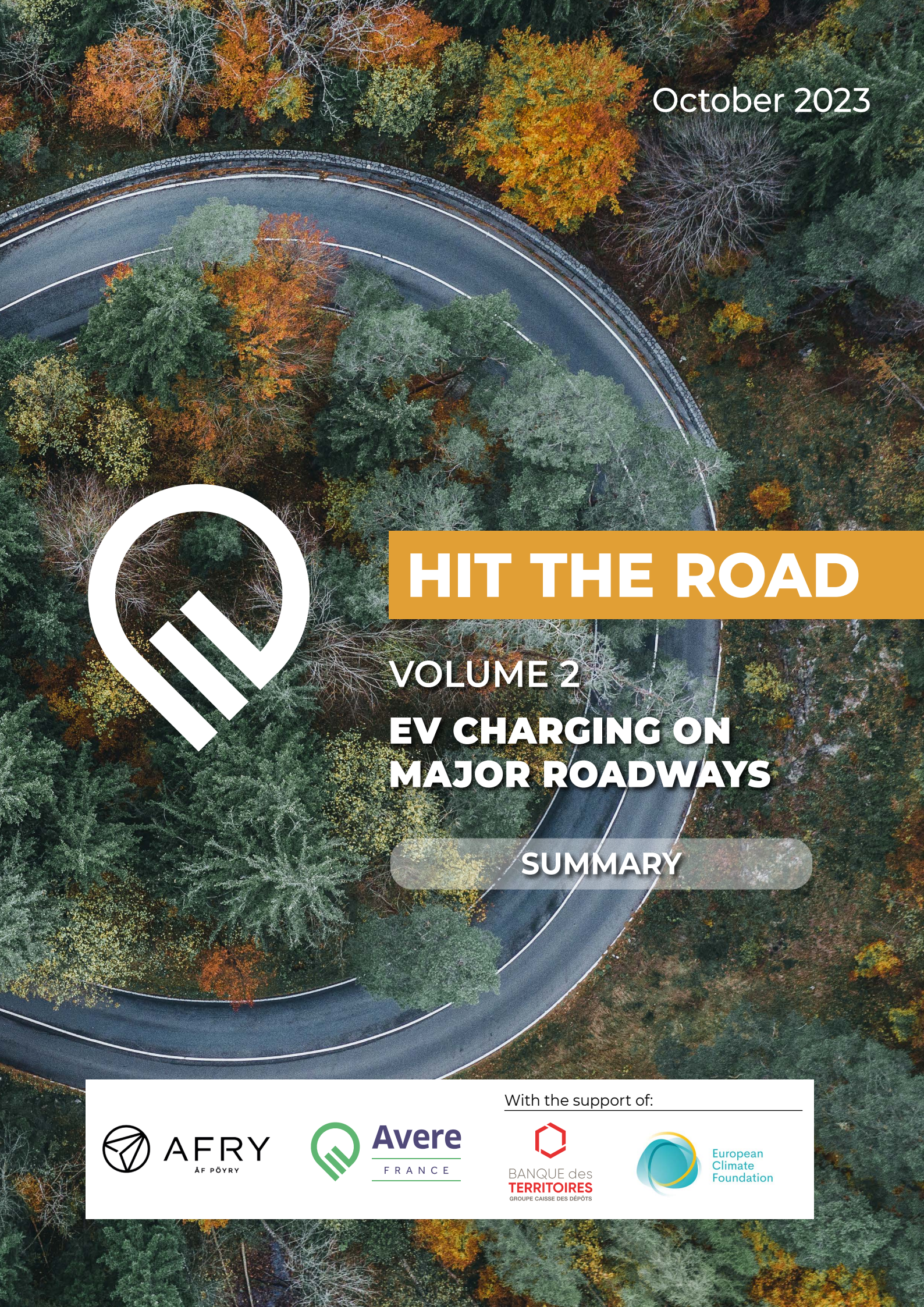


October 2023

HIT THE ROAD

VOLUME 2

EV CHARGING ON MAJOR ROADWAYS

SUMMARY

With the support of:

AFRY
ÅF PÖYRY

Avere
FRANCE

BANQUE des TERRITOIRES
GROUPE CAISSE DES DÉPÔTS

European Climate Foundation

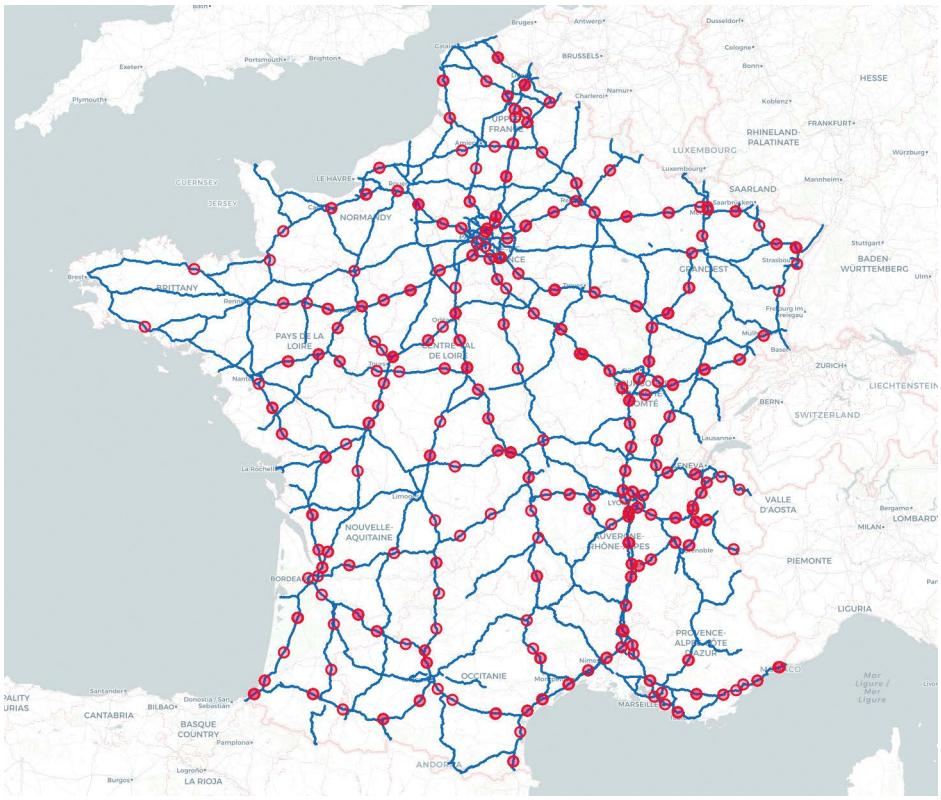
HIT THE ROAD STUDY

In the context of the 'Hit the Road' project for Avere-France, AFRY has conducted the present study on public charging needs by 2035. It consists of **Volume 1 - State of Charging in France**, as well as two analyses based on modeling needs and proposing key measures to address two specific challenges: **Volume 2 - EV Charging on major roadways** and **Volume 3 - EV Charging in areas to be filled**. These documents are intended to be complementary and offer transversal measures.

Electric Vehicle Charging Infrastructure (EVCI) along major roads will be essential, both to ensure long-distance trips electrification and for heavy vehicles covering tens of thousands of kilometers each year.

In May 2023, the milestone of 100,000 publicly-accessible charge points was reached, according to Avere-France's barometer and the Ministry of Energy Transition. Momentum has been gained, with significant growth in EVCI deployment in recent months. However, certain areas are less equipped than others, particularly national roads and non-concession highways. On concession highways, 80% of service areas were equipped with fast charging stations by December 31, 2022, corresponding to one charging station every 60 km[1].

Figure 1: Map of charge points on major roadways



Sources: Eco-Movement data (April 2023), AFRY analysis

[1] *Enjeux du développement de l'électromobilité pour le système électrique, 2019 (Challenges of the development of electric mobility for the grid)*

For the first wave of deployment on highways, planned to be completed by 2023, significant resources have been mobilized by the Concessionaire Companies (SCA) and mobility actors. Moreover, support mechanisms for installation have been implemented (investment subsidies, derogatory increase of the reduction rate for grid connection to 75%). The next wave, which will require additional connections and installed capacities (especially with the arrival of heavy duty vehicles), will need to make strategic choices regarding peak charging demand management and proper network sizing.

