Teasimed

TOWARDS AN EFFICIENT, ADEQUATE, SUSTAINABLE AND INTERCONNECTED MEDITERRANEAN POWER SYSTEM

IDENTIFICATION AND QUANTIFICATION OF LONG-TERM SECTORAL PERSPECTIVES IN MEDITERRANEAN REGION

Part 1: Focus on Electric Mobility

med-TSO MEDITERRANEAN TRANSMISSION SYSTEM OPERATORS

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TASK 3 *Diagnostics and Reports*

Deliverable 3.1 *Electric mobility development and impact, both in terms of energy & peak demand*

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List of abbreviations

AC	: Alternative Current
ALMEE	: Lebanese Association for Energy Saving and for Environment
ANME	: Tunisian Authority for Energy Conservation (‘Agence Nationale de Maîtrise de l’Energie/ ANME)
BEV	: Battery electric vehicles
BRT	: Bus Rapid Transit
CAPEX	: Investment cost
CLG	: Compressed Liquified Gas
COP	: Conference of the Parties (on the climate change)
DC	: Direct Current
E-Bus	: Electric Bus (either battery, plug-in hybrid or hybrid, when technology is not announced)
EV(s) / E-Vehicle(s)	: Electric Vehicles (either battery, plug-in hybrid or hybrid, when technology is not announced)
EU	: European Union
GDP	: Gross Domestic Product
GHG	: Green House Gas(es)
GPL	: Liquified Oil Gaz / ‘Gas de Pétrole Liquifié’
FCEV	Fuel cell electric vehicles
HEV	: Hybrid electric vehicles
LCEC	: Lebanese Center for Energy Conservation - Lebanon
MENA	: Middle East and North Africa region
NDC	: Nationally Determined Contributions
NERC	: National Energy Research Center of Jordan
PHEV	: Plug-in hybrid electric vehicles
PV	: Photovoltaic
RE	: Renewable Energie(s)
TOE	: Tonne of Oil Equivalent
UN	: United Nations
V.	: Vehicles (motorized)

1. Introduction

The current report deals with the Electric Mobility (E-mobility) sector's data presentation and analysis, in the countries of the MED-TSO area, that are targeted by the current Project.

The specific focus of the report is the automotive sector, which is expected to be the most disruptive when considering the impact of future electricity demand in the transportation sector. Other transport modes, such as electric rail, will be mentioned in some specific cases, but they are in general out of the scope of this analysis.

Data are presented by country, separately for MENA countries: Morocco, Algeria, Tunisia, Egypt, Jordan, Palestine, Israel, Lebanon, Turkey, and for European countries: Portugal, Spain, France, Italy, Slovenia, Croatia, Montenegro, Albania, Greece and Cyprus. The reason for this choice is that these two groups of countries share some common features and socio-economic contexts that justify this subdivision.

Data are issued from available biographic sources that could be analyzed, aside to some updates provided based on the outcomes of interviews, that could be remotely conducted with public stakeholders from some of the targeted countries, namely what follows:

- **For MENA countries:**
  - **Tunisia:** The Vice President of the Tunisian Authority for Energy Conservation ('Agence Nationale de Maîtrise de l'Energie/ ANME) dealing with E-Mobility, M. Abdelhamin GANNOUN;
  - **Lebanon:** The Vice President of the Lebanese Association for Energy Saving and for Environment (ALMEE), M. Adel MORTADA);
  - **Lebanon:** Energy Engineer from the Lebanese Center for Energy Conservation (LCEC) of the Ministry of Energy and Water (LMEW), M. Hadi ABOU MOUSSA;
  - **Jordan:** The Manager of the Energy Efficiency & Solar Thermal Division from the National Energy Research Center (NERC) /Royal Scientific Society, M. Muhieddin Tawalbeh;
  - **Turkey:** Head of the Energy Security, Supply, Market, and Statistics Department of the Ministry of Energy of Turkey, M. Ozgur SARHAN.
  - **Algeria:** Representatives of the Ministry of Energy Transition and Renewable Energy, (M. Ismaeil MOUSTAPAHA and his assistant staff) and of SONELGAZ (M. Mohamed Lakhdhar HABIB)
  - **Libya**: Prime Minister's adviser for Electricity and Renewable Energy Affairs, Engineer Osama E. Elderrat.

The report is globally organized as follows:

- **A Synthesis chapter:** is summarizing the main data and information by country globally informing on the current E-Mobility development situation and its future announced major perspectives;

- **Diagnosis sections for each of the countries:** where there are descriptions of (1) the current trends, (2) the future trends, and (3) the main uncertainties pertaining to the E-Mobility sector in each country;

- **A Conclusion chapter:** that summarizes the main qualitative and quantitative data by country, presents a typology of the targeted countries, as an attempt to rank the countries in terms of E-Mobility's preparation and development, and presents a brief analysis of the main common issues between analyzed countries. The conclusion is developed separately for the MENA and European Countries;

- **An Appendix chapter:** that lists the biographic sources on which the presented data and comments are based. It also gathers the E-Mobility questionnaire model by List of Countries. This chapter also includes a presentation of prospective scenarios of the electricity demand due to the E-mobility of the European countries.

2. Synthesis

This report is presenting an analysis of the present and future trends of electric mobility (E-Mobility). The report deals specifically with the road E-Mobility, with a focus on passenger cars, and also the electric mass transit modes, if there are any, based on the gathered and analyzed data, for the European and MENA countries that are included in this project.

Some specific technologies will be considered in this report when discussing passenger cars' electrification. The main definitions are reported here:

- **Hybrid electric vehicles (HEV):** these are hybrid cars, i.e. vehicles that are powered by an electric and a traditional engine (usually running on gasoline or diesel). The electricity consumed by the car is produced by the internal combustion engine or recovered from braking, but no connection with external power sources is allowed. As a result, this technology will have no direct impact on the electricity system;

- **Plug-in hybrid electric vehicles (PHEV):** these cars are hybrid cars that can also be connected to the grid for charging their battery. At the same time, they are also equipped with an internal combustion engine. The actual electricity demand from the grid depends on a number of factors, including the

driving choices from the users, who can impact on the share of annual mileage powered by electricity. Most PHEVs have electric ranges of up to 50 km with a full charge;

- **Battery electric vehicles (BEV):** these cars are operated by an electric engine, without any internal combustion engine as a backup. This technology is expected to have the greatest impact on medium- and long-term electricity demand, as well as the biggest opportunities for road transport decarbonization.

- **Fuel cell electric vehicles (FCEV):** these cars are equipped with an electric engine that is coupled with a fuel cell that is powered by hydrogen. They are in fact electric vehicles, but just like HEVs they do not require to be plugged in the power grid, and they have no direct impact on electricity demand from the grid. However, they may lead to an indirect impact on the network when hydrogen is produced from electricity through electrolysis.

In some reports, statistics and figures on electric vehicles include PHEVs and BEVs, since they are the two technologies that require an electricity demand from the power grid. However, it is important to remember that BEV and PHEV have different characteristics, specific electricity consumption and charging profiles.

The following table briefly summarizes the main data that could be gathered on the electric mobility in the MENA countries, both for the current status and as targeted / planned and announced objectives/ perspectives. More information is summarized in the Conclusion chapter. Few quantitative data is published for most of the MENA countries, as E-mobility is still an emergent / a very new concern for the large majority of the countries.

For countries with current specific context (Libya, Syria and Palestine), E-mobility's development seems not to be yet a priority objective.

MENA Country	Current National Motorization Rate (*)	Current Road E-Mobility Development	Targeted Objectives on E-Mobility
Morocco	**Motorization Rate: ~1.42 V. per 10 persons** (projections for 2021 all modes included)	* **Existing E-bus mobility** in the main cities of Marrakech, Rabat, and Casablanca (unpublished overall number of circulating vehicles) * Unpublished data on the private E-Mobility.	* Already signed the COP26 declaration on accelerating the transition to 100% zero emissions of cars and vans * Already planned expansions of the E-Bus systems in main cities. * Ongoing plans to locally produce domestic EVs by Western and Domestic companies.
Algeria	**Motorization Rate: ~1.50 V. per 10 persons** (2019, all modes included)	* No information on current E-Mobility	**Targeted Future Stocks of EVs: 100,000 by 2030**.
Tunisia	**Motorization Rate: ~2.10 per 10 persons** (2018, all modes included)	* Limited number of circulating Hybrid electric cars (unpublished number). * **48 charging stations** in various cities, operated by private companies in the fuel distribution stations, and in hotels. * Growing trend of the soft E-mobility (2-wheeled plug-in vehicles), especially in the main cities.	* **Targeted Future Stocks of EVs: 1,000 Hybrid and fully E-cars by 2023,** up to **5,000 by 2025**, and to **50,000 EVs by 2035**. * **Future number of charging stations: at least 58 stations nationwide for the short term** to be set-up mainly within the public fuel distribution stations. * Domestic manufacturing of EVs already announced by a Tunisian automotive company * Domestic manufacturing /assembling of E-buses roughly targeted for future development.
Libya	**Motorization Rate: ~ 7.20 V. per 10 persons** (Approximate estimates)	* E-Mobility is more likely not developed yet	Unknown / Not defined
Egypt	**Motorization Rate: 0.98 V. per 10 persons** (2020, all modes included)	* Existing **Public E-bus mobility** in Cairo and Alexandria. * **Number of existing charging stations: 18 for E-Buses** (at least) and **soon up to 97** for cars/ private vehicles.	* More development of the private and public E-Mobility targeted * **Ban of New Fossil Fuel Vehicles' Horizon: 2040** * **Future Stocks of E-Buses: soon** (in 2 years at most) **65 E- buses targeted at least in Cairo and Alexandria** (aside to other stocks in other cities) * **Targeted Charging facilities: soon** (in 2 years at most) **at least 97 (400 charging points)**

MENA Country	Current National Motorization Rate (*)	Current Road E-Mobility Development	Targeted Objectives on E-Mobility
			* Development of local manufacturing of E-Buses targeted, with 45% of the components to be domestically made.
Jordan	**Motorization Rate: Higher than 1.7 V. per 10 persons** (2017, all modes included)	*** Road EVs Stock (2021): ~ 20.5% of the motorized circulating vehicles: 250,000 Hybrid cars and private vehicles, 30,000 fully EVs, 100 E-buses (mainly hybrid and including fully electric ones) in Amman.** ***** Stock of circulating EVs is announced to be higher for 2022. ***** Record of very quick E-mobility's growth, because of the high fuel prices and motivational measures' implementation positively impacting the CAPEX of the EVs in the domestic market * **Charging stations Stock (2021): 15 private stations nationwide** spread in the gasoline stations of urban centers, and not existing on routes. Announced number of charging facilities might not be exhaustive. Spatial spread of charging facilities estimated low.	***** More development of public and private E-mobility with a nationwide spatial spread of the charging facility system is targeted for the very near future (before 2025) ***** E-Buses are also planned for the cities of Irbid and Zarqa ***** Targeted increase of the electric 2-wheeled vehicles; *** Future Stock of EVs: ~ Exceeding 302,000 vehicles soon (in upcoming years before 2025),** if we consider the 280,100 current EVs and E-Buses of 2021, and at least 21,000 to 22,000 more public E-vehicles (cars / little vehicles) of the Government, already announced.
Palestine	**Motorization Rate: 0.96 V. per 10 persons** (2021, all modes included)	*** 1%** of the circulating private vehicles are Hybrid/fully electric vehicles	* Unknown / Potentially not defined yet

Israel	**Motorization Rate: 4.05 V. per 10 persons** (2021, all modes included)	*** Stock of electric circulating vehicles: (by 2021) 300,00 hybrid cars, a number of fully electric vehicles, and 4,315 hybrid taxis** (around one-fifth of all taxis' fleet of the country), and (by 2020) **around 100 E-buses.** *** Current number of charging facilities: ~2,500 stations nationwide, located at the fuel distribution stations.** *** Several domestic automotive industries manufacturing EVs and related batteries** and	*** Hundreds of new E-buses to be subsidized, and hundreds of new charging stations are planned for the up coming 2 years (2023 and 2024).** *** Charging stations within the shared residential building are also getting obligatory by legislation.** *** More motivational economic measures are** under preparation for the E-Mobility's promotion. *** CAPEX of the EVs in the local market are getting lower** by effect of the imported Chinese brands that are competing with the other imported western brands of EVs.

MENA Country	Current National Motorization Rate (*)	Current Road E-Mobility Development	Targeted Objectives on E-Mobility
		conducting R&D activities to enhance their products' performances (level of emissions' reduction)	
Lebanon	**Motorization Rate: 3.13 V. per 10 persons** (2015, all modes included)	* E-Mobility insignificantly developed, by private efforts / NGOs importing Hybrid and fully electric vehicles. * A number of charging facilities exists in some malls, commercial parking lots and open space parking areas.	*** Start horizon of the governmental implementation of the E-Mobility** (for private and public mobility)**: assessed to 2027, and optimistically to 2025** *** Targeted level of E-Mobility by that horizon: 3% of the national passenger vehicles x km** * Strategic recommendations already developed by Experts, but not adopted yet by Government: (1) a prior development of the Hybrid vehicles' stock (progressively up to 2030), (2) Setup of E-Buses, for the longer term (estimated to be dominating by 2050, as they require a wide-scale deployment of the charging facilities and higher investment).
Syria	**Motorization Rate: ~ 1 V. per 10 persons** (2018/19, all modes included)	* E-Mobility is more likely not developed yet	Unknown / Not defined

Türkiye	**Motorization Rate: ~ 3 V. per 10 persons** (2021/22, all modes included)	*** Road EVs' Stock** (**estimates for 2022): ~ 55,000 vehicles** (private and public vehicles): *** Charging stations' number (august 2022): ~3,457 stations countrywide: 818 private stations and 2,639 public facilities**	*** Targeted Future Stocks of EVs: at least 72,000 to 73,000 by 2023 / up to 248,000 by 2024,** and **to more than 1.055 million vehicles by 2030** (data including mainly the domestically produced vehicles only). ***** Spatial spread of the charging stations is targeted ***** Existing domestic and Western automotive manufacturing industries already planned to locally produce fully EVs and Plug-in hybrid vehicles and their batteries, in the very near- future.

(*) **National Average Motorization Rate:** is the national average estimation of the overall stock of the motorized vehicles (all modes included) compared to the overall population, as an assessment of the availability of the motorized vehicles per a number of persons by country.

National Car Motorization/Ownership Rate (presented in the report): is a compared ratio, including only the stock of cars, as an indicator on the potential

The European countries considered in the analysis show a different level of development of electric mobility. Some countries have already clear strategies, and they are mostly on track to reach them, while others remain well behind their potential. In general, most of the countries have already deployed incentive schemes to help customers buying new electric vehicles, although their effectiveness varies from a country to another. The deployment of an effective and distributed public charging infrastructure is seen as a fundamental step in supporting higher EV penetration levels, although often a chicken-and-egg problem arises due to the fact that low penetration rates of vehicles and chargers may damage each other.

National and local policies and measures are of fundamental importance to support passenger cars electrification, especially in the early phase of their development. However, it is also important to remember that most of these countries will be strongly dependent on importing electric vehicles (or parts of them), resulting in potential uncertainties related to the global EV market, which has recently shown that unforeseen events can have important effects on the EV supply chain. Thus, this potential uncertainty should somewhat be accounted for when modelling the future evolution of transport electrification.

The following table summarizes the main common characteristics between many of the European countries considered in this analysis.

Common Weak Signals, Disruption Factors	·Almost all the countries have included **e-mobility among the solutions to address future decarbonization targets**. EU countries have developed integrated national energy and climate plans to describe the targets and policies expected in each sector to support the ambition of a carbon-neutral European Union by 2050. ·Electric cars show an **exponential increase** in the last years in most of the countries, although they remain generally limited to a marginal share of the total passenger car market, and at **lower levels compared to some countries in Northern Europe**. ·**Public charging infrastructure** is being developed in most of the countries, especially in urban contexts, as the existence of a distributed and effective network of public charging is seen as a necessary condition to support the development of the EV market.
Common Barriers	·The **high investment price of EVs** compared to traditional passenger cars remain the most significant barrier for potential users. Although most countries have some sort of incentives to help new users to buy a new electric car, they are not always effective in decreasing this price gap. ·Charging infrastructure remains limited, and it will need to increase at a quick pace if large shares of the current car fleet need to electrify in the next years and decades.

	·Rising EV sales may need to face the **potential lack of materials at a global scale or potential disruptions to the supply chain**, especially for chips and batteries manufacturing. ·A rising share of new EV registrations in the EU is represented by vehicles manufactured in China (although mostly by European and US companies). A continuous increase of this share in the future may have an impact on the automotive sector of EU countries, and the EU may evaluate the possibility of using trade defense instruments, which may slow the development of the market. ·Some experts are arguing that the development of Euro7 standards for vehicles emissions may require investments in traditional powertrains that may divert investments from electric vehicles.
Common Levers / Opportunities	·The **targets on renewable energy in transport** and on the decrease of carbon emissions that have been set in the last decades at the EU level have supported the rise of the EV market in most countries, and they may remain a fundamental lever in the future. ·The **technology evolution** is increasing the performance of EVs in different market segments, and the expected investment in R&D of many European firms may also represent an additional resource for more competitive electric cars. ·The **deployment of EV and battery manufacturing sites across Europe** may represent an important opportunity to develop local economies and compensate the expected decrease of future sales of traditional cars.
Common Interactions	·The **common policies developed at the EU level** are a fundamental aspect in the development of most decarbonization options at national level, including electric vehicles. ·Given the important circulation of vehicles between the different countries, both for commercial activities and for tourism, it will be important to ensure the **compatibility of charging systems** both from a hardware perspective (with uniform standards) and from a software perspective (with e-roaming measures like those implemented for mobile phone networks).

3. MENA countries

Morocco

Review of current trends

General data

Morocco's total population reached **37,345 million inhabitants in 2021,** corresponding to an overall national demographic density of **86.53 inhabitants/km^2**. Its population is mainly concentrated in the major urban and costal centers, as Rabat, Casablanca, Tanger, Senta, Agadir, but also in a number of interior cities as Marrakech, Fes and Meknes.

The urbanization rate of the Moroccan population is assessed to **64% in 2021** (United Nations (UN) data).

The national GDP per capita is estimated to 3,005 € /3,660 USD for 2021, which is comparable to the other Maghreb countries (Tunisia and Algeria). The 2020-2021 change rate is assessed to 6.1%, at constant prices of 2015 (World Bank Data base). This provides a good perspective on the transport and road vehicles' affordability improvement of Moroccans.

Morocco's land mobility context at a glance [2], [7], [9], [11] :

The overall linear of the road system in Morocco reached **57,334 km roads [10], according to data of 2021,** out of which 45,240 km correspond to paved roads (79%). There are around ~1,000 km of express roads, and 1,800 km of highways (totalizing both around 5% of the road system).

The road system is providing the mainstream transport service both for passengers (around 90%) and goods (approaching 75%, according to recent data) [11].

The national registered road vehicles' stock was assessed to 4,056,598 vehicles in 2017 (all modes included) and was rapidly increasing at a **6.99% rate in 2017** [9]. The overall vehicles' number could be thus projected to more than **5,315,380 vehicles in 2021**.

The global modal share of the registered road vehicles was recently estimated to what follows (2017 data) [9]:

- Private cars and Mass Transit Vehicles (Buses & Mini-Buses): 69.2%
- Motorcycles: 3.2%
- Others (Vans, Trucks, other modes rather for goods' transport): 27.5%.

In terms of the motorization/ownership rates, they could be estimated (by the Consultant) to what follows, as projections for the national level in 2021:

- **Motorization rate (overall registered vehicles per person): ~1.42 vehicles per 10 persons**
- **Car motorization rate: 0.98 to 1.0 vehicles per 10 persons.**

Various mass transit systems have been developed and are currently contributing to assure the passengers' mobility in the urban centers:

- A big capacity bus network system, managed by public operators, in every main city;
- A high-level service bus (or a Bus Rapid Transit / BRT) system serving each of the cities of Marrakech (where buses are electric/E-Buses), Rabat and Casablanca (where E-buses have recently been initiated), and Agadir;
- A tramway system in the major cities of Rabat and Casablanca (respectively around 20 km, and 48 km);
- A light subway system in Casablanca, operated since 2014;
- A rapid railways' system (RER) running along longer lines, and respectively linking Rabat to some of its suburbs and Casablanca to its airport's area, and
- Private taxis are also providing further services to the passengers.

For the intercity / interurban passengers' transport , a diversity of mass transport services is being provided by the following modes, aside to the road private vehicles:

- Mixed passengers-goods transport taxis/vans and big shared taxis for passengers are providing services for the short-distance travelers from the suburbs and the near rural areas to the main cities;
- Mainly three big capacity bus companies are providing long distance intercity transport between the major urban areas, and even international land transport;
- A heavy railways system (2,750 km and 90% electrified by planned perspectives for 2018)[11], is offering a transport service over long distances, and is connecting main cities to the ports' area; It also includes a high-speed railways line connecting Kenitra and Tanger.

A growing competition is thus being developed to the road private transport. A significant share of the rural to urban center- mobility is still relying on the shared taxis and the mixed passengers- goods taxis.

Recorded E-Mobility and its context [1], [2] :

The E-Mobility for the Public Transport has been already launched in major urban areas of Morocco, as follows:

- Since 2017, an **E-Bus Rapid Transit (BRT)** line has been harnessed by a private Operator **in the city of Marrakech**, as a pilot project (within the COP22 framework) with **a capacity of 45,000 passengers/day.** The E-BRT network is expected to be expanded and to include up to **10 E-buses and to reach the capacity of 60,000 passengers/day by 2021/2022** (Private operator and public-owned bus fleet); The electricity is supplied by a solar generation plant located in the surrounding area of Marrakech city (750 kW);

- A BRT system, using E-Buses, has been already operated in the city of Rabat, along 1 line and the network is expected to be expanded soon over 4 new lines. **The new type of operated buses is fully electric**

(Battery electric vehicles /BEV), **with 6 to 10 packs of Lithium-ion batteries per bus, for energy storage; the E-buses operator is belonging to the private sector;**

- **New double-deck Electric buses (BEV)** were recently announced (in 2020) to be **soon operated in the city of Casablanca**, by the CASA TRANSPORT operator, and for which specific facilities have been constructed.

Future trends

Existing strategies, quantitative objectives

Regarding the overall land mobility context [(2), (4), (10)]:

Among perspectives of the transport and mobility context, identified in Morocco, and that could have incidences on, or interfere with the E-mobility's future development, what follows:

- **A National Strategy for the Sustainable Development, already defined in 2017 and published in 2018,** has targeted the mobility's sustainability and the energy efficiency of the Transports Sector (road sub-sector included), aside to the acceleration of the renewal of the Vehicle Fleet [(2)];

- New perspectives and ongoing studies / projects are **targeting the modernization and the expansion of the Mass Transit systems in the urban centers and along inter-cities corridors, including the progressively increased E-Mobility by electric buses;**

- Morocco's last Nationally Determined Contributions (NDC)'s updated document of 2021, mentions among targeted interventions in the Transport sector, the reduction of its GHG emissions, the set up i**n major urban cities, of big capacity mass transit vehicles to be operated based on the Renewable Energy sources**. This is in alignment of the E-buses' technologies, for which solar generation could supply the charging facilities;

- Morocco is among the rare Middle East and North Africa (MENA) and the African region's signatories of the COP26 declaration on **accelerating the transition to 100% zero emissions cars and vans [(12)]**.

Regarding the E-mobility perspectives [1] [2] [7] [8] :

E-Mobility future perspectives:

- **More E-Mobility's development is already targeted in Morocco**, as a study was conducted in 2020, on the feasibility of a **support program to the E-Mobility by the Public and Private Stakeholders**; In 2021, a study was also launched on the perspectives on the **E-Mobility's deployment in the Public Transport system and in the urban centers of Morocco.**
- **A Comprehensive Study on an E-Mobility National Master Plan was started in July 2021** and its outcomes were announced to be available by the 1rst quarter of 2022[1]. **The study is supposed to be a road map including all stakeholders, and addressing the electric system, the recharging infrastructures, the regulatory, tariffing, and institutional issues. The optimization of the inter-operation** (between modes and transport systems) is among targets of the study**.** The latter's outcomes are unpublished;
- As mentioned above, **expansion of the E-bus system's network is already planned, notably in the main cities of Rabat, and Marrakech;**
- **Targeted number of EVs to be introduced in the local fleet:** unpublished as a global estimate. Some few information could be known:
  * Expansion of the E-BRT buses' stock of Marrakech to include further 48 E-Buses, resulting in a total **E-buses' stock of 58 vehicles by 2030** [8].

- **Targeted Number of charging stations/points:** unpublished.

EVs and batteries local industries' context perspectives [1] [7] [8]:

- The capacity of the already existing automotive industry in Morocco, is announced to be increased from more than 700,000 vehicles (2021/2022) to **1 million vehicles per year by 2025, with many of those being EVs.**
- **Targeted Number of Locally manufactured EVs: 300,000 vehicles** (more likely by 2025, for export and domestic market).
- **A promotion of the local assembly industry of the Lithium-ion cells**, imported from East Asia, is announced **starting from 2022** (thanks to a more motivative import duty, decreasing from 40% to 17.5% on the related imported components).
- A close signature of a deal with Western EVs' batteries manufacturers was recently announced by Morocco's Ministry of Industry (in august 2022) and **a large-scale factory of EVs' Lithium-ion batteries is expected to be operational in Morocco by the end of 2022[1]**. It's already assessed overall annual output is **3 GWh of energy storage capacity, that could feed up to 30,000 to 45,000 vehicles per year (depending on the sizes and models).**
- The recent initiation of local manufacturing of some Western EVs brands' manufacturing in Morocco, aside to the local production of the EVs' batteries to be started in Morocco, **could pave the way to shift the manufacturing of more European / Western EVs from other countries to Morocco, as it seems to currently be under studies and planning.**
- Local Authorities are being keen and active to place Morocco as **a future EVs' manufacturing Hub, including the manufacturing of E-buses [8].**

Regarding the E-mobility's potential stakeholders in Morocco, and their interactions:

Among the main Stakeholders of the E-Mobility development, promotion and implementation in Morocco:

- the Ministry of Equipment, Transport, Logistics and Water,
- the Ministry of the Ecological Transition, the Ministry of Industry,
- the Ministry of Interior Affaires and Municipalities that are involved in the urban insertion of the E-bus systems,
- the Bus Operators already harnessing Electric-Buses (ALSA Marrakech, CASA Transport),
- ONEE/ the National authority of Electricity and Drinkable Water which is the national electricity supply operators, aside to companies managing renewable energy generation facilities;
- The IRESEN / Research Institute of the Solar Energy and the New Energies, that could be involved in analyzing the E-Mobility's requirements impacts on the Renewable Energies' supply.

A global coordination framework seems to have been already developed between the above major stakeholders, that is targeted for further enhancement.

Weak signals, possible disruption factors

Among the weak signals of the E-Mobility context's perspectives in Morocco, what follows:

- For the urban and sub-urban / interurban transport, the electric public transport could face a fierce competition from other electrified modes, as the subway, the tramway, the LGV/ high-speed railways line, Kenitra-Tanger; This competition is highlighted for the short and middle terms (potentially up to 2027 /2028), especially due to lacking charging facilities;

- The geographically extended road system and the long distances separating major cities, expected to evolve more in the upcoming years, is expected to result in consistent electric charging needs, and a noticeable spatial cover of the electricity charging facility network, which could take time to be developed;

- A significant portion of the Moroccan population is still rural, while E-Mobility has priory been targeted within the major urban cities. The private E-mobility would thus have some slowness to spatially progress in Morocco, and could not concern the road flows exchanged between the rural areas and the major cities.

Levers and barriers

Identified barriers:

No special barriers risking to totally blocking the E-Mobility's development, or significantly impacting the related projects' deadlines, can be identified for Morocco. Foreign technical and financial assistance and support are though required to achieve the E-Mobility's targets.

Identified levers / opportunities:

- Awareness already demonstrated and strategic targets already defined in relation with the decarbonization of the Transport sector and the Land Transport subsector (both private mobility and Public Transport Systems);
- **Feedbacks from the implemented experiences in the E-BRT systems in Marrakech, Rabat and Casablanca cities,** will ease more development and spatial expansion of the public E-Mobility;
- **Already existing automotive industry ecosystem in Morocco** and its predicted and recorded positive growth trend, due to **increasing delocalization of international automotive industries' activities to Morocco**;
- Positive announced perspectives of the local **manufacturing of the EVs and Lithium-ion batteries for EVs;**
- Among mitigation measures announced in Morocco's last NDCs document of 2021, **the planned set up of a bonus-malus system for the road vehicles' purchasing market, as a regulatory measure to favorize the**

selection of low carbon vehicles, as the electric ones, and to penalize the purchase and use of the more polluting ones. This is expected to be a driver for a future evolution trend towards the EVs;

- The European Commission's directive to go ahead in **a phase of out all fossil fuel-powered vehicles in the EU countries by 2035** (decided in 2021), can induce a **progressive acceleration of the EVs' manufacturing in Morocco;**
- **Availability in Morocco of Cobalt reserves** (relatively small though :11th biggest reserve in the World and Morocco was ranked as the 13th biggest Cobalt exporter in 2020) [(1),] and **availability of significant Phosphate reserves in Morocco (70% of the global phosphate rock reserves).**
  The Cobalt reserve strengths the potential for a positive future trend of a local manufacturing of Lithium-ion batteries, then (on a longer term) of manufacturing of Lithium-Iron-Phosphate batteries for the EVs' uses [(*)];
- **Availability of Renewable Energy (RE) sources (Solar and Wind) in Morocco,** aside to **planned related electricity generation projects,** are in favor of increasing the electricity supply and better meeting the future E-Mobility's electric needs by domestic sources. (The already set up National Energy Strategy has targeted a 52% share for the RE by 2030).

(*) Cobalt, is among metals required for the Lithium-Ion batteries, the basis of the modern EVs, aside to Lithium. Those hard-to-find metals, among others, are required to enable the discharge of the batteries' electric current. The Morocco's Cobalt reserves are much closer and easier to access than other African reserves (as the Democratic Republic of Congo's ones, another country of such a natural potential).
A newly growing trend in electric Passenger Cars is to replace the Lithium-Ion batteries with Lithium-Iron-Phosphate (LFP) batteries, to substitute the expensive cobalt by cheaper Phosphate and Iron.

Main uncertainties

Uncertainties float on the following factors:

- Regulatory measures to be implemented and their incentivization level to encourage Moroccan users, and especially the rural, suburban and middle-income households to acquire EVs and to be motivated enough by the shift to E-Mobility;

- Cities and road corridors to be targeted for a prior promotion of the E-Mobility and for the charging facilities' set up, and impacts on the average distance of the EVs' daily itineraries.

Algeria

Review of current trends

General data

Algeria's total population reached **44.617 million inhabitants in 2021**, and has increased at 1.80% average annual rate over the 2019-2021 period. This corresponds to a low overall demographic density (**18.73 inhabitants/km²**, considering the whole country's territory). However, the population is mainly concentrated in the Northern zones, especially in the coastal cities.

The population urbanization rate reached **74%** (UN data) **in 2021**, and among main cities attracting the most of the population: Algiers (the capital), Constantine, Oran, and Annaba.

Algeria's national average GDP per capita is estimated to **3,183 € / 3,872 USD**, according to the 2021 data. The Algerian GDP per capita recorded a moderate 2020-2021 change rate, estimated to **2.1%** (assessment at constant prices of 2015 – World Bank data base).

Algeria's recent Land mobility context at a glance [(2), (3) (4)] :

In 2021, the Algerian total road system's linear reached **108,302 km,** out of which 76,028 km were paved (70.2%). This corresponds to an overall road's density approaching **4.5 Km/Km²** (3.5 Km/Km² for the paved roads).
The National registered stock of vehicles (all modes) is assessed to **6,577,188 Vehicles in 2019[(2)]** that increased by 2.47% compared to the previous year. Its modal share was as follows:

- Cars: 69.5%; - Buses: 0.8%; - Vans: 16%; - Trucks: 3.3%; - Motorcycles: 7.5%; - Others: 3.0%.

Available data helps assess the following rates:

- **National average Motorization Rate (all modes): 1.5 vehicles per 10 persons (2019) [(2) (4)]**
- **National Car Motorization Rate: 1.0 vehicles per 10 persons (2019).**

The recent transport and mobility context in Algeria, can be summarized mainly by what follows:

- The demographic growth and the galloping urbanization in main cities have induced **an increasing trend of urban mobility**;
- Private and Public bus services and related routes are serving most of the cities. Mega buses (with high capacities) and little vans have been added to increase the passengers' transport capacity, as **the Public Bus Operators have been facing growing demand (especially in Algiers and Oran)**. Private and shared taxis participate also to the mass transport capacity in the cities.

- **The public authorities seem to have been rather concerned with the urban, suburban and intercity electrified rail transport modes, over the recent years**, to modernize the mobility context and enhance the passenger-transport system's capacity, as summarized below:
    - The Subway systems: underwent expansions in Algiers. A subway system is also planned in Oran;
    - The Tramway systems: already existing and are planned for progressive expansions in major cities (Algiers, Constantine, Oran). New tramway systems are also planned for other urban centers (Batna, Ouargla, Mostaganem, Setif, Annaba);
    - The heavy railway system: (linear of 4,200 km in 2011) is developed between main cities, which many sections are under/planned to be electrified and modernization. The aim of developing a rapid electrified railway lines is also targeted;
    - Globally, several tramways' projects, a subway project and a tramway assembly company were developed over the last years [(3)];
    - The cable cars/cableways system: are also available in the cities of Algiers, Constantine, Skikda, Annaba, Tlemcen, Blida, Oran and Tizi Ouzou. This mode underwent some technological renewal actions, and is expected to be more developed;

- **Vehicles using the Liquified Petrol Gas (LPG), have already been introduced to the local market**, and the recorded trend of their use has been steady over the last years, as the consumption of LPG for the road transport reached a 40% increase from 2020 to 2021. This quick growth has been induced by a main motivational measure implemented by the Algerian State that is exempting 50% of the expenses of the conventional vehicles' conversion to LPG-Vehicles. This measure was initiated within the framework of the valorization of the abundant gas potential in Algeria, and the LPG production's viability enhancement.

Recorded E-Mobility and its context in Algeria:

There is unpublished data on the **road E-Mobility in Algeria.** The interview conducted in late of November 2022, with a staff of the Algerian Ministry in charge of Energy [(6)], has revealed that E-Mobility is currently insignificantly developed in Algeria. It has been initiated by the private users that rely on their own residential charging facilities. No initiatives, planned by the public bodies are identified for the E-Mobility development.

As mentioned above, the electrified urban and intercity mobility is currently mainly developed by the rail and cable modes (subway, tramway, cable cars/ cableways and railway systems), which spatial covers have been in expansion.

Future trends

Existing strategies, quantitative objectives

Regarding the overall land mobility context [3] [5] [6]:

Briefly, the main future perspectives of the land transport sector can be recapitulated as follows:

- **An ambitious road and railways transport modernization program** has been set up and is under development;
- The **main electrification aim for the Public Transport sector seems to focalize on a prior switch to electric locomotives to substitute the existing thermal trains (Diesel) still in use**. The electrification in the railways sector could be powered by the solar technology (built along the newly planned railways connection spreading from the North to the south / Tamanghasset);
- A **plan for more promoting the transition to a mobility by road vehicles fed by gas has been under operation**; Aside to the encouragement of the conversion of the conventional vehicles to LGP vehicles, the operation of around 200 Buses to be fed by Compressed Liquified Gas (CLG Buses), progressively up to the 2030 Horizon, is also planned [6];
- **Projects of expanding the tramway and subway systems and of a technological renewal of the cable cars/ cableways**, **in various urban cities,** are also planned/ under development, and appear as priority actions for the urban Transport sector' development;
- **There is also an ongoing expansion of the regional road and motorways' system,** which is expected to facilitate an increasing road intercity / regional mobility;
- **On an environmental level, Algeria expressed its commitment to reduce its overall GHG emissions by 7% to 22% by 2030,** in view of its formulated Nationally Determined Contributions (NDC) issued in 2015. Among targeted actions within this framework, is the progressive gas supply of the transport fleet[5]. The road E- road Mobility was not mentioned within the NDCs Document of 2015, leading to conclude that it wasn't ranked as a priority action.

Regarding the E-mobility perspectives [3] [6]:

Very few information is currently available on the road E-mobility development perspectives in Algeria. No significant development is done in the road transport's electrification initiation, and its planning. This witnesses of the low priority level of this issue, in the transport, equipment and energy sectors, compared notably to the rehabilitation and modernization of the rail/cable transport systems' expansions, and the progressive switch to the LPG and CPG vehicles.

E-Mobility is still under initial strategic thoughts' developing phase in Algeria. A Work Group was recently established under the trustee of the Ministry in charge of Energy, to conduct an opportunity study, including

a comparative analysis between the Mobility by Gaz-fed vehicles and the mobility by the Electric Vehicles (different technologies). The deadline for the study outcomes is not reported.

A pilot project is also being envisioned to progressively switch the public administration vehicles stock into E-Vehicles, as a starting and testing initiative of the E-Mobility implementation.

Some foreign automotive industries, operating in Algeria (Western and Chinese), are on their way to locally produce electric vehicles, which might facilitate the transition to the E-Mobility in the Algeria.

On a regulatory framework, according to the 2023 Finance Law of Algeria, very recently defined and validated, there is a decision of **taxes' exemption for the Electric Vehicles' CAPEX**, as a motivational measure to pave the way to the road E-Mobility promotion. However, no more action is already envisioned for the E-Mobility regulatory framework's development, notably in relation with the charging facilities.

For the Charging facilities, the potential stakeholders are not defined yet. It is not known yet if the public fuel distribution company (NAFTAL) could be allowed the authorization to setup those facilities within its stations' network, or if the public electricity facility (if SONELGAZ) would be rather the mainstream stakeholder to be in charge of providing the electricity to the charging stations and of validating their locations and design (AC, DC feeding); The private sector is announced to also be among the future stakeholders of the electricity charging stations.

On a quantitative level, the following data is reported in the biography:

- **Targeted overall stock of E-vehicles: 100,000 vehicles by 2030** (1) globally defined, according to the Minister of Energy Transition (information on the modal share and technologies to be promoted is unpublished);
- **Targeted number of the road EVs' charging facilities:** unpublished (could be undefined yet).

Regarding the E-mobility's potential stakeholders in Algeria, and their interactions:

Among potential local stakeholders that could be involved within the E-Mobility planning, preparation and future implementation in Algeria, what follows:

- **Governmental bodies:** (1) Ministry of Energy Transition and Renewable Energy, (2) APRUE/ Agency for the Promotion of the Rationalization of the Energy Use, that is responsible for the promotion of the energy efficiency measures, and the awareness-raising campaigns on the energy efficiency, (3) CEREFE /Commission for Renewable Energy and Energy Efficiency;
- **Electricity operators:** (1) Sonelgaz (produces and commercializes electricity and is responsible for the national distribution of natural gas), (2) GRTE/'the transmission grid's company owned and operated by Sonelgaz (Société Algérienne de Gestion du Réseau de Transport de l'Electricité), (3) SPE /Algerian company for electricity ('Societé Algérienne de l'Electricité') that produces electricity, while GRTE is in charge of the electricity transmission, (4) SADEG (Societé Algérienne de Distribution de l'Electricité et du

Gaz), in charge of the Electricity distribution, (5) IPPs companies producing energy and selling it to the electricity public market;
- **Public Transport operators:** ETUSA /Urban and Suburban transport company of Algiers ('Entreprise de transport urbain et suburbain d'Alger') in charge of the Bus transport in Algiers (as a potential first pilot E-Mass Transit operator).

A coordination framework will be required to enable a progress towards the E-Mobility's development, especially because of the segmentation of the Electricity subsector's institutional framework.

Weak signals, possible disruption factors

The following factors are among what can be identified:

- **The energy transition in Algeria has been rather slow** (renewable sources by 2018 has accounted for 1% of the national electricity generation mix, produced by solar sources (~389 MWp, 84%), hydropower plants (15%) and wind sources (1%). Gas and oil have contributed with an energy mix share of 99% share [(1)]. Although a plan was set up to increase the RE share (progressively up to 15 GW of solar and wind electricity generation capacity by 2035), the effective evolution trend of the Energy Transition, is getting slowly. **A comparable slow trend of the E-Mobility's development could be expected;**

- **The abundance of the local natural gas resources has been shifting the Algerian stakeholders' concern from the E-Mobility field**. **The promotion of the gas-fed vehicles (GPL cars and CLG Buses) that is targeted prior**, aside to the **low costs of the thermal fuels in the Algerian market**, would hinder the road users' willingness to use the electric vehicles, at least on the short term.

