

WHITEPAPER

MARKET RAMP-UP OF ELECTRIC VEHICLES & CHARGING POINTS IN FRANCE UNTIL 2030

EXPERTS

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P3

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1.0 - INTRODUCTION

As sales of electric vehicles (EV) increase globally as well as in France, the demand for charging infrastructure is rising accordingly. The French government and local industry players have already recognized this challenge and set ambitious targets, i.e., 100,000 publicly accessible charging points by the end of 2021. To achieve a satisfying charging offer for EV drivers, it is important to ensure that all key stakeholders in the field of electric mobility and charging infrastructure will have a common understanding of the future development of this EV ecosystem.

DEFINITIONS

BEV	Battery Electric Vehicle		
EV	Electric Vehicle		
ICE	Internal Combustion Engine		
OEM	Original Equipment Manufacturer		
PHEV	Plug-in Hybrid Electric Vehicle		
EVSE	Electric Vehicle Supply Equipment		
AC	Alternating Current		
DC	Direct Current		
HPC	High Power Charging		

An important building block for this goal is the announcement of the French transport minister, Jean-Baptiste Djebbari, to equip over 400 highway service stations with High Power Charging (HPC) infrastructure by the end of 2022.

Nonetheless, there remains the questions: how many EVs will be newly registered in the next ten years? How many charging points are needed and what are the specific use cases identified that could help adequately plan for this new demand in a powerful EV charging infrastructure? And how to manage this roll-out?

AT A GLANCE

This whitepaper provides an overview of the EV charging ecosystem in France including the different players. Based on a comprehensive CO2 compliance tool, P3 derives a region-specific market forecast for EVs until 2030 in France. Additionally, P3 predicts the required electricity demand until 2030 in France caused by EV charging activities. On this basis, P3 determines a demand-oriented development scenario for charging points for every charging use case. P3 will conclude the white paper with an outlook on the impact of EV charging on the power grid and the quality of today's installed EV charging infrastructure in France.

1.1 - STATUS QUO

1.1.1 Electric vehicle sales 2015-2021

Electric vehicles: New registrations of electric vehicles (EVs) have increased more than fivefold in France over the past six years. While just around 17,200 BEVs were registered in 2015¹, 162,100 BEVs were registered in total in 2021. In 2021, the market share of newly registered EVs was 18.3% compared to 1.2% in 2015. While sales of combustion engines have decreased by over 25%² in 2020, electric cars have seen particularly high demand during the last year. In total, around 439,100 BEVs and 237,300 PHEV vehicles have been sold since 2010.³⁺⁴



1.1.2 Charging point development 2015-2021

Available charging points in France: Based on a bottom-up approach, P3 has calculated a total of around 594,000 (public and non-public) charging points in France in 2021. These are divided between 475,500 residential charging points, 63,700 fleet charging points, 24,500 destination

charging points, 29,000 public urban charging points, 800 metropolitan DC charging points, and 650 highway HPC charging points.⁵

A total of 54,900 of these charging points were publicly accessible. It is noteworthy that over 53% of these AC (semi-) public charging points are in public urban areas, 45% are destination charging points and DC and HPC charging points make up 1% each.

Ratio of EVs per public charging point: This results in an average ratio of twelve EVs per one publicly accessible charging point in France. However, there are huge regional differences. P3 believes that this ratio is currently sufficient to meet the demand. However, keeping up with the rapid growth of the EV market requires rapid and focused development of the charging infrastructure.

1.1.3 E-mobility is booming in France

In the market development of the last six years in France, the steep increase in electric cars in 2020 and 2021 is particularly striking. This development can be explained by the following factors:

CO2 emission targets: On January 1st, 2020, Regulation (EU) 2019/631 entered into force, setting CO2 emission performance standards for new sales fleet: 95 g CO2/km. If an OEM misses this target, it will have to pay fines of 95€ per gram over the limit, multiplied by the number of cars they sell in 2020. Therefore, particularly in the last

Graphic 1: EV market share relative to total car sales (incl. ICE) in France

1.1 – STATUS QUO

year, OEMs have been very keen to produce and sell a high number of electric cars at reduced margins.

