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AUTOMOTIVE AND ELECTRIC MOBILITY

GUE/NGL
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SUMMARY

> The EU favours electric cars via environmental regulation, public procurement, incentives, provision of charging infrastructures, and identification of batteries as a strategic value chain

> EU policies exclude the use of public intervention, leaving the development of this sector to the market

> The number of charging points is still rather low in nearly all European countries. The creation of a European public enterprise could fill this gap as private companies don't invest in charging point grid

> Public procurement doesn't guarantee that vehicles will be produced in the EU. Large multinationals could win the tender, so social and ecological binding clauses should be included

> Battery cell manufacturers may have announced investments in Germany, Hungary and Poland but there is a total lack of a European plan in tackling this. This leaves the sector entirely to market forces. Countries like Spain, France and Italy will be excluded.

> Current availability of Battery Electric Vehicles (BEV) is limited. Their costs are also very high, and the range of charge is unsatisfactory. Ambitious environmental targets of the EU will therefore not be met

> Investment plans of the OEM are mainly directed to China (45%) and, only marginally to Europe (Germany 23.9%, France 3.5%)

> PHEV models have to comply with stricter environmental thresholds, require more components which means they could create more jobs than purely electric ones

> In order to facilitate sectoral change, securing labour and protect the environment, private and public investment need to be directed to other fuels like hydrogen. The number of public transport vehicles must be increased and vehicles need to be subjected to environmental and climate protection

> Huge investments in the public sector are necessary to secure jobs in the automotive industry

AUTOMOTIVE SECTOR NOT READY FOR TRANSITION

The automotive industry and its suppliers are facing major upheavals. Investment decisions are now being made that will be difficult or impossible to correct later. This study is an answer to the question of whether the European Union and the automotive industry have set the right course. Unfortunately, the answer is that neither the environmental targets nor the social requirements are going to be met.

Let´s start with an example to show how far the EU is from achieving the goals it has set itself: according to OEM announcements, the stock of electric vehicles should be between 9 and 20 million in 2020 and between 40 and 70 million in 2025. In fact, as amply demonstrated by the data reported in this study, the stock of electric vehicles is much lower as in 2018 it just exceeded 5 million. In addition, the Commission adopted a strategic action plan on batteries in 2018. The clearly neoliberal approach of this plan has shown all its inadequacies. A report on the implementation one year later acknowledges that the European share in world cell production is only 3% compared to 85% for Asia, which would result in a heavy dependence of European industry on imports of battery cells. Which is no surprise, considering the fact, that investment plans of the OEM are mainly directed to China (45%) and, only marginally to Europe (for example: Germany 23.9%, France 3.5%). The report shows that some European countries would be completely excluded from the investment in the construction of battery production sites. The production would be concentrated in Germany, Hungary and Poland.

However, one of the biggest failures is the lack of public charging infrastructure. The study shows, that the number of charging points is increasing, but most of them are private charging points (90% of the 1.6 million installed in 2018).

This is a major obstacle to the spread of electric vehicles. Infrastructure by a European public company, or a consortium of public companies could make a huge difference by helping to spread public charging points, but also creating an important opportunity for job creation.

In the last couple of years, the EU has tried to support the transition to new forms of vehicle propulsion with the aim of achieving environmental objectives. In doing so, the EU has recourse to various means, such as environmental regulations, public procurement, incentives, provision of charging infrastructure, and identification of batteries as a strategic value chain. However, unfortunately the EU has limited itself in most of the cases to setting general objectives without worrying about how to achieve them. Furthermore, the study shows that the EU made the mistake to leave the fundamental and operational choices to market mechanisms and players and that the EU shows no awareness for the social repercussion, which a transition of this magnitude, if not governed by the public in the collective interest, could generate. Concerning the means listed above, the study reveals for each one the deficits.

In the case of public procurement, the present strategy doesn´t foresee a solution in the case that multinational companies operating in this sector in public tenders in the Member States and relocate after that the productions to countries with low labour costs and environmental protection.

Existing incentive schemes for electric mobility, which we find now in most of the EU countries, represent an incentive for individual purchases. So instead of leaving the choice of assuming orientations to the public level, it´s up to the market and individual behaviour. Moreover, despite the existence of incentives the purchase of electric cars, the prices are still that high that the majority of the population is not able to buy such a car. A price parity with traditional cars will not be reached before 2024. That has the consequences that this kind of incentive only support the private purchase of a rich minority. Incentives like this are misguided.

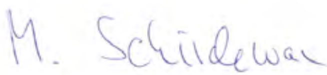
Concerning the batteries as such, the European commission has identified batteries as one of the nine strategic value chains for the competitiveness of EU industry to achieve the decarbonisation targets. Nevertheless, some European countries are moving individually or with restricted forms of cooperation concerning the financing of batteries, which manifests the lack of a European general plan in this sector.

Furthermore, European countries start just now their investment in solid batteries while Toyota has already announced to invest in hydrogen vehicles. Hydrogen is a technology that can also be applied to other means of transport, such as buses, which are important for a development away from individual transport and towards public transport. Again, China has the largest fleet with 400 buses while in Europe only 50 exist. Europe seems like always several steps behind.

This is also reflected in the fact that by now it still doesn´t exist a strategy to counter the threat of mass job losses in this sector.

Ultimately, the report does not allow any conclusion to be drawn other than that the EU and the car industry have no real strategy for the future. European policies do not include active public intervention - although legitimate an important. The development of this sector is therefore delegated to the market and it´s logic and leads to the lack of an actual industrial plan, which could secure or implement social and ecological standards.

I wish you an exciting read!
Martin Schirdewan



1
GENERAL FRAMEWORK

EUROPEAN UNION POLICIES FOR THE TRANSITION TO ELECTRIC CARS

In recent years, EU institutions have undoubtedly defined a broad set of policies to support the transition to new forms of vehicle propulsion with the aim of achieving environmental objectives.

However, on the one hand this wide set of policies appears to be ineffective, leaving the fundamental and operational choices to market mechanisms and players; on the other hand, it shows very little concern for the social repercussions that a transition of this magnitude, if not governed by the public in the collective interest, could generate.

In April 2019, the European Parliament adopted the new emission standards for light vehicles; as a result of this decision, in 2030 new cars will have to reduce CO_2 emissions per km by 37.5% compared to the 95 grams of CO_2 per km required in 2021, and for new vans by 31% compared to the 147 grams of CO_2 per km required in 2020. In essence, this is a strengthening of the standards adopted in 2017 when the European Commission had established a 15% reduction in CO_2 emissions for new vehicles in 2015 and 30% in 2030.

The European regulation assigns a specific emissions target to each manufacturer. Production thresholds are also set to stimulate the spread of zero and low-emission vehicles, including PHEVs (Plug-in Hybrid Electric Vehicles) and BEVs (Battery Electric Vehicles). Manufacturers whose production of zero and low-emission vehicles exceeds 15% in 2015 and 35% in 2030 will have less stringent CO_2 emission constraints on them.

The EU is also using public procurement to stimulate the deployment of zero-emission and low-emission vehicles: in 2019 the Council and the European Parliament reached an agreement on the revision of the Clean Vehicle Directive: the reform envisages increasing the minimum target of clean vehicles (i.e. as a percentage) in supplies resulting from public procurement in 2025 and 2030 (for light vehicles between 17.6% and 38.5% in 2025; for buses from 24% to 45% in 2025 and from 33% to 65% in 2030 and half of clean buses must be zero-emission; for trucks the range ranges from 6% to 10% (2025) and from 7% to 15% (2030).

This measure in itself may seem positive, but does not face the issue of ensuring an adequate European industrial structure capable of meeting the targets set. For example, supporting the diffusion of clean buses raises requires having an adequate industrial structure to achieve the production volumes necessary to achieve the environmental objectives. If this issue is not faced properly, there is no guarantee that environmental objectives will also generate positive industrial and employment spillovers for the Member States.

The same reasoning holds, in more general terms, for public mobility policies: if public procurement were to establish an increase in public transport – trains, trams, metros – in the light of the current guidelines of the European Commission, it is by no means certain that these objectives can be translated into corresponding industrial and employment results. Multinational companies operating in these sectors could, in fact, win public tenders in the Member States, but immediately afterwards they could relocate these productions to third countries (as is the case, for example, of Alstom) with low labour costs – and environmental protection.

On the contrary, in public procurement, in addition to these environmental clauses, clear and binding social clauses should also be included: it should be provided, in fact, that this production must also be assigned in compliance with social standards relating to the level of wages, labour rights and trade union rights. In addition to this legislative measure, the EU should also take care to ensure an industrial structure, i.e. production plants for both vehicles and components, spread evenly across Europe.

Some European countries (33, of which 26 are EU members) have recently implemented or updated incentive schemes for electric mobility.

This tool simply represents an incentive to individual purchases, therefore leaving to the market and to individual behavior the choice of assuming orientations that would instead be up to the public level. Moreover, despite the provision of incentives for the purchase of 'clean' cars, their cost is still quite high and certainly not within the reach of popular strata. These measures, therefore, risk supporting the private purchases of a minority of the population (generally the richest) at the expense of the community: this is certainly not a socially sustainable measure.

The European Directive on alternative fuels[1] requires EU Member States to set targets for publicly accessible loading points as part of their national programs; it also sets targets for the loading points of the TEN-T network.

The 2018 edition of the *Global EV Outlook* underlined that the targets declared by member states in terms of charging points to be produced by 2020 were lower than the number indicated by the European Commission. In 2020, the target of one charging point per ten vehicles will only be met on average in the EU, with some countries well below such average.

In this case too, the EU has limited itself to setting a general objective without worrying about how to achieve it. As a result, a number of unconnected and uncoordinated initiatives are emerging in various countries, whose definition and implementation has been left to the market. The EU should have defined the objective of creating a European infrastructure, with a widespread and balanced distribution in all European countries, the implementation of which could be entrusted to a public company (or a European consortium of public companies) in order to ensure the implementation of this infrastructure on the one hand, and on the other the pursuit of employment goals.

The European Directive on the Energy Efficiency of Buildings,[2] amended in May 2018, provides that buildings to be newly built or restored will have to meet minimum requirements in terms charging points within March 2021. At least one fifth of parking spaces must be equipped to charge electric vehicles and at least one charging point must be guaranteed if there are at least ten parking spaces.

This intervention seems insufficient in many respects. Certainly, the obligation to introduce this type of infrastructure in the renovation of private buildings would

1 https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32014L0094

2 https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv%3AOJ.L .2018.156.01.0075.01.ENG

lead to costs difficult for individual owners to bear. Such infrastructure should be considered public, and therefore provided by a European public company, or a consortium of public companies – in this way not only making it realistic to achieve the goal, but also creating an important opportunity for job creation.

From an industry perspective, the European Commission has identified batteries as one of the nine strategic value chains for the competitiveness of EU industry to achieve the decarbonization targets. In 2017, the European Commission launched the Battery European Alliance, a platform that brings together countries, industrial and innovation stakeholders and banks to jointly develop a battery ecosystem in Europe. With the Strategic Action Plan for Batteries, the European Commission has defined measures to support this objective: ensuring access to raw materials, supporting the development of a European battery industry, developing a value chain in Europe, strengthening R&D, developing the necessary skills, ensuring the environmental sustainability of this industry.

The Commission also intends to support battery production by encouraging R&D, facilitating access to public funding – compatible with state aid rules – for projects of European interest in battery production. Obviously, even in this case, the industrial initiative is entirely left to the market and to private parties, without any direct intervention by the public level other than that of making substantial public resources available to private companies. As we shall see, this lack of resources is likely to have serious industrial and occupational consequences.

Germany has committed to financing battery production in Europe with 1 billion euro, while France intends to develop an action plan with 700 million euro to support a battery value chain. In 2018, France and Germany committed to strengthening cooperation in cell production, given that this does not only concern the electrification of the automotive sector, but also the storage of electricity produced from renewable sources in order to accelerate the decarbonization of energy systems. The fact that some European countries are moving individually or with restricted forms of cooperation shows the absolute lack of a European general plan in this area that will be a central element for the development of the electric car.

THE HIGH LEVEL GROUP REPORT ON THE COMPETITIVENESS AND SUSTAINABLE DEVELOPMENT OF THE AUTOMOTIVE INDUSTRY IN THE EUROPEAN UNION (GEAR 2030)

The European Commission has set up a High Level Group, composed of: Ministers of Economy, Industry and Transport from a large number of Member States, representatives of industry associations, consumer representatives, trade unions, environmental protection and road safety organizations, the European Investment Bank, the Committee of the Regions and the European Social Committee and the European Economic Committee as observers.

Among the main transformations that are affecting mobility, the Report focused on those relating to the development of self-driving cars and alternative propulsion systems, particularly electric ones.

These changes, which will have a major impact on the production sectors concerned, will require considerable financial support and the fact that public authorities play a central role in defining an appropriate legal and financial framework and in building the necessary infrastructure.

This document, too, therefore, limits the role of the Public Authorities to mere financial support and the definition of a regulatory framework, excluding, in fact, the possibility that the public sector plays a decisive role in industrial production itself and therefore in the creation of employment.

In the field of alternative propulsion and electricity, the most important challenges will not only be the development of new technologies, but also the major investments required for new production processes and vehicle charging infrastructure. As seen above, however, the EU appears far from defining a clear industrial solution to these issues.

A key theme for ”Zero Emission Vehicles” (ZEVs, hereinafter) will also be to reduce their weight to increase their range through the use of new materials.

The Report highlights the fact that in 2030 climate targets will require the use of a large number of new cars with low or zero emissions as road transport is considered one of the main contributors to CO_2 emissions. In addition, improving air quality, especially in urban areas, is one of the main objectives of both national and EU policies to address health problems related to exposure to particulate matter, NO2, etc.

For this reason, the Report focuses on ZEVs and ”Zero Emission Capable Vehicles” (ZECs), the latter often referred to as PHEVs. Among the major changes (Big Shift) that will impact on the automotive industry, in fact, the Report identifies in point No. 5 the decarbonization and the ZEV.

The European Union is committed to reducing greenhouse gas emissions by 80-95% compared to 1990 levels with an intermediate target of 40% in 2030 and to reducing them by 40% in non-ETS (Emissions Trading System) sectors, including transport, according to the Paris Climate Agreement. To achieve these objectives, the European Union proposes to adopt an overall approach to the decarbonization of transport that includes:

- improving the efficiency of new vehicles and optimizing the use of road space;
- the transition to alternative fuels and techniques with low emissions of sustainable origin;
- supporting the shift to low- and zero-emission modes of transport;
- better management of mobility and goods, reducing the need for unnecessary travel.

In 2016, the European Commission issued a Communication to define “A European strategy for low emission mobility” defining a framework of regulatory and non-regulatory policies to achieve low emission mobility by optimizing transport systems and improving their efficiency also through the use of alternative energy and low emission vehicles. This Communication also defined a series of horizontal initiatives related to transport and energy systems such as research and innovation, digital technologies, skills, investment, global and city actions. He also stressed the importance of the combination of European, national and local policies to accelerate the use of low- and zero-emission vehicles, adopting a technology neutral approach.