- **The Algerian electricity grid is facing a number of challenges** (referring to data of 2017-2020 period), including one-way communication of the HV grid, high carbon emission levels, long transmission lines to deliver power, high electricity costs, some stability issues predicted if increasing capacities of RE are injected into the grid [(1)]. Those challenges have to be progressively addressed in the future, for the needs of **the E-Mobility needs to be efficient and cost-effective.**

Levers and barriers

Identified barriers:

- The E-Mobility currently seems less prioritized than more development of the road and the rail infrastructures' projects, and the transition to the LPG and CPG – vehicles, which leads to conclude on a realistic starting horizon for the E-Mobility's implementation by the Algerian public authorities, in the long term (2030 / 2035).

- The average travelled distance between main cities is high in Algeria, compared to many countries within the region, leading to conclude on a required consistent development of the charging facilities for the interurban E-Mobility needs.

Identified levers / opportunities:

- Algeria has sufficient Solar and Wind potentials, to **develop Renewable Energies (RE)-based generation power plants, and to enhance its electric system's capacity to better meet future impacts of the E-Mobility on its overall load.** RE could also be in favor of the LCOE (Leveraged Cost Of Energy) of the electricity requested for the EVs' recharging.

- Some foreign automotive industries, operating in Algeria (Western and Chinese) are on their way to locally produce electric vehicles, which might facilitate the transition to the E-Mobility in the country.

Main uncertainties

Uncertainties float over what follows:

- The future cooperation level that could be achieved between the various Algerian Public actors, from the Transport, Energy, Finance and Customs sectors, to progress in the E-Mobility's initiation;

- The regulatory and motivational measures that could be designed than implemented, in order to make the E-vehicles attractive enough, compared to the thermal vehicles that are relying on competitive fuels (locally produced and much less expensive than in other countries within the region);

- Ensuring a cost-effective electric supply for a nationwide charging facility network.

Tunisia

Review of current trends

General data

Tunisia's population reached **11.936 million inhabitants in 2021,** and is expected to increase up to 12.075 million in 2024, and 12.742 in 2034 [6] (according to a moderate scenario of latest projections of the National Institute of Statistics of Tunisia).

Its population is mainly concentrated in Greater Tunis (4 governorates with 23.1% of the national demography), and in the coastal cities (governorates of Sfax, an important economic pole (8.9% of the total population), Nabeul (7.2%) and Sousse (6.1%)).

The national average demographic density reached **72.95 inhabitants/km^2.** However, around 70% of the residents are living in the urban areas, representing around 10% of the national territory (which results in an **average effective urban population density close to 510 inhabitants/km^2,** in 2021).

The special attractiveness of Greater Tunis, then Sfax city, induced a growing pressure on their road infrastructures and mass transit facilities.

Tunisia has a medium GDP per capita, estimated to **3,327 € / 4,037 USD in 2021,** and it increased at **2.3%** compared to 2020 (assessment at constant prices of 2015 – World Bank data base), which represents a better macro-economic improvement, in comparison to previous years.

Tunisia's recent land mobility context at a glance [4] [7] :

The overall road system of Tunisia reached a total linear of around **13,347 km** (597 km of highways), according to the 2018 data, that inform on the following breakdown by road component (according to General Board of Bridges and Roads Pavements' published data base):

The national registered vehicles' stock reached **2,112,100 vehicles (in 2017)** and has been rapidly increasing (at 9.85% /year, since 2015).

The road vehicles' fleet is dominated by cars (64%, while Trucks and Vans represented 21%, the public transport vehicles: 1%, and other motorized vehicles: 13%, according to the newly registered vehicles' stock modal breakdown of 2017) [5].

The Average National Motorization Rate: could be assessed **to pretty more than 2 vehicles per 10 persons** (all modes included)**,** and the **Car Motorization rate is assessed to around 1.35 vehicles / 10 persons (2018)**.

The passengers' mobility by cars and little private vehicles must be mainstream in major cities notably, because of a stagnation in the public transport services' development over the last years. The mass transit system in urban areas, includes public bus networks, private big capacity buses, light subway systems (in Greater Tunis and some other major coastal cities), heavy railways systems serving the suburbs of some cities, private taxis, and private vans, connecting downtowns to their remote suburbs. The routes of these latter are sometimes not well integrated within the cities' spaces.

The fast-growing urbanization and the circulating motorized vehicles' stock in major cities, has been leading to an **increasing traffic congestion and pollution problems within the urban areas and also along the motorways and regional corridors connecting main urban centers**.

The almost status quo situation of the mass transport, over the last decade, and the lack of Intelligent Transport Systems' (ITS) integration, combined to the limited capacity of several urban road sections, aside to delayed updates of the traffic management schemes of main cities, have created a stressful urban mobility context, especially during peak periods. Those rush periods are being enlarged, and have been leading to extended journey times.

Recorded E-Mobility and its context in Tunisia [1] [2] [3] [4] [8] :

The current context is characterized by **a very low availability of circulating private E-vehicles**, because of lack in the regulatory framework's development, a non-enough expanded public charging facility, a lack of information disseminated to users on the E-Mobility, and its electric vehicles' market, a limited number of brands and types of the electric vehicles being locally sold.

Moreover, few efforts have been deployed to arise awareness among drivers and the road users on the E-Mobility, and its economic and environmental benefits.

The E-Vehicles' fleet, and their charging facilities are currently including:

- A **limited number of private Hybrid electric vehicles for passengers' transport**, imported by four (4) car sellers, existing mainly in Greater Tunis and providing just one unique Chinese brand; The existing EVs include 14 electric vehicles of the ANME (National Authority of the Energy Conservation);
- An **increasing number of 2-wheeled electric vehicles and E-bicycles in the main urban cities** (Greater Tunis especially), that are been supplied by small private charging stations;
- A network of **48 public charging stations,** installed within a number of the fossil fuels' distribution stations and Hotels, **in various main cities of different regions of Tunisia**, and managed notably by the private companies. Their setup represents private and non-coordinated initiates that did not require special contracts' establishment with the national electricity utility of Tunisia, STEG (Tunisian Company of Electricity and Gas). The electricity supply of the existing charging facilities is been assured **in alternative current (AC), and different unitary capacities per charging point (50 kW, 42 kW, 32 kW, 22 kW, etc.)**.

The existing charging facility network, is however **not appropriately shared on a spatial level, which cannot procure a warranty to energy autonomy.**

A number of previously launched E-Mobility promotion actions, that remained uncompleted, can also be mentioned. Those actions were initiated by public actors:

- In 2018, some E-buses were introduced in the mass transit system of Greater Tunis without a validated adoption for a long period. A conducted study by ANME (National Authority of the Energy Conservation) showed that low economic profitability of such new E-buses, if they are not domestically manufactured, because of their high CAPEX and an insufficient return on investment, in view of the served traffic. **A domestic manufacturing of E-buses has thus been recommended,** but no advancement could be achieved yet in the decision-making process;

- The public company managing the national fossil fuels' distribution stations for road vehicles and working under the umbrella of the SNDP (National Company of the Oil Distribution), is currently the unique fuel distribution operator **having signed a power purchase agreement with STEG, the national electricity and gas utility,** to supply the vehicles' charging needs with facilities installed within its thermal fuel distribution stations. However, none of its 10 prior charging facilities could be supplied by electricity, due to a connection problem with the national electricity grid;

- the **Tunisian normalization of the international technical standards for the charging facilities and EVs' batteries, already defined and adopted** by the Tunisian National Institute of Normalization and Industrial Property.

Future trends

Existing strategies, quantitative objectives

Regarding the overall land mobility context [(2) (6)]:

Future perspectives of the land mobility context can be drawn mainly by what follows:

- Availability of **a National Strategy targeting the fossil energy consumption's reduction and the enhancement of the energy conservation for the Transport Sector,** by means of measures' implementation to reduce traffic congestion and lower the transport's energy consumption;
- Since its contribution to the Paris Climate agreement of 2016, **Tunisia is committed to reduce its GHG emissions** and has projected to lower its carbon intensity, by 2030, by at least 27% (unconditional contribution) and up to 45% (if conditional positive factors would be available), compared to the reference year of 2010[(6)]. Tunisia is also committed to lessen its Transport sector's energy consumption (assessed to 2.56 million TOE in 2022) [(2)];

- **The rail mass transit system, is expected to be more developed:** extension of the Light Subway system and development of a new Rapid Railways system for passengers, are under development in Greater Tunis. A new subway system is also planned for Greater Sfax;
- **A Bus Rapid Transit (BRT) system is planned in Greater Tunis,** to increase the Mass Transit capacity, enhance the road traffic fluency, and reduce the average travel time;
- **Expansions of the motorway network are ongoing along the Trans-Maghreb corridor, to complete connections within the Libyan and Algerian borders,** and further new sections' development are envisioned.

The overall planned developments in the rail and other mass transit system's modes will be in favor of lowering the traffic congestion problems in Tunis and Sfax, and then of the facilitation of future EVs' road insertion, in case of future development of the E-Mobility.

The extensions of the road system will facilitate the road mobility, including the inter-city and the international flows with Libya and Algeria.

Regarding the E-mobility perspectives [1] [2] [4] [5], [8], [9] :

The main perspectives that can be identified at this stage, are summarized here; they witness that Tunisia is currently in active stage of the E-Mobility preparation:

- Set up (since 2018) by the Ministry of Industry, Mines and Energy of **a Work Team/Task Force, under the umbrella of ANME** (National Authority of Energy Conservation) **to be in charge of the establishment of a National Strategy of the Electric Vehicles' (EVs) integration in Tunisia (under preparation) ;** The ongoing study targets **the setup of a nationwide EVs' charging network,** and to assess the consequent electric needs and the special required incentive measures;
- Above Work Team includes staff from the Ministries of Environment, Transport, Finance and Commerce, the Customs' Administration, and the Union of the Vehicles' Sellers, aside to technical development partners;
- **A pilot project for E-cars' mobility promotion is under preparation** (according to information of August 2022), with AGIL and STEG (the National electricity and gas utility) as direct involved stakeholders; It targets, for a first stage, **the shift to EVs for the administrative vehicles' stock (owned by the public authorities), than for the private vehicles' fleet, during a next stage;** The project might though be encountering some slowness, and needs to be boosted;
- **Ongoing thoughts on the prior initiation of the E-Mobility with the administrative vehicles are ongoing.** Within this framework, a study was conducted by ANME on the conversion of the vehicles of the public mail company to EVs;
- **A study on an E-Bus Deployment Strategy has recently been launched** [3][5]. It is ordered by the Ministry of Transport with the assistance of the World Bank, and intended to prepare a roadmap for the Government, and to identify pilot zones and projects, to be prioritized, with a definition of an action plan. Its results are expected by the first quarter of 2023;

- **Ongoing study** financed by GIZ (Germany) **to assess the projected impacts of the E-Mobility on the national electric system's load curve.** It is in an advanced stage and its results are expected by November 2022;
- On a regulatory level, the Tunisian Finance Law of 2018 decided the application of 30% reduction on the consumption duty imposed on the road vehicles. **This reduction has just been emphasized to 50%, according to the new Finance Law of 2022**, as a measure intended to promote more ecological vehicles on the Tunisian roads;
- On a capacity building level**,** the ANME **is preparing 2 technical training centers, to be awarding technical certifications in the EVs' charging stations' installations and maintenance, in order to enhance technical capacities;**
- On a domestic EV s' manufact uring level : some perspectives are announced:
  - The unique Tunisian manufacturer of 100% made-in Tunisia cars (manufacturing and selling two models) recently announced its **plan to produce electric cars for the domestic market and for exports** (as electric vehicles' engines are simpler than the thermal ones), based on the encouragement of the Ministry of Industry;
  - **Domestic manufacturing/assembly of E-buses are on future plans**, in order for the E-public transport to be economically profitable;

- **Targeted future number of E-Vehicles: announcement of 1,000 hybrid and fully electric cars by 2023, then 5,000 by 2025** [8], which stock is planned to increase to **50,000 electric vehicles by 2035;**

- **Targeted EVs-Charging Facilities number** [1]**:** a recent announcement (in 2020) of the SNDP (the National Company of the oil products' distribution) was made on **planned EVs' charging facilities' development within all the public oil stations that are nationwide spread** [2] (action seemingly still under study). A pilot action targets **prior 10 public charging facilities, as a first stage, including 6 stations within main urban cities** (as Tunis, Sfax, Sousse) **and 4 others along the main motorways;**

  Other charging facilities are also planned by the private companies of the fuel distribution;

  Overall targeted number of charging stations and charging points: unpublished yet;

- **Energy autonomy of the EVs:** it was announced that the public charging facilities are expected to provide up to 300 km- energy autonomy for a 20 minute-charging period by vehicle [2].

Regarding the E-mobility's potential stakeholders in Tunisia, and their interactions:

- **Potential Stakeholders**: among the potential stakeholders that are or are expected to be involved in the E-Mobility's development preparation in Tunisia:

- The Ministry of Transport (DGTT/General Board of Land Transport), the Ministry of Environment, the Ministry of Industry, Energy and Mines, Ministry of Finance, the Ministry of Commerce,
- The National Authority of the Environment Protection,
- The ANME (National Authority for Energy Conservation), and the multi-field E-Mobility Work Team acting under the umbrella of ANME,
- the Customs' Administration,
- the Union of the Vehicles' Sellers (and Manufacturers),
- AGIL and SNDP (National Company of Oil Products' Distribution),
- STEG, the National electricity and gas Utility, and
- AUGT/Urban Authority of Greater Tunis.

- **Interfaces and Interactions (current context):** Coordination between above local stakeholders is needing to be actively enhanced.

The multi-field E-Mobility Work Force, acting under the umbrella of ANME, is among the directly involved stakeholders in the E-Mobility's planning and development preparation, and is supposed to coordinate between the various actors and to foster the interfaces with the funding organizations providing an assistance in the E-Mobility preparatory stage (as GIZ and KfW (Germany), 'Agence Française de Développement' (AFD – France), European Investment Bank (EIB)).

Weak signals, possible disruption factors

We can highlight the following factors:

- **Decongestion of the major cities' downtowns**, by means of infrastructures' development, facilities' setup and appropriate traffic management actions updated to the travel demand, need to be fostered as prior measures, in order for the E-Mobility to be efficiently inserted within the urban transport ecosystem of Tunisia, and to be viable in the future;
- Because of the **depreciation of the Tunisian currency,** the motorized vehicles' CAPEX is currently high in the Tunisian market, in comparison to the households' average incomes. Without a **well-studied highly motivational taxation's implementation**, EVs will be unaffordable for a range of the Tunisian households.
  Currently, electric vehicles' CAPEX is 35% to 40% higher than thermal vehicles, in the Tunisian market. The EVs 'import is still undergoing several layers of customs duties and tax layers (despite some recently decided exoneration).
- **The slowness in the Renewable Energy-based power generation projects' implementation**, already recorded over the last years, is not aligned with upcoming required electricity supply of the future EVs' charging stations with non-thermal power sources. A foster in the implementation of the actions

targeted within the already defined 2030 Solar Plan of Tunisia, is thus recommended for the upcoming years. However, the 4,000 MW of RE-based capacity targeted to supply the national electricity grid by 2030, seems too optimistic, and will require many actions in terms of the grid's stability enhancement.

Levers and barriers

Identified barriers:

The slowdown in the Tunisian economy over the last decade could have been among barriers for a real progress towards the E-Mobility implementation.

Identified levers / opportunities:

Among levers and opportunities for the future E-Mobility development in Tunisia, what follows:

- **Already expressed Governmental commitment to lower Tunisia's GHG emissions** and the Transport sector (specifically the land transport subsector) has been targeted as the major sector to be restructured to achieve that;
- **Active preparation stage of the E-Mobility's planning already launched in Tunisia;** Electric cars are targeted as a priority step, starting by the promotion of the E-cars of the Tunisian administrations. Pilot projects for E-buses are also envisioned to be implemented, later;
- Availability of a **governmental Work Group/Task force,** from different public and private bodies and concerned fields, **to focus specifically on the E-mobility development's preparation** which will **facilitate a cooperative and comprehensive planning, then a preparatory framework for the E-Mobility;**
- **The fossil fuels' import is the mainstream reason for the disbalanced trade balance of Tunisia** and the stressful situation of its foreign currency stock. This is leading Tunisians to seek for potential solutions for a higher energy-autonomy;
- **A BRT system** in Greater Tunis is envisioned and could be an opportunity to integrate the E-Buses in the urban transport ecosystem;
- **The average travel distance by cars and private vehicles is recently estimated to 45 km/day, as an average value in Tunisia, which is a short distance**. A 6 to 8-hour charging period for a car (by a residential charging facility that takes longer charging time, because of a lower electric capacity, than in the commercial charging stations) is assessed sufficient for around a whole week, and will cost much less than the fuel charging, which price has been continuously increasing in Tunisia, over the last years;

- **The good solar potential in all Tunisia's territory and the targeted RE-power generation projects (under studies)** will be in favor of an optimized LCOE of the electricity to feed the future EVs-charging facilities and the electric system's capacity enhancement to face the future extra E-Mobility needs;
- Tunisia already manufactures and exports automotive components (electric and electronic components, chassis and bodies, engines and engine components), aside to the domestic cars' manufacturing (one private company); **This ecosystem could pave the way in the future to a more contribution to the EVs' local manufacturing;**
- **Phosphate reserves available in Tunisia** (Tunisia was ranked in May 2022, the 12th exporter in the international market, after having been ranked the 3rd in 2010), could be a good opportunity for the domestic manufacturing of the new generation of E-cars' batteries: **the Lithium-Iron-Phosphate (LFP) batteries** (that might progressively substitute the more expensive Lithium – Ion batteries, in the middle term). This could catalyze the E-car mobility in Tunisia (rather in the long term), because of lower batteries' costs.

Main uncertainties

Among the main uncertainties on the future E-Mobility's context in Tunisia, what follows:

- **The future evolution of the Government's financial capacity** to manage and promote the E-mobility planning and actions' implementation, especially for the short term. Tunisia is however requesting international financing and technical support to implement its Transport strategic vision, and the related decarbonizing actions (World Bank is among main actors providing assistance);
- **Lack of vision on the participation willingness of the private sector** in the EVs' selling, manufacturing, and charging facilities' development /management and the mass E-Mobility's operationalization (private mass transit operators);
- **Uncertainties about the effective future advancement trend of the Renewable Energy generation projects' implementation and operationalization,** to supply the new charging facilities, and to enable a low footprint of the future E-Mobility.

Libya

Review of current trends

General data

Libya has an extended territory. This makes challenging the development of the road and more generally the land transport infrastructures and services, and could be behind a low inter-region mobility.

The country's population reached **6,959 million inhabitants** in 2021, and has increased at depreciating change rate over the last years. This results in a very low demographic density (**3.96 inhabitants/km^2 in 2021**), if assessed at a national level. Population is however, mainly concentrated in Tripoli, in the main cities of BenGhazi, Al Beida, Ghadamès, Sebha, Syrte, Tobrouk, and within the North coastal areas.

Because of a low development in rural and secondary cities, a large portion of the population, assessed to 81% in 2020/ early 2021 (UN data), is living in the cities and corresponds to the urbanized residents.

The national GDP per capita is evaluated to **5,089 € / 6,638 USD, in 2021,** and recorded an annual increase of **29.7%,** compared to 2020 (at constant prices of 2015 – World Bank data base), due to the increase of the oil revenues.

It's not known though, to which extent the average GPD per capita could currently reflects the real living standard of Libyans, still residents in their country.

Libya's recent land mobility context at a glance [(1), (2), (3)] :

The overall asphalt road system spreads over a total linear, recently assessed to around **84,000 km[(2)]**. This corresponds to a very low road density (0,048 km/km^2), if determined as a national average.

By cross-cutting information from different sources, **the stock of circulating vehicles** (all motorized modes) could be approached to around **2 million in Tripoli, the capital, and to 4.5 million for all over Libya, by 2019**. This stock is reported to having been rapidly increasing. It could globally be approached to **5 million vehicles by 2021**. This results in a very high vehicle ownership rate, that could be estimated to around **7.2 vehicles per 10 persons by 2021** (data is cautiously presented as no precise quantitative data is available).

In urban areas, and along the inter-city corridors, mobility is mainly relying on cars, as the mass transit system is spatially very limited, and its supply is lacking an appropriate organization and a quality service.

The urban public transport system includes urban taxis and shared taxis. The rail, cable, or road exclusive route modes are not available/operational.

Recently in 2019, **a new Bus Transport system was announced to be set up in the capital Tripoli**. It was planned to be operated by a Public Company, and its fleet was expected to include 130 Buses, having each a capacity of 60 passengers. The urban Bus transport is expected to be expanded to further cities [3].

The inter-city mobility relies mainly on cars and private vehicles, but there is a regional **Bus System connecting main cities.**

Globally, **the road traffic management is weak, despite of good rehabilitated infrastructures in many zones** (including the motorways connecting Tripoli to Tunisia and to Egypt). This has led to a transport risky context, characterized by a high level of road accidents and fatalities [1].

Recorded E-Mobility and its context in Libya:

The E-Mobility is currently negligible in Libya.

Future trends

Existing strategies, quantitative objectives

Regarding the overall land mobility context [5] [6]:

We can mainly highlight the following issues that can inform on the future transport and mobility context's perspectives in Libya, over the short and middle terms:

- Potential **further development and spatial expansion of the urban public Bus transport system** in Tripoli and other major cities [3], could be implemented (in case of a stable context);
- Some intercity rehabilitation and pavement road projects are under preparation (as the Wadan – Sirte Road, and Tobrouk – Emsaed road) [6];
- However, the current focus of the Ministry of Transport seems to be shifted rather on restarting the air transport lines, and opening / closing / securing trans-border road corridors, namely those linking Libya to Tunisia and Egypt [6], as those air and road connections are vital for Libya's economy, heavily relying on imports and foreign services.

Regarding the E-mobility perspectives:

Libyan Authorities seem not focused yet on the E-Mobility, as no published information on this issue, its planning and future perspectives, is available. In case of a future development, E-Mobility will rather concern the private passenger cars.

Weak signals, possible disruption factors

- **Libya didn't define its National Determined Contributions (NDC)** in lowering the GHG emissions and the prevention of the climate change [5], and thus the country seems not be not focused yet on decarbonizing its transport sector and on encouraging its people's mobility transition to more energy efficient vehicles and less polluting ones;
- **Unavailability of a comprehensive land/urban transport master scheme**, with prioritized actions to facilitate the E-Mobility studies and planning;
- **Urban traffic management is needing to be improved**, to secure the motorized mobility as general, and that of the future E-Mobility;
- **Unavailability of governmental bodies, in charge of preparing an appropriate institutional, regulatory and organizational framework** for the private and public transport, the electric vehicles' ownership and operation and the required charging facilities;
- **Lacking cooperation between the stakeholders** of the Mobility / E-Mobility, including the Ministry in charge of Transport, the recently created Company for Bus transport in Tripoli, the municipalities, the General Electricity Company of Libya (in charge of the generation, transmission and distribution of electricity);
- **Expanded country's territory and long inter-city distances and long distances up to the Tunisian / Egypt borders that attract heavy traffic flows.** Special efforts' deployment will thus be required in the future to set up a network of EVs' charging stations on the motorway and national road network, in case of a positive E-Mobility development scenario.

Levers and barriers

Identified barriers:

Several barriers could hinder the E-Mobility set up in Libya, especially in the short and medium terms, among which:

- **Many prior requirements are needed to assure the territory's integrity and safety of Libya, its regional security, and to establish its economic recovery**;

- **The unknown level of the technical capacities of the local stakeholders to plan for the E-Mobility integration.** This will require assistance in benchmarking with other comparable countries, and technical support and trainings of the public organizations' staff in the E-Mobility field.

Identified levers / opportunities:

The national electric system's capacity and producible energy have excesses that could cover an incremental electricity demand, in case of an E-Mobility's development and set up of EVs' charging facilities in Libya.

Libya can completely provide its consumers with self-produced energy. The total production of all electric power plants is recently assessed to 34,000 GWh, corresponding to 125% of Libya's own needs (consumption estimated to 27,300 GWh, for current situation). The rest of the self-produced energy is either exported into other countries, or unused [(4)].

Main uncertainties

The major uncertainty is the future overall context of Libya that will impact its stability and its overall future sectors' strategic planning and development trends.

Uncertainties float also on the institutional framework of the overall Transport, Environment and Energy / Electricity sectors, and the level of coordination between their involved stakeholders.

Egypt

Review of current trends

General data

The overall population reached **102.6 million inhabitants by 2021** and increased at a **1.36% change rate,** compared to 2020. Egypt is thus the most populated country in the MEDA region and among the most populated in the whole African continent. Despite some slowdown of its demographic evolution trend, its population's increase is a real challenging issue.

The national average demographic density is assessed to 103.3 inhabitants/km^2 (total population/all territory area). However, as **around 99% of Egyptians are estimated living in only 44,000 km^2** [(1)]**, the effective population's density, could be evaluated to around 2,477 inhabitants/km^2, which is a remarkable level.**

Most of the population is attracted by the major cities, as Cairo, Alexandria, Sohag, and Al Mansoura.
The highest geographic density is that of Cairo, the capital (**52,751.3 inhabitants/Km^2, in 2022**)[(4)].

The national population urbanization rate reaches **48.86%** (UN data). The Government is however targeting to enhance the urbanization evolution, so as **75% of the national population can become urbanized by 2050** [(4)].

In 2021, the national GDP per capita reached **4,309 USD per capita**. It recorded a moderate increase rate of **1.4%**, compared to 2020 (assessment at constant prices of 2015 – World Bank data base).

Egypt has been on its way to an economic recovery, as reforms have been launched in different sectors since 2016. According to the **Sustainable Development Strategy-Egypt Vision 2030 (SDS)**, defined in 2016/17 by the Ministry of Planning, an enhancement of the economic growth is targeted. Consequently, a multitude of national flagship projects, have recently been planned, or under development, with expected positive impacts on the national GDP and GDP/capita increase.

Egypt's road mobility context at a glance [(1)]:

The overall road system of Egypt reached around **~34,000 km by 2020**[(1)].

The overall motorized vehicles' stock (all modes) is estimated to **9,890,062 vehicles,** including a fleet of **around 4.7 million of cars**, increasing at ~ 7,5 %/ year [(1).]

The vehicles' motorization rates can be assessed as follows, according to 2020 data:

- **The average national road motorization rate: 0.98 vehicles per 10 persons**
- **The average national car motorization rate: 1 V. per 10 household (lower than 0.25 V. per 10 persons).**

Regarding the overall mobility's modal share, the available data of 2020 inform on what follows:

- **The informal public transportation and Taxis** correspond to the highest shares for the passengers' transportation**;**
- **The Mobility Share was:** 77.4% Public Transport, 16.1% Private Motorized Vehicles, 6.5% Active Travels;
- **Public Transport Split:** 4% formal Buses, 96% Paratransit (informal). This means the public transportation is still heavily relying on the informal services;
- **Private motorcycles and Tok-Toks** (3 Wheeled vehicles with limited transport capacities) **have been fast-growing**, over the last years, more likely because of their attractive CAPEX.

The urban mobility context is globally characterized by: **a public transport system which quality is needing to be enhanced**, a **high congestion** due to high population densities in the major cities, a lack of appropriate traffic management facilities, and a shortage in the traffic schemes' updates. This is continuing on being behind a **low air quality**, especially in Cairo city.

Recorded E-Mobility and its context [2] [3] :

Egypt is among the MENA countries that has already implemented the E-Mobility. The current context can be summarized as follows:

- An already developed experience in the E-Buses for urban Public Transport, in the two major cities of Cairo and Alexandria, as follows:
  - City of Cairo: 2 Battery-electric Buses have been already operated since 2019, by a public transport operator, which is planning to expand its fleet to **50 Battery-electric Buses** (unknown horizon);
  - City of Alexandria: the operation of **15 Battery-E-buses** was already launched in 2020, by Alexandria Public Transport Authority along 3 routes (after 3 months of pilot and initiating period). It has developed/targeted **18 charging stations. ATA has also planned for a new E-bus line;**

  This experience of public E-Bus systems is announced to be expanded to other cities of Egypt;

- Availability of EVs charging network, mainly developed by a private company that is an Egypt's leading renewable energy solutions' provider. The available charging stations are thus supplied by solar power;

- **Charging stations number**: In 2021, **more than private 90 charging stations (300 charging points)** across 10 governorates of Egypt. The network is announced in 2022, to expand to 7 more stations (with 20 total charging points each) in the Nile Delta Region [2] and the **private charging network, will soon totalize more than 97 charging stations, all over the country** (based on the unique data of the private company mentioned above) ;

- **Charging facilities' current locations and announced new locations (short term)** [2]:

- The private charging stations are located in selected gas stations: within high traffic areas, in high-traffic commercial districts, and gated communities, in all major travelling intercity roads, including roads linking Cairo to Alexandria / Hurghada/ Ismailia/ Ain Sokhna;
- The **7 newly announced EV-Charging stations** in the Nile region will be located in Shebeen, El-Kom, Mansoura, and Damietta cities;

- **Existing charging stations' characterization** (information based on the above mentioned private charging company) [2]:
  - Stations are built according to the EU standards and cater to Type 2 charger cables;
  - Stations are supplied by both Alternative Current (AC) and Direct Current (DC), and they are equipped with double-socket 22kW-AC-chargers and fast-charging DC chargers (these latter are available in major stations only), providing an output of **50 kW;**
  - There are **20 to 30 charging points by existing charging station**.

- **About the Main Existing Providers of EVs-charging [2]:**

A private company set up in 2014, is operating in the RE-Power generation (solar, wind and waste plants, aside to solar carports and rooftops installations). It has already invested in the PV solar projects, and is contributing to the largest Solar PV generation project of the country (Benban Park with a 1,465 MWp capacity). It also operates in the Power Distribution services and the EVs' charging solutions.
The company is harnessing the largest network of the EVs' charging stations across the country (for cars and private vehicles).

Public charging facilities must have been set up for the circulating E-Buses of Cairo and Alexandria, and there might be other EVs' charging operators.

Future trends

Existing strategies, quantitative objectives

Regarding perspectives on the overall land mobility context's [2] [4]:

Globally, what could emerge from the announced perspectives on the overall transport and mobility context in Egypt is what follows:

- The defined National Road project, targets to develop up to **7,000 km[4]** of new roads nationwide and rehabilitate around 10,000 km of existing roads. This is expected to generate induced road traffic over the upcoming years;

- The ongoing and further planned new cities' constructions, to reduce the demographic concentration and traffic congestion of existing cities, mainly Cairo, is expected to induce the inter-city and urban travel needs' increase;
- Egypt's Transport sector share in its overall GHG emissions reached 15% in 2015. Within its 2022 National Determined Contribution (NDCs) to reduce the GHG emissions, the Country is committed to **reduce its overall GHG emissions by 2030, and its Transport sector by 7%, compared to the 2015 situation's extend trend**;
- Within the above framework of NDCs, **several ongoing and planned projects are envisioned to lower the carbon footprint of the land Transport sector,** including what follows:
    - **A new Bus-Rapid-Transit (BRT) being implemented, and planned for further expansions, within Greater Cairo** (operated by the private sector and including more than 200 smart buses linked to mobile applications) [(1)(3);] This modern new bus system has a greater potential to be operated by electric buses;
    - New rail transport systems and related expansions are planned to provide higher urban and interurban transport capacity for the passengers' transport as follows:
        - Ongoing expansion of the Cairo underground metro system with a 3rd line (East-West of Cairo),
        - Planned 2 new monorail lines within the new administrative capital (under construction),
        - Ongoing Light Rail Train (LRT) system connecting northern Cairo with the new administrative capital, and
        - Planned Alexandria's Metro project and the rehabilitation of its Tram line;
    - Planned bike-sharing system and bike-lanes in downtown of Cairo, to enhance the soft mobility and reduce the severe air pollution being faced by Cairo.

Regarding the E-mobility perspectives:

E-Mobility is targeted to be enhanced and geographically expanded in Egypt, among measures to improve the air quality in the major congested cities. The perspectives on the E-mobility can be drawn as follows:

- **A national strategy, covering the EVs, their local manufacturing and the E-charging infrastructures issues,** was recently commissioned (which outcomes and targets could be unpublished yet);

- **Road Electric Vehicles (EVs) have been targeted as an emerging national priority.** This has been encouraged notably by the excess in Egypt's electricity supply. In 2019, the national peak load was reported, by the Egyptian Electricity Holding Company, to have reached 30,800 MW, while the overall electricity installed capacity attained 55,213 MW[(5)]. This capacity excess was planned to supply the EVs' charging needs, for a higher economic profitability of the electricity generation system. Egypt is also endowed with a high RE potential, and ongoing and planned RE-electricity generation plants are being targeted;

- **Phase out of new fossil fuel vehicles is targeted by year 2040**, as it appears in the SLOCAT website, that is tracking the announced targets of countries (and also regions, cities, companies and vehicle manufacturers) to show their growing ambitions in scaling up the E-mobility; Egypt is among the MENA region's countries, that have announced a horizon for phase out fossil vehicles.

- Egypt's Government has announced the **intent to develop 'a robust ecosystem for EVs' manufacturing in the country',** for the up-coming years. Among announced information [3] [6] is a **local manufacturing of 2,000 Battery-electric buses**, previously planned to start in November 2020 and over a 4 year-period. 45% of the components will be domestically produced, within a Private Public Partnership (PPP) initiative. Moreover, the public sector's industrial organizations are **studying the possibility to locally manufacture the EVs;**

- **An EV-Charging Station network is being built nationwide**, by private companies. The leader of those companies has announced in 2022, the set-up of **7 EVs-charging stations (20 charging points within each) in the Nile Delta region**, aside to its target to expand its charging network in new regions across the country;

- **Targeted Stock EVs for future:** unpublished
- **Targeted Number of charging stations/points:** unpublished.

Above ongoing and envisioned actions, aside to the multi-year plan announced by the Government, to replace the private car and microbus engines powered by traditional fuels by dual-fuel engines (consuming gas), lead to conclude on the Government's goodwill to reduce the conventional fuel/high emission– fleets.

Regarding the E-mobility's potential stakeholders in Egypt, and their interactions:

- **Potential Stakeholders**: Main actors that be involved in the E-Mobility subsector, include what follows:

    - The Ministry of Transport, the Ministry of Environment, the Ministry of Planning and Economic Development, the Ministry of Industry, the Ministry of Housing (MoH) that controls transport in the New Urban Communities (NUC);
    - Greater Cairo Transport Regulatory Authority (GCTRA, created in 2012);
    - Specific industries to be involved in the EVs' production (as Foton for the E-buses' manufacturing);
    - the Public Transport operators already managing E-bus networks (Mowasalet Misr in Cairo, and APTA in Alexandria);
    - The Central Agency for Public Mobilization and Statistics (CAPMS);
    - Infinity Company (Private sector), that is a leading EV-charging stations' operator, and a Private Electricity Generator and Distribution Operator);
    - The National Electricity Facility: Egyptian Electricity Holding Company.

- **Interactions and interfaces**: the level of cooperation between the mentioned above stakeholders is not known, and might be needing enhancement (especially regarding the private involvement), in order for the E-Mobility to be implemented in an appropriate advancement trend.

Weak signals, possible disruption factors

Identified weaknesses' sources and disruption factors include what follows:

- **High traffic congestion and extended journey times in urban areas**: increase the risks of a quick exhaust of the energy storage in the EVs' batteries, and thus of the increase of the charging fees to final users;

- **Willingness to pay the new E-vehicles of a range of the Egyptian households might be limited,** which is reflected in the current **low motorization and car ownership rates** (unless new motivational measures will be set up);

- **Still dominating share of the rural population**, having lower potential to transit to E-Mobility and afford / access the EVs;

- **Informal Mass-Transit modes representing the largest share of the public system** and reducing the opportunity for a future rapid and extensive shift to E-Buses;

- **Planned increasing share of the mobility by modern and smarter rail modes in Cairo and Alexandria** (subway systems, and other rail lines) might be competitor modes to the E-Buses, and even to the E-private vehicles, especially on the very congested road sections, unless special measures could be

implemented (as financial incentives including Emission Taxes and non-financial motivational measures, as well-spread charging infrastructures and inter-operability of the charging facilities to support the spatial expansion of EVs, as suggested by a recent study 'Electric Mobility Opportunities and Challenges in Cairo'.

Levers and barriers

Identified barriers:

Among identified barriers on the E-mobility's future promotion and future development, the following factors:

- **The still ongoing significant Demographic growth,** especially in main cities, resulting in increasing pressures in various economic sectors and social development needs, equipment and infrastructures' requirements that could be of higher priority to users tan the E-Mobility, and
- **The high rurality of the Egyptian population**, while operators of/ investors in the charging facilities would rather be interested in the urban areas and the intercity corridors.

Those factors could slow down the effective trend of the advancement to the E-Mobility, mainly on the short term.

Identified levers / opportunities:

Among forces, levers and opportunities that could favorize more development of the E-Mobility in Egypt, the above ones:

- **There is already a feed-back from the experienced operations of E-buses, E-vehicles and E-charging stations** in Egypt that would facilitate further E-Mobility development;

- **Egypt's electric system's capacity excess**: An important Renewable Energy (RE) potential and significant ongoing and planned expansions of the electric supply, are reported. This will be favorable to satisfy the future E-Mobility's impacts on the load charge. Egypt is planning to enhance the RE energy generation capacity share to about 40% by 2030, and to 42% by 2035, as defined in its Integrated Sustainable Energy Strategy 2035[(4)];

- **Good will of the Government to reduce the GHG emissions and improve the air quality in congested areas,** as announced and targeted in many strategic and planning frameworks (Egypt's Vision 2030, the emerging Long Term Low Emission Development Strategy 2050 (LT-LEDS), the National Climate Change Strategy 2050 (NCCS), the National Strategy for Adaptation to Climate Change, and Disaster Risk Reduction, and the Sustainable Energy Strategy 2035, etc.)[(4)]**;**

- **Already existing EVs and charging stations (managed by more than one private company) with targeted expansions** envisioned for many regions and cities. This leads to conclude on an already start in the regulatory framework's design;

- **Already existing innovative policies on the electric transport in Egypt;**

- Availability **of a National Mobility/Transportation Strategy:** targeting the EVs' fleet and the charging infrastructures' development, aside to the development of the local EV industries';

- **The Economic recovery of Egypt and the positive future targeted trends**, aside to planned and ongoing flagship development projects (as construction of new cities) and their expected impacts on the future travel needs' increase;

- **Land-use changes** resulting in the planned set-up of new cities **is expected to result in the travel distances and the motorized modal share' increase**, aside to the growth of the total energy demand. This would incentivize the Government to substitute portions of the fossil thermal vehicles.

Main uncertainties

Uncertainties can be mentioned mainly on what follows:

- **The regulation, tariffing, and tax measures** to be developed and their incidences on the EVs' affordability by the Egyptian households, and

- The **international conjecture's incidence on the economic performance of Egypt** in upcoming years, and on the effective Government's capacity to reach the E-Mobility and the electricity capacity increase targets, at the targeted deadlines.

Jordan

Review of current trends

General data

Jordan's population reached **10.687 million of inhabitants by 2020**, out of which around 4.6 million of people live in Amman the capital (43%). This results in a high density and heavy congestion issues in many areas of Amman.

Irbid and Zarqa are two other major cities attracting residents and the traffic flows.

The average national demographic density can be assessed to **119.6 inhabitants/km²** (2020).

Jordan is among the very urbanized countries of the Southern area of the MEDA region, with **91.63%** of its people living in urban centers (UN data of 2021). This must result in a stressful increase of the equipment, infrastructures and socio-economic services' needs in the cities, and especially in Amman.

Jordan's GDP per capita reached **3,725 € / 4,532 USD by 2021** that increased by 1.6%, over the 2020-2021 period (assessment at constant prices of 2015 – World Bank data base).

Jordan's mobility context at a glance [(1)]:

The overall road system's linear of Jordan reached **around 9,810 km by 2020,** which corresponds to a low average density of nearly 11 km/km². The road system spreads mainly in the urban centers and between the major cities. These latter correspond to a low geographic density.

The overall number of the registered vehicles in the country is reported to **1,583,458 vehicles in 2017** (latest available data).

In 2017, the **national average car motorization rate is assessed to 1 vehicle per 6 persons (1.67 cars per 10 persons).**

Mobility is still heavily relying on cars which represent the mainstream passengers' transport mode, while the public transport systems (buses and taxis / shared taxis) contribute to 33% of the passengers' mobility [(1)].

This situation is due to the existing Public Transport system that is still with efficiency and reliability needing to be enhanced and limited routes.

