BRIEFING

European Parliament

Electric road vehicles in the European Union

Trends, impacts and policies

SUMMARY

Technological advances and societal changes have triggered a drastic evolution in mobility. Alongside other trends, such as digitalisation, autonomous driving and shared mobility, electric mobility is also gaining momentum. Electric mobility could help the EU to achieve its goals of reducing greenhouse gas emissions, air pollution, noise and dependence on oil. However, the extent of this help will depend on a number of factors, such as the share of electric vehicles in the overall vehicle fleet and how environmentally friendly electric vehicles can remain throughout their life cycle.

Global sales of new electric road vehicles have been growing significantly in recent years, largely driven by the mass expansion of this mode of transport in China. Despite its rapid growth, the EU market for such vehicles is still small, and largely dependent on support policies. Most electric road vehicles are concentrated in a few northern and western Member States, although southern and eastern ones have recently recorded the biggest sales growth.

Over the years, the EU has taken various actions to support electric mobility. For instance, EU-level measures have been encouraging the use of renewable electricity and smart charging; helping to develop and standardise charging infrastructure; and supporting research on batteries. Local, regional and national-level incentives (such as the introduction of lower taxes or the provision of free public parking for electric vehicles) are also promoting electric mobility. Countries that offer generous incentives and good charging infrastructure typically have a bigger market share for electric road vehicles.

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Glossary

Battery electric vehicle (BEV): a vehicle powered solely by an electric motor and a plug-in battery

Electric bike (e-bike): an electric power-assisted bicycle using a battery pack and a motor.

Electric mobility: the use of vehicles that are powered by one or more electric motors for propulsion ('electromobility' or 'e-mobility')

Fuel-cell electric vehicle (FCEV): a vehicle that runs on electricity using hydrogen from an on-board tank that is combined with atmospheric oxygen

Hybrid electric vehicle (HEV): a vehicle that relies on a conventional combustion engine as its main source of energy, but uses an electric motor and battery as a complementary power source

Plug-in hybrid electric vehicle (PHEV): a vehicle that is powered by a combination of an electric motor and a plug-in battery, on the one hand, and an internal combustion engine, on the other, allowing these to work either together or separately

Range-extended electric vehicle (REEV): a vehicle powered by an electric motor and a plug-in battery. The auxiliary combustion engine is used only to supplement battery charging.

Sources: Electric vehicles in Europe, 2016 and Charging infrastructure for electric road vehicles, 2018.

Introduction

With advances in technology and changes in society, the way people and goods travel from point A to point B on the road is evolving drastically. In general, cars and other vehicles are becoming increasingly efficient, cleaner, automated and connected. More and more people are open to car-pooling, car-sharing and ridesharing. As demand for mobility rises, the transport network grows and becomes increasingly congested. Along with these trends, electric vehicles (whether hybrid or all-electric) are also gaining in popularity.