The internal combustion engine will continue to have significant market shares in 2030, however – according to the High Level Group document – to remain at the forefront of the transition to zero-emission technologies the European automotive industry will need to invest heavily in these technologies, particularly to compete with China. According to this document, as soon as possible the markets will receive a clear signal on the guidelines of European regulation in the long term, the more feasible the transition.

It is clear that the Community approach is one that leaves the definition of rules and incentives to the public level, so that the guidelines and choices to be made are left entirely to the market.

The GEAR 2030 document wanted to pay particular attention to the ZEV, while recognizing the importance of all the other propulsion systems that contribute to the decarbonization of transport.

According to the GEAR 2030 document, in fact, ZEV and PHEV vehicles are becoming increasingly available for passenger transport: in cars, buses, metros, etc.

As we will see below, however, this presumed availability appears to be very limited from several points of view.

In the GEAR 2030 document it is recalled that according to OEM announcements the stock of electric vehicles should be between 9 and 20 million in 2020 and between 40 and 70 million in 2025. In fact, as amply demonstrated by the data reported in this report, the stock of electric vehicles is much lower as in 2018 it just exceeded 5 million.

Subsequently, the same report seems to take a more cautious attitude when it points out that the hypothesis of a wide spread of electric vehicles can be achieved if different conditions are met (for example, the availability of infrastructure, tax and other aspects, acceptance by consumers), and also, given the average age of cars in circulation, it will take time before the ZEVs and PHEVs are able to represent a significant percentage of cars in circulation.

Light commercial vehicles are often used for in-city transport (including ”last mile logistics” where only small loads are transported by light and small vehicles); again, the use of zero-emission vehicles would have an important effect on air quality. There is also a growing market for battery electric city buses. With these passages, the High Level Group report confirms that these types of vehicles are suitable for predominantly urban use.

Again, these are simple considerations that do not imply anything in terms of public policy, also in view of the fact that many public companies (both postal and transport) could be decisive players in the development of ”clean” light commercial vehicles in urban areas. Both transport companies and postal companies (both public) could be the actors of this diffusion through investment plans that would allow them to renew their fleets so as to make clean vehicle fleets available for deliveries of goods in urban areas.

Also in this case, therefore, the forecasting of investment plans of public companies, and the consequent issue of public tenders, could constitute an important towing instrument for the production of these vehicles and, therefore, of job creation in the EU countries. Social objectives could thus be closely intertwined with environmental objectives: ZEVs, in fact, have the advantage of allowing zero emissions of CO_2 and other pollutants (NOx and particulate matter): this could help reduce pollution and improve the quality of life in urban areas by reducing health risks.

However, and this aspect is also considered in this document, when considering ZEVs from the point of view of the entire product life cycle, the greenhouse emissions from electricity production and the production of vehicles and their materials must also be quantified. For this reason, environmental policies must be carefully assessed because the level of exhaust emissions of ZEVs is likely to be offset by emissions attributable to other ”links” in the same chain such as, precisely, the production of energy and the production of parts and components decisive for this type of vehicle.

The creation of a significant market for zero-emission vehicles and renewable energy will reduce dependence on oil, but at the same time the increased demand for batteries and catalysts for new vehicles could create new dependencies for the raw materials needed for these productions which could be partially solved by the use of recycling or new technologies. The High Level Group document stresses that PHEVs are an important transition technology, as these vehicles have the benefit of maintaining the classic engine to which electrical components would be added: this would create the conditions for an easier transition for the automotive supply chain and for consumers.

As we will see below, the difference in terms of components between eBEV and PHEV vehicles is very significant: this aspect must be taken into account in industrial and employment terms to prevent the transition to new forms of propulsion from turning into a social damage of very significant proportions.

PHEVs are vehicles capable of reaching low emissions if they are regularly recharged and if they have an adequate range of autonomy. While in most Member States a large proportion of the distances traveled daily remains below 40 km, the initial spread of PHEVs in the Netherlands has indicated that they have been used with zero emissions for only about 30% of the total mileage traveled (although there have been improvements due to greater availability of the charging infrastructure).

In order to achieve the objective of a significant environmental improvement, the share of the route covered by electricity must increase significantly: this requires vehicles that have a greater electrical range and an adequate rapid recharging network. For these aspects, the considerations made previously regarding the choices (or the non-choices) made by the EU level regarding the publicly accessible charging network (infrastructure) and the charging points to be set up in buildings apply.

GEAR 2030 expects prices for electric vehicles to decrease over time, while those for conventional vehicles may become higher due to the need for new technologies to increase their efficiency and reduce pollutant emissions.

At the moment, when the minimum and maximum prices of the available models will be displayed, this is not happening: the cost of electricity is still quite high and certainly not within the reach of large sections of the population.

The document reaffirms that combustion engines will maintain a significant share both in 2030 and beyond, especially in light commercial vehicles and heavy duty vehicles.

From the point of view of the competitiveness of the European automotive chain, the development of a strong ZEV market with European industries offering a wide range of powertrain solutions for both the European market and exports is essential, but requires a number of actions and steps. Again, public intervention is not even taken into account and, as we will see below, there is a risk that the industrial initiative for the construction of alternative power train production plants will be taken by entities outside the EU with strong imbalances within the EU.

There is no doubt that the electrification of the automotive sector will also affect European battery production and its location. But the current leaders in the production of Li-on batteries (at the cell level) are mainly non-European (Japan, South Korea and China), and have begun to decide to locate their production also in Europe.

Mass production of cell batteries will require major investment if European companies are to play an important role in the production of these products.

Precisely for this reason, a much more decisive public role should be envisaged: a) since battery cells are the central element of electric propulsion, the production of this component must become an objective of public interest; b) since this sector will be decisive in creating new jobs, there is a need for this to happen in a balanced manner between European countries and in compliance with social standards that allow to avoid recourse to relocation aimed at seeking the low cost of labor.

The forecast of a public role in the battery sector is also decisive in light of the fact that further opportunities for activity will open up in the recycling and reuse of batteries, also to reduce the European dependence on the import of raw materials necessary for these productions.

Batteries will clearly be the key technology for electric mobility as they represent a significant part of the costs of the electric vehicle and the improvement of their performance (range of autonomy, duration, speed of recharging) will be a decisive element for the acceptance of consumers. The GEAR 2030 document acknowledges that although research programs have been carried out, Europe cannot rely on a complete supply chain of electric batteries. Cells are mainly imported from third countries; according to the GEAR 2030 document, this weakness must be addressed by creating a complete supply chain of these products in Europe, but indicating any concrete solutions.

The development of electric and hybrid propulsion will imply a growing need for rare earths. It will therefore be important to ensure access to these raw materials and at the same time develop technologies that reduce Europe's dependence on them.

According to the GEAR 2030 document, the transition to ZEV and ZEC in Europe will not be possible without a number of regulatory and non-regulatory incentives; Europe will also have to combine the approach to reduce greenhouse and pollutant emissions with that aimed at ensuring the growth and competitiveness of the European automotive industry. This means that Europe will have to be one of the first areas to adopt these technologies; by promoting the production and sales of these vehicles, the EU can support the conditions to achieve those economies of scale that will allow the car industry to develop the basis for industrial production. While it is generally possible to agree with this reasoning, it should nevertheless be stressed that the European Union, unlike other countries, renounces in advance and ideologically any form of public intervention (i.e. direct intervention) to encourage the development of this industrial sector.

The main responsibilities of political decision-makers at European, national and local level concern: a) the regulation of CO_2 and pollutant emissions; b) the creation of an efficient and inter-operable charging infrastructure; c) the use of public procurement tools to stimulate demand for ZEV and ZEC; d) the provision of financial and non-financial incentives to encourage the purchase of ZEV and ZEC vehicles; e) the definition of a common European vision and the adoption of a comprehensive framework that, among other things, supports the development of a complete battery supply chain and promotes its production in Europe. At the same time, the industry will have to take the necessary steps to improve the range of autonomy of these vehicles, reduce their costs and increase the choice of models in the market. The distinction of roles between public and private is also confirmed in this passage: the former only has regulatory roles, the provision of incentives and infrastructure; the latter has production and industrial decisions.

One of the most important aspects is the development of adequate infrastructure; in this respect, the implementation of the European Directive for Alternative Fuel Infrastructure is decisive. However, the document acknowledges that the plans submitted by several Member States do not fully meet the requirements of the Directive. The inter-operable charging infrastructure is an essential prerequisite for the acceptance of ZEV and ZEC vehicles.

The document also stresses that the range of charge of these vehicles should be extended, as should the capacity of the charging network.

With regard to the range of autonomy, some manufacturers have announced that they can activate at 700 km in 2020 (a result that does not seem to have been achieved, but many brands offer electric vehicles with a much lower range).

The Guidelines for financial incentives to promote the energy efficiency of vehicles represent a very important aspect, in particular the principles of non-discrimination with respect to the origin of the vehicles, compliance with EU rules on state aid, etc., as well as the need to ensure that the EU's financial incentives to promote the energy efficiency of vehicles are not discriminated against.

The guiding principle is technological neutrality, so incentives should not be limited to a specific technology.

2
SPECIFIC ISSUES

CHARGING INFRASTRUCTURE

The number of charging points worldwide is estimated at 5.2 million, an increase of 44% compared to 2017, but most of this growth is concentrated in private charging points that account for more than 90% of the 1.6 million points installed in 2018. There is therefore a delay in the development of publicly accessible charging points.

The installations accessible to the public for fast charges are 144 thousand, while those with slow charges are 395 thousand (a total of 539 thousand, or just over 10%). While in China about half of the public points are fast-charging, in Europe the majority are slow-charging: this is a major obstacle to the spread of electric vehicles.

The ratio of the global number of publicly accessible charging points to that of electric cars has fallen from 0.14 to 0.11; it is higher than that recommended by the European Directive on Infrastructure of Alternative Fuels – one point every 10 machines; but many leading countries in the spread of electric cars remain below this threshold of 1:10, such as Norway, which has one charging point for every 20 electric cars, while the Netherlands and Denmark have a more favorable ratio (1:4-8). The spread of these charging points is a fundamental requirement for the development of electric vehicles as the availability or otherwise of these infrastructures is a decisive condition for the development of the electric.

The IEA 2019 Report classifies announcements of charging infrastructure into three broad categories: commitments covering all types of charging infrastructure; those for publicly accessible charging points only; and charging infrastructure for highways.

The most significant announcements concern two operators: ChargePoint, the world's largest network of charging stations in the US and Europe, and EV-Box, a Dutch operator recently acquired by Engie. See Table 1.

PLANS FOR THE IMPLEMENTATION OF CHARGING INFRASTRUCTURE

	ALL TYPES OF CHARGE	PUBBLICLY ACCESSIBLE POINTS	POINTS ON HIGHWAYS
Financed by Government			Fast E (370) Next E (252)
Charging points operators	ChargePoint (2,5 mil) EVBox (1 mil)		
Charging serviceproviders	Enel X (0,45 mil)		
Utilities	EDF (0,3 mil)SGCC (0,12 mil)	SCE (48 ths) CSPG (25 ths) Iberdrola (25 ths) E.On (10 ths)	NG (500)
Vehicles OEM		SAIC (50 ths) Tesla (22 ths) EA (3.500)	Ionity (2.400)

TABLE 1

Further action plans are planned by EDF and Enel X. In the U.S., utilities such as DTE Energy, Duke Energy and Consumer Energy Company are active, as are car manufacturers such as Tesla, Electrify America (a subsidiary of VW) and Porsche.

Ionity (a joint venture between BMW, Daimler, Ford and VW with Audi and Porsche, funded by the European Commission) is focusing on the charging points on the highways; also on these should intervene several energy utilities such as Iberdrola in Spain. Also in Europe, other charging points should be implemented through funding from various national and European governments as part of the project ”Connecting Europe Facility” to create fast charging points in TEN-T networks.

China has the largest share of filling points, but private sector announcements are lower than in the EU and US: in fact, most of the announced targets concern state-owned Chinese OEMs and utilities. Utilities include State Grid Corporation and China Southern Power Grid, while OEMs include SAIC’s commitment.

Since the availability of recharging points is one of the elements that most affect the distribution of electric vehicles, it seems useful to check, beyond the announcements and development plans, the current situation in the main European countries.

The data have been extrapolated from the database of the European Observatory on Alternative Fuels.

NUMBER OF CHARGING INFRASTRUCTURES BY COUNTRY

COUNTRY	NUMBER OF INFRASTRUCTURE	INFRASTRUCTURES ON HIGHWAYS (FOR 100 KM)
Germany	28377	35
France	25479	25
UK	20594	133
Spain	5221	5
Italy	3824	12

TABLE 2

Table 2 shows that the number of charging infrastructures for electric vehicles is very low: lack of a European-wide Master Plan and the absence of a public body could lead to major delays in the implementation of this fundamental infrastructure. In fact, the market logics that are guiding the construction of these plants in an almost exclusive way, being driven by profitability logics, do not seem to be able to guarantee a widespread coverage of the European territory, and therefore do not seem to be able to guarantee universal access, guaranteed to all European citizens, to this service.

BATTERIES

The IEA 2019 report estimated that about 70 GWh of battery cells were produced for light electric vehicles in 2018 (see Table 3)

ANNOUNCED BATTERY PRODUCTION FACILITIES

OEM	COUNTRY	ANNOUNCEMENTS (PRODUCTION CAPACITY GWH)
Panasonic	USA	One factory (35 GWh) by 2020
CATL	China	Two factories (24 GWh + 18 GWh) by 2020
CATL	EU	Two factories: (14 GWh by 2021) + (98 GWh – date to be set)
BYD	China	Four factories: (24 GWh by 2019) + (20GWh by 2020) + (30 GWh by 2023) + (10 GWh date to be set)
LG Chem	EU	A factory (15 GWh) by 2022
LG Chem	China	A factory (32 GWh) by 2023
SK Innovation	China	A factory (7,5 GWh) by 2020
SK Innovation	EU	A factory (7,5 GWh) by 2021
Sk Innovation	USA	A factory (9,8 GWh) by 2022
LIBCOIN BHEL	India	Three factories (each one of 30 GWh), by, respectively, 2025, 2026 and 2027
Samsung SDI	EU	A factory (1,65 GWh) by 2020
Northvolt	EU	A factory (32 GWh) by 2023
Lithium Werks	China	A factory (8 GWh) by 2021
Terra E	EU	A factory (4 GWh) by 2020

TABLE 3

Production is concentrated in China, which covers about 50% of the world market; the remaining part is divided between the USA, Korea and Japan. Currently in China there are about 50 manufacturers in this sector, including the two largest, BYD and CATL, covering about half of the Chinese market.

Although most of the production takes place in small plants (with a capacity of 3-8 GWh), some recent announcements regarding the expansion of production capacity point to an increase in the size of the plants and highlight the entry into the market of new manufacturers.

