REPORT

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THE METAMORPHOSIS AND REBIRTH OF THE AUTOMOTIVE INDUSTRY IN CATALONIA

How the industry is facing up to the sustainable mobility revolution

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1. EXECUTIVE SUMMARY

The likely evolution of the industry over the next 10 years

Although the various studies and analyses may not be in complete agreement (and may even, on occasion, contradict each other's views on the transition of the automotive industry), everything seems to point towards electrification and shared mobility. The drop in sales experienced by European markets, partly due to uncertainty in the face of the proliferation of laws, regulations and plans to reduce polluting emissions and greenhouse gases, seems to have instigated a trend that has definitively opened the door to electric vehicles (EVs).

With the arrival of connectivity and digital technologies, along with the rise in shared vehicles, the automotive industry stands on the threshold of radical structural change, which will take place over the course of the next decade. The Asian automotive industry has moved into pole position and will lead the industry at the global level. New actors will emerge and existing manufacturers will develop alliances with technology companies in order to retain their value and embrace these changes.

It is estimated that the new composition of and contribution to the value chain for EVs will be distributed (approximately) as follows: batteries (40%), electronics and connectivity (40%), rest of components and manufacturer (20%). This new value distribution poses challenges: not only for manufacturers, but also for component producers and systems integrators that work for local manufacturers, particularly when we take into account the fact that Chinese and South Korean dominance with regard to batteries and electronics will inevitably move the industry's centre of gravity across to Asia.

In terms of technology, the progressive reduction in the cost of batteries, greater economies of scale, improved energy density on the part of cells and an increase in the number of charge cycles will combine to make EVs a competitive alternative to conventional vehicles. Pure EVs will gain the upper hand over other technologies, including hybrids using energy vectors such as gas or hydrogen. The growth rate for EVs is expected to accelerate rapidly: in 2025, they will achieve cost parity with conventional vehicles, owing to technological improvements and the lower costs of battery packs. By 2030, they will have become the dominant technology.

What are the changes facing the industry?

For some years now, the automotive industry has been undergoing a process of continued transformation and has experienced a number of seismic changes, which have manifested themselves in a number of different ways:

- "Dieselgate", which is a symptom of the industry's resistance to abandoning traditional combustion-engine technology in the face of a toughening of international standards to limit polluting emissions and tackle climate change.
- The emergence of new actors with technologies related to electrification and connected and self-driving vehicles.
- The cultural changes taking place amongst younger citizens, whose lower purchasing power and greater sensitivity to environmental issues are leading them to shun private vehicles in favour of non-mechanical modes, public transport and sharing.

The industry's symptoms are typical of those of a technological revolution in which the changing technological paradigm (innovation allied to changes to the regulatory framework) brings with it, while the process of "creative destruction" is in full effect, a reorganization of the productive structure and even, perhaps, a fundamental transformation of governmental institutions, society and even the dominant cultural and ethical paradigms.

In the wake of a crisis caused by the dramatic fall in demand during the years of the recession, the automotive industry in Europe has been tied to the European agenda to combat climate change and protect the environment, and to the national regulations from which the international directives are derived.

The changes that have been made to the regulatory framework in an attempt to tackle the inertia of the companies involved have led to a transition process characterized by uncertainty. However, connectivity and digital technologies, as applied in the automotive industry, are not solely responsible for the changing paradigm faced by the industry. Trends in consumption among citizens with a growing commitment to environmental issues, as well as an increased antipathy towards mass consumption, are paving the way for a change in habits that will result in reduced use of private vehicles. At the same time, the culture of sustainable mobility is giving rise to new, services-oriented mobility enterprises that are supported by digital connectivity.

In this panorama of transition, vehicle manufacturers are engaged in a process of strategic reflection with a view to defining the new business model, restructuring the value chain and potentially rethinking the dimensions of their production activities. The first major hurdle is to provide a rapid response to a market that is already demanding something different. This will require some manufacturers to abandon the combustion engine (which is the main source of added value under the current industry model) earlier than they wished.

The fall in vehicle production across Europe, especially in Germany and Spain, the two leading producers, and the shrinking demand for diesel are combining to accelerate the decision-making process. The party most affected is the Volkswagen Group (VW), which has been forced to significantly reduce its diesel-based product range (the range, moreover, that represented the group's attempt to reduce CO2 emissions via technological means) and fall back on petrol models while preparing, with great haste, its own EV strategy complete with battery technology and production capacity.

Asia moves into pole position

The problem for VW and the rest of the European and American actors is that they are too late to the party. Battery production technology is controlled by the Chinese, South Koreans and Japanese, all of whom have a considerable advantage over the other players. The world's major manufacturers are busy forging alliances in order to prepare for the investments that are required for the transition to electro-mobility and autonomous and connected vehicles. Companies are fighting tooth and nail to survive in the midst of this industry-wide metamorphosis, as demonstrated by the alliance between Renault, Nissan and Mitsubishi, which has ended up in the courts. Despite the intense competition between companies, cooperation between and mergers of brands and technology partners is vital in order to boost the development of EVs.

Spain and Catalonia suffer the consequences and lose jobs

For over a year, the number of cars registered in Spain has been falling. The drop in production has also resulted in a shrinking workforce for the first time since 2012. Production levels have fallen and jobs have been lost at the Nissan factory in Barcelona's Zona Franca, and the plant is awaiting decisions (which are unlikely to be taken in the short term) that will help it to recover its production capacity and make it a base for new models, products or technologies.

In contrast, Seat is set to maintain and even increase its production levels beyond 2021 and up to 2025, according to its parent company VW. However, it is necessary to make decisions with regard to new products in order to prevent Seat from entering a crisis in the medium term, if it is eventually confirmed that the entirety of VW's investment in EVs will be confined to the plants it is currently renovating in Germany. Ultimately, it would be helpful to create a platform for EV technology in Catalonia, and for the moment the debate over the industry's future is taking place in the board rooms of the world's leading industrial corporations.

Electric vehicles may be a viable solution in five years

Without a doubt, battery-powered electrification is currently the most likely technology to replace petrol- and diesel-powered combustion engines. At least, this is the roadmap that currently lies before us, although in the (indeterminate) long term, vehicles powered by hydrogen fuel cells may come to the fore. It is a view subscribed to by companies such as Toyota, although hydrogen is not yet a viable market alternative. Moreover, policies to reduce the emission of greenhouse gases and improve air quality in urban areas are already playing a key role in the transition from internal combustion engines to electric motors.

The electrification of mobility will lead to a range of alternatives, including (on a transitional basis) hybrid vehicles and plug-in hybrids. The signs suggest that the transition will not be a slow one, as pure EVs will evolve rapidly in terms of efficiency and affordability and thereby gain the upper hand. The initial cost of EVs will achieve parity with that of conventional vehicles within the next five to 10 years. Studies conducted in the United States indicate that the cost of battery packs will fall to approximately $104/kWh by 2025 and $72/kWh by 2030. Cost parity between EVs and conventional vehicles will probably be achieved between 2024 and 2025.

Batteries are a strategic factor in the production of EVs.Catalonia must produce batteries if it wants to ensure the viability of its manufacturing plants

Batteries represent an extremely large part (approximately 40%) of the overall cost of EVs. In turn, this makes them the most strategic component. However, battery manufacturing technology is not currently available to every actor. At present, the battery factories are located in Asia, where they are owned by Chinese and South Korean companies, and in the United States, where they are owned by the Tesla-Panasonic consortium. Moreover, electricity storage is not only a requirement of the automotive industry; it is also required for the development of renewable energies and for auto-consumption in both an industrial and domestic context. However, battery production is currently tied to the capacity to conduct research and engage in innovation with regard to materials. This all leads to the conclusion that countries lacking the capacity to produce batteries will not be able to compete with regard to the manufacturing of vehicles. In Europe there is an on-going debate over who should make batteries and where they should be made. If Catalonia fails to forge agreements or alliances to enable the production of batteries in Catalonia, it could miss the boat with regard to electrical mobility. Some analysts believe that, in the medium term, the existing battery-production facilities, along with those that currently are being built in China and South Korea, could be capable of supplying the European market.

Suppliers and component manufacturers in Catalonia must embrace technological change (digitalization-connectivity-Industry 4.0)

Digital technologies and connectivity comprise the second key plank of technological change, which is paving the way for driver-assistance systems and, ultimately, self-driving vehicles. Auxiliary component manufacturers that are yet to embrace digital technologies will face immense challenges if they leave it too late. Sensors, integrated circuits, part-assembled electronic units, subassemblies and cabling will constitute essential and high-value vehicle components. In Catalonia, companies such as Ficosa, Gestamp, Lear and Denso are representative of the Industry 4.0 paradigm in the components sector and have all embraced the “smart factory” concept. The signs suggest that in Catalonia, companies are well-positioned with regard to digitalization; however, it will be necessary to ensure that SMEs are able to make the necessary investments in advanced production methods, automation and artificial intelligence.

Changing trends in mobility will also change manufacturers’ business models

The third key plank of the transformation is the change in business model, which will shift from its present form (i.e. the mass production of vehicles as private consumer goods) towards a new model oriented more towards the provision of sustainable mobility services. Digital technologies will radically change the vehicle’s function, moving it away from a private good and, increasingly, towards a mobility service. This change will also affect the way in which the vehicle (i.e. the product or service) is produced and marketed.The trend towards limiting vehicle use in urban centres, allied to the predictable boom in the use of shared vehicles, increased use of public and collective modes of transport, and private, urban-oriented car and motorcycle services, points to a new type of business model that will also affect the way in which vehicles are marketed. As such, commercial strategies will be adapted in line with the new demands of the market.Once these trends have become fully apparent, companies in the automotive industry will have to undertake the necessary transformations in order to restructure their entire value chain, and also undergo change in order to adapt to meet a demand that is more selective and less focused on mass consumption.Manufacturers will be compelled to develop new commercial strategies that not only enable the sale of the vehicle, but also provide for the kilometres of service required, in order to capture value before other actors in the market do so.Consequently, we will also see a restructuring of the current model of dealerships and garages for repair and maintenance.

The impact of the transition on Catalan industry

The predictable loss of market share for conventional petrol-and diesel-powered vehicles in favour of a progressive increase in sales of EVs and hybrids will necessitate major investment in (and substantial changes to) the structure of the automotive industry. Moreover, the changing contribution to the value chain on the part of vehicle production, sales and post-sales services creates an air of uncertainty, which presents challenges for European companies and for the automotive industry in Catalonia in particular.

The process of replacing conventional vehicles with EVs and hybrids will be both incremental and rapid, although it will still be necessary to produce conventional vehicles. From the start, the transition must be managed in a way that ensures production of the new technology remains in Catalonia, in order to create new jobs to compensate for those that are lost due to the simplification of processes and a potential fall in production volumes.

It is also the case that a rapid and efficient transition to EVs could represent an opportunity for Catalan companies. Their proven capacity (and that of their workforce) to adapt to changing production processes and market conditions must be considered a potential advantage. The high level of union membership within the industry means that, through collective bargaining and conflict management, agreement can often be reached on how to adapt and achieve the necessary flexibility to adapt to change.

