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**Analysis of 5 automotive companies: how the financial markets are
responding to a rapidly evolving sector**

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Introduction

"If you go back a few hundred years, what we take for granted today would seem like magic-being able to talk to people over long distances, to transmit images, flying, accessing vast amounts of data like an oracle. These are all things that would have been considered magic a few hundred years ago"¹. Thus saith Elon Musk a few years ago, effectively summarizing an absolute truth, the protagonist of any historical period: the irrepressible, more or less constant, inexorable advance of technological innovation in any industrial sector. Our ancestors could not have even imagined what we take for granted today, and what will the future hold for us?

Technology has become part of our everyday lives, making it indispensable. If we think about the last fifty years it is noteworthy to highlight the birth of Arpanet, which took place in 1969 in the U.S. for military use. With the development of the Internet, the personal computer (PC) and the smartphone in a second time, Arpanet has heavily revolutionized the world of communication and information. If we project ourselves into the future, it is clear that the rise of 5G technology and its effects will produce several benefits: a higher data transmission speed, the significant reduction of latency times, the resolution of many technical issues and finally the ability to simultaneously connect a much higher number of users and devices compared to the current 4G technology. We can therefore expect great and unpredictable future developments in terms of automation, robotics, development of artificial intelligence, clouding, etc. The power of innovation is so strong that, if properly directed, it can achieve unthinkable results and open up countless opportunities for the world. The recent European Recovery Plan developed by the EU, the reform of the European Stability Mechanism (ESM), together with other indications that point in the same direction, lead us to believe that in the future health, innovation and the environment will be the focus of great attention and considerable investment.

Each company of any production sector will have to equip itself with a dynamic and flexible organization in order to successfully navigate in a competitive market, characterized by large, sudden and continuous changes. What can be the possible outcomes of the development of these drivers in the Automotive sector? How is the market responding to this change that is already underway?

In particular, in the sector in consideration, I will focus on sustainable innovation (sustainability).

Innovation is a key word for the development of companies in any sector, essential for creating competitive advantage, which now goes hand in hand with digitalization. The latter is now vital in a society that has made the web its fundamental pillar, as well as a useful platform for growth. Environmental sustainability has now become mandatory for all companies, especially in the automotive sector, considering that, as reported by the European Parliament², transport is responsible for 30% of total CO₂ emissions in Europe, 72% of which are caused by road transportation. These drivers are considered fundamental for the future of all companies and the planet, in fact, after the outbreak of the Coronavirus in the world, the EU has decided to allocate 750 billion

¹<https://www.forbes.com/sites/hannahelliott/2012/03/26/at-home-with-elon-musk-the-soon-to-be-bachelor-billionaire/?sh=66bd9f26729b>

² <https://www.europarl.europa.eu/news/en/headlines/society/20190313STO31218/co2-emissions-from-cars-facts-and-figures-infographics>

euros to repair the economic and social damage caused by the pandemic in the countries of the European Union. More than 50% of the money allocated will be used to help countries support the vital and inevitable digital and ecological transition³.

In the first chapter of this work, the aim is to make an historical excursus of the Automotive sector, trying to analyze the birth and development of one of the sectors that influence the GDP of each country the most. Starting from the primordial phase of the sector, it will come to the present with a focus on the latest innovations.

The second chapter will have the objective of analyzing at the financial level five of the largest companies in the world by market capitalization: Tesla, Toyota, Volkswagen, General Motors, Daimler. The financial analysis will be structured, for each individual company, on three levels:

- economic and financial evaluation, in order to study the performance of companies reading their balance sheets,
- valuation of the companies on stock markets, understanding how the latter perceives and evaluates the firms,
- identification of strategic directions trying to analyze and understand, through their business plans, industrial and commercial alliances and investment policies.

At the end of this analysis, carried out individually, the data of the five companies taken into consideration will be compared in order to have an overall picture in which it is possible to analyze similarities and differences in data and strategies implemented.

The aim of the last chapter of the document is to analyze and explain the differences established in the second, trying to understand the directionality of the market.

How will customer needs and the characteristics of the automobile product evolve? What will be the critical success factors in the automotive industry of the future? What strategies will be successful?

³ https://ec.europa.eu/info/strategy/recovery-plan-europe_en

Chapter 1: History of Automotive sector

1.1 Historical background: from birth to present⁴

The automotive sector includes all those companies involved in the design, development, production, marketing and sale of motor vehicles suitable for transporting people and goods by road.

The first attempts to build road vehicles with mechanical traction, i.e. activated by an engine installed on board and equipped with mechanical components useful to transmit the movement of one or more wheels, did not achieve convincing and concrete results due to the inadequacy of existing engines. With the construction of the first steam engines, the military engineer N.J. Cugnot was able, in 1769, to build a self-propelled vehicle with three wheels applied to a sturdy wooden frame, creating the first steam-powered vehicles.

The birth of automotive industry can be traced back, with the development of the gasoline engine, in the 1860s and 70s, mainly in Germany and France. Like any industry, in its early stages it was characterized by very small companies, small stores, capable of producing a very small number of handmade cars for an elite group of people. Only wealthy people could afford the luxury of buying a car, which was seen as a luxury good.

The automotive industry was able to evolve with the introduction and development of mass production, which made the car accessible to everyone. Mass production is a process combining precision, standardization, interchangeability, synchronization, and continuity. The mass-produced automobile by definition is the Ford Model T, created and put on the market in 1908 by Henry Ford. It had an extraordinary success, mainly due

Figure 1. Ford Model T



⁴ For this chapter, these sources have been taken into account: <https://www.treccani.it/enciclopedia/automobile/> ; <https://www.britannica.com/technology/automotive-industry>

to its low selling price, reached thanks to the drastic decrease in production costs that made the machine purchasable even by the workers themselves who produced it. The model, which combined the scientific subdivision of work proper to Taylorism with mass production by means of the assembly line, took the name of Fordism⁵ and is the basis of the production of mass consumption.

Ford achieved astounding success both in America and overseas, and this prompted new entrepreneurs to emulate his virtuous system and increase competition in an industry that was developing very fast. Its dominance remained unchallenged until the sales of the Ford Model T began to decline in the mid-1920s, as it became outdated and obsolete. The automotive industry, at that time, like all other industries in the world, was strongly influenced by World War I. At the end of the conflict, Ford was the world leader of the automotive industry thanks to the Model T, depopulating in the United States and overseas thanks to the many branches opened all over the world. At that time there were no car companies in any part of the world capable of challenging Ford's dominance with the only exception of the emerging General Motors, a company operating in the United States, which represented a potential tough competitor. The scenario began to change radically in the following decade, as Ford was joined by two other car companies, with the birth of the "Big Three": Ford, General Motors and Chrysler Corporation, the three companies together supplied three quarters of the American car market in 1929.

The situation in Europe was different, since, although the automotive market was the protagonist of an astonishing and significant growth, the size was still much smaller than in the US. There are several reasons why the European market was not as developed as the American one, including: lower standards of living with less purchasing power, more restrictions in fiscal policies and smaller national markets. Nevertheless, the European motor vehicle market, just like the American one, grew in size and a trend towards concentration developed:

- In France, three major companies emerged in the 1920's: Peugeot, Renault and Citroën. In 1925, Citroën had a position of undisputed national leader with 40% of the country's automobile production. Over time, however, due to the company's unbalanced financial position, other competitors have gained sales quotas, catching up with it in market positioning.
- In Great Britain, in 1929, three large companies dominated domestic production, controlling 75% of the automobile market: Austin, Singer and Morris. British production had not yet reached a level of size that would allow competitors to have the economies of scale necessary to compete with the large companies in the United States.
- The German automotive sector, due to the defeat suffered during World War I, was more affected than other European countries involved, a victim of dislocation and the subsequent economic crisis that affected the whole of Germany. The most important developments of the 1920's were: the entry of the giant General Motors in the German market through the acquisition of Opel in 1929; the merger, after the death of their founders, of Daimler and Benz in 1926. The Germans had a deep admiration for

⁵ <https://st.ilsole24ore.com/art/cultura/2016-08-06/la-rivoluzione-fordismo-171654.shtml?uuid=ADVb69y>

Henry Ford and his methods for mass production, which they called *Fordismus*, but Ford never managed to enter and become the leader of the German car market. The admiration was such that, during the Nazi regime, Volkswagen tried, unsuccessfully, to imitate Ford by undertaking mass production of a low-priced car.

- In Italy there was not yet a mass market, the automotive industry reached a small scale production and the Italian market had gained a high reputation thanks to highly engineered sports and racing cars.

The complete phenomenon of mass motorization, reached with completely different timing and ways by Europe and United States, because of the different events that affected the two areas during the years, was perfected only after the second post-war period. There was an evident growth of world production in this period, mainly due to the incredible increase of production outside the United States which, up to that moment, represented the leading nation in the automotive industry. This phenomenon is mainly attributable to an expansion and internationalization of the market. The traditional North American and European manufacturers were joined by new competitors in the 60's and 70's. An analysis, by country, of the automotive industry after World War II will follow.

In the United States, the structures of the automotive industry, at the end of World War II, had been enlarged for military needs and remained mostly intact. We can see how, starting in the 1970s, strategies of delocalization and internationalization began to develop on American soil. At the same time, this event increased competition from imported cars in the United States and reduced the market share of American companies in favor of European and Japanese companies that were establishing production facilities in the United States. At the beginning of the 1980s, the automotive industry in the United States was concentrated in four major companies: GM, Ford, Chrysler and AMC. Alongside them, foreign companies began to appear. The German Volkswagen, at the end of the '70s, opened an assembly operation in the United States; the French Renault decided, in 1979, to acquire a 46% stake in AMC with the aim of having a greater presence in the American automotive market, thus also gaining access to AMC's very famous Jeep line; the Japanese Nissan Motor Corporation, in the early '80s, established a plant on American soil so that it could produce and sell its famous pick-up trucks, adding only later the production of cars. Japanese car companies decided to build plants on U.S. soil in response to restrictions imposed on automobile exports to the United States by Japan's Ministry of International Trade and Industry. These restrictions did not prove to be very effective, and were followed by threats from the United States as Chrysler was on the verge of collapse and Ford and GM increased their losses year after year. In fact, these internationalization strategies implemented by European and Japanese companies reduced the share of the American market controlled by indigenous companies for the rest of the 20th century. In 2007 the global financial crisis of subprime mortgages exploded and swept the world, in fact in 2008 the entire American automotive industry was close to collapse. The American government, in order to respond promptly to the crisis and curb its catastrophic effects, set up the Troubled Assets Relief Program (TARP) through which the Treasury purchased from various credit institutions unprofitable and very risky (toxic) assets for a value of 700 billion, in exchange for participation in the form of preferred shares and the

commitment to return what the institutions had received.⁶ Specifically, billions in loans were made to Chrysler and GM while Ford decided not to accept government aid. GM, despite the loans, filed for bankruptcy protection in June 2009, and in the following month managed to emerge from bankruptcy reorganization. The subsequent period was marked by a major downsizing that was necessary for the company's survival. Chrysler also filed for bankruptcy in 2009, and shortly thereafter Italian automaker Fiat purchased a stake in the automaker, eventually becoming a majority shareholder in 2011.

In Europe, after World War II, the situation was completely different. The disastrous consequences of the world conflict are much more present on this continent, and we find different approaches depending on the nation in question. Motor vehicles were recognized as an export item that could help restore economies destroyed by the war.

World War II had disastrous effects on the territory of the United Kingdom, and the entire nation came out on its knees. More than half of the nation's automotive production was destined for export, and imports were limited for several years after the end of the conflict. The British automotive industry after the World War II was characterized by the dominance of the domestic production of four companies: Ford, Vauxhall, British Leyland and Rootes, which passed in 1967 under the control of Chrysler and then in 1978 was sold to the French Peugeot-Citroën. The only exception was Rolls-Royce that, despite the fact that the production of cars was only a marginal part of the company's business and moreover specialized mainly in luxury cars, managed to survive in the British market despite the four giants. In the 1980s the remaining parts of BL, which at that point was focused on building Jaguar, Mini and Rover cars and Land Rover SUVs and commercial trucks, became the Rover Group. The Japanese company Honda decided to enter into a cooperative venture with the Rover Group, and this brought multiple benefits to the Japanese company: the possibility to design and build Honda cars in Rover plants; the opportunity to enter the European car market by selling their cars in Britain and other European countries. The cooperative venture ended in 1994. Rolls-Royce Motor Cars, which was owned by Vickers PLC in the 1990s, decided in 1998 to sell Rolls-Royce and Bentley. Following the offers received by the German Volkswagen and BMW and the agreements reached between the two companies, Volkswagen acquired Bentley maintaining the right to produce and sell Rolls-Royce until 2002 and from 2003 the British brand passed to BMW (which had already founded Rolls-Royce Motors in 1998).

The situation in Germany was different, because, having been defeated by World War II, the German automotive industry, like all German industries, was destroyed or totally wiped out. Its rebirth was, however, an extraordinary event. At the end of the conflict, the city of Wolfsburg and the Volkswagen factory were destroyed. Despite this, after restoring production, it took just over a decade for the company to produce half of the motor vehicles in West Germany and it had managed to gain a strong foothold in the world market, paving the way for it to become one of the largest and most influential car companies in the world. Another peculiarity of Volkswagen, which was born thanks to the German government, was that, at a time when

⁶ <https://www.treccani.it/enciclopedia/tarp/>

nationalization of industry was very common, the government itself decided to sell 60% of the shares to the public. This represented, in the 1960s, an unusual case of nationalization. In the same decade, Volkswagen acquired Auto Union, which evolved into its luxury car segment Audi. In the same decade there was a radical transformation of BMW, which went from being a small car manufacturer to a luxury car manufacturer. Daimler-Benz, on the other hand had developed diversified interests, investing in trains and aerospace products. In 1998 it merged with Chrysler Corporation, which ended in 2007. After the termination of the relationship Daimler-Benz was renamed Daimler AG.

One can see, in the post-World War II period, a substantial difference between the incredible strength and speed of development of the German and English automotive sector, compared to the more timorous and slow Italian and French sectors. In Italy there was only one company that dominated domestic production: Fiat (Fabbrica Italiana Automobili Torino), a company founded in 1899 but without a mass market until 1950. In France, instead, there was the coexistence of four companies that dominated the national car production: Peugeot, Renault, Citroën and Simca. At the end of the world conflict, Renault was nationalized, becoming a public company in 1990. In 1976 Citroën was acquired by Peugeot to form PSA Peugeot-Citroën (later PSA Group). Simca, on the other hand, was initially acquired by Chrysler, and subsequently sold to Peugeot in the late 1970s.

Japan experienced unprecedented growth in automotive history after World War II. In the 1950s it had a marginal position in the world market, and with only 30 years it managed to overtake West Germany, France, Great Britain and the United States to become the world's leading car manufacturer. Protagonists of this success were the small, fuel-efficient Japanese cars, which were exported all over the world. As evidence of this, between the 1970s and 1980s Japanese companies such as Toyota, Nissan, Honda and Tōyō Kōgyō (later Mazda) greatly increased their earnings through exports mainly to North America and Western Europe. These companies, together with Mitsubishi, Isuzu, Fuji and Suzuki, were also able to open factories in the main foreign markets in order to better understand the needs of consumers from different cultures and especially to ease trade tensions. Thanks to these strategies, their competitiveness also increased considerably. By the 1980s, Japanese automakers had already achieved such global prominence that they were taken as examples to emulate, especially for their just-in-time method of delivering components to assembly plants and their use of statistical process controls to improve vehicle quality. Fordism was undoubtedly a worldwide reference as a model of mass production of automobiles until in the '70s, the period of the oil shocks, a new method of management of production processes was established. Ford had developed a production model that, especially during the oil shocks, in a recessionary economic context, was too rigid on the supply side and led to an overabundance of durable goods in markets where consumers due to their insufficient income were not able to buy. There was therefore a need to develop production models more suited to a sector that was changing radically. Thus, Toyotism (TPS) was born in Japan after World War II. Unlike Fordism, whose aim was to increase the number of mass-produced goods, Toyotism aimed at maximizing the value of production by

eliminating waste and minimizing the cost of production itself.⁷ It is through the use of this new model that there was the amazing development of Japan, which became a world leader in the automotive industry. The growth of Japanese automakers was slowed by a severe recession that erupted in the 1990s, and by the end of the 20th century, many Japanese automakers were controlled or tied by joint venture operations with foreign companies.

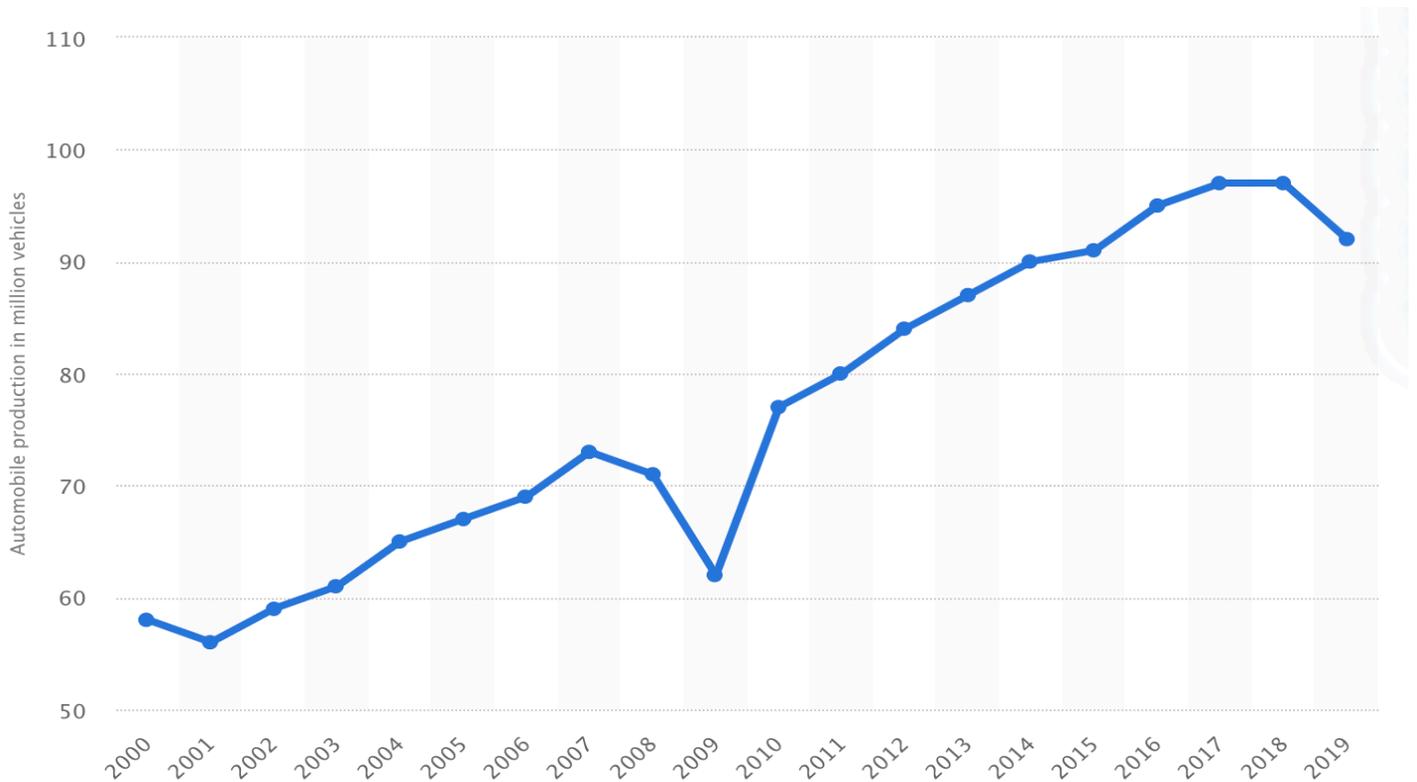
The industrial sector in South Korea, as in Japan, has experienced exponential growth since the 1970s, transforming itself in just 20 years from a small, government-controlled industry to a sector that has become a major player in the world market. Hyundai Motor Company, Kia Motors Corporation and Daewoo Motor Corporation were the three big giants of the automotive industry, controlling about 90% of the domestic market. Hyundai was the country's largest automaker, and was part of the larger Hyundai Corporation group and in addition to building cars, trucks and buses, it also had broader interests working in shipbuilding and construction. In 1999 Hyundai acquired Kia. Daewoo Group, on the other hand, decided to enter the automotive sector in the 1980s and managed to capture about a fifth of the market. Unfortunately, however, it went into receivership and financial reorganization in 2000, and then was finally sold to General Motors.

Asia, in particular China, was the undisputed protagonist of the incredible development that the automotive sector has had and is still having. In the '90s, due to the governmental controls on private property, the major car companies of the world showed interest in the Chinese market. The entry of foreign competitors and new technologies together with economic growth have facilitated the creation of a flourishing automotive market in China. It should also be taken into account that most of China's automotive companies were state-owned. In the 21st century, the vehicle lineup of Chinese companies became very successful, resulting in the country's car sales being among the highest in the world.

⁷ https://www.treccani.it/enciclopedia/taylorismo_%28Enciclopedia-delle-scienze-sociali%29/

In the 21st century there has been a constant growth in world production, with countries with developing economies as protagonists, until the economic and financial crisis of 2007/08, which obviously also had a considerable impact on the automotive industry.

Figure 2. Worldwide automobile production from 2000 to 2019⁹

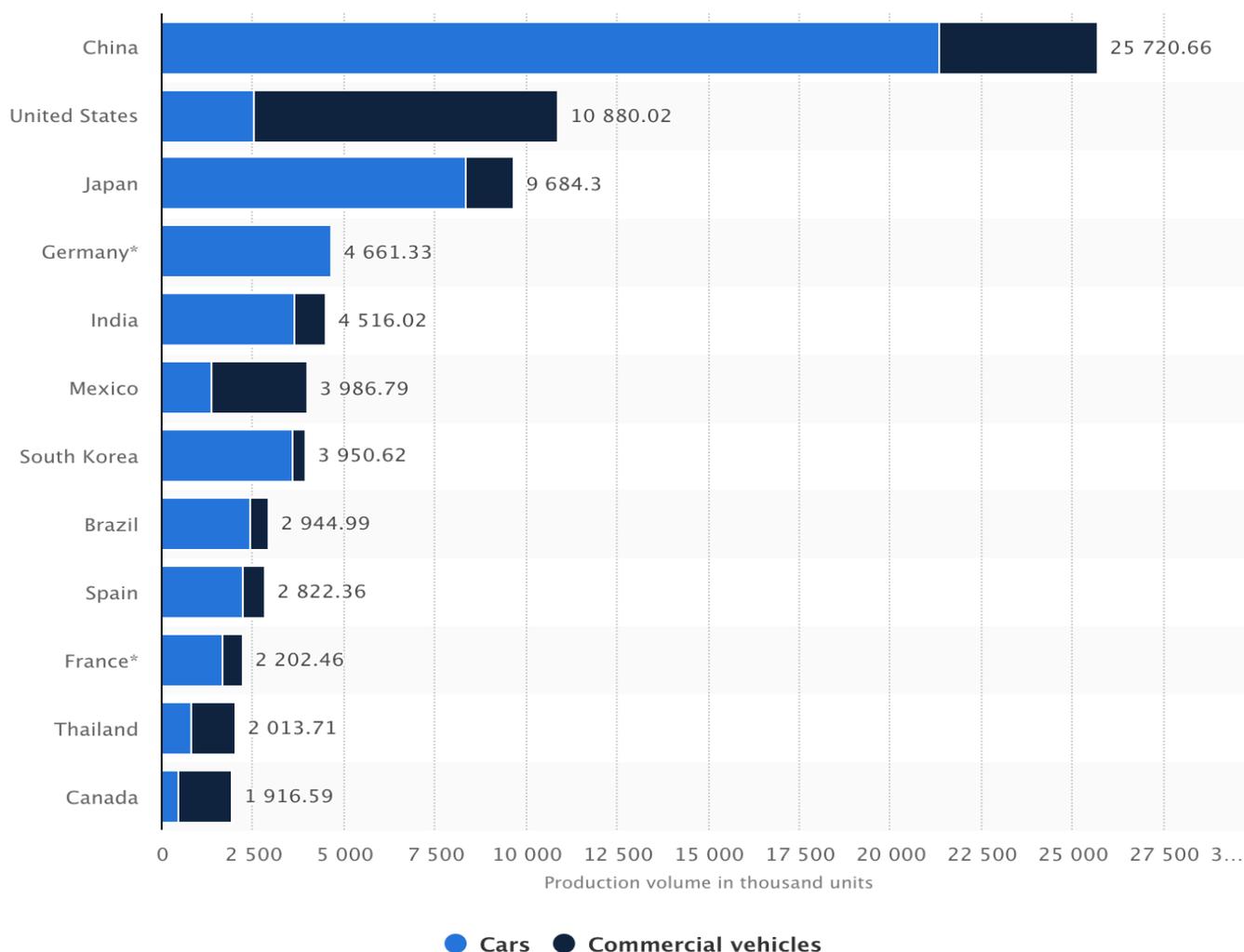


As we can see in Figure 2, there has been a collapse in the cumulative production of automobiles and commercial vehicles worldwide, from around 73 million units in 2007 to 62 million units in 2009. It can be seen that, after 6 consecutive years of growth, world production of motor vehicles recorded its first negative sign in 2008 (-3.4% compared to 2007), to be followed by that of 2009 (-12.6% compared to 2008). Then the recovery in 2010 (+26%) and growing volumes until 2017. In 2018, global automotive production declines by 1% over 2017 and in 2019 by 5.2% over 2018.¹⁰

⁹ <https://www.statista.com/statistics/262747/worldwide-automobile-production-since-2000/#:~:text=Worldwide%20automobile%20production%20through%202019&text=In%202019%2C%20almost%2092%20million,and%20commercial%20vehicles%20in%202019.>

¹⁰ https://www.anfia.it/data/dtracker/industria_%20autoveicolistica_mondiale_2010-2019.pdf

Figure 3. Motor vehicle production volume worldwide in 2019, by country¹¹



In Figure 3, we see that in 2019, China represents the big world leader in automotive production with about 25,720,66 units, followed by the United States with 10,880,02 units and Japan with 9,684,3 units. Europe's only representative in the top 5 is Germany, with 4,661.33 units. In percentage terms, 53% of vehicles are produced in Asia-Oceania, 24% in Europe, 18% in North America and 5% in the rest of the world. China is the world's leading producer (with 28% of world production), followed by the USA (12%), Japan (10%) and Germany (6%).

In early 2020, the Covid-19 pandemic outbreak occurs, causing an unprecedented health, economic and social crisis. Every industry sector is on its knees, including the automotive sector which, logically, is one of the hardest hit due to the lockdowns imposed by many governments to try to stem the galloping spread of the virus. In October, Fitch Solutions revised down its projections for global automotive production in 2020. This crisis, which has been unpredictable and has affected the entire planet, will take time to overcome; help from institutions through investment, support for businesses and families and maintaining jobs will be vital. In emerging countries, Asia, South America and Central-Eastern Europe, there will be the greatest increase in demand, while in countries where the sector is more mature, the allocation and quantity of investments in new

¹¹ <https://www.statista.com/statistics/584968/leading-car-manufacturing-countries-worldwide/>

technologies (electric cars, connected cars and autonomous driving) will be fundamental to achieve the goal of sustainable mobility. The very important challenge of the coming years will be to succeed in making the most of the technological innovations that are appearing for vehicles, services or traffic management, in order to make mobility a more sustainable activity and transform the car into a tool that is increasingly integrated with man's everyday life.¹²

¹² [https://www.anfia.it/data/dtracker/industria %20autoveicolistica mondiale 2010-2019.pdf](https://www.anfia.it/data/dtracker/industria%20autoveicolistica%20mondiale%202010-2019.pdf)

1.2 The vehicles of the future: the main innovations

The mobility and transport system has changed over time as a result of economic and technological development, social changes and consumption patterns. The car, thanks to the effects of globalization, has become the most widely used individual means of transport in every part of the world. It should be noted, however, that due to the effect of continuous and sudden technological changes, the vehicle is no longer conceptually seen as a tool for pure mobility in its own right, but as an element of integration and interconnection with people's lives, a new lifestyle. The changes over time that have marked the sector have been numerous and significant to the point of rapidly and continuously modifying the critical success factors of the market. Over the years, this phenomenon has led to continual upheavals in the competitive positioning of the major manufacturers and in the evaluation of the market. The ranking of the most capitalized competitors in the world has been overturned several times over the years and recently the phenomenon has accelerated (during 2019 the top five companies were Toyota, Volkswagen, Daimler, General Motors, BMW, today they are Tesla, Toyota, Volkswagen, Daimler, General Motors). Below are the main innovations that have occurred over the past few years.

Autonomous driving¹³

The Tsukuba Mechanical Engineering Laboratory in Japan developed in 1977 the first autonomous vehicle, equipped with computer vision, that could reach 30 km/h.

In the 1980s, Mercedes became a partner in the European Prometheus research program of Professor Ernst Dieter Dickmanns of the Military University of Munich, a Princeton alumnus with a background in NASA and a pioneer of the autonomous vehicle. The VaMoRs, a hatchback derived from Mercedes' Vario, was built. The vehicle weighed 5 tons, could reach a speed of almost 100 km/h, was equipped with cameras, sensors and computers and could accelerate, brake and turn the robotic steering wheel on a road closed to traffic.

Mercedes later made, with the same partner, a prototype very similar to its future S-Class sedan model. This robotic vehicle, in 1995, covered a distance of 1678 km (Munich - Copenhagen, round trip), automatically overtaking with peaks of up to 180 km/h, using artificial vision (captured by the 4 cameras) and with 3D obstacle recognition. The vehicle could move 95% of the time without human intervention.

It is worth mentioning that, at that time, GPS was rudimentary and there were no modern digital maps.

¹³For this paragraph, this source has been taken into account: https://cms-static.arval.com/sites/default/files/it--cvo/media/pdf/libri/le_auto_a_guida_autonoma_pdf_protetto.pdf

published by Corporate Vehicle Observatory (CVO), it is an international expert platform which exchanges best practices and provides analysis of trends in the management of vehicle fleets.

Also in 1995, a team of experts in the field of robotics from Carnegie Mellon University drove across America from Pittsburgh to Los Angeles in NavLab 5, a modified Pontiac Trans Sport. The operation was named "No Hands Across America."

In August 1997 in San Diego, thanks to the help of a consortium (Automated Highway Consortium National System), several vehicles of General Motors (which already at the end of the '30s had imagined vehicles capable of moving and parking autonomously, based on a guidance system with magnetic clamps incorporated in the roadway) traveled in convoy, virtually connected at a distance of a few meters. On that occasion, a special infrastructure with magnets for driving was built on some freeway sections. Universities were in turn involved in the automation of the car.

Also the Pentagon has had a relevant role in the innovative path on the vehicles. Since the mid-1980s, one of its agencies, DARPA, has sought to develop autonomous vehicles that would be able to move autonomously in conflict zones without risking the lives of its soldiers. It funded the VLT (autonomous ground vehicle) program and then, in 2004, organized the "Grand Challenge" where many researchers tested new solutions in competition. During the first edition, along 150 miles in the Mojave Desert, none of the 15 vehicles in line successfully reached the destination. The event was repeated in the following years and significant results were achieved.

In 2010 Google presented its "Self-Driving Car" and opened a new chapter in the history of autonomous vehicles, setting itself as the first reference point and as a model for inspiration. The company equipped a fleet of Toyota Prius and Lexus RX450h with cameras and a huge laser rangefinder on the roof; the vehicles, in the test carried out in California, used the information provided by Street View to orient themselves.

The large groups of car manufacturers have preferred, instead, to develop large-scale projects, such as the Volkswagen HAVEit project in 2008, the first tests in autonomous mode that BMW carried out in 2009 at Nürburgring, the Volvo SARTRE project started in 2009.

In 2013, Nissan launched the autonomous Leaf, equipped with a laser scanner and a camera, capable of handling for the first time complex driving situations such as autonomous driving such as side distance control, precedence at junctions and overtaking by monitoring approaching vehicles. Also in 2013, Mercedes presented at the Frankfurt Motor Show the S500 prototype with intelligent drive equipped with significant innovations: the DISTRONIC (safety distance management, through the Pre-Safe system for automatic braking if necessary), the Stop & Go (automatic stop and restart in traffic), the DISTRONIC PLUS (directional control) or the Magic Body Control, (recognition via a camera of irregularities in the road surface and adjusting the suspension accordingly).

Also in the same year Volvo presented in Sweden a V60 able to park automatically with remote control via a smartphone and able to find a place and park avoiding pedestrians and other vehicles. Other manufacturers have sought a direct response to the Google car, with specific prototypes as did Lexus with the AARSV (Advanced Active Safety Research Vehicle) or Audi that in October 2014, presented the RS 7 "Piloted driving" model.

In 2015 Audi, BMW, Honda, Nissan, Mercedes and Tesla, as well as Google have performed a series of tests carried out no longer in closed circuits but in situations of normal road traffic mainly in the U.S. but also in Germany on a stretch of the A9 freeway near Munich.

The United States space agency (NASA), with NASA's Ames Research Center based at Moffett Field (California), along with Nissan, with its research center in Silicon Valley, signed a five-year partnership in 2015 to research and develop autonomous driving systems.

