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CLEAN MOBILITY: THE EUROPEAN WAY

A COMPREHENSIVE APPROACH TO ELECTRIC VEHICLES IN THE ENERGY TRANSITION

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Executive summary

Millions of jobs, 2 hours a day, a third of our energy demand, and a key source of air pollution: this is what transport represents for Europeans.

After the French 'Yellow Vests' movement raised the question of transport affordability, and months ahead of the European elections, how can forthcoming European decision-makers deliver better, cleaner, and more socially-fair transport for all Europeans?

To realise a transition from today's dirty mobility system to tomorrow's clean mobility system, there is no silver bullet. A comprehensive solution can nonetheless build on several pieces of the jigsaw puzzle: better urban planning, reduction and optimisation of our mobility needs, digitalisation, new business models, shared economy, behavioural changes and electrification.

This policy paper focuses on the development of electric vehicles, where the EU needs to act swiftly, with a long-term and comprehensive vision of the energy transition. The European car industry has slowed down the development of electric vehicles in Europe. Dieselgate has eroded citizen trust in carmakers and politicians alike. Now, China and the US are leading the electric vehicle race, with Europe at risk of losing key segments of its economy and jobs.

Cities have meanwhile been playing a positive role. They now need support at national and EU level to achieve economies of scale. For instance, there are today more electric buses in the Chinese city of Shenzhen alone than throughout the European continent. EU action is also paramount to prevent further territorial inequalities between cities and rural areas, between the West and the East of the EU.

The EU has already laid the foundations to make the clean mobility transition a European success. It adopted more stringent CO2 standards for cars, launched the European Battery Alliance and better planned the roll-out of electric charging infrastructure. After the May 2019 European elections, new decision-makers will have the opportunity to build on those foundations.

This is why this policy paper proposes to 1) elaborate a timeline for phasing out diesel and gasoline cars in Europe; 2) accelerate the roll-out of fast charging points for electric vehicles throughout the EU and ensure that no territory is left behind; and 3) create a Social Pact for the Energy Transition that takes into account the social dimensions of the mobility transition. Supported by a comprehensive approach, those proposals will help Europe deliver clean mobility for all Europeans.

INTRODUCTION

Millions of jobs, 2 hours a day, a third of our energy demand, and a key source of air pollution: this is what transport represents for Europeans. As European elections are approaching, how can new members of the European Parliament and European Commission deliver better and cleaner transport for all Europeans?

In this paper, we attempt to draw a general overview of the challenges implied by the decarbonisation of our mobility, the reduction and optimisation of our need to move being essential to that end. Mobility needs to be based on energy-efficient and low-emission modes that rely on clean energy. The solution will not be only technological; the way we think mobility needs to change towards a more sustainable approach. This requires behavioural and societal changes that go beyond the transport sector, i.e. related to intermodal connections and urban planning (e.g. distances between activities), infrastructure and land use (e.g. roads), security, digital opportunities, work organisation (e.g. remote work) and the perception of mobility (e.g. ownership and individual car use vs. collective and shared transport service). Policy-makers should thus adopt a comprehensive approach to transition from today's inefficient and dirty mobility system to tomorrow's efficient and clean mobility system.

Considering the competences of the European Union (EU) and its action in the transport sector, we focus on road transport of passengers, especially on car use, because of its overwhelming importance in daily travelled distances and in CO_2 emissions. Beyond cleaning up the sector, the European impulse also has an economic dimension as international competitors, mainly China, are gaining ground on the electrification of transport. In this context, while still hesitant, European car manufacturers have started announcing and implementing large initiatives for electrifying their fleets.

The Commission has shown political ambition over the last years with its Clean mobility package –e.g. through regulations for reducing vehicles' CO_2 emissions and clear signals such as the launch of the European Battery Alliance which is giving momentum to electric mobility. While recent policy decisions set the right direction, they might miss the necessary ambition to remain in line with climate goals if they are not pursued at different governance levels and accompanied by behavioural change. In this regard, cities have been playing a positive role, e.g. with the roll-out of electric buses, but need national and EU support to achieve economies of scale.

The clean mobility transition is also a political challenge in the way it affects all Europeans in their daily life. As seen with the 'yellow vests' movement in France, policies affecting sectors so strongly embedded in our lives need to be fair to be socially accepted and democratically supported. In this regard, policies promoting electric vehicles can only be one key piece of a more comprehensive approach to improving Europeans' transport behaviours.

Reflecting on some of the challenges identified, this paper highlights three proposals that could serve the clean mobility transition at the EU level: 1) setting a timeline for phasing out diesel and gasoline cars in Europe; 2) accelerating the roll-out of fast charging points for electric vehicles throughout the European Union, to ensure the territorial cohesion of the continent in the clean mobility transition, and ensure that no territory is left behind; and 3) introducing at the EU level a Social Pact for the Energy Transition that includes a transport component taking into account the social dimensions of the mobility transition.

TABLE OF CONTENTS

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1 . WHAT IS AT STAKE IN THE TRANSITION TOWARDS A CLEAN TRANSPORT SYSTEM?

1.1 Transport is crucial for our economy and in our daily lives

To fully grasp the challenge represented by transport in the energy transition, it is essential to take into account all needs fulfilled by transport in our economy and society. Transport is indeed a means to an end, not a goal in itself.

1.1.1 Transport at the core of our economy

From transport of raw materials for production to exportation of packaged goods and delivery services, trade and services largely depend on transportation in their value chain[1]. For example, a batch of potatoes grown in Romania can be exported to the Netherlands to be washed, then chopped in Poland to be finally sold in Italy. Half of the freight in the EU is transported on the road (see figure 1). As a result, **any evolution of the transport system impacts virtually all sectors of the economy.**

Furthermore, over 10 million Europeans work for the transport sector, in both services[2] (i.e. drivers, transport agencies, infrastructure operation, etc.) and manufacturing (e.g. motors, electric equipment).

1.1.2 Passenger transport in daily life

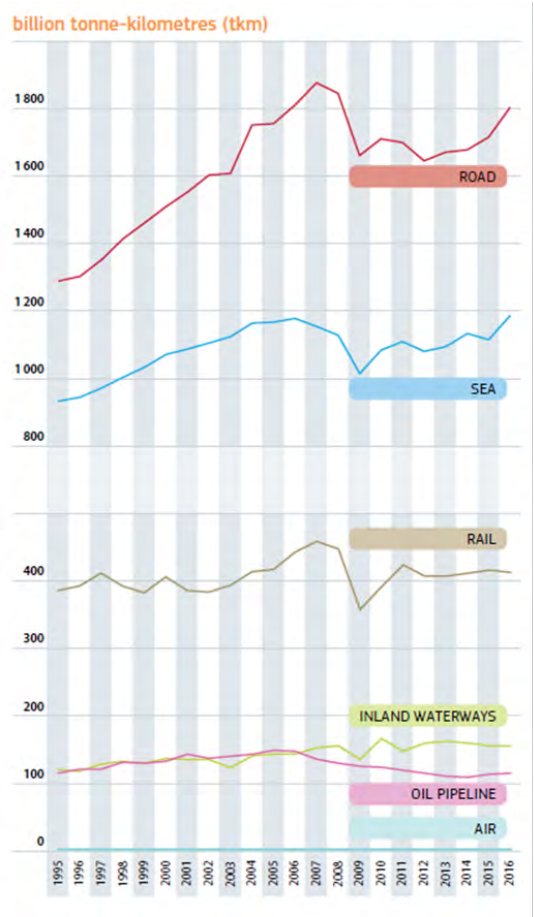
Transport is also a major component of Europeans' daily life. It is the link to all activities such as work, leisure, school, groceries and vacations. According to a study led in ten EU Member States, Europeans spend almost two hours commuting every workday[3]. Journeys are often more of a constraint than a choice.

70% of passenger transport in the EU is made by car. Collective land transport (i.e. buses, trains, trams, metros) account for over 16% of kilometres travelled by passengers. However, Europeans make much more use of public transport than for instance Americans – e.g. they choose the train 10 times more often. About 10% of kilometres are travelled by air, a mode used more occasionally and by few people but mainly on long distances (see figure 1)[4].

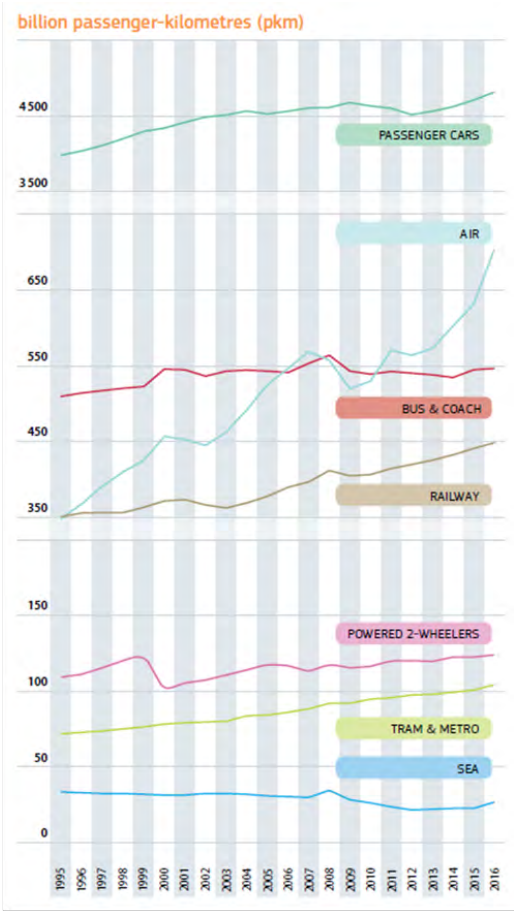
1. Knowing that transport is 94% dependent on oil, it is interesting to note that any GDP growth is correlated with more oil consumption.
2. Statistical Pocketbook: EU Transport in figures, 2017
3. IPSOS study, 2017
4. Statistical Pocketbook – EU Transport in Figures, 2017 and 2018

FIGURE 1 ■ Overview of EU-28 freight and passenger transport by mode

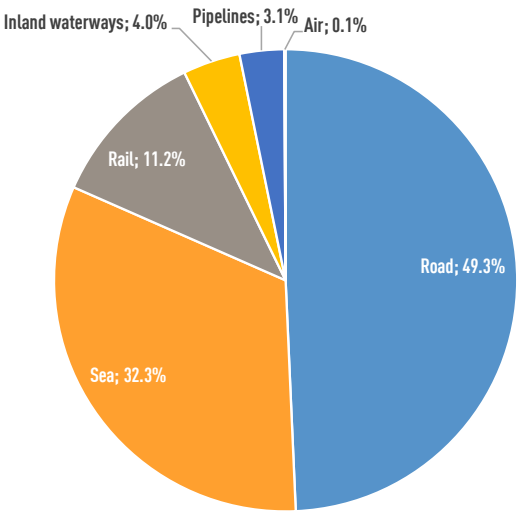
Performance for freight transport by mode, 1995-2016



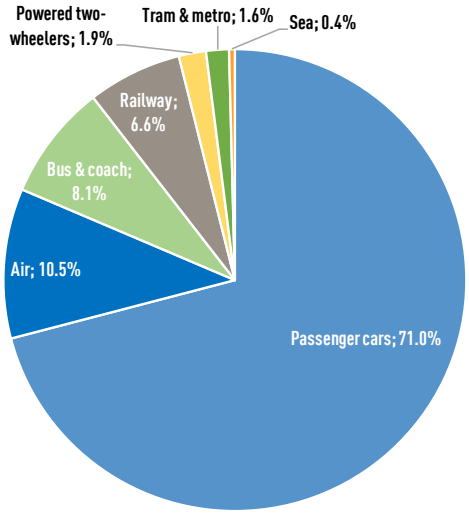
Performance for passenger transport by mode, 1995-2016



Modal split for freight transport in 2016 (in % of total)



Modal split for passenger transport in 2016 (in % of total)



Source: Statistical Pocketbook 2018 – EU Transport in figures, European Union, 2018

Another important aspect is the **cost of mobility**. On average, European households spent 13% of their income on transport-related activities– i.e. more than on food (12.3%)[5]. These figures indicate the importance of transport in a household's budget and especially for low-income families. Besides, these are expenses that are difficult to diminish or avoid. Some studies found evidence that many people would give priority to transport expenses and reduce other spending first, including domestic energy use[6]. Transport has in this regard a low elasticity, i.e. a rise in fuel prices will marginally influence distances travelled, especially in areas where people strongly rely on their cars. The fact that employment (and thus income) usually requires travelling could be one explanation for this prioritisation. Changes in the mobility system can thus have a significant impact on Europeans' daily lives.

1.1.3 Europe needs a comprehensive approach to change our mobility system

Precisely because transport is such an important vector of the economy and society, rethinking its use has implications throughout a wide range of sectors.

The climate imperative requires a rapid decline in our GHG emissions and the ongoing energy transition implies changes in our reliance on energy and has thus significant implications for our current mobility practices. Meanwhile, the transport sector is undergoing changes linked to several developments – mainly electrification, shared economy, connectivity and automation.

