Transition Towards a Sustainable Land Transport

Battery Electric Vehicles Charging at IPT

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Education

2004 Diploma in Electrical Engineering "Computer & Communication Engineering", Lebanese University "Faculty of Engineering".

2009 Master in Electrical Engineering "Computer & Communication Engineering", American University of Beirut "Faculty of Engineering"

Area of Expertise

- Manufacturing of Low Voltage Switchgears and Control gears
- Medium Voltage Substations
- Uninterruptible Power Supplies
- Industrial& Home Automation
- Solar Photovoltaic system
- BEV Chargers

Transition towards a Sustainable Land Transport

Electric Vehicles

Introduction

- Electrical Vehicles, Solar Power and the Future

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Introduction

Introduction

Electrical Vehicles, Solar Power and the Future

ICE Vehicles are rapidly being replaced by electric vehicles and or plug-in hybrid electric cars

Owning an EV can be very advantageous for drivers. The simple design, low maintenance costs, efficiency, convenience of home charging, and environmental benefits make EVs a competitive option

Electric cars are still faced with the problem of energy availability, grid upgrades and need for additional generation capacity.

Without smart planning, adding thousands and millions of new electric vehicles to the grid could make grid operations more costly and will not help in achieving GHG emissions targets.

Introduction

Electrical Vehicles, Solar Power and the Future

Many solutions are proposed and implemented for encouraging the transformation toward EVs for sustainable transportation:

Binding EV penetration to renewable energy targets and mandates.

Demand-side management (DSM) solutions that encourage shifts in EV load from peak hours to off-peak hour demand

Electric vehicles charged using solar power emit 96% less mass of pollutants than all-electric vehicles using the grid (with four percent of pollutants remaining from brake and tire wear).

The growth of PV power production in the world is mainly due to the decreasing costs, increases in production volume, and governmental subsidies.

Same factors are and will be the driving factors of EV-Uptake.

EV Market Growth & Forecast

BEV Market Growth & Forecast

Development of the EV Market

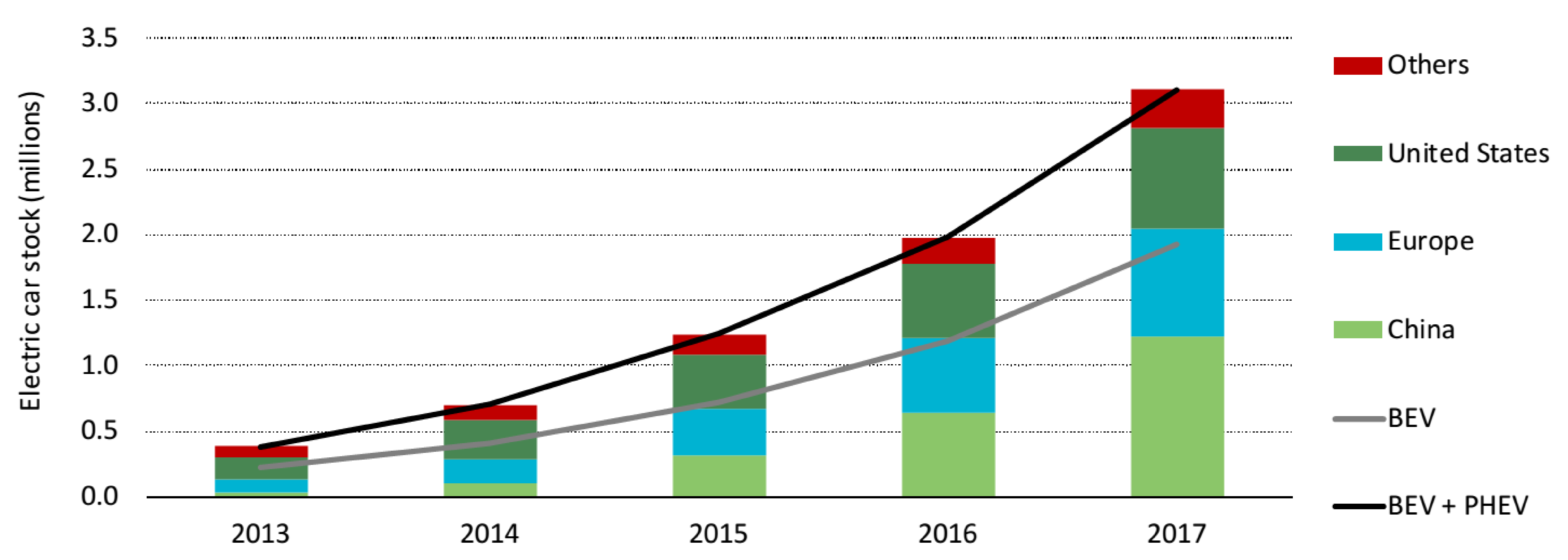
Sales of new electric cars[1] worldwide surpassed 1 million units in 2017 – a record volume. This represents a growth in new electric car sales of 54% compared with 2016

In 2017, sales of electric buses reached 100 000 units and sales of two-wheelers are estimated at 30 million

The global stock of electric cars surpassed 3 million vehicles in 2017 after crossing the 1 million threshold in 2015 and the 2 million mark in 2016.

Stock of electric buses increased to 370 000 units, Light Commercial Vehicles to 250 000 and electric two-wheelers reached 250 million

Evolution of the global electric car stock, 2013-17



Sources: IEA analysis based on country submissions, complemented by ACEA (2018); EAFO (2018a)