The increasing reliance on the private cars has resulted in a growing traffic congestion, especially in the main and high population-density cities (Amman, Irbid, Zarqa).

Recorded E-Mobility and its context [(2) (3) (6)] :

Because of the increasing road traffic congestion and its negative environmental incidences, and especially due to the high fuel prices in its domestic market the Jordanian Government granted in 2020, **tax and**

customs' exemptions for the private fully and hybrid electric vehicles, which reduced their CAPEX. This has been behind the EV fleet's growth and the E-Mobility's development over the last years in Jordan, despite a re-application of a reasonable tax on the EVs' selling prices since 2021.

The recent fast evolution trend of the already implemented E-Mobility (for private and public vehicles), has especially been driven by the fast increase of the fossil fuels' prices in the Jordanian market, over the very recent years, leading to higher bills than those of the electricity consumption for the road vehicles' supply.

The E-Mobility has very recently been expanded to the mass transit system of Amman, the capital, for which E-buses, mainly as Hybrid vehicles and with a low number of fully electric vehicles, are currently being operated for the Bus Rapid Transit (BRT) system of Amman.

Charging facilities:

The Energy and Mineral Regulatory Commission (EMRC) currently provides licenses to public and especially private electric vehicles' charging stations. The network of the charging facilities expanded nationwide. However, the **installed charging facilities remain not widely available** in the country, because of the **existing regulation limiting margins for the private investors** and making tariffs set up by the Government, which is not providing sufficient revenues to the charging facilities' operators, neither a comfortable viability of their investments.

The charging facilities are mainly located within the major cities, and not along the motorways and inter-city corridors which is reported to be not enough to cover the travel needs over long journeys. The charging stations, operated mainly by private companies, are **mainly located within the gasoline distribution stations and they are grid-connected and mainly supplied in DC**. The footprint of the E-Mobility seems not optimal though, as the national grid is supplied by thermal and renewable energy (solar and wind) sources.

Only one branded vehicles can be charged within the charging stations, as the Government is reported to have been in charge of this brand vehicles' import promotion. This limited charging services is being operated despite the availability of other branded EVs circulating on the Jordanian roads.

Very recently, some administrations set up their own charging facilities for the needs of their employees.

Regarding the batteries, **there are restrictions imposed on their import**, which is limiting the opportunities for the EVs' batteries replacement. This has encouraged the **emergency and evolution of an informal market for second hand batteries**, without a systematic respect of the required technical specification and performance standards, which is reported to being behind a lack of road travel security and recurrent accidents.

Recent quantitative assessments:

On a quantitative level, the available data inform on what follows:

- **Total stock of registered Hybrid private vehicles (EVs)[6]: nearly 250,000 vehicles by 2021** (representing nearly 18% of the overall 2021 circulating motorized fleet);

- **Total stock of registered fully electric private vehicles (EVs) [6]: around 30,000 vehicles by 2021** (little less than 2.4% of the circulating motorized fleet);
- **Total stock of the circulating Electric Buses (E-Buses) [6]: 100 vehicles, mainly hybrid with few fully electric vehicles;**
  The overall stock of EVs was assessed to only **16,000 in 2018**[1] (around 1% of the total national fleet). The EVs' stock has thus experienced an impressive increase in Jordan;
- **The public charging stations located within the fuel distribution stations: is assessed by the end of 2021, to nearly 15 facilities country wide setup.** This is a low number compared to the EVs stock. Several private charging facilities must be available, but their number is unpublished.

Future trends

Existing strategies, quantitative objectives

Regarding perspectives on the overall land mobility context's [1] [4]:

Before exposing the perspectives of E-Mobility in Jordan, the perspectives of the overall transport that might interfere with the E-Mobility are exposed here after:

- Ongoing efforts to restructure the Public Transport system, expand it and improve its services, to enhance its share in the overall passengers' mobility; However, mobility by cars is expected to continue on being the mainstream, over the upcoming years;

- An update of the national transport strategy is developed. It targets the foster of the use of:
  - Intelligent transport systems, with a better urban insertion of all modes and the public transit systems, in order to lower the GHG emissions and the travel times;
  - The Bus Rapid Transit (BRT) system, that is already under expansion in Amman (2 operational lines and further 4 lines' development is targeted);
  - The railways transport system;
  - **The electric vehicles (both private and public), with the charging facilities**;

- Recommendations and action plans were already developed on the future transport modes' diversification, with an enhanced modal share of the Public Transport and the small sized vehicles / soft modes, to lessen severe congestion and pollution, mainly in the urban areas.

Regarding the E-mobility perspectives:

More promotion and implementation of the E-Mobility is clearly targeted by the local Governmental actors in Jordan. Within this framework, perspectives can be summarized through what follows:

- Promotion of the hybrid and fully electric cars at a national level is planned, based on a conducted study by the Ministry of Transport, that takes in account the Energy National Strategy 2020-2030. The study targets the **rapid shift of 50% of the public cars' fleet to EVs** [(4)]**;**
- Another project, named 'Future electric bus fleet' was aiming to **provide new public sector's funded bus services also for the main cities of Irbid and Zarqa, based on the set up of electric transport networks**. More **100 new E-buses** would be planned for the public transport organizations operating in both cities, aside to the development of complementary aspects for the success of the project's implementation (charging infrastructure, set up of an organization to oversee the overall E-bus system's operation);
- Further strategic recommendations were set up on:
  - **Incentivization of the electric cars for Taxi companies** to reduce air pollution and traffic; Mobile applications are also recommended for taxis to facilitate their requests by users while waiting at the charging stations;
  - **Encouragement of smaller sized electric vehicles (E-scooters and bikes),** among other small-sized vehicles, **is also proposed** to lessen the congestion and the transport-energy consumption;
  - **New regulatory measures are expected to be defined regarding the charging tariffing and services, aside to the technical specification of the batteries;**
- Regarding the **E- vehicles' manufacturing and the contribution to its supply chains**, it was reported that no perspectives are defined yet for the Jordanian Industrial sector[(6)].
- The short-middle term and long-term strategic planning of the E-Mobility has been analyzed and recommended, with several proposed actions targeting a favorable and progressive future context for the E-Mobility?

On a quantitative level, the following data can be highlighted:

- **Targeted public electric vehicles: 21,000 to 22,000 hybrid and fully electric cars and other small vehicles, owned by the Government planned for the short term** (potentially before 2025)**.** These assessments are excluding the private EVs;
- **Overall targeted stock of the Mass Transit vehicles: 100 more E-buses in the cities of Irbid and Zarqa** (potentially by 2025), **aside to 100 E-Buses of the BRT of Amman**;
- **Targeted number of EVs' charging facilities number:** ongoing studies and unpublished number.

Regarding the E-mobility's potential stakeholders in Jordan, and their interactions:

- **Potential Stakeholders:** among stakeholders that are involved and expected to act in the E-Mobility sub-sectors in Jordan, the following are identified:
  - The Ministry of Transport, the Ministry of Environment, Energy and Minerals,
  - The Energy and Mineral Regulatory Commission (EMRC);

- The Jordanian Renewable Energy and Energy Efficiency Fund (JREEEF)
- The National Energy Research Center (NERC);
- The Jordan Electric Vehicles' Association (JEVA) which represents owners of E-cars and that communicates their concerns to the Government and to the civil society);
- The Municipalities that are expected to facilitate the insertion of the electric public transport routes and required infrastructures within the urban transport system;
- Several public and private entities involved in the Mass Transit system, that are reported to be currently lacking coordination though;
- The Jordanian Electric Power Company Limited, the Electricity Distribution Company of Irbid, and the District Electricity Company, as the national electricity provider;
- The motorized vehicles' manufacturers and sellers that are present in the Jordan market (as Tesla, Jordan Renault, General Motors, Nissan Motor, Fiat, Volkswagen, BMW).

A recommendation was made to establish **a national high-level e-mobility committee**, as an E-Mobility Task Force, to follow up on the updates in the electrification of private and public transport t[(2)]. This committee could operate under the Ministry of Transport;

- **Interactions and interfaces between the stakeholders:** The level of coordination and responsibilities' share between existing entities, could be not optimal, and still requires enhancement. This could be achieved by means of the set-up of the national high-level e-mobility committee

Weak signals, possible disruption factors

Based on the analysis of the recorded E-Mobility experience and its current context in Jordan, among weaknesses and disrupt factors that could affect the optimal development of the E-Mobility, specifically in the short term, the following factors are identified:

- **Limited spatial cover of the public charging facilities, which has led to informal charging services**, as a number of households have made their home charging points available to others, as means for enabling longer trips into areas not well covered by the public charging points [(6)]. However, this informal and not planned charging expansion could induce negative impacts on the electricity distribution grid and its capacity balance;

- **Limited attractiveness of the current regulation of the charging stations' services and tariffs** and already registered adverse impact on the charging infrastructures' spread in Jordan;

- **Limited allowed import of the electric vehicles' batteries** and negative impact on the potential EVs' operating time and financial viability for users (the current lifespan of an EV in Jordan is limited by that of its battery, as replacing batteries is currently not optional, given the Governmental restrictions on the batteries' import);

- **Traffic Congestion, and excess in the travel time on roads,** leading to shorten the electric batteries operational time;

- **Long distances on the major intercity corridors**, while the charging stations could not be expanded on the motorway grids;

- **Consequent registered reluctance of People to acquire EVs as primary/ major vehicles for frequent travels**, (households buy EVs rather as secondary or tertiary vehicles for shorter travel distances, and thus lower potential economic viability) [(1)];

- **Presence of multiple entities involved in ruling the Transport Sector and the Electricity provision,** might not be in favor of an active planning and an optimally integrated coordination between future actions. The national high-level e-mobility committee, once operational enough, could however help to overcome the current context's difficulties.

Levers and barriers

Identified barriers:

- **Technology and its related cost compared to the public actor's capacity:** The deployment of the electric buses in Jordan is announced to be limited by the cost of their technology, operation and required infrastructure (the wide scale charging facilities) [(4)]. This might impact the deadlines of setting up and spreading the mobility by E-buses in the two main cities of Irbid, and Zarqa, where E-Buses are planned, and later in other urban area;

- **The monopoly of the Government in the EVs' charging services and the batteries market** and the applied tariffing policy**,** which might not boost a rapid expansion of the private investors' actions in providing charging facilities and selling batteries, especially along the intercity road connections.

Identified levers / opportunities:

- Currently, **Jordan could be ranked among the most advanced countries of the MENA area in the E-Mobility's implementation and planning,** because the country has been suffering from scarcity of fossil fuel resources, and a difficult importation context. Jordan is importing around 93% of its energy needs (current situation)[(4)], and the recent increase trend of the fossil fuels' prices in the international market seems to have boosted the local deployed efforts to facilitate and activate the shift to E-Mobility;

- Goodwill of the Government to lower the country's GHG emissions (by 31% by 2030, as defined in the NDCs of Jordan, updated in 2021), and the **Transport sector is placed among main targeted sectors of the future interventions;**

- Jordan's electricity grid is characterized by capacity and energy surpluses and **E-Mobility is encouraged by the Government, notably as an electricity storage alternative**. A domestic electricity market is thus announced to be setup in the near future, to enable electricity excesses' injection by the electric vehicles within the national grid. Within this framework, the transition to a smart electricity grid is being prepared to be progressively implemented in the future, starting by the city of Amman;

- **Already ongoing preparatory stages of an innovative policy on the Electric transportation with targeted action plans** (supported by different Governmental bodies) **for the promotion of the future E-Mobility for all modes:** Private vehicles, small sized /2-Wheeled vehicles, and the Mass Transit vehicles / E-Buses

Main uncertainties

Among major uncertainties:

- Feasibility studies of the E-Mobility actions, seem not yet developed and specific actions and choices on more developed E-Mobility, seem not to be defined in detailed action plans (technological choices of the E-vehicles, geographical spread of the charging stations, financial and non-financial motivational measures, etc.);

- Uncertainties are still floating on the E-buses stock's development and on the related charging infrastructures;

- Uncertainties on the projected regulatory framework, regarding notably the import of EV-batteries to the local market and charging services' tariffing;

- Unknown perspectives and targets on the domestic manufacturing of the E-vehicles, their components, and related batteries.

Palestine

Review of current trends

General data

The overall Palestinian population reached **5,227 million inhabitants in 2021,** and increased at the high annual rate of 3.13% over the two last years (4,915 million inhabitants in 2019). This population is spatially split as follows [(1)]:

- West Bank: 60.1% (2,953,943 inhabitants in 019)
- Gaza strip: 39.9% (1,961,406 of inhabitants in 2019)

- Urban centers: 77%
- Rural localities and villages: 15%
- Refugee camps: 8%.

Consequently, more of the three quarters of the Palestinian population is living in urban areas, mainly in East Jerusalem, Gaza City, and the major cities of Nablus, Ramallah/Al-Bireh, Bethlehem, and Hebron, which concentrate the main public services and facilities.

The demographic density is globally high in all the Palestinian territories and it is extremely elevated in the Gaza strip (more than 10 times higher than density in the West Bank) :

- **Overall population density: 868 inhabitants/Km^2 in 2021 / 816 inhabitants/km^2 in 2019,**
- West Bank: 522 inhabitants /km^2 (2019)
- Gaza Strip: 5,374 inhabitants/km^2 (2019).

The Palestinian GDP per capita **reached 903 € / 1,192 USD in 2021** (in average for West Bank and Gaza Strip). Big disparities in the households' revenues must exist between the residents of the main cities of the West Bank on one hand, and those respectively of Gaza Strip and the Refugee camps, on the other hand.

Palestine's land mobility context at a glance:

The linear of the road system serving the Palestinian territories reached 3,697 km in 2020 (92% in the West Bank and 8% in the Gaza Strip), corresponding to an average density of **61.4 Km/Km^2.** Further linear of 1,018 km of bypass roads serving the Israeli settlements, could be considered as potentially used by Palestinians for inter-city / inter-locality transport (in case of non-special imposed restrictions by Israeli authorities).

The road vehicles' fleet of Palestine is estimated to **480,775 vehicles in 2021** (77% in the West Bank and 23% in the Gaza Strip), and increased at the average annual rate of 7.90% over the 2016-2021 period.

The fleet is dominated by cars, and its modal breakdown is as follows:

- Private cars: 82.4%; Taxis: 2.3% ; Public buses: 0.4%

- Trucks and commercial vehicles: 10.3%
- Motorbikes: 0.9%
- Others: 3,7%.

The motorization and car ownership rates and the car ownership rate are among the lowest, in the MENA region. They are assessed as follows for 2021:

  - **Average Motorization Rate (all modes included): 0.96 Vehicles per person**
  - **Average Car Motorization Rate= 0.76 Vehicles per person**; It is though almost 3 times higher in the highly congested urban area of the city of Ramallah/El Bireh(1).

The current context of the Palestinian mobility can mainly be summarized by the following factors:

- Restrictions on the inter-locality travels has **severely impacted the mobility and its evolution;**
- **Outside mobility** (West Bank-Jordan over the King Hussein Bridge on River Jordan, and Gaza Strip-Egypt through the Rafah border corridor) **is also limited** due to security controls;
- **High congestion in main urban cities** (Ramallah/El Bireh, Nablus, etc.), is due to the rapid increase of the traffic volume (4% to 5% annual change rate) and an increasing spatial density and has been behind a noticeable air pollution;
- **The management split of the Transport system's components between the Israeli authorities and the Palestinian National Authority**, created a dual Transport system that is not in favor of the traffic fluidity, neither the travel times;
- **The Public Transport modes (shared-taxis and buses)** are owned and operated by individuals/firms with limited governmental subsidy, and thus **limited profitability and service quality.**

Recorded E-Mobility and its context in Palestine:

A new regulation was implemented since 2010, and consisted in reducing the vehicles' purchase tax for alternate fuel-powered vehicles, based on engine size and alternate fuel type. This resulted in the introduction of fully electric, hybrid, and plug-in hybrid electric Vehicles to the Palestinian road vehicles' fleet. The regulatory measure was intended to reduce illegal vehicles' number, modernize the fleet, improve the traffic safety and also enhance the Government's income (through the vehicles' import income increase).

However, 10 years later (~2020/2021), the share of the alternate vehicles (not fueled by gasoline or diesel) represented only slightly above 1% of the total circulating fleet, **and E-Mobility could not significantly increase.**

A combination of factors might be behind this situation, including what follows:

- Shortage in the charging facilities' availability and their appropriate spatial cover;
- Difficulties in importing the EVs;
- Low income of a large range of households and firms and their unaffordability of new modern vehicles;
- Challenging context of the electricity supply and its inappropriateness to the E-Mobility needs;

- Unstable overall context, with several requirements needing to be satisfied prior to acquiring EVs.

Future trends

Existing strategies, quantitative objectives

Regarding the overall land mobility context:

Following issues are identified from available data. They would affect the future mobility context in Palestine and potentially induce impacts on the E-Mobility's development:

- The **Road and Transport Master Plan prepared in 2016,** encouraged the development of the Public Transportation and a multimodal transportation system, including **the intra-city BRT**, the **tram line services** (in cities of Nablus, Ramallah/Al-Bireh, and Hebron), and **inter-city railways** for passengers' transport, new public transport terminals and park-and-ride facilities;

- A national Task Force is already set up by the Government to study the potential for implementing **Smart Transportation and Intelligent Transportation Systems (ITS),** and to recommend new actions that will have to be climate-friendly;

- The Nationally Determined Contribution (NDCs) of Palestine target **the shrunk of emissions of the passenger vehicles' fleet by 8% by 2030, and 24% by 2040, by means of actions as [3]:**

  (1) Scrapping 60% of vehicles older than 20 years by 2030 and scrapping all vehicles older than 20 years by 2040;
  (2) Conducting statutory tests on 30% of on-road vehicles by 2030, and 60% by 2040;
  (3) Replacement of 20% of all small transit vehicles (Taxis) with larger capacity buses by 2030, and 40% by 2040;

  (4) Reducing the overall number of vehicles by 20% by 2030, and 40% by 2040.

All above identified and encouraged actions are supposed to result in a higher transport capacity, an increased traffic fluidity, an enhanced organization of the passengers' transport, and a better environmental context in the Palestinian territories. These measures could facilitate the E-Mobility's development and integration within the transport ecosystem of Palestine.

However, updated strategic and urban mobility plans for the Palestinian cities are not defined / issued yet. Moreover, advancement in the above targets' achievement is unknown (preparatory process, developed / ongoing feasibility studies, accompanying regulatory / tariffing measures, etc.)

Regarding the E-mobility perspectives:

What could be mentioned in relation with the potential future perspectives of E-Mobility in the Palestinian territories is mainly the guidelines and recommended measures, proposed by local and foreign experts (especially the assigned national Task Force) that have focused on the Transport and Environmental sectors of Palestine. Namely, the following recommendations have been made:

- For the short-term, recommendations include : (1) the need to develop a **Mobility Plan in a climate-friendly way**; (2) the encouragement of the Mobility Transition towards the use of cleaner and environment-friendly vehicles; **Special attention has been highlighted, within this regard, to support the development of changing facilities, both for the Private and Public Transport vehicles;**
- For the Long-term, formulated recommendations specially include what follows: Encouragement of the shift towards highly efficient and effective vehicles, through **the renewal of the vehicles' fleet and the disposal of old vehicles**. Targets seem not to be quantified yet, **but the future long-term context is encouraged to be favorable for a quicker transition to E-Mobility**.

The announced recommendations studied have been targeted both for the West Bank and the Gaza Strip territories. However, **detailed, prioritized and quantified action plans seem not defined yet**.

Regarding the E-mobility's potential stakeholders in Palestine, and their interactions:

- **Main Stakeholders**: that could be involved in the E-Mobility's future development and preparatory stages include:
  - the Ministry of Transport, the Ministry of Local Government (MoLG), the Ministry of Public Works and Housing,
  - the Higher Traffic Council,
  - the Municipalities, as they are fully responsible for the Transport planning, the traffic management, the roads' design, construction, rehabilitation, and maintenance in the cities,
  - the Villages' councils that are in charge of above activities jointly with the MoLG,
  - the Municipal Development and Lending Fund (MDLF), that is responsible for supporting developments in the Municipalities,
  - the Palestine Energy and Natural Resource Authority.

- **Interfaces and Interactions:** the current situation informs though on a lack of organization and overlapping responsibilities between the above stakeholders. Their financial and technical capacities are more likely needing reinforcement, in order for the planning and preparatory actions to be efficiently implemented.

Weak signals, possible disruption factors

The critical context of Palestine results in a long list of weak signals and disrupt factors of the mobility and transport sector's context as whole, and thus of the E-Mobility subsector specifically. We present the particular following issues:

- **The limited financial profitability of the already operational Mass Transit system,** reducing the capacity for acquiring new vehicles by operators and the Government standing behind them, unless new motivational regulation measures could be set up by the Government;

- The municipalities and the villages' councils are the organizations directly involved in the road sector's planning and related actions' implementation, with some support from the Ministry Local Government. However**, those governmental entities have limited financial, logistic and technical capacities to appropriately introduce the E-Mobility in the Palestinian ecosystem.** Enhancement of their capacities is required, notably in enhancing awareness of the population regarding the environmental and operational costs of the electric vehicles' usages.

Levers and barriers

Identified barriers:

A list of heavy barriers is unfortunately standing in front the potential for the E-Mobility's development in Palestine. The mainstream ones, are the following:

- Unfavorable global geopolitical context **adversely impacting the Governmental and public authorities' logistic and financial capacities** to progress in planning and implementing regulatory, infrastructures and services' development actions in the Transport, Mobility, Electricity and Environment fields, as a whole;

- **Spatially scattered Palestinian communities and localities within a geographically discontinuous territory** and severe constraints imposed on the Palestinians' traffic flows, travel distances and times **reducing the potential for a profitable and viable EVs' acquisition, and hindering the E-Mobility's future spread.**

Identified levers /opportunities:

Despite the challenging overall context of the Transport sector in the Palestinian territories, a number of levers / opportunities are here after highlighted:

- **An already modest start in E-Mobility's development and encouragement,** has already been experienced and feedback is recorded that can better help future planning and operational measures;
- **Already registered high in-city Traffic congestion in the main urban areas** (Ramallah/El Beireh, Nablus, Hebron, and the overall Ghaza Strip), **with impacts on the air quality and the citizens' health**, and catalyzing new thoughts on solutions' considerations;
- **Governmental commitment to reduce the emissions of the Transport sector,** and awareness of the benefits of the low-carbon transport modes;
- **Recommendations and encouragements, already expressed of the EVs fleet's and charging farcicalities' development (both for the private and mass transit modes),** for the short term, as a climate friendly solution for the traffic congestion;
- The **particular increase of the fossil fuels' prices in the international markets** is normally among drivers that could catalyze the transport transition and the E-Mobility's promotion;
- **Potential favorable incidences of the future E-Mobilty actions' implementation and advancement in neighboring countries** (as Jordan, Egypt, and potentially Israel) on the E-Mobility growth in Palestine.

Main uncertainties

- The complicated overall context of Palestine and its region, is unpredictable and might worsen or get improved, depending on many interrelated local and international factors.

- Future achievements in the transport sector and the E-Mobility subsector, cannot be attained without a robust support and an assistance from international actors, to finance the studies, and the action plan's elaboration, and to help in their implementation, and their operations' monitoring.

Israel

Review of current trends

General data

By 2021, Israel's population is reported to **9.393 million of residents**, corresponding to a **high average national demographic density of 462.2 inhabitants/km²** (inland water area excluded).
Available data inform on around **92% of Israeli citizens that are living in urban areas**.

Israel national GDP per capita is estimated to **51,430 USD in 2021** (according to the World Bank data), which is by far, the highest compared to all the studied MENA countries.

Land transport context at a glance [(1)] [(2)]:

In view of data of late 2017/2018, the road system's linear of Israel is estimated to **19,224 kms**, with more than 62% pf paved roads.

Several carriers are providing in- city and inter-city transport services, with **more than a 5,700 bus - stock** on scheduled routes. A handful of cities are being served by **Bus Rapid Transit (BRT) systems** since 2013. Cities are also served by **trams,** that are electrified rail mass transit systems, which number impressively increased, over the last years.
The country is also served by a **railways system** stretching across more than 1,270 km, and operated solely by the Government.

The number of motorized vehicles circulating on the Israeli roads, has been in a steady increase, and is estimated for 2021, as follows (according to the Central Bureau of Statistics of Israel):

- **Total stock of road motorized vehicles: around 3.8 million vehicles;**
- **Total stock of cars: 3.3 million vehicles** (87% of the motorized fleet).

In 2021 about 405,000 new cars (thermal and electric) were added to the Israeli roads, which represented a 4.4% growth rate compared to 2020.

The continuous expansion of the circulating vehicles has been behind traffic jams and congestion intensification, especially in the main cities and the areas with high density.
Moreover, the unitary average travel distance has been increasing, and reached in 2019 (before the COVID crisis) **17.6 thousand km per year for a private car**, which is deemed much higher than that of many European countries (Italy: 8.5 thousand km, Spain: 10.6 thousand km, Germany: 13.6 thousand km, for the same year) [(2)], despite a less expanded territory.

The motorization rates have also been growing, and could be assessed for 2021, as follows:

- **Overall motorization rate (all motorized modes included): 4.05 vehicles per 10 persons;**
- **Car motorization rate: 3.51 vehicles per 10 persons.**

Those rates are clearly the highest, compared to the other studied MENA countries. They remain, though lower than those of many European and developed countries.

Current context of the E-Mobility in Israel [2] [3] [5]

Current Stock of the EVS

Israel has recently been active on developing the E-Mobility to reduce its dependency on the fossil fuels, because of their high prices in the local market.

E-Mobility includes the trams (which **number reached 16,251 in 2021,** that is five times higher than the 2020 number) [2], aside to the circulating road fleet that is mainly including hybrid electric vehicles. The stock of road electric vehicles recently reached the following numbers [2] [3]:

- **Stock of hybrid electric cars (including rechargeable) in 2021: 300,00 vehicles** that increased at a 34% rate compared to 2020;
- **Stock of hybrid taxis in 2021: 4,315 vehicles** (around one-fifth of all taxis' fleet of the country); the number doubled, in comparison to 2020;
- **Stock of electric buses in late of 2020: around 100 E-buses.**

Many motorists are also using cars powered only by electric batteries (fully E-cars).

According to 2020 data, the average travel time by the electric cars was estimated to around **20 minutes per trip** (in the cities of Haifa and Netanya).

Existing charging facilities

The EVs sales market has been very recently quickly evolving. Until 2021, the variety of EVs' supply was limited to 12 models of EVs (opposed to more than 40 in Europe). The variety has increased to 24 models in 2022 [3] offering the users different vehicles' sizes, brands and prices.

The country is currently having a spatially extended network of charging stations to facilitate the charging and exchange of car batteries for the road vehicles:

- **Stock of charging stations: By July 2021 approximately 1,000 stations of DC and AC stations which number increased to 2,500 charging stations by the end of 2021[2].**

The charging stations are installed in around 500 parking spots in central areas and residential neighborhoods. There are public stations and others operated by a number of charging companies offering **low charging prices**. A total number of 4 charging companies is reported in the available data.

Most of the DC charging stations, that provide quicker charging, are located in areas with short-term parking and limited stopping periods, as the gas stations. The AC charging stations that are slower (need several

hours to fully recharge a battery), are used in areas where vehicles can stop for long periods, such as the parking lots around malls and other public areas, entertainment centers, and also in residences (for private usages).

E-mobility's developed regulation

On a regulatory level, **tax incentives and other policy aspects related to integrating alternative fuels in the road Transport Sector**, are already adopted. Taxation of EVs is currently low (only a 10% purchase tax), but this is announced to rise to 20% in 2023 and 35% from 2024 onwards.

Moreover, the **Government is subsidizing the public charging services for the EVs**, as a motivational initiative to encourage the E-Mobility development.

EVs' manufacturing

Israel is a market for EVs, as it imports electric vehicles (Western companies and more recently Chinese EVs brands), but it is also a producer of EVs, as it has its innovator automotive manufacturers (more than 6 manufacturing industries), that are developing inventions to reduce the EVs' emissions.

Future trends

Existing strategies, quantitative objectives

Israel seems very concerned with limiting pollution, adverse environmental impacts and climate change sources within its own territory. Within this framework, Israel is engaged to **ban the introduction of new Diesel and petrol vehicles by 2030**, and it was among signatories of COP26 declaration on **accelerating the transition to 100% zero emission cars and vans by 2050** [3] [4]. This is aligned with its strategic policy to steadily develop the E-Mobility, progressively boost it, reduce the transport's dependency on the expensive fossil fuels and the land transport sector's emissions.

Among actions under preparation or development to facilitate the E-Mobility promotion in the near future, what follows:

- A two-year fighting climate change program is already set-up by the ministries of Transportation, Energy and Environmental Protection. This plan is expected to accelerate the transition to EVs, and includes **subsidies for charging stations and purchasing hundreds of new electric busses; The E-buses' number is thus expected to substantially increase by 2024;**
- Planned / ongoing set up of a new inter-ministry committee (third Green Taxation Committee) to **examine taxation and economic rules for the alternative propulsion transport systems** (including the EVs);
- Recently adopted **regulation for installing charging components in the electric vehicles**;

- Update of the **Israeli standards for the charging stations**, to incorporate these latter within the residences and the newly constructed shared residential buildings. Charging facilities are to be planned and developed since the construction phase of the new buildings, as being defined by the plan of the Ministry of Construction and Housing and imposed by a new legislation;
- **Establishment of a new sharing systems / services of E-vehicles for self-service and short-term rentals of vehicles**, as an initiative to encourage the increase of the E-Mobility demand, defined and promoted by the Ministry of Environmental Protection;
- **Hundreds of more charging stations are under ongoing development and expected to be operational in the upcoming months;**
- Establishment by the Ministry of Energy, of a **computerized information system of charging stations to provide a view to the public on the locations and status of the charging facilities**, at any given time;
- **Several Israeli automotive companies are working on improving EVs' technologies, the energy management software, and the batteries' technologies,** for higher EVs' performance (less emissions), faster and more sustainable charging.

Weak signals, possible disruption factors

As per information that could be gathered and analyzed, weak signals seem to be insignificant, compared to levers and favorable driving factors for the future of E-Mobility of Israel.

Levers and barriers

Identified barriers:

Rare are the barriers that could be identified for more promotion and development of the E-Mobility in Israel. We can however, mainly highlight the two following potential barriers:

- Special geopolitical context of Israel, that could result in unpredictable events leading to temporarily reduce the mobility and the transport flows of passengers / goods on some corridors; This would threaten the viability of the new charging stations and that of the new EVs / E-buses;

- Traffic flows generated by settlements in the West Bank, and along some inter-city corridors crossing the Palestinian neighborhood, might have longer travel times and thus costs, because of more security controls, which would reduce the mobility during special unrest periods, or lead to a quicker exhaust of the electric charging of EVs.

Despite of their importance, those constraints would not compete enough with the identified levers and positive factors favorizing the future growth of E-mobility in the country.

Identified levers /opportunities [2] [3]:

Israel can be ranked among the targeted MENA countries with the greatest potential for adopting EVs and providing more promotion and development of the E-Mobility on the short term, mainly because of the following driving factors:

- It is a relatively **small country** with a population highly concentrated in urban centers (more than 90%); It thus requires a simpler charging infrastructure, than in spatially extended countries, as many of its neighbors;

- It significantly developed the **solar generation sources** to produce electricity, because of its high annual incident solar irradiance and the expensive costs of the thermal electric generation (around 90% of households are using solar sources for heating water, or electricity usages)[1];

- The **electricity is thus provided at relatively low prices**, while the prices of fuels are known for being high, and they tend to increase on the upcoming years, as an impact of the current special international conjuncture;

- The country has also been tending to **adopt and promote the technological innovations** and the local users have been enthusiastic about new technological innovations' consumption;

- Since the recent introduction of the imported Chinese E-cars brands, **selling prices of these latter recorded decreasing trend and this impacted also the Western EVs brands' prices in the local market that are tending to decrease by competition effect**.

Main uncertainties

Context of Israel in some zones, as the newly established settlements, could be unpredictable and would impact somehow the promotion of the E-Mobility and the expansion of the charging facilities' network at their level.

Lebanon

Review of current trends

General data

The overall Lebanese population reached **6,856 million inhabitants** in 2019, with an urbanization rate of **88.5%**. This high urban concentration is behind pressures on the cities' infrastructures and the transport services, especially in major urban centers located along the coast, as Beirut, Tripoli, Sayda, etc.

The population resident in Lebanon achieved **6,769 million inhabitants in 2021** (corresponding to an average density of **648 inhab./km^2** in 2021))**.** A shrinking trend of the resident population is seemingly taking place, since the recent tragedy of the Beirut's port explosion and the resulting socio-economic severe crisis.

The GDP per capita is assessed, on a national level, to **17,658 € / 21,483 USD in 2021** (at constant prices of 2015 – World Bank data base). It recorded an impressive shrank of **-9.8%** compared to the 2020 situation, because of the unusual socio-economic context of the country.

Lebanon's road mobility context at a glance [(1), (4) (5)] :

The overall road system of Lebanon was spreading along a **total linear of 21,705 km, according to the available data of 2013[(1),]** out of which 15,325 km (around 71%) were within the municipal territories.

The overall road motorized vehicles' stock was assessed to **2,001,200 vehicles in 2013[(1)],** and was rapidly increasing at a 7.1%/year change rage, over the rather stable 2008 – 2013 period.

According to recent data, the modal characterization of the land transport can be summarized as follows:

- **Modal breakdown of the registered road vehicles:** Cars ~85%; Buses: 0.9%; Light Vehicles and Heavy Vehicles for passengers and fret (vans, trucks): 7.9%; Motorcycles: 6.2% (according to a recent estimate) [(4)];
- **Overall motorization rate = 1 Vehicle per 3.2** persons (in 2015, all modes included) [(4);]
- **National car motorization rate** = **1 Vehicle per 3.7 persons** (in 2015), among the highest in the Arab Countries [(4)]:
- **Public Transport/Mass Transit system:** has become dominated by Taxis and shared-Taxis. The system also includes Mini-Buses and Vans, providing their services in a non-organized way. The public transport services are mostly informal.

Globally the status quo in the road system's development, over the last years, has led to an **increasing reach of the roads' capacities limits and even their complete saturation**, especially in the main urban areas.

The urban transport and mobility context is thus currently mainly characterized by an increasing traffic congestion, a low environmental effectiveness, and an absence of organized and efficient methods in the management of the travel flows and the whole road transport System.

The passengers' mobility is endowed with a poor quality and unsustainable conditions, where the accessibility of many urban zones' and inter-city corridors is low. This situation is needing a comprehensive and an integrated planning roadmap, associating both the mass transit system, the private vehicles and the soft modes.

Recorded E-Mobility and its context in Lebanon [5] [6]:

The **E-Mobility might be insignificantly developed in the current context**, in Lebanon, because no valuable efforts have been deployed by the Governmental bodies on this new road mobility type, as many other urgent needs are required to be satisfied in the country, prior to the electrified mobility.

Indeed, the electricity system is currently facing noticeable difficulties, because of the shortage in the operational electric system's capacity and the damage in the transmission and distribution grids, which is leading to recurrent electricity delivery interruptions and a limited energy provided to users per day (delivery over just a bunch of hours per day), in many areas of the country, and especially in different zones of Beirut.

This has resulted in an increasing set up of off-grid Solar Photovoltaic (PV) electricity power generation facilities, mainly outside of Beirut, to cover the electricity needs of both households and other socio-economic users. Those off-grid systems are being installed and operated by private actors, with the facilitation of Non-Governmental Organizations (NGOs), in a non-coordinated way. The excesses/ shortage of these off-grids' capacities are not known, as these facilities are still in an initiating stage.

However, and despite of the challenging local context, **the E-mobility is not totally unavailable in the country**. Private initiatives have been behind its low development. NGOs have imported mainly hybrid electric vehicles and plug-in hybrid electric vehicles (and some fully electric ones), as the probate of the electric vehicles was allowed by the Government, and some charging facilities were setup.

The Governmental efforts have been focusing, since 2019, rather on the reconstruction and rehabilitation of the damaged and old electricity system's components, the promotion of the low-energy consuming lighting facilities and their distribution to users, and more globally, on many other socio-economic requirements.

Existing Charging facilities:

Charging facilities have been set up by private operators mainly in the gas stations, malls' parking lots, and open space parking areas.

Currently, the charging service is paid directly to the operators which are also the private owners of the charging stations, and there is still no pre-set technical or registration requirements; the private stakeholders have a free access to such activities, and have already installed a variety of charging stations technologies.

- **Current available EVs stock and charging stations:** unpublished and could be unknown as a whole and by electric vehicles' technology.

Future trends

Existing strategies, quantitative objectives

Regarding the overall land mobility context [1], [4]:

Different preparatory actions and projects have been engaged, and were intended to increase the share of a more sustainable, organized and affordable Mass Transit System, in order to improve the traffic conditions, and address the car-transport decreasing affordability. Within this regard, a number of projects have been targeted, including what follows:

(1) Removal of fake/informal mass transport licenses;

(2) Setup of a **Bus Rapid Transit systems (BRT) in Greater Beirut**, to link Beirut and Tabarja, Beirut and Sidon, and within the city of Tripoli (ongoing project);

(3) Design and **construction of an intercity public bus network** with expanded service, and with stops and stations in the Great Beirut's area;

(4) **Restoration of the Railway system** (over 80 km), that hasn't been in operation since the civil war.

However, and based on reviewed available data, the above actions **have not yet been endorsed, neither implemented**, and delays are also recorded in the required regulatory actions.

Regarding the E-mobility perspectives [3] [4] [5]:

- On an environmental level, **Lebanon is committed to reduce its GHG emissions by at least 15% by 2030 compared to 2010 levels** (under the 2016 Paris Agreement by parties of the United Nations framework Convention on Climate Change (UNFCCC)).

- The GHG emissions' reduction objective was planned to be accomplished by (i) the renewal of old circulating vehicles (representing a high share) through incentives, and (ii) **the commercialization of Fuel-Efficient Vehicles (FEV), and EVs (Hybrid Electric Vehicles, Plug In-Electric Vehicles, Electric Buses), to achieve a share respectively of 35 % (for FEV) and 10 % (for EVs) of the passenger vehicles' market by**

2040, and by (iii) revitalizing the Mass Transit System to increase its share in the overall passenger.km travelled by Bus by 15%[4].

- **A 'strategy of low-emission and environmentally sound transport systems in Lebanon', was launched in 2019** with the assistance of the UNDP, with plans to more development of the Private and Public E-Mobility (the project is funded by the Global Environment Facility (GEF), in cooperation with Lebanon's ministries; Studies are completed but not implemented yet [3]).

- The above strategy**, proposes first: *on the interim term (progressively up to 2030) the Hybrid Electric Vehicles, (2) than on the longer term, the Bus Electric Vehicles (expected to be dominating by 2050)** as they require a wide-scale deployment of an electric-charging infrastructure and a higher investment cost.

- **A Solar Powered Electric Public Bus system project**, was also recently announced to be developed **in Byblos city** and which is expected to be promoted by its municipality. **A solar power plant is planned to be installed in the municipality's building, to supply the E-bus system** of the city [3]**.** Advancement on the design and implementation of the project couldn't be known.

- **Globally, we can conclude that awareness of the mobility transition in Lebanon has been rising by Experts**, which have roughly recommended the E-Mobility (aside to carpooling, mass transit restructuring and smart expansion), as a solution to limit congestion and impacts on the severe air pollution in Lebanon. The experts' thoughts led to strategies and initiatives mentioned above. However, the involvement of the Governmental actors to endorse and implement effective E-Mobility actions, in a coordinated way and with studied plans, is not yet achieved.

- No roadmap could be set up yet for the E-mobility's promotion and development, on a governmental level, neither nationwide.

- Among the rare recently developed Governmental measures in the field, is the **elaboration in 2018 of a draft energy conservation law, that targets the exemption of the electric vehicles' import from the duty taxes (total exemption), and more motivational measures for the public and private EVs**. **This law's validation is expected by 2023** [5].

- The Lebanese Association for Energy Saving and for Environment (ALMEE) and the Lebanese Center for Energy Conservation (LCEC) are both among the public bodies that could be involved in the E-mobility preparatory stages. The earliest predictable horizon for a new trend of the E-mobility's development in Lebanon (for both private and public / mass transit vehicles), with an effective involvement of the Government, is assessed to in the period **2025 to 2027**.

- **The future of the E-mobility is estimated relying rather on the private initiatives, for the short term**. Many prerequisites are needed to be prepared by the public stakeholders, before the implementation of

the E-Mobility, as the institutional and regulatory frameworks' preparation of the E-Mobility, and more development of the electricity system, and its reliability enhancement.

