



Electricity 2018 חשמל

The International Annual Convention of SEEI
November 6-10, 2018 | Eilat, Israel

EV Charging Infrastructure

A developing market

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EV Charging Infrastructure

A developing market

- The market of Electric Vehicle (EV) and EV Chargers (EVSE):
 - Market growth
 - A new business: EV Charge (time, electricity) and EV Chargers
 - European scenario, Incentives and regulations
- Expected Evolution of EV Charge technology
- Conclusions



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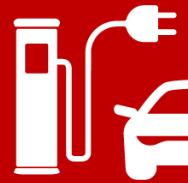


EV SALES

World:

2016 = 774,384 un (+ 41%)

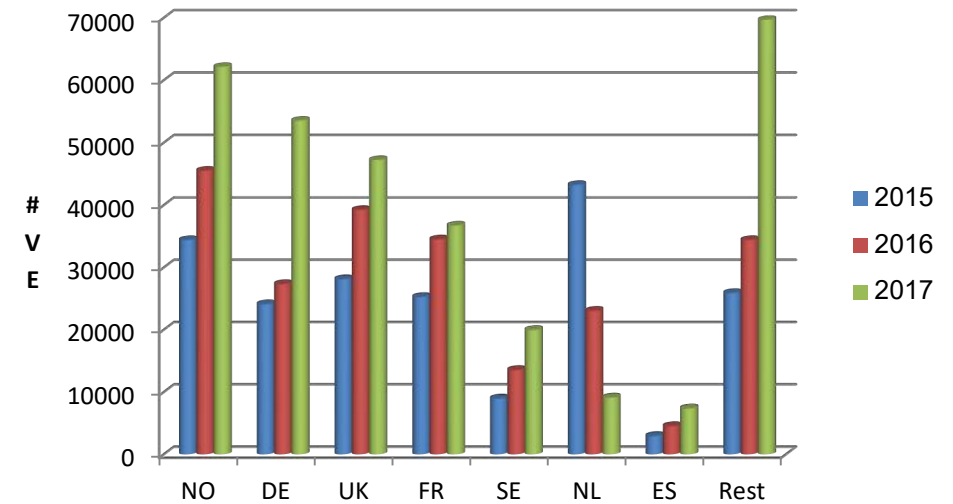
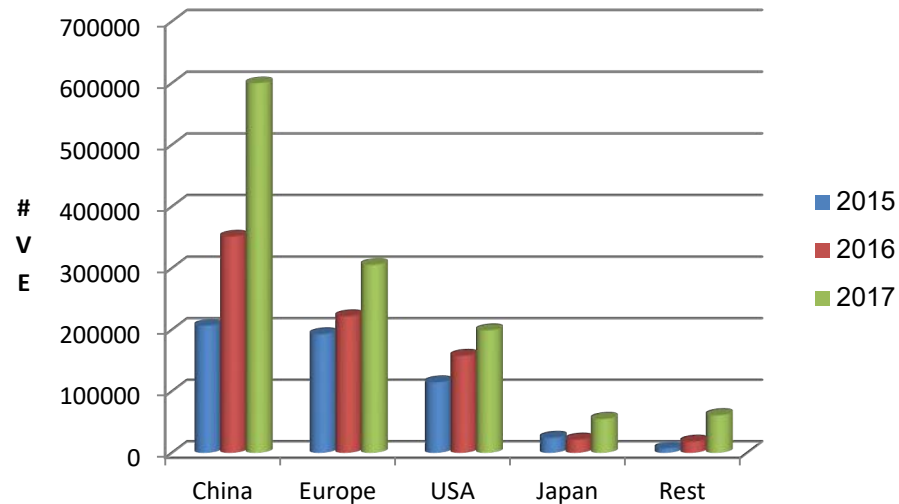
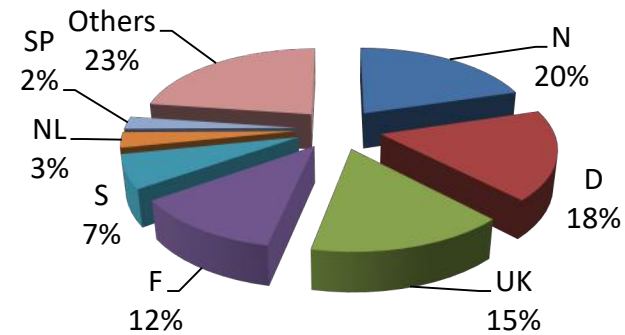
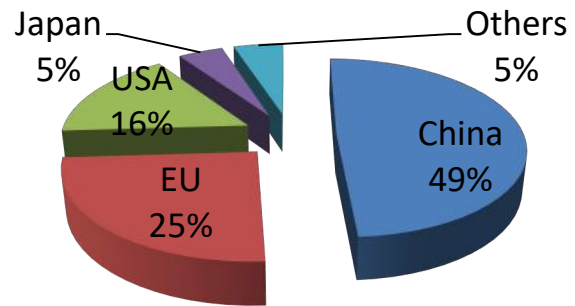
2017 = 1224,103 un (+ 58%)



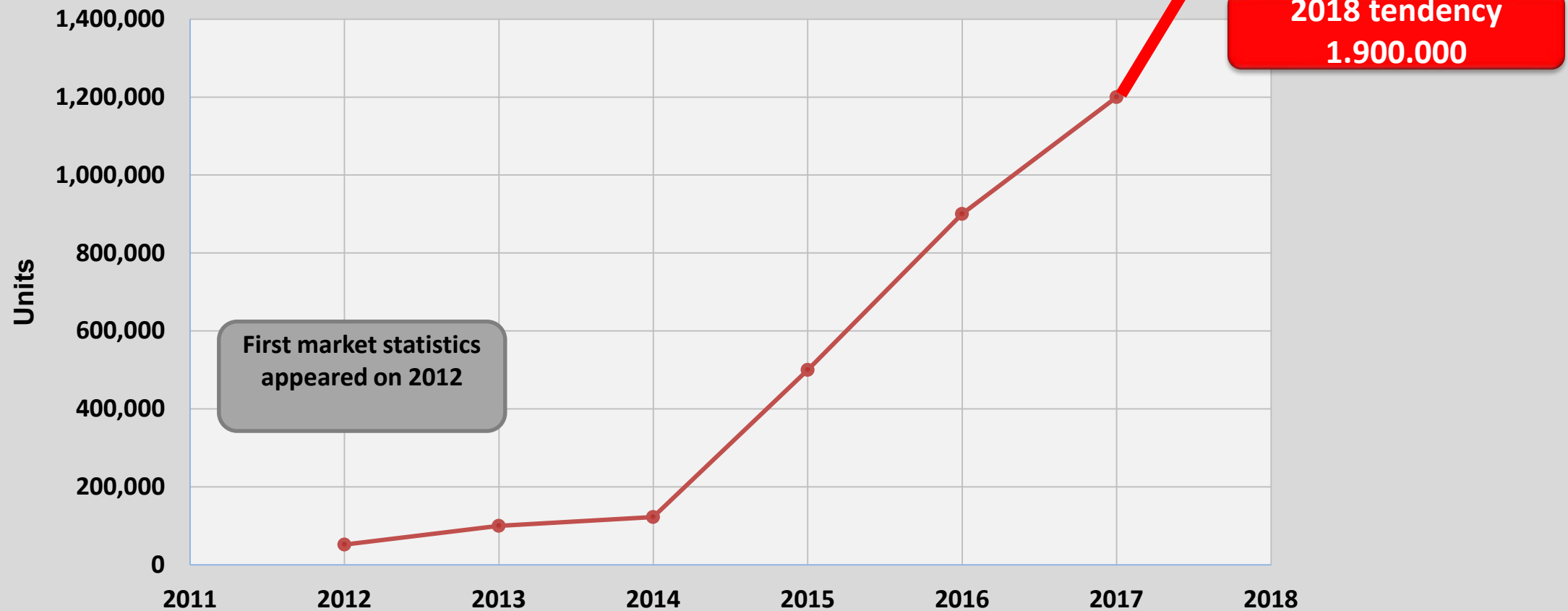
Europe:

2016 = 222,619 un (+15%)

2017 = 306,143 un (+38%)



WORLD-WIDE EV SALES (2012-17)















SITUATION AND FORECASTS

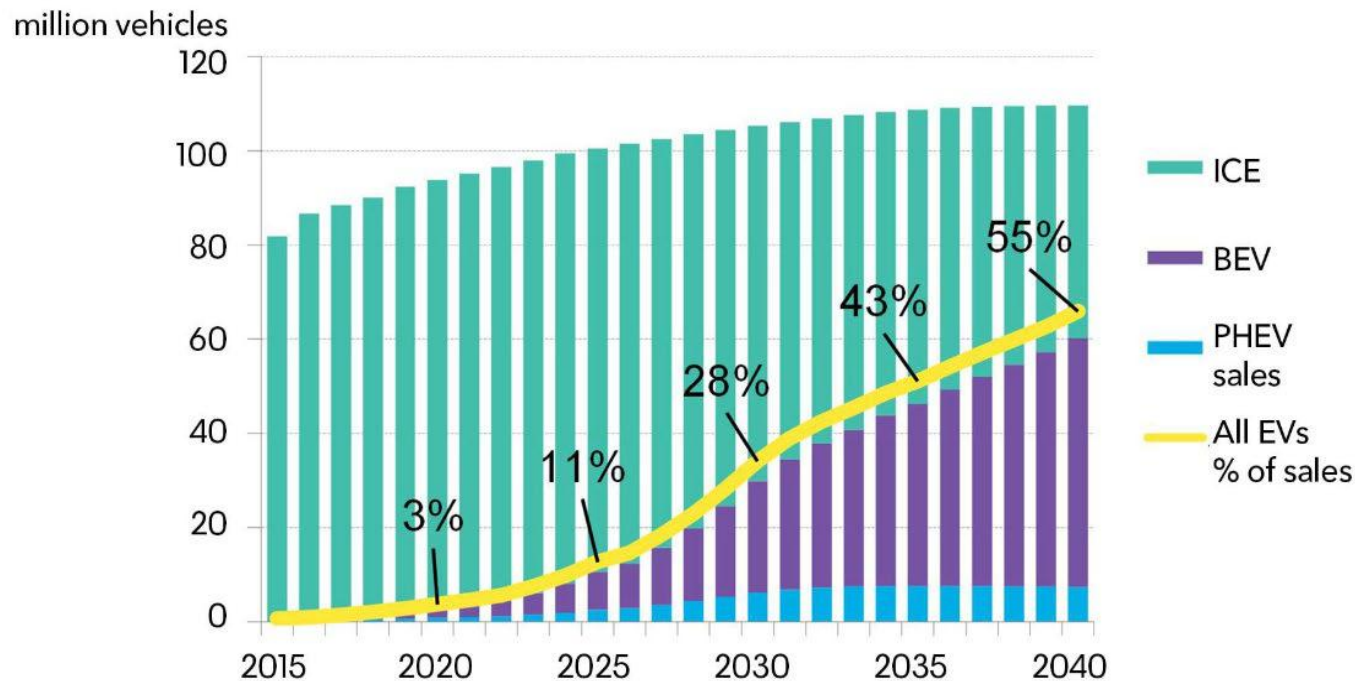
AUTOMOTIVE SECTOR

The EV sales will grow at a rate of 40-60% per year, for many years.

In 2020, there will be 11 Mio EV. In 2030 is expected to be 140 Mio (10% of the total).

	2017				2020			
	Total Vehicle stock		New Sales		Total Vehicle stock		New Sales	
								
	1,2 Bio	3 Mio	78 Mio	1,2 Mio	1,4 Bio	11 Mio	80 Mio	4 Mio
	256 Mio	1 Mio	16 Mio	300 k	300 Mio	3,5 Mio	17 Mio	1 Mio
	22 Mio	23 k	1,2 Mio	7,5 k	26 Mio	115 k	1,4 Mio	35 k
	3,2 Mio	7 00 ?	282 k	250 ?	3,7 Mio	3 k ?	290 k ?	2 k ?

Annual global light duty vehicle sales



Source: Bloomberg New Energy Finance

- The outlook for EV sales in the long term will be influenced by how quickly charging infrastructure spreads across key Markets.
- China is and will continue to be the largest EV market in the world through 2040.
- E-buses. Buses go electric faster than light duty vehicles.
- Electrified buses and cars will displace a combined 7.3 million barrels per day of transportation fuel in 2040.

*In 2040, **60 Mio EVs are to be sold**, equivalent to 55% of the global light-duty vehicle market and 33% of the global fleet will be electric.*

EV Charging Infrastructure

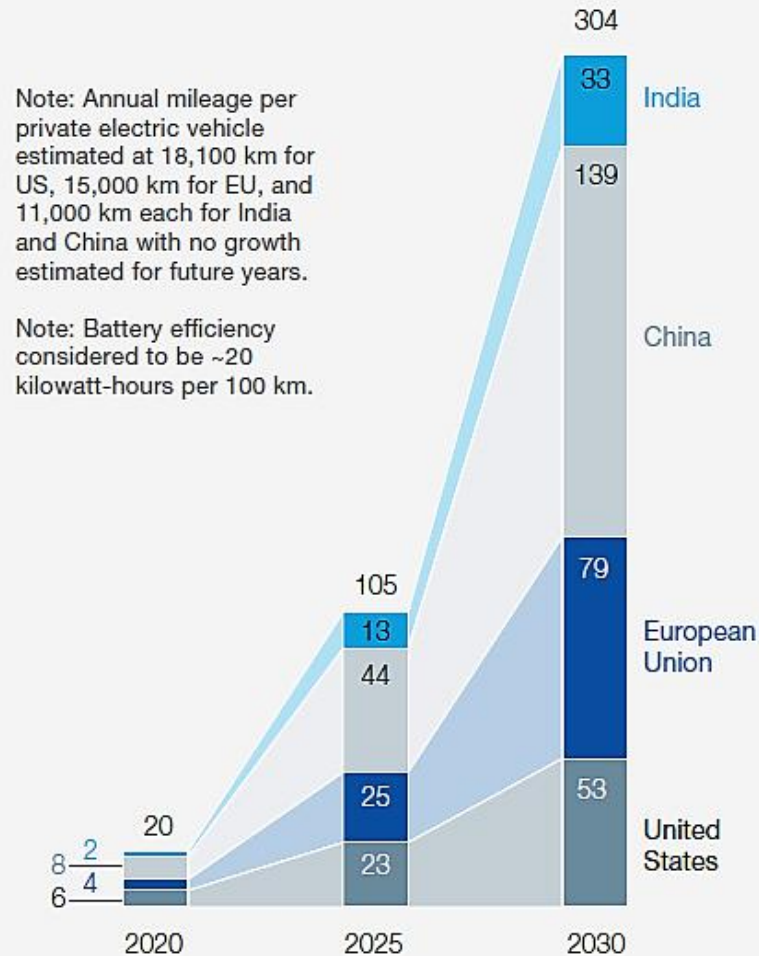
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EV growth to revolutionize the Power sector



