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Combined Charging the universal charging system

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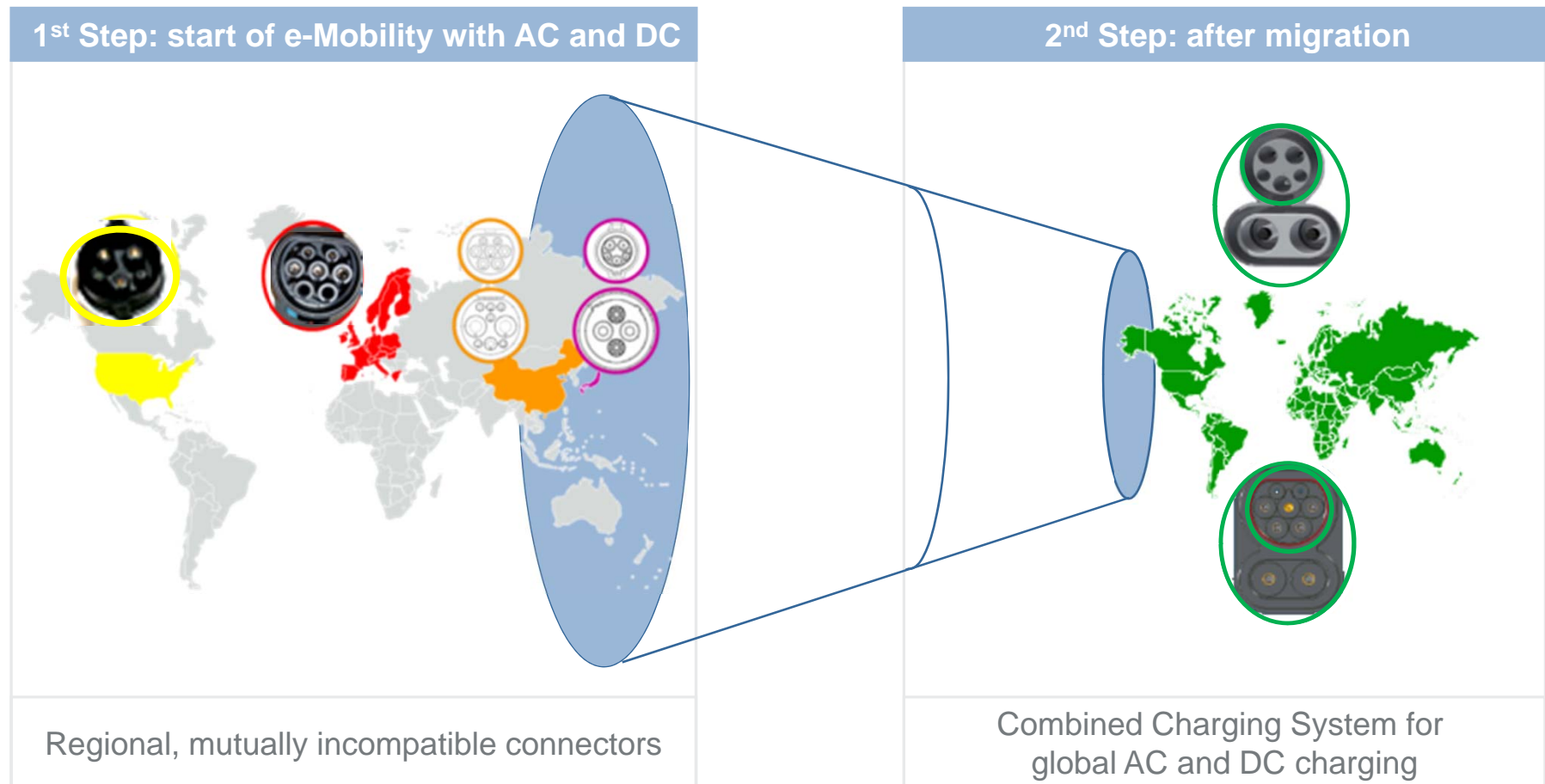
Heiko Dörr, Coordination Office



Current Status Charging Systems



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



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Customer 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



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Design Requirements for the Combined Charging System



AC national standards remain the same.

Two additional Pins allow DC charging in the same vehicle inlet while accepting the legacy AC connector.



How to speed up from up to 8 h charging to 20 min?

How the Combined Charging System Responds



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Two additional Pins allow DC charging in the same vehicle inlet while accepting the legacy AC connector.



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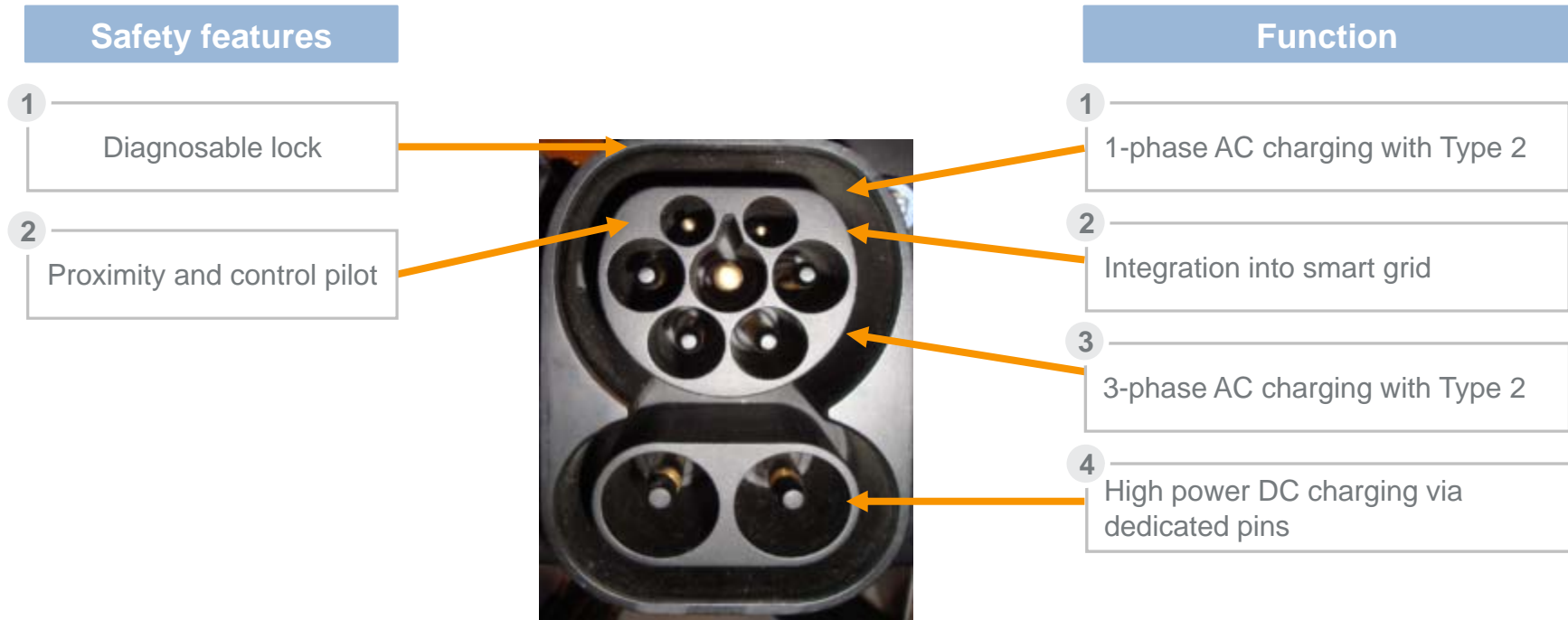