Each of the three largest battery plants has a capacity of 20 GWh per year and covers about 21% of installed production capacity. Most of them are currently located in China, Japan and Korea.

Eight plants, with a production capacity of more than 20 GWh, are expected to be operational by 2023, with a total capacity of more than 180 GWh per year, i.e. 2.5 times the 2018 production. In the long term, plants with a production capacity of around 100 GWh could also be built; Panasonic had considered the opportunity to expand its production with an expansion that would bring production capacity in its Gigafactory to 105 GWh, but this project was suspended in April 2019. CATL also considered expanding its Erfurt plant to 100 GWh per year.

The battery cells sector has been haracterized by overcapacity in recent years. This has been favored by the tax advantage scheme for electric cars established by the "New Energy Vehicle Subsidy Program" defined by the Chinese Government; in China, moreover, investments in battery production have also been made by foreign companies such as LG Chem which has invested over $ 1 billion to expand production in Nanjing and Panasonic which has set up a plant in Dalian. A European company, Lithium Werks, has also announced the construction of an 8 GWh factory per year.

These foreign investments in China can be explained by two factors.

First, factories in China can be used to produce and export to other markets; second, if the announced phase out of the New Energy Vehicle Subsidy Program is maintained, it can open up a large market for all battery manufacturers.

While some manufacturers are suffering from overcapacity, recent announcements of capacity expansion indicate that major battery manufacturers have greater confidence in market demand.

This is the case for a major battery manufacturer like LG Chem, which announced that it will increase its production from 70 to 90 GWh per year in 2020; or for BYD, which has changed the plan for its third Chinese factory from 10 to 24 GWh per year.

Asian manufacturers are investing in new production facilities in Europe as well. For this purpose too, agreements have been signed between the major OEMs, especially German ones. For example, BMW has signed a $4.7 billion battery supply contract with CATL, while Daimler has undertaken to purchase 20 million batteries over the next decade, but without specifying the names of the suppliers. VW, in turn, has selected LG Chem, SK Innovation, CATL and Samsung as strategic battery suppliers.

The European manufacturer with the most advanced plans to become a large-scale manufacturer is Northvolt, which is building a factory in Sweden with a capacity of 8 GWh per year and will expand to 32 GWh by 2023.

European companies are investing in R&D in solid batteries, hoping to gain space vis-à-vis Asian manufacturers in next-generation battery cells instead of trying to compete on current technologies. SAFT, for example, is investing 200-300 million euro in solid state technologies, as well as VW has invested 100 million dollars in a company specializing in solid state batteries.

At the same time, significant investments are underway in solid state batteries in Japan, where an alliance between domestic manufacturers is being formed with the public support of the Organization for the Development of Industrial Technologies and New Energies to develop solid state batteries. Toyota has already carried out research into solid state batteries and has filed numerous patents and built prototypes. Toyota and Panasonic also created a joint venture to develop solid state batteries in 2025.

Therefore, according to the manufacturers' announcements, the geographical distribution of future plants and total production capacity is described in Table 4.

GEOGRAPHICAL DISTRIBUTION OF FUTURE PLANTS AND TOTAL PRODUCTION CAPACITY

COUNTRY	N. OF FACTORIES	TOTAL PRODUCTION CAPACITY
USA	2	44,8 GWh
EU	6	172,15 GWh
China	8	143,5 GWh
India	3	90 GWh

TABLE 4

In Europe, the European Battery Alliance, launched in October 2017 as part of a ”new industrial policy strategy”, has brought together various players in the chain: since then, a number of industrial consortia have been set up and new production facilities have been planned (listed below in a specific table). In 2018, the European Commission adopted the strategic action plan on batteries as part of the third mobility package ”Europe on the Move”. The plan provides for a series of measures to support initiatives aimed at creating a battery value chain in Europe.

This Plan aims to:

- guarantee access to raw materials from resource-rich third countries, to facilitate access to European sources of raw materials and to access, through recycling, to secondary raw materials within a circular battery economy;
- support European industrial-scale production of battery cells and creating a complete value chain in Europe by bringing together key industrial players and national and regional authorities; working in partnerships with Member States and the European Investment Bank to support production projects;
- strengthen industrial leadership through enhanced EU research and innovation support for advanced (e.g. lithium-ion) and breakthrough (e.g. solid state) battery technologies; this should aim at support at all stages of the value chain (advanced materials, new chemicals, production processes, battery management systems, recycling, innovations in business models), be closely integrated into the industrial ecosystem and help accelerate the uptake and industrialization of innovations;

- develop and strengthen a skilled workforce in all parts of the battery value chain in order to fill skills gaps through training and retraining.

To achieve these objectives, the Commission also envisages the use of sources of finance, for example by working with Member States and the European Investment Bank to provide public and private funding for battery cell production projects to reduce the risks of investment in the private sector. Possible financing channels include the European Investment Bank, InnovFin, Horizon 2020, the European Regional Development Fund, the European Strategic Investment Fund, the Innovation Fund, etc.

The clearly neoliberal approach of this European Plan has shown all its inadequacies. In fact, in April 2019, the European Commission published a report on the implementation of the strategic plan mentioned above. In this document, the Commission acknowledges that the European share in world cell production is only 3% compared to 85% for Asia, which would result in a heavy dependence of European industry on imports of battery cells. This dependence would become particularly heavy if the sales forecasts for electric vehicles were to be met, bringing the need for lithium-ion batteries to 660GWh in 2013, 1,100GWH in 2028 and 4,000GWh by 2040, compared to only 78GWh today.

Obviously, these estimates have been made by imagining that the expected replacement rates of ICE cars with electric cars will be achieved. The dependence of European industry is in danger of being enormous at all stages of the chain.

To reduce the level of dependency, the European Commission has launched a series of initiatives that involve:

- research, innovation and demonstration to bring to market the next generation of battery technologies through specific financing instruments in the EU budget; in this context, for support to demonstration and pilot projects, the European Investment Bank has provided a loan of more than 52 million euro for a demonstration line in Sweden and other projects in Croatia, France, Greece and Sweden have benefited from the European Strategic Investment Fund;

> the industrial diffusion of innovative solutions: in this context, the European Battery Alliance has set up a network directed by EIT InnoEnergy, which has announced investments of 100 billion euro for the production of raw materials and the production of batteries by various European consortia (plants are planned in Poland and Finland to produce essential materials for batteries).

In this case, therefore, public resources are planned for carry out only research and innovation activities; leaving to private actors the concrete decisions on industrial and productive choices with the industrial and social imbalances that may arise without effective public intervention.

In fact, a Transport & Environment report has reconstructed, on the basis of company announcements, the list of initiatives planned in Europe with regard to battery production plants (see Table 5).

INITIATIVES PLANNED IN EUROPE WITH REGARD TO BATTERY PRODUCTION PLANTS

COUNTRY	**COMPANY**	**PRODUCTION CAPACITY**
Germany	Northvolt	12-30 GWh (2020)
Germany	CATL	14 GWh (2021) – 60 GWh (20121)
Germany	Partenrship BMZ and others	34 GWh (2028)
Germany	Farasis	6-10 GWh (2022)
Hungary	SK Innovation	– (2021)
Hungary	SK Innovation	7,5 GWh (2020)
Hungary	Samsung SDI	2-3 GWH (2016) – 15 GWh (2020)
Poland	LG Chem	6 GWh (2019) – 70 GWh (2022)
Austria	Samsung SDI	-
Sweden	Northvolt	16 GWh (2021) – 32 GWh (2023)
UK	AESC	2 GWh

Note: Five more battery production plans are likely but have not been officially confirmed at the time of writing the report. We decided, therefore, not to include them.

TABLE 5

Looking at the report mentioned above, some European countries would appear to be completely excluded from investment in the construction of production sites.

With the exception of the investment planned in Sweden by Northvolt, in fact, most of the production capacity of battery cells will be concentrated in Germany (as the largest car manufacturer in Europe) and Hungary and Poland (as low-cost countries from the point of view of employment). While Spain, France and Italy seem to be completely excluded from these investments.

If this hypothesis were to materialize, there would be a serious imbalance in industrial and employment terms within the European Union.

EUROPEAN EMISSIONS REGULATION

It seems appropriate to recall some passages of the premises and considerations of the European Regulation on vehicle emissions as these allow to highlight the political objectives that the EU level has defined and to reconstruct some passages of the main European policies on the subject.

The text of the Regulation opens with a very significant programmatic statement: *"In order to contribute to the objectives of the Paris Agreement, the transformation of the entire transport sector towards zero emissions must be accelerated."*

The European Commission's communication of 28 November 2018 entitled "A clean planet for all - A long-term European strategic vision for a prosperous, modern, competitive and climate neutral economy", which sets out the economic and social transformations that must be undertaken to achieve the transition to zero net emissions by 2050, is recalled.

The premises of this Regulation underline the objective that emissions from vehicles with conventional combustion engines will have to be further reduced in the period after 2020, and it will be necessary that zero and low-emission vehicles are widespread and have gained a significant market share by 2030.

In addition, reference is made to the Commission Communications of 31 May 2017 entitled ”Europe on the Move - An agenda for a socially just transition to clean, competitive and interconnected mobility for all” and of 8 November 2017 entitled ”Low Emission Mobility: A European Union that protects the planet, empowers its consumers and defends its industry and its workers”, which shows that CO_2 emission performance standards for passenger cars and light commercial vehicles are a strong incentive for innovation and efficiency and will help to strengthen the competitiveness of the automotive industry and pave the way for the introduction of zero and low-emission vehicles in a technology-neutral way.

The Community level, therefore, has defined the Regulation for the reduction of CO_2 emissions from the road transport sector and contribute to achieving the binding target of reducing domestically in all economic sectors by at least 40% of greenhouse gas emissions by 2030, compared to 1990.

The previous Regulation (EU No 2018/842 of the European Parliament and of the Council) laid down the obligations of Member States to meet the EU target of reducing its greenhouse gas emissions by 30% below 2005 levels in 2030 for sectors not covered by the EU Emissions Trading Scheme, including road transport.

This new regulation aims to set new CO_2 emission reduction targets for EU passenger cars and light commercial vehicles for the period up to 2030 by adopting a differentiated approach for the two types of vehicle.

In order to achieve this transition, the Regulation recalls the need for an integrated approach in relation to public and private investment in research and innovation, an increased supply of low- and zero-emission vehicles, the establishment of charging and refueling infrastructure, sustainable material supply and sustainable production, reuse and recycling of batteries in Europe.

The European Regulation sets emission reduction targets for 2025 and 2030 for new passenger cars and light commercial vehicles at EU level, taking into account the timing of fleet renewal to contribute to the climate and energy targets for 2030, while for the existing fleet is mentioned the possibility of adopting additional measures including those to encourage a higher rate of vehicle renewal.

The text of the Regulation takes up industrial concerns when it recalls that, although it is one of the leading manufacturers of motor vehicles and can boast a technological leadership in the automotive sector at a global level, the European Union has to deal with growing competition; for Community decision-makers to maintain competitiveness at global level, the Union needs a regulatory framework, which includes a special incentive in the sector of zero and low emission vehicles. Once again, therefore, European policies merely call for public intervention only in terms of regulation and incentives, without providing for other, more concrete and direct, means of intervention.

The Regulation also considers it useful to establish appropriate reference thresholds for the share of zero and low-emission vehicles in the EU fleet so as to facilitate the introduction and marketing of such vehicles.

The concerns of the European Community, in the context of the emission reduction process, also involve competition issues, in order to avoid unjustified distortions; in addition, it is proposed to encourage the automotive industry to invest in new technologies by promoting eco-innovation and by introducing a mechanism to take account of future technological developments.

In order to achieve the emission reduction targets, the Regulation makes it possible for manufacturers to form groups: in this way, the achievement of the specific emission targets is verified through the average emissions of the group itself.

Manufacturers exceeding the maximum average specific CO_2 emissions threshold must pay an allowance for excess emissions; the resources of these penalties could in future constitute a specific fund to ensure a fair transition to zero-emission mobility and support the retraining, retraining and updating of other skills of workers in the automotive sector; but this is currently only a declaration of intent.

The Regulation therefore sets CO_2 emission performance standards for new passenger cars and new light commercial vehicles.

As of 1 January 2020, the Regulation sets the target for the entire EU fleet of:

> 95 g CO_2/km for average emissions from new passenger cars;
> 147 g CO_2/km for the average emissions of new light commercial vehicles registered in the EU.

The Regulation will be supplemented until 31 December 2024 by other measures aimed at achieving a reduction of 10 g CO_2/km.

As of 1 January 2025, the following targets will apply to the entire EU vehicle fleet:

> for average emissions from the new car fleet, a target for the entire EU fleet of a 15% reduction in the target by 2021;
> for average emissions from the fleet of new light commercial vehicles, an EU-wide target of a 15% reduction in the target by 2021.

From 1 January 2030, additional targets are foreseen for the entire EU fleet:

> for average emissions from the new car fleet, an EU-wide fleet target of 37.5% reduction of the target in 2021;
> for the average emissions of the new light commercial vehicle fleet, an EU-wide fleet target of a 31% reduction of the target by 2021.

From the point of view of the threshold for zero and low-emission vehicles, from 1 January 2025 this is expected to be equal to 15% of the fleets of new vehicles (passenger cars and light commercial vehicles) in order to obtain less stringent emission constraints for the various manufacturers.

The same mechanism is envisaged from 1 January 2030 onward:

> a threshold of 35% of the new car fleet;
> a threshold equal to an annual share of 30% of the new light commercial vehicle fleet.

Among the definitions provided by the Rules of Procedure, it is specified that:

> The ”average specific CO_2 emissions” for the manufacturer are the average of the specific CO_2 emissions of all new passenger cars or all new light commercial vehicles it produces;

- The ”specific emissions target” for each manufacturer is the target to be achieved by each vehicle manufacturer;
- The ”zero and low emission vehicle” is a new passenger car or light commercial vehicle with exhaust emissions from zero up to 50 g CO_2/km.

The ”specific emissions target” for the manufacturer is set through an annual target. In order to calculate this specific target, the specific emissions for each new car must first be calculated for 2020 using a formula that adds up to 95 with a parameter that depends on the mass of the vehicle in running order ($CO_2 = 95+0{,}0333\times(M - Mo)$.)

A manufacturer's specific emissions target in 2020 is calculated as the average of the specific CO_2 emissions of each new vehicle registered.

From 2021, the specific reference target for emissions for a manufacturer depends on the level of average specific emissions achieved in 2020, multiplied by the ratio of the specific target for CO_2 emissions in 2020 to the average specific emissions of CO_2 in 2020 ($WLTP = WLTPco2\times NEDC2020target/NEDCCO2$).

This specific reference target becomes a central element for the calculation of the manufacturer specific target for the years 2021 to 2024.

In 2020, 95% of new passenger cars registered will have to be taken into account in determining the average specific emissions of each manufacturer, and from 2021, 100% of new registrations will have to be taken into account.