Four complementary approaches can thus be identified to achieve the transition towards clean mobility and should be addressed in the following order of priority:

1. **Reducing the need and demand for transport**: the high need for transport is strongly related to the modern structure of cities that separate areas of living, work and activities such as leisure and shopping. As an essential part of the solution to cut energy use, emissions, congestion and pollution, reducing the need for transport implies reducing distances between main activities through urban planning (by reducing urban sprawl) and developing alternatives to travels (e.g. teleworking). This also raises the concern of car dependence and behavioural changes.
2. **Increasing the energy efficiency of transport**: reducing the energy required for travelling a certain distance will save energy. This implies technological and fuel improvements as well as the construction of lighter vehicles.
3. **Operating a modal shift to cleaner modes**: this implies developing infrastructure that help to switch towards cleaner transport services (e.g. rail, public transport and soft modes like cycling). National and local authorities have more tools than the EU to operate such changes. These shifts, however, require that users and companies find convenient alternatives – in terms of cost and time, and this is often not the case today.
4. **Decarbonising the energy sources of remaining transport**[7].

All these options should be pursued in order to achieve a clean mobility transition and **they require action at different levels: governance, technology, infrastructure, skills, financing, social practices and behaviours.**

Improvements in energy efficiency and the shift to zero-emission technologies are aspects that can be tackled at the EU level as seen with the Clean Mobility Package (see part 2.3).

5. European Commission, "Connecting people: Transport improves the quality of life for all Europeans", 2016
6. Mattioli, G., Lucas, K., & Marsden, G. (2018). Reprint of Transport poverty and fuel poverty in the UK: From analogy to comparison. *Transport Policy*, 65, 114-125.
7. For an overview of the articulation needed between these approaches towards decarbonisation, see also IDDRI, "Beyond emission targets: how to decarbonise the passenger transport sector?" Issue Brief, November 2017

1.2 The clean mobility transition is vital for Europe

1.2.1 Decarbonising transport is crucial to fight climate change

The transport sector represents a crucial challenge in the energy transition. **33% of the energy demand in the EU comes from transport, relying almost entirely on oil** (see figures 2.1 and 2.2). 24% of GHG emissions in the EU are emitted by transport. It is the only sector where emissions have been rising since 1990 (figures 3.1 and 3.2).

FIGURE 2.1 ▪ Energy consumption by sector in the EU-28 in 2016 (in % of total)

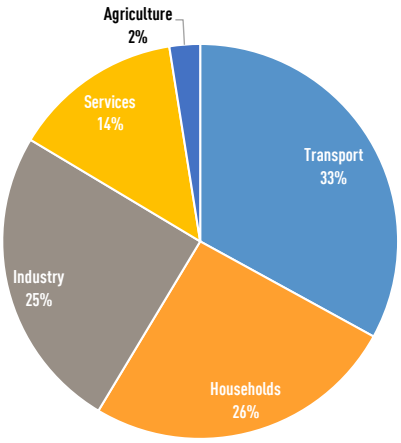
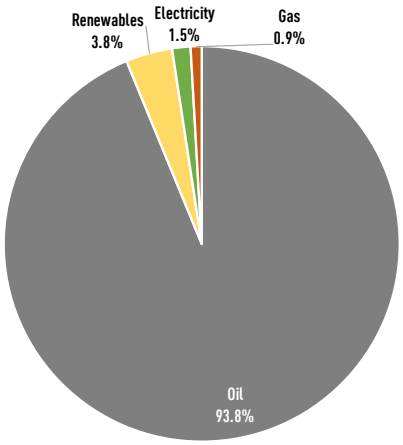


FIGURE 2.2 ▪ Energy sources in the transport sector in the EU-28 in 2016 (in % of total)



Source: Statistical Pocketbook 2018 – EU Transport in figures, European Union, 2018; EEA and Eurostat, 2018

FIGURE 3.1 ▪ Evolution of GHG emissions in the EU-28 by sector, 1990-2016

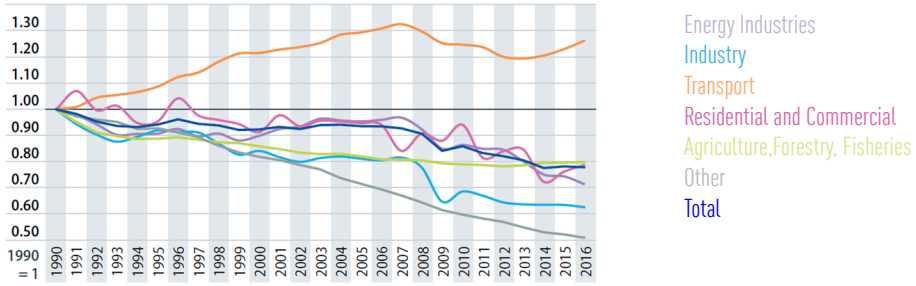
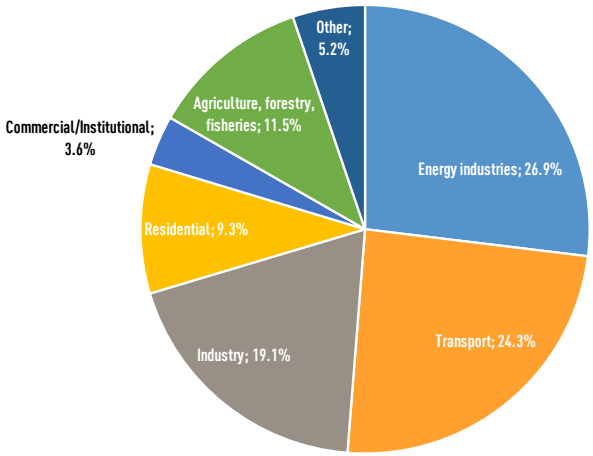


FIGURE 3.2 ▪ GHG emissions in the EU-28 by sector in 2016 (in % of total)



Source figures 3.1 and 3.2: Statistical Pocketbook 2018 – EU Transport in figures, European Union, 2018

The large share of road transport

Among these emissions, **road transport alone is responsible for over 70% of GHG emissions within the sector**, hence the importance of putting big efforts in decarbonising road transport (figures 4.1 and 4.2). Freight transport is also a decarbonisation priority as trucks only represent 5% of road transport but account for 22% of these emissions[8].

FIGURE 4.1 ▪ Transport GHG emissions in the EU-28 by mode in 2016 (in % of total)

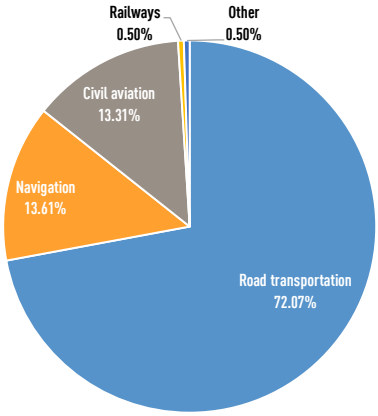
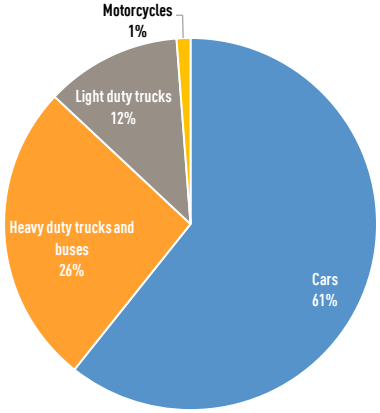


FIGURE 4.2 ▪ Transport GHG emissions by road mode in the EU-28 in 2016 (in % of total road transport emissions)



Source: Statistical Pocketbook 2018 – EU Transport in figures, European Union, 2018

What about other modes?

While not in the focus of this paper, **aviation and navigation represent each about 13% of transport GHG emissions in the EU** (figure 4.1). Biofuels, synthetic fuels and solar power could be part of the solution in the long term but for now decarbonising aviation remains an unanswered concern while the demand for air transport is growing with the large offer of cheap flights, also as a result of the lack of taxation on kerosene. Shipping emissions are also predicted to increase but considering that they go beyond the sole EU scope, a global approach is required through e.g. better logistics and shorter trips.

Emissions from rail transport have significantly decreased since 1990 for reasons such as improved energy efficiency and increased electrification of railways[9]. Rail transport emissions however are often accounted as emissions of the power rather than the transport sector so that the ongoing decarbonisation of the power sector supports a modal shift to rail, especially as Europe has a dense railway network.

Sector coupling

Such synergies between the decarbonisation of the transport and the power sector are essential. **Sector coupling can strongly benefit the energy transition as progress in one sector can accelerate progress in the other.** The deployment of electric vehicles (EVs) for instance is foreseen as a promising option to store the abundance of variable renewable electricity at specific moments (e.g. sunny midday, windy nights). Conversely, the rise in electricity production from renewable energy sources makes electricity cleaner, thus making electric mobility increasingly cleaner[10].

8. T&E, "EU truckmakers hide polluting diesel trucks behind the façade of electrification", 18 September 2018
9. In the EU-28 (with Switzerland and Norway), about 53% of railways are electrified (UITP, 2016).
10. Thiel, C., Nijs, W., Simoes, S., Schmidt, J., van Zyl, A., & Schmid, E. (2016). The impact of the EU car CO_2 regulation on the energy system and the role of electro-mobility to achieve transport decarbonisation. *Energy Policy, 96,* 153-166.

1.2.2 Europe can save lives by fighting air pollution

Air pollution remains one of the main environmental dangers to public health causing **around 400,000 premature deaths in the EU each year**[11]. The transport sector is a main source of pollution through the combustion of hydrocarbons[12]. Historical decisions favoured diesel in Europe, which emits excessive levels of air pollution on our roads. Furthermore, real-world emissions of main pollutant, such as NOx, generally exceed the authorised level of exhaust emissions set by European emission standards, as shown by Dieselgate[13] (see part 2.1.1).

1.2.3 Europeans have to address the geopolitical and security challenges of our current and future transport system

Beyond CO_2 emissions and air pollution, transport comprises also geopolitical aspects that should be considered in order not to repeat dependence patterns of the past. **84% of oil for transport in the EU is imported.** This increases the trade deficit while creating a dependence on oil-rich governments like Russia and Saudi Arabia who in turn use oil money to finance actions, including military action and political propaganda, that oppose European interests and values[14].

Options to reduce this reliance on oil are being explored – from energy conservation and energy efficiency to alternatives such as electricity, green hydrogen, biogas and sustainable biofuels.

However, solutions such as electric vehicles can increase other forms of dependence. Battery production for EVs relies on metals such as cobalt and nickel and their extraction outside of the EU is a source of concern[15].

Finally, with the rise of autonomous transportation[16] on the horizon, new security threats arise: with an on-board system driving the vehicle, cybersecurity concerns need to be anticipated accordingly.

1.3 The automotive industry: a key economic sector where Europe lags behind US and Asian competition

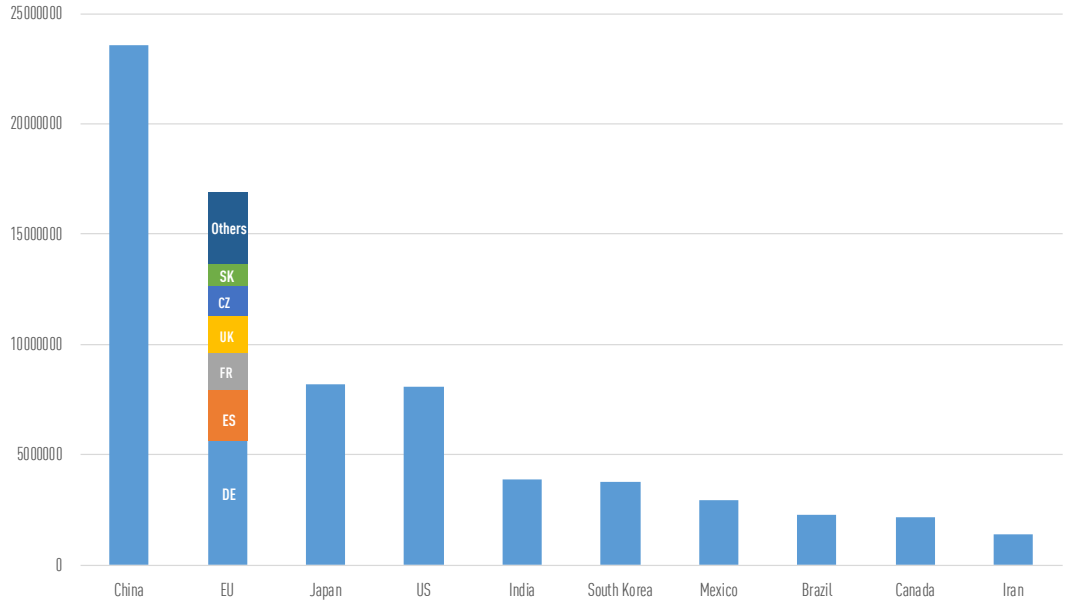
1.3.1 Europe has for decades been a leader in the automotive sector

The transition towards clean transport also implies a huge transformation in the automotive industry, which has for decades been a key and prosperous economic sector in Europe. It represents 8 million jobs and over 4% of the GDP of the EU[17]. **The EU is the second largest producer of cars behind China with 21% of the world production.** Leading producers in the EU are Germany with over 5.5 million cars in 2017, Spain with 2.3 million, followed by France and the UK with 1.7 million (see figure 5)[18]. In some countries, the automotive industry represents

11. European Environment Agency, *Air quality in Europe—2018 report*, 2018
12. InnoEnergy, "Clean Air Challenge: Transport and heating solutions for better air quality", 2018
13. European Environment Agency, "Emissions of air pollutants from transport", 22 November 2018; According to a 2017 MIT study, "1,200 people in Europe will die early [...] as a result of excess emissions generated between 2008 and 2015 by affected cars sold in Germany"
14. Thomas Pellerin-Carlin, Jean-Arnold Vinois, Sofia Fernandes and Eulalia Rubio, "Making the Energy Transition A European Success", Jacques Delors Institute, June 2017
15. Cobalt in particular is mainly mined in the Democratic Republic of Congo, a country where political instability and use of child labour for cobalt mining raises ethical concerns.
16. Autonomous transport, i.e. self-driving connected vehicles, is expected to develop over the next decade raising many questions related to regulation, insurance, security, data access, urban planning, etc.
17. European Commission, DG GROWTH, *Automotive Industry*. It represents 6.8% of GDP according to ACEA.
18. ACEA, "Top 10: car producing countries, worldwide and EU", 13th April 2018

a dominant share of the total industrial production: e.g. 44% in Slovakia (2017)[19] and 25% in the Czech Republic (2014)[20].

