the mass market.

What about now

Although the problem is still tangible, mayor improvements are made on a daily basis. Thanks to the high investment in research, the technology is reaching more appropriate costs.

Moreover, this problem was initially faced by Tesla, because of its lack of a production capacity capable of reducing the costs through high scale. This factor does not exist for those manufacturers which can rely on high capital and number of resources such as well-established car manufacturers which are now proposing their electric vehicles. Even Tesla, thanks to investments and government loans, managed to build factories which are expected to be able to meet the mass demand and gain cost efficiency because of their scale.

5.2.3. Lack of Infrastructures

The lack of appropriate infrastructures and complementary services for the introduction of electric mobility is again to be associated to the mass commercialization of the gasoline competitor. Ford's Model T, and the associated fuel-powered engine, won the race to the mass market. By doing so, it set the standard of modern transportation, and infrastructures and complementary services followed straight after. As soon as thousands of cars started to fill the American society, modern streets, gas stations and businesses providing mechanical assistance begun to appear and quickly spread largely, granting the support that the market needed. After such an effort was made, it was definitely difficult to think about going back, even in the utopic case in which a competitive electric-powered alternative existed.

In that case, it was the proactiveness of an entrepreneur that triggered the movement of the market. It is somehow similar to what Tesla is trying to achieve, but in the modern economy this is not as simple.

What about now

The issue is indeed still valuable today. However, steps towards a proper implementation of the network needed are being made from different actors. If Tesla implemented its own system of superchargers, and it's promising to increment it until the necessary level is met, governments too are taking action. As a consequence to the big push from environmentalists, municipalities around the world started to build charging stations in their cities, often collaborating with car manufacturers as in the case of Daimler and the City of Hamburg.

The point of optimality is far to be reached, but compared to just a few years ago, the infrastructure has grown so much that forecasting a near future in which this is not a problem anymore is definitely rational.

5.2.4. Charging Issues

When talking about electric cars, there are two big questions that arise in the mind of any person:

- What is the range of the car?
- How long does it take to charge it?

It is hard to not admit how inferior e-cars have been to gas cars on these topics. It is extremely convenient to be able to fill your tank in a few minutes and drive unconditionally for hundreds of kilometres, and the electric vehicle never allowed that.

The range of electric cars has historically always been underneath the range of the more common alternative; and on top of that, people would have had to keep their cars charging for hours before being able to drive again. This made electric mobility extremely inconvenient, especially when long trips were discussed.

What about now?

In this case, again, technological advancements, together with bold moves of single actors, brought the problem of the range to what seems to be an end. Electric vehicles options of today grant ranges between 300 and 400 kilometres, and will potentially improve with further development.

Regarding the charging time too, improvements have been made (regular stations charge vehicles in a few hours, while supercharging stations just need approximately one hour), however, compared to the 5 to 10 minutes needed to fill a tank of fuel, the practice remains inconvenient.

It is not easy to visualize a more efficient way to deal with the fact that batteries need a long time to charge once they are out of power (maybe if technology reaches the point of diminishing the dimensions, an option could involve the implementation of exchangeable batteries that can be carried in the car as additional sources of power),

and this represents still a tangible problem for those who need their car to run for long distances on a daily basis. However, the focus of the electric car is currently moving towards the city centres, where people do not need these ranges and do not care about the charging times. GM was the first in modern history to frame the electric car as the vehicle for city inhabitants, which could drive the needed distance and leave the car charging at home, during the night, or at a public station. Car Sharing is showing how this system could work at present, with hundreds of e-cars parked in their reserved spots connected to the provided stations.

5.2.5. Customers reluctance

As it often happens with disruptive innovations entering the market, consumers do not easily show familiarity nor approval at the early stages, and for electric cars, most attempts of introductions in history have stopped at the early stage. It was easy to point out the defects, especially in comparison with the well-established gasoline-powered automotive industry.

