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Electric vehicles in Europe from 2010 to 2017: is full-scale commercialisation beginning?

An overview of the evolution of electric vehicles in Europe

Tsakalidis, A., Thiel, C.

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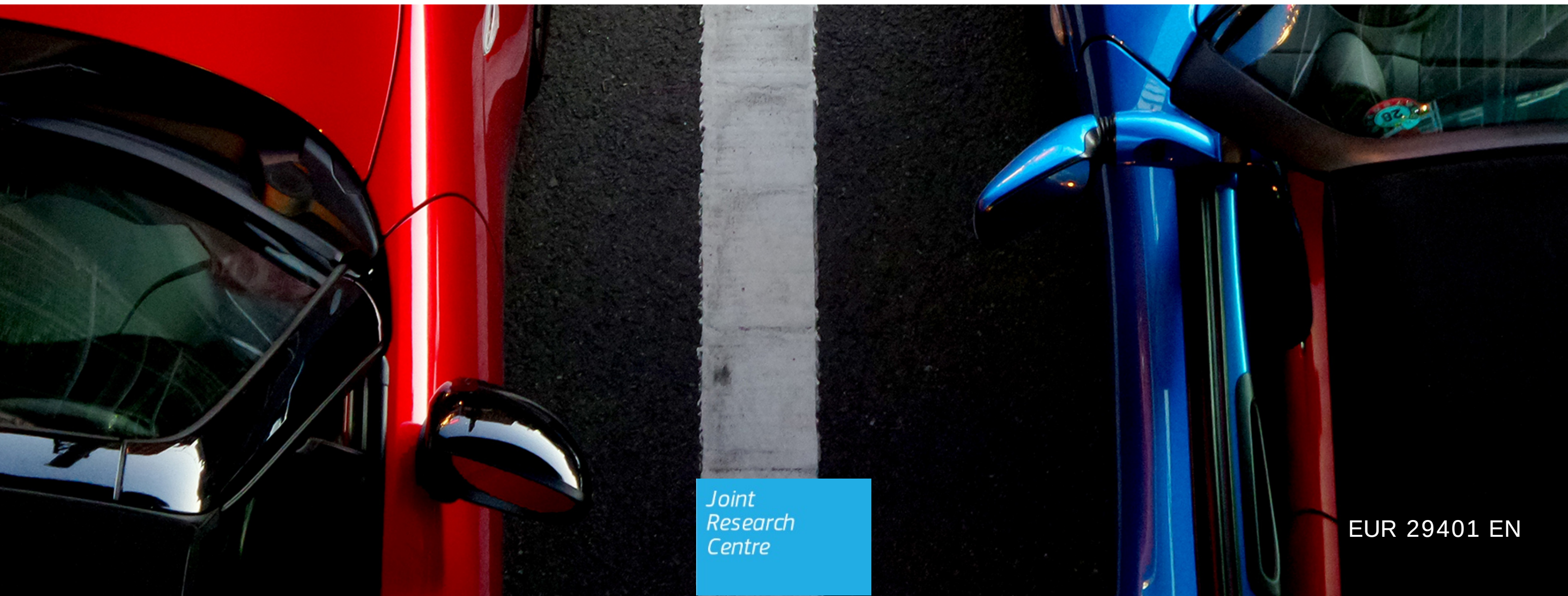

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Electric vehicles in Europe from 2010 to 2017: is full-scale commercialisation beginning? - An overview of the evolution of electric vehicles in Europe

This study analyses electric vehicle deployment in Europe from 2010 to 2017. Since 2010, the number of models offered, the size segment coverage, the number of registrations, the electric vehicle market share and available recharging infrastructures have increased significantly, albeit still small to be characterised as full-scale commercialisation. Further research and development efforts are needed while the European political trajectory should be adjusted according to the needs introduced by current technological trends, towards a sustainable and economically viable future.

Contents

Acknowledgements

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Executive summary

The present report provides a comprehensive analysis of recent Electric Vehicle (EV) deployment in the European Union (EU) and the European Free Trade Association (EFTA) ([1]) up to date. The report studies the development of EVs, the evolution of the type and number of models offered over time, the level of success of EV configurations in various vehicle segments, the analysis of country performance in EV registrations and registration shares, and the detection of signals indicating future trends for EVs in Europe. Since 2010, the number of models offered, the size segment coverage, the number of registrations, the EVs market share and available recharging infrastructures have increased significantly, albeit still small to be characterised as full-scale commercialisation. Further economies of scale in production as well as research and development (R&D) efforts are needed, while the European political trajectory should be adjusted according to the needs introduced by current technological trends, towards a sustainable and economically viable future.

Policy context

One of the key priorities for the European Union is the transition to a low-carbon economy. Since transport today still is heavily reliant on fossil fuels and one of the main pollution sources, with an associated major impact on economy and the environment, low- and zero- emission vehicles can have a positive impact on Europe's decarbonisation efforts. In many countries therefore relevant policies and incentive schemes are supporting the transition to electro-mobility.

Key conclusions

The electric vehicle market in Europe is gaining momentum. While electric vehicles were still a niche in 2010, most of the car brands nowadays offer EV models. European consumers now have the choice of a wide range of EV models that cover all car segments. Support policies remain important to help the transition to a low emission mobility future.

Related and future JRC work

Through desk-top research on electro-mobility, the Joint Research Centre (JRC) analyses challenges and opportunities of a wider deployment of electro-mobility in Europe. The JRC also looks at well-to-wheel emissions and sustainability aspects of different fuel options. The JRC also performs experimental pre-normative research, testing cars and charging equipment in its Interoperability Centre for Electric Vehicles and Smart Grids. Through its Interoperability Centre, the JRC supports the development and harmonisation of EV standards and test procedures, a prerequisite for a predictable framework that gives innovators confidence to bring their electro-mobility products to market.

Quick guide

This report analyses available data on the major elements of individual electro-mobility surrounding the user, namely the electric vehicle, the supporting infrastructure and all relevant policies and incentives. Thus, it analyses the EV deployment in Europe during the past eight years, covering the period between 2010 and 2017, using data from publicly available databases and sources of information covering the development of EV, the evolution of the type and number of models offered over time, the level of success of EV configurations in various vehicle segments, the analysis of country performance in EV registrations and registration shares, and the detection of signals indicating future trends for EV in Europe. In this study we cover the following EV configurations: Battery Electric

([1]) EFTA includes: Iceland, Lichtenstein, Norway, and Switzerland. Data on Lichtenstein not included in this report.

Vehicles (BEV), Plug-in Hybrid Electric Vehicles (PHEV), Range-extended Electric Vehicles (REV), and Fuel-cell Electric Vehicles (FCEV).

1 Introduction

This report is a follow-up of the *Electric Vehicles in the EU from 2010 to 2014 – is full scale commercialisation near?* published in 2015 (Thiel et al., 2015). The relevant literature has been increasing during the past years including studies on various aspects of electro-mobility, concerning their deployment and integration in the transport systems and their impacts on society, economy and the environment.

Scientists from the JRC have contributed to the literature with the following publications. Thiel et al. (2010) compared the conventional and electric vehicle (EV) CO_2 emissions and total ownership costs. The role of EVs within the urban environment, their environmental performance and costs were studied by Perujo et al. (2011). The role of the twinned Interoperability centres in the EU and the United States of America (USA) for assuring a harmonised approach in standardisation of both EVs and their charging infrastructure was presented by Hardy et al. (2013). The potential contribution of EVs in CO_2 reductions, energy demand and cost to the end-users was analysed by Pasaoglu et al. (2012). EV cost effectiveness and well-to-wheel implications of EU emission regulations were investigated by Thiel et al. (2014). The potential impacts of electro-mobility on the grid was studied by De Gennaro et al. (2014) and Pasaoglu et al. (2013), options for vehicle-to-grid and grid-to-vehicle concepts and applications by De Gennaro et al. (2015) and Loisel et al. (2014). The attitude of car drivers towards EVs and the conventional and EV driving patterns and drivers' behaviour was investigated by Donati et al. (2015), Gómez Vilchez et al. (2017) and Thiel et al. (2012). Weiss et al. (2015) contributed a review of the environmental, economic, and social performance of electric two-wheelers. Additionally, the evolution of costs of battery manufacturing and its impact on EVs was analysed by Weiss et al. (2012) and the optimal allocation of recharging infrastructure and its impact evaluated by Gkatzoflias et al. (2016). Lucas et al. (2018) presented an indicator-based methodology for assessing EV Charging Infrastructure. Since 2015, the experimental work at the EU Interoperability Centre also renders ever more data on specific technical issues, like e.g., the grid harmonic impact of EV fast charging (Lucas et al., 2015) or the efficiency of EV fast charging under Extreme Temperatures (Trentadue et al., 2018).

An analysis of the role of electro-mobility within the current, and, on the other hand, a stricter alternative emissions legislative framework within the EU was performed by Thiel et al. (2016), potential policy interventions to stimulate the transition of vehicle technology were studied by Harrison and Thiel (2017). The impact of EV cost on vehicle market and the role of fiscal incentives to increasing EV sales was examined by Lévay et al. (2017) and finally, the impact of the EU carbon intensity on EV well-to-wheel greenhouse gas (GHG) emissions was calculated by Moro and Lonza (2017).

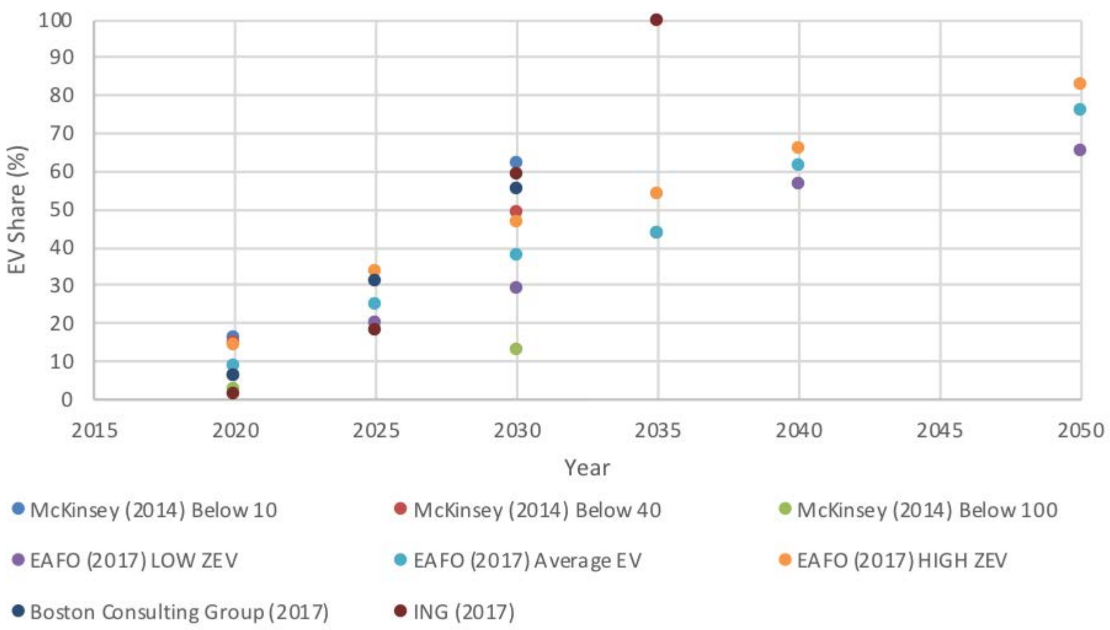
Various government authorities, organisations, companies and research entities have produced multiple estimations and projections relevant to the evolution of the EV market evolution and penetration, highlighting the importance of EV technology in the fields of transport and energy.

Figure 1 provides an overview of selected projections on the future of EV sales share globally until 2040 according to relevant sources found in the literature (ACEA, 2017; Bloomberg New Energy Finance, 2017; Boston Consulting Group, 2017; IEI and EEI, 2017; IRENA, 2017; McKinsey & Company, 2016; Oliver Wyman, 2015; Roland Berger, 2016; Wood Mackenzie, 2017). Figure 2 provides an overview of selected projections on the future of EV sales share for the EU until 2050 according to relevant sources found in the literature (Amsterdam Roundtables Foundation and McKinsey & Company, 2014; Boston Consulting Group, 2017; EAFO, 2017; ING, 2017).

Figure 1. Range of global sales projections for BEV/PHEV until 2040

Source: Own elaboration.

Figure 2. Range of sales projections for BEV/PHEV in Europe until 2050



Source: Own elaboration.