The modeling of energy needs by 2030-2035 aims to better to estimate the energy requirements needed for EV charging infrastructure on major roadways. These roadways are characterized by traffic that can vary daily and seasonally. The different scenarios considered will bring sensitivity to the results. It is worth noting that the modeling aims to establish a global vision of EVCI needs by road, taking into account traffic. More detailed analyses, area by area, will help identify these needs better and address specific issues such as land management, periodicity, the interaction between Heavy Vehicles (HVs) and Light Vehicles (LVs), etc.

The different steps of the modeling process are as follows:

- **Step #1**
  Consideration of traffic data for both light vehicles and heavy vehicles on each of the major French roadways (national roads, concessioned highways, and non-concessioned highways) using 3 scenarios to represent different traffic trends.

- **Step #2**
  Application of 3 scenarios for electrification rates. Projections of electric vehicles from RTE[1,2], and BNEF[3] were utilized;

These steps allow for the calculation of scenarios:

- **High**, Central and Low with electrification rates of 31%, 27%, and 16% respectively for light vehicles by 2035;
- For heavy trucks, the **High** scenario reflects a manufacturer's perspective with an electrification rate of nearly 40%, while the rates for the other two scenarios are 18% and 3%.

- **Step #3**
  Consideration of vehicle consumption, drive ranges, and typical routes to estimate the energy requirements for public charging along major routes.

- **Step #4**
  Translating the energy requirements into the number of charge points through a linear increase in the utilization rate from 6% (in 2022) to 12.5% (in 2035) and a distribution of charging technologies based on use cases (slow charging for trucks during long breaks, ultra-fast charging, and possibly mobile charging stations for short breaks).

The results of the modeling **(Figure 2)** show a total need for over 40,000 charge points by 2035 to support an average electrification rate of 27% (Central scenario of electrification), assuming an utilization rate of 12.5%.

[2] *Forecast assessment for 2023: progress report*
[3] *Projection of the fleet of light electric vehicles*
[4] *AFRY analysis taking into account the model assumptions*
[5] *Charging for phase-out, T&E, 2022*
[6] *The numbers of total charge points modeled are here rounded to the nearest hundred (and to the nearest ten for the detail of light vehicles / heavy goods vehicles; certain roundings (CP light vehicles) have been slightly adapted to allow concordance of the are*
[7] *Eco-Movement data, April 2023*

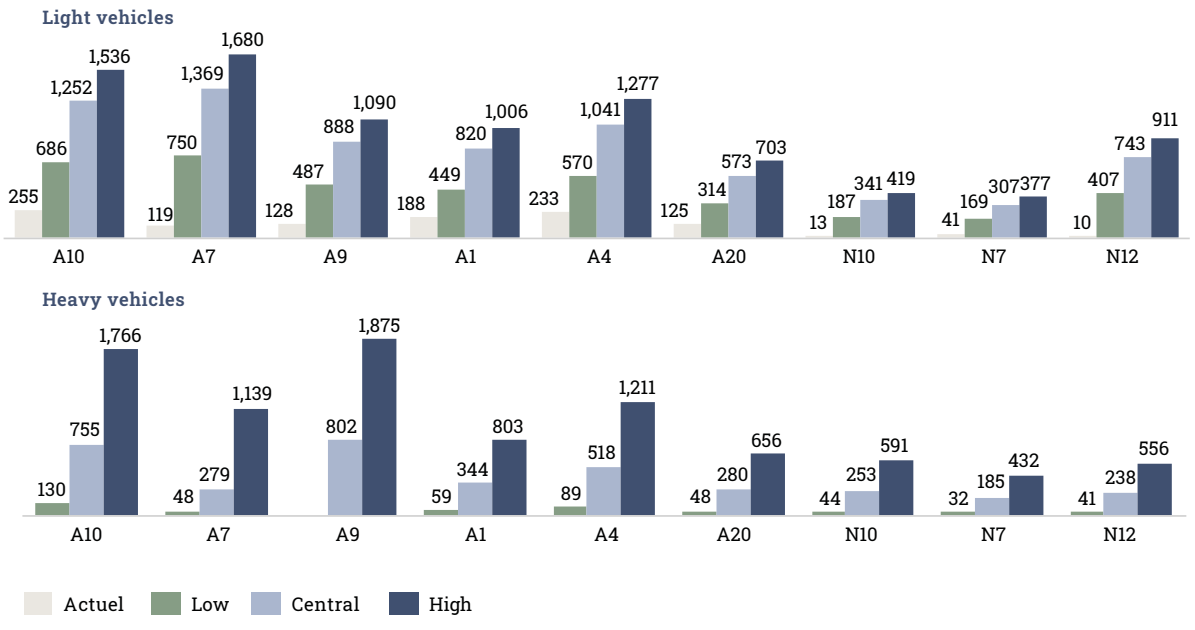
The topic of utilization rate is a crucial indicator in the planning of EV charging deployment projects, directly impacting profitability. This rate represents the average value over a year of the number of hours a charge point is used per day, meaning the number of hours the charge point delivers energy to one or more vehicles. While the current average utilization rate of charge points nationwide is around 2%[4], this value is expected to increase as users transition to electric vehicles. The European Commission[5] targets a utilization rate of 12.5% for the ultra-fast chargers by 2030. This is why this value was chosen in the context of modeling the need for charge points along major highways.