BEV Market Growth & Forecast

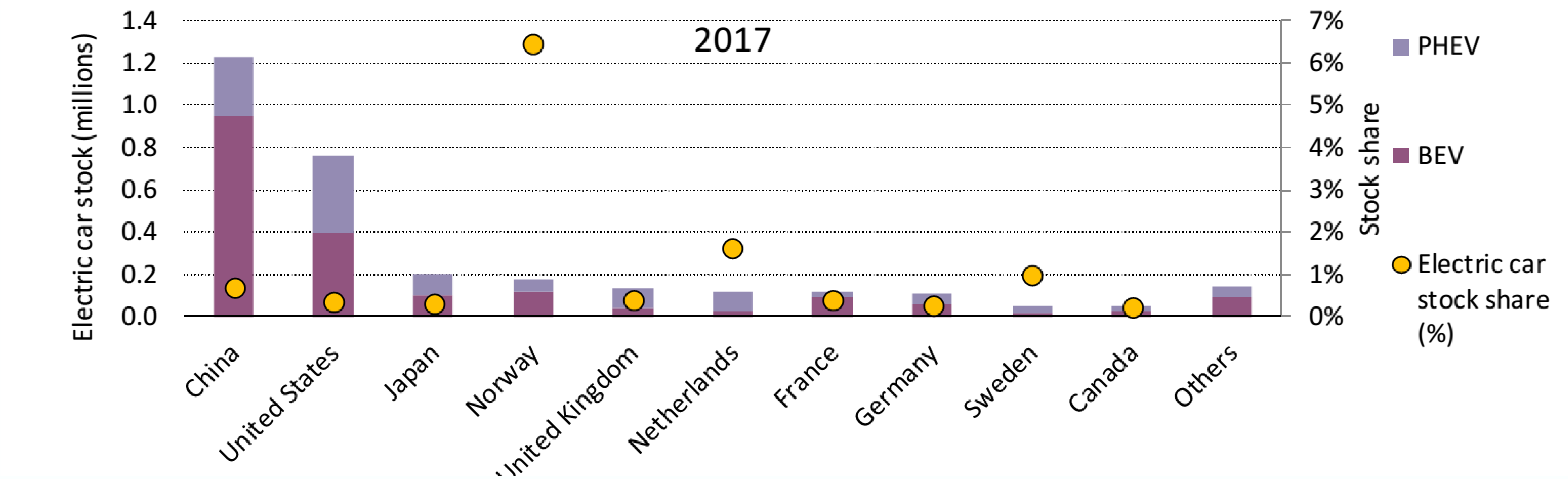
Development of the EV Market

Around 40% of the global electric car fleet is in China

The European Union and the United States each accounted for about a quarter of the global total

Norway has the world's highest share at 6.4% of electric cars in its vehicle stock

Global EV stock in 2017

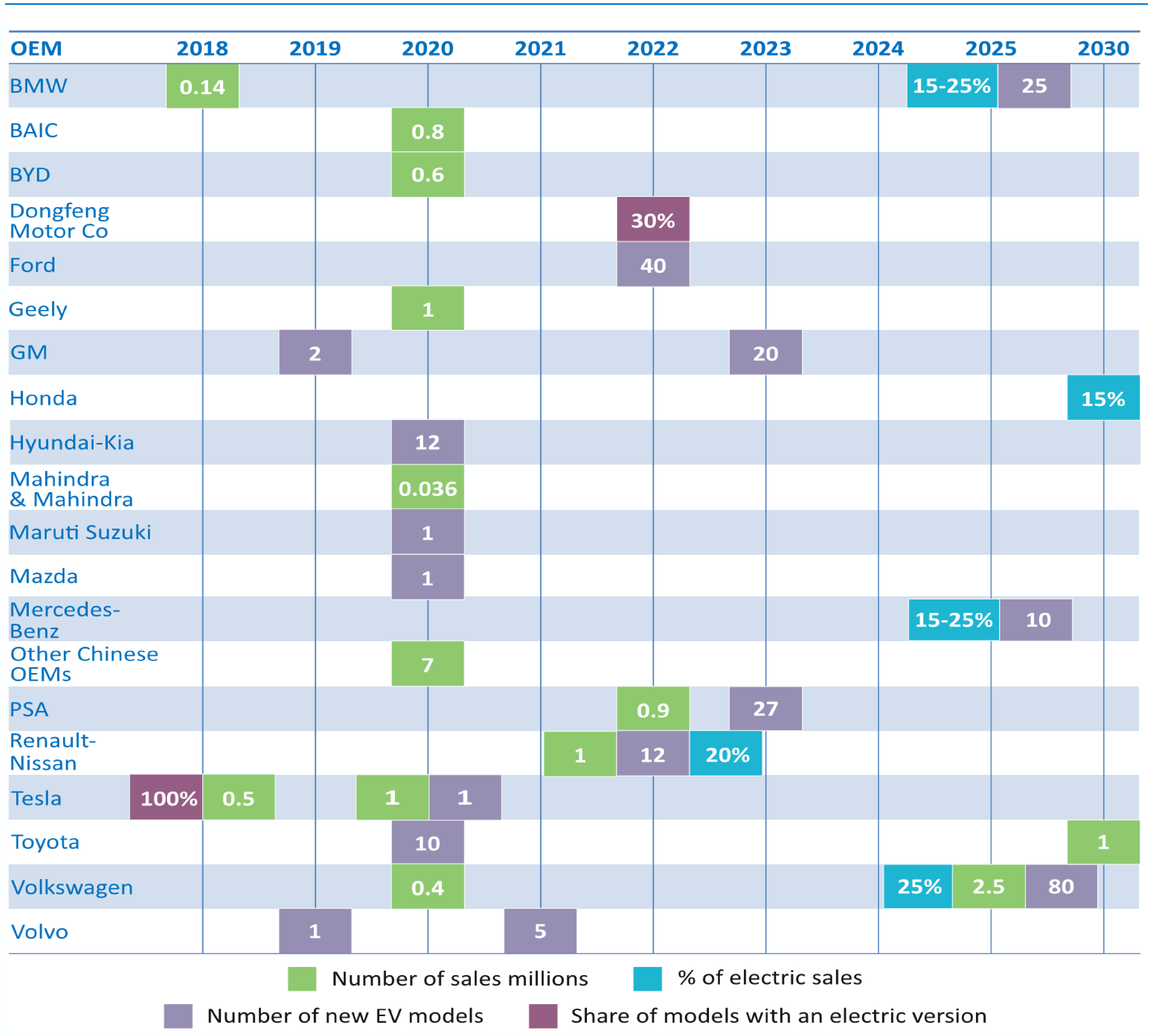


Source: IEA analysis developed with the IEA Mobility Model (IEA, 2018a).