FIGURE 5 ▪ Passenger car production in the world and in EU Member States in 2017



Note: DE: Germany; ES: Spain; FR: France; UK: United Kingdom; CZ: Czech Republic; SK: Slovakia

Source: Jacques Delors Institute, based on ACEA, based on OICA and IHS Markit

Considering the role that the automotive industry plays in the European economy and especially the numerous jobs it offers, the decarbonisation of transport will largely impact the sector and needs to be properly anticipated and prepared, especially in terms of employment.

According to NGO Transport & Environment, the vehicles' fleet in the EU should be fully decarbonised by 2050 to achieve the Paris Agreement's objectives and to do so, no internal combustion engine cars and vans should be sold after 2035[21]. The internal combustion engine technology (ICE) is thus progressively becoming outdated and fails to fulfil the need for more energy-efficient and less polluting vehicles[22] (see Box 1 for a historical perspective).

BOX 1 ▪ From horse to oil: a brief history of a past mobility transition

Transforming the industry in the next 15 years might seem difficult to fathom but such transitions already happened in the past. At the beginning of the 20th century, large cities such as Paris or New York mainly relied on horses for transportation. Within less than 10 years, the introduction of cars transformed mobility in cities.

New cars were expensive to purchase but owning a horse implied higher maintenance costs (e.g. veterinarian, stable, farrier). Such a transformation can nonetheless be disorganised with both horses and cars on the streets, especially as there was no regulatory framework to accompany this change. While Paris was already full of cars in 1920, traffic laws and lights were only implemented in the following years. Car insurance came ten years later.

The shift towards cars also had different impacts on the population. Many jobs related to horses disappeared while the rise in automotive

19. Slovak Investment and Trade Development Agence, "Automotive Sector in Slovakia", December 2017
20. ERSTE, Kozelský and Novak, "Automotive Industry: Future Trends", September 2015
21. Transport & Environment, "CO_2 emissions from cars: the facts", April 2018
22. Over the last years, significant improvements have been achieved in reducing CO_2 emissions of gasoline vehicle. Automotive design has also evolved in terms of engine power, displacement, size and weight of vehicles. Large CO_2 emission reductions have been achieved despite cars becoming heavier, meaning that if car mass decreased, CO_2 savings could be further reduced, according to the ICCT (2018).

production created new ones. The adoption of cars also reflected the existing territorial differences with a fast spread in big cities and a much later adoption in rural areas.

Based on Livre blanc InnoCherche « Nouveaux usages – Nouvelle mobilité : Impact sur nos villes et sur nos vies »

1.3.2 Investing in electric cars: a key part of the solution

What alternatives do we have and why such an emphasis on electric mobility?

When observing global dynamics on the automotive market, a shift towards electric mobility is occurring in most of the world. This can be explained by several reasons: the technology can be considered as sufficiently mature, market-ready with a growing number of models on the market, already competitive with combustion-powered cars in many contexts (see part 2.1.2), electric infrastructure exists so that creating a dense network of charging points is achievable and already deployed to a large extent.

At the EU level, **the signals sent by the European Commission seem to push for the electrification of road transport** (e.g. with the European Battery Alliance) and are often criticised by a share of stakeholders who consider it as an approach that is not technologically-neutral anymore. The European approach is however far from being as radical as in China where manufacturers face binding EV sales objectives (see part 1.3.4); but this approach does to a certain extent set a policy that brings more weight to EVs in the definition of low- and zero-emission vehicles. This is aligned with the reality of the market (e.g. there are no car models running on hydrogen developed by European manufacturers), but can indeed hamper the development of other solutions (e.g. hydrogen, biogas).

Alternative solutions are also needed in other areas. For example, hydrogen for large vehicles (e.g. trucks and coaches) appears as a promising option to accommodate both their weight and autonomy need, while Siemens experiments on this segment with electric highways for freight. Besides, alternatives such as synthetic fuels and hydrogen should be used **in priority for modes that are difficult to decarbonise** through electrifications, such as aviation and navigation, or other sectors (e.g. chemical industry, steel production, military).

It is also worth reminding that so-called "biofuels"[23] were earlier seen a first step towards replacing fossil fuels in transport. Their potential has nonetheless become very controversial with concerns over the sustainability of their production and their impact on food security. While biofuels emit less CO_2 than fossil fuels when burnt on the road, their production leads to indirect land-use change and additional CO_2 emissions. Interestingly, while the EU capped the share of conventional biofuels at 7% in the transport sector[24], the recent review of the Renewable Energy directive still includes high-emitting biofuels (incl. palm oil biodiesel that emits more greenhouse gas emissions than fossil diesel) as contributing to EU's green energy targets and plans for their phase-out only in 2030[25]. Advanced biofuels based on waste and renewable energy should be the only biofuels allowed provided that they fulfil sustainability criteria.

Considering the scale and urgency of climate challenge, **electric mobility is for now the most scalable solution for at least decarbonising passenger transport** for daily trips. However, the decision to shift towards this form of mobility needs to consider all aspects and drawbacks cautiously. This shift will only make sense towards climate objectives if achieved jointly with the decarbonisation of the power sector. Furthermore, battery production requires high amounts of energy and raises the need for a life cycle assessment rather than just tail-pipe

23. Most biofuels could actually be more accurately (and less confusingly) described as "agrofuels".
24. ICCT, "Final recast Renewable Energy Dorectoce for 2021-2030 in the European Union", July 2018
25. Transport & Environment, "EU ends target for food-based biofuels but will only halt palm-oil support in 2030", 2 July 2018

emissions of the car. Currently, EV batteries are not produced in Europe. If production lines do not develop, the risk of losing the lead in car production becomes a possibility.

Besides, we are currently not aware of the long-term implications of electrified mobility – e.g. will there be enough raw materials to provide for billions of EVs? Will batteries be used sufficiently to offset their polluting production? Will we manage to recycle them properly? While the European Battery Alliance (see part 2.3.2) tries to provide answers to some of these questions, these also raise the question of our model of individual car ownership, and hence of the societal acceptance of a new system no longer based on individual mobility (see part 2.1.3).

BOX 2 ▪ TYPES OF EVs: Understanding what we are talking about

Hybrid Electric Vehicle (HEV): HEVs rely mainly on an internal combustion engine, which is complemented by an electric power train used for low speed conditions and when idling. The battery is charged by the internal combustion engine.

Plug-in Hybrid Vehicles (PHEV): PHEVs are rechargeable hybrid vehicles. They use essentially the electrical drive train and run on the combustion engine when the battery is used. PHEVs are different from HEVs as they have bigger batteries, can be charged from the grid and can thus be zero emission if running only on the battery.

Extended Range Electric Vehicles (E-REV): E-REVs are EVs with extended autonomy through a combustion engine. But as opposed to PHEVs, the combustion engine only acts as a generator to charge the battery when it is depleted.

Battery Electric Vehicles (BEV): BEVs are cars with an electric motor and a chargeable battery. Nowadays, they have an average 300km-range.

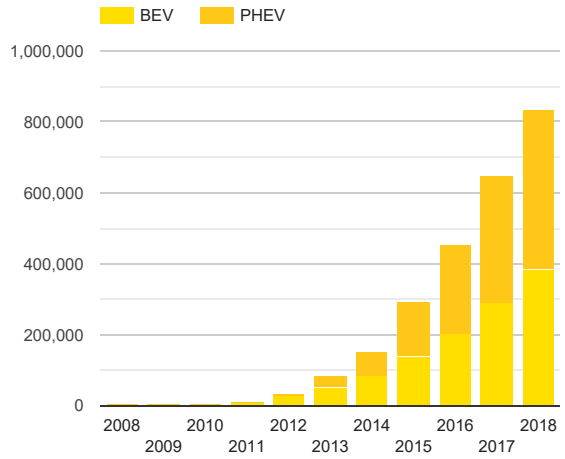
Fuel Cell Vehicle (FCEV): FCEVs have an electric motor powered by a fuel, mainly hydrogen. Fuel cells in vehicles generate electricity to power the motor, generally using oxygen from the air and compressed hydrogen. Most fuel cell vehicles are classified as zero-emission vehicles that emit only water and heat.

Based on Internal Energy Agency, Global EV Outlook 2018

State of the art of EV market shares

While sales of BEVs and PHEVs (see Box 2 for an overview of the different types of electric cars) are rising in the EU, they still represented together only 1.4% of cars registered in 2017 in the EU, with a rise to 1.9% in the fourth quarter of the year. This number rose by 39% compared to 2016[26]. The share of EVs is slightly higher in EU-15 countries (see figures 6 and 7).

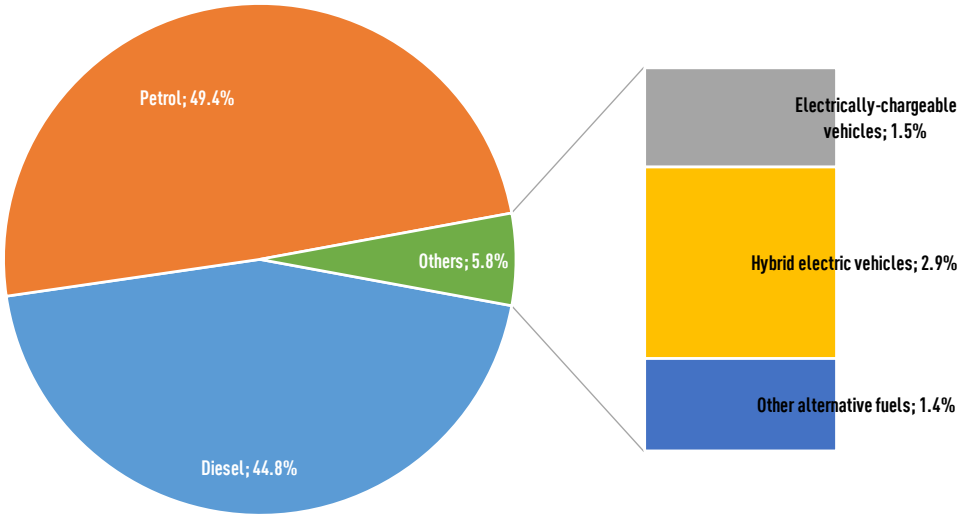
FIGURE 6 ▪ The growth of the BEV and PHEV fleets in the EU, 2008-2018



Source: EAFO, 2019

26. ACEA data, 2017

FIGURE 7 ▪ New passenger cars in the EU-15 by fuel type in 2017



Source: ACEA, AAA[27]

The market shares of EVs remain low throughout Europe, one of the main reasons being the high purchase price. Norway, leading the shift towards electric mobility, has achieved a 40% share of EV sales thanks to a combination of high incentives that made them more affordable than combustion-powered cars (see Box 3 on Norwegian EV policy). While Norway is a particular example considering its wealth, its policy to promote e-mobility provides examples of good practices that can be replicated in EU countries.

In its 2011 White Paper on transport, the Commission already envisioned phasing out conventionally-fuelled vehicles in cities by 2050 and halving their use by 2030[28]. The transition towards clean vehicles is now at its very beginning and needs to be accelerated as the required shift could have been anticipated several years ago.

BOX 3 ▪ Norway: electric mobility leadership encouraged by ambitious policy measures

In 2017, almost 40% of newly purchased cars in Norway were BEVs or PHEVs – compared to 1.4% in the EU.

The country aims at reaching sales of only zero-emission cars by 2025 and thus focuses on the promotion of BEVs. To achieve this ambitious target, many measures have been introduced to accelerate the shift towards electric cars since the 1990s: e.g. BEVs are exempted of vehicle registration tax, circulation tax and congestion charge, benefit from free parking and ferries and have access to bus lanes. A VAT exemption and import tax are major incentives for users to buy EVs as, in these conditions, EVs become more affordable than comparable combustion-powered cars.

These measures were accompanied by a large deployment of charging stations and high taxes on petroleum.

Based on ACEA data 2017 ; France Stratégie, « Les politiques publiques en faveur des véhicules à très faibles émissions », 2018 and presentation at the Norwegian Embassy by Mr Henrik Harboe, 21 September 2018[29]

27. Petrol stands for gasoline-powered cars.
28. European Commission,"Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system", White paper, 28 March 2011
29. "Véhicules électriques : l'expérience norvégienne", presentation by Henrik Harboe, Minister Counselor of the Norwegian Embassy in France, during the Journées des nouvelles mobilités of Issy-les-Moulineaux, 21 September 2018

1.3.3 How the automotive industry and its lobby have delayed the development of electric vehicles

Many car manufacturers in the EU have been reluctant to develop EVs over the last years. This is understandable in a situation likely to disrupt their business models, but the lobby, its tools and some governments' implication in doing so are questionable in some cases (see box 4 on the weight of these lobbies).