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Design DC Combo 2 Inlet

The Combo 2 inlet provides comprehensive functionality at a high level of safety.



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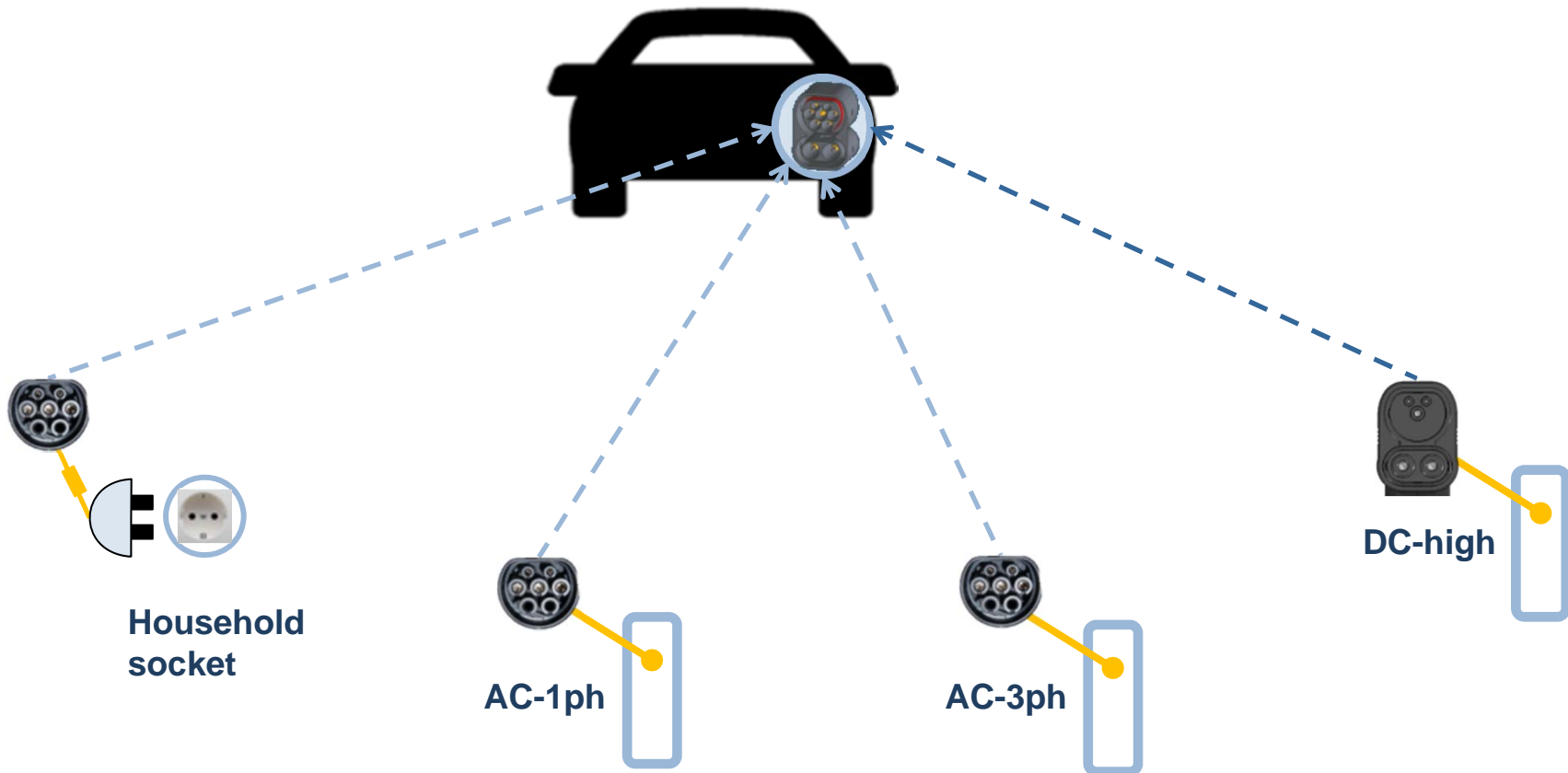


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Charging Connectors for the Combined Charging System

The Combo inlet shall serve as a universal plug for all relevant charging scenarios.



