

Electric vehicles in Mexico's market, are they ready to plug-in?

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Candidate Declaration

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I certify that the dissertation entitled:

“Electric vehicles in Mexico’s market, are they ready to plug-in?”

submitted for the degree of: **MSc in Global Brand Management**

is the result of my own work and that where reference is made to the work of others, due acknowledgment is given.

Candidate signature:

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Date: **September 3th, 2021**

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Dedication

To my family, who always supported me through my long and exciting journey.

To my outstanding partner, whom I always trust, always believed in me, and helped me every step of the way.

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Electric vehicles in Mexico's market, are they ready to plug-in?

Alejandra Aimeé Maldonado Ortegón

Abstract

The present dissertation reviews the current adoption of electric vehicle technology within Mexico's automotive market, and aims at answering the research question: "are they ready to plug in?". Specifically, the objective of this case study is to analyse whether the country is ready to embrace the EV revolution, after a careful consideration over the recent energy reform promoted by the federal government, the limitations imposed on the entrance of private investors in the energy supply chain, and the aspiration that the country shows towards addressing the environmental issues Mexico is currently affected by within a sustainability framework. With contamination representing a major issue in Mexico, a deep dive into the environmental cause will also be included to understand whether this could be a relevant factor able to encourage private consumers and large companies to invest into this new technology.

The dissertation will also examine all the different requirements that need to be implemented in the country to successfully open up the opportunity represented by the EV technology, such as infrastructure, economic incentives, and other strategies, eventually comparing them with best practices already deployed by other countries which heavily invested in this new type of vehicles. The theoretical background of the present case study includes literature review from the fields of technology, sustainability, politics, economy and social science. The findings collected from structured interviews, online questionnaires and studies from the literature reviewed were leveraged to support relevant viewpoints on the analysed topics, showing where they aligned, and where they failed to produce conclusive generalisations over the research objectives and main questions.

Conclusions will show how the Mexican country is still far from planning a consistent path to innovation that will be able to address the current contamination issues, with the federal government, private companies and individual consumers still doubtful on whether to embrace the new revolution offered by this technology.

Chapter 1: Introduction

1.1 Overview

“Pollution problems are not new. But they have changed over time”

(Soto-Coloballes, 2020: p. 1)

If we had to rank the most important elements that make a human being's life precious and valuable, we might find ourselves having different opinions on the priority order to give to the several aspects of it. Nevertheless, I believe that people's health would definitely position itself at the first places in our minds: from health, we in fact derive the overall improvement of our life's quality - and with the latter, also general well-being and happiness come along.

Wealth is also an important element we would hear mentioned by a few people, as the money-power equation is still on top of everyone's mind; and yet, if we are not in good health, any personal finance business would likely be disregarded as a secondary matter.

The level of general awareness around the critical environmental situation we live in today, the type of world we will be able to leave to the next generations, and the care towards our future descendants are very delicate subjects. On the one hand, there's a lot at stake for our own future, and we should all be very conscious of humanity's impact on the environment; on the other, the most basic behaviors of the green revolution, such as recycling, are still very far from being a common sense habit for everyone, and laws and regulations are not necessarily implemented at the same level across all the countries around the world.

The development and the introduction of Electric Vehicles (EVs) within the marketplace has recently become a hot trend within the automotive industry and beyond. Specifically, the popular knowledge around EVs has been fuelled by marketing campaigns promoted by car manufacturers, as well as the recent movements within the American and Chinese stock markets.

As a hot trend driven by big corporations and larger companies, we have yet to know whether the conversation around the new EV market will contribute to the

environmental challenge with a program for a more sustainable energy consumption, or it will merely be yet another opportunity for these companies to increase the profit, with little or none regards for a greener world: what are Tesla, Nio, Toyota, Nissan, GM and, lately, Ford really after? Is this an opportunity for a paradigm-shift in our behavior towards the environment, or a matter of pure business investment for these manufacturers?

Developing countries like Mexico could also be the target of the new EV revolution, once the challenges represented by the specific automotive market and its internal regulations and limitations will be further analysed.

1.2 Research Purpose

The business strategies that vehicle manufacturers will need to invest in and deploy to position their EV products and complementing services within a market such as Mexico will take a lot of time, investment and resources: it's a hard challenge, and an investment with outcomes difficult to predict.

On the other hand, the purchase of an Electric Vehicle will also represent, for the average Mexican consumer, a hard choice and a risky long-term investment: how this market will develop in the future is not as certain as the traditional automotive market.

The analogy employed in the dissertation's title specifically relates to the need of EVs to be plugged into charging stations, or charging docks, to be actually powered: as much as a vehicle's battery is plugged in, recharged, and ready to hit the road, is Mexico's automotive sector aligned with the new industry trends and set up to face the environmental challenge?

This dissertation will therefore aim at analysing the Electric Vehicle market in Mexico, understanding what this specific country is activating as compared to the ones actioned by other countries. Ultimately, the final objective will be to reply to the dissertation's main question, *are they ready to plug in?*, outlining which policies and technology shifts will need to happen to validate the EV industry in Mexico's economy, as a new flourishing ecosystem improving population's lives and their relationship with the environment.

1.3 Significance of the Study

The first step to introduce this specific subject is to analyse which considerations drive companies and private individuals towards the testing and purchasing of an EV: as it appears, there's a fundamental lack of awareness and knowledge of key factors on why it would be more convenient or profitable to make an investment into this new technology.

“A number of reasons are given for the slow uptake. Availability is one; there's not a lot of choice in the local market, particularly for new vehicles; there's also a widespread lack of first-hand knowledge and information – getting behind the wheel of an electric vehicle is not something many of us have done. Then there's the price.” (Moore P., 2015).

For companies, a key driver might also be represented by the big responsibility they have to commit to the overall reduction of CO₂ emissions within their fleet.

“CO₂ levels are definitely a consideration when it comes to fleet purchasing but there are also a number of others. Whole-life analysis is incredibly important, ease of operation, safety rating, and fit-for-purpose are all considerations” (Bell N., N.D.)

In this regard, Fleet managers are the main protagonists within their companies, as they are the ones who'd be able to increase the adoption of this new technology: in fact, to evaluate the long-term cost-benefit ratio of buying EVs, they'd be in the best position to consider sustainability targets of such an investment.

In the Mexican case, on top of the economic sustainability reasons, we also need to take into account a broader context - which could represent an additional push in the direction of adopting this environmental friendly technology: in fact, Mexico has been struggling with pollution since long time ago:

“In 1967, the Mexican government joined the measurement program of the World Health Organization (WHO). This is the antecedent of the current atmospheric monitoring practices in Mexico City” (Soto-Coloballes N., 2020).

To have an idea of how long Mexico is going to take to efficiently implement the EV in such a way that the current pollution levels might be positively impacted and reduced, it is important to firstly understand how vehicle manufacturers are accustomed to work within the present automotive industry: a high level analysis of

their processes, as well as the governmental policies in place, is paramount to determine how much time each brand will need to enter the new market successfully. The current infrastructure available in the country to support these new vehicles will also be a big subject, when Mexican consumers will start considering investing in an EV - a few public and economic incentives might be needed to swing the balance and play the ultimate role in potential customers' purchase-making process.

From a private individual perspective, the overall country's economy, average salaries, inflation and taxation rates will be additional factors contributing to how fast the Mexican country will be finally ready to offer its population this new technology, and hope in its widespread adoption.

For consumers who are keen to test these new vehicles and the technology empowering them, together with the ones who feel a responsible investment in this sector will be beneficial for the environment, the revolution will be significant and relatively quick. In fact, this industry is already expanding and growing at a very fast rate:

“Currently more than 3 percent of new vehicle sales, electric vehicles sales could grow to nearly 7 percent -- or 6.6 million per year -- worldwide by 2020, according to a report by Navigant Research” (Department of Energy, 2014).

1.4 Research Aim and Objectives

The aim of the dissertation is to assess whether the Mexican automotive market is ready to embrace the green revolution represented by the introduction of Electric Vehicles.

The main aim will be pursued by relying on the following objectives:

Research Objective	Research questions
1. Evaluate the Electric Vehicle market	<ul style="list-style-type: none"> • Which electric vehicle's brands operate in México?
2. Provide a benchmark by comparing different countries that have already implemented this technology.	<ul style="list-style-type: none"> • How developed are other countries within the electric vehicles' technology? • What are the incentives that these countries and Mexico have for people

	and organisations that own an EV?
3. Provide an assessment of EV brands and their business strategies.	<ul style="list-style-type: none"> • What are the marketing strategies that this technology needs?
4. To provide an evaluation of current pollution situation in Mexico	<ul style="list-style-type: none"> • How is contamination affecting Mexico?
5. Make recommendations over the EV manufacturing industry in Mexico	<ul style="list-style-type: none"> • What is possible to recommend over the EV market in Mexico? • How can the Mexican government improve to support this technology? • What are the limitations for this technology in Mexico?

Table 1.1 Research aims and questions.

1.5 Methodology

As mentioned in the previous section, some considerations over policies and laws existing in Mexico, affecting manufacturers' strategies to position their vehicle brands, makes and models within the automotive industry, will need to be investigated to understand how EVs could be promoted and marketed, as it pertains to their technical performance, and compared with traditional gasoline, or diesel-powered, vehicles. These surrounding considerations will however only serve to outline the theoretical background and the practical context of the present analysis, such that the resulting information from the data collection and the dissertation itself will still be accessible to any reader new to the topic.

To estimate how close, or how far, a specific market is in successfully adopting this type of technology, data will be collected through different research methods.

In this regard, literature research illustrating the EV market in Mexico, as well as the automotive sector in other countries, will be helpful to compare how advanced these are in terms of developed infrastructure, general policies and promoted incentives.

Further, this dissertation will represent a case-study including primary data, in the form of structured interviews with experts and online questionnaires submitted to a defined audience pool, and secondary data, such as academic papers and articles:

this data collection will be employed for qualitative research purposes. Concerning the academic papers for the literature review, these include academic papers and articles related to research main topics. With regards to the structured interviews, these will be one-to-one online interviews with four experts; the online questionnaires, on the other hand, will be shared with 30 people, whom I will ask to answer open-answer and multiple-option questions through an online form.

The experts interviewed work on important companies in Mexico and all of them are in the same level of line function in procurement areas. Accordingly, the data collected and analysed from these interviews not only will help formulate a theory about Mexico and its environmental challenge, but also will contribute to outline a more generic view about EV technology. “To conduct a study where you place great importance on data collected through interview work suggests that you value personal interaction with your respondents more highly than their views expressed through an anonymous questionnaire” (Saunders, Lewis, Thornhill, 2009).

The people that will participate in the online questionnaires are not experts, though some of them are very interested in electric vehicles and have considered buying one. The Purchase intention is still worth investigating: was it the consumer’s environment friendly choice? Was it driven by brand preference, was it to attribute to the organic word of mouth, or to a sponsored marketing campaign? The information that I will collect and later present in this dissertation will help clarify these behaviors in general terms, and the intention that triggered them in the first place. For the purpose of this research, we will leave less space to a description of the technical side of the EV product, and we will focus our attention to the reasons supporting the purchase of an EV, (namely what encourages a consumer to be curious about EVs) governmental issues that Mexico is going through and contamination issues that Mexico needs to address urgently.

1.6 Structure of the Study

The present dissertation work will be structured around five main chapters: (1) Introduction, (2) Literature Review, (3) Methodology, (4) Presentation and Discussion of Findings, (5) Conclusion.

In (1), I will summarise the topic by introducing the most important elements that will be pivotal to provide a response to the dissertation's title, *are they ready to plug in?*

In (2), I will emphasise on the research carried on to analyse the relevant literature for the topic in review. Analysis and evaluation are the main means to provide a suitable structure of my research, offering a clear picture of the general state of knowledge on the current subject. I will include a deepdive on Mexico's automotive industry, discussing how far (or how close) they are to the implementation of the EV technology at scale. Secondary data is collected through qualitative research and added to this work.

In the methodology chapter (3), I will explain the frameworks and the theories used to provide an answer to the main question of the dissertation, as it pivots to the Mexican market..

In the fourth chapter, Presentation and Discussion of the Findings (4), I will report findings from the expert interviews and the online questionnaires to identify any patterns in consumers' behaviours. I will also refer back to the relevant literature, reviewed in Chapter 2.

In my Conclusion (5), I will summarise the key aspects of the overall analysis, trying to address the main dissertation's question by offering an informed and personal viewpoint: finally, I'll conclude by outlining a set of recommendations and suggestions for future researchers on this topic.

Chapter 2: Literature Review

2.1 Overview

This chapter aims at detailing an overview of the contextual premises and the practical implications surrounding the Mexican EV technology sector in comparison with other markets where this technology is already launched, or is about to launch.

Specifically, in Section 2.2, I will summarize the most important features that electrified vehicles include to later focus on the EV technology as such.

In Section 2.3, I will then list all the benefits that EV brings, together with the most important brands currently operating in markets such as the US, Mexico, Norway, and China. I will also justify the reasons for comparing these countries among each other, offering an objective overview of the level of their infrastructure development, as well as their preparation to implement this technology at scale.

In Section 2.4, I will take into consideration the “Planned behaviour” theory by Fishbein and Ajzen (1975), providing a detailed explanation of the components that cause the consumer’s decision-making process. This will be applied to understand what and how the consumers in Mexico’s market take into consideration when they evaluate buying an EV.

Further in Section 2.5, I’ll review the infrastructure and incentives that Mexico’s government is applying and the basic requirements needed, including the new energy reform and how this will affect or benefit the EV technology within Mexico.

With the support of academic papers, in Sections 2.6 and 2.7, I will evaluate how contamination is a big issue in Mexico, and how marketing and sustainability needs to be applied together in order to have a successful effect in the consumer's mind for people who are not experts and also for people who evaluate buying an EV.

Lastly, in Section 2.8 a conceptual framework will be included explaining the different phases to assess the main objectives and answer the question of the topic: “are they ready to plug-in?”.

Chapter’s conclusions will be ultimately summarised in Section 2.9.

2.2 Fundamentals and futures of electrified vehicles

2.2.1 Definition

When consumers approach the electric vehicle market for the first time, they might face a lot of bias and misconceptions related to this technology, which would not normally apply to internal combustion vehicles (ICV) - which everyone is naturally more familiar with. Moreover, this new market is crowded with an unprecedented range of offerings, which can be ultimately grouped into (1) hybrids, (2), plug-in hybrids, and (3) electric cars - each one with its technical features, translating into performance advantages or disadvantages. Feeding these biases and misconceptions is the common belief that all these electrified new car models still require a certain quantity of gasoline to perform specific tasks (e.g. engine starting), as well as the general concern that moving towards 100% electrification would lead to the end of the gasoline engine era within the wider market.

Regardless, when we generally speak about “Electrification” in relation to vehicles, we mean some degree of electric input powering the driving experience. For EV and plug-in hybrids, this is specified by the concept of “range”, i.e. the distance, measured in kilometers or miles, which a vehicle can cover when its batteries are fully charged: the longer the range, the better is the overall electrification of the vehicle itself. Since this concept is relatively new, and does not apply to combustion cars we are all more familiar with, the automotive sector found other parameters to allow for a fair comparison across cars powered by different energy types. In this regard, the concept of the “MPG” (*Miles Per Gallon of gasoline*) characterizing gasoline vehicles is borrowed, evolved and updated within the EV industry by defining the MPGe (*Miles Per Gallon of gasoline-equivalent*): these two values can be fairly compared through a mathematical equation that engineers have used to simplify the understanding of fuel efficiency in more popular terms.

Moreover, the way we are used to assess the efficiency of an internal combustion car is completely different and unrelated to the one we have to take into consideration when measuring the performance on an EV. For these new vehicles, in fact, we have to focus on “kilowatt hours per 100 miles”: this is the efficiency number that this technology offers to compare different vehicles and make an informed decision on which one is best to invest on in the longer run.

Having a wider overview of vehicle types and technologies available will help us understand what is currently adopted and what is going to be implemented in the Mexican market in the near future. Below I outlined the various electrified vehicles, further explaining the technical differences between one another:

1. Hybrids (“HEV”). These hybrid electric vehicles are 100% gasoline fueled, which means that you can’t electrically recharge them at all. In fact, they have a gasoline engine, an electric motor, and a transmission that can combine the two with a battery. The electricity for the battery comes mainly from braking: when the driver pushes the brakes, the functionality is called “regenerative braking”, and this is a feature anyway shared with all the electrified cars. Choosing this type of car means that the driver will be able to make a great use of recycled energy, limiting its wasting, and reducing the usage of gasoline overall.
2. Plug-In Hybrids (“PHEV”). They are a “part-time EV” that is initially powered by their electric motors and batteries, but they also have a gasoline engine and a gas tank. Therefore, there are two ways to fuel them up: electrically recharging them by plugging them into a charging station, and inputting gasoline in the tank, as we normally do with ICVs (Internal combustion vehicles) . Whilst driving this type of car, if the electric battery goes out, the gasoline engine comes to automatically power and assist the car, like a regular gasoline hybrid.
3. Electric Vehicles (“EV”). In these types of car, there is neither an engine, nor a gas tank, as they use zero gasoline and have no tailpipe, and they don’t have the classic transmission: all these features make the maintenance so much cheaper than a combustion vehicle. Moreover, EVs have internal batteries, and similarly to other types of vehicle, the overall energy consumption varies by size and type.

2.2.2 Types of charge

Below is an example of one brand’s timing of charging and range:

“As one type of the new energy vehicles, pure electric vehicles have developed most rapidly. For example, Japan launched the first pure electric car Leaf in 2010, with

excellent appearance design and long continuous mileage after charging once. At the 2011 Shanghai Auto Show, the Changan BenBen MINI pure electric car with lithium battery was presented, which can provide a maximum speed of 120 km/h and continuous mileage can be reached to 150 km after one charge. In addition, the ferric phosphate batteries are employed by BYD e6. The standard charging time of it is 6 h, which can provide a maximum speed of 160 km/h and continuous mileage of 300 km” (Zhao, 2019, p. 1).

To understand which technology will be more suitable for Mexican consumers, a more complete overview about how chargers’ and batteries’ efficiency is delivered, and the different ways by which a vehicle can be charged.

“According to the standard IEC 62196¹, there are four different charging modes designed for EV:

Mode 1 is the standard mode for charging EVs at residential houses. It involves charging the batteries at 230v and a maximum current of 16A. The process of recharging most EVs can last up to 8 hours, and therefore, it is considered a slow charge mode. In this case, assessing the different charging methods using Mode 1 it's recommendable since it is the mode most commonly used at residential households.

Mode 2. This charging mode supports currents up to 32 A. Depending on the type of vehicle, the recharging process can last between 2 and 4 hours. Hence, this charging mode is known as semi-fast.

Mode 3. This mode, known as fast-charge, supports currents between 32 A and 250 A. Depending on the type of vehicle, the recharging time, using this mode, can take less than 1 hour.

Mode 4 supports currents up to 400 A, and it is known as ultra-fast charge. It is very promising since it will extremely reduce the time required to charge EV batteries, although many types of batteries are not able to withstand the heat generated due to the amount of electricity introduced within a very short time” (Martinez F., 2018, p. 4).

¹ The code represents a series of international standards that define requirements and tests for plugs, socket-outlets, vehicle connectors and vehicle inlets for conductive charging of electric vehicles. “IEC” stands for Electrotechnical commission.

2.3 Benefits and brands

2.3.1 Benefits of electric vehicles

In the following table, different types of vehicles are compared, illustrating driving components, energy source, special features and potential weaknesses. The FCEV² is another model which derives its energy source through fuel cell “FCVs carry the hydrogen in special high pressure tanks, another ingredient for the power generating process is oxygen, which it acquires from the air sucked in from the environment. Electricity generated from the fuel cells goes to an electric motor which drives the wheels. Excess energy is stored in storage systems like batteries or supercapacitors” (Un-Noor, Padmanaban, Mihet-Popa, Mollah and Hossain, 2017, p. 6).

EV Type	Driving Component	Energy Source	Features	Problems
BEV	<ul style="list-style-type: none"> • Electric motor 	<ul style="list-style-type: none"> • Battery • Ultracapacitor 	<ul style="list-style-type: none"> • No emission • Not dependent on oil • Range depends largely on the type of battery used • Available commercially 	<ul style="list-style-type: none"> • Battery price and capacity • Range • Charging time • Availability of charging stations • High price
HEV	<ul style="list-style-type: none"> • Electric motor • ICE 	<ul style="list-style-type: none"> • Battery • Ultracapacitor • ICE 	<ul style="list-style-type: none"> • Very little emission • Long range • Can get power from both electric supply and fuel • Complex structure having both electrical and mechanical drivetrains • Available commercially 	<ul style="list-style-type: none"> • Management of the energy sources • Battery and engine size optimization
FCEV	<ul style="list-style-type: none"> • Electric motor 	<ul style="list-style-type: none"> • Fuel cell 	<ul style="list-style-type: none"> • Very little or no emission • High efficiency • Not dependent on supply of electricity • High price • Available commercially 	<ul style="list-style-type: none"> • Cost of fuel cell • Feasible way to produce fuel • Availability of fueling facilities

Table 2.1: Comparison of different vehicle types based on Un-Noor, Padmanaban, Mihet-Popa, Mollah and Hossain (2017), p. 9.

It is interesting to analyze the case of Tesla, potentially the most famous EV brand and manufacturer nowadays: Elon Musk, Tesla’s co-founder and CEO, always showed his intention to produce cars that were not hybrid, nor powered by alternative fuels. In fact, the company estimates that their EV models cause 50

² The FCV vehicle is not being considered in much detail, due the most important electrified vehicles are discussed in the Section 2.2.1, so this is only to have a reference of the benefits of each vehicle.

percent less³ CO₂ (carbon dioxide), although the vast majority of the electricity production comes from a coal-powered plant.

Tesla launched its production with “Model S”, a vehicle featuring lightweight aluminum parts: this new industrial design aimed at improving the power to weight ratio, further helping increase the car performance and its overall range, i.e. the maximum distance covered by the car once its batteries are 100% charged. These two factors were very relevant for the co-founder and technical chief, JB Straubel. In fact, the company itself started investing in its internal R&D to push the technology and improve the electric powertrain, the main element replacing the combustion’s car transmission in EVs: together with the new aluminium parts, Tesla also managed to improve the life of the battery overall by implementing thousands of small lithium ion cells, similar to laptop batteries. With these new key adjustments and improvements, Model S could achieve an impressive range of 480 km - a result that, at the time of its development, was very difficult to match by Tesla’s competitors.

Buying an EV brings a lot of benefits, which I’ll detail in greater depth in Chapter 4. Concerning the content just presented, it is however important to mention the most relevant ones. Firstly, one of the advantages is the money saving due to fuel, as the energy to power an EV costs about 20-30% less than the one of the gasoline - with this percentage slightly varying, depending on the country on which we calculate the fuel cost on a year basis. Secondly, another benefit is also the savings associated with the vehicle maintenance, which depends on the manufacturer’s spare part availability. In Chapter 4, data analysis and data collection, together with a business case presenting a detailed cost prospectus, will show the numbers related to the mentioned savings: such breakdown of costs will therefore be useful for readers to draw their own conclusions about the choice of purchasing an EV, as compared to a standard combustion vehicle.

As previously mentioned, there are a few advantages from owning an electrified vehicle; on the other hand, before purchasing one, it is worth noticing that owning an EV in Mexico might bring a few disadvantages, due to the specific economic situation of the market, and how fast they will be able to react to respond to internal challenges.

³ Data stated on National Geographic documentary in 2012.

In the table below, I compare EV's advantages and disadvantages, which will have to be further contextualised in each country which aims at implementing this new technology. With regards to the Mexican automotive market, which is the subject of the present research, there are a few points that are important to further clarify. I will provide further details in Chapter 5 about these disadvantages, and how they are part of the challenges. As this will be part of my point of view, it will also help support and give a final conclusion on whether Mexico is ready or not for this technology.

Advantages	Disadvantages
Reduce fuel cost and minimize maintenance	Vehicle sales prices are high
According to Electric Power Research, electric cars are 97% cleaner than conventional ones that work by combustion	Low autonomy of the electric vehicle
Some countries have tax incentives to promote this type of vehicle	Charging points are scarce
High efficiency of electric motor (60% -85%)	They offer less mileage than conventional ones and the recharge times are high
The operation of the internal combustion engine makes it possible to reduce the noise level emitted by the moving vehicle	They require attention in specialised garages.