The car industry should learn from transformations in other sectors: The so-called Kodak dilemma in photography (i.e. missed digital disruption) is often quoted as an example of failed transition and highlights the need of companies to adapt to the changing environment. **The industry is witnessing several opportunities brought about by electrification, digital technology, collaborative economy and automation**. The power sector has also struggled to deal with major changes (e.g. renewable energy sources and energy efficiency), lulling itself into a "false sense of security"[30] according to Johannes Teyssen, CEO of the German energy supplier E.ON. However, the power and automotive industries also rely on large infrastructure (e.g. grid, roads) which link their decisions closely to those taken by public authorities. Several attempts of EV commercialisation in the early 2010s failed indeed due to a low market uptake and lacking infrastructure and were followed by more investment in hybrid vehicles as an option that does not require electric charging[31].

On this point, car manufacturers' lobby ACEA still argues that **the low market uptake of EVs is caused by an insufficient number of charging points and incentives**[32]. The French example shows the opposite: the country has a generous set of incentives for EV purchase and exemptions and has currently over 205,000 charging points – including public and private stations, which is more than the 157,800 EVs on its roads[33]. On the other hand, a study by NGO Transport & Environment points towards **the failure of manufacturers to provide these cars on the market**[34]. Several reasons contribute to explaining the low uptake according to this study.

First, the European car industry invests around EUR 50 billion yearly in **research and development**. But in 2012-2014, still as much as 36% of patented activities of the EU automotive industry were realised on the internal combustion engine, while electric and hybrid technologies each represented 23% of patented activities[35].

Second, models of electric cars on the market are not yet numerous compared to internal combustion cars, with **only 19 BEVs compared to over 400 ICE models on the European market in 2017**[36]. However, considering the general regulatory and international environment pushing for electric mobility (see 1.3.4. and EU CO_2 standards in 2.3.1.), many carmakers have committed to developing PHEVs and BEVs, and announced their objectives for the years to come (see figure 8)[37]. If these announcements are respected, the offer on the market should provide a wide range of EVs for consumers in the coming years.

30. "Das trügerische Gefühl der Unangreifbarkeit", Opinion piece published in *Tagesspiegel*, 11 September 2017
31. E.g. in France: https://www.automobile-propre.com/chiffre-ventes-voitures-electrique-2010-france/ PSA for example sold 30 units of its freshly launched iOn EVs in 2010.
32. ACEA, "Making the transition to zero-emission mobility: Addressing the barriers to the uptake of electrically-chargeable cars in the EU", June 2018
33. Connaissance des énergies, "Véhicules électriques: près de 25 000 points de recharge publics en France à fin novembre 2018", 8 January 2019
34. Transport & Environment, "Carmakers failing to hit their own goals for sales of electric cars", September 2017
35. Simon Tagliapietra and Georg Zachmann, "Addressing Europe's failure to clean up the transport sector", Bruegel, policy brief, April 2018
36. BEUC, "When will electric cars be an affordable option for European consumers?", 2018
37. See EV Global Outlook 2018, table 2.5 "OEM announcements related to electric cars", for more OEM announcements by 2030.

FIGURE 8 ▪ Some European manufacturers' announcements related to electric cars until 2025

	NUMBER OF SALES	% OF EV SALES	NUMBER OF NEW EV MODELS
BMW		15-25% (2025)	25 (2025)
Mercedes Benz		15-25% (2025)	10 (2025)
PSA	900 000 (2022)		27 (2023)
Renault - Nissan	1000 000 (2022)	20% (2022)	12 (2022)
Volkswagen	2 500 000 (2025)	25% (2025)	80 (2025)
Volvo			5 (2021)

Note: intended achievement year in brackets
Source: Jacques Delors Institute, based on EIA, Global EV Outlook, 2018

Third, the visibility of EVs is still limited as they are rarely displayed in showrooms and **only 3.7% of marketing expenditure went to zero-emission and plug-in hybrid models in EU core markets** in 2016. In comparison, carmakers seem to move in this direction when the government offers incentives for these cars, like in the case of Norway where carmakers spent more of their advertising budgets on EVs[38]. This trend is changing quickly as several manufacturers are putting much effort in the 'greening' of their business, e.g. Volkswagen following Dieselgate.

Fourth, there are situations of **unavailable electric car models and thus long waiting time to get the car**. This is for example the case in Norway again where delivery dates have been extended and consumers now have to wait "between eight months and two years" to get their car[39].

BOX 4 ▪ The weight of car and oil lobbies: what are policy-makers doing?

The powerful lobby of car manufacturers often manages to have significant weight in political decisions and to water down legislations that could go against what they perceive to be their interests. Also represented by ACEA in Brussels, they actively lobbied against higher CO_2 emissions standards in order to delay the roll-out of clean alternative fuel vehicles.

They are also linked to the oil lobby (e.g. FuelsEurope and IOGP representing among others BP and ExxonMobil) in protecting their common interests.

Furthermore, the EU and its Member States still largely subsidise fossil fuels' production. They do so through the EU budget and tax breaks but also with European Central Bank bond purchases as highlighted in a 2017 study: "Recent analysis by the Corporate Europe Observatory shows that car manufacturers, oil and gas companies, energy companies and motorways account for 107 of the 271 different bonds bought between December 2016 and June 2017".[40]

This point also raises the responsibility of decision-makers in failing to adopt the right policies to trigger the uptake of zero- and low-emission cars in the EU and in pushing the European car industry towards the development of a sustainable fleet for the health of citizens and in the context of climate change.

Germany is a striking example where the car industry and political interests are strongly intertwined. According to academicians Gössling and Cohen, "[...] in 2007, car manufacturers and related organizations successfully used a public relations campaign in German newspapers to question mandatory EU CO_2 emissions targets. The campaign gained the support from the German chancellor, who opposed and prevented new EU legislation on various occasions. Particular attention was paid to the issue when Germany delayed the EU limit on CO_2 emissions from cars, at a time when it became known that the ruling party had received financial contributions from car manufacturer BMW"[41], a topic widely covered in the media in 2013.

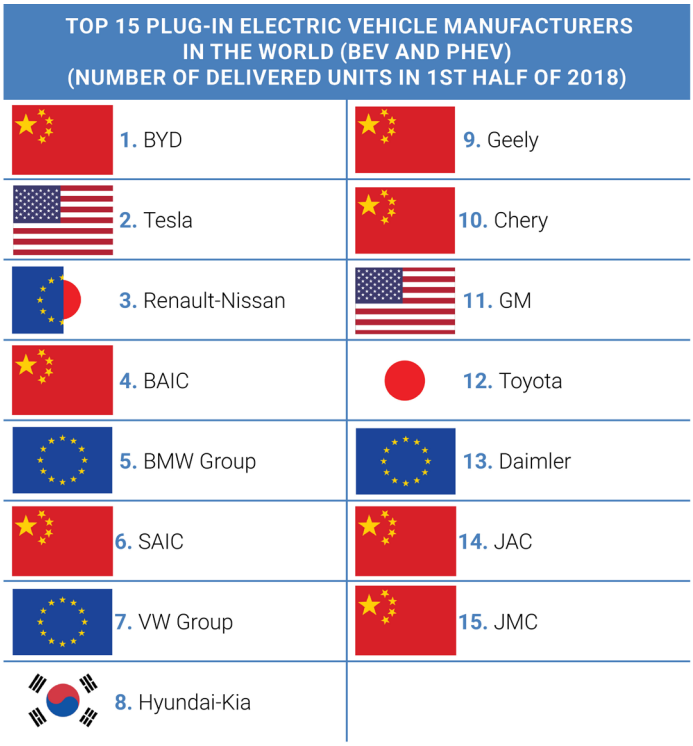
38. Transport & Environment, "Carmakers failing to hit their own goals for sales of electric cars", September 2017
39. "Shortage of electric cars in Norway puts climate strategy at risk", *Energy Post*, 15 March 2018
40. Quote from: Overseas Development Institute and CAN Europe, "Phase-out 2020: monitoring Europe's fossil fuel subsidies", Brief, September 2017, p.7
41. Quote from: Gössling, S., & Cohen, S. (2014), "Why sustainable transport policies will fail: EU climate policy in the light of transport taboos", Journal of Transport Geography, 39, 197-207 ; supported by *Die Zeit* and *BBC* articles; Thomas Pellerin-Carlin, Jean-Arnold Vinois, Sofia Fernandes and Eulalia Rubio, "Making the Energy Transition A European Success", Jacques Delors Institute, June 2017, p.29

Following the Dieselgate fraud, several German carmakers are currently suspected of collusion to prevent the roll-out of clean emissions technology. Margrethe Vestager, the European Commissioner for Competition, launched a probe into the case in September 2018[42]. Attempts to maximise profit as long as possible based on companies' current business models also contributed to delaying the introduction of new cleaner options and gave more space for non-EU competitors.

1.3.4 International competitors are taking over Europe

The EU industry is already lagging behind American and Chinese competitors in EV production. Chinese leading companies such as BYD have been selling the largest amounts of EVs in the world. In the US, Tesla has made premium electric vehicles popular and reinforced the position of the country on the electric car market (see figure 9).

FIGURE 9 ▪ Leading manufacturers in EVs sales



Source: Jacques Delors Institute, based on EV-volumes.com data

In terms of volumes, China is by far leading in electric mobility: in 2017, half of the 1.2 million EVs sold worldwide were in China. The country gave a strong impulse to the development of clean alternatives for transport, driven not only by its major pollution problem in cities but also by economic reasons to develop leadership in the car industry. China has set a favourable and strict regulatory framework for the roll-out of 'new energy vehicles' (i.e. all electric, hybrid and hydrogen cars) with generous local and national subsidies for the purchase of such cars sold by Chinese manufacturers as well as quotas for manufacturers from 2019 onwards[43]. The success of the policy led to a shift from mainly incentives for buyers to constraints for

42. European Commission, "Antitrust: Commission opens formal investigation into possible collusion between BMW, Daimler and the VW group on clean emission technology", Press release, 18 September 2018

43. The quota for manufacturers is of 10% calculated based on the share of EVs and their autonomy. For a detailed explanation, see France Stratégie, "L'avenir de la voiture électrique se joue-t-il en Chine ?", 2018; France Stratégie, "Les politiques publiques en faveur des véhicules à très faibles émissions", 2018

carmakers, as incentivising all buyers was becoming a strain on the national budget. However, **considering the carbon intensity of the Chinese electricity mix, their EVs are not clean as this trend is displacing pollution and emissions from road and oil to power plants and coal.**

Furthermore, **the EV battery market is largely dominated by Asian companies** (Panasonic, Japan; BYD, China[44]), which for long provided batteries for electronics. Nonetheless, new actors emerge on this competitive market: the firm CATL in China is supported by subsidies from the Chinese government, which help the company grow fast[45]. European EVs are currently supplied by these battery markets.

Without an EV battery value chain in Europe, the continent is at risk of being outperformed by international competitors on the car and battery market. Launched last year, the European Battery Alliance creates the momentum to alter the current balance of power in favour of the European industry (see part 2.3.2). The R&D potential of the EU could be devoted to such investments: the automotive industry represents the largest R&D investment sector in the EU – 30% of companies' R&D- as compared to the US (8%) and China (12.5%)[46].

Furthermore, **digital players (e.g. GAFA, Uber) are gaining ground on that topic**. With the rise of digitalisation and the growing interest of digital players in the car industry, there is a risk of decarbonisation becoming only an opportunity to bring forward a connectivity agenda that could overshadow the decarbonisation objectives.

Taking into account that it takes on average five years for a manufacturer to develop a new range of cars and 15 years to renew a car fleet, it is urgent to work on new models so they might be commercialised as soon as possible. **Delays in the roll-out of clean vehicles, while bans are multiplying and deadlines are approaching, could lead to a growing competition of non-European companies selling clean vehicles on the European market**.

2 . A BOTTOM-UP TRANSITION: FROM CITIZENS TO THE EU, WHAT IS THE TREND ON EUROPEAN ROADS?

After an overview of the situation in the transport sector, and more specifically in the automotive industry, this second part brings forward developments occurring in policy at the levels of cities and of the EU but also importantly, changes in society mind set and behaviours that contribute to cleaning up daily mobility of passengers.

2.1 A paradigm shift from a transport-intensive to a transport-efficient society?

2.1.1 A turning point in our perception of mobility: the consequences of Dieselgate and changes in car use

In 2015, the world learnt that Volkswagen (VW) installed defeat devices in its cars to circumvent emission standards. This so-called Dieselgate scandal has opened our eyes on the prac-

44. France Stratégie, "L'avenir de la voiture électrique se joue-t-il en Chine ?", 2018
45. Carole Mathieu, "The EU Battery Alliance: Can Europe avoid technological dependence?" Ifri, Edito Energie, 20 February 2018
46. 2017 EU Industrial R&D Investment Scoreboard

tices of many carmakers[47] and has severely damaged the public perception of the car industry and diesel technologies.