- **Targeted Hybrid Vehicles / fully EVs' stock by future horizon: not determined yet.**
- **Targeted electric charging facilities' number by horizon: not determined yet.**
- **Targeted level of E-Mobility's development by 2025/2027: 3% of the national passenger vehicles x km** (according to the renewable energy outlook for Lebanon adopted by the Ministry of Energy and Water).

Regarding the E-mobility's potential stakeholders in Lebanon, and their interactions [3], [4]:

Among the potential stakeholders to be involved in the field of the E-Mobility:

- the Ministry of Energy and Water, the Ministry of Public Works and Transport, the Ministries of Environment and Finance,
- LCEC (the Lebanese Center for Energy Conservation)
- ALMEE (Association for the Energy Conservation and for the Environment),
- the Ministry of Interior and Municipalities that monitors the Municipalities,
- the Traffic and Vehicles Management Authority (TAVMA) and the Traffic Management Organization (TMO),
- the Directorate General of Land and Maritime Transport (DGLMT), the Directorate General of Urban Planning (DGUP), the Council for Development and Reconstruction.

The Non-Governmental Organization (NGOs) and the civil society have already been involved in seeking to share their expertise and knowledge to bring solutions to the Transport sector's improvement, and to effectively provide some development in the E-Mobility.

Weak signals, possible disruption factors

Among signals and factors that inform on the weakness of the mobility and E-mobility's context in Lebanon, that could adversely impact the capability for more effective mobility transition, what follows:

- **Lack of coordination between the existing local Stakeholders involved in the Transport Sector** (services and infrastructures), and fragmented responsibilities, institutional and regulatory framework between several authorities, allowing for overlapping;

- **Cumulative lack of investment, and regulation in the Transport and Environment Sectors,** that might maintain comparable context over the short/middle term;

- **Lack of the Governmental capacity to effectively make advancements in the Transport transition** [4];

- **Negative trend registered for many households, and mass transit companies' revenues over last years,** leading to limited financial capacities to renew their vehicles. The recently planned taxes' exemption for the EVs' acquisition (under final approval) is though expected to be a motivational measure;

- **Current public transport system is mainly informal** and its potential for being restructured and shifted to new guidelines, could be revealed challenging and time-consuming;

- **Government slowness to restructure the Transport Sector and implement alternative solutions**: more efforts in planning actions and comprehensive prospective visions are required, absence of monitoring systems, unpublished targeted indicators for the E-mobility and the overall transport context.

Levers and barriers

Identified barriers:

The following main barriers can be identified for the Lebanese context:

- **The socio-economic crisis having resulted notably from the recent outstanding tragedy of Beirut's port,** and its impacts on the overall country's financial and economic situation and ongoing evolution trends. This context has hindered the Transport and mobility development and improvement. It would hinder (on the short term) the potential stakeholders' capacities to go in a rapid planning process, to attain a quick shift to the E-mobility, its promotion and sponsorship;

- **Rehabilitation, reconstruction and capacities' development of the electric system**, aside to **definition and implementation of appropriate regulatory and institutional measures** are prerequires needed to be set up, prior to a coordinated E-mobility development on a national level;

- **High cost of the electricity provided to users in the current situation** [5], especially in comparison to the households' revenues, could not facilitate the quick shit to the E-Mobility, because of a low users' willingness to pay the EVs and their charging fees.

Identified levers /opportunities:

Among what is identified based on the bibliographic sources and outcomes of the interviews with local representatives of ALMEE and LCE, what follows:

- **Significant mobility by cars and increasing pollution context, mainly in Beirut and major urban areas,** would be favorizing the future planning of environment-friendly actions as the E-Mobility;

- **High population urbanization,** which is among drivers for favorizing the E-Mobility to be among future required solutions for the passenger transport;

- **Already finished strategic study** providing a global framework for the future urban passengers' transport, including recommendations on the E-Mobility's development (without proposition of any equipment program, though);

- Already **expressed goodwill of international stakeholders/funding organizations to provide assistance and financing sources** for the Transport and Energy sectors in Lebanon (especially after Beirut commercial port's explosion);

- **The growing set-up of off-grids supplied by Renewable Energy sources and installed by NGOs, in the secondary cities,** could favorize these latter to be areas for a prior E-Mobility promotion [(5)];

- **E-Mobility is suggested to be associated to the solar panels to be developed in the bus depots in remote mountainous areas (the jbeils), still lacking electricity access** [(2) (5)], could be adopted by international Funding Organizations to contribute in the design and financing of the E-Bus transport systems' projects and their electricity feeding;

- The Electric Vehicles are estimated by the Lebanese Centre for Energy Conservation (LBCE) to represent **an interesting opportunity for the electricity storage in Lebanon (e.g. Smart charging, Vehicle-to-grid, Etc.),** due to the severe electricity crisis. The residential sector in Lebanon has recently witnessed a boom in the solar PV and storage applications, and can have a large potential for EVs' development. This would lead to benefiting from the existing Solar PV applications to efficiently interact with the grid, in terms of charging hours and electricity storage;

- According to the ALMEE, a project named 'REFIT' is recently announced. It's intended to **recycle the lithium-batteries of the growing number of the PV solar electricity generation plants,** being installed in several zones of the country, to compensate the electricity grid's capacity. Thoughts are being developed to benefit from the recycling process for recycling the EVs' batteries also, after the exhaust of their lifespan;

- **The private sector, NGOs and the civil society (residents and local business firms) could be more active and endowed with a higher goodwill about the transport transition and the E-mobility,** and could thus help compensate the Governmental bodies' weakness and activate the E-Mobility development[(2)].

Main uncertainties

- **Uncertainties, on the short term, on the global context of Lebanon and its future stability,** and its potential impacts on the whole future Mobility/Transport projects' planning, studying, implementation and operational stages;

- **Uncertainties on the Governmental ability to quickly implement the required regulatory, institutional measures and prerequired actions in the infrastructures** (transport, electricity grids, RE sources feeding these latter) in order to 'host' the future E-Mobility, without constraining delays.

Syria

Review of current trends

General data

Syria's resident population reached **18,276 million inhabitants** in 2021, and its national average demographic density can be assessed to around **99 inhabitants/km** for the same year. Damascus (the capital), Homs, Tartous, Latakia, Aleppo, are among the major cities with the highest population densities.

The national population, that accounted for 19,454 million in 2019, has been rather in a decrease trend, since 2011.

The national GDP per capita is evaluated to **1,192 € / 1,446 USD in 2021,** and has been in a shrinking trend, over the recent period (it attained 2,900 USD in 2015 [(1)]), because of the overall special context of the country. This should witness of the lowering average affordability of the new vehicles, and the travels' expenses by Syrians.

Syria's land mobility context at a glance [(1), (2), (3)] :

The overall road system of Syria is expanding along **a total linear of 69,873 km** [(1)] (according to a recent published estimate), including 1,103 km of motorways. It corresponds to a national average density of **0.38 km of paved roads/km²**.

The total number of registered motorized vehicles was assessed to around **2 million** in 2018 (all modes). This corresponds to an overall **motorization rate approaching 1 V. per 10 persons in 2018/2019** (all modes).

This data could be of a non-optimal reliability though (available data on the current transport context is rare). **There have been damages in the Transport infrastructures (and the electricity grids),** in many urban and inter-city areas, which has highly hindered the passengers' mobility.

The land transport facilities are more likely needing heavy restructuring, rehabilitation, modernization and spatial expansion, in many zones of the country.

The road transport would be **lacking traffic management facilities and accident risks** [(2)].

In terms of modal share, the urban passengers' mobility might still be dominated by **cars, small carriers / collective taxis and microbuses**. Private firms and a public transport company provided bus/coach transport, on longer distances between main cities.

The inter-city transport was also ensured by a train system (**2,600 km**[(3)]), and was including just two lines connecting major cities (Damascus, Aleppo, Hassake, Deir ez-Zur, and Qamishle, Tartous, Banias, Damascus, Homs, and Deraa).

Recorded E-Mobility and its context in Syria

The unpublished data on the E-Mobility, in the current situation, leads to conclude on its current unavailability, or its insignificant development in Syria.

Future trends

Existing strategies, quantitative objectives

Regarding the overall land mobility context and the E-mobility perspectives:

No planning processes seem to be ongoing in Syria, for the needs of the land transport sector's reconstruction, upgrade and more expansion, if we refer to the available and recently published bibliographic sources.

According to the formulated Nationally Determined Contributions (NDCs) of Syria issued in 2018, among mitigation measures identified for the Transport sector to reduce its emissions:

(i) the rehabilitation and development of the railway system, and
(ii) **the encouragement of the use of gas-powered buses and environmentally-vehicles powered by 'modern technologies' (gas, electricity, and hybrid).** This could reflect an awareness of the positive returns of the E-Mobility implementation.

However, no more detailed perspectives are drawn for the electrification of the road fleet and the passengers' mobility, and no action is announced neither for the charging facilities' development in Syria.

The country seems to be facing much prior development emergencies in various sectors, including the road infrastructures' reconstruction and the electricity supply re-development and expansion.

Weak signals, possible disruption factors

Unfortunately, many weak signals can be identified, based on the current transport and overall macro-economic context of Syria, among which what follows:

- **Many emergent requirements can be ranked prior to E-Mobility** (as reconstruction of the transport and electricity infrastructures, many power plants have been out of operation);

- **Decreasing standard level of a large portion of the Syrian households and the economic actors,** aside to the recorded and ongoing hyperinflation of prices in the local market, must adversely impact the

transport users' affordability of new vehicles and further mobility expenses (between 2010 and 2019, Syria's GDP shrunk by more than a half) [4];

- **Restrictions imposed on the importations of Syria** (including those of the road vehicles);

- The context of starting a business for domestic companies in Syria, was ranked in 2015 the last, by the World Bank group, in comparison with other Arab MENA and North-African countries, leading to conclude on **a predictable slowness in the EVs' commercialization and operating, and the charging stations' development process**, in case of a potential future E-Mobility's initiation [5].

Levers and barriers

Identified barriers:

The level of capacities (technical, financial, logistic) of the Governmental bodies, would be not enough to engage Syria in an active and efficient process of E-Mobility's planning, preparation and implementation. International assistance would be thus required (capacity building and financial support).

Identified levers / opportunities:

Syria is endowed with **a good solar potential** that might be in favor of supplying the excess of the electricity demand, to be resulting from the E-Mobility and the needs of the vehicles' batteries charging, in the scenario of a future E-Mobility's development.

The Photovoltaic (PV) solar power plants can enhance the electric capacity of the national grid, and even the off-grid systems that could be installed (by private operators) to supply remote cities and areas, located far from Damascus and major urban centers.

Main uncertainties

Several uncertainties are floating on the short-term future context of Syria. Mainly what follows can be highlighted:

- **Future restrictions on Syria's imports,** and their impacts on the transport vehicles' provision and prices in Syria's market;
- **Future goodwill of the international funding organizations** to provide required assistance, and financial support to the Government of Syria, in its Transport, Electricity and Environment sectors' recovery.

Turkey

Review of current trends

General data

The Turkish population reached **85,043 million inhabitants in 2021**. Its annual increasing rate, over the 2015 – 2021 period, fluctuated between 1.20% (in 2020) and 1.68% (in 2021). This rate tended to increase over the very last years, because of the growing external migration to Turkey.

The demographic growth resulted in an overall average population density of **108.5 inhabitants/km^2** (population over the overall country's territory). It varies from rural to urban areas, and reached the highest level in the **megacity of Istanbul**, characterized by its noticeable attractiveness (14% of the overall Turkish population, that is around 15 million residents, and a demographic density of **2,725 inhabitants/km^2**, in 2021, that is far above all other major cities' densities of the country).

More than three quarters of the Turkish population is concentrated in the urban centers (**urbanization rate: 77%**, in 2021 according to the UN data).

The average GDP per capita in Turkey is assessed **to 8,054 €/9,773 USD**, for the 2021 situation. It recorded an impressive change rate of **10.1%,** compared to 2020 (assessment at constant prices of 2015, according to the World Bank database), which leads to conclude on an ongoing improvement of the affordability of the road transport fees by Turkish people.

The road mobility context at a glance [(1), (5) (8)] :

The overall road linear of Turkey is recently assessed to **around 64,384 km (Motorways: 2,036 km; National roads: 31,428 km, regional roads: 30,920 km)** [(6)].

In early 2022, the stock of **the road motorized modes** (all modes, for passengers and duty transport) accounts for **25,385,084 Vehicles,** having rapidly increased at more than 6% /year over the last years [(8)]. For the same year (2022), the vehicles' stock includes:

- **Private cars number: ~ 13.124 million vehicles**
- **Buses and Mini-buses number: ~ 279,240 vehicles**.

The **modal share of the national registered motorized road vehicles (in early 2022)** is estimated as **follows** [(5)]**:**

- Cars: 51.7%; Motorcycles: 21.7%; Vans: 5.9%; Trucks: 3.6%;
- Buses and Mini-buses: 1.1%;
- Others: 4.1%**.**

The **national Motorization Rates for 2021/early 2022,** reaches the following levels:

- **Overall Motorized Vehicles Rate = ~ 3 vehicles per 10 persons**;
- **Car Motorization Rate = 1.54 vehicles per 10 persons**
- **Bus / Minibus Motorization Rate: 3.3 vehicles per 1,000 persons.**

Regarding the urban transport context, it is globally characterized by a traffic increase, because of the demographic growth, the increasing trend towards urban migration from rural areas to cities, and the growth recorded in the vehicles' ownership. Consequently, investments have been heavily dedicated to the transport infrastructures' development, the traffic management and the Intelligent Transport Systems (ITS), over the last years [8].

Globally, there has been a growing trend for the share of the Mass Transit transport in main cities, especially in Istanbul, where the soft mobility has also been encouraged, to lower congestion, air pollution and emissions of the motorized vehicles.

Six among the Turkish cities are facing the highest level of traffic congestion: Istanbul (spotted recently spotted as the 6th most congested city in the word [8]), followed by Ankara, Izmir, Bursa, Adana and Mersin.

Recorded E-Mobility and its context in Turkey [1], [2] :

Turkey can be deemed as an advanced country in the E-Mobility promotion and implementation, in the current situation, compared to other studied MENA countries. The following key information summarizes its current E-Mobility context:

- **Road Electric Vehicles number= ~ 55,000 vehicles (private and public vehicles), including around 48,000 Hybrid and Plug-in hybrid electric vehicles (PHEV)** (estimates for 2021) [1] **and 6,500 to 7,000 full Electric vehicles** (estimated for august 2022 [7]). The overall circulating electric vehicles are still representing a low portion of the national road vehicles' fleet. However, the growth trend has been increasing (**multiplied more than 50 times,** over the 2016-2022 period), in compared previous years, where the electric vehicles stock accounted for what follows [2]:
  - **In 2017[2]: 4,528 vehicles (4,451 Hybrid vehicles and 77 full EVs)**
  - **In 2016 [2]: 994 vehicles (950 Hybrid vehicles and 44 full EVs).**

- **Charging stations number (by July 2022) [7]: ~ 3,457 stations countrywide: 818 private stations and 2,639 are public charging stations,** set up in different cities**,** as Istanbul, Izmir, Ankara, Ordu, Adana, Antalya, etc.;

- **Tax incentives were implemented since 2017**, which induced a quick increase of the EVs' use, over the last years;

- **Rules and procedures regarding the set up and operation of the Charging Stations and the electricity supply of the EVs,** were released by the Energy Market Regulatory Authority (EMRA) in 2017 and became operational in 2018;

- **Charging stations' locations selection, rules and management** [2]**:** At least one (1) of every fifty (50) parking spaces are requested to have charging stations for EVs at paid parking lots, on the street sides and at shopping malls, according to the current Regulation on Parking Areas. Moreover, and according to the Regulation on landscape, the EVs' charging infrastructures have to be installed at the parking lots, the fuel stations and other locations with the approval of the affiliated electricity distribution company.

The charging stations are increasing in major cities, while they remain rare in small and secondary cities and on the long-distance roads between major cities. The E-Mobility is thus currently developed within the territory of the major urban areas of Turkey;

- **Electric automotive industry in the current situation:** Turkey has deployed efforts to become a regional hub for different brands of vehicles' manufacturing, because of its relatively low man power costs, in comparison notably to many European countries. Currently, different Western automotive manufacturing facilities are heavily set up in Turkey, and many of them are investing in a local Electric Vehicles' production, in Turkey.
A domestic automotive industry has also started, and it already manufactures electric vehicles for the Public Transport (a production jointly developed by different Turkish companies).

Future trends

Existing strategies, quantitative objectives

Regarding the overall land mobility context [4] [10]:

Turkey is committed to reducing the emissions of its transport sector. Within this regard, it has signed the COP26 declaration on the acceleration of the transition to cars and vans having net emissions.

A commitment of the Turkish Public Authorities and Municipalities to progressively **develop urban environment-friendly transport ecosystem,** was expressed within the 'Istanbul Sustainable Urban Mobility Plan' (SUMP) (published in March 2022, and developed within the framework of the Global Future Cities Program Turkey). The Istanbul SUMP targets actions that could have incidence on the E-Mobility development, namely:

- Implementation of projects for the decarbonization of the Bus Rapid Transport / BRT (Metrobus) and the urban bus fleet in Istanbul;
- Creation of low emissions zones within the megacity of Istanbul
- Development of actions in line with the **Istanbul Climate Vision** to **support Istanbul's goal of becoming a carbon neutral and climate resilient world city by 2050.**

Other planning projects as SUMP are under development for other cities of Turkey, targeting the **decarbonization of their transport systems.**

Moreover, the road intercity mobility is expected to increase in the upcoming years, with regards to eleven (11) new motorway projects that are under development, expected to totalize more than 5,236 km.

Regarding the E-mobility perspectives:

Globally, a goodwill to develop more the E-Mobility in Turkey van be identified from the available information as summarized here below:

- An ongoing strategic study of the National Energy Strategy of Turkey is currently at its final stage of preparation (outcomes expected by the end of 2022); It is addressing the E-Mobility's future framework, and defining related upcoming targets [9]; Other studies are also being conducted on different E-Mobility issues, to prepare the future context to be more favorable;

- On the very short term, electric microbus are expected to be operated by 2022, as announced [8];

- Globally, the Electric Vehicles (EVs) are encouraged to increase their range of travels, and to progressively become mainstream in the mobility within the highly congested cities [8];

- Perspectives are targeted also for the fully EVs and related accessory components' manufacturing in Turkey, among which what follows:
    - A Turkish domestic automotive mass production, beginning in 2023, is planned by a domestic company to be manufacturing 5 different models of EVs [1][7]; The characteristics of these latter are as follows [3]:

      *** Vehicles' type and electric need: Plug-in charging;**
      *** Motor's electric need: up to 150 kW;**
      *** Battery cells: Lithium-ion type, with expected capacity of just below 80 kWh, enabling around 500 km energy autonomy.**

      The manufacturing of these E-cars is estimated to reach **17,000 to 18,000 vehicles by 2023 [9], up to 175,000 vehicles by 2024**, and up to **1 million vehicles by 2030**[3][9]; This announced target for 2030 is however deemed somehow optimistic by the interviewed representative of Ministry of Energy of Turkey [9]; The stock of EVs to be produced will have to be commonly validated by the Ministry of Energy and the Ministry of Industry;

    - Other foreign automotive companies are on their way to invest in the local manufacturing of EVs and batteries in Turkey (1)[9].

Regarding the E-mobility's potential stakeholders in Turkey, and their interactions:

The current and future E-mobility's local stakeholders include at least:
- the Ministry in charge of Transport,
- the Ministry of Energy and Natural Resources (MENR), and the Energy Market Regulatory Authority (EMRA),
- the Municipalities, the Electricity Distribution Companies (21 public and private operators),

- the existing domestic manufacturer of electric vehicles for Public Transport, and
- the Turkish Electric and Hybrid Vehicles Association (TEHAD).

The MENR and EMRA are the authorities responsible for formulating and implementing policies to support the energy markets. They will be involved in the future E-Mobility planning, regulatory and strategic issues.

The electricity distribution operators are expected to authorize the electric supply for the EVs charging facilities, and to validate the locations of the charging stations.

The Municipalities are directly involved in the urban transport and mobility planning, and thus in the E-mobility management.

There are also the foreign automotive industries set up in Turkey. Their plans for local manufacturing of EVs and their components, as batteries could positively impact the overall E-Mobility future progress in Turkey.

Weak signals, possible disruption factors

Despite a recorded increasing trend, **the Hybrid vehicles and fully EVs (Battery electic vehicles) are still representing a low portion of the overall road motorized fleet.** This is due to a combination of factors:

- The EVs' prices, in the local market, remain relatively high, despite tax incentives. **Their purchase prices and overall maintenance costs are still higher than those of the thermal vehicles, in the Turkish market.** The EVs' affordability by Turkish households is estimated to be moderate over the 5 to 6 upcoming years [(9)] (could be the highest in the city of Istanbul which has a higher potential for the transition to the E-Mobility);

- **Difficulties are faced by the Turkish customers to keep appropriately informed on the new EVs' market** (the types, brands, and vehicles' available stocks in the local market);

- There is also a low range of electric cars in the local automotive market [(8)];

- One of the main concerns in major cities, is the unpredictability of time to be spent in traffic, which risks to induce rapid exhaust of the electricity charged in batteries.

Those factors have created hesitation for users to rely enough on the EVs/Hybrid Vehicles, and the E-Mobility could not become mainstream over the past period.

Levers and barriers

Identified barriers:

- ✓ Recorded lack of the municipalities and other public bodies' involvement to boost the development of charging infrastructures for the electric private vehicles and minibuses (on route charging stations) [8];

- ✓ Duty transport flows could be important even during the peak hours in major cities, despite regulatory restrictions, which impacts the average road travel time and could lead to users' hesitation to travel by EVs or Hybrid vehicles [8], as this transport context could result in travel expenses' increase.

Identified levers / opportunities:

Different positive factors can be identified, mainly as follows:

✓ **Real goodwill of the local Decision Makers to promote more the E-Mobility, both for the public and private transport,** and local awareness of the E-Mobility's positive impact on the environment and climate.

The goodwill appears in effective recorded progress of the E-mobility implementing, aside to Turkey's Nationally Determined Contributions (NDCs) to lower the World's emissions. Within this framework, **a commitment was done to reduce the country's overall emissions by 21% by 2030 (compared to a Business-as-Usual scenario), by means notably of actions targeted in the Transport and Energy sectors**;

✓ **Decentralized role of the municipalities** which are directly in charge of the urban transport planning, the traffic and Mass Transit systems' managing and monitoring, **is in favor of the acceleration of the E-Mobility integration and related projects' operationalization within the urban areas;**

✓ The National Energy Efficiency Action Plan (2017–2023) [2] of Turkey defined **a differentiating tax regime, based on fuel consumption and carbon dioxide emissions, was planned**, to encourage the use of vehicles with low CO_2 emissions. This should be in favor of the E-Mobility promotion. The tax regime for EVs might be further adjusted, though, to enhance the affordability of these alternate vehicles;

✓ An increase of the RE-based electricity generation capacity of Turkey is targeted (up to **10 GW from solar power, and 16 GW from wind power, by 2030** [7]). This will favorize the electric supply's alignment to the demand excess resulting from the foreseen growing E-Mobility, and the optimization of the E-mobility decarbonization;

✓ **A growing industrial automotive ecosystem of off-shore and domestic vehicles' manufacturing companies**, **locally investing in E-buses, other E-Vehicles and charging batteries**, could be another catalyzing factor for further promotion of the E-Mobility, with good incidence on the EVs and batteries' selling prices, and maintenance costs, in the Turkish market.

Main uncertainties

- ✓ **The future spread of the EVs' charging facilities in the secondary cities and along the intercity and motorway corridors:** uncertainty about how, and at which growth trend it will take place.

- ✓ Uncertainties seem to still exist about the future **regulatory measures regarding the fully EVs and the Hybrid vehicles' acquirement and the charging facilities' set up, operationalization**, **and tariffing fees**.

4. European countries

Portugal

Review of current trends

Portugal has 6.8 million of passenger cars, with a motorization rate of 662 cars per 1,000 inhabitants. The two charts below show the evolution of battery electric vehicles (BEV) and plugin hybrid electric vehicles (PHEV) new registrations and fleet over the last years (data from the European Alternative Fuels Observatory). Electric passenger cars show an increasing success in the last five years, reaching around 10% of total sales for both BEV and PHEV, although their share in the total fleet of the country remains below 1% for each technology.

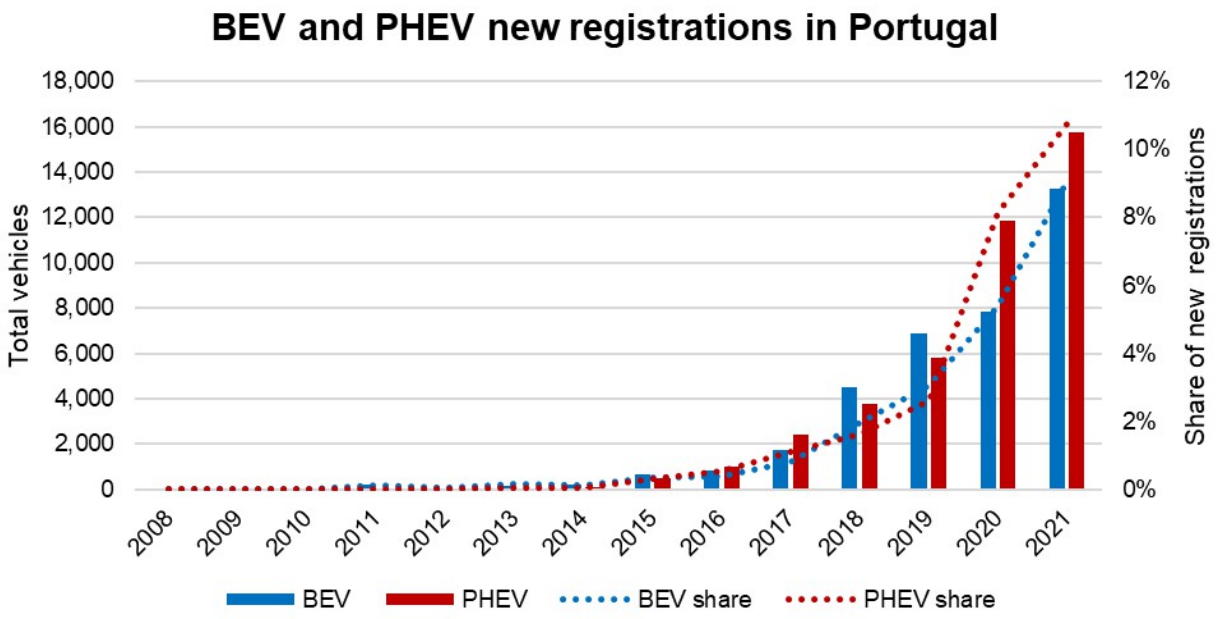

Figure 4: New electric car registrations in Portugal (data source: EAFO).

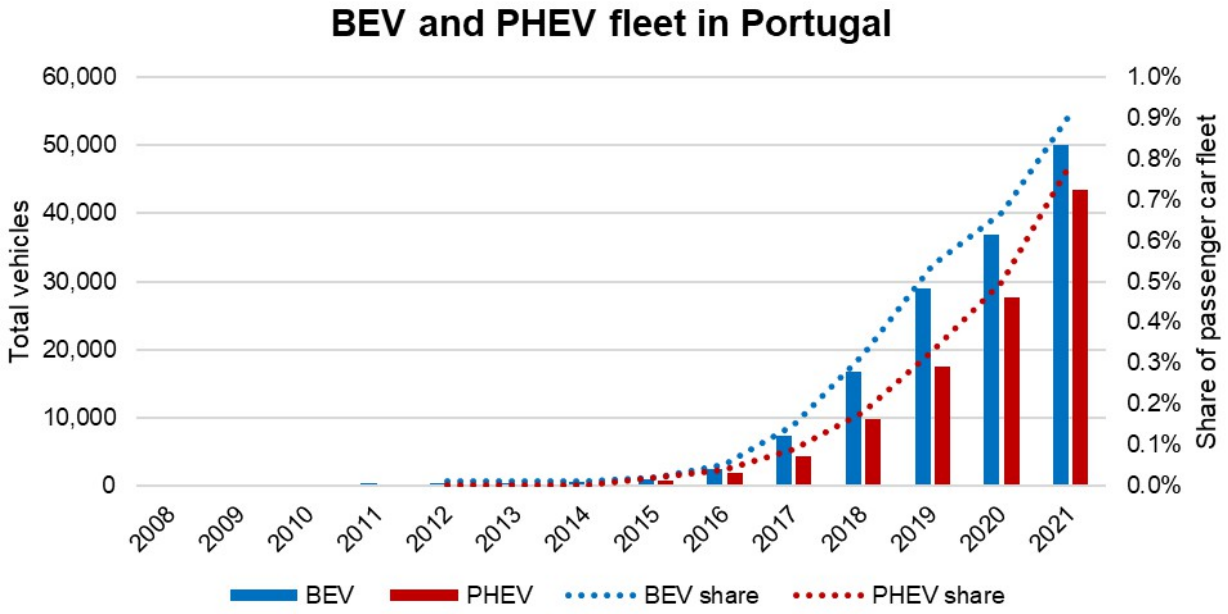

Figure 5: Electric car fleet in Portugal (data source: EAFO).

As of 2022, Portugal has installed more than 4,000 public AC recharging points (mostly between 7.4 and 22 kW) and more than 1,000 DC public recharging points (mostly between 50 and 150 kW).

Electric vehicles in Portugal benefit from registration tax reductions as well as purchase subsidies and other financial benefits, both for private citizens and companies.

Future trends

Existing strategies, quantitative objectives

The TYNDP scenarios expect between 14 and 15.6 TWh of electricity consumption in the transport sector in 2050, of which around 7 TWh due to passenger cars. The following chart shows the expected evolution of electricity consumption in transport by mode, comparing the “Distributed Energy” and the “Global Ambition” scenarios. An important share of electricity consumption will be related to passenger cars, and on the medium and long term also trucks, buses and aviation will show an important growth. Rail transport is expected to remain quite constant, representing a marginal share of the total consumption, slightly above the current levels.

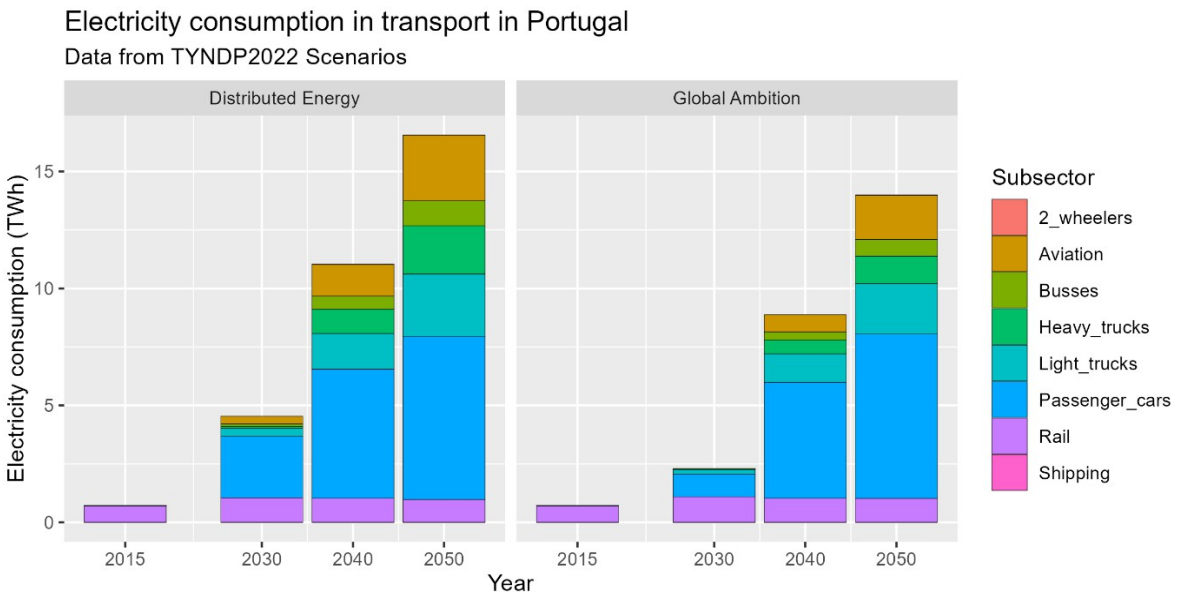

Figure 6: Transport electricity consumption in Portugal in TYNDP2022 Scenarios.

The following chart represents the expected market share of new passenger cars registrations for battery electric vehicles (BEV) and plugin hybrid electric vehicles (PHEV). The "Distributed Energy" scenario show a very strong increase in BEV market share, reaching 100% of passenger car sales in 2050, while PHEV sales remain marginal. In the "Global Ambition" scenario BEV sales increase after 2030, reaching a market share of 80% by 2050, while PHEV sales remain below 10%.

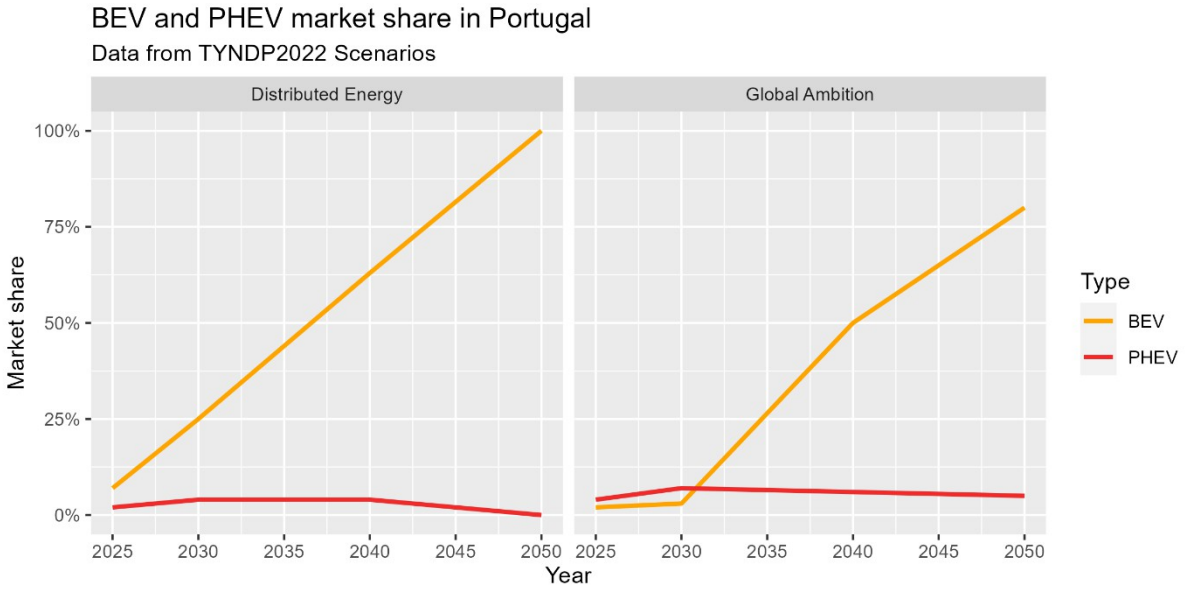

Figure 7: Future electric cars market share in Portugal in TYNDP2022 Scenarios.

Portugal has not set a specific official target for the number of electric vehicles in the total fleet by 2030, although electric mobility will play an important role for the target of 20% of renewable energy in the transport sector in 2030.

Weak signals, possible disruption factors

Ongoing trends clearly show a very important increase of electric vehicles sales, but public charging infrastructure needs to be deployed faster and faster to support a widespread adoption of BEVs by citizens. Company fleets are being electrified, and many cities are supporting electrification by giving advantages to EVs, including on parking and tolls.
EV users are often actively supporting electrification: the Electric Vehicle Users Association of Portugal was established in 2015, and since then its members have been organizing events all around the country, making partnerships with different stakeholders and interacting with government leaders.
A recent survey shows that 84% of Portuguese car buyers say they will either pick a hybrid or electric car the next time they purchase a vehicle (17 points above the European average). Public awareness on the importance of climate change and the need of concrete actions to limit it is an important signal. However, 10% of the overall Portuguese population say they do not have a vehicle now and are not planning to buy one, so that the current motorization rate may increase in the future.

Levers and barriers

Portugal already has a significant share of renewable power generation: renewables accounted for 62% of the total electricity production in the country in 2021. Even more, solar energy remains relatively low, and its potential could be further expanded. The high share of renewable power generation is a key resource to foster a significant decarbonization of the transport sector through electrification, and charging strategies need to be optimized to make the most of the available generation where and when it is available.
Distribution system operators are already starting pilot projects to evaluate the potential contribution of smart charging on the grid and the need for specific regulations to limit the potential negative impacts.
The lack of municipal permits for public electric chargers and electrical grid licensing are still obstacles that need to be overcome in the near future to reach an effective EV charging network.
A general barrier, which is also common for most other countries, is related to the still high upfront cost of electric vehicles compared to the traditional ones, which are still limiting the adoption of the technology for many potential users. In addition to incentives, new business models such as long-term renting or leasing may play help the development of the market.

Main uncertainties

Portugal has clear goals of transport electrification, and it is on track to reach them. Potential uncertainties are related to external factors, including the global availability of materials and batteries to support a significant increase of demand. If supply is not able to keep the pace of the demand increase, a market failure may impact the user's willingness to adopt EVs.

Spain

Review of current trends

The passenger cars fleet in Spain reaches 29 million units, with a motorization rate of 614 cars per 1,000 inhabitants. New registrations of battery electric vehicles (BEV) and plugin hybrid electric vehicles (PHEV) cars have surpassed 1% of total registrations only in the last couple of years, remaining below other European countries (data from the European Alternative Fuels Observatory). As a result, the total share of electric cars circulating in the country still remains marginal.

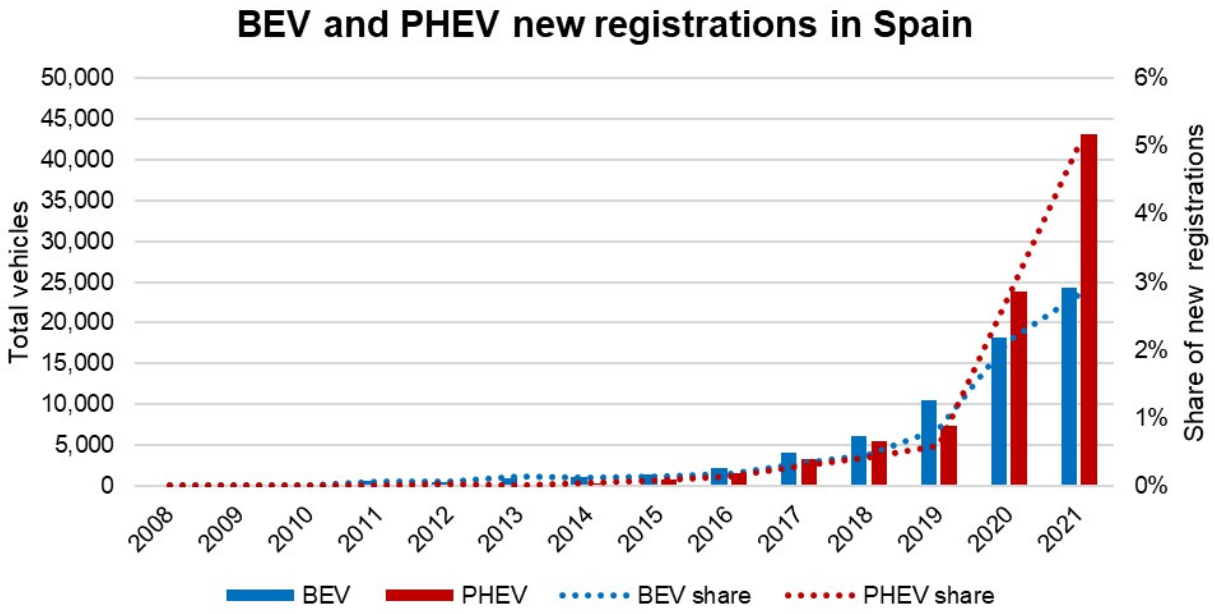

Figure 8: New electric car registrations in Spain (data source: EAFO).