The increasing EV registrations in the EU during the past years provide a starting point for a first technological and market penetration evaluation and an analysis of status and future trends. It also provides an opportunity to discuss these developments in the context of policies related to EVs. The European Commission (EC) adopted the Energy Union Package (COM(2015)80) in 2015 committing to the development of a strategy for a low-carbon competitive economy. For this, a certain electrification of the European car fleet and other means of transport is needed and Europe should play a leading role in electro-mobility and energy storage technologies (European Commission, 2015a). The Communication "Towards an Integrated Strategic Energy Technology (SET) Plan" (COM(2015)6317) highlights the need for Europe to become competitive in the battery sector that will support the further development of electro-mobility (European Commission, 2015b). The European "Strategy for Low-Emission Mobility" (COM(2016)501) highlighted the need to have an efficient transport system as a starting point towards the transition to a low-emission mobility and also the need to move towards zero-emission vehicles (European Commission, 2016a). The "Accelerating Clean Energy Innovation" (COM(2016)763) Communication of 2016, underpins the need for an accelerated transition to a low-carbon competitive economy characterised by energy efficiency, European leadership in renewables, and the provision of a fair deal for consumers. Towards this threefold goal, electro-mobility and a more integrated transport system supported by a fast development and introduction of next generation EV is of great importance (European Commission, 2016b). In 2017 the Strategic Transport Research and Innovation Agenda (STRIA) was published, highlighting seven transport research and innovation (R&I) roadmaps representing seven main focus areas, including a roadmap on transport electrification, and priorities concerning the transport sector towards a clean, connected and competitive mobility (European Commission, 2017a). Moreover, the Transport Research and Innovation Monitoring and Information System (TRIMIS) has been developed to monitor the implementation of STRIA roadmaps, such as transport electrification, providing a holistic assessment of technology trends, transport R&I capacities, to publish information, data and to develop analytical tools (Tsakalidis et al., 2018a, 2018b).

In his speech at the Industry Days Forum on the Industry-led initiative on batteries / the EU Battery Alliance on 23 February 2018, EC Vice-President for Energy Union Maroš Šefčovič ([2]) highlighted the need for competitive and sustainable battery cell manufacturing in Europe. He explained that this must be supported by a full EU-based value chain with focus on "green" high performance batteries i.e., sustainable and responsible supply of raw materials, clean energy based production process, recyclability and second use. To this aim, combined efforts are required from industry and the EU Institutions to form the necessary supportive framework.

The present report aims at providing a comprehensive analysis of recent EV deployment trends in the EU and the European Free Trade Association (EFTA) ([3]). The report studies the development of EV, the evolution of the type and number of models offered over time, the level of success of EV configurations in various vehicle segments, a country-by-country analysis of EV registrations and registration shares, and the detection of early signals indicating future trends for EVs in Europe. In this context, the evolution of electric vehicle registrations in Europe from 2010 to 2017 are analysed in detail, covering Battery Electric Vehicles (BEV), Plug-in Hybrid Electric Vehicles (PHEV), Range-extended Electric Vehicles (REV), and Fuel-cell Electric Vehicles (FCEV). For the purpose of this analysis, the term 'electric vehicles' refers to all the aforementioned variants combined (BEV, PHEV, REV and FCEV), while Plug-in Electric Vehicle (PEV) describes in this report the group of BEV, PHEV, and REV. The analysis includes the M1 (passenger cars), N1 (light

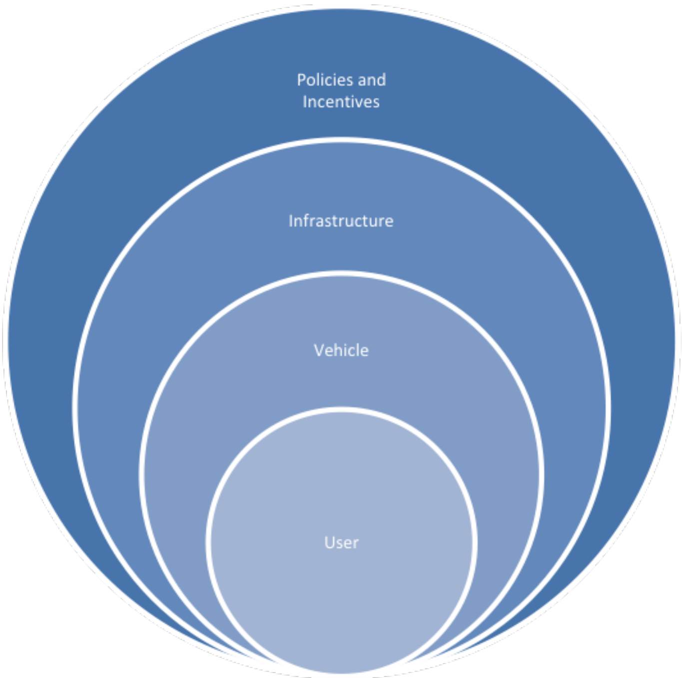
([2]) http://europa.eu/rapid/press-release_SPEECH-18-1168_en.htm
([3]) EFTA includes: Iceland, Lichtenstein, Norway, and Switzerland. Data on Lichtenstein not included in this report.

commercial vehicles) and M2-M3 (buses) vehicle categories ([4,5]). EVs that are not registered as either M1-3 or N1 are not part of the present analysis.

This report is intended to cover the major elements of electro-mobility including a user perspective, covering namely electric vehicle choice, the supporting infrastructure and relevant support policies and incentives (see Figure 3). Besides contributing to the wider policy debate on the role of and challenges for electric vehicles, this report can be instrumental to inform the implementation and possible adaptation of national policy frameworks that Member states (MS) adopted in the context of Directive 2014/94/EU on the deployment of alternative fuels infrastructure ([6]).

The report is structured in three chapters; in addition to the introductory Chapter 1, Chapter 2 presents the analysis conducted within the framework of this report and discusses the results concerning EV deployment across European countries, EV-related infrastructure status, EV-related incentives and policies and a comparison to other major global markets. Finally, Chapter 3 draws conclusions on the work presented.

Figure 3. Outline of covered elements of electro-mobility



Source: Own elaboration.

([4]) Commission Directive 2001/116/EC of 20 December 2001 adapting to technical progress Council Directive 70/156/EEC on the approximation of the laws of the Member States relating to the type-approval of motor vehicles and their trailers *OJ L 18, 21.1.2002, p. 1–115*

([5]) United Nations Economic and Social Council. Consolidated Resolution on the Construction of Vehicles (R.E.3) Revision 6 *United Nations ECE/TRANS/WP.29/78/Rev.6. 11.7.2017, p. 1-117*

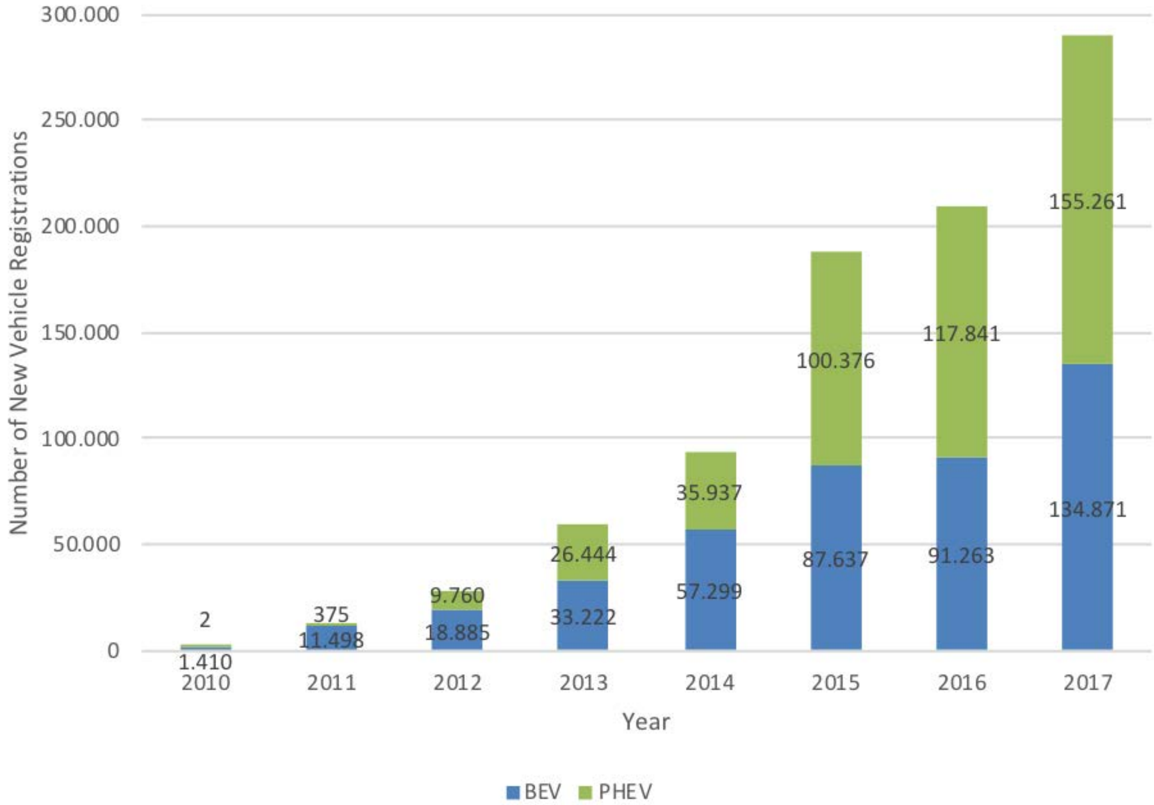
([6]) Directive 2014/94/EU of the European Parliament and of the Council of 22 October 2014 on the deployment of alternative fuels infrastructure *OJ L 307, 28.10.2014, p. 1–20*, see also Commission Staff Working Document: Detailed Assessment of the National Policy Frameworks (SWD (2017) 365)

2 Electric Vehicles in Europe from 2010 to 2017

2.1 Passenger Cars (M1)

According to the analysis of data from the European Alternative Fuels Observatory (EAFO), 882,081 M1 category electric cars were registered in Europe between 2010 and 2017. In terms of powertrains, 436,085 BEV and 445,996 PHEV were registered (European Alternative Fuels Observatory, 2018). Figure 4 presents the evolution of new M1 category BEV and PHEV registrations in Europe (EU28+EFTA) over the last eight years. By the time of publication of this report there are probably more than one million electric vehicles on the road in Europe.

Figure 4. Evolution of M1 category registrations of BEV and PHEV in Europe between 2010 and 2017



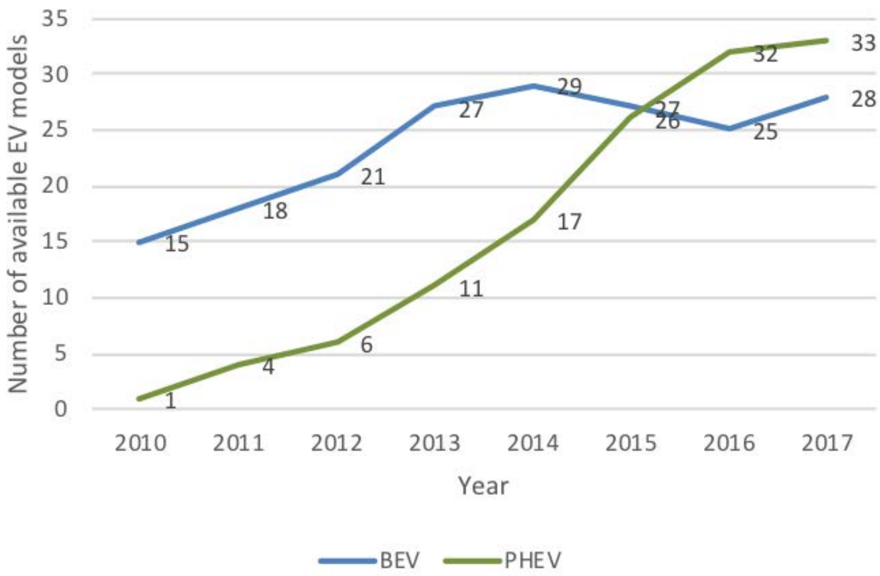
Source: Own elaboration on EAFO data.

According to Figure 4, there has been a steady growth of registrations for BEV and PHEV during the last years. At first, BEV dominated the EV market until 2012 comprising a limited number of models. PHEV vehicles presented a significant EV market share from 2012 onwards and by 2015 they exceeded BEV sales.

Tables A.1-A.2 in the Annex present the corresponding *Top 10* registered model names for the period 2010-2017 per powertrain. Models are ranked by registration numbers in each given year (model with the highest registrations on top). It should be noted that some models of different brands may basically correspond to re-badges of technically the same model i.e. Opel/Vauxhall Ampera and Chevrolet Volt corresponding technically to one model family and similarly Peugeot Ion, Citroen C-Zero, and Mitsubishi I-Miev being based on one model family.

The number of different EV models that were available in Europe from 2010 to 2017 are presented in Figure 5.

