POLITECNICO DI TORINO

Master of Science in Automotive Engineering

Final Project

Market Analysis and Strategic Management of Battery Cooling System for Electric Vehicle

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"There's progress now where there once was none,
Where there once was none, then everything came along.
Although no one understood,
We were holding back the flood learning how to dance the rain."

Take That

Abstract

Due to the COVID-19 pandemic, global automotive markets have suffered a tragic decline. Fortunately, forecasts for the future lead to hope that the industry will quickly regain production and sales numbers, maintaining its leading position among the most profitable industries in the world. However, some threats to the automotive industry remain. The first is the shortage of microchips, and the second is the demand by governments to minimise their carbon footprint.

With the almost inevitable shift to electrification, the entire product value chain will also change, as will the supply chain. The upstream players, the suppliers, will therefore have to cope with this change by expanding their component portfolio to meet the demands of this new trend. This thesis collaborates with Mubea, a leading supplier of automotive lightweight components, to study future trends in the automotive market and identify possible strategies to generate profits.

The project is divided into several sections. The automotive market will be analysed in detail, studying possible future production volumes and synergies in using the same platform for different vehicles. Then, the strategic management of the battery cooling system will be developed, a product that has already been launched on the market by Mubea but is still in the embryonic stage. The sales path of this component will be checked to highlight any issues to be improved in future projects. Finally, an analysis of the current environmental condition will be covered, with all government requirements to reduce carbon footprint and global warming. These will be the fundamental goals of the automotive industry. The contribution of this thesis aims to provide strategic support for a product that is already on the market and to develop an insight that can be useful as a strategy to expand the business portfolio.

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Acronyms

ADAS Advanced Driver Assistance Systems. 13, 20

AEB Automatic Emergency Braking. 13

BCG Boston Consulting Group. 9, 63

BEV Battery Electric Vehicle. 11, 17, 19–21, 24, 26, 30–32

CFRP Carbon Fibre Reinforced Plastic. 2

ELKS Lane-keeping Assist. 13

EV Electric Vehicle. 1, 3, 11, 12, 19, 21–24, 26, 30, 31

FCEV Fuel Cell Electric Vehicle. 21

GFRP Glass Fibre Reinforced Plastic. 2, 5–7

GHG Greenhouse Gas. 54

HEV Hybrid Electric Vehicle. 17, 24, 30–32

ICE Internal Combustion Engine. 12, 19–23, 30, 31, 34

ISA adaptive cruise control. 13

MHEV Mild Hybrid Electric Vehicle. 24, 30, 31

NBP New Body Products. 3, 4, 48

NPL Neuro-Linguistic Programming. 14

OEM Original Equipment Manufacturer. 9, 11, 12, 17–19, 21

PHEV Plug-in Hybrid Electric Vehicle. 17, 21, 24, 30

SES Stationary Energy Storage. 26

TRB Tailor Rolled Blank. 2–7

V2G Vehicle to Grid. 22

V2I Vehicle to Infrastructure. 20

Introduction

The automotive industry has always been one of the most important in terms of turnover. In the wake of the COVID-19 pandemic, the numbers have taken a significant plunge that needs a few years to recover. The 2020 show a drop of 15 million vehicles produced, and it is estimated that it will take three years to recover to pre-crisis levels. Under these precarious conditions, it's easy to imagine how imperative it is to analyse the market carefully. A false move could lead to a substantial loss or even exit from the market.
This thesis has been made possible through collaboration with Mubea, a leading supplier of lightweight components. This company has vigorously resumed its main course after the pandemic crisis. To capitalise on an opportunity where disruption occurred and remain a leader in a competitive segment, Mubea began developing a series of proactive strategies that would allow it to increase revenue as quickly as possible.
In the aftermath of the pandemic, the automotive industry faces other issues, including chip shortages due to the semiconductor crisis and stringent regulations imposed by governments regarding environmental pollution. In the first case, the semiconductor crisis is creating not minor disruptions. The absence of chips in cars creates a bottleneck that compromises production. As a result, the entire supply chain will have to recognise the slowdown and adapt its production to maintain a "Just in Time" approach. On the other hand, stringent regulations have been enshrined to reduce the carbon footprint and global warming when it comes to pollution. For example, in Europe, the 2015 Paris Agreement set a goal of containing global warming within the 1.5°C threshold. Subsequently, European climate law requires a strong commitment from OEMs to reduce their carbon footprint. Not only that, requiring them to take charge of the entire product value chain, upstream and downstream. For Mubea, it is then important to analyse all the requirements for each OEM in terms of emissions to continue supply. This thesis aims to carefully analyse the automotive market, extracting valuable data to develop future strategies. Strategic support is provided to the

company, with marketing and business portfolio expansion proposals that reflect the likely customer demands. Finally, pollution-related regulations are analysed in detail, providing research into possible options for reducing the company's carbon footprint.
The thesis is developed into four main sections. The first section is a market analysis of the automotive industry. This section provides a study of the consumer, their willingness to purchase EVs, and the possible purchase formulas they might choose. Next, an analysis is offered on the possible scenarios of the auto industry and what role electricity will play in the future. Attention is drawn to the semiconductor crisis and the resulting shortage of microprocessors. It is strategic for the company to optimally manage production reductions to OEMs to maximise profits and reduce inventory costs. A case study is proposed in the 2.5.1 chapter, namely the The future Stellantis platform. This analysis results in a breakdown of volumes for each platform shared in the future within the Group. This will help the company identify the right strategy correctly choose the platforms to focus on.
The second section of the study proposes a marketing and strategic management analysis of an EV-specific product, the battery cooling system. This development aims to understand the extent to which this product has entered the market and set the stage for future projects. Furthermore, it will serve as an exercise to increase knowledge in future EV related projects. Various frameworks will be used to complete this analysis, with a view from inside and outside the company. The frameworks used are PESTEL, Porter Five Forces, Growth-Share Matrix, SWOT, and VRIO. In the third section, the battery cooling plate sale for the customer Maserati is analysed. This has as objective the research of problems arising after the commercial process of the component, with the acquisition of knowledge for future projects following the logic of continuous improvement. The second objective is to record the customer's impression of the product and the interest in deepening future projects qualitatively.The last section aims to understand how the automotive industry will adapt to meet pollution requirements. The carbon neutrality and positive climate concepts are analysed. A search is made to meet the emission limits of individual OEMs provided by Mubea to reduce the carbon footprint as soon as possible and minimise the Scope 3 of car manufacturers. In conclusion, some climate actions were proposed to reduce the company's carbon footprint.

Chapter 1

Mubea, the Company

This thesis was carried out in collaboration with Mubea, a world leader in developing lightweight and complex components for the automotive industry. The company intends to promote lasting commercial development over the years and, for this reason, invest in technological and product innovation. The company is present in 48 locations in 20 countries with 14,000 employees and can count on more than 100 years of experience. The turnover is 2.08 billion euros, 10% of which is an investment [12].

The main ambition is to remain among the world's top 100 automotive suppliers. To do this, Mubea uses its knowledge to approach new strategic business units. As you will see throughout this thesis, the electric market is growing rapidly, and a supplier needs to change its product portfolio to remain competitive in the market.

While some of Mubea's products provided customers for ICE car manufacturing, the industry's evolution led the company to shift its focus to a growth sector, Electric Vehicle (EV). Entering a new industry allows the company to hedge the profits generated by sales for the declining industry and, more importantly, seek to increase profits by taking full advantage of new opportunities.

1.1 History and growth of the Brand

Mubea was founded on August 1, 1916, in Attendor. Before 1980, the production of stabiliser bars to be applied in a vehicle began. The Porsche 928 was equipped with Mubea bars that allowed a weight saving of 40%. At the end of the 80s, Volkswagen Group has a problem with its Audi Quattro, Golf and Passat models to manage the transverse force in the MacPherson strut. Mubea provides them with the solution through an axially offset spring. In the 2000s, Mubea specialised

in flexible rolling and formed a Tailor Rolled Blank (TRB) factory. By 2010, it acquired Carbo Tech's product portfolio and began supplying premium customers such as McLaren. In 2015, Mubea Performance Wheels (MPW) debuted, wheels made from Carbon Fibre Reinforced Plastic (CFRP) and aluminium to provide maximum performance at the lowest weight. In 2017, the urban mobility business introduced two new products, the Mubea e-bike and e-cargo bike. In 2018, Mubea created new leaf springs made of Glass Fibre Reinforced Plastic (GFRP) that save 50 kg compared to traditional ones.
Looking to the future, the Mubea Corporate R&D competence centre located in the RWTH Aachen University in Germany focuses on developing research activities for lightweight body construction, new manufacturing processes and materials, and new components for e-mobility.

1.2 Main products and brand philosophy

Mubea has always been a leader in the field of lightweight automotive components. Its strength is the TRB technology, which characterises most of its products. The main application of this technology concerns the longitudinal and transverse structures of the chassis, responsible for safety in the primary load paths of the accident. The sheet thickness variation can generally be used on different shapes, even the most complex ones, starting from the blank machining. An example is the clamping brackets inside the battery cooling case with a high-performance structure thanks to this technology.
The flexible lamination process passes a blank of constant thickness through two moving rollers. The control of the roller distance in the lamination process allows obtaining different wall thicknesses in the longitudinal direction with linear and harmonious transitions in the material. Laser monitoring allows for minimal tolerances, ensuring high precision in wall thickness, regardless of the thickness of the sheet.
The benefits of this technology are several. The thickness variation in the rolling process mainly allows concentrating higher thicknesses only where necessary. This allows for more remarkable performance in areas subjected to more significant stresses and strains. On the other hand, having a lower thickness in the areas subjected to less stress saves weight. Last but not least, the price saving due to the lower use of material, a critical aspect for the customer who is forced to pay high sums for the current high prices of raw materials.

Mubea's products are divided into five business units.

- *Chassis*: Coil Spring System / Stabilizer System / Chassis Composite
- *Body*: New Body Products (NBP) / Tailor Rolled Products / Mubea Carbo Tech / Interior
- *Powertrain*: Valve springs / Belt tensioner system / Tubular shafts / Transmission system
- *Aviation*: Modular elements
- *Industry*: Disk spring / CFRP Structural and Visual Parts

This thesis focuses only on the components related to NBP and develops a strategic analysis of these components. In the following section, NBP will be analysed, and all parts, their characteristics, and manufacturing will be explained in detail.

1.2.1 New Body Product

The development of the first electric car began more than 120 years ago, but only in recent years have EV given concrete signs of an all-electric future. Sales numbers are promising, and manufacturers are finding themselves compelled to offer new models in the range that meet state-mandated pollution standards. Although an electric car still has many limitations, mainly related to price and autonomy, EV buyers are becoming more and more, as evidenced by the exponential growth of the market for these cars.
One of the main problems of electric cars is producing energy that generates higher CO_2 emissions than gasoline or diesel engines, if not made through renewable sources. On the other hand, despite the crucial technological developments, the battery pack is bulky and weighs several kilograms. As the weight increases, the rolling resistance increases and therefore also the consumption. Therefore, it is necessary to find the right balance between autonomy and battery weight.
The great challenge of recent years is to reduce the weight of the elements that make up the car as much as possible. One of the heaviest components of future vehicles will be the battery pack. Compact, lightweight construction is even more critical for battery-powered vehicles than for combustion cars. In this regard, Mubea has dedicated a separate department to developing New Body Products to address the problems and needs of new electric vehicles. Some of these components are made with TRB technology to cope with the weight problem.

Technical description of New Body Products

New Body Products (NBP) components result from a careful study by the marketing and research and development departments. The marketing team analyses the market and the numbers for the sales prospectus. Once a plan of action is created, the R&D engineers and designers study a solution that can be competitive and advantageous compared to direct rivals.
The products featured within the NBP are inherent to electric mobility. Mubea offers the new High-voltage storage housing, which is the set of different elements such as battery top cover, clamping brackets, battery cells, TRB crash structure, cooling plate and underride protection, following the order from top to bottom of the set. All these components will be analysed individually in the following paragraphs.
Thanks to the experience gained over the years by Mubea and the innovative technologies available, the high-voltage storage housing is a very competitive system on the market. The components in the assembly offer high flexibility in design, and the materials that make them up to have excellent features such as crash performance and cooling capacity. One of the essential benefits of NBP is that they support the scalability of all components in terms of size and production volumes.

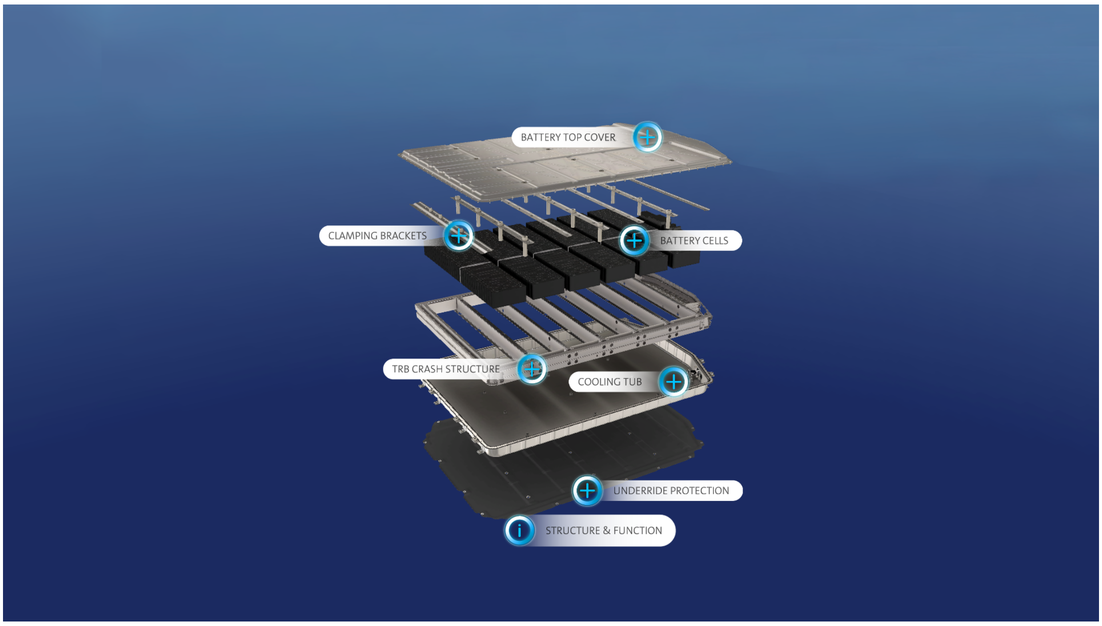

Figure 1.1: New Body Products assembly (Source: Mubea)

- **Battery Top Cover**
  The battery top cover (also called Lid) is the highest element in the storage housing. Its function is to cover the battery structure from the car's chassis. One of its essential tasks is safety, specifically the ability to resist thermal runaway and ensure the best protection for all car occupants. This component can be manufactured in GFRP (glass fibre reinforced plastic) or in GFRP-aluminum hybrid, depending on the customer's requirements. Also, the product's geometry is entirely modifiable depending on the customer needs. Compared to the same component made of Mica, a mining material commonly used for these applications, the Battery Top Cover made of GFRP allows improved dielectric strength, i.e. better electrical strength of insulating material. Compared to steel, the material with which it is created allows a weight reduction of more than 30%. This is surprising if you also consider the excellent fire response capabilities. The main target of the Top Cover is not to have the most competitive price but to guarantee the highest efficiency and the lowest weight. The production process of the battery top cover is fully automated and allows a high-volume application.

- **Clamping brackets**
  Clamping brackets are critical components within an electric vehicle battery pack. Their primary purpose is to support the lithium-ion cells of the battery pack, acting as a reinforcement for the structure. More specifically, these brackets act as reinforcement for the side pole loads. This type of strain is critical to the battery because a side pole load could induce battery deformation and cause massive damage. A concrete example is a side-impact accident. The clamping brackets, working in conjunction with the crash structure, prevent incorrect deformation of the battery modules. In this way, all passengers are protected from possible debris that could result from the deformation of the battery. The clamping brackets are made with TRB technology, which, through the optimised variation of the sheet metal thickness, improves the component's performance and reduces its weight.

- **Battery cells**
  The heart of the high-voltage storage housing is the battery pack. This component allows for the storage of the chemical energy that will be transformed through the inverter into electrical energy to power the electric motor of an EV. Current lithium-ion battery technologies will enable the battery to be recharged during road use through regenerative braking using the reverse work of the inverter. Mubea, in cooperation with a development partner,

can offer battery cases adaptable to different cell module sizes. The design of the battery case allows compact dimensions adjustable to any platform. Each row of battery cells guarantees structural load support of 58 kg.

- **TRB crash structure**
After having treated the battery cells and the Clamping brackets that support the single cells, it is necessary to examine the Crash Structure that represents the simple framework of the whole. The structure is composed of longitudinal and transversal elements positioned to optimise the load path to protect the battery pack. Each transversal part, except for the external ones, is placed between two lines of battery cells. This represents an improved response under conditions of lateral impact to the structure. As for the LID, the materials used are steel and, according to the customer's needs, GFRP. The longitudinal and transverse structures are created using TRB technology, i.e. a laminate with variable wall thickness. This makes it possible to optimise crash performance and minimise the weight of the entire component. Compared to a material with constant thickness, the weight saving is more than 20%. The design of the crash structure allows it to undergo the process of cathodic painting, a type of coating aimed to protect the substrate from corrosion. Spot welding is available to optimise costs. This type of welding has several advantages. First of all, it makes it possible to weld different metals with different thicknesses and join coated steel sheets or corrosion-resistant alloys. Secondly, this technology does not require a metal filler and a protective atmosphere. On the other hand, the hermetic seal in joining two components is not guaranteed, and electrodes' consumption involves replacement. The side crash test was developed following the GB 38031-2020-CN standard for safety reasons. The component impacting the crash structure has a diameter of 150 mm and maintains a loading time of 10 minutes with a minimum intrusion force of 105 kN. The result obtained from this test fully meets the target set. There is no intrusion of the crash structure into the battery cells.

- **Cooling plate**
This component is crucial in the proper functioning of the batteries while operating an EV. The passage of coolant through the cooling plate allows the maintenance of the optimal operating regime of the batteries. The cooling plate is made entirely of aluminium alloys (e.g. 3xxx, 5xxx). This allows for the best performance in terms of heat dissipation. The entire element is 100% recyclable. It is also possible to adapt the component

three-dimensionally and weld it to the frame. The manufacturing process of the cooling plate starts with two separate aluminium coils. Both sheets are straightened and cleaned of impurities or coil defects. The bottom sheet now undergoes a critical step called "screen-printing". A layer of screen printing paint is applied locally. This prevents the two aluminium foils from sticking together in specific areas and marks the path for the liquid to cool the coils. Next, both sheets are heated and joined into a single sheet through the roll-bonding process. Once again, the sheet will be heated and straightened to be cut finally. All cut sheets will be packaged in columns awaiting the following process. The last process is to place the sheet inside a machine that performs the one-sided inflation process. Pad pressure is applied to the space within a specific platen area. The applied pressure presses the flat side of the cooling plate against the inflation press. Next, the pressure is applied to the channel structure. The differential pressure between the support pressure and the channel pressure forms the channels. A system inside the machine recognises the reference system and, through a punching process or an alternative laser-cut, cuts the external contour of the plate, thus generating the final product. As a final step, the cooling plate undergoes quality control, and leakage tests are carried out by monitoring the inflation and support pressure. This continuous production process saves time and cost compared to a more common brazing process. The price of the cooling plate created with this technology is also lower because there is no tooling cost for channel generation. As mentioned earlier, battery temperature control is essential for future cars since they will be predominantly electric. Next, a case study of a sales plan and marketing study of this component will be analysed.

- **Underride protection**
  In the lowest part of the assembly is the underride protection. This component is important because it divides the cooling plate from the outside and protects the plate and batteries from elements such as rain and debris from the asphalt. This component is divided into four layers, two externals (top and bottom belts) in GFRP material, while the core ribs and the core plate are steel (TRB technology). Compared to the past, where the underbody protections were entirely metallic, this innovative component uses composite materials to reduce weight. In total, the switch from aluminium to fibreglass has led to a reduction in vehicle weight of 10 kg. Innovative materials have improved acoustic behaviour, better cabin insulating, and increased onboard

comfort. Moreover, the safety of the occupants has been increased, and there are no problems in case of an external bonfire. The requirements for ECE 100 homologation have been met, following the tests conducted on lithium batteries installed on 4-wheel electric vehicles to transport persons or goods of category N and M with electric traction.

Chapter 2

Future scenario and market trend

The first analysis covered in this thesis involves market research with market trends to analyse a likely future scenario. Initially, several leading technologies that could be profitable for the company were identified. Following this analysis, the Mubea group decided to continue its research towards the electric vehicle industry, one of the most promising of this decade.
To analyse the state of the art in this industry and understand the leading players and how it could evolve over the years, different reports procured by consulting agencies, such as McKinsey and Boston Consulting Group (BCG), have been analysed. In addition, customers have opened debates to understand their opinion of electric vehicles and their shares of investment in this industry.
Following the requests of the marketing group, the first analyses were done on consumers. It is important to remember that Mubea's customers are automotive manufacturers. Nevertheless, it is important to study the end customer to draw further conclusions about the performance of this market and estimate its productivity. Then, a possible future scenario in the automotive world is proposed. In more detail, the solution of electric vehicles is analysed, with its merits and demerits and, above all, the timing of development of this industry. The current semiconductor crisis is discussed with the consequent shortage of chips, a bottleneck for all Original Equipment Manufacturer (OEM) production and the respective supply chain.
Finally, a practical case is analysed, namely a study conducted by Mubea's group on the Stellantis customer. IHS forecasts were used to understand how much the customer invested in the electric vehicle industry. As an output of this analysis, the estimated production numbers for the Group's different platforms were reported.

2.1 Consumer analysis

One of the main benchmarks when analysing a high-growth market is consumer opinion. Sales are directly related to customer needs and requirements. The customer will only buy a product because it fully meets his requirements. For this reason, the customer has become the heart of the marketing department's research. The goal of this department is to create value and engagement for the customer.

The desires of humans are simply the demand for the fulfilment of human needs, shaped by individual culture and personality. When supported by purchasing power, desires become demands. Companies address customer needs by presenting a value proposition, a set of benefits that promise consumers that their needs will be met. The value proposition is created through a market offering, which provides value and satisfaction to the customer, resulting in long-term exchange relationships with customers. In exchange for creating value for targeted customers, the company captures value from customers in the form of profits gained from purchasing the product or service.

Thus, it can be understood that all marketing and sales strategies are driven by the end consumer, which leads to the use of the term "customer-driven marketing strategy." The company manages to identify the right customer through market segmentation, targeting, differentiation and positioning. In this way, the company divides the total market into smaller segments, selects the segments it can best serve and decides how it wants to bring value to the target consumers in these chosen segments. After that, it designs an integrated marketing mix to produce the output it wants to achieve in the target market. The marketing mix is a marketing operation that consists of the 4Ps model of making product, price, place and promotion decisions.

Therefore, it is essential to understand what end-consumers think about the current car market, what they would be willing to buy, or the motivations that lead them to choose substitute products. This thesis looks at the analysis carried out by Deloitte in 2021, summarised in the report called "2021 Global Automotive Consumer Study" [13]. In this study, different issues regarding the automotive industry were put under analysis. At first, the advent of electric vehicles still brings uncertainty in customer choice. Next, the new fractional payment and online vehicle sales solutions will be analysed. Finally, the intention to purchase a vehicle after the pandemic is interpreted.