Table 2.2: Advantages and disadvantages of electric vehicles. Source: De Alba (2016).

2.3.2 Relevant brands and markets

According to Statista (2021)⁴, Europe is leading the race of electric vehicle adoption. Despite the negative impact of the pandemic on the automotive industry, the sales of electric vehicles experienced significant growth in many countries during 2020.

⁴ An online portal providing data on the global digital economy, industrial sectors, consumer markets, public opinion, media, demography and macroeconomic trends.

Norway, whose goal is to decarbonize its new vehicles from 2025, has once again been the country in the world with the highest share of electric vehicles and plug-in hybrids. Sweden and Finland also made it to the Top 5, a testament to the rapid adoption of electric cars in the Nordic countries.

China, which is by far the largest market for electric cars in terms of unit sales, was left out of the Top 10. On the other hand, according to Statista's studies (2021), China is the leading market for projected production from 2018, and it will keep this position until 2023.

In the findings chapter, different countries will be compared over their new EV and PHEV car sales in 2020, with Norway and the Nordics figuring in the first positions.

This comparison is useful to identify the main countries which the Mexican case could be compared against. On the one hand, it is impossible to directly compare Mexico with other countries due to major differences on the level of the technology developed, the supply chain and related processes, as well as policies promoted by governments and population sizes representing the respective markets, on the other hand, a quick analysis of a few aspects is required to unearth insights supporting the present research. Specifically, I made the arbitrary choice to select a few countries, such as the US, the closest market to Mexico in North America, Norway, the best driver of EV sales in 2020, and China, the leading EV producer in the world.

Starting with China: "China is forecast to be the world leader in terms of electric vehicle production over the next few years. The country is already at the forefront of the electric vehicle revolution. The total stock volume of BEVs and PHEVs in China was around 3.3 million in 2019, an increase of almost 46 percent on the previous year's volume. This estimated figure means that China had the most electric vehicles in use worldwide as of 2019" (Statista, 2021).

The top manufacturers' brands in China are:

1. BYD
2. SAIC
3. FAW
4. NIO
5. XPENG
6. BAIC

7. GAC
8. Chery
9. Geely

BYD “Build Your Dreams” is the largest Chinese EVs manufacturer, and it has been evolving its operations since they started their production in 1995.

After having begun as a phone battery manufacturer, in 2003, BYD entered the automotive and renewable energy sectors. Based in the city of Shenzhen, in the Guangdong Province, they evolved the business over the years: the company currently owns 20 factories, producing EV components and software. BYD also grew internationally, expanding their presence around the world, in Russia, Syria, Egypt, Sudan, the US and Brazil. The business is also now specialized in producing a particular phosphate battery, which is environmentally friendly, safe, reliable and fully recyclable: additionally, it has proven to be able to go through extremely harsh tests, hence making its life-cycle durable over time.

BYD Company Limited has devised what they denote as a “7 + 4 strategy”, also known as Green Mobility Strategy, which consists of electrifying all transportation currently dependent on fossil fuels. The 7 refers to on-road transportation (urban transit, taxis, private cars, tourism and commuting coaches, garbage trucks, urban goods logistics and urban construction logistics) and the 4 refers to off-road environments (harbor, warehouse, mining and airport) (Masiero, Risso and Ogasavara, 2016).

Not only BYD produces EVs, but it also provides different charging solutions and facilities. With these solutions, allied with the “7+4 strategy”, BYD is accomplishing one of their three green dreams. Infact, the other two dreams are creating a mass solar power generation (through solar panels) and streamlining the energy storage for grid operations and renewable balancing.

“Although China is at the leading edge of global vehicle electrification, China’s path toward global leadership has at times been rocky, and it is not yet complete. China has continued to work, revise, and improve its long-term strategies, and central, provincial, and local policies. Technology and market changes require that policies in China remain a work in progress and continue to adapt to meet industry, mobility, oil

security, air quality, and climate change goals in the years and even decades ahead” (Jin, He, Cui, Lutsey, Wu, Chu, Zhu, Xiong and Liu, 2021).

China has been beneficial to the purpose of the present research as this country will likely keep the role of the main player within the industry, manufacturing EVs to market and sell outside China until 2023.

Another market to review is the US, which is the main one in North America and the closest to Mexico.

The main EV brands in the US are:

1. Tesla
2. General Motors
3. Ford Motor Company
4. Buick (a GM company brand)
5. Chrysler (part of FCA, now Stellantis)
6. BYD

Tesla has created one of the top-selling full-size luxury cars in the United States and has built a company with a market capitalization about twice that of Fiat Chrysler and half of Ford or General Motors. Tesla’s Model S has won multiple car of the year awards and earned an all-time top rating from *Consumer Reports* (Stringham, Miller and Clark, 2015).

Over the last few years, Tesla has shown very solid business and operations, facing and overcoming many economic uncertainties; and the US market seems to have rewarded their resilience, becoming brand loyalists and product ambassadors.

In this regard, the American market seems to have responded positively to the effort of the automakers, but what about the wider general public’s view? Does this follow the vertical market’s consensus?

In an article from Detroit, they mentioned that the automakers have made something abundantly clear: They believe electric vehicles will dominate their industry in the years ahead. (Krisher and Mchugh, 2021). But when it is about a member from a family like Steve Bock - a person from North Carolina interviewed - seems to not be so interested due the high investment he would have to make: “I would consider it if the prices would come down,” Bock said, though leaving open the possibility of buying an electric vehicle next time.

In this article it is also mentioned that opinions in polls show that a substantial majority of Americans are aligned with Bock. An EV might be on their shopping list if it cost less, if more charging stations existed and if a wider variety of models were available. In other words, the time isn't right (Krisher and Mchugh, 2021).

Naturally, if we drill down to the individual level and carefully listen to each consumers' opinions, different concerns might arise within their decision making process about upgrading from a combustion car to an electric one. Among these, there might be personal concerns related to their own individual economic situation and lifestyle, as well as contextual ones - i.e. a careful evaluation on whether the location where the potential buyer lives can actually benefit from the infrastructure supporting EVs.

On the other side of the Atlantic, when we look at the Norwegian market, we move to the analysis of the country that has been recently named "the capital of EVs". As mentioned earlier, not only Norway was the market recording the highest sales share of electric vehicles and plug-in hybrids number in 2020, but it is also the country where the adoption of this technology has been significantly increasing over the last few years at a rapid pace.

The underlying reason explaining these positive data trends is Norway's EV incentive policy promoted by the central government. The Norwegian scheme introduces some benefits, e.g. supporting the EV charging infrastructure through national funding, as well as exempting EV owners from paying the toll fees on specific roads. Through these incentives, consumers are encouraged towards the investment on an EV - as opposed to other countries, such as Sweden and Germany, where consumers are "forced" to be less dependent on their combustion cars to reduce the overall emissions of CO₂.

In Norway, the most popular EV brands are:

1. Tesla
2. Nissan
3. KIA
4. Volkswagen
5. Hyundai
6. Audi

7. BMW

As Nissan being a big player in EV, here are some facts regarding their history with the vehicles:

- The company released its first electric vehicle in 1947. Beginning in the 1960's the company became more active in developing such vehicles and has since released and sold numerous electric-powered automobiles.
- Nissan was the first manufacturer to believe in the potential of the Lithium ions batteries for automotive applications and they began to develop them in 1992.
- In 1997 the company released the "Prairie Joy" EV equipped with a lithium-ion battery. More recently, at the 2005 Tokyo Motor show Nissan unveiled the "Pivo"; the first vehicle with a compact laminated lithium-ion battery. The "Pivo 2", with an increased cruising range, debuted at the Tokyo Motor Show 2007 (Nissan Motor Co., L., 2021).
- The British government gave Nissan a £20.7 million (\$32.5 million) grant to support a new plant that will serve as the manufacturing base of the Nissan Leaf for all of Europe (Todd, Chen, and Clogston, 2013).
- "Leaf" model was displayed in Tokyo in 2009 and the sales started in Japan and Europe in 2010. The global expansion came later in 2012.

In the findings chapter, different reasons why consumers consider purchasing an EV across the Nordics markets: Norway, Sweden and Denmark, comparing one country to the other will be included.

After reviewing China, the US and Norway's markets, we can now move to the consideration of the Mexican case. Providing an outline of this market, whilst comparing it to other countries, will clarify the current position of its automotive sector, how far this is from implementing this technology not only in key cities, but also across the Mexican states and regions, ultimately understanding the federal government's decisions regarding sustainability reforms.

"Mexico's climate legislation targets emissions cuts of 50% by 2050 (from 2000 levels) and 35% renewable energy by 2024. Mexico City's overall goal is to reduce emissions by up to 30% (8 to 10 million tonnes of CO₂) from business as usual between 2014 and 2020" (Netherlands Enterprise Agency, 2019).

Following the numbers quoted by the Netherlands Enterprise Agency, a local Ministry of Foreign Affairs institution, Mexico has already set a plan towards specific sustainability targets that has to be reached in the following years, due to the high pollution the country is endangered by.

As Soto-Coloballes mentioned in his academic paper, the “Smog as a result of production processes and the use of the automobile was not a concern for researchers and government managers in Mexico City, who were used to the dust storms resulting from the desiccation of the great Texcoco Lake during much of the 20th century” (Soto-Coloballes, 2020).

Notoriously, pollution has been a major problem for the Mexican country for a very long time. Since the federal government seems to be now committed to address this cause, we might wonder which measures they are considering to tackle this issue. Details of contamination in America Latina, and in Mexico specifically, will be further discussed in the “Data Analysis” chapter, later in the present research.

By looking at Statista’s website numbers (2021) the Mexican automotive industry’s recent picture EV sales in Mexico have positively increased through the years. The number of electric and hybrid vehicles sold in Mexico exceeded 24,400 units in 2020. This represents a decrease of around 4.7% in relation to the sales volume of this type of cars registered in 2019 - but yet the sales are being positive - Regular hybrid cars led the sales within this segment, with almost 22,140 units in 2020, followed by plug-in hybrids, with about 1,820. Total electric vehicle sales volume reached 449 units that same year. As per Norway’s case, we might conclude that incentives are yet to be regulated and also infrastructure needs to be effective to encourage Mexican consumers to approach a more careful evaluation of whether purchasing this product is a profitable investment over time.

In Table 2.3, we can see the most popular existing EV brands in Mexico and their 2020 sale volume:

Company	Units
Nissan	53
Chevrolet	38
BMW	81
Audi	69
Jaguar	7
Renault	53
Giant Motors	96
Giant motors commercial vehicles	287

Table 2.3: EV sales in Mexico in 2020. Source: INEGI, available at: www.inegi.org.mx.

Elías Massri, general director of Giant Motors of Latin America points out: "Prácticamente todas las marcas tienen vehículos eléctricos, pero no todas las han traído a México. China es el mayor fabricante de modelos eléctricos y lo que estamos haciendo nosotros es traer lo que el mercado necesita" Rodríguez I. (2021). ("Virtually all brands have electric vehicles, but not all have brought them to Mexico. China is the largest manufacturer of electric models and what we are doing is bringing what the market needs ").

2.4 Theory of planned behaviour

"The theory of planned behavior proposes that behavior is predicted by behavioral intention which is, in turn, predicted by three base components: attitudes toward the behavior, subjective norms regarding the behavior, and perceived control over the behavior" (Sussman and Gifford, 2019).

These three base components are included in the theory planned behaviour made by Fishbein and Ajzen (1975), but then another theory was proposed later for them which was the precursor called: theory of reasoned action (TRA), in which describes

the process by which internal mental processes can lead to an action. Factors needed to be considered to conclude in which sequence the decision is being made. In Figure 2.1 the traditional theory of planned behaviour is illustrated at the bottom, compared with the traditional theory placed at the top:

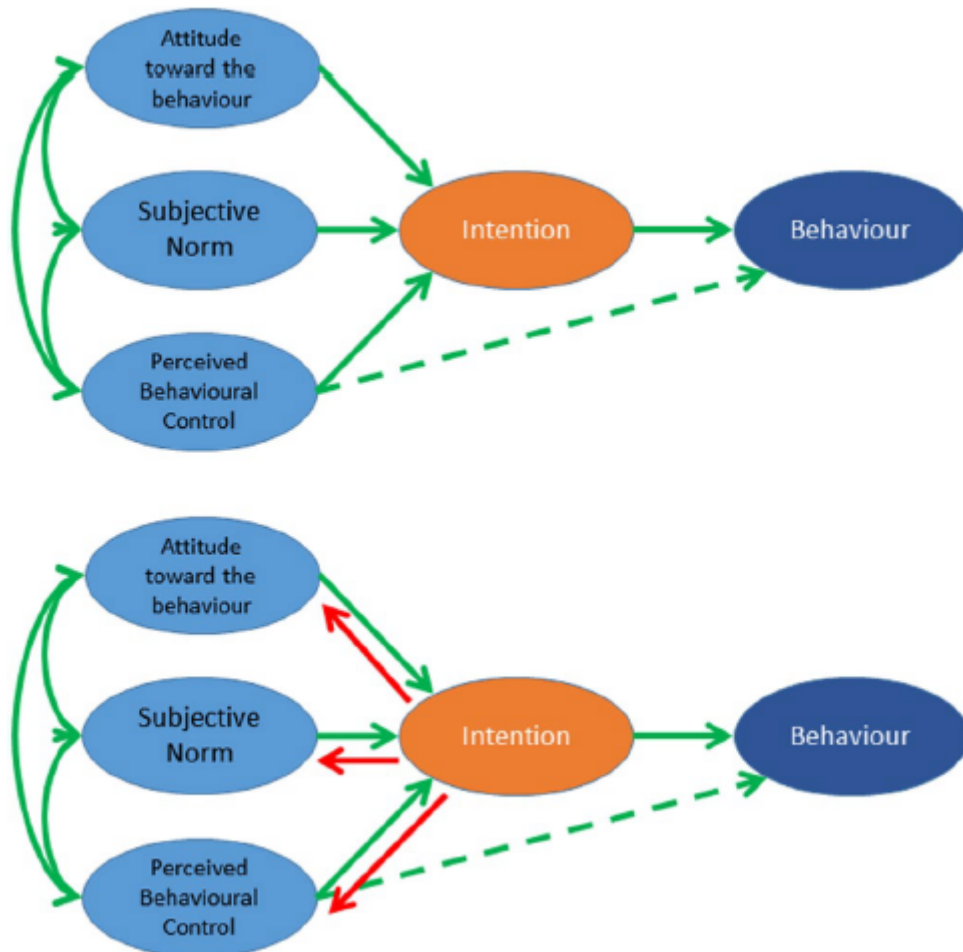


Figure 2.1: Modified (below), traditional (above) Theory of Planned Behaviour (TPB), Sussman and Gifford (2018).

The cause-effect relation implied within a consumer’s decision making process highlights a relation between the above mentioned components and the purchase intentions. Why would anyone want to purchase an EV without being fully aware of what it takes to drive it and maintain it over time? In an oversimplified picture, a consumer might enter a Tesla dealership, speak to the dealer, ultimately deciding to go ahead and finalise the EV purchase. What is driving, however, that purchase intention is still worth investigating: was it the consumer’s environment friendly choice? Was it driven by brand preference, was it to attribute to the organic word of mouth, or to a sponsored marketing campaign? The information that I will collect in

my interviews and online questionnaires later present in this dissertation will help clarify these behaviours, and the intention that triggered them in the first place. For the purpose of this research, we will leave less space to a description of the technical side of the EV product, and we will focus our attention to the reasons supporting the purchase of an EV, namely what encourages a consumer to be curious about EVs, hence considering owning one as a means for transportation.

To understand how Mexico may consider this technology as a general improvement for the society and the environment, Petter Wells describes the efforts to promote the EV as “Efforts to promote electric vehicles, recharging infrastructures and the required industrial base amount to a form of policy convergence in terms of transport policy, industrial policy and environmental policy” (Wells P., 2012).

In my view, these efforts need to be sponsored and encouraged from both the biggest energy producers in Mexico and the federal government. These institutions will need to develop a strategy to promote the awareness of this new industry and the surrounding technology among consumers, who will hence be in a better position to make an informed decision, once they will need to replace their current vehicles.

Another issue that has to be addressed is the EV current price: the average consumer in Mexico would not be able to afford one. In this regard, a collaboration between the government-led CFE (Comisión Federal de Electricidad) and Banco de México would also be needed have to facilitate the purchase of these vehicles, offering assistance from both an awareness perspective, guiding and supporting consumers through their purchase journey (e.g. providing information and addressing their concerns), as well as an economic perspective, perhaps introducing purchase schemes, facilitated loans, leasing services, etc.

With the above considerations in mind, we can then start reasoning on how the EV technology and ecosystem can be developed in Mexico, comparing available infrastructure, policies and laws, brands, and energy accessibility of this country against the ones of other developed markets.

A few pages of research literature have already been written to cover policy implications raised by the EV market. In his essay *Converging transport policy, industrial policy and environmental policy: The implications for localities and social equity*, Wells focuses his review on the UK market, explaining that a few agencies in

the country were involved in the promotion of innovative automotive technologies and their infrastructure. Even though Wells's analysis focuses on the UK market specifically, I will take his arguments as equally applicable to the Mexican case, despite the numerous differences that characterise both countries in many ways.

He also describes the situation of a market that would struggle to expand, due to the lower income opportunities for the target consumers: "According to Poverty UK, using data from the 2011 National Travel Survey, nearly half of the households in the lowest 20% for income did not have a car in 2010. Less wealthy households are increasingly suffering what has come to be termed 'fuel poverty' arising from rising household energy costs (defined as the situation where 10% or more of income goes on household energy bills), but with rising petrol costs those disadvantaged households that do still own a car are likely to suffer even further" (Wells P., 2012).

Lastly, the author points out that, in order to introduce new layers of technology within a society, there are not just income availability concerns to focus on. As Wells reminds, "The so-called multi-level perspective identifies a 'landscape' level that defines the broad socio-economic context or setting for change and stability" (Wells P., 2012).

In fact, by furthering his analysis through the framework by which innovation emerges, Wells explains that poverty isn't simply defined by lack of economic resources (i.e. individual income), but it is also represented by the lack of technology accessibility. In this regard, the lack of access to affordable and environmentally friendly mobility is a lack of technology accessibility, and it leads to defining a new concept of poverty.

A series of contradictory policies being introduced, implemented, and lately amended by the different Mexican parties alternating in governing the country contributed to create tensions among the different demographic sides of the Mexican population.

Specifically, the country is divided into industrial cities, who support the claim of being the ones where people work the most, and the country's outskirts, less developed and usually in higher need of the state's aid for social welfare: an example is represented by Mexico City, the country's capital, where the highest amount of state taxation is sourced from.

2.5 Infrastructure and Incentives in Mexico

2.5.1 Infrastructure

As briefly outlined in Section 2.2.2, EVs and HEVs require plug-in charging to operate. Usually, charging docks can be installed at home, or they can be found in charging stations located in public places, which are suitably equipped to manage the right voltage needed.

Although the general requirements to install charging stations in Mexico could be easily met, there are other supply chain related issues that need to be solved to scale their deployment across the country, like the compatibility of the vehicle types with electricity suppliers. It is important to guarantee a solid infrastructure for each type of vehicle, ensuring the availability of electric energy sourcing to each station, independently from its location: failing to provide a suitable environment would in fact compromise the possibility to secure smooth operations for the country's electric mobility overall.

Additionally, the emission and distribution of energy in the country is still heterogeneous: this represents another challenge for the Mexican EV industry, as it limits the possibility for an homogeneous electrification of the automotive sector.

2.5.2 Comisión Federal de Electricidad

The "Comisión Federal de Electricidad", also called "CFE", is the state-owned electric utility of Mexico and the main governmental entity in charge of deploying the electricity infrastructure in the country.

Over the years, this company has been supporting the development of the EV infrastructure, as well as the one related to HEV. In coordination with SENER⁵ and FOTEASE⁶, CFE is responsible for planning and delivering the promotion of electromobility within the country, investing into recharge infrastructure (PEII). Its program initially contemplated the installation of 100 electric stations in places of

⁵ SENER, or "Secretaría de Energía", is the Secretariat of Energy, the government department in charge of production and regulation of energy in Mexico.

⁶ FOTEASE, "Comité Técnico del Fondo para la Transición Energética y el Aprovechamiento Sustentable de la Energía", is a public policy instrument by the Ministry of Energy, the objective of which is to implement actions that serve to contribute to the fulfillment of the National Strategy Transition and the sustainable Use of Energy.

public access, such as the metropolitan areas of Mexico City, Monterrey and Guadalajara (SEMARNAT, 2018). Since the costs of the supplied energy are covered by the charging point installer, recharging is free for the final consumer: moreover, the installed infrastructure is also “universal”, as it is compatible with all EVs and HEVs currently available in the country’s automotive market.

Nevertheless, there are additional challenges related to the supply chain that affect the transmission and the distribution of electric power in Mexico. As previously mentioned, they can affect the homogenous electrification of the country, which is needed to develop a suitable and efficient infrastructure in the future.

1. *Costs:*

CFE’s electricity production costs Mexico around \$300 and \$350 (MXN, Mexican pesos) billions, equal to €12.3 and €14.3 billions. According to local newspaper “El Periódico de la Energía”, the government granted Mexico \$456.83 MXN billions (i.e. €18.73 billions) for the year 2020, apportioning 87.5% for energy production, and 12.5% for working labor margins, on top of the subsidy to compensate the financial balance. Daniel Chacón, Director at Iniciativa Climática de Mexico (ICM), estimates that this governmental subsidy for domestic consumption can reach up to \$100 MXN billions (i.e. €4.1 billions) annually (El Periódico de la Energía, 2020).

2. *Obsolescence:*

In the same article, Chacón explained that CFE costs are significant for the Mexican government’s finances: in the first budget, \$26 MXN billions (€1.06 billion) were requested just for the maintenance of old plants. Additionally, ICM pointed out that CFE owns obsolete plants up to 50 years old, the production of which is just over 20% of the overall electricity generation, and it mainly comes from fuel or coal. With another 12% of the total energy production coming from hydroelectric plants, 4% from nuclear and 4% from geothermal ones, the remaining majority of 50% is produced by natural gas plants with private participation that supplies the CFE. In this regard, Chacón emphasised that the introduction of new renewable energy is challenging the Mexican government: since the dispatch of renewables is very cheap, they

have an easy penetration within the market, making the old plants outdated and in need of being displaced.

3. *Transmission lines:*

CFE has an installed production capacity of 57,872GW. Specifically, the state-owned company owns a monopoly including 109,589km of transmission lines and a distribution network of more than 850,549km to supply 44.5 million consumers. Considering the little to none investment into the transmission lines from 2014, the new Mexican economic statism underlying the recently proposed policies would steer away private investments needed to increase this infrastructure and guarantee additional supply by 2040 (El Periódico de la Energía, 2020).

4. *Debt:*

According to recent financial reports, CFE's debt reached \$16.81 MXP billions. In 2020, the state-owned company requested an additional financing of \$34.3 billions MXP (€1.407 billions), which is more than three times the figure requested in the previous year. In the article, Chacón concludes by describing CFE as a “bottomless barrel”, as it does not seem to have the capacity of profitably managing the borrowed money: in his words, CFE looks to be very indebted, as well as a very inefficient company, owning a set of old plants and transmission lines (El Periódico de la Energía, 2020). According to financial agencies Moody's and Fitch, the new energy policy carries a negative rate, meaning that the planned investments will not have a positive impact over the infrastructure supporting the energy supply across the country. As a consequence, the infrastructure that the country will need to implement new energy-related technologies, such as EV, will also remain underdeveloped.

2.5.3 Mexican incentives on Electric Vehicles

The Mexican government published an overview of the benefits related to the usage of an Electric Vehicle: these mainly relate to Income Tax, Tax Law Added Value, the

Federal Tax Code and the Tax Law on New Cars. The following table presents a summary of these:

Incentive	Description
ISAN ⁷ exemption	Electric vehicles do not pay taxes on new vehicles.
Exemption from payment of the “tenencia ⁸ ” (tenancy)	Exemption from “tenencia” payment in most states. In the state of Mexico, no tenancy is paid for the first five years, then you pay with a 50% discount.
Stickers "E"	In the City and State of Mexico, a special sticker is assigned to identify electric vehicles.
Exemption from environmental verification	Electric vehicles, given the technologies used for their propulsion and not producing polluting emissions, are exempt from the vehicle verification program that involves the review of semi-annual emissions, as well as they are exempt from the participation to the program " <i>Hoy no circula</i> " ⁹ .
Income tax deductibility for the acquisition of electric stations	In the General Criteria of Economic Policy for the Initiative of Income Law and the Expenditure Budget Project of the Federation corresponding to Fiscal Year 2017, a tax credit of 30% is deducted on the income tax related to the acquisition of charging stations where public access is guaranteed.
Exemption from custom duties	Exemption from custom duties when importing vehicles with electric engines, including cars, vans and trucks. This applies to companies that subscribed to the governmental competitiveness policy, as proposed by the Ministry of Economy.
“Ecological vehicle” license plates	Introduction of “ecological vehicle” license plates, helping identify electric or hybrid vehicles.