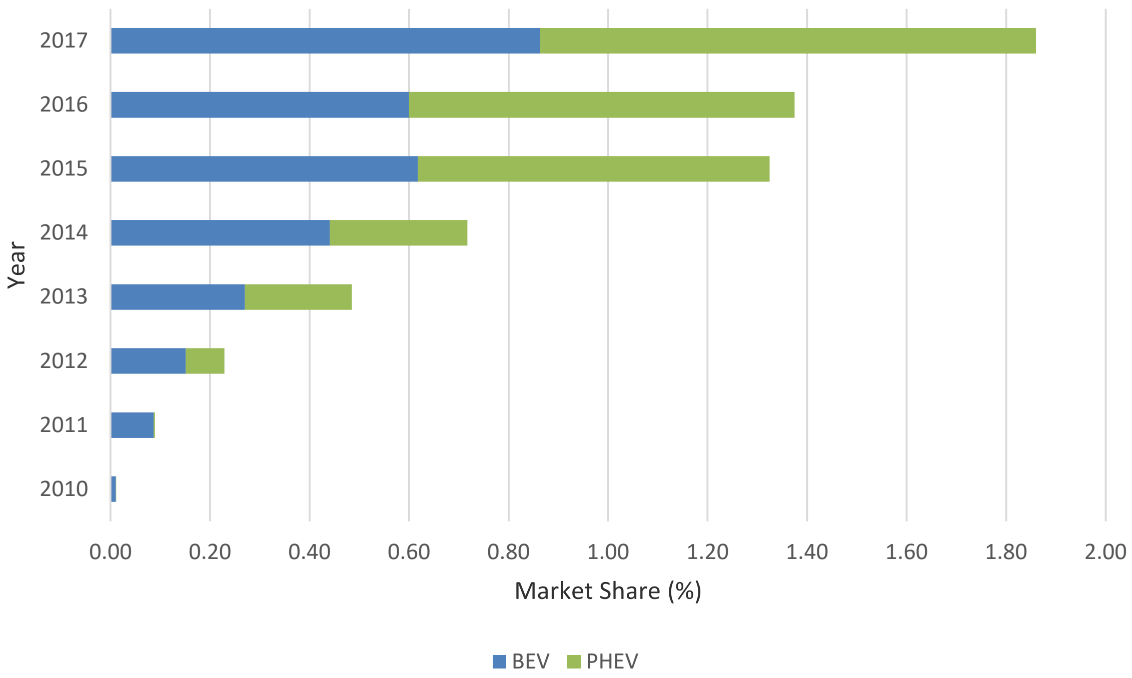
Figure 5. Number of available M1 EV models in Europe



Source: Own Elaboration on EAFO data.

BEV models have had a constant presence in the automotive market providing a wide range of options even during the first years following the recent technology's market introduction. The number of models has been steadily increasing until 2014 when this trend was stabilising up to day reaching almost twice the number of models versus 2010. PHEV models on the other hand, after a minimal initial market presence in 2010, have been increasing until today surpassing BEV models' availability in 2015 and now leading the EV market in terms of both new registrations and model availability. The BEV and PHEV market shares' evolution between 2010 and 2017 are presented in Figure 6.

Figure 6. Market share of M1 EV in Europe between 2010 and 2017



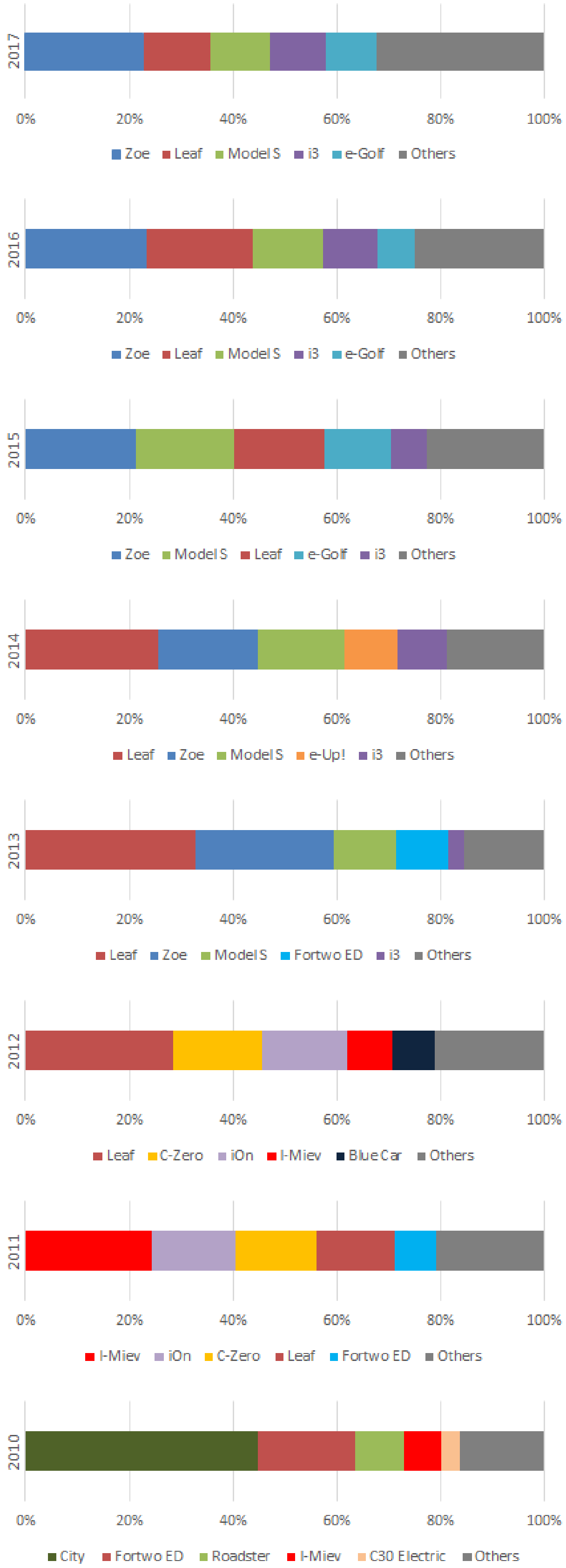
Source: Own elaboration on EAFO data.

2.1.1 BEV registrations

M1 BEV registrations evolved from just over a thousand in 2010 to more than 11,000 in 2011 followed by a continued growth of around 60% increase per year between 2012 and 2015. From 2015 to 2016, the growth rate was lower in comparison to the previous years', showing signs of stabilisation. According to Figure 5, the number of different BEV models that were registered in Europe had been almost steadily increasing between 2010 and 2014 with an all-time high of 29 different models. After 2014, PHEV begun to take the lead both in terms of model choice and absolute sales numbers; 2015 was the year when BEV models slightly declined, and PHEV took the lead with 27 compared to 26 different BEV models available and in 2016 models were reduced to 25. By the end of 2017 an increase was observed again; there were 28 different BEV models available.

Figure 7 provides a detailed overview of the BEV model registration shares in Europe between 2010 and 2017. In the early years, there were a few BEV models exits from the market with the Tesla Roadster and Volvo C30 EV not being sold after 2012, and Mia and Mercedes A-class E-cell last sold in 2013, providing an indication of the model cycle effect that can be observed over time. The effect of model cycles leads in some cases to peaking registrations in the second or third year after market launch for specific models and a declining number of registrations thereafter. This phenomenon can be observed in cases such as for the Ion, C-Zero, I-Miev or the Ampera/Volt. Exceptions can also be observed such as the case of Nissan Leaf and Renault Zoe that still exhibit increasing registrations. For the Zoe this increase coincided with the offer of an additional battery with much higher capacity than the first battery.

Figure 7. BEV model registrations share in Europe between 2010 and 2017



Source: Own elaboration on EAFO data.

It should also be noted that the two top BEV model families constituted more than 50% of total BEV registrations in each year from 2010 to 2017 in terms of number of new registrations per year, even though more manufacturers have been providing BEV options and also more models per manufacturer were available. In general, it can be noted that while from 2010 to 2017 the number of models where the BEV powertrain option is one option among many conventional powertrain combinations has increased, the European BEV market is still dominated by dedicated BEV models that do not offer conventional alternatives under the same model name.

2.1.2 PHEV registrations

In a similar way to the BEV, but with a one-year delay, PHEV evolved from just a few hundred registrations in 2011 to reaching over nine thousand in 2012 with an increase over the years both in registration numbers and models available. From 2012 to 2013 registrations were further increased having their numbers almost tripled. From 2013 to 2014, this growth rate decelerated showing an estimated 30%, while again numbers almost tripled between 2014 and 2015. From 2015 to 2016 the growth rate decelerated, while 2017 showed again an increased growth. Figure 8 provides a detailed overview of the PHEV model registration shares in Europe between 2011 and 2017.

Since 2010, PHEV models available have been constantly increasing, jumping from just one model (with only two registered cars, probably part of a field test) in 2010 to four in 2011. This increase rate was greater every year until 2015 when registered models became 27, almost seven times the numbers of PHEV models offered in 2011. Model choice continued to increase at a lower rate between 2015 and 2016, reaching 32 in 2016, a number increased to 33 by the end of 2017.

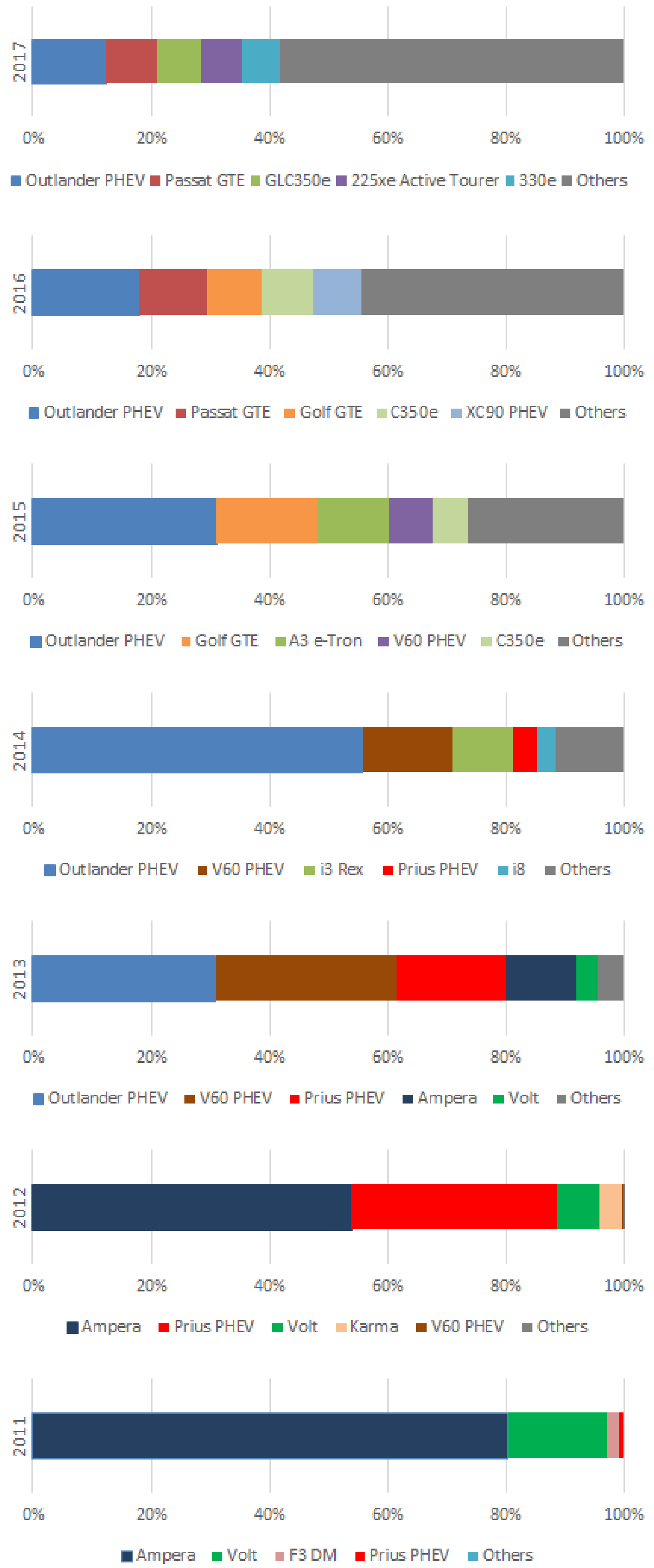
The number of models where the PHEV option is just one out of several other conventional powertrain options and also their sales share is much higher for PHEV than it is for BEV. Interestingly, the turnover of EV models, i.e. the number of models that appeared and disappeared during the 2010 to 2017 interval is much higher for BEV than it is for PHEV. During this time period many manufacturers brought BEV to the market in limited numbers in order to gain experience.

2.1.3 FCEV registrations

The first FCEV registrations in the EU were observed in 2013 and different to the model evolution of BEV and PHEV, numbers of available and registered FCEV models have remained low compared to the other technologies. In 2013 and 2014 only one model was registered, the Hyundai ix35 Fuel Cell, followed by the Toyota Mirai in 2015 and 2016, raising the number to two models and again followed by the Honda Clarity in 2017, leading to three different available FCEV models, still much below BEV and PHEV levels. By the end of this year, at least one more fuel cell vehicle should become commercially available in Europe, the Mercedes GLC F-Cell ([7]). Interestingly, this is a plug-in capable version.