2.1.1 Purchasing electric and connected vehicles

Proceeding in order, customers' intention to buy electric vehicles is analysed. In contrast to the development of new cars on which OEM invest, many customers are still uncertain about purchasing an electric vehicle. In Germany, for example, 59% of customers are willing to buy a car with a combustion engine (ICE) gasoline or diesel. 25% of consumers, on the other hand, would like to buy a hybrid vehicle (HEV), i.e. equipped with a conventional engine and a battery pack that helps to reduce CO_2 emissions. Most automakers have converted some of their cars to hybrids, intending to fall within the emissions range where they don't pay pollution penalties.
In many cases, if you're sure to buy a specific model, you have to buy a hybrid powertrain. The 9% of German customers choose vehicles with alternative powertrains such as ethanol, CNG, and hydrogen fuel cells. Finally, only 7% of consumers are willing to select an Battery Electric Vehicle (BEV).
At the top of the list of customers' concerns to buy an electric vehicle are the autonomy of the batteries and the absence of infrastructure for this type of vehicle. In the first case, the freedom that an electric car promises can vary depending on its use. For example, if you drive many kilometres on the highway at 130 km/h, the driving range is quickly reduced compared to use at the speed of 60 km/h. For information purposes, the highest range ranges are the Mercedes EQS, with 770 km, the Tesla Model S, with 663 km, and the Ford Mustang Mach-E Extended Range, with 610 km. The lowest ranges of autonomy, on the other hand, are of the smart EQ forfour (138 km), Mazda MX-30 (200 km), Honda e (222 km), and Mini Cooper SE (235 km).
Another concern that worries about 30% of customers is infrastructure and charging points. Unfortunately, charging stations are not yet present in high numbers. About 80% of early EV buyers relied primarily on private charging. The next generation, however, will depend on public charging. More than half of EV owners will not have the availability of a personal charger and will have to rely on public charging outlets. In the past couple of years, however, the number of charging stations has risen sharply, and while there are still far fewer of them than there are traditional refuelling stations, they pose less of a problem for drivers. However, when facing a journey longer than 500 km, you should always plan your stages according to a conservative strategy. If you get stranded, you don't just need a tank of fuel, and you need to call a tow truck!
On top of that, recharging times are not as immediate as a traditional fuel supply. Enel X, for example, declares (for a car with a 40kWh battery) that with a

domestic charging station with power ranging from 3.7kW to 7.4kW, it takes 5 to 12 hours to recharge 100% of the battery [16]. Instead, the higher power, typically 22kW, allows a complete recharge (0-100%) in public charging points in 2 hours. There are also fast stations with a capacity up to 50 kW for a recharge in less than an hour and Ultra-Fast stations with power up to 350kW and recharge in less than 25 minutes. Obviously, in the latter case, prices are very high and no longer economically competitive than Internal Combustion Engine (ICE) vehicles. According to an analysis, in Europe, more than 50% of electric car buyers will choose to recharge at home. The 25% will choose public street charging while 10% will recharge the car at work.
Other issues related to buying an electric vehicle include the purchase price and the cost of installing a home charging outlet. The cheapest electric car on the European market is the Dacia Spring, purchased for 19,900 euros. The average European price is about 48,000 euros, and most of the vehicles are SUVs or premium sedans. The average price of purchasing and installing a home wallbox (power less than 7.4kW) is about 1,500 euros. In addition, it is necessary to consider the possible expense of updating the electrical system of the box.
However, in a broader view, it can be assumed that all these concerns will be mitigated in the short term over the next five years. All OEM are looking to maximise the range of their cars with new energy storage technologies. Another factor in the development is the timing of charging. As mentioned earlier, batteries can already be fully charged in less than 25 minutes, and the cost of charging will likely be reduced in the future. Third-party charging companies on the ground are also investing in creating more charging points and new forms of charging (fast induction charging). Finally, consumers are being strongly influenced by the government, which, through incentives targeted at EV, is offering cheaper solutions accessible to most drivers. The use in cities of these vehicles is also incentivised. For example, there is no parking charge and no stamp duty for the vehicle's entire life in some Italian regions.
A new chapter of interest for customers concerns vehicle connectivity. A networked vehicle offers different possibilities. For example, it allows the driver to have up-to-date traffic information in real-time or, by using a smartphone, accessing the status of the car, such as tire pressure, fuel level and other operating parameters. In some cases, the device can also control the vehicle, setting the temperature inside the car or unlocking the doors. Tesla and Mercedes-Benz even allow you to control the car's movement remotely. Because of this, the percentage of consumers who fear that someone will break into their connected car and put their safety at risk continues to grow. There have already been several reports of hackers

being able to disgorge a car's protections. Being able to offer the highest level of security for connected vehicles will be a gamble for the future.
Consumers use technology with high frequency in their everyday lives. Often, the use of digital devices while driving poses a serious threat. The debut of Advanced Driver Assistance Systems (ADAS) has helped reduce accidents due to high levels of driver distraction. Customers have become much more demanding about in-car ADAS devices. Examples of driver assistance systems include:

- Blindspot warning/alert
- Automatic emergency braking
- Lane departure warning
- Navigation system
- 360-degree camera system
- Adaptive cruise control
- Electronic parking assist
- Built-in Wi-Fi hotspot
- Over-the-air software updates
- Apple CarPlay/Android Auto interface
- Semi-autonomous drive mode

Some of these systems are mandatory in Europe. Beginning in 2022, every new car will have to have Automatic Emergency Braking (AEB), adaptive cruise control (ISA), Lane-keeping Assist (ELKS), and driver distraction and drowsiness monitoring [17].

2.1.2 New formulas and purchasing methods

Over the years, OEMs decided to create new sales formulas to allow all customers to meet their needs. New formulas are convenient for consumers who couldn't immediately purchase a vehicle at a total price, or new procedures that include various services for those who use their cars for work or who drive many miles. It's common for consumers to consult all of their car-buying options before deciding. On average, customers spend about 3 hours researching an advantageous formula

that may fit their needs.
One example is the difference between leasing and renting. In the first case, the consumer essentially takes out a loan, is responsible for damages and wear and tear of the car and can choose whether to repurchase it at the end of the contract, paying a large final payment. In the case of renting, the customer does not own the car, will not have to pay for maintenance (and in some cases not even for damages) but will not be able to buy the vehicle at the end of the contract [18].
Consumers have access to all this information via the web. These days, it's easier to get a clear and objective idea about financing proposals. Customers can browse different sites, compare services, and choose the most advantageous one through the internet. For this reason, distributors and dealers try to convince consumers to buy from them through advantageous offers.
The power of the web has pushed car manufacturers to sell their products on dedicated web platforms. For example, Fiat has decided to sell the new 500 online on Amazon's platform. So, the customer can configure the car according to his needs and even buy it. However, the customer will be bound to pick it up from the dealer. Other formulas even transport the car to your home, like the used vehicle dealer "Noi compriamo auto". However, market analysis reports conflicting data to this trend. All over the world, customers are more likely to buy a car in person than online. In Europe, less than 20% of buyers choose to buy online. For example, in Germany, 76% of buyers choose the "in-person" mode, 8% "Partially virtual", and 16% "Fully virtual"[13]. Those who choose to buy a vehicle online do so for convenience, speed, or ease of purchase.
Most in-person purchases are made from an authorised dealer, which is often more advantageous and convenient than the direct manufacturer and more elite than a third-party dealer. People are more willing to show up at a dealer to buy a car because they can see, touch, and drive the vehicle before writing the check. What's more, when the money gets big, consumers prefer to be supported throughout the process by a personal advisor who can give them advice. Even when setting up the vehicle, it is possible that the advisor can provide expert advice that is hard to come by on the web.
Within a dealership, customers look for a salesperson with specific skills. First, they want a relationship based on trust, in which the salesperson is not subjective. The hustle and bustle of finalising a contract may annoy them. In this context, the "aspect rapport", a term Neuro-Linguistic Programming (NPL), is essential. This is, the ability to penetrate someone else's world, making them understand a strong common bond. After that, basic knowledge and technical arguments are needed to dispel any doubts and respond to inquiries regarding the technical

aspect and the many positive qualities and features of the product being sold. The salesperson must know how to listen to the customer's requests and, only if strictly necessary, object to their idea to make them change it. The salesperson must use appropriate and straightforward words to approach the customer with a short and logical message. Finally, they must appropriately use the form of a question followed by pauses to keep attention active, if possible, use examples and play with the tone of voice to highlight critical points. In conclusion, auto manufacturers need to consider any new forms of lending and leasing that may be more beneficial to the customer. The customer also recognises the benefit of having access to all information on the web so that a great digital experience can be a substantial opportunity. Focusing all of one's efforts on selling online would not be helpful as customers are still predominantly willing to buy in person.

2.1.3 New vehicle purchase intention

The final chapter of the customer analysis that will be covered concerns future new vehicle purchase intentions. This data is fundamental in the wake of the severe damage caused by the COVID-19 pandemic. According to IHS data, 2020 saw a drop of about 15 million units, from 88.9 million in 2019 to 73.58 million. Unlike the crisis that hit the world in 2008, this pandemic will need a time horizon of about three years to recover to pre-crisis levels. In 2023 alone, IHS estimates global registrations of 91.96 million units. The following chart shows light vehicle production as reported by IHS.

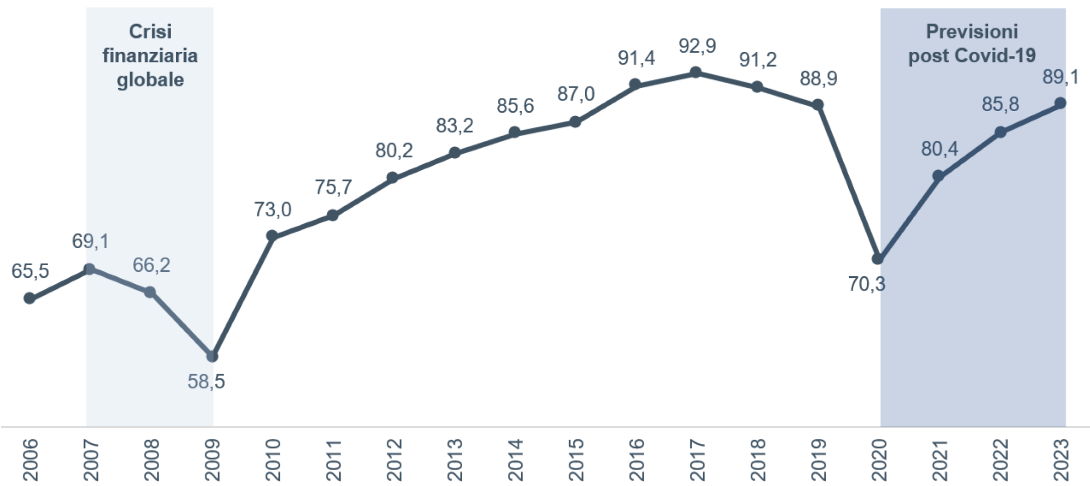

Figure 2.1: Global light vehicle production (Source: OICA, IHS, 2020)

Globally, about 20% of people intending to purchase a new vehicle have decided to delay it. In fact, according to a study published by Deloitte, it has been shown that many buyers have not decided to postpone the purchase and, of these, only 15% have changed their vehicle type, perhaps to an eco-friendlier one (except China and India, where about 50% have decided to change their mind about the vehicle to be purchased) [13].
Stringent government pollution regulations are promoting the car-sharing philosophy. According to some studies, a driver's average use of a car is shallow compared to the car's entire life. For this reason, many car manufacturers have decided to create or partner with companies that allow time-based car rentals, thus maximising the actual hours of use since the car is registered. In this way, the number of vehicles within population centres is reduced. In a future where urban mobility will be highly automated, this concept of shared mobility may appeal more to customers with self-driving vehicles.
Despite the high expectations of car sharing, most customers still prefer to purchase vehicles. There are about 20 million users of this technology, but by 2025, it is expected to exceed 35 million [20]. This significant growth has led many manufacturers to invest in this sector. The Daimler Group created the car2go service back in 2008 and now, after merging with BMW-owned DriveNow, has created Share Now, the world's most extensive shared mobility system. However, not all OEMs want to take on the burden of managing the entire service, so they are offering themselves as partners in car sharing, seeing this market as another sales channel for their models.
Other manufacturers offer their cars using the subscription model and propose reasonable customer solutions. For example, Porsche in the United States has created the Passport service, allowing access to most Porsche models with a monthly subscription. Globally, this service is well seen in China and India, where there is strong interest in subscribing to a subscription that allows access to several models from the same manufacturer. Manufacturers could create a strong bond with the customer by proposing discounted rental and long-term rates and offering the possibility of having a new vehicle at the end of the contract. In this way, customers will be loyally tied to the manufacturer and more willing to have a new model from the same brand, perhaps at a higher price. Customers are no longer solely tied to purchasing a new vehicle but are intensely interested in the services associated with the product. In many cases, the dealer or the manufacturer itself offers consumer services related to car maintenance. For example, the service of picking up the car at work or home following a malfunction. This saves the consumer much time and does not tie them to public transportation to get home.

Most customers would be interested in this service if it is free. A small percentage are not interested in this service, perhaps because they prefer to rely on a trusted mechanic.
With a short-to-medium term forecast, it can assume that the automotive industry will continue to post record sales numbers, filling in the gaps of the post-pandemic period. Manufacturers will also need to focus on developing customer services, not just the product. This will allow them to differentiate themselves, particularly from competitors and increase trust with the customer. Customers will be more interested in buying a product if combined with the right service. The intention of customers to buy an electric car is overgrowing. Although the numbers are still low, the mindset is changing rapidly. It is estimated that 45% of the Western European population is considering buying an electric car.

2.2 Automotive future scenario

The future of the automotive industry is growing dramatically, driven by technological evolution. Most of the largest OEM have acquired start-ups in recent years to create strategic alliances that would allow them to stand out from the competition. What's more, automakers have made a substantial new form of business, which has seen a surge in profits. The introduction of new auto finance companies has allowed OEM to significantly increase revenue compared to previous years, creating a new form of income that accounts for between 30% and 50% of total revenue.
Different factors can affect future products and, therefore, the automotive scenario. Technological factors will be increasingly present. For example, artificial intelligence, autonomous driving, dialogue between vehicle and infrastructure, safety inside the car. Environmental factors, such as reducing the carbon footprint, recycling, and increasing the life cycle of a product. Political and economic factors will also have an impact. These include financing options (buy versus lease), cost of capital, different regulations such as freedom of trade and data retention.
One possible scenario sees OEM still playing a significant role. The automotive industry will be heavily influenced by technology, and consumers will be accustomed to using technology-driven, low-polluting (Hybrid Electric Vehicle (HEV), Plug-in Hybrid Electric Vehicle (PHEV) and BEV) and networked vehicles. Most of the car fleet will be private, and the consumer will have the possibility to choose between different brands with different proposals and different prices. OEM will try to prevail in terms of technology over competitors and will probably continue

to shift their primary source of profit to financing formulas.
Another scenario sees the car as an empty box filled with technology. There would be two possible solutions. The first is where OEM will retain the Brand figure and services attached to the purchase but leave it to third-party companies to configure the technology in the vehicle. The second is where OEM will defend themselves against technology companies, preventing them from entering the industry. Doing so, however, will slow down technology development within a car, and consumers will take longer to get used to new forms of autonomous driving and connected vehicles.
A final possibility could be one in which carsharing giants take over. Using car ownership in the city would be too expensive so most consumers will rent. With this in mind, OEM will focus on fleet management rather than high production numbers and seek to minimise production costs to maximise interest from car-sharing companies. The vehicles produced will be nearly standardised, with an internal configuration that can be adapted to any user and, most importantly, easy-plug components that quickly replace broken or worn parts.
Given the current changes in the automotive industry, it is very likely that the supply chain will also undergo significant changes. Mubea is also keenly interested in consulting all possible future scenarios to understand how the market will evolve and play the right moves to remain a player in the industry. An analysis was done by Deloitte, "The future of the automotive supplier industry in 2030" [14], was taken as a reference According to this report, there could be four possible scenarios.

- The first scenario predicts moving toward economic and technological growth as it liberalises global trade. OEM will launch new alternative concepts. Examples are car-sharing and Robo-taxis. The value attached to the vehicle will no longer be linked to the concrete components, the hardware part, but it will be the software. So technology companies will establish themselves in the marketplace, provide systems to OEM, and orchestrate data ecosystems globally. Traditional suppliers will increasingly specialise and seek to develop components that can be monitored by sensors and connected to the car (also think of pressure sensors in cars). Suppliers will gain significant power across the entire product value chain. Autonomous driving equipment suppliers and battery manufacturers will form global oligopolies and force OEM to depend on standardised vehicle platforms. OEM will lose their leverage and be focused on struggling to keep up the pace of innovation.

- Even in the second, less likely scenario, technological growth gains importance. However, the aftermath of the COVID-19 pandemic crisis leads to protectionism and the introduction of more trade barriers, thus stifling economic growth. For this reason, OEM must either focus on domestic markets or create joint ventures to supply on a large scale. In this case, suppliers act as local players, developing tailor-made solutions such as software and customer platforms. It will still be the suppliers who will have the technology leadership.

- The third scenario sees a continued slowdown in technological progress triggered by the pandemic, which produces geopolitical conflicts. Again, there are trade barriers that limit market liberalisation. Technology development is so slowed that ICE continue to dominate EV and prevent realising the limits imposed by the Paris Agreement. Eastern markets manage to dominate due to competitive pricing and developing in-house technologies. Even the strongest OEM develop software internally, achieving lower innovations than an outsourced logic. Suppliers are highly dependent on OEM.

- In the fourth scenario, intense competition is dictated by the global expansion of Chinese suppliers and opening borders from the East. Growth technological innovation is highly dependent on pricing. Developments to produce batteries for BEV accelerate the shift to electrification. To survive, OEM must follow international consolidation and use standardised platforms. Here, OEM position themselves as the new market leaders, controlling more significant and extensive parts of the value chain. On the other hand, suppliers will have to find different development paths to survive.

Either way, suppliers must think and move proactively. Moving from producing components for ICE to BEV takes time and development. OEM need to leverage the proceeds from traditional component sales to invest in R&D as they look to expand their product portfolio by creating new solutions for BEV.

2.2.1 C.A.S.E.

In most future scenarios, and according to most analysts and future predictions, the future cars will be C.A.S.E., which stands for Connected, Automated, Shared and Electric. Even if the timing to get to this situation is not yet certain, some regulations will lead to the affirmation of these technologies.
Consider, for example, the targets stipulated by the Paris Agreement for pollution. The best solution for all car manufacturers is to develop EV that can quickly

lower emissions values. Over the next decade, BEV will go from representing a niche market to being a mass transportation that can make a difference in terms of carbon footprint. The issues that have caused consumers to choose an ICE still will be mitigated, and the benefits of selecting an electrified vehicle will be more significant. The price will be lower, the range will be more meaningful, and the charging time will be shorter. In addition, the infrastructure to accommodate all electrified vehicles will be upgraded with government funding.
The vehicles of the future will be more shared. As mentioned in the 2.3 chapter, vehicle sharing brings several benefits, including optimising actual usage time over the car's life. A significant number of consumers will likely choose this solution if they feel the cost of a new electrified vehicle is too high. The consumer will not have to think about insurance, road tax, maintenance, or even fuel through this service. The number of cars on the road in crowded cities can be reduced with car-sharing. This will tackle the problem of traffic and urban pollution. Consumers are increasingly willing to purchase automated and connected vehicles. This is both for safety and technological adaptation. Driver assistance systems, known as ADAS, allow the driver a higher level of safety and comfort. For example, the consumer who travels many miles on the highway can no longer do without cruise control, maintaining the distance to the vehicle in front. Other ADAS will also become an essential requirement for the future consumer. To date, Level 2 autonomous driving is permitted in Europe, allowing autonomous assistance from the car to avoid a hazard. Still, it does not allow the driver to be distracted while driving. Level 3 autonomous driving system, already available in some cars but blocked for legal issues, enable the driver to distract himself from driving during heavy traffic conditions. In the future, it will go up to Level 5 autonomous driving, which will allow cars to move without human intervention. There are already studies in development. For example, Mercedes-Benz, Tesla and Google have developed vehicles to park themselves without anyone inside the car.
Most of the new vehicles being produced are connected to the grid. Many insurance companies, for example, track vehicle data to assess the driver's driving style and, as a result, offer them a specific rate. However, the significant innovations in connected vehicles come from the concept of Vehicle to Infrastructure (V2I), granted by the disruptive arrival of 5G technology. The key to this invention is to connect all vehicles with the infrastructure. Therefore, it will be possible to optimise vehicle flows and minimise traffic and accidents through applied mathematics and complexity calculations. However, this connected vehicle technology leaves many consumers doubtful about security. OEMs will focus on minimising these occurrences and maximising cybersecurity.

2.3 Electricity in the future cars

City dwellers are used to being surrounded by a highly hectic environment. Emissions, congestion and safety are the main issues today. Compared to the 1990s, population growth is lower than the growth rate of car ownership. These worries governments pushing inhabitants to choose new forms of mobility with public transport or new mobility concepts, e.g., electric scooters. As analysed in the previous chapter, consumer awareness is also changing, and alternative and sustainable solutions are more widely accepted. If, before 2018, shared solutions were little used and infrequent in the years to come, there is strong growth in acceptance of this mobility. Indeed, the pandemic has made its contribution, pushing people to opt for a particular type of mobility that would allow them to keep the proper distances and avoid crowding in buses. Different world governments have declared global pollution a real problem that cannot be solved unless action is taken promptly. The European Union, for example, has laid out a new blueprint that aims to reduce net greenhouse gas emissions by at least 55% by 2030 and zero emissions for new cars by 2035. The United States of America has introduced a 50% electric vehicle (EV) target for 2030.

As a result of the economic crisis caused by the COVID-19 pandemic, EV sales have experienced substantial growth. In Europe, EV registrations grew by 10%, thanks to new incentives and stringent regulations that encourage buyers to think long-term. In addition to robust incentives, sales growth was driven by a drop in the cost of lithium-ion batteries, the most expensive component of EV (25% of the overall cost). This price decline stems from innovation in cell chemistry and pack assembly.

On a practical level, local government institutions provide incentives for low-emission mobility. Paris, France, announced a significant investment to expand the cities' bicycle network and introduced 5,000 scooters. Shenzhen, China, converted all buses and cabs to electric propulsion, totalling more than 30,000 vehicles. Oslo, Norway, reached 66% EV registrations in July 2021, and nationwide from 2025, the sale of ICE vehicles will be discontinued. Some OEM have declared to stop investing in or producing ICE models. Seven brands have reported 100% electric vehicle production by 2030 in the European Union.

However, the exponential growth of electric is putting significant pressure on OEM, their supply chains and the broader EV ecosystem to meet their targets. Adoption of electric-powered and alternative-powered vehicles (BEV, PHEV, and Fuel Cell Electric Vehicle (FCEV)) is estimated to be about 45% by 2030, which is very low compared to the 75% target for achieving carbon neutrality by 2035.

If the growth slope remains roughly constant, these numbers can be achieved. The problem will remain public opinion, which will be heavily influenced by the evolution of the necessary charging infrastructure. Vehicle electrification will play a vital role in the future auto industry. Introducing new EV as quickly as possible is a strategic move to enable electric mobility. At the same time, technology development for connected vehicles will help reduce the cost of purchasing and operating cars and, significantly, increase the acceptance of shared mobility. The forecast for electric vehicle production is well established. The numbers are firmly in favour of an electric future. This explains the $100 billion invested in research and development for this industry. The transition to electric vehicles will be gradual. Still, suppliers, dealers, energy providers, and charging station operators will need to seize this opportunity by adapting their knowledge to the industry's new needs.

To cope with the exponential growth of electric vehicles, Europe will need to build around 24 new giga-factories of batteries. This is the only way to produce the 70 million EV in Europe in 2030. In addition, the industry will need to install a large number of public chargers to avoid a bottleneck and limit accessibility to EV. An estimated 15,000 chargers per week by 2030 in the European Union, with 100 million worldwide in the long term. Also impactful will be the ability to control energy flows through a Vehicle to Grid (V2G) logic, managing charging in a way that makes it more profitable.

The entire supply chain will undergo a major upheaval. Components critical to electrification, such as batteries and electric drives, and autonomous driving, such as light detection and ranging (LiDAR) and radar sensors, will likely make up about 52% of the total market size by 2030. Components that exclusively equipped ICE vehicles, such as conventional transmissions, engines, and fuel injection systems, will halve in size in the years ahead. This drastic change will force traditional component players to adapt quickly to compensate for declining revenue streams.

2.3.1 Why EV won't be so disruptive

The electric vehicle market has experienced an unexpected surge in sales numbers. Predictions of EV growth were lower than what happened. Market share grew from 8% in 2019 to 12% in 2020 and continued growth in 2021. While it's true that no more ICE cars will be produced over the course of a decade, that doesn't mean the global car fleet is no longer made up of traditional vehicles. This non-negligible amount of cars currently on the road in 2030 will play havoc with

the Paris Agreement's goals to reduce global emissions.
In contrast to the substantial electric vehicle revolution in Europe, the United States, and China, other countries will slow the adoption of this technology by insufficient infrastructure and related regulations. In Brazil, for example, the state does not regulate incentives towards EV. Instead, it incentivises biofuels. It is expected that by 2030, less than 10% of new cars sold in Brazil will be fully electric or hybrid [2].
The almost sudden growth in producing only more EV has created complications for OEMs. For example, global platform design and optimised supply chains will have to be abandoned in favour of new platforms that contains batteries. Although established brands in Europe have already made experienced moves toward designing new platforms (e.g. MEB for Volkswagen Group), some manufacturers will struggle more to accommodate this change.
One of the highest hurdles for EV expansion concerns raw materials for battery production. Moreover, the materials used to produce new EV are 80% more polluting than ICE. As mentioned above, a further slowdown is related to infrastructure. If Europe expects that 70 million EV will be produced by 2030, an adequate infrastructure to host them will have to be developed just as quickly. An estimated € 950 investment per charging location is not insignificant. Governments should also hurry to sell and produce new EV, remove polluting vehicles from the road, and promote alternative mobility.
If EVs are primarily intended to reduce pollution, their energy to generate power must be produced environmentally friendly. Currently, the energy produced from renewable sources would not meet the high demand of an all-electric car fleet. A minimum 5% increase in renewable energy (source) is estimated.
Finally, changing car manufacturers from ICE to fully electric vehicles will take time. This path will be difficult because the entire value chain will have to change, both upstream and downstream, so suppliers and dealers will also have to overcome tough challenges. Customer acceptance of an electric brand vehicle is not assured. Think of a brand like Lancia, winners of essential rally titles in the past, who had to change its image entirely, and the most passionate fans of the brand will never accept this change.

2.3.2 Circular economy in battery disposal

The increase to 70 million electric vehicles by 2030 leads to the question of what the end of the batteries will be used once they can no longer generate power and ensure the proper range. Like a smartphone, after a series of cycles, the

battery can't handle the necessary voltages, and therefore the phone shuts down. Imagine the enormous damage this phenomenon could generate in a car during an overtaking manoeuvre. It has been shown that when battery capacity drops below about 80% of nominal capacity, the performance to power the vehicle is no longer guaranteed. Currently, according to an analysis by telematics service provider Geotab, the average useful life of lithium-ion batteries in electric cars on the road today is about 10 years. In the future, this range should be extended beyond 20 years, with more than 450,000 kilometres driven. In addition, the rare materials used in the production will be replaced by other less expensive and more abundant such as sulphur, increasing revenues and margins of recycling.
According to a study conducted by BCG [9], recycling EV batteries will be the most likely choice because generating profits from reuse ("second life" applications) will be much more difficult. This growing market will be worth an estimated 10 billion dollars in 2030. In 2020, more than 32 million EV were in use globally. Of these, 8 million are either all-electric passenger vehicles (BEV) or hybrids (PHEV, HEV and Mild Hybrid Electric Vehicle (MHEV)). To date, more than 1 million of these cars will need a battery change, while by 2030, there will be more than 4 million, and this trend will continue to grow in parallel with EV registrations.
At the end of its life cycle, i.e. when it falls below 80% of its rated capacity, a battery can take three possible destinations:

- a recycling plants
- a second life application
- a waste disposal plants

Below, the first two solutions will be analysed. In the third case, the batteries are stored in a landfill without recovery of the residual value of the batteries. Governments are creating new regulations to prevent batteries with the remaining value from ending their lives in waste disposal facilities.

