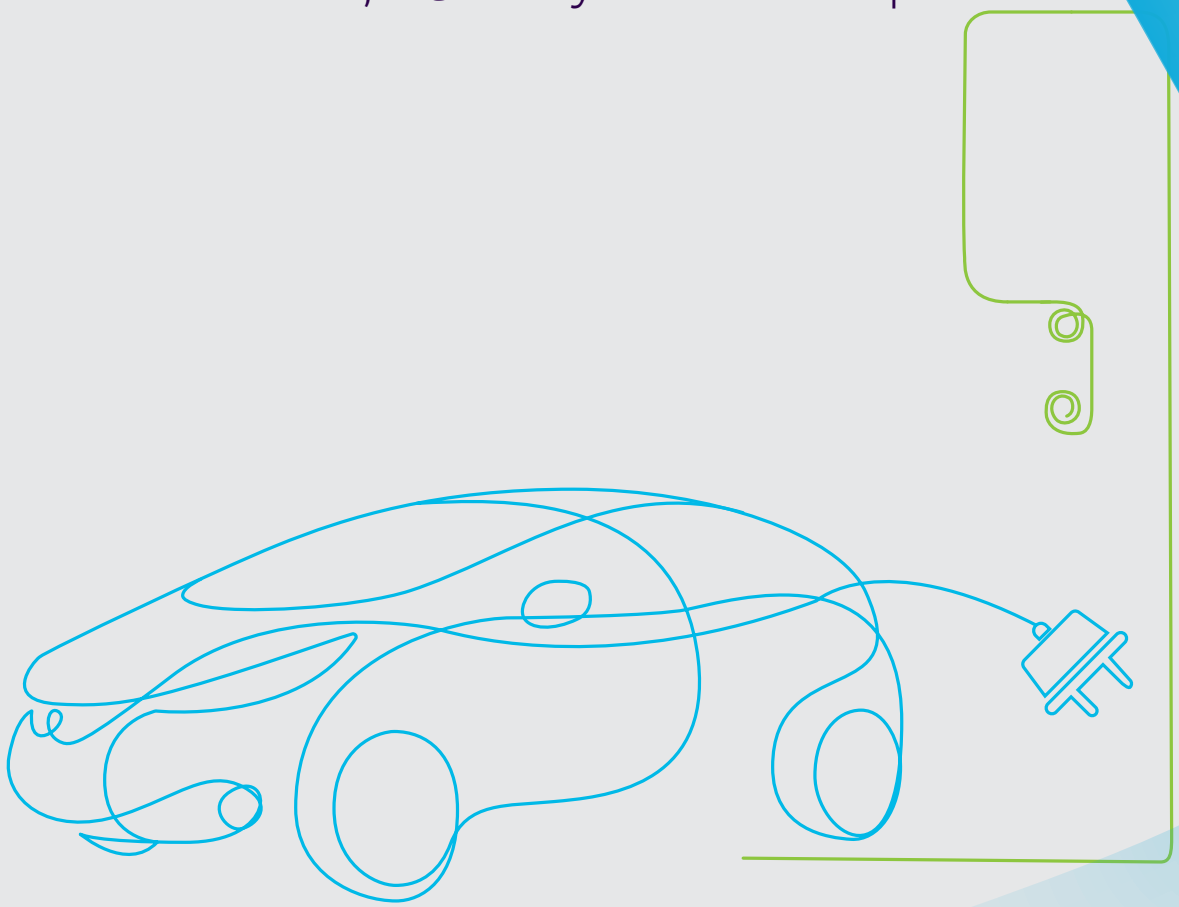
E-MOBILITY – ELECTRIC VEHICLE CHARGING INFRASTRUCTURE DEVELOPMENT

Will there be enough charging points to support electric vehicle rollout in the next decades, in Germany and across Europe?



Capgemini invent

INTRODUCTION

With today's emphasis on carbon emissions reduction, electrification has become a core component of mobility industry transformation across the globe. This trend is seen in the increase in global electric vehicle (EV) sales (in this report electric vehicles are understood as passenger cars), which grew from 1.2 million in 2017 to 2.2 million in 2018.[1] Despite structural differences across regions and markets, sales generally are likely to soar in the future.