([7]) https://www.autocar.co.uk/car-news/new-cars/mercedes-benz-glc-f-cell-2018-first-ride

Figure 8. PHEV model registrations share in Europe between 2011 and 2017

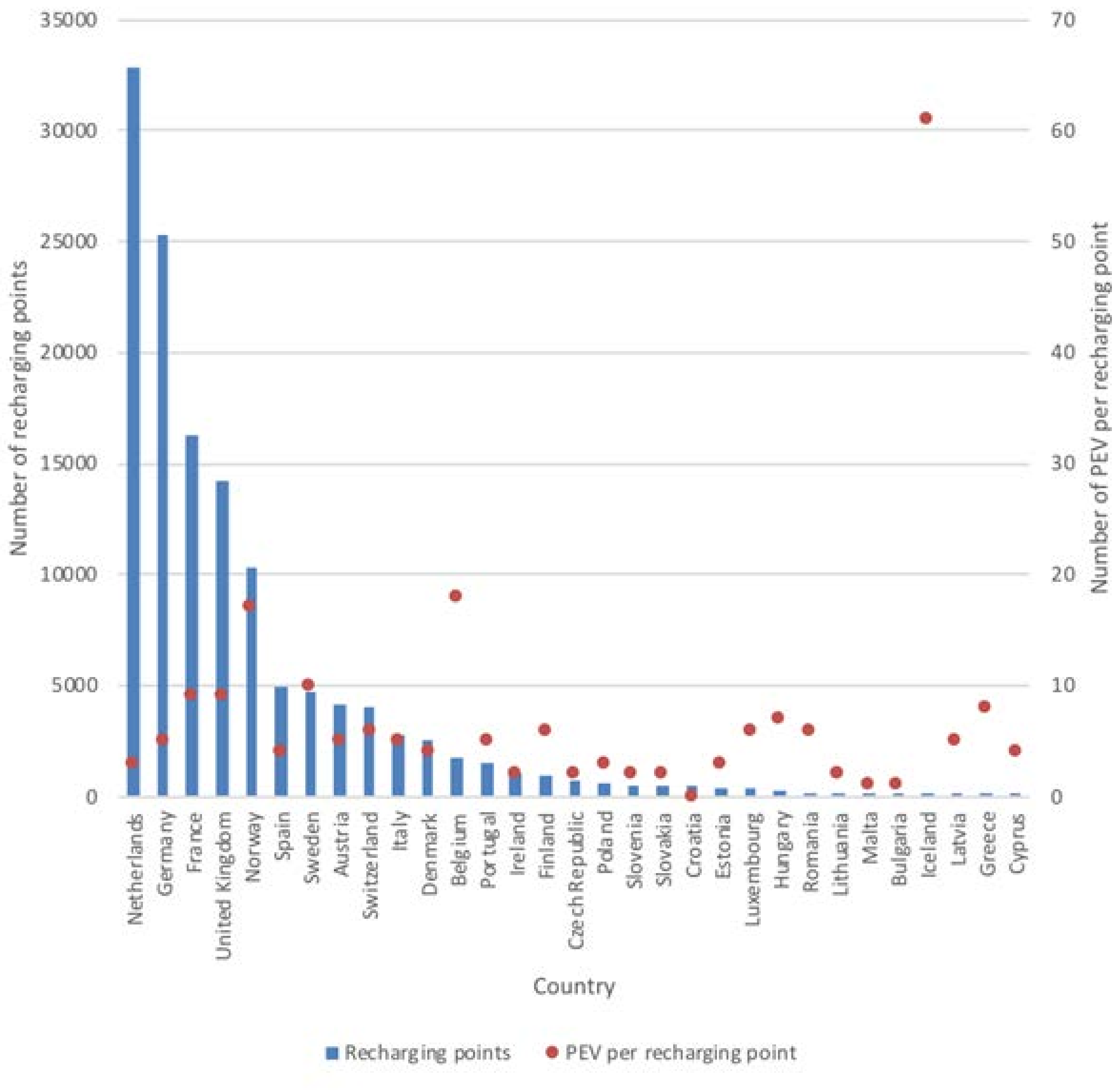


Source: Own elaboration on EAFO data.

2.2 Publicly accessible EV infrastructure across Europe

The availability and development of EV recharging infrastructure is another important element related to the development of electro-mobility. EV recharging infrastructure presents variations both in terms of availability and level of development across Europe. Some related main indicators are the total number of available recharging points, the number of high power to normal recharging points and the number of PEV per recharging point. The European status can be seen in the following figures (European Alternative Fuels Observatory, 2017a). Figure 9 presents the European status in terms of available PEV recharging infrastructure across Europe, along with the respective PEV per recharging point numbers.

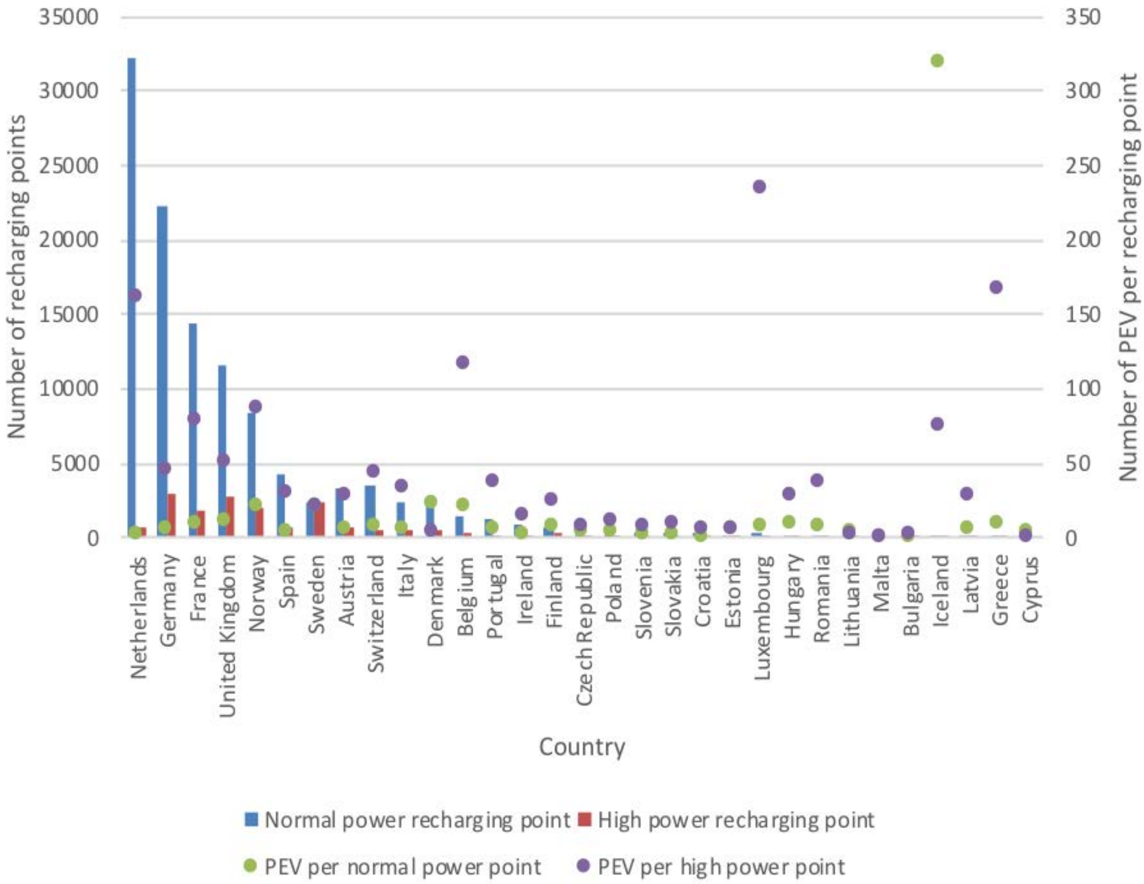
Figure 9. Recharging points and PEV per point across Europe



Source: Own elaboration on EAFO data.

Figure 10 presents the European status in terms of available PEV recharging infrastructure allocated by recharging power across Europe, along with the respective PEV per point numbers. Normal power recharging points offer up to 22 kW of power, whereas high power recharging stations offer more than 22 kW. In the future it may be desirable to differentiate for the mapping further categories of high power recharging beyond 22 kW.

Figure 10. Recharging points and PEV per point by level of power across Europe

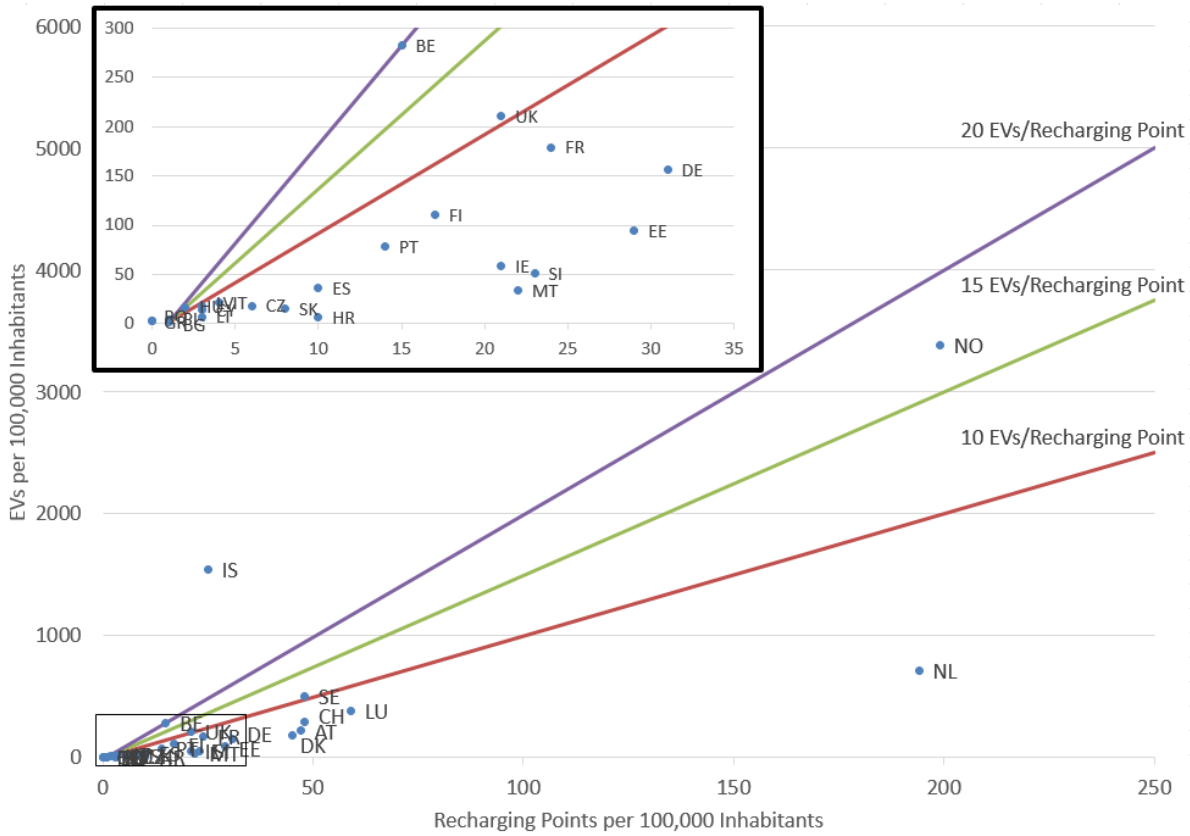


Source: Own elaboration on EAFO data.

Additionally, Figure 11 gives a European overview of the existing PEV in relation to the existing recharging points. Most European countries have ratios of less than ten PEV per publicly accessible recharging point. Iceland is an outlier with 60 PEV per publicly accessible recharging point. An initiative is underway to drastically increase the number of publicly accessible recharging points in Iceland ([8]). It is noteworthy to mention that Norway, globally the leading country in EV market share, has a ratio of PEV per publicly accessible recharging point of around 18. This is a country wide average. It can be much worse in specific areas, such as Oslo, where it seems that consumers may fear a lack of available recharging points ([9]).

([8]) http://icelandmag.is/tags/charging-stations
([9]) http://www.dw.com/en/lack-of-charging-stations-in-oslo/av-40564284

Figure 11. Supply of recharging points and EVs across Europe



Source: Own elaboration on EAFO data.

An EU wide interoperable network of recharging infrastructure, both for slow and fast recharging, will be necessary to achieve higher shares of EVs on the road. Further standardisation efforts are needed in order to ensure interoperability of the recharging infrastructure. Amongst others these include fast recharging beyond 50kW and even above 300kW, wireless recharging, vehicle to grid integration and the underlying communication protocols as well as e-roaming. Goal must be to ensure the same level of comfort, safety, and seamless cross-border interoperability for the customers as they are used to today. The JRC supports these activities amongst others through its Interoperability Centre for Electric Vehicles and Smart Grids.

