Combined Charging
the universal charging system

Key Challenges of e-Mobility

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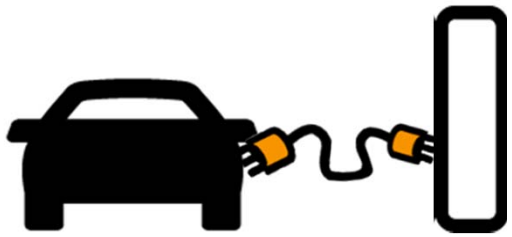


Driving Factors e-Mobility

Electric vehicles contribute to climate goals.
Efficient supply infrastructure serving customer needs is key prerequisite.

Key success factors

- Consumers will find a unique, user friendly solution, at reduced cost and fulfilling all safety requirements
- OEMs are providing a clear indication about future developments and investment planning to infrastructure providers
- OEMs are harmonizing globally to the greatest extent possible and intend to progress more quickly on the market penetration of electrically chargeable vehicles.

Challenges

- Unified charging technology for fast market penetration
- Unified communication protocols as a simple foundation for future smart grid integration
- Certainty in planning

Costumer Expectations drive Charging Capabilities

All DC fast-charging should be designed to meet customer needs and wants.

Long range travels

- ICE vehicles have a wide operating range
- Operating range of current Battery EVs is comparably limited before refueling
- Consumers expect convenient vehicle fueling/charging

Power access at multifamily homes

- Many consumers don't have access at home to a convenient place to charge a plug-in EV.
- Consumers still need a place to charge at/near home

Emergency charging

- Battery driving range is sufficient for the vast majority of everyday trips
- Uncertainty of range limits to be overcome by fast charging spots

DC Charging Opportunities

DC fast-charging provides better access to electricity for customers living in dense areas.

Approach

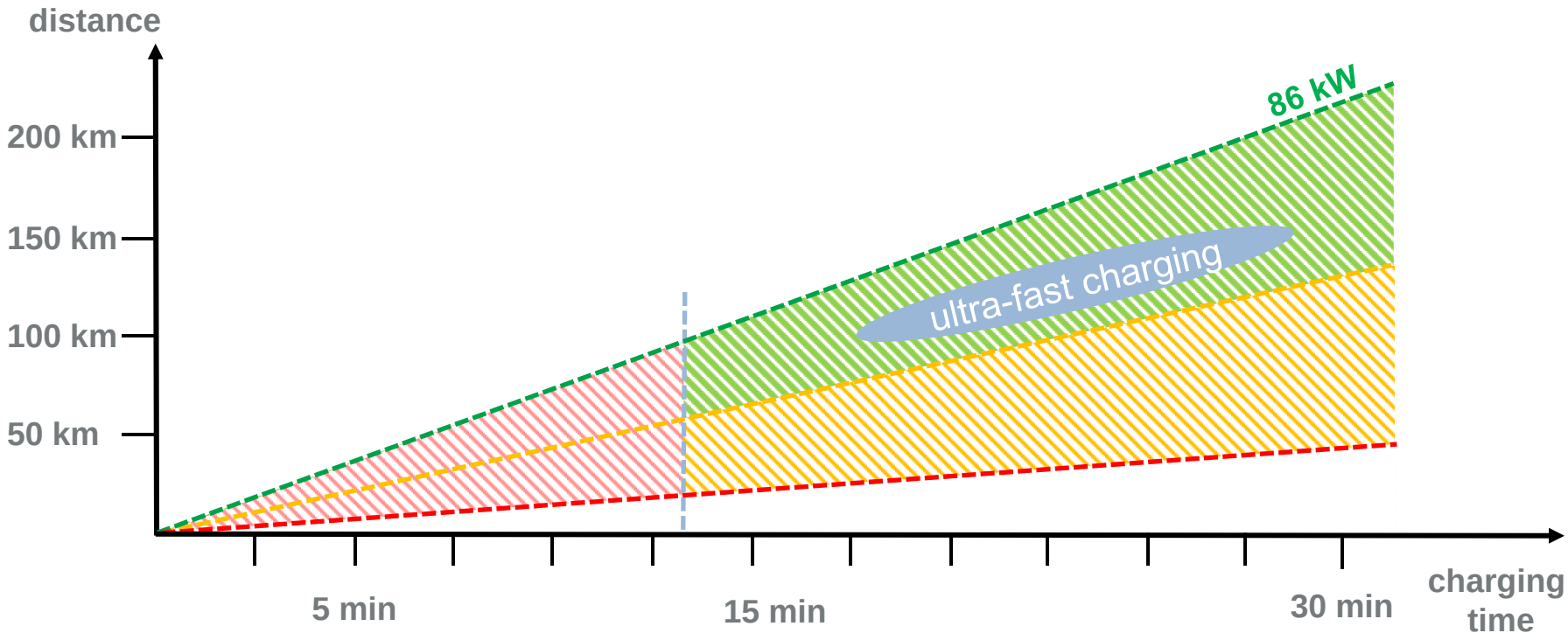
- Corner “fast” Stations to Expand Customer Base
  - Congested residential areas with curbside parking (e.g. brownstones)
  - Apartments, condos (e.g. MDU’s in Miami, Manhattan)
- Improve charge spot “throughput” at destinations (INL)
- Some practical use of DC to enable mid- and longer-distance BEV driving