Charging infrastructure is critical to mass adoption of EVs. The large-scale rollout of charging points (CPs) will address customer concerns about range and infrastructure availability, increasing EV attractiveness and encouraging mass adoption. The question is, can infrastructure deployment keep up with the rapid rise of EVs?

This report gives a perspective on future public infrastructure deployments in Germany and other parts of Europe with a focus on projections of public CP availability in 2030. We outline Capgemini's multi-factor model for forecasting the supply of CPs, and compare the resultant forecasts with projections of likely demand. This comparison suggests investment gaps. We quantify these and discuss the implications for e-Mobility market players and their customers.

The EV development scenarios consider plug-in EVs: that is, plug-in hybrid EVs (PHEVs), and pure battery EVs (BEVs). The report takes account of alternating current (AC), direct current (DC), and high-power charging (HPC) CPs.

Public infrastructure plans by the German government

The German government recently announced investment plans of €3bn in public charging infrastructure to reach one million CPs by 2030. According to our study, this would significantly surpass the CP need. Due to the planning status of these announcements, we have not yet considered the resulting implications in our forecast model.

EXECUTIVE SUMMARY

Capgemini has built models to forecast the supply of and demand for public charging points (CPs) in Germany and across Europe over the next decade (see table). For all scenarios, our model suggests a sizeable shortfall in the supply of CPs, which could constrain the development of electric vehicles (EVs).

Public CPs in Germany

	Supply	Demand	Shortfall	Investment needed
2018	16,000			
2025	105,000–160,000	210,000	24%–50%	**€ 600–€1.26bn**
2030	190,000–350,000	510,000	31%–63%	**€ 1.92–€3.84bn**

Public CPs across Europe (EU)

	Supply	Demand	Shortfall	Investment needed
2018	120,000			
2025	570,000–900,000	1,000,000	10%–43%	**€ 1.2–€5.16bn**
2030	970,000–1,800,000	2,800,000	36%–65%	**€ 12–€21.96bn**

It's clear that current implementation plans will not meet demand. To close the gap, CP rollout will need to be accelerated steeply in the coming years. Close cooperation will be needed between all industry stakeholder groups. Governments must provide initial support plus incentives to get the necessary traction in the market. In their transformation from a pure vehicle manufacturer to a service provider, OEMs need to push and support the provision of charging infrastructure. Other suppliers of charging stations should invest appropriately in competencies and production capacity.

Without these additional efforts and investments, overall deployment of EVs will be in jeopardy along with individual OEMs' EV programs.

1. *https://www.electrive.net/2019/02/11/zahl-der-e-fahrzeuge-klettert-weltweit-auf-56-millionen/.*

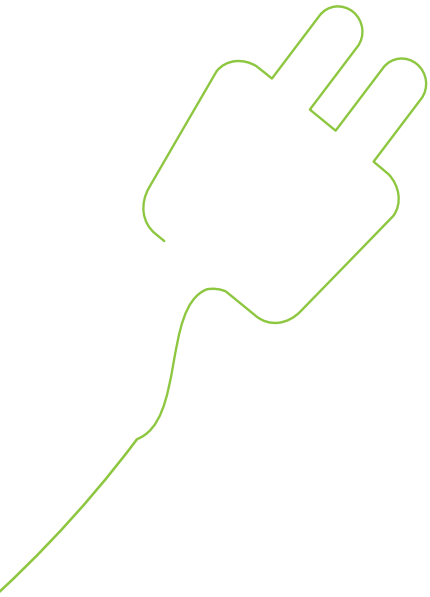
MODELING THE SUPPLY OF CHARGING POINTS

To predict the development of charging point (CP) infrastructure under different scenarios, Capgemini has developed a model for simulating the effects of several factors that directly and indirectly influence the demand for CPs. We quantified these factors and their effects drawing on Capgemini and third-party research.

Factors directly influencing infrastructure development

Historical CP development

EVs are still at the beginning of their development, as is the available public charging infrastructure. However, the historical development of CPs provides an indication of potential future CP developments. Other factors, such as technological advancements, are reflected in the historical development and were therefore not modeled separately.



EV expansion

We considered various scenarios for uptake of EVs as described in the appendix. It should be noted that although EV expansion drives the supply of CPs to some extent, the reverse is also true. Especially in metropolitan areas and for long-distance travel, rapid EV uptake entails an increase in public charging infrastructure. So EV expansion directly contributes to future CP development. But the availability of charging points also affects people's willingness to use EVs.