BEV Market Growth & Forecast

Development of the EV Market

Increasing relevance of electrification in OEM strategies



BEV Market Growth & Forecast

Reductions in the Total Cost of Ownership (TCO)

The most significant factor limiting consumers' uptake of electric cars is the higher TCO compared to conventional ICE cars

Today's purchase price of an electric car is significantly higher than an ICE one, and this is primary from the price of lithium-ion batteries (USD 155-360/Kwh)

Cost reductions for batteries over the period to 2030 are likely to stem from three main drivers:

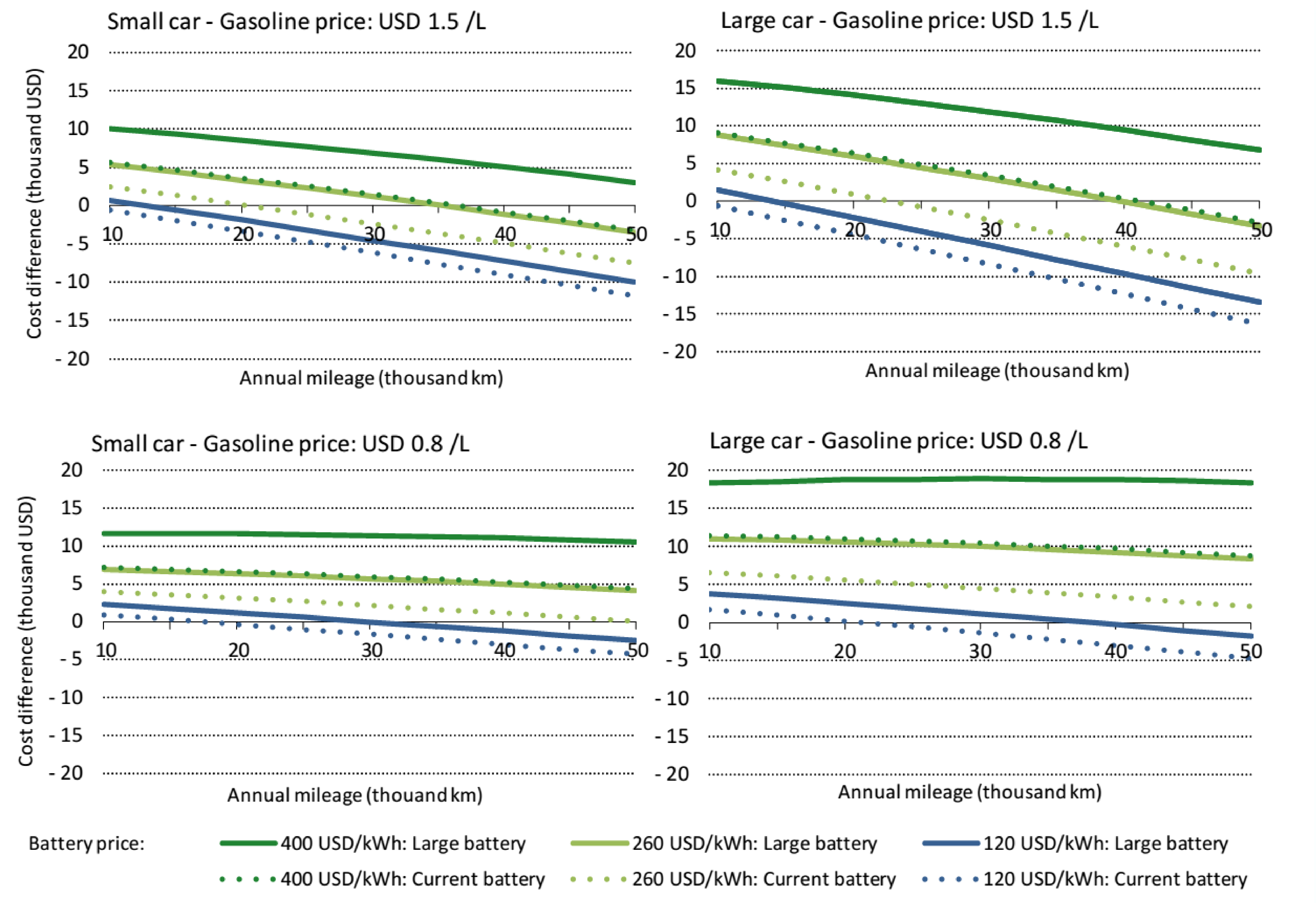
- Battery capacities will increase to serve large all-electric driving ranges.
- Battery manufacturing will take place in plants with large production capacities that provide economies of scale.
- Battery chemistries will evolve to options with higher energy density and lower reliance on cobalt.

EV battery cost reduction targets in 2030 for the European Union at USD 93/kWh

BEV Market Growth & Forecast

Reductions in the Total Cost of Ownership (TCO)

Main Factors influencing TCO gap between BEV and ICE cars are: Annual mileage and Battery/gasoline prices



BEV Market Growth & Forecast

Reductions in the Total Cost of Ownership (TCO)

Service & Maintenance:

Annual maintenance costs of a BEV are approximately 20% of the costs for an ICE vehicle

The main reasons are:

- Elimination of oil changes
- No need for replacement of exhaust systems and couplings
- Regenerative breaking reduces brake wear
- Fewer moving parts
- Electrical systems do not require frequent maintenance