As stated above, the threat to companies in the automotive industry in Catalonia comes from the supply (or lack thereof) of batteries from Catalonia and/or Spain. The absence of battery suppliers could, in the medium term, jeopardize the continued presence of the companies that currently have a presence in Spain. In the short term it will be necessary to explore alliances with a Chinese or South Korean manufacturer and create the conditions for collaboration and mutual understanding among the actors involved and the governments of Catalonia and Spain.

Because EVs are simpler to assemble, there may be fewer manufacturing processes involved, particularly given the tendency to import complete sets of batteries, motors and electrical control units from the major systems integrators in Asia. In consequence, domestic industries would lose a significant proportion of their added value.

In the medium to long term, the highly probable fall in total sales may make it necessary to restructure the factories, which may in turn result in job losses. However, many roles will have to be redefined and workers will need specific training in order to adapt to new roles that require increased interaction with robots and computer programs.

The potential employment-related impact of the transformation of the automotive industry, in line with the revolutionary changes brought about by Industry 4.0 as estimated in the study titled *TheEmployment-Related Impact of Industry 4.0 in Catalonia* (Generalitat de Catalunya), will translate to the loss of the most manual and repetitive jobs. Around 13,000 jobs are expected to be lost between now and 2030, although almost 30,000 positions will be created in services linked to the automotive industry.According to the study, the automotive industry itself will create 3,727 new jobs: however, to make this estimate a reality, policies must be drawn up in order to attract investment, in line with the proposals put forward in this document.

The transformation of the industrial model brought about by EVs, connectivity and shared mobility will also have a significant impact on employment. Although thousands of new positions may be created in Catalonia, they will be taken by young, highly qualified individuals, and the jobs that will disappear are currently occupied by people who are over the age of 45 and have low or medium-level qualifications. In the long term, technological progress will create other jobs; however, in the short term, thousands of employees currently working in production, administration, transport and other areas will have to be reassigned.

The *Industry Observatory* will need to map the risks for the automotive industry in a way that allows us to understand how the industry will be reshaped by technological transformation, and which enables us to anticipate the impact on jobs and plan fair transition strategies accordingly.

Catalonia will need to develop an ancillary industry dedicated for the most part to electronic components, as these will make up the lion's share of the parts and components used to make EVs. Without the capacity to produce these connectivity systems, motor control units and other AI-based systems, we will lose a very significant proportion of the added value of EVs. Companies

in the automotive ancillary industry must adapt to the new demands of this market and must adapt and train their workforce in order to meet this new challenge. To achieve this aim, wide-ranging agreements must be reached between the actors involved and the governments of Catalonia and Spain, in order to help fund this transition process.

Some studies estimate that, in the long term, garages and post-sales services could lose up to 60% of their business, given that EVs - unlike conventional vehicles - contain far fewer parts that are subject to wear, do not require lubricants, and do not require regular servicing.

2. THE METAMORPHOSIS OF A KEY INDUSTRY WITHIN THE CATALAN ECONOMY

The automotive industry is transitioning towards new technological scenarios, new concepts and even new raisons *d'etre.* It is facing a transformation that is not only technological, but also involves its business model. The focal point of the automotive business is moving away from the mass production of vehicles and towards the provision of mobility services. The metamorphosis the industry is undergoing forms part of the complex process of restructuring: a process that involves not only digital technologies, but also manufacturing and services. Tangible and intangible mobility-related components come together to create new business paradigms that will give greater importance to accessibility, the exploitation of transport-related data, planning and alternative modes of transport. The use of big data will open the doors to new leisure activities and business opportunities.

Mobility-oriented enterprises will not focus as exclusively on vehicles (or in other words, on the consumer good); rather, they will focus on intelligent exploitation based on demand and the availability of resources at a given moment. At the heart of the new industrial paradigm in the Technology 4.0 context is the hybridization or fusion of technologies and enterprises, which - along with the revolutionary concept of the circular economy and the gradual elimination of combustion as a driving force - signifies the reinvention of an entire industry; moreover, an industry which has led the Catalan economy since the second half of the 20th century. We are using the term "metamorphosis" because we are contemplating not only a technological adaptation, or even a reconfiguration of production processes, but also the rebirth (or reinvention) of an entire industry - the automotive industry - under the auspices of the new mobility sector.

The great changes that are affecting the automotive industry bring with them both opportunities and threats.The future contains significant unknowns: although all of the signs point towards EVs as the alternative to combustion engines, the transition includes hybrid vehicles with a range of different energy vectors (and not discounting the future emergence of hydrogen), which may coexist for a time alongside combustion engines as diesel dwindles. One of the unknowns is exactly how long the transition will last and how quickly the current fleet of conventional vehicles will be replaced. Another variable, this time relating to cultural change, can already be observed in younger generations, who are more accustomed to sharing than to owning their own vehicles. Without losing sight of the long-term panorama of radical transformation, the current concern is how to manage a transition that is filled with uncertainties and in which the levers that govern the markets are chiefly political and regulatory, against a backdrop of growing citizen awareness of the need to tackle climate change and the other impacts brought about by the end of the hydrocarbon era.

The dwindling resources of the main global repositories of high-quality crude oil (e.g. Brent-type crudes) threaten to strangle the flow of energy required by industrial economies. In its *World Economic Outlook* (WEO, 2019), the International Energy Agency (IEA) warned of the fall in global oil production and the risk of insufficient supply in the medium term, which could principally affect the supply of diesel fuel and consequently give rise to price spikes. In turn, these spikes could have a significant impact on economies that are highly dependent on oil. Additionally, the most comprehensive scientific reports on climate change warn of the need to reduce emissions of greenhouse gases to below the levels agreed at the Paris summit (COP21) in order to prevent average global temperatures increasing by more than 1.5 degrees Celsius before the end of the century, if we wish to prevent irreparable damage to the planet's ecosystems and the species that inhabit them.

This reduction would mean leaving most hydrocarbon reserves untouched, regardless of their size.In fact, many companies have already undertaken a significant disinvestment in oil exploration. The parliament of Norway, one of the largest oil producers in Europe, has ordered a substantial disinvestment in fossil fuels, while the Spanish company Repsol is also disinvesting in oil exploration and investing in renewables instead. These are signs that our society, whose mobility systems are highly dependent on fossil fuel, is coming to terms with the inevitable transformation of the industry. Moreover, this transformation is urgent and cannot be put off any longer, and will also cause great upheaval in both the industry and the markets.

A whole range of digital technologies, including sensors, connectivity, computing and AI, have erupted onto the automotive scene in recent years and have given vehicles new capacities that break the umbilical cord between machine and individual. The cultural revolution, or in other words the disruptive effects of these new technologies (which have already begun to make themselves felt), point the way to dramatic social and political transformation, in much the same way as the Fordist revolution in American and

European car factories a century ago fundamentally changed the world by creating industrial, interclass societies that consumed great amounts of resources, had high levels of employment and enjoyed unprecedented levels of well-being. Today, however, the job market faces the threats of unemployment, low salaries and increased inequality. The changes are not only affecting production models and divisions of labour: they are also prompting a global reconfiguration on the part of multinational corporations, which are restructuring the map of production in line with the reorganization of the value chain. This places a question mark over traditional industrial locations and brings with it a risk that production centres may close while plants around the world undergo functional restructuring.

At the epicentre of the seismic changes rocking the automotive industry is a change in values. There are new priorities and challenges, such as tackling climate change, and significant tensions caused by geopolitical reconfiguration and the rebalancing of power. It is particularly evident that the highly internationalized automotive industry is affected by strategic and market-related factors and is not immune to the impact of powerful national interests. Undoubtedly, within this context of change and uncertainty a struggle is taking place between automotive companies, technology companies, energy lobbies, citizens and other actors.

They have all observed signs of radical social change in the use of technology, mobility habits (especially amongst younger consumers) and an awareness of environmental issues, which are becoming increasingly important to citizens and have an increasing impact on political decisions, such as environmental standards and directives to preserve air quality and local government regulations on sustainable mobility. Digital technologies are changing not only the form and function of products, but also the perceptions, needs and desires of citizens. They are transforming the industry's production processes and business models and opening the door to new companies such as Tesla, Google and Uber, whose arrival has disrupted the pre-existing balance.

The main driver of the convulsion currently gripping the industry is the progressive implementation of legislation to combat the harmful effects of combustion engines on the climate and health. In this respect, the most significant factors are the policies and regulations that are advancing on several fronts: first and foremost at the European level via the Euro standards designed to reduce the emission of greenhouse gases (such as CO_2), other toxic exhaust fumes (such as nitrogen oxides, NO_2) and microparticles. Added to these are municipal policies to improve air quality, reduce congestion and the number of traffic accidents, restore public spaces for citizens by limiting vehicle access to urban areas through the use of municipal regulations, the establishment of low-emission zones, electrification of the public transport network and the use of sticker-type toll transponders for high-capacity roads.

However, the most important regulatory factor is mandatory compliance with the quantitative objectives for emissions reduction agreed at the climate summit in Paris (specifically, the agreement to reduce greenhouse gases by 40% by 2030, compared to 1990 levels). Predictably, this agreement will result in a progressive increase in the taxation of fossil fuels. Moreover, the member states of the EU are obliged to implement, in full, the comprehensive package of measures agreed in Katowice at COP24 , which will enter into effect on 1 January 2021. The measures will accelerate the reduction of diffuse emissions (non-ETS (Emissions Trading System) emissions) in the transport industry through the implementation of Regulation2018/842 of 30 May 2018. This regulation sets binding objectives for reducing emissions in industries that are outside the scope of the EU's ETS between 2021 and 2030.

Clearly, the aim of all of these government policies is the definitive elimination of combustion engines.However, the timescale for achieving this aim is unclear. It will be conditioned by the commitments to reduce emissions entered into by the countries of the EU, by the stringency of national and municipal legislation to protect the climate and air quality in urban areas, and by the concerns of a populace that may determine the course of government action by engaging in a greater or lesser amount of social action.

The Spanish government recently unveiled draft legislation on climate change and energy transition that proposes a definitive ban, from 2040 onwards, on the registration and sale of vehicles that directly emit CO2. The government of the Balearic Islands just passed a climate change law which, among other measures, will ban the use of diesel-powered vehicles from 2025 onwards. Numerous countries have announced plans to ban the sale of vehicles with combustion engines before 2040, including Austria, Norway, Denmark, the Netherlands, Ireland, India, the United Kingdom, Taiwan, China and France.

The first vehicles to be prohibited will be diesels: although they are more efficient than petrol-powered models, they emit more pollutants and toxic substances into the air in urban centres. Their place will be taken by the various types of electric vehicle. Many manufacturers now offer hybrid models incorporating an electric motor and battery designed solely to recover kinetic energy, which serves to reduce overall fuel consumption (and therefore emissions).Some manufacturers also offer pure EVs and/or plug-in hybrids.

The signs given by the automotive industry suggest that the future of the car will be electric, although the markets have yet to recognize this fact or are doing so very cautiously. The alternatives to conventional combustion-engined vehicles are still perceived by citizens as immature, inadequate and incomparable in terms of performance and range. The advertisements manufacturers place in the media feature expensive sports models with powerful combustion engines; however, it is evident that the future lies elsewhere. At the most recent Paris Motor Show, almost all of the manufacturers presented alternatives to conventional vehicles, whether in the form of plug-in hybrids or pure EVs. It would appear that electric motors and batteries (which, for the moment, take the form of lithium-ion cells with low energy density (i.e. the relationship between the energy stored and the volume or weight of the battery)) have moved ahead of other solutions, such as electric motors powered by hydrogen fuel cells and hybrid systems powered by natural gas.