⁷ ISAN is a tax that is charged when buying a new car. Its regulations appear in the Federal Law of Tax on New Cars (LFISAN).

⁸ “Tenencia” is a tax that both individuals and legal entities must pay to the government for the simple fact of owning a car, regardless of the use that is given to it.

⁹ “Hoy no circula” (literally, “Today doesn’t circulate”) is an urban program of restriction to vehicular circulation the purpose of which is to control and reduce the levels of environmental pollution. Its scope of application extends to all the Delegations of Mexico City and to 18 municipalities of the State of Mexico.

"ECOTAG"	Introduction of discounts across toll roads, e.g. 20% special discount for electric cars and hybrids on TeleVía roads in Mexico City, such as Urbana Norte highway, Urbana Poniente highway and Urbana Sur highway.
CFE special meter	To promote the adoption of EV, CFE directly installs a standalone meter at the property of the plug-in car's owner. This meter allows to exclusively invoice the consumption of the electricity necessary to the vehicle, while keeping charging costs within standard domestic rates.
Preferred parking lots	A few companies related to the EV industry (e.g. ChargeNow, and others) offer preferred parking lots, including necessary charging points, to their customers driving hybrid or electric vehicles.

Table 2.4: Incentives for electric mobility in Mexico, Sanchez, Fabela, Hernandez, Flores, Vazquez, and Cruz (2020). Source: ChargeNow (Charge Now, 2019). Secretaría de Hacienda y Crédito Público, (SHCP, 2017). Servicio de Administración Tributaria, (Cámara de Diputados del H. Congreso de la Unión, 2018).

2.5.4 Energy reforms in Mexico

“Throughout 2020 and 2021, the Mexican government has promulgated a number of legal reforms that favor the Federal Electricity Commission (CFE) and Petróleos Mexicanos (Pemex), both companies owned by the Mexican state, and give them competitive advantages in the hydrocarbon and electricity markets to the detriment of private investors in these sectors” (Paramo, Brown, Guerrero, 2021).

To understand the main objectives which are driving the Mexican government to implement new regulations, we need to explain how they were introduced.

In 2013, Peña Nieto’s government, the former Mexican president, worked on a new constitutional reform based on six main principles:

1. Hydrocarbons has to be maintained as a state-owned resource;
2. The increasing competition within the energy sector will bring higher productivity, and fairer prices;
3. Empowering strong regulatory agencies;
4. Ongoing operational transparency;

5. Maximising support towards clean energy;
6. Strengthening the roles of PEMEX and CFE;

As per the above principles, CFE's legal status was modified, similar to the PEMEX's one: CFE became a state-owned producing company. With regards to electricity production, the reform removed all the limitations to private participation, previously introduced by the 1992 Electric Energy Public Service Law. For the first time in decades, Mexico became a market allowing for private investment and free competition within this sector. The control over the energy transmission network was transferred from CFE to a new agency, CENACE (*Centro Nacional de Control de Energia*, i.e. the National Energy Control Center). Adequate access to natural gas supplies was secured by building out cross-border pipelines to the United States, and institutionalising a national gas transportation regulatory agency, CENAGAS (*Centro Nacional de Control de Gas Natural*, i.e. the National Natural Gas Control Center). Lastly, the renewable energy industry was empowered by introducing new laws promoting clean energy employment, as well as opening up opportunities to private investors around the production of geothermal energy (Wood, 2018).

Nevertheless, the possibility for private investors to enter the Mexican market did not last long. New measures were in fact introduced by a new government, which reversed the 2013 constitutional energy reform. This energy counter-reform had the main objective to restore the monopoly over the governmental entities, such as CFE and PEMEX, as they used to be in the past.

We therefore may be wondering how the combined results of these policies affect the deployment and the implementation of the technology supporting EVs.

As Paramo, Brown and Guerrero conclude in their recent publication (2021), by increasing CFE's participation in the power production and supply markets, free competition was essentially removed from the picture, fundamentally limiting the operations of the private companies working in the sector. Moreover, by severely imposing limitations over the development of further private infrastructures, the overall availability of energy across the country was affected, with the end result of a general unavailability of charging stations on highways or wherever they are needed the most.

2.6 Contamination

2.6.1 How affects PM and CO2

The contaminants of gasoline vehicles includes: carbon monoxide (CO), hydrocarbon (HC), carbon dioxide (CO₂) and polycyclic aromatic hydrocarbons (PAHs); and the diesel vehicles includes nitrogen oxides (NOX) and particulate matter (PM).

According to *The Environmental Protection Agency (EPA) (2013)* - US Government agency responsible for the protection of human health and the environment - “The PM stands for particulate matter (also called particulate pollution) - the term for a mixture of solid particles and liquid droplets found in the air. Some particles, such as dust, dirt, soot, or smoke, are large and dark enough to see with the naked eye. Others are so small that they can only be detected using an electron microscope”.

This Particle pollution includes:

- PM₁₀: inhalable particles, with diameters that are generally 10 micrometers and smaller; and
- PM_{2.5}: fine inhalable particles, with diameters that are generally 2.5 micrometers and smaller.

How small is 2.5 micrometers? Think about a single hair from your head. The average human hair is about 70 micrometers in diameter – making it 30 times larger than the largest fine particle (United States Environmental Protection Agency, 2021).

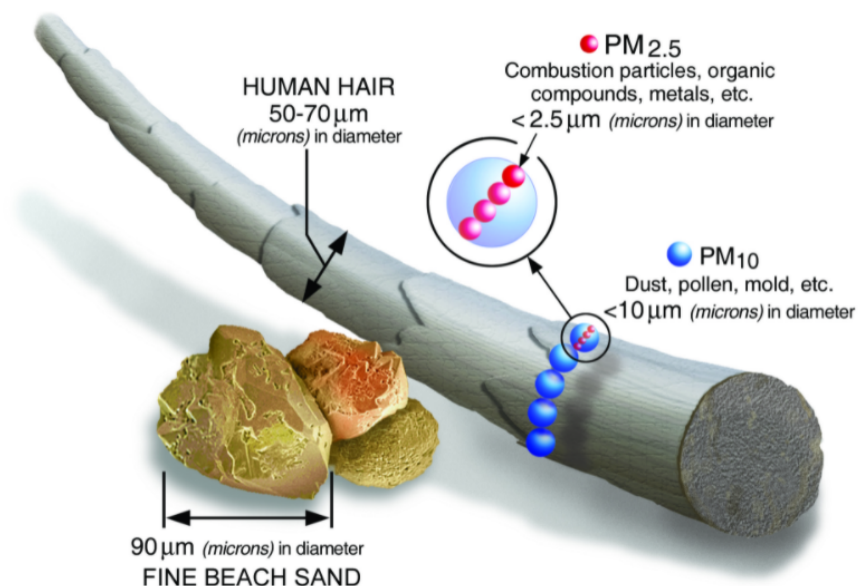


Figure 2.2: Size comparisons for PM particles, United States Environmental Protection Agency (2021).

According to EPUK (Environmental Protection UK), cars' CO₂ emission represents the biggest contaminant, contributing to the overall pollution caused by vehicles, among other additional factors that have an additional impact on climate change, air quality, noise, resource disposal, and our own local lifestyle.

By representing 22% of total emissions of carbon dioxide (CO₂) in the UK, road transportation is a significant contributor to climate change. Although the EU reached agreements with automotive manufacturers to cut the average CO₂ emissions for new car models, traffic levels are forecasted to increase over the next few years, with road transportation keeping the role of fundamental contributor to greenhouse gas emissions.

Additionally, road transportation emissions include nitrogen oxides, particles, carbon monoxide, hydrocarbons, and other air pollutants that ultimately impact the quality of the air we all breathe, with dangerous consequences over the health of people, animals and the local vegetation. The increasing number of vehicles on the road and kilometers driven is eroding the benefits brought by the employment of new technologies and cleaner fuel formulations aimed at cutting the emissions of pollutants. In fact, it is worth noticing that vehicles tend to emit more pollution during the first few kilometers of journey, which is when their engines are warming up.

According to EPUK, noise should also be added to the list of elements polluting our environment, including engine and tyre noise, car horns, car stereos, door slamming, and squeaking brakes. Although EU legislation has tried to subject vehicles' noise to reasonable communitary standards for many years, the sound of engines remains a problem in cities and towns; on the other hand, the rural areas are mostly affected by the tyre noise on busy roads, or from vehicles that increase their speed. To help reduce the noise levels, effective noise barriers installed across sensitive areas, low-noise road surfaces, and low-noise tyres should be primarily considered, together with a general effort of educating drivers to close their windows when playing loud music in the car, as well as discouraging the use of 'boom box' car stereos.

From a resource perspective, the construction, usage and ultimate disposal of vehicles have also a major impact on the environment. Over a car's life span, EPUK's reports estimate that 85% of its CO₂ emissions come from fuel use and servicing operations; additionally, 10% are required for its initial manufacture, and 5% are required for its eventual disposal. Of course, these calculations do not take into account the emissions of carbon dioxide and other air pollutants coming from vehicles related industries (e.g. fuels), which also consume significant amounts of raw materials, and produce large quantities of waste to operate.

Finally, EPUK argues that vehicles also affect the quality of our local lifestyle. In fact, traffic can be dangerous and intimidating, vehicles abandoned on the road cause nuisance, and air pollution and traffic noise can make urban living uncomfortable, dividing communities and affecting pedestrians' safety on the street.

Of all the toxic effects attributed to PM₁₀, death has been the most thoroughly documented. Death due to effects of air pollution occurs generally between 1 and 5 days after the hazardous exposure. Since the 1950's, many studies have recorded increased mortality associated with high levels of pollution (Borja, Rosales, Torres, Corey and Olaiz, ND).

According to EPA these are the effects due PM₁₀:

- Premature death in people with heart or lung disease.
- Nonfatal heart attacks.
- Irregular heartbeat.
- Aggravated asthma.
- Decreased lung function.
- Increased respiratory symptoms, such as irritation of the airways, coughing or difficulty breathing.

2.7 Electric Vehicles Marketing and Sustainability

For new technologies and innovations, skillful marketing is needed to get it accepted and diffused throughout society (Garling and Thogersen, 2001).

In fact, Garling and Thogersen (2001) believe that an important challenge for marketers and policy-makers wanting to create a global market is adequately

informed, not only about the disadvantages, but also about the advantages of the new technology.

Having this first approach, for instance, will make the buyer more aware of what innovation will bring and what the consequences are.

As previously reported in Section 2.5.3, Mexico has addressed the rise of the EV market by introducing a few incentives; nevertheless, if the marketing strategies are not consistently and carefully deployed by manufacturers, the scope of the governmental policies, aiming at improving the country's sustainability, might be undermined.

Every manufacturer should therefore approach their marketing plans by tailoring them to specific local needs - e.g. Monterrey's market in Northern Mexico might require a different marketing approach than the one addressing the needs of Mexico City, in Central Mexico. As suggested by the experts:

"Typically, market penetration starts with a small segment or niche, consisting of customers with particular characteristics, needs or wants. Hence, it is of tremendous strategic importance for producers of new products to correctly identify the customer segment(s) that contain(s) the most likely early adopters and to target their marketing effort as effectively as possible towards this (these) segment(s) from the outset" (Garling and Thorgersen, 2001).

Additionally, marketing plans should be drafted to separately target two different types of buyers, private individuals and businesses. According to Garling and Thorgersen (2021), private consumers might be considered as a later adopter of this technology. In fact, nowadays, companies position themselves in the first line to test EVs to grow their own business fleet: it is unsurprising that, by implementing this new technology, companies hope to optimise their operations and have a positive impact on the environment, whilst reaching aggressive savings goals.

The aim of the marketing plan is to target potential consumers and influence their decision: it is not simply a matter of having impactful video assets for advertising purposes; following Kotler's traditional definition, marketing is the effort of exploring, and then also communicating, the *value* that each brand can deliver to each potential customer within the target market. As the entry cost of EVs is significantly higher than the average ICV (Internal Combustion Vehicle), the value proposition of the

product has to leverage all the other elements of the marketing mix to counterbalance its price. To this end, experts observe that: “Furthermore, trialability and observability are two important characteristics of EVs that should be used actively in the marketing campaign” (Garling and Thogersen, 2001).

To successfully introduce this new technology in the automotive sector, we have to acknowledge that the environmental cause, as well as governments’ initiatives, whether they are incentives towards EVs or restrictions on the use of combustion vehicles, might not be sufficient, or convincing enough. Accordingly, proving to potential consumers that the price/performance equation will be positive and profitable in the long-run becomes paramount for brands within the market. Therefore, it goes without saying that: “A successful market penetration strategy probably should include a fairly low introduction price based on introduction rebates or learning curve pricing, focusing first on achieving market acceptance by a few carefully selected segments” (Garling and Thogersen, 2001).

Garling and Thogersen propose a few important strategies that should help shape a successful marketing plan:

1. Bridging the gap between trialability and final purchase for the consumer’s benefit: hardly anyone buys a new car without having had the opportunity for a test drive;
2. Making the initial investment more widely affordable, by lowering entry-prices, introducing rebates, agreeing on generous return policies, making space for leasing opportunities before deciding on whether purchasing an EV;
3. Leverage the government’s support to public initiatives (e.g. incentives);
4. Competition: by having different entry-prices in relation to different product options. This will help consumers make a more informed decision;
5. Two phase strategy: “We suggest that the following organizations and private consumers, represent particularly promising segments to be targeted in phase 1 of the marketing plan. (i) public sector organizations, (ii) green companies and (iii) multi-car households whose transportation needs regarding the second car are within the present generation of EVs technological capabilities and whose values and lifestyle are compatible with owning an EV.”(Garling and Thogersen, 2001).

6. Importance of word of mouth: it is important that the EVs are not over-marketed, due the implications that might occur “(i) The selling of an EV in the early phase should be based on thorough scrutiny of the interested customer’s needs and on information about both the pros and cons of the EV. An interested customer whose needs cannot be properly solved by an EV should explicitly be advised not to buy one. (ii) The EV offer should include measures to reduce feelings of uncertainty about whether the driving range of the bought EV actually covers the desired driving range.”(Garling and Thøgersen, 2001).

From a sustainability perspective, consumers’ behaviour needs to be somehow shifted, especially in the context of the Mexican market, where pollution issues must be considered as a radical element. In Chapter 4, I will additionally provide an overview of the findings on contamination affecting Latin America: this will help clarify how specific needs have to be addressed in the Mexican case, ultimately shedding light over the marketing approach required by a sustainability framework.

In their article “How to SHIFT consumer behaviors to be more sustainable: a literature review of guiding framework” White, Habib and Hardisty (2019), discussed the role of marketing in relation to the ability of encouraging sustainable consumption, further analysing the most effective ways to shift the consumer’s behavior, and align it to the sustainability principles. The framework used by the authors is represented by the acronym “SHIFT”, and it suggests that consumers tend to be more inclined to engage in pro-environmental behaviours when the marketing message includes the following factors: **S**ocial influence, **H**abit formation, **I**ndividual self, **F**eelings and cognition, and **T**angibility. Without entering into more granular details of their approach, I will keep their framework and its constitutive elements into consideration. Regardless of the market, this framework is also very useful for Mexico’s case, and this marketing approach towards sustainability would be fundamental for EVs technology.

In their own words: “A sustainable business focus has advantages such as identifying new products and markets, leveraging emerging technologies, spurring innovation, driving organizational efficiency, and motivating and retaining employees. Moreover, research suggests that socially and environmentally responsible practices

have the potential to garner more positive consumer perceptions of the firm, as well as increases in profitability” (White, Habib and Hardisty, 2019).

The SHIFT framework will therefore help address the attitude-behavior gap that is commonly observed in sustainability contexts. As per their definition, the authors refer to sustainable consumer behaviour as “[...] actions that result in decreases in adverse environmental impact as well as decreased utilization of natural resources across the lifecycle of the product, behaviour, or service” (White, Habib and Hardisty, 2019).

After consulting and reviewing multidisciplinary literature, including behavioral sciences, business, psychology, economics and management journals, the authors analysed the five constitutive factors of their SHIFT framework in greater depth:

1. With “Social influence”, the authors include three different facets: (a) social norms, (b) social identities, and (c) social desirability.
 - a. Social norms can have a powerful influence on the consumer’s sustainable behaviour, for example, recycling, avoiding plastic, selecting eco-friendly transportation, etc. In this regard, one of the questions that I will ask to the selected pool of my interviewees is “Is there anything you do, whether once in a while or on a daily basis, to contribute to the environmental cause?”. Such a question aims at identifying whether they spontaneously contribute to the environmental cause, or whether they engage in environment-friendly choices due to social pressure - for instance, by seeing family, friends or colleagues, feeling responsible, and acting accordingly. In this facet, the authors then move forward by discussing a theory I already outlined in Section 2.4: this is the theory of planned behaviour, the application of which is discussed by the authors, together with the way this might help address the predicted behaviour.
 - b. Social identities represent the second facet, including the impact driven by the individual as a member of a group. For example, consumers are more likely to engage in sustainable actions, if ingroup members are also doing the same.
 - c. The third facet is social desirability. As per the authors’ words: “Consumers tend to select sustainable options to make a positive

impression on others, and they endorse high-involvement sustainable options to convey social status to others. However, observers sometimes view sustainable behaviours negatively, leading some consumers to avoid pro-environmental actions” (White, Habib and Hardisty, 2019).

2. “Habit formation” is the second element of the SHIFT framework. Specifically, “habits refer to behaviours that persist because they have become relatively automatic over time as a result of regularly encountered contextual cues. Many behaviours with sustainability implications are strongly habitual. Actions that encourage repetition, such as making sustainable actions easy and utilizing prompts, incentives and feedback, can strengthen positive habits” (White, Habib and Hardisty, 2019).
3. The third element that can play a significant role on consumption behaviours is the “Individual self”, including concepts such as self-concept, self-interest, self-consistency and individual differences. I will not discuss this factor further, as it does not appear to be relevant to the purpose of this dissertation.
4. “Feelings and cognition” represent the fourth element of the SHIFT framework: according to the authors, consumers may take two different routes to action, either the one moved by feelings, or the one that is driven by cognition. Within the decision making process, the cognitive route can dominate the intuitive and affective one moved by feelings - which, on the other hand, could also play a major role in impulsive shopping scenarios.
5. Lastly, “Tangibility” entails “more sustainable consumer behaviours involve putting aside more immediate and proximal individuals interests to prioritize behaviours with ill-defined consequences that are focused on others and are only realized in the future. Moreover, consumers are not likely to act on issues that are impalpable in nature” (White, Habib and Hardisty, 2019).

Once marketers have successfully identified their core market audiences and segmented them accordingly, it won't be necessary to rethink their marketing strategies from scratch to approach private individuals across different markets: the key to target new potential customers and drive incremental sales will be insisting on marketing campaigns highlighting the benefits of owning an EV. In this regard,

depending on the market, the local government's support is therefore pivotal. In the Mexican case, the public administration should keep encouraging the population, inviting them to evaluate the offerings made available by the different brands, as well as helping them make an informed decision on which product option would suit them the best. Contextualising the government's initiatives by publicly sharing reports over pollution levels within the country, and supporting the collected data with the insightful help of sector experts at open press conferences, will help consumers and the wider community to understand how the most affected cities can improve their own environmental conditions.

2.8 Conceptual Framework

In this section, I will introduce the conceptual framework that will be used to analyse and interpret both the referenced literature, and the data collection, based on primary data (qualitative research) and secondary data (case studies). As shown in Figure 2.3, I will use background literature, structured interviews with experts, and online questionnaires submitted to a defined audience pool of Mexican consumers as to support the research methods and develop the conceptual framework. This mixed approach will give further insights around the actual individual's considerations, based on the planned behaviour theory explained in Chapter 2: this will ultimately help clarify the elements determining a decision-making process favourable to EV, as opposed to the one leading consumers to purchase a more traditional internal combustion vehicle. From this analysis, it should also become clearer how private individuals and businesses in Mexico make their own purchase decisions, after considering the government's initiatives and the overall situation of the automotive market in the country.

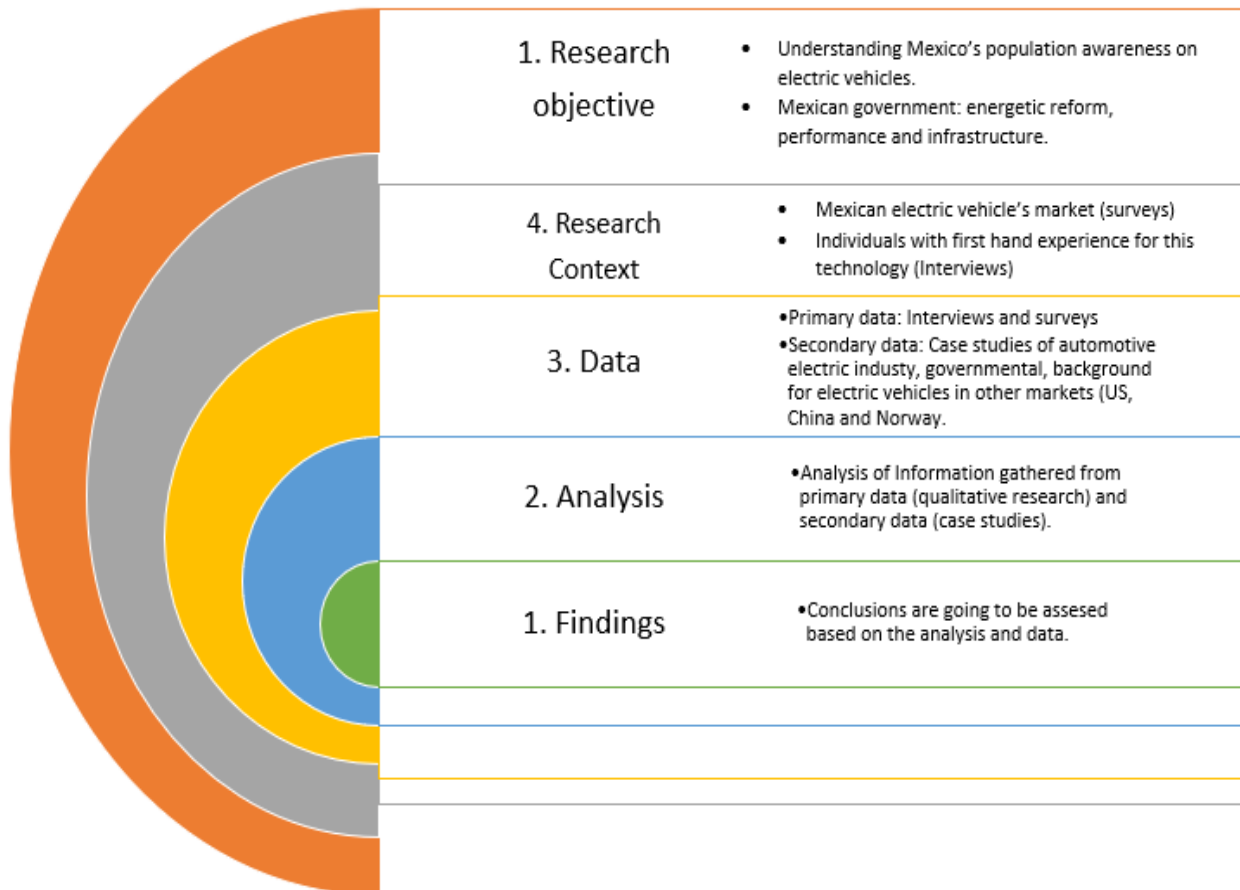


Figure 2.3: Conceptual research framework.