2.3 Other infrastructure needs, generation capacity, grids

When a person decides to drive an EV, the EV will normally become the biggest electrical consumer in that person's (private) household. If 15% of the cars on European roads were EVs in 2030, a number that is reached or exceeded in several scenarios of the analyses carried out for the Communication on "A European Strategy for Low-Emission Mobility" (European Commission, 2016c) and various other scenario studies (e.g. Pasaoglu et al., 2012; Thiel et al., 2016), these would add an extra electricity demand of roughly 95 TWh per year to the power system. This equals about 3% of the total electricity consumption in the EU in that year (European Commission, 2016d). Such EV deployment would require ca. 5 million public charge points of which 500,000 with fast recharging capability (probably above 50kW). Together with private recharging this could potentially lead to increase the power peak by roughly 20GW or 3-4% of the expected 2030 peak load (extrapolated from Eurelectric, 2015). However, if the EU creates the right environment so that the deployment of appropriate measures and technologies (smart grids) is fostered, a lot of the power demand could participate in load shifting or even power storage through vehicle to grid (Loisel et al., 2014; Pasaoglu et al., 2013;

Thiel et al., 2016). Still, grid reinforcements will be required especially to high-power (HPC, > 50kW) recharging stations, where, in a future scenario of massive EV deployment, at peak demand times power requests from BEV may easily add up to a total of around 20MW ([10]) at service areas along major European motorways.

2.4 Policies and incentives concerning EV registrations in Europe

Currently, and for a foreseeable future, the sales price of EVs is generally higher than that of its conventional alternative. On average an EV currently costs at least 40% more than a comparable conventional car. For certain brands and models this difference can even go beyond 100%. In theory, because of the smaller battery, a PHEV should be cheaper than a comparable BEV (Bishop et al., 2014; Thiel et al., 2010; Wu et al., 2015).

However, this effect is currently difficult to observe in the market. Because of the price differences, incentives - along with other support measures - play an important role to foster early deployment. Norway is probably the country that has the most complete spectrum of demand stimulating support measures in place. Typically, countries with the highest financial incentives for EVs will also witness the highest share of EVs on the road. However, when incentive schemes for EVs are discontinued, potential EV buyers react immediately and EV sales go down (Lévay et al., 2017; Thiel et al., 2015).

In addition, when a similar level of incentives is granted to a PHEV as compared to a BEV, customers tend to choose a PHEV. This seems to indicate that range anxiety still plays an important role and consumers are still more likely to accept an EV that effectively offers unlimited range, when running in charge sustaining mode. Infrastructure deployment, including fast recharging, will be important to overcome range anxiety.

Largely, the evolution of EV registrations in Europe can be attributed to technology progress (also in terms of costs) combined with a series of policies and incentives combined with an increase in model choice across the various countries. The European automotive market presents large variations across the various countries in terms of size, customer preferences and fleet composition. Figure 12 presents the levels of EV registrations in Europe per country between 2010 and 2017.

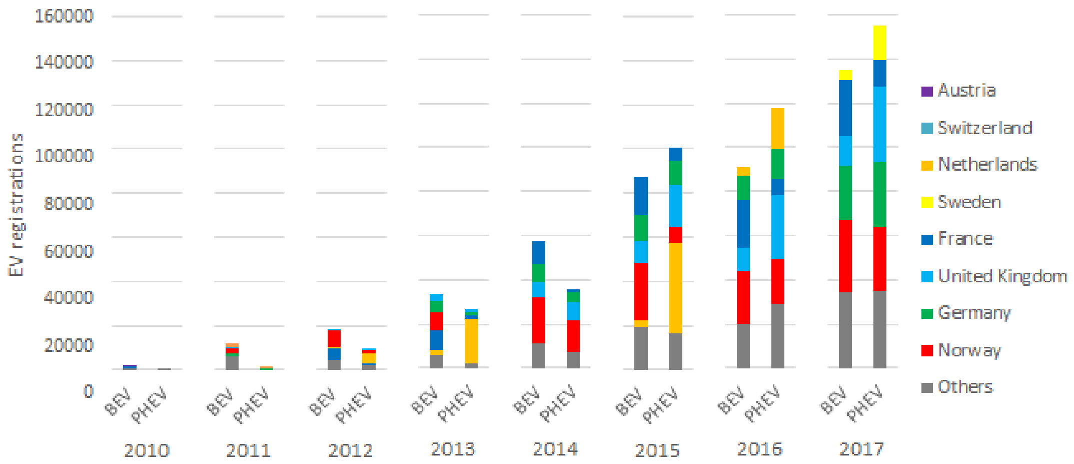
The automotive market is characterised by extensive differences with respect to preferred size segments and equipment levels, influencing the average transaction price in a given country, a fact with potential impacts on EV registrations in cases where EV models' availability is not sufficient to face these affecting factors in specific segments. In the following sections, the most important developments in terms of policies and incentives related to EVs per country are presented. The information related to incentives is based on data from the European Alternative Fuels Observatory (2017c) and the European Automobile Manufacturers Association (2017) for the period 2010-2017, although incentives may have been introduced earlier than 2010 in some cases (Lévay et al., 2017).

Figure 12 reveals some interesting effects of changes in support policies that could be observed in the Netherlands and Norway. Because of the incentive structure, EV sales in the Netherlands from 2010 to 2015 showed very high shares of PHEV (versus BEV). A change in the incentive scheme led to a strong reduction of PHEV sales in the Netherlands from 2016 onwards. BEV sales continued to grow but could not make up for the reduction of PHEV sales, so the overall EV market share went down from 2015 to 2017 in the Netherlands. In Norway, the opposite happened. In the past mainly BEV were incentivised and this led to very few PHEV registrations. From 2016 onwards the Norwegian incentive policy was extended in scope to also include PHEV with more substantial monetary support. This led to a rapid increase in PHEV sales in this country in 2016 and 2017. From these observations one may be able to conclude that range anxiety

([10]) 100 BEV simultaneously recharging at an individual rate of 200kW.

still plays an important role in consumer considerations and consumers seem to favour PHEV over BEV, when the total cost of ownership is similar.

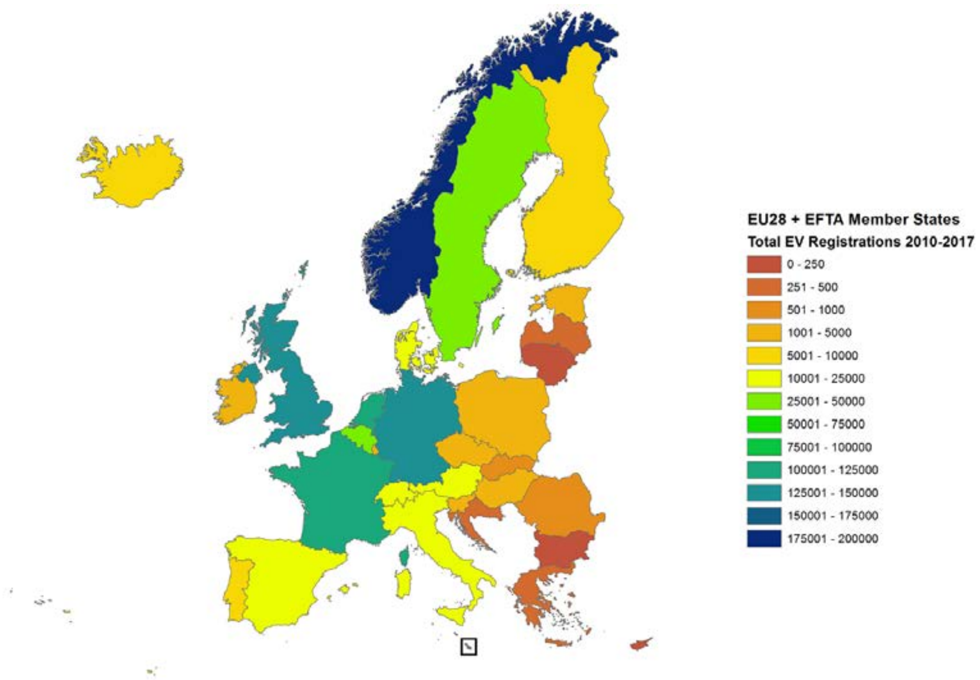
Figure 12. Levels of EV registrations in Europe per country between 2010 and 2017



Source: Own elaboration on EAFO data.

In Figure 13, the map shows the total EV registrations from 2010 to 2017 in the EU per MS, while the map of Figure 14 shows EV registrations as share of total car registrations per MS from 2010 to 2017 ([11]) (European Alternative Fuels Observatory, 2018; European Automobile Manufacturers Association, 2018; European Environment Agency, 2018). It can be easily observed that for the two metrics the various MS ranking is quite different when comparing the two maps.

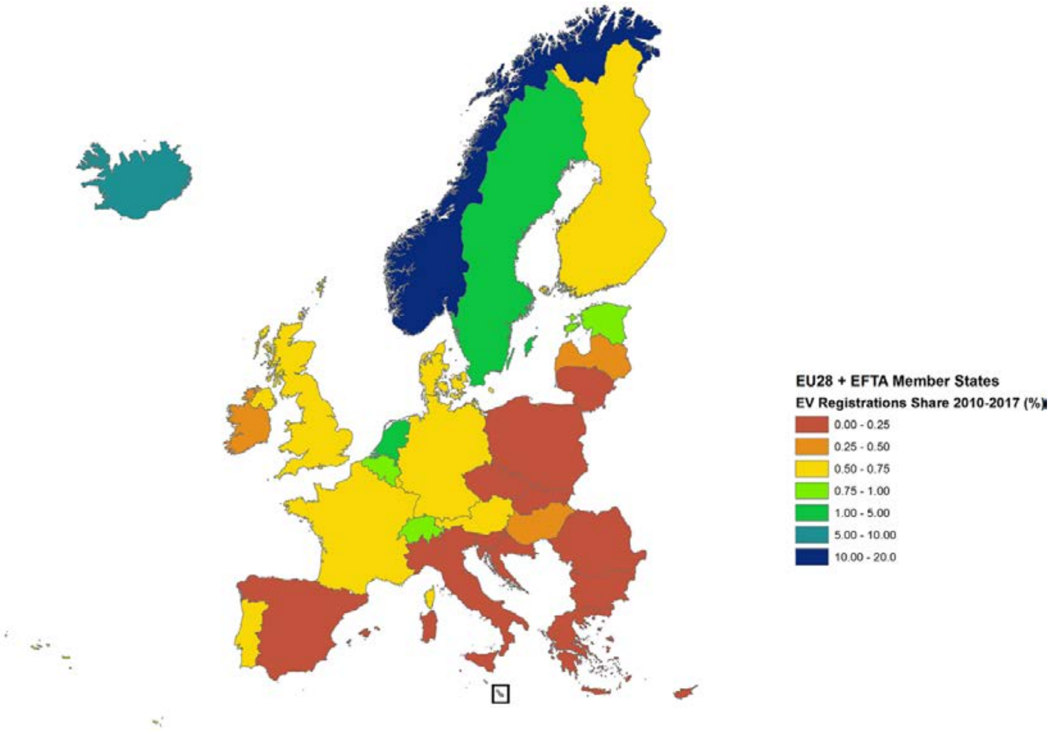
Figure 13. Levels of total EV registrations in Europe per country between 2010 and 2017



Source: Own elaboration on European Alternative Fuels Observatory, 2018.

([11]) Malta has been increased in size for better visibility.

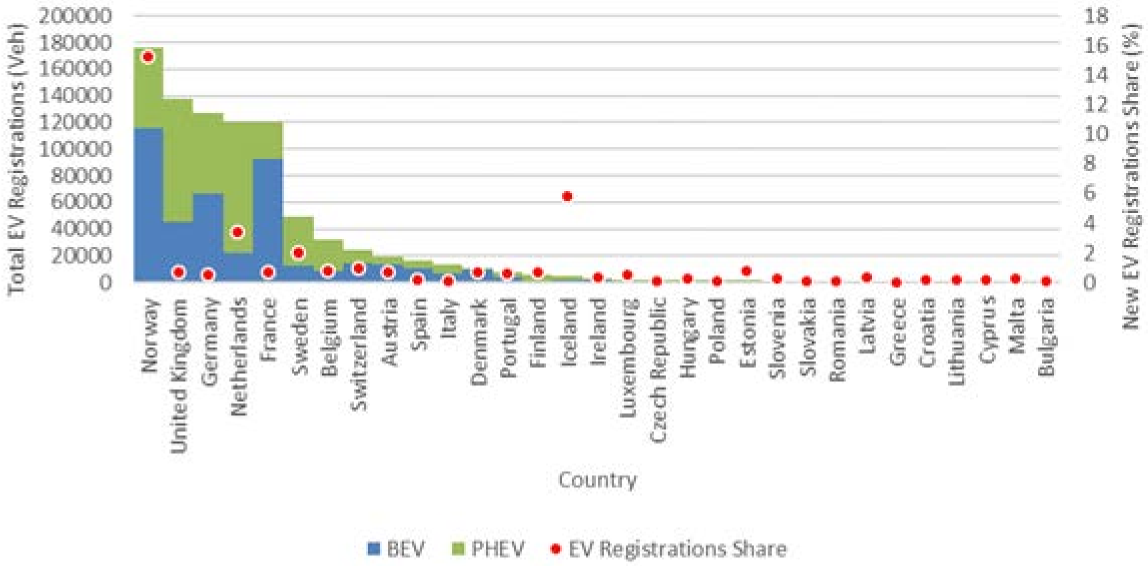
Figure 14. Levels of EV registrations share in Europe per country between 2010 and 2017



Source: Own elaboration on European Alternative Fuels Observatory, 2018; European Automobile Manufacturers Association, 2018; European Environment Agency, 2018.