There are other signs that offer a glimpse of the direction in which the industry is moving: “Dieselgate”, which struck at the heart of VW and revealed fraudulent practices on the part of both manufacturer and regulator, has hastened the demise of diesel engines and also marked a point of no-return for combustion engines in general. Moreover, for the automotive industry, the rise of EVs means the loss of the industry’s most valuable component: namely, the engine. The equivalent for EVs is the battery (the vehicles’ electric motors can be considered a commodity), and Europe does not have its own battery technology or production facilities.

This stark reality may result in the elimination of an entire industrial approach and production model, and explains why the manufacturers have been so resistant to change. For some time now, manufacturers have seen their profits fall dramatically and have had to undergo harsh restructuring processes and business-reorientation measures, resulting in mass layoffs. The restructuring of the automotive industry has led to a variety of collaborative arrangements, such as the alliance between Renault and Nissan that has recently caused a fratricidal power struggle between Paris and Yokohama. At present, it is difficult to predict the impact this will have on Nissan’s plants in Catalonia. Moreover, since the middle of 2018 Europe has witnessed a decline in the production of both diesel- and petrol-powered vehicles, which can only be interpreted as an unequivocal sign that the tide has turned definitively towards EVs.

Ultimately, the foundations of the automotive industry are being shaken by a subtle force that manifests itself in the form of signs and information that can be contradictory and confusing. This force consists of radical changes in people’s mobility habits and in the legal and regulatory conditions governing the transportation of people and goods. In turn, these translate to changes that also affect the automotive industry and its business approach. It is a process of transition towards a new concept of mobility: a process, moreover, that has already begun, with new business approaches and updated industrial products. From the perspective of the Catalan economy, this process is far from trivial, as the automotive industry contributes a significant proportion of the region’s added industrial value and provides employment for a very large number of people.

3. THE AUTOMOTIVE INDUSTRY: CHARACTERIZATION AND DIMENSIONS

The automotive industry in Spain

The automotive industry carries significant weight within the Spanish and Catalan industrial panorama. Spain is Europe's second-largest vehicle producer after Germany and the leading producer of industrial vehicles. In global terms, it is the world's eighth-largest producer. Spain's vehicle-manufacturing industry consists of nine manufacturers: Ford, Nissan, Seat/Audi, Opel, Volkswagen, Mercedes-Benz, Renault, the PSA Group andIveco. Between them they have a total of 17 factories and a supply chain comprised of around 1,000 companies dedicated to the manufacture of components and equipment. The number of people employed by the companies that manufacture vehicles, equipment and components (including complementary activities, such as distribution, sales, post-sales, financial services and insurance, transportation, service stations, vehicle rental and driving schools) account for 9% of Spain's population in active employment. Of these workers, some 300,000 are employed directly, while a total of around 2 million jobs are linked to the industry. 82% of the goods manufactured are exported to more than 100 different countries, which accounts for 18% of Spain's total exports.

The number of vehicles manufactured in Spain has now returned to pre-recession levels. Between 2012 and 2018 production increased by 42.5%, which represents an additional 840,386 units compared to the number manufactured in 2012. According to data from the annual report of the Spanish Association of Car and Lorry Manufacturers (ANFAC), in 2017, 2,848,335 vehicles were manufactured in Spain, of which 2,243,220 were passenger cars and 605,115 were industrial vehicles. 81.4%, i.e. 2,318,217 units were exported, which accounts for 13.5% of total Spanish exports, although in purely value-based terms the total exports of the automotive industry account for almost 18% of the Spanish total. The industry accounts for around 10% of the country's GDP, when we take into account the estimated contribution of all the sectors related to the automotive industry.

The numerous vehicle manufacturers and assembly plants require the support of an even larger industry of equipment and component manufacturers: with more than 1,000 suppliers belonging to 720 corporate groups, these ancillary industries play a key role in the sector's competitiveness. The automotive industry as a whole recorded turnover of 36.2 billion euros in 2018. It provides 364,000 jobs, of which 224,700 are direct. 85% of employees in the industry are on permanent contracts. Industry investment in R&D&I amounts to 1.53 billion euros, or 4.2% of turnover. Companies in the components and equipment industry export 20.02 billion euros' worth of products and services (55% of their turnover) to more than 170 different countries. The EU is the main recipient and accounts for 72% of total exports. By country, Germany receives 27%, France 23.3%, the United Kingdom 3.2%, Portugal 9.2% and Italy 7.2%. They are followed by Poland, the Czech Republic, Belgium, Romania and the Netherlands, all of which receive smaller percentages.

In overall terms, the automotive industry (including the manufacturers of motor vehicles, trailers and semi-trailers) is of enormous importance to the Catalan economy. It encompasses the manufacturing of passenger vehicles, commercial and industrial vehicles, buses, coaches, and vehicle-related systems and components. In 2017 it boasted an annual average of 40,268.1 registered contributors to the social security system, including employees and the self-employed.

One of the key contributors to the industry's competitiveness is the country's modern logistics and distribution infrastructure, which is capable of transporting more than five million vehicles across Spain every year. This makes it a superbly placed logistics platform for exportation to other European markets, the United States, Latin America and North Africa. Another major contributor is the country's level of automation, which is one of the highest in Europe with around 1,000 robots per 10,000 workers.

Manufacturers in Catalonia

The passenger-vehicle segment accounts for 7% of Catalonia's industrial turnover, 3.6% of employment and 4.6% of gross value added (GVA). Its importance is even greater if we take into account its impact on the region's other industrial activities. More than 65% of its output is exported and it accounts for almost 12% of Catalonia's total industrial exports (*Annual Report on Industry in Catalonia*, 2017, Generalitat de Catalunya).

According to data for 2015, turnover was almost 9.23 billion euros, which accounts for 23.4% of the Spanish total. The number of people employed in the industry as of 2015 was 15,675, while GVA at basic prices was almost 1.412 billion euros. The largest company in the automotive industry in Catalonia is Seat, which is owned by VW, the world's largest vehicle manufacturer. At present, Seat is Catalonia's largest industrial company in terms of turnover. It employs more than 14,000 people, of whom 1,200 are highly qualified and work at the company's Technical Centre in Martorell. In 2017, production levels at the Seat factory in Martorell grew by 1.4% in comparison to the previous year, with a total of 455,470 vehicles. These figures are almost 20% higher than the equivalent for 2013 and 50% higher than the equivalent for 2009. For the time being, production at Martorell is guaranteed up until 2025. However, there is growing uncertainty for the medium and long term in light of the decision taken by senior management at VW to assemble EVs at the group's German plants, where it will invest 43 billion euros over the coming years. It would appear that the group has decided to ring-fence future production for its domestic factories and to use Martorell for the production of hybrids powered by compressed natural gas (CNG), a transition fuel that emits less CO_2 than petrol and diesel but is unlikely to prove profitable in the future.

Traditionally, Catalonia has occupied a leading position in the production of buses, coaches and commercial and industrial vehicles. In 2015, the turnover for this segment of the industry was 873.5 million euros, with 1,484 people employed and GVA at basic prices of close to 1.334 billion euros. The second-largest company in the passenger car segment, and the largest in the commercial vehicle segment, is Nissan Motor, which produces both types of vehicle at its plant in Barcelona's Zona Franca. Nissan is part of the Renault-Nissan-Mitsubishi alliance, which is the world's second-largest producer of vehicles. Nissan's production levels at Zona Franca fell by 12% in 2017 to a total of 92,737 units. At the national level, as of 2017 Nissan employed 5,229 people, 1.4% less than the equivalent figure for the previous year. The company's plant at Zona Franca provides employment for 2,500 people. Production of a number of models has ceased, which resulted in a drop in the number of vehicles produced in 2018. Consequently, the production capacity of the Zona Franca plant needs to be restored to its former levels through the assignment of new models. Although Nissan is currently experiencing difficulties due to the issues regarding the group's leadership and the poor results recorded for the last financial year, Barcelona could even gain importance within the European context if Catalonia establishes itself as a platform for EVs, specifically as part of Renault's plan to manufacture EVs for industrial use.

The automotive systems and components industry (as categorized under Catalan Classification of Economic Activities (CCAE) number 293), which is traditionally based in Catalonia, accounts for 31% of jobs, 28.7% of companies and 35.5% of the industry's turnover at the nationwide level, according to 2015 data from Generalita de Catalunya's *Annual Report on Industry in Catalonia*. The industry comprises some 250 companies (2017 data) dedicated to the manufacture of components, parts and accessories for motor vehicles and their engines. The majority of these companies are concentrated in the counties of Vallès Oriental, Vallès Occidental, Baix Llobregat and Barcelonès. In 2015, the industry's turnover exceeded 6.336 billion euros, which accounts for 35.5% of the Spanish total. It employed 20,386 people (31% of the Spanish total) and generated GVA at basic prices of more than 1.24 billion euros (30.6% of the Spanish total). (Source: the Catalan Statistics Institute (Idescat) and the National Statistics Institute (INE)).

The systems and components industry incorporates two types of company: large companies that are considered tier-one suppliers, i.e. they supply products directly to vehicle manufacturers; and a large number of smaller firms (in terms of both turnover and workforce) that are considered tier-two suppliers. While the tier-one suppliers tend to specialize in modules and systems, and to a lesser extent in components and subassemblies, the tier-two suppliers generally specialize in components, parts and spares.

According to an analysis of the industry's dimensions commissioned from KPMG, the automotive industry (in the broadest sense of the term) boasts turnover of 23.842 billion euros per year in Catalonia, which accounts for 10% of the region's GDP. If we take into account direct, indirect and induced employment, the industry provides jobs for 143,400 people.

4. NOTES ON THE INDUSTRY AS A WHOLE

The Global Context in Figures

After several years of continued growth, in 2018 global sales of light vehicles reached a record high of 96.5 million units, which represents a 31% increase over the equivalent figure for 2010. It is anticipated that in 2019, 100 million new units will be registered around the world. Although there are signs of a slowdown, the global market continues to grow owing to the demand from China and India, which together account for 60% of market growth. China is now the world's largest market, with a total of 28.6 million units sold in 2017. The equivalent figure in Europe for that same year was 16.2 million units. However, the current slowdown in economic activity has led to a fall in production, which began in 2018 and is forecast to continue throughout 2019. China will remain the world's largest and most important market.

Taking into account both direct and indirect employment, the automotive industry provides jobs for 3.4 million people across Europe. The largest employer is Germany, which accounts for 857,000 jobs (2016 data). The sales charts are led by the Renault-Nissan-Mitsubishi alliance, with 10.8 million vehicles sold (including cars and light industrial vehicles). According to IG Metall, the German metalworkers' union, the fall in sales of combustion-engined vehicles could result in the loss of up to 150,000 jobs across Germany. Even though EV production may create around 40,000 new jobs, this would not compensate for the losses.