The management of the scandal by policy-makers in the EU and in national governments was generally deemed poor. Right after the scandal was revealed, the European Parliament set an inquiry committee and based on its work, the Parliament called on "the [European] Commission to conduct an internal review to verify the claim that the **JRC's[48] research findings and concerns discussed among the Commission's services with regard to possible illegal practices by manufacturers never reached the higher levels of the hierarchy**"[49]. It also highlighted that the EU should aspire to stricter and better enforced standards, such as those in the US. The latter tackled fraud seriously with high sanctions for carmakers and compensation for consumers.

In the EU, the European Commission proposed a New Deal for Consumers in 2018 creating more adequate tools (e.g. collective redress) to sue companies in the future[50]. But to compensate consumers for the past prejudice, VW has only offered free fixes of the manipulated devices without any financial compensation[51].

At the national level, **fraud was tackled in a particularly indulgent manner towards carmakers** which have taken limited action to fix the damages. The fix has been slowly operated in almost all German affected cars and German prosecutors eventually fined VW with EUR 1 billion in June 2018[52]. In France, the country with the largest number of polluting diesel cars on its roads[53], there has been no compulsory recall procedure for now[54].

Diesel dumping in Eastern Europe

Furthermore, the diesel scandal also points out to a **divide that is being maintained between Western and Eastern EU countries**, the latter importing many second-hand cars. In 2016-2017, over two million second hand cars older than 10 years were imported in Poland[55]. This trend might even increase with current diesel bans being implemented in cities, mainly in Western Europe, and thus more and more people trying to get rid of diesel cars that are exported in the East.

This is a situation where **the EU should act to protect all Europeans equally against air pollution**. Displacing the problem by dumping polluting diesel cars with defeat devices to Central-Eastern countries should be prevented or at least regulated. As highlighted by T&E, national measures could be taken to prevent these imports – e.g. temporarily forbidding the sale and use of damaging cars for the environment and health[56].

47. Still in 2019, Fiat Chrysler has to pay over EUR 800 million in compensation in the country following a software manipulation accusation in 2017.
48. JRC stands for Joint Research Centre, the Commission's service providing independent scientific advice.
49. European Parliament recommendation of 4 April 2017 to the Council and the Commission following the inquiry into emission measurements in the automotive sector
50. European Commission, "A New Deal for Consumers: Commission strengthens EU consumer rights and enforcement", Press release, 11 April 2018
51. "European Commission strikes Dieselgate deal with Volkswagen", *Politico*, 15 June 2017
52. "Dieselgate - a timeline of Germany's car emissions fraud scandal", *Clean Energy*, 17 December 2018
53. The Dieselgate has nonetheless led in France to a reduction of the diesel fleet due to scrappage incentives, a fall in diesel cars sales and in the value of second-hand diesel cars.
54. Réseau, Action, Climat, "Dieselgate : les associations tirent encore la sonnette d'alarme", 18 September 2018
55. "Zachód odwraca się od diesli i zaostrza wymogi dla aut w miastach. Stare diesle kopcą więc w Polsce", wyborcza.pl, 16 January 2018
56. T&E, "Diesel going East" series on Bulgaria and Poland, 2017-2018. While such measures are even planned for in EU directives on new cars homologation and air quality (2007/46/EC and 2008/50/EC), they are in fact difficult to implement by the concerned Member States as there is no legal basis to prove that imported cars have excessive emissions.

Change in the perception of cars

The scandal seriously damaged public trust – both in car manufacturers and in policy-makers. Half of respondents in a 2016 cross-country survey said the event had a negative impact on their perception of the brands involved and that they are less likely to buy their cars[57]. In Germany alone, two thirds of survey respondents said that the handling of the scandal by authorities and carmakers was bad[58].

Since the democratisation of cars, mobility has been seen through individual car ownership. Cars are often seen as representative of social status and freedom. Automotive advertisements are a case in point. Through their illustration of cars as the incarnation of freedom and strength, they have contributed to creating this social construct around the individual car.

However, **this trend is changing in the approach of young generations**. A study led by the JRC in 2017 highlights that a plateau has been reached in some Western EU countries in terms of car travel demand. This 'peak car' phenomenon experienced is partly linked to young people's behaviour: the take-up of driving licenses is declining, especially among youth in their 20s that live in urban areas[59]. Obtaining one's driving licence and buying a car are not aspirations as much as they used to be 30 years ago. In Eastern countries and outside urban areas, a moderate growth in car ownership is still expected. **In 2016, there was on average one car per two European inhabitants**, **rising from 1990** with one car per three inhabitants. The topic remains nonetheless understudied and should be developed to understand better the main reasons and individual motivations towards relying less on cars. This could have an important contribution to reducing congestion in European cities and developing more alternatives to cars.

2.1.2 New opportunities for Europeans: electric cars as an acceptable alternative to oil-powered cars?

Consumer interest for electric mobility is increasing but several aspects still prevent their diffusion on our roads. In 2016, 44% of vehicle buyers in Germany did consider the purchase of an EV. The main reasons people mentioned for not buying one were the purchase price, but also aspects that are more linked to individual perception and preferences, i.e. the driving range, the lack of the desired car model or brand and the perceived lack of charging infrastructure[60].

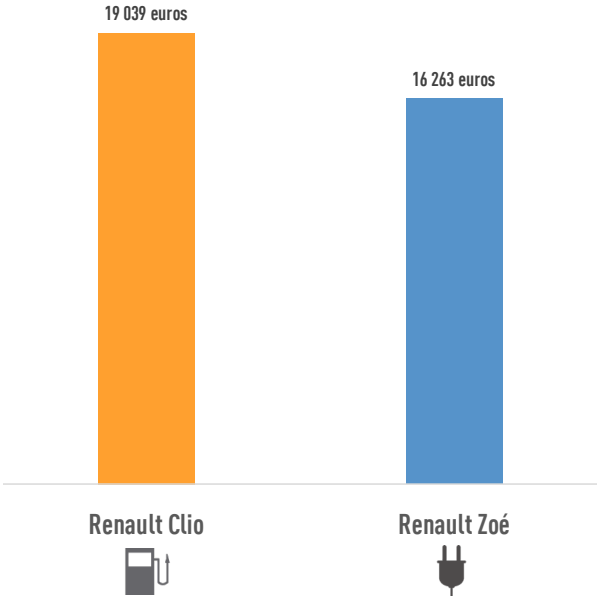
Decreasing price

Batteries represent almost half of the cost of an electric vehicle and the decrease in their price over the last years has been driving down the cost of the car. Battery costs fell from 350-400€/kWh in 2015 to less than 200€/kWh in 2018[61]. The Total Cost of Ownership[62] (TCO) of electric cars is also decreasing and in some cases already competing with ICE cars, especially when the purchase of electric cars is supported by financial subsidies[63]. According to the European Consumer Organisation (BEUC), **owning an electric car is already more affordable over a period of 4 to 7 years than owning a diesel car in Bulgaria, France, Portugal and Spain**[64]. In France for

57. TNS-Sofres, L'Observatoire Cetelem de l'Automobile, 2017.
58. Survey by the Federation of German Consumer Organisation.
59. Caralampo Focas, Panayotis Christidis, *What drives car use in Europe?*, European Commission, Joint Research Centre, 2017
60. Based on a survey led with German and US respondents by McKinsey, 2017
61. France Stratégie, « L'avenir de la voiture électrique se joue-t-il en Chine ? », 2018
62. The Total Cost of Ownership includes all costs related to the car – i.e. purchase price (and depreciation), but also insurance, maintenance and fuel or electricity cost.
63. See research led by Palmer, K., Tate, J. E., Wadud, Z., & Nellthorp, J. (2018). Total cost of ownership and market share for hybrid and electric vehicles in the UK, US and Japan. *Applied energy, 209*, 108-119; BEUC study (2016). "Delivering low carbon cars in the 2020s: Consumer impacts and EU policy implications" and France Stratégie, « Les politiques publiques en faveur des véhicules à très faibles émissions », 2018
64. BEUC, "When will electric cars be an affordable option or European consumers?", 2018

instance, a study found that the Renault Zoé, most sold EV in Europe, is cheaper than a gasoline car over a 4-year period when driving 15,000km/year[65] (see figure 10).

FIGURE 10 ▪ Total Cost of Ownership of a small car (B-segment) over 4 years, 15 000km/year



Note: The study takes into account the purchase price, maintenance, insurance, fuel and financing costs and registration tax.
Source: Jacques Delors Institute, based on UFC Que Choisir, 2018

Additionally, **the market for second-hand EVs can be even more attractive as the high up-front cost of the car is reduced through depreciation**. When the EV second-hand market develops in the years to come, it will offer an alternative that is cheaper in both capital and operational expenditure for consumers. This second-hand market still needs to be better grasped as the lifetime of the battery which also depends on its use by its former owner is difficult to estimate and raises a regulatory vacuum.

Improvements in battery autonomy and charging infrastructure

Range anxiety, while still a major barrier, **is decreasing because of improvements in the battery range and thanks to a growing network of charging points** (fast charging in particular). Furthermore, most of charging is done at home or at the office. Public charging stations are thus mainly needed for long trips (where rail should be preferred to road) and should provide reliable fast charging to make electric mobility attractive to consumers. To ensure that they all benefit from the same conditions, charging points need to be made available for consumers living in shared buildings or not owning a parking place. This should be facilitated with the implementation of the Energy Performance of Buildings Directive, which sets requirements to facilitate the installation of charging points in new and renovated buildings[66].

While EVs are a promising option to replace current diesel and gasoline cars, **a full shift to all-electric will neither reduce congestion and parking space issues, nor resolve air pollution issues in cities**[67]. It may also create in the long run a high pressure for raw material extraction with economic, environmental and geopolitical consequences (see part 1.2.3). To this end, rethinking the way we move and optimising our trips would have a positive impact on

65. « Budget auto : L'électrique, c'est du bonus ! », *UFC Que Choisir*, 10 October 2018
66. Directive (EU) 2018/844 of the European Parliament and of the Council amending Directive 2010/31/EU on the energy performance of buildings and Directive 2012/27/EU on energy efficiency.
67. A share of air pollution (PM2.5) is emitted by brakes and tyres as they wear.

controlling urban sprawl, limiting the use of individual cars and thus making urban space more friendly to all users.

2.1.3 Optimising our mobility: from new tools to societal and behavioural change

Beyond the technological shift to cleaner options, a larger change is expected in mobility and implies societal and behavioural changes. **Reducing the need for transport is the most efficient way to limit energy** devoted to this sector but also all associated externalities, such as congestion, air and noise pollution. Remote work (or tele-working) is an option to reduce the frequency of trips, time spent on commuting and thus energy needs. Such options for employees should be more developed and acknowledged but remain limited to office work. This also implies different urban planning to reduce distances and congestion, improving at the same time the well-being of people.

Experimentation can also encourage a shift to public transport. Many cities, for instance, give free access to public transport during pollution peaks in order to encourage people not to use their cars.

Innovation in mobility

Several conditions make the trend towards a more transport-efficient society possible. Start-ups developing new concepts of mobility are flourishing with new technologies to move around, applications that provide reliable data on all available transport modes and shared services.

To accompany innovation in the field of mobility, the European Startup Prize for Mobility launched in 2017 is an excellent opportunity to develop new companies and ideas. The prize rewarded 10 start-ups to help them develop and many of them are based on concepts with social impact and environmental benefits[68].

With technological and digital opportunities available and the numerous drawbacks of cars, especially in cities, **the concept of Mobility as a Service (MaaS) offers new possibilities by associating different modes** (see Box 5).

Shared transport (e.g. scooters, bikes, motorcycles and cars) is part of such services. Applications based on shared economy like Blablacar have experienced a large success over the last decade proving that individual and collective transportation can be efficiently articulated.

Electric vehicles are very adapted to such services: the more EVs are used, the lower is their environmental impact linked to their production. Besides, **developing electric car-sharing can contribute to acquainting people with EVs**. In a study on car-sharing led in several European countries, most of interviewed users evaluated the technology positively and preferred it to combustion-powered engines[69]. Such services foster "try-out" behaviours and can thus trigger change in the way people think their mobility.

BOX 5 ▪ Mobility as a Service: the future of mobility?

From car ownership to mobility as a service, many options are currently being explored. The European Mobility as a Service (MaaS) Alliance has been created as an EU-wide public-private partnership to reflect on and deploy MaaS in Europe. The Alliance defines MaaS as "the integration of various forms of transport services into **a single mobility service accessible on demand.** [...] For its users, MaaS should be the best value proposition, by helping them meet their mobility needs and solve the inconvenient parts of individual journeys as well as the entire system of mobility services". This includes services as a one-stop-shop:

- Offering diverse and combined transport options: incl. public transport, shared or rented cars (esp. electric), sharing rides, publicly available bikes, taxis;

68. European Startup Prize for mobility, "Mobility Funders and Founders Need to Get Together", 30 April 2018
69. This study was led as part of the EU Horizon 2020-funded project ENABLE.EU. The report on car-sharing can be downloaded here.

- Through one application with real-time information on all modes;
- Paying through one single channel for all modes (comparable to a data plan for example).

Such an initiative was launched in Finland with the MaaS application Whim. The deployment of such systems can be facilitated through an open-data system, like required in Finland from all transport operators and authorities since January 2018. This nonetheless raises the question of user data protection.

Based on the MaaS Alliance's website

2.2 Can European cities lead the clean mobility transition?

As we have seen that the transition to clean mobility needs to occur through a reduction of car use, improved transport services and behavioural change, the role of cities is key in this endeavour and already visible. We highlight in this part the growing efforts on cleaning up urban bus fleets. Such actions in the EU remain nonetheless a drop in the bucket compared to Chinese initiatives.