BEV Energy Demand & Emissions

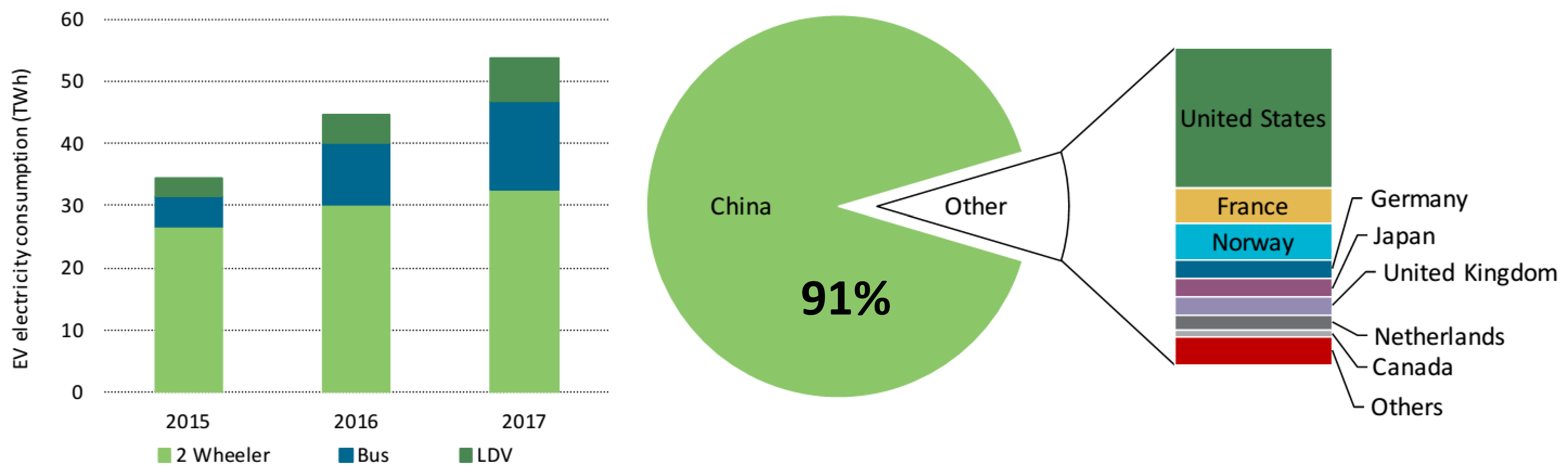
BEV Energy Demand & Emissions

Energy Demand and Change in Oil Demand

In 2017, the estimated global electricity demand from all EVs was 54 terawatt-hours (TWh), which amounts to 0.2% of the total global electricity consumption

Estimated electricity demand from EVs in 2017 increased by 21% compared with 2016.

Total electricity demand from EVs by country, 2017



Source: IEA analysis based on country submissions; IEA, 2018c

Passenger vehicle:
20-27 kWh/100 km
8 500 - 18 800 km
Two-wheelers:
3-5 kWh/100 km
5 900 - 7 500 km
Urban bus:
135 - 170 kWh/100 km
28 000 - 47 000 km

BEV Energy Demand & Emissions

Energy Demand and Change in Oil Demand

Managing the impact of EVs on the power system

Shifting charging loads to periods with lower demand

Utilizing dynamic side management instruments for dynamic tariffs will encourage consumers to charge EVs in a way that maximises the power draw when electricity prices are low

Aligning EV charging with periods of high output from renewables, such as night time charging when generation from wind generators is often highest or mid-day when photovoltaic generation peaks

Change in Oil Demand

EVs provide fuel efficiencies (in final energy terms) that are two-to-four-times higher than ICE powertrains. This is due both to the higher efficiency of the powertrain in EVs and the EVs' ability to regenerate kinetic energy when braking

It is estimated that EVs operating worldwide in 2017 displaced 0.74 exajoules (EJ) **(**17.5 million tonnes of oil equivalent [Mtoe], 0.38 million barrels per day [mb/d]**)** of diesel and gasoline demand.

BEV Energy Demand & Emissions

Greenhouse Gases (GHG) and Local Air Pollutants

The high energy efficiency of electric motors and low-carbon electricity potentially allows EVs to significantly cut CO_2 emissions with respect to Internal Combustion Engines (ICEs)

In Europe When taking into account the entire life cycle of the vehicle (manufacturing, use and disposal) and based on current generation mix; BEVs deliver roughly 30% GHG emission savings compared with gasoline ICE vehicles

In countries with a carbon-intensive power generation mix (e.g. India and China), an increase in CO_2 emissions is expected when considering the Well-To-Wheel life-cycle for EVs.

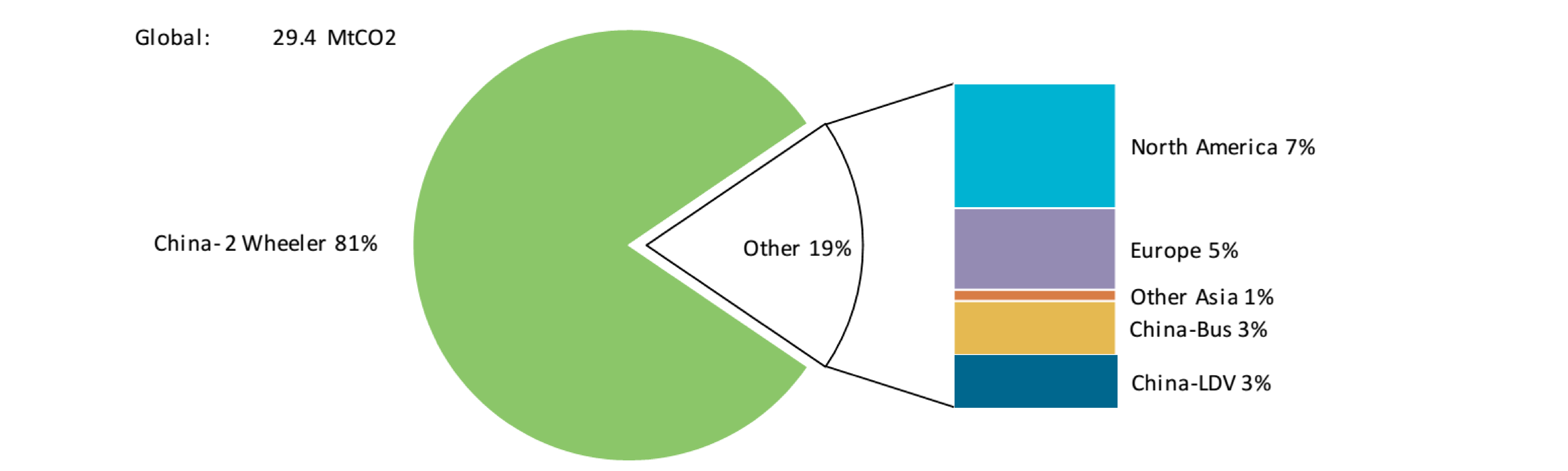
To guarantee EVs decarbonisation, countries could introduce a “hard coupling” policy framework that aligns EV stock shares with renewable energy production targets

BEV Energy Demand & Emissions

Greenhouse Gases (GHG) and Local Air Pollutants

EVs in operation worldwide emitted around 35.7 million tonnes of CO_2 ($MtCO_2$), and avoided emissions of 29.4 $MtCO_2$

CO_2 emissions avoided due to EVs worldwide, 2017



Source: IEA analysis based on country submissions; IEA (2017b)

BEV Energy Demand & Emissions

Greenhouse Gases (GHG) and Local Air Pollutants

Local air pollutants

Lower emissions of local air pollutants are one of the main drivers of interest in electric mobility

BEVs emit no tailpipe emissions and therefore have significantly lower NOx emissions than conventional diesel ICEV

BEVs with the regenerative breaking reduce non-exhaust emissions

Electrical Vehicles Supply Equipment

Electrical Vehicles Supply Equipment

Charging Standards

The three main EVSE characteristics that differentiate chargers from one another include:

Level: the power output range of the EVSE outlet.

