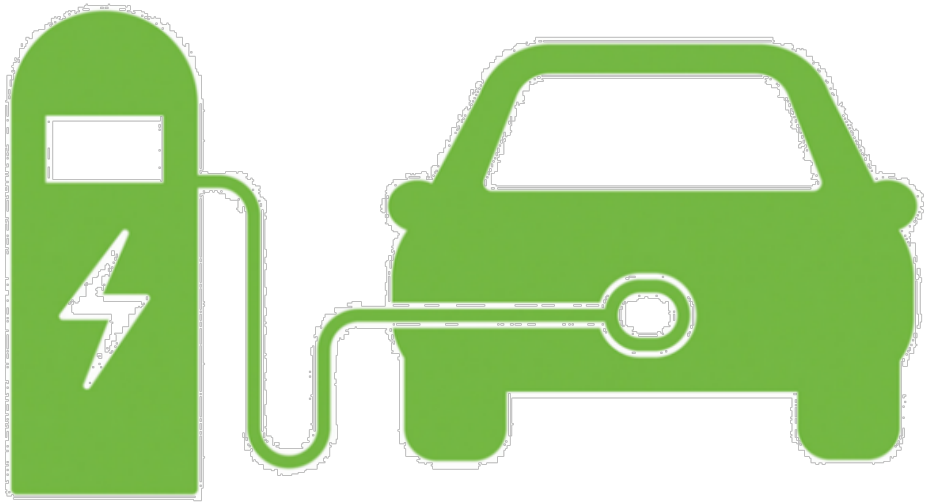
Sistemi di ricarica per PEV

Ing. Ottorino VENERI (Istituto Motori CNR)



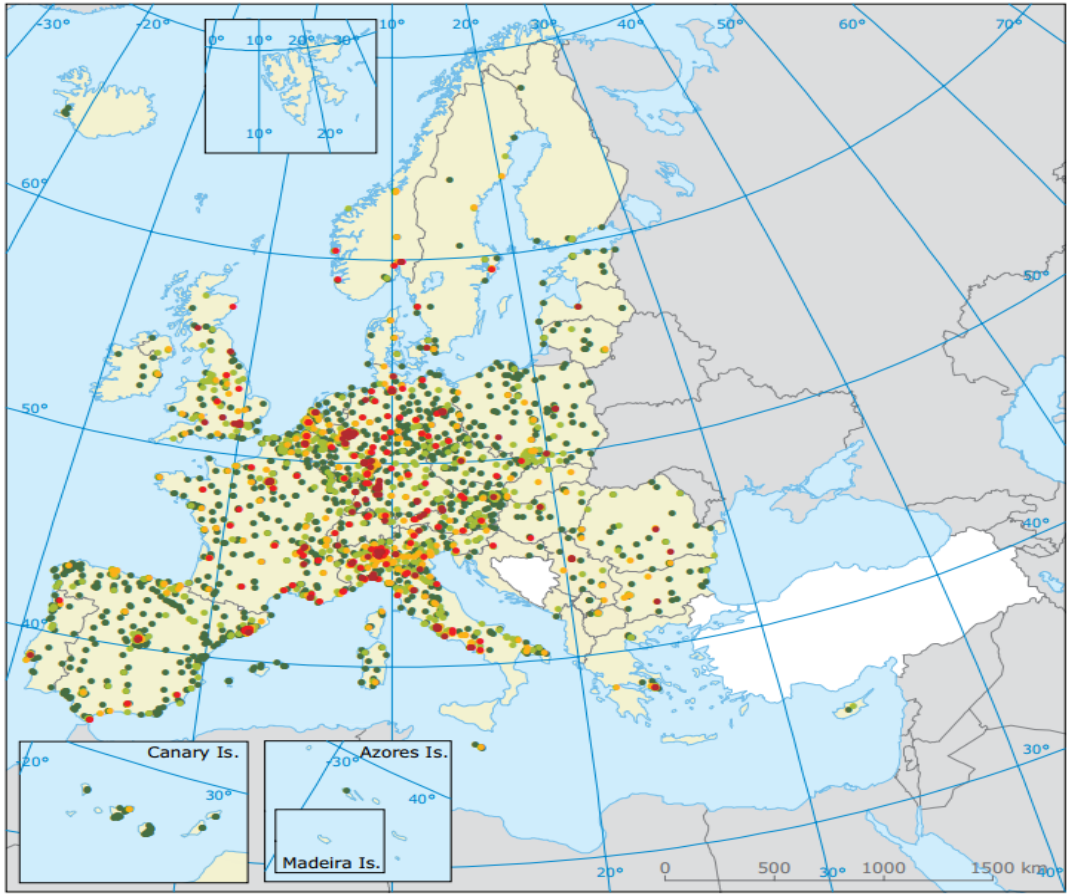
EXPERT PANEL FOR POLLUTING EMISSIONS REDUCTION – EXPAPER

21 – 22 Maggio 2018

CNR Istituto Motori Napoli

ISTITUTO MOTORI
National Research Council of Italy

Map 5.1 Concentrations of NO_2 in 2013



Notes: Red and dark-red dots correspond to exceedances of the EU annual limit value and the WHO AQG (40 µg/m³). Only stations reporting hourly data and with > 75% of valid data have been included in the map.

Fonte: Air Quality e-reporting database (EEA, 2015a)

Country	$PM_{2.5}$	O_3	NO_2
Austria	6 100	320	660
Belgium	9 300	170	2 300
Bulgaria	14 100	500	700
Croatia	4 500	270	50
Cyprus	790	40	0
Czech Republic	10 400	380	290
Denmark	2 900	110	50
Estonia	620	30	0
Finland	1 900	60	0
France	43 400	1 500	7 700
Germany	59 500	2 100	10 400
Greece	11 100	780	1 300
Hungary	12 800	610	720
Ireland	1 200	30	0
Italy	59 500	3 300	21 600
Latvia	1 800	60	90
Lithuania	2 300	80	0
Luxembourg	250	10	60
Malta	200	20	0
Netherlands	10 100	200	2 800
Poland	44 600	1 100	1 600
Portugal	5 400	320	470
Romania	25 500	720	1 500
Slovakia	5 700	250	60
Slovenia	1 700	100	30
Spain	25 500	1 800	5 900
Sweden	3 700	160	10
United Kingdom	37 800	530	14 100
Albania	2 200	140	270
Andorra	60	4	0
Bosnia and Herzegovina	3 500	200	70
former Yugoslav Republic of Macedonia, the	3000	130	210
Iceland	100	2	0
Liechtenstein	20	1	3
Monaco	30	2	7
Montenegro	570	40	20
Norway	1 700	70	200
San Marino	30	2	0
Serbia (a)	13 400	550	1100
Switzerland	4 300	240	950
Total (b)	**432 000**	**17 000**	**75 000**
EU-28 (b)	**403 000**	**16 000**	**72 000**

Table 9.2 **Premature deaths attributable to $PM_{2.5}$, O_3 and NO_2 exposure in 2012 in 40 European countries and the EU-28**