In 2015, an artificial city called M-City was built in Ann Arbor on a campus that is part of the University of Michigan and its MTC (Mobility Processing Center) department, covering an area of 13 hectares and involving an initial investment of \$10 million, funded by the University of Michigan and the Federal Department of Transportation. In the city, all possible critical scenarios in heavy and chaotic traffic situations that an autonomous vehicle would face in reality have been reconstructed. There is a four-lane highway with on- and off-ramps, graffiti-covered traffic signals, obliterated signs, traffic circles, a green light intersection with pedestrians crossing, bike lanes, trees whose shade hinders the reading of traffic signs, construction barriers, and railroad tracks. A tunnel has also been constructed that interferes with satellite data transmission. The aim is to improve the development of connected and autonomous vehicles able to manage, also through wireless communications with the surrounding infrastructure, sudden and unexpected situations. M-City is open to all organizations but the Partners of the MTC including some car manufacturers (Ford, GM, Honda, Nissan and Toyota), some of their suppliers (Bosch, Denso) and telecommunications companies (Verizon, Qualcomm) are obviously entitled to priority access.

A large contribution in terms of innovation in robotics has been made by Japanese technology, which traditionally stands out in the field.

Honda developed the Asimo robot, which was presented at various auto shows. Toyota introduced Kirobo Mini, a small intelligent robot that can interact with the driver. It is placed in the vehicle's cup holder between the two front seats or in the glove compartment and responds to voice commands from the driver and passengers or detects the emotions of its interlocutor with a small camera.

There are many manufacturers in China that are exploring new solutions, BYD launched a remote control system for parking cars in 2012 and has been working on the autonomous vehicle for some time. SAIC, GM's partner in China, has said it plans to produce automated shuttles by 2030. In the bus sector, Yutong has already developed a vehicle that maintains the lead position on the row, adapts to traffic while also taking into account traffic lights at intersections. In addition to traditional manufacturers, Baidu, Google's Chinese competitor, Huawei, Alibaba and Pateo have been moving for some time with highly innovative projects, investing considerable capital in research and development. Vanke, the largest real estate company in China, also conducted a successful demonstration of its unmanned vehicle.

In Korea, Hyundai has been investing in autonomous driving since 2010 while Samsung announced in late 2015 the creation of a division dedicated to the design and production of components for the automotive

industry with the aim of creating multimedia systems for vehicles, along the lines of what Google and Apple already offer to some manufacturers.

Valeo's innovation director, William Devauchelle, said that, "the technology is not 100 percent ready today." Partial automation is made possible on existing vehicles thanks to various technologies, such as adaptive speed control, but unfortunately they have not reached a maturity to cope with any driving situation. For example, flooded or snow-covered roads represent situations in which car cameras are not yet fully efficient. To back up this thesis, William Devauchelle himself states that it can be estimated that the fully autonomous car will only be available after 2030. In order to achieve this arduous goal, it will be vital to be able to predict any false alarms, preventing driver assistance systems from being influenced by "false obstacles" that they think they have in their path, and this implies huge investments and progress in different areas: artificial intelligence, sensors and human-machine interface. Therefore, we can list several critical success factors to consider in order to have satisfactory autonomous driving:

- The role of the human-machine interface. It will be essential for the driver to become aware of the new possibilities and functionalities of the machine to the point of total trust. To increase trust, it is vital to have a monitor inside the vehicle that demonstrates how the machine can "see" and analyze real situations and respond effectively to any unforeseen events. In this way, the driver, through the information received, begins to establish a new type of relationship with the vehicle. In this area, known as HMI (Human Machine Interface), manufacturers are focusing their investments and attention. In addition to the purely technological part, the human part of the relationship should not be underestimated, leading to humanistic studies on: cognitive science, ergonomics and psychology. The objective is to make the information made available to the driver as clear and simple as possible; on the other hand, the accumulation of the number of assistance systems and their annexed types of alarms (audio, visual and tactile), creates disturbance to the driver and raises his stress level. Nowadays, drivers still don't know exactly what an autonomous vehicle is, so their apprehension about acquiring a vehicle in which the power of the driver is limited is understandable;
- Connectivity. The autonomous vehicle of the future will always have a connection with the outside world, which will be crucial for updating the database, maps and on the latest changes in the roads, but also for updating data related to driver and traffic safety. It is hypothesized that, through the Cloud and 5G technology, the car will be able to receive real-time and modify its speed according to traffic conditions. It will be through this permanent connection, and through its sensors and cameras, that the car will be an independent tool;
- The mapping issue. This is a critical point, as the fully autonomous vehicle needs to have more detailed and accurate tracking systems and mapping information than the current systems that currently appear inadequate;

- Protection against piracy. From the moment the vehicle has a permanent connection, the risk of hacking the vehicle increases exponentially; the vehicle could theoretically be controlled by an external user who could put the driver's life at risk.

The SAE (Society of Automotive Engineers) codified the different levels of driving automation internationally in 2019, through a scale of levels ranging from 0 to 5:

- Level 0, the driver has full control of the vehicle, in which there are instruments that can provide warnings or momentary assistance;
- Level 1, the vehicle offers more tools, such as Electronic Stability Control (ESC) useful for correcting driving errors, or Emergency Brake Assist;
- Level 2, the driver also has to steer, brake or accelerate to maintain safety as in the previous levels, but has additional tools available to avoid certain tasks while driving. There are tools such as: the Adaptive Cruise Control (ACC) that automatically maintains a safe distance in relation to speed; the lane centering that supports the driver to the right direction of the vehicle on the road;
- Level 3, if in the first three levels the driver drives, even when the support tools are active, level 3 is the first level in which the vehicle begins to automate even for more complex functions. In these vehicles we can find: the Traffic Jam Assist, which combines the ACC with the rear direction support (anti-skid), which is the procedure for driving in traffic. From 0 to 65 km/h the vehicle is fully automated and controls the accelerator, brake and steering wheel;
- Level 4, the tools that assist the driver's driving are further enhanced by the installation of systems that can manage driving on a road trip without driver assistance;
- Level 5, this level encompasses complete independence of the vehicle resulting in it being able to handle a complete trip whether the driver is in the vehicle or not.

This scale allows manufacturers to measure the level reached in the process of vehicle automation, and to analyze above all what is lacking to make the vehicle even more independent, and at the same time to develop a man-machine interface capable of giving clear information to the driver so that he understands what is happening around him and when it is time to regain control of the vehicle. The critical aspect is represented by the continuous research of the correct balance between the technological development of the vehicle and the improvement of its safety.¹⁴

At the University of Maryland (NREL), the National Renewable Energy Laboratory conducted a study that found that autonomous driving would reduce fuel use by about 15%, taking advantage of improved efficiency and coordination of vehicles at intersections, and contributing to a 30% increase in fuel efficiency.

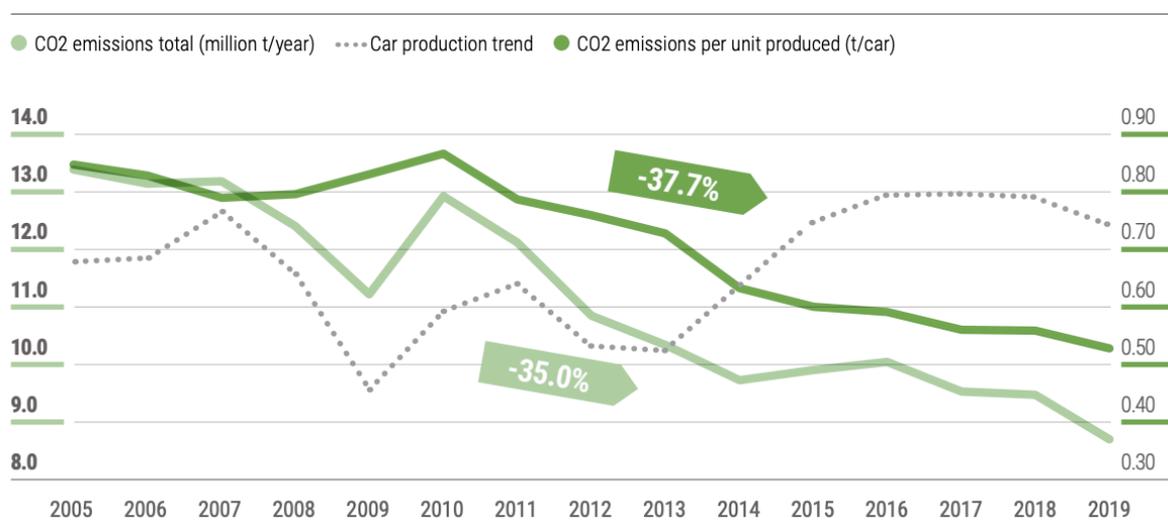
¹⁴ <https://www.sae.org/news/2019/01/sae-updates-j3016-automated-driving-graphic>

Sustainable innovation: reduction of the environmental impact of production processes¹⁵

Fundamental, in addition to the environmental impact of the car itself, is the pollution created in producing it. The European Union is very focused on environmental issues and, together with other non-European countries, has signed the Paris Agreement. This agreement is of vital importance, as it aims to strengthen the capacity of countries to deal with the impacts of climate change and to support them in their efforts. The Paris Agreement, adopted in December 2015 at the Paris Climate Conference (COP21), is the first universal and legally binding agreement on climate change. Its main goals are:

- To succeed in keeping the average global temperature increase below 2°C, with the goal of limiting global warming to 1.5°C;
- Ensure that global emissions reach the highest possible level as soon as possible, and then implement a rapid reduction strategy to achieve a balance between emissions and removals in the second half of the century.¹⁶

Figure 4. CO2 emissions from car production



The Automotive sector, obviously called upon to meet these guidelines, has greatly reduced the environmental impact of its production over the past decade. As shown in Figure 4, from 2005 to 2019, CO2 emissions from car production decreased by 37.7%, despite a gradual increase in production over the years. The positive trend is not only about decreasing emissions, but, thanks to the efforts of automakers, other virtuous attitudes can be highlighted:

- The reduction of energy consumed during production by 16.7% from 2005 to 2019. Cars, over time, are becoming increasingly intelligent and interconnected vehicles, thanks to the installation of cutting-

¹⁵For this paragraph, this source has been taken into account:

https://www.acea.be/uploads/publications/ACEA_Pocket_Guide_2020-2021.pdf

¹⁶https://ec.europa.eu/clima/policies/international/negotiations/paris_it#tab-0-0

edge tools that, however, increase the complexity of production. Despite this, it has been possible to reduce energy consumption, thanks to the greater efficiency achieved in the production of vehicles;

- The reduction of volatile organic compounds (VOCs) during production by 43.3% from 2005 to 2019. These are organic solvents emitted by paint stores, and their reduction is mainly due to the replacement of solvent-based paints with solvent-free paints;
- The reduction in water consumption during production by 44.8% from 2005 to 2019, due to the application of water recirculation and reuse technologies.

Sustainable innovation: vehicle fuel system

The diesel engine has been the most widely used engine since World War II, thanks to the tax incentives presented especially in Europe and the undeniable cheapness of the fuel. These factors favored the exponential growth in the use of diesel vehicles, until in 2005 it became the engine used for about 50% of European cars. In parallel, however, there was a growing interest in alternative fuel systems, one of which was the electric motor. The first concrete steps taken in the development of an electric engine occurred in 1973-74, during the fuel crisis, when America became the protagonist of numerous experiments with electric vehicles. The Sebring Vanguard, Inc, a Florida company, developed the CitiCar, which is the most successful electric vehicle model of the time. The main features of the CitiCar were: a two-seat vehicle with a wedge-shaped plastic body, all on a welded aluminum frame. The engine, a 3.5 horsepower General Electric, received power from lead-acid batteries in the vehicle. It was the most prolific electric vehicle of the turn of the century with about 2,600 models built between 1974 and 1976, then there was an abrupt halt due to falling oil prices that temporarily blocked the sale of electric vehicles. Growing environmental concerns led to a growing interest on the part of car manufacturers in an alternative and less polluting power system compared to the one commonly used. In 1990, even before the Paris Agreement mentioned above, the California Air Resources Board mandated that all automakers must, over the next eight years, ensure that 2 percent of sales in the state were "zero emission" vehicles.

The main problem of the vehicles built was represented by the low autonomy (on average less than 100 miles with lead acid batteries). The alternative was the use of nickel-metal hydride cells, which provided a greater range, but were too expensive. For this reason, there was not the development of electric vehicles as hoped, with the consequent relaxation of the provisions of California Air Resources Board.

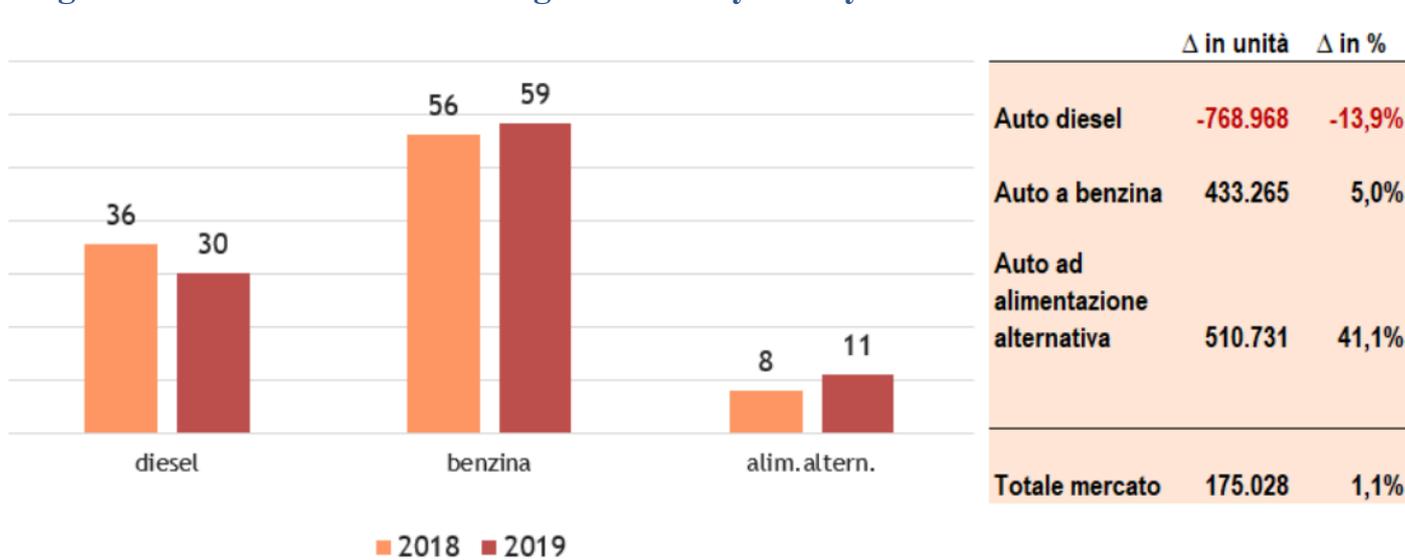
To be able to overcome the problem of autonomy, since the existing technologies did not give many guarantees, they began to develop hybrid cars, characterized by the presence of a classic combustion engine supported by an electric motor. The first hybrid car to be placed on the market was the Prius hybrid four-passenger, produced and sold in 1997 by Toyota on the Japanese market. The Prius had some very precise characteristics: the coexistence of an electric motor with a gasoline engine, where the car used the latter only when necessary to integrate the electric propulsion or to recharge the batteries. In Europe, in the same year,

there was a similar attempt with the introduction of the Audi Duo hybrid, but it was not successful and convinced European manufacturers to focus on the development of diesel models. The first hybrid to be sold in the U.S. market was produced by Honda, with the two-passenger Insight in 1999. Hybrid vehicles are less polluting, for this reason many states, in order to encourage the production and especially the purchase of vehicles with alternative fuel system, have offered and still offer various economic or tax incentives, exemption from payment of the parking meter or unlimited use of commuter lanes.

The Prius was introduced in the United States in 2000 was an extraordinary success, and also received the attention of many celebrities who wanted to drive a hybrid car and less polluting rather than a luxury car at all costs. The amazing success received compared to pure electric vehicles is also to be found in the fact that, in addition to a much greater autonomy due to the coexistence of the two engines, there is no need to recharge the batteries of the car.

The first American hybrid was the Ford Escape Hybrid (SUV), produced in 2004. A year later, in 2005, there would be the release of the first luxury hybrid vehicle, the Lexus RX 400h. The first innovation in hybrid vehicles can be found in 2010, when General Motors produced the Chevrolet Volt, which had the peculiarity of being able to drive up to 35 miles only with electric batteries, and use the gasoline engine only after the batteries were discharged. An obligatory mention deserves Tesla, which has been enjoying enormous success since 2003 with the design and production of all-electric cars.¹⁷

Figure 5. UE/EFTA - Vehicle registrations by fuel system¹⁸



According to an analysis by ANFIA (Associazione Nazionale filiera Industria Automobilistica) based on ACEA (European Automobile Manufacturers Association) data regarding the EU/EFTA market for alternative fuel cars in the years 2018-2019, as shown in Figure 5, diesel cars, which had a market share of 30.3% in 2019, decreased by about 768,968 units or a minus 13.9% compared to the previous year. Gasoline cars, on the other

¹⁷ <https://www.britannica.com/technology/automobile/Alternative-fuel-vehicles#ref259077>

¹⁸ <https://www.anfia.it/en/component/jdownloads/send/13-mercato-autovetture-ad-alimentazione-alternativa/191-122019-ue-efta-focus-mercato-auto-ad-alimentazione-alternativa>

hand, had a 5% increase in sales with an additional 433,265 units. Most striking is the huge increase in sales of alternative fuel cars of 41.1%, representing 510,731 more units. In order to reach the EU target of 95 gCO₂/km by 2021¹⁹, the average emissions need to be reduced by another 25.4 g/km compared to the 2018 value, and the contribution of new diesel cars, which have lower CO₂ emissions than gasoline vehicles, will be vital, and above all a huge increase in electric cars will be needed. Considering the current market trend, it can be assumed that there will be a definitive affirmation of electric cars once the aforementioned problems of battery autonomy are satisfactorily resolved, adequate improvements are made to the recharging infrastructure network and public policies of economic support for purchase are intensified. To this end, it is worth pointing out the decisive willingness of EU member states to invest decisively in charging infrastructures and to implement greater purchase incentives for consumers.

Figure 6. UE/EFTA - Market of alternative fuel system²⁰

	2019	%	2018	%	VAR % 19/18
Totale auto elettriche ECV	564.225	32,2	387.748	31,2	45,5
Auto elettriche a batteria (BEV) ¹	365.372	20,8	202.117	16,3	80,8
Auto ibride plug-in (PHEV) ²	198.853	11,3	185.631	14,9	7,1
Auto ibride (HEV)	931.801	53,1	624.519	50,3	49,2
Auto a gas³	257.281	14,7	230.309	18,5	11,7
Totale auto ad alimentazione alternativa	1.753.307	100,0	1.242.576	100,0	41,1

¹ include fuel cell

² include extended range

³ include gas naturale, GPL, E85

Looking specifically at trends in sales of alternative-fuel cars (Figure 6), we find that in 2019, new registrations totaled 1,753,307, up 41% from 2018, broken down by fuel type as follows: 564. 225 electric cars (ECVs), including 365,372 battery-powered (BEV+fuel cell) and 198,853 plug-in hybrids (PHEV+Extended Range); 931,801 hybrids (mild-full HEVs); and 257,281 gas-powered cars (natural gas, LPG, E85). The electric car segment (ECV) accounted for 32.2% of the alternative fuel market and was made up of 20.8% of BEV/FC cars (battery electric vehicle that includes fuel cell) and 11.3% of PHEV/ER cars (plug-in hybrid electric vehicle that has extended range). The main difference between the two is that BEVs are powered only by the car's internal electric battery, while PHEVs, being hybrids, can also count on the support of an internal combustion engine. In contrast, the mild-full hybrid car (HEV) segment was worth more than half of the alternative drive market (53.1%). There is also an important difference between HEVs and PHEVs, as HEVs charge the battery only internally, while PHEVs can also charge the electric battery from external sources. Finally, the other alternative fuels (CNG, LPG, ethanol) accounted for 14.7% of the market. In 2019 in the

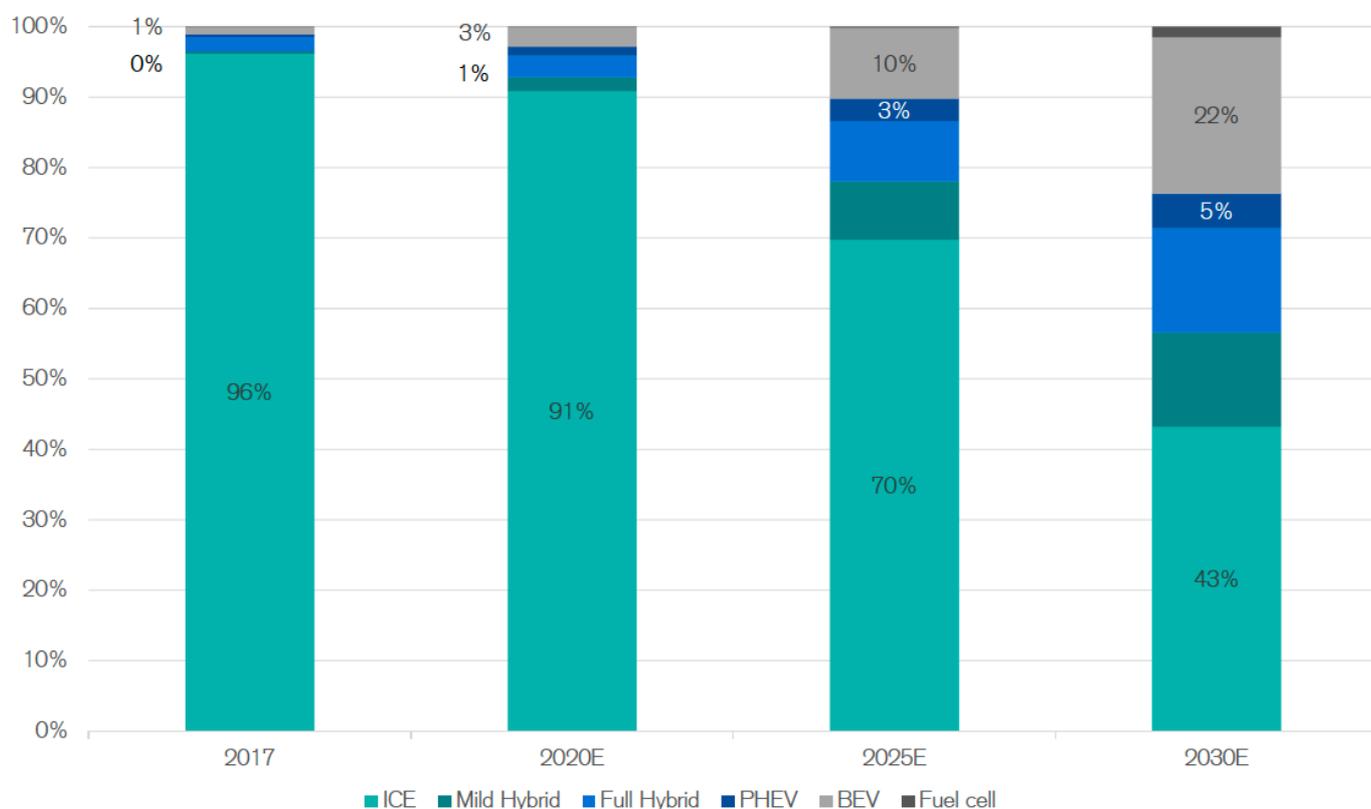
¹⁹ https://ec.europa.eu/clima/policies/transport/vehicles/cars_it

²⁰ <https://www.anfia.it/en/component/jdownloads/send/13-mercato-autovetture-ad-alimentazione-alternativa/191-122019-ue-efta-focus-mercato-auto-ad-alimentazione-alternativa>

EU/EFTA 1 in 28 registered cars was electric considering both BEVs and PHEVs. If EFTA is not considered, the ratio rose to 1 in 33 registered cars, where the value is 1 in 5 registered ECV (BEV and PHEV) cars. The undisputed leader in EU/EFTA rechargeable car sales was Norway (1 in every 2 cars registered in the total national market), followed by Iceland and the Netherlands (1 in every 6), Sweden (1:9), and Finland (1:15). At the bottom of the ranking were Estonia (1:344), Lithuania (1:285) and Slovakia (1:277).

Figure 7. Forecasts future sales by combustion type, Credit Suisse²¹

Sales mix by combustion type: EVs to gain share rapidly this decade



Last data point: 14/09/2020. Source: Company data, Credit Suisse estimates

Thanks to research conducted by Credit Suisse, we can see how the forecast for future global car sales will change dramatically. In 2017, as shown in Figure 7, 96% (i.e. almost the entire vehicle production) was ICE (internal combustion engine) i.e. cars powered by gasoline, diesel, LPG and CNG. The study predicts that in 2030 there will be a strong increase in the share of alternative fuel vehicles, in particular it is noted the strong increase in the diffusion of BEVs (battery electric vehicles) that increase from 1% in 2017 to 22% in 2030. This assessment is based on the assumption that states will continue and increase incentives to purchase these types of vehicles. The forms of incentives are many and very much add up; the most common is the recognition of a financial contribution to the purchase. Also very frequent are: partial or total exemption from payment of

²¹ Electric vehicles on the fast track, 01.02.21 Credit Suisse

public parking fees or taxes (income tax, road tax, registration tax) based on the level of CO₂/km emissions of the vehicle in question. In addition to the incentives offered, as previously written, the diffusion and capillarity of the recharging points, the reduced autonomy of the electric battery, the time and cost of recharging should not be underestimated.

Chapter 2: Financial analysis of automotive companies

In the following chapter, a financial analysis of five of the most important automotive companies will be carried out: Tesla, Toyota, Volkswagen, General Motors and Daimler. The performance of the last 4 years of these companies will be specifically analyzed in order to examine the major changes that have occurred. A more detailed focus will be received through a broader analysis of the last year, in order to have a more specific picture of the current situation of the five companies.

2.1 Tesla



Company overview²²

Tesla is a relatively young automotive company, founded in 2003 by engineers Martin Eberhard (CEO) and Marc Tarpenning (CFO). The name was given in honor of Nikola Tesla, the well-known scientist whose inventions in the late 1800s and early 1900s contributed to the development of the alternating current electrical system and the alternating current electric motor. The main goal of this revolutionary company is to accelerate the transition to a world of sustainable energy sources. The two engineers wanted to prove that you don't have to make compromises to drive an electric car, you can receive the same performance even without a combustion engine. Tesla's offering, in fact, is not limited to the sale of all-electric cars but also to highly scalable solutions for generating and storing clean energy. The company's goal, therefore, is to offer an electric vehicle that, through sublime engineering capabilities, contains a state-of-the-art design with performance on the level of a non-electric vehicle, and with the use of Autopilot and Full Self-Driving (FSD), making it unique. In 2004 Elon Musk, co-founder of PayPal, joined the company as a principal investor and became the chairman of the company.

In 2008 they entered the automotive market with their first fully electric car: Roadster. It was an electric sports car with remarkable performance, reaching 245 miles (394 kilometers) on a single charge, a result never

²² For this paragraph, these sources have been taken into account: <https://www.britannica.com/topic/Tesla-Motors>; https://www.tesla.com/it_IT/about; https://www.annualreports.com/HostedData/AnnualReports/PDF/NASDAQ_TSLA_2019.pdf

achieved before by an electric car, and, above all, had nothing to envy to gasoline-powered sports cars. At the end of 2007, Eberhard resigned as CEO and president of technology and joined the company's advisory board, remaining a shareholder. Tarpenning, likewise, resigned as vice president of electrical engineering and left the company for good in 2008. At the same time Musk took over as CEO. In 2010 Tesla raised about \$226 million through an initial public offering (IPO).

The Roadster model was discontinued in 2012 to commit all forces in the production of the new Tesla Model S. The new model was an unprecedented success, due to a very modern design and exceptional performance. It entered the market with three different types of battery, which allowed the car a range that varied from 235 to 300 miles (379 to 483 kilometers). In 2014, the Tesla Autopilot was added to the model.

In 2015, the Model X SUV (sport-utility vehicle) was introduced. This model has a maximum battery range of 295 miles (475 kilometers).

In 2016, the Tesla Model 3 was presented, a high-volume distributed electric vehicle with a low price, which has a range of about 360 miles (580 kilometers).

In 2019, the company presents two new models: Tesla Model Y, which represents a mid-size SUV that can have up to seven seats; Cybertruck, which represents a more innovative pickup truck with more performance than a sports vehicle.

Tesla is still the largest producer of batteries on the market, although several Gigafactories, such as the one in Nevada, are not at full capacity. According to the company's plans it will be possible to further reduce the cost of battery production by increasing production and activating significant economies of scale. This will allow Tesla to be able to sell its vehicles at more affordable prices.

Tesla operates not only in the Automotive sector, it also has a presence in the energy generation and storage sector. The latter includes the design, manufacture, installation, sales and leasing of solar power generation and energy storage products, services related to those products, and sales of incentives for solar energy systems. Specifically, Tesla sells and leases retrofit solar energy systems, which are solar panels that convert sunlight into electricity and, alternatively, provides some customers with access to their solar energy systems through power purchase or subscription-based agreements. Another very important product offered by the company is the Solar Roof, whose customer sales began in 2019, which in addition to producing solar energy, also has a design suitable for integrating the architecture of the house with its glass panels.

In addition to these services, thanks to the knowledge in the energy sector, Tesla also manufactures energy storage products, such as Powerwall, Powerpack and Megapack that represent a fully integrated energy storage solutions for commercial, industrial, utility and energy generation customers. These scalable systems are suitable for both residential and commercial facilities, and, like vehicles, these products can be remotely updated over-the-air with software or firmware improvements.

All of the company's primary components and final products are manufactured in several facilities:

- Fremont Factory and facilities in the Bay Area of California, where the company's vehicles and most of its key components are manufactured. Bay Area facilities contain several manufacturing operations, including stamping, machining, casting, plastics, body assembly, paint operations, seat assembly, final vehicle assembly and end-of-line testing for our vehicles.
- Gigafactory Nevada, represents the facility where Tesla, together with its suppliers, works on the production and integration of battery material, cell, module and battery pack production in one location.
- Gigafactory New York, where Tesla focuses primarily on the production and development of the Solar Roof and other solar products and components.
- Gigafactory Shanghai, where there is the remaining production of Tesla vehicles, Model 3 above all.

Figure 8. Equities and shareholders²³

Equities							
	Vote ⓘ	Quantity	Free-Float		Company-owned shares		Total Float
Stock A	1	959,853,504	770,376,034	80.3%	0	0.0%	80.3%

Shareholders			Tesla, Inc. (US) ▼
Name	Equities	%	
Elon Musk	170,492,985	17.8%	
The Vanguard Group, Inc.	54,445,577	5.67%	
Capital Research & Management Co. (World Investors)	46,249,648	4.82%	
SSgA Funds Management, Inc.	29,550,379	3.08%	
Baillie Gifford & Co.	27,304,170	2.84%	
BlackRock Fund Advisors	17,398,994	1.81%	
Larry Ellison	15,006,250	1.56%	
Fidelity Management & Research Co. LLC	14,152,832	1.47%	
Jennison Associates LLC	12,121,582	1.26%	
Geode Capital Management LLC	11,567,235	1.21%	

Figure 8 shows the composition of the company's equities and shareholders.

Tesla currently has 70,757 employees and sells 500,000 vehicles. The main competitors in the electric vehicles sector are in order of size: the Chinese Nio INC, Xpeng Inc and Li Auto Inc and the American Nikola Corporation and Fisker Inc.

²³ <https://www.marketscreener.com/quote/stock/TESLA-INC-6344549/company/>

Figure 9. Brand Portfolio²⁴



As evidenced by Figure 9 the Portfolio Brand, in addition to the main brand, consists of:

- Maxwell Technologies Inc. is an American company based in San Diego, California that develops manufactures and markets energy storage and delivery products worldwide.
- DeepScale, Inc. is an American technology company headquartered in Mountain View, California, which develops computer vision technologies, which allow for a three-dimensional model of reality similar to that of human sight, for use in automated vehicles.
- Tesla Powerwall is a storage system with rechargeable lithium-ion batteries that stores electricity for consumption, charge transfer and as a power reserve.
- SolarCity is a U.S. company, headquartered in San Mateo, California, that designs, finances and installs solar energy systems in the United States.

²⁴ <https://www.marketscreener.com/quote/stock/TESLA-INC-6344549/company/>

Analysis of Balance Sheet²⁵

Figure 8. Consolidated balance sheet Tesla 2019²⁶

Tesla, Inc. Consolidated Balance Sheets (in millions, except per share data)		
	December 31, 2019	December 31, 2018
Assets		
Current assets		
Cash and cash equivalents	\$ 6,268	\$ 3,686
Restricted cash	246	193
Accounts receivable, net	1,324	949
Inventory	3,552	3,113
Prepaid expenses and other current assets	713	366
Total current assets	12,103	8,307
Operating lease vehicles, net	2,447	2,090
Solar energy systems, net	6,138	6,271
Property, plant and equipment, net	10,396	11,330
Operating lease right-of-use assets	1,218	—
Intangible assets, net	339	282
Goodwill	198	68
MyPower customer notes receivable, net of current portion	393	422
Restricted cash, net of current portion	269	398
Other assets	808	572
Total assets	\$ 34,309	\$ 29,740
Liabilities		
Current liabilities		
Accounts payable	\$ 3,771	\$ 3,405
Accrued liabilities and other	2,905	2,094
Deferred revenue	1,163	630
Resale value guarantees	317	503
Customer deposits	726	793
Current portion of debt and finance leases	1,785	2,568
Total current liabilities	10,667	9,993
Debt and finance leases, net of current portion	11,634	9,404
Deferred revenue, net of current portion	1,207	991
Resale value guarantees, net of current portion	36	329
Other long-term liabilities	2,655	2,710
Total liabilities	26,199	23,427
Commitments and contingencies (Note 16)		
Redeemable noncontrolling interests in subsidiaries	643	556
Equity		
Stockholders' equity		
Preferred stock; \$0.001 par value; 100 shares authorized; no shares issued and outstanding	—	—
Common stock; \$0.001 par value; 2,000 shares authorized; 181 and 173 shares issued and outstanding as of December 31, 2019 and 2018, respectively	0	0
Additional paid-in capital	12,737	10,249
Accumulated other comprehensive loss	(36)	(8)
Accumulated deficit	(6,083)	(5,318)
Total stockholders' equity	6,618	4,923
Noncontrolling interests in subsidiaries	849	834
Total liabilities and equity	\$ 34,309	\$ 29,740

2019 was a record-breaking year for Tesla in many respects; the company, always focused on growth, achieved important results summarized in the following:

- The production and delivery of approximately 370,000 vehicles,

²⁵ For this paragraph, these sources have been taking into account: Annual report Tesla 2019 https://www.annualreports.com/HostedData/AnnualReports/PDF/NASDAQ_TSLA_2019.pdf ; <https://finance.yahoo.com/quote/TSLA?p=TSLA&.tsrc=fin-srch>

²⁶ Annual report Tesla 2019, https://www.annualreports.com/HostedData/AnnualReports/PDF/NASDAQ_TSLA_2019.pdf

- The production of the new Tesla Model 3 at the Shanghai Gigafactory,
- The schedule of the future production of the Tesla Model Y at the Fremont facility, arranged for the first quarter of 2021,
- The selection of the location of Tesla's next facility in Europe to enter the European market, which will be located in Berlin,
- The unveiling of the innovative pickup truck with sports vehicle-like performance, Cybertruck,
- A strong enhancement of Autopilot and FSD (Full-Self Driving) features.