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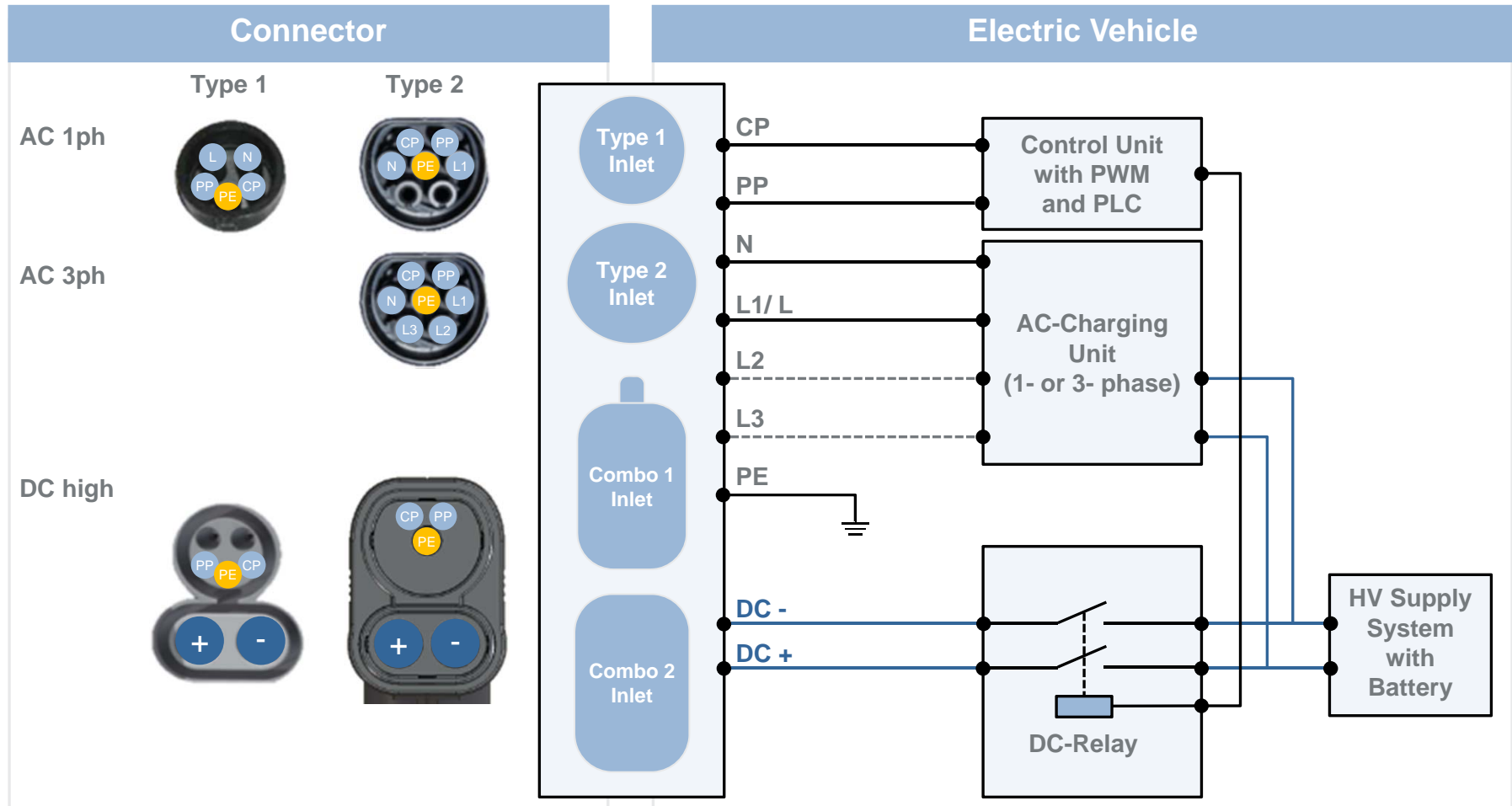
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Efficiency of Combined Charging



Integration of AC and DC in the vehicle architecture may be applied to charging stations accordingly.



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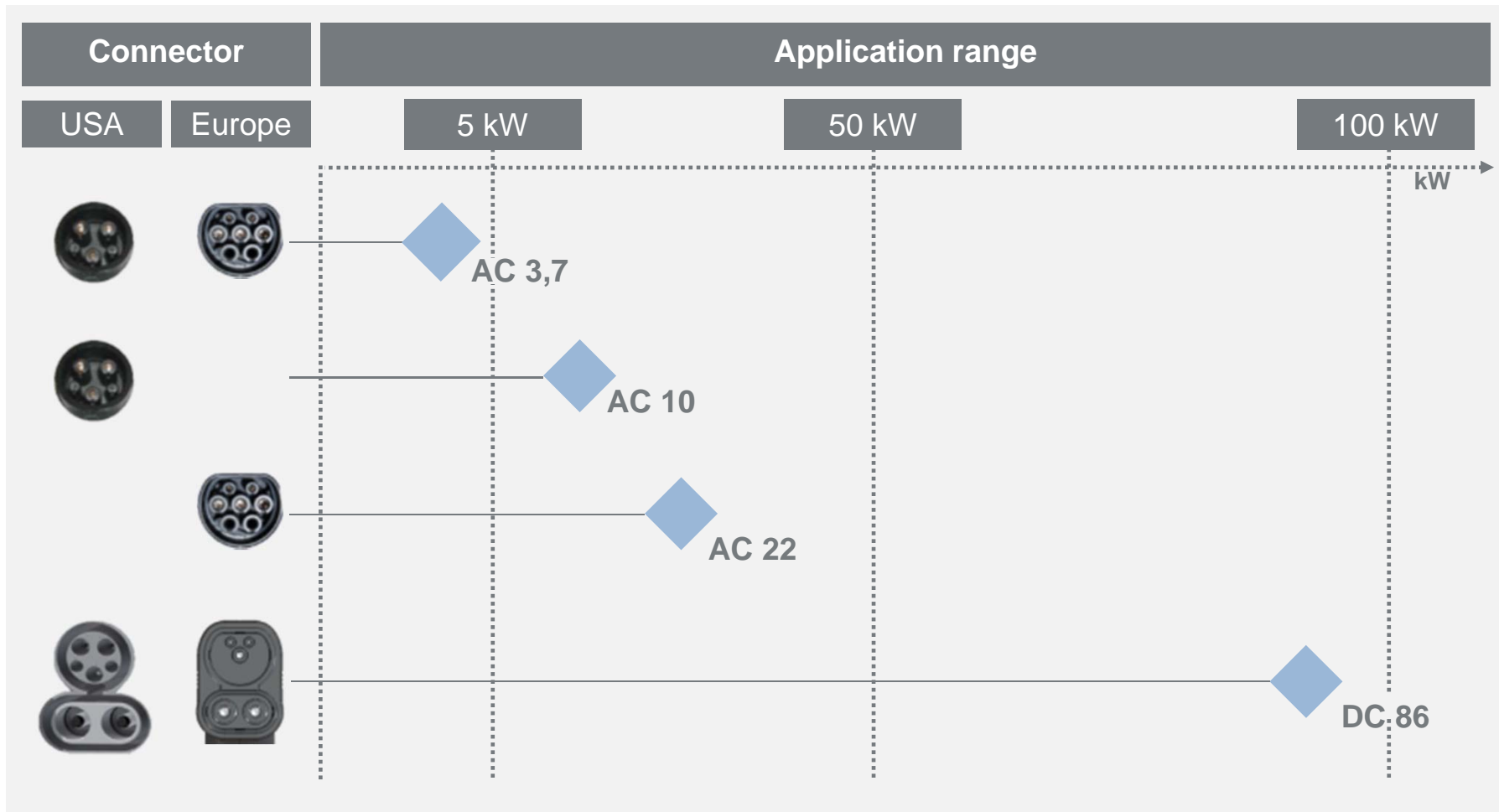
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Combined Charging Connector Concept