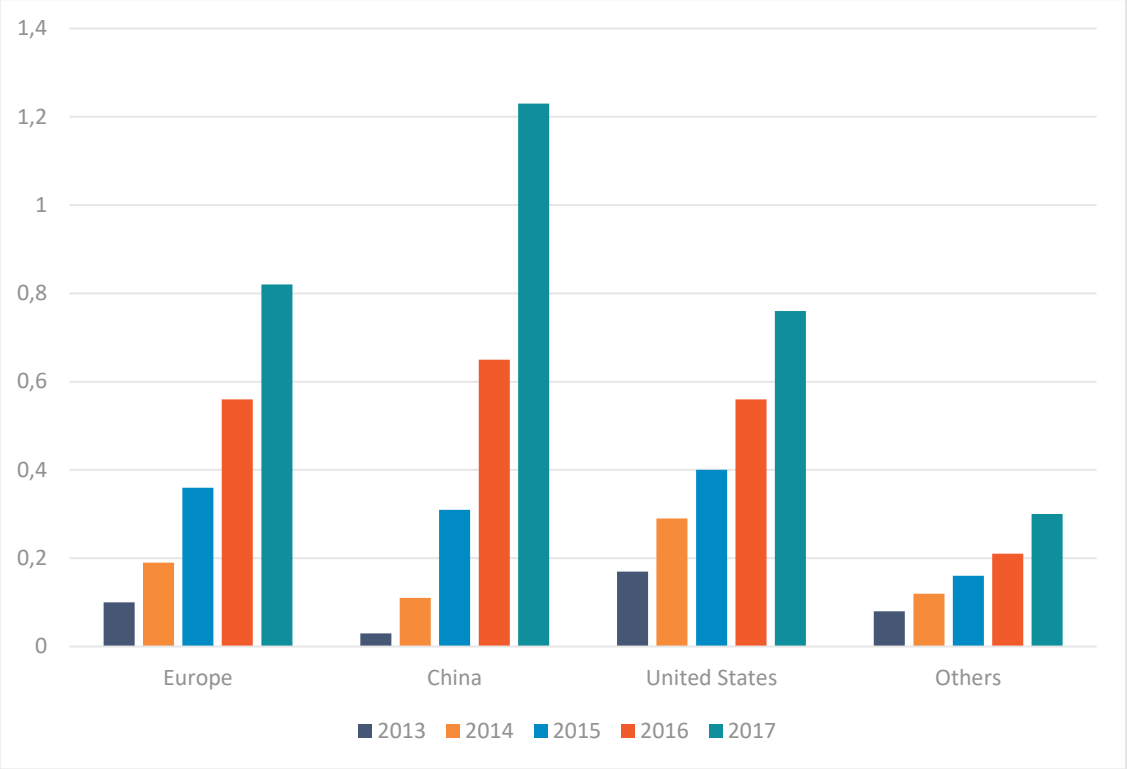
Electric vehicles are not a new invention. They were among the first vehicles in the 1800s, and by 1900 accounted for around a third of all vehicles on the road. However, battery and electrical network weaknesses and the rise of the cheap oil era, together with the technological advancement of diesel and petrol vehicles, shifted interest away from electric vehicles for many decades. Although all vehicles can be electric, this briefing focuses only on electric road vehicles (EVs).

With the cheap oil era drawing to an end and climate change posing an increasingly serious threat, EVs have once again come into the spotlight. All levels of governance within the EU have recognised that EVs are needed to make transport smarter and more sustainable. However, the EU market for EVs is still in its infancy and is largely dependent on support policies. The EU still needs to address problems, such as high upfront cost and limited offer of electric models compared to the conventional ones, as well as limitations of the electrical network, charging infrastructure and batteries. In broader terms, the development of the EV market also depends on the level of ambition of the EU emission regulations; the incentives offered to users of EVs; fuel prices; general travel behaviour and advances in research.

A growing market

As shown in Figure 1, the global market for electric cars has enjoyed significant growth in recent years. In 2017, there were an estimated 3.1 million electric cars in the world, which is more than 50 % more than in 2016. Some 40 % of these cars were in China. In addition, about 250 000 electric light commercial vehicles (vans) and billions of two- and three-wheelers were in circulation globally in 2017. In the same year, Norway was a world leader in terms of the market share of electric cars (39 % of new cars sold were electric) and also had the world's highest share of electric cars in its vehicle stock: 6.4 %. These figures are at least partly attributable to fiscal and other incentives in this country.

Figure 1 – Number of electric cars in circulation, 2013-2017 (in millions)



Source: Global EV Outlook, 2018.