Charging-energy demand for electric vehicles in the four regions studied could reach 300 billion kilowatt-hours (300 TWh) by 2030.

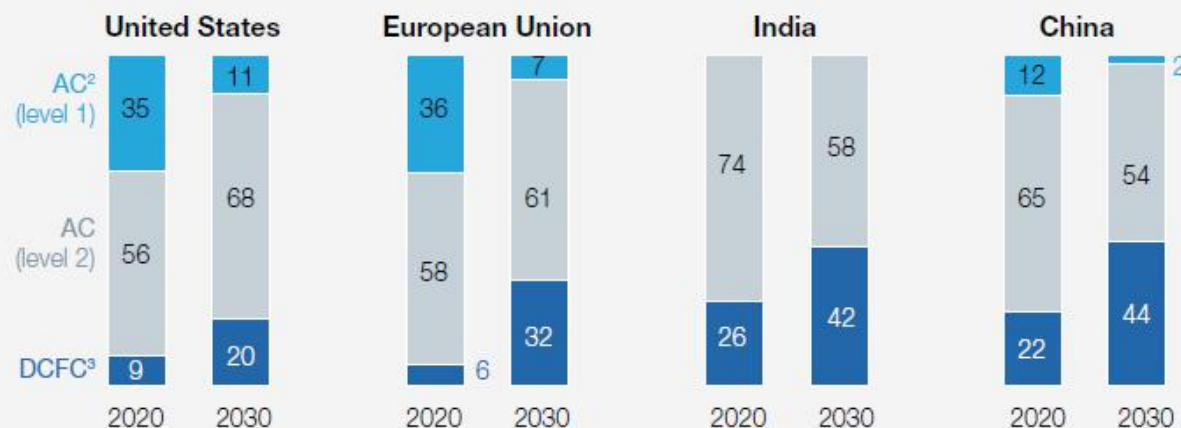
While 300 billion kilowatt-hours sounds like a big number, it represents less than 10 percent of current US energy demand.

However an Intelligent EV Charge is a must due to Power Stress at the LV distribution network

How are we going to load **so many kWh?**

Level 1 and Level 2 charging will likely remain the dominant source of charging energy demand.

Energy demand by charging technology, % of kilowatt-hours,¹ home-centered scenario



¹Figures may not sum to 100%, because of rounding.

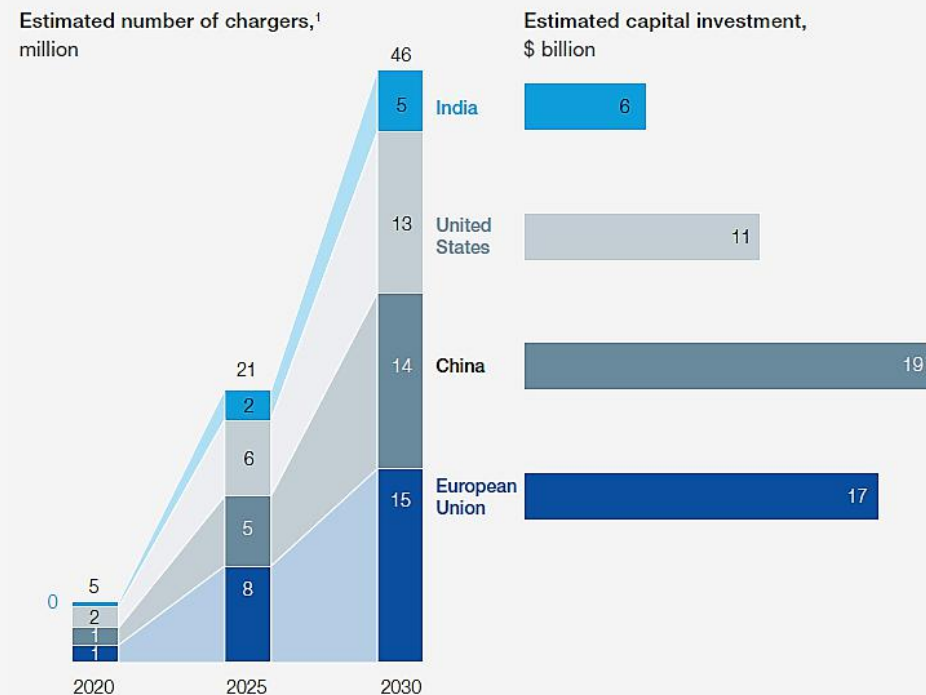
²Alternating current.

³Direct current fast charging.

McKinsey&Company | Source: McKinsey analysis

AC charge bigger than DC. But DC Rapid charge needed for transit charges, fleets, drivers w/o Home charger, eBUS, ...

The industry may need to invest \$55 billion in the four regions studied through 2030 to meet the need for chargers.



¹Figures may not sum, because of rounding.