Recycling

With recycling, a specialised company recovers precious metals from the battery, including cobalt, manganese, nickel, and lithium. It then sells these materials to use them again as raw material in producing the same batteries. The emerging market for lithium car batteries will need to model itself on lead-acid batteries, proven recycling that has been successful, and not use the current logic in consumer electronics that batteries end up in landfills or incinerators.

Chemistry is the most interesting thing in the business. Within batteries, the value of nickel, in particular, will determine the industry's attractiveness as batteries with higher nickel content grow. On the other hand, recyclers' operating costs are relatively fixed for all chemistry types. The recycling process is divided into three steps

- deactivation of cells to avoid fires
- pre-treatment to deconstruct the main components of the cell (aluminium, plastic, and cathode)
- material recovery

The cost of acquiring batteries for recycling varies significantly by region. In China, where the recycling market is mature and full of players, acquisition costs can be high due to intense competition, up to 50% of the total expected recovered value. On the other hand, in the U.S. and Europe, acquisition costs are virtually zero because the market is embryonic, and players operate at a low scale. For the latter, an investment in a plant capable of disposing of batteries of different sizes and scales would be worthwhile. This would generate greater yield and scale but would increase their investment costs. In addition, disposal technologies evolve quickly, making previous technologies obsolete. This could benefit new market entrants. Established companies will have to cope with the fluctuating cost of energy and metals and meet stringent environmental demands by investing additional capital.
This market looks very promising. Emissions from recycling materials are significantly lower than from mining. This is just one indicator that values this process for a less polluting future. Battery recyclers won't be the only ones to benefit. Other players could profit from this business. For example, OEMs, cell pack manufacturers, and component suppliers could develop a strategy that leads to a long-term competitive advantage just through recycling.
The main bet for this market will be to invest in technologies that maximise metal recovery and resource efficiency. Digitisation will be the real player in this process in the future. Thanks to incentives, in Europe, starting a business now could be risky but profitable. OEMs, as well as more robust suppliers, will be able to invest in new recycling facilities. This would reduce the high transportation costs for battery packs, given their weight, shape and risk during transport.

A second life for EV batteries

Unlike recycling, this solution repurposes battery cells for new use without dismantling them. Taking a real-world example, a 60-kWh battery pack in a BEV , after dropping below 80% of rated capacity, is still capable of producing 18 MWh of electrical load in static form, e.g. powering an entire house for more than ten years. Stationary Energy Storage (SES) applications are the most promising second life solution. These give the ability to store energy generated from a variable renewable source (such as, for example, wind or solar power) for use at a later date. The main problem is that the cost of batteries in mature markets is remarkably increasing, so it is no longer a profitable solution.

Batteries could in the future be adapted before being used as SES . As they are not exposed to a dynamic and unprotected environment, the bark of the batteries could be reduced by decreasing the footprint. The entire storage facility will need to provide the proper security, but each battery could be separated from its casing. This solution is very beneficial to the environment. If the carbon footprint is present (although to a reduced extent compared to extraction), there are no emissions by exploiting the concept of second life. This minimises the amount of CO_2 generated to produce the battery throughout its life cycle.

OEMs can benefit significantly from this solution. After 2030, the largest OEMs will have access to a high number of batteries for replacement. With these, they will create SES plants to power factories or use their technical knowledge to integrate them into a new vehicle. Importantly, OEMs also have access to historical battery management data to study them more closely and understand their evolution over the years. Having access to the history of previous battery use is a critical input in calculating the residual battery value to be leveraged. SES companies, on the other hand, could create new customer-friendly formulas. For example, they could secure a large battery to be leveraged by offering a battery rental agreement.

An alternative to the second battery route could be the Vehicle-to-Grid (V2G) solution, i.e. mobile vehicles capable of storing energy and releasing it when needed. Many modern cars possess this technology, such as the Kia EV6. In the future, when the number of V2G vehicles is higher, this technology may replace SES, a threat to the business of this market.

Most likely, due to the logistical issues associated with battery storage and residual value recognition, this technology will not be the most widely used. It’s possible to assume a 20% reuse rate of batteries recycling of materials to create new batteries will be favoured.

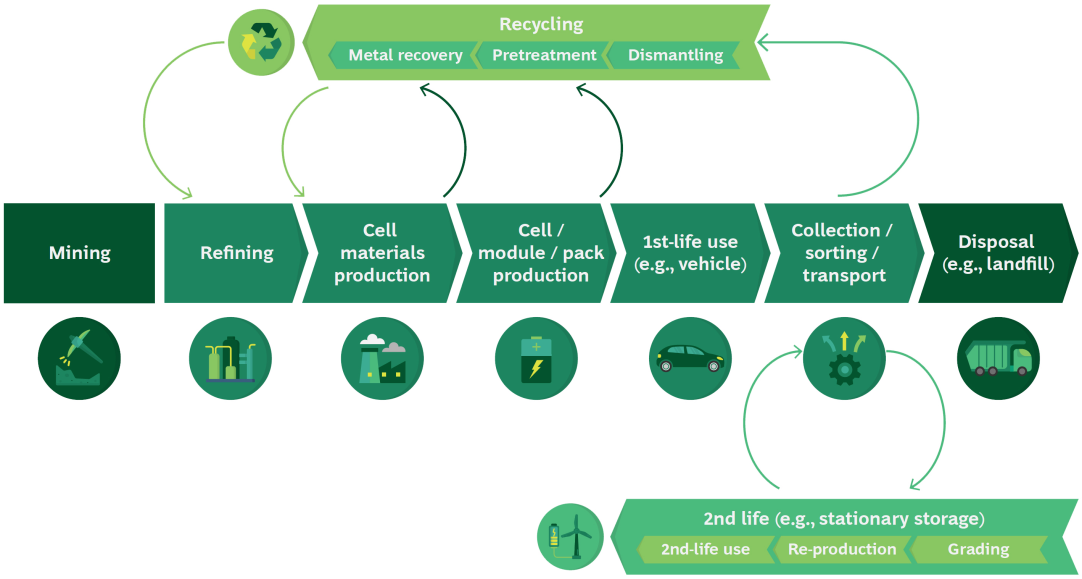

Figure 2.2: Three Options for EV Batteries at the End of Their First Life (Source: BCG analysis, 2020)

2.4 Chip shortage

In the market analysis conducted so far, there has been no mention of one of the automotive industry problems: the shortage of microchips. During the first quarter of 2021, the lack of supply of small silicon chips slowed down the supply chain around the world. This affected several industries. Household appliances, smartphones, electronic systems applied in vehicles are just a few products that function through microchips. The crisis related to the COVID-19 pandemic has seen a terrible reduction inline production. To maintain a "Just In Time" philosophy, the demand for microchips also stopped, as stocks were already total. As the contracts were short term (a few weeks), the chip producers, mainly Asian, opened the borders to new industrial players that, on the contrary, in this period saw an improvement in sales.
As soon as sales picked up again, the automotive market found itself at a disadvantage compared to personal computers, WI-FI and servers request. The computer sector had a more significant demand for semiconductors and greater sales security. In the automotive industry, there was no certainty that sales were consistent. They were thought to be fluctuating. When the auto industry recovery took off (not all those sales were expected), the semiconductor companies were serving other industries and could no longer produce chips for them. So a war arose to

win chips, without which auto production could not continue. Those who could foresee the chip shortage tried to increase their inventory levels significantly.
Even OEMs with a stockpile of chips in their inventory found themselves in a bottleneck a year after the shortage began. The surge of technology inside a car and the connections between vehicles and infrastructure will require more chips. Think of the debut of 5G connectivity in the automotive environment. This imbalance between supply and demand will not yet be balanced in the short term. Chip shortages will therefore be a constant problem that may last for several years. This is also due to the difficulties encountered in changing chip suppliers. An OEM has chips specifically designed for him, and changing the factory would have to re-set the machinery and measurements to meet his requirements.
Nevertheless, in the U.S., the Biden administration has allocated 52 billion dollars for the U.S. Chips Act to support the semiconductor supply chain. In Europe, automakers have decided to unlock dependence on the East by creating a strategy to double the EU's current share of semiconductors by 2030. These measures are encapsulated within the European Chips Act [21]. The investment of around 43 billion euros (of which 11 billion for R&D) between private and public investment aims to expand chip production on this continent from 10% to 20% world share. This move also has hidden objectives. The first is to stimulate the presence of industries within European borders. The second is to more easily identify the main weaknesses and bottlenecks to react more promptly.

2.4.1 BOSCH new chip factory in Dresden

Some powerful global companions have begun their private investments in the microchip industry. For example, Bosch has established a new chip factory in Dresden, Germany. To understand how complex it is for a plant like Bosch to invest in this industry, it is correct to analyse the chip manufacturing process. Semiconductor manufacturing processes begin in the sub-fab, an area below the actual wafer (silicon disk) factory, equipped to supply gas, air and electricity [26]. Miles of piping, cables, and tubes run through the sub-fab. Each has a digital counterpart so that any problems can be consulted immediately. The heart of the factory is called the "clean room," and a specific procedure is required to access it. Each worker must wear a particular white jumpsuit and enter an air shower that blows away every speck of dust. In this chamber, semiconductors are transported inboxes. The purity of the air reaches very high figures. In 28 litres, there is no more than one particle weighing half a microgram. Almost everything in the cleanroom is automated. An autonomous transport system

transports wafers from one processing step to the next. Robotic arms immerse them in liquids. Powerful microscopes autonomously scan them at the end of the line. An artificial intelligence-powered algorithm that detects even the slightest imperfections inspects the images, looking for flaws. A team of experts intervenes, if necessary, both to solve a problem and to increase productivity.
In detail, the technical specifications of the silicon disks (wafers) produced at the Bosch plant in Dresden are analysed. The manufacturing technology is 300-millimetre type, in which a single wafer can accommodate 31,000 individual chips. This means that the size of the round silicon disks is 300 millimetres in diameter and 60 micrometres thick. To summarise the high level of technology in this plant, and its capabilities in a simplified way, the following points have been listed:

- Opening by the end of 2021
- Investment of approximately 1 billion euro, the company's most significant single investment
- The Dresden team of about 250 people (700 people at the end of the ramp-up phase)
- Plant size 72,000 square meters
- Fully automated plant to increase efficiency (AIOT)
- Augmented reality tools such as smart glasses are used in the factory
- 5G communication standards
- The entire plant will be carbon neutral and use only green electricity and zero-emission natural gas
- 380 km of electrical cables connect every part of the facility
- The whole building is mapped in a 3D model with precise detail to create a digital twin

2.5 Stellantis future production

At this point, a case study is developed. This involves the analysis of Stellantis production forecasts through 2028. In this regard, IHS Markit's monthly updated automotive report was used. This analysis reports projected sales for each new model from the current year. With simple mathematical operations, all trends of interest and an estimate of vehicle production for each year through 2028 can be obtained.

Even during this market analysis, electrification was the focus. With a quick look at sales volume forecasts, it' can be observed that most future vehicles will be electrified. In the first moment, the market will develop towards hybrid solutions (with ICE, mainly gasoline). Only in a second step it will pass to a purely electric engine. The possible development of electric vehicle technology can be divided into three phases.

Embryonic phase, where the first buyers are incentivised to purchase an electrified vehicle. At this early stage of development, criticism for electric cars is very high, and consumers are not convinced to invest money in a vehicle that is still in its embryonic stage. Many European governments have decided to create incentives to increase support for electrification. The incentives apply not only to BEV but also to hybrids (MHEV, HEV and PHEV). Through these incentives, the purchase of a BEV vehicle, for example, will achieve parity in the initial cost and maintenance of an ICE over five years. For hybrids, on the other hand, the investment costs are variable depending on the use of the car, especially PHEV where the more significant weight burdens greater fuel consumption (it pays to recharge the car often and always travel in hybrid mode). One of the biggest problems that plague consumers in this area is the variety of models. Unfortunately, there are still few BEV models on the market compared to the number of ICE vehicles. By 2023, however, this issue will be solved because there will be about 300 electric vehicles, including hybrids and fully electric models. Consumers will therefore have more choices than they do today. Data report that new hybrids will capture nearly 40% of vehicle production in 2025. In the same year, BEV will reach 16% of production.

The development stage is where the economic advantage in using an electric vehicle is validated. By 2030, the year in which OEMs must prove their contributions to addressing the Paris Agreement, electrified vehicles will be consolidated in the market. Customers will have a wide range of choices, and the majority of the offering will likely be hybrid, making it nearly impossible to purchase a traditional ICE. It is assumed that the overall ICE market share will drop to 20%. A significant development in this phase will be the cost of batteries, which will likely fall to about 75 dollars per kWh. So, vehicle purchase costs will also come down and, inversely, customer interest in EV will grow. In these stages, the first bans on ICE will be introduced. It will be increasingly difficult to get around. The goal of these bans will be to eliminate pollution from vehicles truly.

Maturity phase, where electrification will be supply-driven. Most OEMs will no longer see advantages in producing ICE and shift their efforts to EV. In the medium term, BEV will take about 50% of the market. The remainder will be all hybrids. The most reliable trend shows a 45% share-share in 2035 to reach all BEV in 2035 in Europe. But this will be almost impossible. Indeed, by 2050 all vehicles using a combustion engine will not be eliminated because that would mean removing all vehicles produced in those years. To have such a change takes several years. For example, it is very likely to see a vehicle with more than twenty years of life in many developing countries and poorer EU countries. Thirty years will not be enough to have only BEV even in these countries. Finally, every player along the automotive value chain will have been reshaped at this stage. All suppliers will have to prove that they do not have a footprint on the environment. Only then will they be able to continue producing for OEMs.

2.5.1 The future Stellantis platform

The Italian Mubea Group has been working on analysing future Stellantis platforms. The marketing team, the commercial team and the engineers have studied the possible platforms that the Group will use to launch the new electrified vehicles. HIS Markit databases were used to conduct this study, with data updated from September 2021 to February 2022.
This analysis decided to consider all Stellantis' vehicles with SOP 2023, leaving out those currently in production already being launched on the market. The reason for this choice is to provide actual data for the development of an electric vehicle component to be proposed to the customer for the launch of a new project, excluding the ones already present on the market. This analysis aims to extrapolate the platforms with the highest production level to propose a component with an advantageous price to the customer, optimising the variable costs due to the production quantity. Another output of this research is a table that can show the vehicles with the highest production as a function of their SOP to understand how much time there is before starting a proposal to the customer.
First, a table was created for all Stellantis vehicles with SOP as of 2023, broken down by Brand. This allows the marketing department to analyse sales for each Brand and understand when they will be there in the future for electrified vehicles. Different diagrams have been created according to the requirements of the marketing and sales team. For the sake of simplicity, only some of the charts created as a result of this analysis are shown.
First, the chart 2.3 was marked showing the production trend of HEV, MHEV, and BEV vehicles.

It can be easily deduced that by 2026, Stellantis' BEV will be the highest production vehicles. This confirmed the marketing team's development strategy towards a component for electric vehicles. According to this data, HEV will not follow the growth of others. Mild hybrids will likely go the way of the pack because they allow the OEM to be within the emissions limits of the engines and offer the consumer the best price tradeoff.

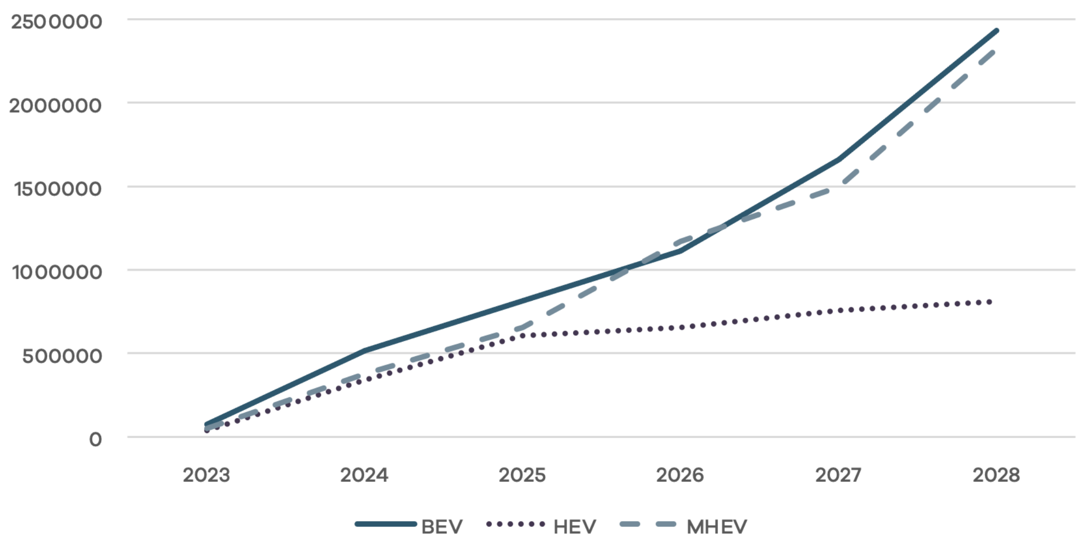

Figure 2.3: Stellantis sales forecast for EV from 2023 to 2028 (SOP 2023)

After that, cumulative production volumes for each OEM and subdivision by powertrain type (BEV, HEV and MHEV) are reported.

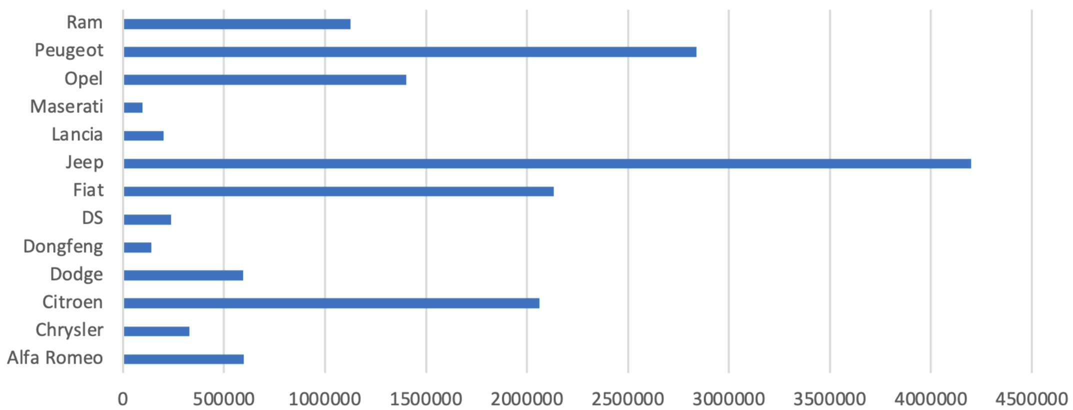

Figure 2.4: Cumulative Stellantis Brands sales forecast for EV (BEV+HEV+MHEV)

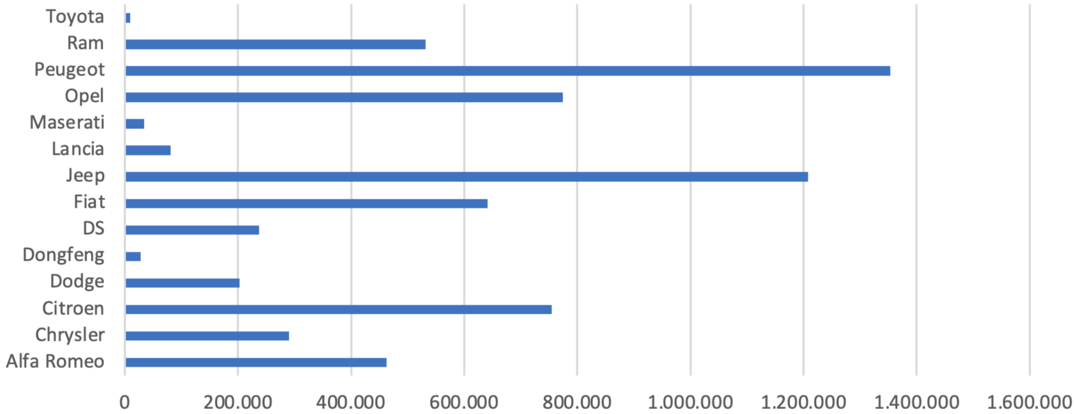

Figure 2.5: Stellantis Brands sales forecast for BEV from 2023 to 2028 (SOP 2023)

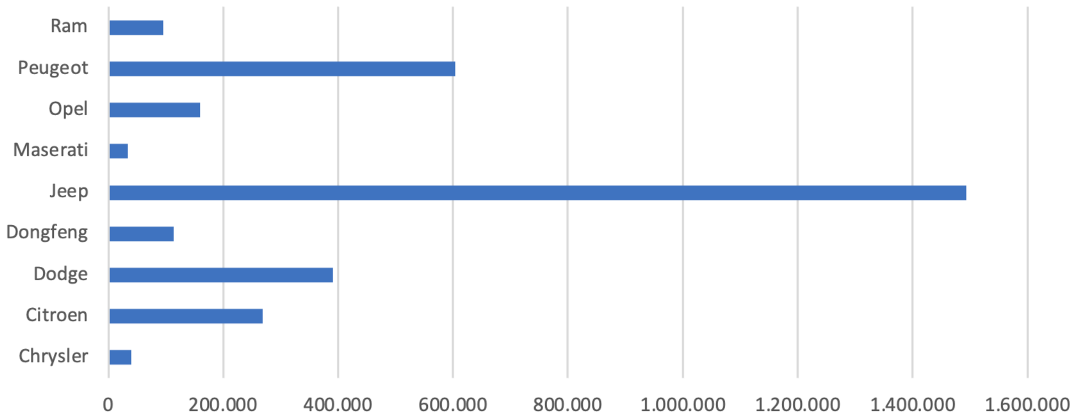

Figure 2.6: Stellantis Brands sales forecast for HEV from 2023 to 2028 (SOP 2023)

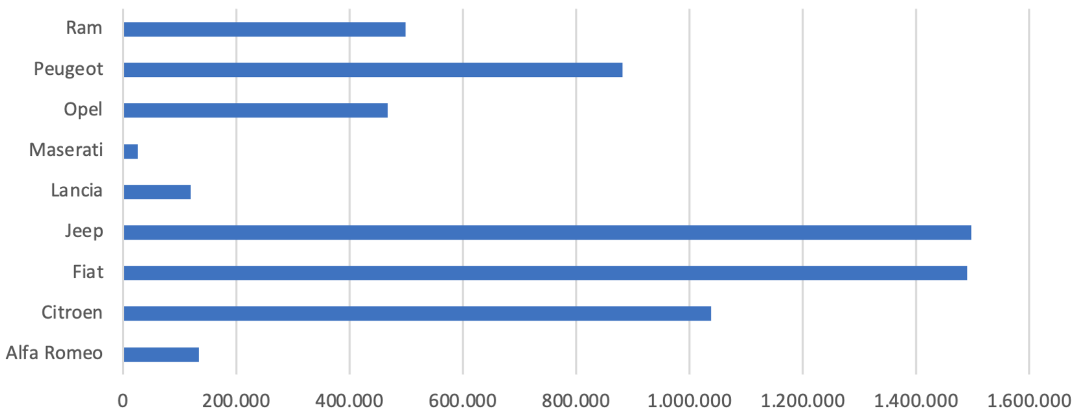

Figure 2.7: Stellantis Brands sales forecast for MHEV from 2023 to 2028 (SOP 2023)

The analysis shows that Jeep will be the most electrified car with SOP from 2023. This figure is plausible as Jeep is a premium brand with high production numbers, especially with the arrival of the new crossovers and next-generation best sellers Jeep Cherokee and Renegade. The following table shows the estimated electrified vehicle production results for each OEM with SOP 2023 and through 2028.

Table 2.1: Cumulative estimate production per Brand [2023-2028, SOP 2023]

Production Brand	**Estimated production volume**
Alfa Romeo	597,743
Chrysler	329,230
Citroën	2,063,018
Dodge	593,616
Dongfeng	141,485
DS	237,364
Fiat	2,131,543
Jeep	4,200,276
Lancia	199,897
Maserati	95,022
Opel	1401,692
Peugeot	2,839,382
RAM	1,126,785

It is important to remember that all these data are related only to electrified cars. Therefore, the graphs shown above are not comparable with the total sales of the brands in that period. It would be necessary to add also the ICE that represent a significant percentage in sales.
As a second analysis, sales for each model with SOP 2023 and forecast to 2028 were analysed. It's possible to visit the complete table of analysis in the appendix A. An index was associated with each model according to the estimated production level.

The index is broken down as follows:

- *index 1*: sales > 300,000
- *index 2*: 100,000 < sales < 300,000
- *index 3*: sales < 100,000

This content made it possible to understand which vehicles are the most interesting in terms of sales and to develop strategic analyses to hypothesise a profit. From the investigation, it was found that the vehicles with index 1, i.e., with sales above 300,000 units, are as follows:

Table 2.2: Vehicles with a total sales prospectus greater than 300,000 units

Model	**Type**	**SOP**	**Volume**
Jeep Cherokee	Hybrid-Full	2023-09	762,349
Jeep Renegade	Hybrid-Mild	2025-01	521,349
Fiat 500X	Hybrid-Mild	2023-04	517,103
Peugeot 3008	Hybrid-Mild	2023-11	461,492
Jeep G.Cherokee	Hybrid-Mild	2027-03	425,055
Citroën C3	Electric	2023-08	420,271
Peugeot 3008	Hybrid-Full	2023-11	412,680
RAM 1500 EV	Electric	2024-07	387,564
Peugeot 2008	Electric	2026-07	371,108
Opel Corsa	Electric	2026-07	369,800
Fiat Panda	Hybrid-Mild	2024-08	365,031
Jeep Compass	Hybrid-Full	2025-01	356,863
Jeep B-SUV EV	Electric	2024-04	337,233
Peugeot 208	Electric	2026-04	336,568
Jeep D-SUV EV	Electric	2023-11	310,733
RAM 1500	Hybrid-Mild	2027-01	305,532

Finally, as a third analysis, all platforms that will use EVs belonging to the Stellantis Group were analysed. Once again, the calculations are done for vehicles with SOP 2023, and only EVs will be analysed, excluding ICEs.