The energy generation and storage sector has seen a marked improvement. In fact, Tesla's solar installations increased 48% and 26% quarter-over-quarter, respectively, in the second half of the year. The improvement can also be seen in distribution, Tesla in fact distributed 1.65 GWh of energy storage in 2019, more than the total of all previous years. There was also the development of the third-generation Solar Panel, with more efficient performance, and the development of the Megapack, which is the largest utility-scale energy storage product to date.

Analyzing the main items and changes in the Balance Sheet (Figure 8), it can be seen that the company closes the year 2019 with \$6.27 billion of Cash and cash equivalents. The company's cash and cash equivalents are steadily improving, allowing for the funding of ongoing operations, research and development for new products, and improvements to current products and facilities. The growth of Cash and cash equivalents is massive, increasing by 70.11% compared to 2018 and, and 86.11% compared to 2017.

The aforementioned \$2.582 billion improvement in Cash and cash equivalents in 2019 is primarily due to changes in Cash from operating activities (+\$2.405 billion), Cash from investing activities (-\$1.436 billion), Cash from financing activities (+\$1.529 billion).

Total Current assets for 2019 are \$12.103 billion, and here again there is an impressive growth (+45.71% over 2018 and +84.20% over 2017). This increase can be explained primarily, in addition to the previously mentioned rise in cash, by growth net of depreciation in Accounts receivable, which are up 39.51% over the previous year and 73.85% over 2017, and Inventory, which is up 14.09% over the previous year. It is interesting to take a closer look at the changes that occurred in Inventory, which consists of Raw materials, Work in process, Finished goods and Service parts.

Figure 9. Inventory²⁷

	December 31, 2019	December 31, 2018
Raw materials	\$ 1,428	\$ 932
Work in process	362	297
Finished goods (1)	1,356	1,581
Service parts	406	303
Total	\$ 3,552	\$ 3,113

As depicted in Figure 9, the Inventory item that increases most significantly is Raw materials which in 2019 grow 53.25% compared to the previous year and 73.85% compared to 2017. This can be explained by the strong increase in the production and sales of full electric vehicles, which leads to the need to increase the inventory stock. Despite a general growth in Inventories, there is a reduction in Finished goods (from \$1.581 billion to \$1.356) indicating: a reduction in vehicles in transit to meet customer orders, new vehicles available for sale and used vehicles and energy storage products.

Total non-current assets, equal to \$22.206 billion in 2019, represent the company's long-term investments. The overall growth of 3.61% compared to 2018 is more moderate than the items previously analyzed. Again, changes in the most significant items are analyzed in more detail. Solar energy systems, net of depreciation, increased year-over-year by 3.90%, from \$6.431 billion in 2018 to \$6.682 billion in 2019, due to a substantially improved energy generation and storage sector, thanks to Tesla's numerous solar installations. One of the most important items represented by Total non-current assets is Property, Plant and Equipment, the details of which are depicted in Figure 9.

Figure 10. Property, Plant and Equipment, Net²⁸

	December 31, 2019	December 31, 2018
Machinery, equipment, vehicles and office furniture	\$ 7,167	\$ 6,329
Tooling	1,493	1,398
Leasehold improvements	1,087	961
Land and buildings	3,024	4,047
Computer equipment, hardware and software	595	487
Construction in progress	764	807
	14,130	14,029
Less: Accumulated depreciation	(3,734)	(2,699)
Total	\$ 10,396	\$ 11,330

Discussing about Construction in Progress, all the machinery and equipment required to manufacture Tesla's products and build the Shanghai Gigafactory are considered. Once the products are finished, they are transferred to the item they belong to and depreciated when ready for use. Machinery, equipment, vehicles and office furniture had a 13.24% increase between 2018 and 2019, a clear sign of the company's steady growth,

²⁷ Annual report Tesla 2019, https://www.annualreports.com/HostedData/AnnualReports/PDF/NASDAQ_TSLA_2019.pdf

²⁸ Annual report Tesla 2019, https://www.annualreports.com/HostedData/AnnualReports/PDF/NASDAQ_TSLA_2019.pdf

and more importantly, the industry in which it operates. In 2019, Panasonic partnered with Tesla on Gigafactory Nevada. The agreement included investments by Panasonic in all those equipment suitable to produce battery cells, with Tesla's commitment to acquire the entire production of battery cells at negotiated prices. For this reason, Panasonic's equipment is accounted for as Leased assets.

In the same year, Shanghai government, after ascertaining Tesla's commitment to implement manufacturing equipment investments at the Shanghai Gigafactory, agreed to confer \$85 million to the company. \$46 million was received in cash, the remaining \$39 million in the form of goods and services provided by the government. These incentives reduced the value of Property, Plant and Equipment, net on the balance sheet.

Despite the growth in Machinery, equipment, vehicles and office furniture, the overall Property, Plant and Equipment line item decreased from 2018 to 2019. The explanation lies in the adoption of a new standard lease January 1, 2019, which states gross build-to-use assets, previously included in Property, Plant and Equipment, net, are now located in Operating lease right-to-use assets. Regarding the latter item, confirming that this was a change in the accounting system, that in 2018 the item Operating lease right-to-use assets is zero.

It is interesting to note that in the two-year period examined, Total assets (which grew by \$4.569 billion (+15.3%)) represent around 140% of Total revenues in 2019 (capital intensity ratio). This incidence is very high and indicates a high need for invested capital in relation to revenues, mainly due to investments linked to the continuous innovations in the company's product. Stockholders' Equity grew in 2019 by 34.4% compared to the previous year due to the effect of Additional paid in capital. Stockholders' Equity, which was \$4.923 billion in 2018, is \$6.618 billion in 2019 and increases further in 2020 to \$22.225 billion.²⁹

²⁹ <https://it.finance.yahoo.com/quote/TSLA/balance-sheet?p=TSLA>

three-year period 2017-2019, overall growth is \$12.819 billion or 109%. Since this is a key item, it can be broken down and studied in more detail as shown in Figure 11.

Figure 12. Revenues³¹

(Dollars in millions)	Year Ended December 31,			2019 vs. 2018 Change		2018 vs. 2017 Change	
	2019	2018	2017	\$	%	\$	%
Automotive sales	\$ 19,952	\$ 17,632	\$ 8,535	\$ 2,320	13%	\$ 9,097	107%
Automotive leasing	869	883	1,107	(14)	-2%	(224)	-20%
Total automotive revenues	20,821	18,515	9,642	2,306	12%	8,873	92%
Services and other	2,226	1,391	1,001	835	60%	390	39%
Total automotive & services and other segment revenue	23,047	19,906	10,643	3,141	16%	9,263	87%
Energy generation and storage segment revenue	1,531	1,555	1,116	(24)	-2%	439	39%
Total revenues	\$ 24,578	\$ 21,461	\$ 11,759	\$ 3,117	15%	\$ 9,702	83%

As described in Figure 12, Tesla's Revenues are divided into: automotive sales revenue and energy generation and storage segment revenue.

Automotive sales revenue includes the cash sales of the various models: Model 3, Model S and Model X, with, of course, the possibility to access and use Autopilot, FSD and internet connectivity, giving the company the possibility to design and implement updates for the various models. Another important source of revenue for the company is the revenue received from the sale of regulatory credits to other automotive companies. Tesla receives regulatory credits through the production, delivery, placement into service and ongoing operation of their zero emission vehicles, charging infrastructure and solar systems in global markets. These credits are necessary to comply with emission standards, and every company must possess them. However, the law gives to the most virtuous companies the option of selling the excess regulatory credits they receive to other car companies that need them to meet these standards. Most car manufacturers have to buy the credits sustaining a huge cost while Tesla, due to its virtuous environmental policy, sells them increasing its revenues. This is a great competitive advantage for Tesla over its competitors.

As depicted in Figure 12, Automotive sales revenue in 2019 is \$19.952 billion, about \$2.32 billion more than the previous year, a growth of 13%. This increase is even more massive when analyzing the year 2017, with Automotive sales revenue at \$8.535 billion, a growth of 134%. The reasons behind this increase are:

- The increase in cash sales of 137,969 Model 3s,
- The sale of regulatory credits of \$594 million, an increase of \$175 million over the prior year.

These increases were partially mitigated by a reduction in Model X and Model S deliveries of 30,487.

³¹ Annual report Tesla 2019, https://www.annualreports.com/HostedData/AnnualReports/PDF/NASDAQ_TSLA_2019.pdf

Figure 13. Cost of Revenues and Gross Margin³²

(Dollars in millions)	Year Ended December 31,			2019 vs. 2018 Change		2018 vs. 2017 Change	
	2019	2018	2017	\$	%	\$	%
Cost of revenues							
Automotive sales	\$ 15,939	\$ 13,686	\$ 6,725	\$ 2,253	16%	\$ 6,961	104%
Automotive leasing	459	488	708	(29)	-6%	(220)	-31%
Total automotive cost of revenues	16,398	14,174	7,433	2,224	16%	6,741	91%
Services and other	2,770	1,880	1,229	890	47%	651	53%
Total automotive & services and other segment cost of revenues	19,168	16,054	8,662	3,114	19%	7,392	85%
Energy generation and storage segment	1,341	1,365	874	(24)	-2%	491	56%
Total cost of revenues	\$ 20,509	\$ 17,419	\$ 9,536	\$ 3,090	18%	\$ 7,883	83%
Gross profit total automotive	\$ 4,423	\$ 4,341	\$ 2,209				
Gross margin total automotive	21%	23%	23%				
Gross profit total automotive & services and other segment	\$ 3,879	\$ 3,852	\$ 1,981				
Gross margin total automotive & services and other segment	17%	19%	19%				
Gross profit energy generation and storage segment	\$ 190	\$ 190	\$ 242				
Gross margin energy generation and storage segment	12%	12%	22%				
Total gross profit	\$ 4,069	\$ 4,042	\$ 2,223				
Total gross margin	17%	19%	19%				

As can be seen from Figure 13, Tesla's main costs derive from the automotive sector, which considers the entire process, starting from the purchase of raw materials and labor costs through to shipping and logistic costs, put in place to produce and sell the vehicles; costs arising from the energy generation and storage sector are, however, marginal.

In parallel with the growth of Automotive sales revenue, the Cost of automotive sales revenue has also increased. Figure 13 shows that in 2019 the Total automotive & services and other segment cost of revenues are \$19.168 billion, while in 2018 they were \$16.054 billion, a boost of about 19% (+\$3.114 billion). Again, we can look specifically at the reasons for the increase:

- An increase in cash deliveries of 137,969 Model 3,
- A higher average cost per unit for Model S and Model X compared to the previous year.

The increase in these costs was partially reduced by a decrease in Model S and Model X deliveries of 30,487, and also to the reduction in the average cost per unit of the Model 3.

Gross profit total automotive increased over the two-year period, in absolute terms, due to higher sales and revenues, from \$4.341 billion in 2018 to \$4.423 billion in 2019. Gross margin total automotive, on the other hand, appears to have declined between 2018 and 2019 (from 23% to 21%) primarily due to lower Model X and Model S prices in 2019.

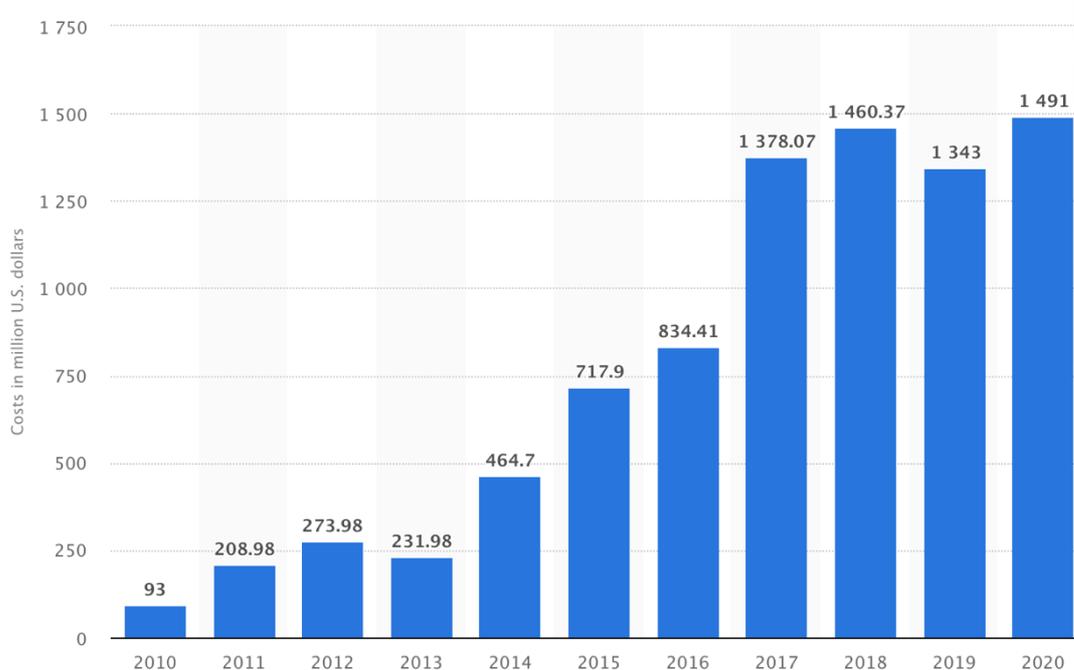
³² Annual report Tesla 2019, https://www.annualreports.com/HostedData/AnnualReports/PDF/NASDAQ_TSLA_2019.pdf

Figure 14. Research and Development Expense³³

(Dollars in millions)	Year Ended December 31,			2019 vs. 2018 Change		2018 vs. 2017 Change	
	2019	2018	2017	\$	%	\$	%
Research and development	\$ 1,343	\$ 1,460	\$ 1,378	\$ (117)	-8%	\$ 82	6%
As a percentage of revenues	5%	7%	12%				

Tesla's research and development expenses, which are necessary for an ever-evolving industry such as automotive, decrease as a percentage of revenues from 7% in 2018 to 5% in 2019. This decrease is primarily caused by an increase in overall expanding sales revenue and to a lesser extent a decrease in expenses in absolute value. Thus, R&D spending falls from \$1.460 billion in 2018 to \$1.343 billion in 2019, a percentage decrease of approximately 8%.

Figure 15. Tesla's research and development expenses from 2010 to 2020³⁴



But looking at the company over a longer time frame, as shown in Figure 15, Tesla has exponentially increased its R&D spending in ten years. Starting from \$93 million in 2010, up to \$1.491 billion in 2020, and it is also thanks to this strong growth that Tesla is one of the fastest growing brands worldwide.

The company ends the year 2019 with a net loss of \$862 million essentially because the \$4.069 billion gross profit does not cover Operating expenses of \$4.038 billion and interest expenses of \$685 million. The loss would have been even worse if it had not been for regulatory credits, which have a positive contribution of

³³ Annual report Tesla 2019, https://www.annualreports.com/HostedData/AnnualReports/PDF/NASDAQ_TSLA_2019.pdf

³⁴ <https://www.statista.com/statistics/314863/research-and-development-expenses-of-tesla/>

\$594 million to the income statement but do not relate to typical industrial operations. The expected increase in sales and the improvement in the efficiency of the production processes will guarantee better economic performance in the coming years.

In this work, financial statement data for the year 2019, taken from the company's latest annual report, has been considered. It is considered appropriate, in order to allow homogeneous comparisons with other companies analyzed that have released more updated data, to briefly represent the most significant statistical data updated to 2020 taken from the Yahoo Finance website.

Total revenues further increased to \$31.536 billion in 2020, sanctioning a 28.31% growth. Total cost of revenue, as a result, grew 21.44%, from \$20.509 billion in 2019 to \$24.906 billion in 2020. Gross profit, of \$6.630 billion, improved in 2020 over the prior year both in absolute terms (+\$2.561 billion) and as a percentage of Total revenues from 16.5% in 2019 to 21% in 2020.

Unlike previous years, 2020 is a historic year for Tesla as it manages to close the year with a net income of \$690 billion. The main reasons for this result are:

- The production and delivery of 500,000 vehicles in 2020, a company record that led to an increase in revenue,
- The collection of regulatory credits of approximately \$1.4 billion in 2020. An astonishing figure, considering the received revenue of \$594 million in 2019, an increase of about 135.7%. Figures that, according to several studies³⁵, are set to rise further in 2021 (to \$2 billion), making regulatory credits even more critical to Tesla's health.

³⁵ <https://www.bloomberg.com/news/articles/2021-01-27/tesla-credit-revenue-may-rise-to-2-billion-credit-suisse-says>

Analysis of the Statistics³⁶

In order to carry out a comparative analysis of the companies examined in this work, it was considered useful to obtain from the Yahoo Finance website some data considered significant updated to the date of May 14, 2021, in order to compare homogeneous data. Figure 16 shows the most significant balance sheet data and valuation measures calculated as of May 14, 2021.

Figure 16. Income statement, balance sheet and valuation measures³⁷

Income Statement		Valuation Measures	
Revenue (ttm)	31.54B	Market Cap (intraday) ⁵	679.32B
Revenue Per Share (ttm)	33.80	Enterprise Value ³	703.97B
Quarterly Revenue Growth (yoy)	45.50%	Trailing P/E	1,105.84
Gross Profit (ttm)	6.63B	Forward P/E ¹	119.35
EBITDA	4.27B	PEG Ratio (5 yr expected) ¹	4.79
Net Income Avi to Common (ttm)	690M	Price/Sales (ttm)	21.54
Diluted EPS (ttm)	0.64	Price/Book (mrq)	30.57
Quarterly Earnings Growth (yoy)	157.10%	Enterprise Value/Revenue ³	22.32
		Enterprise Value/EBITDA ⁷	164.75
Balance Sheet			
Total Cash (mrq)	19.38B		
Total Cash Per Share (mrq)	20.19		
Total Debt (mrq)	13.34B		
Total Debt/Equity (mrq)	56.32		
Current Ratio (mrq)	1.88		
Book Value Per Share (mrq)	23.15		

¹ Data provided by Refinitiv.³ Data derived from multiple sources or calculated by Yahoo Finance.⁵ Shares outstanding is taken from the most recently filed quarterly or annual report and Market Cap is calculated using shares outstanding.

⁷ EBITDA is calculated by S&P Global Market Intelligence using methodology that may differ from that used by a company in its reporting.

The Market Cap value, calculated considering the outstanding shares according to the company's latest official report, is \$558.42 billion. EBITDA, at \$4.55 billion, is up on 2019 by 109.3% (\$2.174 in 2019), trailing P/E (based on the most recent 12-month financial data) is 580.84, while forward P/E (that uses forecasted earnings for the P/E calculation) is 92.75. This ratio expresses the number of years it takes for the return on investment.

³⁶ For this paragraph, this source has been taking into account: <https://finance.yahoo.com/quote/TSLA/key-statistics?p=TSLA>

³⁷ <https://finance.yahoo.com/quote/TSLA/key-statistics?p=TSLA> data of May 14, 2021

These values are very high because they indicate that, at current earning levels, 580 years are needed to recover the capital invested while, according to future earnings forecasts by analysts consulted by Bloomberg, 92 years are needed. The average worldwide P/E value of the automotive sector in the period 2012-2019 was 10-12, today it has risen up to 40 due to the crisis caused by Covid, analysts predict that this value will return in the next two years to 13-14.³⁸ Tesla's P/E figure just mentioned is much higher than the global average for the sector, a sign of great investor confidence that seems to give the company a significant competitive advantage and strong prospects for future earnings growth. The same considerations can be made for the Enterprise value/EBITDA ratio (Earnings before Interest taxes depreciation and amortization) which is equal to 120.31, a much higher value compared to the global average (in the period 2012-2019 equal to 4-6, today equal to 10 and at the end of the next two years equal to 7).³⁹ This ratio expresses the multiple of EBITDA on the basis of which, according to one of the most widely used valuation methods, the value of the company is calculated. Total cash is \$17.14 billion and total cash per share is \$17.79. The Current ratio, which represents the ratio of current assets to current liabilities, is 1.66. This indicator indicates how liquid the company is, i.e. Tesla's ability to repay short-term or scindent obligations in one year. This value is higher than the Current ratio of the automotive industry, which as of 2020-12-31 was about 1.09.⁴⁰ A signal that represents the company's state of health. Diluted EPS, in which the total number of shares of common stock is calculated taking into account possible exercise or conversion of equivalent securities by, for example, holders of convertible bonds and stock options, is \$1.

Analysis of strategic alliances

Tesla, as all car manufacturers, has activated many strategic partnerships with important market players; we briefly highlight some operations that seemed particularly significant.

In April 2010 Daimler AG acquired a stake of almost 10% in Tesla Motors Inc. with the aim of strengthening the alliance and collaboration even more closely in the development of battery systems, electric drive systems and in individual vehicle projects.⁴¹ Of particular note, Tesla was already the supplier of batteries and powertrains for Daimler. In 2014, Daimler sold its holdings in Tesla realizing a large capital gain.

In June 2010, an agreement was stipulated with Toyota Motor Corporation (TMC) which included cooperation for the development of electric vehicles, parts, production system and engineering support. On this occasion it was announced the purchase, by TMC, of \$50 million of Tesla's common stock issued in a private placement.⁴² Also in this case Tesla was already the supplier of batteries and powertrains for TMC. Toyota sold its last Tesla shares in 2017, exiting the company permanently and realizing a strong capital gain.

³⁸ Bloomberg: MSCI WORLD AUTO & COMPONENTS INDEX data of April 28, 2021

³⁹ Bloomberg: MSCI WORLD AUTO & COMPONENTS INDEX data of April 28, 2021

⁴⁰ <https://www.macrotrends.net/stocks/charts/GPI/group-1-automotive/current-ratio>

⁴¹ https://www.tesla.com/it_IT/blog/strategic-partnership-daimler-acquires-stake-tesla

⁴² https://www.tesla.com/it_IT/blog/tesla-motors-and-toyota-motor-corporation-intend-work-jointly-ev-development-tm

In October 2011, an agreement was reached with Panasonic corporation, which is the world's leading battery cell manufacturer and a diversified supplier to the global automotive industry, to supply automotive-grade lithium-ion battery cells.⁴³ Of the collaboration with Panasonic on the Nevada Gigafactory dating back to 2019 has already been reported.

Tesla reached an agreement with the Prony Resources Consortium in March 2021 under which the company becomes the technical partner for the development and improvement of the industrial process of the nickel mine in New Caledonia owned by the Consortium. The deal is strategically important as it gives Tesla control over the problematic supply of nickel for its production of lithium-ion batteries that power electric cars. New Caledonia is the world's fourth-largest producer of nickel, which has seen a 26 percent increase in prices over the past year.⁴⁴

Press reports indicate that Tesla may soon finalize a partnership with Samsung for the realization of a highly innovative system for fully autonomous driving of cars. The technology would be based on a 5-nanometer chip (this is the technology used in iPhone 12). The Full Self-Driving system currently in Tesla's self-driving cars uses 14nm technology, also provided by Samsung, but the 5nm chip will simplify the development of fully autonomous driving, thanks to its ability to improve the processing of information coming from sensors.⁴⁵ It was deemed appropriate to report the news, although not yet confirmed, to highlight the company's strategic direction in product and technology development.

To the same purpose it is important to report another operation initiated not by the company but by the founder Elon Musk that could open revolutionary scenarios in the automotive sector. The CEO of Tesla, Elon Musk, founded Neuralink in 2016 along with other major investors, the company was born with the intent to treat serious neurodegenerative diseases through the link of the computer or a mobile device with the sole use of the human brain. Their definition of the link is: "We're designing the first neural implant that will let you control a computer or mobile device anywhere you go", "Micron-scale threads are inserted into areas of the brain that control movement. Each thread contains many electrodes and connects them to an implant, the Link".⁴⁶

⁴³ https://www.tesla.com/it_IT/blog/panasonic-enters-supply-agreement-tesla-motors-supply-automotivegrade-battery-c

⁴⁴ <https://www.bbc.com/news/business-56288781>

⁴⁵ <https://it.finance.yahoo.com/notizie/samsung-fornir%C3%A0-il-cervello-delle-094518855.html>

⁴⁶ <https://neuralink.com/>

2.2 Volkswagen



Company overview⁴⁷

Volkswagen Group, also called Volkswagen AG, is one of Germany's largest automakers. It was founded in Wolfsburg in 1937 by the government, with the goal of mass-producing and selling low-priced "people's cars." Austrian automotive engineer Ferdinand Porsche was hired to be in charge of this important project, but with the outbreak of World War II in 1939, it stalled. The reason lies in the fact that the company was originally run by the German Labor Front (Deutsche Arbeitsfront), a Nazi organization. The outbreak of the world conflict revolutionized the production structure in the whole of Germany, and the factory was converted to produce military equipment and vehicles. This conversion made the factory a target for Allied bombers. At the end of the World War the factory was destroyed, and later rebuilt under British supervision. Volkswagen nameplate mass production began in 1946.

Once this transition period was over, the company experienced exponential growth in the fifties. Sales increased a lot, mainly in European countries, while in the United States the performance was still pretty flat, because of the unusual size and appearance of the cars and, above all, the close connection with Nazi Germany that the American people still attributed to them. The situation began to change even overseas when, in 1955, Volkswagen of America was born. In order to get the company's image revalued, a massive advertising campaign was implemented that exploded the "Beetle" model, promoting its unique and unconventional design. In fact, the "Beetle" was the most imported car in the United States for many years.

Volkswagen, from the beginning of the 60's went through a serious financial crisis, mainly due to the fierce competition of car companies that developed more modern and sporty cars. Starting from the '70s, Volkswagen decided to make a radical change in the company's philosophy, abandoning the creation of rear-engine cars and starting to produce vehicles with front-engine and front-wheel drive. Volkswagen's greatest success was the Golf model, introduced in 1974. Sales skyrocketed, making the Golf the best-selling Volkswagen car in the world.

⁴⁷ For this paragraph, this source has been taking into account: <https://www.britannica.com/topic/Volkswagen-Group>

The company, around the 60s, being owned by the West German government and the state of Lower Saxony, was the protagonist of a massive denationalization, in which more than 60% of the shares were sold to the public. This process was accompanied by a strong internationalization and relocation strategy for the company, which opened numerous factories around the world, including: Brazil, United States, Mexico and China.

In 2015, Volkswagen received the award as the world's largest car manufacturer by volume, and shortly thereafter was the protagonist of one of the most important public relations crises in recent years. It erupted as the U.S. Environmental Protection Agency (EPA) discovered that diesel cars produced by the German company had software inside them ("defeat device") that managed to alter vehicle performance in order for them to pass emissions tests. Volkswagen decided to plead guilty to having installed the "defeat device" in its cars, this led to the recall of more than 10 million cars worldwide and, only in the United States, had to pay fines for a total amount of more than 4 billion dollars. Despite the worldwide scandal, Volkswagen remains one of the world's largest automakers.

Volkswagen has 118 plants around the world, where, in addition to cars, engines and other key mechanical components are produced. The most important ones are divided as follows:

- In America we find: a factory in Tennessee, where Passat and Atlas models are built; one in Chattanooga. In Mexico there are 4 plants, including the one in San José Chiapa where the Audi Q5 is assembled.
- In Europe there are most of the plants, as many as 71: in Italy Lamborghini is produced; in Spain Seat cars and Audi Q3 are produced; in Portugal the Volkswagen T-ROC is produced; in France the Bugatti Chiron.
- In Germany a total of 28 plants are located. Mainly Audi and Porsche models are produced, while in Zwickau, Dresden, Osnabruck, Emden, Hanover and Wolfsburg there are other important VW plants.
- The German company has a very strong presence in Asia, with a total of 33 plants. Six of these are located in India, while there are 22 in China. ⁴⁸

⁴⁸ <https://www.ilsole24ore.com/art/auto-dove-sono-stabilimenti-piu-importanti-marca-marca-AEZ20cNF>

Figure 17. Equities and shareholders⁴⁹

Equities							
	Vote ⓘ	Quantity	Free-Float		Company-owned shares		Total Float
Stock A	1	295,089,818	78,762,646	26.7%	0	0.0%	56.8%
Stock B	1	206,205,445	206,205,445	100.0%	0	0.0%	

Shareholders			Volkswagen AG (DE0007664039) ▼
Name	Equities	%	
Qatar Investment Authority (Investment Company)	23,040,095	11.2%	
Union Investment Privatfonds GmbH	6,036,878	2.93%	
The Vanguard Group, Inc.	4,507,503	2.19%	
Capital Research & Management Co. (World Investors)	3,741,324	1.81%	
Capital Research & Management Co. (Global Investors)	3,161,332	1.53%	
DWS Investment GmbH	2,685,911	1.30%	
Lyxor International Asset Management SAS	2,585,442	1.25%	
DWS Investments (UK) Ltd.	2,440,826	1.18%	
BlackRock Asset Management Deutschland AG	2,327,426	1.13%	
Amundi Asset Management SA (Investment Management)	2,147,999	1.04%	

Figure 17 shows the composition of the company's equities and shareholders. Volkswagen in 2020 had 662,575 employees and sold about 9.3 million vehicles.⁵⁰

Figure 18. Brand portfolio⁵¹



VOLKSWAGEN FINANCIAL SERVICES
THE KEY TO MOBILITY

⁴⁹ <https://www.marketscreener.com/quote/stock/VOLKSWAGEN-AG-436737/company/>

⁵⁰ <https://annualreport2020.volkswagenag.com/>

⁵¹ Annual report Volkswagen 2020, https://www.volkswagenag.com/presence/investorrelation/publications/annual-reports/2021/volkswagen/Y_2020_e.pdf

Figure 18 shows all the brands that are part of the Volkswagen Group:

- Most of these are part of the automotive sector: Audi, Seat, Skoda, Bentley, Bugatti, Lamborghini, Porsche, Volkswagen Commercial Vehicles;
- Ducati, an Italian motorcycle manufacturer;
- Scania and Man, which are companies, the former Swedish and the latter German, that produce heavy vehicles such as trucks or buses;
- Volkswagen Financial Services, which provides financing, car rental and insurance services to customers.

Analysis of Balance Sheet⁵²

Figure 19. Consolidated balance sheet Volkswagen 2020⁵³

€ million	VOLKSWAGEN GROUP		AUTOMOTIVE ¹		FINANCIAL SERVICES	
	2020	2019	2020	2019	2020	2019
Assets						
Noncurrent assets	302,170	300,608	156,861	153,736	145,309	146,873
Intangible assets	67,968	66,214	67,781	66,010	187	204
Property, plant and equipment	63,884	66,152	62,807	65,043	1,077	1,110
Lease assets	50,686	48,938	1,512	2,084	49,174	46,853
Financial services receivables	82,565	86,973	-377	-390	82,942	87,363
Investments, equity-accounted investments and other equity investments, other receivables and financial assets	37,067	32,331	25,137	20,989	11,930	11,342
Current assets	194,944	187,463	97,236	93,081	97,708	94,382
Inventories	43,823	46,742	39,055	41,898	4,768	4,844
Financial services receivables	58,006	58,615	-557	-640	58,562	59,255
Other receivables and financial assets	38,044	38,620	17,012	17,803	21,033	20,817
Marketable securities	21,162	16,769	17,503	13,546	3,658	3,223
Cash, cash equivalents and time deposits	33,909	25,923	24,222	19,679	9,687	6,243
Assets held for sale	-	795	-	795	-	-
Total assets	497,114	488,071	254,097	246,816	243,017	241,255
Equity and liabilities						
Equity	128,783	123,651	96,733	92,774	32,050	30,877
Equity attributable to Volkswagen AG shareholders	111,336	109,117	79,913	78,872	31,423	30,246
Equity attributable to Volkswagen AG hybrid capital investors	15,713	12,663	15,713	12,663	-	-
Equity attributable to Volkswagen AG shareholders and hybrid capital investors	127,049	121,781	95,626	91,535	31,423	30,246
Noncontrolling interests	1,734	1,870	1,107	1,239	627	631
Noncurrent liabilities	202,921	196,497	93,523	90,822	109,398	105,675
Financial liabilities	114,809	113,556	15,637	17,592	99,173	95,965
Provisions for pensions	45,081	41,389	44,207	40,631	874	759
Other liabilities	43,031	41,551	33,680	32,600	9,352	8,951
Current liabilities	165,410	167,924	63,840	63,220	101,569	104,703
Financial liabilities	88,648	87,912	-2,806	-7,312	91,454	95,224
Trade payables	22,677	22,745	19,539	19,603	3,137	3,142
Other liabilities	54,085	56,896	47,107	50,559	6,978	6,337
Liabilities associated with assets held for sale	-	370	-	370	-	-
Total equity and liabilities	497,114	488,071	254,097	246,816	243,017	241,255

1 Including allocation of consolidation adjustments between the Automotive and Financial Services divisions, primarily intragroup loans.