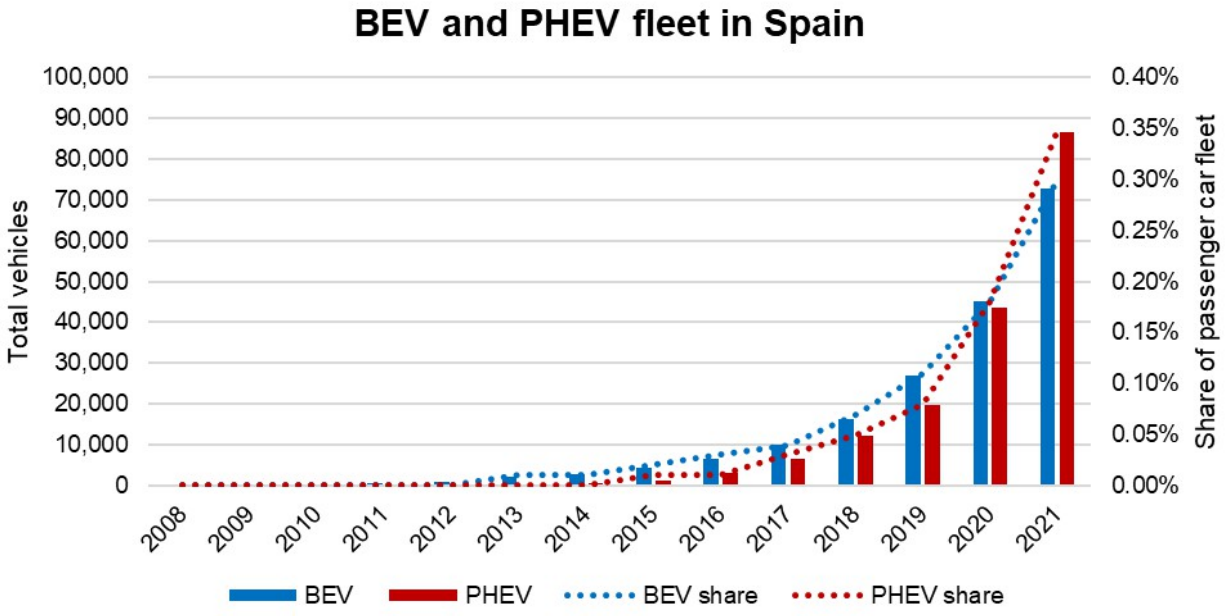

Figure 9: Electric car fleet in Spain (data source: EAFO).

As of 2022, around 13,000 AC recharging points and more than 3,000 DC recharging points have been installed in Spain, in line with the 2025 target of 17,000 electric refuelling points in the country.

There are several benefits for BEV and PHEV owners in Spain, both at national and local level, including registration and ownership tax benefits and purchase subsidies. The national government has also set a subsidy for small municipalities to install charging infrastructure.

Future trends

Existing strategies, quantitative objectives

The TYNDP scenarios expect between 50 and 80 TWh of electricity consumption in the transport sector in 2050, of which around 25-27 TWh due to passenger cars. The following chart shows the expected evolution of electricity consumption in transport by mode, comparing the “Distributed Energy” and the “Global Ambition” scenarios. An important share of electricity consumption will be related to passenger cars, especially in the “Global Ambition” scenario, and on the medium and long term also trucks, buses and aviation will show an important growth (and in particular in the “Distributed Energy” scenario). Rail transport is expected to remain quite constant, representing a marginal share of the total consumption, slightly above the current levels.

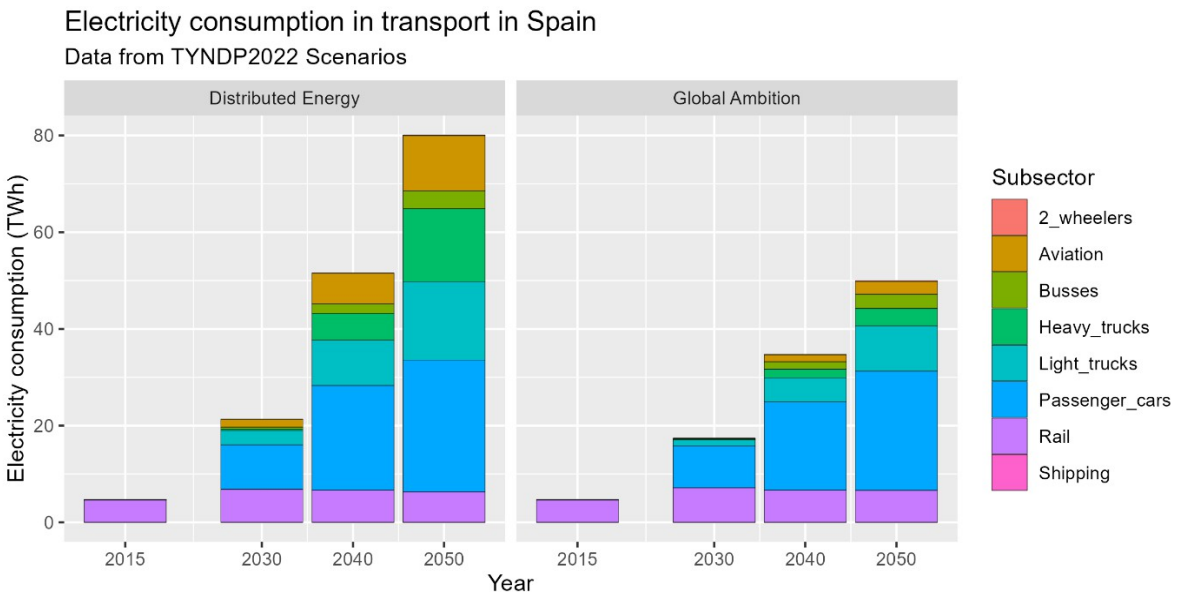

Figure 10: Transport electricity consumption in Spain in TYNDP2022 Scenarios.

The following chart represents the expected market share of new passenger cars registrations for battery electric vehicles (BEV) and plugin hybrid electric vehicles (PHEV). The "Distributed Energy" scenario show a very strong increase in BEV market share, reaching more than 80% in 2050, and a very modest increase of PHEV share. The "Global Ambition" scenario shows a lower increase of BEV sales, reaching 55% of passenger car sales by 2050, and an increase of PHEV sales up to 20% in 2050.

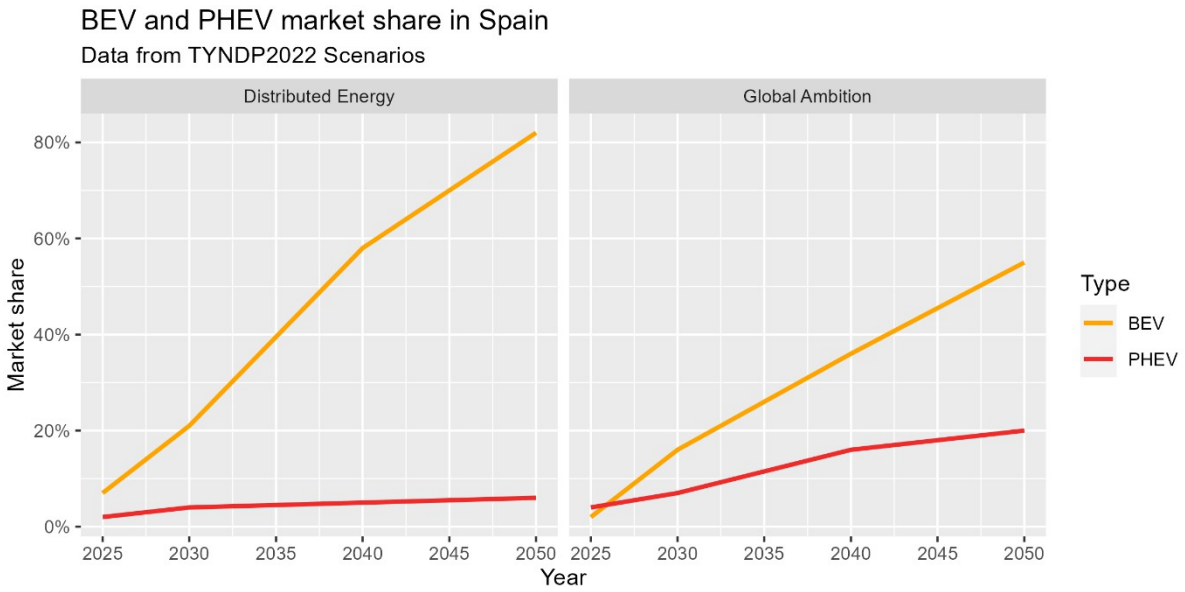

Figure 11: Future electric cars market share in Spain in TYNDP2022 Scenarios.

Spain's National Energy and Climate Plan has an official target of reaching 5 million electric vehicles in its fleet by 2030, including cars, vans, buses and motorcycles.

Weak signals, possible disruption factors

BEVs sales in Spain have been increasing in the last few years, but they still remain at lower levels compared to other large EU countries such as France and Germany. The same is true for public charging infrastructure. However, the regulatory environment seems favorable for a catch up of both trends, since specific measures are being developed to support the evolution of the markets of both vehicles and chargers.
There are currently plans for four gigafactories in Spain, for a total planned manufacturing capacity of 110 GWh (as of July 2022). An effective deployment of battery manufacturing can strengthen the EV supply chain in the region, in addition to providing additional workplaces and benefits to the local communities and economies.
A recent survey by the European Investment Bank shows that 78% of car buyers in Spain say they will either pick a hybrid (44%) or electric car (34%) the next time they purchase a vehicle (above the European average). Only 22% would consider a petrol or diesel vehicle.

Levers and barriers

Spain has already a well-developed electricity generation from renewables, and this could support a faster transport decarbonization via electrification. Optimized charging strategies will be needed to ensure the most effective use of available resources.
Research surveys focused on Spain shows that customers still perceive the high investment cost of EVs as a significant barrier for their adoption, in addition to technological barriers such as charging times and potential range. Potential users' perceptions remain fundamental for the adoption of any new technology.

Main uncertainties

Potential uncertainties are related to external factors, including the global availability of materials and batteries to support a significant increase of demand. If supply is not able to keep the pace of the demand increase, a market failure may impact the user's willingness to adopt EVs.

France

Review of current trends

France has around 38 million passenger cars circulating in the country, with a motorization rate of 563 cars per 1,000 inhabitants. The charts below show the BEV and PHEV new registrations and share on the total fleet (data from the European Alternative Fuels Observatory). Both technologies have reached around 10% of total sales in 2021, although BEVs circulating in France remain around 1,4% of the total cars and PHEVs below 1%.

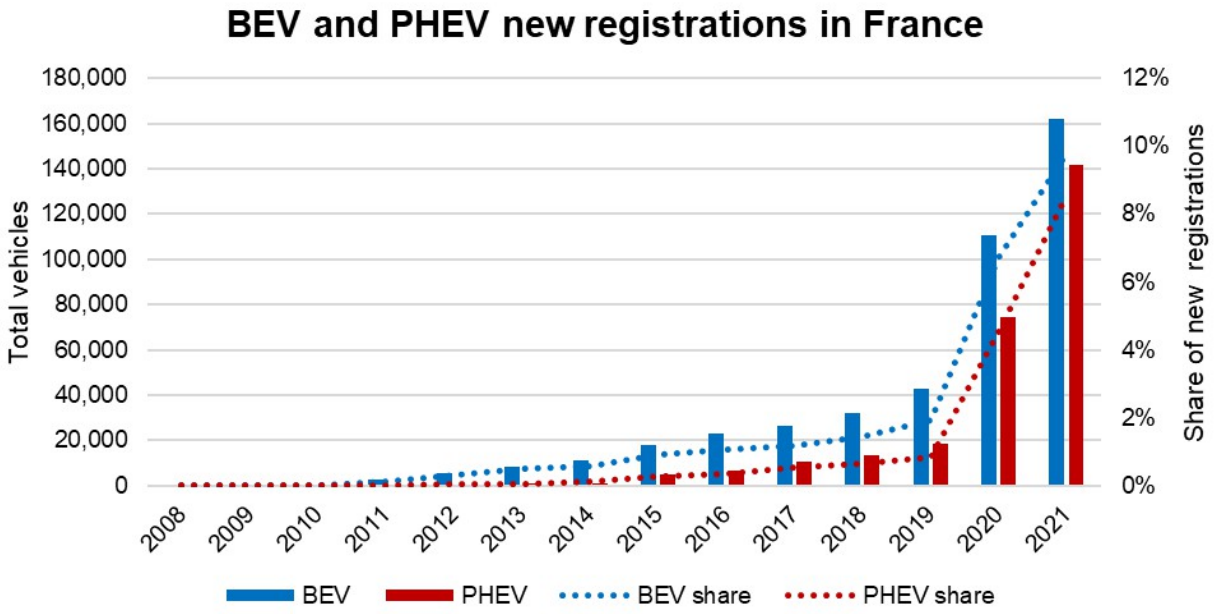

Figure 12: New electric car registrations in France (data source: EAFO).

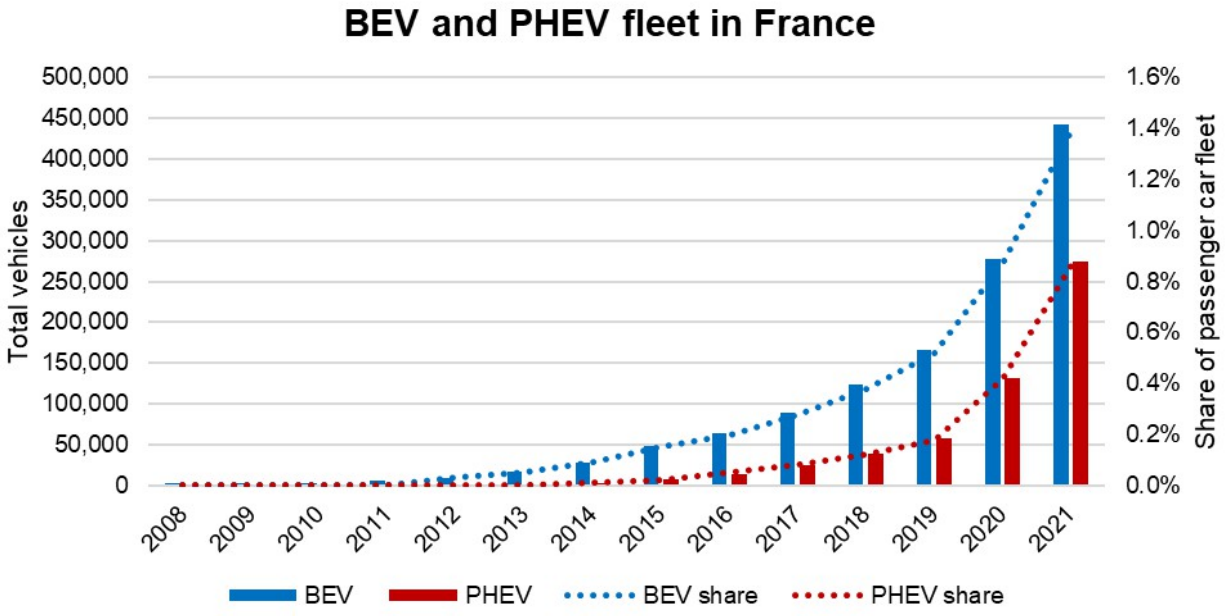

Figure 13: Electric car fleet in France (data source: EAFO).

As of 2022, there are 60,000 AC recharging points and 5,000 DC recharging points, with a significant increase year-over-year, on track to reach the 2025 target of 100,000 electric refuelling points on a national basis.

In France EV owners can benefit from registration and company tax reductions and purchase subsidies, depending on the CO_2 emission level of the vehicle.

Future trends

Existing strategies, quantitative objectives

The TYNDP scenarios expect between 120 and 133 TWh of electricity consumption in the transport sector in 2050, of which around 63-66 TWh due to passenger cars. The following chart shows the expected evolution of electricity consumption in transport by mode, comparing the “Distributed Energy” and the “Global Ambition” scenarios. The largest share of electricity consumption will be related to passenger cars, and on the medium and long term also trucks, buses and aviation will show a significant growth. Rail transport is expected to show a slight increase by 2030, and then a gradual decrease in the following two decades, but remaining slightly above the 2015 levels.

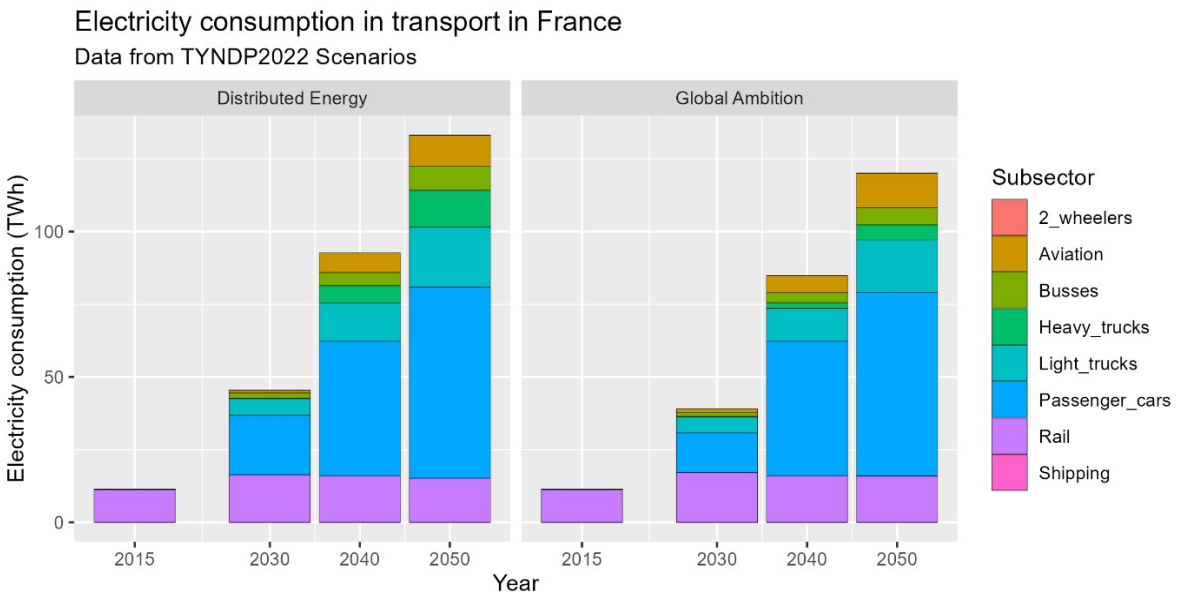

Figure 14: Transport electricity consumption in France in TYNDP2022 Scenarios.

The following chart represents the expected market share of new passenger cars registrations for BEVs and PHEVs. Both scenarios show a steep increase of BEV market share, which reaches almost 100% in the "Distributed Energy" scenario, and around 85% in the "Global Ambition" scenario. Conversely, the PHEV market share, which is higher than BEV market share in 2025, slightly decreases in both scenarios.

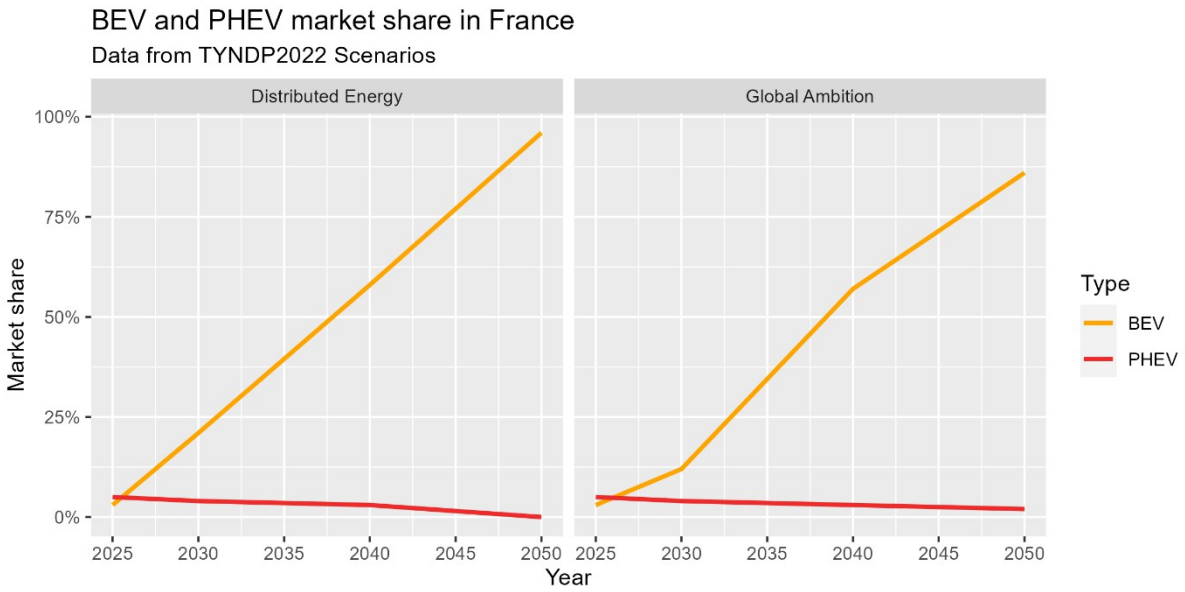

Figure 15: Future electric cars market share in France in TYNDP2022 Scenarios.

France's transmission system operator, RTE, has also developed national scenarios towards carbon neutrality by 2050, which have been published in February 2022 (in the document "Futurs énergétiques 2050"[1]). These scenarios include a reference scenario and an ambitious scenario. In the reference scenario, more than 40% of the light vehicle fleet and more than 80% of new registrations must be made up of electric or plug-in hybrid vehicles by 2035, which is consistent with the national ban on the sale of new cars and light commercial vehicles using fossil fuels by 2035[2]. In this scenario, electric cars will reach a total of 7.3 million units by 2030, compared to 13.1 million in the ambitious scenario. By 2050, the reference scenario implies that nearly 95% of the fleet of light vehicles, i.e. nearly 36 million units, will have an electric motor (including BEV and PHEV). In this scenario, the total electricity consumption of the transport sector in 2050 is estimated at around 100 TWh (which is lower than the results of the TYNDP2022 scenarios presented above).

The French government has also made several announces recently:

- an increase in the ecological bonus for half of the most modest French households.
- A target of 1 million electric vehicles produced in France in 2027, and possibly 2 million in 2030
- A target of 100,000 electric charging points by mid-2023 (compared with 70,000 at present) and 400,000 by 2030. + the extension of the tariff shield to these charging points, from January 2023.

Weak signals, possible disruption factors

Avere-France (the national association for the development of electric mobility) has published a report[3] for 2021 with very positive conclusions: the association speaks of a record year for electric mobility. In addition to the very positive trends registered for both EV sales and charging infrastructure, Avere-France highlights regulatory and legislative changes that are very favourable to the development of electric mobility.
The French government has deployed many regulations to support road transport electrification, including dedicated communication campaigns for citizens with the aim of helping them to understand the potential benefits of EVs. A dedicated website[4] also includes simulation tools to assess the economic advantages compared to traditional cars, available incentives, estimation of environmental benefits and EV charging times.
There are currently plans for three gigafactories in France, for a total planned manufacturing capacity of 65 GWh (as of July 2022). An effective deployment of battery manufacturing can strengthen the EV supply chain in the region, in addition to providing additional workplaces and benefits to the local communities and economies.
A recent survey by the European Investment Bank shows that 77% of car buyers in France say they will either pick a hybrid (39%) or electric car (38%) the next time they purchase a vehicle (above with the European average). Only 23% would consider a petrol or diesel vehicle.

[1] Document (in French) available here: https://www.rte-france.com/analyses-tendances-et-prospectives/bilan-previsionnel-2050-futurs-energetiques#Lesdocuments
[2] https://ec.europa.eu/commission/presscorner/detail/en/ip_22_6462
[3] https://www.avere-france.org/mobilite-electrique-une-annee-2021-record-une-annee-2022-qui-en-promet-encore-plus/ (in French).
[4] https://jechangemavoiture.gouv.fr/jcmv/ (in French)

Levers and barriers

The very low carbon intensity of electricity in France, both due to nuclear and renewable generation, represents an important asset to support transport decarbonization throughout electrification. Specific research for France shows that small and medium electric cars have 2 to 3 times less carbon emissions compared to similar traditional cars. These benefits are quickly diminishing for larger SUVs, due to the need of larger batteries that significantly increase the total weight of the vehicle.

The French Agency for Ecological Transition (Ademe) published in 2022 a report on the opportunities of transport electrification[5], which also includes a few black spots: the recycling capacity of end-of-life batteries, which should be multiplied by 3 by 2027, and the health impact (electric vehicles do not emit any exhaust pollutants, but particles are nevertheless emitted, in particular due to tire abrasion). Road transport electrification should thus be developed in parallel with other solutions, including demand management and active and public transport development.

An additional aspect is the deployment of low emission zones (ZFE) in French cities. This measure aims to limit the circulation of the most polluting vehicles, defined by the Crit'Air sticker, and could encourage the use of electric mobility.

A general barrier, which is also common for most other countries, is related to the still high upfront cost of electric vehicles compared to the traditional ones, which are still limiting the adoption of the technology for many potential users. In addition to incentives, new business models such as long-term renting or leasing may play help the development of the market.

Finally, although public charging infrastructure is increasing, its pace seems still not sufficient to match the EV rising sales, and actions will be required to avoid negative effects on the market development. Moreover, while high-speed EV charging will be deployed and available for users, Ademe stresses the importance of using it only when it is needed, due to the very high effects on the grid in terms of peak power demand. The users' behaviour in charging habits will likely represent a key aspect for ensuring an optimized effect of EVs on the environment. A similar topic exists for PHEVs, which can only be climate-effective if their owners try to maximize the distance driven on electricity rather than on gasoline or diesel.

The main Distribution grid operator, ENEDIS, published a report[6] in 2022 about the behavior of EV users that confirms that the charging is mostly (92%) done at home.

[5] Avis de l'Ademe : Voitures électriques et bornes de recharges, available at: https://librairie.ademe.fr/mobilite-et-transport/5877-avis-de-l-ademe-voitures-electriques-et-bornes-de-recharges.html

[6] https://www.enedis.fr/presse/enedis-publie-un-nouveau-rapport-sur-le-comportement-des-utilisateurs-de-vehicules#:~:text=Les%20v%C3%A9hicules%20%C3%A9lectriques%20sont%20aussi,%25%20contre%2033%20%25%20de%20locataires.

Main uncertainties

Potential uncertainties are related to external factors, including the global availability of materials and batteries to support a significant increase of demand. If supply is not able to keep the pace of the demand increase, a market failure may impact the user's willingness to adopt EVs.
The future evolution of electricity generation in France should keep the pace with rising electric penetration in some specific final sectors, including higher cooling demand and transport electrification. A strong share of nuclear and renewables helps keep the electricity carbon intensity among the lowest in Europe. In the long term, this raises the question of France's economic and industrial capacity to carry out the gradual renewal of its nuclear fleet..

Italy

Review of current trends

Almost 40 million passenger cars are circulating in Italy, with a motorization rate of 672 cars per 1,000 inhabitants, one of the highest in the EU. Nevertheless, total BEV and PHEV sales remained relatively low in the last years, with a slower uptake compared with other European countries, as shown by the charts below (data from the European Alternative Fuels Observatory).

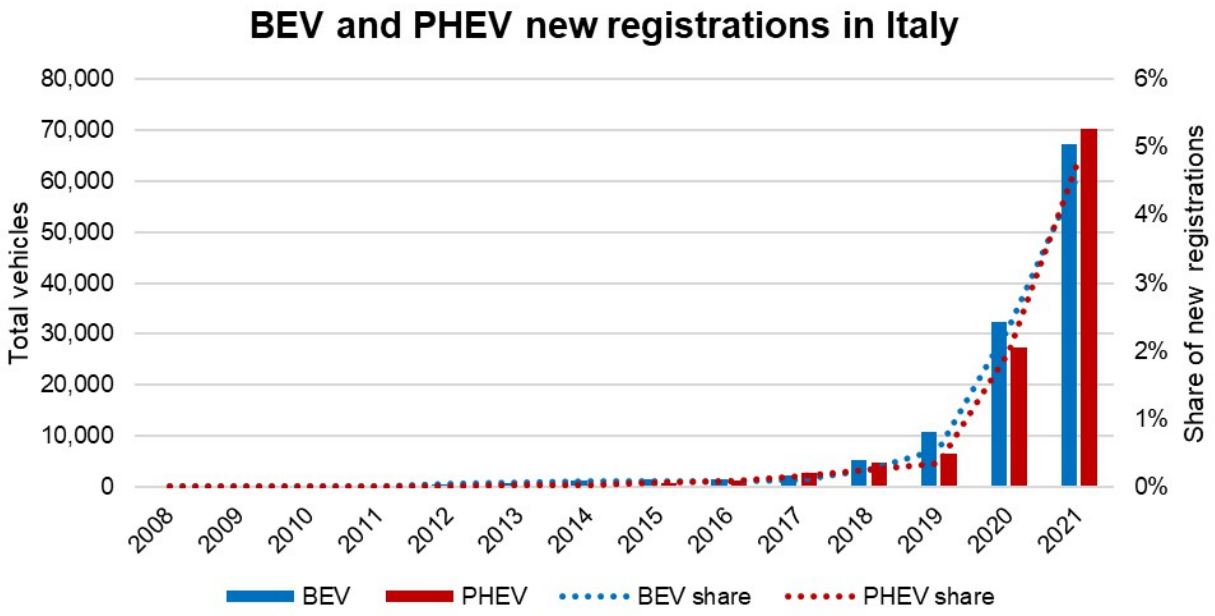

Figure 16: New electric car registrations in Italy (data source: EAFO).

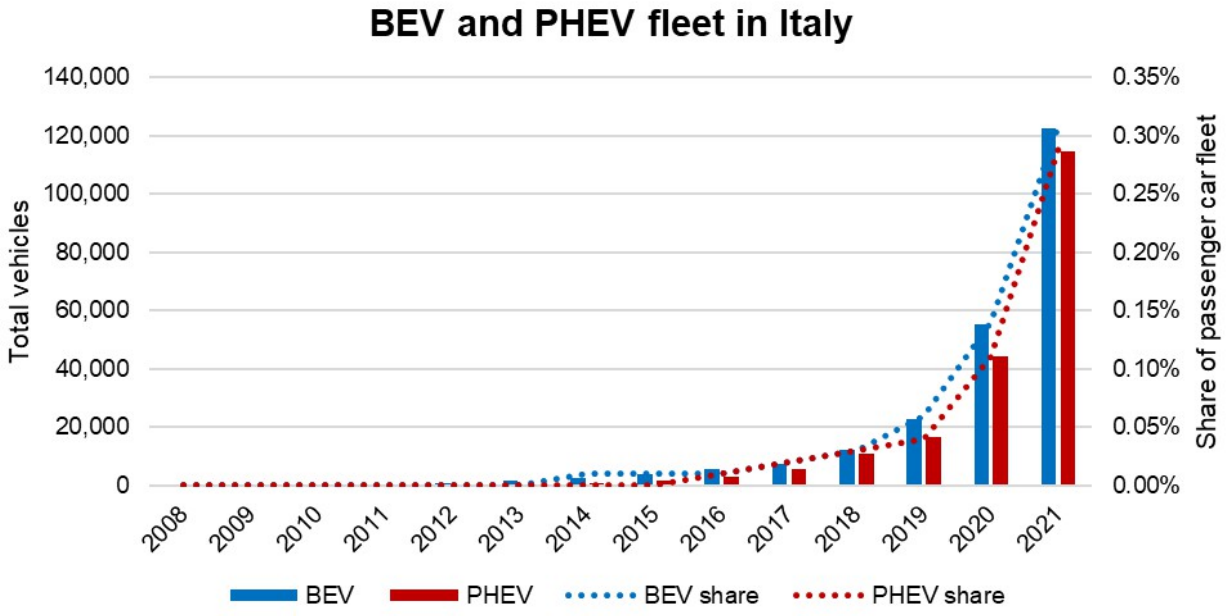

Figure 17: Electric car fleet in Italy (data source: EAFO).

As of 2022, around 25,000 publicly accessible AC recharging points and 3,000 DC recharging points are installed in Italy.

National benefits for EV owners include ownership and company tax reductions and purchase subsidy, in addition to other financial benefits in many urban centres (such as access to low-traffic zones and free parking). Some regions have also additional incentives for the purchase of electric cars and light commercial vehicles.

Future trends

Existing strategies, quantitative objectives

The TYNDP scenarios expect between 74 and 101 TWh of electricity consumption in the transport sector in 2050, of which around 45-50 TWh due to passenger cars. The following chart shows the expected evolution of electricity consumption in transport by mode, comparing the “Distributed Energy” and the “Global Ambition” scenarios. The largest share of electricity consumption will be related to passenger cars, especially in the “Global Ambition” scenario, and on the medium and long term also trucks, buses and aviation will show an important growth. Rail transport is expected to remain quite constant, representing a marginal share of the total consumption, slightly above the current levels.

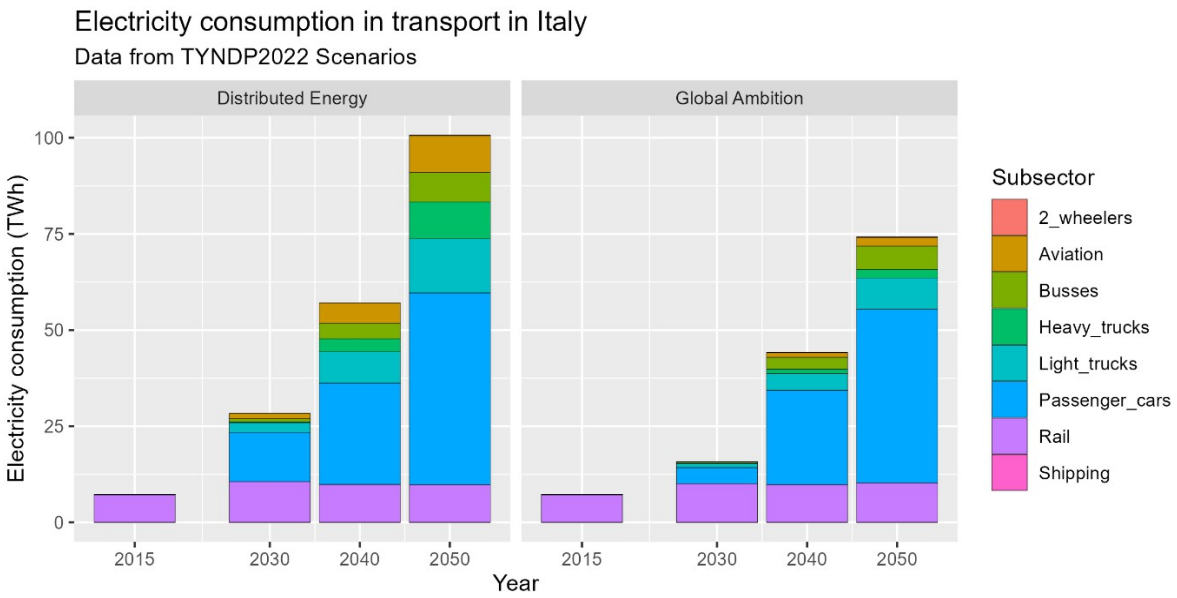

Figure 18: Transport electricity consumption in Italy in TYNDP2022 Scenarios.

The following chart represents the expected market share of new passenger cars registrations for battery electric vehicles (BEV) and plugin hybrid electric vehicles (PHEV). The "Distributed Energy" scenario show a very strong increase in BEV market share, reaching more than 80% in 2050, and a very modest increase of PHEV share. Conversely, in the "Global Ambition" scenario PHEV sales always remain above BEV sales, reaching a market share of 45% by 2050 (compared to 30% for BEV).

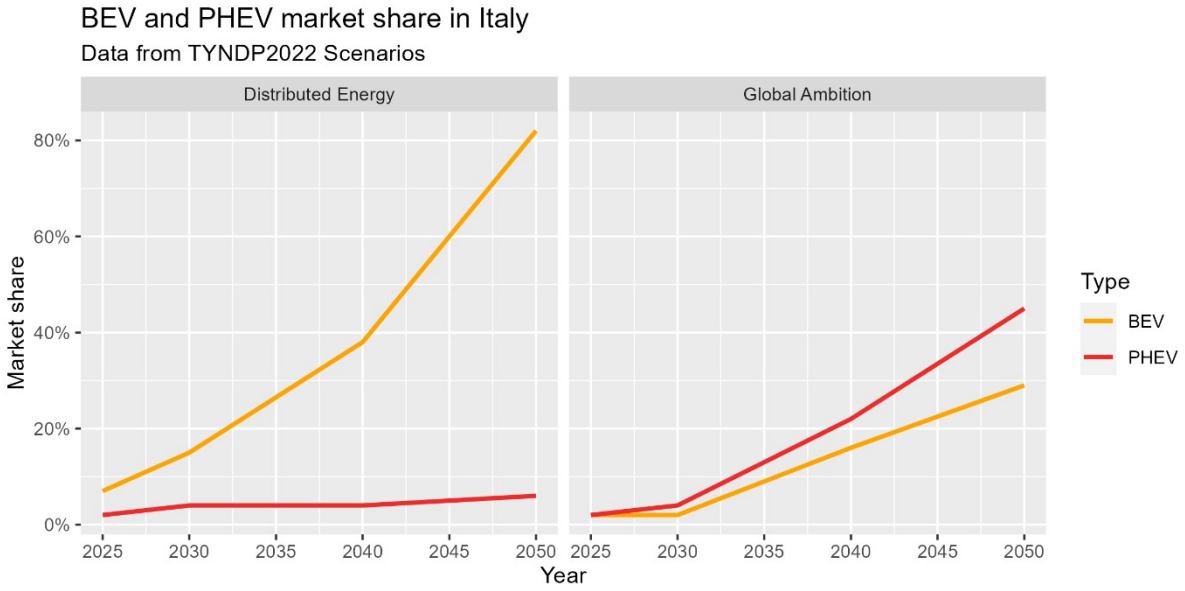

Figure 19: Future electric cars market share in Italy in TYNDP2022 Scenarios.

The Italian government in its integrated national energy and climate plan has included a 2030 target of 6 million electric cars in the total fleet, including 4 million BEV and 2 million PHEV. Many experts agree that this target seems ambitious compared to the current trend, and a significant increase of new electric vehicles registrations is needed to get back on track.

Weak signals, possible disruption factors

The recent EV uptake has been slower compared to other large EU countries. Higher upfront costs for EVs may remain a barrier for some users, even if the total lifetime cost of ownership is often lower than for traditional cars.
However, there are many policies supporting private cars electrification, both at national and local level. In the main large cities, car sharing providers are operating electric car fleets, which could allow users to experience the difference of driving an electric car compared to their usual traditional private car.
There are currently plans for three gigafactories in Italy, for a total planned manufacturing capacity of around 90 GWh (as of July 2022). An effective deployment of battery manufacturing can strengthen the EV supply chain in the region, in addition to providing additional workplaces and benefits to the local communities and economies.
A recent survey by the European Investment Bank shows that 78% of car buyers in Italy say they will either pick a hybrid (51%) or electric car (27%) the next time they purchase a vehicle (above the European average). Only 22% would consider a petrol or diesel vehicle.

Levers and barriers

Potential car buyers show a positive attitude towards electric vehicles, but the Italian industrial sector may not be on track to match this new demand. Italy has a long history of car manufacturing, also for the supply of components and mechanical parts (eg parts for the powertrain, chassis, brakes) with world-renowned industrial companies. The advent of the electric car strongly impacts current paradigms, as the related companies are called to a reconversion made not only of machinery and equipment but first of all of processes, tools, human resources and skills. This certainly represents a challenge, as investments in innovation involve long times in the transition to large-scale production of technologies and products.

Service providers are one of the possible enablers of mobility if, with it, they will be able to evolve in the near future. In fact, the high dispersion of the current mobility services market, and in particular public charging infrastructure, does not contribute to the improvement of the customer experience and, more generally, represents a strong barrier to entry to the world of e-mobility in general. This factor, often underestimated in the analysis of the electric mobility adoption curve, is actually decisive. The aggregation of the sector into large players, or an effective standardization through common digital platforms for customers, can represent in this sense a facilitator and, perhaps, one of the real greatest enablers in mass adoption in the country.

An additional barrier that needs to be considered is the ability of consumers to recharge vehicles: not all have domestic charging stations (especially when living in dense urban environments), and many use those in the workplace. Fortunately, there are few electric car owners who have to rely exclusively on public infrastructure, but this could change significantly in the future, it is clear the need to work on charging services in places of interest in the city. Furthermore, it is important to remember that the cost of home charging is generally much lower than that of public charging stations.

Moreover, transport electrification shows huge differences between northern and southern regions in Italy, both in terms of EV sales and recharging infrastructure. This North-South divide emerges also in other economic and energy indicators, but also in this case it may represent an additional barrier to an effective development of low-emission transport solutions in the country. This aspect is even more important considering the higher potential of renewable power generation in southern regions, both for solar and wind energy. A large imbalance of new EVs deployment in northern regions could further aggravate the current mismatch between electricity demand (mostly in the North) and renewable generation (mostly in the South).