Moreover, the lack of direct experience and trials fed the general idea that the electric engine was less powerful, less durable, less convenient, less reliable and, above all, less enjoyable than the competitor.

What about now?

As mentioned in the previous chapter, Car Sharing has the potential to reduce this problem at a huge degree. Indeed, the fame and success of examples like Tesla or Toyota (with the hybrid Prius) attracted a lot of interest from everywhere; however, the majority of the population, even in developed countries, would not have easy access to these vehicles yet. Car Sharing provides the possibility to access e-cars without big efforts nor high prices, and without the need to find the way to participate to a test-drive (personally, I drove my first electric car thanks to Car Sharing). Thanks to this, a

great number of drivers can become familiar with the alternative technology, recognize its defects, but also its many advantages.

It is true, though, that the different concept of the electric vehicle remains a factor of influence, for which gasoline engine-loyal drivers (and not only) struggle to give up the fun associated to driving a standard vehicle (in terms of gear usage, noise, performance...). Although e-cars have raising cults too, the idea that the word “car” projects in most people’s mind, is highly associated to the combustion engine and its features.

5.2.6. Individual and Fragmented Attempts

Another factor that negatively affected the different attempts to integrate e-cars in the automotive market, is the fact that innovators acted most of the times as lone pioneers without the support of competitors or other businesses.

Since the take-off of the mass commercialization of gasoline vehicles, which happened at the beginning of the 20th century as a consequence to Ford’s effort, the alternative electric industry remained a niche market characterized by sporadic attempts to expand performed by single entities, which did not find the support of a high-enough number of parties.

As an example to this, GM’s EV1 entered the streets of California on its own, fighting against several different parties (competitors, sceptics, oil industry and eventually governments). In this case, the proactive Company was a big and established entity which played a crucial role in the automotive industry; nevertheless, the lack of support and the opposition from parties with conflicting interest was so strong to manage to stop the innovation from entering the market. In most cases, these actors were much smaller realities that could not even count on their own image to step into the market frantically.

What about now

For the first time in history, several different parties are moving all together. After Tesla showed the world that the technology was available, and gained a great deal of interest and approval (also measurable in funding and investments), well-established car producers quickly moved to develop their own version of the electric alternative. GM tried to recover from the failure of the EV1 proposing the Chevrolet Bolt; Nissan lunched the Leaf model; Toyota rode the wave of success coming from the hybrid Prius model and lunched plug-in versions of its models. In Europe as well enterprises reacted promptly: BMW lunched the i3, Mercedes Benz brought forward the EQ brand, and Volkswagen has recently proposed the e-Golf. For what concerns Italy, the reaction is taking a bit longer, with the FIAT 500e which seems to be still out of the competition standard.

With all of these, and several other companies engaging in the same, it is rational to assume that the industry is moving all together, creating a momentum that is very likely to be unstoppable already. Competitors are learning from one another, and different business models characterize the different simultaneous entry modes adopted by the parties.

This is another reason that boosts businesses and governments everywhere to take part and invest in those complementary services that are necessary for the technology to break into the market, and speed-up the process.

5.2.7. The Interest of The Oil Industry

It seems trivial to stress how big of an interest the oil industry has into sabotaging the development of a technology that opens the way to an alternative source of power. The world is currently highly dependent on oil derivatives, and it has been like that for the last 100 years. Loosing this extremely favorable position is a prospect that no rational entrepreneur would like to face. To give a measure of this, according to a study from

the Lawrence Livermore National Laboratory, in 2017 72% of oil usage in the US was dedicated to transportation. (Lawrence Livermore National Laboratory, 2017)

For this reason, oil companies often interfered during the several different attempts of developing electric mobility. One major and most recent example took place during the EV1's campaign started by GM between the end of the 20th and the beginning of the 21st century. In this occasion, oil companies were found responsible of pushing against the electric innovation regardless of their attempt to remain anonymous. As a matter of fact, they would lunch, fund and support grassroots campaigns like Californians Against Utilities Abuse to fight against the integration of the EVs.