Green mindset & Low Emission Zones (LEZ): In general, there is a change in awareness about climate protection in French society. Last year, more permanent LEZs were introduced, and dependent on-air quality access conditions were tightened. To be permitted to drive in these zones, drivers need a valid anti-pollution Crit'Air sticker on their vehicle. In the Paris low emission zone, stickers in categories 1-3 are currently permitted. However, Crit'Air sticker 3 will be banned from traffic in July 2022, Crit'Air sticker 2 in January 2024 and only category 1 will be allowed. EVs are part of category 1, together with ICE Euro 5 and 6 which were registered after January 2011.6 Moreover, with the generalization of the LEZ, which should affect more than one million vehicles, the low emission zones should be an incentive to replace old ICE vehicles with EVs.

Expanded and renewed product portfolio of EV from the OEM: Car manufacturers have not only launched new vehicle models but have also given existing models a facelift. It is not surprising that two of the most popular EV models since the market introduction in France received facelifts in 2020: Renault Zoe and Nissan Leaf. However, in terms of new registrations in 2020, only the Renault Zoe still experiences high popularity with a market share of 12%. The newly launched Peugeot e-208 obtained 10% of the market share of newly registered BEVs in 2021. Tesla Model 3 is the most popular BEV with a market share of around 13%. However, a growing trend towards larger BEVs such as the Hyundai Kona, Kia e-niro and VW ID.3, as well as PHEVs such as the Peugeot 3008 and Renault Capture, can be observed. As there are car-sharing offers with EVs in most of the big cities in France for nearly 10 years, people have grown accustomed to the advantages of driving an electric car and they consider it an option for their private vehicle.⁷

Targets: The automotive industry has joined forces with the government and set strategic goals in the contrat stratégique de la filière automobile signed on May 22, 2018: the target is to bring 1 million EVs by the end of 2022 on the road. However, there is no doubt that the massive introduction of EVs will require a simultaneous expansion of available charging points. Therefore, the French government has also set ambitious goals for the publicly accessible charging infrastructure: It was planned to install 100,000 charging points nationwide by the end of 2021.

Incentive program for EVs: In order to boost the French automotive industry, which has been weakened by COVID-19 pandemic, President Macron has launched an 8€ billion aid package, of which 1.3€ billion are dedicated to EV purchase incentives. However, starting on July 1st, 2021, the bonus will be gradually reduced (Décret n° 2020-1526 du

1.1 – STATUS QUO

Graphic 2: Incentive program for EVs

7 décembre 2020). Additionally, for the purchase of a used or new EV to swap a diesel car (older than 2011) or gasoline car (older than 2006), a conversion bonus (ICE to BEV) up to 5,000€ can be allocated. Moreover, if the place of residence or work is in a low emission zone, purchasers can apply for an additional low emission zone (LZE) bonus of 1,000€.



Source: P3 France

Tax benefits: EV buyers benefit from full exemption of the registration tax in all Metropolitan France, except in Bretagne and Centre-Val de Loire (only 50% discount). Commercial EVs benefit from full exemption of the company car tax for EVs that emit less than 60g/CO2.⁸

Incentive programs for charging infrastructure: To achieve such growth rates, France's policy landscape for the EV segment has evolved over the years from providing tax credits to the 100€ million incentive program ADVENIR for public and semi-public charging infrastructures. ADVENIR aims to finance 45,000 charging points by the end of 2023. In addition to charging in the residential area, the government has considerably increased its support for the deployment of HPC charging stations as part of the France Recovery Plan ("Plan France Relance"). 100€ million of the recovery plan were dedicated to ultra-fast charging facilities on highways, in order to allow long-distance travel. Moreover, charging infrastructure installation for private individuals is eligible for a 300€ tax credit.⁹

1.2 - FRENCH EV CHARGING ECOSYSTEM

Graphic 3: French EV charging ecosystem

Grid Operators CPOs¹ MSP Vehicle Manufacturers Energy Suppliers* Aggregators 4 ★ ≁ ★ \bigcirc Ē y y ≝ y 1 \approx \approx • L_ 11. Grid Power Cabin EVSE³ Customer 🔺

*Note: non exhaustive selection of market players in the french market

¹CPO =Charge Point Operator ²MSP =Mobility Serivce Provider ³EVSE= Electric Vehicle Supply Equipment ⁴EV=Electric Vehicle



1.2 - FRENCH EV CHARGING ECOSYSTEM

The EV charging ecosystem is a highly complex and dynamic market with an interface between the Energy and the Mobility sector. Therefore, it is important to define specific roles of key players.