The Volkswagen Group consists of two macro-divisions: the Automotive Division, which includes the brands described above, and the Financial Services Division. The Automotive Division comprises a large number of activities, including in particular: vehicle, engine and vehicle software development, the manufacture and sale

⁵² For this paragraph, these sources have been taking into account: Annual report Volkswagen 2020, https://www.volkswagenag.com/presence/investorrelation/publications/annual-reports/2021/volkswagen/Y_2020_e.pdf

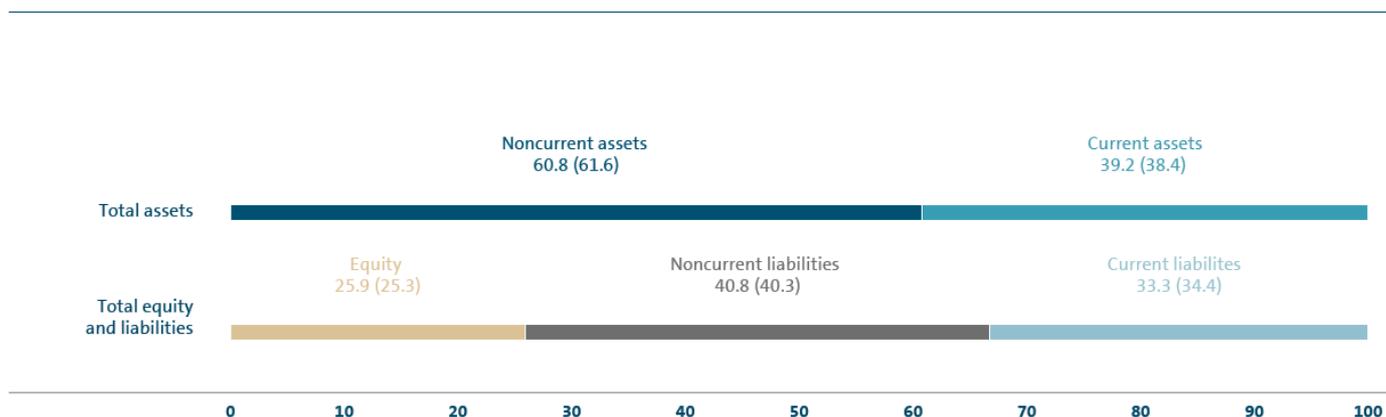
⁵³ Annual report Volkswagen 2020, https://www.volkswagenag.com/presence/investorrelation/publications/annual-reports/2021/volkswagen/Y_2020_e.pdf

of passenger cars, light commercial vehicles, trucks, buses and motorcycles, as well as activities for original parts, large diesel engines, turbo-machines, special gearboxes and powertrain components. With regard to the Financial Services Division, as specified above, all activities of: dealer and customer financing, vehicle leasing, direct banking and insurance, fleet management and mobility services are considered.

2020 was a very complicated year for all product sectors, and obviously the automotive sector was not exempt from the serious negative consequences brought by the pandemic. Analyzing Volkswagen Group, and therefore its entire brand portfolio, Covid-19 had a considerable impact on the business, in terms of sales, revenues and profits of the entire Group. Before quoting and discussing the Balance Sheet and Income Statement figures, it should be noted that Volkswagen Group had off balance-sheet commitments of €8.6 billion at the end of the year 2020. These mainly relate to legal risks due to the diesel issue. In addition, the company has €22 billion of other financial obligations, most of which relate to commitments to purchase property, plant and equipment and irrevocable credit commitments to customers. Part of these financial commitments are inherent in the commitment to invest in infrastructure for zero emission vehicles, approximately €0.9 billion. These investments derive from settlement agreements with the USA due to the diesel issue.

Analyzing the company's Balance Sheet, Figure 19, at year-end 2020 Total assets €497.1 billion, while at year-end 2019 they amounted to €488.1 billion. There was a positive change of 1.9%, mainly due to the boost in gross liquidity and the success of the hybrid notes issue. The growth is even sharper when analyzing 2017, when total assets were €422.2 billion. A growth of about 17.7%.

Figure 20. Consolidated Balance Sheet Structure 2020 (in percent)⁵⁴



As depicted in Figure 20, Total assets are divided into: 60.8% Non-current assets and the remaining 39.2% in Current assets. A more detailed analysis of these items can be made.

⁵⁴ Annual report Volkswagen 2020, https://www.volkswagenag.com/presence/investorrelation/publications/annual-reports/2021/volkswagen/Y_2020_e.pdf

Non-current assets, in absolute terms, in 2020 are €302.170 billion, up from 2019 when they were €300.608 billion, while the growth is more substantial if one analyzes the years 2017-2020, i.e. +15.3% (Non-current assets in 2017 were €262.081 billion). Considering the year 2020, Non-current assets are divided as follows:

- €156.861 billion (51.91% of Non-current assets) in the automotive division, with Intangible assets and Property, plant and equipment as the main items;
- €145.309 billion (the remaining 48.09%) in the financial services division, with Financial services receivables as the main item.

Growth in 2019-2020, while slight, can be explained by an increase in Lease assets, Intangible assets and Investments/receivables. One of the most important items in Non-current assets is Property, Plant and Equipment (PPE). Figure 21 provides a more specific analysis.

Figure 21. Property, Plant and Equipment⁵⁵

€ million	Land, land rights and buildings, including buildings on third-party land	Technical equipment and machinery	Other equipment, operating and office equipment	Payments on account and assets under construction	Total
Cost					
Balance at Jan. 1, 2020	43,531	50,090	81,997	7,526	183,143
Foreign exchange differences	-907	-1,343	-1,765	-200	-4,214
Changes in consolidated Group	153	0	47	-32	168
Additions	1,914	1,281	3,935	4,410	11,540
Transfers	852	1,040	2,096	-3,883	105
Disposals	392	1,246	1,920	56	3,613
Balance at Dec. 31, 2020	45,151	49,822	84,389	7,766	187,129
Depreciation and impairment					
Balance at Jan. 1, 2020	17,389	36,498	62,862	242	116,991
Foreign exchange differences	-326	-973	-1,393	-9	-2,701
Changes in consolidated Group	34	9	28	-	71
Additions to cumulative depreciation	2,050	3,226	6,561	-	11,838
Additions to cumulative impairment losses	58	46	18	6	127
Transfers	115	-19	98	-193	2
Disposals	177	1,116	1,760	13	3,066
Reversal of impairment losses	0	6	7	3	16
Balance at Dec. 31, 2020	19,142	37,665	66,408	30	123,245
Carrying amount at Dec. 31, 2020	26,009	12,158	17,981	7,736	63,884

Property, Plant and Equipment is that item on the balance sheet that contains the majority of the company's long-term assets, vital to the execution of the company's business operations. It can be seen from Figure 19, that in 2019 it was €66.152 billion, while in 2020 €63.884 billion, experiencing a 3.43% decrease. This decline is mainly due to exchange rate factors and depreciation in excess of additions. Figure 21 gives a more detailed representation, describing and analyzing the different sub-items that are part of it. As understandable from an automaker, the largest sub-item is Land, land rights and buildings, including buildings on third-party land which is €26.009 billion, slightly lower than year 2019, which was €26.142 billion. Obviously, most of the

⁵⁵ Annual report Volkswagen 2020, https://www.volkswagenag.com/presence/investorrelation/publications/annual-reports/2021/volkswagen/Y_2020_e.pdf

Property, Plant and Equipment is used by the automotive division, with €62.807 billion out of the total €63.884 billion, about 98.3%. The remainder is used by the financial services division.

Current assets, which represent 39.2% of the company's Total assets in 2020, have a value of €194.944 billion. There was a growth compared to 2019, when the value was €187.463 billion, of about 3.99%. If taking the 2017-2020 period as a reference point, Volkswagen's Total assets in 2017 were €160.112 billion, and the growth over the three-year period was massive, by about 21.75%. To take a more detailed look at the composition of the €194.944 Current assets, they can be divided as follows:

- €97.236 billion attributable to the automotive division (about 49.88% of total Current assets), whose main items are Inventories and Cash and cash equivalents;
- €97.708 billion attributable to the financial services division (the remaining 50.12%), whose most important item is Financial service receivables, but this item, unlike the one present in Current assets, represents receivables with long-term maturity.

Looking at the value of Current assets in absolute terms, €194.944 billion, and its growth in 2019-2020, by 3.99%, we can see that the latter was mainly caused by an increase in Cash and cash equivalents, which is one of the key items along with Inventories. There will be a more in-depth analysis of these two items.

Cash, cash equivalents and time deposits amount to €33.909 billion in 2020. It is possible to analyze, even in this situation, where the value of this item comes from:

- €24.222 billion from the automotive division, or about 71.43% of the entire value of Cash and cash equivalents;
- €9.687 billion from the financial services division, which represents the remaining 28.57%.

In the period 2017-2020 there has been a considerable growth, in fact Cash and cash equivalent has increased from €18.457 billion in 2017 to €33.909 billion in 2020, with a percentage growth of about 83.7%. If the time period 2019-2020 is taken as a reference, the growth is still positive, but less substantial. In 2019 Cash and cash equivalent was €25.923 billion, in 2020 there was a percentage growth of about 30.81%. The growth in 2019-2020, in absolute values, was €7.986 billion, and can mainly be explained by changes in Cash from operating activities (+€24.901 billion), Cash from investing activities (-€22.690 billion), Cash from financing activities (+€7.637 billion).⁵⁶

⁵⁶ Data taken from Cash flow statement, Annual Report 2020, https://www.volkswagenag.com/presence/investorrelation/publications/annual-reports/2021/volkswagen/Y_2020_e.pdf

Figure 22. Inventory⁵⁷

€ million	Dec. 31, 2020	Dec. 31, 2019
Raw materials, consumables and supplies	6,966	6,099
Work in progress	4,022	4,110
Finished goods and purchased merchandise	27,204	30,617
Current lease assets	5,337	5,699
Prepayments	288	222
Hedges on inventories	6	-6
	43,823	46,742

In Figure 22, the company's Inventory is analyzed in detail. First of all, it should be noted that there was, from 2019 to 2020, a decrease in volumes of about -5.83%, from €46.742 billion in 2019 to €43.823 billion in 2020. This decrease represents the result of reduced production due to the ongoing pandemic and due to exchange rate effects. As a demonstration of this, Finished goods also decreased from 2019 to 2020 by -11.15%, while Raw materials remained almost unchanged. Again, almost all Inventories are attributable to the automotive division, amounting to €39.055 billion, or 89.12% of the total.

Equity in 2020 is €128.783 billion, an increase of about 4.15% compared to 2019, when it was €123.651 billion. Again, as specified in Figure 19, an analysis by division can be made:

- In the automotive division, Equity amounts to €96.733 billion, 4.3% more than in 2019. It represents approximately 75.11% of the company's entire Equity;
- For financial services division, Equity amounted to €32.050 billion, 3.8% higher when considering 2019.

Total assets (which grew in 2019-20 by €9.043 billion or +1.8%) represent around 223% of Total revenues in 2020 (capital intensity ratio). If only the automotive sector is taken into consideration, this incidence drops to around 140%. This figure confirms a high need for invested capital in relation to revenues mainly due to investments linked to continuous product innovation.

⁵⁷ Annual report Volkswagen 2020, https://www.volkswagenag.com/presence/investorrelation/publications/annual-reports/2021/volkswagen/Y_2020_e.pdf

Analysis of Statements of Operations

Figure 23. Consolidated Statements of Operations Volkswagen 2020⁵⁸

€ million	VOLKSWAGEN GROUP		AUTOMOTIVE ¹		FINANCIAL SERVICES	
	2020	2019	2020	2019	2020	2019
Sales revenue	222,884	252,632	182,106	212,473	40,778	40,160
Cost of sales	-183,937	-203,490	-150,507	-170,477	-33,430	-33,014
Gross profit	38,947	49,142	31,599	41,996	7,348	7,146
Distribution expenses	-18,407	-20,978	-17,267	-19,712	-1,140	-1,266
Administrative expenses	-9,399	-9,767	-7,147	-7,522	-2,252	-2,245
Net other operating result	-1,466	-1,437	-522	-1,014	-944	-423
Operating result	9,675	16,960	6,664	13,748	3,012	3,212
Operating return on sales (%)	4.3	6.7	3.7	6.5	7.4	8.0
Share of profits and losses of equity-accounted investments	2,756	3,349	2,697	3,278	60	71
Interest result and Other financial result	-765	-1,953	-469	-1,889	-296	-64
Financial result	1,991	1,396	2,227	1,389	-236	7
Earnings before tax	11,667	18,356	8,891	15,137	2,776	3,219
Income tax expense	-2,843	-4,326	-2,228	-3,491	-615	-836
Earnings after tax	8,824	14,029	6,663	11,646	2,161	2,383
Noncontrolling interests	-43	143	-98	79	55	64
Earnings attributable to Volkswagen AG hybrid capital investors	533	540	533	540	-	-
Earnings attributable to Volkswagen AG shareholders	8,334	13,346	6,227	11,027	2,106	2,319

1 Including allocation of consolidation adjustments between the Automotive and Financial Services divisions.

Figure 23 shows the company's Income Statement. Delving into the values of the various items, it is clear how the pandemic has strongly influenced Volkswagen's financial performance in terms of unit sales, sales revenue and profit throughout the Group. In fact, Sales revenues went from €252.632 billion in 2019 to €222.884 billion in 2020. A percentage decrease of 11.78%, mainly explained by the pandemic that decreased volumes and also by the negative effects of exchange rate changes. This item can be studied in detail.

⁵⁸ Annual report Volkswagen 2020, https://www.volkswagenag.com/presence/investorrelation/publications/annual-reports/2021/volkswagen/Y_2020_e.pdf

Figure 24. Sales revenue⁵⁹

€ million	Passenger Cars and Light Commercial Vehicles	Commercial Vehicles	Power Engineering	Financial Services	Total Segments	Reconciliation	Volkswagen Group
Vehicles	129,913	13,385	–	–	143,298	–13,703	129,595
Genuine parts	11,755	3,249	–	–	15,004	–118	14,886
Used vehicles and third-party products	11,716	1,455	–	–	13,171	–637	12,535
Engines, powertrains and parts deliveries	12,625	669	–	–	13,294	–41	13,253
Power Engineering	–	–	3,640	–	3,640	–2	3,638
Motorcycles	567	–	–	–	567	–	567
Leasing business	767	1,698	0	31,608	34,073	–4,334	29,739
Interest and similar income	192	8	–	7,707	7,907	–261	7,646
Hedges sales revenue	–357	–18	–	0	–375	30	–345
Other sales revenue	8,806	1,709	–	1,463	11,978	–608	11,370
	175,984	22,156	3,640	40,778	242,557	–19,673	222,884

As can be seen in Figure 24, Volkswagen Group had sales vehicle revenue of €129.595 billion in 2020, down sharply from 2019 when sales vehicle revenue was €157.212 billion. In fact, every brand that is part of Volkswagen Group has decreased vehicle sales for their models in 2020, none excluded, depicted in Figure 25.

Figure 25. Vehicle sales and Sales revenue by Brand⁶⁰

Thousand vehicles/€ million	VEHICLE SALES		SALES REVENUE	
	2020	2019	2020	2019
Volkswagen Passenger Cars	2,835	3,677	71,076	88,407
Audi	1,017	1,200	49,973	55,680
ŠKODA	849	1,062	17,081	19,806
SEAT	484	667	9,198	11,496
Bentley	11	12	2,049	2,092
Porsche Automotive ¹	265	277	26,086	26,060
Volkswagen Commercial Vehicles	345	456	9,358	11,473
Scania Vehicles and Services ²	73	101	11,521	13,934
MAN Commercial Vehicles	118	143	10,838	12,663
Power Engineering	–	–	3,640	3,997
VW China ³	3,577	4,048	–	–
Other ⁴	–418	–685	–26,573	–30,931
Volkswagen Financial Services	–	–	38,637	37,957
Volkswagen Group before special items	–	–	–	–
Special items	–	–	–	–
Volkswagen Group	9,157	10,956	222,884	252,632
Automotive Division ⁵	9,157	10,956	182,106	212,473
of which: Passenger Cars Business Area	8,965	10,713	156,311	182,031
Commercial Vehicles Business Area	191	243	22,156	26,444
Power Engineering Business Area	–	–	3,640	3,997
Financial Services Division	–	–	40,778	40,160

In 2019 vehicle sales were 10.956 million (with sales revenue of €252.632 billion), while in 2020 vehicle sales decreased to 9.157 million (with sales revenue of €222.884 billion). A percentage decrease in vehicle sales of

⁵⁹ Annual report Volkswagen 2020, https://www.volkswagenag.com/presence/investorrelation/publications/annual-reports/2021/volkswagen/Y_2020_e.pdf

⁶⁰ Annual report Volkswagen 2020, https://www.volkswagenag.com/presence/investorrelation/publications/annual-reports/2021/volkswagen/Y_2020_e.pdf

approximately 16.42%, partially offset by an increase in average revenue from €23.058 in 2019 to €24.340 in 2020. Vehicle sales, despite this decrease, remains the main source of the company's sales revenue. The others are especially: leasing business inherent mainly to the financial services division, and the production of genuine parts which, clearly, decreased as a result of the decrease in vehicle production (€16.676 billion revenue in 2019, €14.886 billion in 2020).

The direct consequence of the considerable decrease in volumes produced (and therefore in sales revenue) is a reduction in cost of sales. As depicted in the Income Statement, Figure 23, in 2019 the item amounted to €203.490 billion, of which as much as €170.477 was attributable to the automotive division. In 2020, the value of Volkswagen Group's cost of sales decreased to €183.937 billion, broken down as follows:

- €150.507 billion arising from the automotive division, a reduction compared to 2019 of around 11.71%;
- €33.430 billion coming from the financial services division, which remained roughly unchanged considering the previous year.

As can be seen from the above breakdown, the 9.61% decrease in total cost of sales is entirely due to the decrease in costs arising from the automotive division. It should be noted that the incidence of the cost of sales on sales revenues worsens from 80.5% in 2019 to 82.5% in 2020, highlighting an apparent and normal worsening of production efficiency.

A strategic item, when talking about costs incurred by the company, present in the Income Statement is R&D.

Figure 26. Research and Development costs in the automotive division⁶¹

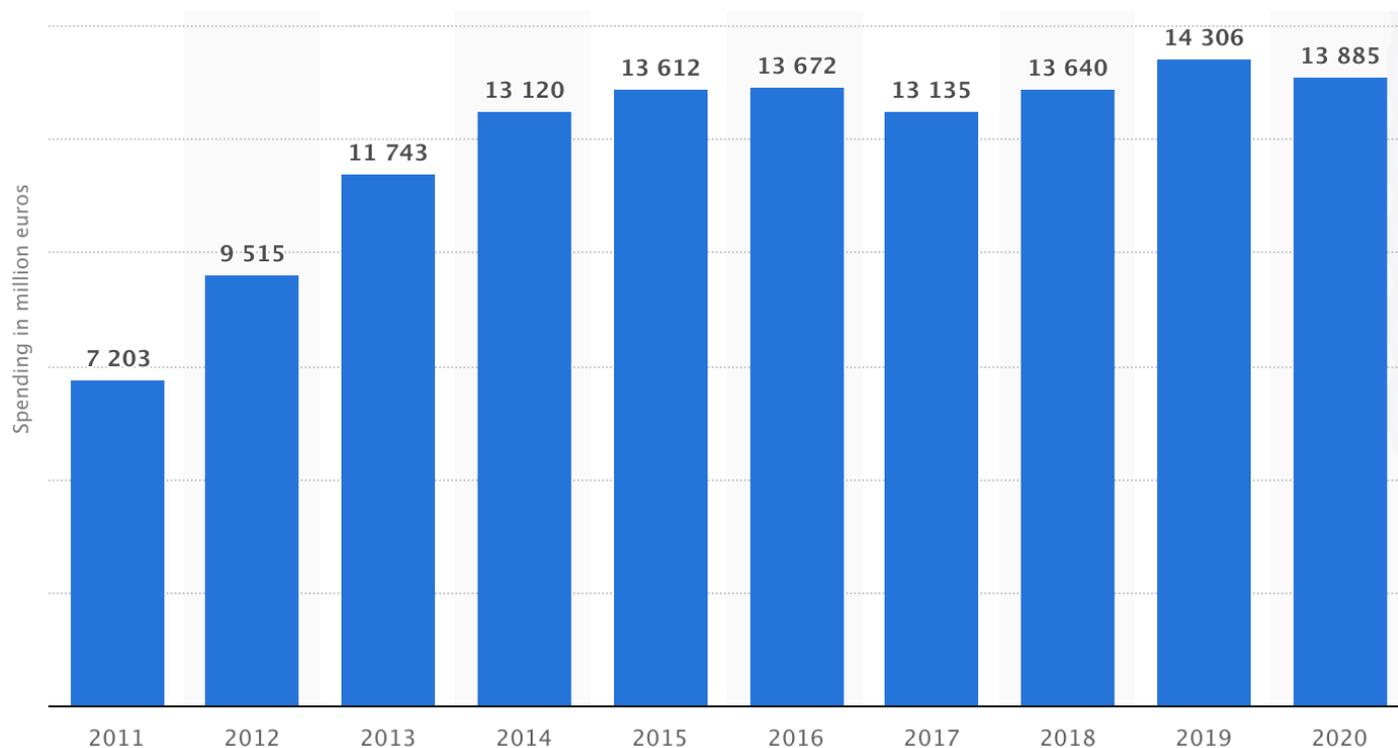
€ million	2020	2019
Total research and development costs	13,885	14,306
of which capitalized development costs	6,473	5,171
Capitalization ratio in %	46.6	36.1
Amortization of capitalized development costs	4,644	4,064
Research and development costs recognized in profit or loss	12,056	13,199
Sales revenue	182,106	212,473
Total research and development costs	13,885	14,306
R&D ratio	7.6	6.7

Total research and development costs, like other costs, also decreased. In 2019 they amounted to €14.306 billion, while in 2020 they are €13.885 billion, a percentage decrease of 2.94%. Despite this, Volkswagen filed as many as 6.795 patent applications worldwide for employee inventions in 2020. The fact that an ever-increasing share of these patents cover important cutting-edge fields underscores the company's strong desire to invest in the future and not be unprepared. These fields include driver assistance systems, automation and

⁶¹ Annual report Volkswagen 2020, https://www.volkswagenag.com/presence/investorrelation/publications/annual-reports/2021/volkswagen/Y_2020_e.pdf

connectivity, and alternative driving systems. It can be seen in Figure 26 that R&D ratio, despite the decrease in the absolute amount, has increased in 2020 compared to 2019, in fact it goes from 6.7% in 2019 to 7.6% in 2020 mainly due to the strong decrease in sales revenue.

Figure 27. Volkswagen's research and development expenses from 2011 to 2020⁶²



Considering that R&D appears to be one of the most significant items of a company, it can be analyzed by considering a wider time frame, in Figure 27. It can be seen that, except in the period 2011-2013, there is a certain constancy in the expenses that the company has allocated to research and development. On the contrary, in the three-year period 2017-2019 there was a good growth (+8.92%) then crushed by the advent of the pandemic.

Gross profit for the company amounted to €38.947 billion in 2020, about €10.2 billion less than in 2019. This figure also included risk provisions for possible non-compliance with legal emission limits. Gross margin amounted to 17.5%, without taking special items into account, while it was 19.5% in 2019.

The persistent negative impact of the spread of the SARSCoV-2 virus was the main factor of the various economic and financial damages suffered by the company, mainly causing a decline in unit sales due to a drop in customer demand, but also created turbulence in the capital markets had a negative effect on the valuation of foreign currency receivables and payables. Lower volumes led to a decrease in the cost of sales, although its ratio to sales revenue increased compared to the previous year. In addition, there were also one-off expenses of €0.5 billion which contributed to the reduction in profit. The positive aspects are, however, manifold:

⁶² <https://www.statista.com/statistics/566234/volkswagen-automotive-division-research-development-spending/>

- Consequent decrease in costs, as analyzed above;
- The contribution of the consolidated subsidiary Autonomous Intelligent Driving (AID) to Argo AI, a company that is working on the development of a system for autonomous driving, led to income of €0.8 billion, a figure that also includes proceeds from the sale of Renk.

The Volkswagen Group's operating profit decreased significantly year-on-year (-42.95%) from an operating profit of €16.960 billion in 2019 to €9.675 billion in 2020. This reduction is mainly attributable to the automotive division, considering that Operating profit in 2020 is €6.664 billion while in 2019 it was €13.748 billion.

Unlike Tesla, Volkswagen's annual report does not have sufficient information regarding regulatory credits. The company is committed to substantially decrease emissions, stating that in 2021, thanks to the strong investment in electric vehicles, it will be able to meet EU's CO2 fleet targets. In this regard, in 2016 was announced the TOGETHER 2025+ Group strategy, then improved in 2019 and still one of the main projects of the company. The stated goal is "to more actively shape the future of mobility while safeguarding it sustainably, for present and future generations. Our goal is to make mobility sustainable for us and for future generations." ⁶³

According to a British news agency, Volkswagen's joint venture with Chinese state-owned automaker FAW, or FAW-Volkswagen, has agreed to buy regulatory credits from Tesla. ⁶⁴

⁶³ <https://www.volkswagenag.com/en/sustainability/environment/strategy-together-2025.html>

⁶⁴ <https://www.reuters.com/article/uk-volkswagen-tesla-china-exclusive-idUKKBN2BO588>

Analysis of the Statistics

In order to carry out a comparative analysis of the companies examined in this work, it was considered useful to obtain from the Yahoo Finance website some data considered significant updated to the date of May 14, 2021 in order to compare homogeneous data. Figure 28 shows the most significant balance sheet data and valuation measures calculated as of 14 May 2021.

Figure 28 Income Statement, Balance Sheet, Valuation measures⁶⁵

Income Statement		Valuation Measures	
Revenue (ttm)	230.21B	Market Cap (intraday) ⁵	121.48B
Revenue Per Share (ttm)	459.22	Enterprise Value ³	266.13B
Quarterly Revenue Growth (yoy)	13.30%	Trailing P/E	9.46
Gross Profit (ttm)	36.7B	Forward P/E ¹	N/A
EBITDA	27.19B	PEG Ratio (5 yr expected) ¹	N/A
Net Income Avi to Common (ttm)	11.17B	Price/Sales (ttm)	0.53
Diluted EPS (ttm)	22.29	Price/Book (mrq)	0.80
Quarterly Earnings Growth (yoy)	547.50%	Enterprise Value/Revenue ³	1.16
Balance Sheet		Enterprise Value/EBITDA ⁷	9.79
Total Cash (mrq)	44.5B		
Total Cash Per Share (mrq)	88.76		
Total Debt (mrq)	205.74B		
Total Debt/Equity (mrq)	152.94		
Current Ratio (mrq)	1.20		
Book Value Per Share (mrq)	264.78		

¹ Data provided by Refinitiv.³ Data derived from multiple sources or calculated by Yahoo Finance.⁵ Shares outstanding is taken from the most recently filed quarterly or annual report and Market Cap is calculated using shares outstanding.

⁷ EBITDA is calculated by S&P Global Market Intelligence using methodology that may differ from that used by a company in its reporting.

The Market Cap value, calculated considering the outstanding shares according to the company's latest official report, is €121.48 billion. EBITDA of €27.19 billion is down from 2019 by 8.47% (2019 EBITDA of 29.706 billion, trailing P/E (based on the most recent 12 months' financial data) is 9.46. This value is quite aligned with the global average P/E value of the automotive sector which was in the 2012-2019 period equal to 10-12 and in the post-Covid period rose up to 40 due to the crisis. The Enterprise Value/EBITDA ratio (Earnings before Interest taxes depreciation and amortization), which is equal to 9.79, appears slightly higher than the global average value (in the period 2012-2019 it was equal to 4-6, today it is equal to 10 and at the end of the next two years it is expected to be equal to 7).⁶⁶

⁶⁵ <https://finance.yahoo.com/quote/VOW3.DE/key-statistics?p=VOW3.DE> data of May 14, 2021

⁶⁶ Bloomberg: MSCI WORLD AUTO & COMPONENTS INDEX, data of April 28, 2021

Total cash is €44.5 billion and total cash per share is €88.76. The Current ratio, which represents the ratio of current assets to current liabilities, is 1.20. This indicator expresses the company's ability to repay short-term or current obligations within one year. This value is better than the Current ratio of the automotive industry, which as of 2020-12-31 was about 1.09.⁶⁷

The diluted EPS ttm, in which the total number of ordinary shares is calculated taking into account the possible exercise or conversion of equivalent securities by, for example, holders of convertible bonds and stock options, is €22.29.

Analysis of strategic alliances

Volkswagen Group, especially through its TOGETHER 2025+ program, seeks to make innovation its flagship, in fact employees work on sustainable solutions for urban and intercity mobility systems. The areas of digitalization, sustainability and e-mobility receive continuous support through innovative projects. In order to make the studies in these areas more effective, innovation structures are very often created that allow the company to initiate projects with international partners. The following are Volkswagen Group's alliances, described in the 2020 Report.

An alliance has been formed with Ford Motor Company with the intention of working together on the development of mid-size vans and pickups. In early June 2020, Ford Motor Company and Volkswagen AG signed additional contracts within their existing global alliance for light commercial vehicles, electrification and autonomous driving. These additional contracts include the development of three projects: the existing mid-size pickup truck project; projects for an urban van; and a one-ton cargo van. Approximately 8 million vehicles are expected to be produced from this alliance.

An investment has been made, along with Ford, in Argo AI, a company that is working on developing a system for autonomous driving. This alliance turns out to be crucial, as it allows both automakers to integrate Argo AI's autonomous driving system into their vehicles, independently of each other. The system that Volkswagen and Ford are integrating makes fully autonomous driving possible.

Ford, thanks to the stipulated alliance, intends to use the Modular Electric Drive Toolkit (MEB) developed by Volkswagen for a zero-emission model that is expected to be offered in Europe from 2023.

The goal of this strategic alliance, is to allow both Volkswagen and Ford to increase their competitiveness in the market by seeking to develop innovations in cooperation, adapt their products to better meet the needs of customers around the world and at the same time exploit synergies related to costs and investments.

Volkswagen also has a strategic alliance with Microsoft, which allows the automaker to accelerate the process of digitalization and connectivity it has set as its goal, which is to become a mobility service provider with a

⁶⁷ <https://www.macrotrends.net/stocks/charts/GPI/group-1-automotive/current-ratio>

fully connected vehicle fleet, developing software for increasingly high-performance cars and increasing the company's IT expertise.

Volkswagen's goal is to make battery technology a core competency, as it represents 20-30% of the material cost of an electric vehicle and will also be one of the key components to differentiate the company's product from the competition. In this sense, in order to meet the huge demand (battery capacity of more than 150 GWh), strategic agreements are being developed with several suppliers, and above all a 16 GWh battery cell factory will be built in Salzgitter.

The Volkswagen Passenger Cars, Audi and Porsche brands are involved in the pan-European High-Power IONITY joint venture, in which a comprehensive charging infrastructure is being built to ensure long-distance mobility. The goal is to have 400 charging stations in operation by the end of 2021.

Another very important partner is QuantumScape, with whom Volkswagen is working to bring solid-state batteries to market.

2.3 Toyota



Company overview⁶⁸

Toyota Motor Corporation is a limited liability, joint stock company incorporated under the Commercial Code of Japan and continues to exist under the Companies Act. Toyoda Kiichiro in 1933 founded what we now call Toyota Motor Corporation, and was a division of Toyoda Automatic Loom Works, Ltd. a company created by his father. In 1936 the first model, called Model AA, a sedan, was released. In August 1937 Toyota became a separate and autonomous company headed by Kiichiro, who over the years, founded several related companies, including: Toyoda Machine Works, Ltd. (1941), and Toyota Auto Motor Company. (1941) and Toyota Auto Body, Ltd. (1945).

During World War II, the company decided to suspend production of cars, given the historical moment, and focus on trucks. The world conflict caused general destruction and brought chaos to the post-war economy, for these reasons Toyota did not start producing cars again until 1947, when the Model SA was released.

By 1950, Toyota factories were back in full operation, but the technical and economic difference with the big American car manufacturers was still very marked. The Japanese company decided, then, to implement a detailed study of American manufacturers to gain competitiveness and knowledge. Several Toyota executives visited American factories, including the Ford Motor Company, to learn about the different technologies implemented in American plants. It is thanks to this careful study that Toyota's production efficiency increased considerably.

The result of the careful study and emulation of technologies led to the birth of Toyota Motor Sales, U.S.A., Inc. and the following year the company launched the Toyopet sedan, its first model to be marketed in the United States. Unfortunately, the first model launched in the U.S. market was not as successful as hoped, in fact it was criticized because of its high cost and lack of horsepower. In 1958 was launched the Land Cruiser,

⁶⁸ For this paragraph, this source has been taking into account: <https://www.britannica.com/topic/Toyota-Motor-Corporation>

a 4x4 utility vehicle that had a fair success. The first vehicle that was a real success, however, was the Toyota Corona, which was the Toyopet model redesigned for American drivers.