When calculating average CO_2 emissions, each new car with specific CO_2 emissions below 50 g CO_2/km will count as:

- 2 cars in 2020,
- 1.67 cars in 2021,
- 1.33 cars in 2022,
- 1 car since 2023.

As seen, manufacturers can form pools to meet their emissions obligations. The European Commission manages a centralized register of the data transmitted by the Member States and by 30 June each year calculates provisionally for each manufacturer:

- the average specific emissions of CO_2 produced in the previous calendar year;
- the specific target for emissions for the previous calendar year;
- the difference between the average specific CO_2 emissions of the previous calendar year and the specific emissions target for that year.

For each year for which a manufacturer's average specific CO_2 emissions exceed the specific emissions target, the Commission shall require the manufacturer or the pool to pay the excess emissions premium, which shall be calculated as follows: (excess emissions × EUR 95) × number of newly registered vehicles.

In order to facilitate the uptake of eco-innovations, CO_2 savings achieved through the use of innovative technologies or a combination of innovative technologies ('innovative technology packages') shall be taken into account at the request of a supplier or a manufacturer; to be taken into account, the methodology by which they are assessed shall provide verifiable, repeatable and comparable results.

Emission levels in Europe by country and by brand show that over the years there has been a continuous decrease in emissions, while remaining above the threshold set by EU legislation.

Figures 1 and 2 come from the International Council of Clean Transportation (ICCT) publication.[3] They show that:

- the average CO_2 emissions of each country are above the average of 95g/km established by European legislation;
- the average CO_2 emissions of each brand are above the average of 95g/km established by European legislation;
- Countries and brands with a higher share of diesel are further away from the threshold.

3 ICCT, European vehicle market statistics, PocketBook 2018/19.

> The distribution of the individual models by emission level shows that plug-in hybrid vehicles are able to comply with the most restrictive emission limits.

PASSENGER CARS: CO_2 EMISSIONS BY MEMBERSTATE

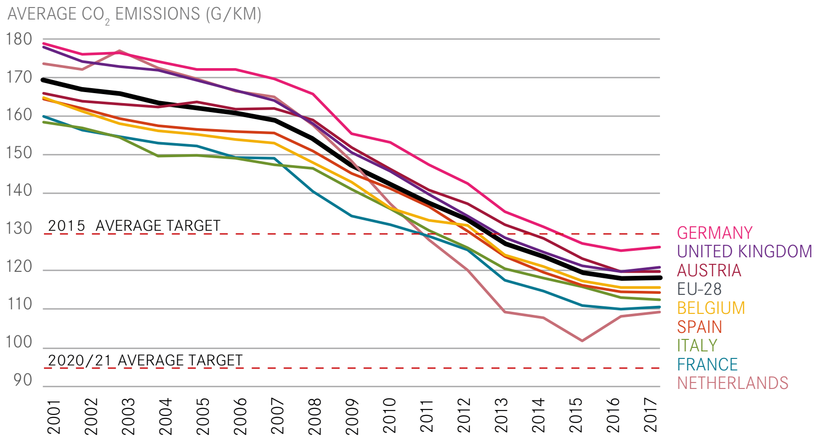


FIGURE 1

PASSENGER CARS: CO_2 EMISSIONS BY BRAND

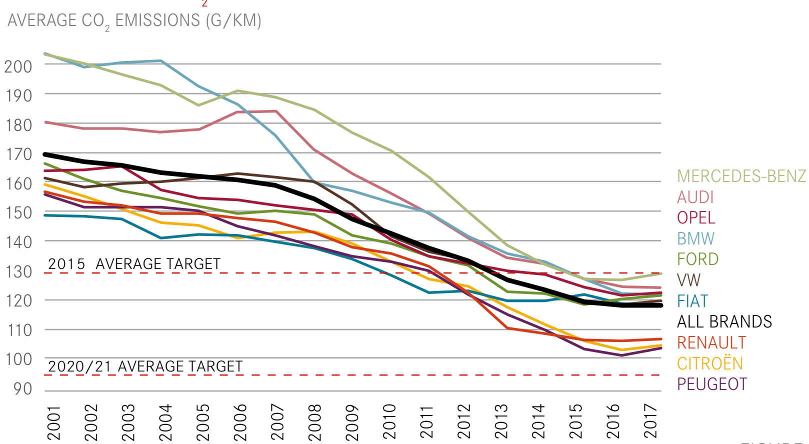
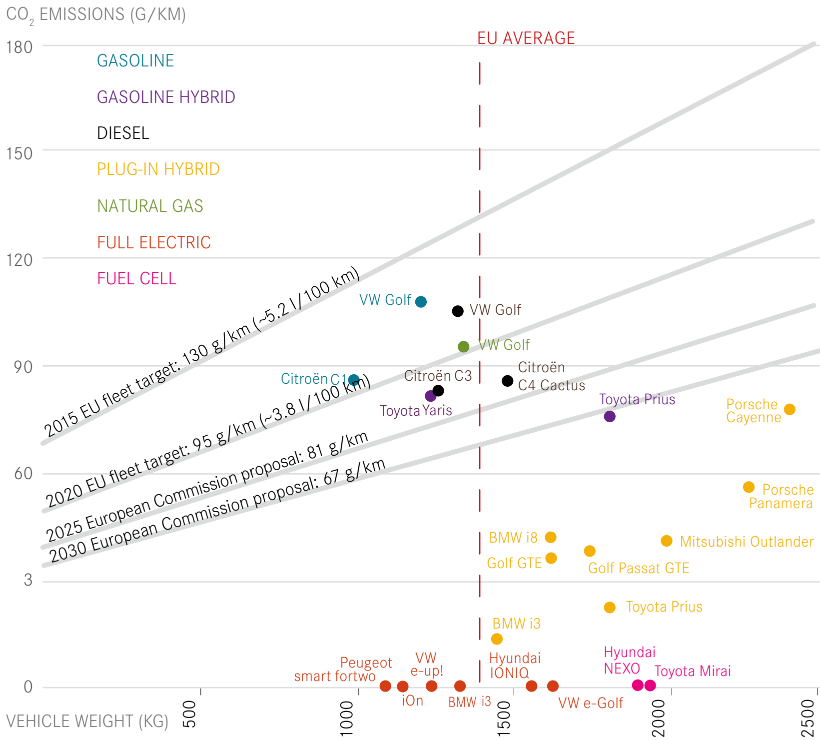


FIGURE 2

sources FIGURES 1, 2, 3: European Vehicle Market Statistics, Pocketbook 2018/2019 (ICCT). p.31, 32, 38-39

CO$_2$ EMISSIONS OF SELECTED NEW PASSENGER CAR



Data source: (DAT, 2018), manufacturers' websites.

FIGURE 3

Figure 3 represents the distribution of individual models by emission level. The graph was drawn up in 2018, i.e. before the approval of the new European Regulation. As can be seen, plug-in hybrid vehicles are able to comply with emission limits, even the more stringent ones implied by the new Regulation itself.

This aspect should be taken into account, since, also to ensure a more gradual and manageable transition to ever cleaner forms of mobility, the hybrid vehicle could be an interesting element. This aspect will also be explored from an employment point of view, comparing the number and type of components that electric and hybrid vehicles need.

3

ANNOUNCEMENTS OF OEM ABOUT ELECTRIFICATION PLANS

From the point of view of OEM announcements and plans, there have been continuous changes over time, as evidenced by data collected from various sources that show significant deviations over time.

These announcements and plans are difficult to compare over time even in the light of the different targets that are assumed by the same OEM: sometimes we speak of the number of models, sometimes of sales targets in absolute terms, sometimes of targets for sales increases, sometimes of shares of electric vehicles sold on the Group's total sales.

The IEA 2019 report provided a broad overview of OEM announcements on electrification, both in terms of new models and sales targets.

German OEMs are among the leading manufacturers who have announced their intention to embrace electrification. In March 2019, VW announced that it would consider withdrawing from the German manufacturers' association Verband der Automobilindustrie (VDA) if there were insufficient efforts on batteries for electric cars. BMW and Daimler acknowledged that electric mobility will be one of the key technologies in the next decade to achieve the goals set by environmental legislation in the EU and that VDA will work to define a document as a basis for the deployment of charging infrastructure as well as financing schemes.

In Japan, Toyota has expressed its intention to continue to invest in hydrogen vehicles and to define new models.

Some OEMs who are leading the electrification process in vehicles have decided to share technologies and platforms with other manufacturers. For example, VW has announced that it intends to share its new platform for electric vehicles (Modular Electric Toolkit-MEB) with other manufacturers. Similarly, Toyota has announced that it will share its patents in hybrid technologies with other OEMs, a decision that seems to have been taken by Tesla in 2014. This attitude can be interpreted as a way of dealing with the risk of taking such an important technological initiative in isolation from other manufacturers.

In the case of VW, the sharing of technology platforms could help all OEMs to achieve economies of scale more quickly; in this sense, cooperation between manufacturers could be able to accelerate the technological transition to electric mobility.

As a result of these announcements, the number of electric car models available may increase significantly in the coming years. China is the country with the highest availability of models.

BEV and PHEV will have a heterogeneous distribution among all the various segments, with the exception of PHEVs which seem to be not very common in the small vehicles segment.

The aforementioned IEA 2019 report also published a summary table of OEM announcements – see Table 6.

A recent report (July 2019) by Transport & Environment[4] points out that manufacturers' forecasts highlight their intention to move decisively towards electrification, "going beyond the "technological neutrality" approach and focusing on increasing volumes of electric cars". According to this report, after years of timid growth, the number of EVs produced in Europe is expected to grow from 60 models (BEV + PHEV + FCEV) available in 2018 to 176 models in 2020, 214 models in 2021 and 333 models in 2025. The jump of the years 2020 and 2021 would coincide with the entry into force of the new EU legislation on CO_2 emissions. As the number of models increases, so should the production, which would multiply 6 times and reach over 4 million vehicles (including cars and vans).

In the electric sector, BEV technology is expected to make progress, reaching 60% of EVs in 2025, while from the point of view of manufacturers Volkswagen, PSA, Renault-Nissan and Daimler should cover two thirds of production in 2025.

More specifically, the number of BEVs expected in the coming years is expected to increase from 5 in 2018 to 19 in 2019 and so also in the following years: 33 in 2020, 22 in 2021, 30 in 2022 and 33 in 2023 for a total of more than 100 in 2022 and 172 in 2025.

4 Transport & Environment, *Electric Surge: Carmakers' electric plans across Europe 2019-2025*, July 2019.

The distribution for the main producers should be as follows:

- Volkswagen Group (Volkswagen, Audi, Seat, Porsche and Skoda): about 50 models in 2025;
- PSA (Peugeot, Citroen, Opel and DS): 23 models in 2025;
- Daimler: 16 models in 2025;
- Renault-Nissan: 13 models in 2025;
- BMW: 12 models in 2025;
- Toyota 12 models in 2025.

The availability of models for PHEVs should also follow a similar trend to that of BEVs: a low number of models before 2019 and sustained growth in subsequent years: it would then increase from 55 models to 100 in 2020; but then their number, annually, would grow less than that of BEVs (between 20 and 25 models per year for a total of just over 140 models in 2025). The distribution between the main manufacturers should be as follows:

- Volkswagen Group: 27 models in 2025;
- FCA Group: 17 models in 2025;
- Toyota: 15 models in 2025;
- BMW: 14 models in 2025;
- PSA: 14 models in 2025.

As far as FCEVs are concerned, only 14 models should be available in 2025 from the two currently available (Toyota Mirai and Hyundai Nexo).

Overall (BEV + PHEV + FCEV), therefore, in 2025 there should be 333 models of EV so divided:

- 53% of BEV;
- 41% of PHEV;
- 4% of FCEV.

SUMMARY OF OEM ANNOUNCEMENTS

COUNTRY	COMPANY
BMW	From 15 to 25% sales of electric vehicles in 2025 and 25 new EV models by 2025
BJEV - BIAC	0.5 million sales of electric vehicles in 2020 and 1.3 million in 2025
BYD	0,6 million sales of electric vehicles in 2020
Chonquing Changan	25 new BEV models and 12 new PHEV models in 2025; 1.7 million sales in 2025 (100% of sales)
Dongfeng Motor	6 new models in 2020 and 30% share of electric in 2022
FCA	28 new models in 2022
Ford	40 new models in 2022
Geely	1 million sales (90%) in 2022
GM	20 new models in 2023
Honda	15% sales of electric vehicles in 2030
Hiunday - Kia	12 new models of electric vehicles in 2020
Mahindra	36thousand sales of electric vehicles in 2020
Mazda	A new model of EV in 2020 and 5% of sales of Mazda full electric in 2030
Mercedes Benz	100thousand sales in 2020, 10 of new models of EV in 2020 and 25% of Group's sales in 2025
Other chinese OEM	7 millions sales in 2020
PSA	900thousand sales 2022
Renault / Nissan / Mitsubishi	12 new models of EV in 2022. Renault expects to reach 20% of the Group's sales of full electric. Infinity has planned to have all electric models in 2021
Suzuki	A new model of EV in 2020, 35 thousand electric cars sold in 2021 and 1 million in 2030
Tesla	500 ths sales of electric cars in 2019 and a new model in 2030
Toyota	Over 10 new models in the early 2020s and 1 million BEV and FCEV sales in 2030
Volkswagen	400 thousand sales of electric cars in 2020, 3 million in 2025 (25% of Group sales), 80 new models in 2025 and 22 million sales (cumulative figure) by 2030
Volvo	50% of Group sales of full electric in 2025

TABLE 6

Moreover, from 2025, according to the Transport & Environment report, the gap between BEV and PHEV should continue to widen, confirming that PHEVs are widely perceived as a transition technology and are the result of an adaptation strategy by manufacturers.

With the growth of the models, the number of vehicles produced and sold should also increase, also waiting for the fact that from 2024 the Transport & Environment report expects to reach a price parity with traditional cars.

The number of EVs produced in Europe is expected to grow from around 750,000 in 2019 to over 4 million in 2025. By type, the production of PHEV should grow by about 300 thousand vehicles per year reaching 1.8 million in 2025, while that of BEV should reach 2.5 million. While in the early '20s the division between BEV and PHEV should be around 50/50, in 2025 the former would reach 60% and the latter 40%. The report predicts a decline in the production of traditional cars, much more pronounced in the case of diesel (in total in 2025 is expected a decline of 2.7 million vehicles with internal combustion engine).

The report considers the production of FCEV and gas vehicles negligible, and believes that the production of hybrids (full hybrids, i.e. not plug-ins) will remain contained (650 thousand vehicles in 2025, with Toyota the main manufacturer).

From the manufacturers' point of view, Volkswagen is expected to be the leading company with about 1 million BEV produced in 2025 (300 thousand Audi, 300 thousand Volkswagen, 160 thousand Porsche, 75 thousand Seat, 50 thousand Skoda), while the production of PHEV should reach 300 thousand vehicles. The production of electric vehicles should take place through the use of 5 MEB platforms (Modular E-Antriebes Baukasten - Modular E-Drive), 4 of which are located in Germany and one in the Czech Republic. PSA will also produce under different brands (Peugeot, Citroen and Opel) a high number of BEVs, while it should be in first place for the production of PHEV (350 thousand). Daimler (Mercedes and Mini) should cover 11% of the production of BEV and Renault-Nissan 10%.