McKinsey&Company | Source: McKinsey analysis

EV Chargers industry to invest due to the growing demand in charging solutions

Electric Vehicle Chargers (EVSE) Sales 2017

World:

2016 = 210,000 un

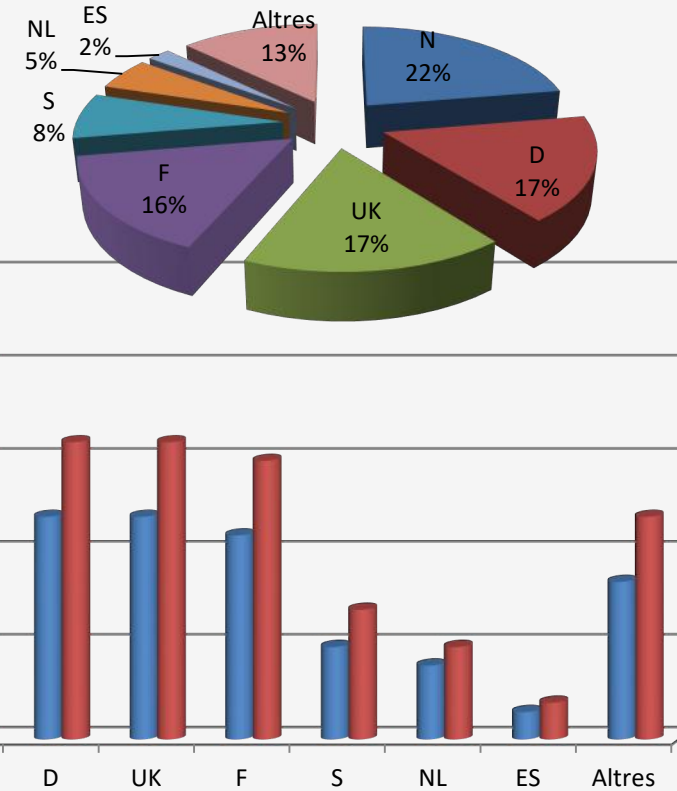
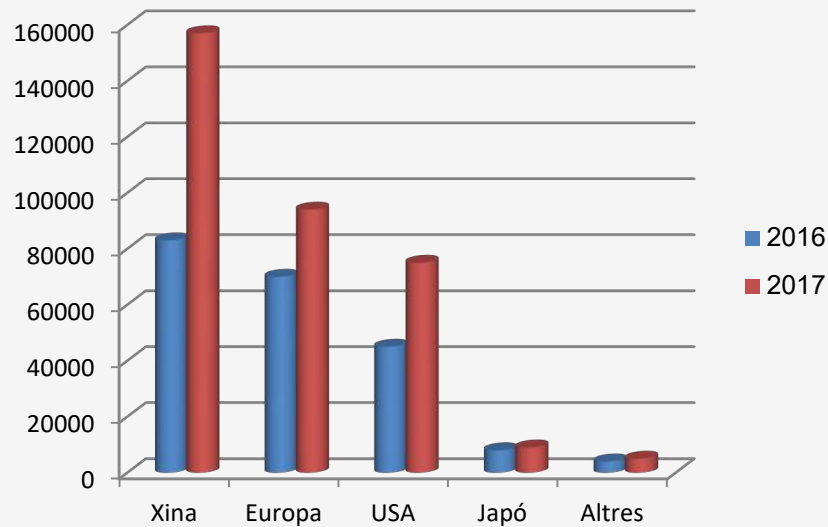
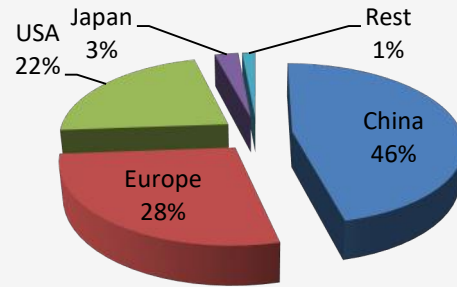
2017 = 340,000 un (+ 62%)



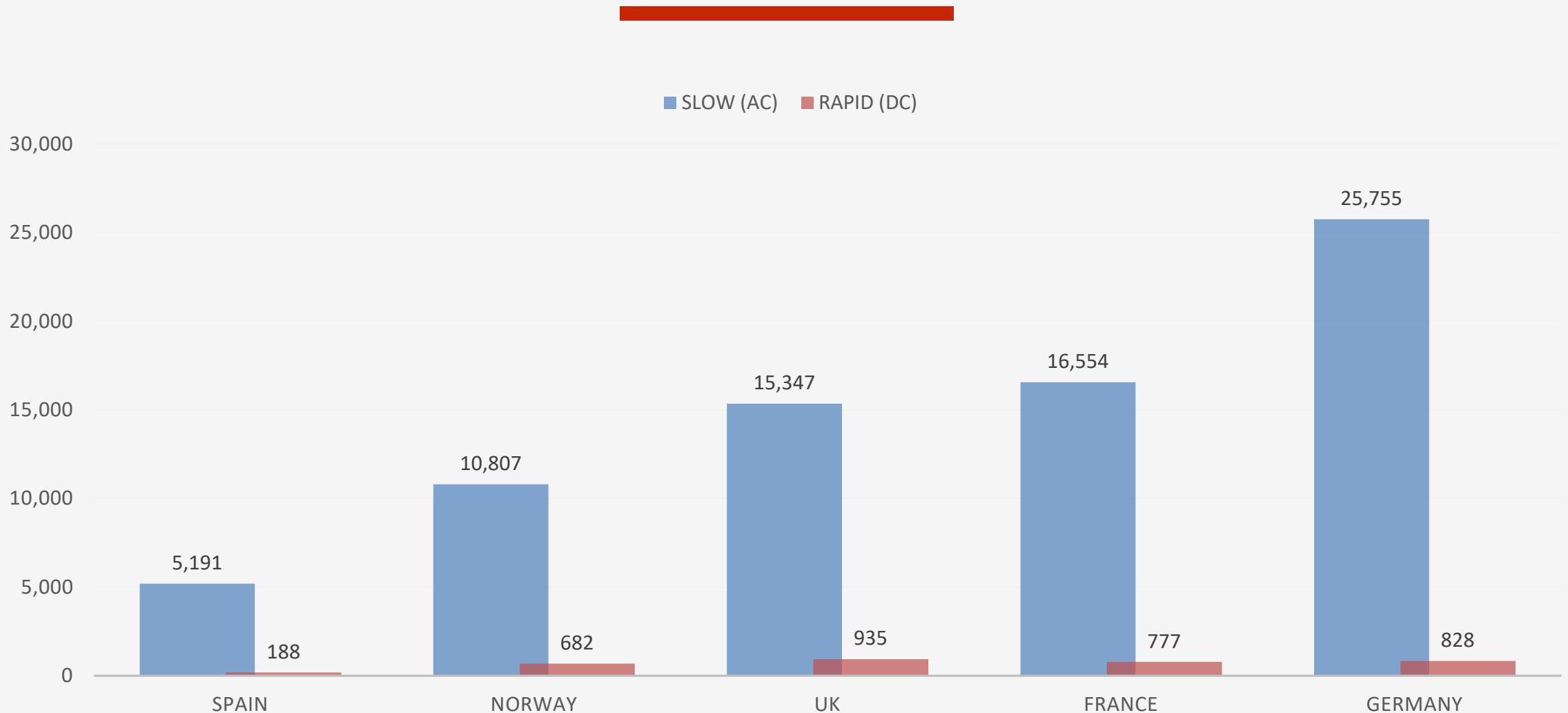
Europe:

2016 = 70,000 un

2017 = 94,000 un (+34%)