In the '60s and '70s, Toyota expanded very rapidly and began to export more and more cars to foreign markets. It was during this period that it acquired several companies such as: Hino Motors, Ltd. (1966), a manufacturer of buses and large trucks. (1966); Nippondenso Company, Ltd. a manufacturer of electrical components for automobiles; and Daihatsu Motor Company, Ltd. (1967). It became Japan's largest automobile manufacturer and continued to be successful in the United States because of the reputation it had earned: low-cost, fuel-efficient, and reliable vehicles.

In 1982 Toyota Motor Company and Toyota Motor Sales merged into one company, the Toyota Motor Corporation of today.

The company has experienced significant growth into the 21st century, differentiating and innovating every year. It has created: Lexus, its luxury brand (1989); the first mass-produced hybrid-powered vehicle in the world, the Prius (1997). In 1999 Toyota was listed on both the London Stock Exchange and the New York Stock Exchange.

However, there have also come some very complex times that Toyota has had to deal with: the global financial crisis of 2008 and the one stemming from the still ongoing Covid 19 that caused sales to plummet; an international safety recall of more than eight million vehicles in 2010, which temporarily halted production and sales of many models. Beginning in 2014, millions of Toyota vehicles and more were recalled by regulators in the U.S. due to potentially malfunctioning airbags manufactured by Japanese automotive parts supplier Takata.

Today, Toyota is one of the world's largest automakers, and its manufacturing is not just about cars; it has subsidiaries around the world that produce: rubber and cork materials, steel, synthetic resins, auto looms, and cotton and wool items.

In 2020, Toyota and its affiliates produce automobiles and its components through more than 50 overseas manufacturing organizations in 27 countries and regions besides Japan. Plants are located primarily in Japan, the United States, Canada, the United Kingdom, France, Turkey, the Czech Republic, Russia, Poland, Thailand, China, Taiwan, India, Indonesia, South Africa, Argentina and Brazil.

Figure 29. Equities and shareholders⁶⁹

Equities							
	Vote ⓘ	Quantity	Free-Float		Company-owned shares		Total Float
Stock A	0.01	3,262,997,492	2,350,915,870	72.0%	467,048,832	14.3%	72.0%
Stock B	0	47,100,000	0	0.0%	0	0.0%	

Shareholders		
Toyota Motor Corporation (JP3633400001) ▼		
Name	Equities	%
Toyota Motor Corporation	467,043,585	14.3%
Toyota Industries Corporation	238,466,000	7.31%
Nippon Life Insurance Co.	127,340,000	3.90%
DENSO Corporation	89,915,000	2.76%
Nomura Asset Management Co., Ltd.	74,151,014	2.27%
The Vanguard Group, Inc.	60,449,000	1.85%
MS&AD Insurance Group Holdings, Inc.	56,814,000	1.74%
Tokio Marine Holdings, Inc.	51,064,000	1.56%
Sumitomo Mitsui Financial Group, Inc.	37,611,495	1.15%
Daiwa Asset Management Co. Ltd.	35,696,914	1.09%

Figure 29, depicted below, shows the composition of the company's equities and shareholders. Toyota, in 2020, has 366,283 employees.

Figure 30. Brand portfolio⁷⁰



Figure 30 shows the most important brands that are part of Toyota, namely:

- Daihatsu, a Japanese automaker that produces mini vehicles and compact cars;
- Lexus, the luxury vehicle brand of the Toyota group;
- Toyota Hybrid, which is the hybrid vehicles branded Toyota;
- Hino, not included in Figure 30, manufactures and sells trucks and buses.

⁶⁹ <https://www.marketscreener.com/quote/stock/TOYOTA-MOTOR-CORPORATION-6492484/company/>

⁷⁰ <https://www.allbrands.markets/brand/price-share-stock-market-toyota-21074540400-jp3633400001/other-brands-toyota/>

Analysis of Balance Sheet⁷¹

Figure 31. Consolidated balance sheet Toyota 2020⁷²

	Yen in millions	
	March 31,	
	2019	2020
Assets		
Current assets		
Cash and cash equivalents	3,574,704	4,190,518
Time deposits	1,126,352	828,220
Marketable securities*1	1,127,160	678,731
Trade accounts and notes receivable, less allowance for doubtful accounts of ¥16,370 million in 2019 and ¥23,944 million in 2020	2,372,734	2,094,894
Finance receivables, net	6,647,771	6,614,171
Other receivables	568,156	564,854
Inventories	2,656,396	2,434,918
Prepaid expenses and other current assets	805,964	1,236,225
Total current assets	<u>18,879,237</u>	<u>18,642,531</u>
Noncurrent finance receivables, net	<u>10,281,118</u>	<u>10,423,858</u>
Investments and other assets		
Marketable securities and other securities investments*1	7,479,926	7,348,651
Affiliated companies	3,313,723	4,123,453
Employees receivables	21,683	21,484
Other	1,275,768	1,518,934
Total investments and other assets	<u>12,091,100</u>	<u>13,012,522</u>
Property, plant and equipment		
Land	1,386,308	1,346,988
Buildings	4,802,175	4,730,783
Machinery and equipment	11,857,425	11,939,121
Vehicles and equipment on operating leases	6,139,163	5,929,233
Construction in progress	651,713	510,963
Total property, plant and equipment, at cost	24,836,784	24,457,088
Less - Accumulated depreciation	<u>(14,151,290)</u>	<u>(13,855,563)</u>
Total property, plant and equipment, net	<u>10,685,494</u>	<u>10,601,525</u>
Total assets	<u><u>51,936,949</u></u>	<u><u>52,680,436</u></u>

⁷¹ Annual report Toyota 2020, https://s3.amazonaws.com/toyota-cms-media/toyota-pdfs/20-F_202003_final.pdf

⁷² Annual report Toyota 2020, https://s3.amazonaws.com/toyota-cms-media/toyota-pdfs/20-F_202003_final.pdf

	Yen in millions	
	March 31,	
	2019	2020
Liabilities		
Current liabilities		
Short-term borrowings	5,344,973	5,286,026
Current portion of long-term debt	4,254,260	4,574,045
Accounts payable	2,645,984	2,434,180
Other payables	1,102,802	1,020,270
Accrued expenses	3,222,446	2,926,052
Income taxes payable	320,998	218,117
Other current liabilities	1,335,475	1,443,687
Total current liabilities	<u>18,226,938</u>	<u>17,902,377</u>
Long-term liabilities		
Long-term debt	10,550,945	10,692,898
Accrued pension and severance costs	963,406	978,626
Deferred income taxes	1,014,851	1,043,169
Other long-term liabilities	615,599	821,515
Total long-term liabilities	<u>13,144,801</u>	<u>13,536,208</u>
Total liabilities	<u>31,371,739</u>	<u>31,438,585</u>
Mezzanine equity		
Model AA Class Shares, no par value,*2	498,073	504,169
authorized: 150,000,000 shares in 2019 and 2020;		
issued: 47,100,000 shares in 2019 and 2020		
Shareholders' equity		
Toyota Motor Corporation shareholders' equity		
Common stock, no par value,*2		
authorized: 10,000,000,000 shares in 2019 and 2020;		
issued: 3,262,997,492 shares in 2019 and 2020	397,050	397,050
Additional paid-in capital	487,162	489,334
Retained earnings	21,987,515	23,427,613
Accumulated other comprehensive income (loss)	(916,650)	(1,166,273)
Treasury stock, at cost, 430,558,325 shares in 2019 and 496,844,960 shares in 2020	(2,606,925)	(3,087,106)
Total Toyota Motor Corporation shareholders' equity	<u>19,348,152</u>	<u>20,060,618</u>
Noncontrolling interests	718,985	677,064
Total shareholders' equity	<u>20,067,137</u>	<u>20,737,682</u>
Commitments and contingencies		
Total liabilities, mezzanine equity and shareholders' equity	<u>51,936,949</u>	<u>52,680,436</u>

*1: Marketable securities and Marketable securities and other securities investments for the fiscal year ended March 31, 2020 include securities loaned of ¥156,051 million and ¥2,061,295 million, respectively.

*2: The total number of authorized shares for common stock and Model AA Class Shares is 10,000,000,000 shares.

The accompanying notes are an integral part of these consolidated financial statements.

Toyota's automotive operations include the design, manufacture, assembly and sale of passenger vehicles, minivans and commercial vehicles such as trucks and related parts and accessories. Toyota's financial services consist mainly of providing financing to dealers and their customers for the purchase or lease of Toyota vehicles.

Figure 31 shows Toyota's 2020 Balance Sheet. It also felt the impact of the pandemic outbreak, as all automotive companies do, because its primary business is conducted in the automotive industry. Markets

collapsed, leading to the suspension of operations at factories and the suspension of business at dealers around the world.

Toyota sold a total of 8,958 million vehicles on a consolidated basis in 2020, an almost imperceptible reduction when compared to the year 2019, when sales were 8.976 million.

Analyzing the Balance Sheet, depicted in Figure 31, shows that Toyota ended 2020 with Total assets of ¥52,680 billion. In 2019, the same item amounted to ¥51,936 billion, so there was a percentage growth of about 1.4% in the two-year period considered. Considering the pandemic, in order to have a more detailed analysis, Total assets can be analyzed by studying a larger time frame. For example, they were ¥48,750 billion in 2017. The growth in Total assets, therefore, appears to be more considerable (+8.06%).

Among the most important Total assets is Property, Plant and Equipment, which is depicted specifically in Figure 32.

Figure 32. Property, Plant and Equipment⁷³

Property, plant and equipment

Land	1,386,308	1,346,988
Buildings	4,802,175	4,730,783
Machinery and equipment	11,857,425	11,939,121
Vehicles and equipment on operating leases	6,139,163	5,929,233
Construction in progress	651,713	510,963
	<u>24,836,784</u>	<u>24,457,088</u>
Total property, plant and equipment, at cost		
Less - Accumulated depreciation	(14,151,290)	(13,855,563)
	<u>10,685,494</u>	<u>10,601,525</u>
Total property, plant and equipment, net		

The net total in 2020 was ¥10,601 billion, compared to ¥10,685 in 2019. A decrease of approximately ¥83.9 billion, percentage -0.8%, reflecting THC and Misawa Homes no longer being the parent company's consolidated subsidiaries, partially offset by capital expenditures.

Total capital expenditures for property, plant and equipment, excluding vehicles and equipment on operating leases, amounted to ¥1,407.8 billion in 2020, roughly unchanged from 2019.

Analyzing the items, it can be seen that the main one is Machinery and equipment, with a value in 2020 of ¥11,939 billion, common in all automotive companies. Buildings have decreased significantly, -1.49%, also due to the block of production in many countries due to Covid, which has discouraged further investment.

Toyota planned to invest in Property, plant and equipment approximately ¥1,350.0 billion during fiscal 2021. Current assets are ¥18,642 billion in 2020, down from 2019 when they amounted to ¥18,879 billion, a percentage decrease of approximately 1.26%. As depicted in Figure 31, the items that decreased in value the most, from 2019 to 2020, are: trade accounts and notes receivable; marketable securities, which are assets that can be liquidated into cash very quickly, 1 year or less; time deposits; and inventories.

To analyze the changes specifically, the most important items in Current assets will be analyzed below.

⁷³ Annual report Toyota 2020, https://s3.amazonaws.com/toyota-cms-media/toyota-pdfs/20-F_202003_final.pdf

Cash and cash equivalents equate to ¥4,190 billion in 2020, a considerable growth when considering 2019, in which it amounted to ¥3,574 billion. An increase of 17.23%, which in absolute values is approximately ¥616 billion, which can be explained mainly by:

- Net cash from operating activities amounting to + ¥3,590.6 billion in 2020, decreased however compared to 2019 when it was ¥3,766.5 billion, due to the decrease in operating income;
- Net cash used by investing activities of - ¥3,150.8 billion in 2020, while it was - ¥2,697.2 billion in 2019. This difference was mainly due to the purchase of marketable securities and security investments;
- Net cash from financing activities amounted to + ¥397.1 billion, while it amounted to - ¥540.8 billion in 2019. A change due to the ¥690.5 billion increase in funding by long-term debt.⁷⁴

Figure 33. Inventories⁷⁵

	Yen in millions	
	March 31,	
	2019	2020
Finished goods	1,746,159	1,517,173
Raw materials	475,504	485,069
Work in process	324,921	315,139
Supplies and other	109,812	117,537
Total	<u>2,656,396</u>	<u>2,434,918</u>

Figure 33 depicts Inventories more analytically. First, it shows that they amount to ¥2,434 billion in 2020 and ¥2,656 billion in 2019. A percentage decrease of 8.34%, or, in absolute values, ¥221.4 billion. This decrease was due mainly to THC and Misawa Homes no longer being the parent company's consolidated subsidiary companies.

Examining the numbers in Figure 33, the item that suffered the largest decrease was Finished goods. The latter amounted to ¥1,746 billion in 2019, while in 2020 it is ¥1,517 billion, a percentage reduction of 13.08%.

Equity in 2020 amounts to ¥20,737 billion, quite a remarkable increase when considering 2019, in which it was ¥20,067 billion. A growth of about 3.34% which, as depicted in Figure 31, can be mainly attributed to a strong increase in Retained earnings during the period under review. In 2019 they were equivalent to ¥21,987 billion, while in 2020 they become ¥23,427 billion, with a percentage growth of around 6.55%.

Total assets, which, as mentioned above, decreased in 2019-20 by ¥744 billion, represent around 176% of total revenues (capital intensity ratio) in 2020. The high need for invested capital in relation to revenues is also confirmed for this company.

⁷⁴ Data taken from Cash flow statement, Annual Report 2020, https://s3.amazonaws.com/toyota-cms-media/toyota-pdfs/20-F_202003_final.pdf

⁷⁵ Annual report Toyota 2020, https://s3.amazonaws.com/toyota-cms-media/toyota-pdfs/20-F_202003_final.pdf

Toyota's most significant business is automotive, in fact it accounts for about 88% of the company's total revenues. In fiscal 2020, Toyota's primary markets based on unit sales of vehicles were: Japan (25.0%), North America (30.3%), Europe (11.5%) and Asia (17.9%).

The most significant items will be analyzed in detail.

Figure 35. Net revenues⁷⁷

	Yen in millions			
	Year ended March 31,		2020 v. 2019 Change	
	2019	2020	Amount	Percentage
Vehicles	23,066,190	22,852,916	(213,274)	(0.9)%
Parts and components for overseas production	625,483	603,928	(21,555)	(3.4)
Parts and components for after service	2,093,437	2,103,478	10,041	0.5
Other	1,249,382	1,274,163	24,781	2.0
Total Automotive	27,034,492	26,834,485	(200,007)	(0.7)
All Other	1,070,846	925,264	(145,582)	(13.6)
Total sales of products	28,105,338	27,759,749	(345,589)	(1.2)
Financial Services	2,120,343	2,170,243	49,900	2.4
Total	30,225,681	29,929,992	(295,689)	(1.0)%

In Figure 35 there are Toyota's net revenues represented by product category and by business. Total net revenues were ¥30,225 billion in 2019 and ¥29,929 billion in 2020. There was a decrease, in absolute terms, of ¥295.6 billion or approximately 1% compared to the prior fiscal year. This decrease can be mainly explained by the ¥880,0 billion unfavorable impact of changes in exchange rates, partly offset by the ¥440,0 billion impact of changes in vehicle unit sales and sales mix. Net revenues for fiscal 2020 reflects a ¥380,0 billion negative impact attributable to the decrease in consolidated vehicle unit sales due to the effects of the global spread of COVID-19.

Total automotive net revenues in fiscal 2020 are ¥26,834 billion, a decrease of 0.7% compared to fiscal 2019, when it stood at ¥27,034 billion. If looking at Net revenues from total sales of products, in which net revenues from automotive operations and all other operations are included, they decreased by 1.2% in the 2019-2020 period. The main reasons for this, in addition to COVID-19 of course, are: the unfavorable impact of fluctuations in foreign currency translation rates.

In contrast, net revenues from financial services increased in the 2019-2020 period by 2.4%, ¥49.9 billion, from ¥2,120 billion to ¥2,170 billion.

⁷⁷ Annual report Toyota 2020, https://s3.amazonaws.com/toyota-cms-media/toyota-pdfs/20-F_202003_final.pdf

Figure 36. Operating costs and expenses⁷⁸

	Yen in millions			
	Year ended March 31,		2020 v. 2019 Change	
	2019	2020	Amount	Percentage
Operating costs and expenses				
Cost of products sold	23,389,495	23,142,744	(246,751)	(1.1)%
Cost of financing operations	1,392,290	1,379,620	(12,670)	(0.9)
Selling, general and administrative	2,976,351	2,964,759	(11,592)	(0.4)
Total	<u>27,758,136</u>	<u>27,487,123</u>	<u>(271,013)</u>	<u>(1.0)%</u>

Figure 36 shows the costs incurred by the Company in 2019 and 2020. Total operating costs and expenses decreased by ¥271 billion from 2019 to 2020, as a percentage -1.0%, due to the following main reasons:

- ¥575,0 billion favorable impact of exchange rate changes;
- ¥170,0 billion decrease in cost reduction efforts, of which ¥100 billion resulted from the reduction in design-related costs due mainly to ongoing value engineering activities, and the remaining ¥70 billion related to cost reduction efforts at plants and logistics departments;
- ¥45,0 billion decrease in expenses and cost reduction efforts;
- ¥208,1 billion decrease in others;
- A ¥700 billion increase in the impact of changes in unit vehicle sales and sales mix.

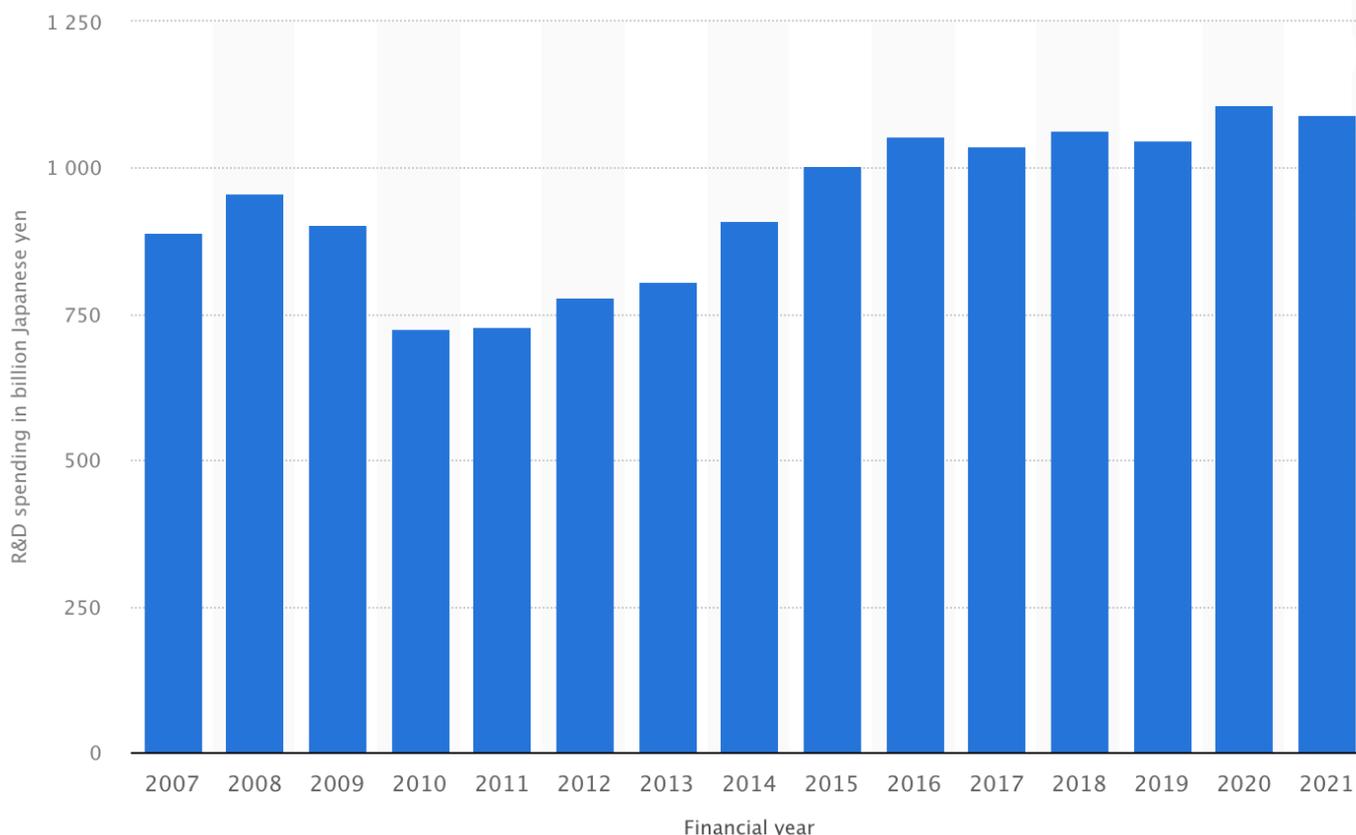
Toyota's research and development expenditures were approximately ¥1,110.3 billion in fiscal 2020, ¥1,048.8 billion in fiscal 2019 and ¥1,064.2 billion in fiscal 2018. This is a strategic item for an industry as competitive and evolving as the automotive industry. In fact, in 2016, Toyota founded the Toyota Research Institute, Inc. ("TRI") to accelerate research and development of artificial intelligence technology, which has significant potential to support future industrial technologies. It also established a technical development center in Otemachi, Tokyo, to speed up the development of key IT technologies that will be critical and support automated driving, leveraging big data.

Toyota was the first to produce and sell a mass-produced hybrid car (Toyota Prius), which stands as it makes R&D its workhorse to stay competitive.

A more comprehensive study can be made by analyzing Toyota's research and development expenses over the last 10 years.

⁷⁸ Annual report Toyota 2020, https://s3.amazonaws.com/toyota-cms-media/toyota-pdfs/20-F_202003_final.pdf

Figure 37. Research and Development expenses Toyota from 2007 to 2021⁷⁹



As shown in Figure 37, R&D spending from 2015 onwards has been more or less constant, peaking in 2020 at ¥1,110.3 billion and then falling sharply in 2021 at ¥1,090.4 billion. The lowest, on the other hand, in the years taken into consideration, was 2010 with ¥725.35 billion. The R&D ratio, calculated on sales of products, is 3.7% in 2020.

Net income attributable to the shareholders of Toyota Motor Corporation increased by ¥193.3 billion, or 10.3%, in fact in 2019 the value stood at ¥1,882.8 billion, while in 2020 it was ¥2,076.1 billion. Total net income in 2019 was ¥1,985.6 billion, while in 2020 it turns out to be ¥2,142.3 billion, a percentage growth of 7.89%.

There is no data on regulatory credits in Toyota's annual report, but like every other company in the automotive industry, it is committed to improving the emissions of its vehicles and plants. The company's 2030 Milestone is:

- Achieve global sales of electrified vehicles of more than 5.5 million, including more than 1 million zero emission vehicles ("EVs") and FCVs.) Compared to 2010, the company anticipates a 35% decrease in global average CO₂ emissions, in g-CO₂/km, from new vehicles produced;
- Compared to 2013, reduce CO₂ emissions by 25% or more over the entire vehicle lifecycle through the support of suppliers, energy providers, infrastructure developers, governments and customers;

⁷⁹ <https://www.statista.com/statistics/279648/research-and-development-spending-at-toyota/>

- Compared to 2013, reducing CO2 emissions from global plants by 35%, while also seeking to reduce water consumption.

Analysis of the Statistics

In order to carry out a comparative analysis of the companies examined in this work, it was considered useful to obtain from the Yahoo Finance website some data considered significant updated to the date of May 14, 2021 in order to compare homogeneous data. Figure 38 shows the most significant balance sheet data and valuation measures calculated as of May 14, 2021.

Figure 38. Income Statement, Balance Sheet, Valuation measures⁸⁰

Income Statement			
Revenue (ttm)	27.21T		
Revenue Per Share (ttm)	19,471.76		
Quarterly Revenue Growth (yoy)	8.30%		
Gross Profit (ttm)	4.83T		
EBITDA	3.84T		
Net Income Avi to Common (ttm)	2.25T	Valuation Measures	
Diluted EPS (ttm)	14.49	Market Cap (intraday) ⁵	215.2B
Quarterly Earnings Growth (yoy)	1,130.30%	Enterprise Value ³	19.27T
		Trailing P/E	10.77
Balance Sheet		Forward P/E ¹	N/A
Total Cash (mrq)	7.49T	PEG Ratio (5 yr expected) ¹	N/A
Total Cash Per Share (mrq)	5,357.47	Price/Sales (ttm)	0.01
Total Debt (mrq)	25.66T	Price/Book (mrq)	0.01
Total Debt/Equity (mrq)	105.65	Enterprise Value/Revenue ³	0.71
Current Ratio (mrq)	1.06	Enterprise Value/EBITDA ⁷	5.02
Book Value Per Share (mrq)	16,741.76		

¹ Data provided by Refinitiv.³ Data derived from multiple sources or calculated by Yahoo Finance.⁵ Shares outstanding is taken from the most recently filed quarterly or annual report and Market Cap is calculated using shares outstanding.

⁷ EBITDA is calculated by S&P Global Market Intelligence using methodology that may differ from that used by a company in its reporting.

Income statement e balance sheet currency in ¥ valuation measures currency in usd

The Market Cap value, calculated considering the outstanding shares according to the company's latest official report, is \$215.2 billion. EBITDA is ¥3.84 trillion, the trailing P/E (based on the most recent 12-month financial data) is 10.77. This value is quite aligned with the worldwide average P/E value of the automotive sector which was in the period 2012-2019 equal to 10-12 and in the post-Covid period increased up to 40 due to the crisis. The Enterprise Value/EBITDA ratio (Earnings before Interest taxes depreciation and amortization), which is 5.02, appears in line with the global average value (in the period 2012-2019 it was

⁸⁰ <https://finance.yahoo.com/quote/TM/key-statistics?p=TM> data of May 14, 2021

equal to 4-6, today it is equal to 10 and at the end of the next two years it is expected to be 7)⁸¹. Total cash is ¥7.49 trillion and total cash per share is ¥5,357.47. The Current ratio, which represents the ratio of current assets to current liabilities, is 1.06. This indicator expresses the company's ability to repay short-term obligations or current obligations within one year. This value is slightly worse than the average figure for the automotive industry, which at 2020-12-31 was around 1.09.⁸² The diluted EPS ttm, in which the total number of ordinary shares is calculated taking into account also the possible exercise or conversion of equivalent securities by, for example, holders of convertible bonds and stock options, is ¥14.49.

⁸¹ Fonte Bloomberg: MSCI WORLD AUTO & COMPONENTS INDEX data of April 28, 2021

⁸² <https://www.macrotrends.net/stocks/charts/GPI/group-1-automotive/current-ratio>

Analysis of strategic alliances

Toyota, over time, has entered into several strategic partnerships to increase competitiveness in the automotive market. The most important ones are listed below.

Toyota and SUBARU formed an alliance in 2005 to share their respective resources in development and production. In September 2019, the two companies agreed that Toyota would increase its equity stake in Subaru to 20% and at the same time Subaru would acquire shares in Toyota in order to "expand their collaboration to survive during this once-in-a-century period of profound transformation."

Toyota and BMW Group entered into an agreement, stipulating that they would begin joint research in lithium-ion batteries and that BMW would supply diesel engines to Toyota's European subsidiary. In 2013, they jointly developed a fuel cell system and joint research and development of lightweight technologies. They completed research on lithium-air batteries, a postlithium-battery solution to be competitive on the next generation of lithium-ion batteries.

Toyota and Mazda entered into agreements that allowed the latter to use the license of Toyota's hybrid technologies to Mazda and the production of compact cars for Toyota at Mazda's plant in Mexico. In addition, they established the EV C.A. Spirit Corporation together with Denso Corporation, with the goal of basic structural technologies for EVs.

In December 2017, Toyota and Panasonic entered into an agreement to study the feasibility of a joint automotive prismatic battery business. In 2019, they established a joint venture related to the automotive prismatic battery business, with the objective of research, development and production of: automotive lithium-ion prismatic batteries, solid-state batteries and next-generation batteries.

In April 2019, Toyota announced that it will grant royalty-free licenses to patents it holds (including certain pending applications) for vehicle electrification-related technologies, such as electric motors, power control units (PCUs) and system controls, to further drive the deployment of electric vehicles.

2.4 Daimler



Company overview⁸³

Daimler AG is one of the world's leading automotive companies. It was founded in 1926 as an amalgamation of two German companies: Daimler Motorenengesellschaft and Benz & Cie. Prior to this time both companies produced, and are considered pioneers in the industry, and sold cars independently. Benz built the first automobile in 1885 and sold it in 1887, while Daimler succeeded in obtaining a German patent for a three-wheeled, gasoline-powered vehicle in 1885.

The birth of Daimler-Benz allowed the development of the classic Mercedes "S" series, also it was the first company to use diesel engines in their cars, the first model became available in 1936.

Being a German company, Daimler was heavily influenced by World War II. During the conflict, all the engines produced were used in German tanks, bombers and fighter planes. In 1945 the Daimler-Benz factories were almost completely destroyed by Allied bombing, also lost all foreign subsidiaries, affiliates and branches as well as all assets in the Soviet-occupied areas. In the following period there was a great effort to rebuild the plants, despite the strong downsizing that the company was experiencing.

From 1949 to 1960 the German automotive industry went through a period of rapid expansion, in which Daimler AG played a leading role. In 1954, in fact, it reached 1 billion in sales, breaking the existing sales record.

Despite the strong fluctuations in sales that the sector underwent in those years, Daimler managed to maintain its leading position, becoming, in the 1980s, the largest German car manufacturer in terms of sales value.

The end of the 70's was characterized by the second oil crisis, which quickly increased various discussions on environmental issues, and by the advent of new Asian competitors. These were the main reasons that moved Daimler to implement several diversification strategies, especially in high technology, acquiring: AEG AG (a manufacturer of electrical systems, turbine engines and radio and radar communication systems); Dornier GmbH (aerospace and medical products); and Motoren & Turbinen Union GmbH (aircraft engines).

Many of these acquisitions were not profitable, in fact in the 1990s the company underwent a major restructuring, selling many subsidiaries and also drastically reducing the workforce.

⁸³ For this paragraph, these sources have been taking into account: <https://www.britannica.com/topic/Daimler-AG> ; <https://www.daimler.com/company/tradition/company-history/>

On November 12, 1998, Chrysler Corporation and Daimler-Benz merged, with Daimler-Benz acquiring the U.S. automaker for more than \$35 billion in a stock swap. The merger agreement stipulated that the brand identities would remain autonomous and independent, in fact it would not be possible to acquire Mercedes vehicles in Chrysler dealerships and vice versa.

In the early 2000s, to try to strengthen its position on the world market, Daimler decided to acquire 34% of Mitsubishi Motors. An operation that made the company the third largest manufacturer of vehicles in the world. This agreement, at the same time, turned out to be a financial drain, in fact in 2005 DaimlerChrysler had completely sold its stake in the Japanese car company.

Chrysler, meanwhile, in 2006 closed its accounts with a loss of 1.5 billion, leading to its sale to the U.S. private equity firm Cerberus Capital Management in 2007. DaimlerChrysler renamed itself Daimler AG in October 2007.

Daimler AG produces on four continents, and the worldwide production network is growing continuously. Several plants can be analyzed:

- Vehicle plants, mainly in Germany, South Africa, USA, France, Brazil and Hungary;
- Passenger car assembly locations, in Thailand, Vietnam, Indonesia and India;
- Powertrain plants, in Germany and Romania.⁸⁴

Figure 39. Equities and shareholders⁸⁵

Equities							
	Vote 	Quantity	Free-Float		Company-owned shares		Total Float
Stock A	1	1,069,800,000	870,412,400	81.4%	0	0.0%	81.4%

Shareholders				Daimler AG (DE0007100000) 
Name		Equities	%	
Shu Fu Li		103,619,340	9.69%	
Kuwait Investment Authority (Investment Management)		72,748,946	6.80%	
Beijing State-Owned Assets Supervision & Administration		53,491,873	5.00%	
Harris Associates LP		31,884,698	2.98%	
Deka Investment GmbH		24,863,816	2.32%	
BlackRock Advisors (UK) Ltd.		17,974,244	1.68%	
Amundi Asset Management SA (Investment Management)		17,305,602	1.62%	
Renault SA		16,488,378	1.54%	
Nissan Motor Co., Ltd.		16,448,378	1.54%	
Credit Suisse Asset Management LLC		11,416,577	1.07%	

⁸⁴ <https://media.daimler.com/marsMediaSite/en/instance/ko/The-production-network-The-worldwide-plants.xhtml?oid=9272049>

⁸⁵ <https://www.marketscreener.com/quote/stock/DAIMLER-AG-436541/company/>

The company's equities and shareholders are represented in Figure 39. It has an employee count of 288,481.

Figure 40. Brand portfolio⁸⁶



Figure 40 depicts Daimler AG's brand portfolio of which the most important are:

- Mercedes Grand Prix, the German Formula 1 racing team;
- Car2go and Mytaxi, representing a mobility provider and a car sharing company, respectively;
- Smart, Mercedes-Benz, Maybach, EvoBus, manufacturers of cars and buses;
- Mercedes-Benz Financial Services, not included in Figure 39, which provides financing, car rental, and insurance services to customers.