FCA is not mentioned among the main producers of pure electricity, but would rank third in the production of PHEV (250 thousand).

Overall, therefore, the Volkswagen Group would produce in 2025 about 1.2 million electric vehicles; PSA 700mila; Daimler and Renault-Nissan about half a 500mila each: in all two thirds of the production of EV in 2025.

From the point of view of the percentage of electric vehicles in total production, for most manufacturers this is between 19 and 23% for Volkswagen, PSA, Renault-Nissan, BMW, Ford; while it would reach 26% for Daimler and even 27% for FCA (as seen focused on PHEV). In the case of Volvo, this percentage would be 60% (but with a low number of cars produced).

From the point of view of the geographical location of these productions, 85% of these volumes will be concentrated in Germany, France, Spain, Italy and the United Kingdom, but with profoundly different proportions among these countries.

But above all, the overall level of production is seen in relation to the demographic size of each country.

It may be noted that:

- Slovakia has the highest ratio of 25 EV per thousand inhabitants;
- followed by Germany with 19;
- from Sweden with 14;
- from Belgium, Czech Republic and France with 12;
- while Italy is in the lowest steps with Hungary, Slovenia, Austria and Portugal, countries in which the figure is between 2 and 6.

In Germany, Spain, France and the United Kingdom there will be at least 4 different manufacturers that will produce significant volumes of EV:

- Germany: BMW, Mercedes, Volkswagen, PSA (Opel);
- France: Renault-Nissan, PSA, Toyota, Mercedes;
- Spain: Volkswagen, Mercedes, Renault-Nissan-Mitsubishi, PSA, Ford
- United Kingdom: BMW, PSA, Nissan, Toyota, Land Rover-Jaguar.

In the Czech Republic there will be 3 manufacturers (Volkswagen, PSA, Hyundai-Kia) as well as in Slovakia (Volkswagen, PSA, Land Rover-Jaguar); in Italy only FCA.

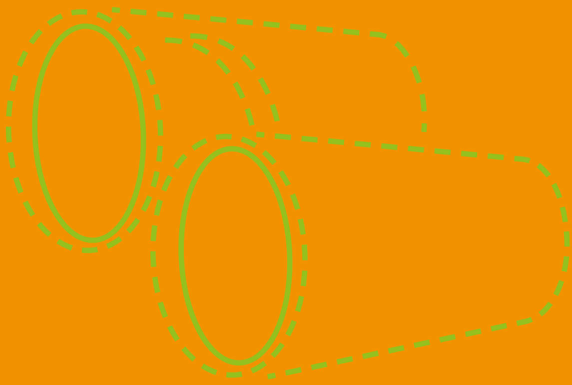
Manufacturers have planned major investments to prepare for the production of electric vehicles. Reuters[5] has compiled an interesting database from which it is possible to extract data shown in Table 7. See also figure 4 for details.

The amount of investments planned by the manufacturers on electric vehicle is undoubtedly significant (Reuters has calculated the total figure of 300 billion dollars), but 45% of these are for China. Looking at Figure 4, we can see that the 23.9% of total investments will be directed to Germany, the 11.3% to US, the 6.7% to Korea, the 6.3% to Japan, the 3.5% to France, and the 3.1% to other countries.

Looking at Table 8 it is possible to visualize both the country of origin and the country of destination of the investments.

Reading Tables 7 and 8 clearly shows that both the manufacturers' plans and the related investments are heavily linked to the situation of the Chinese market which, as seen in relation to overall sales and stock data, plays the lion's share in the electricity market.

5 https://graphics.reuters.com/AUTOS-INVESTMENT-ELECTRIC/010081ZB3HD/index.html

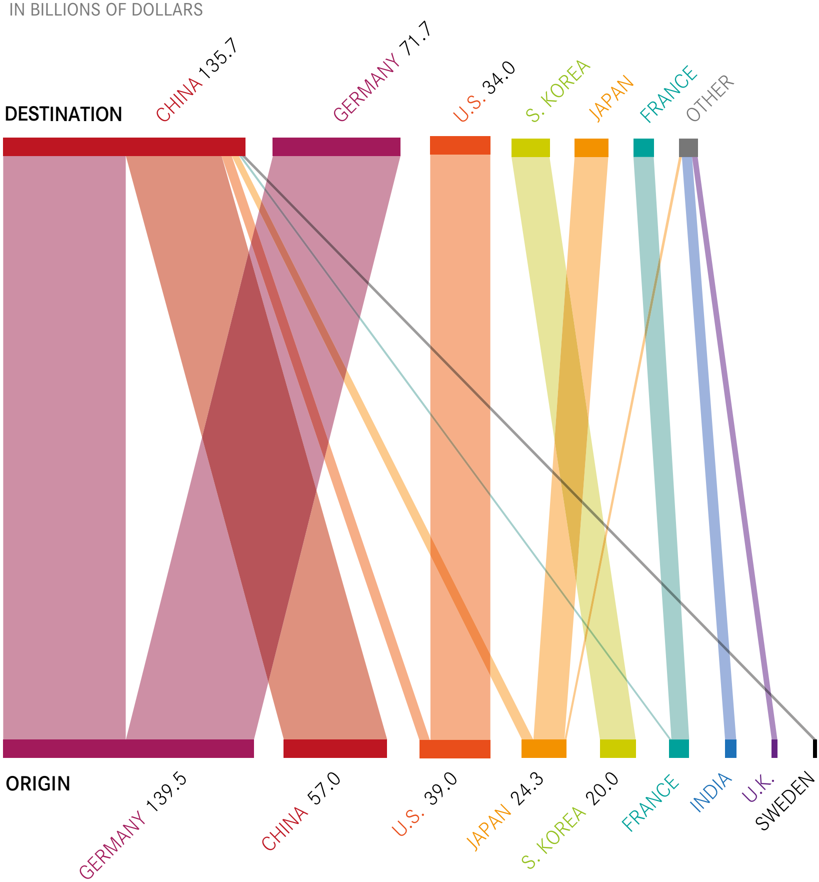


4
GOVERNMENT FORECASTS FOR ELECTRIC VEHICLES

Several governments have defined instruments of intervention and established objectives for the diffusion of electric vehicles. Table 9 summarizes the main aspects. In addition, EV30@30 signatory Countries have announced a ban on sales of internal combustion engine vehicles from 2040.

EV INVESTMENT FLOWS BY ORIGIN OF AUTOMAKER

IN BILLIONS OF DOLLARS



sources FIGURES 4: Reuters analysis

PLANNES INVESTMENTS FOR ELECTRIC VEHICLES BY BRAND, IN BILLION DOLLARS

OEM	TOTAL IN-VESTMENTS	OF WHICH: BATTERIES	IN CHINA	JV, PARTNERSHIP, AGREEMENTS ECC.
Volkswagen	91	57	50%	Faw (CHI), Saic (CHI), Jac (CHI)
Mercedes	42	30	52%	Geely (CHI), Byd (CHI), Baic (CHI), Nissan (JPN)
Hiunday-Kia	20			Baic (CHI), Dongfeng (CHI)
Toyota	13,5	13,5		Faw (CHI), Gac (CHI), Mazda (JPN), Subaru (JPN)
Ford	11			Changan (CHI), Zoyte (CHI), Jac (CHI), Jangling (CHI) Mahindra (IND)
FCA	10			Gac (CHI), BMW (GER)
Nissan	10		45%	Dongfeng (CHI), Renault (FRA), Mitsubishi (JPN)
Renault	10		1%	Dongfeng (CHI), Brilliance (CHI), Nissan (JPN), Mitsubishi (JPN)
Tesla	10	5	50%	
GM	8			Honda (JPN), Saic (CHI), Wuling (CHI), Faw (CHI)
BMW	6,5	4,5	6%	Great Wall (CHI), Brilliance (CHI), FCA
PSA	0,77		34%	Dongfeng (CHI), Changan (CHI)
Volvo	0,72		100%	Geely (CHI)

TABLE 7

INVESTMENTS IN BILLION $ BY COUNTRY OF ORIGIN AND DESTINATION

COUNTRY OF ORIGIN OF INVESTMENTS		COUNTRY OF DESTINATION OF INVESTMENTS	
Germany	139,5	China	135,7
China	57,0	Germany	71,7
USA (including FCA)	39,0	USA (including FCA)	34,0
Japan	24,3	South Korea	20,0
South Korea	20,0	Japan	18,9
France	10,8	France	10,4
India	6,4	Other-Countries	9,4
UK	2,3	Sweden	0,7

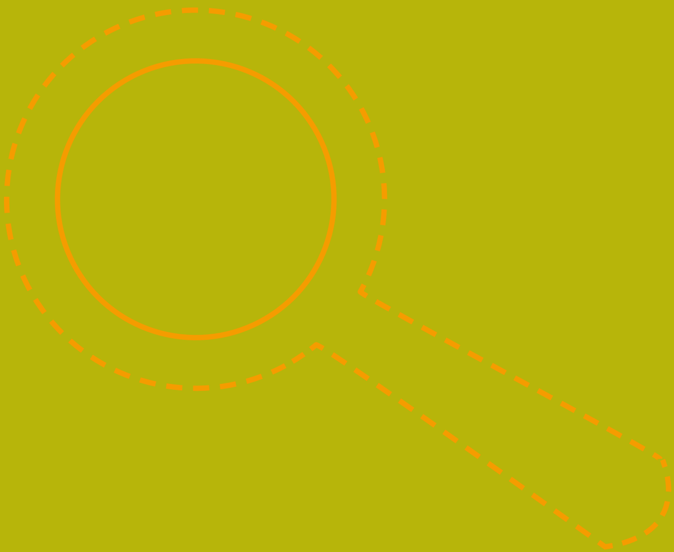
TABLE 8

GOVERNMENT OBJECTIVES, BY COUNTRY

COUNTRY	OBJECTIVES
China	5 million electric vehicles by 2020; Roadmap for sales shares of electric vehicles: 7-10% in 2020; 15-20% in 2025; 40-50% in 2030
India	30% of sales of electric vehicles by 2030
Japan	20-30% of sales of BEV e PHEV by 2030 (in addition to 40% of HEV and 3% of FCEV)
Korea	430 thousand BEV and 67thousand FCEV on the road by 2022
USA	3,3 millions of sales of electric vehicles (8 States); 22% of credits from sales of zero-emission vehicles including PHEVs (10 States); 1.5 million zero-emission vehicles and 15% of sales by 2025 and 5 million by 2030 in California
France	Prohibition of greenhouse gas emitting car sales by 2040, 5-fold increase in BEV sales in 2022 compared to 2017, 1 million BEV and PHEV fleet in 2022
Netherlands	100% of sales of zero-emission vehicles by 2030
Poland	1 million of electric vehicles in 2025
Spain	5 millions of electric vehicles (including bus, light vehciles and two-wheelers), 100% of sales of zero emission vehicles by 2040
UK	50-70% of sales of electric vehicles by 2030
Germany	1 million of electric vehicles in 2020, over 5 million in 2030. Leading global market of electric mobility (Electric mobility Made in Germany)°

°See Electromobility in Germany: Vision 2020 and Beyond

TABLE 9



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THE CURRENT STATUS OF THE ELECTRIC CAR MARKET

Once we have taken note of the manufacturers' plans and the governments' policies, it is of fundamental importance, however, to evaluate the actual situation of electric mobility.

Table 10, reconstructed thanks to the EV-Database[6], highlights the real availability of models, the incoming ones and their price range. The models below are BEV models. As Table 10 shows, the number of available and upcoming models of the main brands is still very limited; moreover, the price range is very high for almost all models, resulting in a lack of accessibility of these products for the mass market and in particular for the popular classes.

INCOMING MODELS AND PRICE RANGE (EURO, THOUSAND)

OEM	AVAILABLE	UPCOMING	CONCEPT	COST RANGE
Audi	1	0	3	60-125
BMW	2	0	1	42-60
Citroen	1	1	0	34-42
Kia	1	3	0	37.5-43
Opel	1	1	0	31-46
Peugeot	1	2	0	22-38
Mercedes/Mini	1	0	1	35-81
Nissan	3	0	0	37-46
Renault	4	1	0	33-38
Volkswagen	2	1	3	22-47,5
Tesla	11	4	0	47-111
Smart	3	0	0	24-27

TABLE 10

As anticipated, therefore, the average level of prices is so high that even the system of incentives to purchase is not able to allow the purchase of these vehicles for large sections of the population.

6 https://ev-database.org/

The lowest prices are for smart vehicles; 1 model of Volkswagen with only 95 km range and 1 model of Peugeot (iOn) with little appeal. For the same price, therefore, it can be expected that higher performance vehicles will be purchased.

It is therefore necessary, after having seen from various sources the announcements of manufacturers and the ambitious programs of governments, to put the discussion back on the ground by resuming the data of sales of vehicles to 2018.

In the European market only 200 thousand electric cars were sold in 2018, while we talk about 8.7 million petrol vehicles and 5.5 million diesel ones. The market for electric cars, therefore, is currently absolutely marginal in Europe.

It is worth, therefore, to resume the examination of Zachary Shahan published on the site of Enel X[7] that showed how between the announcements and how much actually realized has manifested a considerable dyscrasia.

Toyota announced at the end of 2017 that it would produce and sell more than 10 fully electric car models worldwide by 2020; but already in April 2018, it stated that the 10 "electrified" models would be available by the end of 2020. It should also be noted that "electrified" cars are BEVs, PHEVs and conventional hybrids. At the moment Toyota does not sell any all-electric model; it is also not clear how many fully-electric cars and plug-in hybrids it will put on the market in the next 3-5 years and how many it will sell outside China. Toyota has declared its intention to sell one million fully electric cars (BEV and FCEV) by 2030, but according to the author this goal seems quite unlikely also in light of the need for batteries that such a commitment would entail.

Volkswagen seems to be the most "driven" manufacturer on the full electric by planning to produce 50 fully electric models by 2025 and investing for this purpose 35 billion euros, mainly on batteries, by 2022. The sales forecast is 2 - 3 million electric cars per year by 2025 (i.e. 20-25% of the company's sales). But in 2018 Volkswagen's sales of electric cars just

7 https://www.enelx.com/it/it/news-media/notizie/2018/11/case-automobilistiche-auto-elettriche

exceeded 82,000 units (with a forecast of a few years before 300,000), including many plug-in hybrid vehicles.

Hyundai/Kia propose hybrid, plug-in hybrid and fully electric versions of the new models; at the end of 2017 they announced the goal of placing 38 models of ”green cars” on the market in the next 8 years, but only 7 of which are planned for the next 5 years. It is not clear how many of these models will be fully electric: a report, at the beginning of 2017, predicted that they would be 8 out of 31. Moreover, it is not clear what percentage of full electric cars Hyundai-Kia intends to sell will be in ”green cars”.