Type: the socket and connector used for charging.

Mode: the communication protocol between the vehicle and the charger.

AC chargers: Level 1,2 and 3

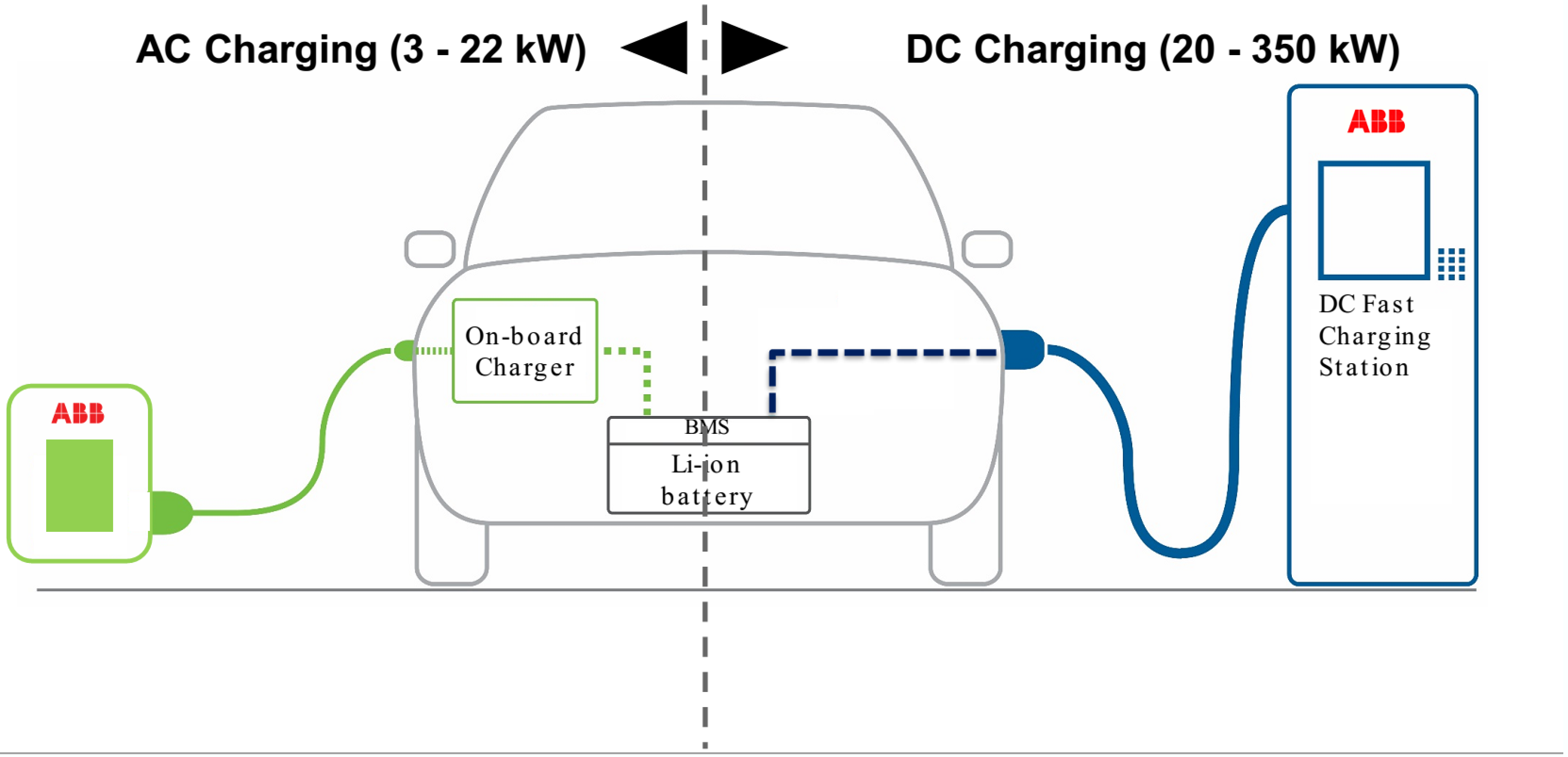
DC fast chargers Combined Charging System (CCS), CHAdeMO, Tesla and GB/T