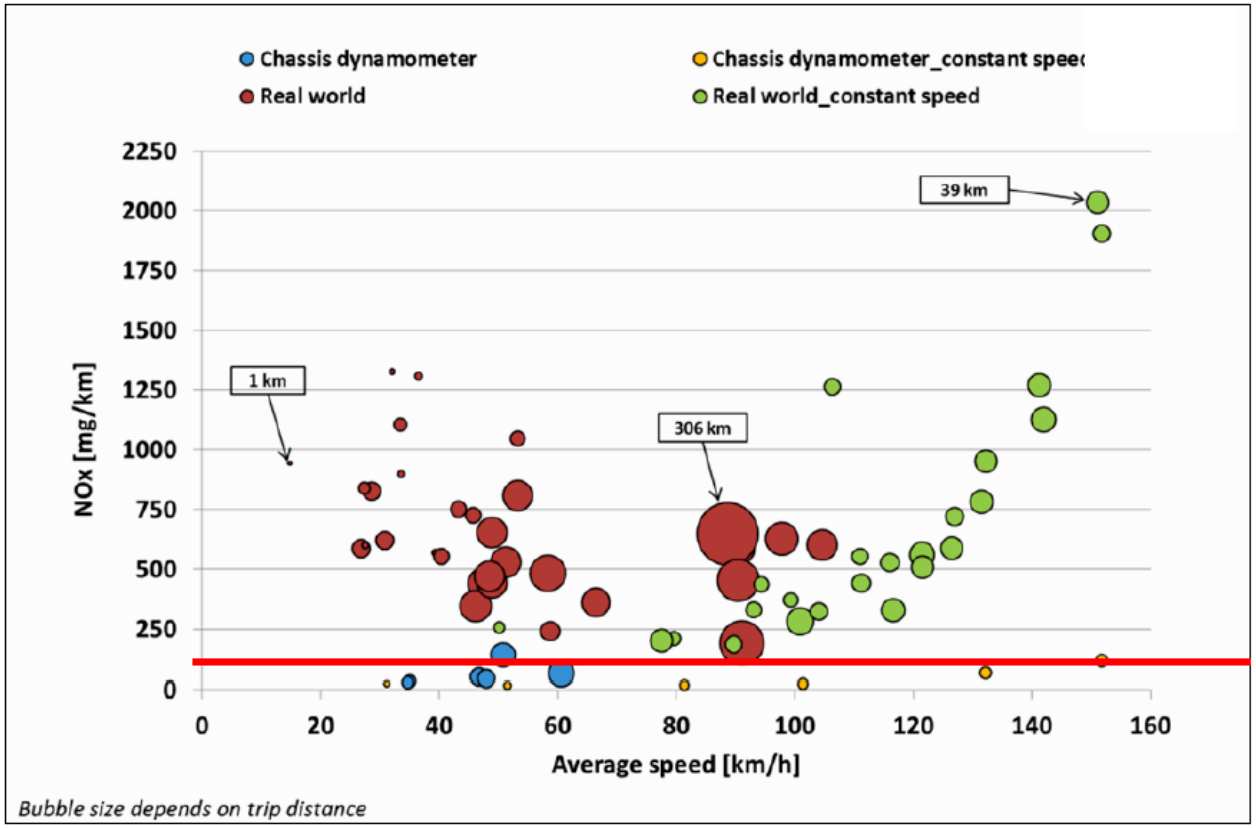
Notes: (a) Including Kosovo, under the UN Security Council Resolution 1244/99.

(b) 'Total' and 'EU-28' figures are rounded up or down to the nearest thousand.

Fonte: Air Quality e-reporting database (EEA, 2015a)

Le emissioni inquinanti vere delle auto

Emissioni di NOx estremamente alte (diesel Euro 6)



Fonti: TNO, LUBW, Ricardo (test su 19 modelli)

L'obiettivo UE è di dimezzare per il 2030 il numero di auto alimentate con carburanti convenzionali

La stima della Green Vehicles Initiative è che al 2025 il 10% del mercato auto sia elettrico (batteria ricaricabile)

Il vincolo UE dei 95 gCO2/km al 2020-21 significherebbe 150.000 auto elettriche vendute nel solo nel 2020

Fonte: CEI-CIVES Commissione Italiana Veicoli Elettrici Stradali

The world is ready for PEVs !?

Auto Manufacturers:

Governments:

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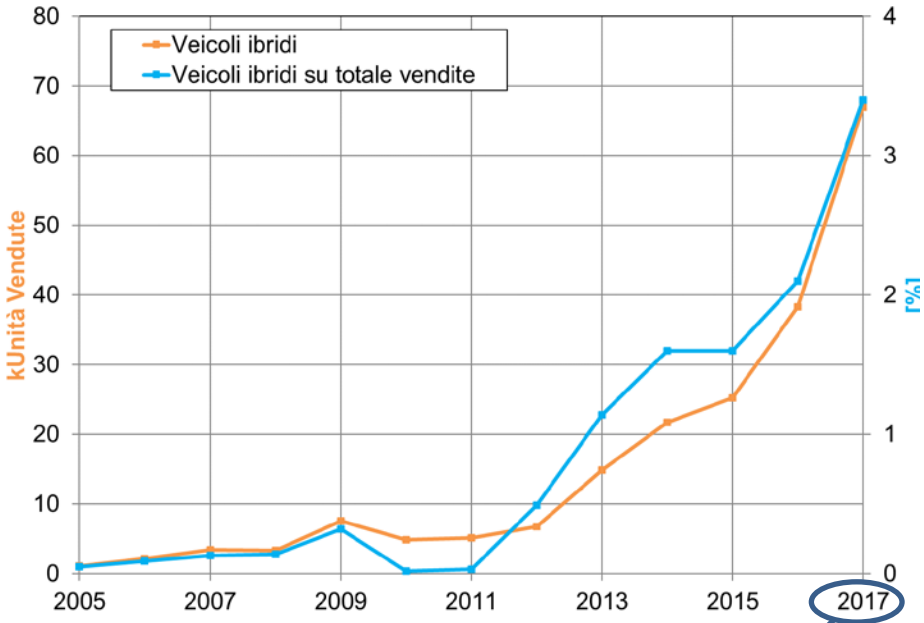
National Research Council of Italy

The world is ready for PEVs !?

TRASPORTI, INFRASTRUTTURE E TELECOMUNICAZIONI: riduzione dell'utilizzo di autoveicoli con motori diesel e benzina; incentivi per veicoli ibridi ed elettrici; Piano Nazionale Infrastrutturale per la ricarica dei veicoli alimentati ad energia elettrica; potenziamento del car sharing elettrico; sviluppo delle reti ciclabili urbane ed extra urbane; investimento di risorse per attrezzare i porti; ammodernamento e potenziamento delle linee ferroviarie;

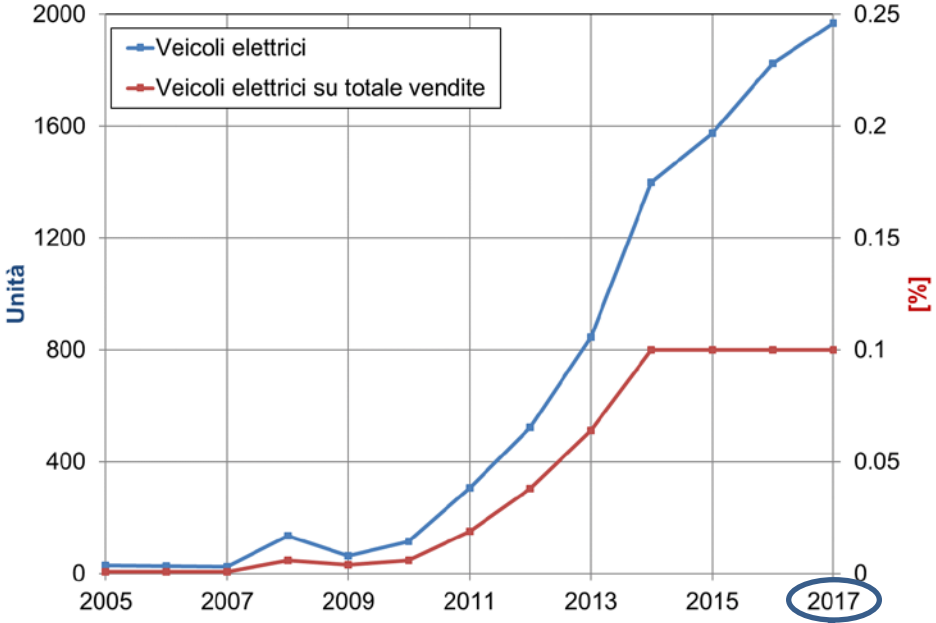
Analisi Mercato PEV in Italia

Immatricolazioni Veicoli Ibridi in Italia(*)



68000 3.4 %

Immatricolazioni Veicoli Elettrici in Italia(*)