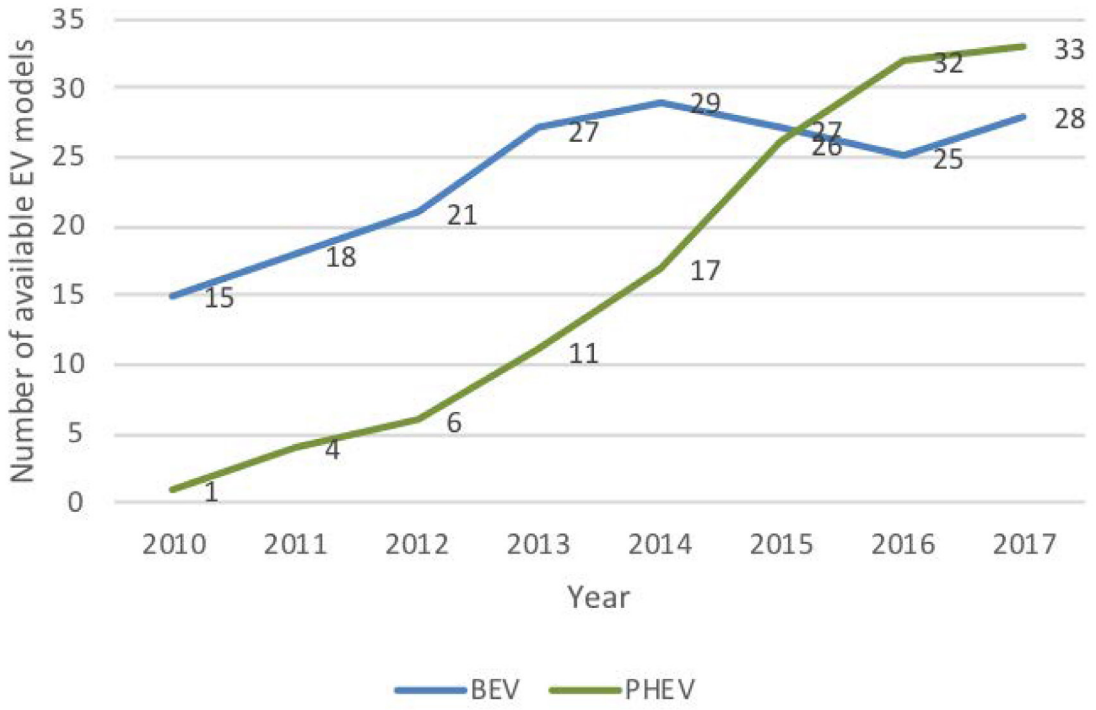
The EU market is still dominated by petrol and diesel vehicles, but the share of electric vehicles is growing fast. According to the European Automobile Manufacturers' Association (ACEA), the market share of electric cars in the EU was about 2 % in the third quarter of 2018, around 30 % higher than in 2017. While most of these cars are in use in a few northern and western Member States, their largest sales growth in recent years has been registered in southern and eastern ones. In most Member States, hybrid car sales exceed fully electric car sales.

Statistics kept on electric vehicles include different types of electric vehicles. For instance, the Global EV Outlook includes battery electric vehicles (BEVs) and plug-in hybrid electric vehicles (PHEVs), while the European Automobile Manufacturers' Association (ACEA) includes fuel cell electric vehicles (FCEVs) and range-extended electric vehicles (REEVs).

Source: Global EV Outlook, 2018; ACEA, 2018.

Major motor vehicle manufacturers are increasing their investments to offer more and more EV models in all vehicle sizes. However, the choice of EV models is still limited compared to conventional vehicles. According to recent data from the European Commission's Joint Research Centre (JRC), there were 33 plug-in hybrid electric vehicle (PHEV) models and 28 battery electric vehicle (BEV) models available in Europe in 2017 (see Figure 2). In addition, the waiting time for getting an EV is often very long, and vehicle configurations or options, such as additional equipment, design and motor options, are limited. Moreover, the purchase price of an EV is in general still higher than that of a comparable conventional vehicle. According to the JRC, '[o]n average an EV currently costs at least 40 % more than a comparable conventional car'. However, the total cost of ownership can be lower for certain models. A 2016 study by the European Consumer Organisation (BEUC) shows that even if small tax breaks were to be applied, by 2024 the average four-year cost of running an EV would be expected to match that of a petrol car, and by 2030 that of a diesel one. According to the JRC, EV maintenance costs are in general lower, due to EVs having fewer moving parts compared to conventional vehicles.

Figure 2 – Number of electric vehicle models available in Europe, 2010-2017



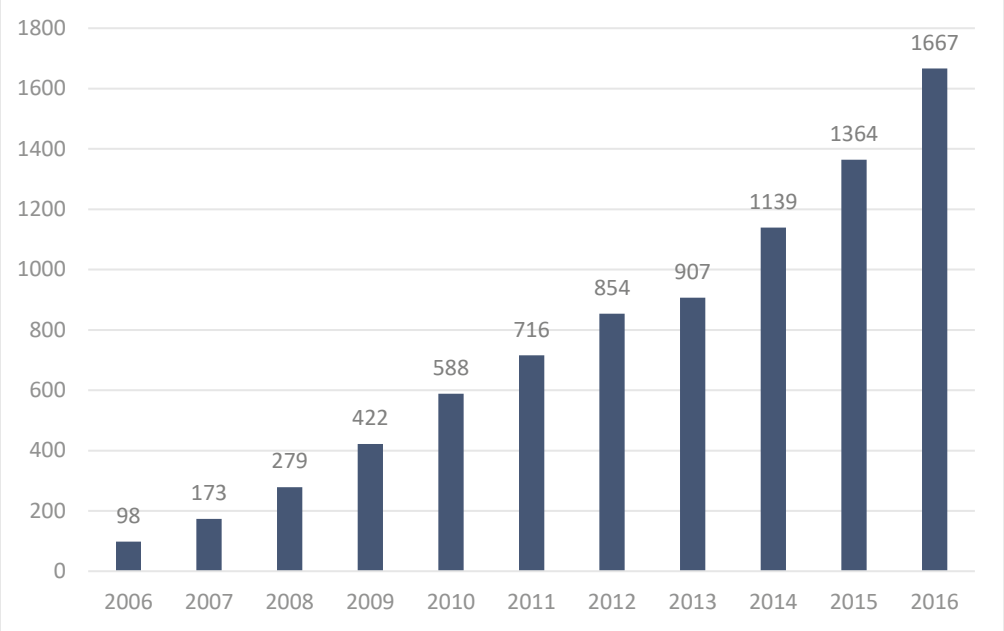
Source: Electric vehicles in Europe from 2010 to 2017: is full-scale commercialisation beginning, European Commission, 2018.