Grid operators ensure the connection of the charging points to the energy grid. For the grid operators, there is a high need for investment, as many local transformer stations will have to be expanded in the long term for private use cases and additional connections to the medium-voltage grid will have to be created for public HPC charging. In France, the grid structure still reflects the former monopolistic position of EDF. RTE is France's transmission system operator and Enedis, as distribution grid operator, is responsible for over 95% of the French grid. This situation is the major cause of slow development of public charging infrastructure. Now, approximately 1/4 of highway service stations are not equipped with access to medium voltage network, which would be needed for HPC infrastructure. It will be very time and cost intense to provide these grid connections.

Energy providers supply the charging station with electricity. The customers of the energy suppliers primarily include the operators of the charging infrastructure in the case of public charging as well as private customers and companies in the case of private charging. In France, selling energy is still a highly regulated market and requires an authorization from the government (see law article L.333-1 of 16th of March 2021). Charge point operator (CPO) operates the charging infrastructure and is responsible for its construction, technical operation, and reporting. The CPO has the task of ensuring the functionality of the charging infrastructure. In the semi-public sector, the so-called "Charging as a Service" (CaaS) model is widespread. Operating a charging point involves reselling energy to EV drivers. As seen above the EV charging ecosystem has still market entry barriers for smaller players: only large companies are easily able to fulfill the high requirements (e.g. financial and purchasing capacity) to get the authorization. The French market is characterized by a very heterogenous CPO landscape: many small CPOs (often part of syndicats d'énergie) are acting on a very local level.

Mobility service providers (MSP) offer EV drivers access to (semi-) public charging infrastructure via a specific authentication medium, such as an RFID card or a charging app, which enables the driver to charge at certain conditions and provides billing services. The MSP is either connected to one or more specific CPO networks through a direct interface or the connection is made via a roaming platform. In France, many small CPOs are starting to join forces as bigger regional MSP networks (e.g. Ouest Charge).

Roaming platforms act as a link or intermediary platform between CPO and MSP. The goal of such a platform is to guarantee a high coverage of CPO networks and MSPs. Thus, they offer the EV user

1.2 - FRENCH EV CHARGING ECOSYSTEM

more convenience in using the charging infrastructure and open up a larger customer potential for CPO and MSP. In France, GIREVE still has a monopolistic position but is facing the arrival of Hubject in the market.

Original equipment manufacturer (OEM): The vehicles differ significantly in terms of available charging plugs, battery capacities, and potential charging power. Furthermore, the OEM can push the market launch of additional charging services, like the Plug & Charge technology. However French OEM seems to be not that active as for example German OEM regarding the deployment of charging infrastructure. Stellantis agreed with Engie and EVBox and Renault founded Elexent end of 2020 which are both still slow in building up charging points.

2.0 - MARKET FORECAST

The following section is devoted to calculating the demand-driven need for charging infrastructure for the French market. The underlying concept for the model is the forecast of the development of the electric vehicle market, as this is also a decisive factor in determining how much and what type of infrastructure is required.

The P3 CO₂ Compliance Model is modulated to simulate various markets and regions as well as their specific CO₂ target regulations. Therefore, the model covers approximately 95% of the total vehicle market including all major OEMs. The model consists of more than 25,000 vehicle configurations in multiple segments to consider specific CO₂ consumptions. Each OEM has its individual target emission goals in different markets, for Europe based on the average fleet weight. This results in different goals per OEM. Based on the OEM individual electrification strategies (e.g., HEV, PHEV, BEV strategies), the model can derive the individual OEM target sales volumes in order to meet the legal requirements. If OEMs miss their targets, they must pay high penalties (e.g. 95€ per missed g of CO₂ and sold vehicle within the European Union).

2.1 - EV MARKET

Based on the P3 CO2 Compliance Model, the following figure shows the calculated number of EV passenger car new registrations in France until 2030, divided into BEVs and PHEVs.

A market forecast can be derived from the model, which forecasts 436,000 new EVs (battery electric vehicles and plug-in hybrids) registrations in 2022 which are split into 34% PHEVs and 66% BEVs. The official target from the French government is one million EVs in 2022. This goal will be surpassed according to the simulation model (1.1 million EVs in 2022). In total in 2025, there will already be 2.8 million EVs on French roads of which 72% are purely electric vehicles and 28% plug-in hybrids. In the long term, a total of 8.2 million electric cars are expected in the French market by 2030. It is interesting to note that the share of BEVs of overall EVs, will increase to 91%, while the share of plug-in hybrids will only represent 9% of newly registered passenger cars in 2030.

This also shows that plug-in hybrid vehicles represent a transition technology towards full electrification.