Figure 2: Number of Charge Points needed for Public Charging on major roadways[6]

	Total	Light Vehicles	Heavy Vehicles
High	# 67,700 (10.3 TWh)	# 37,160 (5.5 TWh) of which 27,030 on highways of which 28,720 are ultra-fast	# 30,540 (4.8 TWh) of which 24,490 on highways of which 3,256 are ultra-fast
Central	# 43,300 (6.5 TWh)	# 30,230 (4.5 TWh) of which 22,030 on highways of which 23,400 are ultra-fast	# 13,070 (2 TWh) of which 10,470 on highways of which 1,400 are ultra-fast
Low	# 18,900 (2.8 TWh)	# 16,640 (2.5 TWh) of which 12,070 on highways of which 12,820 are ultra-fast	# 2,260 (0.3 TWh) of which 1,810 on highways of which 240 are ultra-fast

The electrification of the vehicle fleet will require an expansion of the charging infrastructure network, even within the Low scenario with the target of 20,000 points, which is significantly higher than the approximately 4,000 points[7] currently present on the major roadways. **Figure 3** illustrates the need for the number of points for some major roadways, comparing it with the current situation.

Figure 3: Number of Charge Points needed for Public Charging on a few roadways for light vehicles and for heavy-duty trucks in different scenarios compared to the current situation



Obstacles and key measures

Interviews and workshops with stakeholders from the electric mobility ecosystem helped identify obstacles at every stage of EV charging infrastructure deployment throughout the territory:

- Obstacles to optimal EV charging infrastructure planning;
- Obstacles to EV charging infrastructure installation;
- Obstacles to EV charging infrastructure operation;
- Obstacles related to electric vehicle purchase related to charging.

Figure 4: Obstacles to the deployment of EVCI

OBSTACLES TO OPTIMAL PLANNING OF EV CHARGING INFRASTRUCTURE

1.1	Grid connection
1.2	Insufficient visibility for proper SDIRVE development
1.3	Uncertainties regarding alternative technologies for heavy electric mobility

OBSTACLES TO THE INSTALLATION OF EV CHARGING

2.1	Limited land availability (major roadways)
2.2	Limited land availability (dense urban areas)
2.3	Significant investments required (DC charging)
2.4	Delivery time for stations and other supply chain challenges

OBSTACLES TO THE OPERATION OF EV CHARGING STATIONS

3.1	Insufficient profitability
3.2	Legal duration of highway sub-concession contracts
3.3	Maintenance challenges and availability rate
3.4	Energy price volatility

OBSTACLES TO ELECTRIC VEHICLE PURCHASE RELATED TO CHARGING

4.1	Complex charging process
4.2	Opaque pricing and charging costs
4.3	Charging anxiety
4.4	Unavailability of affordable nearby charging

To address these obstacles, the study has identified "key measures" which are also based on discussions with the ecosystem during workshops, as well as the results of the modeling. These measures have been distributed between the **Volumes 2** and **3** of the study; only the measures related to major routes, as well as the identified cross-cutting measures, are listed here.