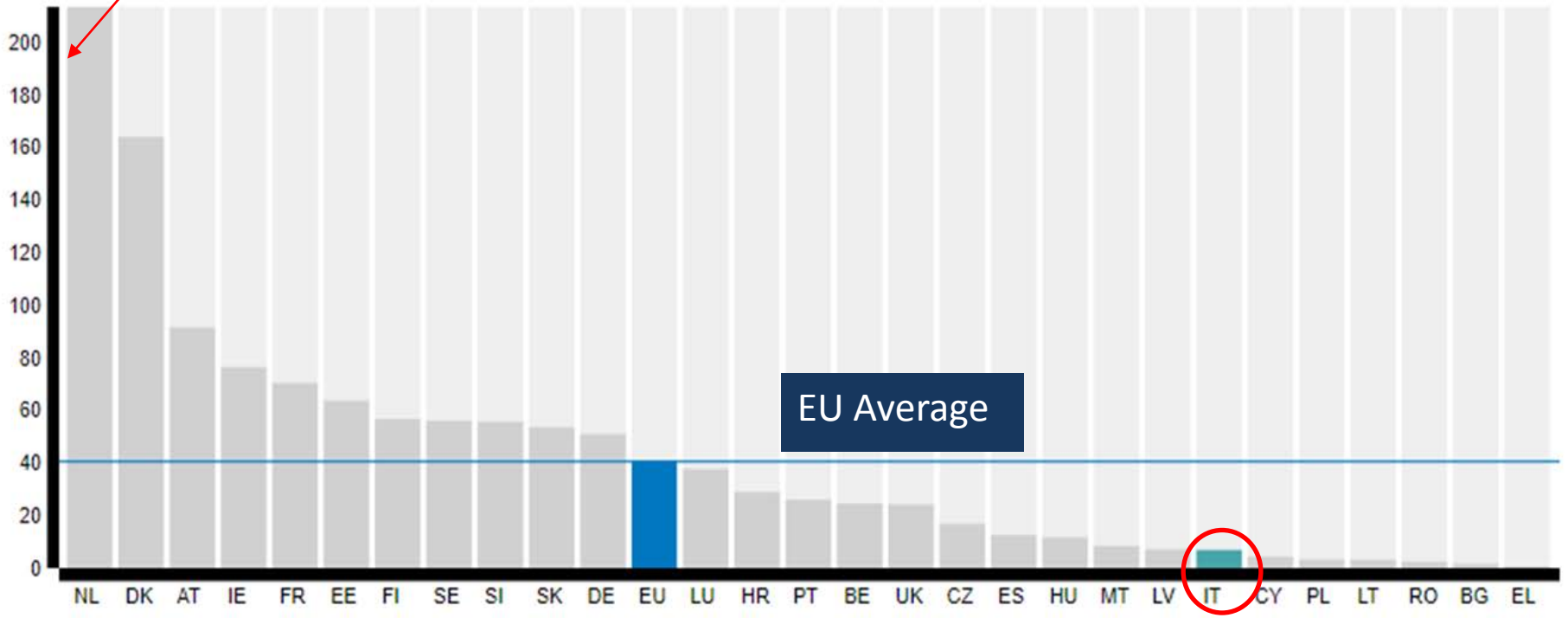


1970 0.1 %

(*) **Dati UNRAE**

Electric vehicle charging points: EU Analysis

Numero Punti di ricarica per ogni 100.000 abitanti

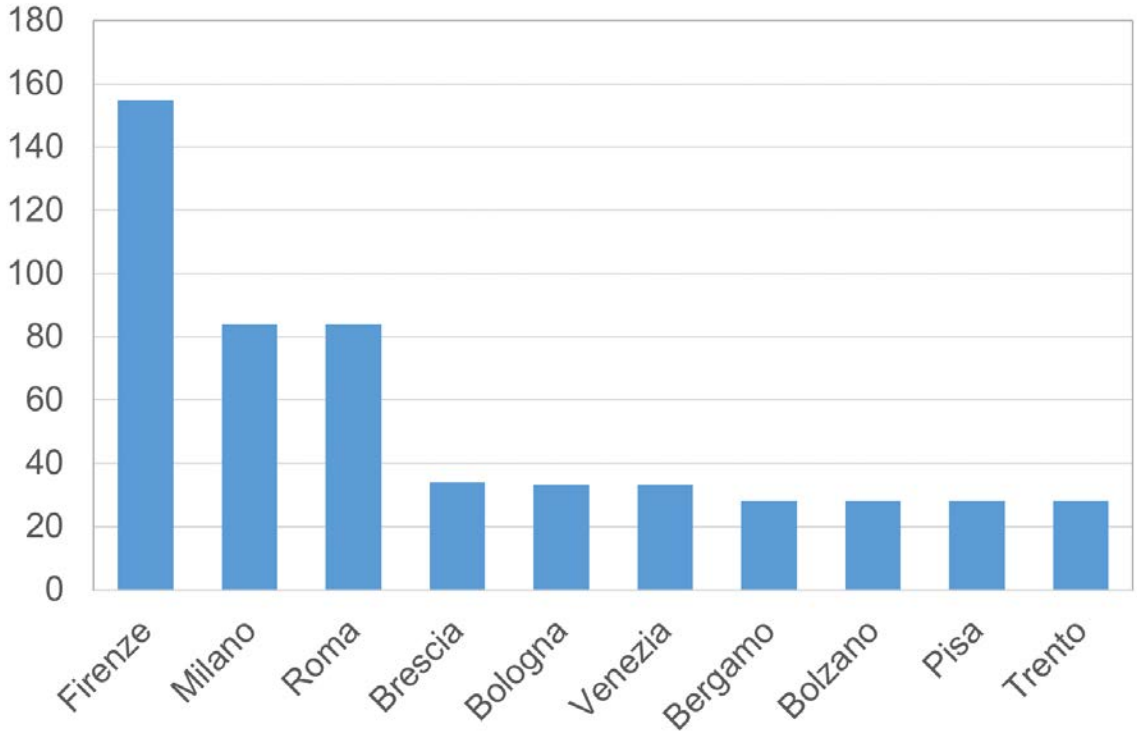


Source: European Commission – Mobility and Transport

Infrastruttura di Ricarica in Italia

- **1150 punti di ricarica totali**
- **50 punti di ricarica rapida DC**

- **10 Città con maggior numero di punti di ricarica**



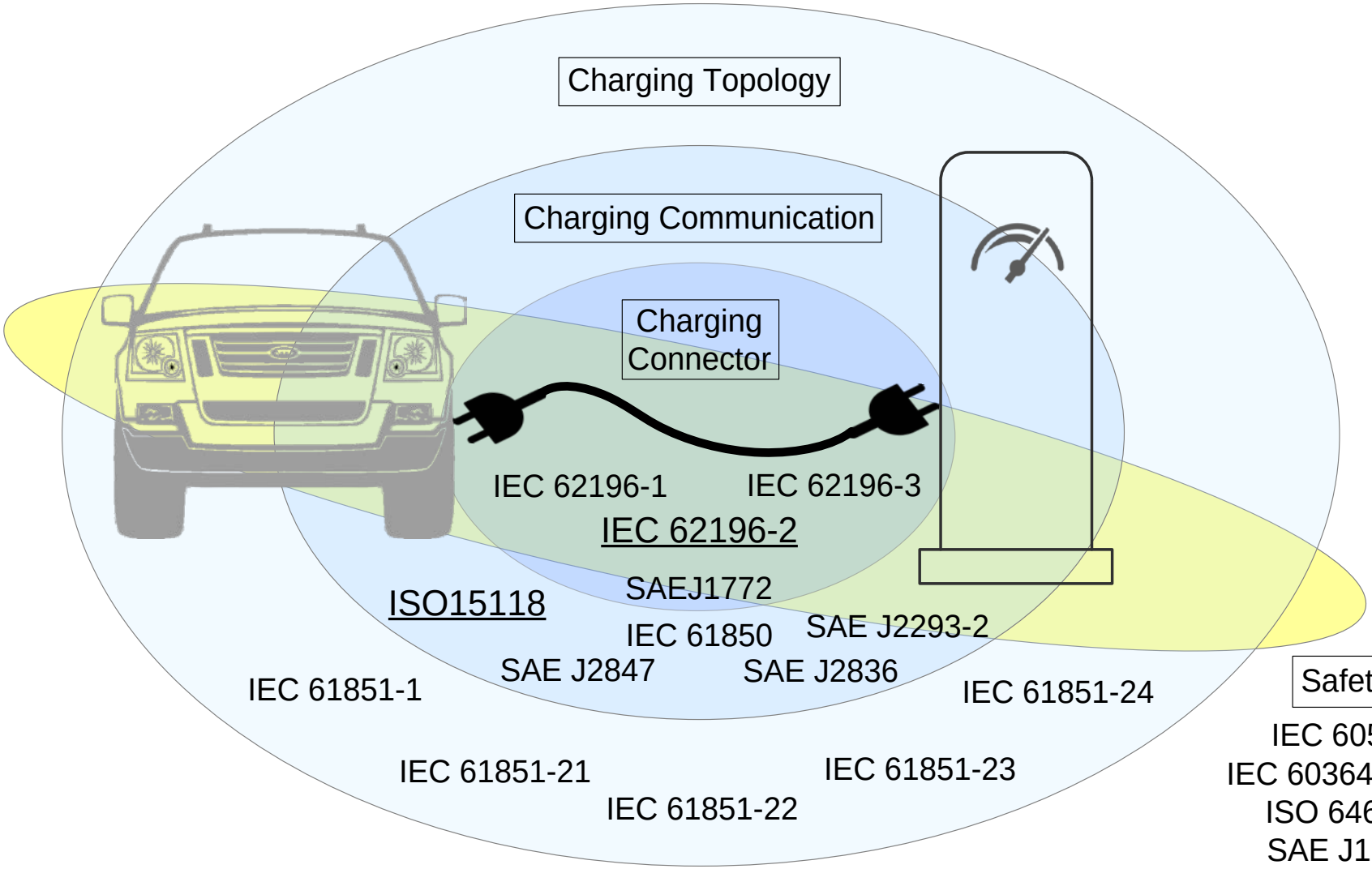
Source:
https://www.colonnineelettriche.it/
https://www.eneldrive.it/