Other types of electric road vehicles

Other types of electric road vehicles are also increasing in number. As shown in Figure 3 below, around 1.66 million e-bikes were sold in the EU in 2016, compared to only 98 000 in 2006. This number is expected to further increase to 62 million by 2030. Most of these e-bikes are being used in a few Member States (for instance, Germany, the Netherlands, Belgium and France) and are imported, mostly from China. In general, e-bikes are still more expensive than conventional bikes,

but purchase subsidies in some countries (see the section on local, regional and national incentives) have somewhat helped to overcome this trend.

Figure 3 – Number of e-bikes sold in the EU, 2006-2016 (in thousands)



Source: European Bicycle Industry & Market Profile, CONEBI, 2017.

While demand for electricity-driven buses, mopeds, scooters and motorcycles is on the rise, demand for electric trucks remains limited, awaiting further technological progress in the area of batteries. Currently, there are around 2 500 electric buses in Europe – a relatively small number compared to the overall 725 000 buses (mostly diesel) in operation. However, a number of cities (for instance, Paris) are planning to electrify most of their bus fleet in the near future. Some cities (such as Berlin, Brussels and Paris) are also offering shared e-scooter services. As for electric trams, they have been in use for decades and are a proven technology.

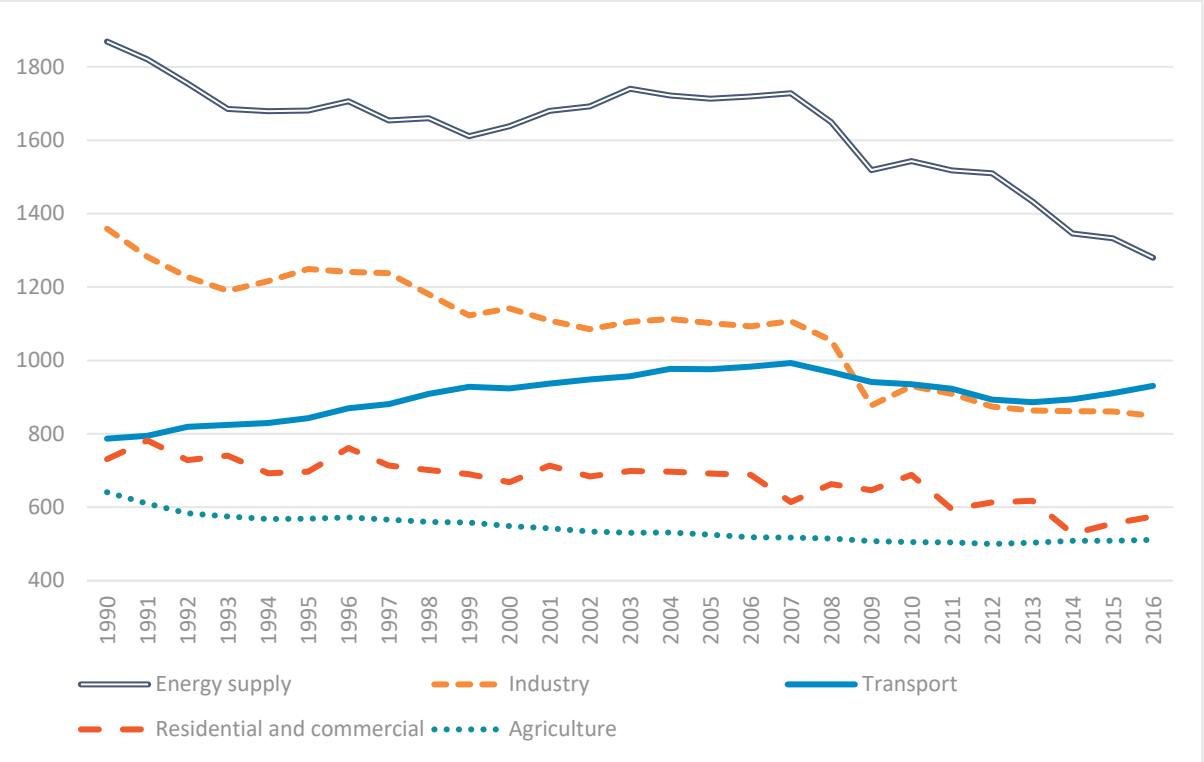
Environmental and health impacts

Greenhouse gas emissions

Despite technological improvements, transport is still responsible for around one quarter of Europe's greenhouse gas (GHG) emissions, which are a substantial contributor to climate change. While in other sectors GHG emissions have gradually declined since 1990, those from transport only started to decrease in 2007 and still remain higher than in 1990 (see Figure 4). Within the transport sector, road transport is by far the biggest emitter, accounting for about 80 % of all EU GHG emissions from transport.

The EU is committed to reducing GHG emissions from transport and other sectors. Overall, its aim is to cut GHG emissions by at least 40 % below 1990 levels by 2030. For transport in particular, the aim is to cut GHG emissions by 60 % compared to 1990 levels by 2050.

Figure 4 – GHG emissions by sector in the EU-28, 1990-2016



Source: European Environment Agency, 2018.

Electric mobility is one of the alternative transport technologies – especially in urban areas – that could help the EU to cut GHG emissions from transport if a certain number of conditions were met. Namely, EVs emit less GHG emissions during their entire life cycle (manufacture, use and disposal), only if the electricity used to manufacture and use them is at least partly generated from renewable sources. Other factors, such as the lifetime mileage,[1] the size of the vehicle[2] and what is done with the components (for instance, the battery) at the end of the vehicle's life cycle, also matter. The largest potential reduction in GHG emissions in an EV compared to a conventional vehicle occurs in the use phase of the vehicle. EVs typically have higher GHG emissions in the manufacturing phase but this can be more than offset in the use phase, if the vehicle is mostly charged with renewable energy.