The Combined Charging System integrates the existing AC connectors, allowing for one standard global vehicle interface for AC and DC charging.



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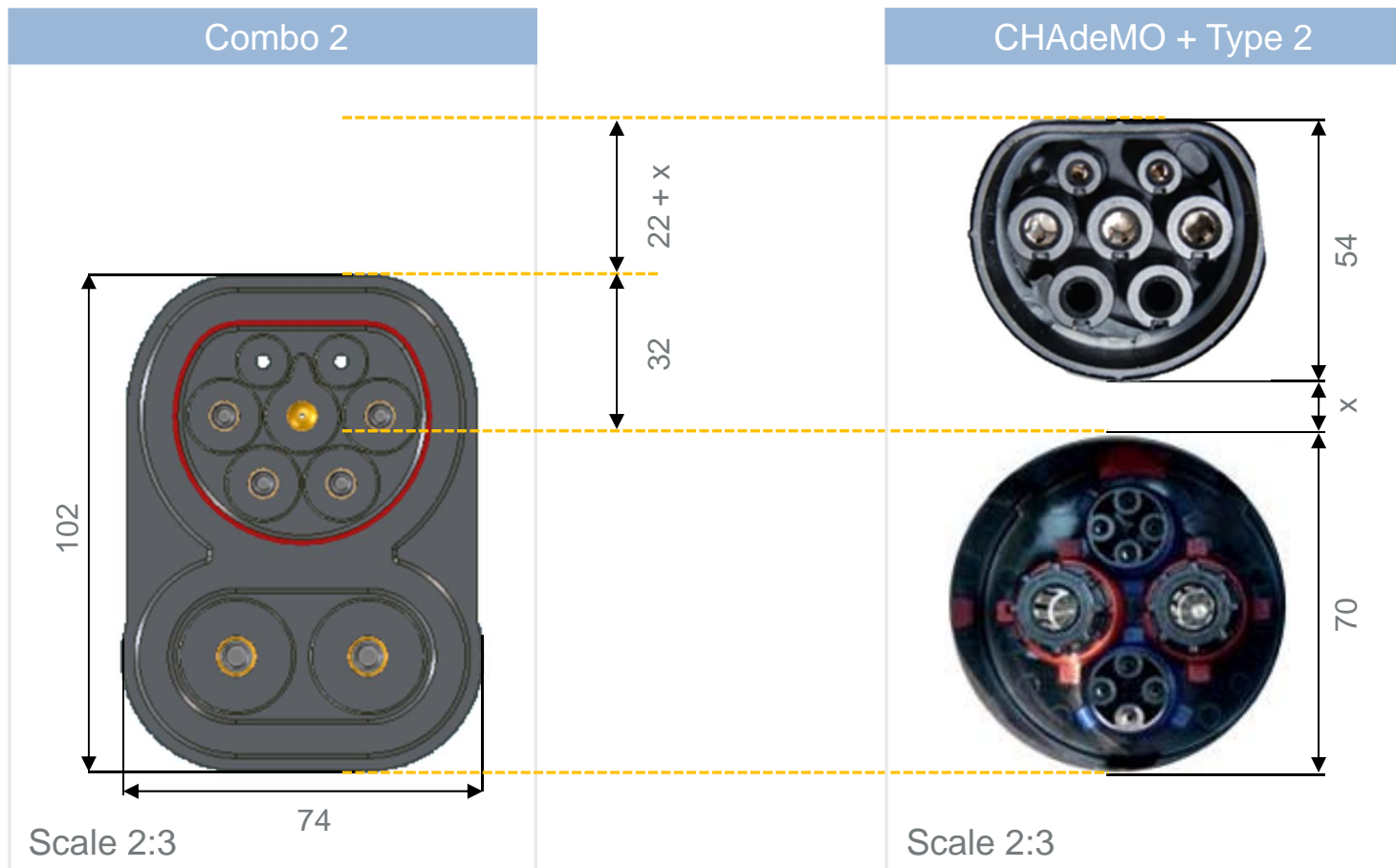
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Comparison Combo 2 and alternative Approaches



Integration of AC and DC into a single inlet provides high freedom for vehicle design and in addition a reduction of size.