REPLICATE

EU2020 - Progetto Replicate
Comune di Firenze, Comune di San Sebastian, ENEL, CNR - IIT, CNR - IM

PRINCIPALI TECNOLOGIE DI RICARICA PER PEV

PEV Charging Standards



Source: L. Rubino, C. Capasso, O. Veneri "Review on plug-in electric vehicle charging architectures integrated with distributed energy sources for sustainable mobility" Applied Energy 2017

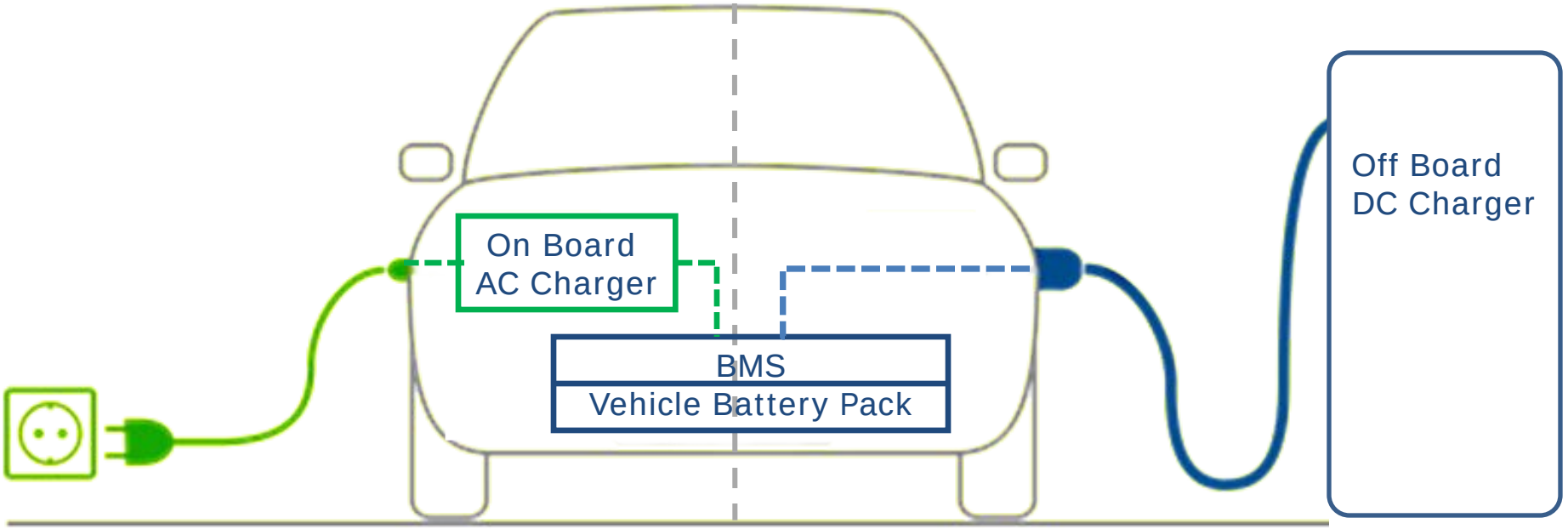
PEV Charging Devices

On Board AC Chargers:

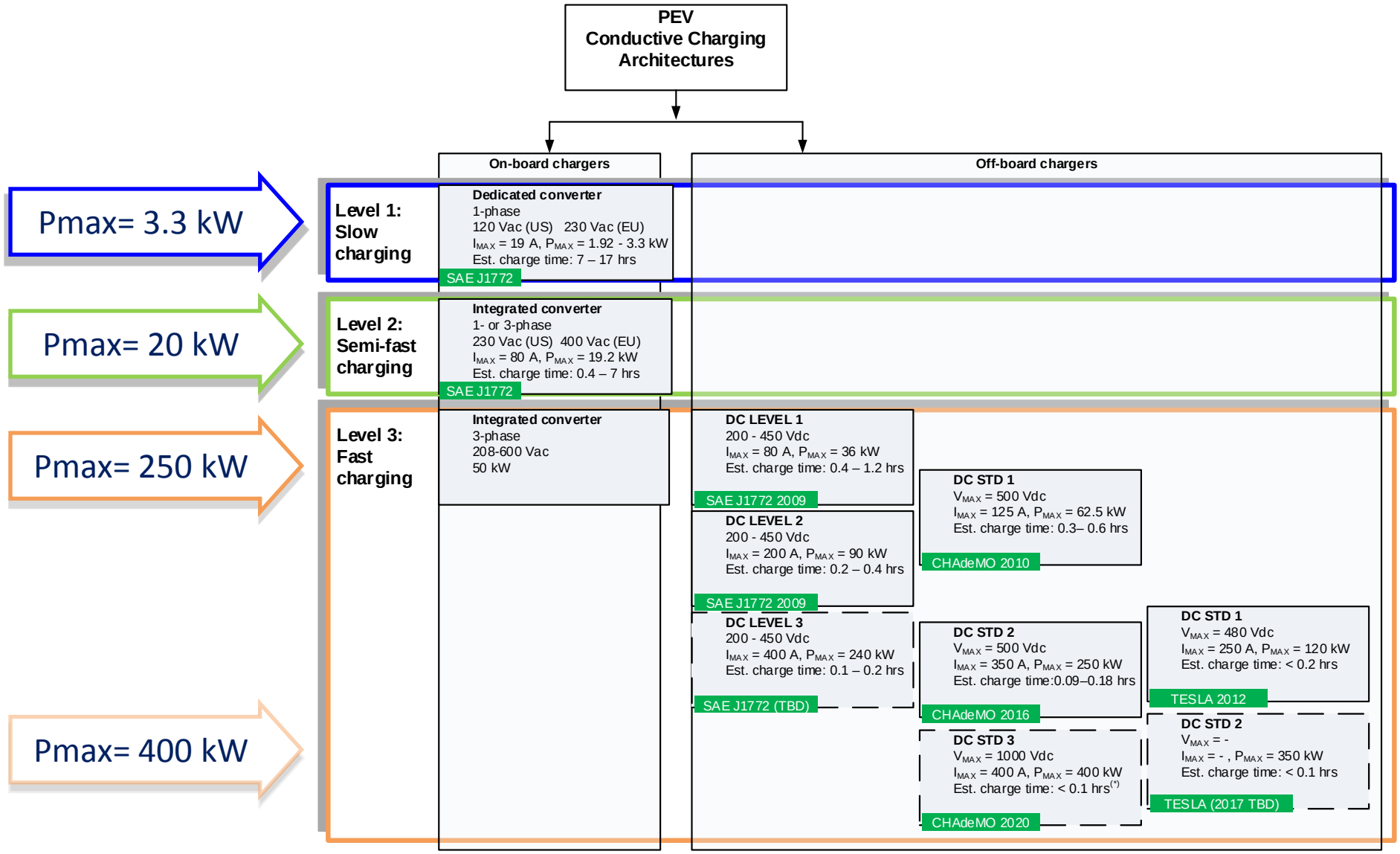
- Reduced Charging Power
- Affected by Size and weight constraints
- Typical recharging Time: 4-8 h

Off Board DC Chargers:

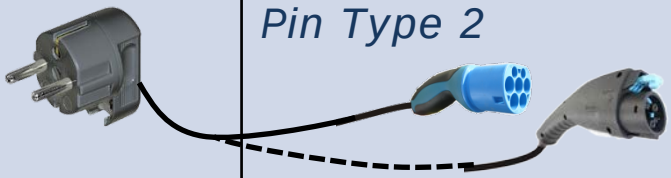
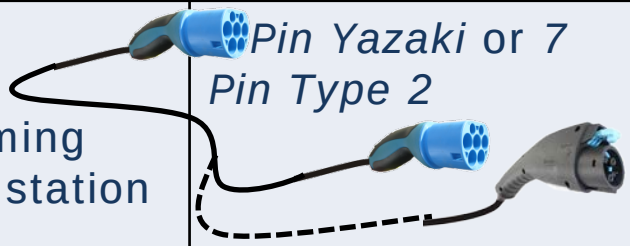
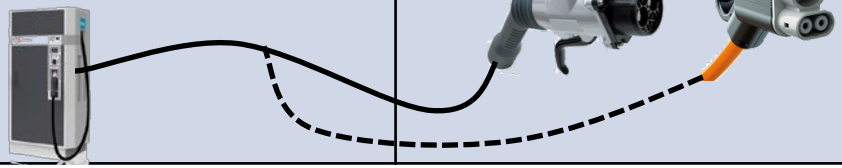
- V2G Management
- Data communication system with the recharging vehicle
- High Power requirements from the main grid
- Typical recharging Time: 0.5 – 2 h



IEC Charging Standard



Charging Connectors - IEC 61851-1 Standard

Charging Power	Charging Time [0-100%]	Charging Point Connector Type	Vehicle Connector Type
Slow: 3-7 kW	8 – 12 h	Standard plug and socket 	*5 Pin Yazaki* or *7 Pin Type 2*
Fast: 7 kW **AC Quick:** 22 - 40 kW	2-4 h	▪*7 Pin Type 2* ▪Cable directly coming from the charging station	*Pin Yazaki* or *7 Pin Type 2* 
DC Quick: 50 kW	20 – 30 min [0 to 80%]	▪Cable directly coming from the charging station 	*CHADEMO* or *SAE DC Combo*

DC Charging Connectors

	System A CHAdeMO (Japan)	System B GB/T (PRC)	System C COMBO1 (US)	System C COMBO2 (DE)
Connector				
Vehicle Inlet				
Communication Protocol	CAN		PLC	