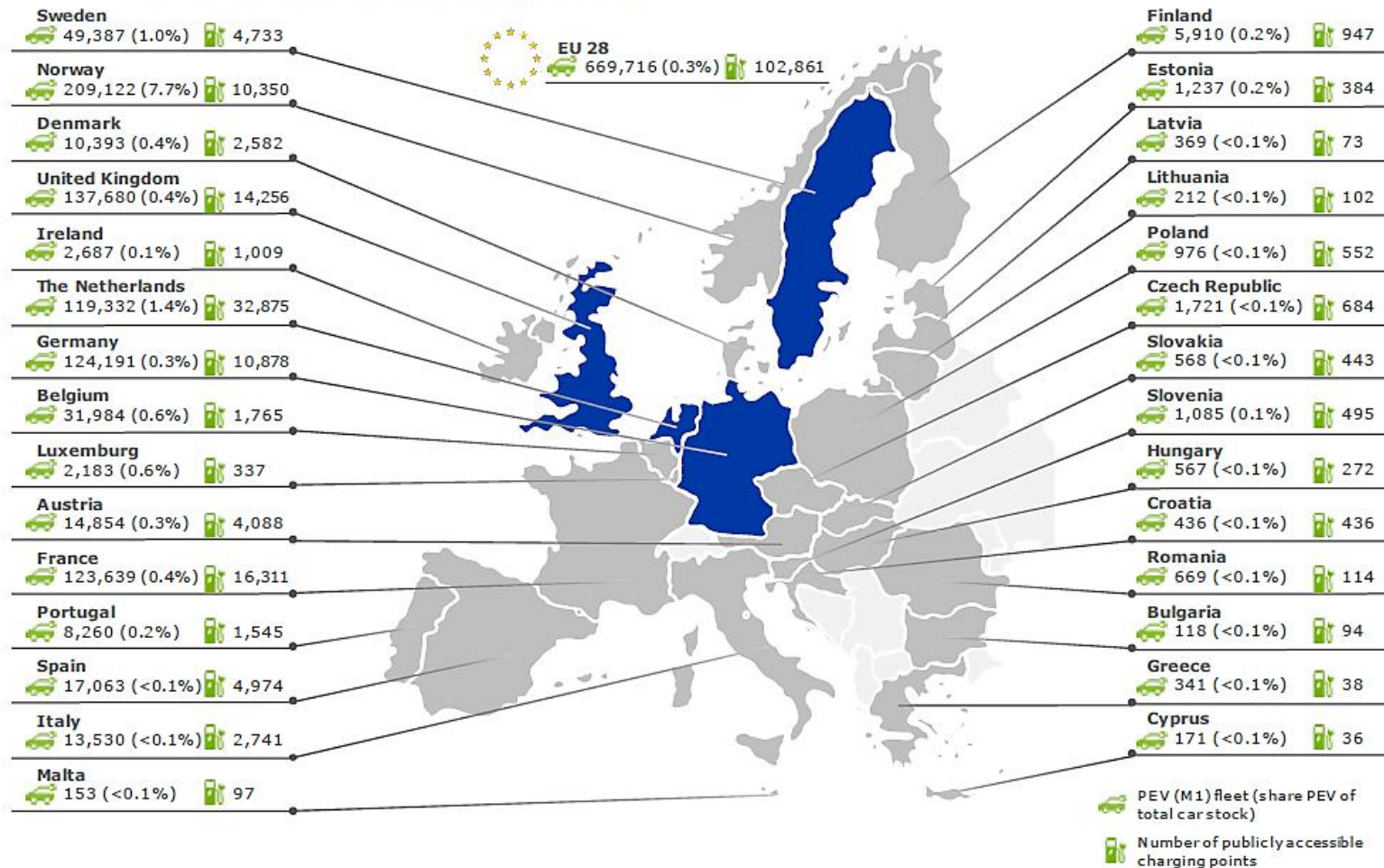


Public EV Charging Points in Europe



EV and EVSE in Europe 2017

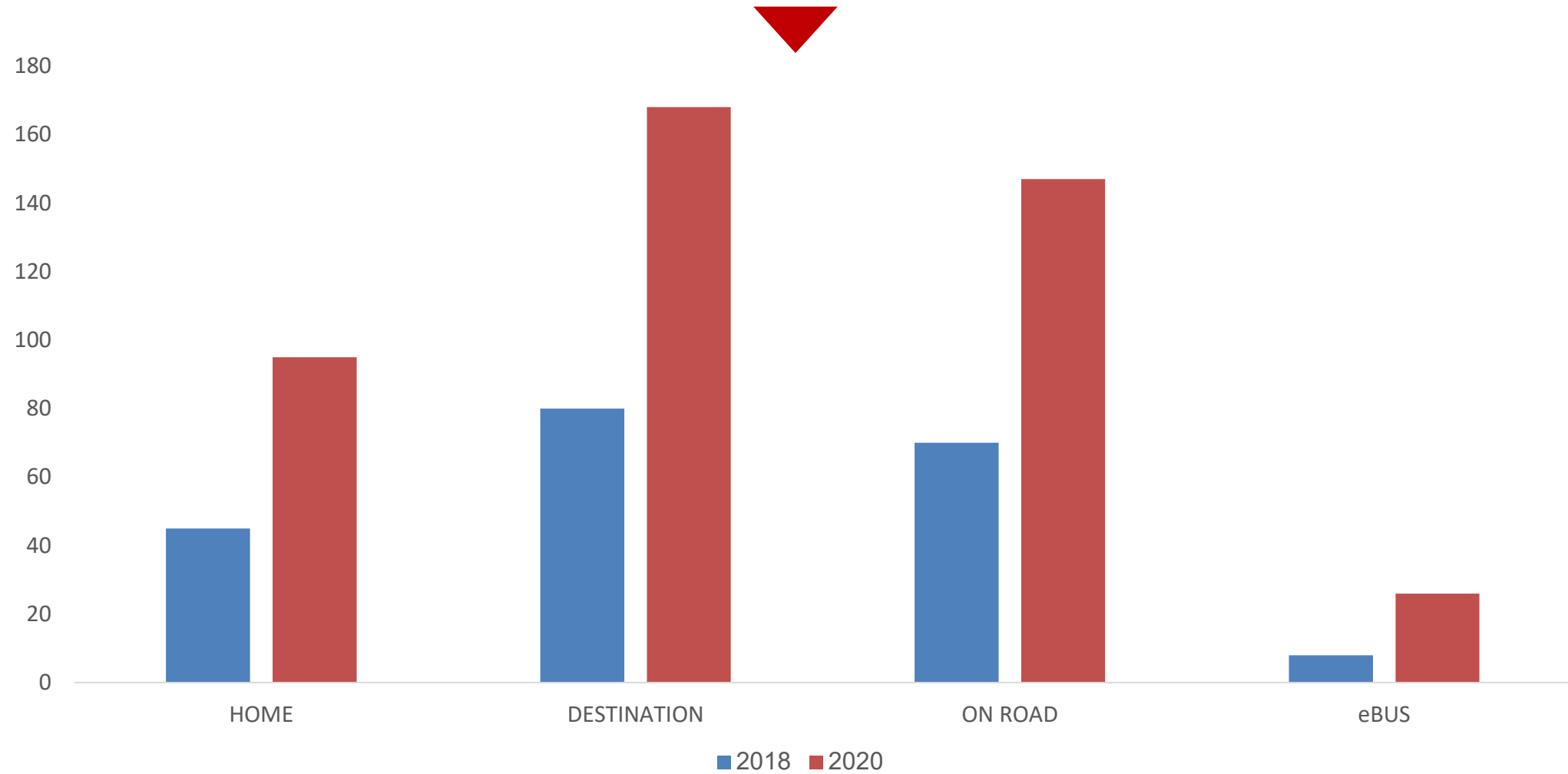
Figure 1: Number of PEVs (M1²) and publicly accessible charging points in Europe (EU28 and Norway) (2017)