What about now

In history, the power of these actors has decreased, not because their business has become less profitable, nor because they lost market share or bargaining power deriving from the market's dependency on oil derivatives; but rather because with globalization and the third industrial revolution, which digitalized and connected a big portion of the world, allowing extremely fast exchange of information and transparency, any form of open action against the development of the electric mobility would cause an ethical scandal. As a matter of fact, nowadays more and more governments are committing and taking positions in favor of an environmental global policy, which includes the objective to break world's dependency on oil and switch to renewable and cleaner resources.

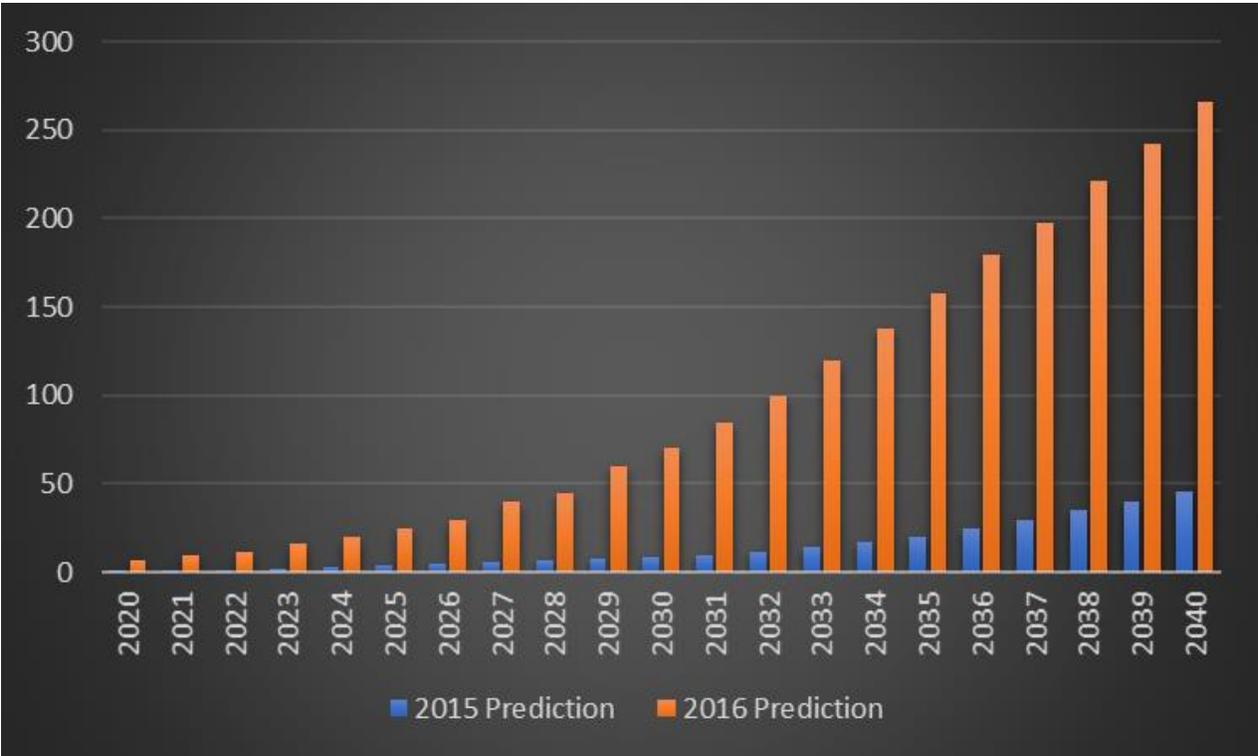
As a consequence to this, the oil industry is now facing a number of opponents that is much higher than what happened in the past, when attempts in favor of the introduction of electric cars were mostly sporadic and individual.