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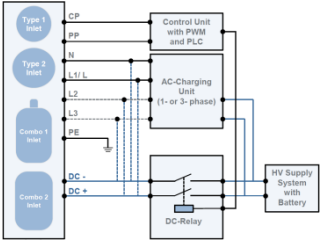


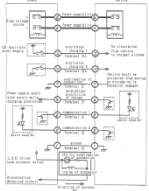

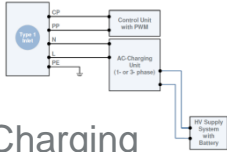


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Impact on Vehicle Costs – Combined System vs Separate Systems

Separation of AC and DC charging systems has significant extra costs.
 Total cost for customer is reduced by application of Combined Charging System.

Combined Charging System	CHAdeMO with separate charging systems	
<ul style="list-style-type: none"> Integrated electric architecture which implements all relevant AC and DC charging scenarios Integration of AC and DC in one single inlet 	<ul style="list-style-type: none"> No integrated architecture for both AC and DC charging Separate AC and DC connectors with two inlets in the vehicle 	
  <p>AC plus DC Charging</p>	  <p>DC Charging</p>	  <p>AC Charging</p>

Consequences of a second separated charging system:

- Module costs much higher than 50€ according to expert evaluation*
- Loss of installation space and freedom of design through additional inlet

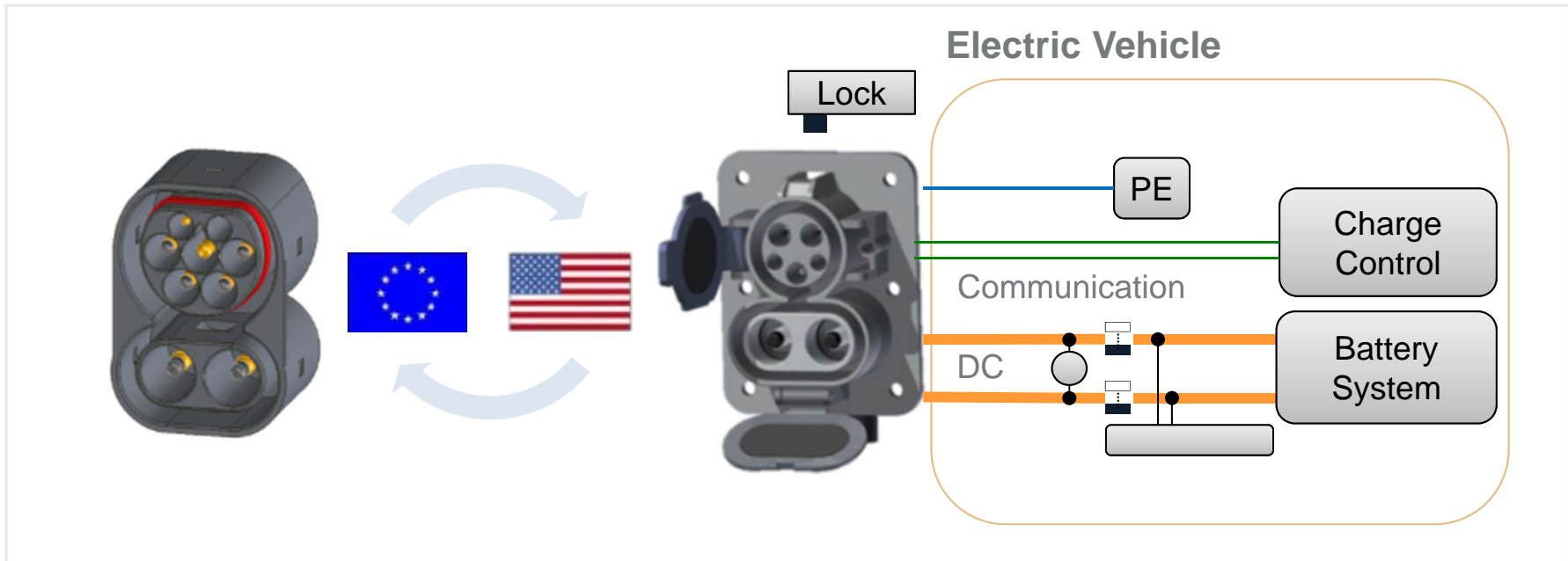
*depends on implementation

Combined Charging System



Low Complexity and Cost Optimized:

Cost efficient re-use of multiple parts, resulting in win – win situation.



Benefits

- One inlet
- No extra design required
- DC re-uses the complete AC communication and adds only DC specific data
- Extensive use of same parts

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Design Combo Inlet

Easy Handling and Widely Spread User Acceptance: Single car design concept that enables fuel tank as well as combined AC/ DC charging inlet.



The combo inlet fits behind typical fuel doors
No need for variants



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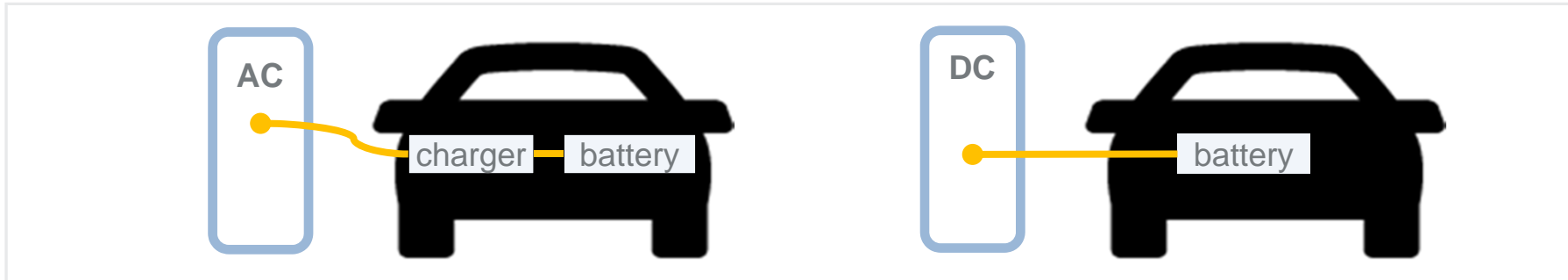
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Charging Communication for DC Charging



The charging communication between vehicle and charger is standardized in ISO/IEC 15118 in close cooperation with SAE.