⁸⁶ <https://www.allbrands.markets/brand/price-share-stock-market-mercedes-21320172800-de0007100000/other-brands-mercedes/>

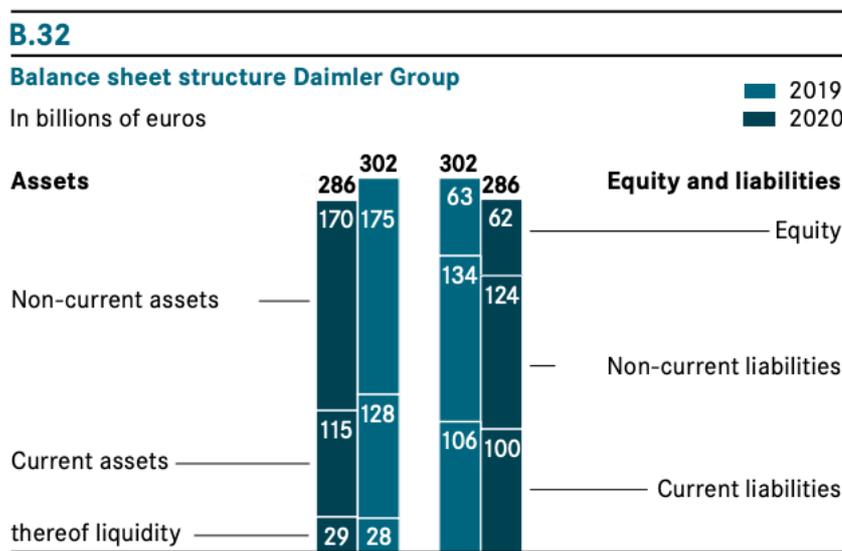
Daimler AG has two macro-divisions:

- Industrial business, where there is the production of a worldwide product range of premium cars and commercial vehicles;
- Financial and mobility services.

Like all businesses, the covid-19 pandemic strongly affected the company's performance, which suffered an overall decrease in Total assets from €302.4 billion in 2019 to €287.7 billion in 2020.

As the automotive industry is one of the company's main businesses, it is important to consider that the global market car had a 15% contraction in the whole 2020, in fact the vehicles sold by Daimler in the year in question are 2.84 million, compared to 3.34 million sold in 2019.

Figure 42. Balance sheet structure⁸⁹



As represented in Figure 42, the downsizing of Daimler's balance sheet is caused by a general decrease of all macro-items present, Current assets in particular. A more detailed analysis of the balance sheet will follow.

Total non-current assets in 2020 amounted to €170.473 billion, in 2019 it stood at €174.638 billion. A decrease of about 2.38%, which goes against the trend if we analyze a broader temporal basin, in fact in 2017 they were equal to €148.870 billion, the growth in the three-year period is 14.51%. The decrease in 2019-2020, analyzing the Balance Sheet, is not caused by Daimler Mobility, of which Daimler Financial Services is part, as Receivables from financial services (non-current) increased significantly (from €52.880 billion in 2019 to €53.709 billion in 2020). The above decrease is caused by a decrease in:

- Equipment on operating leases, decreased by approximately €4.1 billion, due to a strong reduction in contract volume due to a contraction in customer demand;
- Property plant and equipment, specifically analyzed in Figure 43.

⁸⁹ Annual report Daimler 2020, <https://www.daimler.com/documents/investors/reports/annual-report/daimler/daimler-ir-annual-report-2020-incl-combined-management-report-daimler-ag.pdf>

To underscore the momentum, the company in 2019 had invested €7.2 billion for development and modernization in Property, plant and equipment. By contrast, €5.7 billion was invested in 2020, a sharp decrease from the previous year.

Total current assets in 2020 stood at €115.264 billion, or around 40% of the balance sheet total. In 2019, this item amounted to €127.800 billion and represented around 42% of the balance sheet total. There was therefore a reduction in the 2019-2020 biennium, both in absolute terms (by 9.81%) and in terms of incidence on the balance sheet total (about -2%). The slowdown in 2020 was quite sharp, also considering that in 2017 Total current assets were €106.735 billion and until 2019 this item has always grown. In this case, unlike Non-current assets, the main cause of the reduction is attributable to the Financial Services division, as Receivables from financial services amounted to €42.476 billion. In 2019 they amounted to €50.781 billion, a percentage reduction of 16.35%. The change in Total current assets also depended on changes to Inventories and Cash and cash equivalents. The changes are analyzed specifically below.

Cash and cash equivalents in 2019 were €18.883 billion, while in 2020 they grew by €4.165 billion, in percentage +22.06%, to €23.048 billion. This increase partially limited the total reduction in Current assets, and this was possible mainly through:

- Cash provided by operating activities amounting to +€22.332 billion in 2020, a clear increase compared to 2019 when it amounted to +€7.888 billion;
- Cash used by investing activities amounting to -€6.421 billion in 2020, a better outflow than in 2019 when it amounted to -€10.607 billion, thanks also to the reduction in investments;
- Cash provided by financing activities amounting to -€10.474 billion in 2020, a worsening compared to 2019, amounting to +€5.628 billion.

Overall, therefore, the Net increase in cash and cash equivalents is €4.165 billion.⁹¹

⁹¹ Annual report Daimler 2020, <https://www.daimler.com/documents/investors/reports/annual-report/daimler/daimler-ir-annual-report-2020-incl-combined-management-report-daimler-ag.pdf>

Figure 44. Inventories⁹²

In millions of euros	At December 31,	
	2020	2019
Raw materials and manufacturing supplies	3,010	3,321
Work in progress	3,629	4,290
Finished goods, parts and products held for resale	19,675	21,922
Advance payments to suppliers	130	224
	26,444	29,757

Illustrated in Figure 44 are Inventories, which were the protagonists of a significant reduction in the two-year period considered. In 2019, in fact, it was €29.757 billion, while in 2020 it amounts to €26.444 billion, a percentage decrease of about 11.13%. The reduction of €2.1 billion is mainly caused by the automotive sector, specifically by a lower production volume compared to the previous year. Analyzing Figure 44, it is possible to notice a general decrease of all Inventories components, specifically:

- Raw materials decreased by 9.36%;
- Work in progress down 15.41%;
- Finished goods decreased by 10.25%.

Total Equity, in 2020, is €62.248 billion, very similar to the 2019 value of €62.841 billion. Despite a decent growth in Retained earnings, from €46.329 billion in 2019 to €47.111 billion in 2020, the negative item Other reserves, -€1.041 billion in 2020, caused the slight reduction.

Total assets, which has already mentioned decreased in the two-year period 2019-20 by €16.701 billion, represent around 185% of total revenues (capital intensity ratio) in 2020. The high capital expenditure requirement in relation to revenues is also confirmed for this company.

⁹² Annual report Daimler 2020, <https://www.daimler.com/documents/investors/reports/annual-report/daimler/daimler-ir-annual-report-2020-incl-combined-management-report-daimler-ag.pdf>

Analysis of Statements of Operations

Figure 45. Consolidated Statements of Operations⁹³

	Note	2020	2019
In millions of euros			
Revenue	4	154,309	172,745
Cost of sales	5	-128,721	-143,580
Gross profit		25,588	29,165
Selling expenses	5	-11,058	-12,801
General administrative expenses	5	-3,534	-4,050
Research and non-capitalized development costs	5	-6,116	-6,586
Other operating income	6	2,022	2,837
Other operating expense	6	-742	-4,469
Profit on equity-method investments, net	13	797	479
Other financial income/expense, net	7	-354	-262
Earnings before interest and taxes (EBIT)	34	6,603	4,313
Interest income	8	220	397
Interest expense	8	-484	-880
Profit before income taxes		6,339	3,830
Income taxes	9	-2,330	-1,121
Net profit		4,009	2,709
thereof profit attributable to non-controlling interests		382	332
thereof profit attributable to shareholders of Daimler AG		3,627	2,377
Earnings per share (in euros)			
for profit attributable to shareholders of Daimler AG	36		
Basic		3.39	2.22
Diluted		3.39	2.22

Illustrated above, Figure 45, is Daimler AG's 2020 Income Statement. Also, and most importantly, in this document, the effects of the pandemic outbreak and the contraction of vehicle demand around the world are clearly visible. As reported above, the global car market contracted by 15% in 2020 and, more generally, the global economy contracted by 4% in real terms.

Revenues, as depicted later in Figure 46, are €154.309 billion in 2020. A substantial reduction if compared to 2019, when they were €172.745 billion, a percentage reduction of 10.67%, which is quite significant. Analyzing a broader time period, in 2017 Revenues were equal to €164.330 billion and in the following years, until 2020, it has always grown. Revenues in 2020 represent, therefore, a fairly significant negative result, considering that they reached a lower value than even 2017. In the following, the most significant items will be analyzed.

⁹³ Annual report Daimler 2020, <https://www.daimler.com/documents/investors/reports/annual-report/daimler/daimler-ir-annual-report-2020-incl-combined-management-report-daimler-ag.pdf>

Figure 46. Revenues⁹⁴

Revenue	Mercedes-Benz Cars & Vans	Daimler Trucks & Buses	Daimler Mobility	Total segments	Recon- ciliation	Daimler Group
In millions of euros						
2020						
Europe	42,507	11,063	4,929	58,499	-2,563	55,936
North America	17,598	13,630	5,679	36,907	-530	36,377
Asia	31,871	5,951	174	37,996	-21	37,975
Other markets	3,468	3,049	132	6,649	-9	6,640
Revenue according to IFRS 15	95,444	33,693	10,914	140,051	-3,123	136,928
Other revenue	3,132	978	16,785	20,895	-3,514	17,381
Total revenue	98,576	34,671	27,699	160,946	-6,637	154,309
In millions of euros						
2019						
Europe	46,290	12,777	4,606	63,673	-2,595	61,078
North America	21,097	19,178	6,244	46,519	-992	45,527
Asia	31,839	6,930	145	38,914	-21	38,893
Other markets	4,998	4,544	150	9,692	-17	9,675
Revenue according to IFRS 15	104,224	43,429	11,145	158,798	-3,625	155,173
Other revenue	2,673	1,000	17,501	21,174	-3,602	17,572
Total revenue	106,897	44,429	28,646	179,972	-7,227	172,745

Figure 46 shows the Revenues broken down by segment. After establishing that Daimler AG had the lowest total revenues in the year 2020, the reasons can be studied:

- The automotive division, Mercedes-Benz Cars & Vans and Daimler Truck & Buses, has Total revenues of €126.610 billion (subtracting reconciliation). Mercedes-Benz Cars & Vans had a decrease of about 8% and Daimler Truck & Buses of 22%. In 2019 Total revenues from the automotive division were €144.099 billion, this implies that in 2020 the percentage decrease is -12.14%;
- Revenues from Daimler Mobility in 2020 are €27.699 billion, while in 2019 they were €28.646 billion. The reduction, in this case, is milder and stands at -3.31% in percentage terms.

In absolute terms, this decrease is mainly explained by a strong reduction in vehicles sold, from 3.334 million in 2019 to 2.84 million in 2020.

As can be easily guessed, such a reduction, in addition to decreasing Revenues, has consequently decreased Cost of sales.

⁹⁴ Annual report Daimler 2020, <https://www.daimler.com/documents/investors/reports/annual-report/daimler/daimler-ir-annual-report-2020-incl-combined-management-report-daimler-ag.pdf>

Figure 47. Cost of sales⁹⁵

Cost of sales	2020	2019
In millions of euros		
Expense of goods sold	-110,916	-123,180
Depreciation of equipment on operating leases	-9,181	-9,047
Refinancing costs at Daimler Mobility	-2,620	-3,114
Impairment losses on receivables from financial services	-766	-495
Other cost of sales	-5,238	-7,744
	-128,721	-143,580

Cost of sales was also the protagonist of a significant reduction between 2019 and 2020. In 2020 it amounted to -€128.721 billion, while in 2019 it amounted to -€143.580 billion. A percentage decrease of 10.3%, with the Expense of goods sold as the most decreased item, going from -€123.180 billion in 2019 to -€110.916 billion in 2020. Also in this case, as in Revenues, it is the automotive division that has the biggest drop:

- Cost of sales attributable to the automotive division are -€104.153 billion in 2020, while in 2019 they amounted to -€118.626 billion;
- Cost of sales attributable to financial services, on the other hand, remained more or less the same at -€24.568 billion in 2020 and -€24.954 billion in 2019.

Gross profit (revenue - cost of sales) decreased over the two-year period from €29.165 billion in 2019 to €25.588 billion in 2020, it is interesting to note that in terms of efficiency there was a slight worsening as the incidence of gross profit on revenues goes from 16.88% in 2019 to 16.58% in 2020.

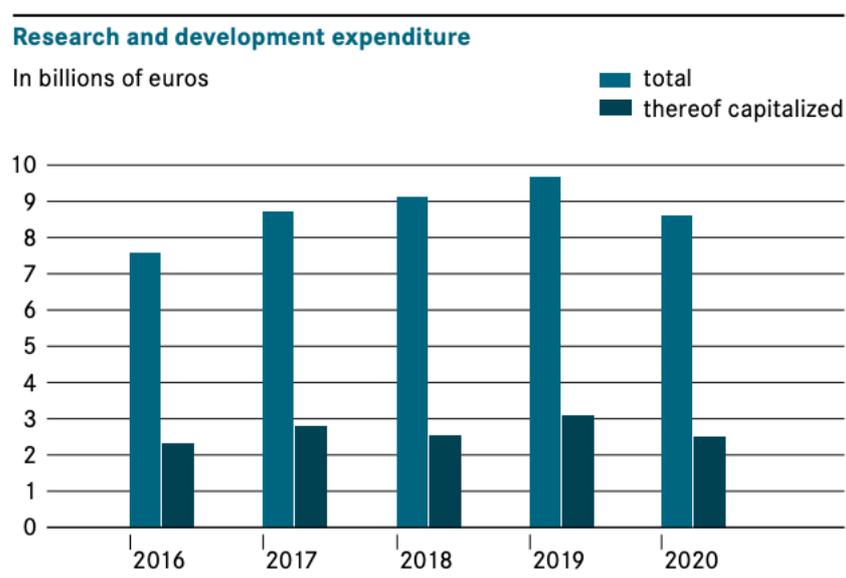
⁹⁵ Annual report Daimler 2020, <https://www.daimler.com/documents/investors/reports/annual-report/daimler/daimler-ir-annual-report-2020-incl-combined-management-report-daimler-ag.pdf>

Figure 48. Research and development expenditure⁹⁶

Research and development expenditure by division			
	2020	2019	20/19
In millions of euros			% change
Daimler Group	8,614	9,662	-11
thereof capitalized	2,498	3,076	-19
Mercedes-Benz Cars & Vans	7,199	8,061	-11
thereof capitalized	2,391	3,000	-20
Daimler Trucks & Buses	1,488	1,689	-12
thereof capitalized	107	76	+41

Research and development represents one of the most important cost items, since it is through it that a company manages to strengthen and increase its competitive position in the market. R&D in 2020 amounted to €8.614 billion. In 2019, on the other hand, it amounted to €9.662 billion. A significant reduction due to both cost reductions in response to Covid-19 and the conclusion of individual development projects. Despite the reduction of around 11%, the R&D ratio remains constant between 2019 and 2020 at 5.6% due to the decrease in revenues. Daimler's goal is to increase investment in automated driving digitalization, so they plan to increase R&D expenditure in the coming year.

Figure 49. Research and Development expenses Daimler from 2016 to 2020⁹⁷



⁹⁶ Annual report Daimler 2020, <https://www.daimler.com/documents/investors/reports/annual-report/daimler/daimler-ir-annual-report-2020-incl-combined-management-report-daimler-ag.pdf>

⁹⁷ Annual report Daimler 2020, <https://www.daimler.com/documents/investors/reports/annual-report/daimler/daimler-ir-annual-report-2020-incl-combined-management-report-daimler-ag.pdf>

As can be seen in Figure 49, it is since 2016 that Daimler has been increasing research and development expenses, until it reaches its maximum value of €9.662 billion in 2019. Thanks to this graph it is even clearer the difficult time Daimler is going through because of the pandemic.

The company's net profit in 2020 is €4.009 billion, which is significantly higher than the previous year's amount of €2.709 billion. An increase of 47.99%, mainly due to the significant reduction in Other operating expenses. In 2019 this item was much higher due to the high amount of provisions for other risks, due to ongoing governmental and court proceedings and measures relating to MercedesBenz diesel vehicles in various regions.

The official report does not include much data on regulatory credits, but in 2020 Daimler has acquired them for not meeting emission targets in the US and China.

The company has set strategic objectives, summarized in the name "Ambition 2039", in which:

- Achieve CO2 neutral production from its factories by 2039;
- To have in its vehicle portfolio more than 50% of plug-in hybrids and all-electric drive systems.

Analysis of the Statistics

In order to carry out a comparative analysis of the companies examined in this work, it was considered useful to obtain from the Yahoo Finance website some data considered significant updated to the date of May 14, 2021 in order to compare homogeneous data. Figure 50 shows the most significant balance sheet data and valuation measures calculated as at May 14, 2021.

Figure 50. Income Statement, Balance Sheet, Valuation measures⁹⁸

Income Statement			
Revenue (ttm)	158.1B		
Revenue Per Share (ttm)	147.79		
Quarterly Revenue Growth (yoy)	10.20%		
Gross Profit (ttm)	25.43B		
EBITDA	16.49B		
Net Income Avi to Common (ttm)	7.82B		
Diluted EPS (ttm)	7.31		
Quarterly Earnings Growth (yoy)	4,463.80%		
Balance Sheet		Valuation Measures	
Total Cash (mrq)	27.56B	Market Cap (intraday) ⁵	79.11B
Total Cash Per Share (mrq)	25.76	Enterprise Value ³	198.29B
Total Debt (mrq)	146.92B	Trailing P/E	10.11
Total Debt/Equity (mrq)	216.08	Forward P/E ¹	N/A
Current Ratio (mrq)	1.14	PEG Ratio (5 yr expected) ¹	N/A
Book Value Per Share (mrq)	62.05	Price/Sales (ttm)	0.50
		Price/Book (mrq)	1.19
		Enterprise Value/Revenue ³	1.25
		Enterprise Value/EBITDA ⁷	12.02

¹ Data provided by Refinitiv.³ Data derived from multiple sources or calculated by Yahoo Finance.⁵ Shares outstanding is taken from the most recently filed quarterly or annual report and Market Cap is calculated using shares outstanding.

⁷ EBITDA is calculated by S&P Global Market Intelligence using methodology that may differ from that used by a company in its reporting.

The Market Cap value, calculated considering the outstanding shares according to the latest official company report, is €79.11 billion. The EBITDA is €16.49 billion, the trailing P/E (based on the most recent 12 months financial data) is 10.11. This value is in line with the worldwide average P/E of the automotive sector which was 10-12 in the period 2012-2019 and in the post-Covid period rose to 40 due to the crisis. The Enterprise Value/EBITDA ratio (Earnings before Interest taxes depreciation and amortization), which is 12.02, is higher than the global average value (in the period 2012-2019 it was 4-6, today it is 10 and at the end of the next two years it is expected to be 7)⁹⁹. Total cash is €27.56 billion and total cash per share is €25.76. The Current ratio, which represents the ratio of current assets to current liabilities, is 1.14. This indicator expresses the company's

⁹⁸ <https://finance.yahoo.com/quote/DAI.DE/key-statistics?p=DAI.DE> data of May 14, 2021

⁹⁹ Fonte Bloomberg: MSCI WORLD AUTO & COMPONENTS INDEX, data of April 28, 2021

ability to repay short-term or scudent obligations in one year. This value is slightly better than the Current ratio of the automotive industry, which at 2020-12-31 was about 1.09 . The diluted EPS ttm, in which the total number of ordinary shares is calculated taking into account possible exercises or conversion of equivalent securities by, for example, holders of convertible bonds and stock options, is €7.31.¹⁰⁰

¹⁰⁰ <https://www.macrotrends.net/stocks/charts/GPI/group-1-automotive/current-ratio>

Analysis of strategic alliances

Daimler AG, in order to cope with the continuous and rapid change of the market, has entered into several strategic alliances. The most relevant ones are listed below.

Daimler Truck AG and Volvo Group created a joint venture in November 2020, in which it was agreed that Volvo Group will acquire 50 percent of the shares of Daimler Truck Fuel Cell GmbH & Co. KG for approximately €0.6 billion. The goal is to develop, manufacture and market fuel cell systems for heavy-duty commercial vehicle applications and other areas of application.

On May 26, 2020 Daimler Truck AG made public the cooperation with the British technology company Rolls-Royce plc. The goal of the partnership is to supply stationary fuel cell generators as CO₂-neutral emergency power generators for safety critical facilities such as data centers.

On June 23, 2020, Daimler AG announced a partnership between Mercedes-Benz and NVIDIA to develop an in-vehicle computing system and an AI computing infrastructure. The goal is to be able to use for all Mercedes-Benz model series the most intelligent and advanced computing architectures in the automotive industry, considering that NVIDIA is a global leader in this field.

July 3, 2020 saw the announcement of a strategic partnership between Daimler AG and Chinese battery cell manufacturer Farasis Energy, which is vital to achieving the goals set out in the "Ambition 2039" program. The agreement involves the development and industrialization of battery cell technologies.

On August 5, 2020, Mercedes-Benz and CATL (Contemporary Amperex Technology) planned to enter the next phase of their strategic partnership and begin developing innovative battery technologies. The agreement between the parties includes: the supply of battery cells, modules for Mercedes-Benz Cars and complete batteries for Mercedes-Benz Vans, all of which will be manufactured in a CO₂-neutral manner. In addition, there are plans to market the Mercedes-Benz EQS electric luxury sedan in 2021, which will be equipped with CATL modules.

On October 27, 2020, there was the announcement of a further strategic partnership between Daimler Truck AG and Waymo, in which autonomous driving technology is featured. The goal is to produce a highly automated truck (SAE Level 4), to increase road safety and enhance customer productivity.

On November 20, 2020, Daimler AG announced a strategic partnership with the Geely Holding Group and its affiliated brands. The goal here is joint work on the development of hybrid powertrain solutions, so as to benefit from economies of scale and strengthen the company's competitiveness in the industry.

2.5 General Motors



Company overview¹⁰¹

General Motors (GM) is one of the largest automotive companies in the world. Born in America, this corporation has been for most of the XX century and early XXI, the largest manufacturer of motor vehicles in the world. General Motors Company was founded, based in Detroit, in 1908 by William C. Durant with the aim of consolidating several companies, which produced: Cadillac, Oakland (later Pontiac), Oldsmobile, Buick, Ewing, Marquette, Reliance and Rapid (both truck manufacturers).

In 1916, General Motors was reincorporated and named General Motors Corporation, maintaining its headquarters in Detroit. Subsequently, four companies joined General Motors: Chevrolet Auto Company and Delco Products in 1918; Fisher Body Company and Frigidaire in 1919.

1920 was a crucial year, as Durante was forced to leave General Motors and, in his place, came Alfred P. Sloan, Jr. who was the author of a real revolution in the company, eliminating the confusion that characterized the organizational design of the company at that time. He transformed the company into a single enterprise that consisted of five major automotive macro-divisions: Cadillac, Buick, Pontiac, Oldsmobile, and Chevrolet. All five divisions were monitored and controlled by a single central corporate office, equipped with a large staff of financiers and consultants. The real peculiarity of the era introduced by Sloan was that each division maintained a high level of autonomy in order to operate as efficiently as possible in the marketplace.

In 1929 General Motors became, for the first time, the largest American manufacturer of automobiles, surpassing Ford once and for all. Moreover, it began to implement internationalization strategies, carrying out operations abroad such as: Vauxhall in England in 1925, Adam Opel in Germany in 1929, and Holden in Australia in 1931. The rise did not end, indeed, in 1931 it became the largest manufacturer of motor vehicles

¹⁰¹ For this paragraph, these sources have been taking into account: <https://www.britannica.com/topic/General-Motors-Corporation>

in the world, while in 1941 about 44% of all automobiles in the United States were produced by General Motors.

The growth of the American giant continued hand in hand with that of the country, in fact it bought Electronic Data Systems Corporation, a large data processing company, in 1984 and acquired Hughes Aircraft Company, a manufacturer of weapons systems and communications satellites, in 1986.

Around the 1970s and 1980s, the advent of more and more Japanese cars on American soil made the competition for General Motors, and all other American automakers, much stiffer. Because of this, GM sought to differentiate itself by opening a new automotive division called Saturn. The goal was to produce subcompact cars through the use of highly automated plants. Unfortunately, despite the fact that the modernization goal was receiving its results, General Motors in the 1990s suffered heavy losses, which forced it to close many plants and reduce its workforce by tens of thousands.

After a strong corporate reorganization, the company managed to become competitive again by focusing specifically on the automotive business, selling the other companies it owned.

The next step was the economic and financial crisis of 2008, which literally brought the entire planet to its knees. George Bush, the then president of the United States, announced an emergency financial rescue plan for the "Big Three" automakers: General Motors, Chrysler and Ford. The objective was to avoid the destruction of the country's automotive industry. General Motors accepted the aid, unlike Ford, asking for Chapter 11 bankruptcy protection in June 2009. It emerged from bankruptcy reorganization the following month, remaining with only four divisions: Buick, Cadillac, Chevrolet and GMC.

In 2010 they made one of the largest IPOs in US history, and the following year they regained the title of the world's largest car manufacturer.

Growth suffered another hard setback in 2014, when it became public that for nearly a decade the company had been covering up the fact that several car models had faulty ignition switches; the faulty part was believed to have caused more than 120 deaths. In Europe, it was forced to sell Opel and Vauxhall to the PSA group for around \$2 billion.

General Motors has manufacturing, assembly, distribution, office or warehousing operations in 29 countries. The most important plants are in the United States, but there are also important factories in Argentina, Brazil, Canada, China, Colombia, Mexico and South Korea.

Figure 51. Equities and shareholders¹⁰²

Equities							
	Vote 	Quantity	Free-Float		Company-owned shares		Total Float
Stock A	1	1,450,670,870	1,379,213,534	95.1%	0	0.0%	95.1%

Shareholders				General Motors Company (US) 
Name	Equities	%		
Capital Research & Management Co. (Global Investors)	101,299,594	6.98%		
The Vanguard Group, Inc.	89,694,871	6.18%		
Capital Research & Management Co. (World Investors)	82,754,767	5.70%		
UAW Retiree Medical Benefits Trust	68,507,107	4.72%		
Berkshire Hathaway, Inc. (Investment Management)	67,000,000	4.62%		
SSgA Funds Management, Inc.	53,430,707	3.68%		
Harris Associates LP	36,550,095	2.52%		
BlackRock Fund Advisors	29,287,189	2.02%		
Invesco Advisers, Inc.	27,169,206	1.87%		
Fidelity Management & Research Co. LLC	24,181,937	1.67%		

Figure 51 shows the company's equities and shareholders. It has an employee base of 155,000 people.

Figure 52. Brand portfolio¹⁰³

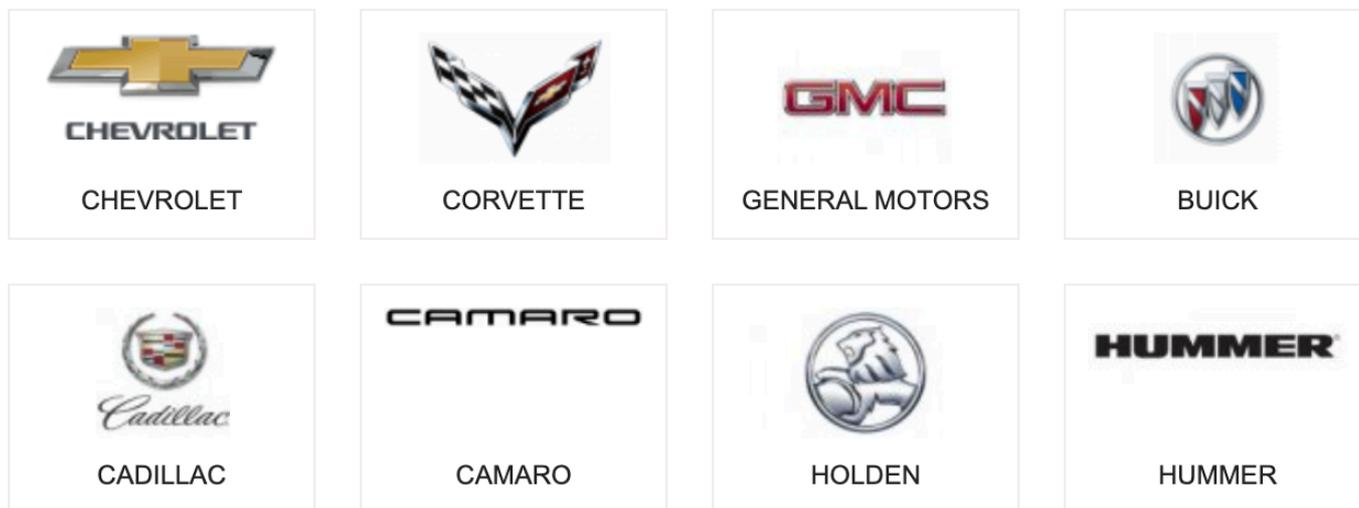


Figure 52 depicts General Motors' brand portfolio, which includes:

¹⁰² <https://www.marketscreener.com/quote/stock/GENERAL-MOTORS-COMPANY-6873535/company/>

¹⁰³ <https://www.allbrands.markets/brand/price-share-stock-market-chevrolet-21270550500-us37045v1008/other-brands-chevrolet/>

- Chevrolet, Corvette, Buick, Cadillac, and Holden are automobile manufacturers, divisions of General Motors;
- General Motors Financial Services, not shown in Figure 50, provides financial services to customers.

General Motors Company designs, builds and sells trucks, crossovers, automobiles and automobile parts worldwide. The company provides automotive financing services through General Motors Financial Company, Inc. (GM Financial).

General Motors sold, in 2020, 6.83 million vehicles. This is a significant reduction when considering 2019 in which 7.72 million vehicles were sold. This reduction, however, cannot be totally blamed on the ongoing pandemic since, evaluating a broader time period, we can see that General Motors had a growth in vehicles sold until 2016, reaching its highest in the last ten years of 10.01 million vehicles. From 2016 onwards, the company has been the protagonist of a continuous decrease, until reaching its lowest value in the last ten years, which corresponds to 6.83 million vehicles in 2020.¹⁰⁶

Importantly, despite the aforementioned reduction in vehicles sold between 2019 and 2020, General Motors increased its global market share from 8.5% in 2019 to 8.7% in 2020, as global vehicle sales also declined sharply (91.3 million in 2019, 78.6 million in 2020).

The Covid 19 pandemic has, clearly, caused severe damage to General Motors as well, forcing it to radically change its strategies. During the first half of 2020, the company executed a series of austerity measures, including aggressive actions to reduce costs and preserve liquidity, such as limiting advertising and other third-party spending, suspending the dividend on common stock, deferring employee compensation, and postponing non-critical projects, including some future product programs. Subsequently, production normalized, and allowed the company to soften previous austerity measures put in place to deal with the extraordinary situation. Obviously, the extent of the impact of Covid 19 on the future operations of General Motors, as well as the automotive industry in general, is unclear and will depend on how the pandemic evolves around the world.

Analyzing the Balance Sheet depicted in Figure 53, it can be seen that the company had a growth in Total assets in 2020, which are \$235.194 billion. In 2019, on the other hand, the value was \$228.037 billion, so there was a percentage growth of 3.14%. An even higher increase if we consider a longer time period, in fact in 2017 this item amounted to \$212.482 billion, so in 2020 Total assets increased by 10.69%. In order to have a deeper analysis, we will specifically study the most significant items belonging to Non-current assets and Current assets and their changes.

Non-current assets stood at \$154.270 billion in 2020, and represented about 65.6% of the company's total assets. There was a growth from 2019, where it stood at \$153.045 billion, of 0.8%. The most significant items will be analyzed specifically.

¹⁰⁶ <https://www.statista.com/statistics/225326/amount-of-cars-sold-by-general-motors-worldwide/>

Figure 54. Property, Plant and Equipment¹⁰⁷

	Estimated Useful Lives in Years	December 31, 2020	December 31, 2019
Land		\$ 1,339	\$ 1,302
Buildings and improvements	5-40	9,671	9,705
Machinery and equipment	3-27	30,013	29,814
Special tools	1-13	20,851	23,586
Construction in progress		3,581	3,042
Total property		65,455	67,449
Less: accumulated depreciation		(27,823)	(28,699)
Total property, net		<u>\$ 37,632</u>	<u>\$ 38,750</u>

Property, plant and equipment, which typically represent the company's long-term assets, declined, as depicted in Figure 54, between 2019 and 2020. \$37.632 billion is the value in 2020, while it was \$38.750 billion in 2019. A percentage reduction of 2.89%.

General Motors, as of December 31, 2020, has more than 100 locations in the United States used primarily for manufacturing, assembly, distribution, warehousing, engineering and testing. It has active facilities, as previously written, in 29 countries. GM Financial, on the other hand, has 37 administration facilities and regional credit centers, 24 of which are located in the United States.

As can be seen from Figure 54, the items: Machinery and equipment, Buildings and improvements, Construction in progress and Land have remained roughly constant. The item that primarily drove the 2.89% decrease is Special tools. This item represents all product-specific propulsion and non-propulsion related tools, dies, molds and other items used in the vehicle manufacturing process. It is down about 11.6%. The strategy of hard cost reduction can be seen in this item as well, adding that, Expenditures in property also decreased significantly in the two years under consideration: in 2019 they stood at \$7.592 billion, while in 2020 they stand at \$5.300 billion.

Current assets stand at \$80.924 billion in 2020, representing approximately 34.6% of total assets. We can see a significant growth of 7.91% compared to 2019 (at that time the value was \$74.992 billion) and compared to 2017 (value was \$68.744 billion).

The said growth in Current assets in 2019-2020 can be mainly attributed to a strong growth in Marketable debt securities (\$4.174 billion in 2019, \$9.046 billion in 2020). The latter represent short-term bonds held by the company as an alternative to cash, which are very useful for meeting obligations in the short term. The most important items will be analyzed below.