The platforms that Stellantis Group will use for its EV fleet are as follows:

Table 2.3: Forecast production units per platform [SOP 2023]

Platform	**TOT production**
CMP	4,773,960
EMP2	190,756 (V.3)
STLA Small	1,457,109
STLA Medium	4,400,258
STLA Large	3,415,636
STLA Frame	1,244,041
MASERATI Spaceframe	4,285

For simplicity, the K0 platform used for the Scudo and ProAce vehicles and the X2 (2) platform used for E-segment vehicles these vehicles, have been excluded from the analysis. Except for the Maserati Spaceframe platform, all other platforms will be analysed in detail. In this case, only one vehicle is equipped by this platform (Maserati GranCabrio EV), with a total of 4,285 vehicles between 2023 and 2028.

CMP Platform

The CMP platform (EMP1) was developed by the partnership between PSA and Dongfeng Motor. Its name stands for Common Modular Platform. Introduced in 2018, this platform is suitable for B and C-category vehicles and fits an architecture with a transverse front engine and front or all-wheel drive. It can accommodate gasoline, Diesel, electric and hybrid engines.

Table 2.4: About the CMP Platform

CMP (EMP1) B/C-segment
SOP: 2019 (DS3 Crossback)
3 variations: ICE / MHEV / BEV
Annual volume WW Max (MHEV & BEV): 1,179,037 Annual volume WW Average (MHEV & BEV): 795,660

For the sake of consistency, the analysis of MHEV and BEV application of this platform has been performed. In the timeframe between 2023 and 2028, these two versions will trend as follows.

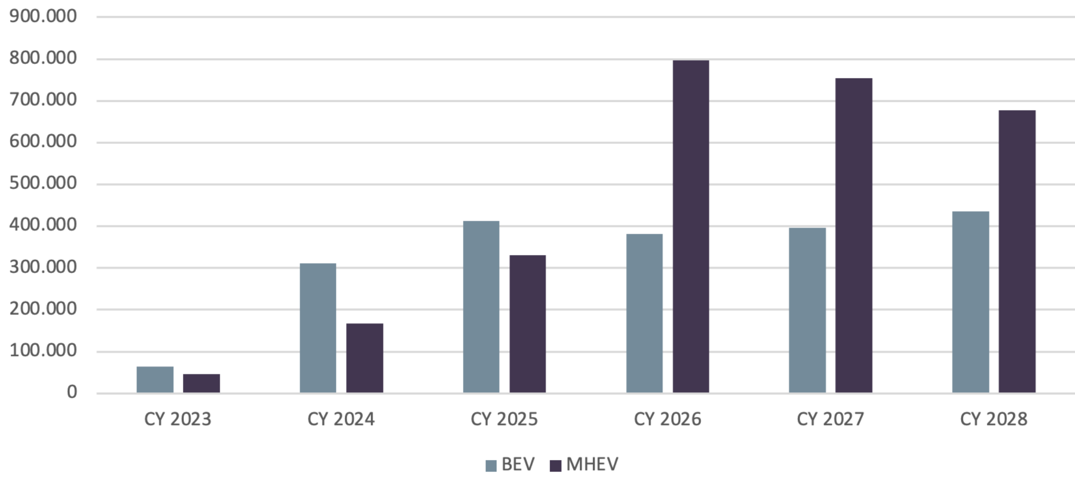

Figure 2.8: Estimaded sales of CMP platform 2023-2028 (SOP 2023)

Although the volumes of the application of the CMP platform on BEVs have remained constant since 2024, it's possible to see that for MHEVs, there is a significant growth in 2026 (+59%, from 330,192 to 797,320 units). This is because precisely in 2026 is set the SOP of vehicles that promise large volumes, such as the Fiat Panda and C-CUV, or the Citroën C-Elysee and new C3.
Listed below are the upcoming vehicles. Only vehicles with sales volumes greater than 200,000 units over the vehicle's entire lifecycle were considered.

- Citroën C3 Aircross Electric (2024) → 600,691 units
- Jeep Renegade Hybrid-Mild (2025) → 560,251 units
- Fiat 500X Hybrid-Mild (2023) → 517,103 units
- Fiat Panda Hybrid-Mild (2024) → 365,031 units
- Jeep B-SUV EV Electric (2024) → 337,233 units
- Citroën C3 Hybrid-Mild (2026) → 311,620 units
- Peugeot 208 Electric (2028) → 266,854 units
- Opel Crossland Hybrid-Mild (2023) → 232,166 units
- Citroën C3 Aircross Hybrid-Mild (2025) → 203,876 units
- Fiat 500X Electric (2023) → 201,250 units

The table 2.5 shows the OEMs using this platform without distinguishing between BEVs and MHEVs. It's possible to see that Fiat holds the most significant number of vehicles produced with a value of 1,510,000 units between 2023 and 2028.

Table 2.5: CMP Platform Cumulative Brand Sales

OEM	**Estimated Volume**
Fiat	1,508,075
Jeep	1,189,760
Citroën	1,170,033
Opel	325,287
Peugeot	268,386
Lancia	150,242
Alfa Romeo	134,556

EMP2 Platform

The EMP2 platform, which stands for Efficient Modular Platform 2, is used for front transverse engine vehicles and front or all-wheel drive, as with the CMP. However, it is commonly used for higher car segments (C-D-E). This platform was unveiled in 2013 and can accommodate gasoline, Diesel, Hybrid (from V.2) and BEV (from V.3) engine architectures.
The course of this platform has almost come to an end. In 2025 there will be the last SOP. To replace this platform in Stellantis vehicles, the STLA Medium was introduced, which will be analysed later. It's possible to divide the development of EMP2 into three steps.

Table 2.6: About the EMP2 Platform

EMP2 V.1	EMP2 V.2.x	EMP2 V.3
C-D-E-segment	C-D-E-segment	C-segment
SOP: 2013	SOP 2.1: 2016 SOP 2.2: 2018 SOP 2.3: 2018	SOP: 2021
1 version: ICE	3 variations: ICE / PHEV /MHEV	4 variations: ICE / MHEV / PHEV / BEV
Max Ann. EV: 50,869 Average Ann. EV: 7,644	Max Ann. EV: 841,970 Average Ann. EV: 524,493	Max Ann. EV: 752,002 Average EV: 519,360

Only EMP2 V.3, with SOP from 2023, will be considered in this analysis. In diagram 2.9, the production trend of vehicles using this platform with SOP beyond 2023 will be analysed. These are BEVs and MHEVs, as is the case with CMP, but the volumes are significantly lower.

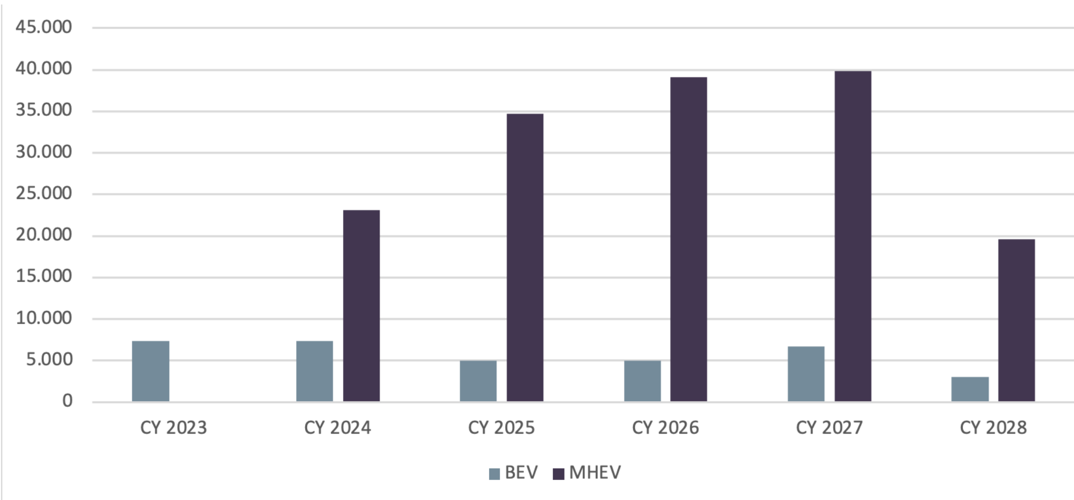

Figure 2.9: Estimaded sales of EMP2 platform 2023-2028 (SOP 2023)

Volumes for BEVs remain small, with an average annual production of about 5,000 units. MHEVs, on the other hand, have higher production, but annual volumes do not even reach 50,000 units. Upcoming vehicles include the following:

- Fiat Doblo Hybrid-Mild (2023) → 85,491
- Peugeot 408 Hybrid-Mild (2023) → 51,589
- Fiat Doblo Electric (2025) → 31,579

- Citroën C3L Hybrid-Mild (2024) → 19,213
- Peugeot Partner Electric (2025) → 1,597
- Citroën Berlingo Electric (2025) → 1,287

OEMs using this platform for electric vehicles between 2023 and 2028 are represented in the table 2.7.

Table 2.7: CMP Platform Cumulative Brand Sales

OEM	**Estimated Volume**
Fiat	117.070
Peugeot	53.186
Citroën	20.500

STLA Small Platform

The STLA Small (eSMP) platform will be introduced to the market in 2023, at the launch of the new Peugeot 208. This platform will be exclusive to B-segment electric vehicles (BEVs). This platform will accommodate a battery pack with a capacity between 37 and 82 kWh and provide a range of up to 500 km.

Table 2.8: About the STLA Small Platform

eSMP = STLA small B-segment
SOP: 2026 (Peugeot 208)
1 version: BEV
Annual volume WW Max (BEV): 783,584 Annual volume WW Average (BEV): 182,139

Although this platform will only equip small, all-electric vehicles (BEVs), production volumes will rise quickly. From 2026 to 2028, production will grow by 80%, reaching nearly 800,000 units.

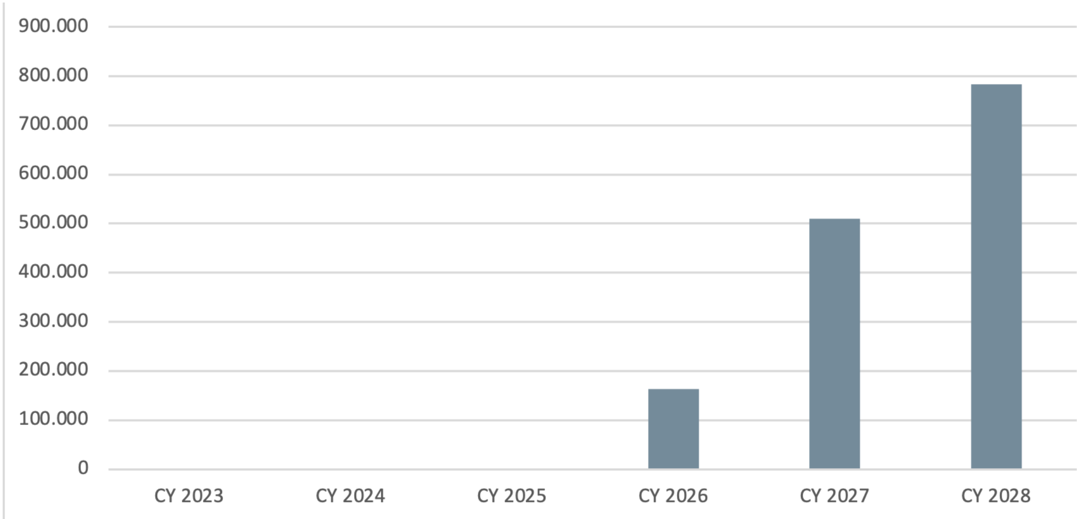

Figure 2.10: Estimaded sales of STLA Small platform 2023-2028 (SOP 2023)

The upcoming vehicles that will be equipped with this platform all have an SOP beyond 2026. Here's what they are and what volume they will reach by 2028:

- Peugeot 2008 BEV (2026) → 378,702
- Opel Corsa BEV (2026) → 369,800
- Peugeot 208 BEV (2027) → 336,568
- Fiat 500 BEV (2028) → 204,064
- Opel Mokka BEV (2026) → 70,307
- DS DS3 Crossback BEV (2026) →63,633
- Citroën C4 BEV (2028) → 34,035

Comparing the car manufacturers using this platform, the following data can be obtained in the table 2.9.

Table 2.9: CMP Platform Cumulative Brand Sales

OEM	**Estimated Volume**
Peugeot	715,270
Opel	440,107
Fiat	204,064
DS	63,633
Citroën	34,035

STLA Medium Platform

The STLA Medium (eVMP) platform is being presented as an update to the latest variant of EMP2, meaning it could be categorised as EMP2 V.4. This will allow it to accommodate traditional and electric powertrains. Its application will be for C-SUVs and D-segment vehicles. The STLA Medium, for electric vehicles, will provide a range of up to 700 km and will accommodate a battery between 87 and 104 kWh.

Table 2.10: About the STLA Medium Platform

EMP2v4 = EVMP = STLA Medium C-SUVs & D-segment
SOP: 2023 (Peugeot 3008)
4 variations: ICE / MHEV / PHEV / BEV
Annual volume WW Max: 1.519.546 Annual volume WW Average: 733.376

The breakdown of production according to the type of powertrain hosted is shown in the graph 2.11.

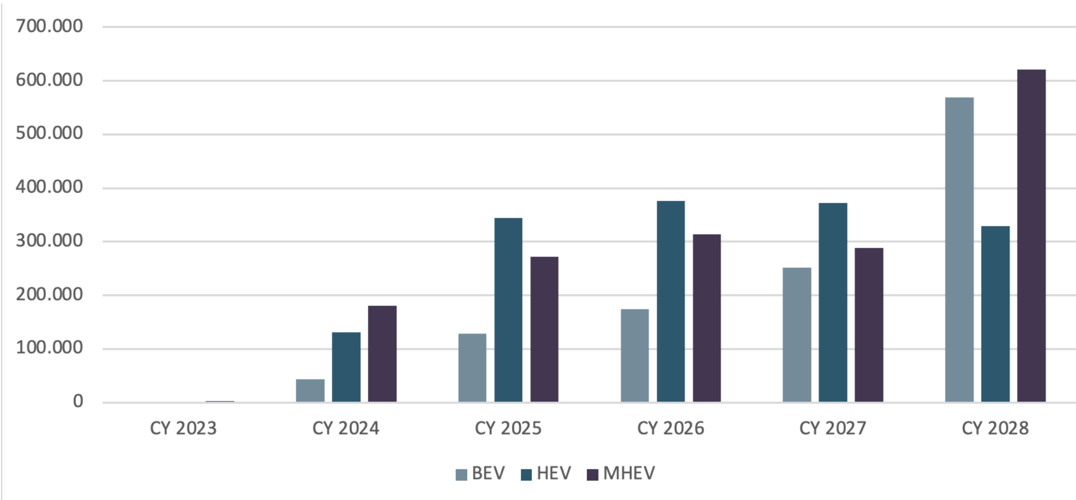

Figure 2.11: Estimaded sales of STLA Medium platform 2023-2028 (SOP 2023)

HEV volumes grow until 2026, then begin to decline slightly. BEVs and MHEVs, on the other hand, follow roughly steady growth. MHEVs will reach the highest level of the three, exceeding 600,000 units per year in 2028. Incoming vehicles with the STLA Medium platform, with a total production volume greater than 130,000 units, are shown below:

- Jeep Compass Hybrid-Full (2026) → 487,615 // Jeep Compass Hybrid-Mild (2026) → 169,198 // Jeep Compass Electric (2026) → 145,724
- Peugeot 3008 Hybrid-Mild (2024) → 475,231 // Peugeot 3008 Hybrid-Full (2023) → 412,680 // Peugeot 3008 Electric (2023) → 140,478
- Citroën C5 Aircross Hybrid-Mild (2025) → 270,461 // Citroën C5 Aircross Hybrid-Full (2025) → 267,310
- Peugeot 5008 Hybrid-Full (2025) → 191,757 // Peugeot 5008 Hybrid-Mild (2025) → 180,673
- Opel Grandland Hybrid-Mild (2024) → 169,354 // Opel Grandland Hybrid-Full (2024) → 160,060 // Opel Grandland Electric (2024) → 129,754

Interestingly, all-electric vehicles are characterised by low production volumes. This trend is because 2028 is still too early to see BEVs at the top with production numbers. It can be expected that after 2030, BEVs can take the top spots in terms of production and sales in this category type. The ranking of manufacturers in terms of total sales between 2023 and 2028 of electrified vehicles equipped with the STLA Medium platform is shown in the table 2.11.

Table 2.11: CMP Platform Cumulative Brand Sales

OEM	**Estimated Volume**
Peugeot	1.641.987
Jeep	885.173
Citroën	767.104
Opel	605.281
DS	173.731
Alfa Romeo	145.442
Fiat	131.885
Lancia	49.655

STLA Large Platform

The STLA Large platform will be introduced with the launch of the Jeep Cherokee in 2023 and will target D-E segment vehicles. It will also be the platform of the new Alfa Romeo Stelvio and Giulia, which is why it could be found with the platform designation Giorgio 2. This platform will accommodate a battery pack with capacities of 101 and 118 kWh and a range of up to 800 km.

Table 2.12: About the STLA Large Platform

Giorgio (2) = STLA Large D&E-segment
SOP: 2023 (Jeep Cherokee)
4 variations: ICE / MHEV / PHEV / BEV
Annual volume WW Max: 1,012,815 Annual volume WW Average: 569,273

These vehicles will have the ability to accommodate four variants (ICE / MHEV / PHEV / BEV), but for consistency reasons, ICEs will be excluded. As you can see in diagram 2.12, BEVs will outperform the other categories in terms of production from 2026. By 2028, BEVs will reach 400,000 units. It's possible to consider the increase in sales volumes of MHEVs that start to grow from 2026 (+82% from 2026 to 2028).

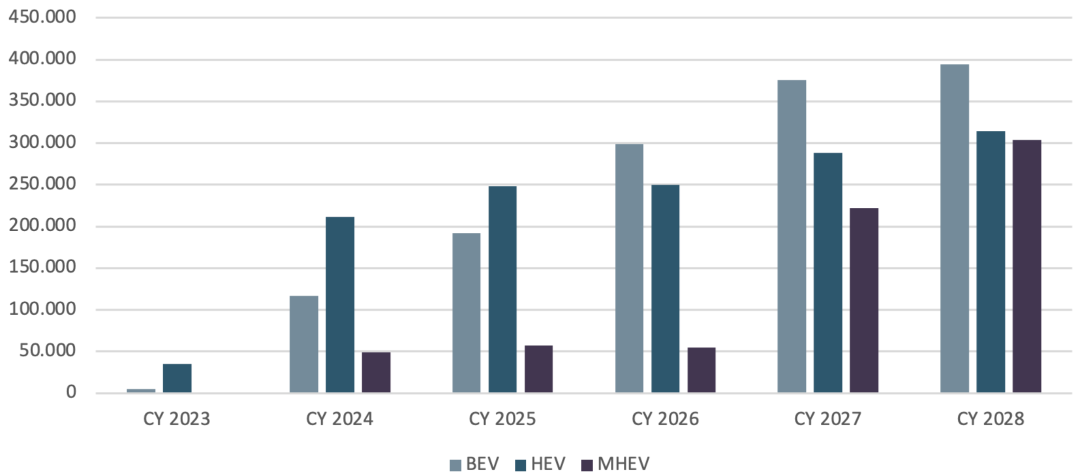

Figure 2.12: Estimaded sales of STLA Large platform 2023-2028 (SOP 2023)

Next, the vehicles that will use the STLA Large platform are shown to estimate the sales volumes they will achieve.

- Jeep Cherokee Hybrid-Full (2023) → 762,349
- Jeep Grand Cherokee Hybrid-Mild (2027) → 426,952 // Jeep Grand Cherokee Hybrid-Full (2027) → 120,438 // Jeep Grand Cherokee Electric (2027) → 106,003
- Jeep D-SUV EV Electric (2023) → 310,733
- Dodge D-CUV Hybrid-Full (2025) → 207,846
- Ram D-Pickup Hybrid-Mild (2024) → 193,842 // Ram D-Pickup Electric (2024) → 129,228
- Dodge Charger Hybrid-Full (2023) → 182,681 // Dodge Charger Electric (2023) → 109,353
- Chrysler Pacifica EV Electric (2026) → 181,377
- Alfa Romeo Stelvio Electric (2025) → 124,937

As it is possible to catch from the total production numbers between 2023 and 2028, this segment has several BEV proposals. The reason probably relates to the price of these vehicles and that customers are willing to invest more capital for an innovative vehicle. Moreover, in most cases, OEMs are premium, which is one more reason why all-electric vehicles will be produced in more significant numbers than hybrids.
Below table 2.13 showing the OEMs using this platform and their production volumes during this timeframe.

Table 2.13: CMP Platform Cumulative Brand Sales

OEM	**Estimated Volume**
Jeep	1,776,595
Dodge	593,616
Chrysler	329,230
Ram	323,070
Alfa Romeo	211,663
Maserati	90,737
Peugeot	90,725

STLA Frame Platform

The STLA Frame platform completes Stellantis' new proposal for the architecture of vehicles that will be produced starting in 2023. Unlike the others, this platform will be introduced on models made in the US and Mexico. It was developed for large SUVs and will be available with ICE, hybrid and all-electric engines. The platform will accommodate a large battery pack, with a capacity between 159 and more than 200 kWh. Due to the vehicles high weight, however, the range will be identical to that offered by the STLA Large (about 800 km).

Table 2.14: About the STLA Frame Platform

STLA Frame Full-Size and Full-Frame
SOP: 2024 (RAM 2500-3500)
4 variations: ICE / MHEV / PHEV / BEV
Annual volume WW Max (BEV): 667,250 Annual volume WW Average (BEV): 207,340

Sales volumes of these vehicles will peak in 2028 and will average about 207,000 vehicles per year from 2023 to 2028. From chart 2.13, it's possible to see that the first SOPs with this platform were electric vehicles. Later, however, it's possible to see that MHEVs will take over most of the production. This is likely because many ICE vehicles will be converted to MHEVs to meet stringent emissions regulations.

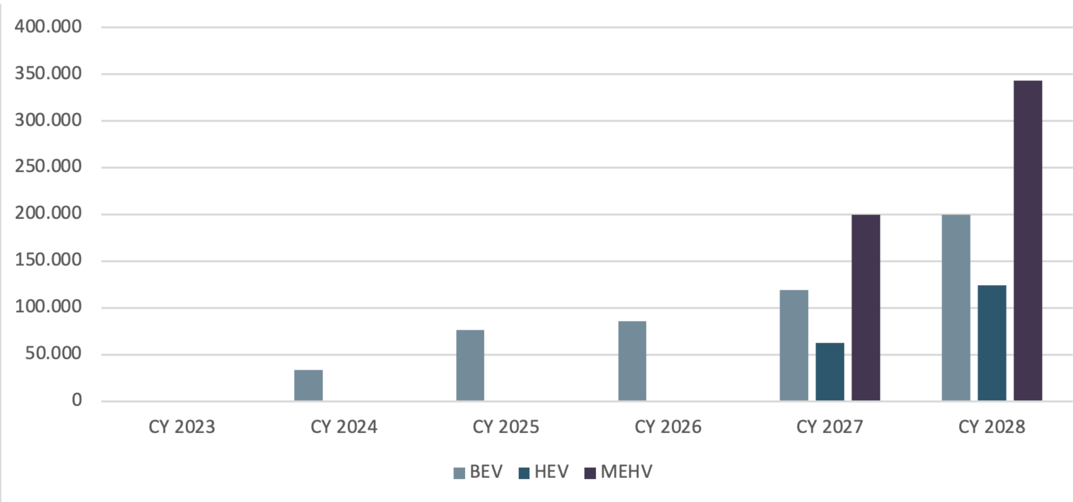

Figure 2.13: Estimaded sales of STLA Frame platform 2023-2028 (SOP 2023)

The electrified vehicles that will be offered with this platform are all Jeep or RAM. Below is the list of models with expected production numbers:

- Ram 1500 EV Electric (2024) → 387,564 // Ram 1500 Hybrid-Mild (2027) → 305,532 // Ram 1500 Hybrid-Full (2027) → 96,115
- Jeep Wrangler Hybrid-Mild (2027) → 135,955 // Jeep Wrangler Electric (2027) → 80,993 // Jeep Wrangler Hybrid-Full (2027) → 72,316
- Jeep Wagoneer/Grand Wagoneer Hybrid-Mild (2027) → 91,090 // Jeep Wagoneer/Grand Wagoneer Electric (2027) → 42,632 // Jeep Wagoneer/Grand Wagoneer Hybrid-Full (2027) → 18,532
- Jeep Gladiator Hybrid-Mild (2028) → 10,650 // Jeep Gladiator Electric (2028) → 2,662

As mentioned earlier, only two OEMs will use this platform. Table 2.15 shows the projected volumes for the period between 2023 and 2028.

Table 2.15: CMP Platform Cumulative Brand Sales

OEM	**Estimated Volume**
Jeep	454,830
Ram	789,211

Chapter 3

Strategic Management of NBP

After analysing the electric vehicle market and future trends, an analysis of EV industry's marketing and strategic management of components is made. As described in the Chapter 1.2.1 Mubea entered this industry through its NBP, especially with the battery cooling plate. Developing strategic product management aims to understand how far this product has entered the market and set the basis for future projects. The analysis will serve as an exercise to increase the valuable knowledge for future components that the company will propose to customers for electric vehicles.