Electrical Vehicles Supply Equipment

Charging Standards

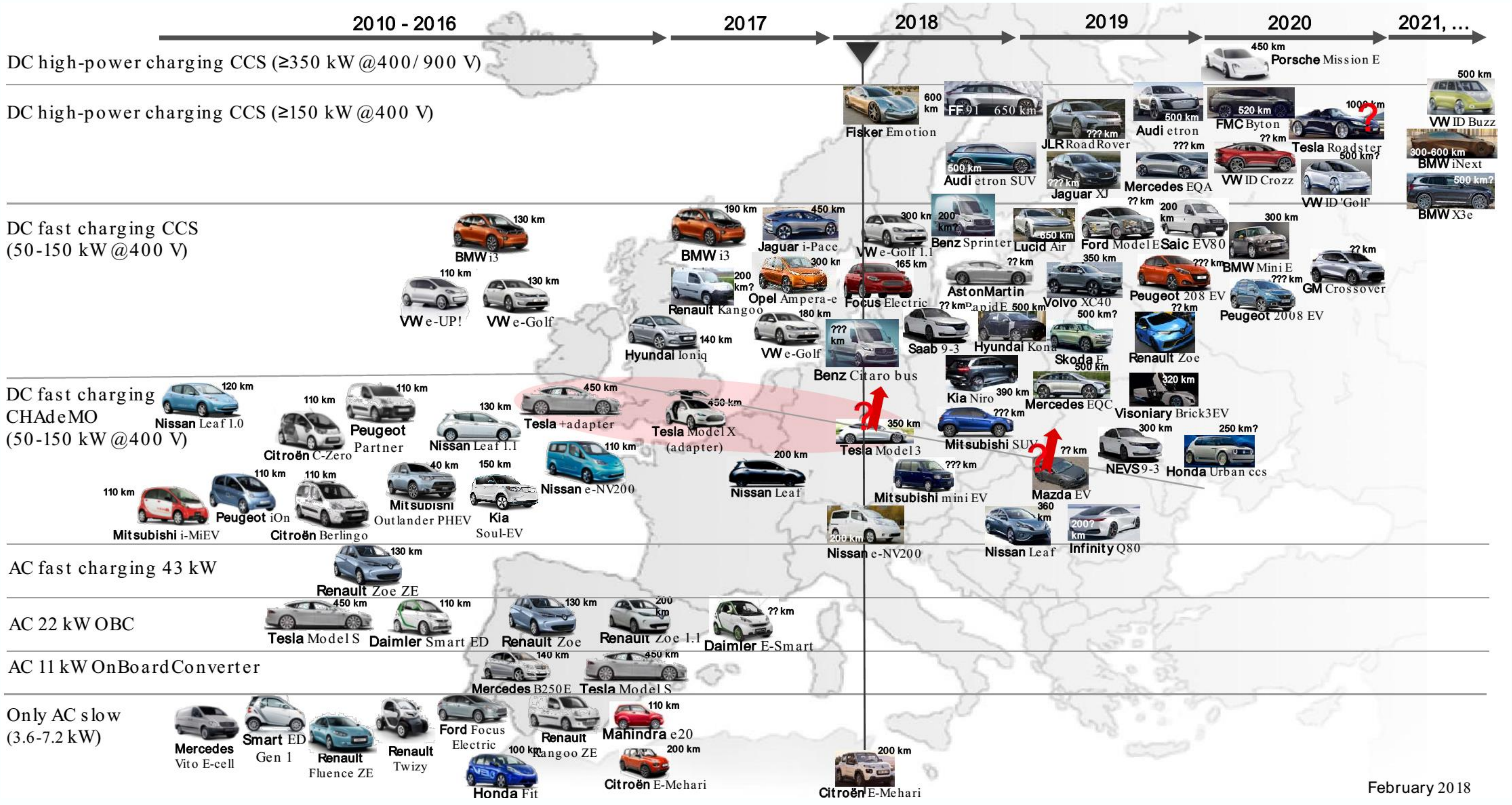
Charging of electric vehicles

AC charging versus DC charging



Electrical Vehicles Supply Equipment

Charging Standards

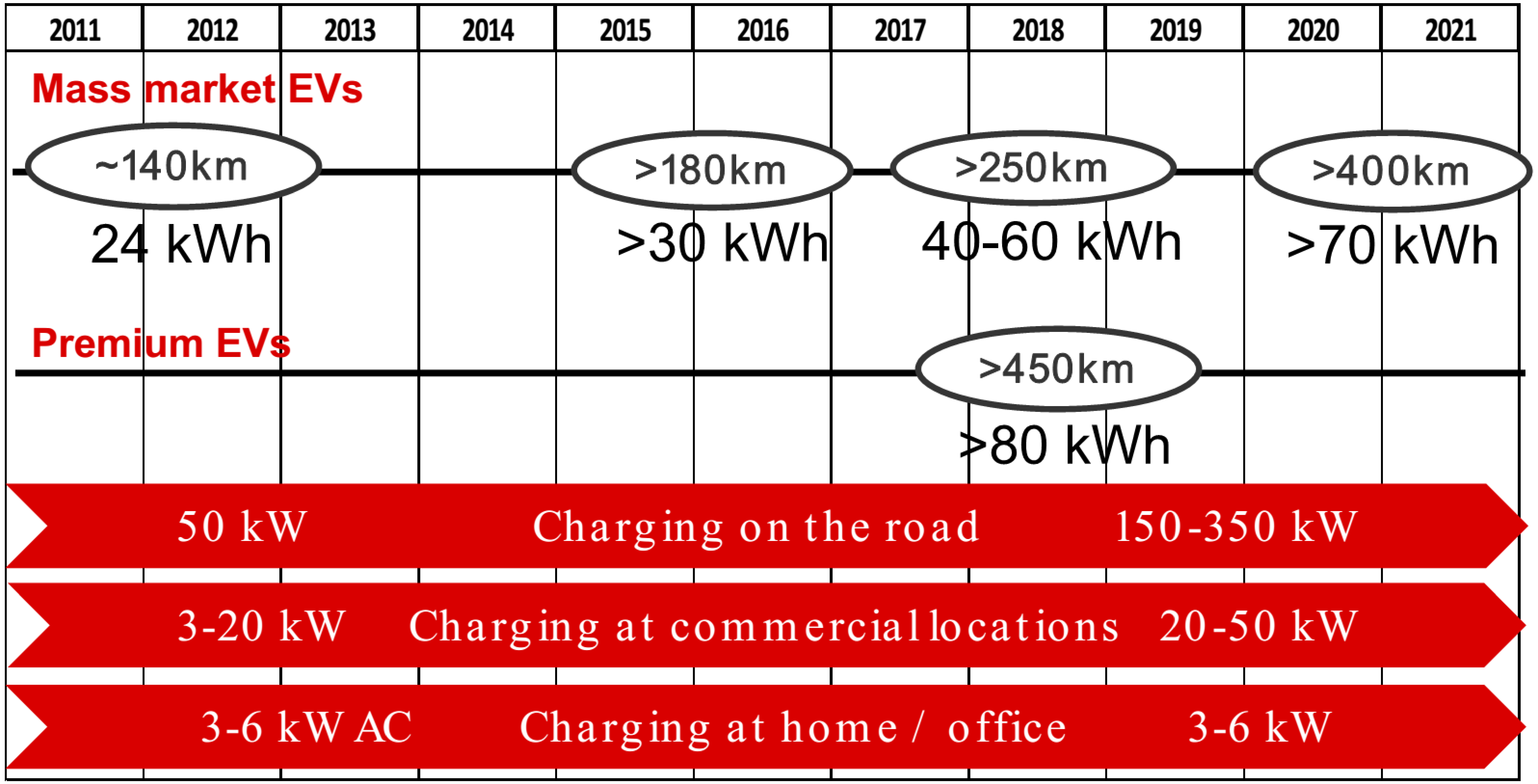


Electrical Vehicles Supply Equipment

Charging Standards

Driver: The EV range roadmap

Batteries get bigger, range of EV increases



Electrical Vehicles Supply Equipment

Charging Standards

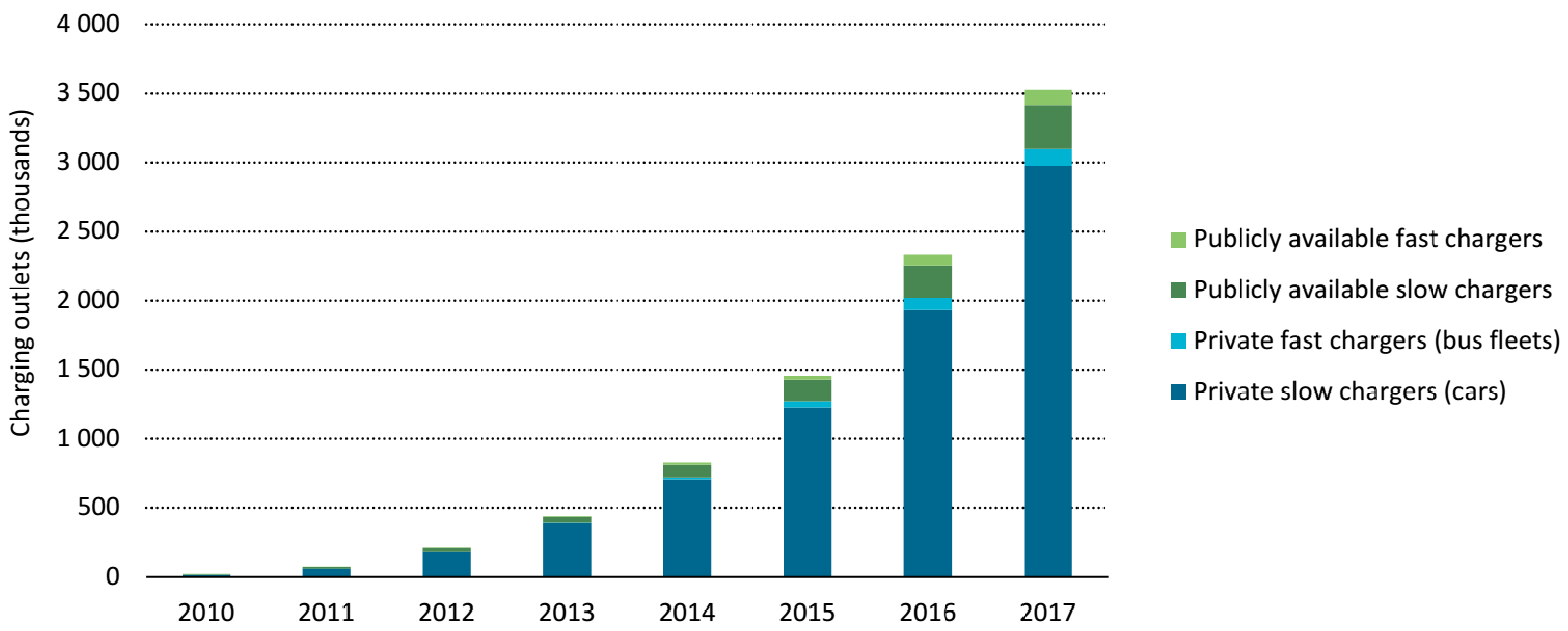
Charging service should match charging application and demand

Public and commercial EV Charging			
Home & Work	Parking	Commercial	Highway
3-22 kW (AC)	20 kW (DC)	50 KW (DC)	150 to 350kW+(DC)
4-16 hours	1-3 hours	15-60 min	5-20 min

Electrical Vehicles Supply Equipment

Charging Development and Availability

EVSE Availability



Sources: IEA analysis based on EVI country submissions, complemented by Zheng (2018) and EAFO (2018b).

Electrical Vehicles Supply Equipment

Charging Development and Availability

Regulatory Frameworks on Electricity Distribution

EV charging stations are integrated in the electricity system and, as such, are subject to power sector regulations. The regulatory structure has strong implications for the development of the charging infrastructure.

National Measures

Definition of clear deployment targets, regulations and the mobilisation of funding for direct investment and the provision of financial support

Chargers Distribution strategies

Establishment of an EV charging network along major road network, commercial hotspots, gas stations, etc.

Fiscal Policies

Fiscal policies for EVSE support can take the form of financial incentives, tax relief and direct investment