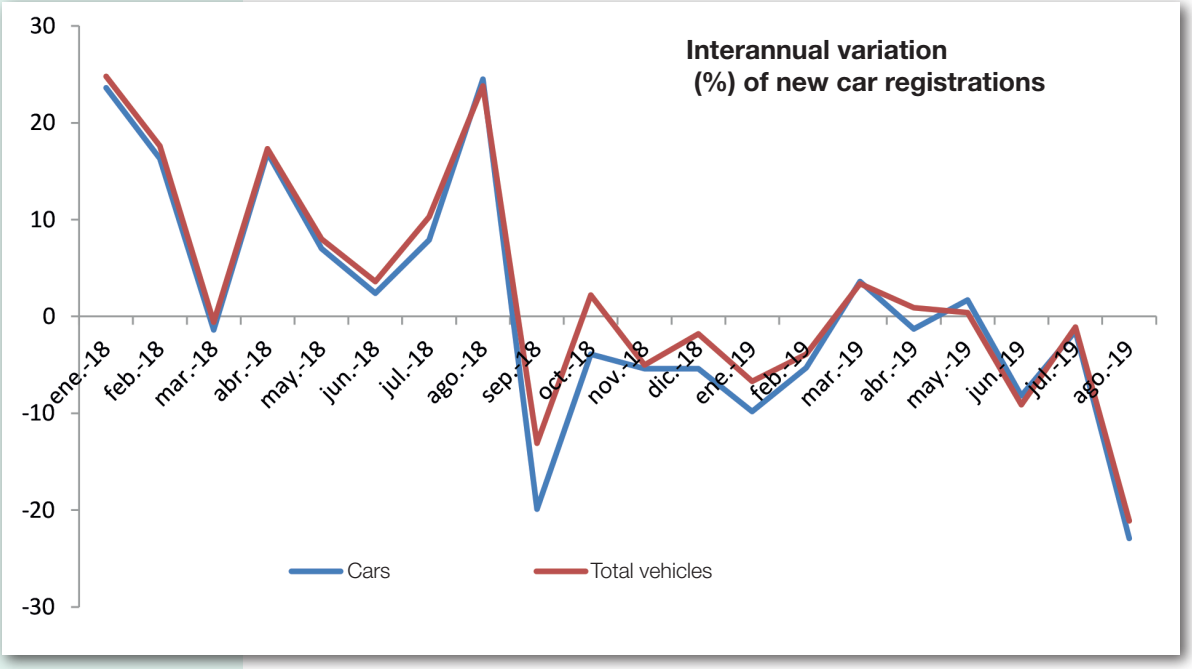
In 2018, worldwide sales of EVs exceeded 1 million units (1.7% of total vehicle sales), which represents an increase of just over 50% compared to the previous year. However, this growth is confined to just a handful of countries, and is highly dependent on government support. In the United States, Tesla has captured almost 25% of the EV market. With 878,000 new vehicles sold in 2018, China is also the world's largest market for EVs, ahead of the United States (264,000), Germany (74,000), the United Kingdom (55,000) and France (49,000). By a substantial margin, the world's leading manufacturers of EVs are Chinese companies such as BYD (26% market share), Zotye (10%) and BAIC (8%). The largest manufacturer of EVsin Europe, BMW, only accounts for 3% of global sales.

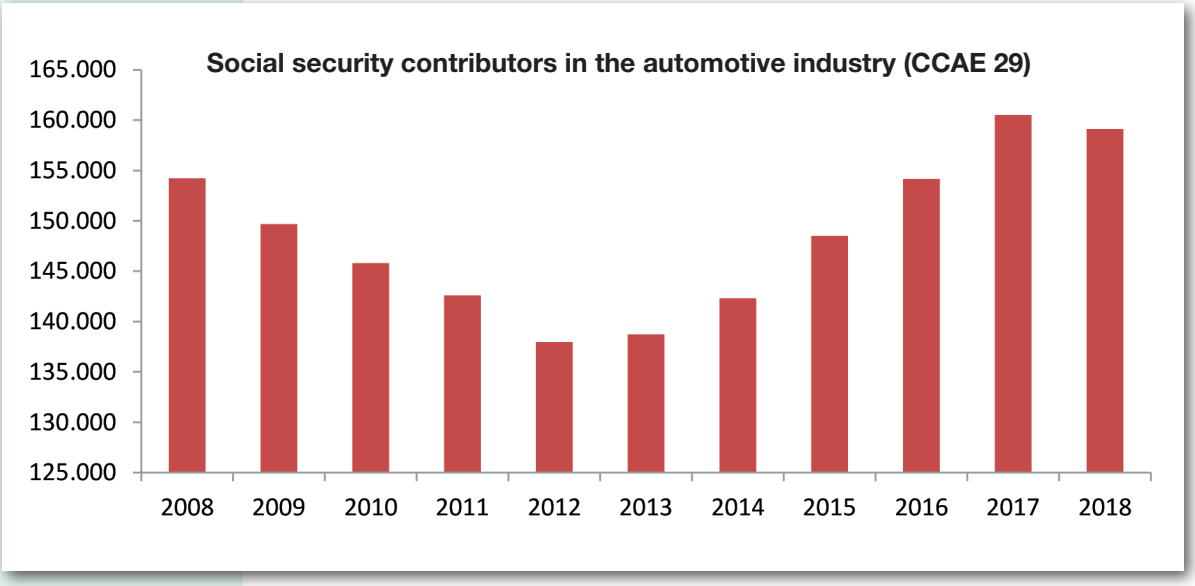
The global restructuring of the automotive industry

Shrinking demand during the worst years of the recession, allied with falling demand for private vehicles as other mobility solutions come to the fore, has prompted significant restructuring of the industry. Moreover, in order to prepare for the new production cycle that is on the horizon, companies need to make major capital investments, which in turn is forcing them to reduce their less profitable operations. In certain cases, such as that of General Motors (GM), the restructuring is extremely wide-ranging in scope. GM has closed several plants in the United States and Australia and has sold its operations in Europe, Russia and Africa, eliminating 6,000 jobs in the process. In the United Kingdom, a number of operations are expected to close, which will result in significant job losses. The companies in question include Honda (3,500 jobs), Jaguar Land Rover (4,500 jobs worldwide) and Nissan. Ford intends to close a factory in Brazil (3,000 jobs) and recently closed a production plant in Bordeaux (France). Stagnating demand, along with the industry's fresh hopes for EVs, which are now seen as an imminent reality, are the factors underpinning these major corporate restructuring strategies.

The Spanish and Catalan market

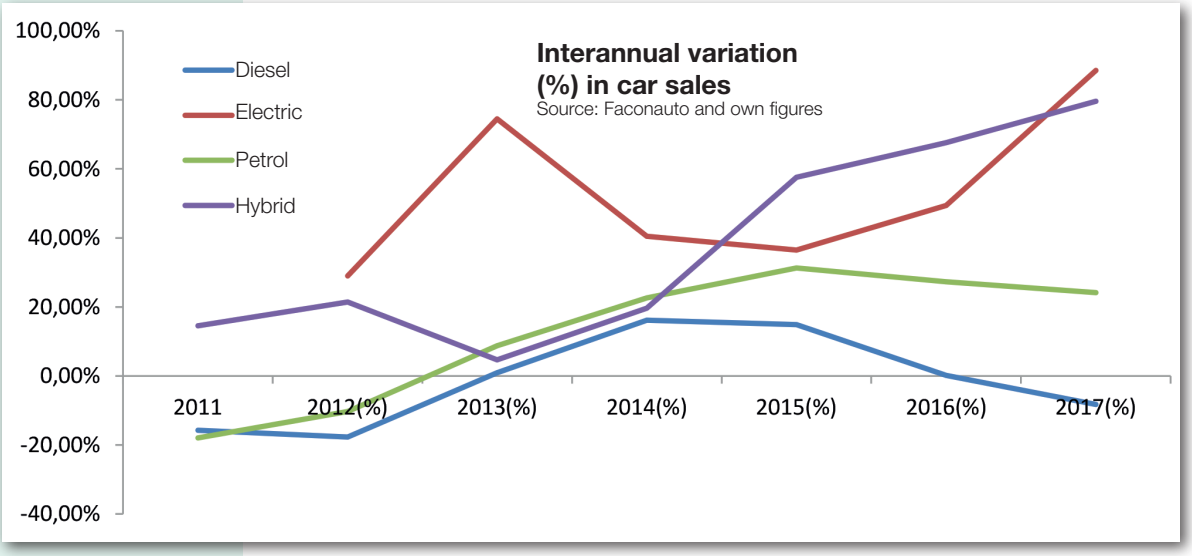
In January and February 2019, Seat's sales were 12.8% up on the equivalent period in 2018. The record-breaking figures for February 2019 stand in contrast to the fall in registrations for the Spanish market as a whole, which has suffered from 12 consecutive months of slowing demand. In parallel, the number of social security contributors for the automotive industry in Spain fell in 2018, breaking the pattern of continued growth that began in 2012.

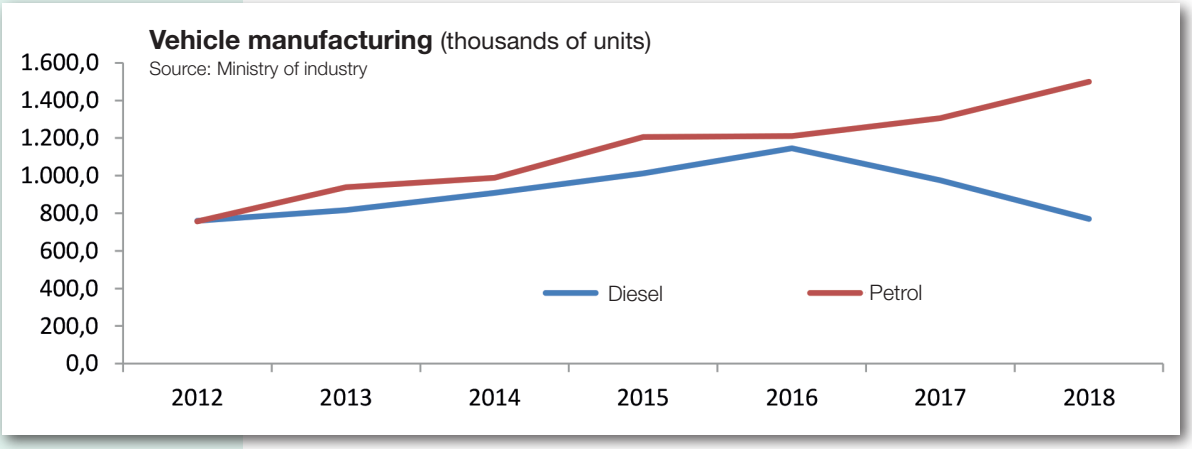




Some industry executives attribute the fall in demand to confusion on the part of citizens as a result of the various decisions and declarations made by governments in relation to combustion-engined vehicles. The setback experienced by diesel as a result of the emissions fraud, the regulations to improve urban air quality and the emission-reduction policies announced by various European governments have all helped to slow demand for conventional vehicles while boosting the demand for hybrid, electricity- and gas-powered alternatives.