2.9 Conclusion

Through the present Literature chapter, I presented the main elements that are being considered by Mexican government and affect the Mexican market regarding the EV technology: I have identified the conceptual framework through theories that have conceptualised the processes that developed countries, such as the US, China, and Norway, have already adopted to introduce EVs, and pointed out the underlying differences with the Mexican case, whenever relevant. In this regard, I also presented general environmental issues that may affect Mexico, and which I will further tailor for my country-specific research over my discussion of findings in Chapter 4.

As this dissertation focused on presenting the limitations of the EV technology in Mexico, deep diving into the country's current situation and expectations for its

future, I considered the federal government's approach to the matter, listing a set of initiatives that they have been issuing in the last few years. By additionally outlining the EV purchase-making process, referring to literature on the subject, I will leave to the following paragraphs the analysis of individual point of views from Mexican decision makers and experts in the field, who I interviewed and made the samples from to understand their different perspectives.

The following chapter will cover the methodology and research design applied in this dissertation. The main objective is to answer the research questions included in Chapter 1, whilst showing my support (or arguing against) academic papers and theories already produced around the current topic.

Chapter 3: Methodology and research design

3.1 Overview

The present chapter illustrates the methodological approach applied to this dissertation, which is the “research onion” - an explanation model created by Saunders, Lewis and Thornhill (2009), to describe the different stages which a researcher has to go through to develop a study. For the investigation to have the maximum credibility, it must provide explanations, justifying them at every level of the methodological decisions. The research onion gives form to the present chapter and provides a structure to the dissertation itself: as the onion has different layers, the main idea is to start describing the external layers first, and then peel off every layer until we reach the nucleus.

These layers are represented by six areas:

1. Philosophies
2. Approaches
3. Strategies
4. Choices
5. Time horizons
6. Techniques and procedures

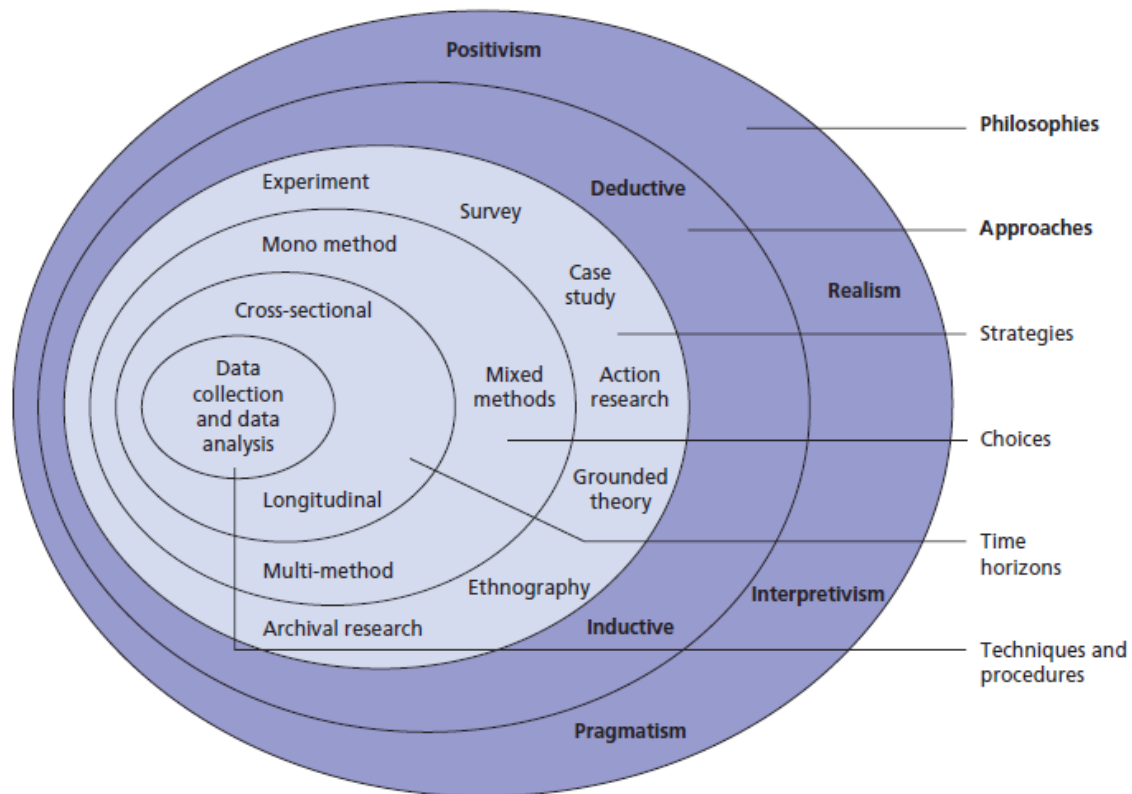


Figure 3.1 Research onion, Saunders, Lewis and Thornhill (2009).

The Philosophies layer (1) refers to the assumptions believed about the nature of the reality that is being researched. This is the first layer that has to be considered, as it has a significant impact in both epistemological¹⁰ and ontological terms¹¹. Among the four available research philosophies - Positivism, Realism, Interpretivism and Pragmatism - the present dissertation will follow Pragmatism. As I will further specify in Section 3.2, this research philosophy assumes that no single perspective can ever provide a full picture; only the research question is central, and the integration of different perspectives, as they will be analysed in the following chapter, will ultimately help interpret data (Saunders, Lewis and Thornhill, 2009).

The Approaches layer (2) represents the way the researcher tackles the studied phenomenon: it could be described either as “inductive” or “deductive”. The inductive approach starts from the small and then it gets bigger, i.e. it starts with specific hypotheses that have been developed on the basis of empirical information, or patterns observed by the researcher, and then it seeks to prove these same

¹⁰ Epistemology: refers to what constitutes valid knowledge and how we can obtain it.

¹¹ Ontology: refers to what constitutes reality and how we can extend its existence.

hypotheses on a wider scenario, eventually developing a theory from it. Conversely, the deductive approach starts with a general theory to then infer conclusions over small and specific details. It is important to note that the deductive approach mostly leverages quantitative research, whilst the inductive one is often related to qualitative research. The present dissertation is supported by qualitative research as conducted through the inductive approach.

The Strategies layer (3) outlines how the research aims at leading and carrying out its work, specifying the particular design that will be used for the data collection. The designs that are most frequently employed are the experiment, the survey, case studies, action research, grounded theory, ethnography and archival research. As mentioned in Chapter 1, this dissertation will be presented in the form of a case study.

Concerning the Choices layer (4), this is usually mono method, mixed methods, or multi-method, depending on the number and the type of the employed research designs (Saunders, Lewis and Thornhill, 2009). As mentioned in previous chapters, I will conduct qualitative research by using structured interviews and online questionnaires: these latter will be specifically useful to collect insights and further findings to support my conclusive position on the main topic of the dissertation. Since I will leverage two research designs of the same type, the Choices layer will be multi-method.

The Time Horizon layer (5) refers to the time frame the project requires to be completed. In the research onion, there are two types of time horizons, “cross-sectional” and “longitudinal”: the former prescribes a preset time for the data collection, eventually delivering a snapshot of a given phenomenon; conversely, the latter interprets data collection as an extended process over time, as it is the case for a given phenomenon developing over time, and therefore requiring data being collected over a prolonged amount of time. As further detailed in the next section, by leveraging structured interviews and online questionnaires as qualitative research designs conducted over a short period of time, the present research will aim at providing a snapshot around the topic, and it will therefore employ a cross-sectional time horizon.

The final layer consists of Techniques and Methods (6), and it explicitly addresses “how” and “why” research is conducted. This layer includes two sections: data

collection and data analysis. Concerning data collection, I specified the qualitative research designs which I will leverage; for what concerns data analysis, traditional research techniques will be employed, such as audio-recorded transcription of the interviews. As per the different nature of the online questionnaires, this research will not apply any quantitative method over those: rather, it will use them as a basis to infer additional insights on the audience pool itself, without extending its result through generalised conclusions.

In the following section, I will further break down the research onion, illustrating how every layer is applied to my research.

3.2 Research philosophy and approach

The research philosophy I selected for the present dissertation is Pragmatism, which argues that the most important and crucial element of the adopted epistemology, ontology and axiology is the research question.

The main reason why I will consider pragmatism as the philosophy adopted in my research is due to the meaning and the value assigned to its consequences, which allow me to discard the existence of absolute and unobjectionable truths. As per the case of EVs in the Mexican market, I will have to consider that there is no absolute truth: ideas are provisional and they are always subject to change.

My conclusion will be developed once all the data will be collected from the interviewed experts and the Mexican consumers targeted by the online questionnaires, (See appendix G) and an inductive approach will be applied over it. Research using an inductive approach is likely to be particularly concerned with the context in which such events were taking place. Therefore, the study of a small pool of subjects might be more appropriate than a large number, as it is often the case for an inductive approach (Saunders, Lewis and Thornhill, 2009).

By embracing an inductive approach, qualitative data will be suitable to describe and establish different views over the adoption of the electric vehicles technology in Mexico.

3.3 Research strategy and time horizon

As mentioned in the previous sections, the present dissertation will be an explanatory research: “Studies that established relationships between variables may be termed explanatory research. The emphasis here is on studying a situation or a problem in order to explain the relationships between variables, alternatively , or in addition to” (Saunders, Lewis and Thornhill, 2009).

Qualitative data will be collected to support the reasons why I believe Mexico is ready, or not, to adopt the electric vehicles technology, following its current political context and other surrounding variables.

The time horizon of this research will be driven by the cross-sectional study strategy. The cross-sectional studies support the sample strategy from a quantitative perspective - however, they may also be based on interviews conducted over a short period of time: in this regard, they will be used in the context of a qualitative research to positively support the chosen methods.

The people I will be interviewing face to face will already have a background in the EV market and related technology. With them, I'll conduct a more in-depth research, focusing our conversation on the following topics:

- Different EV brands and vehicle manufacturers;
- Marketing activities aimed at promoting this technology;
- Mexico's market regulations and current policies;
- The monopoly of energy's industry in Mexico;
- The future of the EV market in Mexico;
- The awareness of the contamination issues in Mexico;
- A general comparison of the EV market potential with developed countries;
- The infrastructure that may be needed in Mexico to implement this technology;
- General political opinion on the Mexican government's operate;
- Mexico's energy reform plans;
- Their overall personal experience driving an EV;
- Their thoughts in relation to potential savings on fuel and return on investment as a consequence of buying an EV;

These structured interviews will be based on a predetermined and standardised set of questions. As Saunders, Lewis and Thornhill (2009) mentioned: “While there is social interaction between you and the participant, such as the preliminary explanations that you will need to provide, you should read out the questions exactly as written and in the same tone of voice so that you do not indicate any bias. As structured interviews are used to collect quantifiable data they are also referred to as ‘quantitative research interviews.’”

Although structured interviews are more common within quantitative research, whereas semi-structured interviews are more frequently leveraged by qualitative studies, having predetermined questions for all the interviewees, irrespective of the level of their experience, will aim at collecting the same results which semi-structure questions could provide, i.e. collecting different views on the industry sectors the interviewees operate in, learning more about each individual’s perspective, opinions and feelings, to ultimately examine their professional experience, as well as personal attitudes and beliefs.

	Exploratory	Descriptive	Explanatory
Structured		✓✓	✓
Semi-structured	✓		✓✓
Unstructured	✓✓		

✓✓ = more frequent, ✓ = less frequent.

Table 3.1: Use of different interview types in each of the main research categories, Saunders, Lewis and Thornhill (2009).

In Table 3.1, Saunders, Lewis and Thornhill illustrate which types of interview are more frequent for each type of research study. In this context, structured interviews supporting qualitative research will be key for the explanatory study this dissertation will present in the form of a case study.

In the following Section 3.4, I will address the sources and selection criteria for the expert interviews and the online questionnaire submitted, showing the benefits that they will bring to this research.

3.4 Research method

3.4.1 Sources

This case study research will consist of primary data, including structured interviews and online questionnaires, as well as secondary data, already referenced to within the literature review.

As mentioned, I will apply the multi-method approach to collect primary data: by being expert interviews and online questionnaires used as qualitative research designs, I will use them to unearth additional insights on the research topic; however, they will not be used to draw any conclusion of statistical nature.

Concerning the expert interviews, this will be conducted face to face over Zoom calls: Table 3.2 summarises the questions I will ask to interviewees, who already had direct experience of the EV market and its related technology.

Expert Interview: questions	References
<p>1. Which EV brand do you think has the highest market share in the country where you live?</p>	<p>Elías Massri, general director of Giant motors of Latin America, points out: "Virtually all brands have electric vehicles, but not all have brought them to Mexico. China is the largest manufacturer of electric models and what we are doing is bringing what the market needs ". Rodriguez, (2021), "Esta empresa mexicana ya es la que más vehículos electricos vende en el pais," <i>Expansion</i>, Available at: https://expansion.mx/empresas/2021/02/22/esta-empresa-mexicana-ya-es-la-qu-e-mas-vehiculos-electricos-vende-en-el-pais [Accessed: 05 July 2021].</p>
<p>2. Could you please quickly summarise your experience of driving an EV, mentioning the model and brand of the vehicle?</p>	<p>BYD "Build Your Dreams" is the largest Chinese EVs manufacturer, and it has been evolving its operations since they started their production in 1995: "In 1995, BYD Company Limited started operations with 20 employees and US\$</p>

	<p>300,000 in initial investment. Since then, the company has grown at an average of 70% per year. Today, the Chinese company has a staff of 190,000 employees worldwide and around US\$ 9.1 billion in sales” (Masiero, Risso and Ogasavara, 2016).</p>
<p>3. What do you think is the key decision driver in the consumer’s purchase journey? Do you think people are convinced to buy an EV due to the messages promoted by specific marketing strategies, or because they really believe in the technology that each brand is bringing to the market?</p>	<p>This question might help support the theory of "planned behaviour" by Icek Ajzen, discussed in the academic paper from White K., Habid R., Hardisty J., (2019).</p>
<p>4. How much do you know about the current policies, processes and incentives that Mexico is promoting to implement this technology within the country? Do you think they are doing a successful job to encourage the population to adopt and buy this technology, in an effort to create a more sustainable automotive industry within the country?</p>	<p>Infrastructure and incentives in Mexico are discussed in Section 2.5, Table 2.4, and Sanchez, Fabela, Hernandez, Flores, Vazquez, and Cruz (2020), further analysed in Section 2.5.3.</p>
<p>5. What’s your opinion about energetic reform in Mexico?</p>	<p>Energy reforms in Mexico are reported in Section 2.5.4. Wood D. (2018), "Mexico's New Energy Reform" Wilson Center Mexico Institute. Available at: https://www.wilsoncenter.org/sites/default/files/media/documents/publication/mexicos_new_energy_reform.pdf [Accessed: 08 July 2021]</p>
<p>6. Is there anything you do, whether once in a while or on a daily basis, to contribute to the environmental cause?</p>	<p>Understanding how social practices and norms (e.g. recycling, using eco-friendly transportation, etc.) might influence consumer’s sustainability behaviours, as reported in Section 2.6.</p>
<p>7. As we know, pollution has a</p>	<p>Firstly understanding the contamination</p>

<p>significantly negative impact on our health: have you, or someone that you know (friends, family members, colleagues), been directly affected?</p>	<p>issue in Mexico will help discuss why it is very important for this technology to be implemented in its automotive market, as per Section 2.5. Borja-Aburto, Rosales-Castillo, Torres-Meza, Corey and Olaiz-Fernandez, N.D. Evaluation of health effects of pollution in Mexico, Available at: https://www.oecd.org/environment/cc/2053205.pdf [Accessed: 15 August 2021]</p>
<p>8. Which country do you consider the most advanced in relation to this technology? Do you know anything they are doing better than Mexico to develop this technology?</p>	<p>Relevant markets are analysed in Section 2.3.2. Norway, China and the US are the main countries where EV technology is already developed: "Virtually all brands have electric vehicles, but not all have brought them to Mexico. China is the largest manufacturer of electric models and what we are doing is bringing what the market needs ". Rodriguez I. (2021), "Esta empresa mexicana ya es la que más vehículos eléctricos vende en el país" Expansion. Available at: https://expansion.mx/empresas/2021/02/22/esta-empresa-mexicana-ya-es-la-que-e-mas-vehiculos-electricos-vende-en-el-pais . [Accessed: 02 July 2021].</p>
<p>9. What would be your general political opinion (without giving information about the party you support) on how Mexico's government operates in terms of bringing this technology? How much do you think the country will take in terms of infrastructure to be able to operate in the more developed cities?</p>	<p>Understanding how the infrastructure works in general terms will give an idea how close or far Mexico is in terms of implementing this technology within the infrastructure variable. As mentioned in Section 2.4 "Efforts to promote electric vehicles, recharging infrastructures and the required industrial base amount to a form of policy convergence in terms of transport policy, industrial policy and environmental policy" (Wells P. 2012). This is discussed as part of the findings in Chapter 4 and conclusions in Chapter</p>

	<p>5, with the support of the academic paper: "A Comprehensive Study of Key Electric Vehicle (EV) Components, Technologies, Challenges, Impacts, and Future Direction of Development". Un-Noor, Padmanaban, Mihet-Popa, Mollah, Eklas Hossain, (2017). doi:10.3390/en10081217</p>
<p>10. What are your thoughts in relation to potential savings on fuel and return on investment as a consequence of buying an EV?</p>	<p>Advantages and disadvantages are discussed in Section 2.3.1. Details about financial savings will be discussed in the findings section of Chapter 4. This analysis will be supported by the following academic papers:</p> <ul style="list-style-type: none"> • Velzen, Annema, Van de Kaa, Van Wee (2019). "Proposing a more comprehensive future total cost of ownership estimation framework for electric vehicles" , EISEvier. DOI: https://doi.org/10.1016/j.enpol.2019.02.071 • Bauer, Hsu and Lutsey (2021), "When might lower-incomer drivers benefit from electric vehicles? Quantifying the economic equity implications of electric vehicle adoption" International council of Clean Transportation, Available at: https://theicct.org/sites/default/files/publications/EV-equity-feb2021.pdf [Accessed: 26 August 2021]

Table 3.2: Interview questions and references.

I will conduct four structured face to face interviews with experts, audio recording them for transcription purposes.

Among the interviewees, three experts work for the same company, which is located in Mexico, and it is a major player within the logistics industry, with scaled operations across several Latin American countries. The fourth interviewee used to work for the same company, and recently moved to a different Mexican firm of comparable size, within the steel industry. These four experts all work in procurement departments,

and are responsible for developing projects around the company's fleet, and for managing negotiations with electric vehicles suppliers.

From these structured interviews, the experts' contribution will help complement the picture already presented in Section 2.5, shedding new light over the country's current policies and their impact on private companies.

In Figure 3.2, I reported the framework I referenced to formulate my structured interviews with experts: the type of questionnaire administered, sometimes known as "interview schedules", refers to those questionnaires where interviewers physically meet respondents and ask questions face to face. This differs from semi-structured and unstructured (in-depth) interviews, as there is a defined schedule of questions which interviewers should not deviate from (Saunders, Lewis and Thornhill, 2009).

By conducting structured interviews, questions will not change depending on the interviewee's answer, nor follow-up questions will be added, as it is the case for semi-structured interviews. Moreover, as physical interviews are not possible due the distance of the interviewee and myself, a Zoom video call will be held with each expert instead.

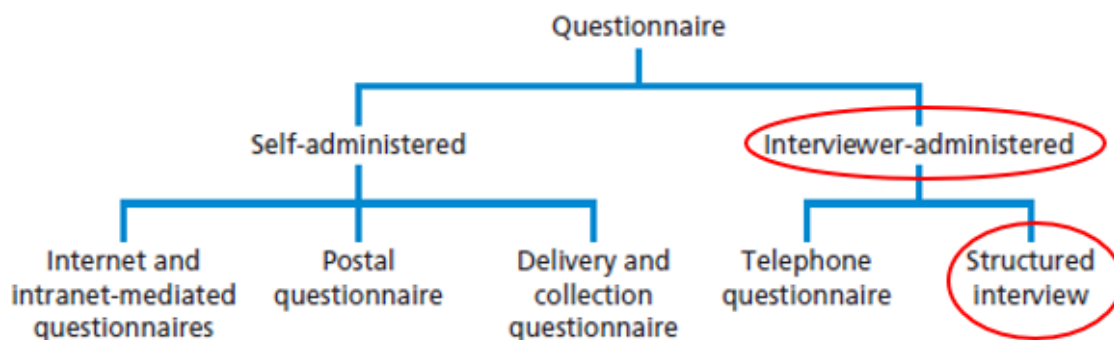


Figure 3.2: Types of questionnaire, Saunders, Lewis and Thornhill (2009).

Concerning the second research design employed in this dissertation, in Table 3.3, I reported the questions that will be submitted to a pool of consumers via an online questionnaire. The selected audience pool do not include experts within the sector; rather, it aims at collecting a first dataset from Mexican consumers to infer reasonable hypotheses about their decision-making process, as it relates to the elements that are considered before actually purchasing an EV:

Online questionnaire: questions	References
<p>1. Have you ever heard about Electric Vehicles and the technology empowering them?</p>	<p>In Section 2.2.1, I mentioned different concepts related to Electric Vehicles: "Regardless, when we generally speak about "Electrification" in relation to vehicles, we mean some degree of electric input powering the driving experience. For EV and plug-in hybrids, this is specified by the concept of "range", i.e. the distance, measured in kilometers or miles, which a vehicle can cover when its batteries are fully charged". The main purpose here is to clarify whether consumers are aware of the introduction of this specific technology in Mexico, and which level of knowledge they have about the elements supporting it.</p>
<p>2. On a scale from 1 (never heard of) to 5 (extremely familiar), please rate how familiar you are with each brand producing EV models. By familiarity, we mean how much you know about these brands actually commercializing EVs, and how well you know the EV models. The more you know about the EV brand, the higher you should rate it; the less you know about the EV brand, the lower you should rate it. If you have never heard of them, please select 1. Available options: Tesla, Nissan, General Motors (Chevrolet), JAC, BYD, BMW, Volkswagen, KIA.</p>	<p>In Section 2.3.2, I mentioned the most important brands available in Norway, the US, China and Mexico. As the interviewees are all Mexican consumers, it is important to validate the knowledge they have about the EV market. According to INEGI (Instituto Nacional de Estadística y Geografía): Nissan, Chevrolet, BMW, Audi, Jaguar, Renault and Giant Motors are the EV manufacturers who reported the highest sales volumes during 2020.</p>
<p>3. If, in the above list, we haven't included an EV manufacturer that you heard of, please add it below:</p>	<p>See reference above.</p>
<p>4. Have you ever driven an EV before?</p>	<p>As reported in Section 2.7, one of the marketing strategies proposed by Garling and Thogersen is in fact the test-drive experience of an EV: this is an</p>

	<p>opportunity that car brands can give to potential customers to prove the value of their product, bridging the gap between trialability and final purchase for the consumer's benefit: "Hardly anyone buys a new car without having had the opportunity for a test drive" This strategy will help shape a successful marketing plan. Garling and Thogersen (2001).</p>
<p>5. If your previous answer was "Yes", could you please explain your experience in detail? Also, which brand did you drive?</p>	<p>As mentioned in Section 2.7, one of the strategies suggested by Garling and Thogersen to help shape a successful marketing plan is having a wide range of offering, alternatives, and competition: "By having different entry-prices in relation to different product options, this will help consumers make a more informed decision". Garling and Thogersen (2001)</p>
<p>6. Do you know anyone owning an EV?</p>	<p>In Section 2.7, I reported the importance assigned by Garling and Thogersen to word of mouth in the context of shaping a successful marketing plan: "It is important that the EVs are not over-marketed, due the implications that might occur". Garling and Thogersen (2001). Specifically, these implications are mentioned in Section 2.6.</p>
<p>7. If your previous answer was "yes", please specify how many people that you know own an EV</p>	<p>See reference above.</p>
<p>8. How much do you think (or know) the entry price for an EV is? (in MXN\$)</p>	<p>Advantages and disadvantages are discussed in Section 2.3 and further illustrated by Table 2.2. As a disadvantage, the electric vehicle's entry-prices are higher, as compared with the ones of an internal combustion vehicle. De Alba (2016), "¿Es viable el auto eléctrico en el mundo? ¿Y en México?", pp. 25, DOI:</p>