2.2.1 Cities are the most active players towards clean mobility

Cities are currently key players in the clean mobility transition[70]. **Initiatives of low emission zones (LEZ), congestion prices and diesel bans are currently multiplying all around Europe**. Cities like Paris, Milan, Hamburg and London are planning to implement bans on diesel cars in the years to come. Even Stuttgart, hometown of Mercedes-Benz and Porsche, will forbid the circulation of old diesel cars from 2019[71].

Madrid is also leading by example by aiming at reducing air pollution and improving mobility through an integrated action called 'Plan A' designed in 30 complementary measures[72]. The plan includes the creation of a zero-emission area, a network of intermodal parking space at the outskirts of the city close to public transport stations, investment in cleaner and more efficient public transport, incentives for low-emission taxis and delivery services, limited speed on the road, extension of the bike lanes' network and street improvements for pedestrians.

The **deployment of a clean public transport fleet** is among further actions that cities can undertake. Many cities focus on large vehicles, such as buses and delivery trucks because **these vehicles represent a small share of the fleet but emit proportionally much more.** Since 2016, many local authorities and transport operators and manufacturers work together within the framework of the European Commission-led Clean Bus Deployment initiative. The latter aims at accelerating the deployment of clean alternatively-fuelled buses in Europe. While still quite expensive, electric buses' prices are falling, and more and more cities (e.g. within the C40 cities[73]) are committing to buying only clean buses by 2025. The city of Warsaw for instance is planning to acquire 130 electric buses by 2021[74]. The EU Cohesion Fund will finance about 40% of the EUR 95 million needed. The city, which wants to a become a leader in e-mobility, has already tested e-buses with the domestic Polish manufacturer Solaris[75].

70. The author would like to thank Thomas Mourey from POLIS for his useful insights on the role of cities.
71. "Stuttgart to introduce diesel driving ban in 2019" , DW, 11 July 2018
72. See "Plan de Calidad de aire de la ciudad de Madrid y Cambio Climático (PLAN A)" by the city of Madrid
73. C40 is a network of almost 100 large cities worldwide cooperating, sharing experiences and implementing measures to address climate change.
74. Keeping in mind that such buses still have a large CO_2 impact considering the high carbon intensity of electricity in Poland. However, EU policy to decarbonise the electricity sector will support the progressive reduction of emissions from transport running on electricity.
75. "130 electric buses for Warsaw funded with €41m through EU", electrive.com, 21 January 2018; European Commission, "130 new electric buses for Warsaw thanks to EU Cohesion policy", 18 January 2018

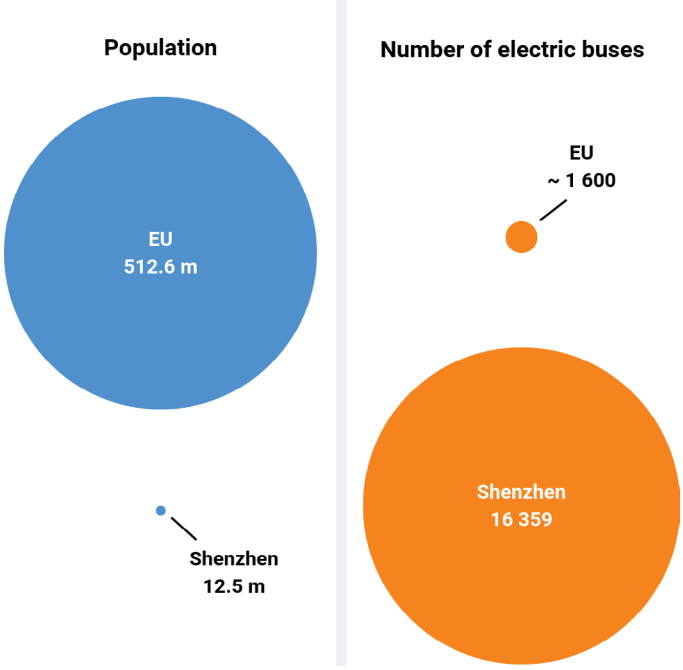
Joint experimentation where cities pursue similar objectives and share experiences –e.g. through networks like Polis or Horizon 2020 projects- **can have a domino effect**. For instance, the recently finished ZeEUS project (Zero Emission Urban Bus System) tested innovative electric bus technologies and the project FREVUE (Freight Electric Vehicles in Urban Europe) brought together cities and operators to improve urban logistics with electric freight vehicles. These demonstrators provide experimentation in diverse regulatory settings and practices to scale up[76].

2.2.2 Without EU action, European cities remain limited in their scope: the case of electric buses

Investment in European cities remains nonetheless limited as illustrated by the slow shift to electric buses: e.g. some cities launch experiments with just one zero-emission bus and most projects remain below 100 vehicles. **There is a need to scale-up these initiatives to achieve economies of scale and contribute to climate goals** – as the Clean Bus Deployment initiative does.

Conversely, in China, subsidies from local and national authorities for electrification of buses and charging infrastructure deployment are massive. Bus operators can also rely on leases if they are not able to provide funding upfront. **The city of Shenzhen deployed a fleet of 10,000 new buses in 2016 only.** As a matter of comparison, there were almost 370,000 electric buses in China in 2017, whereas **in Europe, the stock of electric buses accounts for less than 2,000 vehicles**[77] (see figure 11 for an illustration of the order of magnitude).

FIGURE 11 ▪ Comparison of the e-bus fleets in the EU and in the Chinese city of Shenzhen



Data: Jacques Delors Institute, based on IEA, Global EV Outlook; Stefan Baguette and T&E data, 2018

Not only 9,500 new zero-emitting buses are deployed in Chinese cities every five weeks, but the country is also the main provider for electric buses worldwide[78]. According to Stientje van Veldhoven, Dutch State Secretary for Infrastructure, some companies and cities would like to buy a fleet of electric vehicles but they struggle to find a European manufacturer that could positively answer their requests in terms of number of vehicles and delivery deadlines,

76. See the projects' websites for more information: http://zeeus.eu/ and https://frevue.eu
77. IEA, Global EV Outlook 2018, p.29
78. World Economic Forum, "China is adding a London-sized electric bus fleet every five weeks", 26 April 2018

and they eventually turn towards Chinese companies (the Chinese manufacturer BYD is currently one of the largest electric bus suppliers in Europe)[79].

While European bus manufacturers are extending their fleets, e.g. Solaris in Poland and VDL in the Netherlands, **the shift towards cleaner solutions in the EU could be accelerated through the promotion of innovation-based public procurement** to provide market certainty and encourage the private sector to develop cleaner solutions, as intended by the Clean Vehicles Directive currently under review[80]. **Defining 'missions' of carbon-neutral cities** in the future EU research and innovation programme **could also support faster deployment of clean alternatives**[81].

Additionally, from an industrial perspective, the production of electric buses and in particular of their batteries in the EU would need to reach similar levels to Chinese production in order to be profitable. The challenge from there is to foster a demand from local authorities that will absorb such a production and be able to finance bus purchases. It would be beneficial for the EU to analyse the Chinese success in this field and study how the roll-out of e-buses in the EU can be accelerated[82].

2.2.3 Local action can contribute to territorial inequalities

Cities can be considered as experimentation labs to test and assess new projects. Nonetheless, their experiments take place locally, in a fragmented approach and thus lack economies of scale. This is one of the reasons for the shortcomings of the car-sharing system in Paris, Autolib', which was judged to be too costly to carry on with its service used by over 100,000 customers. Furthermore, European cities have a limited scope for action in terms of scale and areas of competence for regulation.

Their initiatives can have a positive snowball effect but they can also contribute to increasing social injustice and fragment the EU single market. While 75% of Europeans live in urban areas, a share of Europeans live in areas with poor public transport options. This way, **sole action of cities in urban areas can dig further disparities between urban, peri-urban and rural areas in terms of access to transport**. Those living further or with no alternative options can be isolated, e.g. in the case of diesel bans or urban tolls, many people need to drive long distances and have no possibility to invest in cleaner vehicles. **A short-term solution is to implement park-and-ride areas** close to stations on the outskirts of cities, where people living further can come by car, park and continue their trip to the city by public transport (see Madrid's Plan A).

Furthermore, impacts of bans on old polluting cars need to be assessed and anticipated as **the most affected by such restrictions are likely to be low-income households unable to get rid of an old polluting car and to buy an energy-efficient one**. Such divides need to be prevented as they can fuel social unrest and widen inequalities. Beyond an impact assessment, preventive measures should be implemented to identify most affected households and provide at least efficient public or on-demand transport not to isolate them through a circulation restriction.

To cope with these two problems, the paper supports the proposal for a Social Pact for the Energy Transition (see part 3.3).

79. Presentation at a conference organised by the Dutch Embassy in Paris on the roll-out of electric vehicles, 09 May 2018
80. The ongoing review of the Clean Vehicles Directive (2009/33/EC) plans to improve sustainability requirements of EU public procurement. See also T&E, "Electric buses arrive on time", November 2018
81. LAB-FAB-APP report, 2017, p.12-15. And see forthcoming Jacques Delors Institute's brief on Horizon Europe by Thomas Pellerin-Carlin.
82. "Electric Buses Can Save Local U.S. Governments Billions. China's Showing Us How It's Done", Forbes, 21 May 2018

2.3 The Clean Mobility Package: will the EU deliver?

At the EU level, three packages on clean mobility proposed since November 2017 have designed a comprehensive framework with a large set of legislative proposals related to clean, connected, automated and safe mobility. Among the main files aiming at decarbonising the sector, we focus on the controversial review of standards for CO_2 emissions from cars and vans, the loud and ambitious initiative for battery production in the EU and the plan to accelerate the roll-out of alternative fuels infrastructure in Member States.

2.3.1 Limiting CO_2 and pollutants' emissions: EU standards are essential but are not sufficient

CO_2 emission standards

CO_2 emission standards are an essential tool to limit emissions on the road. **By setting a CO_2 cap for the average emissions of each manufacturer's car fleet, EU regulation sends a clear signal to the industry and offers a stable framework for the years to come**. Improvements in ICE technology helped manufacturers to achieve targets to date and do not sufficiently encourage them to shift towards the production of zero-emission vehicles[83].

Agreed in December 2018, **the 2030 objective requires a reduction of 37.5% in CO_2 emissions** with an intermediary target of 15% by 2025. It is interesting to note that this file is a rare case where the initial Commission's proposal setting a 30% emission reduction target for 2030 was less ambitious than the target agreed on in the Council (35%) before trilogue. Following the alarming October 2018 IPCC report, the Council's position has nonetheless been generally criticised as too weak, including by Denmark, Ireland, Luxembourg, Netherlands, Slovenia and Sweden which stated their disappointment with the less ambitious target[84].

Generally considered as a positive outcome of negotiations, the regulation includes several elements impeding its general ambition[85]. Yet, to reach carbon neutrality, cars will have to emit no CO_2[86]. The Commission is supposed to review the effectiveness of the regulation by 2023 and reflect on the inclusion of life-cycle emissions from cars in future regulation. This regulation paves nonetheless the way towards more efforts in developing clean car fleets and can enable a general trend that could outperform the objectives once clean vehicles' sales gain in volume.

Emission limits for harmful pollutants

Since the 1990s, **the EU has been protecting its citizens through regulations called Euro emission standards that put a legal limit on the pollution emitted by newly sold cars**[87]. These have even been transposed in other countries and are becoming stricter every five years. These Euro emission limits have been driving down emissions from pollutants, mainly nitrogen oxide (NOx) and particulate matter (PM), that have no impact on climate change but do severely harm human health (see section 1.2.2).