Cash and cash equivalents in 2019 was \$19.069 billion, while in 2020 it stands at \$19.992 billion. A growth in absolute terms of \$0.923 billion, or 4.84% more than in 2019. This positive change, as highlighted in the cash flow statement, can be partly explained:

¹⁰⁷ Annual report General Motors 2020, https://www.annualreports.com/HostedData/AnnualReports/PDF/NYSE_GM_2020.pdf

- Net cash provided by operating activities amounting to +\$16.670 billion, up from 2019 when this value amounted to +\$15.021 billion;
- Net cash used in investing activities equal to -\$21.826 billion, while in 2019 it was equal to -\$10.899 billion;
- Net cash provided by financing activities +\$5.552 billion, a marked improvement over the previous year when this figure stood at -\$4.677 billion.

Overall, the company's liquidity has grown not only to meet liquidity requirements, but also and above all to increase flexibility in a totally uncertain period devastated by the ongoing pandemic.

Figure 55. Inventories¹⁰⁸

	December 31, 2020	December 31, 2019
Total productive material, supplies and work in process	\$ 5,117	\$ 4,713
Finished product, including service parts	5,118	5,685
Total inventories	\$ 10,235	\$ 10,398

Figure 55 shows Inventories, which saw a slight reduction between 2019, when they amounted to \$10.398 billion, and 2020, when they amounted to \$10.235 billion. A percentage reduction of 1.57% that, as shown in Figure 55, depends on the decrease in Finished product, including service parts (by -9.97%), despite the significant increase in Total productive material, supplies and work in process (+8.57%).

Total equity in 2020 amounted to \$49.677 billion, leading to significant growth compared to 2019 when it stood at \$45.957 billion. A percentage increase of 8.09% that, as visible in Figure 53, can be mainly attributed to a strong increase in Retained earnings by the company: \$26.860 billion in 2019 and \$31.962 billion in 2020 (+18.99%). The strategy of reducing dividend payments is a confirmation of the company's objective to increase its capitalization, in response to one of the most uncertain periods ever. Total assets, which, as mentioned above, increased in 2019-20 by 3.14%, represent approximately 192% of total revenues (capital intensity ratio) in 2020. The high requirement for invested capital in relation to revenues is also confirmed for this company.

¹⁰⁸ Annual report General Motors 2020, https://www.annualreports.com/HostedData/AnnualReports/PDF/NYSE_GM_2020.pdf

Analysis of Statements of Operations

Figure 56. Consolidated Statements of Operations¹⁰⁹

	Years Ended December 31,		
	2020	2019	2018
Net sales and revenue			
Automotive	\$ 108,673	\$ 122,697	\$ 133,045
GM Financial	13,812	14,540	14,004
Total net sales and revenue (Note 3)	122,485	137,237	147,049
Costs and expenses			
Automotive and other cost of sales	97,539	110,651	120,656
GM Financial interest, operating and other expenses	11,274	12,614	12,298
Automotive and other selling, general and administrative expense	7,038	8,491	9,650
Total costs and expenses	115,851	131,756	142,604
Operating income	6,634	5,481	4,445
Automotive interest expense	1,098	782	655
Interest income and other non-operating income, net (Note 19)	1,885	1,469	2,596
Equity income (Note 8)	674	1,268	2,163
Income before income taxes	8,095	7,436	8,549
Income tax expense (Note 17)	1,774	769	474
Income from continuing operations	6,321	6,667	8,075
Loss from discontinued operations, net of tax (Note 22)	—	—	70
Net income	6,321	6,667	8,005
Net loss attributable to noncontrolling interests	106	65	9
Net income attributable to stockholders	<u>\$ 6,427</u>	<u>\$ 6,732</u>	<u>\$ 8,014</u>
Net income attributable to common stockholders	\$ 6,247	\$ 6,581	\$ 7,916
Earnings per share (Note 21)			
Basic earnings per common share – continuing operations	\$ 4.36	\$ 4.62	\$ 5.66
Basic loss per common share – discontinued operations	\$ —	\$ —	\$ 0.05
Basic earnings per common share	\$ 4.36	\$ 4.62	\$ 5.61
Weighted-average common shares outstanding – basic	1,433	1,424	1,411
Diluted earnings per common share – continuing operations	\$ 4.33	\$ 4.57	\$ 5.58
Diluted loss per common share – discontinued operations	\$ —	\$ —	\$ 0.05
Diluted earnings per common share	\$ 4.33	\$ 4.57	\$ 5.53
Weighted-average common shares outstanding – diluted	1,442	1,439	1,431

Figure 56 shows General Motors' Income Statement for the years 2018-2020. As written earlier, the reduction in vehicles sold (from 7.72 million to 6.83 million) between 2019 and 2020 greatly impacts the company's revenues, which, in addition, was forced to suspend their production facilities in March 2020 due to the pandemic. It wasn't until May 2020 that major manufacturing operations were restarted, but despite this, vehicle production and sales were naturally lower than in previous years.

Total net sales and revenue in 2020 is \$122.485 billion, a major player in a sharp decrease compared to 2019, when it was \$137.237 billion. A percentage reduction of 10.75%, totally consistent with the suspension of production in 2020 and the consequent reduction in vehicle production and sales. The decreasing phase of Total revenues is not limited in the two years considered above, in fact in 2018 they stood at \$147.049 billion, with a percentage reduction considering 2020 of 16.70%.

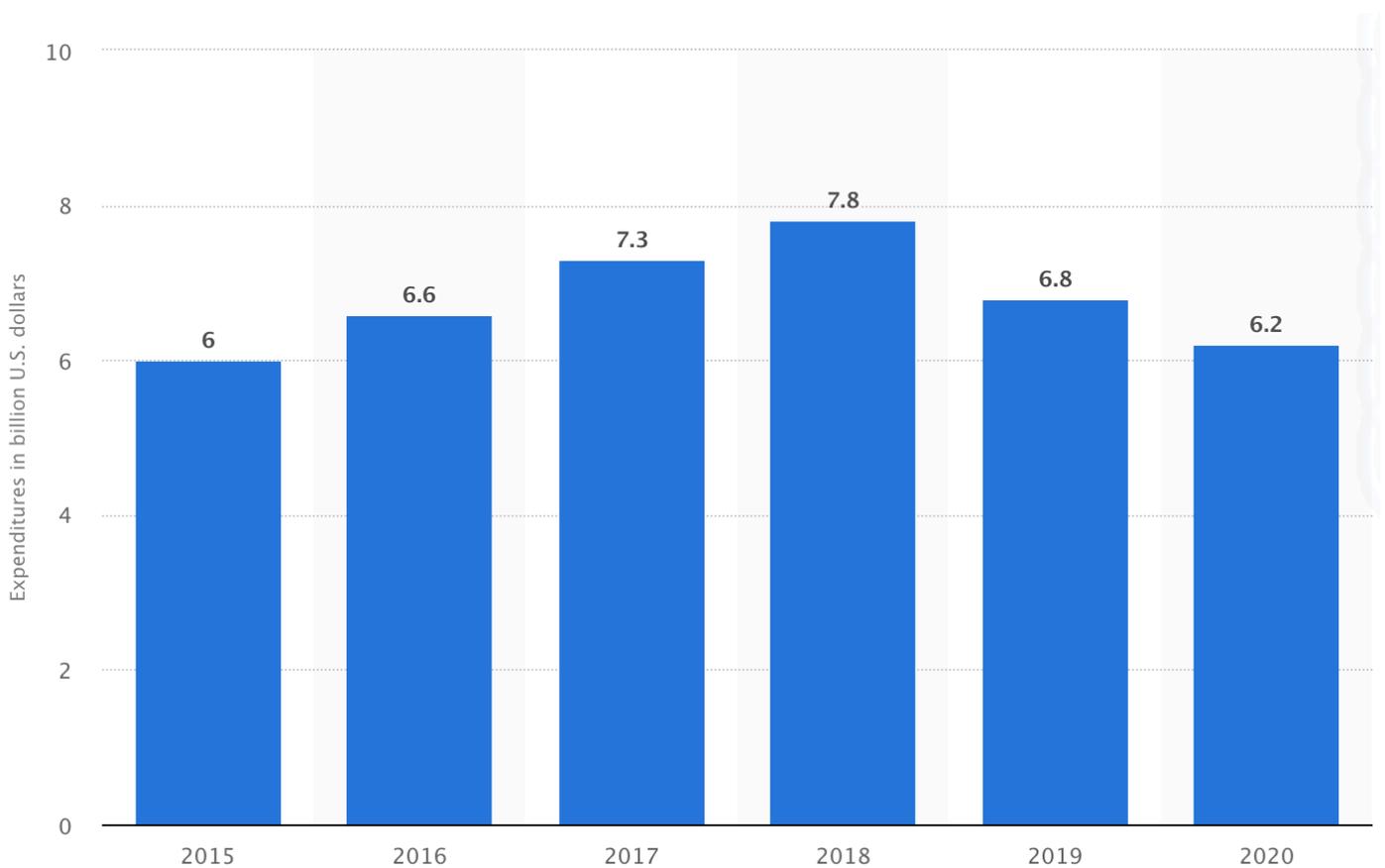
¹⁰⁹ Annual report General Motors 2020, https://www.annualreports.com/HostedData/AnnualReports/PDF/NYSE_GM_2020.pdf

- Costs arising from the GM Financial section increased from \$12.614 billion in 2019 to \$11.274 billion in 2020, a percentage reduction of 10.62%;
- Other selling, general and administrative expenses decreased from \$8.491 billion in 2019 to \$7.038 billion in 2020, a percentage reduction of 17.11% primarily due to a large decrease in advertising.

Importantly, automotive and other costs of sales as a percentage of automotive net sales improved from 90.18% in 2019 to 89.75% in 2020.

When analyzing costs, it is necessary to describe the costs arising from research and development activities. Especially in an ever-changing industry such as automotive, having an active and effective R&D could be strategic to achieve substantial competitive advantages. General Motors in 2020 has research and development expenses of \$6.2 billion.

Figure 58. Research and Development expenses General Motors from 2015 to 2020¹¹¹



As can be seen in Figure 58, this item experienced a sustained decline from 2018 to 2020. In 2019 R&D expenditures stood at \$6.8 billion, while in 2018 they were as high as \$7.8 billion. The reduction in absolute terms is considerable, representing a percentage decrease of 8.82% from 2019 and as much as 20.51%. R&D ratio however remained constant in these years: 5.3% in 2018, 5.0% in 2019, 5.1% in 2020. So the intensity of R&D spending in the years 2018-2020 remained more or less constant, due to a parallel reduction in

¹¹¹ <https://www.statista.com/statistics/260866/research-and-development-expenditures-of-general-motors/>

revenues in the same years, despite the fact that the amount of money invested in R&D, in absolute terms, was lower.

The company's Net income in 2020 stood at \$6.321 billion, a minimal reduction when considering 2019, where that figure was \$6.667 billion. A reduction of 5.18%, which due to a contraction in revenues not fully covered by the consequent reduction in costs.

In the annual report of General Motors there are no explicit references to regulatory credits, but the company has purchased them and has plans to purchase them in the future to meet emission standards. At the same time, in order not to be forced to purchase them, General Motors plans to:

- Become carbon neutral by 2040 in its global products and operations;
- It aspires to eliminate tailpipe emissions from new light-duty vehicles by 2035;
- The company has committed to a 1.5°C Business Ambition Pledge.

Analysis of the Statistics

In order to carry out a comparative analysis of the companies examined in this work, it was considered useful to obtain from the Yahoo Finance website some data considered significant updated to the date of May 14, 2021 in order to compare homogeneous data. Figure 59 shows the most significant balance sheet data and valuation measures calculated as of May 14, 2021.

Figure 59. Income Statement, Balance Sheet, Valuation measures¹¹²

Income Statement			
Revenue (ttm)	122.25B		
Revenue Per Share (ttm)	85.10		
Quarterly Revenue Growth (yoy)	-0.70%		
Gross Profit (ttm)	14.5B		
EBITDA	15.9B		
Net Income Avi to Common (ttm)	8.98B		
Diluted EPS (ttm)	6.20		
Quarterly Earnings Growth (yoy)	927.90%		
Balance Sheet			
Total Cash (mrq)	23.08B		
Total Cash Per Share (mrq)	15.91		
Total Debt (mrq)	112.19B		
Total Debt/Equity (mrq)	206.07		
Current Ratio (mrq)	1.08		
Book Value Per Share (mrq)	34.53		
		Valuation Measures	
		Market Cap (intraday) ⁵	80.63B
		Enterprise Value ³	174.42B
		Trailing P/E	8.97
		Forward P/E ¹	8.42
		PEG Ratio (5 yr expected) ¹	0.84
		Price/Sales (ttm)	0.66
		Price/Book (mrq)	1.61
		Enterprise Value/Revenue ³	1.43
		Enterprise Value/EBITDA ⁷	10.97

¹ Data provided by Refinitiv.³ Data derived from multiple sources or calculated by Yahoo Finance.⁵ Shares outstanding is taken from the most recently filed quarterly or annual report and Market Cap is calculated using shares outstanding.

⁷ EBITDA is calculated by S&P Global Market Intelligence using methodology that may differ from that used by a company in its reporting.

The Market Cap value, calculated considering the outstanding shares according to the company's latest official report, is \$80.63 billion. The EBITDA, equal to \$15.9 billion, the trailing P/E (based on the financial data of the most recent 12 months) is equal to 8.97, while the forward P/E (that uses forecasted earnings for the P/E calculation) is equal to 8.42. These values are lower than the global average P/E value of the automotive sector which was 10-12 in the period 2012-2019 and has now risen to 40 due to the Covid crisis. The Enterprise Value/EBITDA ratio (Earnings before Interest taxes depreciation and amortization), which is equal to 10.97, appears to be quite in line with the worldwide average trend (in the period 2012-2019 it was equal to 4-6, today it is equal to 10 and at the end of the next two years it is expected to be equal to 7)¹¹³. Total cash is

¹¹² <https://finance.yahoo.com/quote/GM/key-statistics?p=GM> data of May 14, 2021

¹¹³ Fonte Bloomberg: MSCI WORLD AUTO & COMPONENTS INDEX, data April 28, 2021

\$23.08 billion and total cash per share is 15.91. The Current ratio, which represents the ratio of current assets to current liabilities, is 1.08. This indicator expresses the company's ability to repay short-term or scindent obligations within one year. This value is in line with the Current ratio of the automotive industry, which as of 2020-12-31 was approximately 1.09¹¹⁴. The diluted EPS ttm, in which the total number of ordinary shares is calculated taking into account also the possible exercise or conversion of equivalent securities by, for example, holders of convertible bonds and stock options, is \$6.20.

¹¹⁴ <https://www.macrotrends.net/stocks/charts/GPI/group-1-automotive/current-ratio>

Analysis of strategic alliances

The most significant strategic collaborations implemented by General Motors will be analyzed below.

The company has developed a strategic partnership with Honda aimed at advanced engineering research on fuel cell systems, developing and commercializing fuel cell systems with production expected in the early 2020s. In January 2021, there was an announcement of an agreement to supply Hydrotec fuel cell power cubes to Navistar for use in its production fuel cell electric vehicle model.

General Motors has entered into a strategic partnership with NREL with the goal of implementing a multiyear, multimillion-dollar joint research and development effort to lower the cost of automotive fuel cell stacks through improvements in materials and manufacturing. The goal is to simultaneously lower the cost of fuel cell systems and increase their durability, which will help make the total cost of zero emission vehicles more affordable. "GM is working with NREL to find innovative solutions to the next generation of fuel cell electric vehicle challenges, including reducing platinum loading, achieving higher power densities, and accelerating manufacturing processes to achieve greater economies of scale."¹¹⁵

General Motors has finalized a strategic partnership with SolidEnergy Systems with the goal of enhancing range, reducing costs, and improving energy density of its battery technology. The companies plan to work jointly on a manufacturing prototyping line, with the goal of producing a high-capacity pre-production battery by 2023. This alliance may prove key to General Motors' ultimate acceleration in the development and production of electric vehicles (EVs), as the company's ultimate goal is to achieve a once-in-a-generation improvement in energy density and cost of its battery technology.¹¹⁶

¹¹⁵ <https://www.nrel.gov/workingwithus/partners/partnerships-gm.html>

¹¹⁶ <https://www.nasdaq.com/articles/general-motors-gm-enhances-battery-tech-with-solidenergy-deal-2021-03-12>

Chapter 3: Comparative analysis & final considerations

In the third, and final chapter, a comparative analysis of the five automotive companies studied above will be carried out, with a focus on the most significant and strategic values.

The study will be conducted as follows:

- Analysis of the companies' stock price trends;
- Analysis by size;
- Analysis by market capitalization;
- Analysis by economic parameters (EBITDA margin, gross margin, regulatory credits);
- Analysis by patrimonial parameters (current ratio, capital intensity ratio);
- Analysis by valuation measures (EV/revenues, EV/EBITDA, trailing P/E);

The objective of this research is to analyze, through the differences of these values, which are the strategies that are rewarding the financial markets in this historical period, understanding which are the critical success factors that create a competitive advantage. All valuations and analyses below will be presented in euros (€), using the appropriate exchange rate where necessary.

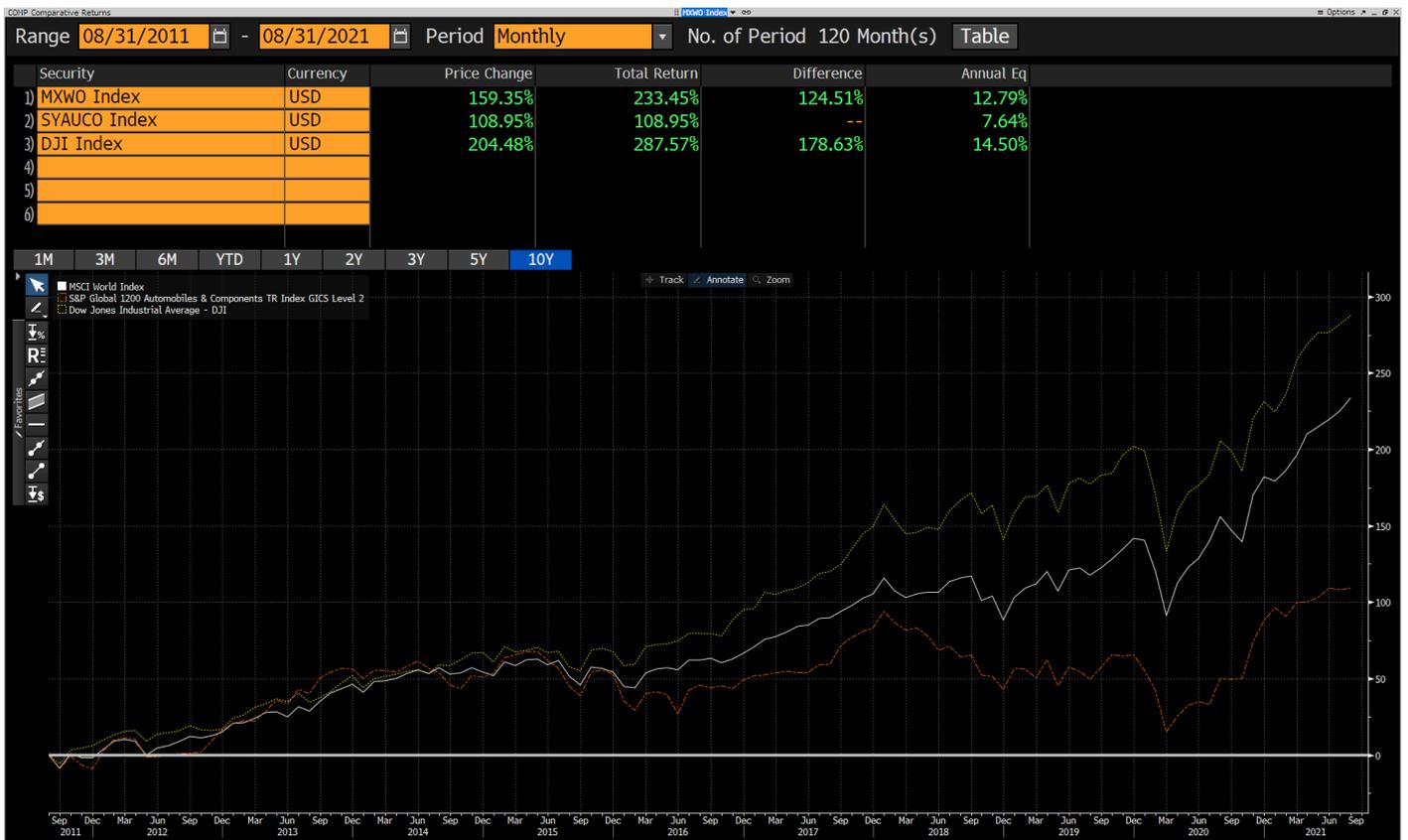
3.1 Analysis of companies' stock price trends

The following section aims to study the stock performance of the five companies considered, to understand what the markets are rewarding and, in the final considerations, to delve into what may be the critical success factors of a fast-growing industry such as the automotive sector. All charts included in this paragraph have Bloomberg as their source, and will be outlined as follows:

- An initial chart studying the general trend of the automotive industry;
- A chart analyzing the trend of the stocks of the five companies studied;

Below you will find the various graphs analyzed in detail.

Figure 60. Trend of automotive sector¹¹⁷



The first graph is represented in Figure 60. The latter gives a representation, from 08/31/2011 to 08/31/2021, of three very important indices:

- SYAUCO Index, which includes 1200 automotive and component companies. It is taken as an industry benchmark¹¹⁸;
- MXWO Index, which includes large and mid-cap representation across 23 Developed Markets countries. Used, in this case, as a benchmark of global stock market performance¹¹⁹;
- DJI Index, stock index of the New York Stock Exchange, taken to have a representation of the American economy.

Before making considerations on the chart, clarifications will follow:

- The data value as of 08/31/2011 is considered to be 0 for all three indices;
- Price change measures the total return for the period calculated through the difference in the value of the quotation in the time considered.
- Total return¹¹⁸ measures the total return for the period, considering not only the change in price but also any dividends distributed. In the case of the SYAUCO index the two values (price change and total return) coincide in that the index is calculated as total return including dividends distributed during the period.

¹¹⁷ Source Bloomberg.

¹¹⁸ Source Bloomberg.

¹¹⁹ <https://www.msci.com/documents/10199/178e6643-6ae6-47b9-82be-e1fc565ededb>

- Difference: measures the difference in absolute value between the percentage return (total return) of the share compared with the reference benchmark (shown in line 2)
- Annual eq.: this measures the average annualized return for the period.

Analyzing the graph specifically, it can be seen a strong correlation of the three curves until the end of 2015, so the automotive sector, the world economy and the U.S. economy went hand in hand undergoing the same fluctuations. This means that during that period, the automotive sector was strategic and a key player in boosting the economies of the various countries. The trend changes radically from 2016 onwards when, as can be seen in the graph, the world and American economies continue to grow, while the automotive sector undergoes an abrupt slowdown. The main reason for the now lack of correlation could be that, over time, the automotive sector firstly, and all the "heavy" sectors, have lost their centrality within their countries. The focus is increasingly shifting towards sectors with strong digitalization.

The proof can be seen in the numbers:

- SYAUCO has an average annual return of 7.64%, lower than MXWO (12.79%) and DJI (14.50%);
- SYAUCO's Total Return which is 108.95%, is also lower than MXWO (233.45%) and DJI (287.57%).

So, in conclusion, it is clear that the automotive sector is no longer performing as well as the world economy (MXWO) and the US economy (DJI). This trend is probably due to the fact that, in relative terms, the automotive sector is perceived as an underdeveloped sector that will require strong innovation and huge investments to meet future technological and environmental requirements. Finally, it should be noted that in the last twenty years the world's financial markets have rewarded the so-called "new economy" sector, which has introduced strong innovation (internet, information technology (ICT), artificial intelligence and robotics, clouding, etc.) and has given a considerable boost to the growth of stock market values.

Figure 61. Analysis of companies' stock prices trend and SYAUCO¹²⁰



Figure 61 shows a comparison of the stock returns of the five companies, using the SYAUCO index as a benchmark, examined over the period 08/31/2011 - 08/31/2021. The returns are calculated in the reference currencies of each company so as to strip the results of the exchange rate effect. The data shows Tesla's Total Return of 14,769.04%, well above the Total Return of the SYAUCO industry index (108.95%) and the average value of the other four companies considered (around 240%). It should be noted that Tesla is the only company that has not distributed dividends during the period (price change = total return). The interpretation of the possible causes of the different trend between the Tesla shares and the other companies is referred to the final considerations.

Once the analysis of the share performance of the five companies in question was completed, in order to carry out an even more detailed comparison, the data considered strategic were collected through the annual report and Yahoo Finance.

¹²⁰ Source Bloomberg.

3.2 Analysis by size

The following analysis will be based on the size of the five automotive companies analyzed so far. The number of vehicles sold per company, the number of employees and the revenues will be studied to get a picture of the actual size of the latter. The rankings will be represented below.

Figure 62. Ranking by vehicles sold¹²¹



Figure 62 represents the number of vehicles sold by the five automotive companies analyzed. The ranking is as follows:

1. Volkswagen 9.2 million;
2. Toyota 8.958 million;
3. GM 6.829 million;
4. Daimler 2,840 million;
5. Tesla 500 thousand.

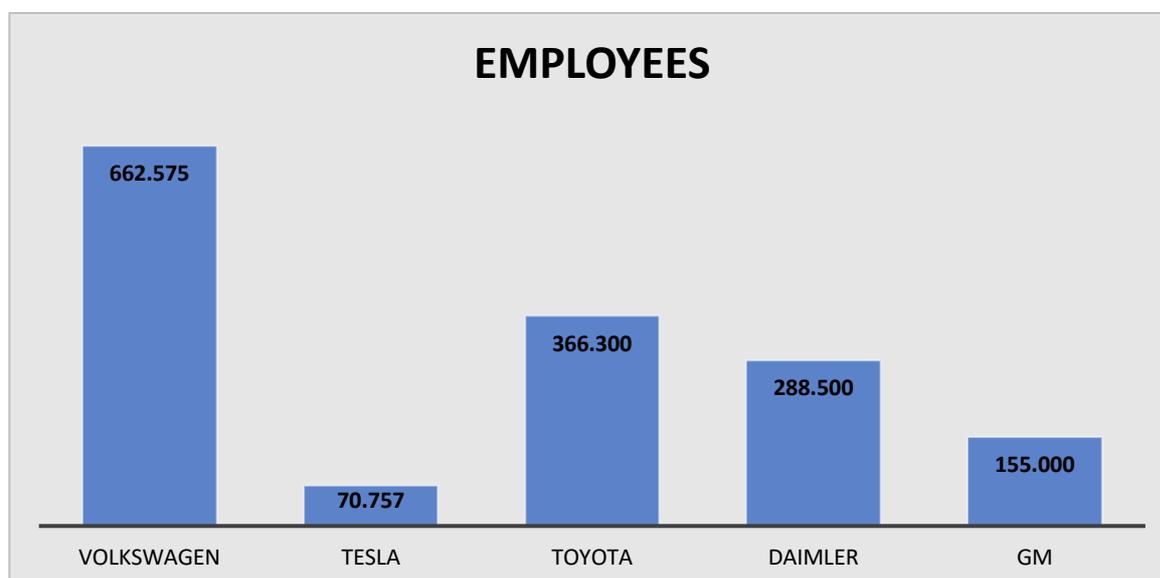
Volkswagen is the company that sold the most vehicles in 2020, with an average price of its cars of around €25,000. It should be noted that the above-mentioned data on the average price has been summarily determined, by simply dividing the total revenues in euros by the number of cars sold. In order to have more precise information, it would be necessary to examine revenues relating only to cars (thus excluding other items such as financial services, components, etc.). It is reported that the companies Daimler and Tesla, which have sold fewer cars, produce cars with a higher average unit price than the others (Tesla around €59,000, Daimler around €55,000).

The substantial difference that can be seen from the chart is the vehicles sold by Tesla, half a million, and the other four companies, which all exceed 2.5 million. Tesla, in fact, among the five, is the youngest company

¹²¹ Comparative analysis automotive companies, excel file created with data taken from annual report and Yahoo Finance.

and also, as pointed out in the previous chapter, the one most focused on innovation, which in the automotive sector takes the name of electric vehicle.

Figure 63. Ranking by employees¹²²



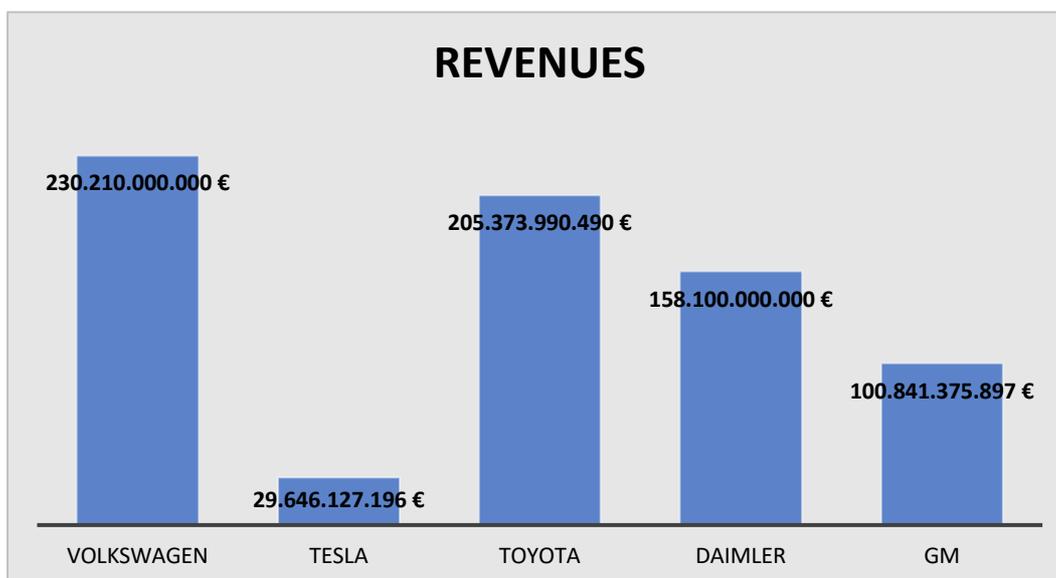
The second type of analysis in the paragraph is by analyzing the number of employees working for the companies. Below is the ranking represented in Figure 63:

1. Volkswagen 662,575;
2. Toyota 366,300;
3. Daimler 288,500;
4. GM 155,000;
5. Tesla 70,757.

Again, Volkswagen emerges as the winner of this ranking, with 662,575 employees. This figure perfectly mirrors the company's record for the number of vehicles produced and sold in 2020.

¹²² Comparative analysis automotive companies, excel file created with data taken from annual report and Yahoo Finance.

Figure 64. Ranking by revenues¹²³



In the final analysis of this section, we will look comparatively at the revenues earned by individual companies in 2020. The ranking, found in Figure 64, is as follows:

1. Volkswagen €230,210,000,000;
2. Toyota €205,373,990,490;
3. Daimler €158,100,000,000;
4. GM €100,841,375,897;
5. Tesla €29,646,127,196.

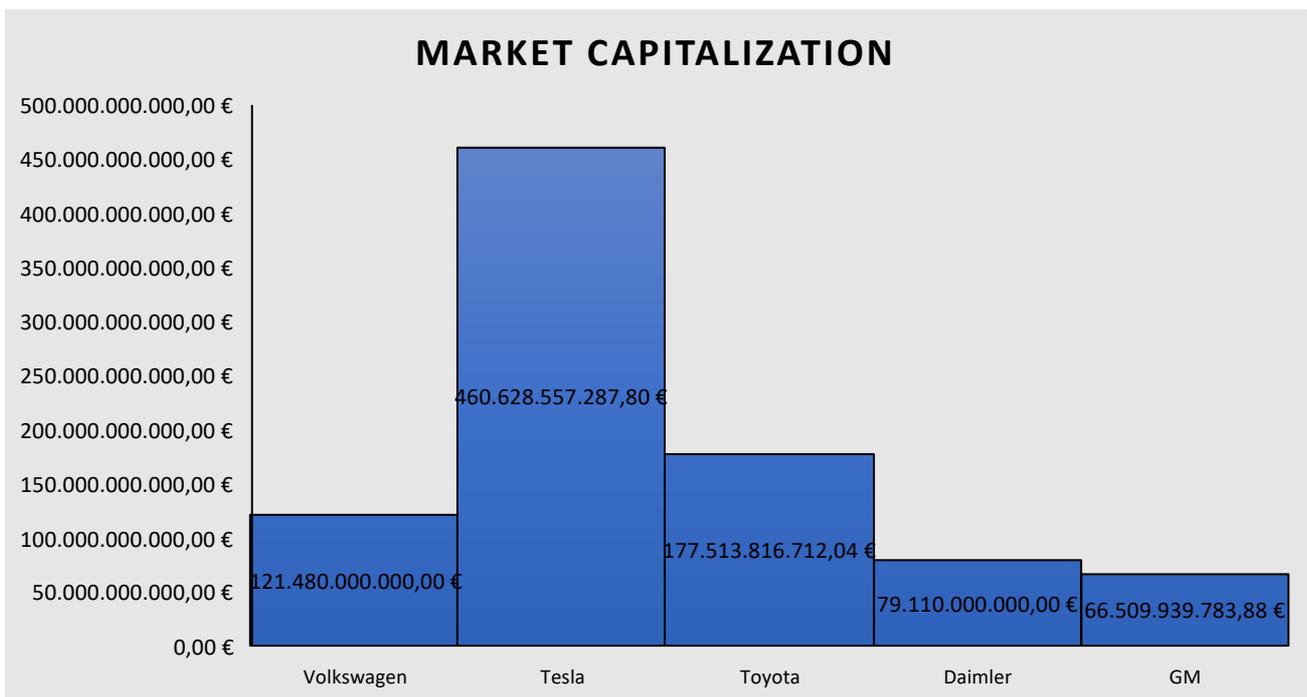
Also in the last ranking, Volkswagen is the company with the highest revenues in 2020. We can see, therefore, a certain consistency between the graphs represented, which clearly say that Volkswagen is the company with the largest size of all, being the first in terms of vehicles sold, employees and revenues, followed by Toyota, while more detached are Daimler and GM. At the same time, Tesla, which is the youngest company, turns out to be the smallest company of the five, having relatively small values compared to the others.