Tasks

- Charging control requires a permanent communication between vehicle and charge pump.
- Current and voltage are adjusted continuously during charging

Goal

- One communication system for all charging modes, world-wide:
 - Requirements and functionality
 - Transmission technology
 - SW protocols

Solution

- PLC-based communication ISO/IEC 15118 for all charging modes applying IEEE 1901 HomePlug Greenphy, IPV6 and data security

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One Charging Communication for all Charging Modes



The Charging Communication shall realize intelligent charging with high comfort by one implementation for both AC and DC charging.

Controlled charging

- Support of controlled intelligent charging based on dynamic rates
- Forecast of network load through planned charging
- Support of fleet- and load-management
- Active control of network load

AC and DC charging control

- Authentication with the same methods for AC and DC Charging
- DC Charging takes control over voltage and status information
- Same communication technology for AC and DC Charging

Value added services

- Certified payment and accounting system
- Future integration of vehicles in home networks or cloud services
- Integration of Electric Vehicles into Smart Grid

Simple realisation

- Using existing connections
- One implementation for all charging modes

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Charging Protocol defined by ISO/ IEC 15118



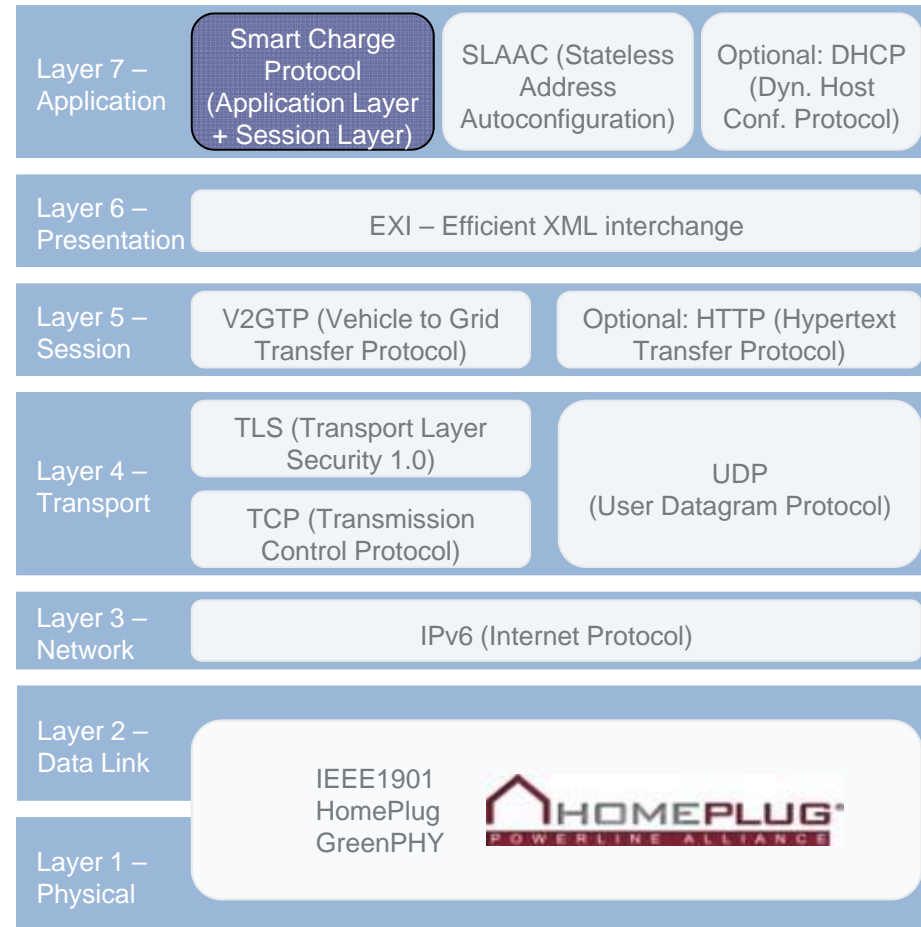
DC Charging communication is standardized based on existing AC Charging communication.

DC Charging and AC Charging use the same protocol stack

- IPv6 based protocol
- Transport layer with dedicated security measured
- Flexible XML-based messages
- AC as well as DC messages

ISO/IEC15118-3 focus on HomePlug GreenPhy as Layer 1 & Layer 2 solution

- HomePlug GreenPhy on Control Pilot
- Uses GreenPhy SLAAC for EV/EVSE Association
- Common Layer1 / Layer2 solution for AC and DC-Charging



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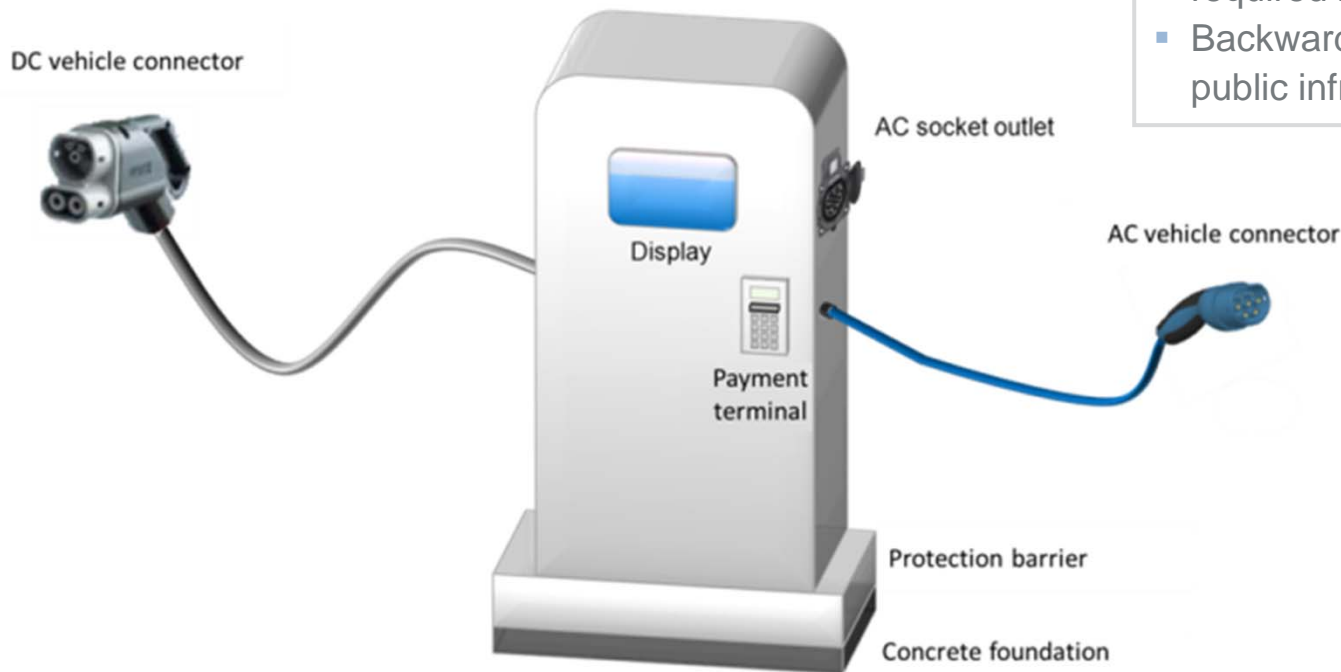
Station for (Semi-)Public Infrastructure in Europe