Air pollution

Transport is the main cause of air pollution in cities. Fossil fuels used in transport emit a range of substances, including nitrogen oxides (NO_X) and particulate matter (PM), which inflict significant harm to air quality and human health; more than 400 000 citizens in the EU die prematurely each year and millions more have respiratory and cardiovascular diseases as a result of poor air quality.

Road transport is responsible for around 40 % of NO_X emissions in the EU, most of which come from diesel-powered vehicles. The pollution from road transport is all the more harmful, as emissions released by vehicles occur close to the ground, often in areas where many people live and work.

Electric mobility could significantly reduce air pollution caused by transport, due to less fossil fuel use, especially if the electricity is produced from renewable sources. EVs emit no tailpipe CO_2 and have significantly lower NO_X emissions than conventional vehicles. However, EVs still emit PM from road-, tyre- and brake wear. Besides, EVs are often heavier than equivalent conventional vehicles and vehicle weight tends to correlate with an increase in non-exhaust emissions of PM. In addition,

electricity generation also produces pollution; however, since power stations are usually located away from cities, the pollution they cause has a lower impact on human health than pollution from conventional vehicles.

Noise

Transport is also a major source of noise pollution. High-levels of noise can lead to hearing loss, sleep disturbance, poor mental health and well-being, increased risk of heart disease and change in blood pressure, among other effects. According to 2018 data from the European Environment Agency, almost 88 million people living in urban areas and almost 41 million people living outside urban areas in the EU are exposed to road, rail and air traffic noise levels exceeding EU thresholds.

In general, EVs have lower noise levels than conventional vehicles, especially at lower speed, where the minimal noise they produce can even pose a risk for other road users if they do not hear the EV coming.[3] However, on rural roads or motorways, where speeds are higher, the difference in noise levels is much smaller. The extent of noise reduction also depends on the proportion of EVs in the overall vehicle fleet. In brief, even though EVs do make some noise, if they are used mostly in urban areas and once their proportion in the overall vehicle fleet becomes significant, they can help to achieve noise levels that are less harmful for human health and well-being.