In this chapter, different frameworks will be developed, depending on the company's external and internal reference levels. It will start with a global view of the macro environment through the PESTEL analysis. Porter's five strengths will be analysed in detail, considering interaction with new players, customers, and suppliers. The corporate level will be analysed with the Growth-Share matrix (BCG) tool, highlighting the various product stages and potential strategies. Finally, it will be possible look at the business level through the SWOT analysis, which combines the company's external and internal factors, and the VRIO framework for assessing the product's sustained competitive advantage.

These analyses and frameworks will be applied to the current European condition, focusing on Italy, where Mubea's EV products have yet to develop fully. Although these analyses need to be applied to the general case, with a broader vision of the company, large companies like Mubea may be asked to carry out studies in parallel that can highlight key factors to be implemented in the strategy to achieve the objectives. Observation and monitoring activities are necessary to keep this approach up-to-date and not miss any opportunities.

3.1 PESTEL analysis

PESTEL aims to help in analysing an organisation's external environment. This is especially useful when starting a new business or entering a foreign market, or a different industry with an existing company. The PESTEL analysis is about the macro-environment outside the company.
Everything that exists and happens within the company (culture, employees, management, shareholders, etc.) can be considered internal. Instead, the external environment is divided into everything that surrounds the company. It can interact bi-directional (competitors, suppliers, distributors, customers, and strategic partners).
As mentioned earlier, the PESTEL framework considers the macro-environment and does not refer to this type of environment. More generally, it analyses macro-environmental factors that can strongly impact the company but not the other way around, thus marking a flow of unidirectionality.
PESTEL is an acronym that stands for political, economic, social, technological, environmental, and legal factors. Together they form a comprehensive list of the overall environment. In other words, if you look at all these six factors combined when analysing your organisation's environment, you are less likely to miss some essential macro-environmental elements that could have a massive impact on the company and its sales. Focusing on all these factors gives the company more clarity on the big picture and suggests how they may shape the future of the business.
This chapter will conduct a PESTEL study for the electric vehicle market. All six factors will be analysed one by one. A schematic representation is available in the appendix B.1.

3.1.1 Political factors

These factors relate to how and to what degree the government intervenes in the area's economy. This is reflected in the opportunities that the company can take advantage in a given sector. All the influences that government policies have on the companies' activities are divided into:

- Government policy
- Political stability or instability
- Corruption
- Foreign trade policies

- Tax policies
- Labor Law
- Environmental law
- Trade Restrictions

In addition, the government can have a profound impact on how a nation's education system functions, what the infrastructure looks like, and how the healthcare sector is regulated. These are all factors that need to be considered when assessing the attractiveness of a potential market.
Most countries have sanctioned regulations on producing components and ensuring all passengers' safety in the automotive industry. The company must homologate its products by passing the test and obtaining a license. There are protocols to be respected for security, such as the European New Car Assessment Programme (Euro NCAP), which assigns a score to the vehicle under examination with a scale of 1 to 5 stars. To get the maximum score, the car manufacturer will require standards to be met by suppliers. It is essential to consider that suppliers must also guarantee this approval, which requires a not inconsiderable amount of time. At the policy level, in Italy and most European countries, stringent regulations have been proposed to limit the widespread use of fossil fuels. Car manufacturers must prove that their vehicles meet consumption and CO_2 emissions within a defined range. One example is the European pollutant emission standards, which are progressively updated with a limit of g/km of CO_2 emissions to be met. Since 2017, the new WLTP test has been introduced, alongside the RDE (Real Driving Emissions) test, to verify and homologate manufacturers' consumption. These regulations no longer only affect the finished product but also the entire supply chain, which, according to the new Paris Protocol, must be ultimately carbon neutral by 2050. Government regulations command the export and import [27] of raw materials and finished products. Therefore, the manufacturer will study these regulations to reduce expenses and maximise profit while maintaining a competitive advantage. The best condition is to import high-quality parts at the lowest possible rate.

3.1.2 Economic factors

They are determinants of the performance of a particular economy. These factors can have a direct or indirect long-term impact on a company, as they affect the purchasing power of consumers and could change supply and demand in the industry market. How companies set prices for their products and services depends on these. It is possible to imagine costs are lower in a relatively low purchasing power country. Examples of some economic factors are:

- Economic growth
- Exchange rates
- Inflation rates
- Interest rates
- Disposable income of consumers
- Unemployment rates

People's income is growing steadily for the automotive market in Western Europe, so their spending power is also increasing. Consequently, the demand for cars is also increasing slightly. The arrival of electric vehicles in the industry has not marked exponential growth yet. It is still in the embryonic stage. Electric cars are still too expensive for the average European buyer, and the infrastructure still has many shortcomings.
Governments' substantial tax breaks for stamp duty and insurance have increased interest in electric vehicles. Let's take the example of Italy. For a few years now, cars with more than 250 HP registered on the registration book have to pay an additional tax called "Superbollo". With the purchase of an electric vehicle, not only do you no longer have to pay this extra tax, but you will not have to pay the stamp duty for the first five years (after that, only 25% compared to the cost of a car with a traditional engine) or, as in the case of Piedmont and Lombardy, you will not have to pay for the entire life of the vehicle. Automobilists are therefore more interested in buying an electric car when choosing a more powerful vehicle. However, some factors limit interest in the electric market. An example is the recharge columns for the car, whose installation (after the availability of car boxes) has a cost that cannot be underestimated. If, on the other hand, public recharge columns are used, the costs increase, and in the case of ultrafast columns, the cost equals that of fuel, therefore uneconomical. A second example concerns the price of car parts. As technology grows exponentially, the price of vehicle parts will increase and consequently, so will the cost of the finished product. These factors could reduce the demand for automobiles.

3.1.3 Social factors

This dimension of the general environment represents the demographics, norms, customs, and values of the organisation's population. These factors are crucial to the marketing team when targeting particular customers.

- Population growth rate
- Age distribution
- Income levels
- Professional attitudes
- Healthy lifestyle
- Cultural barriers

They also specify the current situation of the local workforce and its willingness to work under certain conditions. As far as the automotive sector is concerned, there is a long list of factors influencing the social dimension.
Especially in Europe, cars are a means of transport, but they are also an authentic fashion item representing a person. It is no coincidence that Europe's most famous car manufacturers have chosen actors and influencers as their brand ambassadors. Marketing studies also claim that European customers are interested in buying a fashionable car and not just a functional one. The Lancia Ypsilon is a perfect example of this. This model was born in 2011, taking its name from an existing model, and underwent restyling in 2015 and 2021. In 2022, more than a decade later, it is possible to still buy this car that has undergone almost no technical changes. Nevertheless, other design updates and collaborations with major fashion houses have allowed the compact Italian car to stand out in the charts in terms of sales.
Culture and population distribution are other vital factors to consider. High sales numbers are recorded in more developed countries or countries where the population's concentration is low. On the contrary, where the concentration of people is high, having a car is almost a disadvantage to get around, and public transport is preferred. Moreover, depending on the age distribution and the number of family members, it is possible to understand the types of vehicles that will be most in demand. SUVs are likely to be the most popular vehicles in countries with large families.

3.1.4 Technological factors

These factors relate to innovations in terms of technology and related regulations that could affect the operation of the industry in the marketplace favourably or unfavourably. Understanding these factors is extremely important. A company could use them to decide whether or not to enter specific industries, launch or not launch certain products, or outsource manufacturing operations overseas. Examples of technology factors include the following:

- Technology incentives
- The level of innovation
- Automation
- R&D activities
- Technological change
- The technological awareness that the market possesses

Knowing what's going on at the technology level can help you avoid having your company spend much money developing technology that would become obsolete very soon due to disruptive technology changes.
In the automotive industry, technology is one of the most important pillars. Technological advances drive competition from fierce competitors. The past decade has seen significant innovations within a car, and technology is expected to be the main subject of the future vehicle. First of all, technology is widely used in terms of safety. All modern cars are equipped with the best driver assistance systems to minimise the impact on humans, both inside the passenger compartment and outside. For example, the front hood of cars has undergone significant changes that allow for a less fatal impact if a pedestrian is hit. The management system installed on the vehicle can detect the surrounding environment and consequently take actions to avoid an accident or mitigate its effects.
A second aspect relates to technology-related comfort. Nowadays, cars are equipped with intelligent voice recognition systems that allow you to control some of the car's parameters with your voice, which is a great way not to distract the driver. In addition, there are systems for maintaining the set speed with automatic maintenance of the safety distance, keeping the car in the lane and even an autopilot that can drive and park the vehicle by itself. Car manufacturers must remain perpetually up to date in terms of technology to take advantage of future opportunities. Proposing the latest autonomous driving and safety systems

allows the manufacturer to gain customers and increase profit.
Another factor that can strongly influence sales numbers is the technological evolution of a car's fuel consumption. Investing heavily in R&D for new forms of alternative propulsion will bring a significant competitive advantage in the future. Focusing on the electric vehicle sector, technology can help recharge times and the autonomy that the battery pack will guarantee.

3.1.5 Environmental factors

These have become highly relevant in recent years. The scarcity of raw materials and the stringent regulations set by governments and NGOs have led companies not to neglect these factors, giving them all the attention they need. Quite simply, if companies that decide to produce and sell in Europe do not respect all the rules imposed for the environment, they will no longer be able to produce. Becoming carbon-neutral is the first step to not having future problems. Many companies are racing to become carbon positive, therefore cancelling more CO_2 than they produce (see chapter 5.1). To win, companies must also focus on their products and make them as environmentally friendly as possible, with the possibility of recycling or reuse. This has led many companies to become increasingly involved in corporate social responsibility and sustainability practices.
One of the most challenging issues to address is carbon neutrality across the entire supply chain, from raw material to consumer, through suppliers and manufacturing processes. On July 29, 2021, the European Climate Act (EEC/EU Regulation No. 1119 of June 30, 2021) came into force, setting the binding goal of climate neutrality in the union by 2050, containing global warming within the 1.5° threshold, as also envisaged by the 2015 Paris agreements. The reduction of Greenhouse Gas (GHG) emissions by 2030, from 40% to at least 55%, compared to 1990 levels. The European Climate Act requires the EU to have an interim climate target for 2040, but the value is unclear.
Great attention must be paid to environmental factors to gain a sustainable competitive advantage. New electric vehicles will reduce the CO_2 impact on the consumer side (considered within Scope 3). Most car manufacturers choose electric propulsion because of the stringent penalties applied to those who do not comply with car emission limits. This is also the reason for brand collaborations, such as the agreement between Tesla and FCA. Proposing electric vehicles and new partnerships will reduce, in most cases, the profits, but it could be the only solution to remain present on the market.

3.1.6 Legal factors

Although these factors may have some overlap with political factors, they include more specific laws such as:

- Discrimination laws
- Antitrust laws
- Employment laws
- Consumer protection laws
- Copyright and patent laws
- Health and safety laws

Companies need to know what is and what is not illegal to operate successfully and according to the law. If a company decides to sell abroad, it needs to become fully conversant with the rules and regulations of that territory. It is essential to stay abreast of potential changes in legislation to minimise a possible negative impact on future sales. When a company is large, this task becomes difficult. Mubea, for example, operates in 18 different countries and cannot afford not to study all the regulations in each country carefully. A small mistake could cost dearly.

In the automotive industry, there are both tax laws and environmental laws. Therefore, a company operating in an international market must respect these regulations if it does not want to be banned from the country. There are strict laws to reduce the number of vehicles on the road in many countries. The incentive of governments to move more by bus and train is mainly aimed at eliminating the high rate of pollution in city centres and mitigating accidents and heavy traffic.

3.2 Porter Five Forces

Porter's five forces analysis is a framework that helps analyse the level of competition within a given industry. This tool was invented in 1979 by Michael Porter, a specialist in industrial economics and business strategy, to define the competitive intensity of an industry. According to this model, the state of competition in an industry depends on five fundamental forces:

- The threat of new entrants,
- Bargaining power of suppliers

- Bargaining power of buyers,
- The threat of substitute products or services
- Rivalry between competitors

These forces influence the long-term profit potential of an industry and thus its attractiveness. The Porter Five Forces analyses the company's outside, similar to the PESTEL analysis. However, unlike the latter, the Porter framework uses a task environment and not a macro-environment. The task environment encompasses fewer situations and, more importantly, predicts interactions between the internal environment (the company) and the external environment. In contrast, the macro-environment unidirectionally affects the company without the company changing anything. The Porter framework highlights the connection between competitive forces and potential profit. If competitive forces in an industry are high or intense, a company's potential profit in that specific industry will decrease. Each of the five forces can influence the profit potential in the industry either positively or negatively.
The Porter framework identifies an attractive industry by achieving as monopolistic as possible situation. Then, the business strategy team can use the Porter value-chain theory to achieve a sustainable competitive advantage by beating competitors. According to the whole Porter model, strategy is war, and one must continue to struggle in the market to maintain one's advantageous position.
This chapter aims to explain each force in this framework and apply the study to the automotive industry, more specifically to new battery-powered vehicles. This study is intended to give concrete advice on the company's investments towards developing components for new electric cars. The development of the new battery cooling system is closely related to the future scenario of BEVs. Based on this analysis, Mubea will be able to capture some opportunities. A schematic representation is available in the appendix B.2.

3.2.1 Threat of new entrants

The relative strength of new entrants varies depending on the capabilities and desire of new companies entering the industry with the hope of gaining market share. Factors that affect this strength include, for example:

- Number and size of existing competitors
- Rate of industry growth

- Product differentiation among rivals
- Entry and exit barriers

Rivalry is high, for example, when many competitors are roughly equal in size and power. If there is not much differentiation, competitors are likely to offer similar products and services and try to wage war on price or invest in advertising campaigns, seriously damaging a company's profits. The severity of the threat from new entrants depends on the barriers to entry in a given industry. The higher these barriers to entry, the lower the threat to existing players. Examples of these types of barriers may include

- Capital requirements
- Economy of scale
- Absolute cost advantage
- Product differentiation
- Access to the channel of distribution
- Governmental and legal barriers
- Retaliation

In addition, the rivalry is most intense when exit barriers are high and forces companies to stay in the industry even if profit margins decline. An example of these exit barriers may be due to long-term loan agreements or high fixed costs. Applying the case study of battery-powered vehicles, it's possible to say that there are a high number of barriers to entering the industry. This industry is on the rise, bringing new opportunities and new players. The growth in this sector will see conventional automotive manufacturers as the leading players, and now it will be explained why.

As mentioned earlier, the barriers to entry are high. For example, producing a new electric vehicle involves a significant upfront investment (representing high fixed costs) and additional capital to secure market share. The initial investment includes production lines, machinery, technology and research and development costs. Currently, profit margins are relatively low due to the high price of technology (e.g., developing the battery cooling management system). Only OEMs that can afford to invest heavily in R&D in this area will achieve significant results. In addition, experience in the automotive sector is necessary

to invest most effectively.
Even manufacturers unrelated to the automotive sector may decide to propose their idea. Such is the case with Sony, which unveiled the Vision S01 prototype and recently the Sony S02 at CES 2022. Even though the prototypes come very close to the idea of the car of the future, Sony reiterated that it is not interested in building cars. Apple and Google have also been developing ideas for this industry but are not yet claiming to be ready to debut. The main reason is that they would have to contend with giants like Volkswagen Group, Daimler, BMW, Volvo Cars and Stellantis.

3.2.2 Bargaining power of suppliers

Throughout the value chain of a product, the figure of the suppliers is fundamental. In general, there are no significant differences in the bargaining power of suppliers from the previous condition, linked to vehicles with combustion engines, to the new EVs. Only the components have changed. Before, all the elements that made up a powertrain had their path. With EVs, the picture has shifted slightly. Most suppliers, including Mubea itself, have shown interest in expanding their offerings. Unlike before, however, suppliers are - in most cases - offering a complete system, already assembled. The automaker is increasingly becoming an integrator. This change is the shift from the closed innovation approach to the open innovation approach due to the difficulty of achieving a competitive advantage with new technologies. In the first case, R&D activities are entirely developed within the company. This allows more effective management of the integration between product development and process development. In the case of open innovation, on the other hand, the car manufacturer wants to achieve the best for the product and therefore decides to rely on a specialised external supplier. The cost will obviously be higher, but the car manufacturer won't have to invest in R&D and will always be able to choose the best supplier on the market, with the certainty of achieving the set competitive advantage. The number and concentration of suppliers to choose from are essential factors in determining supplier power. The fewer there are, the more power they have. On the other hand, companies are in a better position when there are many suppliers. Sources of supplier power also include the cost of switching companies in the industry, available substitutes, the strength of their distribution channels, and the uniqueness or level of differentiation in the product or service the supplier is providing.
Unlike before, suppliers have gained more bargaining power, at least in the embryonic stage of the electrical industry. There are fewer specialised suppliers,

and each offers different materials, weight, and price solutions. While innovations often come from the manufacturer's side, the opposite is true for electric vehicles. As long as car manufacturers have not acquired a strong knowledge of these new components and as long as the number of contributors is not high, suppliers will have high bargaining power.

3.2.3 Bargaining power of buyers

Before analysing the bargaining power of buyers, it is good to make a distinction. If the motor vehicle market is examined, end-users should be considered as buyers, i.e. those who purchase the electric car. In this case, as the supply of new electric vehicles increases, the buyer gains bargaining power, so the manufacturer will have to choose the right strategy to convince him. The Internet has enabled customers to become more informed and, therefore, more powerful. Customers can easily compare prices online, get information on a wide range of products and have access to other companies' offerings instantly.

On the other hand, if you focus your attention on the Mubea company, you have to analyse the end customer like the car manufacturer and consequently the dealers and the end customer. In this case, the customer has less bargaining power until the number of suppliers is high. Only when there is intense competition among suppliers will a price war for equal performance begin, and buyers can increase their bargaining power.

In general, customers have much power when not many of them are present and have many alternatives to buy from. Moreover, it should be easy for them to pass from one company to another, therefore low loyalty. However, purchasing power is low when customers buy products in small quantities act independently and when the seller's product is very different from its competitors. Companies can reduce buyer power by implementing loyalty programs or differentiating their products and services.

3.2.4 Threat of substitutes

A substitute product poses a real threat to the company. Its purpose is to attract consumers to the industry by offering a different product from the main one but with the same purpose. With an example, this concept can be explained better. The typical radio station has found a threatening replacement, digital radio. Spotify has attracted many customers by adding features that were not available before. For example, the ability to access a vast set of music tracks for

a fixed and derisory monthly price. If before the customer had to buy the song or the music album, now it is the producers themselves who have to accept the conditions imposed by Spotify.
It is difficult for a company to discover the threats of substitute products in advance. It's not enough to initiate research on similar products branded differently by competitors. Instead, every product that serves a similar need for customers should be considered. Thus, the number of substitutes, the willingness of customers to substitute the product, and the relative price performance of substitute products are factors that determine the total threat of substitute products.
Because substitute products can lure customers away, companies must take action to remain more attractive and prevent their development from being replaced or obsolete. They can, for example, initiate a price war or invest in advertising, but, of course, this will negatively affect the bottom line.
As far as the EV industry is concerned, it is possible to see a real threat, although not vital. Even if electric cars pose as replacements for vehicles with traditional engines, they, in turn, have to watch their backs against new forms of mobility. The high price of buying an electric vehicle leads consumers to consider a wide range of different products. Many agencies decided to develop new ideas that could replace the emergence of electric cars.
One example is precisely the new urban mobility. Electric vehicles have access to several limited traffic zones in the city centre, but substitutes allow for more. It refer to scooter rental companies. Through a monthly subscription or the payment of a single ride, the consumer can use the scooter to travel around the city. Being electric-like BEV cars will not have an environmental impact. This, in addition, can allow to avoid the city car traffic and park precisely in front of our destination, without parking problems. The threat of scooter rental might seem very strong in many ways (price, no parking, reduced traffic, ease of use).
Nevertheless, there are many reasons why customers will not choose this type of mobility. In winter, for example, you travel in the cold, and you have to equip yourself with the right clothes when it rains, very uncomfortable when going to work, not to mention the high risks of falling on ice. In addition, the new regulations for the use of scooters require them to circulate in specific areas and not on bicycle paths, drastically increasing the chances of having an accident with heavy vehicles. Also, in the future, scooters will have to be registered with a license plate (just like motorcycles and cars) and - probably - be insured. These disadvantages make the threat of scooter rentals weaker.
Of course, the world of electric vehicles faces countless substitutes. Traditional vehicles such as trains, buses, bicycles, and even previous combustion engine

vehicles can be mentioned, which in some respects are even more advantageous than electric cars.

3.2.5 Rivalry between competitors

The focus of the Porter framework relates to the current competition present in the marketplace. This strength is determined by the number of players present and the type of services or products they can fulfil. There are different situations where competition between other players is high, such as when many competitors are roughly equal in size and power. Furthermore, when the industry grows slowly, consumers can easily switch to a competitor that offers lower prices. In addition, the rivalry will be more intense when barriers to exit are high, forcing companies to stay in the industry even if profit margins are shrinking. When rivalry is fierce, players are likely to follow price wars or advertising campaigns, thus reducing their profits.

There are several tools to calculate the level of competition in an industry, for example, the concentration ratio and Herfindahl index. In general, competition in the electric vehicle industry is very high. The prediction of exponential market growth in the next five years leads the current key players to invest significantly in electricity, increasing competition even more.

3.2.6 Conclusions

The growth of the electric car industry marks an exponential curve. That is why most European players are betting on an electric future. The whole technological development and the strong support from governments worldwide support this industry. The need for manufacturers to find a solution to stringent ecological regulations forces them to enter this sector. Environmental awareness and the long-term savings of electric vehicles will drive demand and, with it, sales numbers. What's more, as soon as the infrastructure caters to the needs of an all-electric car fleet and the range of electric vehicles allows all customers to buy cars at any price, growth will be even sharper. Over the years, the automotive industry has seen record sales and profits worldwide, and there is a good chance that adaptation to an electric future will not involve any reduction or shrinkage.

As a result of the analysis above, it is possible to classify all the different forces in the Porter framework by assigning a level of intensity. The table 3.1 shows the results.

Table 3.1: CMP Platform Cumulative Brand Sales

Threat of new entrants	Medium
Threat of substitutes	Strong
Rivalry between competitors	Very high
Bargaining power of suppliers	Medium-high
Bargaining power of buyers	Weak-medium

It is also fair to see what effect the electric vehicle market will have on the product that Mubea has decided to develop, namely the battery cooling management system. Thus, in the following lines, the analysis made will be adapted to Mubea's intentions as a manufacturing company.
The high barriers for new entrants lead conventional automotive manufacturers to stand out from the rest due to their knowledge of the industry and thus their ability to invest efficiently. Therefore, it will be necessary for Mubea to consider the development of the essential OEMs in Europe. Betting on a new entrant could be risky as sales numbers in Europe would vary significantly from consumer experience.
There are substitute products that can threaten the EVs industry. An example would be new forms of urban mobility and traditional solutions such as trains and buses. Nevertheless, the exponential growth of the EV industry will not be compromised. Mubea must analyse the market trend to invest in a product closely related to the sales numbers of electric vehicles. In addition, the battery cooling management system product does not yet see any substitutes. There will probably be upgrades to the same product using new materials and cooling liquids, but this will not be a big problem with the suitable R&D investment.
The bargaining power of suppliers will remain medium-high in the coming years. This may suggest the company to take full advantage of this opportunity. Profits will be high as long as the quantity of suppliers remains low. In addition, it would need to use all its knowledge to develop a complete battery cooling management system, as manufacturers do not yet have strong expertise in this area. The company itself could think about strategic acquisitions aiming to sell a finished product directly integrated into the car.
As for the buyer's bargaining power, in the case of Mubea, is about OEMs. It is still relatively low. As long as there are few suppliers, buyers will not engage in intense competition and try to drive down purchase prices. In this case, Mubea will have to make solid and long-term agreements with customers to create a

strong loyalty between the two sides. The level of service and support will need to remain at an all-time high.
Competition between existing competitors is very high in the electric vehicle sector. However, the number of suppliers is still low in the market, resulting in low competition between suppliers. Entering the industry as early as possible may allow the company to gain the best knowledge and be more fierce when the market becomes much more competitive.
Defining all five forces in the Porter framework allows understanding competition in the industry. This is the starting point for developing the strategy. The fact that the company can influence these forces similarly to how these forces can affect the company allows strategic actions to be set on what to do next.

3.3 Growth-share matrix

Guided by its mission statement and goals, the corporate strategy team plans its business portfolio. The company wants to produce a portfolio of products that best matches its strengths to the opportunities in the environment. To do this, it must analyse and adjust its strategic business units and currently developed product lines and build growth and scaling strategies to modify the future portfolio. The best-known method of this type is the Boston Consulting Group (BCG) approach. Essentially, a diagram is created whose axes are relative market share and market growth rate. Within the diagram, four quadrants are identified: stars, question marks, cash cows and dogs.
The objective of this tool is to study the company business units and understand where to allocate financial resources or where to disinvest. Although it may seem simple to use this tool, the position of the business units within the diagram are calculated through values that are difficult to find in a company. Therefore, the following analysis has an informative purpose, based on approximate assumptions.
The growth sharing matrix identifies four types of SBUs:

- Question marks are low share business units in high growth markets that require large amounts of money to maintain their share. Question marks need to be carefully analysed to determine if they are worth the investment required to increase market share or if the risk is too high. This SBU could turn into stars or dogs, depending on whether a market share is achieved.
- Stars are high growth, high share businesses or products. Stars generate large amounts of money because of their high relative market share, but they also require significant investments to combat competitors and maintain

their growth rate. Many companies would have to rely on a few star SBUs to ensure a steady cash stream. Eventually, they will turn into cash cows.