As it can be observed in Figure 15, the following countries present the highest numbers in order of total number of EV registrations forming the European top-10: Norway, the United Kingdom, Germany, the Netherlands, France, Sweden, Belgium, Switzerland, Austria, and Spain. It should be highlighted that the top-5 countries in terms of total EV registrations account for more than 80% of all EV registrations in Europe. Moreover, EV registrations in the EU from 2010 to 2017 have been increasing their market share with the exception of 2016 as it can be seen in Figure 6.

Figure 15. Ranking of EV registrations in Europe per country and EV registration shares between 2010 and 2017



Source: Own elaboration based on EAFO data.

The graph presents the development of total EV registrations and their shares for Europe during the study period, with countries being ranked according to total EV registrations between 2010 and 2017. The red dots represent the respective registration share to the total number of registrations. The observed spikes reveal discrepancies between the development of the EV market in terms of absolute numbers and share ratio.

Table 1 provides a general overview of the various EV support measure types that have been identified across European countries, while Table 2 presents a country specific overview. Besides the measures listed in the tables, also the difference between retail electricity prices and gasoline/diesel prices at the pump may have a positive or negative impact on the attractiveness of EVs in the different countries.

Table 1. Different support measures types for EVs.

Impact on	Type of Support
Purchase	Tax reduction/exemption, purchase premium, penalty for polluting cars
Annual tax/cost	Tax reduction/exemption
Privileged access	Free access to bus/taxi lanes, access ban for polluting vehicles, reduction or exemption from road tolls or parking fees
Recharging	Provision of public recharging points (slow/fast), free recharging, condition to use low-carbon electricity
Research, development and demonstration	Support to R&D projects and field tests

Source: Adapted from Thiel et al., 2015.

Table 2. Support measures for EVs in Europe.

Country	Purchase Subsidies	Registration Tax Benefits	Ownership Tax Benefits	Company Tax	VAT Benefits	Other Financial	Local Incentives	Infrastructure Incentives
Austria								
Belgium								
Bulgaria								
Croatia								
Cyprus								
Czech Republic								
Denmark								
Estonia								
Finland								
France								
Germany								
Greece								
Hungary								
Iceland								
Ireland								
Italy								
Latvia								
Lithuania								
Luxembourg								
Malta								
Netherlands								
Norway								
Poland								
Portugal								
Romania								
Slovakia								
Slovenia								
Spain								
Sweden								
Switzerland								
United Kingdom								

Blue colour: support measure still existing in 2017; brown colour: support measure existing sometime between 2010 and 2016 but phased out by 2018

Source: European Alternative Fuels Observatory, 2017b.

2.5 Light commercial EVs (N1)

Apart from the M1 passenger car category, the N1 electric light commercial vehicles (eLCV) category has also an increasing presence in the EV market mainly due to its extensive use potential in commercial fleets.

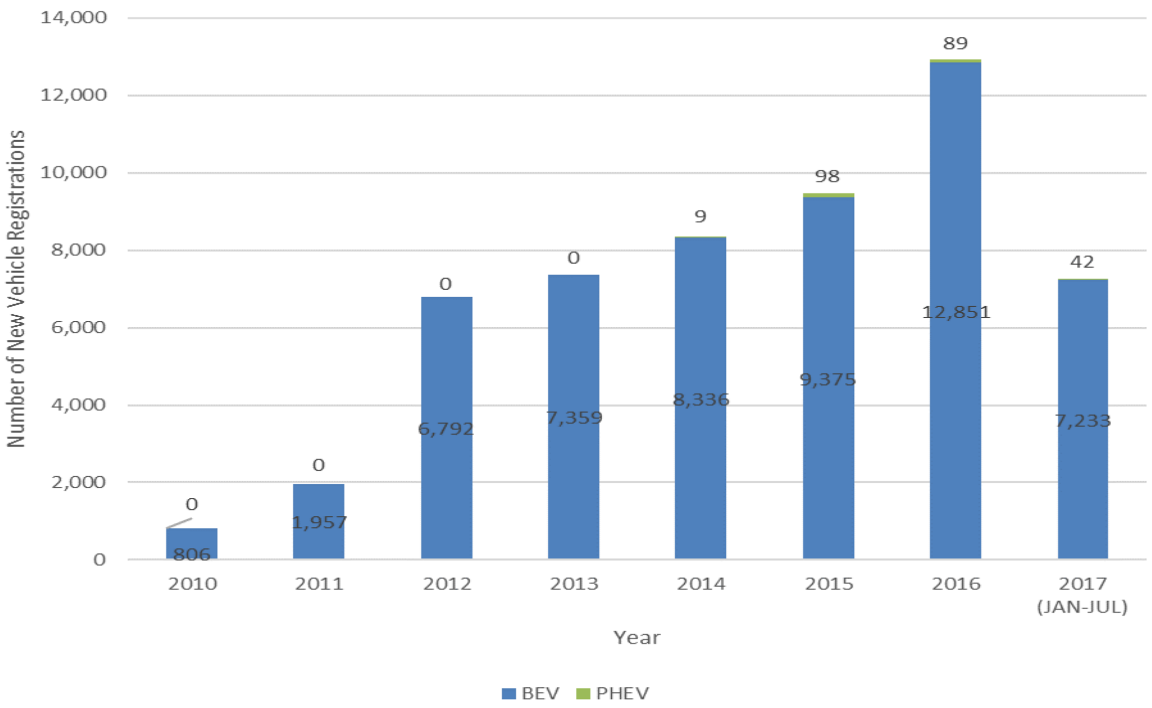
Commercial vehicles and fleets present a series of common characteristics that can benefit the introduction and further market penetration of N1 EVs. First, the acquisition of light commercial vehicles (LCV) and the development of fleets comprising vehicles of this category depends highly on their cost effectiveness while their total cost of ownership is a major decisive factor for their acquisition.

Many small LCV are devoted solely on small distance trips while generally, commercial fleets are parked overnight at designated parking depots. Those elements can be influential to EV acceptance since range barriers and recharging infrastructure availability challenges can be overcome more easily compared to regular passenger cars, while in terms of fuel costs electricity can provide lower fuel costs.

At the writing of this report, data for eLCV were only available for the period 2010 to July 2017. During this time a total of 55,143 eLCV were registered in Europe. BEV accounted for the vast majority and most of the available models are based on vehicle architectures primarily developed for goods transport. As a matter of fact the few PHEV N1 vehicles registered were all derivatives of passenger cars.

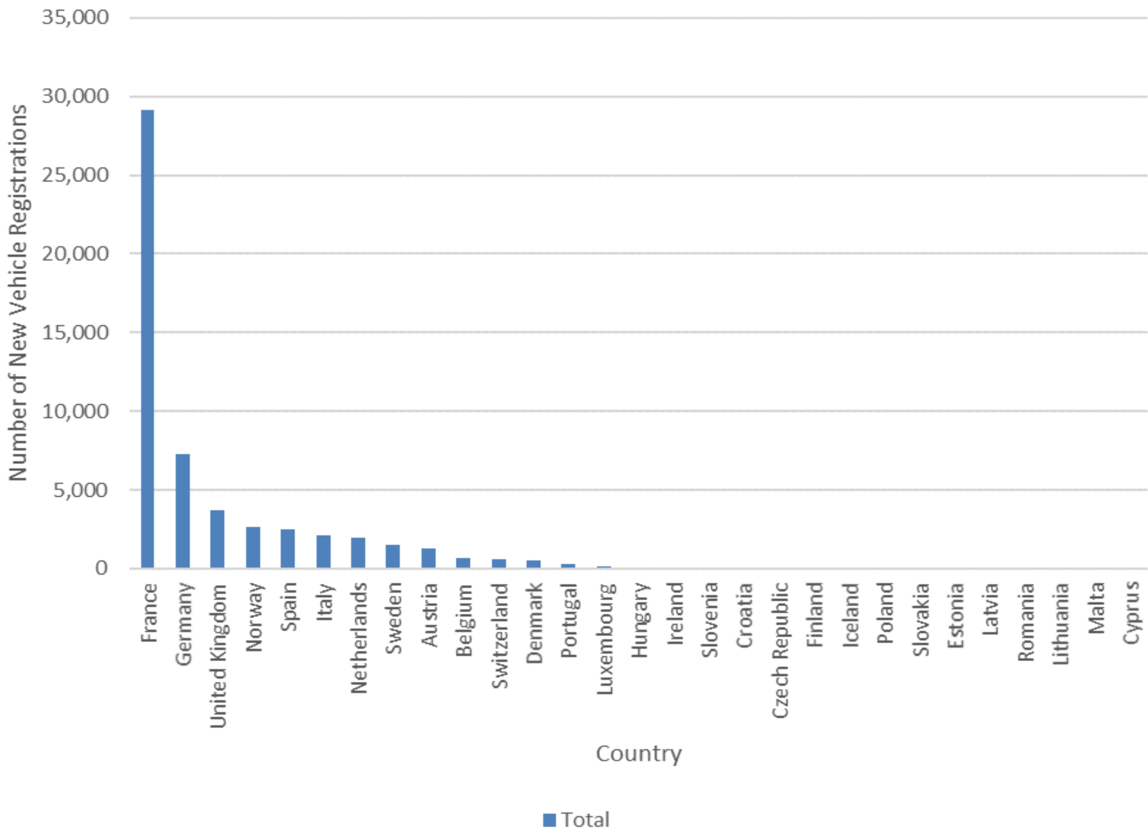
The total eLCV registrations in Europe from 2012 to 2017 are presented in Figure 16, while the total registrations per country are presented in Figure 17. France is by far the biggest eLCV market. Germany, the United Kingdom, Norway and Spain complete the top-5 countries in terms of N1 vehicle registrations. The difference between the number of registrations and ranking of countries between M1 and N1 vehicle categories is notable, with more than half of the countries included in this study presenting minimal or no eLCV presence, opposite to passenger cars that have a wider presence in the market and have a wider geographical coverage.

Figure 16. Number of new eLCV (N1) registrations in Europe between 2010-2017



Source: Own elaboration on EAFO data.

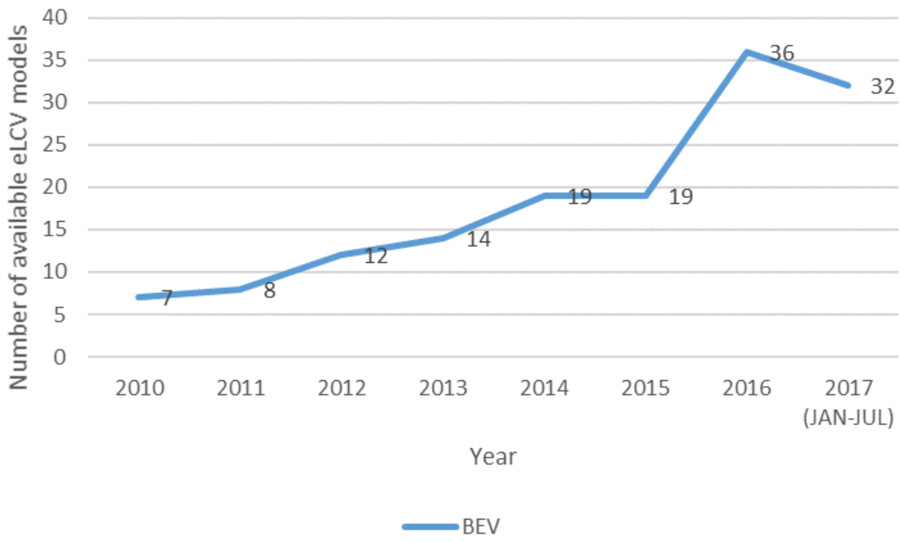
Figure 17. Number of new eLCV (N1) registrations in Europe per country between 2010-2017



Source: Own elaboration on EAFO data.

In terms of eLCV models availability, Figure 18 presents the evolution of the number of different N1 category models that were available in Europe from 2010 to 2017. Moreover, Tables A.3-A.4 in the Annex present the top models and Figure 19 presents the eLCV model registrations share in Europe between 2010 and 2017.