In any case, the effects of the slowdown in vehicle registrations are starting to be felt in the job market. Between January and July 2019, the motor vehicle, trailer and semi-trailer segment saw the greatest number of planned redundancies. Specifically, of the 1,076 people affected (accounting for 19% of planned redundancies during this period), approximately half were dismissed outright.





Some months ago, in its draft legislation on climate change and energy transition, the Spanish government announced that from 2040 onwards the registration and sale of cars and light commercial vehicles that directly emit CO_2 would be banned. Other European countries have set even shorter deadlines for the elimination of combustion-engined vehicles. The draft legislation, the final version of which is currently being prepared, states that a study will be carried out on the implementation of the Eurovignette system, which is regulated by Directive 1999/62/EC of the European Parliament on the charging of heavy goods vehicles. The legislation also stipulates that filling stations must be fitted with infrastructure for the charging of EVs. The transition to EVs is no longer a prospect for the future: it has become a reality. More specifically, in March 2019 the Spanish government approved the 2019-2025 Strategic Plan Providing Full Support to the Automotive Industry, which acts as a roadmap for the transition towards sustainable, integrated and intelligent mobility.

The plan, which was unveiled by María Reyes Maroto, the Minister of Industry, Trade and Tourism, allots 2.634 billion euros in funding for the 2019-2025 period, with the aim of incentivizing this transition while providing assistance to the industry in accordance with the Fair Transition Strategy. The plan will provide funding to offset the negative economic impacts arising from the application of the United Nations' 2030 Agenda for Sustainable Development. Specifically, the plan's aims include: the provision of 1.127 billion euros for the creation of a Sustainable Mobility Forum for 2019-2025, which will incorporate measures to stimulate demand for low-emission vehicles; a package of 422 million euros to restore provision for semi-retirement via job-sharing and to fund the restructuring of industrial workforces to include more young people and more women; 1.085 billion euros in grants to support innovation through the funding of R&D&I projects; and provisions to reinforce the dual (i.e. in-class and in-company) professional training system.

However, industry actors (including senior executives at car makers, ancillary businesses, dealerships and distributors) consider these measures to be insufficient and have called on the government to include modern, low-emission combustion-engined vehicles in its decarbonization strategy, in order to boost citizens' confidence in conventional vehicles and stimulate a market that currently appears cautious in the face of uncertainty and doubt. The reality, however, is that the policies underpinning the energy and climate packages are motivated by the emission-reduction agenda of the Paris Agreement, and point unequivocally towards an accelerated transition in favour of electrical mobility. Although manufacturers are asking for more time, electrification is making rapid advances. At the Geneva International Motor Show in March 2019, numerous manufacturers presented luxury electric models, including the historic Catalan brand Hispano-Suiza.

With regard to Brexit, we must take into account the fact that the United Kingdom is the third-largest recipient of vehicles manufactured in Spain, accounting for 13.2% of exports (valued at 4.9 billion euros), and the third-largest recipient - behind Germany and France - of exports of automotive equipment and components (source: Industry Report on the Spanish Economy, 2017). The potential impact of new tariff policies is uncertain, as is the potential impact of Brexit on Nissan's plants in the United Kingdom.

5. THE TRANSITION OF THE INDUSTRIAL MODEL: FROM THE AUTOMOTIVE INDUSTRY TO THE MOBILITY SECTOR

The transition of the automotive industry model is partly conditioned by mandatory compliance with the emission-reduction targets established in the United Nations' 2030 Agenda for Sustainable Development, as a result of the targets' assimilation into European and national legislation. However, it is also linked to factors related to social and economic transformation of a more local nature, such as the transition of electricity production towards more sustainable sources, the impact of changing social values and habits, the availability of technology, corporate initiatives in the field of sustainable mobility, and more. In recent years, manufacturers have gone to great efforts to slow the progress of these substantial changes and have placed obstacles in the path of EVs, particularly in Europe. This has given Asian manufacturers a competitive advantage. Now, societal pressure and government policy are setting the pace of change, by accelerating or delaying the strategic decisions that are tipping the balance definitively in favour of electrification.

The target for 2030 is for new cars to reduce their CO2 emissions by 37.5% compared to 2021 levels, and for vans to reduce theirs by 31%. Moreover, by 2025 their emissions must be reduced by 15%, which will require an accelerated transition. According to ANFAC, in order to reach these targets while maintaining current production levels, Spain will have to manufacture 600,000 electric cars by 2030. The draft Integrated National Energy and Climate Plan for 2021-2030 (a document drawn up by the Spanish government that details the process, nationwide targets, policies and measures to achieve the decarbonization aims of the EU's "Winter Package", in accordance with the stipulations of the Paris Agreement) anticipates that the use of renewables in mobility and transport will drive the decarbonization process. In line with this approach, it expects 5 million EVs to be in use by 2030.

Electrical mobility has already begun to make its presence felt in many areas around the world. EV sales accounted for more than 2% of new cars sold in 2018, which represents an increase of more than 70% compared to the previous year. In total, some 5 million EVs were sold over the course of the year. The largest market is China, with the United States a (very) distant second. In Europe, vehicles with electric motors - whether hybrids or pure EVs - have been very slow to penetrate the market, although there are some exceptions. Norway, for example, is home to 250,000 EVs and boasts the most extensive fast-charging network in the world. It accounts for 33% of European EV sales: a fact that owes much to the efforts of the Norwegian government to promote the sale of these types of vehicle.

In Spain, according to the Directorate General for Road Traffic (DGT), as of 31 December 2018 less than 0.2% of all the vehicles registered in Spain (or, to put it another way, just 63,134 vehicles out of the total fleet of over 34 million) were EVs.

However, according to the Association of Businesses for the Development and Promotion of Electric Vehicles (Aedive) that same year sales of EVs grew by 60%. Some 21,181 vehicles were registered, of which 15,495 were pure EVs and 5,686 were plug-in hybrids. Together they accounted for 1.1% of all vehicles sold. The Spanish market for hybrid EVs is one of the strongest in Europe in terms of total volume of sales. In part, growth has been aided by the fall in diesel sales following the emissions scandal in 2015. It has also been helped by local authority measures to restrict the use of polluting vehicles in low-emission zones. These measures take the form of tax incentives, financial incentives to purchase vehicles, and reduced toll and parking costs, particularly in Madrid and Barcelona.

At present, EVs are competing with other alternatives such as liquefied petroleum gas (LPG), a fossil fuel that is less polluting than petrol. According to the DGT, some 20,088 LPG-powered vehicles - 40% of the total number in circulation on Spanish roads - were registered in 2018: a rate of growth that is nothing short of spectacular. The number of vehicles powered by compressed natural gas (CNG) is, however, much smaller: just 5,255 vehicles were registered in 2018. One of the companies supporting the development of CNG is Seat, which offers both petrol- and CNG-powered hybrid models. CNG consumes less fuel and produces fewer emissions than petrol and diesel, while providing a longer range than the current generation of lithium-ion batteries. It is a transitional option on the pathway to electrification, as although it offers fewer emissions, its appeal may vanish once batteries become cheaper and their range improves.

The demand for EVs could grow exponentially above and beyond the levels currently estimated by manufacturers, as a result of the maturing of EV technology and fluctuations in the price of petrol. However, the EV fleet in Catalonia remains very small, and growth is mostly accounted for by hybrid models. Nonetheless, we should not lose sight of the fact that fossil fuel reserves, and especially oil, are shrinking worldwide. Some theorists posit that although the growth in the global EV fleet will reduce the demand for fuel and thereby cause the price of crude oil to drop, this will be counteracted by the fact that global demand for crude oil will continue to grow, driven particularly by China and India.

Looking beyond the argument to limit the use of fossil fuels for environmental and climate-related reasons, it should also be noted that of all the fossil fuel reserves, oil is the closest to exhaustion: yet despite this, transport still accounts for 64.5% of final oil-derived energy consumption. Biofuels obtained from crops do not provide sufficient capacity to meet today's mobility and transport needs. According to the document titled *Keys to a New Energy Paradigm*, published by Universitat Politècnica de Catalunya (UPC) in October 2017, the renewable alternative for transport systems will be based on electric motors powered by one or more of the following: electric batteries, renewable hydrogen and fuel cells. Cables and trolley poles will also be used on main rail and road routes.

Electric motors, whose efficiency levels exceed 90% (far higher than the equivalent figure for combustion engines), offer significant advantages, particularly in urban environments, although their use in the automotive field presents significant differences with regard to functionality. The transition from combustion engines to electric motors will also include the various types of hybrid electric vehicle (HEV), which combine the advantages of electric motors with the operating range of conventional vehicles. Currently, range is one of the main obstacles facing the EV market. The speed at which EVs penetrate the market will be determined by improvements in battery capacity and charge time and the widespread provision of charging facilities. Full replacement of the current fleet of conventional vehicles is only likely in the long term, as it will be hindered by a series of other factors.

The electrification of mobility is dependent not only on the automotive industry, but also on changes to the energy paradigm. Changing the model means moving away from the management of fossil fuel reserves and the intensive use of high energy-density yet finite hydrocarbons, and towards the management of energy that may not be easy to store, and is obtained from sources that may only be intermittently available, but is nonetheless infinite in its abundance. The new paradigm will require us to adapt the way we use energy in line with the flows that are available, and to increase the availability of energy by diversifying power-generation technologies. These changes require not only new technology, but also new forms of behaviour and habits. With regard to generation, it will be necessary to diversify the energy matrix (which will be 100% renewable) and manage the distribution networks intelligently. The processes of changing the energy matrix and transitioning to EVs will run in parallel, as electrification of the vehicle fleet will necessitate a restructuring of the electricity network and the introduction of demand-management systems in order to prevent the network from being overloaded. The mass electrification of mobility will reconfigure the electricity network in its entirety, resulting in a new type of market that will incorporate all of the different types of energy needs (including private mobility) and extend to cover storage systems such as vehicle batteries.

The transition to electrical mobility means transforming the energy system in its entirety. We should remember that the ultimate aim is the complete decarbonization of the economy, and that at present the transport industry is responsible for the majority of CO_2 emissions (accounting for 42.3% of final energy consumption in Catalonia). The electrification of mobility would be meaningless without an energy matrix for electricity generation comprised mainly of renewables. In Catalonia, the use of renewables is less widespread than in other Spanish regions, so Catalonia will have to make greater efforts to generate more electricity from renewables, in line with the targets for 2030.

In order to meet the increased demand for electricity resulting from the progressive electrification of mobility, we will need comprehensive programmes covering infrastructure, planning and investment to ensure that Catalonia's electricity network is able to meet the demand for electricity in accordance with the targets for renewable energy set by the European Parliament. The penetration of renewable energies and the transformation of the electricity mix is discussed in Article 19.1 of the Climate Change Act (Law 16 of 1 August 2017) and will be implemented via the provisions of the National Agreement for Energy Transition in Catalonia. In turn, these measures should give rise to a law on energy transition and the consequent adaptation of the Catalan Energy Institute (ICAEN), accompanied by the corresponding implementing regulations.