- Cash cows are low growth, high share businesses or established products and successful SBUs that require less investment to maintain market share. Money generated at low investment should be invested for question marks or keep stars high.

- Dogs are low-growth, low-share businesses and products that can generate enough money to sustain themselves but not promise to be significant money sources. This SBU is therefore not as attractive to investors.

Before identifying the battery cooling system position of the diagram, it is fair to define the variables. Relative market-share 3.2 is the focal company's share of its largest competitor [24]. It is calculated from the market-share formula 3.1.

$$\text{Market-Share} = \frac{\text{company B.U. revenue}}{\text{tot. industry revenue}} \cdot 100 \tag{3.1}$$

$$\text{Relative Market-Share} = \frac{\text{Company B.U. market-share [\%]}}{\text{Largest industry market-share [\%]}} \cdot 100 \tag{3.2}$$

It isn't easy to access the data that compose these formulas. This is one of the shortcomings of using the matrix. However, the index for the market size of the management cooling system for electric vehicles, calculated in 2020, has been found. In 2020 the market size was 2.1 billion dollars, and it is assumed that in 2027 it will reach a value between 8 and 12 billion $ [8] [11].
The second variable is the growth rate of the market. This is used to measure market attractiveness. Fast-growing markets are the most attractive to companies because they promise attractive returns on investment over the long term. The downside, however, is that companies in growth markets are likely to need investment to make growth possible. In the management cooling system industry, a CAGR (Compound Annual Growth Rate) of 22.5% from 2021 to 2028 has been estimated [8] [11]. This rate is high compared to others SBU and makes this industry highly profitable for investment.

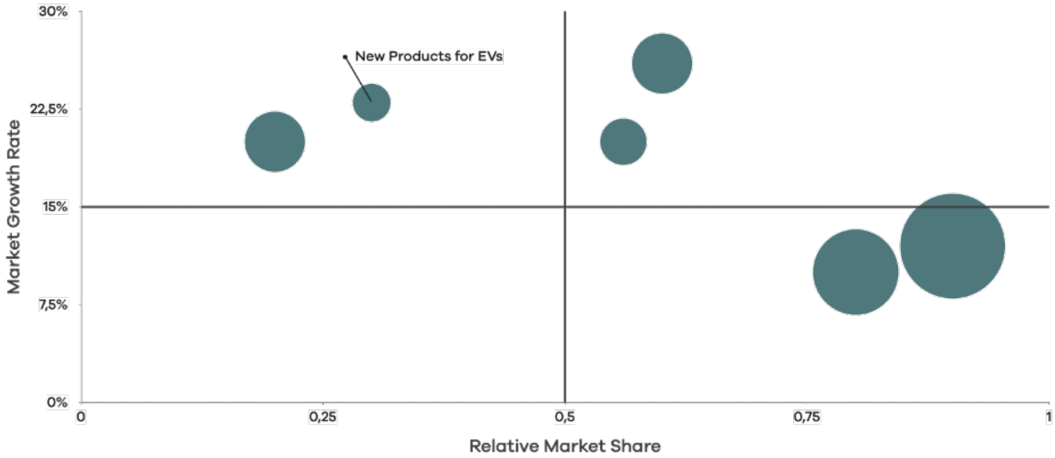

Figure 3.1: Schematic representation of NBP in the BCG Matrix

From a rough analysis based on the company's SBUs, it was possible to position the management cooling system as a "question mark". The high growth rate makes this industry very profitable. However, care must be taken, and no missteps must be made to maximise the value of these electric vehicle products and turn them into a star SBU.

The Growth-Share matrix is closely correlated with the product life cycle diagram. It's possible to divide the sales curve according to the four SBUs previously described. The question marks follow the part of development and design and represent the lower point of the sales when the product comes introduced in the market. On the other hand, stars represent the surge in sales when products are in their growth phase. Next, there is a maturity zone characterised by cash cows. Finally, the Dogs are in the decline phase: the final phase of the cycle, when sales start to decline. In image 3.2, the condition of extending the product life cycle that would keep it as a star is not represented [23]. For example, this can be achieved by adding new features, optimising existing ones, creating variants, or taking it to a new market or market segment. It is commonly called restying.

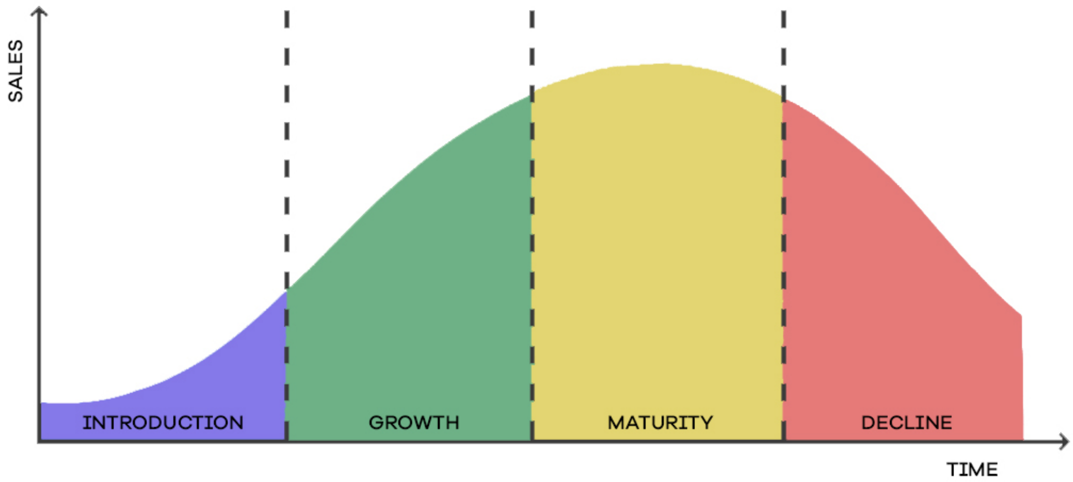

Figure 3.2: Product life-cycle diagram

Very close to this concept, Arthur D. Little's ADL model is a portfolio management method based on product life cycle thinking. The ADL portfolio management approach uses environmental assessment and business strength assessment dimensions. The environment measure is an industry life cycle identification. The business strength measure categorises the company's SBUs into one of five competitive positions: dominant, strong, favourable, tenacious, and weak. This produces a five (competitive positions) matrix by four (life cycle stages). The corporate strategy team must identify discrete businesses by finding commonalities among products and business units, using a set of available guidelines that include typical rivals, pricing, customers, quality/style, substitutability, divestiture, or liquidation. Each firm's industry life cycle stage is evaluated based on several parameters used as descriptors, such as growth rate, industry potential, product lines, number of participants, share distribution, customer loyalty, revenue, and technology.

A company's competitive position is based on an assessment of the following criteria:

- Dominance: there are few players, and rivalry is low. Power often results from a near-monopoly or highly protected technology leadership.
- Strong: leading companies can usually follow different specific strategies, following other moves from competitors
- Favourable: a situation where the industry is fragmented, and the more experienced players have an easy time standing out and becoming leaders
- Tenable: in this case, there are many leaders in the market. While generating profit, serving the industry in a secure situation may require specialising in a niche of the industry.
- Weak: weak competitors may be inherently too small to survive independently and profitably over the long term, given the competitive economics of their industry, or they may be more significant and potentially more robust competitors but suffering from costly past mistakes or a critical weakness.

Positioning in the matrix identifies an overall strategy that can be developed regarding market share, investment requirements, profitability, and cash flow.
Suppose to consider the position of Mubea with the battery cooling plate. In that case, it's possible to place it in a growing and strong position, given the presence of few competitors and highly differentiated solutions in the competitors' offer. For future components related to the EV industry, it's possible to assume a favourable/strong condition at an embryonic life cycle stage. In both cases, the company's product lines are going through a natural development phase, and there should be no issues for which to divest and exit the industry.
However, this matrix approach (BCG) can lead to problems: measuring market share and growth, an expensive and time-consuming process, not focusing on future planning but on current businesses. Because of these problems, companies have turned to a more customised approach, developed by managers who are close to the market. Another possible tool to take advantage of future opportunities is the product/market expansion grid (Ansoff Matrix). This looks at new products, existing products, new markets, and existing markets to grow the company.

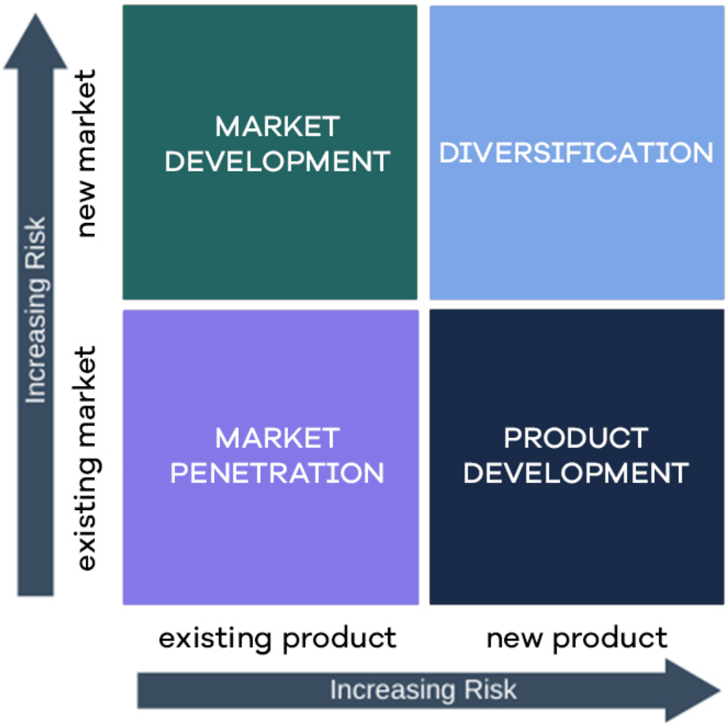

Figure 3.3: Ansoff Matrix

Market penetration involves making more sales to current customers without changing its original product, e.g., adding new stores in current market areas to make it easier to visit. Market development involves identifying and developing new markets for its existing products. For example, managers might examine new market demographics, such as the United States or Asia. Product development involves offering modified or new products to current markets, such as moving into new categories. Diversification consists in starting or acquiring businesses beyond their existing products and markets. For example, the company might acquire another company that operates in different market segments with a diverse product mix.

3.4 SWOT analysis

SWOT analysis (strengths, weaknesses, opportunities, and threats) is a tool used for strategic planning and to assess a company's competitive position. A SWOT analysis evaluates internal and external factors and current and future potential. A SWOT analysis is designed to facilitate a realistic, fact-based, data-driven look at a company's strengths and weaknesses and propose new opportunities not to be missed or threats to be avoided.

The SWOT framework consists of four quadrants, each of which constitutes a specific significance. This visual arrangement provides a quick overview of where the company stands. It is important not to exclude any quadrant in the analysis. Each is equally important.
By analysing each quadrant, it is possible to define internal factors, strengths and weaknesses, and external factors, opportunities and threats. The former can be changed with company intervention, while the latter can only be observed and monitored. Having a complete view of the environment allows you to grow with sales.

- *Strengths* describe what an organisation excels at and what sets it apart from the competition. Examples may include a strong brand, a loyal customer base, a strong balance sheet, unique technology, and so on. Sometimes it is possible to refer to strength by calling it a USP (unique selling proposition).

- *Weaknesses* prevent an organisation from operating excel within an industry. They are areas where the business needs to improve to remain competitive. Examples include high levels of debt, an inadequate supply chain, or a lack of capital.

- *Opportunities* refer to favourable external factors that could give the organisation a competitive advantage. For example, the advent of technology has opened up new business forms in every industry. Significant opportunities will be missed if online platforms are not utilised internally and for customer contact.

- *Threats* refer to factors that have the potential to harm an organisation.

The company's main goal is to use this framework to leverage positive factors (opportunities), matching them to the company's strengths and minimizing the negative effect of environmental threats. It is as simple as it is important to develop a SWOT framework to set goals and create growth strategies for the company. Macro-environment and external environment tools such as the Porter Five Forces and PESTEL analysis can track external factors. In contrast, the VRIO model (for strengths) and the product life cycle model can be considered for internal factors. In addition, all internal and external factors must be constantly monitored and controlled to ensure that opportunities are not missed, strengths are enhanced, threats are avoided, and weaknesses are mitigated. These are all highly variable factors depending on market trends.

Therefore, the SWOT framework serves as a median tool between the external and internal views, assisting the other specific tools have been analysed in this thesis. Applying the SWOT framework to the actual case, some considerations can be made. This tool has been used for the battery cooling plate produced by Mubea. The idea is to evaluate the internal and external factors for this component and build an experience that can be an example for future projects.
As for the strengths of the battery cooling plate, reference can be made to its manufacturing process, which through the use of custom rolled blanks (TRB), allows for a final product with low weight and low cost. This is a crucial strength if you think that the competitive factors in the EV industry of the future will be price, to create more economically competitive vehicles, and weight, which can compensate for the high mass of the battery pack. Another decisive factor is the one-sided inflation process that allows for unique geometries optimised for coolant flow within the plate channels. This process is protected by the Mubea patent, giving a competitive advantage in the short/medium term. Finally, about the entire NBP unit, Mubea has established strategic alliances that have allowed it to gain the necessary knowledge to operate in this industry quickly.
In terms of weaknesses, Mubea's battery cooling plate applies to BEV cars to cool a generously sized battery pack located under the passenger compartment. The development would be needed for these new applications, given the tremendous growth of hybrid vehicles (MHEVs, HEVs and PHEVs) that will replace ICEs before BEVs do. Unlike other established competitors in the market, Mubea has yet to build a defined image in the industry. Some customers may therefore complain about a lack of experience in electrification. On the other hand, Mubea has always worked with rolled blanks and, through strategic alliances and R&D, can quickly fill this gap.
Moreover, Mubea has had to spend many resources in research and development. The investments are probably not finished, given the significant growth in technology. To remain competitive in the market, further investment will be needed. While not a real weakness, these investments and strategic alliances have frozen some of the company's capital that could be invested differently.
External factors, such as opportunities and threats, echo the discussion addressed in analysing the macro-environment external to the company. Indeed, the environmental factor with the imposition of governments to reduce the carbon footprint and the encouragement for consumers to buy EVs create a substantial opportunity for new suppliers to this industry. Research into new lightweight materials may also represent a new form of business to reduce weight for future EVs. On the negative side, however, threats include shortages of raw materials and valuable

materials that could reduce the production of electrified vehicles. Material recycling will be able to address this issue. Indeed, the established competitors in the market will try to maintain their leadership by leveraging their industry expertise and investing heavily in R&D to distance themselves from new entrants.

3.5 VRIO Frameworks

A company can find a variety of resources within itself. When these are valuable, rare, difficult to imitate and support at the organisational level, a lasting competitive advantage is established. Most previous research studies of business organisations were based on economic principles and industry dynamics that made them rather externally oriented. It was thought that the external environment alone was the starting point for determining strategy. However, this did not interpret long-term business performance well.
A new trend recommended looking instead at its inside and its resources. Thus, was born the resource-based view. One of the proponents of this idea was the creator of the VRIO framework, Jay Barney. He developed the resource-based view into a comprehensive theory. He published a well-known article on the notion of resources in 1991, in which he also introduced to the concept of VRIO.
Although there is no single defined definition of resources, Barney described enterprise resources as diverse concepts. For example, resources can be

- Assets
- Capabilities
- Production processes
- Business organisation
- Knowledge

In this way, it is possibly better to understand the nature of the firm's business. In the following table, it is possible to see an example of both cases.

Table 3.2: Tangible and intangible assets

Tangible assets	**Intangible assets**
Equipment	Trademarks
Machinery	Copyrights
Inventory	Brand Reputation
Vehicles	Patents
Land	Licenses
Buildings	Know-how
Cash on hand	Organizational culture

Another breakdown of resources within a company might be as follows:

- Physical capital
- Human Capital
- Organisational capital

For companies to turn these corporate resources into a sustained competitive advantage, resources must have four qualities or requirements summarised in the VRIO concept. Corporate resources must be valuable, rare, inimitable, and non-substitutable. Let's examine each letter one by one.
First, resources must *have a value*, a peculiarity to the resource. Resources are valuable when they allow a company to implement strategies that improve its efficiency and effectiveness by exploiting opportunities or mitigating threats and profit from them. This is reflected in an increase in revenue or a decrease in costs. It is possible to quantify this with the help of the net present value (NPV) method. Any resource or investment with an NPV value greater than zero is assumed to add value to a business and be considered a valuable resource.
Rare. Resources that one or a few companies can only acquire are considered rare. If many players in the industry own a specific valuable resource, each player can exploit the resource in the same way. Thus, no one gets a competitive advantage. Therefore, rarity is significant in differentiating one's product and increasing profits by increasing consumer interest and ensuring patents. *Inimitable*. If a resource is profitable, many players will be interested in copying it. Profit generates interest in competitors who do not have the same resources. Even if the long-term advantage is not pursued, competitors will try to clone the resource to make a profit. For example, one resource that can be copied is the production

process of a particularly innovative product. Resources, therefore, should be difficult and expensive to imitate or replace. There are some cases where other players in the segment cannot copy a resource.

- Historical uniqueness: once a particular historical moment has passed, companies that have not acquired the time-dependent resources can no longer obtain them
- Causal ambiguity conditions: the firm's sustained competitive advantage is not fully understood by both rival firms and the focal firm itself. A big question that cannot be understood because of its complexity.
- Social complexity: intangible resources such as the relationship between suppliers and customers, teamwork, and organisational culture. The figure of the brand.

Organisation. Even if a company has valuable, rare and inimitable resources, it will not automatically lead to sustained competitive advantage. To fully realise this potential, a company must also be organised to leverage its resources. An appropriate division of labour is therefore necessary. It is critical to consider fair compensation that will lead workers to work to their full potential (and make them feel involved under a global mission and feel they are actively influencing the company).

These different phases are consecutive. If one of them is not verified, the subsequent ones cannot be fulfilled. If the resources do not have value, the company would be severely disadvantaged. Otherwise, the question must be asked: are resources rare? If the answer to this question is no, so that more players in the sector can similarly use the same resource, the situation is called competitive parity. In this case, no one player prevails over the others.

However, if the answer is yes, the situation is more favourable for the company. This has valuable and rare resources but is not inimitable, which results in a temporary competitive advantage. Competitors are likely to find ways to duplicate or replace the resources as time goes on.

Finally, there is a non-competitive advantage if there is no organisation. This is why it is so important to use this framework from time to time and think critically about resources to truly understand if the competitive advantage continues to exist or if internal improvements are needed to re-establish itself in the marketplace. There is a sustained competitive advantage if the organisation is also structured correctly.

It's possible to apply VRIO analysis to a product of Mubea already on the market, closely related to electric vehicles. This product is the battery cooling plate described at the beginning of the thesis within the NBP products (described in detail in the chapter 1.2.1). The VRIO analysis is made on the production process of this product, as this is what gives value to the plate. Through an in-depth study of the production process, it was possible to understand the essential steps precisely and, based on this, create a truthful analysis. First of all, the process is valuable. It allows the production of an object that represents an added value for the customer (without which he could not cool the battery pack) and for the supplier, who profits from it. The manufacturing process is rare because it consists of machines running in succession to create the final product. Although a competitor might buy a machine (at high investment risk), the machine's setup would be inimitable to achieve the same outcome. Years of development are needed to design the production of a battery cooling plate. Moreover, the rarity of the process is due to the experience gained by Mubea over the years for the rolled blank processing.

The creation of the battery cooling plate of Mubea is inimitable because the process of unilateral inflation for the creation of the channels where the coolant will pass is covered by a patent. You might think that once the patent expires, other players could copy the technology and produce the final product as well. In reality, given the exponential growth of technology in this industry, it is plausible to assume that in a few years, this process will have to be updated to avoid becoming obsolete, so it is correct to reason in the short to medium term. Finally, the process is organised. This is because many of the designers who created it are working on its development, and for them, it is an opportunity not to be missed. The manufacturing process works well because many brains work together to optimise the final product. Not a single figure makes this process unique, but rather the constant work of many pawns.

These features allow the battery cooling plate to obtain a sustained competitive advantage in the short to medium term. This analysis can be the basis for developing the other components of the NBP to see if they can have a competitive advantage and, more importantly, if they need improvement not to lose it.

Chapter 4

Sales analysis of Maserati M189

At this point of the thesis, a case study has been evaluated using the battery cooling plate on a real case, the Maserati M189 project. This is an important project for the manufacturer as it aims to update one of the most important cars in the Maserati fleet. If the M182 project was launched, namely Maserati Grecale, to increase the turnover and sales numbers, the brand needed the restyling of a historical icon. This icon bears Maserati Gran Turismo's name and has always been synonymous with luxury and elegance.

The commercial development of this case study is a long and tortuous process and has been divided into different paragraphs for simplicity. The sale plan will initially analyse the sourcing process that sees the proposal from part of the customer (under the shape of Request for Quotation) and the supplier's offer. The process considers the presence of different departments. The purchasing team and the product development team are present from the client-side, while the commercial team and the engineering team are present for the supplier. A key figure at the head of the commercial department is the key account manager (KAM), who creates a relationship of trust with the customer to promote customer loyalty over time. Through his experience, the KAM can make agreements to solve specific client problems and do so [4]. This worker draws up tailored proposals.

Once the formal offer has been sent to the client, a technical review is initiated, which allows the client to understand how well the proposed solution will fit the request. During this crucial phase, there needs to be excellent communication between the parties as the customer needs to find the most suitable supplier for their needs. In contrast, the supplier needs to show their best to win the bid.

For the battery cooling plate, Mubea offers two options to the customer. The first one sees Mubea design as responsible. The second one considers the customer taking care of the component's design. In the first case, the company takes care

of the thermal and mechanical design of the plate, defines the geometries and optimises the position of the inlet and outlet ducts. Simulations and tests are then carried out for all production steps of the cooling plate and the functionality of the finished product according to the technical specifications required by the customer. In the second case, Mubea supports the customer in adapting the design to the roll bonding process and produces the final product.
The time frame that the customer has to take into account varies depending on many parameters. As a general indication, the time required for the design phase, i.e. the time between the customer requirements and the design freeze, ranges from 4 to 8 weeks. For the production and delivery of the prototype, you will have to wait from 2 to 6 weeks, and times may vary depending on the availability of raw materials. To estimate the prices, instead, are required two weeks from delivering the project information.

4.1 The Maserati customer

Once you've seen Maserati's plans and understand how it will approach the electric world, it's good to understand its relationships with suppliers to acquire new components for electric vehicles. When a new platform is introduced, the manufacturer investigates which suppliers might be interested in developing new components or services for this platform. There are three types of models that the automaker can choose.

- Cooperative model: similar to the Japanese "keiretsu" model, it is based on close relationships between the automaker and its suppliers. It is usually used when long-term cooperation is established and a transparent agreement is used, clearly showing all the benefits on both sides. Often whose actions are the subject of exclusive commercial contracts.

- Competitive model: this is the opposite of the previous one and is based on open requests to a wide range of potential suppliers. In this case, the ability to specify the new product or service's new features is required so that all suppliers have the same documents. There must be no preference among suppliers, and no one is given an advantage. Only with maximum transparency can fair competition be achieved. The client initiates a bidding process with the best return with this model. The bidder offering the best service at the lowest price wins the race.

- The "controlled competition" model: is a hybrid solution between the previous ones. In this case, preference is given to suppliers located close to the car manufacturers' production facilities. This model is no longer used frequently as it is challenging to find a local supplier at a competitive price. For the customer, globalisation is good if you are looking for a broader range of suppliers, but there will be a non-negligible logistical impact. This could get in the way of choosing a supplier if they cannot share their components across the globe.

For example, in the case of the M189 platform, Maserati has opened a dialogue with Mubea to present the new design and understand what components the supplier might be interested in producing. Among the different products in Mubea's range, the "New Body Products" were the most relevant for the new platform. Maserati was intensely interested in Mubea's proposal as it proposed a unique patented technology to create the Battery Cooling Plate. This technology saves on production costs because it does not involve a high expenditure for machinery as it happens in the brazing process.

4.2 The supplier

When developing a new vehicle, an automotive manufacturer may choose different suppliers. Commonly, suppliers are divided into engineering suppliers, style suppliers and product suppliers. Each is selected according to the requirements of the buyer.

- Engineering suppliers. They are used during the design phase of the product. They support the OEM by replacing resources that are part of the carmaker company. The benefit to the carmaker is that they do not have workers on their balance sheet and have a higher level of flexibility to handle problems.

- Style suppliers. They are involved in the technical activity related to the style (macro-feasibility analysis of the style) and draw up the different variants of the style architecture. Their task is to support the creation of the style master.

- Product supplier. These are the most common because they are responsible for developing components assembled on the vehicle to create the finished product. There are four different levels of integration depending on the assembly of the part inside the vehicle and the supplier's knowledge.

- Not-codesign: the supplier is not responsible for design but only for industrialisation and delivery. This approach is also called build to print and is the level where the supplier has the least responsibility.
- Codesign for components: the supplier develops the product according to component specifications. Again, the supplier has no responsibility for adequately integrating the part into the vehicle.
- Codesign for modules: the supplier develops the product according to the specifications requested by the customer (STS or SSTS). The supplier must ensure the development and the integration of the components
- System Codesign: the supplier shall develop the system/component according to the carmaker's performance objectives imposed and required. The supplier must ensure physical integration on the vehicle. At this level, his responsibilities are maximised.

When the supplier's level of integration is highest, there will likely be contracts for different components rather than one. Over time, the supplier and the customer gain mutual trust. Both sides will benefit from this trust. On the one hand, the supplier will be highly likely to be approached for new projects, and on the other hand, the customer will be more likely to have the final product meet their expectations. This is why the carmaker always has a "plan b".