Figure 18. Number of available N1 eLCV models in Europe between 2010-2017



Source: Own elaboration on EAFO data.

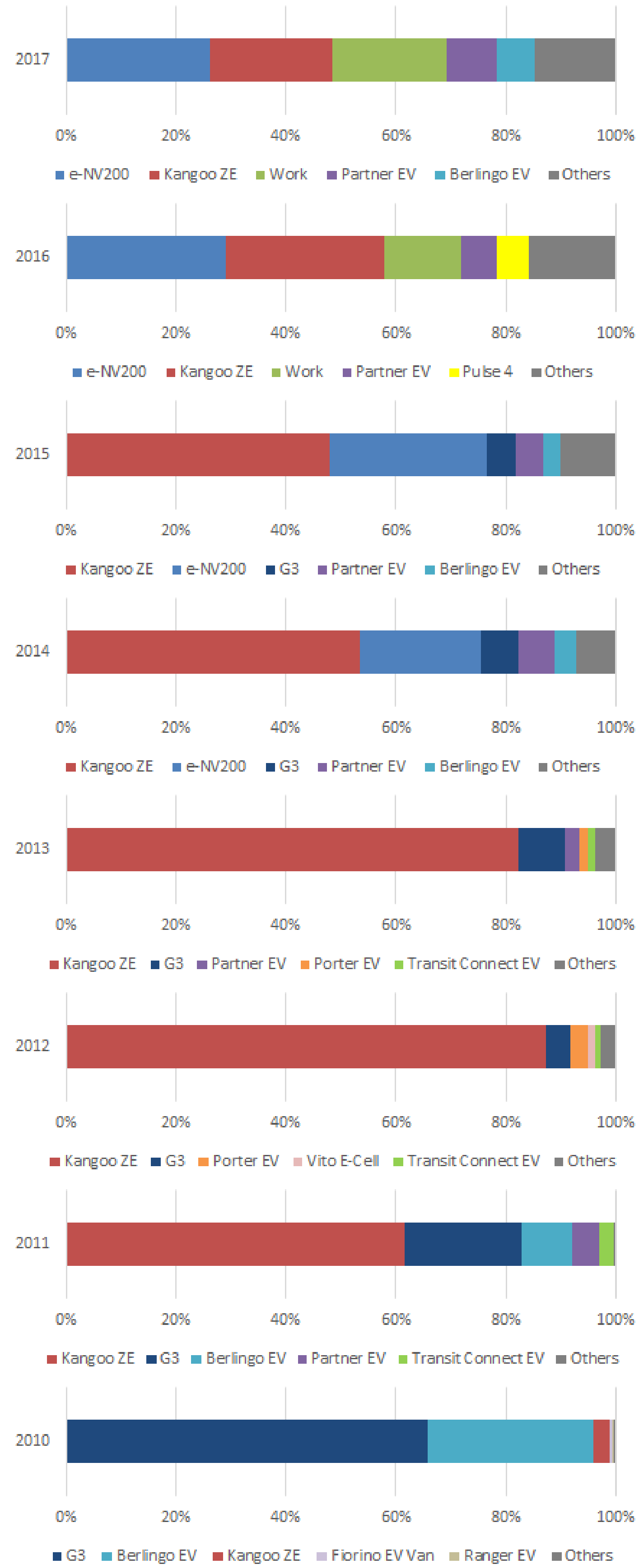
The available number of BEV models has been steadily increasing from 2010 to 2014 when a pause was observed partly due to changes in model preferences. Then a new higher increase is observed in 2016 reaching an all-time high of 36 models compared to the 7 initial models in 2010.

The above data combined with the top eLCV models presented in Tables A.3-A.4 and the models distribution in Figure 19 reveals a Japanese/French domination of the market and a small group of models gathering the vast majority of consumers' choice, with Renault Kangoo ZE being by far the first choice between 2011 and 2015 then coming second behind Nissan e-NV200. Since 2016 the Street Scooter Work occupies the third place in new registrations with the three top models having a great difference from the others in terms to numbers. The number of models registered show large differences in comparison with the M1 figures.

Box 1. New sector entrants

StreetScooter GmbH is an example of a new entrant in the BEV light commercial vehicle sector and is now the third biggest manufacturer of BEV N1 vehicles in Europe. It is fully owned by Deutsche Post DHL Group, a German postal and logistics service company, which has plans to electrify large parts of its 70,000 units delivery van fleet, and which has meanwhile > 5,000 StreetScooter light commercial EV in use.

Figure 19. eLCV BEV model registrations share in Europe between 2010 and 2017

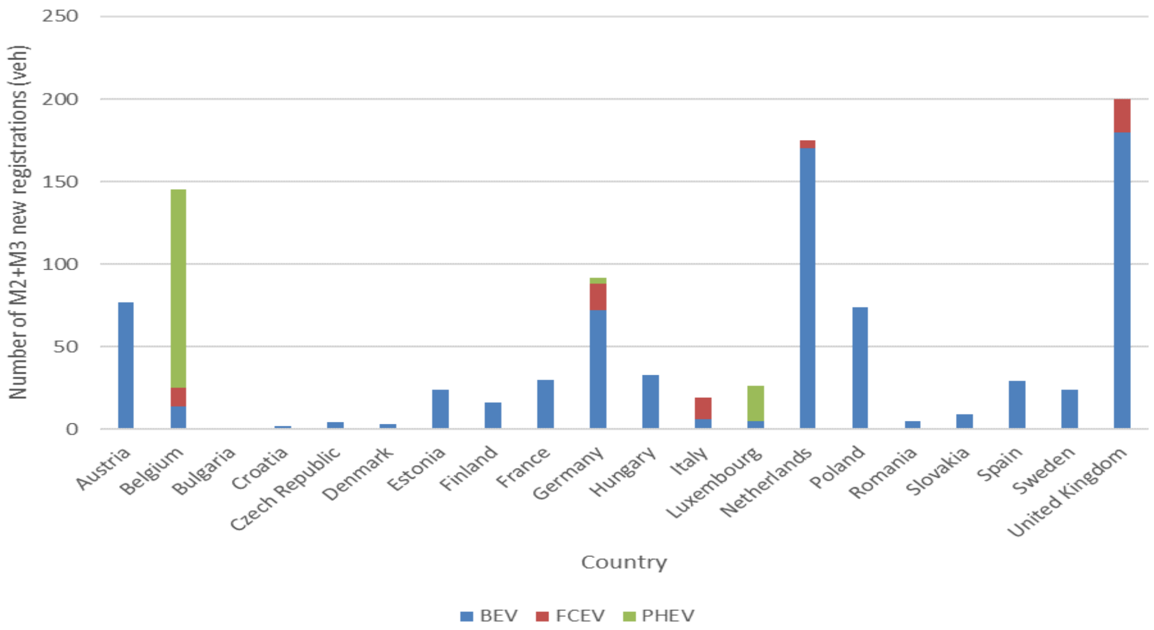


Source: Own elaboration on EAFO data.

2.6 Electric buses (M2-M3)

Electric buses are another category of vehicles that can offer an environmentally friendly alternative, especially within the urban context, where a large part of public transport is based on the use of M2-M3 category Diesel propelled vehicles that have an impact on road transport traffic and environmental performance. While there are already electric trolley-buses available in many cities since decades, BEV, PHEV, and FCEV versions are a rather new sight. Our data only covers these latter categories. Figure 20 presents data on the levels of new electric bus registrations in Europe between 2010-2017 (July) and total new registrations by EU Member State and powertrain. Data on buses is sparse in Europe. The most comprehensive analysis was performed for the impact assessment accompanying the proposed amendment of the Directive on the promotion of clean and energy-efficient road transport vehicles (European Commission, 2017b). It also states that the global electric bus stock is estimated to count 173,000 buses (2015 figures), out of which ~150,000 are battery-electric. 98% of the global stock is situated in China.

Figure 20. Number of new electric bus (M2-M3) registrations in Europe per country and powertrain between 2010 and 2017 (July)



Source: Own elaboration on EAFO data.

Only in twenty countries in Europe M2+M3 category BEV vehicles were registered, with the UK, the Netherlands, Belgium, Germany and Austria forming the top-5. It should be noted that the vast majority of PHEV vehicles can be found in two countries, namely Belgium and Luxembourg.

3 Conclusions

This report analyses the EV deployment in Europe during the past eight years covering the period between 2010 and 2017, using data from publicly available databases and sources of information. In this context, it should be highlighted that since 2010 the deployment of EV in Europe has been gaining momentum, increasing both in absolute numbers of registrations and market share. The brands offering EVs and EV models available in the market increased significantly from 2010 to 2017, covering a wider range of passenger car size-categories, offering at the same time a wider variety of alternatives. The number of EV registrations and market share, while still small compared to conventional ICE passenger cars, has increased steadily in Europe with some countries witnessing impressive growth with higher results every year. While EVs were mainly niche cars seven years ago, most of the car brands now offer EVs, and nowadays these cover the entire spectrum of car segments. Especially BEV offer the opportunity for new market entrants. For example, the Tesla Model S was with a share of 18% the third most successful BEV-model in the EU BEV-market in 2015. In the same year the French EV maker Bolloré, supplying models to several car sharing schemes, had a market share of more than 2% of all newly registered BEV in the EU.

Moreover, in the passenger car market, a clear distinction between the various EV powertrains exist i.e. BEV, PHEV and FCEV. PHEV typically present higher numbers of registrations in the larger car size segments, while BEV present higher numbers in the smaller car size segments. FCEV vehicles still comprise a very small fraction of the market and are targeted at mid-sized vehicles or sport utility vehicles (SUV). Most of the current PHEV models offered are derived from conventional internal combustion engine (ICE) cars, while BEV models offered mainly include unique models specifically developed as BEV only, but the number of models that are derived from conventional ICE dominated car platforms is increasing. In the future, this may change again if electrification becomes a dominant trend.

Regardless of the increasing numbers in market penetration, barriers for mass market uptake still seem to exist. Generally, consumers tend to be concerned about several EV characteristics that can act as a factor limiting EV demand (Gómez Vilchez et al., 2017; McKinsey & Company, 2017):

- Purchase costs
- Driving range
- Recharging infrastructure availability
- Model choice
- Maintenance costs
- Vehicle performance and driving experience

Some of the barriers could also be related to consumer misconceptions about EV characteristics.

Higher purchase costs for EV, mainly because of the significant batteries' cost, seem to remain an important barrier for a larger EV uptake. Recent studies, nevertheless, indicate that battery costs may decline faster than originally anticipated (Bloomberg New Energy Finance, 2018). In this framework, it should be highlighted that purchase costs decrease as technology evolves and more models are available on the market and increase competition. Additionally, support policies and incentive schemes are instrumental in many countries to support the transition to low emission mobility. A notable increase in EV demand has been observed in various European countries where incentive schemes were introduced, while countries with low or no incentives present low EV registrations and market shares. Thus, total EV registrations and market shares observed across European countries align well with the levels of financial benefits accompanying the EV market, proving that the form of the incentives and its continuity can play a catalytic role in EV deployment at this stage. In some cases, such as in the Netherlands and Estonia, changes in the incentives led to large variations in EV registration numbers, demonstrating the still very important role of incentives in EV deployment. All the above indicate that policies remain crucial to overcome market barriers at national and European level. Various types of incentives and levels of support have been already tested across the vast majority of European countries providing useful experiences and insights that can be used to underpin the implementation of national policy frameworks or their further development.

Driving range has been constantly increasing parallel to EV battery pack evolution and mass production, enabled by *on-purpose* constructed EV models to take up bigger batteries. Moreover, high mileage or years-of-use warranties are offered by EV manufacturers and are becoming common for EVs and especially, their battery packs.

Recharging infrastructure has evolved in numbers of available recharging points but also in terms of recharging speed following the technological advances within this field. Potential grid restrictions may need to be tackled through targeted infrastructure investments and grid reinforcements and upgrades. Clear dominance of the Combined Charging System (CCS) fast charging technology, meanwhile adopted by more than 60% of world car industry, has been observed. It was accompanied by good progress in the maturation of important standard families like standards ISO 15118 and IEC 61851. But recent announcements of Japanese and Chinese producers, to develop a new high-power charging fast standard based on the Japanese CHAdeMO and the Chinese GB/T standard may jeopardise this development.

Model and brand choice restrictions are being reduced since more brands offer a wider spectrum of available models and powertrains. Limitations of this kind that occurred during the first years of the recent EV deployment are gradually overcome both by traditional car manufacturers offering electric alternatives but also by new entrants exclusively offering EV models.

Even though many customers believe that an EV purchase will be accompanied by high maintenance costs, in reality the actual EV maintenance costs may actually be lower due to fewer moving parts compared to ICE vehicles. Another possible misconception is that EV are slower or provide an inferior driving experience compared to ICE vehicles. In fact EV provide the benefits of high levels of acceleration through instantly available torque and increased performance of electric motors. As the EV market grows and user experiences increase more consumers will be able to realistically assess the characteristics of driving electric. This theme may also bear potential for fruitful information campaigns.