EVSE MARKET SEGMENTATION



EVSE Market in Europe (M€)



Usage prices vary by country and operator

- DC
 - 0,146 €/min
 - 0,75 €/kWh

NL




- DC
 - 2,5 NOK/min
- AC
 - 2,5 NOK /kWh
- 1 NOK = 1,106 €

NO




- DC
 - 0,482 GBP/min
- AC
 - 0,33 GBP/kWh
- 1 GBP = 0,879 €

UK



- DC
 - 0,79 €/session
 - 0,289 €/min
- AC
 - 2,49 €/session

FR



- DC
 - 7,5 €/session
- AC
 - 6 €/session

DE



EV Charge examples



Single family house



Communal blocks



Work Places

EV Charge examples



Fleets (Royal Mail United Kingdom)



Public car park (Tele2 Arena, Stockholm)



Shopping Mall / Hospitality (Finland)

EV Charge Examples



Public charger in Hamburg city Hall



Ski resort



Motorway “petrol” station

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The European automotive sector “to move up a gear”



- **Volvo 2019:** All vehicles to be electric or hybrid.
- **VW 2025:** 80 electrified models; 50 Electric, 30 hybrid.
- **BMW 2025:** 32 electrified models; 12 Electric, 25 hybrid.
- **Jaguar-Land R 2020:** All vehicles to be electric or hybrid.
- **Daimler 2025:** 25% of vehicles to be electric.
- **Porsche 2023:** 50% of vehicles to be electric.
- **Renault - Nissan - Mitsubishi 2022:** 12 new full electric Models.
- **PSA 2025:** All vehicles to be electric or hybrid.
- **World 2025:** 25 Mio of electrified vehicles will be manufactured in approx. 400 models, of which 20% will be pure electric.



Europe: Ultra-fast EV Charge network Plan



Europe: Ultra-fast EV Charge Network Plan (I)

Name	#sites #points	Share Holders	Countries	Remmarks
Ionity	400 / ~2,400	BMW, Mercedes, Ford, VW Group (Porsche and Audi)	24 countries	End 2020 Partner Shell
Ultra-e	25 / ~100	Allego, Audi, BMW, Magna, Renault, Hubject	NL(5), B(4), DE(12), AT(4)	End 2018 Average distance betw. stations 150-200 km
E-Via Flex-E	14 / ~60	Enel (coordinator), EDF, Enedis, Verbund, Nissan, Renault, Ibil	T(8), ES(4), FR(2)	
MEGA-E	39 / 322	Allego	20 countries Centro EU y Escandinavia	Focuses on Hubs for metropolitan areas
Central European Ultra Charing	118 / N.A.	Verbund (coordinator), CEUC, Enel X, Smatrics, Greenway, OMV	AT, CZ, IT, HU, RO, BG, SK	Focuses on Hubs for metropolitan areas

Europe: Ultra-fast EV Charge Network Plan (II)

Name	#sites #points	Share Holders	Country	Remmarks
NEXT-E	30 / N.A.	E.ON, MOL, HEP, PETROL, Nissan, BMW	CZ, SK, Croatia, Hungary, SI, RO	222 DC (50kw) Chargers included
E.ON x Clever	180 / N.A.	E.ON and Clever	DE, FR, NO, SE, UK, IT, DK	2-6 Chargers/Station
Instavolt network	N.A. / 200	Instavolt	UK	EVSE from ChargePoint
Fastned network	25	Fastned	DE, NL, UK	ABB Equipment More stations to the future
Pivot Power and the National Grid	45 / 100		UK	50 MW battery storage
EnBW	1000 / 800	EnBW and OMV	DE	2 Chargers/Station Focus on urban areas
Porsche	N.A.	Porsche		Porsche private Network Cooperation with OMV

EU countries **Incentive** comparison

COUNTRY	BONUS PAYMENTS AND PREMIUMS	TAX BENEFITS	LOCAL INCENTIVES	CHARGING INFRASTRUCTURE INCENTIVES
Austria	✓	✓	✓	✓
Belgium	✓	✓		✓
Bulgaria		✓		
Croatia	✓			
Cyprus		✓		
Czech Republic		✓		
Denmark		✓	✓	✓
Estonia				
Finland		✓		
France	✓	✓	✓	✓
Germany	✓	✓	✓	✓
Greece		✓		
Hungary		✓	✓	
Ireland	✓	✓	✓	✓

COUNTRY	BONUS PAYMENTS AND PREMIUMS	TAX BENEFITS	LOCAL INCENTIVES	CHARGING INFRASTRUCTURE INCENTIVES
Italy	✓	✓		✓
Latvia		✓	✓	
Lithuania			✓	
Luxembourg		✓		
Malta	✓	✓	✓	✓
The Netherlands		✓	✓	✓
Poland				
Portugal	✓	✓	✓	
Romania	✓	✓		
Slovakia	✓	✓	✓	
Slovenia	✓	✓		
Spain	✓	✓	✓	✓
Sweden	✓	✓		
The UK	✓	✓	✓	✓

European and Spanish **Legislation**

The European Directive 2014/94/UE published on 22 October 2014 on the implementation of infrastructure for alternative fuels: the Member States of the European Union are asked to create an appropriate number of charging points for electric vehicles
(Recommendation: Minimum 1 Charger every 10 EV's).



» In Spain there is a multiplicity of regulations:

RD Law 6 of 2010:
Integral strategy for the impulse of the VE, including the new figure of the "CPO".

RD 647/2011:
Regulating Charge Point Operator (CPO) activity

Law 24/2013:
of the electrical Sector, specifying rights and obligations of the CPO.

RD 842/2002:
REBT to which all electrical installations must be referred...