15-30 minute stops
every 100 miles

Congested urban areas / MDU’S

Consumer Expectation

DC charging offers additional comfort for customers, leverages e-Mobility and creates new use cases due to faster charging.

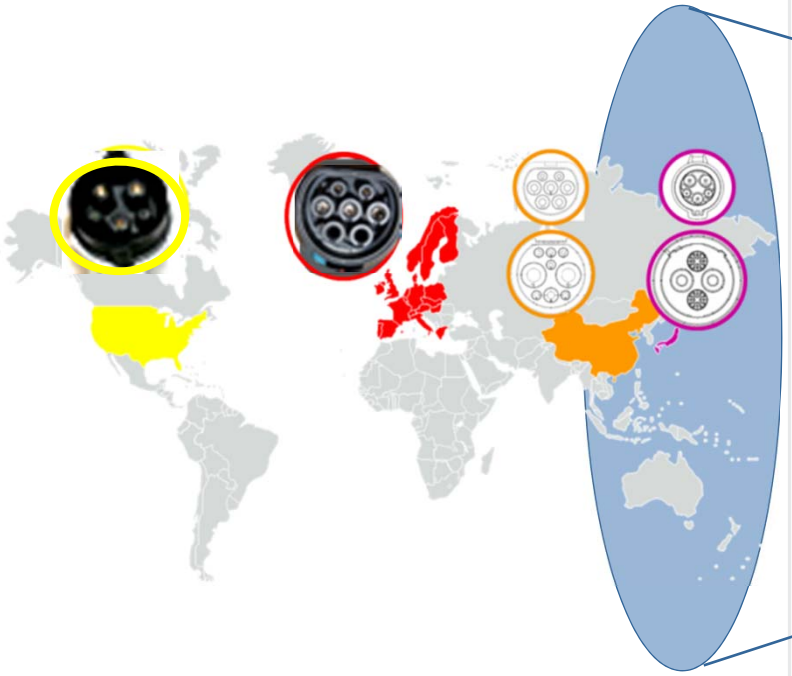


- DC charging satisfies customer expectations for ultra-fast charging.

Current Status Charging Systems

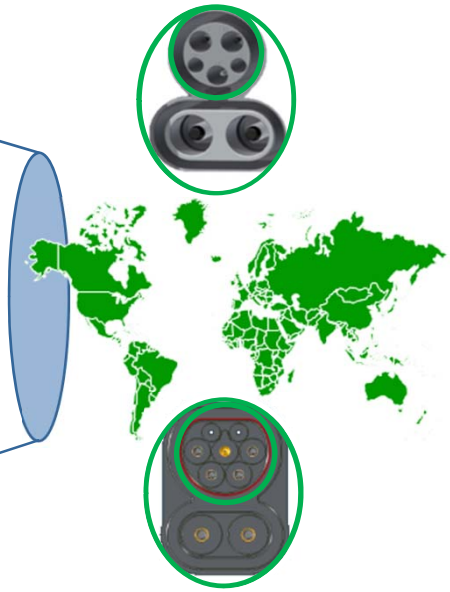
The main regions for e-Mobility have developed individual charging systems. One global solution needed.

1st Step: start of e-Mobility with AC and DC



Regional, mutually incompatible connectors

2nd Step: after migration



Combined Charging System for global AC and DC charging

Implementation of Combined Charging System

OEMs drive the development of the Combined Charging System.

2011

- Kickoff standardization of Combined Charging System
- Validation of PLC technology for charging communication

2012

- First working Combined Charging System and PLC communication for charge control
- First functional Combo connectors
- SAE Combined Charging Standard finalized
- German DIN Standard for Combined Charging finished
- Sample Combo Charger available

2013

- Certified Combo Charger in the market
- Vehicles with Combo System in the markets

Main Requirements to the Combined Charging System

Charging System shall serve all needs of electric vehicles.

Integrated communication for charge control and value added services

Common charge topology for AC and DC

Booth at EVS26

Single vehicle inlet for all charge scenarios

Comprehensive safety measures for all charging scenarios