The topic of the destiny of the oil industry remains one of the most discussed in the present, as many statistics providers, as well as energy organizations are forecasting a dramatic fall of the oil demand to be expected in the next decades. The OPEC

(Organization of the Petroleum Exporting Countries) itself is optimistically forecasting a sequential deceleration in the demand's growth rate.

All of this comes from an acknowledgement of the momentum that is taking place, and the collective commitment of several car manufacturers to heavily invest on electric mobility for the next future. Bloomberg proposes an interesting change in the OPEC's forecast of electric vehicles in the market from 2015 to the 2016, in which the numbers quintupled (see figure 5.1).

Figure 5.1 - OPEC Prediction for e-vehicle Sales in Millions. 2015 against 2016



Source: www.bnef.com

It would be bold to dig into predictions and forecasts on the destiny of the oil industry, as too many factors are involved and uncertainty remains high. However, the world is starting to believe that a switch is about to take place, and the trillion Dollars-worth oil business remains limited on its range of actions.

5.3. Chapter's Conclusion

As this chapter states, different factors remain potential obstacles for the development of the electric mobility. Nevertheless, the present reality seems to have the opportunity to take a different direction from what happened several times in history. Indeed, the reality is different from the past. Thanks to the global commitment on improving human's behaviour in terms of environmental sustainability and usage of resources, a great number of parties representing a great deal of political and economic power are acting towards the development of a cleaner way of moving people around the globe. This, together with the high level of transparency and flow of information that characterizes this period of time, are promising factors for the success of the technology.

It is bold to guess specific predictions on what is going to happen, on the successful integration of the electric mobility, on the destiny of harmful usage of resources in our planet and on the complete switch to a clean way of powering human's life. However, it is fair and rational to hope for a brighter future on this matter.

Conclusions

The drawing up of the Master Thesis has proven how, at least at a potential level, there exist a correlation between the electric mobility and the concept of Car Sharing.

The two share some important implications, in particular the intention of developing a system capable of reducing Humans 'negative impact on the environment. However, what is more interesting, is the influence that one can have for the expansion of the other. Car Sharing can support the implementation of a charging network that will benefit the e-car industry in the short run, and it allows people to become friendly with a technology that remained otherwise still difficult to access (and therefore reduce scepticism against electric vehicles). On top of this, Car Sharing can enable market testing to such an extent that would otherwise be impossible. If providers of shared mobility integrate electric vehicles in an appropriate and rational way, these will serve as information collectors in favour of local governments and, most of all, car manufacturers, which can use these information and data to develop the best possible product before even launching it in the market.

There is a big opportunity here to take into consideration for car companies, and some of this are clearly already jumping on the train. In Germany three big entities (Daimler, BMW and Volkswagen) are launching subsidiary Car Sharing companies filling their fleets with their models. When this is done taking into consideration electric vehicles, the potential benefit is definitely interesting. At first, they could increase customer awareness and familiarity with the new technology. Then, they could gather data and

information coming from this huge test environment and use it to develop great products. At last, but definitely not least, they could show in practice how the electric car is the perfect mean of transport in an urban area when it is combined with an appropriate infrastructure, and target this share of the market. This gives to these actors an interesting competitive advantage against those that are trying to breach the market with a premium and expensive product.

Abbreviations

BCS - Bundesverband CarSharing (Federal Car Sharing Association)

CARB - California Air Resources Board

COP - Conference of Parties

DPD - Dynamic Parcel Distribution

EEG - Erneuerbare Energien-Gesetz (Renewable Energy Act)

GPS - Global Positioning System

KBA - Kraftfahrt-Bundesamt (Federal Motor Vehicle Office)

OPEC - Organization of the Petroleum Exporting Countries

UNEP - United Nations Environment Program

UNESCO -United Nations Educational, Scientific and Cultural Organization

US - United States

USD - United States Dollars

VW - Volkswagen

ZEV - Zero Emission Vehicle

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