PEV Charging Equipment

Level 1 - Slow Charging

Level 2 – Semi-Fast Charging

Level 3 – DC Fast Charging

TESLA Supercharger

Power: 120 kW DC
Standard: CCS

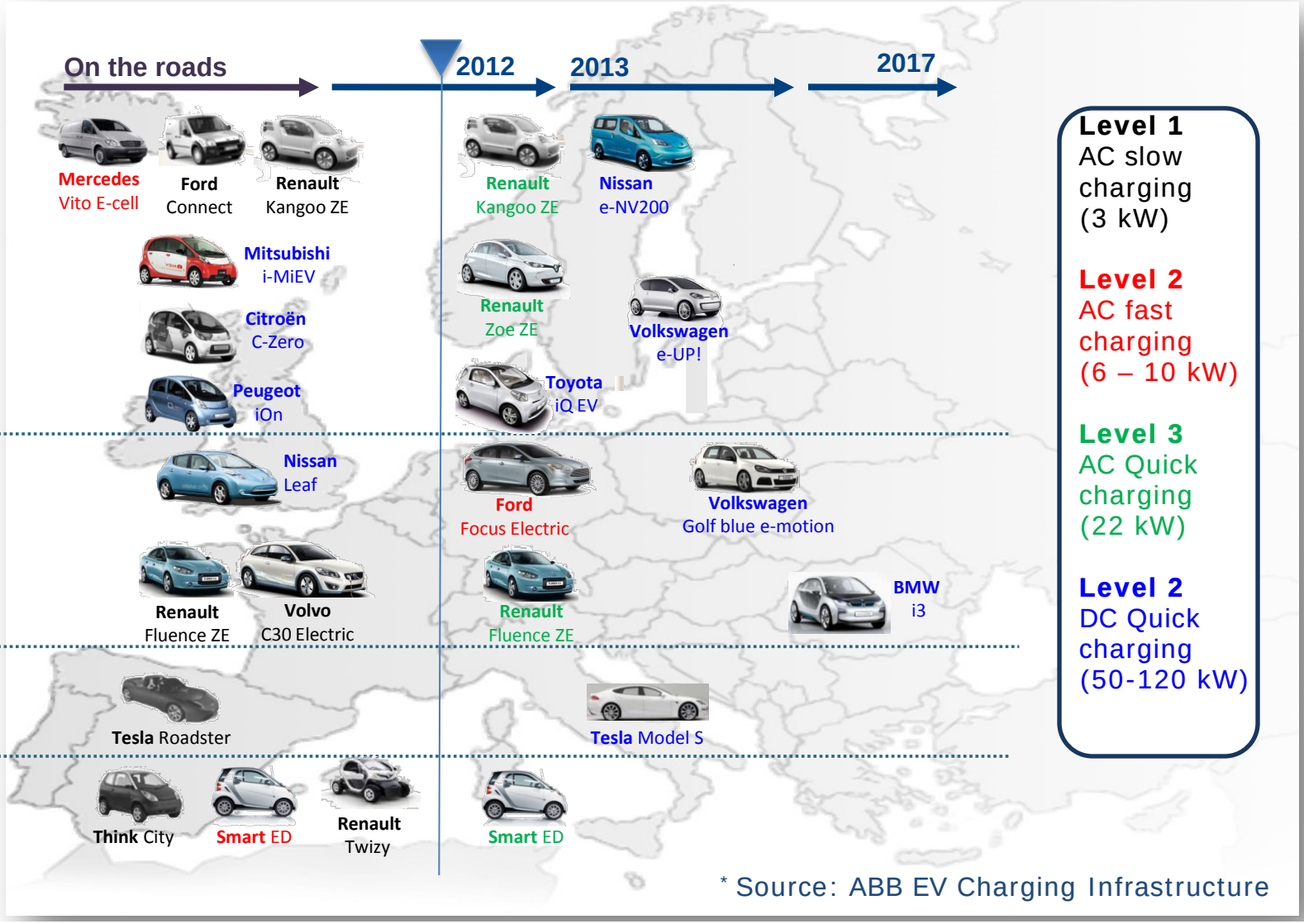
ABB Terra 51

Power: 50 kW DC
22 kW AC (Level 2)
Multi-standard

Siemens QC 45

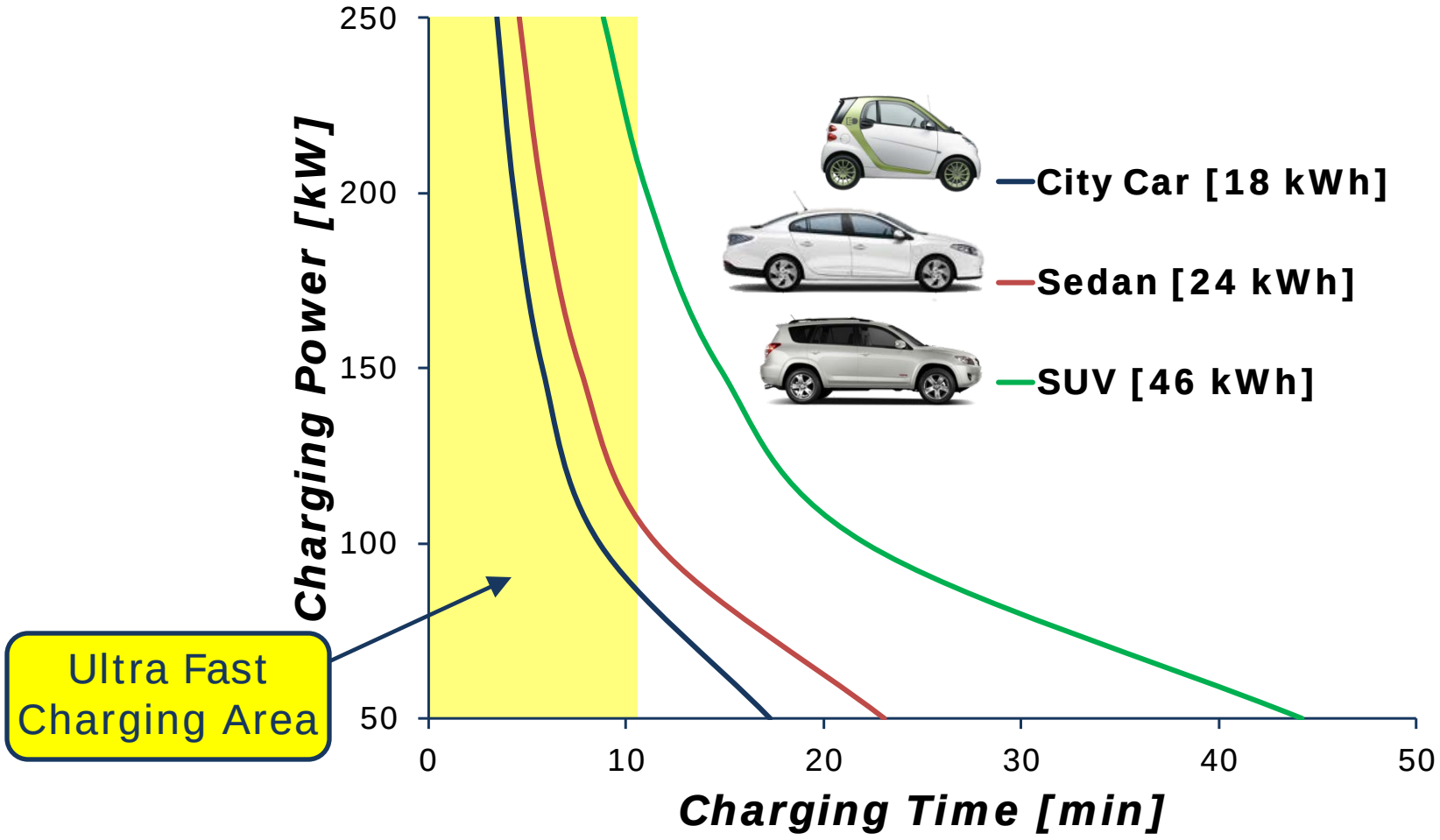
Power: 45 kW DC
22 kW AC (mode 3)
Multi-Standard