4.3 Request for quotation (RFQ)

The first relationship established between customer and supplier is a research activity performed by the customer to understand if the requested product can be created and, more importantly, what type of customer can meet the requirements. When sourcing a new component, the buyer considers whether to hold an internal KSM (Key Stakeholders Meeting) to verify that all the inputs needed to begin sourcing are available, complete and consistent and to share the Supplier Panel with E&D (Engineer & Design). The technical costs and investments are indicated, the technical documentation related to the product sheet is prepared. After checking if the product is present in the supplier's range, the customer sends a product draft to the supplier. In this way, the supplier can verify if the product's technical characteristics are compatible or adaptable with its production processes. This process is called Request for Information (RFI). The car manufacturer commonly leaves a free initiative to the supplier to improve the product, both technical and production. As seen above, it's possible to talk about co-design in some cases depending on the level of integration. At this time, the supplier's goal is to see if they can provide superior technology to the competition to keep profits high and win the bid. The customer uses an online portal with an interface between them and the vendor. This portal allows for maximum transparency on both sides so that suppliers and manufacturers are honest. In the case of Maserati, the portal used is called *"e-supplier"* portal and is shared across the Stellantis Group. Mubea, like all the other suppliers, registers within the portal and will have access to all the data to participate in the tender. From now on, the Request for Quotation process is started. Maserati enters the proposal for the specific component on the portal and sends the Source Package to all interested suppliers. A Source Package is a collection of business requirements for new components in production to define a working guideline. Requirements include technical, functional, design, program timing, part volume, packaging, and other business requirements. It will be look at the different attachments to the RFQ in detail in the following chapter. Once the Source Package is downloaded, the salesperson sends the various documents to the project manager and project engineer, who will do a quick feasibility analysis. If they both verify the feasibility and respond positively, the KAM must accept the proposal on the portal. This is critical as a bidding number is generated for that component associated with Mubea. This code will represent the company and be valid beyond the nomination letter phase and the start of component production. From this point on, the technicians and engineers work on the requirements within the CTS. Their goal is to adapt their knowledge and technology to customers' needs. In some cases, the supplier himself recommends a different solution to improve the request. In this case, the salesperson's role is to support the engineers and ensure that all the documents they need are in place. The engineering team must meet the deadline. If this is not the case, the salesperson will not upload the proposal to the portal in time, and the company will exit the competition. Often, a significant time frame is not required to upload the proposal to the portal. A couple of days is usually considered. To complete the upload of the offer on the portal, the commercial team needs to enter a few fields. First, it must define the production capacity for each part number on the chosen production facility. This breaks down the production volume into a week, day and shift. In the case of a production increase request from the customer, you must also enter the time required for this increase and the corresponding cost. The part numbers (PN) required by the customer for the battery cooling plate product are associated with the various parts that make up the overall assembly (bottom, top, left, etc.).

Afterwards, it will be necessary to insert the commercial offer. You must enter

the unit price for each PN. The logistic cost must also be communicated, constant for all the part numbers and representing about 13% of the total price. The discount applied by the supplier to the customer must also be considered when present. Usually, the discount varies according to the production quantity and the distance from the SOP. It can be represented a trend of production that follows a Gaussian curve. A discount can be applied on the peak of the bell, defined from the more significant number of sales in the years of means.
Every produced PN has also associated a cost for the tooling. To create a piece, it is necessary to consider the cost of the machinery and the price for setting it. The customer bears these costs. To give an order of magnitude, the machinery used to produce these components have prices oscillating between 35,000 euros and 75,000 euros. The sales team must consider the entire price breakdown when doing this activity. This includes raw materials, machining, intermediate and final assembly, equipment breakdown, logistics costs, and R&D costs.
Finally, the sales team must complete the technical proposal field. This should include all the technical documents requested by the buyer. Examples include the Manufacturing Feasibility Assessment (MFA) and the Advanced Quality Requirement and Capacity Requirement Book. Once all these steps have been completed, the RFQ is complete, and the customer can judge the company proposal. The buyer will evaluate the consistency between the offer and the RFQ input data, the completeness of the bid (e.g. development, logistics, tools and materials) and the homogeneity of the contents of the various proposals. The Product Development Team will initiate the next phase called Technical Review. Suppliers who have not been able to satisfy the buyer's requirements ultimately will receive a red light and be excluded from the tender.

4.3.1 Source package

As mentioned in the previous chapter, the supplier downloads a Source Package from the e-supplier to verify all the technical and feasibility data of the project. Different documents aim to explain the project and the requirements to the suppliers in detail.
Specifically, the different documents attached in an RFQ are:

- Tech Sheets / SSTS (CTS) / Product Card: these are among the essential documents shared in the RFQ. They contain all the technical specifications of the product.
- Timing of the project: a table inside the "technical solution" section is

created. It shows all milestones from the start concept to JOB1. The most important dates to consider are

- Program Approval: it is a milestone that marks the passage from project setting to project execution. The concept and style freeze is very close to the program approval date.
- CAD Step 2: definition of the 3D mathematical model, material reference and material thickness.
- CAD Step 3: welding points, technological plan and virtual feedbacks are defined. In some cases, a tooling kick-off (TKO) may be required at this stage.
- CAD Step 5: 2D drawings are finalised, and specific tolerances are defined. At this time, you can complete the tool launch.
- VP (Validation Process) [chapter 4.6]
- PS (Pre-Series production) [chapter 4.6]
- JOB1 [chapter 4.7]

- Annual volume forecasts and CRB (Capacity Requirement Book)
- Quality requirements related to the type of product to be developed and the production process
  - AQR (Additional Quality Requirement) for the different processes
  - Basic requirement Checklist
  - MFA (Manufacturing Feasibility Assessment)
- Project technical/technological feasibility to be guaranteed by the supplier (Supplier Feasibility Letter)
- General purchase conditions and cost target
- Specific logistics of supply and packaging: in this case, it is necessary to follow the dimensions imposed from FCA (Stellantis) and the carrier's container (iFast) always chosen from the buyer.

Source Packages are established to communicate a baseline of business requirements so that suppliers can provide technical and commercial offers. As a practical matter, the supplier will need to submit proof of actual verification of the conditions in the Source Package.

For example, the Supplier Quality Source Package is a 21-page document that shows all the different requirements with explanations. In this case, Mubea must acknowledge all conditions and, if all are met, submit the document stamped and signed.
The technical and commercial aspects of the bid will then be defined during an optional meeting with the suppliers invited to bid, the development team and the FGP product development representative.

4.4 Technical review

After the Buyer has checked the proposal sent by the supplier, the technical review is carried out. In this phase, a check is carried out to verify that all the requirements indicated in the RFQ have been interpreted correctly by the supplier. A series of meetings is then scheduled to monitor that everything follows the customer's request. The supplier must demonstrate that its capabilities are sufficient to produce the component. The requirements must be met from a technical point of view and about the production capacity and industrialisation of the process. The technical review aims to highlight any changes to the design documents made by the carmaker's engineers to facilitate the supplier's production, increase performance through supplier knowledge and reduce costs.
Any concerns of the supplier must be resolved during this phase. If the supplier is to produce a product redesign, the customer must provide them with all the lessons learned from its production history.
Different issues are discussed during these meetings. All the design requirements and interpretation of the drawings from the supplier side must be covered. Packaging requirements (including quantities per box) are set and must align with the customer's quantity requirements. All manufacturing processes and tools used in the methods are analysed. Each machine corresponds to a different investment, and, in the following negotiation phase, the customer will choose the investment to make. The inspection processes that will be analysed during the APQP are chosen. The guidelines for the PPAP (Production Part Approval Process), the process used to obtain approval of component suppliers and their production processes, are decided. At the end of the Technical Review, the strengths and weaknesses of each supplier are evaluated. If necessary, it is defined any improvement actions that the supplier must share before the end of sourcing. The buyer must maintain good supplier management by continually reviewing individual suppliers to ensure they can meet the long-term needs of the end customer.

During this phase, the carmaker uses a checklist with technical questions to monitor the supplier's current situation and competencies. The supplier must answer these questions, and the carmaker notes the current status. Also within this document is a table that identifies the risk status for each question asked. Red identifies a risk that needs an inpatient action. There is a medium risk in yellow for which a recovery action is marked, but there is no impact on the next milestone and the result. In green, on the other hand, there is no risk and hence no recovery action.
At the end of the Technical Review, the client chooses the strengths and weaknesses of each supplier. In an internal meeting, any actions to improve the supplier are assessed to meet the requirements fully. These actions must be shared with the supplier before the sourcing process.

4.5 TKO and nomination letter

Following the technical review, the target setting phase is addressed, where the client analyses variable costs, tool investments, and cost targets. Then follows the negotiation phase, where the supplier has to propose the best offer (maintaining maximum profits for its interests). The vendor search process concludes with the *Recommendation*, which is the client's final selection with a *Nomination Letter*. This document is the proof of the agreement between the client and the supplier, with the economic terms and the various requirements to be met. Once the customer has signed the contract with the supplier, they will have to rely on them to develop that component (unless other suppliers are producing the same part). Some technical changes to the product and the economic terms are possible. For this reason, ODM (Ordine Di Modifica) are created where the buyer's new requirements are formalised.
The mathematical models and the 3D drawings of the component with the moulding specifications (references, fin holes and radii) are entirely released. This step is called CAD STEP 3. Finally, a higher level of detail is reached in STEP CAD 5, where 2D drawings and specific tolerances are frozen.
Tooling Kick-Off (TKO), or tooling deliberation, occurs mainly at this stage. The automotive manufacturer tries to anticipate this phase as much as possible, sometimes even with the nomination letter. This milestone authorises suppliers to begin developing and constructing machinery and moulds.
As soon as the machinery is ready to produce, the first product samples are produced, which will be used to fine-tune the production process. In addition,

once production is reached with the final moulds (Off Tool), the components can be used for the first physical tests. These include safety, stress resistance and functional tests. Afterwards, the Technical Validation is carried out, verifying the conformity of the component and the application on the prototype vehicle, the feasibility analysis is done, and the final tooling modifications are made with the measurements made on the prototypes.

4.6 VP and Pre-Series

Following the Off Tool, it proceeds with the Validation Process (VP). This involves the study of the workstation, considering the position of containers and tools, the sequence of movements, and the worker's ergonomics. It is also necessary to study all the operations, formalising all the details for the manufacture of each component and the sequence/timing needed (known as *operation tag*).
After that, product reliability tests are finalised to obtain product validation. Finally, the final product is used to perform the homologation tests required to sell the product. The Pre-Series production phase ends with the JOB1 milestone.

4.7 SOP and JOB1

The Start of Production (SOP), also known as JOB1, is the milestone that marks the entry into the Ramp-Up phase. In this phase, the supplier produces consistently to meet customer demands. Initially, vehicles destined for motor shows and press/media are produced, after which production gradually reaches its rated capacity with vehicles destined for the end consumer.
In the Ramp-Up phase, vehicles' production grows gradually to identify possible residual risks and decide on the necessary corrective actions to solve the problems. It is challenging for the manufacturer to respect delivery dates and market launches, especially when the absence of raw materials and semiconductors slows down the supply chain.

4.8 Final considerations

The analysis of this sales plan was essential for developing the thesis work. Understanding the succession of all the processes is extremely important to see the client's approach to this new industry. In addition to market analysis and strategic analysis, it is necessary to have concrete feedback with the client to truly understand their strategy for the future in terms of electrification. Reporting all the tricks and problems for this battery cooling plate sales process was valuable to define a future strategy following the continuous improvement.

The customer Maserati showed a great interest in the production process technology, especially for the inflation technique. Corrective actions of the Mubea proposal have been defined to minimise the weight and optimise the cost. Correct annotating the changes provided a solid foundation for being more competitive in future projects.

The study of the battery cooling plate results has allowed further considerations on the level of detail and customer requirements for this new generation of components. It will be necessary to maintain a very high level of technology trying to find simple but effective solutions that will allow low costs and, above all, low weight. These considerations apply to the plate and other components that make up the battery cooling system. Further advice for the future is to sell a complete product (closed box) to cool batteries and motors of EVs. All components will have to talk to each other and send data to the intelligent control centre of the car. This will allow all elements to be varied depending on vehicle setup and optimise component life and performance.

Chapter 5

The environmental crisis

After analysing the market trends and studying the various strategies frameworks for electrification, it is essential to understand why this scenario will happen. Underlying this is a great moral purpose, according to which the European Union decided to allocate limits and laws that could regulate vehicle pollution.
The sanctioned regulations would erode the big car manufacturers. First, the OEMs' internal emissions are challenged, after which the ultimate goal is to eliminate carbon emissions throughout a product's value chain, both upstream and downstream. That means both the suppliers, with all tiers in succession, and the retailer and end consumer side. Electric vehicles allow for energy with no carbon footprint (if renewable energy is used), enabling the end consumer to be carbon neutral. This explains why OEMs are choosing this solution for the future.
On July 29, 2021, the European Climate Act (EEC/EU Regulation No. 1119 of June 30, 2021) came into force, setting the binding goal of the Union's climate neutrality by 2050, containing global warming within the 1.5° threshold, as also provided for in the 2015 Paris Agreements. Reducing greenhouse gas (GHG) emissions by 2030, from 40% to at least 55%, compared to 1990 levels. The climate requirements imposed by the EU link to the GHG (Green House Gas) emission Protocol, which is divided into three purposes:

- Scope 1: it asks to calculate all direct emissions of the company, i.e., those resulting from the use of fuels for energy production, for company vehicles, for the production process, in addition to those resulting from the use of chemicals for production processes and other so-called "fugitive" emissions, such as leaks from mechanical equipment or methane emissions from organic deposits.

- Scope 2: emissions are calculated from purchased electricity or steam, hot or cold carrier fluids. These energy sources produce indirect emissions, as their physical production occurs outside the company and is not under its control.

- Scope 3: requires the calculation of indirect emissions due to the use of energy for the production of products and materials purchased externally, fuels for non-company vehicles (transport of materials, finished products or products to be processed, waste, employee commuting home/work, services) and fuels for company travel (planes, trains, etc.).

All of these three scopes must be carbon net-zero by 2050. Beware, however, that some automakers want to meet these goals early, trying to neutralise scope 3, 20 years in advance. As time goes on, the penalties that OEMs will have to pay based on the emissions of their vehicles or even stop their vehicle production will become more severe. In the decade between 2015 and 2025, some regulatory requirements such as Corporate Average Fuel Efficiency (CAFE) have been shared globally. For example, limits in Europe are 95 g/km of CO_2 for 100% of the average fleet sold. If they are not met, the OEM will have to pay 240 million euros for 1 g/km of CO_2 that exceeds the limit.
Analysing the current condition of competitors and OEMs can help the company have a clear picture of where to develop the right strategy. If the company, as a supplier, does not comply with an OEM's plan in terms of pollution, it will no longer be able to supply components. So, it is essential to include these studies within the future scenarios and the company's strategy on future projects.

5.1 Carbon neutrality and climate positive

To truly understand all the new regulations related to pollution and carbon footprint, it is necessary to dwell on their definitions.

Carbon neutral

Defining something as "carbon neutral" means that CO_2 emissions, i.e., the carbon emitted by a given activity, are effectively "cancelled out." This is achieved by balancing carbon emissions with techniques such as offsetting. Offsetting CO_2 emissions means using carbon credits generated by projects with a positive impact to reduce or neutralise the effect caused by one's activities. Each credit certified according to the most critical and recognised international standards (Gold Standard, VCS) certifies reducing (or removing) one tons of CO_2 equivalent from the atmosphere.

For example, one way to avoid an emissions reduction is to pay someone not to cut down trees on land they own. This is a good thing, but it effectively pays someone not to do something that would negatively impact. It doesn't lead to planting more trees that would positively impact removing carbon. Carbon neutrality requires that Scope 1 and 2 of the GHG protocol be met. Scope 3 is encouraged but not mandatory.

Net-Zero Emissions

Achieving "net zero emissions" means that any carbon dioxide released into the atmosphere by a company's activities is offset by an equivalent amount removed. According to the Intergovernmental Panel on Climate Change (IPCC), limiting global temperature rise to 1.5°C above pre-industrial levels requires that global net greenhouse gas (GHG) emissions reach net zero around 2050, meaning no additional emissions are added to the atmosphere.
The name "net zero" means that a company removes as much carbon as it emits. The term is "net-zero" and not simply "zero" because there are still carbon emissions, but these are equal to carbon removal.
In this case, being net-zero emission means satisfy Scope 1-2-3

Climate Positive or Carbon Negative

Being climate positive (or carbon-negative) is an additional step. It means that an initiative can neutralise the associated carbon emissions and take steps to ensure that the project removes extra carbon dioxide from the atmosphere.

5.2 OEM strategy and requirements

Analysing OEMs' electric vehicle strategy is essential for two reasons. The first relates to creating specific offerings for specific automaker models. Making a correct forecast could allow for early development and a distinct advantage over competitors. As a result, profits will also be positively affected. The second reason concerns the ability to continue supplying OEMs. This is because, as a result of the Paris Agreements and the GHG Protocol, automakers will have to become carbon neutral across the entire value chain, so they will require suppliers to eliminate their carbon footprint. If this does not happen, the suppliers' emission data will affect Scope 3 upstream in the component value chain, and the OEM will not meet the EU requirements. For marketing or simply competition, automotive brands are trying to anticipate their carbon neutral transformation from 2050. If

the suppliers don't comply with the OEM's strategic plan to reduce emissions, they won't continue supplying components to the OEM.
Mubea decided to carefully analyse and not underestimate all OEM requests, even the most ambitious ones. The analysis conducted aimed to report the timelines of all the company's customers and carefully analyse the suppliers' requirements in terms of emissions. To simplify the discussion, only the analysis results will be discussed. The job was to report all customer requests within an Excel spreadsheet and, depending on the proposals to suppliers and the date for carbon neutrality. It was possible to associate all OEMs to a risk index. Following heavy investment in recent years, Porsche aims to convert 50% of its fleet to electric vehicles by 2025. By 2030, the company will become carbon neutral, the first compared to other Mubea customers. Porsche requires its battery suppliers to use only renewable energy, significantly reducing emissions. In addition, the manufacturer requires the completion of the Excel file "Fragebogen Dekarbonisierungs- u. Strategieziele_PM", where the supplier declares all its emissions.
Stellantis, is the second to anticipate carbon net-zero, setting a target of 2038. In addition, it will reduce carbon emissions by 50% by 2030, compared to 2021 metrics. Five million BEVs in 2030, reaching 100% of the BEV sales mix of passenger cars in Europe and 50% of passenger cars and light vehicles in the U.S. Daimler, a company that includes several manufacturers, including Mercedes-Benz, is the third to anticipate carbon neutrality. By 2030, 50% of vehicles sold will be plug-in hybrids or electric cars. Mercedes-Benz plants in Germany will operate CO_2 neutral from 2022. By 2039 Daimler will be carbon neutral. All products supplied by suppliers from 01/01/2039 will be produced in a CO_2 -neutral manner at all stages of the value chain. This includes production at all supplier locations and the supplier's upstream supply chain. Daimler requires the latest version of the self-assessment questionnaire (SAQ) and a sustainability declaration file to be completed. Volvo Group declares carbon neutrality in 2040. By 2030, the manufacturer reports an absolute reduction in CO_2 emissions to -50%, with 2019 as the baseline. There are other ambitions for Volvo.

- Reduce by 25%/car in the Volvo supply chain by 2025 using a minimum of 25% recycled material and 100% renewable energy at Tier 1.
- Reduce life cycle carbon footprint per vehicle by 40% between 2018 and 2025.
- Be a circular company by 2040 (circular economy).
- Be a recognised leader in ethical and responsible business

- 50% of vehicles produced by 2025 must be electric. 100% electric vehicles by 2030

Tier 1 suppliers must declare 100% renewable energy by 2025. In addition, they will have to have a certified quality and environmental management system (ISO9001, IATF16949 and ISO14001), meet recycled content targets, report material content to the International Material Data System (IMDS) and be proactive in addressing issues and driving improvements.
All other manufacturers declare carbon neutrality by 2050 but are ambitious in their targets. Audi will be CO_2-neutral at all sites from 2025, generating a saving of 1.2 tons of CO_2 per car on average. BMW sites will be CO_2-neutral from 2021, and the company will lower CO_2 emissions from production by 80%, during the use phase by more than 40% and in the supply chain by at least 20%. By 2030, at least 50% of global sales will be generated by all-electric models, saving about 200 million tons of CO_2. Stellantis Group has not clearly defined its plans, but the former PSA claims an electrified version for 100% of models by 2025 and more than 50% of electrified vehicles sold in 2035. By 2034, PSA is committed to reducing greenhouse gas emissions from the use of products sold by 37%/km per vehicle compared to the 2018 base year. Finally, Volkswagen boasts 100% renewable energy sourcing at all European plants. Plants in Europe, North and South America, must switch to renewable energy by 2030.
There are still many gaps in the information required by vehicle manufacturers. For example, Germany recently rejected the ICE production stop imposed by 2035. Many OEMs think the targets set by the Paris Agreement are too strict and unattainable. To date, it is difficult to quantify how many OEMs will be able to meet the demands of the European climate law of net-zero emissions by 2050. OEMs that cater to a customer base with low orders and high sales numbers will aim to produce ICEs and HEVs as long as possible. It is essential to continuously monitor the current position of car manufacturers to avoid unnecessary investments and maintain their supplier position in the market.

5.3 Possible climate action

In work done for this thesis, an attempt has been made to take stock of the situation regarding innovations to become climate positive. This is still a growing area, so the various proposals are almost all being tested. There is still no certainty about the large-scale feasibility and long-term benefit, but only an estimate of costs and benefits.

The various solutions under development with their relative merits and demerits are listed below.

Forest

Expanding, restoring, and managing forests to encourage more carbon uptake can leverage the power of photosynthesis, converting carbon dioxide in the air into carbon stored in wood and soils. WRI estimates that the carbon-removal potential from forests and trees outside forests in the United States is more than half a gigaton per year. These approaches to remove CO_2 through forests can be relatively inexpensive compared to other carbon removal options (generally less than $50 per metric ton [22]) and yield cleaner water and air in the process. Reforestation must not compromise the food supply.

Farms

Building soil carbon is good for farmers and ranchers, as it can increase soil health and crop yields. Incorporating trees into farms can also remove carbon by providing other benefits, such as shade and forage for livestock. Using compost can improve profits while storing the compost's carbon content in the soil. Not widely used as the risk is greater than the return.

Bio-Energy with Carbon Capture and Storage (BECCS)

This is much more complicated than planting trees or managing land, and it doesn't always work. BECCS is the process of using biomass for energy in the industrial, energy, or transportation sectors. This captures the emissions before they are released into the atmosphere and then stores the captured carbon underground or in long-lasting products like cement [22].
But it's not always easy to determine if the conditions for using it are met. Some forms of BECCS would convert waste such as agricultural residues or garbage into fuel. These feedstocks may be critical to the future of BECCS since they would not require dedicated land use.

Direct air capture

Direct air capture is chemically scrubbing carbon dioxide directly from ambient air and then storing it underground (Carbon Capture and Storage CCS) or in long-lived products. It is similar to BECCS, but the difference is that direct air capture removes excess carbon directly from the atmosphere rather than capturing

it at the source.
It is relatively easy to measure and account for the climate benefits of direct air capture, and its potential scale of deployment is enormous. But the technology remains expensive (94-232 dollars per metric ton) and energy-intensive. Direct air capture also requires substantial heat and energy inputs (which must be "green" to result in net carbon removal). The direct air capture is still a new technology, and while it shows tremendous potential for scalability, these systems are the first of their kind and need public support to advance [22].

Carbon mineralisation

Some minerals naturally react with CO_2, transforming carbon from a gas into a solid. The process is commonly called carbon mineralisation or accelerated weathering, and it happens naturally very slowly, over hundreds or thousands of years. But scientists are trying to figure out how to speed up the process of carbon mineralisation, primarily by increasing the exposure of these minerals to CO_2 in the air or ocean [22].
This might mean pumping alkaline spring water from underground to the surface where the minerals can react with air, moving air into large deposits of mine waste that contain the suitable mineral composition, crushing or developing enzymes that chew up mineral deposits to increase their surface area.

Ocean-based concept

Each project aims to accelerate natural carbon cycles in the ocean. They could include harnessing photosynthesis in coastal plants, algae, or phytoplankton, adding certain minerals to increase dissolved bicarbonate storage, or running an electric current through seawater to help extract CO_2 [22].
Some options for removing carbon from the ocean could also provide co-benefits. For example, coastal blue carbon and algae cultivation could remove carbon while supporting ecosystem restoration and adding minerals to help the ocean store carbon could also reduce ocean acidification.