	10.13140/RG.2.2.14785.35689
9. If you could afford an EV, would you consider purchasing one?	In Section 2.4, I mentioned the “theory of planned behaviour” by Fishbein and Ajzen (1975): “The theory of planned behavior proposes that behavior is predicted by behavioral intention which is, in turn, predicted by three base components: attitudes toward the behavior, subjective norms regarding the behavior, and perceived control over the behavior.” Sussman and Gifford, (2019). Causality in the Theory of Planned Behavior, pp. 1, DOI: 10.1177/01461672188013
10. If your previous answer was "No" please explain why	As I argued in Section 2.4: "Why would anyone want to purchase an EV without being fully aware of what it takes to drive it and maintain it over time? In an oversimplified picture, a consumer might enter a Tesla dealership, speak to the dealer, ultimately deciding to go ahead and finalise the EV purchase. What is driving, however, that purchase intention is still worth investigating". This comment is based on the "Theory of planned behavior" by Fishbein and Ajzen (1975): In Figure 2.1, I also showed the cause-effect relation implied within a consumer’s decision making process.
11. If your answer was "Yes", which of these factors are important to you when you make the decision about which brand of EV to purchase?	This question aims at identifying the factors that are considered when considering purchasing an EV, so they can be further grouped and ranked in a sequential order to eventually illustrate the decision making process.
12. What do you think will encourage you to buy an EV?	This question will help support the SHIFT framework about marketing and sustainability, as discussed in Section 2.6. The framework used by the authors is represented by the acronym “SHIFT”,

	<p>and it suggests that consumers tend to be more inclined to engage in pro-environmental behaviours when the marketing message includes the following factors: Social influence, Habit formation, Individual self, Feelings and cognition, and Tangibility. White, Habib and Hardisty (2019), "How to SHIFT Consumer Behaviors to be More Sustainable: A Literature Review and Guiding Framework", pp. 1, DOI: 10.1177/0022242919825649</p>
<p>13. Do you know if Mexico has any incentives for people who own an EV?</p>	<p>Infrastructure and incentives in Mexico are detailed in Section 2.5 and Table 2.4. Sanchez, Fabela, Hernandez, Flores, Vazquez, and Cruz, (2020.) "Estado del arte de la movilidad eléctrica en México", Secretaría de Comunicaciones y Transportes, PP. 24. Available at: https://imt.mx/archivos/Publicaciones/PublicacionTecnica/pt596.pdf [Accessed: 3 July 2021]</p>
<p>14. If your previous answer was "yes," please specify which incentives you are aware of.</p>	<p>See reference above.</p>
<p>15. On a scale from 1 (never heard of) to 5 (extremely familiar), please rate how familiar you are with contamination issues in Mexico. By familiarity, we mean how often you have come across pollution issues, and what it is like. The more you know about the topic, the higher you would rate it. The less you know about, the lower you would rate it. If you are not aware, please select 1 (never heard of).</p>	<p>Firstly understanding the contamination issue in Mexico will help discuss why it is very important for this technology to be implemented in its automotive market, as per Section 2.5. Borja-Aburto, Rosales-Castillo, Torres-Meza, Corey and Olaiz-Fernandez, N.D. Evaluation of health effects of pollution in Mexico, Available at: https://www.oecd.org/environment/cc/2053205.pdf [Accessed: 15 August 2021]</p>
<p>16. Are you helping overcome any pollution issues that Mexico has, or involved in any environmental friendly activity?</p>	<p>Understanding how social practices and norms (e.g. recycling, using eco-friendly transportation, etc.) might influence consumer's sustainability behaviours, as</p>

	<p>reported in Section 2.6. White, Habib and Hardisty, (2019). "How to SHIFT Consumer Behaviors to be More Sustainable: A Literature Review and Guiding Framework" Journal of marketing. PP. 1, 10.1177/0022242919825649</p>
<p>17. If your previous answer was "yes", please specify how you are involved with the environmental cause.</p>	<p>As discussed in Section 2.6 regarding the SHIFT behaviour, the “challenge of collective action” is relevant to how social influence might operate when considering sustainable actions vs. conventional) ones. When people observe others engaging in an action, this may increase perceptions of collective efficacy or “a group’s shared belief in its conjoint capabilities to organize and execute the courses of action required to produce given levels of attainments”, e.g. some people might be involved in recycling practices, or doing other activities to help the environment cause, hence influencing collective actions, as White, Habib and Hardisty mentioned (2019).</p>
<p>18. Do you have any knowledge about Mexico's energy reform?</p>	<p>The energy reforms in Mexico are discussed in Section 2.5.4. Wood D. (2018), "Mexico's New Energy Reform" Wilson Center Mexico Institute. Available at: https://www.wilsoncenter.org/sites/default/files/media/documents/publication/mexicos_new_energy_reform.pdf Accessed: 08 July 2021]</p>
<p>19. If your previous answer was "yes", what is your position regarding this reform, and how do you think it will affect or benefit Mexico?</p>	<p>As mentioned in Section 2.5.3, by increasing CFE’s participation in the power production and supply markets, free competition was essentially removed from the picture, fundamentally limiting the operations of the private companies working in the sector. Paramo, Brown</p>

	and Guerrero (2021), "Reforms in the energy legal framework in Mexico and challenge mechanisms, DLA Piper Global Law Firm, Available at: https://www.dlapiper.com/en/latinamerica/insights/publications/2021/06/reforms-in-the-energy-legal-framework-in-mexico-and-challenge-mechanisms/ , [Accessed: 20 July 2021]
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Table 3.3: Online questionnaire questions and references.

The online questionnaire will be submitted to an audience pool of 30 people: they will be all Mexican consumers, who may not necessarily be experts on the subject; they might not have heard about this technology and its potential applications before, or they might have heard of it, but they would not have an informed perspective, or direct professional experience, on how this could work in their country.

To summarise, Table 3.4 will help illustrate advantages and disadvantages of both the qualitative research designs included in my multi-method approach.

Case study research	Good for assessing	Advantages	Disadvantages
Structured Interviews	<ul style="list-style-type: none"> • Attitudes • Opinions • Interpretations • Motives • Experiences 	<ul style="list-style-type: none"> • Different responses or opinions to the same questions capture individuals' perspective of the phenomenon . • It is generally used for exploration of individuals' opinions of complex phenomena. • Conversational by design which 	<ul style="list-style-type: none"> • The interviewer may give out unconscious signals which impact how the respondent expresses themselves. • Not very reliable as there is a lack of standardisation to exactly repeat an interview. Even though the researcher used an interview guide, the use of probing questions results in respondents being asked different questions.

		allowed respondents to share insights and facts that they might have deemed irrelevant.	<ul style="list-style-type: none"> • Requires substantial time from researcher and respondents to gather data, with the additional burden to transcribe interviews to complete the analysis.
Online questionnaires	<ul style="list-style-type: none"> • Knowledge • Attitudes • Intentions • Behaviours 	<ul style="list-style-type: none"> • A quick and inexpensive way to get information from a large number of people. • It's easy to be consistent in how you administer the surveys. • Analysing surveys is relatively straightforward. • Can be easily conducted online and are convenient cost-effective solution. 	<ul style="list-style-type: none"> • Writing a good survey is harder than many people realise. • If a survey is too long, participants may get bored and leave the survey incomplete. However, if the survey is short, not enough data will be collected to form a full picture. • Behaviours are self-reported (and maybe biased).

Table 3.4: Advantages and disadvantages of data collection methods.

3.4.2 Access and ethical issues

“Ethical issues are likely to be of importance throughout your research and require ethical integrity from you as a researcher, your research sponsor (if any) and the organisation’s gatekeeper”.

Saunders, Lewis and Thornhill (2009).

After having worked for several years in a company promoting the usage of EVs, and having participated in the development of projects regarding this new technology first

person, I will be able to take advantage of my professional network, and I will personally contact potential candidates for my interviews: the interviewee pool will include, for example ex-colleagues who worked together with me on the EV project.

Regarding the ethics underlying my interviewing practices, I will adopt the standard principles of the scientific research, namely:

- Anonymity
- Confidentiality
- Informed consent

To better qualify these principles, I will add the below statement:

“According to Richards and Schwartz’ findings, the term ‘confidentiality’ conveys different meanings for health care practitioners and researchers. For health care practitioners, confidentiality means that no personal information is to be revealed except in certain situations. For researchers, however, the duty of confidentiality is less clear and involves elaboration of the form of outcome that might be expected from the study” Sanjari M., Bahramnezhad F., Fomani F., Shoghi M., and Cheraghi M., 2014).

3.4.3 Potential outcomes

With regards to the multiple topics at stake within this research, I’ll have to proceed carefully, introducing an order to the agenda of the questions involved. In fact, different types of challenges are raised by the main subject of this dissertation, which can be ultimately summarised in environmental, technological, governmental, strategical, and analytical issues.

I will make sure to employ logic, as well as critical and documented theories to conduct my investigation, such that the outcomes of a qualitative research can be reported from the most possible objective viewpoint.

The pool of interviewees chosen might also affect the qualitative insights collected: we know they will be expert consumers, or potential customers, of the EV products and services part of the interviews; on the other hand, their opinions might be in contradiction with my personal view of Mexico’s market issues and further analysis.

Lastly, as limited literature is available around the main dissertation's topic in connection with the Mexican country, I'll treat the available insights coming from other countries with a critical approach: although there might be some shared elements, questions, frameworks and theories are always relative to the markets where the analysis is conducted in the first place - and it might not necessarily be applicable to the Mexican's wider context.

The evidence sourced from the academic papers used for the literature review include studies about technology, environment, politics, laws, policies, marketing, etc. Such heterogeneous literature has to be leveraged to report on the diversity of the industrialized world, and specific problems such as natural and chemical pollution that are affecting in different ways the environment across the world. Contamination might not be the main topic; nevertheless, this is an important issue that has to be addressed in relation to Mexico and the potential for the development of its EV market: elements like these will in fact impact in our understanding of the time that this market will need to fully develop, and become profitable for both vehicle manufacturers, their investors and their consumers.

3.5 Approach to data analysis

In the present dissertation, data that will need to be analysed include expert interviews, online questionnaires, and secondary data I referred to in the literature review earlier introduced in Chapter 2.

Following the qualitative approach described earlier, the structured interviews will focus on asking experts their view on how the EV technology is implemented in Mexico, how the federal government is promoting its adoption, and the impact of this revolution on the contamination issues that affects the country, as reported by the reviewed literature. Specifically, given the professional positions covered by these experts in their respective companies, the analysis of their interviews will help shed specific light on how larger organizations are implementing this new technology in their scaled operations and workstreams, including related improvements and limitations.

To analyse the expert interviews, I will use the methodology recommended by Meuser and Nagel: this procedure aims at ensuring a meaningful comparability of thematic units and passages with similar topics, as they are identified when organising data collected from the respondents (Meuser and Nagel, 2009). Their methodology follows six steps:

1. Transcription: after audio recording the interviews, conversations are reported in writing verbatim, to be used as prerequisite for the analysis;
2. Paraphrase: i.e. sequencing the transcribed thematic passages into summarised units;
3. Coding: i.e. organising and ordering the paraphrased passages thematically, while adopting the interviewee's terminology;
4. Thematic comparison: by following the same logic as coding, similar thematic passages are now compared across interviews and tied together;
5. Sociological conceptualisation: i.e. aiming at producing a distant review of the interviewee's text and terminology. At this stage, common and differing features from the interviews are determined.
6. Theoretical generalisation: the researcher arranges the categories as per their internal relations, empirically generalises from the findings, and draws a conclusion.

With regards to the online questionnaires, they were initially submitted to over 200 Mexican consumers, aimed at providing a population sample to draw generalisations from, as supported by quantitative analysis and rigorous statistical methods. However, due to the small number of 30 respondents actually engaging with the online questionnaire, I will not be able to take this collected data into consideration as a reliable "sample". As the word "sample" is traditionally used as a scientific term in quantitative analysis, I'll avoid its employment in this context, hence using respondents' replies as part of a qualitative research design, eventually referring to them as an "audience pool" instead. As this "audience pool" is not a statistically relevant sample, I will limit my considerations over the data collected by the questionnaire to infer particular insights related to the audience pool itself, rather than using induction and extending generalisations, as it is the case for the expert interviews.

Finally, findings from the structured interviews to experts, literature review, and online questionnaires are combined, respecting role, contextual value and consideration limitations, assigned to each of these research elements.

Chapter 4: Presentation and discussing of the Findings

4.1 Overview

In this chapter, I will present, discuss, and conclude over the research findings as derived by a careful examination of primary and secondary data sources.

Primary data are mainly represented by structured interviews with field experts working for large companies in Mexico, and collect their own professional experience with EV technology.

Additional insights will be added by the replies of participants to an online questionnaire, which was also submitted to a wider non-technical pool of Mexican consumers: limitations related to research design have already been clarified in Section 3.5.

Secondary data sources are represented by a series of case studies which have already been discussed in the literature review, and will be further analysed in the following paragraphs. The purpose of this data is to reference all the best practices and available information related to electric vehicles in Mexico, in order to clarify the implications that might positively and negatively affect the country's adoption of this new technology.

After including further details about structured interviews' and the online questionnaire population (Section 4.2), I will clarify the interview data gathering and data analysis techniques (Section 4.3 and 4.4), ultimately presenting the findings' main topics in Section 4.5.

4.2 Structured interview & online questionnaire population

The structured interview population included four experts, 30-40 years old, working in large companies based in Mexico: they are all in charge of vehicle and transportation projects in their respective sourcing departments, including passenger and non-passenger vehicles.

As described in Section 3.4.2 about Access and Ethical Issues, I will not provide their company names, nor I will add any further anagraphic details of the interviewees themselves. In this regard, I can only mention that potential candidates for these interviews were chosen by leveraging my previous professional network. As I used to work in a company promoting the usage of EVs for several years, and I used to be directly involved in the development of projects employing this new technology, I had the possibility to contact former colleagues, as well as suppliers who worked with me on these EV projects. Unfortunately, only my former colleagues agreed to participate to these interviews: although the number and type of interviewees could be improved and further diversified, I still believe that, given the importance and the scaled operations the company they work for has in Mexico, their contribution is absolutely valuable and data collected from such experienced professionals in the field is indeed reliable.

The first company where three out of the four interviewed expats work for is an organisation that creates economic and social value through subsidiaries and institutions. This company participates in the Retail industry through a Health division, including drugstores and related activities, and a Fuel Division, which operates retail service stations. They also operate within the Beverage industry specifically, beer and other alcoholic drinks) as a shareholder of one of the biggest breweries in Mexico and across Europe, with operations in over 70 countries. Additionally, this company participates in the logistics and distribution industry through its Strategic Business Unit, which additionally provides point-of-sale refrigeration and plastic solutions to the company's business units themselves as well as third-party clients.

The other company where the last interviewee works is a steel company, which supplies housing and infrastructure works, by manufacturing high-quality products mainly used in the roofs of houses and factories, in the mezzanines of buildings, and in walls insulation.

With regards to the online questionnaire's population, I was able to collect responses from 30 participants of same demographics - 30-40 years individuals from the

Mexican medium-low class¹², based in Monterrey (some of them used to live in the city); they all own an internal combustion vehicle.

4.3 Data gathering

The primary data gathering instrument employed are structured interviews and online questionnaires

To note:

- The final list of questions was agreed between the interviewees and me (see *Appendix B*).
- These interviews took place via Zoom calls. In person, face to face, interviews were deemed as not feasible for the purpose of this research, due to the distance between the experts' respective residencies and me.
- Interviews were recorded for transcription accuracy purposes, as set out in the Plain language statement and informed consent form (see *Appendix A*), shared with the all participants via email ahead of their interview, and it was agreed in all instances;
- The duration of the interviews was 15-20 minutes.
- Due to the different time zones related to the participants' location, the pre-set list of questions of the structured interview was shared in advance with them: this did not have any negative impact on the outcome; on the contrary, it helped participants organise themselves for our conversation.
- The duration of the online questionnaire was 10-15 minutes.
- The final list of the online questionnaires are included in Appendix G

4.4 Data analysis

The following section includes the categorisation of the different topics that emerged during the expert interviews, as well as the insights collected from the online questionnaire's respondents. Whenever relevant, the analysis of both primary data

¹² The third social class, according to the Ministry of the Economy, is the "Medium-Low", The main characteristic of this class is that their income "is not very substantial but it is stable", and it is estimated that it is 20% of the national population.

sources has been conducted together, specifying role and limitations of each chosen research design, if any generalisation, or inductive inference of any nature, had to be drawn.

4.5 Topics Categorisation

As per Meuser and Nagel (2009), I categorised the topics raised during the expert interviews in the following thematic units, eventually applying sociological conceptualisation.

Theoretical generalisation is then applied to primary data collected from these interviews, and further integrated with supporting references to literature review's secondary data.

Results from the online questionnaires are also added to each thematic unit to provide additional insights on the respective topic - without generalising findings from the respondents, due to the "audience pool" being a non-representative sample.

The topics categorised below contribute to the aims and the objectives of this dissertation, which will be further summarised and addressed in my conclusions in Chapter 5:

- Evaluation of the Mexican EV market
- Benchmarking
- Mexican government's approach to the EV technology
- Sustainability
- Purchase journey
- Advantages and disadvantages for EVs

4.5.1 Evaluation of the Mexican EV market

The main objective of this section is to evaluate the level of perception that experts and Mexican consumers have about the different EV brands operating in Mexico.

From the structured interviews, a single voice was raised by experts, who mentioned Tesla, Nissan and JAC, a Giant Motors' partnered company, as the most popular brands.

As secondary data from the literature review showed in Section 2.3.2, with 96 cars and 287 commercial vehicles sold, Giant Motors was the company which reported the highest volume of sales in 2020.

JAC commercial vehicles are mostly employed by companies to transport goods, or for private or public people transportation services: these are likely to be the ones experts referred to, given their professional experience with the vehicles acquired by the company they work for. In this regard, we can conclude that JAC vehicle offerings, targeting private consumers, might not be as well brand positioned as their commercial vehicles.

The participants to the online questionnaire were asked whether they were familiar with different EV brands that were presented as options to select from. The most common answer was Tesla, though a few participants indicated additional brands which were not mentioned in the questionnaire in the section “Other”, such as Audi, Honda and Toyota.

Surprisingly, most of the participants answered that they were not very familiar with JAC vehicles, which would support the hypothesis that JAC’s marketing strategy is mostly focused on selling their vehicles to organizations, rather than private individuals.

On the other hand, the other brands mentioned, e.g. Audi, Honda, and Toyota, might maintain a mixed marketing strategy, targeting both organizations and consumers. Unfortunately, not having a representative sample of respondents to the online questionnaire submitted to Mexican consumers, this consideration will need to remain a mere hypothesis.

A special observation should be done in relation to Tesla, a brand that was mentioned by both experts and online questionnaire participants. This particular EV brand and manufacturer, together with its CEO, entrepreneur and business magnate Elon Musk, are often mentioned in the headlines of major newspapers and news TV shows: their current popularity inside, as well as outside, the automotive market is absolutely unquantifiable - which makes it a marketing case that would deserve to be analysed on its own. For the purpose of this dissertation, I will not therefore further speculate on Tesla, but I will limit my considerations by reporting the available data,

which represents a company whose marketing has spread globally and well beyond the EV industry as such.

4.5.2 Benchmarking

To understand how far, or how close, the Mexican automotive market is from adopting the EV technology at scale, I will report the perceptions of the interviewed experts, supporting their statements with the available literature which compares Mexico's with other countries.

Three out of the four experts benchmarked the Mexican case with Norway, which is perceived to be the most advanced country with regards to EV technology implementation:

“Yes, I suppose it will be Norway, since I recently read an article in which it indicated that Norway is the first country in the world in which the sale of electric vehicles is already bigger than the combustion vehicles. And what they did was to set a goal of ending the sale of gasoline and diesel cars by 2025. And also Norway exempts fully electric vehicles from taxes imposed on those relying on fossil fuels. And with these strategies, they have achieved that the sale of electric bicycles represents today 54% of all new cars sold in Norway”.

Interviewee 3

The fourth interviewee indicated the US to be the most advanced market in this regard, *“due to their good incentives”*.

From the literature review of Section 2.3.2, secondary data compares Norway, China and the US, concluding that Norway is the rightful “capital of EVs”. According to Statista (2021), Norway, whose goal is indeed to decarbonize its new vehicles from 2025, is leading the European race towards electric vehicle adoption.

As Figure 4.1 shows, in 2020, the Norwegian market was also the one with the highest share of electric vehicles and plug-in hybrids over total new car sales globally (ratio at 74.8%); moreover, it is a country where the adoption rate of this technology has been growing impressively fast over the last few years.



*EV and Hybrids EV plug-in. Includes light vehicles, excluding commercial vehicles.

Figure 4.1: EV and PHEV sales comparison (Statista, 2021). Source: ACEA, CAAM, EV-Volumes

China, which is by far the largest market for electric cars in terms of units produced and sold, was left out of the Top 10, as electric vehicles only account for 6.2% of car sales in the country.

Nevertheless, as Figure 4.2 shows, China is forecasted to be the world leader in terms of electric vehicle production over the next few years (Statista, 2021).

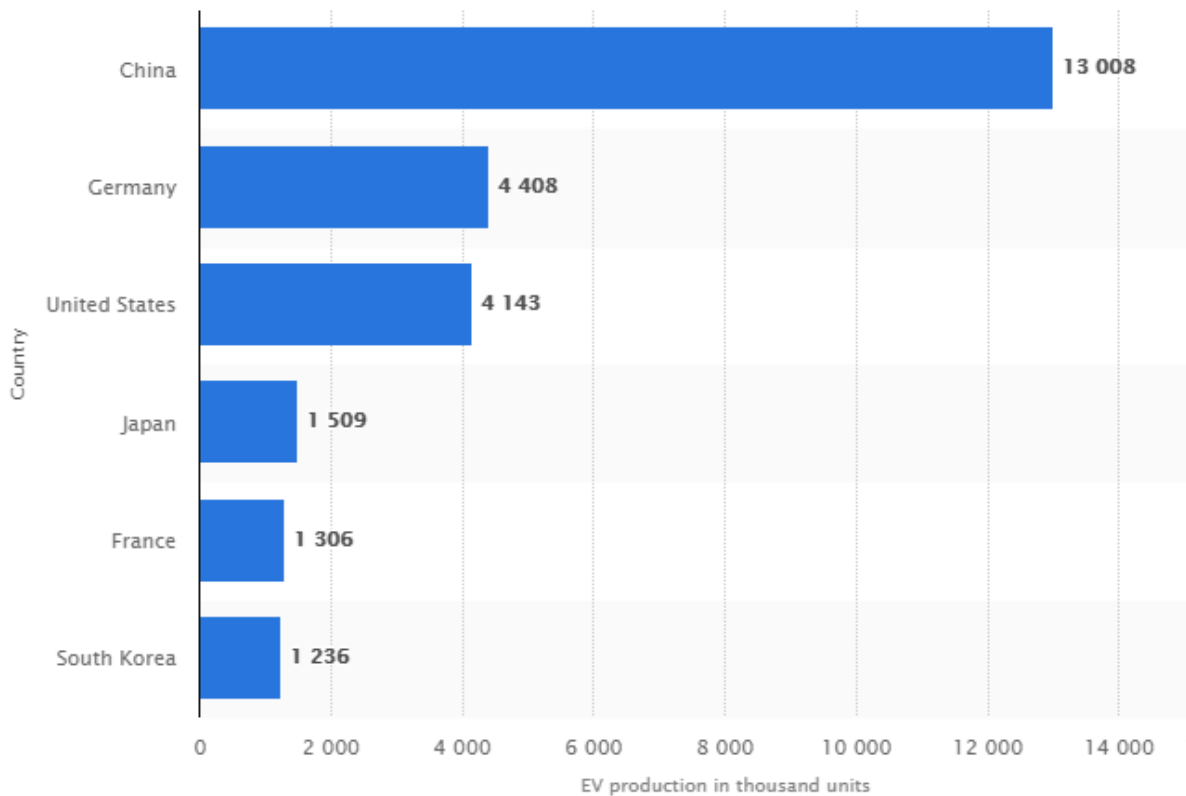


Figure 4.2: Projected production of electric vehicles and plug-in hybrid electric vehicles in selected countries between 2018 and 2023, Statista (2021).

Although China surpasses the USA in annual production, the USA has a higher PEV ownership per capita. At the end of 2017, the average ownership of PEVs in China was 0.81 per 1000 people, while ownership in the USA was 2.3. The promotion of PEVs is unevenly distributed across different regions of China and is highly related to regional policies. Similarly, in the USA, variations in incentives, infrastructure availability, and climate greatly affect the adoption of PEVs by state (Zhou et al. 2017).