According to the study carried out by the UPC, between 2000 and 2014 the transportation of passengers and goods around the world has increased by an inordinate amount in comparison to the rate at which the population has grown. The study concludes that despite the economic crisis of 2008, transportation is increasing at an explosive rate worldwide. In the OECD countries,

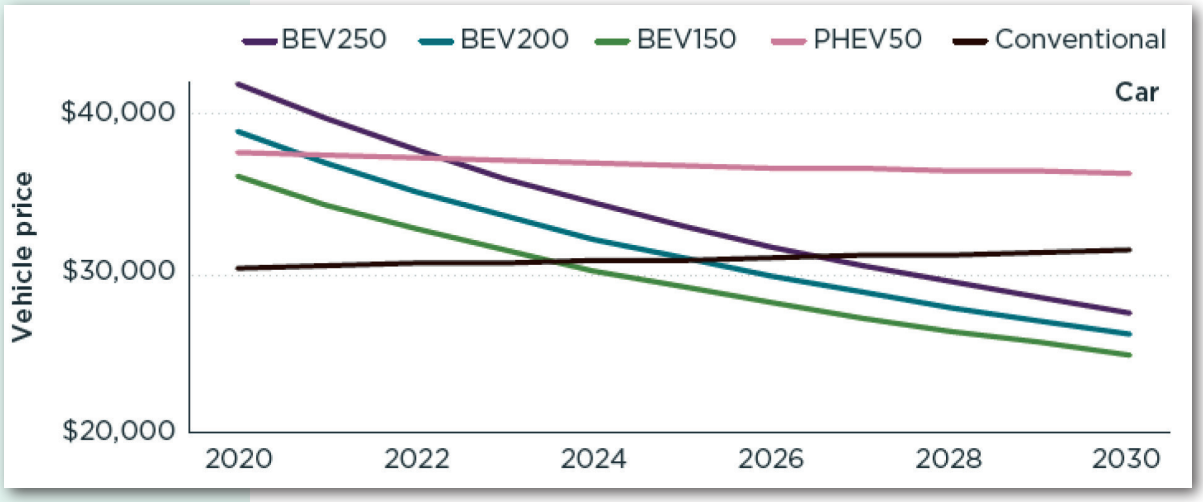
people mostly travel by car and plane, which are the two most energy-intensive forms of transport, together accounting for 96.1% of transport-related energy consumption and 95.9% of transport-related emissions.

In the face of this data on the amount of energy consumed by moving people and goods, it is impossible to imagine how the fleet of combustion-engined vehicles could be replaced by EVs. In turn, these figures also make it impossible to imagine how the current model, based on private vehicles, can continue.We must also bear in mind that, according to the study, "the manufacture of each new vehicle involves the use of a significant amount of materials and around 100 GJ of grey energy (i.e. energy invested in materials and processes), which is equivalent to the amount of energy the vehicle itself would consume while travelling 50,000 km". Moreover, the transformation or restructuring process currently facing the automotive industry has an additional component: namely, the lack of sufficient energy to reproduce the model of private mobility.

Batteries: the key to lowering costs

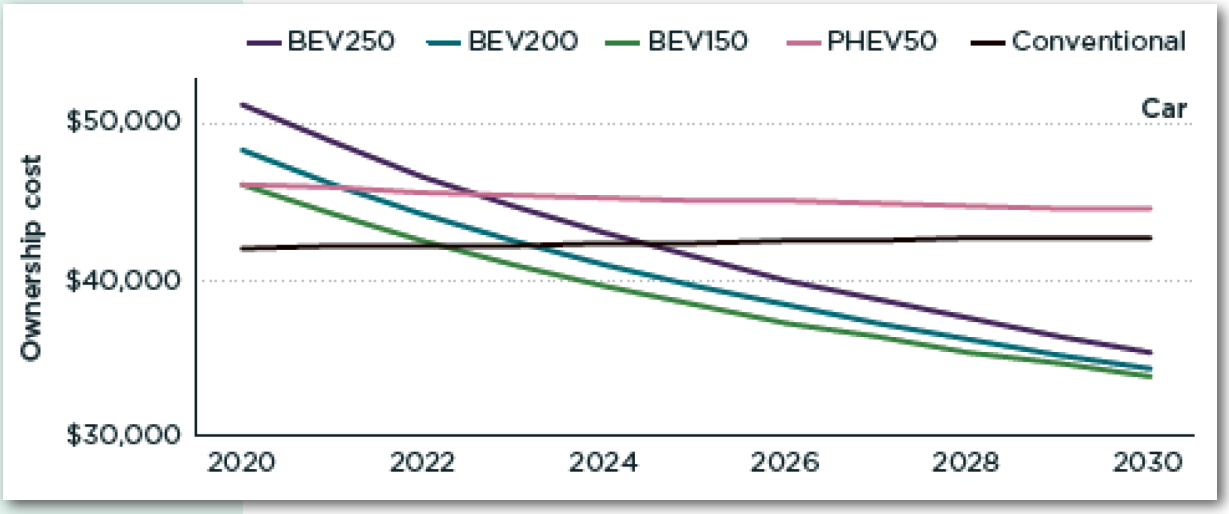
Energy storage is one of the main handicaps of EVs. The energy density (i.e. the relationship between the amount of energy stored per unit of weight or volume) of modern lithium-ion batteries is very poor compared to that of petrol. The batteries in the vehicles that are currently on the market have specific energy of 150 to 300 Wh per kg of weight. The Panasonic cells used by Tesla vehicles have an energy density of 254 Wh/kg. A 100 kW battery weighs around a tonne: this reduces the vehicle's efficiency, as it is dead weight that the vehicle must always carry around. Moreover, the cost of such batteries is high (ranging from 215 to 260 euros/kWh), although it has fallen substantially in recent years and is expected to fall even further, even without any improvements in cell chemistry. Some experts in the United States estimate that the cost of battery packs will fall to around 130-160 US dollars/kWh by 2020-22, and to around 120-135 US dollars/kWh by 2025. Tesla believes that the cost will have fallen to 100 US dollars/kWh by 2022. On average, manufacturers contend that the cost of battery packs can be reduced to 62 US dollars/kWh by 2030.

According to a study published by Nic Lutsey and Michael Nicholas in April 2019, the prediction that EVs will make significant inroads in the coming years is based on an anticipated reduction in battery costs that will, in turn, depend on a variety of other factors, such as economies of scale and a more competitive market driven by increased demand. It is believed that sometime between 2022 and 2026 the cost of battery packs will fall to around 130 euros/kWh, which will then mark the achievement of cost parity between EVs and conventional vehicles. According to the study (see the graph below), BEV 150-type electric vehicles (i.e. battery-powered hatchbacks with a range of around 240 km) will reach cost parity with conventional vehicles in 2024: earlier than EVs with greater range. Plug-in hybrids (marked PHEV50 on the graph) will never reach parity, because their much smaller batteries mean that even drastic reductions in battery cost will have little impact on the price of the vehicle. Hybrids' dual-drive systems will also remain expensive, which means they will become less competitive than EVs in the future.



Although the affordability of EVs will largely depend on reducing the cost of batteries, other factors will also play a role. These factors will vary according to the segment or family to which the vehicle pertains, i.e. hatchback, crossover, SUV, etc., all of which are essentially differentiated from each other by size, power and weight. Each vehicle can be equipped with battery packs of greater or lesser capacity, depending on need. Today's EVs have battery packs that can offer 40 kWh with average range of around 250 km; 60 kWh with average range of around 320 km; or 90 kWh with average range of around 400 km. Plug-in hybrids have a 14-kWh battery that offers a range of around 80 km when the vehicle is running on electrical power. The amount of distance that can be covered in each instance will depend on a diverse range of factors, of which the vehicle's weight is the most important (and in turn, the vehicle's weight depends largely on the weight of the battery). The larger the battery pack, the less efficient the vehicle.

According to the aforementioned study, the cost of a battery pack that would enable a mid-range vehicle to travel a distance of 320 km will have fallen by more than 42% by 2025, owing to the lower cost of the cells, the lower cost of assembling the pack and greater efficiency on the part of the vehicle (which therefore means it would not require as large a battery).Thus, if we wish to compare the total cost of driving an EV for five years with that of driving a conventional vehicle for five years, we will have to take into account their energy consumption (petrol and electricity), maintenance costs, the cost of charging the EV at home, the cost of replacement vehicles for journeys that are too long for the EV, and other costs. In this instance, the study - which was conducted in the United States - revealed that parity, in terms of initial acquisition cost, would be achieved 1.4-2.2 years earlier (see the graph below). The factor that would contribute most to this advance is the saving on fuel.



Proactive policies to incentivize the transition to EVs have been shown to be effective when they are specifically designed to break down real barriers, such as the availability of models on the market, the cost of EVs and consumers' awareness of them. However, one of their initial handicaps is the tendency to compare the performance of EVs to that of conventional vehicles. Combustion-engined vehicles boast an extensive operating range owing to the high energy density of their fuel: petrol, for example, has an energy density in excess of 10 kWh/kg. In contrast, the energy density of a battery, even in a best-case scenario, is currently just 0.3 kWh/kg.

Improving battery energy density is the key to making EVs a permanent fixture in the market. Another important difference is that while a petrol tank can be filled in around 90 seconds, a battery takes much longer, even with fast-charging systems. However, the constant improvements to battery efficiency make it likely that in the next few years, density levels will double with the development of solid-state, sodium-ion batteries. These batteries will also weigh less and have significantly lower costs, given that sodium is much more abundant and cheaper than lithium. From 2020-2022 onwards, sodium-ion batteries with an energy density of 650 Wh/kg (thereby doubling the current operating range) may be available, although this particular forecast is perhaps rather optimistic.

EVs are not entirely emission-free. Essentially, their emissions depend on the energy matrix for electricity generation: in other words, the emissions caused by the generation of electricity from non-renewable sources during the useful life of the battery. We must also take into account the emissions generated by producing the battery: one study estimates 12.5 kg of CO_2 and 14.5 g of NO_x per kg of lithium-ion battery, which translates to around 10 tonnes of CO_2 and 8 kg of NO_x generated during the production of one 100 kWh battery (Tesla SP100D).To optimize the emissions generated by the production of the battery itself, and taking into account the battery's useful life (approximately 10 years, before the performance level drops below 70%), it will be necessary to assess how the batteries can be recycled and reused once this period has passed and find ways to give them a new lease of life, for example in a residential setting, where the energy-to-weight ratio is not as critical as it is in the automotive context.

Battery suppliers

Worldwide, there are only around 15 suppliers of batteries for EVs. However, the market is expected to grow at an enormous rate over the next two to three years. Numerous companies are in the process of setting up battery-manufacturing plants, with the largest being in China. One of the world's leading producers is AESC (Automotive Energy Supply Corporation), which supplies batteries to Nissan. Recently acquired by the Chinese group Envision, it has factories in Japan, the United States and the United Kingdom, and is currently building a plant in China. Another key player is the Chinese manufacturer BYD, which makes lithium-ion batteries for its own EVs and hybrids as well as for those of other companies. Its annual production capacity is scheduled to reach 60 GWh by 2020. Panasonic, the supplier of Tesla's batteries, is another major global supplier, with a factory in Nevada (United States) and several others in China. The alliance between Panasonic and Ficosa, a Catalan multinational operating in the automotive industry, could lead to the development of battery-production capacity in Catalonia. Other major suppliers include A123, which was founded at MIT and purchased in 2013 by the Chinese group Wanxiang; Samsung SDI, whose customers include VW; the Chinese company CATL; and LG Chem, which has a production plant in Poland.