Graphic 4: EV passenger car new registrations (in 1,000 units)

2.2 - ELECTRICITY DEMAND FOR E-MOBILITY IN 2030

In 2030, there will be around 6.8 million BEVs and 1.4 million PHEVs on the French roads, which run an average of around 12,000 kilometers per year. Based on an average electricity consumption of 19 kWh per 100 km of a BEV, 15.5 TWh will be needed for BEVs in 2030. It is expected that PHEVs will drive 60% of their annual mileage with the electric motor and have a consumption of 23 kWh per 100 km. This results in an electricity demand of 2.3 TWh for PHEVs. Therefore, the total electricity demand for e-mobility (passenger cars only) in France in 2030 will be 17.8 TWh. Réseau de Transport d'Électricité (RTE) assumes a total energy demand of approximately 500 TWh in 2030.¹⁰ This would mean that the electricity demand for EVs will be about 4% of the total electricity demand in France in 2030. This indicates that there should be sufficient supply of energy, but that providing it in the right place and at the right time will be a challenge.

2.3 - EV SUPPLY EQUIPMENT (EVSE) MARKET

2.3.1 Charging Use Cases

There are different use cases for EV charging, each with different requirements for the numerous players in the ecosystem. In general, five main charging use cases exist. Today, options for publicly accessible EV charging are still relatively limited in France. Especially the fast-charging segment still has a very small foot-print in the French market today but is showing high growth rates.





2.3 - EV SUPPLY EQUIPMENT (EVSE) MARKET

2.3.2 Market Ramp-up per Use Case

In the P3 CO₂ Compliance Model, the development of the market for charging infrastructure largely follows the development of the vehicle market - both in terms of demand and in the design of the technology, for example, in the area of charging power.

Methodology:

Based on a bottom-up approach, specific quotas for the distribution of charging points per electric vehicle were defined. For this purpose, existing studies and their assessment of the quota distribution of charging points per EV were also used (including Alternative Fuel Infrastructure Directive (AFID), AVERE France). Of course, these quotas change dynamically over the further development of the market, as, for example, the typical customer groups of electric mobility also change. Therefore, P3 has additionally validated the results via a bottom-up consideration of market conditions. This includes, for example, available locations along highways for the distribution of fast-charging infrastructure or market-specific residential conditions.

The developed methodology allows establishing quotas that are used to derive the number of charging points in the markets. For example, the EVSE:EV ratio for home charging decreases from 7.5:10 in 2020 to 6:10 in 2030. For public HPC charging, the ratio in 2020 is 1:1000, whereas in 2030 it will be 1:700 as the demand increases enormously and more vehicles with HPC capability will be on the market.

This ratio results in a forecast of charging points in the French market which is shown in the following figure. Public HPC infrastructure has by far the highest evolution potential: a growth rate of about 2700% is expected by 2030. Public AC charging points, by contrast, will continue to develop at a moderate pace until 2030. By 2030, the model predicts a requirement of a total 5.8 million charging points in France.

#charging points 2020 2025 2030 Residential 261.000 1.832.850 4.727.100 Fleet 29,500 Destination 8.350 63.700 205.600 Public AC 45,800 69,000 Metropolitan DC 8,500 450 3,000 Highway HPC Total 1,832,850 5,801,300 322,650 #Charging Points

Graphic 6: Expected number of charging points in France by 2030

Source: P3 France

3.0 - CONCLUSION

3.1 Governmental announcements

Is the French government's target, set out in the contrat filière, of offering 100,000 publicly accessible charging points by the end of 2021 necessary for the existing EV stock in France?

In order to compare this target with the forecasted number of charging points based on the P3 CO2 tool, four categories need to be summarized: publicly accessible charging points include semi-public, public AC/DC/HPC charging. With the objective of 100,000 charging points by the end of 2021, the number of publicly accessible charging points would have had to increase by 264% within only one year.

Even though subsidies have been increased again, it seems unrealistic to achieve this growth rate until the end of the year. According to the demand driven P3 forecast, the target of over 100,000 publicly accessible charging points will not be reached before the end of 2024 in France.



Graphic 7: Publicly accessible charging points in France [in 1,000 units]

3.0 - CONCLUSION

According to P3's calculations, there is no need for 100,000 publicly available charging points if two conditions are fulfilled: HPC infrastructure at highways and urban traffic nodes and, availability of residential and fleet charging infrastructure. For long-duration charging (e.g. over-night charging at home) 11 kW AC charging fulfills EV user requirements. In contrast, the second use case, ad-hoc charging, requires powers >100 kW as EV drivers wait to get charged.