Limits to the efficiency of standards

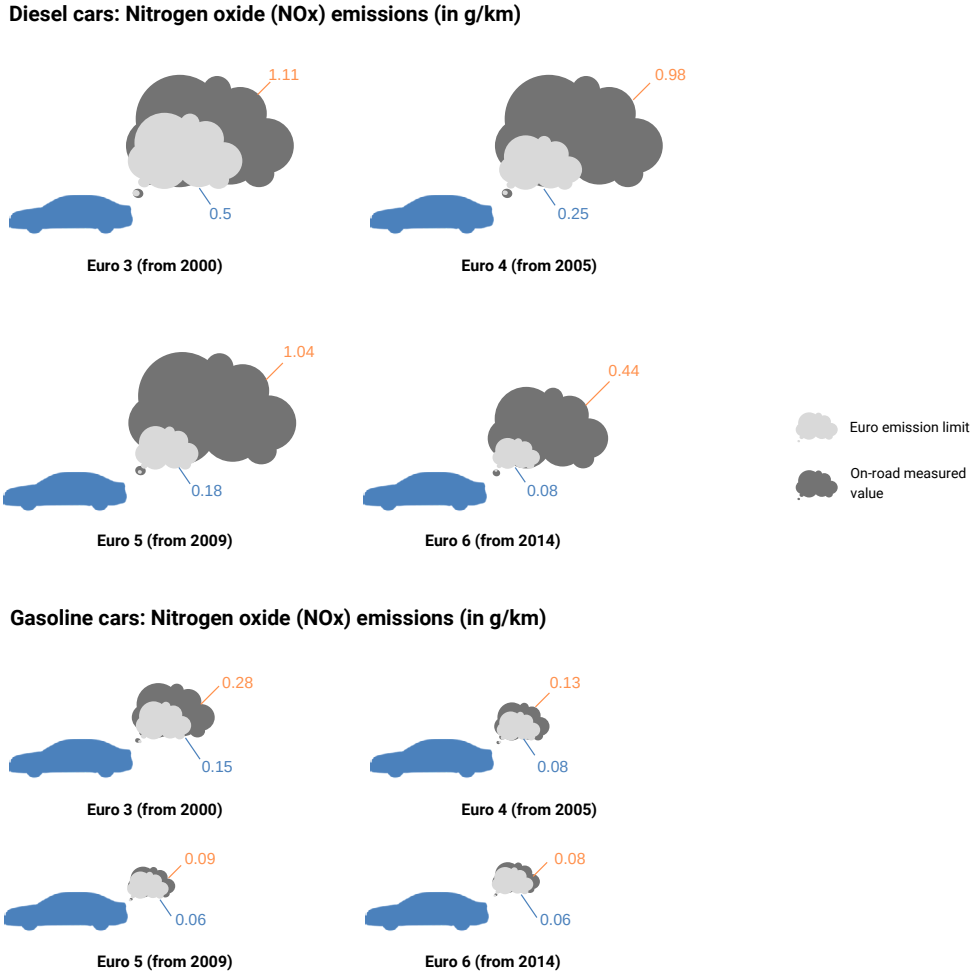
Nonetheless, the **Dieselgate revelations and unsatisfactory enforcement of EU law have weakened the credibility of European emissions standards**, especially in view of more protective and

83. Regulation (EU) No 333/2014 of the European Parliament and of the Council of 11 March 2014 amending Regulation (EC) No 443/2009 to define the modalities for reaching the 2020 target to reduce CO 2 emissions from new passenger cars
84. "'Disappointed' EU capitals agree on 35% car CO_2 cuts", *Euractiv*, 10 October 2018
85. For instance, the car weight component allows heavier cars (e.g. SUVs) to emit more CO_2.
86. France Stratégie, « Le véhicule propre au secours du climat », 2017
87. Euro emission standards aim at limiting the levels of pollutants, such as NOx and PM, contributing to air pollution; different standards limit CO_2 emissions, which is a gas contributing to global warming.

better enforced US standards. This can hinder European car manufacturers' competitiveness worldwide as they may struggle to comply with stricter standards on foreign markets[88].

Based on real-world driving conditions, it appears that **diesel cars in Europe emit significantly more NOx than the emission limit**[89]. Gasoline-fuelled cars emit less NOx and although they are also in excess, they are closer to the Euro emission limit (see figure 12).

FIGURE 12 ▪ Comparison between NOx emissions limits and on-road measured values



Source: Jacques Delors Institute based on ICCT Pocketbook 2017, CONOX Database/IVL, and on Transport & Environment and TRUE Initiative data (based on over 300 000 measurements between 2011 and 2017).

Additionally, in July 2018, the European Commission's Joint Research Centre identified loopholes in the testing for CO_2 emissions. **Carmakers might be overestimating the CO_2 emissions in the tests in order to be able to conform with future more stringent standards**. Figures provided by the JRC show that declared emission values are on average 4.5% higher than measured values. This is happening at a transition time in the emission test procedure, which

88. Hooftman, N., Messagie, M., Van Mierlo, J., & Coosemans, T. (2018). A review of the European passenger car regulations–Real driving emissions vs local air quality. *Renewable and Sustainable Energy Reviews, 86,* 1-21.
89. ICCT, "European Vehicle Market Statistics, Pockerbook 2017-2018", 2018; also supported by recent study by NGO Transport & Environment: "Dieselgate, three years on: 43 million dirty diesels on our roads – and still growing", 2018

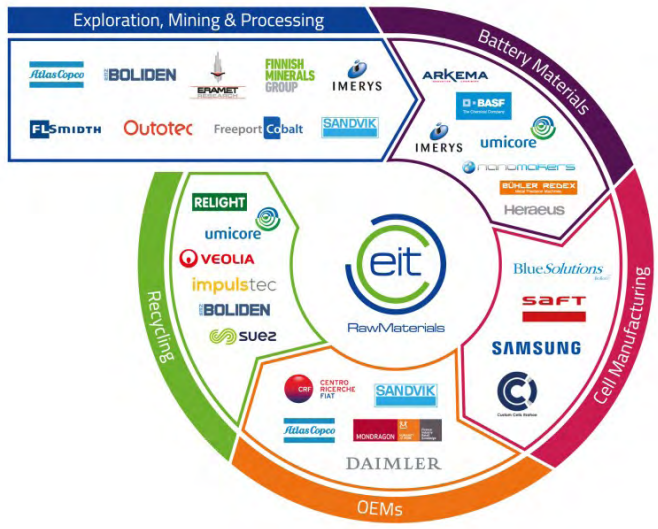
is supposed to provide "emission values closer to those in real-world conditions"[90]. Exploiting this testing shift to inflate official emissions declared by carmakers in 2021, i.e. the starting point for the percentage emission reduction by 2025 and 2030, can thus weaken the targets and concretely result in cars emitting more CO_2 than ambitioned on European roads in 2030.

Emissions standards are key to providing stability for investment and to push the development and fast deployment of clean options by market players. For this reason, emissions tests should be robust, more strictly enforced and controlled, to avoid and sanction any further fraud.

2.3.2 An EU industrial strategy for the energy transition: a step forward with the European Battery Alliance

To be able to fully develop clean alternatives such as electric vehicles and avoid reliance on competitors, Europe needs domestic cell manufacturing, which is currently missing. With the launch of the European Battery Alliance (EBA) by the European Commission Vice-President Maros Šefčovič in October 2017, the EU attempted to jump on the bandwagon of electric mobility, already moving fast, especially in China. It also highlights its **offensive approach to develop a strong common industrial policy on a critical component of the energy transition**. In this regard, this initiative goes beyond the sole battery technology as it mobilises a whole industry, requires highly-skilled workers, pushes for more R&D and reasserts European leadership in sustainable development with an approach that emphasises environmental concerns, e.g. through the promotion of battery recycling, local production and reliance on decarbonised electricity[91]. In terms of resources for instance, **the added value of the European approach is to exploit raw materials in the most sustainable manner**, i.e. identifying deposits in Europe, recycling old electronics, developing a recycling chain for future batteries and leading research to reduce the reliance on raw materials in future battery technologies (see figure 13). This should ensure a model more sustainable in the long term, essential to avoid overexploiting resources and repeating lock-ins of the past.

FIGURE 13 ▪ An example of the circular battery value chain developed by EIT RawMaterials



Source: EIT RawMaterials industry partners role in the Battery Value Chain[92]

90. JRC, Non-paper "CO_2 Regulations for cars/vans. Risk of inflated starting point for calculating the 2025 and 2030 targets". The NEDC procedure (New European Driving Cycle) exists since the 1980s. The new procedure WLTP (Worldwide Harmonised Light Vehicle Test Procedure) is carried out to estimate fuel consumption and CO_2 emissions of new cars more accurately from 2017 onwards. Additionally, the Real Driving Emissions (RDE) procedure now measures emissions of NOx and ultrafine particles in real-life conditions.
91. Carole Mathieu, "The EU Battery Alliance: Can Europe avoid technological dependence?" Ifri, Edito Energie, 20 February 2018
92. "EIT RawMaterials contribution to the European Battery Alliance. Sustainable Materials as Key Enablers for Future Mobility", 17 July 2018

Through this Alliance, the EU provides a platform where European stakeholders (e.g. industrial, institutional) can cooperate and rely on various instruments (e.g. financing support and loans, research projects) towards the development of battery production.

Concretely so far, the most mediatised battery production project was launched by the company Northvolt. It plans to build a gigafactory in Sweden, where it can locally access raw materials as well as cheap and low-carbon energy. The project received a loan from the European Investment Bank[93] and production is set to start in 2020 to eventually reach a level of sales of over EUR 3 billion[94]. The companies Saft, Siemens, Solvay and Manz are joining forces in a R&D partnership on advanced high-density lithium-ion and solid-state battery technology[95]. Several Asian companies also plan to build battery factories in Europe: e.g. Samsung SDI in Hungary, LG Chem in Poland and recently the Chinese companies CATL and BYD have also announced their intention to operate battery factories in the EU[96].

If the EBA proves efficient, it could serve as a model for further initiatives of this sort to develop European leadership in other fields. This could for instance be done to develop the potential of green hydrogen. However, the EBA being mainly a political tool to create momentum and push industrial initiative, its future remains to be seen with the new Commission and the priorities that it will elaborate in the second half of 2019.

2.3.3 Planning for the socially-fair roll-out of charging infrastructure for electric vehicles

The perception of insufficient charging infrastructure is still one of the reasons why consumers refrain from buying EVs. As part of the Clean mobility package, the action plan on Alternative Fuels Infrastructure aims at defining actions to complete national plans "to help create an interoperable EU backbone infrastructure by 2025 [...] so that vehicles and vessels can be easily used across borders and for long distances."[97]. This framework insists on interoperability of services and argues for the need of public-private investment with synergies of different levels of public funding.

With some 133,000 publicly accessible charging positions throughout the EU in 2018, the risk of "running out of battery" is decreasing, especially on main highways and in cities[98]. As seen in the Netherlands for instance (see Box 6), the country relies on dense charging infrastructure that developed through local programmes co-financed by the EU.

The network of charging points remains nonetheless patchy throughout Europe, with less coverage in Eastern European countries[99]. The Czech Republic, for example, is currently investing to deploy EV charging stations throughout the country with co-funding coming from the European Regional Development Fund and the Cohesion Fund[100]. Many cities worldwide also implemented policy measures to accelerate deployment of charging infrastructure and their outcomes could be used for potential replication in the EU (see figure 14).

93. European Commission, "EU Battery Alliance: Major progress in establishing battery manufacturing in Europe in only one year", 15 October 2018
94. Thomas Pellerin-Carlin, Jean-Arnold Vinois, Sofia Fernandes and Eulalia Rubio, "Making the Energy Transition A European Success", Jacques Delors Institute, June 2017, p.74
95. Reuters, "Saft creates European battery alliance with Siemens, Solvay and Manz", 22 February 2018
96. "European Lithium-Ion Battery Dilemma — Build Or Buy?", Clean Technica, 5 June 2018
97. Communication from the European Commission, Towards the broadest use of alternative fuels - an Action Plan on Alternative Fuels Infrastructure under Article 10(6) of Directive 2014/94/EU, including the assessment of national policy frameworks under Article 10(2) of Directive 2014/94/EU, 8 November 2018
98. European Alternative Fuels Observatory, 2018
99. European Commission, Electric vehicles charging points, 2016
100. "Czech Republic invests in alternative fuel infrastructure", *Eltis*, 14 February 2018

While not developed here, **the impact of charging infrastructure installation (especially fast charging points) on the electricity grid need to be assessed** and accompanied by adequate investments. This also raises the question of the charging time and moment, and how high demand can put pressure on the network.

BOX 6 ▪ The Netherlands: a dense EV charging infrastructure developed locally with EU funds

Together with Norway, the Netherlands is an international frontrunner when it comes to electric transport and related infrastructure. In 2015, the country had the fourth largest EV fleet in the world. Its EV fleet is rising fast – from 30,000 EVs in December 2013 to 115,000 in December 2017.

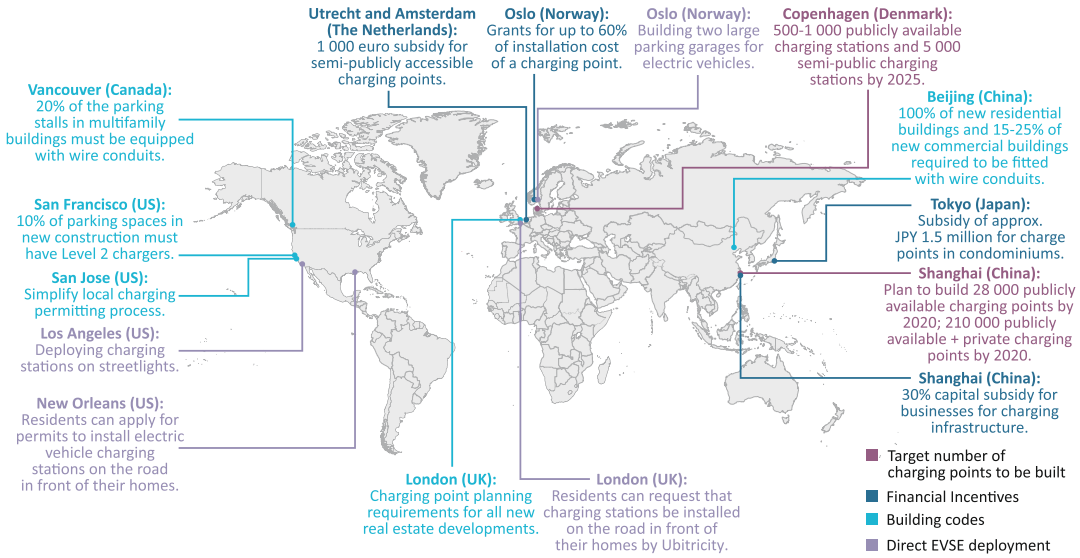
This trend has been encouraged by subsidies and fiscal policies for the purchase and use of EVs. Measures include a vehicle purchase tax and a circulation tax. However, a decrease in subsidies (esp. for PHEVs as they were not used energy-efficiently) led to a sudden collapse in sales, plummeting from 9.7% of sales in 2015 to 2.3% in 2017.