Figure 5: Key measures related to major roadways

"MAJOR ROADWAYS"		ADDRESSED OBSTACLES
Anticipation of grid connection needs		**1.1 | 1.3 | 2.1 | 2.3**
	Stakeholders	State, local authorities, SCA, DSO
	Levers	Political and legislative decisions, regulatory changes
Extension of sub-concession contract durations		**3.2**
	Stakeholders	State
	Levers	Regulatory changes
Reduction of traffic peaks upstream		**4.1 | 4.3**
	Stakeholders	Manufacturers, e-MSP, State, SCA
	Levers	Regulatory changes, communication, and change management support
Absorption of traffic peaks through *ad-hoc* solutions		**4.1 | 4.3**
	Stakeholders	SCA, local authorities
	Levers	Experiments to conduct, support for necessary investments
Innovations such as "electric roads"		**2.1**
	Stakeholders	SCA, local authorities, manufacturers
	Levers	Experience feedback from previous calls for projects and political decision-making

Figure 6: Transversal key measures

TRANSVERSAL		ADDRESSED OBSTACLES
Creation of a public authority responsible for EV charging infrastructure and planning		**1.1 | 1.2 | 1.3**
	Stakeholders	State
	Levers	Political decision, regulatory changes
Smart connection offers (ORI)		**1.1 | 2.3**
	Stakeholders	State, local authorities, SCA, DSO
	Levers	Communication and change management, regulatory changes
Completeness and Reliability of Open-Data		**1.2 | 4.1 | 4.3**
	Stakeholders	State, local authorities, operators
	Levers	Administrative resources
Progressive standardization of 800 V		**4.1**
	Stakeholders	Manufacturers
	Levers	Regulatory changes or specification modifications
Support for the acquisition of electric heavy vehicles		*Launch of heavy electric vehicles' adoption*
	Stakeholders	Manufacturers, users
	Levers	Political decision

Following the modeling and various iterations with the ecosystem, this study draws four essential conclusions:

1) A substantial deployment effort is still required, with nearly 40,000 points to be installed under the Central scenario, to meet the charging needs by 2035 on major roadways, for both light and heavy vehicles.

2) Strategic anticipation of the needs for 2035 by the public authority is the best option to optimize the grid connection costs of service and rest areas on major roadways.

3) Estimations of charging needs area by area must take into account the specific challenges of heavy mobility (land, integration with light vehicles, periodicity, MCS).

4) Electric charging needs during traffic peaks should be addressed by reducing the upstream flow (alternative routes, traffic communication) and downstream through the deployment of ad-hoc charging solutions.

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ABOUT AFRY

AFRY provides consulting, digital, design and engineering services to accelerate the transition to a sustainable society.

We are 19,000 dedicated experts in the industrial, energy and infrastructure sectors. AFRY has Nordic roots with global reach, produces net sales of SEK 24 billion and is listed on Nasdaq Stockholm.

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ABOUT AVERE-FRANCE

Avere-France is the national association for the development of electric mobility. Created in 1978 to represent the entire electro-mobility ecosystem in the industrial, commercial, institutional or associative fields, its objective is to promote the use of electric and rechargeable hybrid vehicles.

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It caters to all regions, from rural areas to metropolitan cities, with the aim of combating social inequalities and territorial disparities. La Banque des Territoires is deployed across the 16 regional offices and 37 territorial branches of Caisse des Dépôts in order to be more easily recognized by its clients and to be as close to them as possible.

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ABOUT ECF

The European Climate Foundation (ECF) is a major philanthropic initiative working to help tackle the climate crisis by fostering the development of a net-zero emission society at the national, European, and global level. The ECF supports over 700 partner organisations to carry out activities that drive urgent and ambitious policy in support of the objectives of the Paris Agreement, contribute to the public debate on climate action, and help deliver a socially responsible transition to a net-zero economy and sustainable society in Europe and around the world.