Instead of setting only a quantitative target, the split of the different charge modes should be better specified. For example, 70,000 new AC charging points do not add the same value to the French EV ecosystem as for example 50,000 AC, 10,000 DC and 10,000 HPC charging points. Thus, the last announcement to equip 400 highway service stations with DC and HPC charging points is a more concrete and qualitative target. Moreover, the concrete requirements for this incentive program have been characterized by uncertainties: the details were long awaited in 2020 and finally announced in December. Good news for CPOs in the new decree n°2021-546 of 4 May 2021: the triple standard has been removed and only AC type 2 and CCS2 or ChadeMo are required. Considering that it takes an average of 18 months to plan and install an HPC station, the planning phase and site selection must be done in the most structured and efficient way possible in order to meet the time frame by the end of 2022.

3.2 Quality of installed EV Charging Infrastructure in France

Besides a high availability of charging infrastructure throughout the country, the quality of this infrastructure is crucial for satisfaction of EV drivers. 83% of EV users are complaining about the reliability of charging points in France. In a study by AFIREV (Association Française pour l'Itinérance et la Recharge Electrique des Vehicules) using data from 22000 charging points and over 500 EV drivers, it was observed that 58% of the charging points have issues. Moreover, 25% of them are damaged and unusable during several months. This results from a lack for formalized requirements for CPOs to maintain the charging infrastructure. The new decree (Décret n°2021-546 du 4 mai 2021) now tightens the obligations for CPOs to maintain installed charging infrastructure. Furthermore, a high importance is now already attached to maintenance during RFQs and tenders to meet the expectation from customers. Another option is to modernize and upgrade existing outdated or broken charging infrastructure, as TOTAL is now doing with the former Bolloré Group charging points, for example.



3.0 - CONCLUSION

3.3 Power supply

Studies published by the transmission system operator RTE come to the conclusion that electric power in France is enough to face a quick growth of EV volumes (all types of EVs together incl. private cars, trucks and buses). With a fleet of 15 million EVs on the roads in 2035, at peaks, this represents depending on the different scenarios, to 5 to 10% of electricity consumption. The only issue is the management of peaks, which can be influenced and monitored at an estimated rate of 80%.

RTE and Enedis have been making simulations and realized that long distance trips only represent 20% of all trips (based on 15.6 million EVs). Peaks in power demand, such as massive holiday traffic, will not use more than 8 MW while available power is 100 MW. Another point that will smooth the demand and the peaks is the progress of battery capacity: one charge per week will be standard.¹¹

3.4 Grid expansion

Now that it has been shown that the overall power supply is sufficient, it must nevertheless be pointed out that the supply is not yet available at all necessary locations. Particularly the connection to the medium-voltage grid is critical. The French government is providing additional incentive programs to boost the infrastructure development. For public DC and HPC charging infrastructure, 75% of the grid connection costs are covered by the state until 2025. Moreover, for residential charging solutions, the government pays all costs for putting in place the main grid connection. On the one hand, subsidies have been provided; on the other hand, Enedis must now ensure that the grid expansion is realized in a timely and efficient manner. Meanwhile, strategic site selection for DC infrastructure is essential for CPOs. **P**3

4.0 - SYNOPSIS

To meet the strong growth in passenger vehicle electrification in France, the number of available charging points must also evolve proportionally.

For this, it is important that players of the EV charging ecosystem can anticipate the future evolution of the market and plan charging infrastructure projects accordingly. Demand-based planning of the different EV charging use cases (residential/ fleet and workplace/ destination/ public urban/ metropolitan and highway charging) is important to meet the needs of the EV drivers.

In addition, detailed planning regarding grid connection requirements, site selection, hardware selection, integration into the existing product portfolio, and subsidy opportunities enables a smooth roll-out of charging infrastructure in the French market.

To minimize the risk of high investment costs for such charging infrastructure projects and to plan the roll-out efficiently, it is recommended to bring in an experienced partner.

We will gladly support your EV charging project.

CONTACT US AT p3_france@p3-group.com

5.0 - ABOUT P3

BUSINESS AS UNUSUAL. Since 1996.

P3 is a technology, process and organizational performance consulting company with a focus on new technologies and innovation. P3 understands the change towards electromobility as a holistic requirement, which demands a completely changed ecosystem. In addition to the technical transformation of drive systems, the provision of suitable charging infrastructure as well as the development of adequate application scenarios and business models are important components of this comprehensive change process. P3 is an E2E partner to their customers from consulting to operationalization.

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