Regulatory Policies - Building Codes and Permits

Development of building codes embedding requirements for "EV-ready" parking.

Solar Power in EV Charging

Solar Power in EV Charging

Building on the Promise of Solar and EV Charging

Increased electrification of road transport has a big impact on electricity demand and consequently on power grids.

Ensuring that this demand is met and with low-carbon electricity is a major imperative for integration of EVs and renewable electricity

Increasing the availability of solar power charging stations reduces EV owner frustration and makes EVs more attractive to consumers.

Solar Power in EV Charging

Case Study: Solar EV Charging at IPT New Station- Amchit-Lebanon

As part of the company's green strategy, and its efforts for Transition Towards Sustainable Transport Solutions:

IPT New Station in Amchit will be the typical model combining:

Photovoltaic System
Energy Storage
Fast DC 50KW EV Charger

ABB Terra 54 Charger

Choosing the location for installing the EV Charger by IPT on a highway is a market approach as a guarantee for long distance driving

Solar Power in EV Charging

Case Study: Solar EV Charging at IPT New Station- Amchit-Lebanon

The ABB Fast DC 50KW EV charger that will be installed in IPT:

Complies with all relevant international standards

Supports 50 kW CCS and CHAdeMO charging standards: Cable compatible the majority of BEVs in the market

Simultaneous AC charging via 22/43 kW cable or 22 kW socket

IEC 61000 EMC Class B certified for industrial and residential areas (including petrol stations, retail outlets, offices, etc.)