The enormous expansion of the EV market over the next 2-3 years could also give rise to battery shortages. If sales of EVs and hybrids take off, it will be necessary to increase production capacity over and above current levels, even taking into account the factories currently under construction. EV manufacturers are adopting different strategies: some source battery packs from third-party manufacturers, while others buy the cells, assemble the packs themselves and use their own charge-management software. Other manufacturers, such as Tesla, have opted to produce their own batteries, thereby making the battery the main focus of added value, rather than the vehicle itself. We should also bear in mind that electricity storage not only plays an important role in the automotive field, but is also becoming increasingly important in the management of electricity networks and domestic auto-consumption of renewable energy. In the medium term, battery production could become of the world's most profitable industries.

For some time now, Europe has recognized that it needs to develop its own battery-production capacity. In recent months, the subject has returned to the top of the agenda following the drop in vehicle sales. At present, battery production is concentrated in Asia and the United States. In the coming years, decisions will be taken in Europe, and specifically in Spain and Catalonia, that will determine the future of the electrification of the automotive industry. Some of Europe's industrial players, such as VW, have proposed the creation of a European consortium to produce batteries (i.e. manufacture battery cells) and build assembly plants. According to some experts, Europe will require a number of factories, although there is currently no agreement on how many and where they should be located. The Chinese manufacturer DLG Energy has drawn up plans to install a factory in Southern Europe (specifically in Spain's Aragon region).

María Reyes Maroto, the Minister of Industry, Trade and Tourism, has made a number of statements on the subject. Spain is Europe's second-largest vehicle manufacturer and Figueruelas in Aragon is home to a factory belonging to the PSA Group. Moreover, 80% of the country's vehicle production takes place within a 300-km radius of Aragon. Sooner or later, the Spanish automotive industry will have to commit itself to EVs. Within this context, while attending the first Sino-Spanish Forum on Electric Vehicles in Shanghai last June, Reyes Maroto took the opportunity to call on Chinese companies to collaborate in setting up a battery factory in Spain. She believes Spain needs at least two factories in the short term, and this has led her to focus on Chinese manufacturers. However, in the long term, and within the context of the European battery alliance, it will be necessary for Europe to develop its own technology in order to avoid becoming dependent on China. Whether the transition to electrical mobility becomes an opportunity or develops into a threat to the thousands of jobs in the automotive industry will depend on the joint actions currently being taken by manufacturers, governments and other industry actors to attract investment and secure the necessary industrial capital.

Catalonia is already home to a number of companies that manufacture batteries (i.e. they assemble cells and design the management software): one example is Silence, a Catalan company that produces electric mopeds and assembles batteries into removable packs that can be charged from any domestic outlet. One potential business opportunity lies in the configuring and reconfiguring of lithium-ion cells using charge-management software, particularly with a view to recycling batteries that will reach the end of their useful life in the next few years. Given the high cost of batteries, which can account for up to 40% of the sticker price of an EV, they are likely to be marketed in different ways, e.g. via leasing plans instead of outright purchase. Ultimately, what matters most when it comes to electrical mobility is the sale of energy, rather than the device itself.

The circular economy

Vehicle manufacture ranks among the activities with the highest environmental impact, owing not only to the use of the vehicles themselves, but also to the process of producing them. In 2018, a total of 70 million cars were produced around the world. In addition to the materials consumed, many of which are scarce, by the end of their useful life these vehicles will have generated many millions of tonnes of scrap and waste of all kinds. Does it still make sense to waste these finite resources by discarding or incinerating them, or would it be more logical to use them over and over again through the process of remanufacturing? The latter argument describes the approach of the circular economy, which is based on the transformation of production processes. It is an approach that should be embraced as rapidly as possible. The transformation of the mobility sector and the automotive industry in general can be traced back to the United Nations' Rio+20 Conference and the strategy adopted by the 2030 Agenda for Sustainable Development (UNEP, 2015) to respond to the challenge of achieving sustainability. The EU codified these aims in the form of the Europe 2020 strategy, which incorporated a number of plans such as *Closing the Loop: An Action Plan for the Circular Economy COM/2015/0614/ final*.

The move from a linear economy, which has an enormous environmental impact that begins with the extraction of resources and continues on through production, distribution and consumption and ends with the discarding of waste, to a circular process that begins with ecodesign and continues on through production or remanufacturing, consumption and reuse, recycling and the management of byproducts in order to reintroduce them as a new resource, requires companies to adapt to these new processes through investment, technology, knowledge and training. SMEs in the ancillary and components industries may find it more difficult to transform their production processes, as some of them will not be able to fund the acquisition of advanced manufacturing technologies designed to achieve a positive environmental impact. Often, these difficulties also arise from the need to adapt in line with legal requirements on the treatment of waste and to incorporate new technology that improves energy efficiency. In any case, the stimulus to change these production processes will also come from regulatory measures and fiscal penalties or incentives, and from strategies drawn up by governments themselves.

In Catalonia, the Catalan Agreement for Industry (PNI) provides a series of measures to promote the circular economy in the industrial sector, thereby facilitating adaptation and making the region's industries more competitive. The scope of these measures extends to training, awareness and promotion: they are designed to promote research projects, provide advisory services to companies and foster industrial symbiosis, among other aims.

The central strategy is likely to consist of changing the business model to focus on offering mobility services, rather than vehicle production. Although services will always be linked to the production and maintenance of a fleet of vehicles, the aim will move away from achieving high volumes of sales and towards maximizing the provision of services to a smaller number of vehicles while consuming as little energy as possible. It is simply not possible to continue producing 70 million vehicles worldwide every year, and it is this shift in commercial focus that must guide the industry's transformation. Electrification, or in other words the transition from combustion-engined vehicles to EVs, represents a commitment to the most efficient way of using energy. There is no doubt that electrical mobility is the best solution from the perspective of both sustainability and efficiency. Moreover, the use of shared or rented vehicles instead of private vehicles also represents a move towards using resources as efficiently as possible.

In terms of the life cycle of a vehicle, the circular economy begins with a fresh approach at the design stage, in which the initial concept for the product takes into account all of the subsequent stages of its life or usage, with the aim of facilitating the eventual recycling or reuse of all of its components. Secondly, and in line with the concept of mobility services, the manufacturer is able to retain ownership of the vehicle, which is then delivered to the customer for a particular time period or purpose, after which the

vehicle is returned to the manufacturer so that it can be remanufactured and inserted into the market once again. If the manufacturer is the sole owner of the vehicle, it will also be responsible for maintaining it and for all of the subsequent stages in the cycle. Customers or users will only have to pay for the use they make of the vehicle.

This concept makes particular sense in relation to EVs, as many of their components (e.g. batteries, video screens, sensors, cabling and electrical components) are valuable and can be reused. They are also very expensive, and their production costs cannot always be recouped through sale alone. We should also remember that, owing to their high level of computerization, EVs are reprogrammable and their functions and/or performance are easy to update, which gives them a longer life cycle and prevents them from becoming obsolete. Although these general principles must be considered in light of the potential applications in each instance, they serve to indicate the path that will need to be taken in order to transform the industry. With regard to manufacturing, it is necessary to start using recyclable materials and to simplify and reduce the number of components. Evidently, the industry is facing nothing less than a revolution, and is embroiled in the process of a transformation that will have to be carefully planned if the industry is to survive in its current location.

In light of the fact that the future of the automotive industry is inextricably linked to battery technology, it may be possible for companies to develop symbiotic relationships with other industries in the renewables sector, such as energy-storage systems. As the batteries of EVs have to be replaced when the amount of charge they can hold drops below 70% of their capacity, recycling plants could be developed and EV batteries reused for other domestic or industrial purposes of a more fixed nature (e.g. charging stations). In order to become profitable, recycling requires industrial processes and adequate investment. Symbiosis in areas such as the automotive, energy, recycling and waste-processing industries could therefore represent an opportunity to establish these activities in Catalonia.

Autonomous vehicles

The inclusion of connectivity and digital technologies in vehicles represents one of the most extensive areas of transformation. Digital technologies, and especially connectivity technologies that enable permanent dialogue between the vehicle, the passengers, other vehicles and the mobility infrastructure as a whole (the so-called Internet of Things, IoT), have the capacity not only to improve the vehicle's features and performance, but also to effect a radical transformation of its use value. The array of sensors, electronic circuits and communication screens, which already help drivers to control the vehicle mechanically and to navigate their route, will evolve towards the concept of self-driving. In turn, this will enable the gradual removal of the need for someone to drive the vehicle.

However, this metamorphosis does not depend solely on technological developments: it also involves a whole range of factors, including safety and ethical criteria, traffic regulations, certification, and more. The Society of Automotive Engineers has established recommendations, rather than imposed standards, and has produced a classification of the different levels of autonomous driving. Along with the gradual introduction and optimization of driverless vehicles, regulations will need to be drawn up in relation to legal aspects such as safety, liability and compliance with traffic laws, in order to allow vehicles of this type to drive on public roads. Currently, a number of countries - such as Germany - have granted permission for prototypes to be tested on the road. In Catalonia, the Autonomous and Connected Vehicle Forum has established the Catalonia Living Lab, which enables companies in the automotive industry to develop, test and evaluate technology related to autonomous and connected vehicles within a regulatory environment that provides the necessary safety guarantees. Within the framework of the PNI, the Catalan government has lent its support to the Forum and backs its aim of making the Catalonia Living Lab Europe's leading benchmark in the field.

In terms of applied technology, there are six different levels, which range from 0(no autonomy)to 5 (maximum autonomy) based on how much human attention and intervention the driving process requires. At level 1, the vehicle has some degree of autonomy with regard to acceleration, braking and steering, but cannot perform all three actions simultaneously on an autonomous basis. A driver is essential and the autonomous systems are only there to assist him/her. These systems include cruise control and alarm activation and emergency braking when the vehicle gets too close to another vehicle or strays out of its lane. Some vehicles are already equipped with these autonomous systems. At level 2, the autonomous systems act in concert to assume lateral and longitudinal control of the vehicle, thereby controlling all of the vehicle's movement; however, they cannot detect or respond to any unforeseen circumstances. Consequently, the driver remains essential.

At level 3, as well as assuming full control of the vehicle's movement, the system can also detect and respond to unforeseen circumstances. However, it works only under specific and relatively uncomplicated conditions, such as motorway driving. If the situation becomes too complex for the system to deal with, it will give the driver sufficient warning so that he/she can take the wheel. At level 4, the vehicle is able to drive itself autonomously and has the capacity to respond to any circumstance, and as a result there is no need for a driver. The system is able to provide support in the event of a breakdown and respond to highly complex situations by taking the vehicle to a place of minimal risk, although once there it will no longer be able to continue driving. Finally, at level 5, much like level 4, the vehicle does not require a driver or manual controls. It is completely autonomous and is capable of continuing to drive under any circumstances.