Minimal infrastructure should be realized with a dedicated charging station.
No specific equipment requirements for semi-public or private areas.

Strategic Impact

- DC charging station without discrimination of AC charging as required by ACEA
- Backward compatible design of public infrastructure



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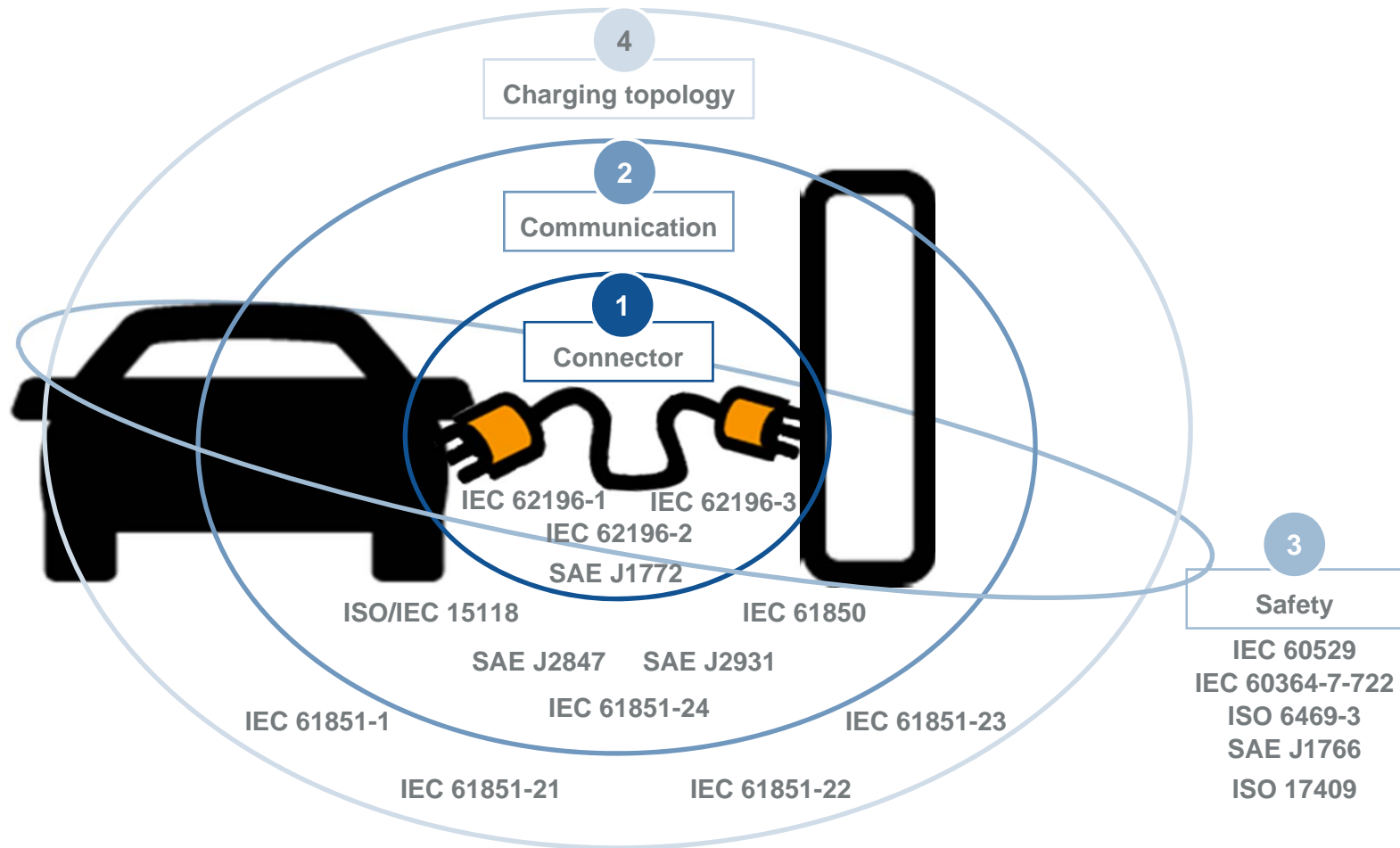


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Relevant International Standards for the Charging Interface

The charging system is comprised by a set of related standards.



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Standardization



Standards for DC charging are ready and implementation baseline defined.

Scope

- DC systems according to Combined Charging Systems will be created according to existing standards:
 - Connector: IEC 62196-3 CDV
 - Topology: IEC 61851-23 CDV
 - Communication: DIN Spec 70121
- DIN SPEC 70121 refers to ISO / IEC 15118-1 DIS, -2 DIS and 15118-3

Benefits

- Series production of DC-Charging ongoing, Transparent requirements for all products on the market
- Common agreement by all stakeholders
- Standards aligned with SAE

Implementation Baseline

- Series products available End of 2012
- Vehicles on the market in 2013 with DC option will comply to implementation baseline 2012 defined by IEC CDV 62196-3, IEC CDV 61851-23 and DIN SPEC 70121

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Summary of using DC Charging in Modellregion Munich

Final project presentation.