N1 category electric vehicles (eLCV) receive usually much less public attention than passenger cars. Our report reveals that also the eLCV market has shown strong and steady growth during the past years. Here the electric vehicle market is practically fully based on BEV sales.

For electric buses little data is available. Nevertheless, battery-electric and fuel cell buses can now be seen in many European cities.

Below we list some considerations with relevance for European policy development that can be derived from this study.

Support measures stimulating EV demand in the EU Member States are not harmonised and this has led to a certain market fragmentation both in terms of EVs on the road and availability of publicly accessible recharging infrastructure. Interestingly, the EU countries with a higher number of EVs typically have more than one public charge point per ten EVs. The share of fast recharging points (>22kW) varies significantly from Member State to Member State. On average, in the EU currently every tenth publicly accessible recharging point supports fast recharging above 22 kW charge power. In some countries the lack of publicly accessible recharging points may have already led to lower consumer confidence in the viability of EVs. Here, interoperability and non-discriminatory access to available public recharging points is crucial.

EVs have not yet achieved cost competitiveness with respect to incumbent technologies. Further R&D efforts are needed to improve their performance further and reduce their costs. R&D related priority actions, besides work on batteries and battery management systems could focus on:

- Components: electric motors (e.g., rare earth free motor concepts of comparable efficiency for long-term economic sustainability, or in-wheel motors to achieve more design freedom), power electronics (for example increased modularity, higher efficiency through mass production with better materials like silicon carbide etc.), ancillary systems (e.g., HVAC systems in EVs of higher energy efficiency)

- System integration: increase functional integration and improve control systems in order to increase energy recuperation, reduce energy losses and vehicle costs

- Leveraging automated driving functionalities: exploit drive automation for predictive highly flexible and adaptive control strategies

Policies that can have an impact on the users' consumer behaviour, affecting the various elements surrounding low emission mobility, can play a major role supporting the beginning transition towards a near zero emission mobility.

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List of abbreviations and definitions

AT	Austria
BE	Belgium
BEV	Battery Electric Vehicle
BG	Bulgaria
CH	Switzerland
CY	Cyprus
CZ	Czech Republic
DE	Germany
DK	Denmark
EAFO	European Alternative Fuels Observatory
EC	European Commission
EE	Estonia
EFTA	European Free Trade Association
EL	Greece
eLCV	Electric Light Commercial Vehicles
EU	European Union
ES	Spain
EV	Electric Vehicle[12]
FCEV	Fuel Cell Electric Vehicle
FI	Finland
FR	France
GHG	Greenhouse Gas
HR	Croatia
HU	Hungary
ICE	Internal Combustion Engine
IE	Ireland
IS	Iceland
IT	Italy
JRC	Joint Research Centre
LT	Lithuania
LU	Luxemburg
LV	Latvia
MS	Member State
MT	Malta
NL	Netherlands

[12] In this report referring to BEV, PHEV, REV and FCEV combined.

NO	Norway
PEV	Plug-in Electric Vehicle
PHEV	Plug-in Hybrid Electric Vehicle
PL	Poland
PT	Portugal
R&D	Research and Development
R&I	Research and Innovation
REV	Range-extended Electric Vehicles
RO	Romania
SE	Sweden
SET	Strategic Energy Technology
SETIS	Strategic Energy Technologies Information System
SI	Slovenia
SK	Slovakia
STRIA	Strategic Transport Research and Innovation Agenda
SUV	Sports Utility Vehicle
UK	United Kingdom
USA	United States of America

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Annex

Table A.1. Top 10 M1 category BEV models by registration numbers in Europe from 2010 to 2017.

EU+EFTA M1 BEV	Year															
Rank	**2010**		**2011**		**2012**		**2013**		**2014**		**2015**		**2016**		**2017**	
1	Think City	632	Mitsubishi I-Miev	2,808	Nissan Leaf	5,383	Nissan Leaf	10,894	Nissan Leaf	14,691	Renault Zoe	18,530	Renault Zoe	21,319	Renault Zoe	30,628
2	Smart Fortwo ED	264	Peugeot iOn	1,849	Citroen C-Zero	3,215	Renault Zoe	8,833	Renault Zoe	11,029	Tesla Model S	16,643	Nissan Leaf	18,599	Nissan Leaf	17,454
3	Tesla Roadster	133	Citroen C-Zero	1,781	Peugeot iOn	3,125	Tesla Model S	3,975	Tesla Model S	9,550	Nissan Leaf	15,346	Tesla Model S	12,508	Tesla Model S	15,553
4	Mitsubishi I-Miev	101	Nissan Leaf	1,740	Mitsubishi I-Miev	1,639	Fortwo ED	3,351	Volkswagen e-Up!	5,838	Volkswagen e-Golf	11,170	BMW i3	9,441	BMW i3	14,493
5	Mini Mini E	50	Smart Fortwo ED	907	Bollore Blue Car	1,543	BMW i3	998	BMW i3	5,433	BMW i3	6,134	Volkswagen e-Golf	6,678	Volkswagen e-Golf	12,895
6	Volvo C30 Electric	50	Renault Fluence ZE	536	Fluence ZE	1,382	Volkswagen e-Up!	940	Smart Fortwo ED	2,945	KIA Soul EV	5,812	KIA Soul EV	4,484	Tesla Model X	12,630
7	Peugeot iOn	43	Think City	432	Fortwo ED	1,029	Mitsubishi I-Miev	887	Volkswagen e-Golf	2,931	Volkswagen e-Up!	2,976	Tesla Model X	3,750	Hyundai Ioniq Electric	6,117
8	Nissan Leaf	36	Bollore Blue Car	399	Mia Electric	540	Citroen C-Zero	825	Bollore Blue Car	1,170	Mercedes B250e	2,795	Mercedes B250e	3,513	KIA Soul EV	5,552
9	Citroen C-Zero	33	Tesla Roadster	299	Tesla Roadster	230	Peugeot iOn	695	Mitsubishi I-Miev	716	Smart Fortwo ED	2,037	Volkswagen e-Up!	2,576	Smart Fortwo ED	5,191
10	Fiat 500e	14	Mia Electric	257	BMW Active E	210	Bollore Blue Car	658	Citroen C-Zero	605	Peugeot iOn	1,477	Peugeot iOn	1,891	Volkswagen e-Up!	3,054

Source: Own elaboration on EAFO data.

Table A.2. Top 10 M1 category PHEV models by registration numbers in Europe from 2010 to 2017.

EU+EFTA M1 PHEV	Year															
Rank	**2010**		**2011**		**2012**		**2013**		**2014**		**2015**		**2016**		**2017**	
1	Toyota Prius PHEV	2	Opel Ampera	291	Opel Ampera	5,253	Mitsubishi Outlander PHEV	8,193	Mitsubishi Outlander PHEV	20,028	Mitsubishi Outlander PHEV	31,177	Mitsubishi Outlander PHEV	21,266	Mitsubishi Outlander PHEV	19,148
2			Chevrolet Volt	60	Toyota Prius PHEV	3,408	Volvo V60 PHEV	8,032	Volvo V60 PHEV	5,462	Volkswagen Golf GTE	17,258	Volkswagen Passat GTE	13,332	Volkswagen Passat GTE	13,599
3			BYD F3 DM	8	Chevrolet Volt	681	Toyota Prius PHEV	4,873	BMW i3 Rex	3,651	Audi A3 e-Tron	12,080	Volkswagen Golf GTE	11,106	Mercedes GLC350e	11,249
4			Toyota Prius PHEV	3	Fisker Karma	379	Opel Ampera	3,207	Toyota Prius PHEV	1,478	Volvo V60 PHEV	7,360	Mercedes C350e	10,233	BMW 225xe Active Tourer	10,805
5					Volvo V60 PHEV	37	Chevrolet Volt	955	BMW i8	1,101	Mercedes C350e	5,858	Volvo XC90 PHEV	9,557	BMW 330e	10,117
6					BYD F3 DM	2	BMW i3 Rex	537	Opel Ampera	1,003	BMW i3 Rex	5,612	BMW 330e	8,695	Volkswagen Golf GTE	9,267
7							Porsche Panamera PHEV	481	Porsche Panamera PHEV	944	Volkswagen Passat GTE	4,819	Audi A3 e-Tron	6,600	Audi A3 e-Tron	8,356
8							Fisker Karma	123	Volkswagen Golf GTE	768	Porsche Cayenne PHEV	3,666	BMW 225xe Active Tourer	5,937	Volvo XC90 PHEV	7,832
9							Volkswagen XL1	30	Audi A3 e-Tron	729	Volvo XC90 PHEV	2,859	BMW i3 Rex	5,625	Mercedes C350e	6,861
10							Mercedes S500e	1	Porsche Cayenne PHEV	258	BMW i8	2,051	BMW X5 40e	5,389	BMW i3 Rex	6,327

Source: Own elaboration on EAFO data.

Table A.3. Top 10 N1 category BEV models by registration numbers in Europe from 2010 to 2017.

EU+EFTA N1 BEV	**Year**															
Rank	**2010**		**2011**		**2012**		**2013**		**2014**		**2015**		**2016**		**2017**	
1	Goupil G3	356	Renault Kangoo ZE	994	Renault Kangoo ZE	5,602	Renault Kangoo ZE	5,895	Renault Kangoo ZE	4,186	Renault Kangoo ZE	4,114	Nissan e-NV200	3,739	Nissan e-NV200	1,897
2	Citroen Berlingo EV	164	Goupil G3	345	Goupil G3	293	Goupil G3	582	Nissan e-NV200	1,712	Nissan e-NV200	2,448	Renault Kangoo ZE	3,688	Renault Kangoo ZE	1,609
3	Renault Kangoo ZE	16	Citroen Berlingo EV	149	Piaggio Porter EV	192	Peugeot Partner EV	191	Goupil G3	549	Goupil G3	449	StreetScooter Work	1,800	StreetScooter Work	1,489
4	Fiat Fiorino EV Van	2	Peugeot Partner EV	80	Mercedes Vito E-Cell	86	Piaggio Porter EV	123	Peugeot Partner EV	498	Peugeot Partner EV	427	Peugeot Partner EV	830	Peugeot Partner EV	670
5	Ford Ranger EV	2	Ford Transit Connect EV	41	Ford Transit Connect EV	73	Ford Transit Connect EV	86	Citroen Berlingo EV	307	Citroen Berlingo EV	268	Ligier Pulse 4	755	Citroen Berlingo EV	494
6	Piaggio Porter EV	1	Piaggio Porter EV	3	Mia Mia EV	66	Mia Mia EV	71	Renault Zoe Van	221	Ligier Pulse 4	216	Citroen Berlingo EV	473	Renault Zoe Van	358
7	Peugeot Partner EV	1	Ford Ranger EV	2	Citroen Berlingo EV	52	Mercedes Vito E-Cell	61	Piaggio Porter EV	114	Renault Zoe Van	215	Renault Zoe Van	442	Goupil G4	267
8	-	-	Fiat Fiorino EV Van	2	Peugeot Partner EV	37	Peugeot iOn Van	59	Peugeot iOn Van	95	StreetScooter Work	200	Goupil G3	396	Ligier Pulse 4	100
9	-	-	-	-	Iveco Daily Electric	6	Renault Zoe Van	47	Mercedes Vito E-Cell	70	Piaggio Porter EV	131	Blu Car Golia	173	Nissan Leaf Van	92
10	-	-	-	-	Fiat Fiorino EV Van	6	Citroen Berlingo EV	22	Nissan Leaf Van	16	Goupil G5	50	Piaggio Porter EV	150	Goupil G5	57

Source: Own elaboration on EAFO data.

Table A.4. Top 10 N1 category PHEV models by registration numbers in Europe from 2010 to 2017.

EU+EFTA N1 PHEV	Year															
Rank	**2010**		**2011**		**2012**		**2013**		**2014**		**2015**		**2016**		**2017**	
1	-	-	-	-	-	-	-	-	Mitsubishi Outlander PHEV	7	Mitsubishi Outlander PHEV	98	Mitsubishi Outlander PHEV	77	Mitsubishi Outlander PHEV	36
2	-	-	-	-	-	-	-	-	BMW i3 Rex Van	1	-	-	Mitsubishi Outlander PHEV Van	7	Audi Q7 e-Tron van	2
3	-	-	-	-	-	-	-	-	Volvo V60 PHEV Van	1	-	-	Volvo XC90 PHEV Van	3	BMW i3 Rex Van	2
4	-	-	-	-	-	-	-	-	-	-	-	-	BMW X5 40e Van	1	BMW 225xe Active Tourer Van	1
5	-	-	-	-	-	-	-	-	-	-	-	-	BMW 225xe Active Tourer Van	1	Mitsubishi Outlander PHEV Van	1

Source: Own elaboration on EAFO data.

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