Main uncertainties

Potential uncertainties are related to external factors, including the global availability of materials and batteries to support a significant increase of demand. If supply is not able to keep the pace of the demand increase, a market failure may impact the user's willingness to adopt EVs. Significant issues and bottlenecks have demonstrated in the last months that the impact on the EV supply chain can be important, and also the environmental and social sustainability of material extraction and manufacturing in some countries remain a potential issue for the effectiveness of electric vehicles compared to incumbent technologies.
National strategies and incentive schemes have often been varied in the past, and the lack of a coherent and durable scheme may deter large investment (e.g. charging infrastructure).

Consumer choices may be difficult to estimate, as cultural aspects and different priorities may not push towards the most rational choice between traditional and electric vehicles. Although lower lifetime costs may push towards choosing EVs, higher investments, range anxiety and other concerns may slower the electrification of the sector.

Slovenia

Review of current trends

There are currently 1.3 million passenger cars circulating in Slovenia, with a motorization rate of 596 cars per 1,000 people. The following charts show the evolution of BEV and PHEV new registrations and share on the total passenger car fleet. Figures show that electric cars remain a marginal share of the total fleet, although BEVs reached over 3% of new registrations in 2020 and 2021 (data from the European Alternative Fuels Observatory).

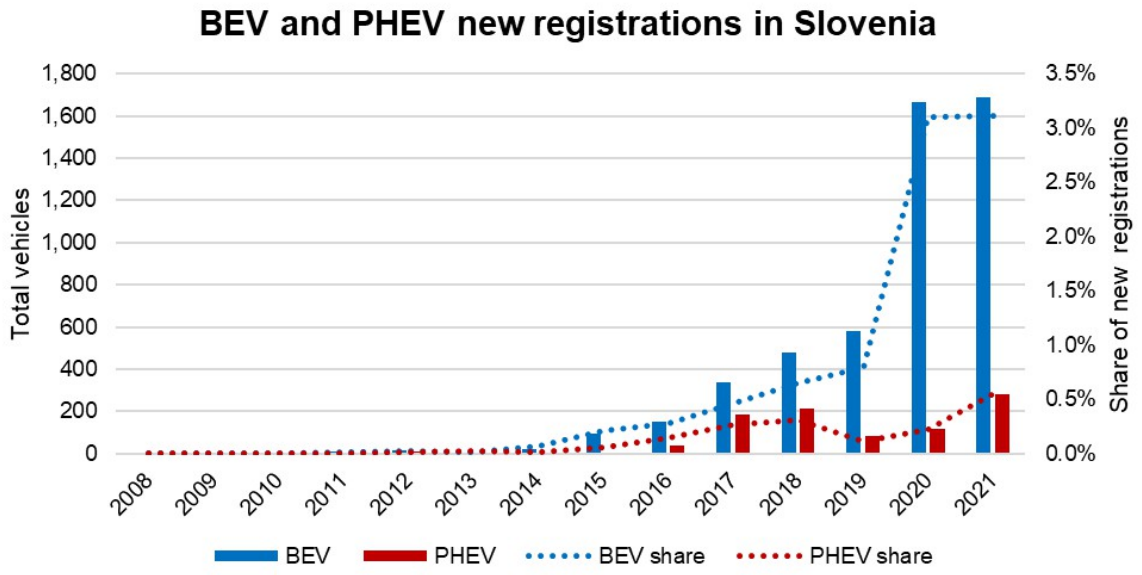

Figure 20: New electric car registrations in Slovenia (data source: EAFO).

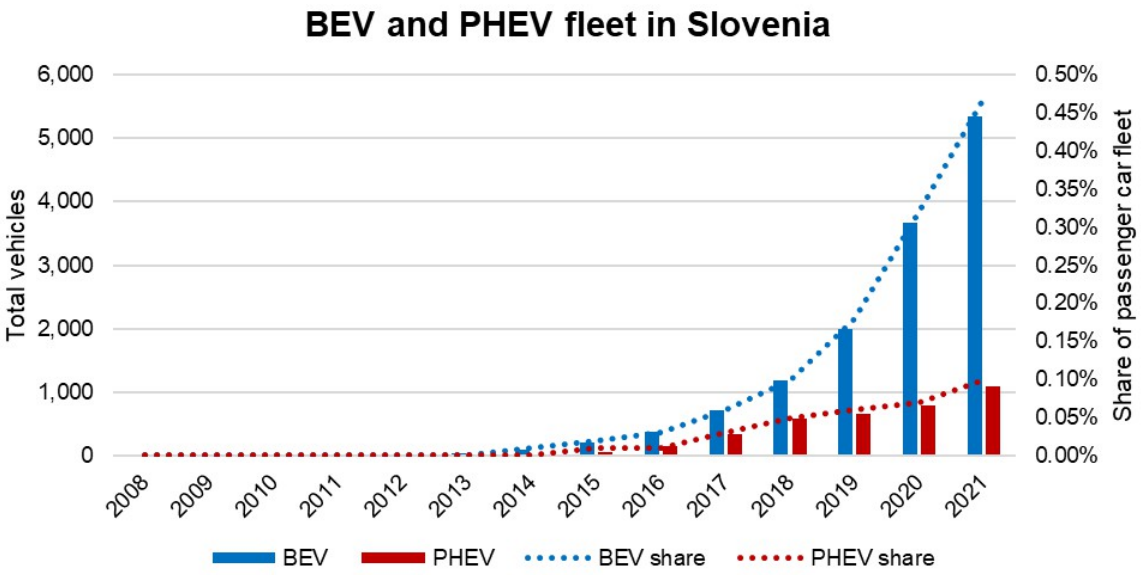

Figure 21: Electric car fleet in Slovenia (data source: EAFO).

Considering public charging infrastructure, 2022 data shows over 1,000 AC recharging points and 200 DC recharging points. The country has set a target of 7,000 recharging points by 2025.

EV owners in Slovenia can benefit from purchase subsidies, with different grant levels based on the category of the vehicle, and long-term loans for the purchase of electric cars at a subsidised rate set by the Bank of Slovenia.

Future trends

Existing strategies, quantitative objectives

The TYNDP scenarios expect between 2.9 and 3.9 TWh of electricity consumption in the transport sector in 2050, of which around 1.8-2.0 TWh due to passenger cars. The following chart shows the expected evolution of electricity consumption in transport by mode, comparing the “Distributed Energy” and the “Global Ambition” scenarios. An important share of electricity consumption will be related to passenger cars, and on the medium and long term also trucks and buses will show an important growth, especially in the “Distributed Energy” scenario. Rail transport is expected to remain quite constant, representing a marginal share of the total consumption, slightly above the current levels.

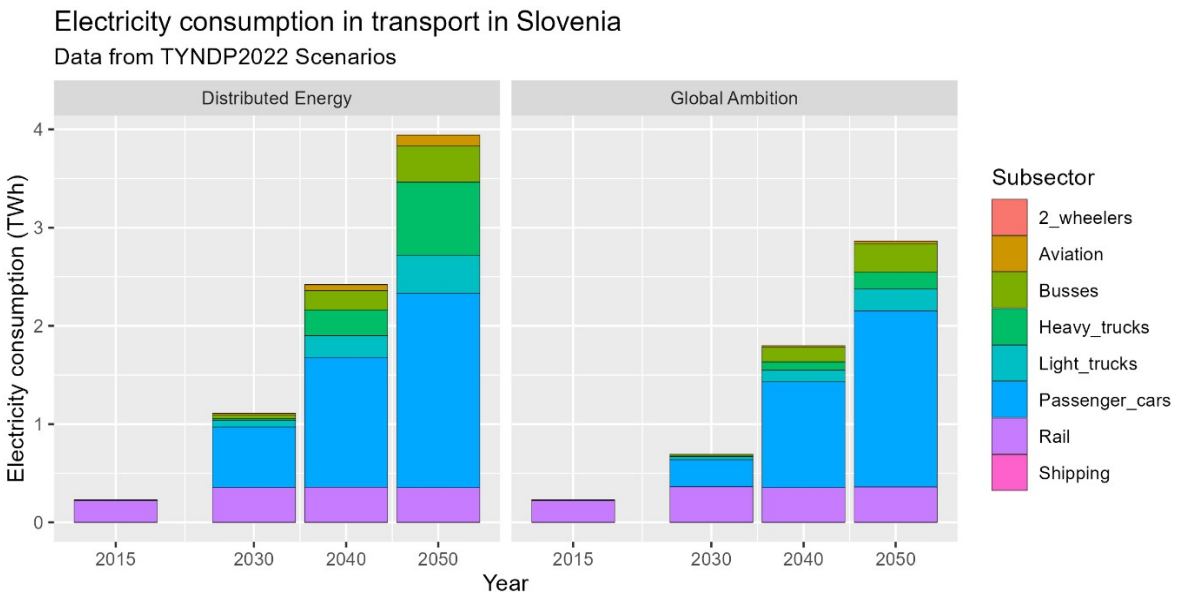

Figure 22: Transport electricity consumption in Slovenia in TYNDP2022 Scenarios.

The following chart represents the expected market share of new passenger cars registrations for battery electric vehicles (BEV) and plugin hybrid electric vehicles (PHEV). The "Distributed Energy" scenario show a very strong increase in BEV market share, reaching more than 80% in 2050, and a very modest increase of PHEV share. Conversely, in the "Global Ambition" scenario PHEV sales always remain above BEV sales, reaching a market share of 45% by 2050 (compared to 30% for BEV).

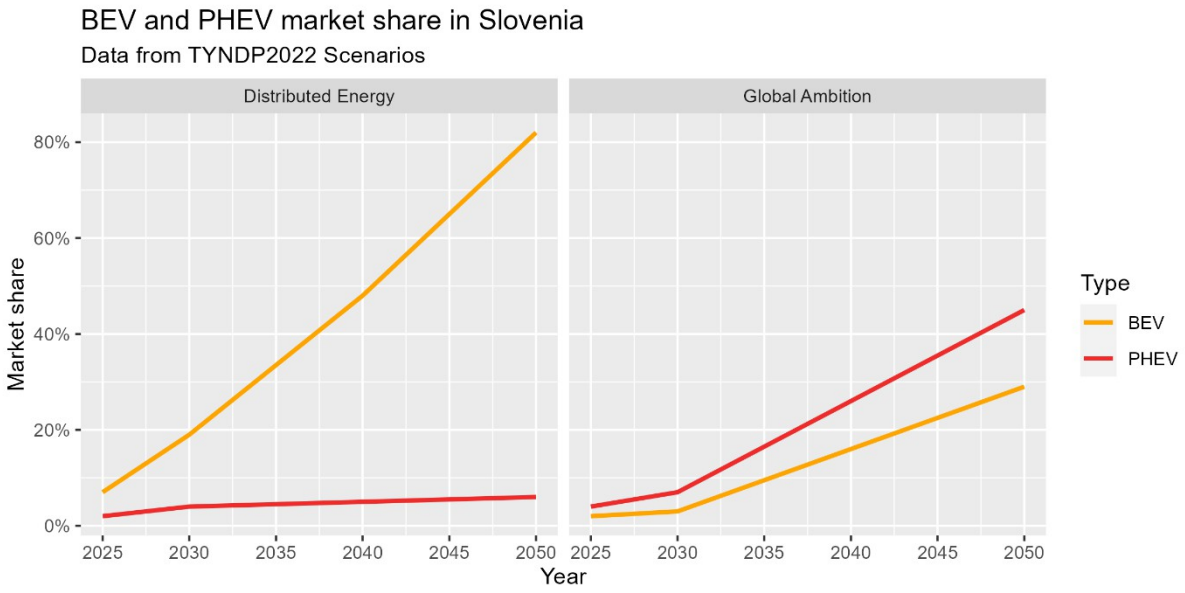

Figure 23: Future electric cars market share in Slovenia in TYNDP2022 Scenarios.

Slovenia adopted a decarbonization strategy in 2017, which includes 2030 targets for the electrification of the transport sector. The aim is to achieve a 9% reduction in transport emissions by 2030 compared to 2020 levels (estimated before the pandemic). It is important to remember that these targets have been set in a context of increasing mobility demand and passenger and freight traffic flows. Specific electrification targets for 2030 include 200,000 BEV and PHEV in the passenger cars segment, which correspond to 17% of the total car fleet in the country. Other targets have been set for electric light freight vehicles and natural-gas-powered buses and heavy freight vehicles. With the projected growth in traffic, Slovenia estimated to require 1,200 chargers of ordinary power for domestic transport by 2020, rising to 7,000 by 2025 and over 22,000 by 2030.

Weak signals, possible disruption factors

At the current rate of new EV registrations in the country, passenger cars seem far from being on track to reach the 2030 target. Public chargers' data for 2022 are slightly below the 2020 target, and they will require a significant increase of deployment trends to match the future targets.
A recent survey by the European Investment Bank shows that 71% of car buyers in Slovenia say they will either pick a hybrid (36%) or electric car (35%) the next time they purchase a vehicle (in line with the European average). Only 29% would consider a petrol or diesel vehicle.

Levers and barriers

In parallel to the development of an effective network of public charging systems, for smaller countries such as Slovenia the concept of e-roaming is of particular importance. Essentially, e-roaming allows EV drivers to charge their cars outside their charging service provider's network with only one customer account. This is particular important for international travellers, given the high fragmentation of this sector in Europe. This aspect could thus represent a barrier to the development of an EV market, but also a significant opportunity to attract foreign visitors, especially in cities that have important tourism attraction.
A general barrier, which is also common for most other countries, is related to the still high upfront cost of electric vehicles compared to the traditional ones, which are still limiting the adoption of the technology for many potential users. In addition to incentives, new business models such as long-term renting or leasing may play help the development of the market.

Main uncertainties

Potential uncertainties are related to external factors, including the global availability of materials and batteries to support a significant increase of demand. If supply is not able to keep the pace of the demand increase, a market failure may impact the user's willingness to adopt EVs.

Croatia

Review of current trends

There are currently 1.9 million passenger cars circulating in Croatia, corresponding to a motorization rate of 463 cars per 1,000 inhabitants. Although BEV new registrations reached 3% of the total in 2021, both BEV and PHEV remain marginal in the national passenger cars fleet, as represented in the two charts below (data from the European Alternative Fuels Observatory).

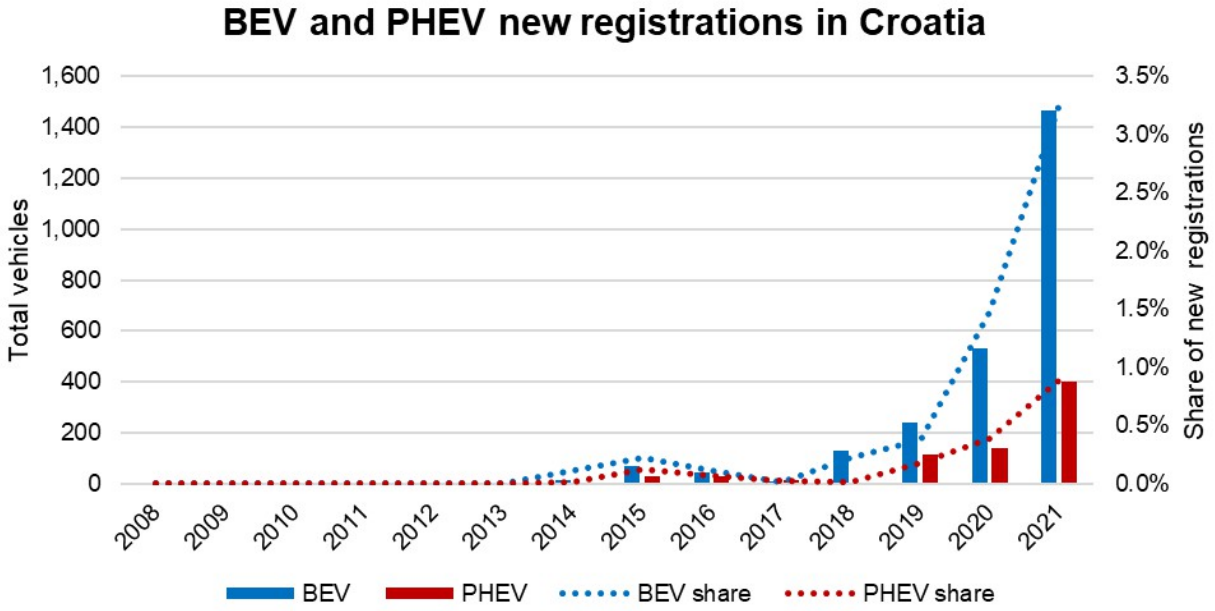

Figure 24: New electric car registrations in Croatia (data source: EAFO).

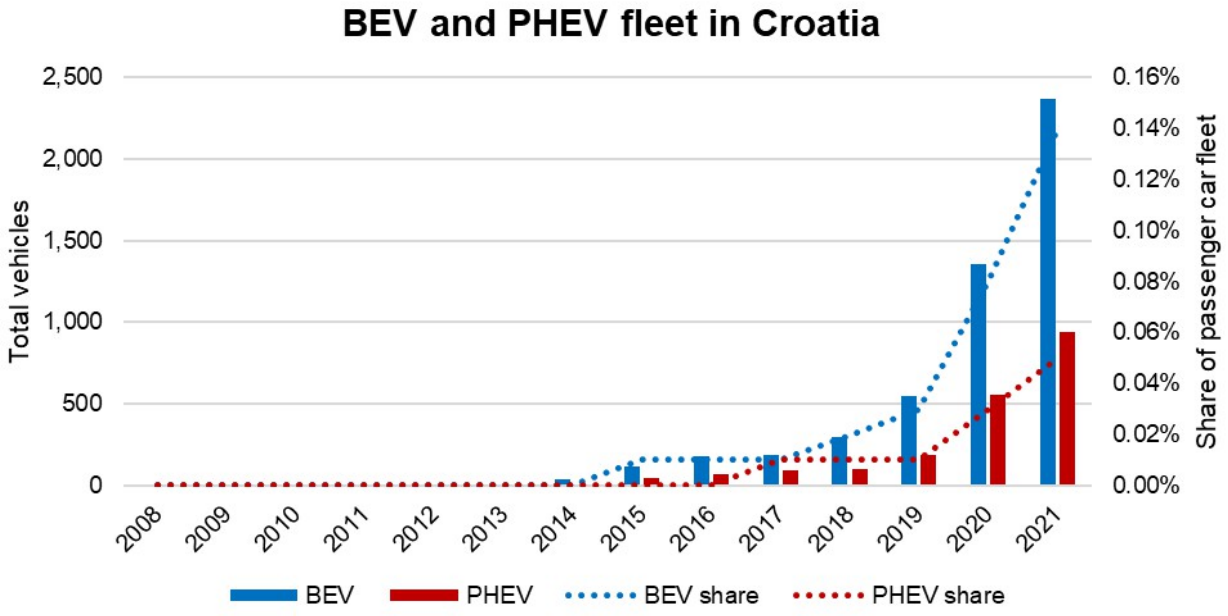

Figure 25: Electric car fleet in Croatia (data source: EAFO).

Considering public charging infrastructure, as of 2022 around 1,000 charging points are available in Croatia, of which almost 70% is relying on alternate current. The country has already reached the 2025 target of 602 Electric refuelling points.

New registrations of EVs in the country are exempted from excise duties and special environmental tax, and the country has also issued purchase subsidies for BEVs and PHEVs emitting less than 50 g_{CO2}/km.

Future trends

Existing strategies, quantitative objectives

The TYNDP scenarios expect between 3.4 and 3.8 TWh of electricity consumption in the transport sector in 2050, of which around 2.1-2.2 TWh due to passenger cars. The following chart shows the expected evolution of electricity consumption in transport by mode, comparing the “Distributed Energy” and the “Global Ambition” scenarios. The largest share of electricity consumption will be related to passenger cars, and on the medium and long term also buses will show an important growth. Light and heavy trucks and aviation will contribute to the total electricity demand in 2050 in the “Distributed Energy” scenario. Rail transport is expected to increase its electricity consumption in 2030, and then to show a slight decrease in the following decades.

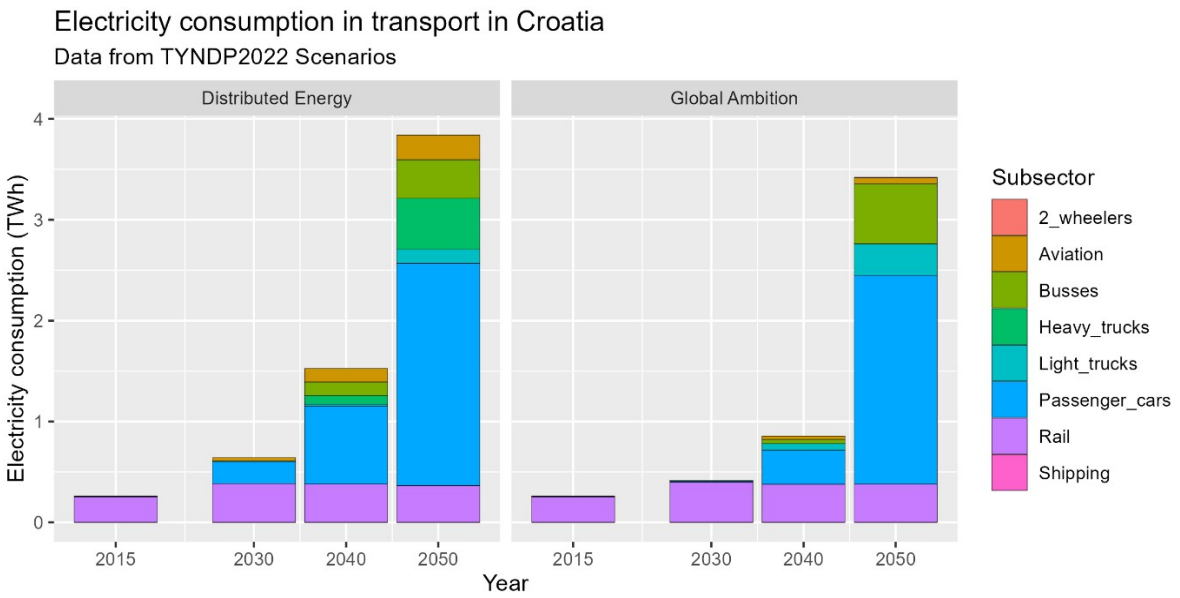

Figure 26: Transport electricity consumption in Croatia in TYNDP2022 Scenarios.

The following chart represents the expected market share of new passenger cars registrations for battery electric vehicles (BEV) and plugin hybrid electric vehicles (PHEV). The "Distributed Energy" scenario show a strong increase in BEV market share, especially after 2040, reaching around 60% in 2050, and a minor increase of PHEV share (around 25% by 2050). In the "Global Ambition" scenario PHEV sales remain lower, and also BEV sales up to 2040, but then the increase is even stronger, reaching a 2050 market share of 65%.

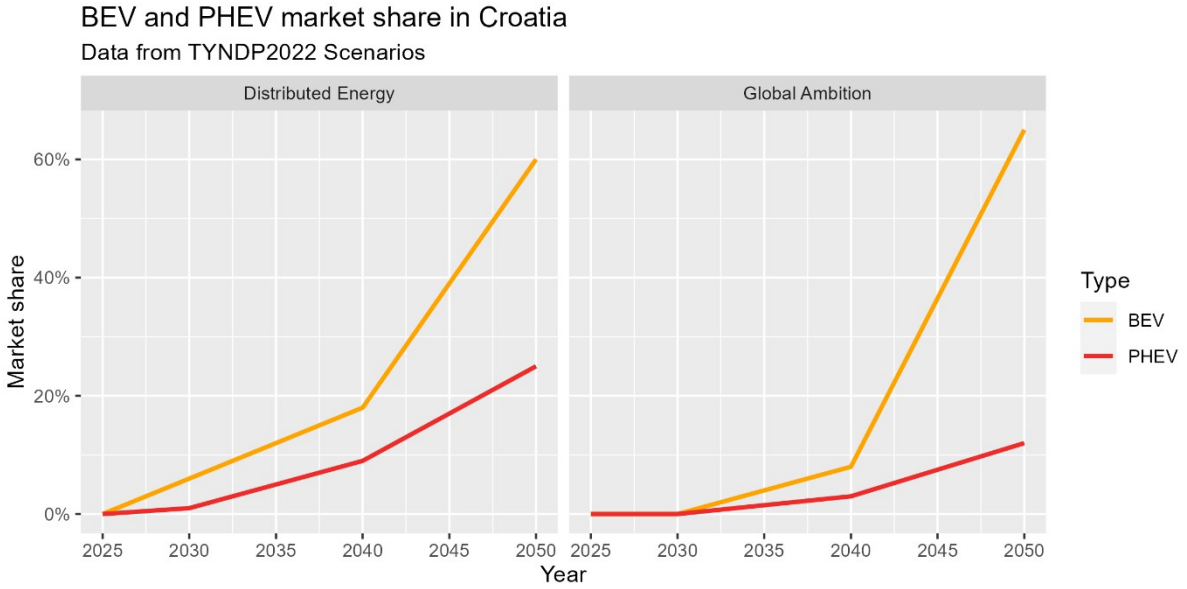

Figure 27: Future electric cars market share in Croatia in TYNDP2022 Scenarios.

In 2021 the Croatian Government proposed a Low Carbon Development Strategy until 2030 with a view to 2050. Electric cars are expected to reach 35% of the total fleet by 2050 to meet the decarbonization targets ahead.

Weak signals, possible disruption factors

An important increase of BEVs can be seen in Croatia in the last few years, although the total number of vehicles remain marginal in the national fleet. National policies, especially when aiming at reducing investment costs, can play an important role in BEV adoption.
A recent survey by the European Investment Bank shows that 73% of car buyers in Croatia say they will either pick a hybrid (37%) or electric car (36%) the next time they purchase a vehicle (in line with the European average). Only 27% would consider a petrol or diesel vehicle.

Levers and barriers

The deployment of an effective network of charging points is a key infrastructural problem. Most Croatian cities and municipalities have charging points, but there are still few charging points on the motorways. A widespread availability of charging points will be crucial, especially for touristic locations.
In parallel to the development of an effective network of public charging systems, for smaller countries such as Croatia the concept of e-roaming is of particular importance. Essentially, e-roaming allows EV drivers to charge their cars outside their charging service provider's network with only one customer account. This is particular important for international travellers, given the high fragmentation of this sector in Europe. This aspect could thus represent a barrier to the development of an EV market, but also a significant opportunity to attract foreign visitors, especially in cities that have important tourism attraction.
A general barrier, which is also common for most other countries, is related to the still high upfront cost of electric vehicles compared to the traditional ones, which are still limiting the adoption of the technology for many potential users. In addition to incentives, new business models such as long-term renting or leasing may play help the development of the market.
The price of electricity is an additional challenge, especially compared with petrol, diesel and gas. The current tariff model should be redefined to support EV adoption, with more favourable green tariffs for EV charging.
A recent research paper has specifically focused on BEV adoption in Croatia. Among other aspects, the paper notices that in case of EV malfunctions, inspection and service of the vehicle are performed by the authorized service centre of a particular vehicle manufacturer because there are no dedicated EV services. This stated lack is a possible reason for the low interest of users toward BEVs, due to fear of complications in case of vehicle failure, and additional costs or prolonged waiting if service or parts procurement must be performed outside Croatia.

Main uncertainties

Potential uncertainties are related to external factors, including the global availability of materials and batteries to support a significant increase of demand. If supply is not able to keep the pace of the demand increase, a market failure may impact the user's willingness to adopt EVs.

Montenegro

Review of current trends

Considering transport as a whole[7], the total number of registered vehicles in Montenegro increased from 188,000 to 209,000 in the period 2010–2016. Consequently, Montenegro has a relatively high and constantly growing rate of motorization, which reached 265 passenger cars per 1,000 inhabitants in 2015. The car fleet is also showing an increasing share of used vehicles. In parallel, the modal share of public transport in the country remains below 5%.

There is currently no official data for electric vehicles and public charging points. Official statistics of electric vehicles in 2017 record 49 vehicles, but they include also hybrid vehicles (there is no separate statistic on electric vehicles). Considering public charging points mapped by EV users[8], While there is only a DC charging site in Podgorica, some AC public charging points are available in the capital and in some cities on the coast.

Future trends

Existing strategies, quantitative objectives

In July 2019, the Strategy for the Development of Transport of Montenegro for the Period 2019-2035 was adopted. A significant increase in road traffic is expected in the future, which will have an impact on the efficiency of the state network and planned highways[9].

Considering EVs, the Third National Communication on Climate Change presents two possible scenarios of transport sector in 2030. The pessimistic scenario expects an EVs penetration of 5% of the total fleet in 2030, assuming that these 13,000 electric cars will replace diesel cars. The expected CO_2 emission savings are estimated around 23,000 tons, requiring an expected budget of 380 million euros. The optimistic scenario considers a higher EV penetration of 7.1% by 2030: the 21,000 cars in the national fleet will allow to save 38,000 tons of CO_2 emissions at a cost of around 620 million euros.

Weak signals, possible disruption factors

Montenegro has currently a lower motorization rate compared to other European countries. This is expected to increase in the future, and proper policy and measures could help to ensure that a part of this rise happen though new BEVs. Policies should target the aspects that are usually limiting BEV adoption, such as financial incentives for BEV buyers, increasing the availability of public charging network and other services related to electric mobility.

[7] Montenegro Third National Communication on Climate Change, 2020, https://unfccc.int/sites/default/files/resource/TNC%20-%20MNE_0.pdf
[8] Data obtained from www.openchargemap.org.
[9] Ibid.

Levers and barriers

A general barrier, which is also common for most other countries, is related to the still high upfront cost of electric vehicles compared to the traditional ones, which are still limiting the adoption of the technology for many potential users. In addition to incentives, new business models such as long-term renting or leasing may play help the development of the market.
In parallel to the development of an effective network of public charging systems, for smaller countries such as Montenegro the concept of e-roaming is of particular importance. Essentially, e-roaming allows EV drivers to charge their cars outside their charging service provider's network with only one customer account. This is particular important for international travellers, given the high fragmentation of this sector in Europe. This aspect could thus represent a barrier to the development of an EV market, but also a significant opportunity to attract foreign visitors, especially in cities that have important tourism attraction.

The tourist sector can also represent an interesting opportunity to develop EV charging infrastructure.

Main uncertainties

Potential uncertainties are related to external factors, including the global availability of materials and batteries to support a significant increase of demand. If supply is not able to keep the pace of the demand increase, a market failure may impact the user's willingness to adopt EVs.

Albania

Review of current trends

There are limited data on the current use of electric vehicles in Albania. Eurostat data for 2020 record a stock of 362 BEVs and 552 PHEVs registered in Albania, on a total of around 540,000 passenger cars.

Publicly accessible recharging infrastructure remains also limited, with only 3 public charging points in the country, nearby the capital Tirana.

Future trends

Existing strategies, quantitative objectives

In December 2021 Albania has submitted to the Energy Community Secretariat a Draft National Energy and Climate Plan, which includes some specific targets and policies related to electric vehicles. Specific actions include the electrification of the transport sectors and the increase of the share of EVs in the national car fleet. The expected result by 2030 is to reach 10% of electric vehicles in the total fleet. To reach this target, specific policy elements include obligations of certain subjects such as public parking or public garages to have electric vehicle charging stations, incentives or simplified procedures for construction/licensing of electricity charging stations for road vehicles, VAT exemption for new electric vehicles. Policies should be revised and possibly adjusted in around 2025 based on a policy and results evaluation.
Considering electric recharging infrastructure, the NECP has set the goal of 200-300 charging points by 2025. The measures expect to obtain a reduction of 2.5-3% of transport CO_2 emissions in 2025 and of 5-6% in 2030.

Weak signals, possible disruption factors

Albania has currently a lower motorization rate compared to other European countries. This is expected to increase in the future, and proper policy and measures could help to ensure that a part of this rise happen though new BEVs. Policies should target the aspects that are usually limiting BEV adoption, such as financial incentives for BEV buyers, increasing the availability of public charging network and other services related to electric mobility.

Levers and barriers

The large amount of renewable electricity generation in the country could represent an interesting asset to push for the decarbonization of transport through electrification. However, it is important to remember that

electricity demand may also rise in other sectors, and although the renewable potential remains significant, economic resources should be correctly allocated to ensure an effective development of renewable capacity. A general barrier, which is also common for most other countries, is related to the still high upfront cost of electric vehicles compared to the traditional ones, which are still limiting the adoption of the technology for many potential users. In addition to incentives, new business models such as long-term renting or leasing may play help the development of the market.
In parallel to the development of an effective network of public charging systems, for smaller countries such as Albania the concept of e-roaming is of particular importance. Essentially, e-roaming allows EV drivers to charge their cars outside their charging service provider's network with only one customer account. This is particular important for international travellers, given the high fragmentation of this sector in Europe. This aspect could thus represent a barrier to the development of an EV market, but also a significant opportunity to attract foreign visitors, especially in cities that have important tourism attraction.

Main uncertainties

Potential uncertainties are related to external factors, including the global availability of materials and batteries to support a significant increase of demand. If supply is not able to keep the pace of the demand increase, a market failure may impact the user's willingness to adopt EVs.

Greece

Review of current trends

There are currently more than 6 million passenger cars in Greece, with a motorization rate of 575 vehicles per 1,000 people. Available data show that PHEV and BEV new registrations increased significantly in 2020 and 2021, reaching around 5% and 2% of the total sales respectively (data from the European Alternative Fuels Observatory). Nevertheless, electric cars remain below 0.2% of the total passenger cars in Greece.

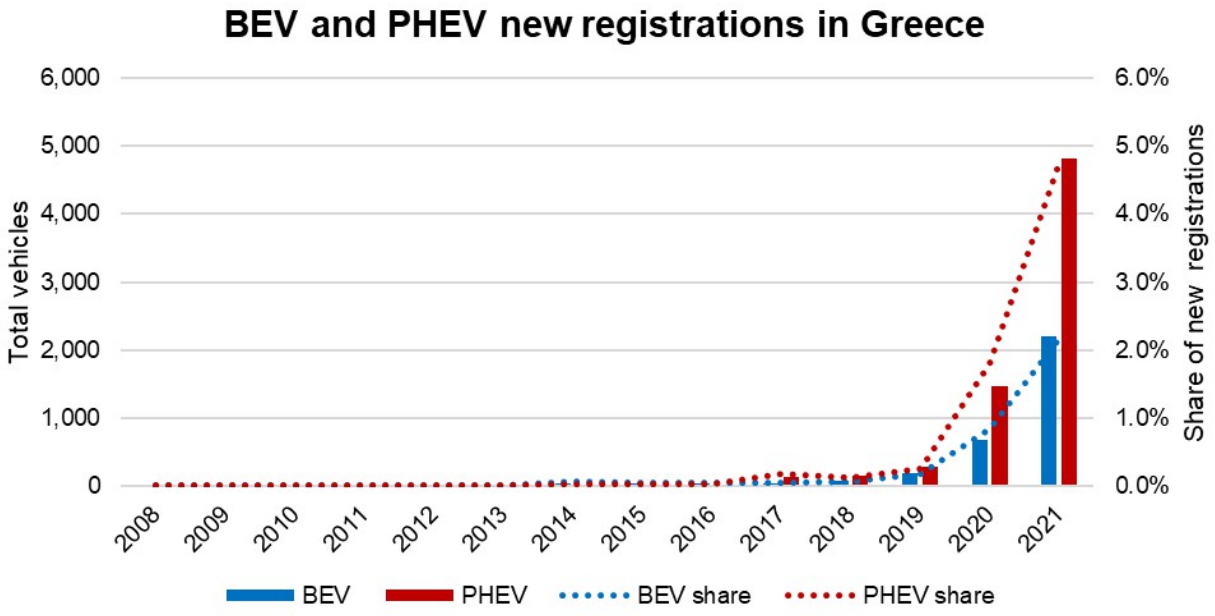

Figure 28: New electric car registrations in Greece (data source: EAFO).

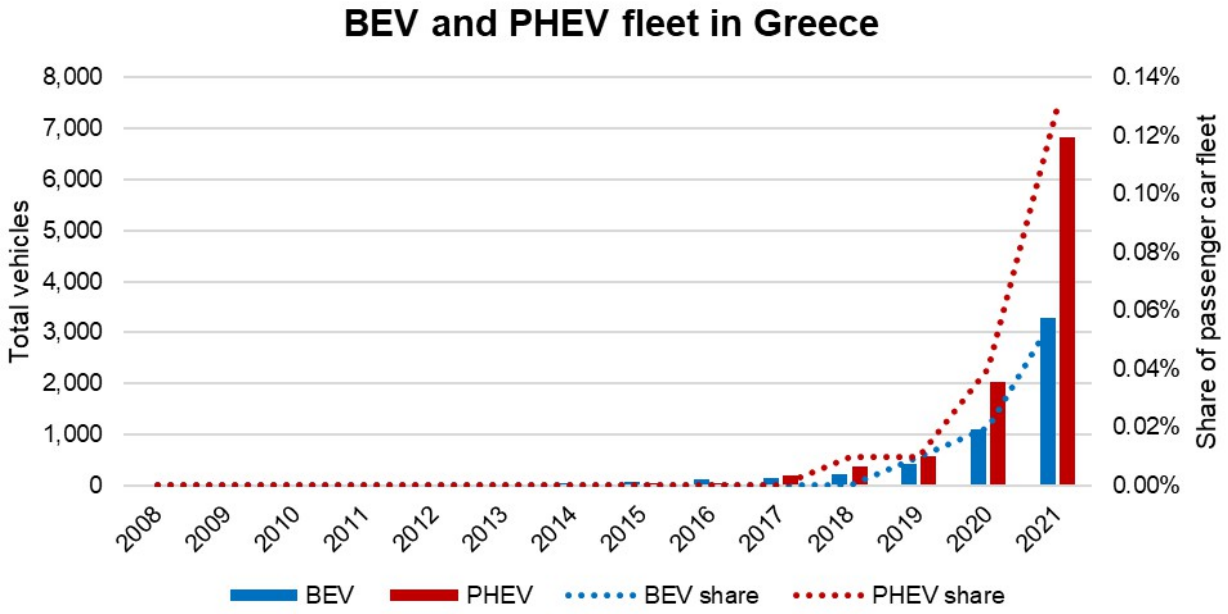

Figure 29: Electric car fleet in Greece (data source: EAFO).

Considering public charging infrastructure, Greece has set a target of 4,000 refuelling points by 2025. As of 2022, there are around 700 AC charging points and less than 50 DC charging points in the country.

EV owners in Greece benefit from registration and circulation tax reductions, in addition to national purchase subsidies and VAT reduction. In many cities, like Athens, electric vehicles can circulate also in city centres that are restricted to other cars (due to air pollution). Incentives are also available for the installation of charging infrastructure.

Future trends

Existing strategies, quantitative objectives

The TYNDP scenarios expect between 11 and 16 TWh of electricity consumption in the transport sector in 2050, of which around 6.4-7.1 TWh due to passenger cars. The following chart shows the expected evolution of electricity consumption in transport by mode, comparing the “Distributed Energy” and the “Global Ambition” scenarios. An important share of electricity consumption will be related to passenger cars, especially in the “Global Ambition” scenario, and on the medium and long term also trucks, buses and aviation will show an important growth. Rail transport is expected to remain to a very marginal share of the total consumption.

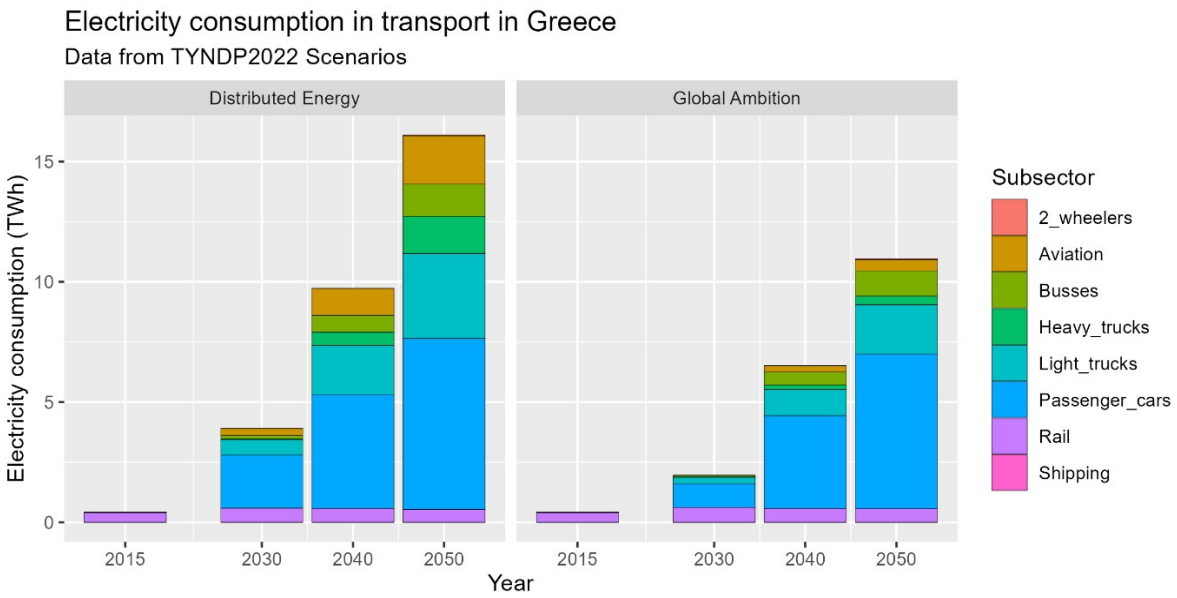

Figure 30: Transport electricity consumption in Greece in TYNDP2022 Scenarios.

