CharIN – Charging Interface Initiative e. V.

The path of charging

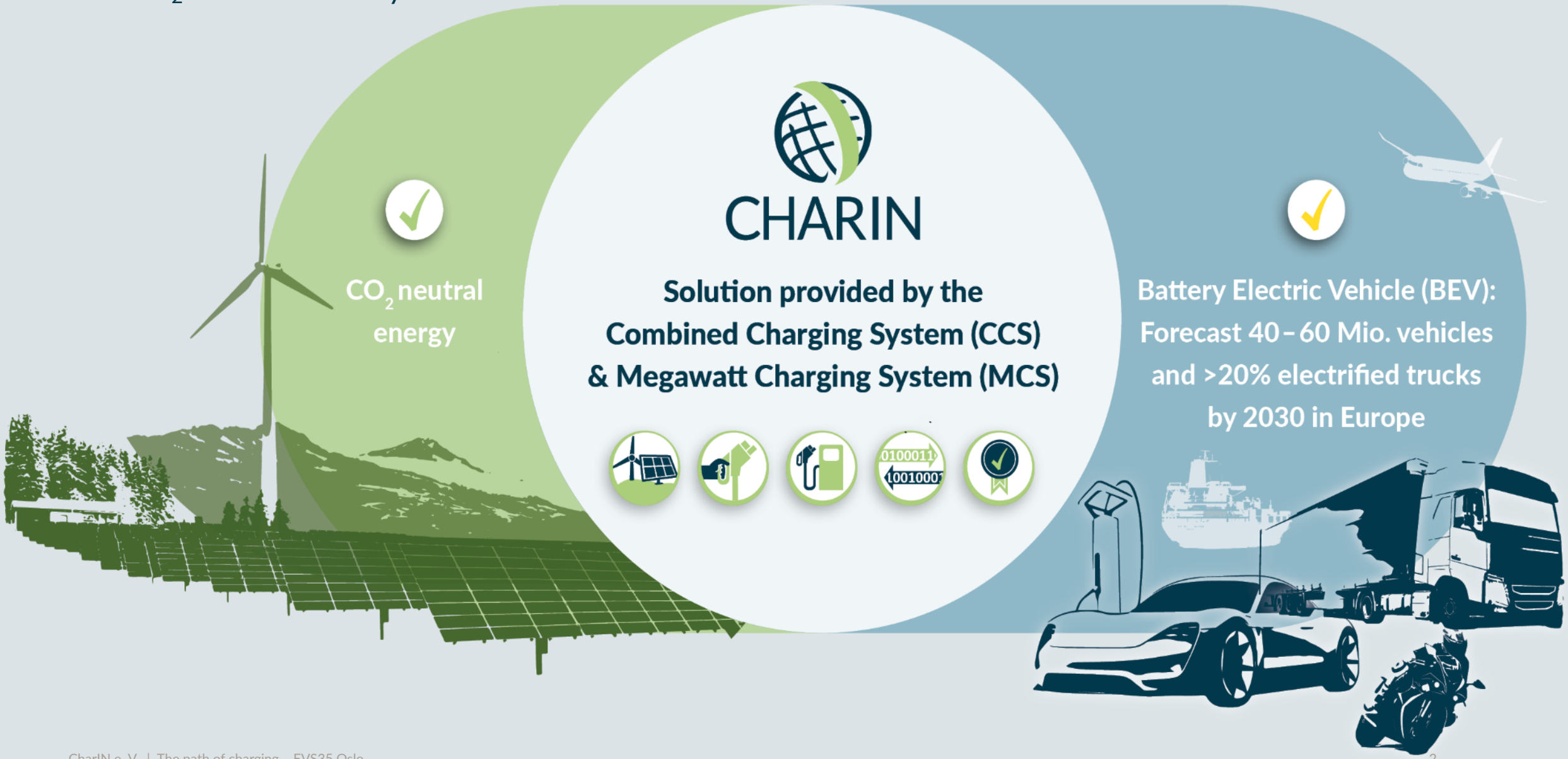