Figure 4.3 shows the rate of PEV ownership per 1000 people in the US at the end of 2017. California has the highest rate of PEV ownership, with about 9 PEVs per 1000 people.

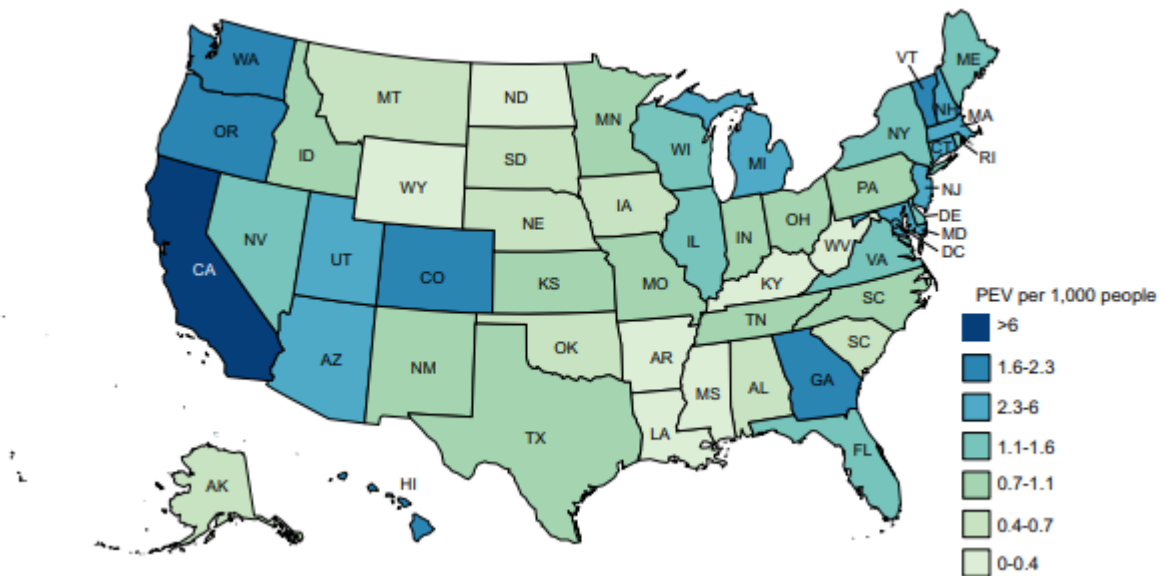


Figure 4.3: PEVs registered per 1000 people in the USA at the end of 2017, Hao, Zhou, Wang and Ouyang (2020).

With regards to data sourced by online questionnaires, I decided to not include any reference to benchmarking, as questions would have been addressed to a wider non-expert Mexican consumer pool, who might have been less aware on topics of such a complexity and technical nature.

To conclude the benchmarking topic, experts' perceptions seem to fully align with secondary data: the majority of the interviewees acknowledged Norway to be the example to follow, and the US also being an early adopter of the EV technology.

In both cases, whether referring to Norway or the US, all the interviewees made a clear reference to these countries' aspirations of reducing their impact on the environment by promoting EV technology through specific policies and incentives: this will be therefore the topic of the next section, which will offer a comparison with the initiatives promoted by the Mexican government in this same direction.

4.5.3 Mexican government's approach to the EV technology

Analysing the Mexican government's approach towards the adoption of EV technology adoption is perhaps the most important step in the present dissertation. This topic can be broken down into three elements: (1) how the government is

involved in this technology from an infrastructure perspective, (2) its incentives around EVs, and (3) how the current energy reform will affect this technology.

When asked about how Mexican government operates towards the adoption of this technology, and how much time they think the country might take to develop a suitable infrastructure, experts provided different answers:

***At least 5 years** from now, maybe we will start to focus on development of new technology, at least until the actual president finishes his term.*

Interviewee 1

*Today, I believe that it would take Mexico **at least 10 years** to develop a regular charging infrastructure*

Interviewee 2

*I think it will take **at least 3 years** to develop the necessary infrastructure for the transition to this new technology. As an example, we have currently carried out some infrastructures to this and we have found that it is not possible at this time to install the Chargers in some places due to the fact that the electricity supplier does not have the required power capacity in those places.*

Interviewee 3

The fourth interviewee struggled to quantify a definite amount of time: nevertheless, he also agreed with the other interviewees on the fact that the government is currently limiting this technology, appearing more interested in driving other projects, rather than focusing on the country's sustainability:

It's clear that the current government is not interested in clean or renewable energies. And they are doing investments for Pemex, like buying refineries and things like that. So in Mexico, I think it's not really a matter of government incentives. I think it's more on companies willing to develop a network or an ecosystem to make

it happen. So, I will not be in Mexico, I will not rely on waiting for governments to give any incentives to move forward. I think that companies need to push on that to make it happen.

Interviewee 4

Online questionnaires did not include any reference to the infrastructure topic: in this regard, I decided to not ask any relevant questions to a Mexican consumer pool, who might not be in the position to reply over topics of such a technical nature.

Moving the conversation towards the incentives coming together with the acquisition and the ownership of EVs, all the interviewees agreed that the ones available in Mexico to private individuals and organisations are not sufficient:

I know that the only benefit that the government has provided is to eliminate the import taxes of our electric vehicles. And I think this strategy is definitely not enough, actually more stimulus is needed to encourage the population to migrate to this new technology.

Interviewee 3

In Section 2.5.3, Table 2.4 listed the incentives promoted by the Mexican government for EV owners; a comparison with the incentives offered by the countries earlier mentioned for benchmarking purposes is available in the Appendix: this can work as a valuable instrument to understand how similar or different these incentives are (see Appendix H).

With regards to the participants of the online questionnaire, they were asked: “Do you know if Mexico has any incentives for people who own an EV?”. As opposed to the interviewed experts, whom I expected to hear a justified opinion from about the role of these incentives, Mexican consumers were generically asked about whether they knew about the existence of these incentives: in fact, my aim was to test their general level of knowledge about the topic, due to their potential interest in buying an EV for their private usage.

Most of the online questionnaire respondents did not actually know about these incentives; on the other hand, respondents who were aware of those were able to provide a few examples by mentioning the following:

- The special invoice delivered by CFE, allowing you to transparently report on energy costs for charging your EV, as separated from all the other household electricity consumption.
- ISAN exemption;
- Exemption over the payment of “Tenencia”

We know that Mexico does have incentives aimed at encouraging private individuals and organisations to invest in EV. Nevertheless, we might still be wondering how much effort the federal government is inputting into promoting these incentives with consumers, whether they need a better strategy to communicate them to taxpayers, and whether it is convenient for the government itself to popularise such saving opportunities: I will address these open questions in Chapter 5, where I will offer my conclusive perspective.

Regarding the last element related to this topic, I included questions around the current Mexican energy reform both in the structured interviews and in the online questionnaire.

From the replies collected from experts, the general opinion on the energy reform was offered by two interviewees, and can be summarised in “is nonsense”, and “not useful”. To quote one of the experts:

Yeah, so about that, the new reform I think is nonsense, because basically it is to benefit CFE which has the most polluting processes for producing energy and that affects how they are changing the way in which energy flows. So first, we will have polluted energy and energy that comes from burning oil and carbon and then we will have renewable energy or kinetic energy like solar or wind power. So that affects all the projects of the companies that are developing clean technologies, so it will stop investment and so on, and I don't see what is a pure benefit for the people nor for the environment. I think it doesn't make sense at all.

Interviewee 4

As I recalled in the Section 2.5.4, new measures were recently introduced by the government, which reversed the 2013 constitutional energy reform, previously encouraging private investment into this sector and opening up the opportunity for competition. As of today, governmental institution CFE does not have competition, benefiting from a national monopoly.

4.5.4 Sustainability

Over the years, contamination has represented a major issue for Mexico, especially for its most developed and industrial cities. To investigate the sentiment about this issue, I was interested to know if participants of the interviews and the online questionnaire were sometimes involved in any activity to support the environmental cause: to this end, I asked similar questions both in the interviews to experts and in the online questionnaire to Mexican consumers.

Interviewed experts mostly approached this question on the professional level, claiming that the projects they oversee in their current position within their company indeed aim at helping the environment by implementing new technologies that involve electric transportation, such as electric trucks, electric forklifts and EVs.

From a personal perspective, they additionally mentioned a more careful attention towards the usage of plastic, whereby they prefer to utilise fabric shopping bags instead of the plastic ones; they also mentioned their preference to leave their cars in their garages, at home, if they have to cover short distances - walking or cycling are seen as valuable alternatives in these instances, someone also mentioned their idea of buying an electric scooter:

I will say on a daily basis while I am working on developing electric vehicles, so I really hope that helps. I hope it will have an impact one day. But well, I was just kidding, but besides that, I think that I don't use my personal vehicle a lot, maybe because of the pandemic, but actually I'm thinking of buying an electric scooter to go grocery shopping or things like that. What else? Probably using reusable bags for grocery shopping. And I think that's it.

Interviewee 4

As discussed in Section 2.7, the SHIFT framework outlines different factors that address the attitude-behavior gap that is commonly observed in sustainability contexts (White, Habib and Hardisty, 2019): the “social influence” factor clearly emerged from the replies of both experts and consumers. Moreover, one of the facets related to this factor, as the framework describes, is “social norms”: “the implied Social norms can have a powerful influence on the consumer’s sustainable behaviour, for example, recycling, avoiding plastic, selecting eco-friendly transportation, etc” (White, Habib and Hardisty, 2019).

In other words, the reason why we feel the urge to engage in pro-environmental initiatives may not necessarily be rooted in our genuine desire to help in general; sometimes, simply observing other people helping the environment prompts us to adopt a similar behaviour.

To this day, pollution has impacted Mexicans' health at some level. Following the insights collected by EPUK (Environmental Protection UK) in the literature reviewed, “cars’ CO2 emission represents the biggest contaminant, contributing to the overall pollution caused by vehicles, among other additional factors that have an additional impact on climate change, air quality, noise, resource disposal, and our own local lifestyle”.

One may be wondered if it should be any different in Mexico:

My husband has acquired allergies from 4 years ago. Something that he never had a problem with before, and the specialist doctor mentioned that it could be because of pollution.

Interviewee 1

With regards to the respondents of the questionnaire, 15 of the 30 respondents answered that they were extremely familiar with the present contamination issues. Additionally, half of them replied that they are currently engaging in relevant initiatives on a daily basis, such as recycling, avoiding plastic bottle consumption, carpooling to go to their respective workplace, preferring walking to driving their own car.

According to the latest report by BP Statistical Review of World Energy, Brazil and Mexico together were responsible for 2.7% of 2018's CO2 emissions worldwide, a total of 905 million tons (Chevalier S. 2019). In Figure 4.4, Statista highlights which countries of Latin America contaminated the most by analysing their respective emissions of carbon dioxide in 2008 (grey) and 2018 (dark grey). As we can observe, Mexico is figuring at the top of this chart:

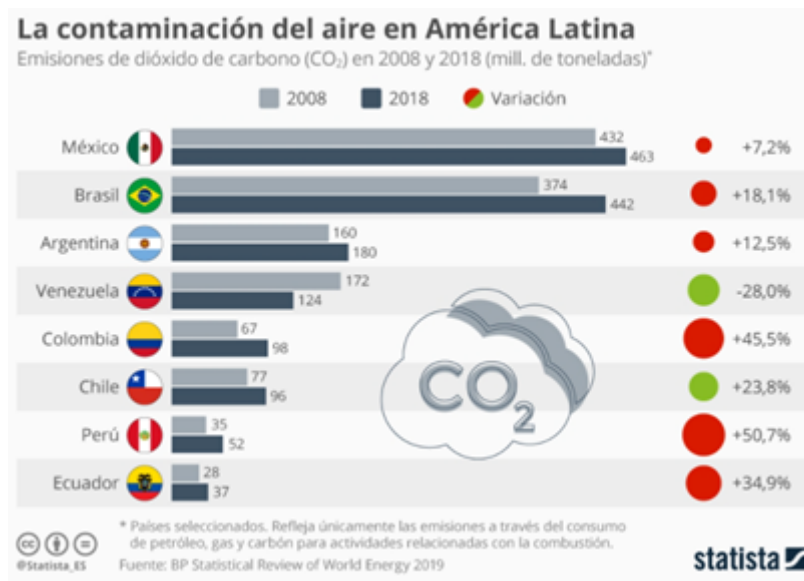


Figure 4.4: The contamination of the air in Latin America, *Statista*, Chevalier S., 2019, available at: <https://es.statista.com/grafico/20195/emisiones-de-co2-en-paises-latinoamericanos-seleccionados/>

As of today, Monterrey, Toluca and Salamanca are the most contaminating cities in Mexico. These results were based on a study made by the WHO (World Health Organization), which analysed nine cities in Mexico: in this regard, one of the interviewees agreed with the study:

But I do know that Monterrey is the first or second most polluted city in Mexico. So I will say there are a lot of cases.

Interviewee 4

In Figure 4.5, we can see a picture of Monterrey affected by pollution: consequence will come at a high price for the health of the Mexican population and the overall environment, further slowing down our efforts to fight climate change:



Figure 4.5: “Monterrey, Toluca and Salamanca las ciudades más contaminadas de México”, *Charge.org* (2021), available at: <https://valor-compartido.com/monterrey-toluca-y-salamanca-las-ciudades-mas-contaminadas-de-mexico/>

As Table 4.1 shows, the WHO report indicates that air pollution is measured based on concentrations of small particles less than 10 microns (PM10) and fine particles less than 2.5 microns (PM2.5) that contain sulfate, nitrates, and black carbon, and that pose the main environmental risk to health:

	CIUDAD	PEQUEÑAS PARTÍCULAS	PARTÍCULAS FINAS
1	Monterrey	86 PM10	36 PM2.5
2	Toluca	80 PM10	33 PM2.5
3	Salamanca	60 PM10	28 PM2.5
4	León	58 PM10	27 PM2.5
5	Irapuato	55 PM10	26 PM2.5
6	Silao	51 PM10	24 PM2.5
7	Ciudad de México	42 PM10	20 PM2.5

FUENTE: OMS

Table 4.1: “Monterrey, Toluca and Salamanca las ciudades más contaminadas de México”, *Charge.org* (2021), available at: <https://valor-compartido.com/monterrey-toluca-y-salamanca-las-ciudades-mas-contaminadas-de-mexico/>

As we can notice, Monterrey is the most polluted city in the country, as it reported a concentration of 86 PM10 and 36 PM2.5 during the surveyed year: this represents a serious environmental problem affecting all the 4.1 million Mexican citizens living in the 12 municipalities included in Monterrey’s metropolitan area (Valor compartido, 2021).

4.5.5 The purchase journey

To further analyse the EV consideration and decision processes within the consumers’ purchase journey, I raised the following question with both the experts interviewed and the respondents to the online questionnaire: “What do you think is the key decision driver in the consumer’s purchase journey? Do you think people are convinced to buy an EV due to the messages promoted by specific marketing strategies, or because they really believe in the technology that each brand is bringing to the market?”

The prevailing perspective among interviewees was that technology itself is the main reason for buying an EV; nevertheless, other factors such as savings on fuel, maintenance, battery warranty, cost of electrical infrastructure needed, and the range

of the vehicle were also mentioned as necessary elements of consideration within their decision process:

Well, I think that right now, there are many factors such as the price of the vehicle, and the range of the batteries, the cost of the electrical infrastructure for the installation of the charger, and the maintenance costs, the battery warranty and the service network. So I believe all these factors are involved in the decision. And at the end, I think the people are convinced to buy an electric vehicle because they believe in the benefits that this new technology has.

Interviewee 3

When asked the same question on the online questionnaire, the majority of respondents answered that they would consider buying an EV, if they could afford it. In the context of the questionnaire, they were given different options to select from, and to identify as important elements driving their purchase decision. If we were to rank them, the most important were the price, the comfort, the autonomy (i.e. the range), and their durability over time; conversely, the less important were their familiarity with the brand, the vehicle's manufacturing materials, the brand customer service, and the vehicle's design.

If we were to merge the insights collected from both the interviews and the questionnaires, we can conclude that consumers seem to care more about the benefits this technology brings, rather than the marketing value proposition that the brands aim at delivering to them.

As per the market comparison proposed in Chapter 2, we can review the main reasons considered by Norwegian consumers within their decision making process in Figure 4.6 below:

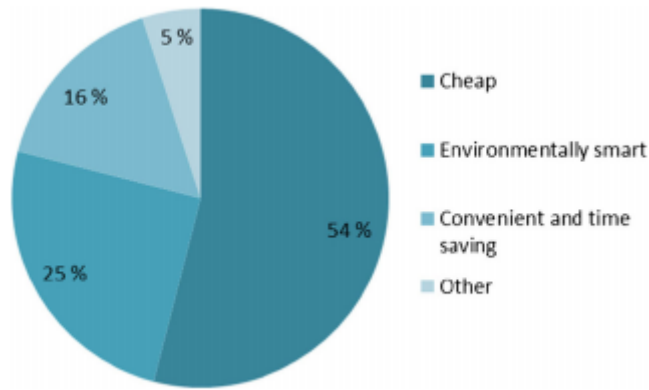


Figure 4.6: Main reasons for buying an EV in Norway, Aasness and Odeck (2015).

In Figure 4.7, further insights are reported about consumers in the Nordics markets, such as Norway, Sweden and Denmark. The chart shows that economic incentives play a major role within the decision making process towards the final purchase. Undoubtedly, the environment is also an important reason due to the significant reduction of emissions of CO₂ that the adoption of this technology entails; nevertheless, consumers seem to be more motivated when the conversation is set around economic savings, to which governmental programs represent a significant contribution.

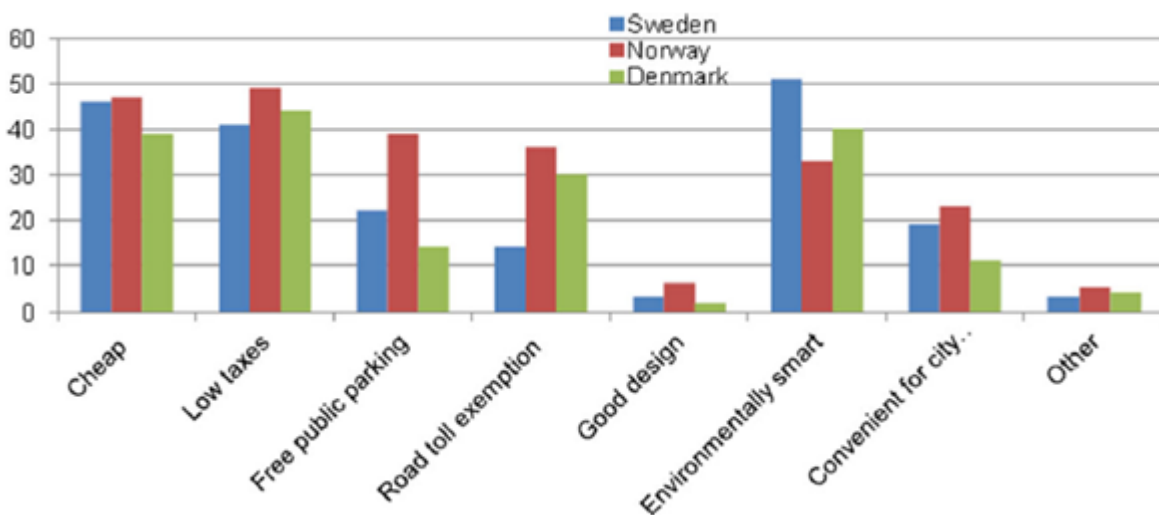


Figure 4.7: Reasons for wanting to buy an EV at next vehicle purchase in Sweden, Denmark and Norway, Aasness and Odeck (2015).

The theory of planned behaviour I referred to in Section 2.4 specifically relates to this topic, describing how consumers' behaviour can be predicted from their intentions, which are mostly represented by three main components: attitudes toward the behavior, subjective norms regarding the behavior, and perceived control over the behavior. The cause-effect relation implied within a consumer's decision making process highlights a relation between the mentioned components and the purchase intentions.

In relation to this topic, a follow-up question I included was: "Why would anyone want to purchase an EV without being fully aware of what it takes to drive it and maintain it over time?".

In my perspective, the answers provided by both interviewees and questionnaire respondents might not be fully reliable in this context: this is due to the complexity of the study, the type and volume of data that would be in fact required to reply exhaustively. The theory of planned behaviour formulated by Icek Ajzen, and discussed in White K., Habid R., Hardisty J., (2019) academic paper, delivered its conclusions by using quantitative methods such as a regression model over a qualified sample of 361 consumers, who were surveyed to determine whether their intentions influenced attitudes towards the behaviour, subjective norms, and perceived behavioral control, ultimately finding which of these factors predicted the final behaviour.

Unfortunately, in the context of the present dissertation, the effort was not easily replicable on the same terms: this case study leveraged qualitative methods and data to provide general insights, and it does not therefore have the same strength in generalising its results as a quantitative study might do instead.

It was however important to include this theory in both the literature review and the findings to flag that a theory testing and explaining behaviours affecting the decision making process within the purchase journey does exist - and, in this case, this can be rightfully applied to EV technology also.

4.5.6 Advantages and disadvantages of EVs

In Section 2.3, I listed the advantages related to acquiring and owning an EV, such as the reduction of CO₂ emissions and noise impact, vehicle's higher efficiency, incentives made available by governments, and overall savings on vehicle fuel and maintenance costs. On the other hand, disadvantages included vehicles' high price (as compared to a more traditional combustion vehicle), insufficient charging points available to cover longer distances, technical expertise required in specialised garages for servicing them, battery's low autonomy, turnaround times to charge the vehicle itself.

These advantages and disadvantages are not necessarily perceived in the same way across all the markets: for example, in Norway's case, this country is so advanced in the adoption of this technology that charging points are actually already available and in sufficient quantity to allow drivers to cover long distances with their EV. Concerning the battery's "low autonomy", this element would depend on the vehicle's make and model, as well as the distance that the EV potential owner would need to cover over a given year. EV brands and manufacturers offer different options that can suit different consumers' needs, such that the "low autonomy" disadvantage could be categorised as a subjective element of consideration, rather than an objective issue affecting all the EVs as such.

During the interviews, I explicitly asked experts to provide their viewpoint on the type of savings generated by the adoption of EV technology through the question: "What are your thoughts in relation to potential savings on fuel and return on investment as a consequence of buying an EV?"

I found interesting the answer by Interviewee 4, who had a specific opinion on the matter, and which slightly differed from the other experts:

In most cases, the electric vehicle is more expensive and talking about total cost of ownership, let me explain why. So Front costs. So you will pay way more for an EV than an ICE (internal combustion engine) in a comparable segment. So to put an example, for the Nissan March is around 200,000 pesos and then you have the EV Nissan LEAF which is also a subcompact vehicle, and that vehicle costs 900,000 pesos. So, it's 4.5 times more expensive than the Nissan March. And then you need

to consider other main costs, which is maintenance and the operating costs of fuel or electricity just to make it comparable. And normally, those numbers are around 50 to 80% less than IC. So, you are always saving something there in maintenance and the operative cost of energy, electricity versus fuel. So, the question is if that is really enough to compensate for the upfront cost of the vehicle and normally it is not. So there is a big concern there on how to make it profitable for the people to identify what is really the reason that people will buy this vehicle over an SUV or a sports car, but for companies it is also different because they require a kind of a vehicle for their operational processes. And in that case, they will need a different type of vehicle without a lot of luxuries so they will need to remove many of the features that these cars offer to the public in general and make it more affordable for those types of operations. Probably in Mexico, I think the first electrification is for trucks and vans rather than for passenger vehicles.

Interviewee 4

If we reference back to Figure 4.5, the main factor that prompted Norwegian consumers to buy an EV was the fact that it seemed to be a “cheaper” choice; similarly, Figure 4.6, comparing consumers’ opinions across Sweden, Norway and Denmark, showed an alignment on this consideration, also highlighting “low taxes” as a close second determining factor.

Unfortunately, a similar study has yet to be conducted among Mexican consumers: nevertheless, according to the data gathered from the structured interviews and the online questionnaires seems to point in the same direction. If EV were a “cheaper” choice, producing “savings”, then Mexican consumers would also be encouraged to buy one: however, manufacturers in Mexico do not position their EV range at a “cheap” price - as Interviewee 4 put it, *it's 4.5 times more expensive* (Interviewee 4, 2021).