As for GM, sales in the USA of its Chevy Volt EV and Chevy Volt PHEV models in 2018 do not seem to have gone particularly well. GM is planning to produce 20 models of electric vehicles by 2023 in China and it is unclear whether they will also be on sale in the United States and Europe.

Ford announced in January 2018 that it would sell 40 electrified (non-electric) models by 2025; however, several models are planned for China and only 16 will actually be electric.

Honda seems to be little committed on the electric, if not for the fact of having a compact electric vehicle on the Japanese market by 2020.

At Renault, the Zoe in Europe 2017 was the best-selling car with about 30,000 vehicles; in 2018 it sold 38,000 (Automotive News Europe data), but was surpassed by Leaf with over 39,000. Observers would have expected Renault to be one of the leaders of electric vehicles in the future, but the company has not launched other competitive electric vehicles: as seen is expected only 1 upcoming compared to the models available. For the batteries Renault has relied on the Chinese CATL. It is not clear, moreover, the future relationship with Nissan, which complicates the possibility of integrating especially on the electric. The PSA Group (Peugeot, Citroen, DS, Opel and Vauxhall) expects 15 new models of electrified cars by 2020, with 8 PHEV,¨ while the electric models are 7.

THE SITUATION OF THE ELECTRIC-STOCK AND GLOBAL SALES OF VEHICLES

The 2019 edition of the International Energy Agency's report[8] on electric mobility provides significant information on the current state and possible developments in this sector.

The global stock of electric cars (BEV and PHEV, excluding from the calculation hybrid vehicles that cannot be "plugged-in") in 2018 reached 5.1 million with a growth of 63% over the previous year; this growth rate is similar to those achieved in 2017 (+57%) and 2016 (+60%). BEV vehicles account for 64% of the electric vehicle fleet.

It should be noted that about 45% of the world's electric fleet is concentrated in China (it was 39% in 2017) with 2.3 million vehicles. In 2018 Europe represents 24% of the global stock of electric cars with 1.2 million vehicles, of which 960 thousand in EU countries, while the US with 1.1 million electric cars have 22% of the stock.

Despite the expansion in sales in recent years, only 5 countries have a fleet of electric cars exceeding 5%: Norway (corresponding to the 10% of globally produced EVs), Iceland (3.3% of total EVs), Holland (1.9%), Sweden (1.6%) and China (1.1% of globally produced EVs).

This data shows that the European market is marked by very low shares of electrical, it is therefore plausible to say that the transition to new traction systems will be neither short nor even less rapid: vehicles with "pure" or hybrid (endothermic + electrical) endothermic engines will make up the vast majority of both stock and sales in the coming years.

Global sales of electric cars in 2018 were about 2 million, with growth of 68% compared to 2017; a growth rate comparable to that of 2015 after two years of weaker growth. China is the leading market with sales of 1.1 million (600 thousand in 2017), representing 55% of total world sales. Europe is the second largest market with 385,000 electric cars sold. It should be noted, as

8 International Energy Agency, Clean Energy, Electric Vehicles Initiative, *Global EV Outlook 2019*.

mentioned above, that in terms of percentage shares this number is around 2% of total car sales.

In Europe, Norway is the country with the highest share of sales of electric cars (50%) of the total number of vehicles sold in that country, followed by Iceland (17.2%) and Sweden (7.9%). In terms of volumes sold, Norway is followed by Germany, the United Kingdom, France, Denmark and the Netherlands.

Sales in the USA increased in 2018 by 82% (the previous year by 24%): this increase is entirely attributable to the sale of 134 thousand copies of the Tesla Model 3.

SALES IN THE FIRST FOUR MONTHS OF 2019 BY TYPE OF PROPULSION

	BEV	PHEV	HEV	APV	GASOLINE	DIESEL
EU	61789	37385	184808	56886	2376827	1298826
EU + EFTA	83676	43209	192087	56968	2428440	1316378
Italy	1183	974	27294	41429	230795	235739
France	10569	3934	22982	1011	323878	190961
Germany	15944	7382	40673	3406	521592	291092
Spain	2754	1726	22412	5654	194214	90151
Poland	413	207	6046	2057	101417	26978
UK	5997	8582	26258	–	468415	191784

TABLE 11

In Japan, sales of electric vehicles fell (-8%) in 2018, as well as in India, South Africa and Mexico.

Overall, more than two-thirds of sales of electric cars in 2018 are represented by BEVs, whose share has risen from 50% in 2012 to 68%; but it should also be noted that this increase in percentage was driven by China (76% of sales of electric cars in China are BEVs).

In fact, the numbers in the EU are quite different, as we will see later.

THE EUROPEAN CAR MARKET BY TRACTION TYPE

The Acea Automobile Manufacturers Association regularly publishes data on vehicle type approvals in Europe, broken down by type of drive.

The May 2019[9] publication contains data for the first four months of the year. These data compare the first four months of 2019 with the same period in 2018 and show, from the point of view of trends, a drop in diesel of 18%, an increase in gasoline of 3% and an increase in the general category of electric of 40%. However, if we look at market share data, gasoline still accounts for 59.3% of sales, diesel for 32.2%, while alternative propulsion is divided into the remaining 8.5% as follows: vehicles with alternative but non-electric propulsion (APV – Alternative Propulsion Vehicles: for example methane gas vehicles, etc.).) 1.4%; hybrid vehicles (HEV Hybrid Electric Vehicles, i.e. non plug-in hybrid vehicles) 4.6%, electric vehicles (BEV + PHEV) 2.5%. It is true, therefore, that pure electric vehicles (BEV) grow by 84.4% (while the plug-in PHEV - remains still thus determining an overall +40%), but the market shares and, above all, the absolute numbers speak clearly about the size of this phenomenon.

In the first quarter of 2019, in fact, in the European Union just under 62,000 BEV cars were sold, reaching 83,676 adding Iceland, Switzerland (EFTA) and especially Norway, which alone weighs for 18,600 sales. Adding up the 43,200 plug-in hybrid vehicles, we reach a total of 126,800 "electric" vehicles in Europe (EU + EFTA). It should be noted that in the new members of the European Union (Eastern European countries) total sales of electric vehicles (BEV + plug-in) are at very low levels (2,100). In Italy, 1183 BEV vehicles were sold and 974 plug-in vehicles were sold, for a total of around 2,100; hybrids with over 27,000 vehicles performed much better.

As can be seen by inspecting Table 11, in the first four months of the year, 192,000 hybrid (non plug-in) vehicles were sold in the EU + EFTA and almost 57,000 with alternative non-electric propulsion (methane, etc.), of which more than 41,000 in Italy, which is confirmed as the country that boasts by

9 Acea, *New passenger car registration by fuel type in the European Union*, Quarter 1–2019.

far the greatest diffusion of this type. There are 2,428,000 gasoline vehicles sold and 1,316,000 diesel vehicles.

MARKET SHARES (%) BY TRACTION TYPE IN 2017 VS 2018

	ECV	HEV	APV	GASOLINE	DIESEL
2017	1,50	2,80	1,40	50,30	44,00
2018	2,00	3,80	1,50	56,70	35,90

TABLE 12

VEHICLE SALES BY TRACTION TYPE IN 2018

	BEV	PHEV	HEV	APV	GASOLINE	DIESEL
UE	150003	151844	578620	229402	8532104	5406574
UE + Efta	201284	182768	606210	230275	8752773	5522882
Italy	4997	4734	81892	161971	678348	978473
France	31095	14528	91815	3043	1188170	844830
Germany	36216	31442	98816	15470	2142700	1111130
Spain	5984	5826	75768	20842	739527	473491
Poland	620	704	22821	7546	368199	131960
UK	15510	44437	81323	–	1475712	750165

TABLE 13

It is also interesting to compare the data of 2018 with 2017 from the point of view of market shares, indicating that the numbers of the transition to the new forms of propulsion are still very limited.[10] This is done in Table 12. Table 12 shows that:

> ECVs - which should be noted include both pure electrical (BEV) and hybrid plug-in (PHEV) increase their market share by 0.5%;

> Traditional hybrid vehicles are growing a bit more;

> in traditional engines, there is a different distribution between petrol (growing) and diesel (falling): overall, these sectors lose only 1.7%.

10 ACEA, *New passenger car registrations by fuel type in the European Union*, Quart 4 - 2018.

However, understanding the real size of the phenomenon requires looking at data about 2018 in absolute terms, which can be found in Table 13.

Data are very clear: in 2018 the ”pure” electric in Europe sold just over 200,000 vehicles. Gasoline propulsion is still the largest (with over 8.7 million vehicles sold), while diesel, although declining, is still above 5 million.

THE GENERAL SITUATION OF CAR PRODUCTION IN EU COUNTRIES

It seems appropriate to highlight the level of production of cars (including each type of traction) divided by country in order to understand how it is distributed between the various areas and to begin to assume some general trends.

Table 14 shows total car production in 2018 by main manufacturing countries.

In Europe, therefore, there seems to be a very strong polarization between countries from the point of view of car production. In addition to Germany, the absolute leading country, two groups of countries seem to be taking shape: the first is made up of Spain, the former Czechoslovakia (the Czech Republic and Slovakia together exceed two million vehicles), France and the United Kingdom; the second is made up of Italy, Romania, Poland and Hungary. As we will see later on, this proximity, from the point of view of car production volumes, of Italy to the countries of the East could also have further consequences in the field of components.

CAR PRODUCTION IN THE EU WAS BY MANUFACTURING COUNTRY (2018)

EU	16504052		
Germany	5120409	Italy	670932
Spain	2267396	Romania	476769
France	1763300	Poland	451600
UK	1519440	Hungary	430988
Czech Republic	1345041	Sweden	281104
Slovakia	1031241	Belgium	265958

TABLE 14

EMPLOYMENT IN THE CAR INDUSTRY, ITALY AND GERMANY

	GERMANY		ITALY	
	HOURS (MILLIONS)	PERSONS (THOUSANDS)	HOURS (MILLIONS)	PERSONS (THOUSANDS)
1998	1270	833	386	212.5
2017	1273	892	283	174.5
Total change	3	59	-103	-38
% change	0.3%	7.1%	-26.7%	-17.9%

TABLE 15

In fact, it is also interesting to see how the change in production volumes of cars (understood as the final good) has impacted on the composition of the automotive as a whole (i.e. including the supply chain of components).

Italy and Germany will be used as an example (see Table 15), bearing in mind that, using of Eurostat and OECD data, these calculations can be carried out for each European country. In Italy, the sector as a whole has recorded the following losses in terms of employment.

It is interesting, within the overall sector, to highlight the employment trend of the three sub-sectors of which it is composed (Manufacture of motor vehicles; Manufacture of bodywork and Manufacture of parts and accessories for motor vehicles and their engines). Summarizing the data, Table 16 is obtained.

In Italy, therefore, the contribution to the fall in employment, in terms of FTE jobs, of the three sub-sectors is as follows:

CAR INDUSTRY, ITALY: CHANGE (Δ ABS AND %) IN EMPLOYMENT

	Δ FTE, %	Δ HOURS, %
Manufacture of motor vehicles, trailers and semi-trailers	-26,30%	-19,00%
Manufacture of motor vehicles	-41,00%	-34,00%
Manufacture of bodies	-42,00%	-38,00%
Manufacture of parts and accessories	-3,60%	4,80%

TABLE 16

- Manufacture of motor vehicles: 81,5%
- Manufacture of bodies: 12,99%
- Manufacture of parts and accessories: 5.6%.

As highlighted, therefore, the Manufacture of motor vehicles plays a predominant role in explaining the negative employment dynamics of the sector.

These decreases, differentiated by sub-sector, have determined a different occupational composition of the overall sector, as shown in Table 17.

Italy has therefore significantly changed the employment composition of the sector.

While in 1998 most of the employment in the automotive sector was concentrated in the production of finished vehicles (essentially the final assembly), in 2016 it is the components sector that holds the first position.

A country like Italy, therefore, is transforming itself from a country that produces cars into a country that produces components; moreover, since the volume of cars produced is continually decreasing, a large part of this component is sold to final manufacturers located in other countries. Italy, therefore, is becoming a supplier of components to other countries, mainly France and Germany, showing a growing similarity with the production and employment specialization of Eastern European countries (Poland, Romania, Hungary) which are among the main suppliers of components for the German automotive industry.

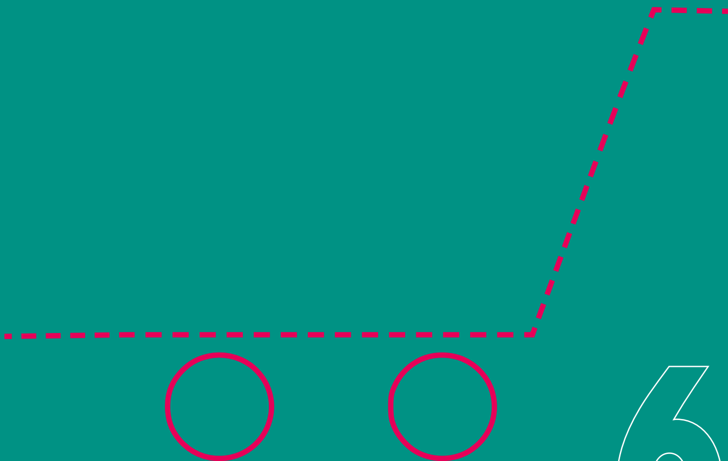
As already mentioned, this study on the evolution of the industrial and occupational composition of the automotive sector can be replicated for other European countries.

In this way it would be possible to grasp the evolution in the change in the employment composition of the automotive sector, which corresponds to the production specialization of each country. It is strongly wrong to believe that this evolution is the result of a natural order; these are precise choices made by private companies which, often, have also been supported by governments and the European Union.

PROPORTION OF TOTAL EMPLOYMENT, 1998 AND 2016, ITALY

	1998	**2016**
Manufacture of motor vehicles	52,00%	41,00%
Manucture of bodies	8,00%	6,00%
Manufacture of parts and accessories	40,00%	53,00%

TABLE 17



6
GENERAL ASPECTS RELATING TO SUPPLY COMPANIES

The situation described above regarding the evolution of car production in the various countries has a clear impact on the supply chain also in terms of employment. The production volume of suppliers, in fact, depends on the requests of the final manufacturer, and in particular of the one located on national soil in the case of Western countries. The situation is different with regard to Eastern European countries, which were born as suppliers of components for Western industry. But in the case of Western European car manufacturing countries, the presence of one or more national manufacturers able to ”absorb” locally produced components becomes decisive for the maintenance or not of the component factories.

For a supplier of parts and components, the value of a supply is generated over several years on the basis of orders acquired in previous years. For example, the production and supply of a headlamp can generate an order intake of 100 million euro over six years, i.e. six years of production of the vehicle model for which the headlamp was ordered; therefore, for each year of production life of that vehicle, the supplier companies invoice a part of the total order acquired.

The problem arises when orders are acquired for certain volumes and then these turn out to be much lower.