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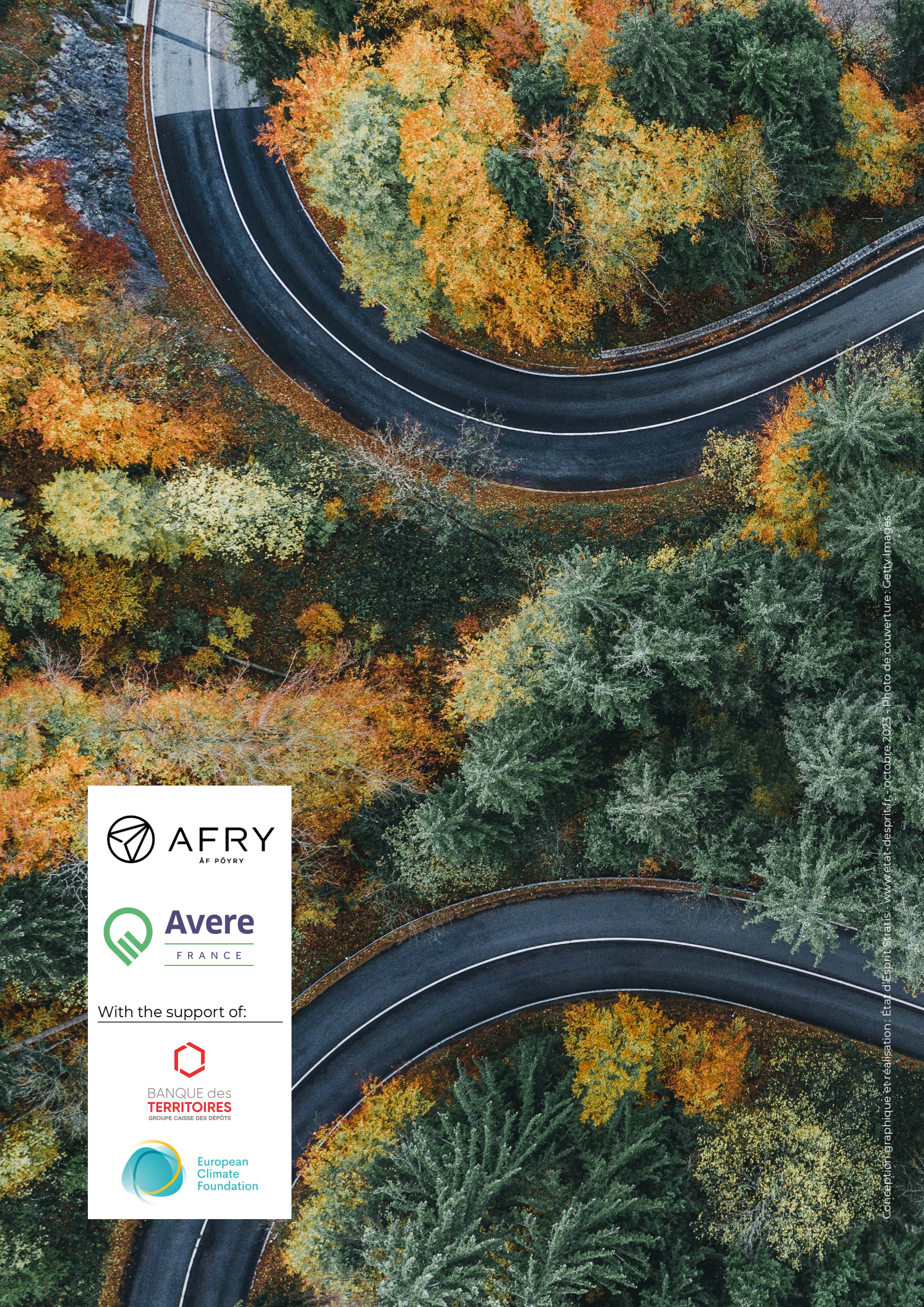

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