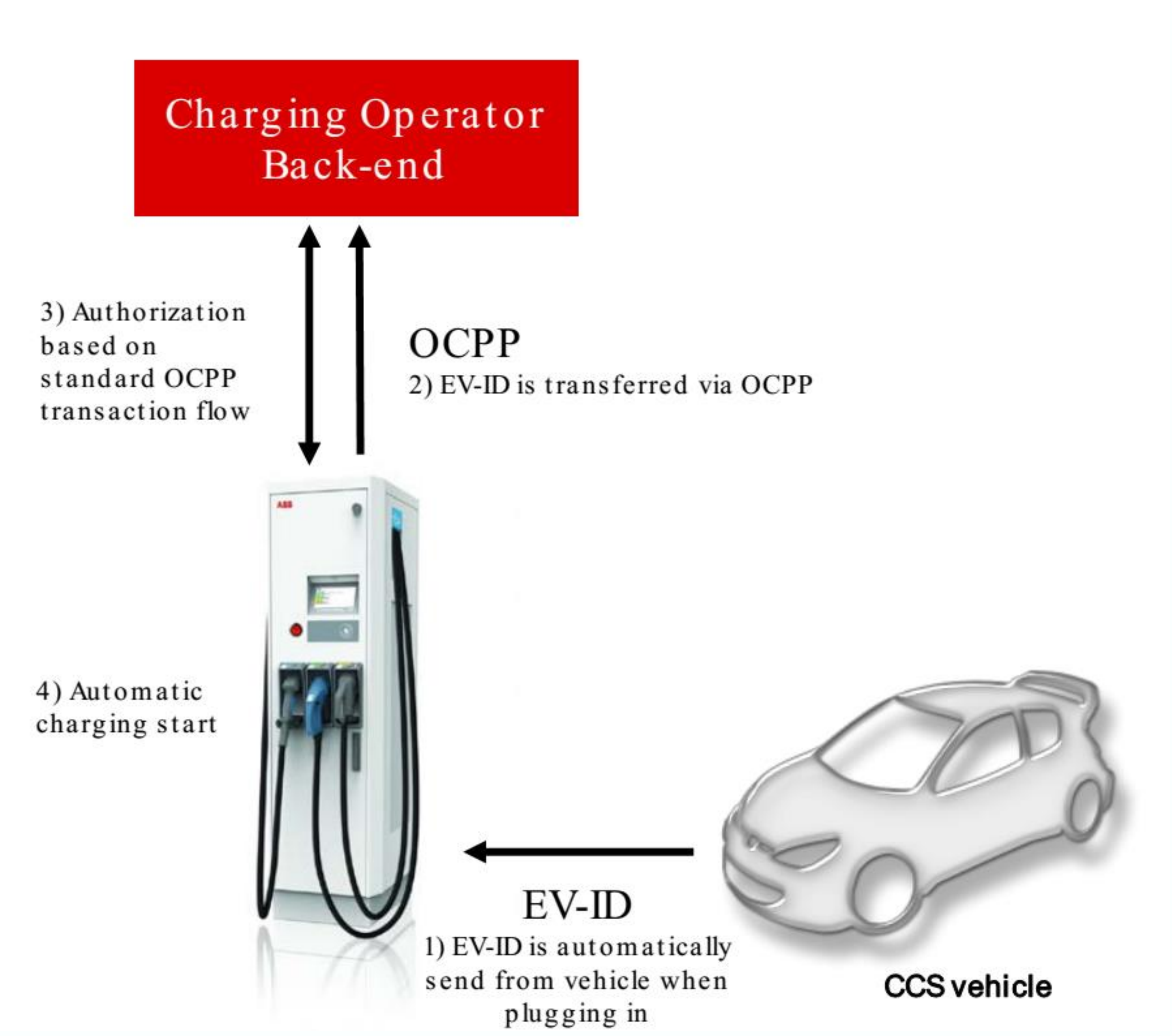
Easy to use with Graphic visualisation of charging progress and includes RFID authorization technology

Solar Power in EV Charging

Case Study: Solar EV Charging at IPT New Station- Amchit-Lebanon

The ABB Fast DC 50KW EV charger that will be installed in IPT:

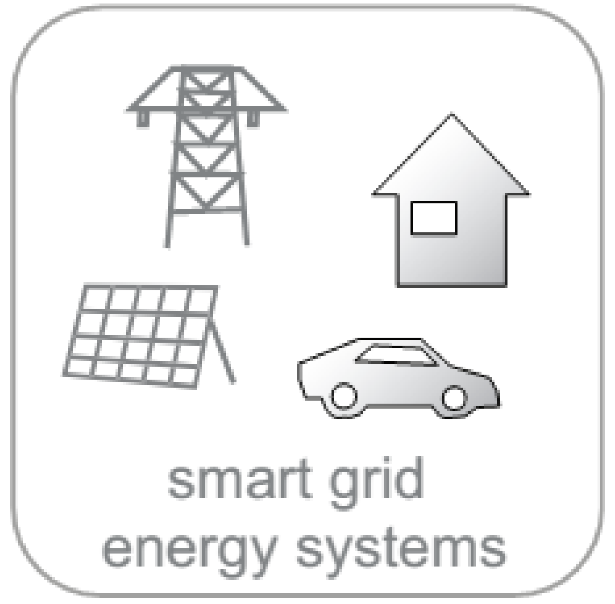
Supports AUTOCHARGE function



Working principle:
During start-up of charging a unique identifier is sent from CCS vehicles. This can be used in standard OCPP flow to identify a car and perform a transaction

Unique identifier: EV-ID
The vehicle identifier used is the EV-ID message which is included in standard CCS communication of the vehicle.

Digital integration



Solar Power in EV Charging

Case Study: Solar EV Charging at IPT New Station- Amchit-Lebanon

As a pilot and model project for green and sustainable transportation in Lebanon, IPT new station is combining the solar Energy with the EV charging:

- Renewable Energy (RE) source to provide as much of the charging energy as possible, independent from the grid
- Energy storage solution so that charging can occur during night and cloudy or windless days
- The station will be grid connected for exporting power when generation exceeds demand.
- The energy generated by solar power with EV is a model for reducing life cycle emissions

Conclusion

Conclusion

Why EV

Decarburization of transportation by enhancing renewable electricity use

Widespread opportunities to improve electric grid efficiency with distributed energy storage.

High efficiency: Requires much less maintenance, and lasts much longer than an internal combustion engine.

It can fuel for as little as one-fifth the cost of a gasoline vehicle per mile.

It may provide other functions, including backup power to the owner’s home and ancillary grid services.

Its only high-cost component, batteries, are falling in price rapidly as production accelerates.

Conclusion

Policies & Incentives

The power of electric cars won't flow automatically, but instead requires the **proper rules** to expand and refine charging infrastructure, charging policies and incentives to ensure all can benefit from transportation electrification

Public procurement programmes to facilitate the acquisition of EVs and cut their usage cost, with a variety of regulatory measures at different administrative levels, such as fuel-economy standards and restrictions on the circulation of vehicles based on tailpipe emissions performance.

Financial incentives such as value-added tax (VAT) and vehicle registration tax exemptions.
Lebanese Law article 55 issued in April 2018 reduce and exempt customs on eco-friendly cars

Subsidy Programs and grants for the purchase of electric cars based on the energy density and efficiency of the car's battery pack

Vehicle charging to follow and accommodate renewable energy supplies

CO_2 emissions standards for new passenger cars and LCVs

Thank You