EV Charging Modes In The European Market*

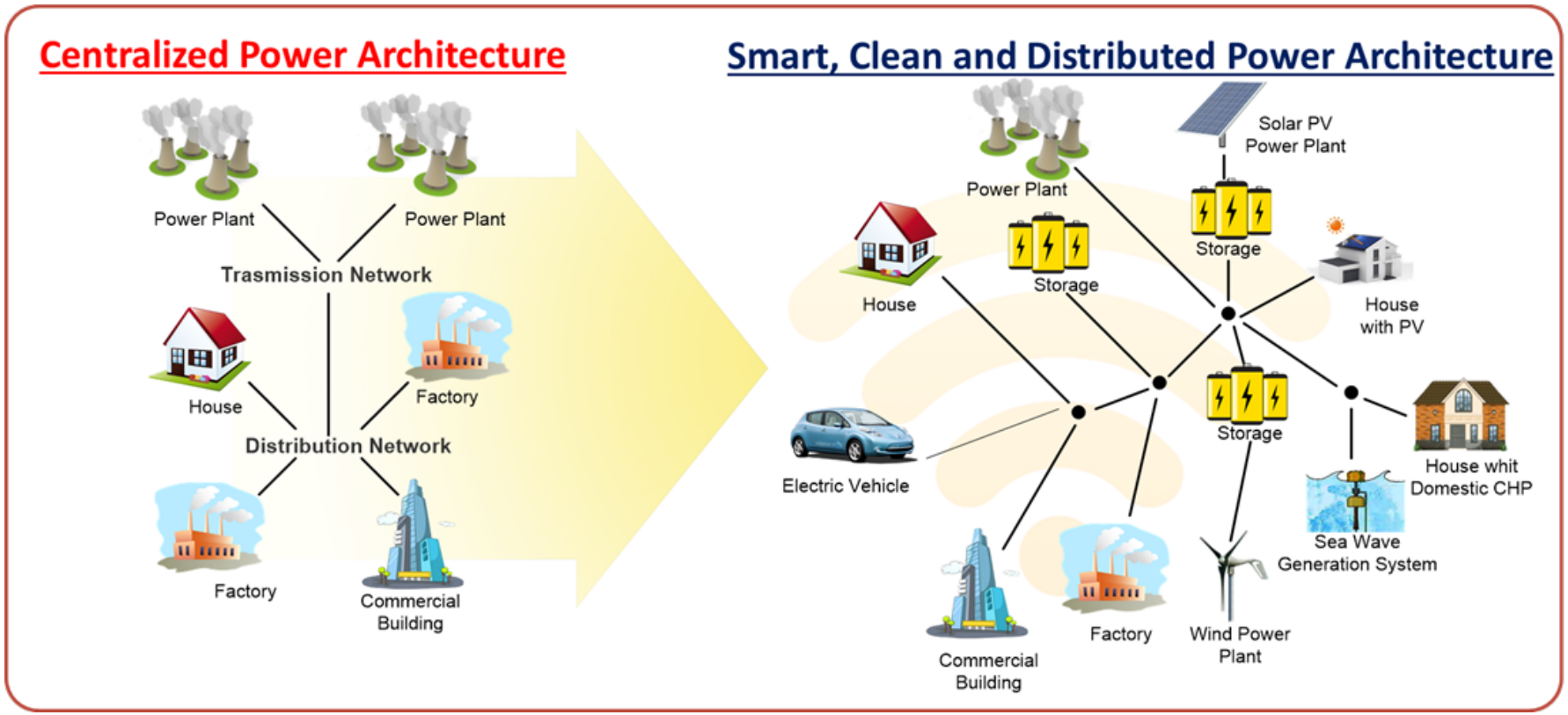


* Source: ABB EV Charging Infrastructure

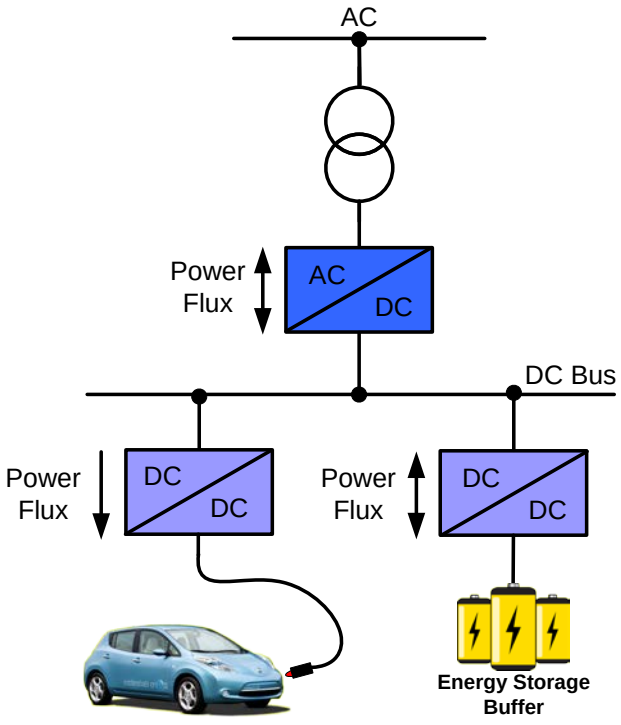
Fast Charging Requirement



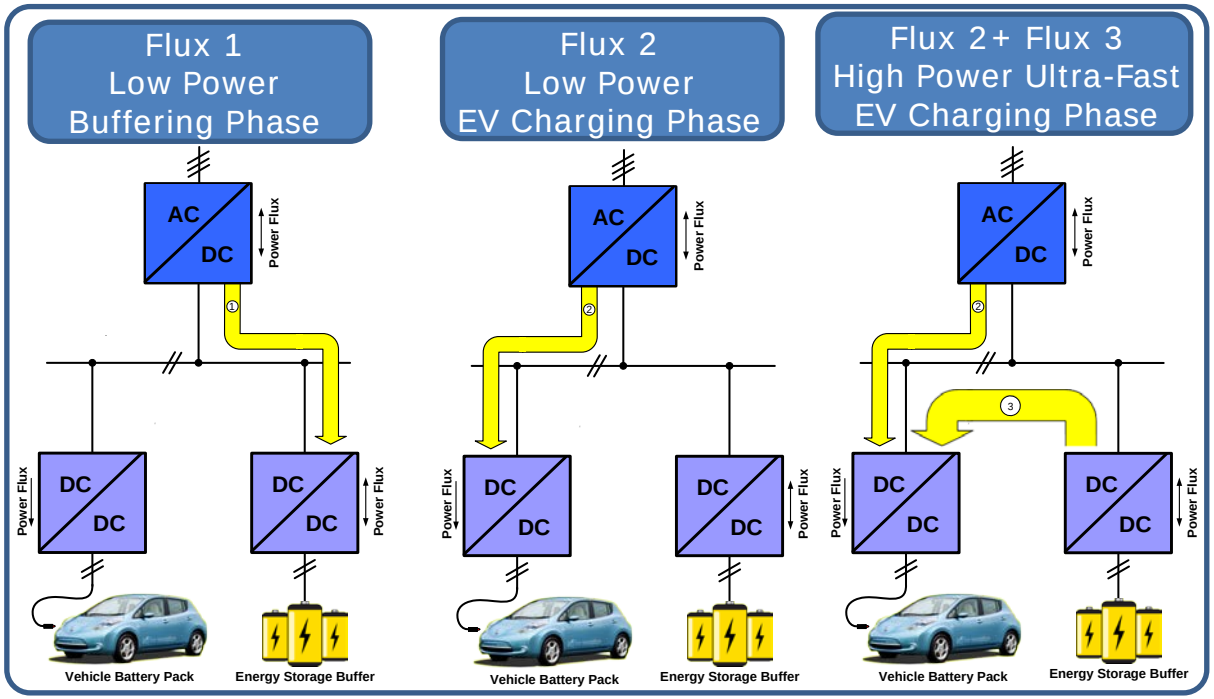
SMART GRID


Centralized Power Architecture
Power Plant
Power Plant
Trasmission Network
House
Factory
Distribution Network
Factory
Commercial Building
Smart, Clean and Distributed Power Architecture
Power Plant
Solar PV Power Plant
Storage
House
Storage
House with PV
Storage
Electric Vehicle
House whit Domestic CHP
Sea Wave Generation System
Commercial Building
Factory
Wind Power Plant

Ultra Fast Charging – Buffered Architecture



- The use of an energy storage system as power buffer can reduce the impact of the ultra-fast charging on the grid
- The grid tie converter can be downsized in terms of power



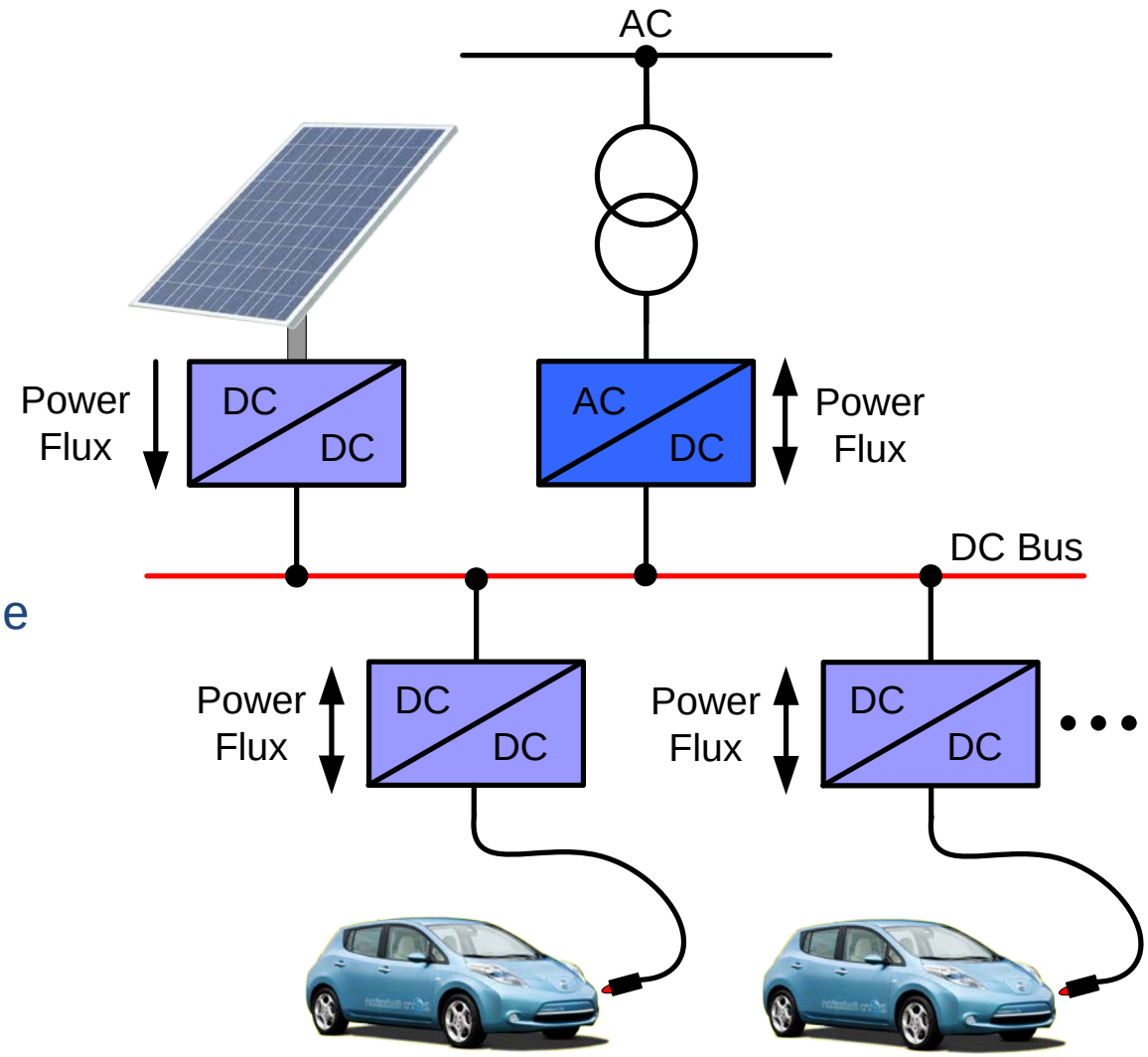
DC Charging Architecture

Advantages:

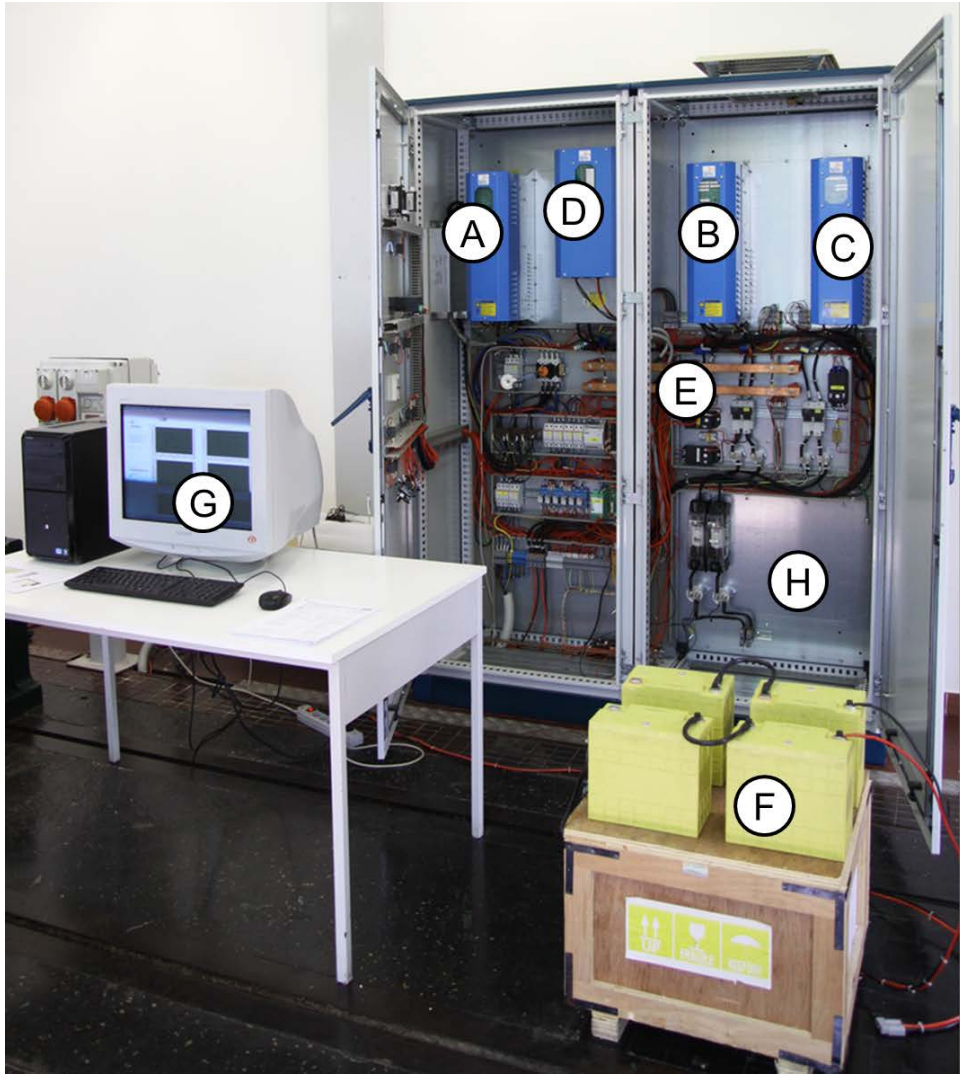
- Only one AC/DC conversion stage
- High efficiency DC/DC converters
- Better RES Integration