This generates great concern in the world of supply as this aspect means that supply companies must make substantial investments to produce the numbers provided for in the order (indicated in the Industrial Plans of manufacturers), but if these prove to be much lower than the forecasts manifest costs to be absorbed and greater difficulty in returning the investment made.

It must also be taken into account that after having acquired a supply order, production actually begins after about two years because it must be taken into account the time of development. The R&D activity is carried out continuously, but for each supply the times and costs linked to the development of the specific product covered by the supply contract must be foreseen.

Clearly, the investment costs of the supply companies are calibrated on the expectations of the production volumes of the vehicles for which the supplies are requested, but if these volumes are lower (and with some manufacturers, such as FCA, for example, the gap between forecast and actual sales is very significant) the margins for the supply company are reduced until they almost disappear.

The launch of new products is always a particularly sensitive aspect also in terms of costs: technologies change continuously and rapidly, each launch represents a new case against which no comparative terms are available and the vehicle becomes more and more complex.

Often at new launches the supplier ”learns” with the OEM that made the launch itself.

From this point of view, co-design is an old concept, today an OEM is looking for technological expertise from a tier-one that he cannot afford directly, i.e. he is looking for a specialist in innovative functions. The OEM is no longer looking, or at least no longer primarily, for a logic of supplying production capacity: in the 1990s, suppliers were suppliers of production capacity (i.e. they produced that the OEM did not want to produce, but without any particular product expertise), so the automotive supply chain could be segmented with component specialists, system engineers, innovators.

Currently, however, within the automotive supply chain, the creation of value and innovation is the responsibility of the component suppliers. The component manufacturers, also in the light of the new technologies that are necessary for the creation of new systems, are forging alliances with companies that were not traditionally engaged in the automotive industry.

We can use the example of electrification. In this sector, a multinational company such as Valeo set up a joint venture with Siemens in 2016 on high voltage components and systems for the entire range of electric vehicles (electric motors, DC/DC converters, inverters, recharging systems): Valeo Siemens Automotive was born with an order-in-take portfolio of 10 billion euros (February 2018) and 2,700 employees (May 2019). As mentioned, these are two companies with different histories and technological specializations: Valeo contributes to this joint venture with its high-voltage power electronics, range extenders and charging solutions, while Siemens contributes with its eCar Powertrain System business unit which includes e-motors and power electronics. Or again: Northvolt and ABB formed an alliance in 2017 to build a lithium battery manufacturing plant in Sweden; Bosch formed a partnership with Swedish fuel cell manufacturer Powercell; Continental formed an alliance with ICT component manufacturer Nvidia to develop products related to the application of artificial intelligence (AI computer system) to driving, etc., and the company is currently working on the development of a lithium battery production plant in Sweden.

As seen, therefore, the alliances between companies that traditionally produce for the automotive industry and those that produce technologies that are necessary for the transition to new propulsion, driving and connectivity systems are multiplying.

New technologies are profoundly changing the automotive sector.

In particular, the technological innovations applied to the final product concern powertrain, connectivity and autonomous driving: traditional manufacturers, both of vehicles and components, often have the skills and technologies necessary to cope with this change.

Just as often, these technological skills are not developed internally by automotive companies, but are introduced into the sector by new operators: for these reasons, mergers and acquisitions are becoming a key element in the transformations of this sector.

A study by Ernst&Young[11] published towards the end of 2018, highlighted the main mergers and acquisitions in the automotive industry.

Table 18 shows the total number of M&A transactions and their total value and the number of transactions involving new technologies with their respective values.

11 *Techonology driven M&A in the automotive industry*, October 2018.

TOTAL NUMBER AND TOTAL VALUE OF M&A TRANSACTIONS

	2015	2016	2017
Total operations	1231	1212	1238
Operations involving new technologies	82	104	131
Total Value of the operations	97629	169046	62260
Value of operations related to new technologies	8328	7849	5156

TABLE 18

The value of M&A operations related to new technologies shows a growing trend: while it was 7% in 2015, this figure reached 11% in 2017. It should also be noted that the investments made by automotive companies (OEMs and suppliers) in those that produce new technologies aims in most cases (72%) to acquire the majority of the latter.

M&A operations from the point of view of technologies are mainly driven by powertrain (42%), followed by independent driving (28%) and connectivity (16%). the remaining 24% of operations are divided into technological issues that relate to less relevant areas from the point of view of numbers such as car architecture, mobility as a service (MaaS), sales channels, etc.

From the point of view of powertrain operations, most of these concern technologies related to the electric vehicle; alternative technologies for zero-emission powertrains, such as fuel cell technology, cover an overall small but constantly growing share, demonstrating that companies keep different options open.

In connectivity, most operations concern software-related technologies (apps, cybersecurity, etc.), while in autonomous driving sensors and cameras play the most important role.

From the point of view of automotive companies, it is the suppliers who are carrying out the greatest number of M&A operations in the technological field. In 2017, in fact, the suppliers concluded 110 technological agreements; that is, 5 times the number of operations carried out by the OEMs. However, despite the percentage decrease, the level of OEM operations increased in absolute terms, with a 5% increase in the number of transactions compared to the previous year. While suppliers drive M&A operations in powertrain and stand-alone driving, OEMs drive those in connectivity and in areas such as MaaS and sales.

Table 19 shows the total number of OEM and technology transactions in 2017. Table 20, in its turn, shows the operations carried out by suppliers in 2017.

The development of electric cars is a very expensive process. Moreover, this transformation process takes place in a very strong framework of margin compression: for this reason all the main Groups, both OEMs and component suppliers, have launched the profit warning: that is, the impossibility of achieving the expected results.

TOTAL AND TECHNOLOGICAL OEM OPERATIONS (2017)

OEM	TOTAL	OEM	TECHNOLOGICAL
Daimler	8	Daimler	6
Renault	7	Volkswagen	3
Volkswagen	5	Jaguar	2
Isuzu Motors	4	Toyota	2
Hyundai	3	Geely (Volvo)	2
Toyota	3	Borgwarner, Nissan, Renault, General Motors, Peugeot	1
Great Wall	3		
Peugeot	3		
Honda, Sanyang, Geely, Jaguar, Landrover, Nissan, General Motors	2		

TABLE 19

TOTAL AND TECHNOLOGICAL SUPPLIERS OPERATIONS (2017)

SUPPLIER	TOTAL	SUPPLIER	TECHNOLOGICAL
AMA Group	11	Aptive (former Delphi)	5
Wuxi Coml Mansion	8	Continental	4
Sumitomo	7	Denso	3
Genuine Parts	7	Dongxu Optel	2
Michelin	6	Stoneridge	2
Continental	6	Tanjing Motor Dies	2
Apollo T & L	6	Lear, Michelin, Valeo, Webasto	1
Aptive (former Delphi), Denso, USC, UralATI, Zhejiang, Michelverder Tyre, Services	5		

TABLE 20

From the point of view of the OEM-supplier relationship, the definition of the technological solution has been passed on to the component suppliers; obviously, if an OEM is able to maintain its orientation on choices such as, for example, product-vehicle strategies. The supplier can offer electrical solutions for BEV, PHEV or Mild vehicles, but of course it is the manufacturer who ultimately decides what he intends to sell and produce.

Suppliers are increasingly developing proprietary technologies even if, obviously, in continuous dialogue with the manufacturers: the supplier generally proposes its own solution and submits it to the customer in order to define its own Technology Development Plan.

This aspect goes far beyond co-design, so much so that today we can speak of “cooperative development”. In a context of co-design, in the presence of significant volumes of supply, working groups within the component manufacturer develop the product with respect to the specifications agreed with the customer, providing for intermediate verification points. To this aspect have been added logics of simultaneous engineering and themes of designed collaboration. But even these aspects are not enough to give an idea of the new dimension of the relationships that have been established: today, in fact, it can speak of an ecosystem within which we create aggregations of actors who are also very different from each other.

A report published by Deloitte[12] provides a definition of the ecosystem: the ecosystem typically brings together several actors of different types and sizes to create, scale and serve markets in ways that go beyond the capacity of each organization or even every single traditional industrial sector. Their diversity and collective ability to learn, adapt and innovate together are key to long-term success. Thanks to a significantly improved connectivity between the specializations and resources of the various actors, ecosystems develop new and co-created solutions.

The skills of the actors can be as diverse as their productive specialization.

The logic of the joint venture between Valeo and Siemens is clear: the latter had never designed a car engine and the former had never designed a high voltage electric motor, yet the two companies came together to create this product for which each of them has provided its specific expertise. Similar aggregations are being formed to involve companies specialized in ICT technologies, in the field of connectivity services that are increasingly affecting the automotive sector.

The role of car manufacturers is certainly very active: it suggests needs, prospects, it is interested in progress, it commissions developments capable of generating new innovation cycles: in this area the ecosystem often needs technologies that are not typical of the automotive supply chain.

For example, for the automotive ecosystems, the issue of the use of new materials (rare earths), sensors, data transmission and management networks and ICT will be raised.

The electric vehicle implies the existence of clusters of technologies that are not typical of the traditional car sector and that must be looked for elsewhere. This poses a theme of depth innovation in the logic of the supply chain as it entails the need to strengthen the co-development of the product and cooperative research within a real ecosystem.

12 Deloitte, *Business ecosystem come of age*.

In perspective, almost all car manufacturers are planning to launch new models, but there are no certainties about their actual introduction on the market, especially in terms of volume. Even from the point of view of regulation, although there are some obvious trends, the evolution is such as to make it very difficult to make predictions.

As a result, relations within the supply chain are very rapid and subject to marked variability.

As anticipated, in Italy, for some component manufacturers, especially those belonging to multinational groups, very large percentages (in the order of 70-80%) of the value of production is represented by exports, since the collapse of production volumes has meant that FCA has no longer been able to ”absorb” them.

In the case of multinational groups, which can count on a very widespread production presence in Europe (almost widespread in all European countries), the reason for the existence of plants at national level is to be close to customers who absorb production. From the point of view of the company’s balance sheet, in fact, it would make little sense to produce components in Italy and then transport them to other countries (Germany, France, etc.).

Two models of supply seem to be emerging in Europe: that of the countries with low labour costs, characterised by the presence of substantial state funding and incentives for investment and located near Germany (Poland, Czech Republic, Slovakia, Hungary, and, to some extent, Romania) at the service of German OEMs; and that of the countries of Western Europe where the permanence or otherwise is determined by the existence of manufacturers present on national soil capable of absorbing the production of parts and components. This does not exclude that part of the production of components can still be oriented towards exports to France and Germany, but the disappearance of a national channel makes the permanence of the plants of components belonging to multinational groups increasingly uncertain.

The level of competition in the automotive sector today is such that labour costs represent a decisive variable, also in light of the fact that there are no longer differences in skills and professionalism between countries.

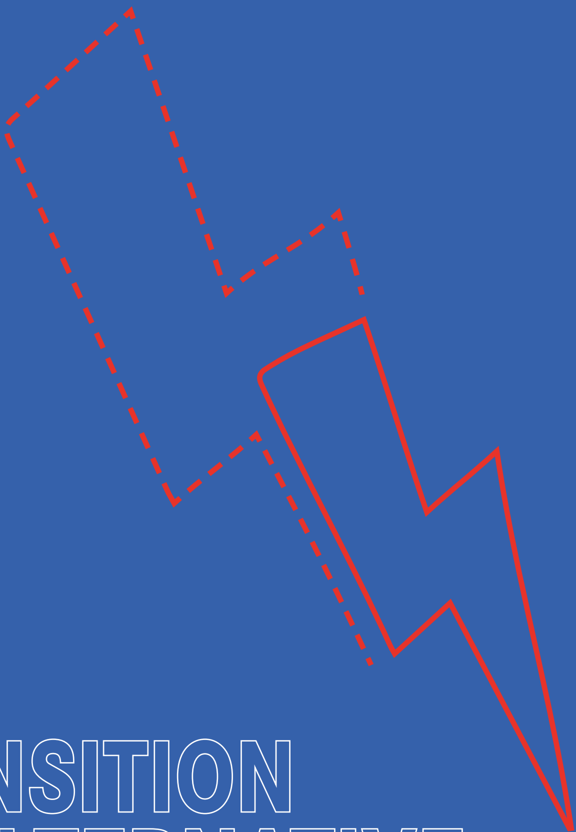
In the presence of ever lower margins in the automotive sector, labour costs have a significant weight above all, it is worth repeating, in the absence of national manufacturers who can purchase parts and components made at national level.

Always about the Italian example: if FCA's production volumes are not such as to be able to absorb the production of parts and components made in Italy by plants of multinationals present throughout Europe, these groups could make very heavy decisions with regard to Italian sites, preferring to supply European OEMs using production sites located in other countries, in particular those with low labour costs and sufficient geographical proximity to the final assembly sites.

The difference in labour costs on some automotive components between Italy and other countries (Eastern Europe) is very high: a huge difference that only the presence of a national manufacturer can be able to limit its heavier social effects. For companies located in Eastern Europe, one of the few critical aspects is given by the high turnover of direct labour, so much so that companies are studying strategies and measures to retain workers and prevent a worker, for example, from deciding to leave within a year in the light of the fact that some data speak of turnover levels of 50% at the level of individual companies.

Here too, if European Union leaves the redefinition of the car supply system to the market, the social consequences could be very serious.

The processes of consolidation and aggregation that are affecting the components sector should be guided by the public tool, also using the National Promotional Banks (Kreditanstalt für Wiederaufbau, Caisse des Dépôts Group, Cassa Depositi e Prestiti etc.) as aggregators. At the same time, the European automotive chain is a prime example of how the freedom of capital movement has triggered downward competition in the field of social rights. New European rules on the mobility of capital and investment are extremely urgent, as is the urgent need to establish a European legal framework for social rights.



7 TRANSITION TO ALTERNATIVE PROPULSION: WHICH COMPONENTS WILL BE NEEDED?

The possible transition to other forms of propulsion requires an adequate analysis of the state of supply, in order to highlight any phenomena of ”displacement” for some companies.

Table 21 shows the components needed or not needed for the various vehicle models.

The BEV (full electric) car model involves the use of a much lower number of parts and components than the traditional car; on the contrary, the hybrid model is the one that requires the most parts as it includes both endothermic and electric technology; the lack of very relevant parts (e.g. the thermal engine, the exhaust, the catalysts and the transmission) will have strong repercussions on factories, suppliers and employment levels.

As the table shows, the hybrid model is the one that needs the most components because it combines both the components needed to make vehicles with traditional engine, and much of that needed to make electric vehicles.

From an industrial and occupational point of view, therefore, the hybrid proves to be by far the preferable model, also in consideration of the fact that it seems to be able to constitute the best model of a phase of transition towards new modes of mobility that is neither short nor simple.

FUEL CELLS ELECTRIC VEHICLES (FCEV)

The spread of hydrogen-powered vehicles through fuel cells is very limited. As highlighted in the IEA 2019 report, in 2018 only 11,800 hydrogen-powered cars were in circulation worldwide. This technology is also extremely marginal compared to electric vehicles as currently there are only 1 hydrogen vehicle per 460 electric vehicles on the road. Most of these vehicles (6,200) are located in the USA and in particular in the State of California. Japan and South Korea also have a number of hydrogen vehicles, while in Europe there are only 1,400.