EU support

Electric mobility is an area where the EU has shared competences with the Member States. The latter promote electric mobility through local, regional and national incentives such as lower taxes or free public parking for EVs. The EU complements these efforts by encouraging measures aimed at increasing resource efficiency and recycling, as well as measures to help break the oil dependency, optimise and improve the efficiency of the transport system, develop sustainable fuels, scale up the use of renewable electricity and remove obstacles to the electrification of transport. Often actions in support of electric mobility are part of wider measures taken with a view to developing a more sustainable transport system.

In 2016, the Commission published a European strategy for low-emission mobility, in which it highlighted the importance of publicly available electric recharging points, the use of renewable electricity for transport and customer awareness of the advances made with regard to EVs (such as increased driving range and lower maintenance costs). The strategy also called on Member States to review their tax systems so as to introduce incentives for low-emissions vehicles and energy.

While welcoming the Commission strategy, the European Parliament called in its 2017 resolution on the Commission to 'adopt an ambitious action plan for the market uptake of electric vehicles and to issue Member States with guiding recommendations to encourage them to implement fiscal incentives for zero- and low-emission vehicles'. The Parliament also wanted to see a long-term European initiative for next-generation batteries as well as for the development of the necessary infrastructure.

In May 2017, the Commission submitted Europe on the Move – a package of legislative and other mobility-related measures aimed at making Europe a leader in clean, competitive and connected mobility; these were introduced in three stages between 2017 and 2018. Some of these measures seek to limit CO_2 emissions from new cars and vans (including giving incentives for low and/or zero-emission vehicles) and to stimulate the market uptake of clean vehicles (including vans and buses) in public procurement. The measures are at various stages of inter-institutional negotiations. In general, the European Parliament has called for more ambitious measures to reduce emissions in road transport and for a wider deployment of alternative fuel vehicles on the European market. For example, in its position on the Commission proposal on the promotion of clean and energy-efficient road transport vehicles, the Parliament raised the 2025 and 2030 clean and energy-efficient vehicle procurement targets for light-duty vehicles.

The EU has also taken steps to improve the way emissions are measured during type-approval procedures of vehicles and their trailers, in order to reduce the gap between the emissions measured during tests and actual on-road emissions.

Finally, the EU provides financial support to electric mobility, for instance, by making non-reimbursable grants from the Connecting Europe Facility (CEF) and the structural and investments funds available for the development of charging infrastructure and the acquisition of electric buses. Projects focusing on research and innovation in electric mobility can obtain support from the EU's Horizon 2020 programme or the European Investment Bank. Indicative of the level of support electric mobility currently enjoys is that over the 2018-2020 period, the Commission aims to invest €200 million in battery research and innovation under the Horizon 2020 programme (on top of the €150 million already allocated).

As part of the next long-term (2021-2027) EU budget, in June 2018 the Commission proposed to spend 60 % of the CEF €42.3 billion budget on projects that contribute to achieving climate objectives, for instance, through the development of charging infrastructure for EVs. The Parliament and the Council are now negotiating on the proposal. In its negotiating position (adopted in December 2018), the Parliament voiced its support for allocating 60 % of the CEF budget to projects contributing to climate action, while also calling for an increase of the overall CEF budget by almost €6 billion compared to the Commission's proposal.

Charging infrastructure

One major issue holding back the wider uptake of EVs is the perception that they cannot cover the desired distance without needing a recharge (range anxiety). This could either be due to the actual lack of charging infrastructure or to a lack of awareness that it exists. Although the charging infrastructure for EVs has been increasing at various speeds across the EU, similarly to the use of EVs, it is still insufficient in some Member States and there is lack of centralised information on all existing recharging points.

Most publicly available recharging points in the EU can be found in the urban areas of countries such as the Netherlands, Germany, the United Kingdom and France. In 2017, for instance, the Netherlands had over 32 000 recharging points and over 119 000 registered EVs, while Greece had less than 40 recharging points and slightly over 300 EVs. In the rest of the world, Norway, China and the US lead the way. On the main EU motorways, there is about one fast-charging point every 60 kilometres.

The EU has taken measures to incentivise Member States to increase the number of recharging points, raise awareness of their existence and make them more standardised and interoperable. Building on the 2013 clean fuels strategy aimed at ensuring that electric recharging points have a standardised design and use, the EU adopted the Alternative Fuels Infrastructure Directive in 2014. The directive recommends introducing a minimum level of infrastructure for charging EVs across the EU (around one public recharging point for every 10 EVs), and also giving consideration to wireless charging and battery-swapping. According to estimates, there is currently one public recharging point for every five EVs. These add to the number of semi-public (for instance, in commercial car parks) and private recharging points. However, as the number of EVs is expected to increase, more recharging points will be needed: the Commission estimates that around 440 000 publicly accessible recharging points will be needed by 2020, and some 2 million by 2025.