Drawbacks:

- Expensive high DC Voltage electric components



Prototype of DC Charging Station for PEV



A – AC/DC Bidirectional Converter

B– DC/DC Bidirectional Converter

C – DC/DC Unidirectional Converter

D – DC/DC Bidirectional Converter for RESs/ESs Integration

E – DC-Link

F – PEV Battery Pack On Charge

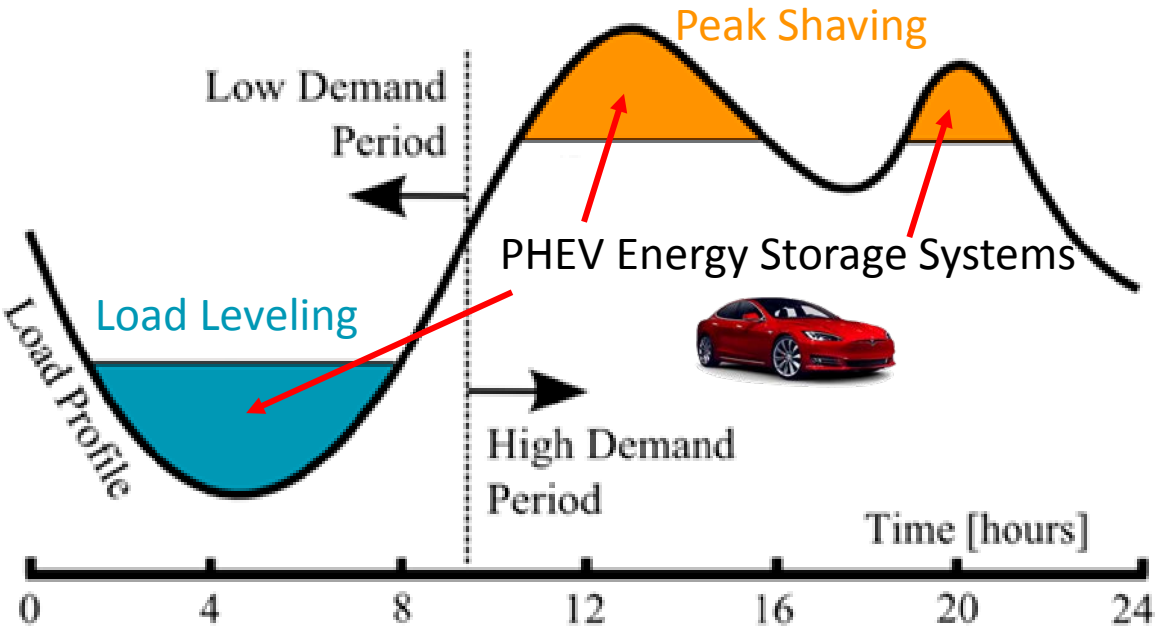
G – Monitoring PC

H – Additional Space for Future Extension

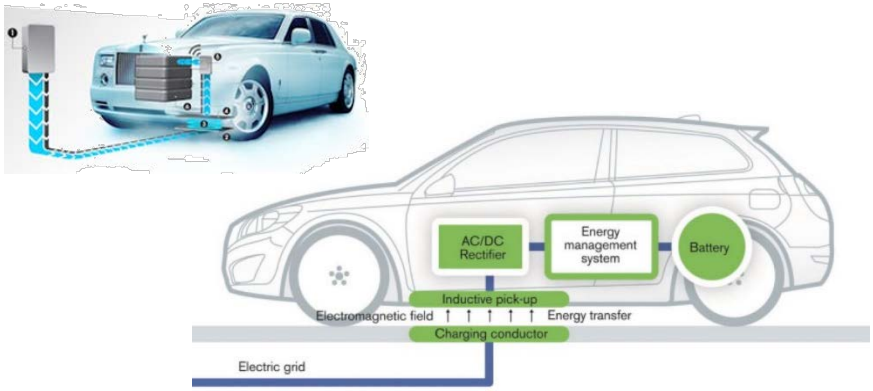
Scenari Futuri: Vehicle to Grid

- I veicoli elettrici ed ibridi plug-in, durante le operazioni di ricarica, possono supportare la rete elettrica con servizi denominati Vehicle to Grid (V2G), mediante operazioni di carica e scarica dei loro pacchi batteria.

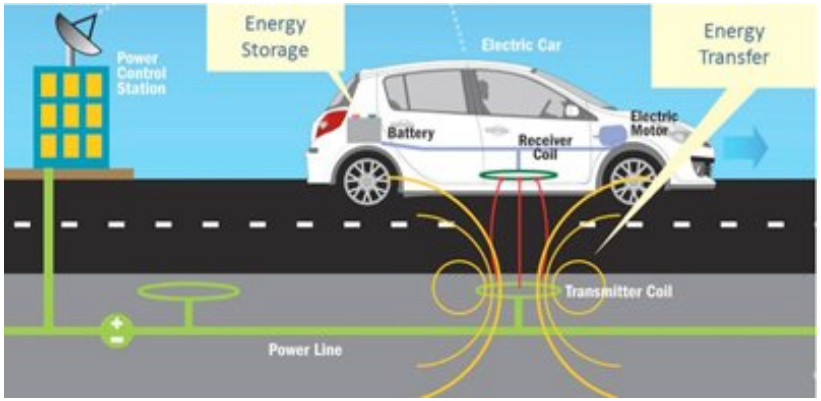
- I principali servizi riguardano il Peak Shaving, il load leveling e servizi di back up.



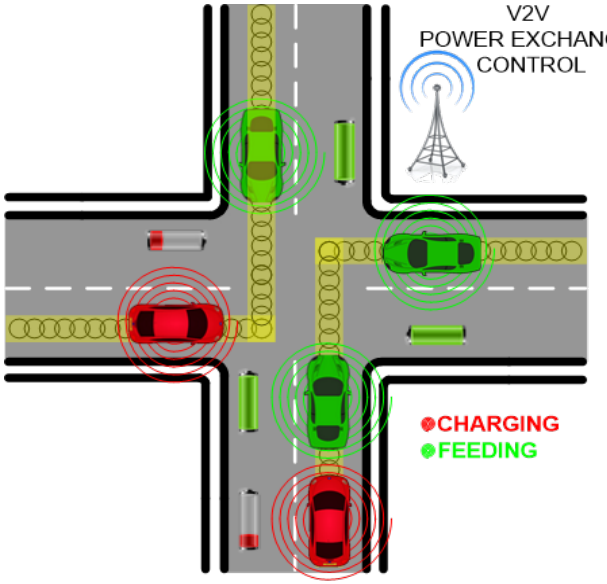
Scenari Futuri: Inductive Charging e V2V



- Stationary Wireless Power Transfer



- Dynamic Wireless Power Transfer



- Vehicle to Vehicle Scheme

THANK YOU FOR YOUR ATTENTION !

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