COMPONENTS BY MODELS

COMPONENT	INTERNAL COMBUSTION ENGINE	HYBRID	ELECTRIC
Crankcase	YES	YES	NO
Cylinder head	YES	YES	NO
Engine gasket	YES	YES	NO
Sealant surfaces	YES	YES	NO
Valve	YES	YES	NO
Camshaft	YES	YES	NO
Crankshaft	YES	YES	NO
Mechanical water pump (on board engine)	YES	YES	NO
Flywheel	YES	YES	NO
Pistons	YES	YES	NO
Connecting rods	YES	YES	NO
Oil pan	YES	YES	NO
Oil pump	YES	YES	NO
Oil filter	YES	YES	NO
Oil level tool	YES	YES	NO
Turbocharger	YES	YES	NO
Exhaust pipe (hot end) + catalyst	YES	YES	NO
Lambda sensor	YES	YES	NO
Exhaust pipe (cold end)	YES	YES	NO
Timing belt	YES	YES	NO
Auxiliary components belt	YES	YES	NO
Compressor -conditioner (mechanical control)	YES	YES	NO
Compressor -conditioner condiziona-tore (electric control)	NO	NO	YES
Gearbox (mechanical or automatic)	YES	YES	NO
Engine Control Unit (ECU)	YES	YES	NO

COMPONENT	INTERNAL COMBUSTION ENGINE	HYBRID	ELECTRIC
Air-flow sensor	YES	YES	NO
Fuel tank (involving pump and level sensor)	YES	YES	NO
Pipeline fuel	YES	YES	NO
Suction line / Throttle body	YES	YES	NO
Fuel injectors	YES	YES	NO
High pressure fuel pipe	YES	YES	NO
Air filter	YES	YES	NO
Engine coolant radiator	YES	YES	YES
Radiator fan	YES	YES	YES
Tank expansion cooling engine	YES	YES	YES
Battery 12v	YES	YES	YES
High-voltage battery (HV)	NO	YES	YES
High-voltage wires	NO	YES	YES
High-voltage wires	NO	NO	YES
Inverter	NO	YES	YES
Electric engine (engine/gearbox group)	NO	NO	YES
Electric engine (without gear reducer)	NO	YES	NO
Control Unit Batteries	NO	NO	YES
Battery water heater HV	NO	NO	YES
Battery watr coolers HV (chiller)	NO	NO	YES
Heater cockpit	YES	YES	YES
Additional water pump	NO	NO	YES
Alternator	YES	YES	NO
Starter motor	YES	YES/NO	NO
High voltage sectioning safety switch	NO	YES	NO

TABLE 21

Hydrogen is a technology that can also be applied to other means of transport, such as buses, which have the largest fleet in China (400 buses); in Europe there are only 50 hydrogen buses.

As far as trucks are concerned, there are 400 in China. There are also two hydrogen trains operating in Germany. In Italy there are only a few hydrogen-powered public transport buses and they are only in Milan, Bolzano and Sanremo.

The hydrogen used for FCEV vehicles is stored in dedicated tanks; the refueling process of the vehicle is similar to that of petrol and takes place in refueling stations, the number of which is extremely low (only 381 worldwide, including public and non-public stations).

In Italy, for example, there is only one, located in Bolzano.

The hydrogen production process is quite problematic as about 95% of the current production is based on fossil fuels. The most common hydrogen production technique is Steam-methane reforming (48%); other techniques used are coal gasification (especially in China) and the cracking of petroleum products in the chemical and refining sectors; while only 4% is produced via electrolysis, mainly with chlor-alkali process.

Some governments have planned measures to support the spread of FCEV vehicles.

For example, Japan has set targets for FCEV sales to be 3% of car sales by 2030 (while electric vehicle sales are expected to be between 20% and 30%).

In the US, the ZEV minimum vehicle threshold targets also include FCEV vehicles, but without any quantification; as well as the Chinese government's NEV vehicle target includes FCEVs, but again without any quantification.

South Korea has predicted 67,000 FCEV vehicles on the road entering 2022 (compared to 430,000 BEV vehicles).

But the IEA report shows that Toyota alone, at the moment, has expressly announced in its business plan the goal of selling cars with this propulsion technology (but without quantifying the number, as we talk about a total of 1 million cars BEV and FCEV to be sold by 2030). Other Asian manufacturers, such as Hyundai, have also announced plans to develop FCEV technology: this Group has decided to increase the production capacity of fuel cell systems up to 700,000 units per year in 2030, and will explore new business opportunities in the supply of fuel cell systems developed in-house to other realities in the world of transport, such as other manufacturers of cars, but also drones, ships, trains and forklifts. It is not specified, therefore, within the overall sector, what will be the number of FCEVs that Hyundai intends to produce, as there is general talk of reaching a production capacity of 500,000 units per year of fuel cell vehicles, cars and commercial vehicles. At the moment, the only more or less certain figure is the production capacity of the subsidiary HMG Hyundai Mobis Co. which produces fuel cell systems, which with a production site in Chungju (South Korea) intends to increase its production capacity to 40,000 units by 2022.

In Europe, however, carmakers are much more cautious about FCEV technology; for example, Volkswagen, BMW and Daimler are investing little in this technology because they do not believe it will be ready for a mass market in the next ten years. It is expected that only 9,000 FCEVs would be produced in Europe in 2025: this figure corresponds only to 0.2% of EV vehicle production in Europe and less than 0.4% of ZEV vehicles. This (very small) production should be carried out by Volkswagen, Audi and Daimler.

The plans of the Asian manufacturers mentioned above (Toyota, Hyundai and Honda) do not envisage investment in production plants located in Europe.

Hydrogen technology, in fact, cannot yet be considered mature for its industrialization and mass production. These include the need for sophisticated safety systems, the need for periodic overhauls of containers, the high cost of storing hydrogen, limits on the percentage of hydrogen blended with natural gas, and the high cost of vehicles and fuel to consumers.

In addition, there is a complete lack of refueling infrastructure to ensure the deployment of these vehicles. Also for this reason, recently Acea, Hydrogen Europe and the International Road Transport Union have published an appeal addressed to the European institutions to speed up the construction of a hydrogen refueling infrastructure in Europe, supporting the need to revise the Alternative Fuels Infrastructure Directive, to provide for a plan for the development of this infrastructure at both European and national level, to develop joint ventures or other financial instruments combined with European funds, and to support the competitiveness of European industry.

AN OVERALL ENVIRONMENTAL ASSESSMENT

The critical considerations expressed with regard to the currently existing modes of hydrogen production should of course also be extended to EV technologies.

In the environmental impact assessment of a vehicle, in fact, one cannot take into account only that produced by the emissions of the vehicle alone, but must count those of the overall cycle of the product and its propulsion system.

At least three aspects must be taken into account in the balance sheet of Greenhouse Emissions:

1. emissions related to the use of the vehicle (essentially exhaust emissions);
2. emissions related to the production of the vehicle and its components;
3. emissions related to the production and distribution of the energy vector used for traction.

The "well-to-wheel" emissions of EV vehicles are determined by the evolution of both the energy used by them and the way in which electricity is generated. At present, given that energy production involves intensive use of coal, well-to-wheel emissions can be very high. These levels could become even higher with a strong growth of EV vehicles sold and circulating on the road.

Therefore, any EV support policy must go hand in hand with a consistent energy policy aimed at decarbonizing energy production.

The fact that EV fleets emit less greenhouse emissions depends on both the overall production cycle of these vehicles and the overall energy production cycle.

The biggest savings in greenhouse emissions can be made in those countries where the use of coal in energy production is low. In regions where electricity is produced using coal to a large extent, the increase in the number of EVs risks translating into a heavy increase in emissions generated by the energy system, with the possible frustration of the advantages obtained by reducing emissions from vehicles.

The public role with regard to energy systems is decisive in this respect. Energy conversion processes require significant investment and clear political decisions. The transformation of the energy sector towards decarbonization cannot be left to the logic of the market; otherwise the environmental objectives would be subordinated to the profit requirements of private companies.

8
CONCLUSIONS

As we could see, public policies at the level of the EU and the member states are pushing towards a new mobility model, mainly via new regulations of vehicles' emissions; public procurement (providing for minimum thresholds of electric vehicles for each tender); the use of purchase incentives and tax benefits; the provision of charging infrastructure; the identification of batteries for electric vehicles as one of the strategic value chains to be supported with R&D, partnerships and platforms.

As thoroughly explained above, European policies do not include active public intervention – although fully legitimate and, therefore, applicable. The development of this sector is therefore delegated to market and its logic.

From the point of view of infrastructures, the number of charging points is still rather low in almost all European countries: this represents a major obstacle to the spread of electric cars, which requires a wide spread of these points – which, moreover, should be recharged quickly. The creation of a European public enterprise could fill this gap, boosting investment and creating jobs.

As regards the objective of including significant shares of clean vehicles in public procurement, the limitations of this strategy are clear. There is no guarantee that these vehicles will be produced in European countries – therefore creating jobs. On the contrary, large multinationals could win the tenders, get public money and then offshore these productions to low-wage countries. European regulations should therefore include social clauses, requiring companies to carry out these productions in countries with certain wage and social levels.

Currently, battery production for electric vehicles is concentrated in Asia (China, Japan, South Korea); battery cell manufacturers have announced investments to build plants in Europe (mainly in Germany, Hungary, Poland), with the exception of Spain, France and Italy. This could cause serious industrial and employment imbalances within the EU. Also here, there is a total lack of a European planning.

Here again, an active public intervention could guarantee the availability of production facilities for this strategic component for electric mobility, and a fair distribution of these facilities between European countries – boosting investments and creating new jobs.

CO_2 emission levels, both by country and by brand, have fallen significantly over the years, but still remain above the threshold of 95 g/km of CO_2 established by EU legislation. The analysis by model, however, shows that PHEV models can comply with the new, stricter thresholds. These models should, therefore, be properly supported also because their production requires a much higher number of components, and hence can trigger more employment than pure electric models.

Despite the fact that manufacturers' announcements of electrified vehicles are very ambitious (in terms of investments, new electric models, sales quotas for electric models, etc.), the current availability of Battery Electric Vehicles (BEV, hereinafter) models is very limited and the cost of purchasing these vehicles is high enough to constitute a major obstacle to the spread of these vehicles, especially among the popular classes; together with the price, it should also be noted that the range of range of these vehicles, although growing, is still lower than that of traditional vehicles.

Looking at OEMs' investment plans, we can see that about the 45% is going to be directed to China. Moreover, concrete results do not always follow the announcements of new models and high volumes of electricity production.

In the EU, at least three clusters of car producing countries are emerging: a) Germany; b) Spain, France, UK, Czech Republic and Slovakia; c) Italy, Poland, Romania and Hungary.

However, in many Western EU countries car production is declining – think of Italy.

The new trends in mobility (electrification, digitalization, etc.) are driving the birth of 'ecosystems' in the supply chains, aggregating heterogeneous actors in terms of skills and production, leading to the birth of technological clusters.

Alliances are emerging between producers coming from different traditions and technological expertise. These alliances should be subject to public control, including through direct participation of public companies. At the moment, however, everything is left to the market.

IS THIS ENOUGH?

In the light of what has been said so far, we cannot ignore the question: is all this enough? From our point of view, the answer is no.

EMISSIONS TRIGGERED BY INTERMEDIATE TRANSPORTSL

A PERCENTAGE OF THE TOTAL

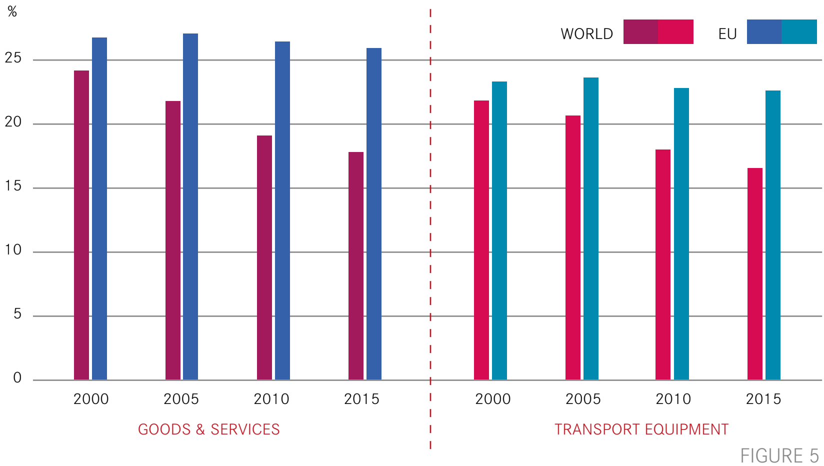


FIGURE 5

Firstly, it is difficult to see whether manufacturers will be able – or willing – to comply with the rules imposed by the EU. Moreover, these rules apply within the borders of the EU itself, but what about manufacturers – or their suppliers – operating outside?

Second, the problem is much wider. In order to understand the meaning of this statement, look at Figure 5.

Figure 5 shows the proportion of total emissions which are triggered by intermediate transports – i.e. B2B transport services – for the whole world and for the EU only.[13]

As can be seen, such proportion is extremely high: looking at all final goods and services, in 2015 it is 17.9% for the whole world, and 26.1% for the EU only. Switching to the production of transport equipment for final use, these figures become 16.6% for the whole world, and 22.7% for the EU only.

In other words, about a quarter of the total emissions generated by production activities depend directly or indirectly on the transport – by land, water or air – of intermediates. These numbers are far too important to ignore.

Environmental considerations are sterile if not accompanied by social considerations, especially in view of the fact that the exploitation of the environment and that of the workforce are two sides of the same coin.

Private companies are and will always be driven by the pursuit of profit, and no further consideration will ever be taken into account. To circumvent European rules, which in fact only penalize non-compliant behavior, it will be sufficient to move production elsewhere, further impoverishing EU workers and productive matrices.

13 Here, we are using the concept of GVC, or vertically integrated international sectors. By total emissions generated by the EU, therefore, we mean emissions generated in the whole world in order to get one unit of final goods and services produced in the EU.

The left should advocate for a radically different approach to the issue, pushing towards a dramatic reduction of intermediate transports. This could be done as follows:

- Standardize labour, environmental and fiscal legislation within the EU to prevent social dumping between Member States.
- Secondly, it is necessary to impose duties on non-member countries whose legislative standards (social and environmental) are lower than those of the EU.
- Finally, and most important, the EU must actively promote the construction of local production matrices (e.g. at the level of individual national states) as complete as possible, identifying European hubs for a small number of specific productions in order to make the most of economies of scale.
- In other words, the EU should dismantle the model of productive specialization, which by its very nature implies the proliferation of cross-border intermediate trade – and hence transport – and implement a project of de-specialization via planning and direct participation into investments and productive activity.

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