Furthermore, the directive aims to make information about the location of recharging points more easily available and to help standardise their technical specifications. It also recommends that recharging points use intelligent metering systems that recharge batteries from the electrical network at times of low general electricity demand, and that in the long term, recharging points would also allow EVs to feed power from the batteries back into the network.

The EU has also taken measures to improve the charging infrastructure at home and at the workplace, given that EVs are mostly charged at home overnight or daily at the workplace. The 2018

Energy Performance of Buildings Directive requires that at least one electric recharging point be fitted into all new non-residential buildings (such as shopping malls), and in existing buildings that are undergoing substantial renovation and have over 10 parking spaces. In addition, the directive requires that at least one in five parking spaces in these non-residential buildings be pre-equipped with conduits for electric cables that enable the installation of recharging points for EVs. In new and renovated residential buildings with more than 10 parking spaces, the directive requires only that every parking space have conduits for electric cables that enable the installation of recharging points for EVs. So far, these provisions have had limited impact, as only a marginal part of the EU building stock is new or is being renovated.[4] The development of charging infrastructure in existing buildings is left to the Member States. They are called on to simplify permitting and approval procedures for the installation of recharging points in buildings.

Batteries

Batteries play a vital role in the transition to electric mobility. The battery production market is big and its worth is estimated at around €250 billion annually. It is mostly dominated by manufacturers from China and other third countries, but the EU wants to change this situation.

Batteries used in EVs include some raw materials that might not be available in sufficient quantities if future demand grows significantly, or raw materials produced in ways that present potential environmental, health and ethical issues. For instance, most of the cobalt used in the lithium-ion batteries that power many EVs, is mined in the Democratic Republic of Congo. Recent research by Amnesty International has found that cobalt mines in this country use child miners, exposing them to fatal accidents and serious lung diseases, while paying them as little as one dollar a day.

The EU would like to produce as many batteries as possible in Europe and rely more on materials sourced in Europe. In May 2018, the Commission presented, as part of the Europe on the Move package, a strategic action plan on batteries that builds on the work already achieved by the European Battery Alliance.[5] The action plan foresees concrete measures to develop an innovative, sustainable and competitive battery production system in Europe. It furthermore aims to ensure (for instance, through free trade agreements) that mining in third countries is done responsibly and that production from European sources is boosted. It also supports collection and recovery of batteries as well as increased use of renewable power in battery production.

Electrical network

Replacing millions of petrol and diesel vehicles with electric ones also means placing a bigger load on the electrical network that is already under pressure at certain times of the day in some areas. According to a 2018 JRC study, the EV is normally the biggest consumer of electricity in its owner's home. The same study calculates that if 15 % of the cars on EU roads were electric in 2030, this would place an extra demand on the electrical network of about 95 TWh per year. This would be about 3 % of total electricity consumption in the EU in 2030. However, by promoting charging at the most convenient times for the electricity grid and at the lowest cost for consumers (smart charging), the EU can limit the costs needed for investing in the electricity grid and shorten the delays in the uptake of EVs. Some electricity grid reinforcements will still most likely be needed, especially for high-power recharging points. In the long run, EVs could also feed energy back to the electricity grid and even earn their owners money, if charging occurs during non-peak electricity times and selling back to the grid occurs during peak times.

To help to connect EV recharging points to the distribution network while increasing the share of renewable energy in the electricity grid, in 2016 the Commission proposed a directive setting new rules for the internal electricity market (on which the Council and the Parliament reached a provisional agreement in December 2018). In this proposal, the Commission called on Member States to create a framework that facilitates the connection of EV recharging points to the distribution network. It furthermore proposed that customers have access to electricity price comparison tools, smart charging, and dynamic electricity price contracts.

To further increase the share of renewables in the electricity grid, the 2018 Directive on the promotion of renewable energy sources set a 32 % binding EU target for the share of renewable energy in final energy consumption by 2030. It also called for giving further incentives on electric mobility (such as giving consumers comprehensive information on the lower running costs of EVs).

Local, regional and national incentives

Local, regional and national authorities in EU Member States offer various incentives to encourage the purchase and use of EVs. Some of these incentives are not limited to passenger cars but also include other road vehicles such as vans, buses, bicycles and motorcycles.