In terms of charging infrastructure, it has developed fast thanks to a financial impetus of the government, municipalities and market players. The country created focus areas in 2009 –mainly large cities like Amsterdam and The Hague- to deploy charging infrastructure expecting a 'snowball effect' in the country. Regions surrounding these cities are nowadays cooperating to quickly roll out charging infrastructure in public spaces. Local authorities gave a strong impulse: they used EU funding to install charging infrastructure and created local incentive programmes for EVs. In July 2017, the country was leading in Europe with 30,500 charging positions.

Range anxiety is reduced thanks to fast charging points available on main roads. While they are exploited by private players, they should be interoperable and accessible for all EVs. To offer the same opportunities to consumers living in houses and in buildings, consumers can also request publicly accessible charging stations to be installed close to their home.

Based on "Vision on the charging infrastructure for electric transport" study by Bank of America Meryll Lynch, 2017; "Charging Infrastructure for Electric Vehicles in Germany", 2015; Global EV Outlook – OECD/IEA 2016; France Stratégie, May 2018.

FIGURE 14 ▪ Examples of policy instruments promoting charging infrastructure deployment in major cities



Source: Global EV Outlook 2018: Towards cross-modal electrification, OECD/IEA, 2018, p.50

3 . PROPOSALS FOR A CLEAN MOBILITY TRANSITION THAT BETTER SERVES EUROPEANS

Considering the challenges implied by the decarbonisation of transport and the importance of car use and car manufacturing industry in the EU, the transition to clean mobility requires action at different levels. This paper provides three policy recommendations to the European Commission, European Parliament and Council of the EU –i.e. national governments, to enable a socially-fair clean mobility transition that delivers on the EU's objectives laid out in its 2050 long-term strategy (EU LTS)[101] and in the Paris Agreement.

The clean mobility transition has to be considered in a systemic approach, i.e. an approach that is cross-sectoral, that takes into account societal and social consequences, that is consistent with long term objectives, and articulates all tools towards clean mobility (energy sufficiency and efficiency, modal shift, clean energy sources and technologies). This is why our proposal to 1) set a timeline for the end of diesel and gasoline car sales in Europe, 2) accelerate the roll-out of fast charging points for electric vehicle, and 3) introduce a Social Pact for the Energy Transition that includes a transport component, are to be considered as three key pieces in a more comprehensive endeavour.

3.1 Set a clear target for the end of diesel and gasoline car sales in Europe

The EU LTS and international negotiations at COP24 reiterated the urgency to fight climate change. For transport, current CO_2 emission limits represent an insufficient tool to embrace a structural and timely change. If we want to reach climate neutrality[102] and considering areas more difficult to decarbonise (e.g. military, aviation), there is no future for combustion-powered vehicles. **A clear timeline setting a date for the end of sales of diesel and gasoline cars in Europe and coherent with the 2050 objective would have the advantage of providing a progressive calendar for phase-out, so that all territories, sectors, businesses and workers affected have a long-term vision and can adapt accordingly.** A harmonised and ambitious timing decided at the EU level would be in the interest of EU Member States and would support common planning and a joint agenda for manufacturers[103].

This could start by setting a date for the phase-out of two-wheelers with internal combustion engines. Policy-makers should furthermore lead by example to make this shift more acceptable for citizens, e.g. all EU and national institutions should renew their fleet with zero-emission vehicles.

The more upfront this timeline is planned, the better the adaptation can be. This can provide not only for changes in production but also for jobs, to plan training and site re-adaptation. Such a measure needs of course to be accompanied by a strong plan for jobs, which is part of the Social Pact for the Energy Transition proposed by the Jacques Delors Institute[104] (see part 3.3).

101. See the Commission's vision towards a climate-neutral Europe by 2050: https://ec.europa.eu/clima/policies/strategies/2050
102. Climate neutrality means reaching net zero carbon emissions. This implies that for each gram of carbon that is emitted, one gram needs to be captured.
103. Several EU countries and cities already pledged to end sales of new gasoline and diesel cars (e.g. Ireland, Slovenia and the Netherlands by 2030, France and the UK by 2040).
104. Jacques Delors, Sofia Fernandes, Thomas Pellerin-Carlin, "Europe needs a Social Pact for the Energy Transition", Jacques Delors Institute, January 2018

3.2 Accelerate the roll-out of fast charging points for electric vehicle throughout the European Union

Improvements in charging infrastructure are still needed to ensure the territorial cohesion of the Continent in the clean mobility transition and that no territory is left behind. **While a network of charging points for electric vehicles already covers the EU, it does not yet ensure a service that is reliable enough to motivate a shift towards electric vehicles and to allow smooth travelling throughout Europe**, especially in Central-Eastern European countries. Indeed, practical aspects such as the diversity of operators and prices, the difficulty to identify charging stations and the length of charging tend to fuel range anxiety and discourage some potential buyers.

Visible efforts should thus be pursued towards the implementation of a backbone network of electric stations on main EU roads. The implementation of this network can be either achieved by EU funds, including from the Connecting Europe Facility funding instrument (CEF), or by regulation to encourage or impose on Member States to deploy such infrastructure. **This core network should be coupled with a plan for installing charging points in more peripheral areas in the whole Union to ensure territorial integration and avoid creating disparities among regions.** Visible communication around this progress is further needed to reduce the perception of range anxiety.

The European Commission should join forces with like-minded public and private actors[105] to equip all remaining European highways, cities but also more remote areas with charging points for electric vehicles by 2025. Such a project may benefit from the financial support of InvestEU. In exchange for this financial public support, the EU should ensure that:

- Any electric vehicle sold in Europe can be plugged on those EU-supported charging points (i.e. interoperable network, payment services);
- The roll-out should not be limited to the most densely populated areas (e.g. European metropolis) but also cover peri-urban and rural areas as to ensure territorial cohesion as well as access to electric vehicles by all Europeans;
- EU support should be clearly visible as to show citizens that their taxpayer money is put to good use by the EU[106].

3.3 Elaborate a Social Pact for the Energy Transition that includes a transport component[107]

In 2017, the Jacques Delors Institute argued that **the Energy Union requires a Social Pact for the Energy Transition to ensure its political sustainability, to deliver more quality jobs, to fight air pollution and to eradicate energy poverty**[108]. All these aspects also apply for transport as a key sector for the energy transition.

105. Example of those actors are States and cities already pushing in favour of electric vehicles (e.g. the Netherlands, Denmark, Poland, France). Companies would also be involved, such as electricity distribution system operators who would like to avoid that a disorganised roll-out of charging points disturbs the stability of local electricity grids. Companies like Total may also be involved, both because they are in the electric battery business, and because they need to ensure the future of the refilling stations they own.

106. Thomas Pellerin-Carlin, Jean-Arnold Vinois, Sofia Fernandes and Eulalia Rubio, "Making the Energy Transition A European Success", Jacques Delors Institute, June 2017, p.50

107. The author would like to thank Sofia Fernandes for her support with this part.

108. See "A social Pact for the Energy transition" by Sofia Fernandes; in Thomas Pellerin-Carlin, Jean-Arnold Vinois, Sofia Fernandes and Eulalia Rubio, "Making the Energy Transition A European Success", Jacques Delors Institute, June 2017

Employment

The shift towards clean mobility involves changes in the industry's current business models. Focusing in this paper on the car industry which is on the edge of this transition, **the shift from internal combustion engine technology to electric motors impacts many companies and jobs along the value chain**. The transition to electric mobility will lead to the creation of new jobs (e.g. in the production of batteries), while some existing jobs will be redefined (e.g. manufacturing) and other jobs will tend to disappear (e.g. fuel extraction and refining). A study by Cambridge Econometrics expects this transition to create 206,000 net additional jobs in Europe by 2030, mainly in the sectors of construction, services, electricity, hydrogen and manufacturing[109].

A main lever for action is education and training. First, it is essential to stop training young people for fossil fuel jobs that will disappear in the decades to come. Second, those current workers who will be impacted by the sector transformation should be, whenever necessary, offered retraining schemes that can allow them whenever relevant to develop new competences to find another job. This can be done internally by companies or organised by public authorities and co-funded by the EU e.g. through its European Globalisation Adjustment Fund[110]. Such a project also needs to be accompanied locally with social partners.

Finally, the shift towards cleaner alternatives in the sector is just a first step of transformation. The developments of automation indicate a possible future with an even deeper change in jobs, essentially losses in transport services (e.g. truckers, taxis) and new opportunities for digital and cybersecurity jobs. If the current transition is smoothly accompanied for workers, future developments will also be easier to anticipate.

Air pollution

Beyond employment in this field, this transition also involves social aspects that affect Europeans as citizens and consumers. Urban congestion and road transport strongly contribute to air pollution, with serious consequences for health. **Robust standards for air quality need to be continuously ensured to prevent the possibility for circumvention**. Most importantly, consequences of cheating such as Dieselgate should be strictly dealt with and the victims properly compensated. The New Deal for Consumers proposed by the Commission in April 2018 is a first step in this direction, e.g. with more adequate tools for European consumers, such as collective redress and more facilitated cross-border action, to sue companies that breached their rights[111].

Social and territorial inequalities

Furthermore, as seen in part 1.1.2, transport represents a significant expenditure in many Europeans' budget. Similarly to the impact of an increase of energy prices on low-income households[112], a rise in the price and in the taxation of fossil fuels for tanking their cars makes them pay more for its use. Meanwhile, **subsidies for purchasing electric cars tend to mainly benefit the richer as the upfront investment costs in such cars remain high and a second-hand market for EVs is only emerging.** As formulated by researcher Georg Zachmann from Bruegel: "owners of a second-hand Dacia will pay the fossil fuel taxes that will be used to pay for a tax break for people to buy a luxurious Tesla"[113]. National authorities could reduce

109. Cambridge Econometrics, "Fuelling Europe's Future: How the transition from oil strengthens the economy", 20 February 2018
110. Sofia Fernandes and Justine Daniel, "Towards a European Transition Support Fund", Jacques Delors Institute, October 2018
111. European Commission, "A New Deal for Consumers: Commission strengthens EU consumer rights and enforcement", Press Release, 11 April 2018
112. Thomas Pellerin-Carlin, Jean-Arnold Vinois, Sofia Fernandes and Eulalia Rubio, "Making the Energy Transition A European Success", Jacques Delors Institute, June 2017, p. 198
113. Georg Zachmann , "Distributive effects of climate policies", Presentation, Bruegel

this discrepancy, at least in the first years of EV deployment, by offering higher EV purchase subsidies for low-income households.

Inequalities related to transport are also linked to territorial differences. The shift towards more efficient public transport is mainly promoted in cities and peri-urban areas, but is less likely to occur in rural areas where people strongly depend on their cars and where developing a dense public transport is too challenging. Policy can accompany this trend for instance by promoting on-demand transport services.

The protests of the 'Yellow vests' against the rise in fuel prices that started in November 2018 in France are a critical example of how a tax on energy products can raise opposition. Such measures need to take into account inequalities in the population and prevent opposition to urgently needed climate policies.

Introducing a Social Pact for the Energy Transition would signal that European leaders recognise the imperative to ensure a just and inclusive transition. The transition to clean mobility by its major impacts on employment, public health and vulnerable households is an essential component of such a Social Pact. As seen with Dieselgate's potential outcome of more polluting diesel dumping in Central and Eastern European countries in the years to come, the EU should protect all Europeans equally against air pollution. Measures thus need to be taken at all governance levels to accompany such changes, but visibility and clear signals at the EU level would show its approach of an energy transition that is socially sustainable and that can benefit all European citizens.

CONCLUSION

The clean mobility transition goes beyond a shift from fossil fuels to cleaner energy sources. It implies rethinking our daily mobility as a whole. To realise a transition from today's dirty mobility system to tomorrow's clean mobility system, there is no silver bullet. The transition requires a comprehensive policy that builds on several elements: better urban planning, reduction and optimisation of our mobility needs, digitalisation, new business models, shared economy, behavioural changes and electrification.

The development of electric vehicles is one aspect where the EU needs to act swiftly, with a long-term and comprehensive vision of the energy transition. The European car industry has slowed down the development of electric vehicles in Europe. Dieselgate has eroded citizen trust in carmakers and politicians alike. Now, China and the US are leading the electric vehicle race, with Europe at risk of losing key segments of its economy and jobs.

Cities have meanwhile been playing a positive role. They now need support at national and EU level to achieve economies of scale. For instance, there are today more electric buses in the Chinese city of Shenzhen alone than throughout the European continent. EU action is also paramount to prevent further territorial inequalities between cities and rural areas, between the West and the East of the EU.

The EU has already laid the foundations to make the clean mobility transition a European success with more stringent CO_2 standards for cars, the European Battery Alliance and pushing for the roll-out of electric charging infrastructure. With European elections approaching, what can forthcoming European decision-makers do to deliver better and cleaner transport for all Europeans?

This paper argues for a more comprehensive approach of this transition with three proposals, starting with a timeline for phasing out diesel and gasoline cars in Europe. The EU should also ensure that no territory is left behind by accelerating the roll-out of fast charging points for electric vehicles throughout the EU. While the French 'yellow vests' movement raised the question of transport affordability, all social aspects of the mobility transition should be part of a Social Pact for the Energy Transition, so that the future mobility system offers clean, fair and better opportunities for all Europeans.

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