Factors indirectly influencing infrastructure development

EV battery technology

Batteries' technological capabilities, especially their range, define the required frequency of charging sessions for EVs, and hence the number of CPs required. Ranges are increasing and traveling 500km+ per charge is already achievable. With further technological advancement of the battery, fewer charging sessions will be needed. This factor indirectly influences the number of public CPs needed in the future.

Charging point technology

The time required to charge EVs depends on the capacity of CPs. Besides regular alternating current (AC) and direct current (DC) charging stations, high power charging (HPC) stations have been gaining traction for public charging; they can charge EVs up to 80% in under 30 minutes. This trend is anticipated to continue, as new CP technologies that have already been announced will double the current available charging speed. Reduced charging times means that fewer CPs are needed for a given volume of vehicles.

Government regulations

It will be practically impossible to meet political regulations, especially future CO2 regulations, with current internal combustion engine (ICE) cars. This factor is a major driver of EV adoption and of R&D by OEMs and others. Appropriate charging infrastructure is therefore a requirement for regulatory compliance.

Public infrastructure budget

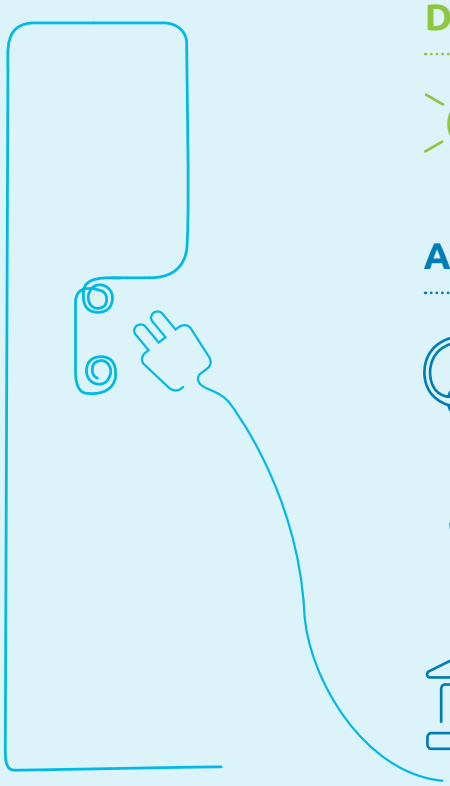
Most of the infrastructure budget comes from policymakers and governments seeking to push electrification in the transport sector in order to meet sustainability and environmental goals. Today, most public CP installations in Europe receive incentives from policymakers. Continued advancement of public CPs will similarly depend on public funding.

EV incentives

Tax incentives encouraging adoption of EVs also boost the requirement for CPs.

Political infrastructure goals

In recent history, political sustainability and environment goals have seldom been met, and are thus not a reliable projection of the future. Nevertheless, the setting of new infrastructure goals by policymakers and governments can influence future CP infrastructure development



Direct Factors

- Historical CP Development
- Electric Vehicle Expansion

Additional Factors

- EV Battery Technology
- Public Infrastructure Budget
- Charging Point Technology
- EV Incentives
- Political Regulations
- Political Infrastructure Goals