Chapter 5: Conclusions and recommendations

5.1 Introduction

The elements which the present case study, “Electric vehicles in Mexico’s market, are they ready to plug in?”, aimed at outlining included:

- the contamination issues that currently affects Mexico;
- the Mexican government’s approach towards the adoption of EV technology (e.g. CFE energy supply, energy reforms, offered incentives), as compared with other countries where this technology is already developed;
- the marketing efforts that Mexico might need to generally commit to;
- the behaviour that consumers show over their decision-making process;
- potential recommendations that could be considered for the Mexican case, which, if implemented, could open up the possibility towards a successful adoption of this technology in the country for both private individuals and larger companies.

The main topics presented throughout the dissertation, and further analysed in Chapter 4, as well as my personal viewpoint on whether Mexico is ready or not to adopt this new technology will be presented in a conclusive form on the basis of the primary data collected from structured interviews and online questionnaire, qualitatively analysed, and eventually combine with secondary data from the literature review.

As per the structure given in Chapter 4, I will report my conclusions on each topic in the present chapter following the same order:

- **Topic 1:** Evaluation of the Mexican EV market
- **Topic 2:** Benchmarking
- **Topic 3:** Mexican government’s approach to the EV technology
- **Topic 4:** Sustainability
- **Topic 5:** Purchase journey
- **Topic 6:** Advantages and disadvantages for EVs

Additionally, I will include a number of recommendations related to EVs in the Mexican market, specifically proposing what other studies can analyse that could be

conducted in the future to further explore how Mexico could proceed towards the implementation of this technology, positively contributing to the environmental cause.

5.2 Research context and population

The structured interview population included four experts, 30-40 years old, working in large companies based in Mexico: they are all in charge of vehicle and transportation projects in their respective sourcing departments, including passenger and non-passenger vehicles.

Concerning the respondents of the online questionnaire's population, I was able to collect the answers of 30 participants: they all share the same demographics traits - 30-40 years old, from Mexican medium-low class, based in Monterrey (some of them used to lived in the city) - and they all own an internal combustion vehicle.

5.3 Research objectives and Research Question

The following research questions were proposed in Table 1.1 of the Introduction, and guided the dissertation throughout its literature review, methodology and presentation of findings:

- Which electric vehicle's brands operate in Mexico?
- What are the incentives that these countries and Mexico have for people and organisations that own an EV?
- How developed are other countries within the electric vehicles' technology?
- What are the marketing strategies that this technology needs?
- What is possible to recommend for the E.V. market in Mexico?
- What are the limitations for this technology in Mexico?
- How is contamination affecting Mexico?

5.4 Research data gathering and Analysis

In the context of the present case study, primary and secondary data were collected to analyse different perspectives from experts, non-experts and from relevant academic papers.

Primary data included structured interviews and online questionnaires.

The structured interviews with experts took place via Zoom calls, they were recorded and later transcribed. Due to the volumes of the experts interviewed, I did not consider any method or instrument to further categorise interviewees and code their transcriptions: in fact, they would have little to no use in this regard.

Online questionnaire's answers were already structured, as I used an online form that facilitated the questionnaire creation and the analysis of the respondents' submissions.

5.5 Research conclusions

Conclusions were categorised into diverse topics, which gave structure and order to the research objectives:

- **Topic 1:** Evaluation of the Mexican EV market
- **Topic 2:** Benchmarking
- **Topic 3:** Mexican government's approach to the EV technology
- **Topic 4:** Sustainability
- **Topic 5:** Purchase journey
- **Topic 6:** Advantages and disadvantages for EVs

5.5.1 Topic 1: Evaluation of the Mexican EV market

From the analysis conducted, interviewed experts and Mexican consumers who participated in the online questionnaire were able to identify global vehicle manufacturers that operate in the benchmark countries (Norway, China and the US), as well as have operations and sales activities in Mexico, e.g. Tesla, BYD, JAC and Nissan. Among others, secondary data suggests that Nissan, Chevrolet, and JAC (Giant Motors) are the biggest brands in Mexico.

The new EV industry itself does not seem to be any different from the traditional automotive sector: brands approach the market by identifying different strategies according to their market audience, whether this is private individuals or large companies.

EV brands' business strategies mostly position their product offerings after segmenting their audiences: they market luxury EVs to private consumers, tailoring their options on individuals' needs, and commercial (or more standard) vehicles to organisations, which aim at minimising operational and financial costs.

Hence, EV manufacturers need a different business and marketing plan for each audience, adopting different sales strategies depending on the buyer persona.

5.5.2 Topic 2: Benchmarking

The main purpose of this topic was to benchmark the Mexican case against how other countries adopted the EV technology, and how they further developed it over time.

As I reported in my findings in Chapter 4, Norway, China and the US are way ahead than Mexico, not only for having already developed this technology at scale, but also for having already planned specific economic strategies (e.g. incentives) aimed at encouraging consumers to buy EVs. The incentives currently offered in Mexico were discussed in Section 2.5.3; additionally, *Appendix H* allows for a comparison with the ones available in the other countries. Moreover, all these countries included in the benchmark clearly operate by having one core motivation in common, which is reducing CO2 emissions.

The possibility to count on suitable infrastructure built in support of EVs has also been flagged as a pivotal element for a successful adoption of this technology. The approach that governments in other countries showed by building charging stations and spreading them out across large areas is totally different, and better suited, than the one that Mexico has proved so far. As I pointed out in Section 2.5.2, the Mexican government, through CFE, is not currently investing into the infrastructure powering the energy supply across the country in any profitable and efficient way.

Learning best-practices from countries where infrastructure has already been developed could be perhaps a promising first step towards the implementation of this technology in Mexico.

5.5.3 Topic 3: Mexican government's approach to the EV technology

As concluded in the section above, charging infrastructure is a key element that has to be taken into consideration from anyone who expects and hopes in the growth of EV technology as such. It goes without saying that building and developing suitable infrastructure requires investment, as well as the cooperation among a host of players within a new flourishing industry: these are all steps that need time to expand and scale before even considering rivalling the universal presence of gas stations.

As opposed to gas stations, which are located everywhere across urban and suburban areas, public PEV infrastructure is in fact traditionally located in large metropolitan areas only; further, home charging is not always an option, as it is the case for multi-family buildings and dense neighborhoods. Additionally, PEVs have a shorter range than gas cars: this will therefore require a higher presence of charging points and stations per square mile to accommodate long and short distance trips.

Concerning the incentives currently available in Mexico, I am still doubtful on whether the commitment of the federal government in promoting these has an effective and solid support: specifically, I would not be able to say whether the direction chosen by the government genuinely aligns with sustainability policies, or it is simply not convenient for the government to popularise these saving opportunities for the benefit of all the taxpayers, and rather investing in other sectors.

Breaking down incentives available in Mexico, and comparing them with the ones promoted by more developed countries, is an opportunity to evaluate which ones could be replicable, and which ones could not be applicable at all: regarding the latter, the Mexican government would also have the possibility to explain to individual taxpayers and businesses why they would not work in the Mexican case.

If we still assume that the purpose of introducing incentives is supporting the environmental cause by reducing CO₂ emissions, one might still wonder why businesses are not the first ones benefiting from these in Mexico. I however showed how it is necessary to go back to the root cause, firstly identifying how the energy supply chain is managed by CFE in Mexico, and how the related issues have to be tackled in the first place through new public reforms and initiatives: in fact, some of the challenges mentioned in Section 2.4.2, such as costs, obsolescence,

transmission lines and the debt represented by the CFE's monopoly are yet to be addressed by the federal government itself.

In this regard, I agree with the opinion of the interviewed experts on the fact that keeping CFE as the only player within a nationalised and monopolistic energy supply industry, whilst wiping out the opportunity for investors and market competition, might not be the right approach to support innovation - or, *nonsense*, as the experts put it.

5.5.4 Topic 4: Sustainability

As a matter of fact, scientific research has already proved that internal combustion vehicles have had a majorly negative impact on the environment since a long time ago. Nevertheless, we have never had such a great opportunity to be fully aware of this issue: large studies, reporting big data and quantitative analysis, are conducted and are immediately made publicly accessible online; further, from a qualitative perspective, videos and pictures uploaded on social media networks are shared and reposted very fast by the online community, complementing the reality of an environment that does require our most careful attention. Additionally, with the recent rise of the pandemic emergency, everyone was surprised by the effect of restrictions and lockdowns which, by forbidding - or strongly limiting - people to travel long distances, had the unexpected benefit of positively impacting the environment.

As the SHIFT framework showed, "Social influence" can be a strong driver of positive consumers' behaviour towards the environment, starting with "simple" initiatives which, summed together, can still deliver a great contribution to this cause. A few proposals about these positive activities were briefly discussed in the findings chapter: nevertheless, in my viewpoint, it is not just about stopping using the car and walk to cover short distances - this would be an oversimplification of the matter, clueless of the context and habits the Mexican population is accustomed to.

For example, in Monterrey, one of the biggest cities in Mexico, the weather is an important limitation: during summer, temperatures are around 35 and 45 degrees, so people prefer to drive their car to take advantage of their air conditioning, a benefit that would be lost by walking. Moreover, public transportation has its own limitations all around Mexico - especially in the country's capital, Mexico City, which is one of the most populated cities in the world.

Although most of the cities in Mexico have public transportation services, people who can afford their own private vehicle prefer to commute and travel with it instead: the idea of leveraging their own car, more reliable and direct than any subway or bus, looks more convenient and comfortable to the average Mexican consumer.

It is also worth noticing that crime episodes such as robberies are not unknown in Mexico, and this fact further prompts consumers to rely even more on their own private transportation vehicle, where they can feel safer and more protected. Even when we consider cycling as an option, the Mexican culture does not see this as a safe alternative, given the amount of accidents and fatalities often reported.

In this sense, sustainability has to be greatly promoted at all levels by the federal government, creating reliable infrastructure and safer opportunities for commuting and travelling in general.

5.5.5 Topic 5: Purchase journey

The picture that was delivered by the interviews with experts and the online questionnaire respondents on the main driver within the consumer's purchase journey towards acquiring an EV was mixed and unfortunately inconclusive.

The majority of the interviewees believe that technology itself should encourage consumers to invest into EVs; on the other hand, the respondents of the online questionnaire think that savings on vehicle fuel and maintenance costs, as well as and the greener choice itself, should be both considered amongst the main factors prompting people to adopt this new transportation technology.

As this data does not allow me to generalise any conclusion about the entire Mexican population, I will keep valid the arguments supported by the reviewed literature, which suggests that both economic savings and the CO₂ emission reduction are both key drivers in the decision making process of buying an EV. Additionally, there are subjective elements that cannot be necessarily resolved into these key drivers, and which are still kept in higher considerations by all prospecting buyers, such as tangible and intangible benefits (e.g. perceptions over savings and social contribution to the environment cause), suitability of the vehicle offering proposed by car brands and manufacturers, availability of incentives sponsored by the national government.

Similar observations can also apply to large companies, which evaluate the purchase of these vehicles to build and increase their commercial fleet.

5.5.6 Topic 6: Advantages and disadvantages of EV

Advantages and disadvantages of owning and using an EV were listed in Chapter 2 and in Chapter 4. These are all considered by consumers during their decision making process: however, in the case of government promoted incentives, experts do not consider them sufficient, and the average Mexican consumer seems to be not fully aware of their availability. In this regard, if the availability of incentives is not perceived adequate, or it is not adequately communicated to consumers, the supposed list of advantages of owning and using an EV is significantly shortened.

5.5.7 Summary

To conclude, I believe that Mexico is not yet ready to adopt EV technology country wide. The main reasons have been validated along the dissertation by pointing out the role of the federal government, which does not seem committed to embrace sustainability and innovation projects, preferring to invest in older infrastructure within a monopolistic management of the energy supply chain. Without counterbalancing the effects of the recent energy reform, CFE will maintain ownership of the market, dictating the price rates within the energy sector: as a consequence, private individuals and businesses will unlikely be encouraged to invest in this new technology, and in the infrastructure that could support it.

There also seems to be a major lack of effort in communicating the availability of incentives around the purchase and ownership of an electric vehicle in Mexico, which raises doubts on whether these incentives are fully supported by the federal government itself: if institutions shows uncertainty about supporting this technology, or looks at least skeptical in investing in its development, how could we expect private consumers and large companies acting differently?

5.6 Recommendations

Providing recommendations about energy supply chain, infrastructure, and new energy policies is simply too complex to be the outcome of the present case study. This research has however shown that the infrastructure supporting the adoption of the EV technology in Mexico will not be developed in the country anytime soon. Accordingly, I would like to embrace a pragmatic view, and use the conclusions of this dissertation to raise awareness over the reasons why Mexico is not ready to adopt this technology, and why Mexico *is not ready to plug-in* yet.

On the other hand, Mexico can still decide to begin an adoption process of policies and processes that mirrors the ones initiated by other countries to ensure that suitable infrastructure will be deployed in specific areas where the EV technology could be firstly tested and later scaled. Taking as examples the best practices introduced by countries such as China, Norway and the US, could be, in this regard, a good recommendation to help the Mexican country improve its electric mobility.

Furthermore, collaborating with other countries on the emerging charging requirements and guidelines to future-proof the infrastructure for smart charging, time-of-use pricing, and grid integration services, could also be a winning strategy, given Mexico's geographical proximity to the US, a major industry innovator and early adopter of this technology.

If a path to innovation will be included in Mexico at a later stage, it will need to therefore focus on the development of the infrastructure, securing the availability of a charging network of electric stations which today does not yet exist: this will allow Mexican consumers to recharge their vehicle easily and conveniently, making the problem of vehicle's autonomy and range more manageable.

The next step would be looking at ways to solve the problem of recharging time turnarounds: as noticed, an EV might still take from many minutes for a partial recharge to several hours for completion; this looks still inconvenient as compared with a traditional ICV (Internal combustion vehicle), the tank of which can be filled in just ten minutes on average. In this regard, I referred to the urgency of looking at updating the recent energy reform, which poses severe limitations to the development of the energy supply chain by private investors, which cannot currently

enter the market, due to the monopolistic role assigned to the CFE by the federal government.

From a sustainability perspective, following the SHIFT framework discussed in Section 2.7, Mexican consumers' behaviour needs to be somehow "shifted": once again, the role of the government is key to address the pollution issues affecting the country, and critical to awaken the sense of urgency "socially" shared by the consumer community. This "social influence" can be encouraged at all levels, starting with ad-hoc national campaigns, promoted by the government, and in support of the environmental cause.

The hope significantly relies on the Mexican government to raise awareness about sustainable consumption - which EV technology is an example of - through effective communication strategies, e.g. leveraging educational or marketing programs promoted by its main institutions.

A stronger collaboration could be also sought with the private sector, opening promotion plans and incentives with the support of vehicle manufactures within the automotive market, which could help increase the awareness about the advantages of owning an EV.

In Table 2.2, I reported the advantages and disadvantages of owning electric vehicles. I would like to draw my conclusions on these to offer a different perspective of how the perception of those can be shifted:

1. The low autonomy is only to be considered a disadvantage in relation to the type of consumers who decide to own an electric vehicle. Since the consumption varies for size and type of the vehicle purchased, "low" autonomy is always related to subjective elements of consideration, such as the average mileage covered by the owner, and the owner's habit about making time for a successful and full charge of the vehicle, etc. that's why I recommend to always validate what are the buyer's needs to decide what is the best for them.
2. The work required to ongoingly service an EV by specialized garages might be perceived as an expensive issue; in reality, maintenance costs related to EVs are far cheaper than the ones needed to repair an internal combustion

engine on average - it is in fact so cheaper that not having an engine to fix, or to replace parts of, could easily turn into a big advantage from an economical perspective. This consideration has been further detailed as part of the findings presented in Chapter 4.

3. Unfortunately, charging stations are insufficient in Mexico: on the other hand, if EV owners install a charger point in their own house, charging stations might not be strictly needed along the road, as long as the planned drive is not a long and urgent trip.

In regards to future studies to conduct over electric vehicles in Mexico's market to analyse the topic in greater depth, I would recommend using a different analysis approach including quantitative data collection, and the formulation of an hypothesis on a slightly different question, i.e. "Why is Mexico not prepared for this technology?", "*Why is Mexico not ready to plug-in*".

Hypotheses around this new research angle would have gone beyond the purpose of the present dissertation, and they would have required additional studies and further data to support an informed view grounded on scientific approach. My hope relies on the fact that this case study could represent a way to open up the academic research in this direction, gathering additional evidence on top of the data I was able to collect and organize from expert interviews and Mexican consumers participating in the online questionnaire, which eventually contributed to shed some light on this new topic.

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Appendices

Appendix A

PLAIN LANGUAGE STATEMENT

I. Introduction to the Research Study

Research Study Title: Electric vehicles in México's market, are they ready to plug in?

University: Griffith College, Graduate Business School.

Principal Investigator: Dr Garrett Ryan.

Researcher Name: Alejandra A. Maldonado Ortegón

Email: ale.maldonado92@outlook.es

II. Details of what involvement in the Research Study will require

This project involves taking part in structured interviews. The interviews will be recorded for transcription purposes and seek to gather information on your experience of Electric Vehicles in Mexico's market. Questions are directed towards your thoughts on knowledge on Electric vehicles, Mexico's market regulations and incentives, awareness of contamination in Mexico, benchmark with other countries, opinion about the current infrastructure, Mexico's energy reform plans, their overall experiences driving an electric vehicle, and potential savings and benefits for buying an electric vehicle. I estimate the interview will take no longer than 20 minutes to complete. Participants will be offered a copy of their interview.

III. Potential risks to participants from involvement in the Research Study (if greater than that encountered in everyday life)

I do not anticipate any risk to participants as a result of participation in this Research Study.

IV. Benefits (direct or indirect) to participants from involvement in the Research Study

The objective of this Research Study is to gain new knowledge that will enable us to aim to answer the research question: "are they ready to plug in?". Specifically, the objective of this case study is to analyse whether the country is ready to embrace the EV revolution, after a careful consideration over the recent energy reform promoted by the federal government, the limitations imposed on the entrance of private investors in the energy supply chain, and the aspiration that the country shows towards addressing the environmental issues Mexico is currently affected by within a sustainability framework. This study may, therefore, be of benefit to you by providing you with the opportunity to contribute to body of knowledge on Electric vehicles in Mexico's market, so that you and or society may benefit.

V. Advice as to arrangements to be made to protect the confidentiality of data, including that confidentiality of information provided is subject to legal limitations

Every effort is made to ensure the confidentiality of the participant. Participant names will not be recorded, as all participants will be assigned a code. Where used, recorded interviews data will be downloaded to a password-controlled computer, typed transcripts results are held within password-controlled documents. Participant biographical details and or mention of other persons will be omitted in the final report. Confidentiality of information provided is subject to legal limitations.

VI. Advice as to whether or not data is to be destroyed after a minimum period

Audio tapes data will be destroyed on the successful completion of this master's degree in full compliance with GDPR regulations.

VII. Statement that involvement in the Research Study is voluntary

Involvement in this Research Study is voluntary. Participants who decide to take part may withdraw from the Research Study at any point. There will be no penalty for withdrawing before all stages of the Research Study are complete.

If participants have concerns about this study and wish to contact an independent person, please contact:

Dr Garrett Ryan

Graduate Business School
Research Committee

Griffith College
South Circular Road, Dublin 8, Ireland
Phone: + 353 1 416 3324
Email: garrett.ryan@griffith.ie

Appendix B - Sample interview structure

1. Introduction

- The interviews were prepared and sent for anticipation to the interviewees.
- Permission to record
- Interviewer introduction
- Interview will take approximately 20 minutes

2. The interview is structure as follows:

- First you will be asked to give a brief about your current role and how much you are involved in the electric vehicles industry.
- Afterwards there will be specific structured questions according to the topics:
 - Different EV brands and vehicle manufacturers;
 - Marketing activities aimed at promoting this technology;
 - Mexico's market regulations and current policies;
 - The monopoly of energy's industry in Mexico;
 - The future of the EV market in Mexico;
 - The awareness of the contamination issues in Mexico;
 - A general comparison of the EV market potential with developed countries;
 - The infrastructure that may be needed in Mexico to implement this technology;
 - General political opinion on the Mexican government's operate;
 - Mexico's energy reform plans;
 - Their overall personal experience driving an EV;
 - Their thoughts in relation to potential savings on fuel and return on investment as a consequence of buying an EV;

Appendix C - Interview Transcript 1

Interviewee number	1
Venue	Zoom
Interviewee	Female, procurement department in the transportation area for vehicles projects such as: forklifts, vehicles and trucks. (I1)
Interviewer	Alejandra A. Maldonado (AM)

Before the interview starts, the interviewer makes a brief about the topic, and asks the interviewee for the recording consent which is granted.

AM: Can you tell me a little bit about your role and how much you are involved in the electric vehicles industry.

I1: Sure, well first of all I will like to introduce myself, my name is Mariel and I work in the transport department in one of the top companies in Mexico, and I directly I'm involved in decisions in procurement vehicles, forklifts and trucks, so thank you very much for inviting me to this interview.

AM: Okay thank you for the brief. So For the first question: Which EV brand do you think has the highest market share in Mexico and why?

I1: I consider that there are three top brands that are in Mexico's market , which are JAC, BYD, and TESLA.

AM: Could you please confirm if you have tested an EV and quickly summarize your experience mentioning the model and brand of the vehicle?

I1: sure, there was one time and it was the JAC brand. And to be honest It was very easy to drive, very silent and basically the same as a regular car. Also the charging experience was very easy.

AM: What do you think is the key decision driver in the consumer's purchase journey? Do you think people are convinced to buy an EV due to the messages promoted by specific marketing strategies, or because they really believe in the technology that each brand is bringing to the market?

I1: In Mexico I consider that people make their decision based on the technology since the purchasing power in my country isn't that easy to acquire an electric vehicle. So, the persons that can really buy one, revise and analyze what they're buying.

AM: How much do you know about the current policies, processes and incentives that Mexico is promoting to implement this technology within the country? Do you think they are doing a successful job to encourage the population to adopt and buy this technology, in an effort to create a more sustainable automotive industry within the country?

I1: Definitely no, unfortunately the incentives in Mexico are very low, and they are not very well promoted , (marketing perspective) . Our president is focused on opening new oil refineries.

AM: What's your opinion about energetic reform in Mexico?

I1: It's not going to be useful and definitely it's not supporting investment in new technologies since funds are focused on the same government based companies that provide combustion energy.

AM: Okay, Is there anything you do, whether once in a while or on a daily basis, to contribute to the environmental cause?

I1: In the company I work for, I directly participate in the decision to buy electric or combustion forklifts and I lead the project to give evidence that electric forklifts are cheaper in the long term.

On personal perspective, I support on small changes as for example bring my own grocery fabric bags and also separate trash from my home

AM: As we know, pollution has a significantly negative impact on our health: have you, or someone that you know (friends, family members, colleagues), been directly affected?

I1: Yes, definitely my husband has acquired allergies from 4 years back. Something that he never had a problem before and the specialist doctor mentioned that it could be because of pollution.

AM: Okay, Which country do you consider the most advanced in relation to this technology? Do you know anything they are doing better than Mexico to develop this technology?

I1: US I know that there are very good incentives for this.

AM: What would be your general political opinion (without giving information about the party you support) on how Mexico's government operates in terms of bringing this technology? How much do you think the country will take in terms of infrastructure to be able to operate in the more developed cities?

I1: At least 5 years from now, maybe we will start to focus on development of new technology, at least until the actual president finishes his term.

AM: thank you, What are your thoughts in relation to potential savings on fuel and return on investment as a consequence of buying an EV?

I1: From what I study, it's around 20% in long term savings considering car price, and maintenance. And return on investment in 2 or 3 years.

AM: Great. Well, thank you so much for your time and for your answers. I will stop recording and have a nice day. Thanks.

Appendix D - Interview Transcript 2

Interviewee number	2
Venue	Zoom
Interviewee	Male, procurement department responsible for the fleet categories related with vehicles (I2)
Interviewer	Alejandra A. Maldonado (AM)

Before the interview starts, the interviewer makes a brief about the topic, and asks the interviewee for the recording consent which is granted.

AM: Can you tell me a little bit about your role and how much you are involved in the electric vehicles industry.