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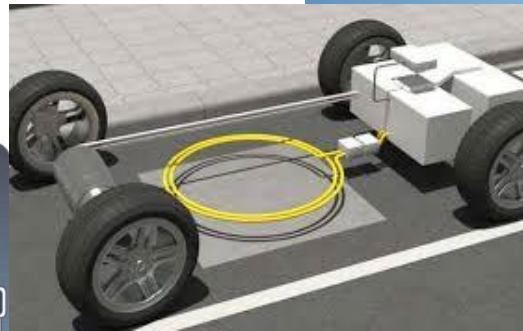
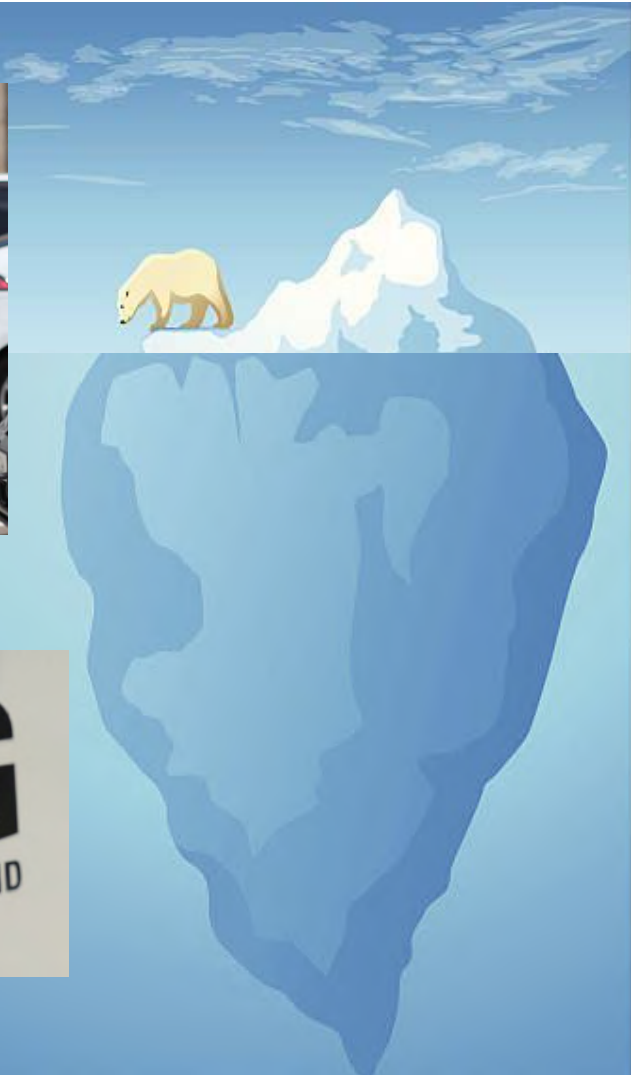
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Coming **EVSE** technology ...



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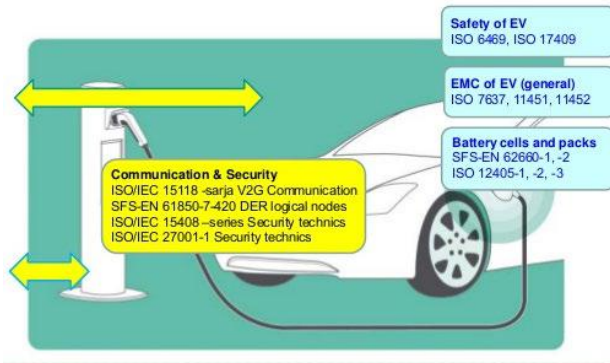
- Dynamic Load Management.
- Integration of existing payment systems to the EV charge.
- OCPP 2.0: + security, + control + information.
- ISO 15118: EV identification through power line.
- Roaming 4.0: Inter-operability for EV charge.
- Ultra-fast DC charge: + V + A = +++ KW.
- V2G @ V2H: The EV returns power to the main grid.
- Energy Storage: From On-board and Off-board batteries.
- Wireless Charging: Charging by magnetic induction



Coming **EVSE** technology...

- ISO 15118: EV identification via Power Line Carrier

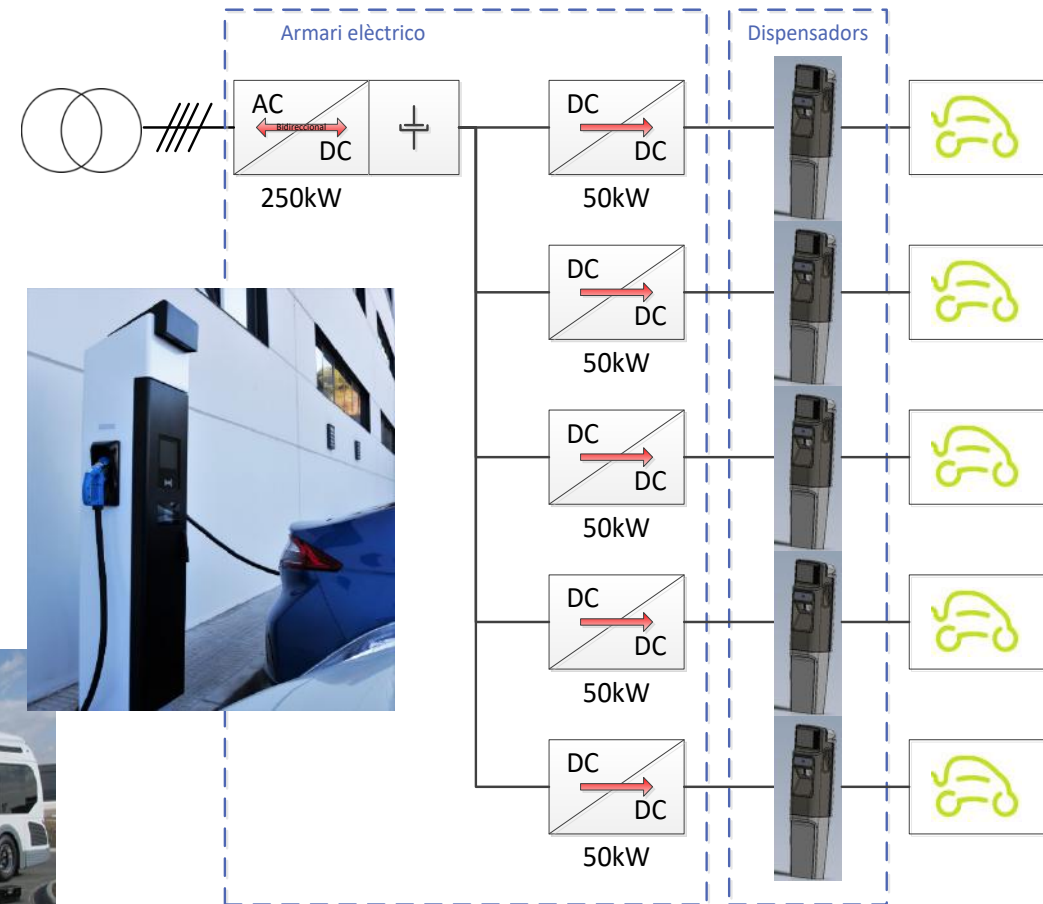
Standards concerning EV, communication and security



- This system simplifies the process of recharging an electric vehicle by completely dispensing with magnetic cards or mobile applications.
- The only necessary action is to insert the vehicle-charger charging cable.
- It is based on the international standard ISO 15118, which regulates the automated and insured data exchange between vehicle and cargo infrastructure (it powers the charging stations through a digital certificate in the vehicle).
- ISO 15118 allows other use cases such as the future connection of V2G (vehicle to grid) electric vehicles, complying with the safety requirements for the future cargo infrastructure.
- Once the vehicle is connected to the charging station, the driver's authorization data is transmitted and synchronized in an encrypted manner.