EV owners are often either fully exempted from paying the vehicle registration tax (for instance, in Flanders in Belgium) or pay a discounted rate (for instance, in Wallonia in Belgium). Other tax reductions are also offered. For instance, Germany exempts EVs from the annual circulation tax for a period of 10 years, starting from the date of their first registration. Austria exempts EVs from the consumption/pollution tax, ownership tax and company car tax. In Ireland, EV owners pay the minimum rate of the road tax.

Some governments also offer purchase grants. The amounts under these grants, the method of calculating them and the types of eligible vehicles vary greatly from one government to another. For instance, swapping a diesel car (older than 2001) for a new electric car in France entitles the owner to up to €11 000 in grants from the state. Many countries also offer purchase grants or discounts to buyers of two-wheelers. One example is Sweden, which subsidises 25 % of the cost of buying an electric two-wheeler (such as a bicycle or a moped).

A number of governments support the installation of EV charging infrastructure. For instance, Estonia has helped to install a nationwide fast-charging EV network within its national electric car mobility system, ELMO, ensuring the presence of quick recharging points, 40-60 km apart, on all roads with dense traffic. All population centres with over 5 000 inhabitants are served. In Sweden, individuals who install a recharging point for an EV in their homes may get a tax reduction for the associated labour cost.

There are other kinds of support for EVs as well. Several governments have, for instance, ensured that EVs are part of their public procurement contracts, or have given them access to bus lanes or to free parking. The Estonian government, for instance, has purchased about 500 EVs for the employees of the Ministry of Social Affairs and allows municipalities to permit EVs to use bus lanes.

Outlook

It is hard to tell how the future of electric mobility will evolve, but it is clear that it holds a lot of potential to make mobility more sustainable and smarter. Electric road vehicles could reduce the EU's dependence on foreign oil, while lowering the pollution from transport. However, the extent to which EVs will effectively lower pollution will depend on their share in the overall vehicle fleet as well as on how environmentally friendly they remain during their whole life cycle.

Most likely, electric mobility will continue to blend with other trends such as digitalisation and connectedness, automation and shared mobility. Instead of owning an EV, people might choose to order an automated EV from a shared fleet with a click on their smartphone. This could also help to reduce congestion, especially in urban areas.

According to forecasts by the International Energy Agency, the market share of EVs in Europe could be around 23 % in 2030 when accounting for all road transport vehicles except two- and three-wheelers. Since a number of motor vehicle manufacturers have announced that they would stop launching new petrol and diesel models in the coming years and launch only fully electric or hybrid ones, it is likely that the offer of EVs will increase and their prices will drop. Range anxiety could diminish significantly with technological advancements, as the driving ranges of EVs get longer and charging times shorter. Motor vehicle manufacturers and governments are also continuing to

develop their charging infrastructure for EVs and are helping customers to find the nearest recharging point (for instance via an app). However, whether these technological advancements will indeed convince customers to replace their diesel or petrol car with an electric one, will also depend on other factors, such as fuel prices.

The EU has an important role to play in supporting the transition to a more sustainable and smarter mobility. The more ambitious it is in its policies that drive vehicle technology improvements and encourage the use of renewable energy and smart electricity networks, the more impressive the uptake of EVs is likely to be. The future of electric mobility will also be determined by incentives at the local, regional and national levels of governance. Namely, countries that offer generous EV incentives and good charging infrastructure, are typically observing a bigger increase in EVs than countries with low or no incentives. Whether they continue to see growth in the share of EVs will largely depend on how persevering they are in applying these incentives.

MAIN REFERENCES

European Environmental Agency, Electric vehicles in Europe, November 2016.

European Parliament, Charging infrastructure for electric road vehicles, June 2018.

International Energy Agency, Global EV Outlook 2018, 2018.

Joint Research Centre, Electric vehicles in Europe from 2010 to 2017: is full-scale commercialisation beginning?, 2018.

ENDNOTES

1 According to some studies, the lifetime mileage of an EV should be at least 44 000-70 000 km for it to achieve a reduction in GHG emissions. This is much lower than the average expected lifetime mileage of an EV.

2 In general, the smaller the vehicle is, the less GHG emissions it emits.

3 In order to mitigate this risk, the EU requires all new electric cars to have an acoustic vehicle alerting system.

4 According to Commission estimates, only about 0.4-1.2 % of the EU's building stock is renovated each year.

5 Cooperation alliance launched by the European Commission in 2017 that gathers key industrial and innovation stakeholders, interested Member States, the European Commission and the European Investment Bank. The alliance has been preparing concrete actions to establish a full value chain of batteries in Europe.

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