Impressions



Facts

- 17.10.2011 in Munich
- Ca. 100 guests
 - stakeholder from industry and government
 - national press, customers
- LIVE CHARGING DEMONSTRATION
 - DC-Type 2 with PLC
 - with 70A (up to 28kW)
 - 85km e-range in 30min
- Press echo:

BMW: Neues Ladesystem für E-Autos — 18.10.2011

Laden leicht gemacht



Projekt von Siemens und BMW

E-Cars mit Gleich- und Wechselstrom laden

Siemens präsentiert flexibles Schnellladesystem



Schnellladen für Autos mit Gleich- und Wechselstrom

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Electric Cars with Combo Inlet.

Announced cars for 2013.



**GM
Chevy Spark**



**BMW
i3**



**Volkswagen
e-up!**



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Strategic Assessment of existing Charging Systems



Main bodies have adopted the Combined Charging System as charging technology.

- All members of the European Association of Automotive Manufacturers ACEA support the Combined Charging System for Europe:



- BMW, DAF, Daimler, Fiat, Ford of Europe, General Motors Europe, Hyundai Motor Europe, Jaguar Land Rover, MAN, Porsche, PSA, Renault, Scania, Toyota Motor Europe, Volkswagen, Volvo Cars, and AB Volvo.

SAE International®

- SAE has developed the Combined Charging System in the U.S.
- The Combined Charging System is the US solution for electric vehicle charging – from AC charging to ultra-fast DC charging.
- Nearly all global automotive companies support the Combined Charging System including US manufactures Chrysler Group LLC, Ford Motor Company, and General Motors.

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Combined Charging System



Combined Charging: the universal charging system for electric vehicles has been demonstrated with vehicles of German OEMs at the 15th international conference „Electronics in Vehicles“ at Baden-Baden on October 12-13, 2011.



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Combined Charging System at EVS 26



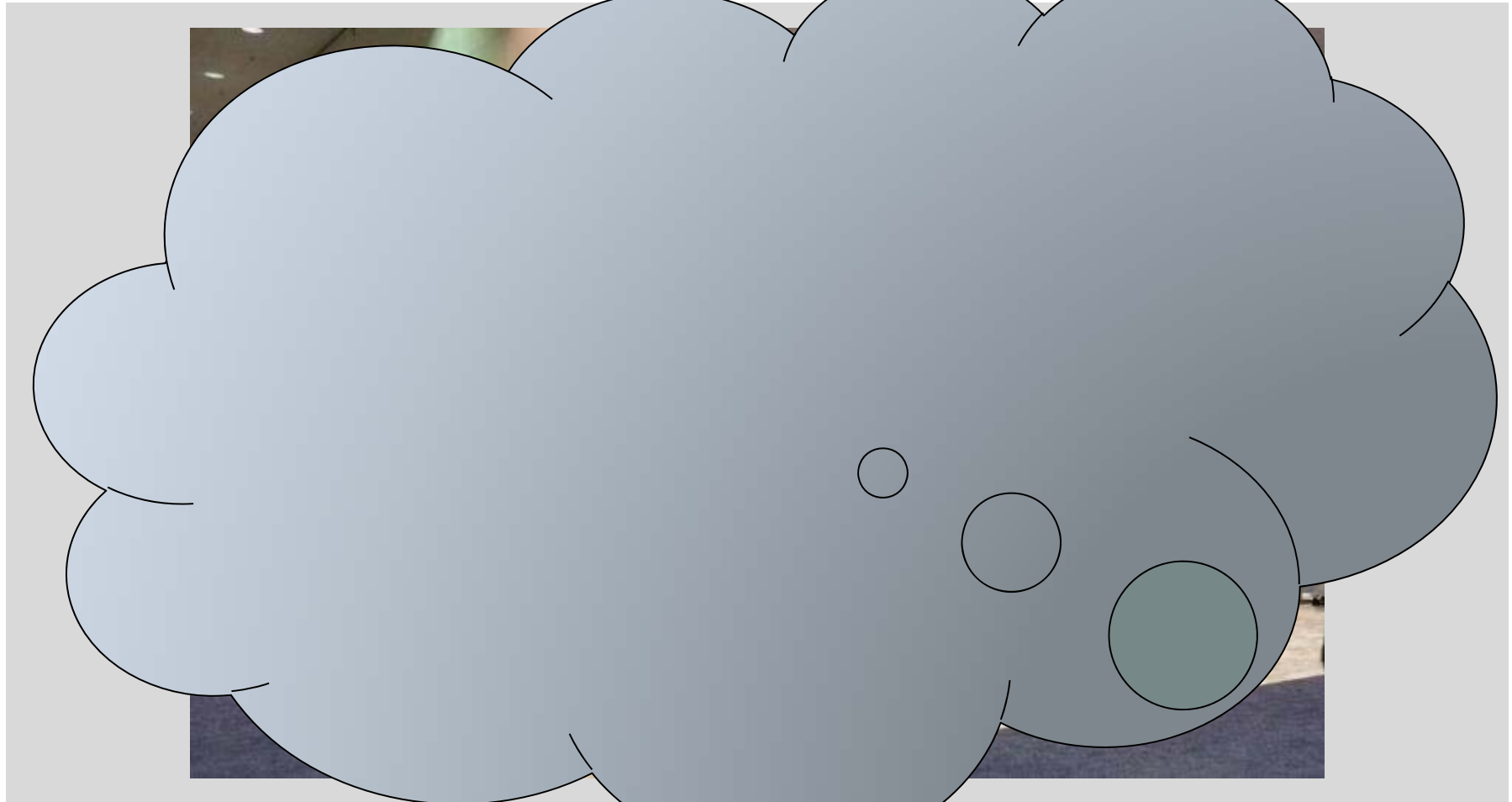
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Combined Charging System at eCarTec



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