Conclusions

This thesis, developed in collaboration with Mubea, has produced results obtained from the market analysis of the automotive sector and the strategic management of the business portfolio of the company's products related to the EV sector.
The overall objective of this project was to provide concrete evidence, qualitatively and quantitatively, of Mubea's market launch of components for electrified vehicles. These analyses were applied to the entire automotive industry, with a broader view than just the company. Although Mubea has already launched some products for EVs in the market, further studies are needed to highlight key factors that could lead to a new strategy and new goals. The observation and monitoring activity is necessary to keep the strategy updated and not miss any opportunity. To achieve this goal, the work was divided into several sections.
The result of the first section, concerning the market analysis, is a detailed report with all the necessary information to reconstruct the current market situation and a prospect as truthful as possible for the future. Following the COVID-19 pandemic and the effect of the microprocessor shortage, average uncertainty in the analysis can be expected. Regrowth values from the pandemic promise a steady increase, while semiconductors impose slight predictable market variation, especially related to the availability of chips from the singular OEM. By predicting these variations in advance, the company will save inventory and production costs. The market will follow a transformation from ICEs to BEVs, or electrified vehicles anyway: this is pretty much inevitable. The bet towards EV-related components, such as all the battery cooling system components, will most likely be rewarded in the future.
Maintaining a high investment in R&D and exploiting the opportunities in this new industry will allow Mubea to survive the change and, above all, to establish itself as a leader in the market of the future. The Stellantis platform analysis showed how Jeep, Peugeot, Fiat and Citroën will be the leaders for electrified vehicles (MHEV, HEV, PHEV and BEV) in the near term by 2028. Jeep's values are promising, with over 4,200,000 cars in production from 2023 to 2028. The

platforms of particular interest in terms of production volumes per year are the STLA Medium (max of 1,520,000 units/year in 2028), the CMP (max of 1,180,000 units/year in 2026) and the STLA Large (max of 1,010,000 units/year in 2028). Respectively for each platform, the vehicles with the highest estimated 2023-2028 production are the Jeep Compass Hybrid-Full (SOP 2026) with 487,615 units, the Citroen C3 Aircross Electric (SOP 2024) with 600,691, and the Jeep Cherokee Hybrid-Full (SOP 2023) with 762,349 units.

The second chapter of this thesis discusses strategic component management for electrified vehicles. Applying frameworks to the company's internal and external environment identified several driving forces. As anticipated, the analyses performed are to be interpreted as supporting a strategic development set by the board and have no intention of replacing this. Each tool analysed in this section confirmed the analyses previously conducted and added some details derived from changes in the current post-pandemic condition. Future strategies conducted at the marketing and sales level can use these analyses to understand the market condition better.

In the third chapter, the Maserati customer's battery cooling plate sales process was explained. After an introduction on the customer and the possible suppliers, the phases encountered during the tender for the supply of this component were detailed. In addition to completeness in the analysis of the battery cooling system, the main objective was to report all possible problems encountered during these phases, maintaining a logic of continuous improvement. Suppose it was possible to make general forecasts on the component with the market analysis and strategic management tools, with direct contact with the customer, it is possible to determine the satisfaction of customer requirements in detail. The key points found by these analyses have been clarified and included in the proposals for new projects.

In the last section, the stringent regulations related to emissions and environmental impact were analysed. The objective was to derive helpful information for the company to understand the current condition and study a strategy to cope with the demands imposed by the government. The analysis produced a positive result, allowing the company to develop solid knowledge. In addition, improvement solutions were proposed to reduce the carbon footprint, and their feasibility was assessed. The analysis conducted on the OEMs' requests allowed Mubea to understand how urgently action is needed to avoid losing the opportunity to supply the customer. The highest risk is related to Porsche, which, given its massive investment towards electrification, wants to achieve carbon neutrality already by 2030. After that, there are Stellantis (2038), Daimler (2039) and

Volvo (2040). Next, the feasibility of OEM requests related to emissions was also assessed. As a result of this research, the analysis will likely need to follow future updates. Market trends and changes due to disruptive technology require constant improvement in researching data and proposing new strategies to remain competitive in the marketplace. One of the most important points is to stay up-to-date on the current market condition. To do this, you can use reports from consulting companies that, through quantitative industry studies, obtain strategically important results to develop future scenarios. In addition, it is very important to maintain direct contact with the client, try to understand their intentions for future projects and not miss any opportunities. To win and stay competitive, companies should not underestimate the environmental impact. On the contrary, they should consider it the main objective to be achieved by 2050 to remain competitive. Finally, this analysis could also be carried out for industries in the embryonic stage, such as the new electric mobility (scooters, e-bikes etc. ..), to understand what opportunities could be proposed and quantify the profits.

Appendix A

Estimated production of Stellantis cars

Table A represents the estimated production of Stellantis group cars with SOP 2023. The time frame analysed is between 2023 and 2028.
The last column shows an index indicating the production level of a certain vehicle.

- index 1: sales $> 300{,}000$
- index 2: $100{,}000 <$ sales $< 300{,}000$
- index 3: sales $< 100{,}000$

It is essential to clarify that ICE vehicles are not considered, nor are EV with SOP before 2023. This selection was decided in agreement with the company for strategic reasons.

Table A.1: Estimated production of Stellantis cars

Production Brand	**Model** Nameplate	**Modular Platform**	**Propulsion** System	**SOP**	**EOP**	**Production Volume**	**index**
Jeep	Cherokee	STLA Large	Hybrid-Full	2023-09	2029-08	762349	1
Fiat	500X	CMP	Hybrid-Mild	2023-04	2030-09	517103	1
Peugeot	3008	STLA Medium	Hybrid-Mild	2023-11	2030-12	461492	1
Citroen	C3	CMP	Electric	2023-08	2030-09	420271	1
Peugeot	3008	STLA Medium	Hybrid-Full	2023-11	2030-12	412680	1
Jeep	D-SUV EV	STLA Large	Electric	2023-11	2029-10	310733	1
Ram	1500 EV	STLA Frame	Electric	2024-07	2030-06	387564	1
Fiat	Panda	CMP	Hybrid-Mild	2024-08	2031-06	365031	1
Jeep	B-SUV EV	CMP	Electric	2024-04	2031-03	337233	1
Jeep	Renegade	CMP	Hybrid-Mild	2025-01	2031-12	521349	1
Jeep	Compass	STLA Medium	Hybrid-Full	2025-01	2031-12	356863	1
Peugeot	2008	STLA Small	Electric	2026-07	2033-06	371108	1
Opel	Corsa	STLA Small	Electric	2026-07	2033-06	369800	1
Peugeot	208	STLA Small	Electric	2026-04	2033-03	336568	1

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Jeep	Grand Cherokee	STLA Large	Hybrid-Mild	2027-03	2033-07	425055	1
Ram	1500	STLA Frame	Hybrid-Mild	2027-01	2035-12	305532	1
Citroen	C3	CMP	Hybrid-Mild	2023-08	2030-09	290299	2
Peugeot	208	STLA Small	Electric	2023-10	2026-03	265960	2
Opel	Crossland	CMP	Hybrid-Mild	2023-11	2030-12	232166	2
Fiat	500X	CMP	Electric	2023-04	2030-09	201250	2
Dodge	Charger	STLA Large	Hybrid-Full	2023-12	2030-11	182681	2
Peugeot	3008	STLA Medium	Electric	2023-11	2030-12	140478	2
Dodge	Charger	STLA Large	Electric	2023-12	2030-11	109353	2
Citroen	C5 Aircross	STLA Medium	Hybrid-Full	2024-07	2031-09	256997	2
Citroen	C5 Aircross	STLA Medium	Hybrid-Mild	2024-07	2031-09	219839	2
Citroen	C3 Aircross	CMP	Hybrid-Mild	2024-05	2031-03	201986	2
Ram	D-Pickup	STLA Large	Hybrid-Mild	2024-03	2030-02	193842	2
Peugeot	5008	STLA Medium	Hybrid-Full	2024-10	2031-09	183418	2
Opel	Grandland	STLA Medium	Hybrid-Mild	2024-07	2031-06	169354	2

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Citroen	C3 Aircross	CMP	Electric	2024-05	2031-03	161886	2
Opel	Grandland	STLA Medium	Hybrid-Full	2024-07	2031-06	160060	2
Peugeot	5008	STLA Medium	Hybrid-Mild	2024-10	2031-09	138786	2
Alfa Romeo	B-CUV	CMP	Hybrid-Mild	2024-01	2030-12	134556	2
Opel	Grandland	STLA Medium	Electric	2024-07	2031-06	129754	2
Ram	D-Pickup	STLA Large	Electric	2024-03	2030-02	129228	2
Lancia	Ypsilon	CMP	Hybrid-Mild	2024-12	2033-03	119219	2
Alfa Romeo	B-CUV	CMP	Electric	2024-01	2030-12	106082	2
Dodge	D-CUV	STLA Large	Hybrid-Full	2025-03	2031-02	207846	2
Fiat	C-CUV	CMP	Hybrid-Mild	2025-07	2033-03	183870	2
Jeep	Renegade	CMP	Electric	2025-01	2031-12	152992	2
Alfa Romeo	Stelvio	STLA Large	Electric	2025-10	2032-09	124937	2
Dongfeng	Yixuan GS	CMP	Hybrid-Full	2025-06	2031-05	113864	2
Jeep	Compass	STLA Medium	Hybrid-Mild	2025-07	2032-06	103343	2
Chrysler	Pacifica EV	STLA Large	Electric	2026-01	2031-12	181377	2

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Fiat	500	STLA Small	Electric	2027-04	2034-09	204064	2
Jeep	Wrangler	STLA Frame	Hybrid-Mild	2027-11	2037-10	135955	2
Jeep	Grand Cherokee	STLA Large	Hybrid-Full	2027-03	2033-07	120202	2
Jeep	Grand Cherokee	STLA Large	Electric	2027-03	2033-07	106003	2
Fiat	Ducato	X2(2)	Hybrid-Mild	2028-01	2040-12	147394	2
Fiat	Doblo	STLA Medium	Hybrid-Mild	2028-01	2036-12	110827	2
Opel	Crossland	CMP	Electric	2023-11	2030-12	93121	3
Fiat	Doblo	STLA Medium	Hybrid-Mild	2023-04	2027-12	85491	3
Peugeot	408	EMP2	Hybrid-Mild	2023-01	2030-02	51589	3
Citroen	C-Elysee	CMP	Hybrid-Mild	2023-04	2030-03	40901	3
Fiat	Doblo	STLA Medium	Electric	2023-01	2028-03	30896	3
Jeep	B-CUV	CMP	Hybrid-Mild	2023-01	2029-12	22058	3
Citroen	C4 Aircross	CMP	Hybrid-Mild	2023-07	2029-12	12945	3
Toyota	ProAce	K0	Hybrid-Mild	2023-03	2029-12	9887	3
Maserati	Quattroporte	STLA Large	Hybrid-Full	2023-12	2031-12	6811	3

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Maserati	Quattroporte	STLA Large	Hybrid-Mild	2023-12	2031-12	6564	3
Fiat	Scudo	K0	Hybrid-Mild	2023-02	2029-12	5064	3
Maserati	Quattroporte	STLA Large	Electric	2023-12	2031-12	4349	3
Maserati	GranCabrio	MASERATI Spaceframe	Electric	2023-04	2030-06	4285	3
Peugeot	1008	CMP	Electric	2023-10	2030-09	1532	3
Fiat	Panda	CMP	Electric	2024-08	2031-06	91846	3
Citroen	C5 Aircross	STLA Medium	Electric	2024-07	2031-09	68228	3
Peugeot	5008	STLA Medium	Electric	2024-10	2031-09	49739	3
Chrysler	E-CUV	STLA Large	Hybrid-Full	2024-08	2031-07	39556	3
Jeep	Cherokee	STLA Large	Hybrid-Mild	2024-03	2030-02	39316	3
Lancia	Ypsilon	CMP	Electric	2024-12	2033-03	31023	3
Maserati	Levante	STLA Large	Hybrid-Full	2024-04	2031-12	27330	3
Maserati	Levante	STLA Large	Electric	2024-04	2031-12	25770	3
Maserati	Levante	STLA Large	Hybrid-Mild	2024-04	2031-12	19913	3
Citroen	C3L	EMP2	Hybrid-Mild	2024-09	2030-08	19213	3

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Jeep	Grand Commander	STLA Medium	Hybrid-Mild	2024-12	2029-11	16057	3
Jeep	Cherokee	STLA Large	Electric	2024-03	2030-02	10804	3
Peugeot	3008	STLA Medium	Hybrid-Mild	2024-07	2031-06	8024	3
Jeep	Grand Commander	STLA Medium	Electric	2024-12	2029-11	7165	3
Jeep	Grand Commander	STLA Medium	Hybrid-Full	2024-12	2029-11	6159	3
Peugeot	3008	STLA Medium	Hybrid-Mild	2024-07	2031-06	5715	3
Dodge	D-CUV	STLA Large	Electric	2025-03	2031-02	93736	3
Jeep	Compass	STLA Medium	Hybrid-Full	2025-07	2032-06	91805	3
Opel	Manta	STLA Medium	Electric	2025-04	2032-06	87495	3
Alfa Romeo	Giulia	STLA Large	Electric	2025-04	2031-09	86726	3
DS	DS7 Crossback	STLA Medium	Electric	2025-07	2032-06	80962	3
Jeep	Compass	STLA Medium	Electric	2025-01	2031-12	80947	3
Fiat	Egea	CMP	Hybrid-Mild	2025-10	2032-09	69605	3
Fiat	C-CUV	CMP	Electric	2025-07	2033-03	65974	3
Chrysler	Airflow	STLA Large	Electric	2025-01	2030-12	63466	3

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Jeep	Compass	STLA Medium	Electric	2025-07	2032-06	47453	3
Chrysler	D-Sedan EV	STLA Large	Electric	2025-03	2031-02	44831	3
Citroen	C5 Aircross	STLA Medium	Hybrid-Mild	2025-07	2032-03	44358	3
DS	DS9 Crossback	STLA Medium	Electric	2025-01	2031-09	33942	3
Peugeot	5008	STLA Medium	Hybrid-Mild	2025-04	2032-03	32570	3
Dongfeng	Yixuan	CMP	Electric	2025-04	2031-03	27621	3
Jeep	Compass	STLA Medium	Hybrid-Full	2025-07	2032-06	24267	3
Jeep	Renegade	CMP	Hybrid-Mild	2025-04	2032-03	18433	3
Fiat	Egea	CMP	Electric	2025-10	2032-09	12339	3
Jeep	Renegade	CMP	Hybrid-Mild	2025-07	2032-06	10552	3
Citroen	C5 Aircross	STLA Medium	Hybrid-Full	2025-07	2032-03	10313	3
Jeep	Renegade	CMP	Hybrid-Mild	2025-07	2032-06	9917	3
Peugeot	5008	STLA Medium	Hybrid-Full	2025-04	2032-03	8339	3
Jeep	Renegade	CMP	Electric	2025-01	2031-12	7822	3
Peugeot	5008	STLA Medium	Hybrid-Mild	2025-01	2031-12	7096	3

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Citroen	C5 Aircross	STLA Medium	Hybrid-Mild	2025-01	2032-09	4793	3
Peugeot	5008	STLA Medium	Hybrid-Mild	2025-01	2031-12	2221	3
Citroen	C3 Aircross	CMP	Hybrid-Mild	2025-01	2031-09	1890	3
Peugeot	Partner	STLA Medium	Electric	2025-07	2036-06	1597	3
Citroen	C5 Aircross	STLA Medium	Hybrid-Mild	2025-01	2032-09	1471	3
Citroen	Berlingo	STLA Medium	Electric	2025-07	2036-06	1287	3
Fiat	Doblo	STLA Medium	Electric	2025-07	2036-06	683	3
Peugeot	6008	STLA Large	Electric	2026-04	2033-03	90725	3
Jeep	Compass	STLA Medium	Hybrid-Mild	2026-01	2032-12	65855	3
DS	DS3 Crossback	STLA Small	Electric	2026-10	2033-09	63633	3
Jeep	Commander	STLA Medium	Hybrid-Mild	2026-01	2031-03	26829	3
Lancia	C-CUV EV	STLA Medium	Electric	2026-07	2032-06	22612	3
Citroen	C3	CMP	Hybrid-Mild	2026-07	2031-12	21321	3
Jeep	Commander	STLA Medium	Hybrid-Full	2026-01	2032-12	19342	3
Citroen	C3	CMP	Electric	2026-07	2031-12	17603	3

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Jeep	Compass	STLA Medium	Electric	2026-01	2032-12	17324	3
Jeep	Compass	STLA Medium	Hybrid-Full	2026-01	2032-12	14680	3
Jeep	Commander	STLA Medium	Hybrid-Full	2026-01	2031-03	7084	3
Ram	1500	STLA Frame	Hybrid-Full	2027-01	2035-12	96115	3
Jeep	Wagoneer	STLA Frame	Hybrid-Mild	2027-06	2033-05	91090	3
Alfa Romeo	Giulietta	STLA Medium	Electric	2027-04	2034-12	81421	3
Jeep	Wrangler	STLA Frame	Electric	2027-11	2037-10	80993	3
Jeep	Wrangler	STLA Frame	Hybrid-Full	2027-11	2037-10	72316	3
Alfa Romeo	Tonale	STLA Medium	Electric	2027-10	2033-12	64021	3
DS	DS6 Crossback	STLA Medium	Electric	2027-01	2033-12	50894	3
Jeep	Wagoneer	STLA Frame	Electric	2027-06	2033-05	42632	3
Jeep	Wagoneer	STLA Frame	Hybrid-Full	2027-06	2033-05	18532	3
Peugeot	2008	STLA Small	Electric	2027-07	2034-06	6496	3
Jeep	B-CUV	CMP	Electric	2027-09	2035-08	3322	3
Jeep	Grand Cherokee	STLA Large	Hybrid-Mild	2027-07	2033-12	837	3

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Jeep	Grand Cherokee	STLA Large	Hybrid-Full	2027-07	2033-12	236	3
Citroen	Berlingo	STLA Medium	Hybrid-Mild	2028-01	2036-12	91525	3
Peugeot	Partner	STLA Medium	Hybrid-Mild	2028-01	2036-12	88378	3
Opel	Mokka	STLA Small	Electric	2028-04	2035-03	70307	3
Peugeot	Boxer	X2(2)	Hybrid-Mild	2028-01	2040-12	36553	3
Citroen	Jumper	X2(2)	Hybrid-Mild	2028-01	2040-12	36235	3
Toyota	ProAce City	STLA Medium	Hybrid-Mild	2028-01	2036-12	34074	3
Citroen	C4	STLA Small	Electric	2028-07	2036-06	34035	3
Opel	Combo	STLA Medium	Hybrid-Mild	2028-01	2036-12	31912	3
Peugeot	Partner	STLA Medium	Electric	2028-04	2036-12	30066	3
Citroen	Berlingo	STLA Medium	Electric	2028-04	2036-12	29473	3
Citroen	Jumper	X2(2)	Hybrid-Mild	2028-01	2040-12	29392	3
Lancia	Delta	STLA Medium	Electric	2028-04	2035-03	27043	3
Peugeot	308	STLA Medium	Electric	2028-10	2035-12	26807	3
Peugeot	Boxer	X2(2)	Hybrid-Mild	2028-01	2040-12	26119	3

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Peugeot	Partner	STLA Medium	Electric	2028-01	2036-12	22094	3
Peugeot	Partner	STLA Medium	Hybrid-Mild	2028-01	2036-12	20954	3
Citroen	Berlingo	STLA Medium	Hybrid-Mild	2028-01	2036-12	19710	3
Opel	Movano	X2(2)	Hybrid-Mild	2028-01	2040-12	16975	3
Fiat	Doblo	STLA Medium	Electric	2028-01	2036-12	16560	3
Opel	Combo	STLA Medium	Electric	2028-04	2036-12	15836	3
Ram	ProMaster	X2(2)	Electric	2028-01	2040-12	14504	3
Citroen	Berlingo	STLA Medium	Electric	2028-01	2036-12	13676	3
Opel	Movano	X2(2)	Hybrid-Mild	2028-01	2040-12	11233	3
Fiat	Ducato	X2(2)	Electric	2028-01	2040-12	11215	3
Jeep	Gladiator	STLA Frame	Hybrid-Mild	2028-11	2038-10	10650	3
Toyota	ProAce City	STLA Medium	Electric	2028-01	2036-12	9056	3
DS	DS4	STLA Medium	Electric	2028-07	2035-12	7933	3
Fiat	Ducato	X2(2)	Hybrid-Mild	2028-01	2040-12	6296	3
Opel	Combo	STLA Medium	Hybrid-Mild	2028-01	2036-12	5310	3

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Opel	Combo	STLA Medium	Electric	2028-01	2036-12	4768	3
Fiat	Doblo	STLA Medium	Electric	2028-04	2036-12	4498	3
Peugeot	Partner	STLA Medium	Electric	2028-01	2036-12	3130	3
Citroen	Berlingo	STLA Medium	Electric	2028-01	2036-12	2945	3
Peugeot	Boxer	X2(2)	Electric	2028-01	2040-12	2782	3
Citroen	Jumper	X2(2)	Electric	2028-01	2040-12	2758	3
Jeep	Gladiator	STLA Frame	Electric	2028-11	2038-10	2662	3
Citroen	C5 X	STLA Medium	Hybrid-Mild	2028-10	2035-09	2266	3
Citroen	Jumper	X2(2)	Electric	2028-01	2040-12	2237	3
Peugeot	Boxer	X2(2)	Electric	2028-01	2040-12	1988	3
Citroen	C5 X	STLA Medium	Hybrid-Full	2028-10	2035-09	1510	3
Opel	Movano	X2(2)	Electric	2028-01	2040-12	1292	3
Peugeot	Boxer	X2(2)	Hybrid-Mild	2028-01	2040-12	1111	3
Peugeot	Boxer	X2(2)	Hybrid-Mild	2028-01	2040-12	1105	3
Jeep	Grand Cherokee	STLA Large	Hybrid-Mild	2028-02	2034-01	1060	3

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Fiat	Pulse	CMP	Electric	2028-09	2035-12	1057	3
Citroen	C3	CMP	Electric	2028-09	2035-12	931	3
Peugeot	208	STLA Small	Electric	2028-07	2036-06	894	3
Opel	Movano	X2(2)	Electric	2028-01	2040-12	854	3
Opel	Combo	STLA Medium	Electric	2028-01	2036-12	792	3
Peugeot	2008	STLA Small	Electric	2028-01	2034-12	615	3
Citroen	Jumper	X2(2)	Hybrid-Mild	2028-01	2040-12	516	3
Peugeot	2008	STLA Small	Electric	2028-01	2034-12	483	3
Fiat	Ducato	X2(2)	Electric	2028-01	2040-12	480	3
Opel	Movano	X2(2)	Hybrid-Mild	2028-01	2040-12	414	3
Opel	Movano	X2(2)	Hybrid-Mild	2028-01	2040-12	202	3
Citroen	Jumper	X2(2)	Hybrid-Mild	2028-01	2040-12	156	3
Peugeot	Boxer	X2(2)	Electric	2028-01	2040-12	86	3

Table A.1: Estimated production of Stellantis cars

Appendix B

Graphical representation of strategic frameworks

This section has been created to include some graphic representations within which the results of the strategic frameworks are entered. The PESTEL and Porter Five Forces frameworks are analysed in detail.

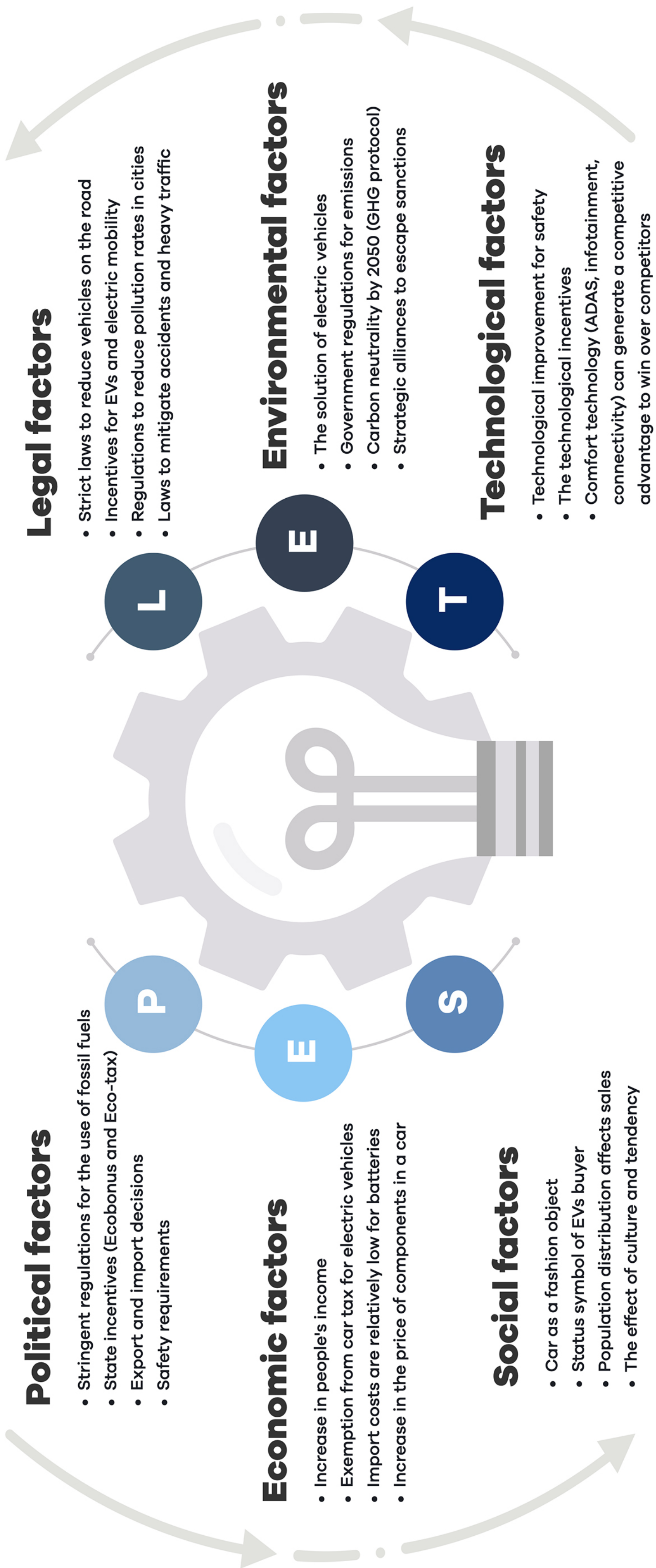

Figure B.1: PESTEL analysis for NPB

Figure B.2: Porter Five Forces analysis for NBP

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"Siamo scintille, siamo dinamite. Non hai ancora visto niente, il meglio deve venire"

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