The gradual incorporation of self-driving technology will be one of the factors used by manufacturers to differentiate their products and position their models within a price range or segment. Nearly every manufacturer already has access to these technologies; however, and there is little difference between brands. It is likely that all vehicles will continue incorporating autonomous systems of some kind, which in turn will lead to the accumulation of collective experience and contribute to the improvement of not only the vehicles themselves, but also the road network and the urban driving environment. Autonomous vehicles and electrification are both contributing to the cultural disruption in the way that we perceive vehicles, as they bring with them new factors and/or criteria: for example, safety or efficiency as opposed to sporting performance; or the functionality of SUVs, 4x4s and other highly inefficient segments that cater to the current demand for luxury and ostentation.

Business model

In addition to automotive companies, the transformation of the industry will also involve other actors. The future appears complex, with multiple players, including mobility and public-transport platforms, telecommunications and data-management companies, insurers of autonomous vehicles, and a range of other actors that we cannot yet conceive of. For the most part, the digital transformation of the value chain points towards businesses based on mobility services, in which vehicles will derive their elevated value from the features and performance they offer - and which will make them relatively unaffordable as a private purchase. However, a significant amount of yield will be extracted from these vehicles through the management and provision of services. Today's manufacturers will become tomorrow's service providers and aggregators, while the traditional players in the automotive industry will have to rethink their roles within this new paradigm in order to determine the ways in which their products can retain their value. The "classical" manufacturers are arriving late to the electrification of mobility and the provision of hyperconnectivity, while other actors (such as Tesla and Google) have had a clearer view of the path to take. Consequently, the traditional companies may also miss the boat with regard to management of the value chain if they are unable to anticipate the nature of future mobility demands.

In the same way that the automotive industry has traditionally revolved around the manufacture of engines, given that they represent the main differentiating factor between brands, the mobility sector of the future will revolve around actors that manage strategic elements (such as batteries for EVs, connectivity and the exploitation of data) and even finance companies and insurers that manage risk for driverless vehicles. The vehicle itself, which today sits at the centre of the business model, will be increasingly relegated to the role of a consumer good, while elements related to software, connectivity, tuning, etc. will constitute the key factors for added value and brand differentiation.

The main disruption in urban mobility is coming from a gradual change in people's habits as they face an urban environment that is increasingly saturated, polluted and accident-prone, which in turn makes private vehicles a highly inefficient mobility solution. EVs are not a definitive solution, as they will continue to cause congestion in urban areas. In addition to tackling noise and air pollution, the trend in cities is towards reducing traffic, which in turn brings the use of private vehicles into question. The problems of saturation and insufficient parking facilities in cities around the world will only get worse as urban development increases, which will make it necessary to find personal mobility solutions that are more efficient, are of a shared and/or public nature, and are facilitated by online platforms.

In cities, the cost of owning one's own vehicle is rising, while the number of young people aged between 20-24 who have a driving licence is continually falling. However, there is no such fall in the number of kilometres travelled by those who are living in the cities. We can therefore deduce that urban travellers are seeking to meet their mobility needs through multi-modal means: in other words, through the combination of different modes of transport depending on circumstances and the options available.

Urban mobility services are an important feature of so-called “smart cities”, which seek to provide services and increase well-being through the use of digital technologies. Such services also include shared or rental vehicles, mopeds, bicycles, scooters, etc. At the same time, platform-based mobility service providers such as Uber and Cabify have emerged dramatically onto the urban scene, often causing conflict due to their lack of regulation. Vehicle manufacturers are starting to think about how they can capture at least some of the value generated by mobility services in the urban environment. Future business models will involve the sale of a mobility “package” instead of just a vehicle. However, such a seismic change for the industry will present challenges in terms of marketing.

Although mobility is (at present) still dominated by private vehicles, and the turning point at which services start to generate more profit than vehicle sales seems far off, manufacturers are exploring the question of how they will relate to their customers in the future. They will need to invent new strategies to retain consumer confidence in their brand once the capital investment of a vehicle purchase (or the signing of a contract with specific brand or service provider) disappears. When people are purchasing journeys instead of vehicles, the hierarchy of consumer preferences will undoubtedly change and greater weight will be placed on other factors such as availability, convenience, ease of use and price, instead of factors such as design, brand value, aesthetics, technology and consumption.

6. PERSPECTIVAS EN CATALUNYA

Catalonia, and more specifically the Barcelona metropolitan area, is home to a number of important industrial assets in the automotive industry. It is also a major repository of industry know-how and is home to several prestigious universities and technology centres, all of which combine to make it a highly attractive location within the European context. Moreover, the city of Barcelona enjoys widespread renown as a "smart city" and a hub for urban innovation and sustainable mobility. Catalonia therefore represents an opportunity for the automotive industry, provided it is able to use the ongoing process of technological change to achieve an advantageous position within the European market and compete successfully in the mobility sector. The region should aspire to become a global hub for electromobility technologies.

However, this will not happen without building bridges and fostering collaboration between actors, without the government drawing up plans to determine the role Catalonia should play in the short, medium and long term, and without investing the necessary resources via specific reindustrialization programmes. In July 2019, the Catalan Minister for Business and Competitiveness announced that the Catalan government would begin talks with the trade unions, employer associations and other leading industry stakeholders in order to explore the creation of a programme to support the mobility sector and automotive industry. The overall aim would be to boost funding initiatives and measures with a view to developing a proactive policy to help the industry adapt to the new market conditions and technological paradigm.

Barcelona has the opportunity to develop urban mobility technologies through the Smart City pilot programme, which equips the city with AI systems to enable level-4 autonomous vehicles to use the roads. Within a few years, a number of manufacturers will be bringing these vehicles to market, and they will be capable of operating autonomously in urban environments equipped with advanced connectivity and AI technologies. Such environments could accommodate autonomous private vehicles and taxis and even autonomous shared and public forms of transport.

At present, Barcelona is home to a European consortium of cities, companies and universities that are dedicated to promoting innovation in urban mobility. Together, the consortium members - which include the UPC, Seat and Barcelona City Council - form the Community of Innovation and Knowledge (KIC) for Urban Mobility. The Community's aim is to rethink the way in which people move around the city and to prepare for the changes of the future, such as shared mobility and the use of EVs. It will help to accelerate the wide-ranging transformation of sustainable mobility by promoting innovation and helping to train a new generation of young professionals in the field of urban mobility; it will also help to accelerate the mobility solutions of the future by integrating user-oriented services and products; it will boost the industry's competitiveness within Catalonia (thereby creating market opportunities); and it will stimulate changes in behaviour through the use of intelligent mobility strategies, regulations and the reconfiguration of the urban environment. Barcelona occupies a position of acknowledged prestige with regard to sustainable mobility policies, which presents Catalonia's mobility sector with a number of opportunities. The KIC for Urban Mobility is a public-private platform that could potentially be granted up to 400 million euros by the European Union and some 1.2 billion euros from Community members.

7. CONDICIONES LABORALES Y OCUPACIÓN

Restructuring processes as extensive as those facing the automotive industry tend to be accompanied by a fall in employment and a worsening of working conditions. The trend is towards job-related uncertainty and increased flexibility, along with lower or stagnating wages. To prevent or minimize the impact on workers, the plans drawn up by companies to adapt to the transition affecting the industry must also be accompanied by social programmes agreed with the trade unions in order to ensure a fair transition so that the workers are not the ones who have to suffer.

The changing composition of the professionals who, in one way or another, work for or with the companies in the automotive industry points to a growing polarization of the job market. In factories that use advanced technologies, the trend is for a minority of highly qualified, high-performing professionals to be remunerated on an ad hoc basis, while the majority of employees suffer from a deterioration in working conditions. Moreover, these factories make extensive use of more precarious and temporary forms of employment for their more labour-intensive operations because these forms of employment provide the flexibility that this particular organizational model demands. The use of these temporary workers, many of whom are subcontracted (and therefore have lower salaries and poorer working conditions), enables companies to adjust their workforces in line with production needs.

The impact of the industry's transition on employment, in terms of both the quantity and quality of jobs, is related to technological change, the business model adopted and the way in which the value chain is managed. It may involve relocation, changes in suppliers, and even the closure of plants. It is also related to the behaviour of the market, as shrinkage can have an impact on workforce stability. The transition to EVs, which have fewer parts and components and are therefore significantly simpler to assemble, may mean that fewer people are employed by manufacturers and also by suppliers and other companies in the ancillary industry. What is certain, however, is that the jobs created will be of a different type. The jobs that will tend to disappear are those that require fewer skills and are more closely linked to the manufacturing process, while there will be an increased need for qualified professionals in areas related to electronics, AI and engineering in general. Although the industry as a whole (and especially the vehicle-manufacturing plants themselves) is already highly automated, the number of manual roles will decrease even further. Instead, there will be a growing demand for people who are more highly trained, who have extensive interpersonal skills, greater creative capacities or the ability to manage teams and make decisions. There will also be an increase in the number of roles related to environmental protection, ecodesign, and similar activities.

Those workers who lose their jobs will have difficulty finding another role within the same company or even within the industry as a whole: some of them because they are nearing retirement age, and others for reasons related to training and skills. Undoubtedly, any corporate restructuring plans, where such plans are required, must include ambitious and carefully studied retraining programmes and assistance measures in order to ensure that the impact of any job losses is as minimal as possible. Governments must also develop programmes designed to mitigate the impact of the transition process on the industry's employees. In Catalonia, these programmes must be approved by the actors involved and incorporated into the PNI.

8. PROPOSALS

As a conclusion to the analysis provided in this report, CCOO presents the following proposals:

- Bolster the resources of the Catalan government's Industry Observatory and the competences of the automotive industry forum.
- Draw up a list of the jobs that will be affected by the transformation of the industry.
- Create a comprehensive training plan encompassing secondary school education, university-level training and continued training in the workplace that is adapted to meet the new needs of the industry:
    - → Digitalization
    - → Driver assistance
    - → Electrification
    - → Connectivity
    - → Interface
    - → Robotics
    - → AI
    - → Industry 4.0
- Create a list of companies that produce components and develop a public-private investment plan to help them adapt to the production of electrical and connectivity-related components.
- Create a list of actors in the post-sales and vehicle-repair industry and an action plan to ensure a fair transition.
- Forge corporate alliances for the production of batteries and battery components.
- Develop a plan to transform the production model in line with the circular economy and define the regulatory changes that are needed in order to promote a sustainable automotive industry at both the local and national level.
- Public investment in charging infrastructure for EVs.
- Draw up a social agreement for a fair transition that guarantees the effective employability of the workers in the industry.

9. REFERENCES

- Annual Report on Industry in Catalonia, 2017. Industry Observatory, Generalitat de Catalunya.
- Armero, Mario. Spain: OEM Perspectives and Reality. ANFAC: 2018.
- Global Automotive Executive Survey 2019. KPMG.
- Keys to a New Energy Paradigm. UPC, October 2017.
- Lutsey, Nic; Nicholas, Michael. "Update on electric vehicle costs in the United States through 2030". ICCT: abril del 2019.
- McKinsey Center For Future Mobility. *Race 2050: A Vision for the European Automotive Industry*, 2019.
- Sachon, Marc; Welter, Beatriz. *Key Data on the Automotive Sector*. IESE: 2018.
- Schotes Ruiz, Roberto. "The Impact of Electric Vehicles on Spanish Industry: Economic Disruption in the Making".
- "The Automotive Industry in Spain". 2017 Annual Report, ANFAC.
- The Impact of Industry 4.0 on Employment in Catalonia. Government of Catalonia, 2018.

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