¹²³ Comparative analysis automotive companies, excel file created with data taken from annual report and Yahoo Finance.

3.3 Analysis by market capitalization

In the following paragraph an analysis will be implemented, with consequent ranking, of the market capitalization of the five automotive companies. This information, which represents the market value of the company's outstanding shares, represents how much the company is worth as determined by the stock market. All data used in this paragraph was taken as of May 14, 2020, shares outstanding is taken from the most recently filed quarterly or annual report and Market Cap is calculated using shares outstanding. Values by individual company are represented in the figure below.

Figure 65. Ranking by Market Capitalization¹²⁴



As depicted in Figure 65, these are the Market Caps of the individual companies:

1. Tesla 460,628,557,287.80 €;
2. Toyota 177,513,816,712.04 €;
3. Volkswagen 121,480,000,000.00 €;
4. Daimler 79,110,000,000.00 €;
5. General Motors 66,509,939,783.88 €.

Tesla turns out to have the highest Market Cap of all, resulting in the company whose markets confer the most value. The ranking is consistent when considering the performance of the companies' shares, depicted in Figures 60 and 61. Tesla is the clear winner of the stock trend and Market Cap, and in both cases the top spot is attributed to Tesla's share price, which is much higher than the other four companies.

The Market Capitalization Market Capitalization is influenced by a number of interrelated factors, such as:

¹²⁴ Comparative analysis automotive companies, excel file created with data taken from annual report and Yahoo Finance.

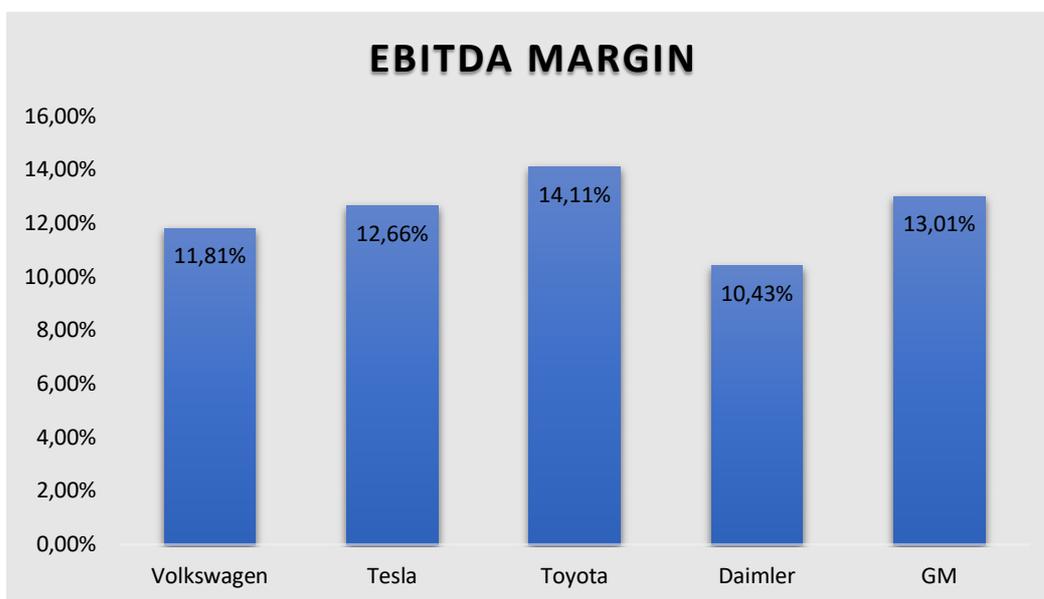
- The first, and most immediate, is that shown above, i.e. the stock price trend;
- Changes in the shares outstanding;
- The distribution of dividends, since if a company chooses to pay dividends (of the companies analyzed, the only one that does not is Tesla) it decreases the value of Market Capitalization;
- The economic performance of individual companies.

Returning to Figure 65, it gives an interesting representation, as there is the first substantial difference in values, between the ranking shown above and those shown in the previous paragraph (Analysis by size), in which Tesla is last in all three rankings shown.

3.4 Analysis by economic parameters

In the following section, the analysis and rankings shift to economic parameters. The most significant and strategic values taken into consideration are: EBITDA margin; Gross Margin and the purchase or sale of regulatory credits. The various rankings will be explained below.

Figure 66. Ranking by Ebitda margin¹²⁵



EBITDA %, earning before interests, taxes, depreciation and amortization, represents an index of the operating profitability of companies. It is given by EBITDA, in absolute values, compared with revenues and is a clear indicator of the real performance of a company that focuses on the fundamentals: operating profitability and cash flows. It is used to compare different companies in the same sector, as it reveals the firm capable of generating more operating cash for each euro of revenues earned.

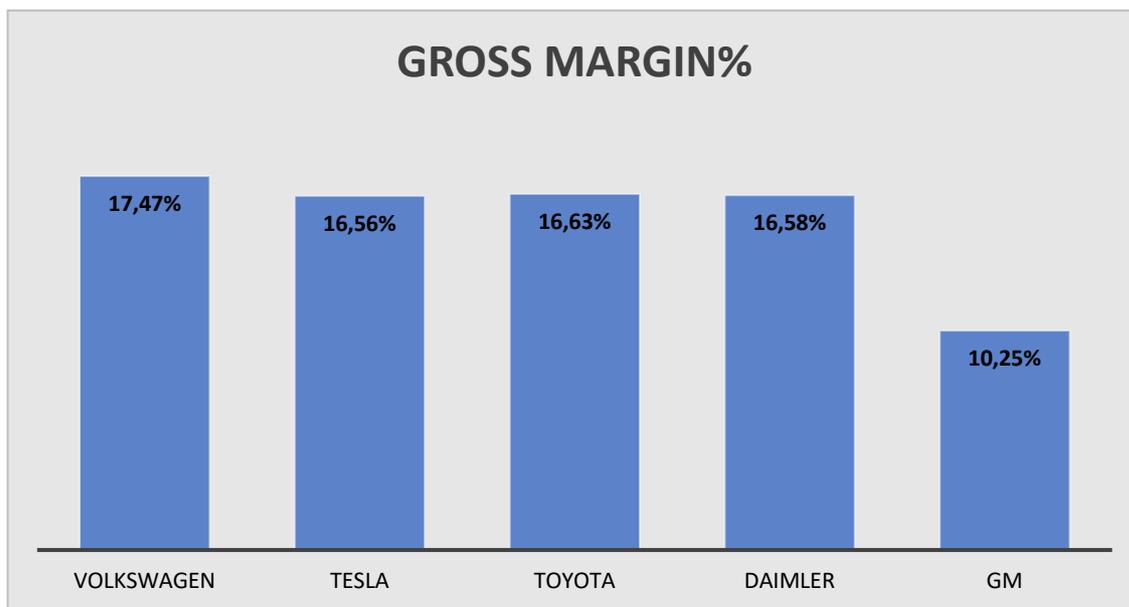
As represented in Figure 66, the ranking is shown below:

1. Toyota 14.11%;
2. GM 13.01%;
3. Tesla 12.66%;
4. Volkswagen 11.81%;
5. Daimler 10.43%.

Toyota, therefore, has the highest EBITDA margin of the five companies. The EBITDA is taken from the Yahoo Finance (see references in the Analysis of the Statistics chapter 2 above) and is calculated by S&P Global Market Intelligence using methodology that may differ from that used by a company in its reporting.

¹²⁵ Comparative analysis automotive companies, excel file created with data taken from Yahoo Finance. Data are TTM (last 12 months) calculated as of May 14, 2021.

Figure 67. Ranking by Gross Margin¹²⁶



In the following image, Figure 67, the ranking is done considering Gross Margin. Mathematically, this value is given by the difference between Net Sales and COGS, compared to Net Sales. The result is a good indicator of company efficiency, as it measures how much production costs weigh on revenues.

The percentages shown in Figure 67 relate to the 2020 report except for Tesla where reference is made to the 2019 report. It should be noted that the values expressed in the previous Figure, not being supported by industrial accounting analysis, express a value of efficiency comparison that is purely indicative since it should be taken into account that the data should be examined in a more analytical form and processed with homogeneous systems among the various companies. The values are also influenced by the price effect (variations in purchase and sales prices affect the index) and the exchange rate effect (for example, the exchange rate variations between the reference currency of the balance sheet and the currencies in which purchases and sales are made should be analyzed).

The ranking represented above is structured as follows:

1. Volkswagen 17.47%;
2. Toyota 16.63%;
3. Daimler 16.58%;
4. Tesla 16.56%;
5. GM 10.25%.

Volkswagen has the highest Gross Margin of the five companies just listed. Although it is important to underline that, as indicated in note 127, the Volkswagen data is calculated considering only the revenues and costs of the automotive sector, while in the other cases the gross margin includes the weight of the other activities.

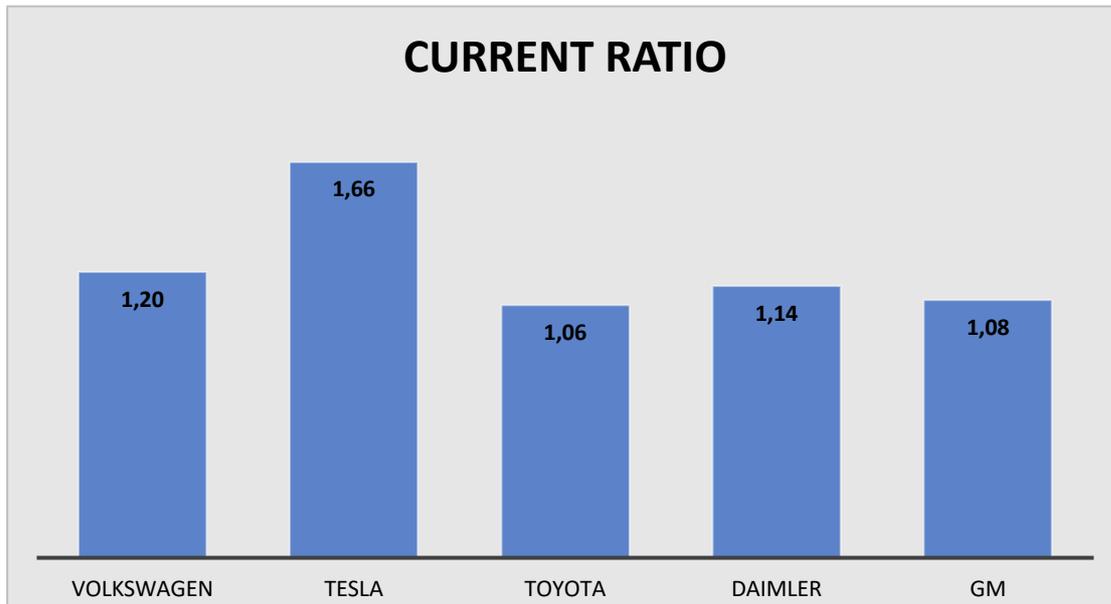
¹²⁶ Comparative analysis automotive companies, excel file created with data taken from annual report 2020 except for Tesla (report 2019)

The last strategic economic parameter to analyze is the sale or purchase of regulatory credits. As explained above, regulatory credits have become necessary for every company that is part of the automotive sector. Among the five companies studied so far, the only one that manages to meet the CO2 emission parameters and sell them is Tesla. In 2020 it sold regulatory credits for a value of €489,977,728.29 and made Tesla able to close the year in profit. Toyota, Volkswagen, Daimler and GM are not yet able to come within the parameters and are forced to buy them from companies that have excess, such as Tesla. In the Final Considerations we will try to interpret this data, and the possible implication in the financial markets.

3.5 Analysis by patrimonial parameters

The comparative analysis continues, now focusing on the patrimonial values of the five automotive companies. The study has been limited to two figures: current ratio and capital intensity ratio. Detailed analyses will follow below.

Figure 68. Ranking by current ratio¹²⁷



The current ratio represents a value that measures the ability of a company to repay short-term obligations, comparing current assets with current liabilities. This ratio, therefore, measures the solvency of the company, and is fundamental to understanding the health of the company's assets.

Looking at Figure 68, the first consideration is that all five of the companies in consideration have a current ratio greater than 1, the detailed ranking is as follows:

1. Tesla 1.66;
2. Volkswagen 1.20;
3. Daimler 1.14;
4. GM 1.08;
5. Toyota 1.06.

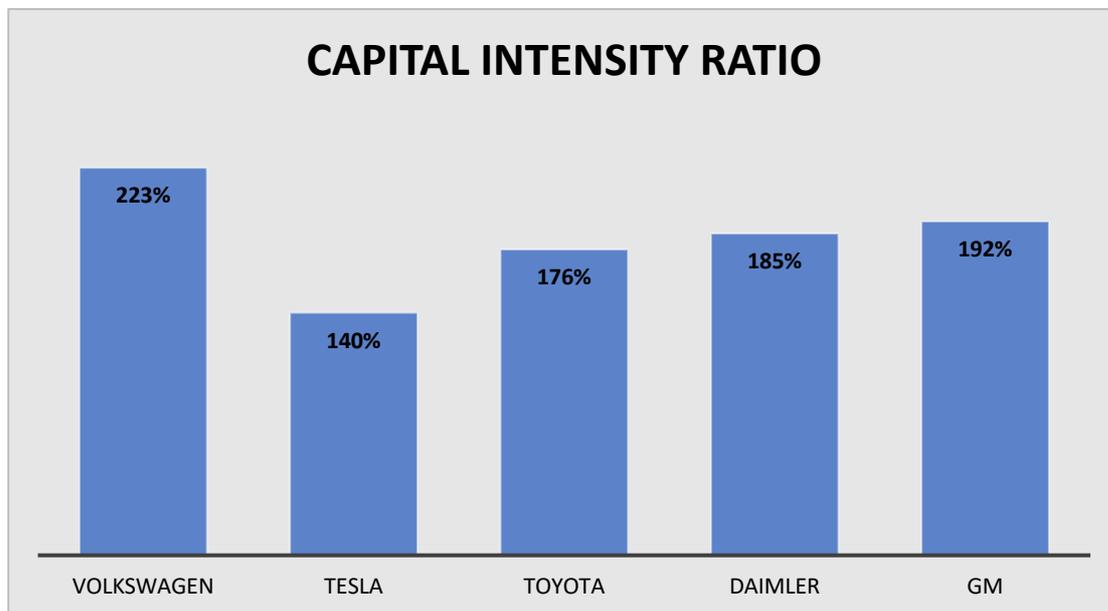
Tesla, as of May 14, 2021, appears to be the company with the highest current ratio of the five, and thus the most solvency. The automotive sector has an average current ratio of 1.09¹²⁸, so it is visible how Tesla, Volkswagen and Daimler perform better than the industry average, while GM and Toyota are below. It is important to specify that this value is very important to represent the ability of a given company to repay its short-term obligations, but at the same time this is a static value, which takes a snapshot on a given day, this

¹²⁷ Comparative analysis automotive companies, excel file created with data taken from annual report 2020 except for Tesla (report 2019)

¹²⁸ <https://www.macrotrends.net/stocks/charts/GPI/group-1-automotive/current-ratio>

does not mean, therefore, that if a company has a current ratio below 1 is not able to repay its short-term obligations in the near future.

Figure 69. Ranking by capital intensity ratio¹²⁹



The capital intensity ratio, on the other hand, represents how much capital is required for a company to produce one euro of revenues. The automotive industry has always been considered a capital-intensive sector, which means that a company, as opposed to one that operates in another sector, needs more assets to generate the same amount of revenues. Now analyzing Figure 69, it can be seen, as specified above, that the automotive sector is characterized by a high use of capital, and therefore depreciation. The ranking is as follows:

1. Volkswagen 223%;
2. GM 192%;
3. Daimler 185%;
4. Toyota 176%;
5. Tesla 140%.

It is worth pointing out, as has been done for other parameters identified, that the comparative data expressed in Figure 69 are affected by the different weight of activities such as financial services, battery production or other components and therefore express an assessment of the different business models. Volkswagen is the company with the highest capital intensity ratio, and thus the one that needs the most assets of all to generate the same amount of revenue. Tesla, on the other hand, is the company, among the five, with the lowest percentage and represents an important competitive advantage. This means that, among the competitors, Tesla is the company able to produce the same revenues as the others but with fewer assets. It is likely that this depends on the circumstance that Tesla is a newly established company and was born on recent foundations

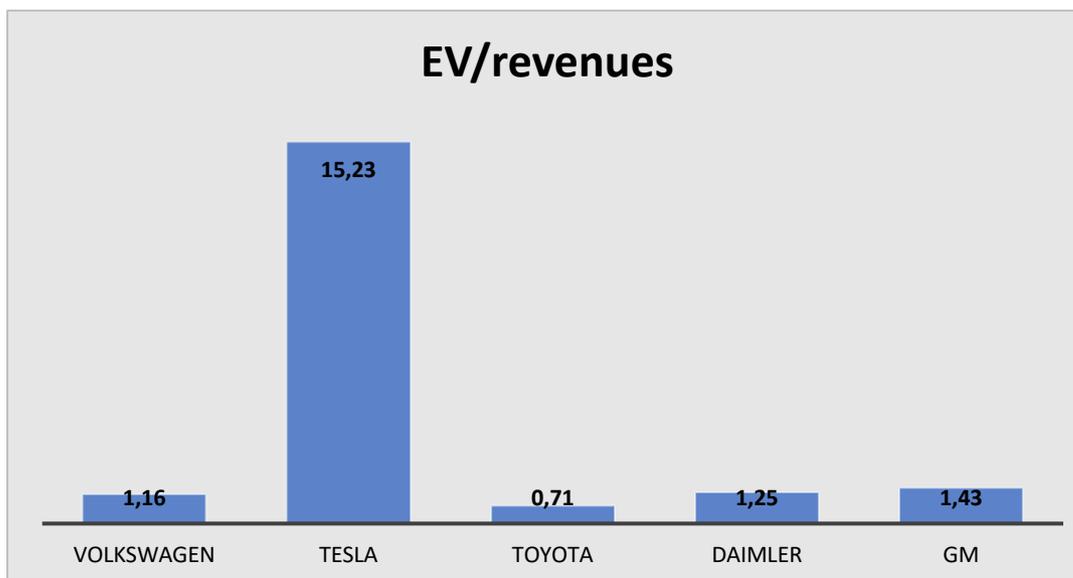
¹²⁹ Comparative analysis automotive companies, excel file created with data taken from annual report 2020 except for Tesla (report 2019)

of product and technology, so it does not require large investments in restructuring and adaptation to new requirements that have the other competitors examined. It can be said that in a period of great change Tesla does not have the weight of its history.

3.6 Analysis by valuation measures

The last step of the analysis focuses on the valuation measures of the companies studied so far. The indicators examined in this paragraph will be: EV/revenues, EV/EBITDA; trailing P/E. These parameters were chosen because they are widely used to determine the fairness of the company's value compared to average industry values. The rankings will be presented below.

Figure 70. Ranking by EV/revenues¹³⁰



The first indicator analyzed is EV/revenues. It is a multiple that compares the enterprise value of a company with its revenues, and it is very much used to have an overall evaluation of the company in consideration and to understand if the stock is priced fairly. Because of this, for a hypothetical investor, the lower the value the better, because it means that the company is undervalued.

The ranking shown in Figure 70 is as follows:

1. Tesla 15.23;
2. GM 1.43;
3. Daimler 1.25;
4. Volkswagen 1.16;
5. Toyota 0.71.

Tesla crushes the other four automotive companies, with a multiple of 15.23. The data is very high if we consider the world average value of the multiple (in the period 2012-2019 it was equal to around 0.6/0.7, today it is equal to 1 and at the end of the next two years it is expected to be equal to 0.9).¹³¹

The possible reasons for such a high value, received by the financial markets, are:

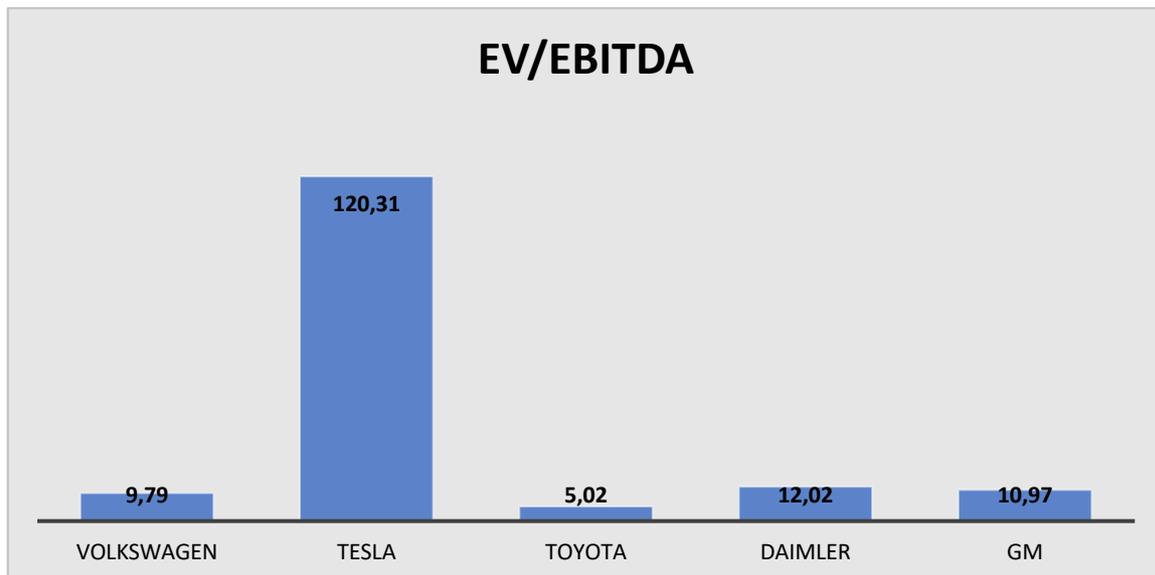
¹³⁰ Comparative analysis automotive companies, excel file created with data taken from Yahoo Finance. Enterprise Value (EV) - Data derived from multiple sources or calculated by Yahoo Finance – data as of May 14 2021

¹³¹ Source Bloomberg: MSCI WORLD AUTO & COMPONENTS INDEX, data as of 28/04/2021

- The expectation of massive revenue growth in the short mid-term, so that this multiple has an average value;
- A temporary overvaluation of the Tesla stock.

The company that, in this case, has the lowest EV/revenues is Toyota with 0.71.

Figure 71. Ranking by EV/EBITDA¹³²



The focus now shifts to the EV/EBITDA multiple, also known as the enterprise multiple. The difference with the previous multiple, also noted by the name, is that in this case the enterprise value is related to EBITDA. It is also used to calculate the overall value of a company, but is based on a different concept: while EV/revenues studies the ability to generate revenues from a company, EV/EBITDA studies its ability to generate cash flows, and therefore its profitability. Each sector has its own average value, and is taken as a benchmark to understand the company's performance. The ranking will be listed below, represented in Figure 71:

1. Tesla 120.31;
2. Daimler 12.02;
3. GM 10.97;
4. Volkswagen 9.79;
5. Toyota 5.02.

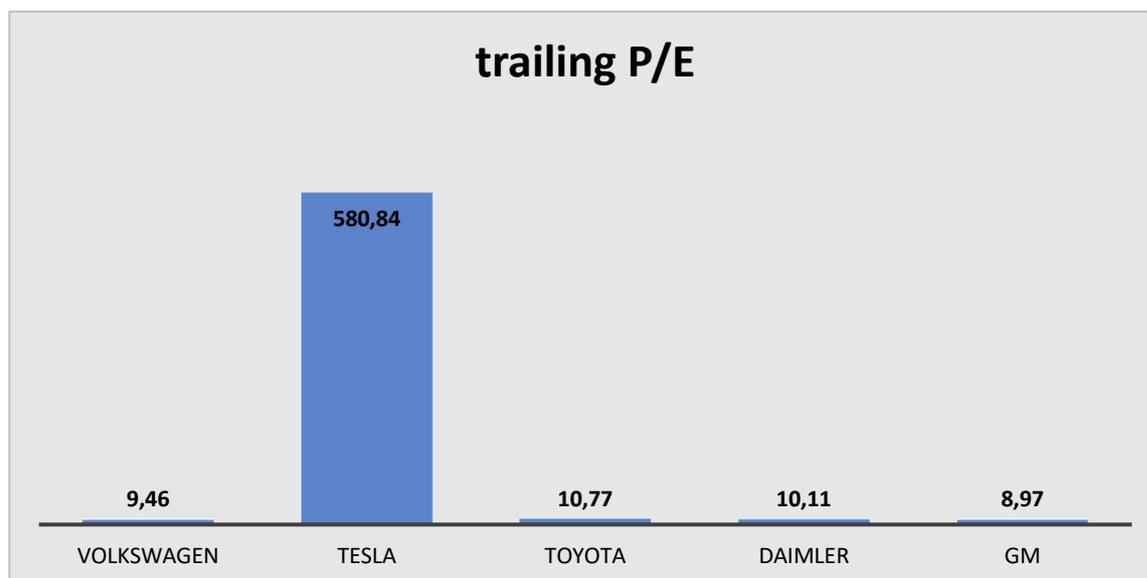
Also in this ranking, Tesla emerges as the undisputed frontrunner with a value of 120.31. Even more astounding, if the global average value of the multiple is considered (in the period 2012-2019 it was equal to 4-6, today it is equal to 10 and at the end of the next two years it is expected to be equal to 7)¹³³. This means that Tesla is considered by the markets to be a fast-growing company capable of generating rapid EBITDA

¹³²Comparative analysis automotive companies, excel file created with data taken from Yahoo Finance. EBITDA is calculated by S&P Global Market Intelligence using methodology that may differ from that used by a company in its reporting. – data as of May 14 2021

¹³³ Source Bloomberg: MSCI WORLD AUTO & COMPONENTS INDEX, data as of 28/04/2021

growth in the future that would realign the ratio to sustainable average values. As mentioned earlier this high value could also be read as a momentary overvaluation of the company. Let's consider that in order to align Tesla's multiple with the average multiple of the other competitors examined (average value 9.5), Tesla's EBITDA would have to grow by about 12 times compared to current values. All the other companies studied, however, present an EV/EBITDA higher than that of the sector.

Figure 72. Ranking by trailing P/E¹³⁴



The last data analyzed is the trailing P/E. The latter is a multiple that is calculated by dividing the stock price of the studied company with the earnings per share of the last 12 months available (reason why they are called "trailing"). This data is used by investors to understand the ability to repay the capital invested, or rather in how many years it is possible to return the investment made. Often a high trailing P/E is reserved for those companies that have a strong competitive advantage, able to maintain a powerful position. As depicted in Figure 72, this is the ranking:

1. Tesla 580.84;
2. Toyota 10.77;
3. Daimler 10.11;
4. Volkswagen 9.46;
5. GM 8.97.

The graph is pretty straight-forward, and Tesla's 580.84, a clear winner in this ranking as well, flattens out all the other values. In practical terms, the above value reveals that the market imagines a strong increase in earnings and gives Tesla a very strong competitive advantage over its competitors. The statistic is striking because it tells that an investor who buys a stock at the values taken into consideration (May 14, 2021) will be

¹³⁴ Comparative analysis automotive companies, excel file created with data taken from Yahoo Finance. Data provided by Refinitiv. Dati as of May 14, 2021

able to return the capital after 580 years. Again, it is useful to know that the industry average P/E was in the period 2012-2019 equal to 10-12 and in the post-Covid period has risen to 40. At the end of 2022 the value is expected to settle at 13. The other four companies are all below that.¹³⁵

¹³⁵ Source Bloomberg: MSCI WORLD AUTO & COMPONENTS INDEX, data as of 28/04/2021

3.7 Final considerations

The comparative analysis of the five companies (Tesla, Volkswagen, Toyota, Daimler, General Motors) in the automotive sector has been finished, and some considerations will be made.

Volkswagen, despite being the company with the best market positioning (it excels in terms of size parameters), is poorly valued on the markets (in terms of valuation measures, it ranks fourth out of five). This consideration seems to tell that other critical success factors are rewarded by investors.

To this end, it is useful to analyze Tesla which, as noted, is the company with by far the best market valuation. Summarizing what emerged from the analyses represented in this work, it is possible to note the following about the comparison between Tesla and the other four companies examined:

- It is the best positioned company in terms of environmental policies (it is the only one that sells regulatory credits among the companies examined). In 2020 it assumes revenue of about \$1 billion from regulatory credits sales alone, while in 2019 revenue due to regulatory credits (about \$594 million) accounted for 7% of the company's total revenue, and without them Tesla would have closed at a loss.¹³⁶ At a time when the global goal is the green transition this aspect is not negligible. As specified in the Introduction, in Europe, as in all countries of the world, the ecological transition appears to be the real protagonist of the coming years (the recovery plan of the EU and the reform of the ESM follow this direction) channeling the majority of capital and investments in this direction.
- Unlike other companies Tesla is perceived as a company that is not only focused on the development of cars given the presence of other strategic business units. As specified in the report, Tesla not only designs, develops and sells fully electric vehicles, but also has an important segment of energy generation and storage. The strategy is clear and diversifies the risk.
- The company, being newly formed, does not need to invest in heavy restructuring necessitated by the major changes affecting the industry. Tesla does not have the weight of its history.
- Confirming the previous point, Tesla is the best from the point of view of the capital indicators examined (best current ratio and capital intensity ratio).
- It seems to be the most advanced on the product developments and critical success factors indicated in Chapter 1: autonomous driving, which is declined in connectivity, vehicle safety, cybersecurity, mapping; sustainable innovations, which instead consider the ability to reduce CO2 emissions through a different vehicle power supply (electric vehicles) and the power supply of the latter. If one takes into consideration the paragraphs of the "strategic alliances" of the five companies studied, Tesla turns out to be the one with the least alliances of all. There is no information necessary to make definitive conclusions, but it would seem to be the only one able to face a frenetic sector in complete transformation like the automotive one alone (presumably thanks to the development of greater internal

¹³⁶ https://www.ansa.it/canale_ambiente/notizie/mobilita/2020/08/11/tesla-certificati-verdi-salvano-conti-secondo-trimestre_4ec44f9e-1847-4bf8-8115-84b5fcc605ef.html

competences), managing to sell regulatory credits to many of its competitors. Other companies, on the other hand, in the sign of change, are making many more alliances.

- Finally, it can be said that Tesla is perceived as an organization constantly oriented towards innovation and the continuous search to build competitive advantages, and the figure of Elon Musk and his past clearly help to reinforce this idea.

During the analysis carried out, several times it has been pointed out that the values reached in Tesla's quotations appear very high and as mentioned above, on the basis of current data, not very sustainable. There are two possible readings of the situation. The first is that investors believe that future developments will bring significant improvements in terms of EBITDA and profit capable of bringing valuations back to more balanced levels (in practice, as often happens, the markets have already transposed future expectations of improvement), or it may be that there is a momentary excess of valuation, dictated by overly optimistic forecasts, destined to return over time.

The following paper strongly underlines how the automotive sector is at an epochal turning point, in which innovations and changes are so rapid that companies that for decades have excelled as leaders in the sector are now being overtaken by much younger ones (Tesla and Nio¹³⁷ above all).

From the performance of the shares (Figure 61) of the five companies studied, it seems clear that the market is rewarding Tesla for all the reasons listed above, and it is not known whether this is a temporary overvaluation or not, but it is certainly true that the sector continues to travel at an unprecedented speed. It is, in fact, more and more concrete the possibility of companies entering the automotive market that until now have focused on other businesses, and it is equally concrete the possibility of companies that have been in the sector for decades not being able to keep up and disappear.

To cite concrete cases, Baidu (the main search engine in Chinese, a company therefore part of the new economy) has entered into a collaboration with the car manufacturer BAIC Group to develop 1,000 driverless cars over the next three years. At the same time, it is testing so-called "robotaxis" (robot taxis) in major Chinese cities.¹³⁸

Amazon itself has invested more than \$1 billion, buying an autonomous vehicle startup called Zoox, thereby opening up delivery via self-driving vehicles.¹³⁹

Even more importantly, and key in representing the speed of change the automotive industry is going through, Taiwan's Economic Daily News reveals that Apple could bring its fully intelligent car to market in 2021, ahead of earlier predictions that the so-called Apple Car would be released between 2023 and 2025.¹⁴⁰ This move would definitely revolutionize the automotive market, with the entry of one of the giants of the new economy in an already very competitive sector, and thus also moving the level of competition in which digitization and intelligence of the vehicle will be central.

¹³⁷ <https://finance.yahoo.com/quote/NIO/profile?p=NIO>

¹³⁸ <https://www.cnbc.com/2021/06/17/baidu-pushes-to-put-driverless-taxis-on-china-roads-with-baic-tie-up.html>

¹³⁹ <https://www.ilsole24ore.com/art/amazon-acquisisce-zoox-implementare-guida-autonoma-consegna-AD1anUb>

¹⁴⁰ <https://it.investing.com/news/economy/la-apple-car-potrebbe-arrivare-nel-2021-1975356>

A clear demonstration of how, in the future, the car will no longer be simply a means of transport, but a robot and an increasingly interconnected device with ample space for artificial intelligence and data management.

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