Coming **EVSE** technology...

- Ultra-Fast DC Charge: + V + A = +++ kW 50 ... 150 ... 350 ... 500 kW



Coming **EVSE** technology...

- V2G @ V2H: The EV returns power to the main grid

V2H / V2G EV Charger

The unit is capable of send power in two directions.

The charge can be made from DC in low voltage (solar energy)



Voltage	Usage	Power	Time
230V ac	Home Office	1.4-1.9kW (12-20A)	4-36h
400Vac	Private Public	4-19.2kW (17-80A)	1-6h
200-600V ac/dc	Commercial Filling Stations	50kW 100kW	0,4-1h

Coming **EVSE** technology...

Pérgola solar con almacenamiento de energía y tomas para la recarga inteligente del VE



- 2 Puntos de recarga de VE (32 A Mode 3 + 16 A Schuko cada uno)
- 3 vehículos en un aparcamiento "On-grid" con gestión del almacenamiento

Pérgola solar



Opciones



Pérgola Solar 2 Plazas de Parking

- Dos plazas de parking
- Dimensiones: 5 m x 5 m
- Potencia instalada: 3,6 kWp



Pérgola Solar 3 Plazas de Parking

- Tres plazas de parking
- Dimensiones: 7,5 m x 5 m
- Potencia instalada: 6 kWp

Armario Exterior



- IP54 (IK10)
- Rango operativo: -10 °C a +40 °C

Puntos de recarga

- 2 puntos de recarga CA integrados
- Cumple con Modo 3 IEC 61851-1
- Tipo II + conectores Schuko
- Conectado con el software de control SCADA

Sistema de almacenamiento de energía

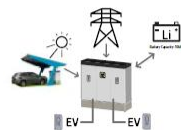
Batería de litio

- Capacidad: Ver Opciones
- Tensión: 48 V
- Potencia de descarga Max.: 6 kW

Inversor de batería / Punto de recarga

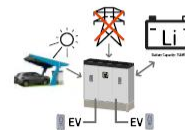
- Red conectada o modos aislados
- Potencia nominal: 6 kW CA (monofásico)

Opciones



Sistema "On Grid"

Capacidad de la batería: 10kWh



Sistema "Off Grid"

Capacidad de la batería: 15kWh

Monitorización y control remoto

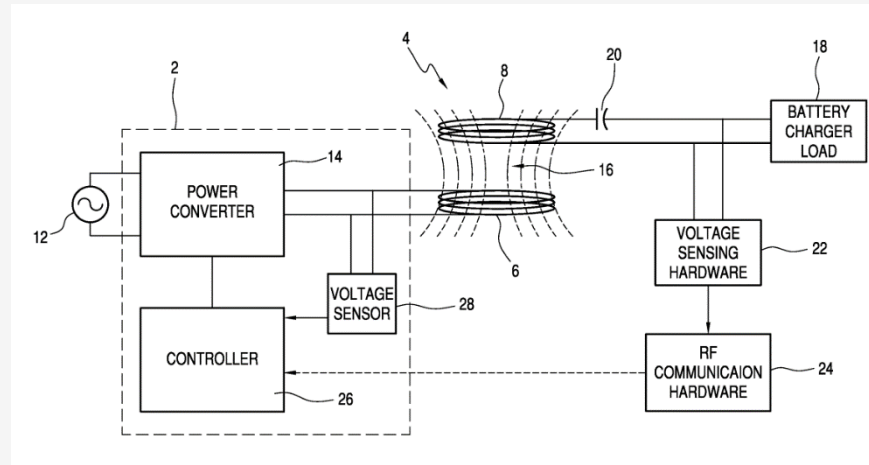


- Gestión de energía & smart power balance
- Monitorización local y sistema de control
- Acceso remoto al PV, datos sobre batería y estado de carga
- Conexión con OCPP y backoffice
- Integración con software externo (OCPP, XML,...)

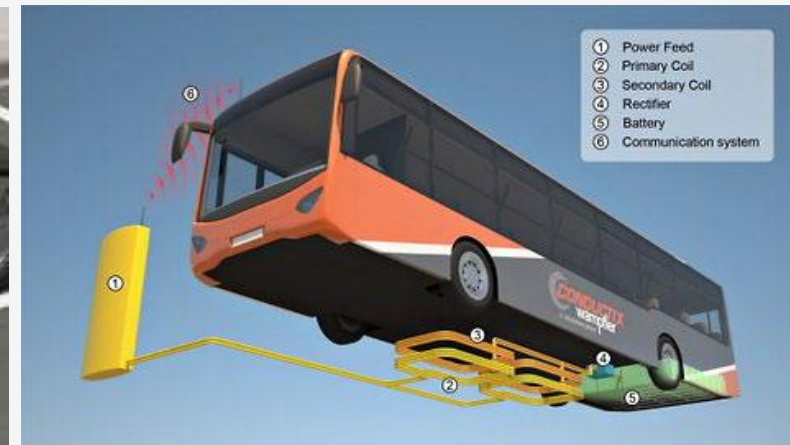
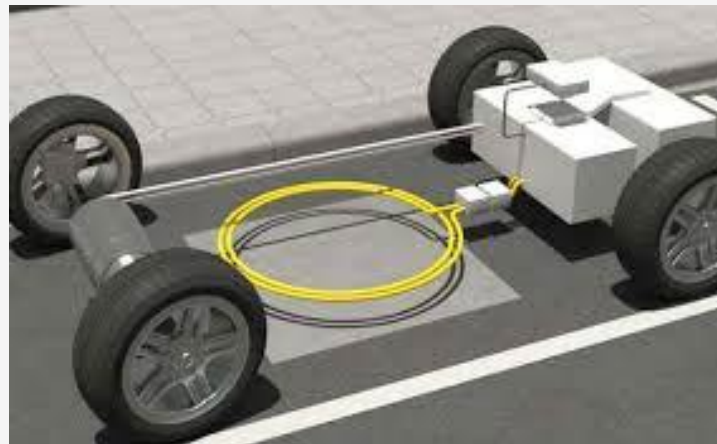


Coming **EVSE** technology...

- Wireless Charging: Charging by magnetic induction



Dubious technology for medium or high power for its losses and electromagnetic waves harmful to health.



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CONCLUSIONS

- **The market**

2017: From the world's vehicle stock (1.2 Billion units), only 3 Million are electric (0.25%). In 2030 the prediction is 1.4 Billion of which 140 Million to be electric (10%).

Europe represents one third of the market.

In 2030 half of the EV's will have a private charger (home) and every 10 EV's will have a public charger. One out of every 20 public chargers would be fast or ultra fast.

The fast and ultrafast charge will be needed, although the large part of the EV's battery charge will be carried out at home or workplaces.

- **The EV Charge Technology**

In coming years there will be better comms and interoperability systems (charger – EV – operator – user).

The main EV Charge technologies will be the conductive ones, with a great progress in the ultrafast DC Charge, renewable energies, energy storage and V2G.

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QUESTIONS?

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