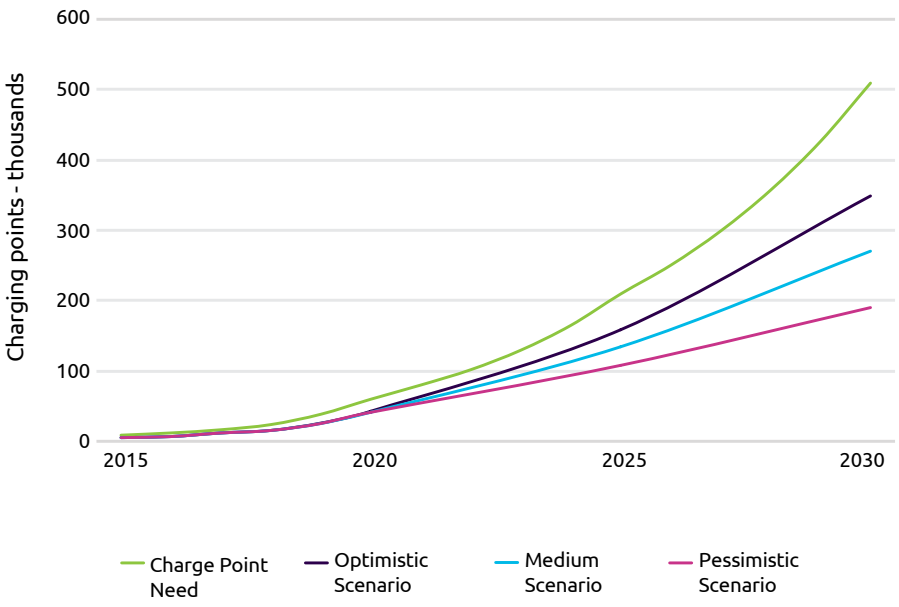
COMPARING PROJECTED DEMAND AND SUPPLY

Germany

The demand for publicly accessible CPs can be estimated using ratios between EVs and CPs. Germany, a leader in EV adoption, currently has eight EVs per public CP[2] but to forecast requirements from 2020 onwards we applied the European Parliament's recommended ratio of 10 EVs per public CP[3] to the intermediate scenario for EV development shown in the appendix. On this basis, Germany is projected to require 210,000 CPs by 2025 and 510,000 by 2030.

Regarding the supply, based on the model described earlier, the maximum number of public CPs will be 160,000 in 2025 and 350,000 in 2030. Comparing this with the projected need, a considerable shortfall becomes apparent. On the basis of current developments there

Figure 1: Charging point demand versus projected supply in Germany



Source: Capgemini Invent

could be a shortfall as high as 105,000 (50%) in 2025. By 2030 there could be a shortfall of 320,000 CPs (63%).

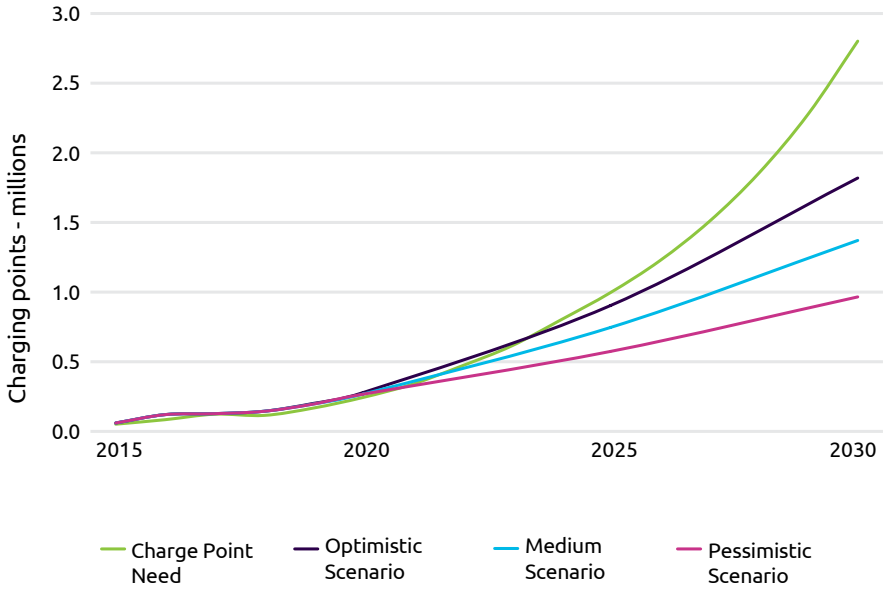
Europe

Across Europe, again there are currently about eight EVs per public CP.[4] Given slower EV developments in the overall European region than in Germany, we applied the ratio of 10 EVs per CP starting only in 2025 to the intermediate EV development scenario for Europe shown in the appendix. From this, we find that about one million public CPs are needed in 2025 and 2.8 million in 2030.