I2: For sure. Well, I have been working in a procurement department specifically. My role is: I'm responsible for the fleet categories including anything related to vehicles. Basically, my role here is to run this analysis for the company. And every business unit, my company owns ,this analysis is for getting these comparisons between internal combustion engines and electric vehicles. So basically, I showed this total cost of ownership from the vehicles and gave the solutions to each company so they can start to migrate this to this technology.

AM: Okay thank you for the brief. So For the first question: Which EV brand do you think has the highest market share in Mexico and why?

I2: There are several brands who offer electric vehicles in Mexico, the most important one is JAC. JAC is the brand with the broadest portfolio of electric vehicles in Mexico and their goal is to offer the same model vehicle on electric and combustion, in addition to being the first brand to offer an electric pickup truck in Mexico.

AM: Could you please confirm if you have tested an EV and quickly summarize your experience mentioning the model and brand of the vehicle?

I2: The first vehicle I drove was an E-SEI1 from JAC. The experience starts from powering the vehicle which emits no noise. During conduction it feels comfortable, while accelerating also you can experience an instant torque or response. I think the most significant difference about this type of technology is the way the car stops by itself while lifting your foot off the accelerator, thanks to the regenerative braking system which is the most iconic characteristic while driving an EV.

AM: What do you think is the key decision driver in the consumer's purchase journey? Do you think people are convinced to buy an EV due to the messages promoted by specific marketing strategies, or because they really believe in the technology that each brand is bringing to the market?

I2: Nowadays I consider that the purchase decision varies among countries and entities. For example, in companies it's a more analyzed decision regarding the amount of investment they need to replace combustion vehicles from their operations. For regular consumers my experience has shown me that the decision is influenced by the marketing strategies each brand follows that resumes in a less environmental impact.

AM: How much do you know about the current policies, processes and incentives that Mexico is promoting to implement this technology within the country? Do you think they are doing a successful job to encourage the population to adopt and buy this technology, in an effort to create a more sustainable automotive industry within the country?

I2: A couple years back, the previous government started to invest resources in generating clean energies for the country through CFE, which is the company in charge of controlling, generating and distributing energy throughout the entire country. Following these initiatives, CFE started to grant incentives for the charging infrastructure, mainly in the big cities.

In the current political framework of Mexico, the government has not made enough efforts to promote the adoption of this technology and hasn't given continuity to previous efforts. The current president has put resources on generating gasoline by the recent acquisition of several Petroleum Refineries, reversing the adoption of electrics in a friendlier environment.

AM: What's your opinion about energetic reform in Mexico?

I2: The objective of the reform is good, to promote jobs and improve the conditions of the use of resources in a sustainable way is good for the country, however from reality to what is planned there are many opportunities to improve the program.

AM: Okay, Is there anything you do, whether once in a while or on a daily basis, to contribute to the environmental cause?

I2: For sure, I'm in charge of generating the different scenarios for the company I work for to start to migrate every combustion vehicle to electric vehicles. We are looking to be the first Mexican company to adopt electric vehicles on their fleet operations, we are talking about 10,000 vehicles for 2030.

AM: As we know, pollution has a significantly negative impact on our health: have you, or someone that you know (friends, family members, colleagues), been directly affected?

I2: No that I know.

AM: Okay, Which country do you consider the most advanced in relation to this technology? Do you know anything they are doing better than Mexico to develop this technology?

I2: Norway has been a role model on the adoption of EV worldwide, they have amazing benefits for the usage of electric vehicles. In context Norway is one of the biggest producers of crude oil but the first one to shift from fossil fuels to renewable energy making them export the main part of their production to other countries. Norway taxes IC engine cars more heavily than any country in the world.

The Norwegian government let electric cars circulate through exclusive bus lanes and toll roads are free for them, allowing a free connection through the entire country.

AM: What would be your general political opinion (without giving information about the party you support) on how Mexico's government operates in terms of bringing this technology? How much do you think the country will take in terms of infrastructure to be able to operate in the more developed cities?

I2: Today, I believe that it would take Mexico at least 10 years to develop a regular charging infrastructure which would make the technology not accessible to most of the population in the short and medium terms. Adoption of this technology for the whole country would be suitable in around 15 years. On the other hand, companies have the advantage and the commitment to make investments for the adoption of EV's. This will make the private sector to be the first entities to count with this technology, if they wait for government support it could be too late.

AM: thank you, What are your thoughts in relation to potential savings on fuel and return on investment as a consequence of buying an EV?

I2: As part of several analyses I have runned, I consider this technology to have a huge potential on savings mainly in fuel and preventive maintenance vs their counterpart of combustion. Besides this, companies can extend the life of their activities by replacing them with electric vehicles. At older age, more maintenance of combustion engines would need giving the EV's leverage among IC. (Internal combustion)

AM: Great. Well, thank you so much for your time and for your answers. I will stop recording and have a nice day. Thanks.

Appendix E - Interview Transcript 3

Interviewee number	3
Venue	Zoom
Interviewee	Male, procurement department responsible for maintenance and logistics area for trucks and trailer categories. (I3)
Interviewer	Alejandra A. Maldonado (AM)

Before the interview starts, the interviewer makes a brief about the topic, and asks the interviewee for the recording consent which is granted.

AM: Okay, great. So let's get started. Can you tell me a little bit about your role and how much you are involved in the electric vehicles industry.

I3: Yes, well, let me introduce myself, I am Adrian Meza. And right now I am working for a Mexican company in their sourcing department. And actually, I have 10 years of experience in the transport area, and going through the maintenance and logistics department. And actually, right now I am working in the sourcing team as responsible for the trucks and trailer categories. We attend to other requirements from our customers in Mexico and Latin America, regarding these categories, we will do all the negotiation with the suppliers, and at the end, we give the solution for each of our customers according to their needs.

AM: Okay thank you for the brief. So For the first question: Which EV brand do you think has the highest market share in Mexico and why?

I3: In my opinion, it will be Tesla. And the reason I believe Tesla is because in the city where I live, every time I am driving it is very common to see at least one Tesla on the street. So if you try to compare with other brands, for example, Nissan or GM, well, actually it is not so common to see one vehicle of the other brands. It is more common to see the Tesla here in my city. And also when I have visited other cities from Mexico, it is also common to find more Tesla's on the streets.

AM: Could you please confirm if you have tested an EV and quickly summarize your experience mentioning the model and brand of the vehicle?

I3: Yes, it was jack, the model of the vehicle was the iEVS4. And actually, the handling was very good, I could actually say that the handling was equal or better than a combustion vehicle. It is very smooth and quiet. I call out that my biggest concern was the range of the batteries, however, and I was able to verify that the battery percentage and range was according to the distance that I drove the vehicle. And another thing that I liked was their regenerative braking of the electric vehicle as it allowed me to increase the range. And I think these will also increase the life of the brakes. And another thing that I liked was their

regenerative braking of the electric vehicle as it allowed me to increase the range. And I think these will also increase the life of the brakes.

AM: What do you think is the key decision driver in the consumer's purchase journey? Do you think people are convinced to buy an EV due to the messages promoted by specific marketing strategies, or because they really believe in the technology that each brand is bringing to the market?

I3: Well, I think that right now, there are many factors such as the price of the vehicle, and the range of the batteries, the cost of the electrical infrastructure for the installation of the charger, and the maintenance costs, the battery warranty and the service network. So I believe all these factors are involved in the decision. And at the end, I think the people are convinced to buy an electric vehicle because they believe in the benefits that this new technology has.

AM: How much do you know about the current policies, processes and incentives that Mexico is promoting to implement this technology within the country? Do you think they are doing a successful job to encourage the population to adopt and buy this technology, in an effort to create a more sustainable automotive industry within the country?

I3: I know that the only benefit that the government has provided is to eliminate the import taxes of our electric vehicles. And I think this strategy is definitely not enough, actually more stimulus is needed to encourage the population to migrate to this new technology.

AM: What's your opinion about energetic reform in Mexico?

I3: Well, I think it's totally against new technologies and sustainable energies, since the use of the fuel continues to be promoted through the construction of new refineries. And with the imposition of taxes on clean energies, in addition to preventing competition in the energy sector with this reform.

AM: Okay, Is there anything you do, whether once in a while or on a daily basis, to contribute to the environmental cause?

I3: Yes, in my case, I try to use my bike when I do short trips instead of my car. And also, sometimes when I need to go to the supermarket and it is close to my home, I try walking instead of going in my car. Those are some examples that I tried to contribute to the environmental cause

AM: As we know, pollution has a significantly negative impact on our health: have you, or someone that you know (friends, family members, colleagues), been directly affected?

I3: Fortunately not.

AM: Okay, Which country do you consider the most advanced in relation to this technology? Do you know anything they are doing better than Mexico to develop this technology?

I3: Yes, I suppose it will be Norway, since I recently read an article in which it indicated that Norway is the first country in the world in which the sale of electric vehicles is already bigger than the combustion vehicles. And what they did was to set a goal of ending the sale of gasoline and diesel cars by 2025. And also Norway exempts fully electric vehicles from taxes imposed on those relying on fossil fuels. And with these strategies, they have achieved that the sale of electric bicycles represents today 54% of all new cars sold in Norway.

AM: What would be your general political opinion (without giving information about the party you support) on how Mexico's government operates in terms of bringing this technology? How much do you think the country will take in terms of infrastructure to be able to operate in the more developed cities?

I3: In my opinion, it is totally in the opposite direction here in Mexico of new technologies and clean energies. And I think it will take at least three years to develop the necessary infrastructure for the transition to this new technology. As an example, we have currently carried out some infrastructures to this and we have found that it is not possible at this time to install the Chargers in some places due to the fact that the electricity supplier does not have the required power capacity in those places. So that's the reason why I believe it will take at least three years or even more.

AM: thank you, What are your thoughts in relation to potential savings on fuel and return on investment as a consequence of buying an EV?

I3: Well, the cost of the energy or fuel is just one of the variables considered in the total cost of ownership. So of course, you can have a saving in the cost of the energy, but based on the numbers that we have analyzed at this time, the total cost of ownership of a combustion vehicle here in Mexico is still lower than that of an electric vehicle for the same period. I think that as the supply of electric vehicles increases here in Mexico, I will expect a reduction in costs that allow us to improve the TCO.

AM: Great. Well, thank you so much for your time and for your answers. I will stop recording and have a nice day. Thanks.

Appendix F - Interview Transcript 4

Interviewee number	4
Venue	Zoom
Interviewee	Male, Automotive company, North american market supporting the engineering team for electric components . (I4)
Interviewer	Alejandra A. Maldonado (AM)

Before the interview starts, the interviewer makes a brief about the topic, and asks the interviewee for the recording consent which is granted.

AM: Okay, great. So let's get started. Can you tell me a little bit about your role and how much you are involved in the electric vehicles industry.

I4: Yeah, absolutely. So I will say I'm 100% involved in the EV industry, but mostly for the North American market. I won't give a lot of details, but currently, I'm working for an automotive company. And here I am responsible for business development. And also, I support the engineering team for the electrical and electronic components, for example, for incorporating battery packs, the power train and other high voltage and low voltage components.

AM: Okay thank you for the brief. So For the first question: Which EV brand do you think has the highest market share in Mexico and why?

I4: Which Evie brand? Okay, so I think, in Mexico, so I think it's kind of sad. Because currently, I mean, it's not the sad question, but probably the answer because actually, in Mexico, you probably know, when you talk about market share, I think it is less than 0.1% or something like that. Because the number of electric vehicles sold in Mexico is very, very low. I think it's around 400 vehicles, and we're talking about cars like passenger cars. And also, I think there are some companies that are developing their own solutions for their fleet. So let's add another 400 vehicles to companies like Bimbo, and their collaborations with giant and jack motors. So let's say there are around 800 vehicles sold in in Mexico per year, but in in total the total number of vehicles sold in Mexico is around 1 million so that that is still less than 0.1% of market share So I don't know how relevant is to talk about market share when the volumes are so small. So you won't be able to identify a solid reason of why specifically those vehicles were actually bought or the answer will be very simple. I mean, people that can afford a Tesla a BMW or or Nissan LEAF so what brand rating is the highest market share i think is probably between Nissan LEAF or or Tesla I don't really really know but and I think there is not a lot of information here in in Mexico which is the brand sales most of the vehicles but that will be my my best bet on that topic.

AM: Could you please confirm if you have tested an EV and quickly summarize your experience mentioning the model and brand of the vehicle?

I4: Yeah, I have driven an extended range electric vehicle which was the boat from traveling also the Nissan LEAF and the Tesla and electric pickup truck. So in general meetings the sensation is very similar. So in one word, I will say it's very fun to drive an electric vehicle because you have instant torque. And additionally I think that most of the technologies that these vehicles have are very advanced and they are putting all these technologies into this vehicle used to be more attractive for the for the market because in most cases, people want buy the vehicle only because is not pollutant but because of the technology that it has already incorporated in comparison with the IC (internal combustion) vehicles, for example, safety technologies or autonomous technologies like Tesla, and so on, but in general, I will say my experiences is, it was very, very fun. I love to drive those electric vehicles. I don't own one by myself, but hopefully I will buy one.

AM: What do you think is the key decision driver in the consumer's purchase journey? Do you think people are convinced to buy an EV due to the messages promoted by specific marketing strategies, or because they really believe in the technology that each brand is bringing to the market?

I4: That's a good question. I don't think I don't think people will prefer and will prefer to buy an electric vehicle paying like one point x time, what they pay for, for an a sport vehicle, for example, or an SUV in Mexico, I think there will be very few people that can afford an EV and be consistent with their thoughts around global warming, for example, or zero emissions and clean technology surveying green in general. So probably the people as I was mentioning earlier, that can afford an EV will be because it offers more technology, or features, such as safety, or things that convince them to buy it over an SUV or on a sports car, because at the end price, the upfront cost is very similar. On the other hand, there are the private companies that have big fleets, you know, in Mexico FEMSA, for example, Coca Cola, Heineken, and that's a different story. And it's probably the other way around in that case, they will actually look at the business case, or the total cost of ownership and see how viable it is to make that transition. But, yeah, I think that's my answer.

AM: How much do you know about the current policies, processes and incentives that Mexico is promoting to implement this technology within the country? Do you think they are doing a successful job to encourage the population to adopt and buy this technology, in an effort to create a more sustainable automotive industry within the country?

I4: Actually, I don't really know if there are a lot of incentives. As far as I know, there are not many or almost none. So, I will say they are not doing a very good job there

AM: What's your opinion about energetic reform in Mexico?

I4: Yeah, so about that, the new reform I think is nonsense, because basically it is to benefit CFE which has the most polluting processes for producing energy and that affects how they are changing the way in which energy flows. So first, we will have polluted energy and energy that comes from burning oil and carbon and then we will have renewable energy or kinetic energy like solar or wind power. So that affects all the projects of the companies that were developing clean technologies, so it will stop investment and so on, and I don't see what is a pure benefit for the people nor for the environment. I think it doesn't make sense at all.

AM: Okay, Is there anything you do, whether once in a while or on a daily basis, to contribute to the environmental cause?

I4: I will say on a daily basis while I am working on developing electric vehicles, so I really hope that helps. I hope it has an impact one day. But while I was just kidding, but besides that, I think that I don't use a lot my personal vehicle, maybe because of the pandemic, but actually I'm thinking on buying like an electric scooter to go to the grocery shopping or things like that. What else? Probably using reusable bags for grocery shopping. And I think that's it.

AM: As we know, pollution has a significantly negative impact on our health: have you, or someone that you know (friends, family members, colleagues), been directly affected?

I4: Is really hard to know exactly the reason why people are getting sick. Because I think pollution is considered a risk factor for pulmonary diseases or conditions. I don't know what's the right word. So I know that is one of the top risk factors and that has an important negative effect for those diseases. But currently, I do not know anyone close that it's that they got the disease because it's exactly that. But I do know that Monterrey is the first or second most polluted city in Mexico. So I will say there are a lot of cases.

AM: Okay, Which country do you consider the most advanced in relation to this technology? Do you know anything they are doing better than Mexico to develop this technology?

I4: I think oh, I mean, almost all countries are doing better than Mexico there. But definitely Norway is a good example. Because there are a lot of benefits for the people that buy an electric vehicle, for example, that are exempt from registration, taxes and VAT taxes. And I think currently Norway has a plan to ban internal combustion engines by 2025, or something like that. And they have, like the highest market share in the world of electric vehicles, like around 80% of their vehicles are already electric. So it is a good example.

AM: What would be your general political opinion (without giving information about the party you support) on how Mexico's government operates in terms of bringing this technology? How much do you think the country will take in terms of infrastructure to be able to operate in the more developed cities?

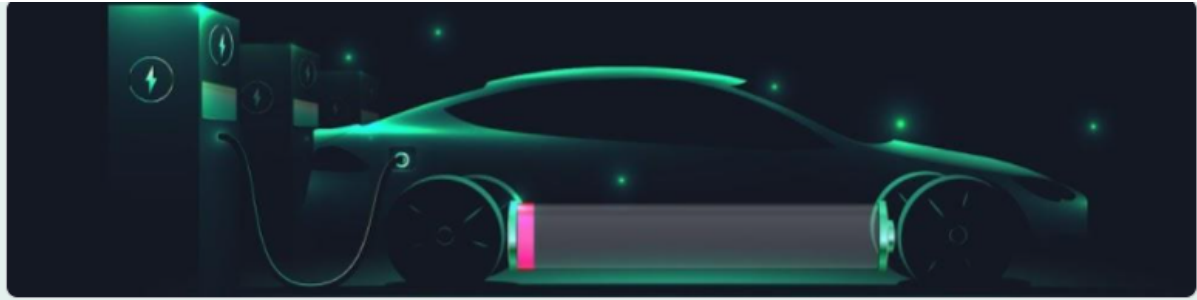
I4: That's a complex question, because I think that I mean, it's clear that the current government is not interested in clean or renewable energies. And they are doing investments for Pemex, like buying refineries and things like that. So in Mexico, I think it's not really a matter of government incentives. I think it's more on companies willing to develop a network or an ecosystem to make it happen. So, it will not be Mexico, I will not rely on waiting for governments to give any incentives to move forward. I think that companies need to push on that to make it happen.

AM: thank you, What are your thoughts in relation to potential savings on fuel and return on investment as a consequence of buying an EV?


I4: This has always been a big topic, but I will try to summarize the explanation in general. I think that it is almost the same, but in most cases, the electric vehicle is more expensive and talking about total cost of ownership, let me explain why. So Front costs. So you will pay way more for an EV than an ICE (internal combustion engine) in a comparable segment. So to put an example, you have the Nissan March, so the Nissan March is around 200,000 pesos and then you have the Nissan LEAF, which is also a similar vehicle as a subcompact vehicle, and that vehicle costs 900,000 pesos. So, it's 4.5 times more expensive than the Nissan March. And then you need to consider two other costs that are many costs with two other main costs, which is maintenance and the operating costs of fuel or electricity just to make it comparable. And normally, those numbers are around 50 to 80% less than IC. So, you are always saving something there in maintenance and the operative cost of energy, electric energy electricity versus fuel. So, the question is if that is really enough to compensate for the upfront cost of the vehicle and normally it is not when you compare apples to apples for the same type of operation. So that there is a big concern there on how to make it profitable for the people are to identify what is really the reason that people will buy this vehicle over an SUV or a sport car as I have been mentioning so it's kind of complex, but for companies is also different because then they require kind of a vehicle for their operational processes let's put it like that. And in that case, they will need a different type of a different kind of vehicle without a lot of luxuries so they will need to remove many of the features that these cars offer to the public in general and make it more affordable for those types of operations. Probably in Mexico, I think it will come first electrification for trucks and vans than for passenger vehicles, it's kind of weird but probably that that is something that will happen.


AM: Great. Well, thank you so much for your time and for your answers. I will stop recording and have a nice day. Thanks.

Appendix G - Online questionnaire



Electric vehicles

Thank you for participating to this survey. This will help gather more insights about the Mexican Automotive 

Have you ever heard about Electric Vehicles and the technology empowering them? 

- Yes
- No

On a scale from 1 (never heard of) to 5 (extremely familiar), please rate how familiar you are with ^{*} each brand producing EV models. By familiarity, we mean how much you know about these brands actually commercializing EVs, and how well you know the EV models. The more you know about the EV brand, the higher you should rate it; the less you know about the EV brand, the lower you should rate it. If you never heard of them, please select 1 .

	1 - Never heard ...	2	3	4	5 - Extremely fa...
Tesla	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Nissan	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
General Motors...	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
JAC	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
BYD	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
BMW	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Volkswagen	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
KIA	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

If, in the above list, we haven't included an EV manufacturer that you heard of, please add it below:

Short-answer text

Have you ever driven an EV before?

Yes

No

If your previous answer was "Yes", could you please explain your experience in detail? Also, which brand did you drive?

Long-answer text

Do you know anyone owning an EV? *

Yes

No

If your previous answer was "yes", please specify how many people that you know own an EV

Short-answer text
.....

How much do you think (or know) the entry price for an EV is? (in MXN) *

Short-answer text
.....

If you could afford an EV, would you consider purchasing one? *

Yes

No

Maybe

If your previous answer was "No" please explain why

Long-answer text
.....

If your answer was "Yes", which of these factors are important to you when you make the decision about which brand of EV to purchase?

- Familiarity with the brand
- Price
- Comfort
- Materials
- Customer service
- Durability
- Autonomy (range of km the car can have on a charge)
- Other...

What do you think will encourage you buying an EV? *

- The environment
- No more spend on gasoline/diesel
- Government incentives
- Maintenance savings
- Be on trend
- Other...

Do you know if Mexico has any incentives for people who owns an EV? *

- Yes
- No

If your previous answer was "yes," please specify which incentives you are aware of.

Long-answer text

On a scale from 1 (never heard of) to 5 (extremely familiar), please rate how familiar you are with * contamination issues in Mexico. By familiarity, we mean how often you have come across pollution issues, and what it is like. The more you know about the topic, the higher you would rate it. The less you know about, the lower you would rate it. If you are not aware, please select 1 (never heard of)

- 1 2 3 4 5
-

...

Are you helping overcome any pollution issues that Mexico has, or involved in any environmental * friendly activity?

- Yes
- No

If your previous answer was "yes", please specify how you are involved with the environmental cause.

Long-answer text

Do you have any knowledge about Mexico's energy reform?

- Yes
- No

If your previous answer was "yes", what is your position regarding this reform, and how do you think it will affect or benefit Mexico?

Long-answer text

Appendix H - Incentives comparison between Norway, China, US and Mexico

Norway	China	US	Mexico
Temporary Exemption from on-off registration tax 1990–1995 1996		Included in the tax rebate	Electric vehicles do not pay taxes on new vehicles
Exemption from annual vehicle tax – 1996	Exemption on vehicle purchase tax	Included in the tax rebate	Exemption from “tenencia” (a type of tax)payment in most states. In the state of Mexico, no tenancy is paid for the first five years, then you pay with a 50% discount.
Exemption from road tolls – 1997	NA	NA	Introduction of discounts across toll roads, e.g. 20% special discount for electric cars and hybrids on TeleVía roads in Mexico City, such as Urbana Norte highway, Urbana Poniente highway and Urbana Sur highway.
Exemption from parking fees on municipal owned parking facilities – 1999	Economic stimulus measures will emphasize investments in “new infrastructure” – which includes NEV charging stations	NA	A few companies related to the EV industry (e.g. ChargeNow, and others) offer preferred parking lots, including necessary charging points, to their customers driving hybrid or electric vehicles.

Reduced company car tax – 2000	Financial subsidies are given directly to manufacturers and then are passed on to consumers, making it convenient for the consumers.	Subsidies are tax subsidies through tax rebates. According to the Plug-In Electric Drive Vehicle Credit (IRC 30D), when the PEV consumer files a tax return, the corresponding tax rebate amount is deducted from the consumer's personal income tax on the basis of the PEV battery capacity	Exemption from custom duties when importing vehicles with electric engines, including cars, vans and trucks. This applies to companies that subscribed to the governmental competitiveness policy, as proposed by the Ministry of Economy.
Exemption from VAT 2001	NA	Included in the tax rebate	A tax credit of 30% is deducted on the income tax related to the acquisition of charging stations where public access is guaranteed.
Permanent use of transit lanes – 2005	NA	NA	NA
Further reduction in company car tax 2009	NA	NA	NA
Exemptions from paying car ferry fees	NA	NA	NA

****“NA” stands for information that wasn't found, or that simply doesn't apply to the country.**