Claas Bracklo – Chairman CharIN

EVS35
OSL2022

CHARIN

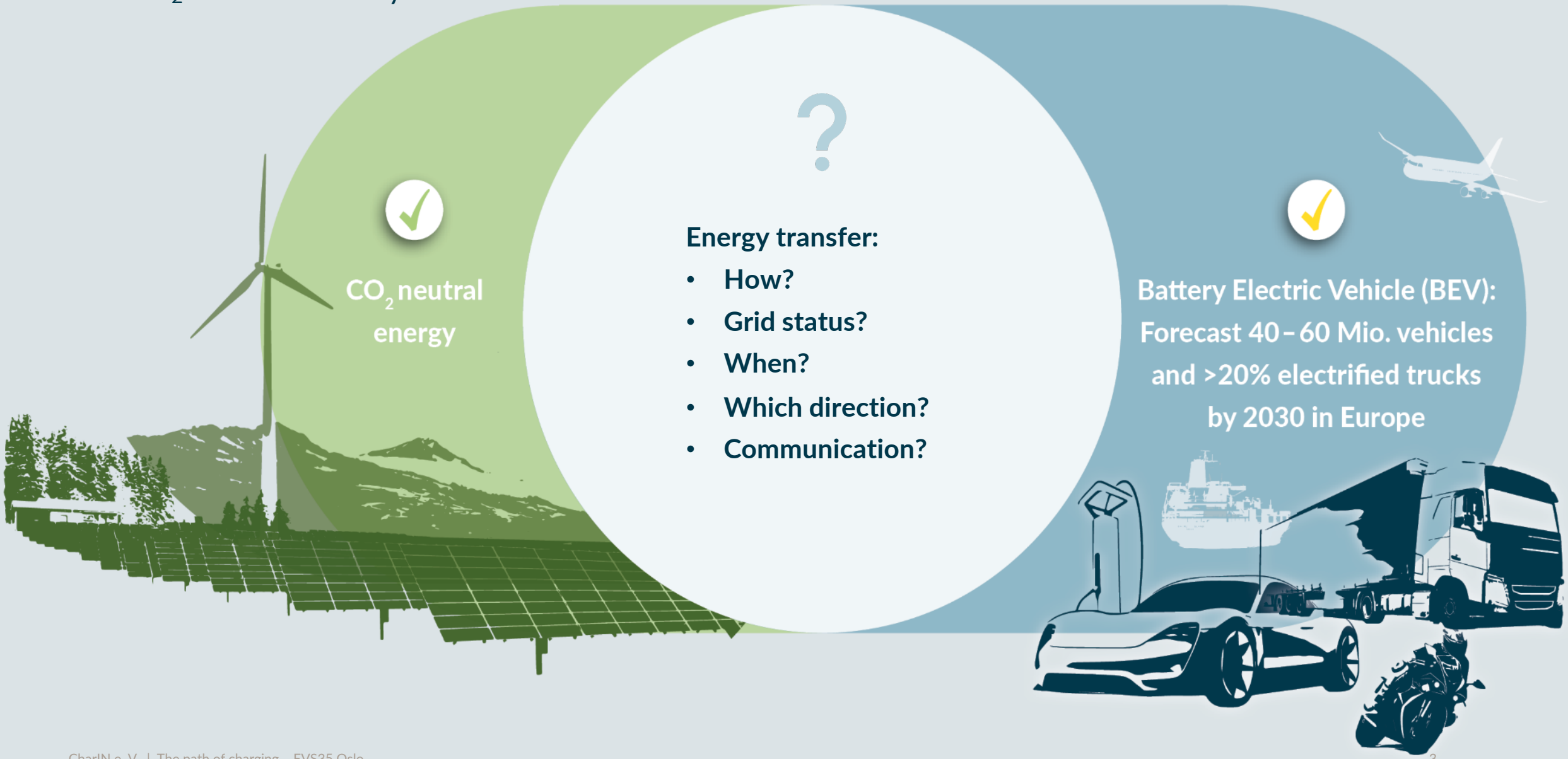