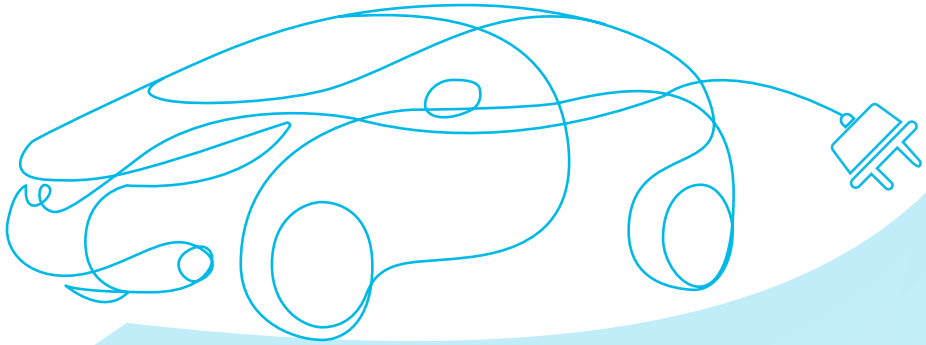
Our supply model gives a forecast of up to 900,000 publicly available CPs across Europe in 2025 and up to 1.8 million in 2030. Europe is therefore projected to have a shortfall as high as 430,000 CPs (10%) in 2025 and 1.83 million (65%) in 2030.

The main reason that the projected shortage of CPs across Europe between 2020 and 2025 is lower than Germany's is that leading e-Mobility countries with a higher absolute number of CPs are pushing up the average availability of charging stations in Europe, concealing CP shortfalls in other countries where EV adoption is low. While this is an appropriate indicator for an overall assessment of the European region, it can lead to inappropriate decision making because structural differences between regions and countries are not taken into consideration. To do this, geographical differences in CP needs and availabilities must be considered – something that is outside the scope of this report.

Figure 2: Charging point demand versus projected supply in Europe



Source: Capgemini Invent



2. EAFO: Germany Dashboard.
3. European Alternative Fuels Directive.
4. EAFO: EU Dashboard.

IMPLICATIONS:

INDUSTRY STAKEHOLDERS MUST ACT TO FILL THE GAP

The projected shortage of publicly accessible CPs will influence customers' take-up of EVs. Currently, the industry's focus is on pushing EV sales and making EV models as attractive as possible. Not enough attention is being paid to customers' experience following an EV purchase. For example, the projected deficit of charging stations, especially in metropolitan regions, could lead to long waiting times and customer dissatisfaction.

Enhancements to plans for CP infrastructure development are therefore necessary to keep up with and further support the adoption of EVs, moving towards a sustainable mobility industry. Below, we identify the implications for three stakeholder groups: **policymakers and governments, OEMs**, and **suppliers**.

Filling the infrastructure gap will take a joint effort from these three groups, with investments in upscaling of public charging infrastructure. In Germany, Capgemini estimates that additional investments of up to €1.26bn are required by 2025, and €3.84bn by 2030. Across Europe, additional investments up to €5.16bn by 2025 and €21.96bn by 2030 are required.

Policymakers and governments

To confront the challenge and obtain the investments required to install the necessary CPs, policymakers and governments need to set attractive incentives for getting involved. Provision of these incentives must be among government entities' top priorities if they are to meet their environmental goals and ensure the mobility sector complies with CO2 regulations.

OEMs

It is not enough for OEMs to push electrification by implementing additional EV models. In their transformation from a pure vehicle manufacturer to a service provider, OEMs need to push and support the provision of charging infrastructure. This role change represents a major challenge, since it will push them out of their comfort zone and require them to build up knowledge and expertise in the field of energy supply and charging infrastructure. But the change will yield opportunities for new business models, and for increased market share and revenue.

Suppliers

Suppliers of charging stations – mainly energy suppliers, CP operators, and mobility service providers – are on the verge of a major increase in the size of their market, with corresponding revenue potential. In order to leverage these new possibilities, they need to set the right level of investment in competencies and production capacity, and must time those investments wisely.

Summing up

Mobility industry stakeholders must work closely together to meet projected infrastructure demand and make availability of charging stations for customers as convenient as possible, so that we can move towards further electrification.