The following chart represents the expected market share of new passenger cars registrations for battery electric vehicles (BEV) and plugin hybrid electric vehicles (PHEV). The "Distributed Energy" scenario show a very strong increase in BEV market share, reaching more than 80% in 2050, and a very modest increase of PHEV share. Conversely, in the "Global Ambition" scenario PHEV sales always remain above BEV sales, reaching a market share of 45% by 2050 (compared to 30% for BEV).

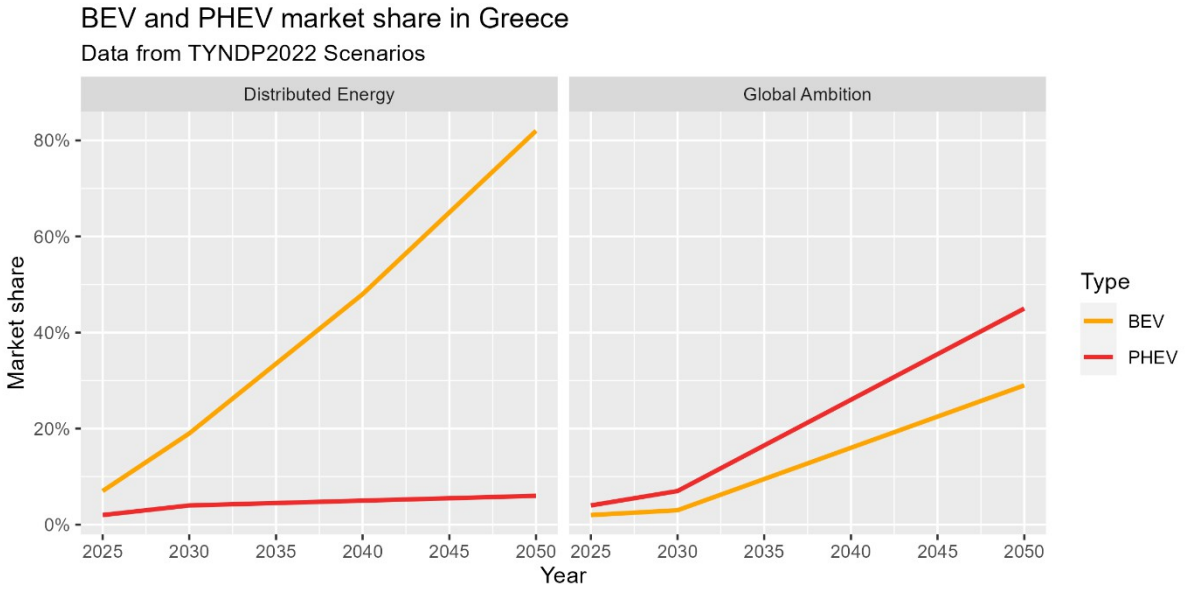

Figure 31: Future electric cars market share in Greece in TYNDP2022 Scenarios.

Greece has adopted its new National Plan for E-mobility in 2020, in line with the EU Green Deal growth strategy and part of a ten-year climate protection plan. The main goal for transport decarbonization is one in three vehicles to be electric by 2030. Considering charging infrastructure, national goals are to install 1,000 new charging stations in the next few years and 10,000 charging points in the medium term.

Weak signals, possible disruption factors

Although electric cars sales have increased in the last few years, especially for the plugin hybrid segment, the share of EVs in the total car fleet remains well below the average figures for other European countries. In order to reach the challenging targets ahead there is a need of effective and coordinated policies supporting users in adopting EVs.
A recent survey by the European Investment Bank shows that 81% of car buyers in Greece say they will either pick a hybrid (41%) or electric car (40%) the next time they purchase a vehicle (well above the European average). Only 19% would consider a petrol or diesel vehicle. Public awareness on the importance of climate change and the need of concrete actions to limit it is an important signal.

Levers and barriers

Greece already had an important increase of the share of electricity generation from renewables, which reached 40% in 2021, half produced from wind power plants. Since the renewable potential remains even higher, it represents a very important opportunity to leverage on electric vehicles to support an effective decarbonization of the transport sector. In addition to deploy an effective charging infrastructure, also EV charging strategies will need to be carefully planned to ensure that electricity demand for charging is matched with the solar and wind generation.
A general barrier, which is also common for most other countries, is related to the still high upfront cost of electric vehicles compared to the traditional ones, which are still limiting the adoption of the technology for many potential users. In addition to incentives, new business models such as long-term renting or leasing may play help the development of the market.

Main uncertainties

Potential uncertainties are related to external factors, including the global availability of materials and batteries to support a significant increase of demand. If supply is not able to keep the pace of the demand increase, a market failure may impact the user's willingness to adopt EVs.
In addition, the development of renewable power capacity needs to be developed in parallel with the increase of electric vehicles, taking into account also the other potential sectors that are expected to increase their electricity demand in the future.

Cyprus

Review of current trends

There are currently around 650,000 passenger cars in Cyprus, corresponding to a motorization rate of 722 cars per 1,000 inhabitants. PHEV and BEV new registrations have shown an increase in the last years, although the share of electric vehicles remains below 0.2% of the total car fleet in the country (data from the European Alternative Fuels Observatory).

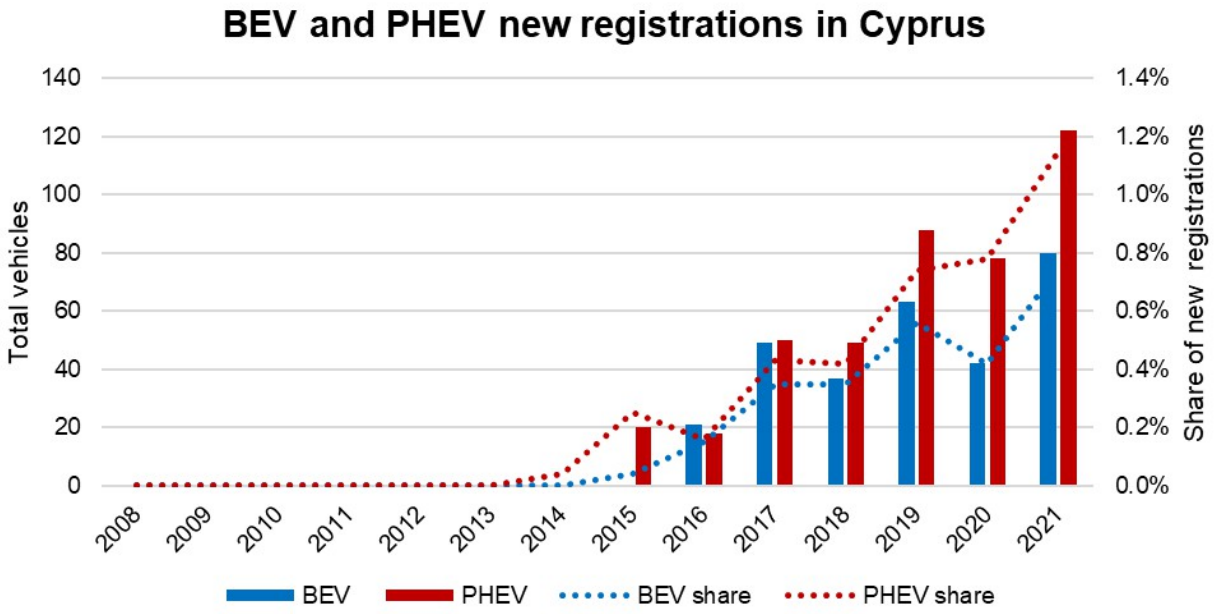

Figure 32: New electric car registrations in Cyprus (data source: EAFO).

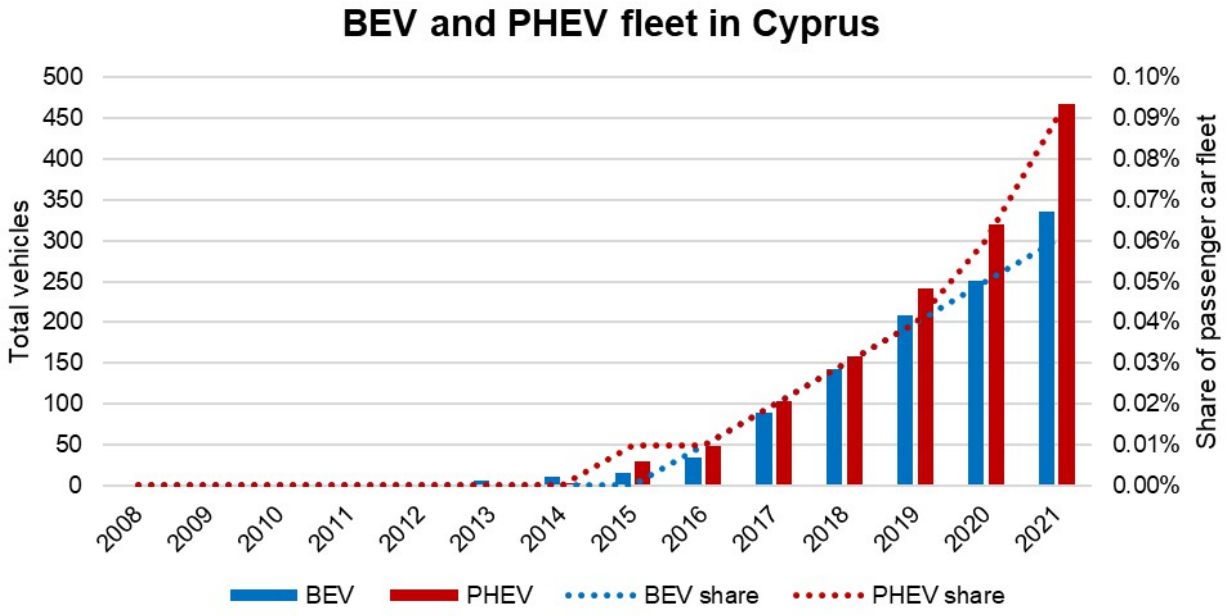

Figure 33: Electric car fleet in Cyprus (data source: EAFO).

Considering public charging infrastructure, Cyprus has set a target of 100 electric refuelling points by 2025. As of 2022 there are 76 AC recharging points and no DC recharging point.

There are some benefits for both registration and ownership taxes for vehicles emitting less than 120 g_{CO2}/km.

Future trends

Existing strategies, quantitative objectives

The TYNDP scenarios expect between 0.9 and 1.5 TWh of electricity consumption in the transport sector in 2050, of which around 0.5 TWh due to passenger cars. The following chart shows the expected evolution of electricity consumption in transport by mode, comparing the “Distributed Energy” and the “Global Ambition” scenarios. An important share of electricity consumption will be related to passenger cars, and on the medium and long term also light trucks, buses and aviation will show an important growth. In the “Distributed Energy” scenario, the electrification of aviation is expected to play a major role in the total electricity demand of the sector. There is no rail transport in Cyprus, nor it is expected in the future.

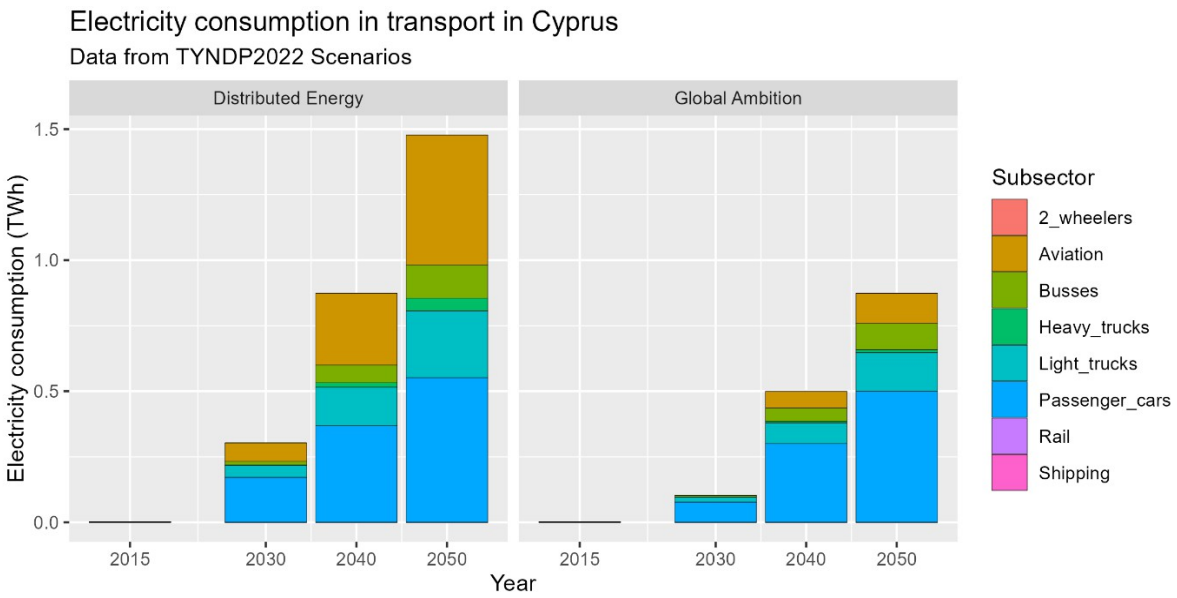

Figure 34: Transport electricity consumption in Cyprus in TYNDP2022 Scenarios.

The following chart represents the expected market share of new passenger cars registrations for battery electric vehicles (BEV) and plugin hybrid electric vehicles (PHEV). The "Distributed Energy" scenario show a very strong increase in BEV market share, reaching more than 80% in 2050, and a very modest increase of PHEV share. Conversely, in the "Global Ambition" scenario PHEV sales always remain above BEV sales, reaching a market share of 45% by 2050 (compared to 30% for BEV).

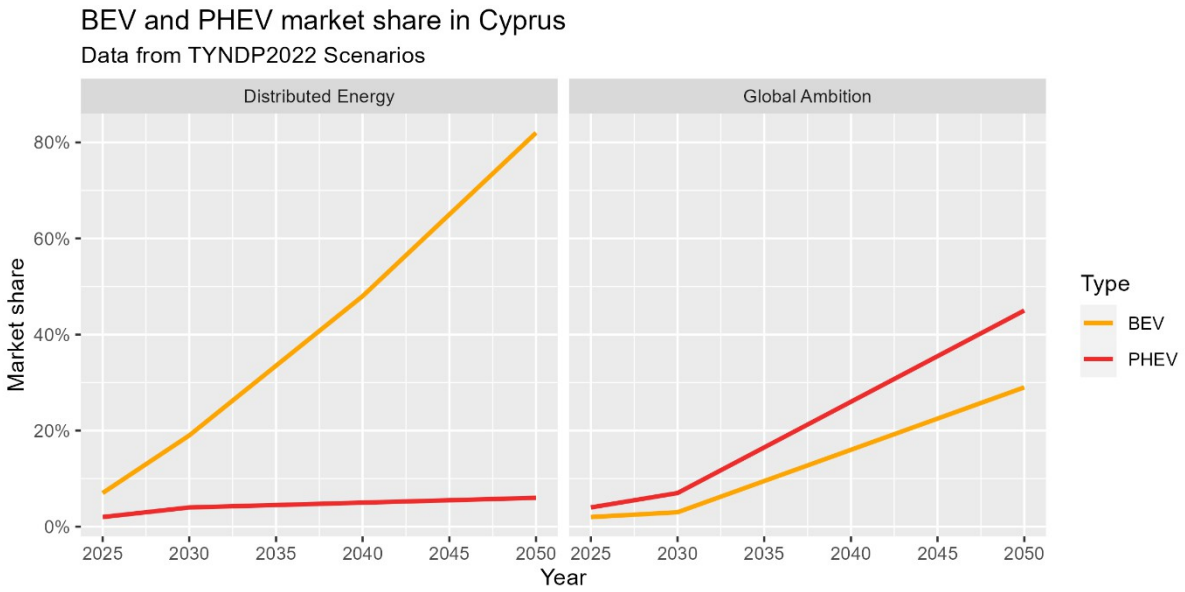

Figure 35: Future electric cars market share in Cyprus in TYNDP2022 Scenarios.

The National Government has set a target of 100% of new cars registrations to be electric by 2035, in line with the current EU target. To do so, generous incentives have been proposed to support owners in buying a new electric car, up to 10.000 € per vehicle. However, this measure has not been particularly successful, and critics have argued that most of the benefits have not been fairly distributed to the population, given the fact that in most cases they have not made EVs cheaper than traditional cars.

Weak signals, possible disruption factors

Most electric vehicles in the country have been purchased by private citizens (94% in 2021, the highest rate in Europe), while in early stages of electrification it would be useful to support electric fleets for companies and public bodies. The availability of fleets of electric company cars usually add to the second-hand market and make them more affordable for the private users. This could be an interesting disruption factor in the country.

A recent survey by the European Investment Bank shows that 85% of car buyers in Cyprus say they will either pick a hybrid (51%) or electric car (34%) the next time they purchase a vehicle (the highest level among European countries). Only 15% would consider a petrol or diesel vehicle. Public awareness on the importance of climate change and the need of concrete actions to limit it is an important signal.

Levers and barriers

The size of the island is relatively small, resulting in lower average distances driven compared to other countries. This is of particular interest for electric vehicles, since the maximum trip on the island is well below their average range. However, a significant improvement of the charging network is necessary to support EV adoption.

A general barrier, which is also common for most other countries, is related to the still high upfront cost of electric vehicles compared to the traditional ones, which are still limiting the adoption of the technology for many potential users. In addition to incentives, new business models such as long-term renting or leasing may play help the development of the market.

Considering the potential environmental benefits of EVs, electricity generation in Cyprus is still heavily relying on oil products (more than 84% of the total power generation in 2021), making many experts to question the effectiveness of electric cars as a solution to fight climate change. Moreover, electricity generation from oil products is also generally more expensive compared to other sources. This remains among the most important barriers for EVs effectiveness in national environmental policies. Thus, in parallel to actions towards transport electrification it is of paramount importance that the country further develops renewable generation (which in ten years has increased from nothing to 15% of the total, of which one third from wind and two thirds from solar).

Main uncertainties

Potential uncertainties are related to external factors, including the global availability of materials and batteries to support a significant increase of demand. If supply is not able to keep the pace of the demand increase, a market failure may impact the user's willingness to adopt EVs.
As discussed above, the evolution of the electricity sector towards renewables remain a major aspect in determining the effectiveness of electric vehicles in supporting road transport decarbonization.

5. Conclusion

MENA Countries

Typology of MENA countries in terms of E-Mobility

Globally and for most of the MENA countries located at the southern and eastern bank of the Mediterranean basin, transition of the road transport to E-Mobility does not present yet a prior need, despite an increasing awareness of its benefits, especially for countries with no domestically produced conventional fuels' sources, and a stressful congestion context in main urban centers.

Prior requirements can be identified in many countries, or many cities / regions of the subject countries, as (1) the restructuring of the overall land transport sector, especially in the urban areas, (2) the set-up of appropriate traffic management means and schemes, (3) the expansion of the mass-transit routes, (4) the renewal of the old vehicles, aside to (5) the withdrawal of the informal public transport systems that have been providing disorganized and low quality services to passengers.

The upgrade, the capacity enhancement of the electricity supply, and more Renewable Energy sources' injection within the electricity grid, are among other prior needs for many of the MENA countries.

However, different levels of advancement to the E-Mobility could be analyzed, depending on countries, which is summarized within the following table, that shows the level of E-Mobily's initiation and development, according to the current statues, identified based on the documents' reviews, and the outcomes of the interviews conducted with some involved local stakeholders.

Israel appears as an exception within this List, as it is the most developed in the E-Mobility's implementation, vehicles and components' manufacturing and related research and development activities.

Turkey, Jordan, Egypt and Morocco could be globally ranked among the most advanced countries in the current E-Mobility's implementation, as memorized below.

Current Status	Concerned MENA Countries
Not Focused yet on E-Mobility	**Libya, Syria**
E-Mobility vaguely targeted /encouraged and no significant actions adopted / planned yet by the Government	**Lebanon** (E-mobility initiated in a limited level just by the private sector) **Algeria** (E-mobility insignificantly initiated mainly by thby the private sector)
E-Mobility already initiated, but remains not enough developed and with unknown future development perspectives	**Palestine**
Insignificant E-mobility initiated, but ongoing active planning and studying stage of the E-mobility	**Tunisia** (E-mobility initiated in a limited level by the public and private sectors)
Already implemented E-mobility with positive recorded growth trends and planned more developments	**Israel** (both private and public EVs / E-Buses. Charging stations already widely spread nationwide) **Turkey** (both private and public EVs / E-Buses. Charging stations nationwide) **Jordan** (especially EVs in various urban centers and E-Buses in Amman, and more development of the electric mass transit system (E-buses) in other main cities. Charging stations nationwide in urban centers) **Morocco** (especially Electric road mass transit / E-bus systems in main cities) **Egypt** (both private and public E-Mobility. Charging stations nationwide in cities and on intercity routes)
Ongoing/planned/announced domestic/local EVs and related components' manufacturing / assembly projects	**Israel** (Several domestic industries already producing EVs and batteries and involved in R&D activities to improve the EVs and batteries' performances) **Turkey** (EVs' manufacturing by domestic industries and western automotive companies locally setup under preparation, and to be launched in 2023)

Current Status	Concerned MENA Countries
	Morocco (Local manufacturing of EVs and batteries by foreign automotive industries already planned) **Egypt** (E-buses' local manufacturing is targeted and might be under preparation, commonly by foreign automotive industries and local stakeholders) **Tunisia** (Domestic manufacturing of a brand of E-cars and required batteries under preparation, as a single private initiative, for export and domestic uses)

- It is not realistic to envision a progress on the short / middle term, in the E-Mobility's preparatory stages neither in Libya, nor in Syria, because of their special global contexts have made the socio-economic development a real challenge in each of these countries.

- E-Mobility is vaguely targeted in Lebanon and Algeria, but seemingly there is no effective planning and preparatory activities already undertaken by the public authorities, in a comprehensive and coordinated way, to move towards action plans, in the near future.

  This is due to the challenging context of Lebanon that is facing difficulties in many sectors and where the existing electric system is not anymore able to meet the country's demand, especially in Beirut, the capital.

  While the Algerian authorities seem to be currently rather concerned by the electrification of the railways, and the modernisation and expansion of all rail modes. Transition to road vehicles consuming gas (Liquified Gas Petrol (LGP) vehicles and Compressed Liquified Gas (CLG) Buses), appears also as a prior targeted objective by local authorities, compared to the transition to the road electric vehicles.

- Palestine is evolving in an outstanding context, where significant challenges are defeating the overall mobility and transport flows of passengers and goods, which threatens the economic viability of any E-Mobility plan. Despite this situation, E-Mobility has been initiated in Palestine, rather to facilitate the old vehicles' renewal. Future progress remains unknown, despite the encouragement of Transport Experts to develop the E-Mobility in major congested cities of the West Bank, especially.

- Despite official announcements of the requirement to transit to E-Mobility in Tunisia, concreate actions have not been implemented yet. The country is however on an active progress to pave the way to a near future E-Mobility's implementation, as many studies have been developed and are under conduction, or being launched, to analyse many E-Mobility issues and plan for it. At least too

seminars on the E-Mobility planning and regulatory issues took place in Tunis, with local and foreign stakeholders' participations, during the period of this deliverable's elaboration.
Major incentives could be behind the E-Mobility's development in Tunisia, mainly the heavy weight of the imported fossil fuels' costs in the country's trade balance that has been in a critical situation, overall all the last decade and up to now.
Moreover, Tunisia has even a private plan for electric cars' domestic manufacturing for near future export, and the local market needs.

- Jordan, Morocco and Egypt are among the most advanced countries in the E-Mobility's implementation, compared to the other Arab MENA countries. Each of these 3 countries has its own motivational factors behind this achieved progress:

  - The domestic fossil fuel prices have been steadily increasing in the Jordanian market, and the thermal vehicles' expenses are getting unaffordable. This, aside the reduction of the EVs' capex, has incentivized both the local authorities and the road users to transit to the E-Mobility, especially because of a weak and not enough expanded mass transit system. The recent private E-mobility's growth trend has been impressive in Jordan, despite a limited number of charging stations and their limited geographical spread;

  - In Egypt, there is a big concern of congestion, increasing emissions of the road transport system, and air pollution, mainly in Cairo, but also in other major cities. This must have been among the major motivations for developing E-bus systems in Cairo and Alexandria, and implementing the E-Mobility for the private motorized transport, both in cities and along intercity road connections. The spreading new cities, under construction to decongest Cairo, and the positive perspectives on the economic growth of Egypt, lead to expect a future moderate to steady growth trend of E-Mobility in Cairo, other major cities and along the motorway corridors (over the middle and long terms), especially for the public transport;

  - Morocco seems in a planning and implementation process of an environmentally sustainable transport system, since COP22 of Marrakech in 2017/18. Morocco has launched E-Bus transport pilot projects in its three main cities (Marrakech, Rabat and Casablanca), which are already planned for future expansions.

- Turkey can be identified as a 'developed country' of the MENA countries in the E-Mobility's planning, recorded implementation and related manufacturing development. The country aims at more development of the private and public E-Mobility, especially for the middle and long terms.
  Turkey seems in a competing process with the EU countries, to approach their level of development in the transition to the road E-Mobility, especially for the private transport, but also for the mass transit, and priory in the mega city of Istanbul. Plans are also being developed for the domestic E-vehicles' manufacturing (E-cars and E-buses).

- Israel stands on top of all the studied MENA countries, as it has implemented both private and public E-Mobility and the charging stations reached already a remarkable number, aside the announced perspectives on hundreds of more E-buses, and charging stations for the upcoming months and up to 2024. The country has a 'developed' legislation regarding the charging facilities and already manufactures EVs and their required batteries, aside plans for more production and higher technological performances.

Summary of some indicators and available information on the current and foreseen mobility context of the E-mobility in the MENA countries

The following tables, progressively presented below in this chapter, summarize some indicators and the gathered and analyzed available information on the studied MENA countries, regarding the E-Mobility.

➢ The first table summarizes general indicators on the current situation.

The **Population density** and the **Urbanization Rate** (nationally assessed for a recent reference year), could successively provide evaluations of (1) the potential traffic congestion and the emergency level of the E-Mobility development by country, and of (2) the spread of the population living in cities, as the E-Mobility is expected to be developed prior in the urban areas.

The **GDP per capita's annual growth rate**, recorded for 2020-2021, is another macro-economic characterization that contributes to help assessing the potential for E-vehicles' affordability by the users in the near future, in each of the studied MENA country, as the electric vehicles' purchasing prices in the local markets is still a main concern in most of the subject countries, and could be among the main factors for a slow progress of the E-mobility over the upcoming years.

The indicator on **recently registered Vehicles x Kms of Roads**, helps assessing the achieved advancements in the expansion of the motorized vehicles' fleet and the road infrastructures, and the importance level of the road mobility as a whole by country, to make a comparative analysis between the MENA countries.

Moreover, the **motorization rate (including all motorized vehicles) and the car ownership/motorization rate**, assessed as national averages for a recent recorded year, help prioritizing the countries in terms of private motorized mobility's affordability, as a whole.

MENA Country	Population Density / Urbanization Rate	Annual Real GDP per capita change rate 2020-2021 (at constant prices of 2015)	Vehicles x Kms of Roads	Motorization Rate (Overall registered vehicles per person)	Car Motorization /Ownership Rate	Current Major Mode(s) with Highest Modal Share in Road Passengers' Transport
Morocco	**86.53 inhab./km²** (2021) **64% of Pop. in urban areas** (2021)	**6.1%**	**~ 304,805 million** (projections of the vehicles' number for 2021)	**~1.42 V. per 10 persons** (projections for 2021 all modes included)	**0.98 to 1.0 V. per 10 persons** (estimates for 2021)	Cars, Buses and Minibuses
Algeria	**18.73 inhab./km²** (2021) **74% of Pop. in urban areas** (2021)	**2.1%**	**~ 710,547 million** (2019)	**~1.50 V. per 10 persons** (2019, all modes included)	**~1.0 V. per 10 persons** (2019)	Cars are the dominant mode
Tunisia	**72.95 inhab./km² (overall)** (2021) **~ 70% of Pop. in urban areas** (2021)	**2.3%**	**~ 31,000 million** (2018)	**~2.10 V. per 10 persons** (2018, all modes included)	**~1.35 V. per 10 persons** (2018)	Cars, and individual taxis are the dominant mode
Libya	**~ 3.96 inhab./km²** (2021) **81% of Pop. in urban areas** (2021)	**29.7%**	**~ 420,000 million** (Approximate recent estimate)	**~ 7.20 V. per 10 persons** (Approximate estimates)	Unpublished updated data	Cars are the dominant mode
Egypt	**103 inhab./ km²** (pop. / territory area in 2021) **2,346 inhab./km²** (according to the population geographical spread, in 2021)	**1.4%**	**336,262 million** (2020)	**0.98 V. per 10 persons** (2020, all modes included)	**Lower than 0.25 V. per 10 persons** (2020)	Shared Taxis and Buses Dominated by informal Mass Transit

MENA Country	Population Density / Urbanization Rate	Annual Real GDP per capita change rate 2020-2021 (at constant prices of 2015)	Vehicles x Kms of Roads	Motorization Rate (Overall registered vehicles per person)	Car Motorization /Ownership Rate	Current Major Mode(s) with Highest Modal Share in Road Passengers' Transport
	43 % of Pop. in urban areas (2021)					
Jordan	**119.6 inhab./km²** (2020/21) **92% of Pop. in urban areas** (2021)	**1.6%**	**15,534 million** (2020)	**Higher than 1.7 V. per 10 persons** (2017 modes included)	**1.67 V. per 10 persons** (2017)	Cars are the dominant mode
Palestine	**868 inhab./km²** (overall, 2019) **522 inhb./km²** (West Bank 2019) **5,374 inhb./km²** (Ghaza strip 2019) **77% of Total Pop. in urban areas** (2019)	**Information not available**	**~ 1,77 Up to ~2,267 million** (if including bypass roads serving Israeli settlements) (2020)	**0.96 V. per 10 persons** (2021, all modes included)	**0.76 V. per 10 persons** (3 times higher in congested area of Ramallah) (2021)	Cars are the dominant mode (more than 82% of the fleet share, 2021)
Israel	**462.2 inhabitants/km²** (2021) **92% of Total Pop. in urban areas** (2021)	**6.5%**	**Exceeding 73,000 million** (by 2021)	**4.05 V. per 10 persons** (2021, all modes included)	**3.51 V. per 10 persons** (2021)	Cars and small carriers
Lebanon	**648 inhab./ km²** (2021, including refugees) **88.5% of Pop. in urban areas** (2019)	**-9.8%**	**43,436 million** (2013)	**3.13 V. per 10 persons** (2015, all modes included)	**2.70 V. per 10 persons** (2015)	Cars are the mainstream mode (~85% of the fleet share)

MENA Country	Population Density / Urbanization Rate	Annual Real GDP per capita change rate 2020-2021 (at constant prices of 2015)	Vehicles x Kms of Roads	Motorization Rate (Overall registered vehicles per person)	Car Motorization /Ownership Rate	Current Major Mode(s) with Highest Modal Share in Road Passengers' Transport
Syria	**~ 99 inhab./km^2** (2021)	**Information not available**	Should exceed **139,700 million** (2020)	**~ 1 V. per 10 persons** (2018/19, all modes included)	Unpublished registered cars number	Cars and small carriers / collective taxis and microbuses
Turkey	**108.5 inhab./km^2** (2021) **75.7% of Pop. in urban areas** (2020)	**10.1%**	**1,634,393 million** (2020)	**~ 3 V. per 10 persons** (2021/22, all modes included)	**1.54 per 10 persons** (2021)	Cars and Mass Transit systems in major cities

➢ In the Table below, the existence or not of Bus Rapid Transit (BRT) systems by country, either in the current situation or as an announced measure / adopted future plan, helps evaluating the potential for the E-Buses' integration in a country, as the BRT systems have higher potential to be converted into electric mass transport systems, notably because of their exclusively assigned routes.

The announced targets in the GHG emissions' reduction, defined within the Nationally Determined Contributions (NDC) of countries to prevent the climate change under the Paris Agreement, could inform on the level of goodwill and capacity by country to implement new decarbonizing transport actions, especially for those with defined and quantified NDC targets assessed for the Transport sector.

The table summarizes also the current situation of E-Mobility's implementation, and reminds the stocks of circulating electric vehicles and the number of operational charging facilities.

➢ The subsequent second table summarizes the gathered information on what can help drawing the future perspectives of the E-Mobility by country, based on the availability of the strategic / political visions, the already defined targets in E-Mobility (in terms of future circulating E-vehicles and charging facilities to set up), the regulatory and incentivization measures already setup / targeted and the ongoing or targeted measures and objectives in terms of the electric vehicles' manufacturing and their supply chains.

MENA Country	Existence of BRT Systems in Urban Areas	Targeted GHG Emissions' Reduction Objectives	Current Road E-Mobility Development
Morocco	BRT already operational in Marrakech, Rabat and recently launched in Casablanca, using E-buses	* Reduction of the country's global emissions by at least **18.3% (unconditional) to 45.5% (under conditions) by 2030**, with 2 to 7 targeted mitigation measures for the Land Transport sector (Public transport fed by RE based supply, according to Morocco updated NDCs of 2021) * Already signed the COP26 declaration **on accelerating the transition to 100% zero emission - cars and vans**.	* Already developed fully E-bus mobility in the three main cities of Marrakech (10 E-buses with a 45,000 Passengers /day unit capacity), Rabat (1 line), and Casablanca.
Algeria	No information	Reduction of the country's global emissions by **7 to 22% by 2030**, according to Algeria NDCs published in 2016 (and not updated since then).	* Insignificantly initiated by the private sector, with a very low circulating EVs' stock, and with private charging means.
Tunisia	Planned BRT system in Greater Tunis	Commitment to reduce the overall Carbon Intensity reasonably **by 27%, and potentially up to 45% by 2030** (under conditional factors), compared to 2010.	* Hybrid electric cars (PHEV) are been sold in the Tunisian market, by 4 cars' sellers. * **Road EVs' Stock: unpublished** * **Charging stations' number: 48 e-charging stations** setup in various cities by private companies and in hotels (2021) * Initiation of E-Bus services in Greater Tunis, in 2018, without more development.

MENA Country	Existence of BRT Systems in Urban Areas	Targeted GHG Emissions' Reduction Objectives	Current Road E-Mobility Development
			* Growing trend of the soft E-mobility by 2-wheeled Battery Electric Vehicles (BEV) in some areas of major cities.
Libya	No BRT system	Undefined NDCs of Libya	* E-Mobility is more likely not developed yet
Egypt	Planned BRT system within Cairo	* Commitment to reduce the Transport Sector's GHG emissions **by 7% by 2030** (compared to a baseline scenario extending the 2015 trends). *** Targeted ban of new fossil fuel Vehicles by 2040**	* **Public E-buses stock:** at least **17 Battery-Electric Buses** in operation in Cairo and Alexandria (by 2021) * **Other EVs' Stock:** Unpublished * **Charging stations' number: existing 18 stations for E-Buses** (at least) and **soon up to at least 97 charging stations (440 charging points)** announced for cars/ private vehicles in 10 governorates, along main inter-city corridors.
Jordan	BRT system in Amman (the capital)	Commitment already done to reduce the country's GHG by **31% by 2030**, and Transport sector is placed among main fields of planned actions.	* **Road EVs Stock (by 2021): 250,000 Hybrid cars and private vehicles** (~18% of the overall circulating fleet)**, 30,000 fully electric cars (BEV) and private vehicles** (~2.4% of the overall fleet), and **100 E-buses in Amman (mainly hybrid, and including fully electric vehicles /BEV)** * **Charging stations number: 15 stations countrywide**, located only in the urban cities, in the gasoline distribution stations and operated by private companies. This number must not be exhaustive (Residential and informal charging facilities might exist also).

MENA Country	Existence of BRT Systems in Urban Areas	Targeted GHG Emissions' Reduction Objectives	Current Road E-Mobility Development
Palestine	Intra-city BRT is encouraged in major cities (Nablus, Ramallah/Al-Bireh, Hebron) (according to the Transport master scheme of 2016)	Commitment updated in 2021 to reduce emissions of the passenger vehicles' fleet to shrunk **by 8% by 2030, and by more 4% by 2040**	* **1%** of the circulating private vehicles corresponds to fully Electric /Hybrid Electric Vehicles (with batteries and plug-in types)
Israel	BRT systems already operated in a number of cities (as Haifa since 2013)	Commitment done to **ban the introduction of new Diesel and petrol vehicles by 2030**, and to accelerate the transition to **100% zero emission cars and vans by 2050.**	* **Road ~~of~~ EVs' Stock: 300,00 Hybrid E-cars**, aside to **some fully electric cars**, **and 4,315 E-taxis** (around one-fifth of all taxis' fleet of the country) **by 2021**; **around 100 E-buses in 2020** * **Charging stations number: 2,500 stations located in the fuel distribution stations, by the end of 2021**
Lebanon	BRT already planned for Greater Beirut Area	Commitment done to reduce the country's global GHG emissions **by at least 15% by 2030** compared to 2010.	* Still insignificantly developed, by private stakeholders / NGOs which are importing mainly Hybrid and some fully electric vehicles. * A number of charging facilities exists in some commercial malls. * No effective coordination between stakeholders in the E-Mobility's development * **EVs existing stock and charging stations' number:** Unpublished
Syria	Unavailable data on a future BRT planning	Mitigation measures in the Transport Sector roughly defined in the NDCs of Syria of 2018 (not updated since that).	* E-Mobility is more likely not developed yet
Turkey	Existing a BRT system that is planned to be decarbonized	* Commitment to reduce the overall GHG emissions **by 21% by 2030.**	* **Road EVs' Stock (estimates for 2022): ~ 55,000 vehicles** (private and public vehicles): **~ 48,000 Hybrid and 6,500 to 7,000 full electric vehicles (BEV)**

MENA Country	Existence of BRT Systems in Urban Areas	Targeted GHG Emissions' Reduction Objectives	Current Road E-Mobility Development
		Actions in the Transport sector are announced. *Commitment, within the framework of COP26, to **accelerate the transition to zero emission cars and vans having**. ***'Istanbul Climate Vision'** targeting the progressive shift of Istanbul to a carbon neutral and climate resilient world city by 2050.	currently circulating, increased at a significant growth trend *** Charging stations' number (august 2022): ~3,457 stations countrywide: 818 private stations and 2,639 public facilities**

Country	Vision / Strategies / Plans / Actions on Foreseen E-Mobility	Targeted Objectives on E-Mobility	Incentives for E-Mobility (Regulation)	Context of Local Industrial EVs' Manufacturing
Morocco	Different studies already launched: * Comprehensive Study on an E-Mobility National Master Plan, * Study on support program to the E-Mobility by Public & Private Stakeholders, * Study on E-Mobility deployment and support in the Public Transport & urban centers	* Expansion of the overall E-BRT buses' stock of Marrakech from 10 (current situation) to **58 E-buses by 2030** * Expansion of the E-buses system of Rabat from 1 to **5 lines** (in the short term) * **Future Stocks of targeted EVs:** unpublished data * **Future number of charging stations:** unpublished/ not defined data	Ongoing study of the E-Mobility National Master Plan (started in 2021) covering the regulatory, tariffing, and institutional issues of the E-Mobility (unpublished outcomes).	* Recent initiation of local manufacturing of some Western brands' EVs in Morocco * Targeted perspectives to set up domestic EVs' assembly industries *** Announced Targeted Number of Locally manufactured EVs: 300,000 vehicles** (more likely by 2025, for export and domestic market)

Country	Vision / Strategies / Plans / Actions on Foreseen E-Mobility	Targeted Objectives on E-Mobility	Incentives for E-Mobility (Regulation)	Context of Local Industrial EVs' Manufacturing
				*** Manufacturing start of Lithium-ion batteries for EVs expected by the end of 2022**
Algeria	**Not yet defined strategic framework, neither action plans**. Just a global announcement of targeted EVs' number by 2030, made by the Ministry of Transport.	- **Targeted Future Stocks of EVs: 100,000 by 2030** (modal and technology breakdown is unpublished/not defined) - **Targeted Future Stocks of Charging Stations (Pilot Project):** unavailable/ not defined data.	**Taxes' exemption for the EVs' purchase costs, decided within the very recently validated 2023 Finance Law.**	Locally installed foreign automotive companies planning to produce EVs.
Tunisia	*** National Transportation Master Plan 2040 of Tunisia** is targeting the road sector's decarbonization * Ongoing preparations of: (1) a **National Strategy of E-Vehicles' integration in Tunisia**, (2) **E-cars' mobility promotion** (targeting first the administrative vehicles), (3) a **High-level strategy for deploying E-buses** ***** The **2040– strategy for the Renewable Energies' use by**	- **Targeted Future Stocks of EVs: 1,000 Hybrid and fully E-cars cars by 2023,** increasing to **5,000 by 2025**, and to **50,000 EVs by 2035**. - **Future number of charging stations: at least 58 stations nationwide for the short term** (10 new stations to be developed by the public company of the fuel distribution (6 within main urban cities, and 4 along main motorways) aside	**A 50% reduction of the consumption duty** (that is imposed on the road vehicles), decided for the benefit of the Hybrid and Battery Electric vehicles, already defined **within the 2022 Finance Law** of Tunisia (estimated though not enough by experts to optimally road incentivize users).	***** Domestic manufacturing of EVs is already announced by the uniquely available Tunisian automotive company. ***** Domestic manufacturing / assembling of E-buses is roughly targeted for future development.

Country	Vision / Strategies / Plans / Actions on Foreseen E-Mobility	Targeted Objectives on E-Mobility	Incentives for E-Mobility (Regulation)	Context of Local Industrial EVs' Manufacturing
	AGIL (public company managing the oil distribution stations), as a preparatory step for planning its charging facilities within the fuel distribution stations	to the private already existing 48 e-charging stations);		
Libya	Not available	Unknown	Unknown	Not targeted
Egypt	National Mobility/Transportation Strategy targeting the E-mobility's development under preparation	* More development of the Private and Public E-Mobility targeted * **Future Stocks of E-Buses: soon (in 2 years at most) at least 65 E-buses targeted** in Cairo and Alexandria (aside other targeted cities) * **Other targeted EVs' stock:** unpublished * **Targeted Charging facilities: soon (in 2 years at most) at least 97** (400 charging points)	* Unknown (financial incentives as **Emission Taxes,** have though been **recommended** in a recent study for the Cairo context).	* Development of local manufacturing E-Buses already announced and targeted, with 45% of the components domestically made
Jordan	* Ongoing preparatory stages of a strategy and an action plan for E-Mobility, within the Road Transport and Energy sectors' planning.	* More development and spatial spread of Public and Private E-Mobility is targeted (progressively up to 2025); * Set up of more E-Buses in the cities of Irbid and Zarqa cities;	* Attractive Tax granted by the Government for the private EVs CAPEX. * Attractive tariffs of the private charging stations	* Seemingly, not targeted yet.

Country	Vision / Strategies / Plans / Actions on Foreseen E-Mobility	Targeted Objectives on E-Mobility	Incentives for E-Mobility (Regulation)	Context of Local Industrial EVs' Manufacturing
	* Already targeted objectives in E-Mobility in the NDCs document (updated in 2021), and in different Plans /Strategies of the Transport, Energy and Environment sectors.	* Targeted increase of the electric 2-wheeled vehicles; * Targeted nationwide spatial spread of the charging facility system * **Future Stock of EVs: ~ Exceeding 302,000 vehicles soon (in upcoming years before 2025),** if we consider the 280,100 current EVs and E-Buses recorded in 2021, and at least 21,000 to 22,000 more public E-vehicles (cars/little vehicles) of the Government, already announced. * **Future Stock of Charging facilities:** unpublished	defined by the Government, but are still not motivational enough for the private investors of the charging sector. * Ongoing analysis of future new incentives for the EVs and batteries' acquirements, and the charging tariffs.	
Palestine	Road & Transportation Master Plan (2016) (with roughly defined recommendations), and other **planning preparation stages of implementing Smart Transport and Intelligent Transport Systems (ITS) and E-Mobility** for the short term	* **Future Stocks of EVs, and Charging facilities:** the more likely not determined	* **BEVs and PHEVs' purchase tax reduction operated since 2010**, (having led to a modest shift to the E-Mobility).	* Not targeted.

Country	Vision / Strategies / Plans / Actions on Foreseen E-Mobility	Targeted Objectives on E-Mobility	Incentives for E-Mobility (Regulation)	Context of Local Industrial EVs' Manufacturing
	(without any quantified and detailed action plans).			
Israel	* A two-year fighting climate change program set-up by the ministries of Transportation, Energy and Environmental Protection (potentially targeting the 2024 horizon), aimed at accelerating the transition to the E-Mobility.	* **Hundreds of new E-Buses** planned to be operated within the two upcoming years (potentially progressively **up to 2024**) * **Hundreds of new charging stations** are being under development and would be operational within few months (**during 2023**).	* Motivational tax already applied for the EVs purchasing prices. * New taxation and economic rules are under study for the alternative propulsion transport systems (including the EVs); * **Planned new subsidies for charging stations and for purchasing new electric buses** (hundreds of new E-buses are planned for the near future, up to 2024).	Existing several domestic automotive industries manufacturing EVs and batteries, and developing R&D activities to enhance their products' performances, notably in terms of emissions' reductions.

Country	Vision / Strategies / Plans / Actions on Foreseen E-Mobility	Targeted Objectives on E-Mobility	Incentives for E-Mobility (Regulation)	Context of Local Industrial EVs' Manufacturing
			* New legislation for an **obligation of incorporating charging stations within the shared residential buildings since the planning phases.**	
Lebanon	* No strategic policies developed / adopted yet, dealing with the E-mobility's future development in Lebanon, but there are many papers and programs, promoted by several ministries, encouraging the shifting towards a sustainable transport sector that includes among targeted actions, the E-Mobility's development. * A Solar Powered Electric Public Bus system project announced for development in the city of Byblos (could be a pilot project).	* Strategic recommendations (not adopted yet by Government): (1) a prior development of the Hybrid electric vehicles (progressively up to 2030), (2) Setup of E-Buses, for the longer term (to be dominating by 2050, as they require a wide-scale deployment of the charging facilities and higher investment). *** Start horizon of the governmental implementation of the E-Mobility: assessed to <u>2027</u> (by ALMEE) and more optimistically to <u>2025</u> (by LCEC)** *** Future Stocks of targeted EVs, and targeted charging facilities:** not determined yet	* Probate of the fully and hybrid electric vehicles allowed. * A draft **energy conservation law**, **targeting the exemption of the electric vehicles' import from the duty taxes and more motivational measures for the public and private EVs usage**, is already defined by the ministries of finance, energy and interior affairs. The law's final version and approval are expected by **2023**.	* Not targeted.

Country	Vision / Strategies / Plans / Actions on Foreseen E-Mobility	Targeted Objectives on E-Mobility	Incentives for E-Mobility (Regulation)	Context of Local Industrial EVs' Manufacturing
		*** Targeted level of E-Mobility by that horizon: 3% of the national passengers x km**		
Syria	**Syria's NDC document of 2018,** with brief encouragement of environmental-friendly vehicles (including EVs and Hybrid EVs). No more updated announcements / plans.	* **Future Stocks of targeted EVs, and targeted Charging facilities**: not determined	* More likely not determined	***** Not targeted yet (a progressive overall socio-economic recovery is needed as perquisite).
Turkey	*** National Energy Strategy** planning the E-Mobility future context (under preparation) ***** 'Istanbul Sustainable Urban Mobility Plan' *(SUMP)* addressing more development in the E-Mobility. ***** Other comparable 'SUMPs' are under studies for other main cities.	*** Targeted Future Stocks of EVs: 72,000 to 73,000 by 2023 / up to 248,000 by 2024,** and announced **to more than 1.055 million of fully electric and plug-in vehicles by 2030**, if we include the current EVs stock aside to only EVs planned to be domestically produced by one Turkish automotive company (TOGG). *** Overall targeted future Stocks of EVs:** Should be higher, if including other vehicles' brands (target under study).	* Motivational tax for EVs' purchase, specific rules and procedures for the EVs and the charging stations' uses, and selection of the chargers' locations, already defined and implemented (since 2018). ***** Future motivational measures: still unpublished.	***** Existing domestic and foreign automotive manufacturing industries planned already to locally produce fully EVs and Plug-in hybrid vehicles and their batteries, in the very near-future.

Country	Vision / Strategies / Plans / Actions on Foreseen E-Mobility	Targeted Objectives on E-Mobility	Incentives for E-Mobility (Regulation)	Context of Local Industrial EVs' Manufacturing
		* **Targeted future number of Charging Facilities**: Unpublished (under study)		

Summary of main common E-Mobility's issues in MENA countries

The following table summarizes main weaknesses / disruption factors, barriers, levers / opportunities, and main interactions, that can be identified as common between many of the MENA countries, regarding the E-Mobility subsector.

Common Weak Signals, Disruption Factors	·**Prior to the E-Mobility's development**, the Transport sector in many countries, or in many of their cities/inter-city zones, **is still requiring restructuring, traffic management and infrastructures' upgrade and development actions** (renewal of the old vehicles that are wide spread, switching the informal mass transport services to formal and organized ones with optimally defined routes, rehabilitation of road sections or their spatial expansions, traffic decongesting measures and update of the traffic schemes, prior development for rail modes, and urban road capacities' increase). ·**A comprehensive strategic and planning framework for the E-Mobility development is still lacking** in many of the targeted MENA countries. **Equipment and investment programs by horizon (defining targeted numbers of EVs and charging facilities, their technologies, areas of their set up, promoters, etc.), are not yet defined, or still roughly drawn**. ·**Advancement is still required in the regulatory framework and related motivational measures, charging services, batteries and electric vehicles' tariffs**, for most countries, to host the E-Mobility or enhance its potential for evolution (through affordability). The E-Mobility projects, are still lacking a definition of their development schemes (promoters, models of stakeholders' partnerships, business plans of the charging facilities and the Mass Transit operators to be using E-buses / EVs). Incentives are not, or not enough studied to be appropriately aligned to the socio-economic context of each country. ·For most of the studied MENA countries, opportunity and feasibility studies of action plans are either not developed or are under start, and mostly their outputs are unknown/unpublished. ·A number of the MENA countries, are more or less rich in fossil fuel resources, as Alegria, Libya and Egypt. Others, mainly Tunisia, Jordan, Lebanon, and Palestine, are still highly dependent on thermal energy imports. Furthermore, subsidized energy prices, aside to non or non-enough liberalized energy/electricity markets, present further challenges for the Energy Transition in many of the MENA country (IRENA, 2014), which will not quickly ease the Mobility Transition, at least on the short and middle terms.

	·The electricity losses in the electricity distribution systems is another issue. The loses stand between 11% and 15% in stable Arab countries (compared to 4% in Germany, for instance (The World Bank, 2019)). **Overall losses in the electricity systems of the different countries, will have to tend to reduction, in order for the future E-Mobility (in case it will be developed), to be energy efficient, and thus cost-effective.** ·**Electric vehicles' purchase prices, and their affordability** are among major concerns; This is expected to slow down the transition to the E-Mobility over the upcoming years, for most of the studied MENA countries (even in Turkey).
Common Barriers	·The critical socio-economic and overall context in some countries (mainly Libya, Syria, Palestine, Lebanon, also Tunisia), are defeating the Governmental bodies to place the E-Mobility's targets on top of their priority action plans. ·The **low motorization rates** and advanced oldness of significant portions of both the private and public vehicles, in many of the MENA countries, generally witnesses of the still low affordability of the conventional vehicles, and likewise the electric vehicles. Highly motivational new measures, aside to an appropriate involvement of the private sector, will be required in the future, to promote the E-Mobility, especially for countries facing significant financial stress and having low stocks of foreign currencies.
Common Levers / Opportunities	- **The significant potential of the Renewable Energies (RE) in almost all zones of the analyzed MENA countries**, is in favor for their electric systems' capacity enhancement, in the upcoming years (stable countries), and the progressive reduction of the fossil fuels' dependency; **which should be in favor for the EVs' charging expenses' reduction**. The targeted countries are, though, not in a real progress in their RE-based electricity generation potential development (Morocco, Egypt, Jordan, and Turkey seem to be the most developed countries, in terms of planned, studied, ongoing and implemented projects). - **The technological evolutions will also progressively help lowering the electricity generation fees for the EVs' charging** (the recorded costs of Solar PV modules have fallen by around 80% since 2010, and the wind turbine prices have dropped by 30% to 40% since 2009 (IRENA, 2019)). This a factor that might emphasis the interest in the RE-based electricity generation. - Maghreb countries, and most of the other MENA countries, are getting, **highly vulnerable to climate change**, as they already experience noticeable levels of hydric stress. Water resources remain among major challenges in most of the countries. **This should be in favor for seeking all**

	alternative Mobility solutions, less climate harmful, and would particularly motivate Funding Organizations to financially and technically help the targeted countries in accelerating the E-Mobility's planning and envisioned projects (as E-Bus or E-BRT systems' set up).
Common Interactions	- **International technical assistance and financial support:** ✓ National efforts alone will not be sufficient to fulfill each of the large majority of the studied MENA countries (at least for those targeting the later). **They will rely on international cooperation and funding organizations**, first to improve the status and expand the road and electricity systems' capacities (paving and rehabilitating the roads, enhancing the electricity systems' energy efficiency and capacities, shrinking their losses, developing the RE capacities' share and progressively moving towards smart grids). They will then, or at the meantime, shift to EVs and E-buses, and progressively set up charging facilities (on depots, on routes, within municipalities' areas and then along motorways' corridors). ✓ Already ambitious targeted plans of the European Union and international markets regarding the EVs' manufacturing fostering, will progressively help the shift to the E-Mobility in various countries of the MENA region, when the selling prices of the vehicles and the batteries, will tend to decrease, as a result of the **technological evolution** (improvements in the batteries' lifespan and performances) and the **western/ foreign automotive industries' competition** (France for instance, which is among main motorized vehicles' exporters to the Maghreb region and other MENA countries, has already planned 1 million EVs' manufacturing by 2025). - **Future international technological evolution and its expected boosting impacts:** ✓ Many countries manufacturing EVs and batteries are initiating and experiencing technological evolutions for the benefits of higher technical performances of the EVs' components (lifetime, level of GHG emissions, batteries' capacities, charging periods). This, aside to the competition from leading international manufacturers are expected to induce selling costs' reduction of the EVs which will be a major factor for fostering the E-Mobility in the upcoming years in the MENA countries, especially in those with the most moderate GDP per capita.

European Countries

The European countries considered in the analysis show a different level of development of electric mobility. Some countries have already clear strategies, and they are mostly on track to reach them, while others remain well behind their potential. In general, most of the countries have already deployed incentive schemes to help customers buying new electric vehicles, although their effectiveness varies from a country to another. The deployment of an effective and distributed public charging infrastructure is seen as a fundamental step in supporting higher EV penetration levels, although often a chicken-and-egg problem arises due to the fact that low penetration rates of vehicles and chargers may damage each other.

The following charts summarize the results of the TYNDP2022 scenarios, that cover all the European countries excluding Albania and Montenegro. The charts compare the contribution of each country in the total electricity consumption in transport, in electricity consumption for passenger cars, and the expected market share of EVs in passenger cars. The detailed data represented in these charts are also reported in tabular form in the Annex.

National and local policies and measures are of fundamental importance to support passenger cars electrification, especially in the early phase of their development. However, it is also important to remember that most of these countries will be strongly dependent on importing electric vehicles (or parts of them), resulting in potential uncertainties related to the global EV market, which has recently shown that unforeseen events can have important effects on the EV supply chain. Thus, this potential uncertainty should somewhat be accounted for when modelling the future evolution of transport electrification.

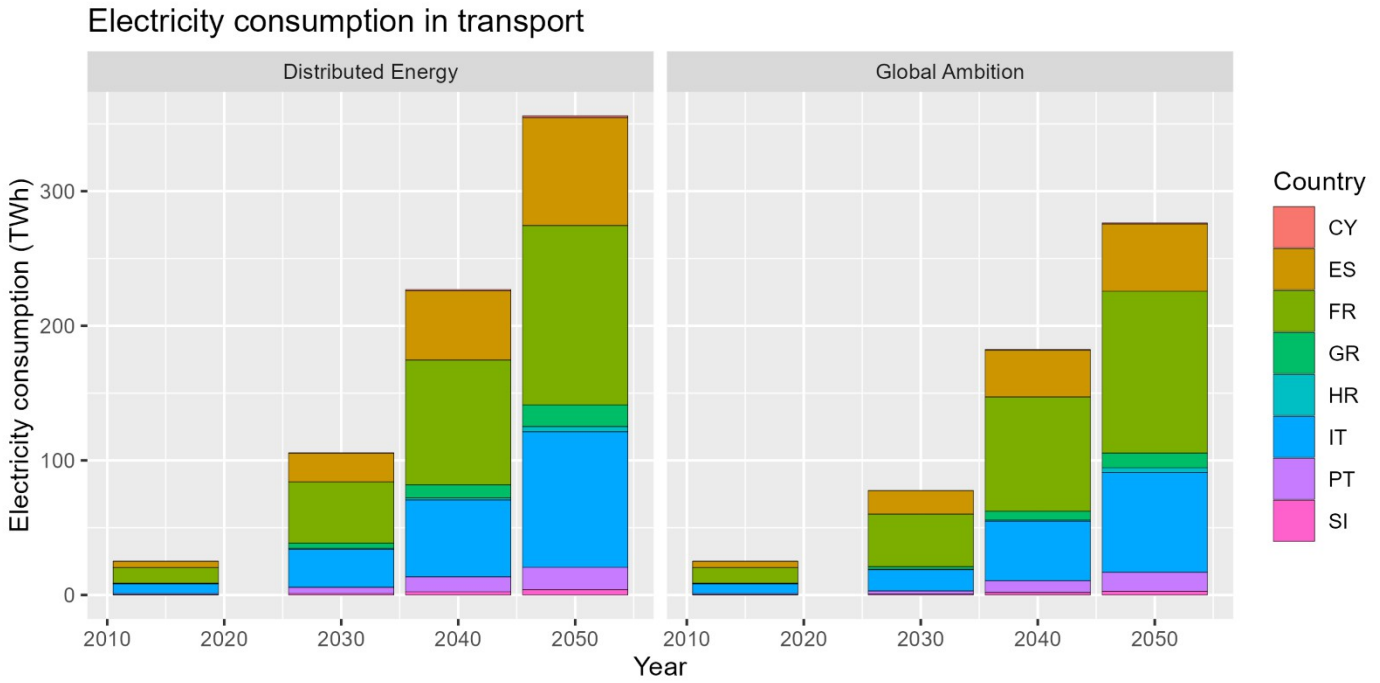

Figure 36: Electricity consumption in transport in EU countries (data from TYNDP2022 Scenarios).

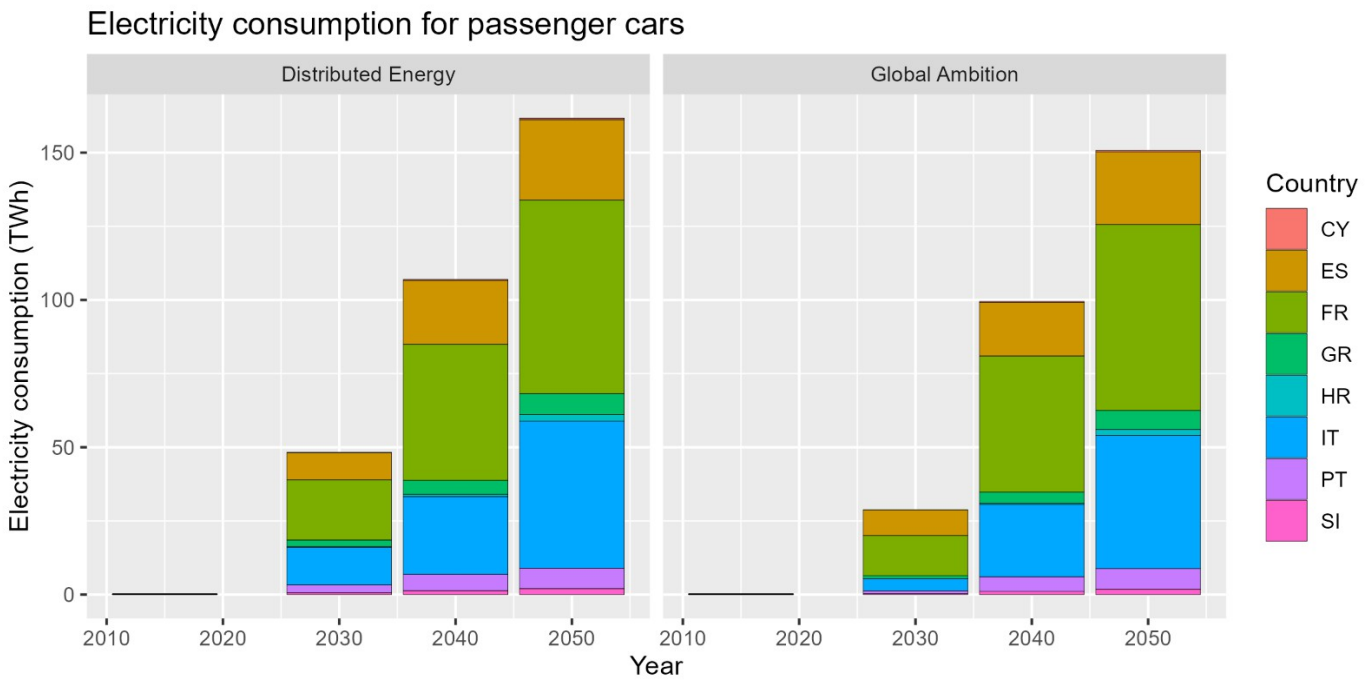

Figure 37: Electricity consumption for passenger cars in EU countries (data from TYNDP2022 Scenarios).

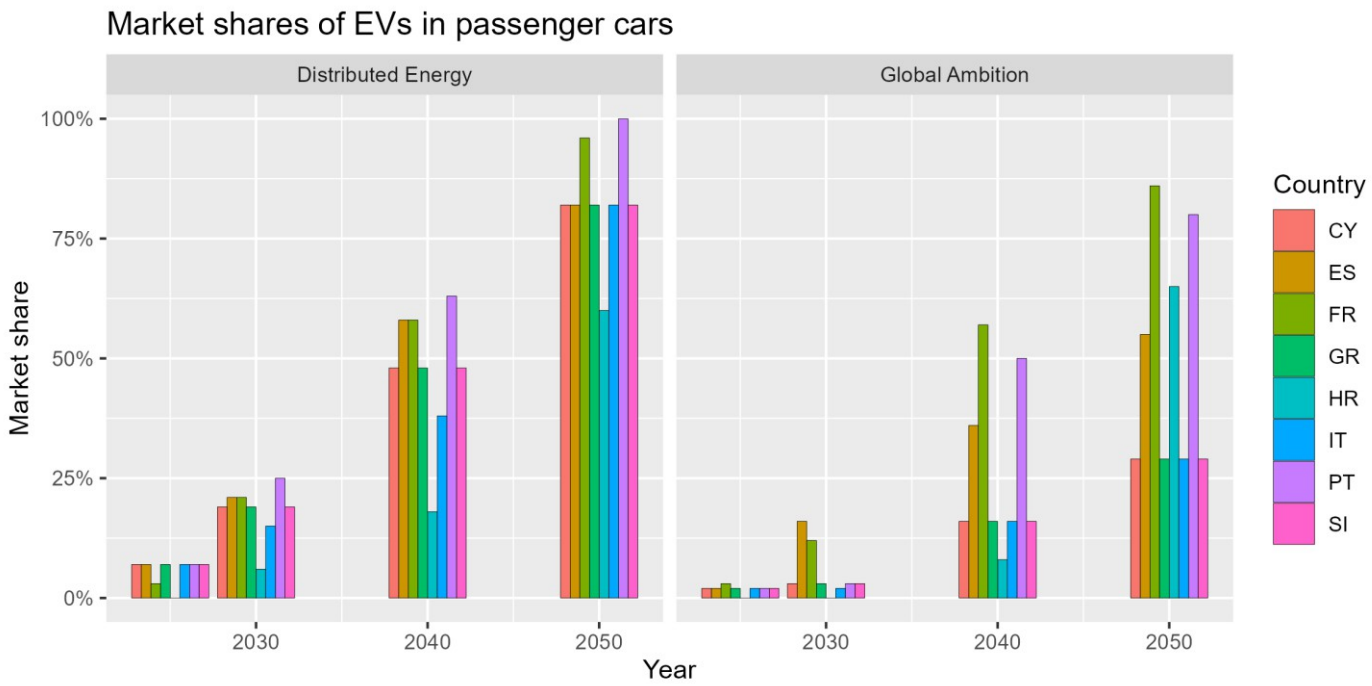

Figure 38: Electric cars market share in EU countries (data from TYNDP2022 Scenarios).

Summary of main common E-Mobility's issues in European countries

The following table summarizes main weaknesses / disruption factors, barriers, levers / opportunities, and main interactions, that can be identified as common between many of the European countries, regarding the E-Mobility subsector.

Common Weak Signals, Disruption Factors	·Almost all the countries have included **e-mobility among the solutions to address future decarbonization targets**. EU countries have developed integrated national energy and climate plans to describe the targets and policies expected in each sector to support the ambition of a carbon-neutral European Union by 2050. ·Electric cars show an **exponential increase** in the last years in most of the countries, although they remain generally limited to a marginal share of the total passenger car market, and at **lower levels compared to some countries in Northern Europe**. ·**Public charging infrastructure** is being developed in most of the countries, especially in urban contexts, as the existence of a distributed and effective network of public charging is seen as a necessary condition to support the development of the EV market.
Common Barriers	·The **high investment price of EVs** compared to traditional passenger cars remain the most significant barrier for potential users. Although most countries have some sort of incentives to help new users to buy a new electric car, they are not always effective in decreasing this price gap. ·Charging infrastructure remains limited, and it will need to increase at a quick pace if large shares of the current car fleet need to electrify in the next years and decades. ·Rising EV sales may need to face the **potential lack of materials at a global scale or potential disruptions to the supply chain**, especially for chips and batteries manufacturing. ·A rising share of new EV registrations in the EU is represented by vehicles manufactured in China (although mostly by European and US companies). A continuous increase of this share in the future may have an impact on the automotive sector of EU countries, and the EU may evaluate the possibility of using trade defense instruments, which may slow the development of the market. ·Some experts are arguing that the development of Euro7 standards for vehicles emissions may require investments in traditional powertrains that may divert investments from electric vehicles.

Common Levers / Opportunities	·The **targets on renewable energy in transport** and on the decrease of carbon emissions that have been set in the last decades at the EU level have supported the rise of the EV market in most countries, and they may remain a fundamental lever in the future. ·The **technology evolution** is increasing the performance of EVs in different market segments, and the expected investment in R&D of many European firms may also represent an additional resource for more competitive electric cars. ·The **deployment of EV and battery manufacturing sites across Europe** may represent an important opportunity to develop local economies and compensate the expected decrease of future sales of traditional cars.
Common Interactions	·The **common policies developed at the EU level** are a fundamental aspect in the development of most decarbonization options at national level, including electric vehicles. ·Given the important circulation of vehicles between the different countries, both for commercial activities and for tourism, it will be important to ensure the **compatibility of charging systems** both from a hardware perspective (with uniform standards) and from a software perspective (with e-roaming measures like those implemented for mobile phone networks).

6. Appendix

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Appendix 3 – Scenarios of electricity demand

Electricity demand in transport in TYNDP2022 Scenarios by country and subsector (data in TWh).

Country	Scenario	Year	Cars	2 wheelers	Aviation	Busses	Heavy trucks	Light trucks	Rail	Total
Cyprus	Distributed Energy	2015	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cyprus	Distributed Energy	2030	0.2	0.0	0.1	0.0	0.0	0.0	0.0	0.3
Cyprus	Distributed Energy	2040	0.4	0.0	0.3	0.1	0.0	0.1	0.0	0.9
Cyprus	Distributed Energy	2050	0.6	0.0	0.5	0.1	0.0	0.3	0.0	1.5
Cyprus	Global Ambition	2015	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cyprus	Global Ambition	2030	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Cyprus	Global Ambition	2040	0.3	0.0	0.1	0.1	0.0	0.1	0.0	0.5
Cyprus	Global Ambition	2050	0.5	0.0	0.1	0.1	0.0	0.1	0.0	0.9
Spain	Distributed Energy	2015	0.0	0.0	0.0	0.0	0.0	0.0	4.6	4.7
Spain	Distributed Energy	2030	9.2	0.1	1.6	0.4	0.3	3.0	6.8	21.4
Spain	Distributed Energy	2040	21.6	0.1	6.3	2.0	5.6	9.4	6.7	51.6
Spain	Distributed Energy	2050	27.3	0.2	11.4	3.7	15.1	16.2	6.3	80.1
Spain	Global Ambition	2015	0.0	0.0	0.0	0.0	0.0	0.0	4.6	4.7
Spain	Global Ambition	2030	8.7	0.0	0.0	0.2	0.2	1.2	7.1	17.4
Spain	Global Ambition	2040	18.2	0.1	1.5	1.5	1.8	5.0	6.7	34.7
Spain	Global Ambition	2050	24.6	0.2	2.6	2.9	3.6	9.4	6.6	50.0
France	Distributed Energy	2015	0.1	0.0	0.0	0.1	0.0	0.0	11.2	11.4
France	Distributed Energy	2030	20.5	0.0	0.9	1.8	0.2	5.7	16.3	45.5
France	Distributed Energy	2040	46.2	0.1	6.7	4.5	5.9	13.2	16.0	92.7
France	Distributed Energy	2050	65.7	0.2	10.6	8.4	12.7	20.6	15.2	133.2
France	Global Ambition	2015	0.1	0.0	0.0	0.1	0.0	0.0	11.2	11.4
France	Global Ambition	2030	13.6	0.0	1.2	1.4	0.2	5.5	17.1	39.0
France	Global Ambition	2040	46.2	0.0	5.9	3.4	2.0	11.4	16.0	84.9
France	Global Ambition	2050	63.1	0.1	11.9	5.9	5.1	18.1	15.9	120.2
Greece	Distributed Energy	2015	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.4
Greece	Distributed Energy	2030	2.2	0.0	0.3	0.1	0.0	0.6	0.6	3.9
Greece	Distributed Energy	2040	4.7	0.0	1.1	0.7	0.5	2.0	0.6	9.7
Greece	Distributed Energy	2050	7.1	0.0	2.0	1.3	1.5	3.5	0.5	16.1
Greece	Global Ambition	2015	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.4
Greece	Global Ambition	2030	1.0	0.0	0.0	0.1	0.0	0.3	0.6	2.0
Greece	Global Ambition	2040	3.9	0.0	0.3	0.5	0.2	1.1	0.6	6.5
Greece	Global Ambition	2050	6.4	0.0	0.5	1.1	0.4	2.0	0.6	11.0
Croatia	Distributed Energy	2015	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.3
Croatia	Distributed Energy	2030	0.2	0.0	0.0	0.0	0.0	0.0	0.4	0.6
Croatia	Distributed Energy	2040	0.8	0.0	0.1	0.1	0.1	0.0	0.4	1.5

Country	Scenario	Year	Cars	2 wheelers	Aviation	Busses	Heavy trucks	Light trucks	Rail	Total
Croatia	Distributed Energy	2050	2.2	0.0	0.2	0.4	0.5	0.1	0.4	3.8
Croatia	Global Ambition	2015	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.3
Croatia	Global Ambition	2030	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.4
Croatia	Global Ambition	2040	0.3	0.0	0.0	0.0	0.0	0.1	0.4	0.9
Croatia	Global Ambition	2050	2.1	0.0	0.1	0.6	0.0	0.3	0.4	3.4
Italy	Distributed Energy	2015	0.1	0.0	0.0	0.1	0.0	0.0	7.1	7.3
Italy	Distributed Energy	2030	12.8	0.0	1.4	0.8	0.2	2.6	10.6	28.3
Italy	Distributed Energy	2040	26.4	0.1	5.3	4.1	3.4	8.1	9.8	57.1
Italy	Distributed Energy	2050	49.9	0.2	9.6	7.7	9.6	14.1	9.8	100.7
Italy	Global Ambition	2015	0.1	0.0	0.0	0.1	0.0	0.0	7.1	7.3
Italy	Global Ambition	2030	4.2	0.0	0.0	0.4	0.1	1.1	10.0	15.7
Italy	Global Ambition	2040	24.5	0.1	1.2	3.1	1.1	4.3	9.8	44.2
Italy	Global Ambition	2050	45.2	0.2	2.2	6.1	2.2	8.1	10.2	74.2
Portugal	Distributed Energy	2015	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.7
Portugal	Distributed Energy	2030	2.6	0.0	0.3	0.1	0.1	0.3	1.0	4.5
Portugal	Distributed Energy	2040	5.5	0.0	1.4	0.6	1.0	1.5	1.0	11.0
Portugal	Distributed Energy	2050	7.0	0.0	2.8	1.1	2.1	2.7	1.0	16.6
Portugal	Global Ambition	2015	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.7
Portugal	Global Ambition	2030	1.0	0.0	0.0	0.0	0.0	0.2	1.1	2.3
Portugal	Global Ambition	2040	5.0	0.0	0.7	0.3	0.6	1.2	1.0	8.9
Portugal	Global Ambition	2050	7.0	0.0	1.9	0.7	1.2	2.2	1.0	14.0
Slovenia	Distributed Energy	2015	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2
Slovenia	Distributed Energy	2030	0.6	0.0	0.0	0.0	0.0	0.1	0.4	1.1
Slovenia	Distributed Energy	2040	1.3	0.0	0.1	0.2	0.3	0.2	0.4	2.4
Slovenia	Distributed Energy	2050	2.0	0.0	0.1	0.4	0.7	0.4	0.4	3.9
Slovenia	Global Ambition	2015	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2
Slovenia	Global Ambition	2030	0.3	0.0	0.0	0.0	0.0	0.0	0.4	0.7
Slovenia	Global Ambition	2040	1.1	0.0	0.0	0.2	0.1	0.1	0.4	1.8
Slovenia	Global Ambition	2050	1.8	0.0	0.0	0.3	0.2	0.2	0.4	2.9

Appendix 4 – Template of the Questionnaire of the Survey on the Electric Mobility for MENA countries

SURVEY –ELECTRIC MOBILITY / E-MOBILITY

I. Current Situation

- **(1) Does the current Road Vehicles Fleet of your country include:**
  - **Electric Vehicles (EV)**: 1. YES 2. NO
  - **Hybrid Vehicles (HV: fuel and electricity consumption) :** 1. YES 2. NO

- **(2) If Electric Mobility already developed in your country,**

  - **(2.1) What is the current EV/HV Stock** (in % of the national road vehicles fleet of 2021 / another reference year to be specified)**:**

	EV Ratio (%)	HV Ratio (%)	Comments
For the National Private Vehicles Fleet			
For the National Bus / Mass Transit Fleet			
Reference Year			

(*) Provide the ratio(s), according to the indicated reference year

- (2.2) How was the recorded trend of the EV / HV fleet and market in your country, during the former 5 years in your country (2015/16-2020/21):

1. Null/ Negligible 2. Low 3. Moderate 4. Fast

- (2.3) Is there a significant difference in the EV / HV fleet? 1. YES 2. NO

(2.3.1) Specify it (*):

1. Between Urban / Rural Areas 2. Between the Capital and other Regions/Provinces
3. Between the Vehicles' Categories:
   - Light Vehicles (passengers/fret)
   - Mass Transit/Collective Vehicles (passengers)
   - Heavy Vehicles (fret)
   - 2 Wheel - Vehicles

(*) Circle the Alternative number if validated, and Underline the more important One

- **(3)** ***Are there any manufactory facilities in your Country, that are participating in the EVs / HVs' supply chain?*** 1. YES 2. NO

- (3.1) If YES, specify their activity fields:

……

- (4) *What is the current development level of the charging infrastructures in your county?*

……

……

- (5) *Are there currently specific incentives for final users of EVs ?* *1. YES* *2. NO*

- (5.1) If YES, specify the major / more important ones:

……

II. Expected Trends and Strategies

- (6) What are the most recent and important National Strategies / Plans / Envisioned Actions specifically targeting the Road E-Mobility/EVs development of promotion in your country?

Name of the Program(s)/ Plan(s) Political Document(s) / Action Plan(s)	Targeted Prospective Horizon	Development Statue (1) Null; (2) Just Announced; (3) Under Study ; (4) Finalized Study ; (5) Under Implementation	Responsible Entity of the Program / Action Plan (Name)

(6.1) What are the main targeted objectives in the mentioned strategic framework:

✓ In terms of EVs / HVs portions to be achieved by horizon:

- For Private Vehicles ……
- For Mass Transit Vehicles / Buses ……

Comment :

……

……

✓ In terms of Vehicles' technologies to be introduced / promoted (specify the decided / potential technology / technologies:

		Yes/No
	- **Battery-Electric Vehicles / Buses (BEV / BEB)** using rechargeable batteries	
	- **Plug-in Hybrid Vehicles / Buses:** hybrid vehicles that, through rechargeable batteries, operate their electric motor in combination with an internal combustion engine. They rely mostly on their internal combustion engine for power, with the electric motor for extra support.	
	- **Fuel Cell Hydrogen Vehicles/Buses operating with Hydrogen:** use Hydrogen stored on board to operate the vehicle, and recharge batteries (or supercapacitors)	
	- **Trolley Buses (they could be** In-Motion Charging Battery Trolley Buses that are charged in-motion through overhead lines. On-board batteries can also function exist as power supply, enabling the independent operation without need of contact with overhead lines	

Comment : ……

……

……

✓ **In terms of Electric Recharging Facilities to be Developed:**

Has the country developed an assessment of future required electricity charging facilities?

1. YES 2. NO 3. Under study / planning

If Yes, could you provide assessments (even approximatively) :

Types of Targeted Recharging Infrastructures by Horizon:	Number of Overall Charging Stations	Number of Charging Points	Targeted Horizon	Other Comments
Collective / All Vehicle Types - Recharges				
Mass Transit Vehicles (Buses / Mini-Buses): On depot or On-route				
Private Recharges				
Residential Recharges (for households)				

✓ **Other targeted objectives, to specify (including the manufacturing, supply chain of the EVs in your country):**

……

……

……

- **(7) Could you provide information on the investment / regulatory / institutional issues and development schemes (partnerships) for the E-Mobility introduction / promotion in your country, if implemented / planned / decided (regarding the E-Buses' operations, the charging infrastructures' managing, the EVs manufacturing, etc.)?**

……

……

III. Constraints / Barriers and Opportunities

- **(8) Specify the main barriers currently hindering the E-Mobility adoption (planning/ promotion) in your country** (check the boxes)**:**

✓ Priority assigned to other transport infrastructures/services not yet satisfied or still needing development	
✓ Lack / Absence of a national integrated strategy / policy in Energy Transition, and /or in the Transport – Mobility Sector	
✓ Lack of potential financing resources for the electric recharging infrastructures' development	
✓ Lack / Absence of taxation measures / subsidies to be addressed by the State as incentives to enhance the final users' willingness to the E-Mobility	
✓ Inappropriate Generation Capacity of the national electric system to face expected impacts on the electric demand and the load curve	
✓ Electric Grids (Transmission / Distribution) not suitable for impacts on the load pics and their variation	
✓ Others (Specify): …… …… ……	

- **(9) According to you, what is the reasonable horizon of the effective start / massive development of the Road E-Mobility in your country:**
  - For the Mass Transit Transport (Buses/Mini-Buses for passengers): ……

  - For the Private Mobility (Private Vehicles for passengers transport): ……

- **(10) Will the Electric Vehicles represent an interesting opportunity for the electricity storage** (e.g. Smart charging, Vehicle-to-grid, Etc.)**?**

  1. YES 2. NO 3. No Comment

  Explain How, if Yes

  ……

  ……

- **(11) Further comments on E-Mobility and its future development in your country (Main Uncertainties regarding the local market, the operating schemes and Partners, the taxation / tariffing issues, the local manufacturing / supply chain, etc.):**

……
……
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