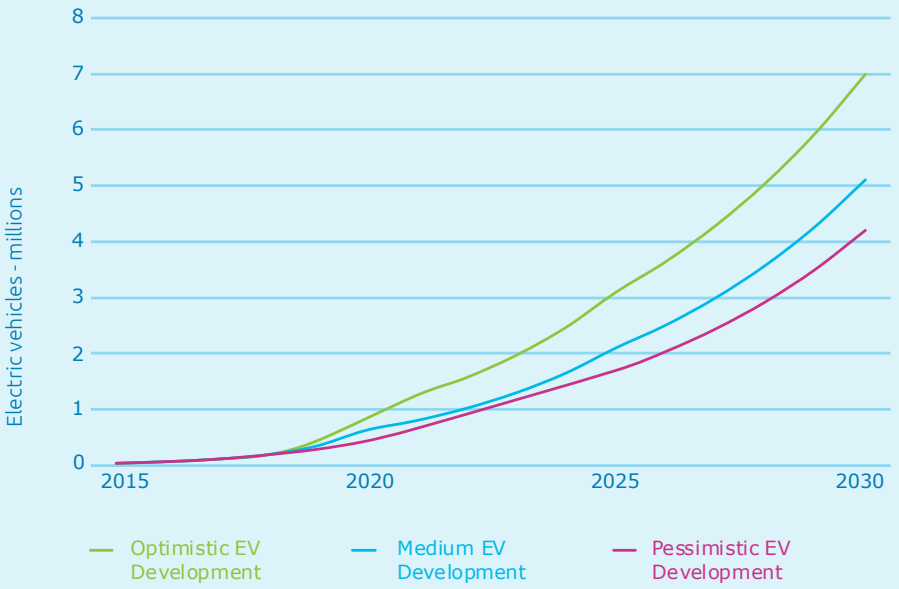
APPENDIX: THREE SCENARIOS FOR EV UPTAKE IN GERMANY AND ACROSS EUROPE

Germany

The German National Platform for Electric Mobility (NPE)[5] – the country's main advisory body for e-Mobility topics – has published three scenarios for future EV uptake.

- ***Optimistic scenario:***
  2025: 3.1 million
  2030: 7.0 million
- ***Intermediate scenario:***
  2025: 2.1 million
  2030: 5.1 million (interp.)
- ***Conservative scenario:***
  2025: 1.7 million
  2030: 4.2 million

Figure 3: EV Development Scenarios in Germany

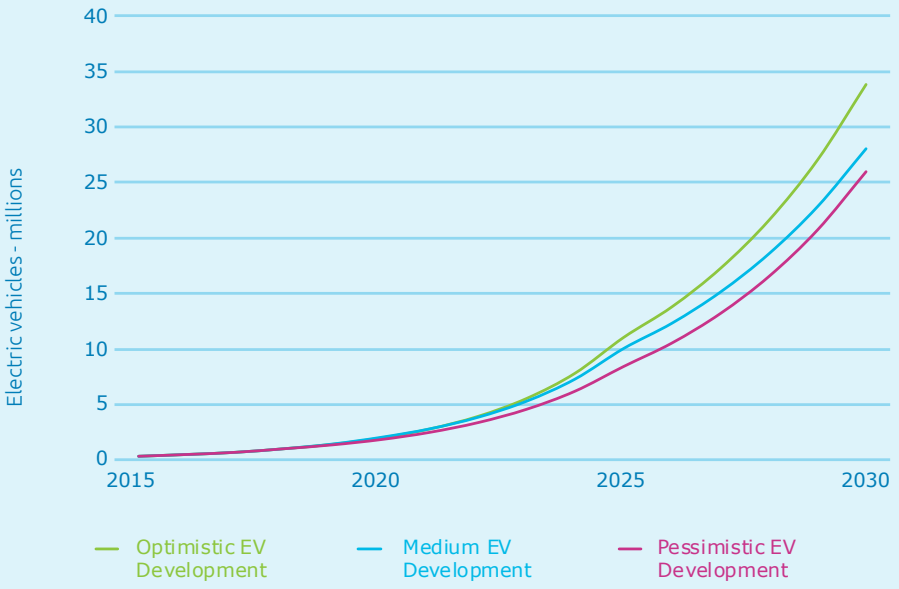


Europe

Drawing on and interpolating from forecasts by the European Commission (EC)[6] and International Energy Agency (IEA)[7] we have created three different scenarios corresponding to the NPE's scenarios for Germany.

- ***Optimistic scenario:***
  2025: 11.0 million (interp.)
  2030: 33.8 million
- ***Intermediate scenario:***
  2025: 10.0 million (interp.)
  2030: 28.0 million
- ***Conservative scenario:***
  2025: 8.4 million (interp.)
  2030 26.0 million

Figure 4: EV Development Scenarios in Europe



Source: Capgemini Invent

5. NPE Progress Report 2018.
6. *https://ec.europa.eu/clima/policies/transport/vehicles/regulation_en#tab-0-1.*
7. IEA Global EV Outlook 2019.

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