General Goal

The CO_2 neutral Mobility



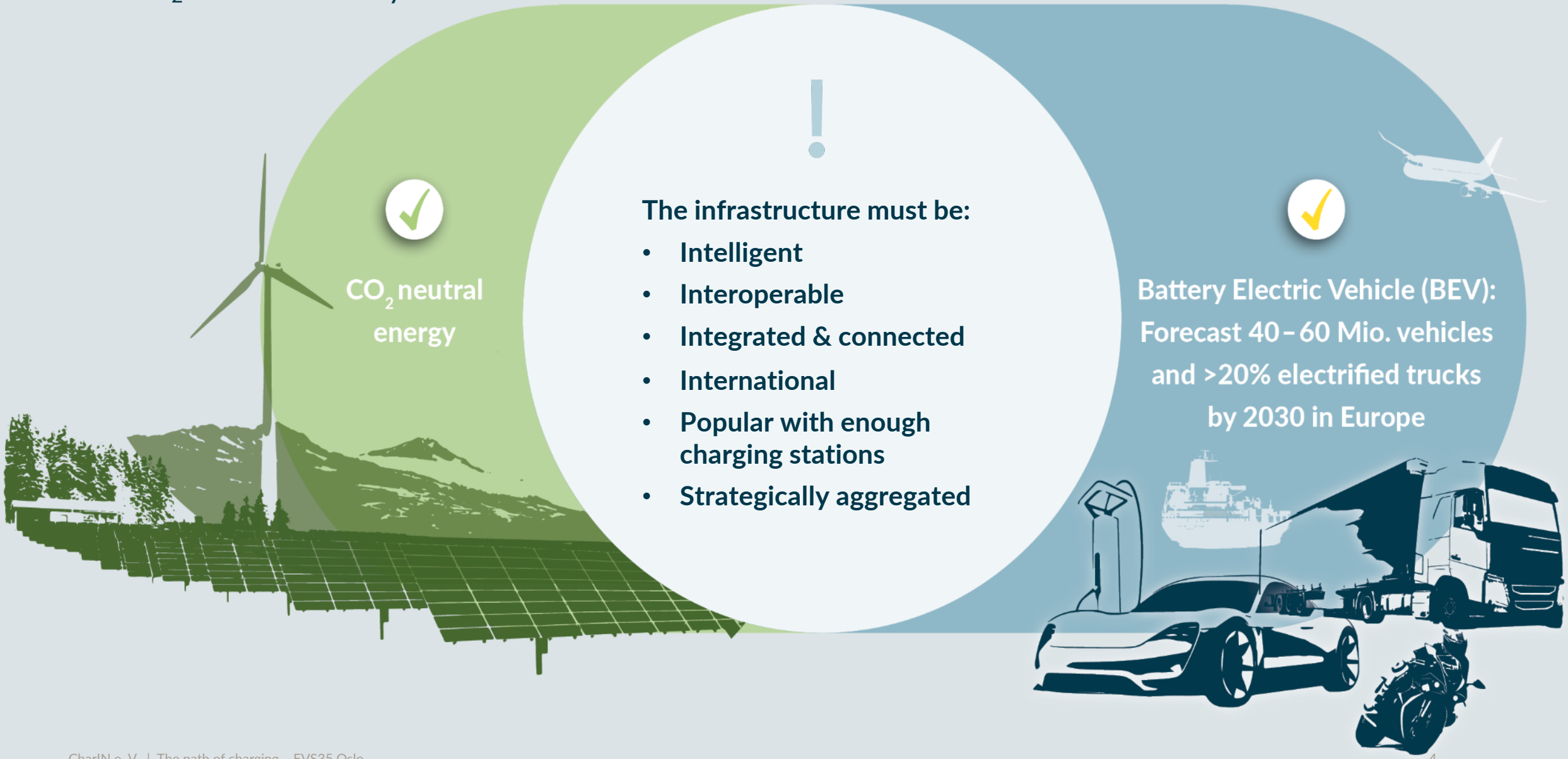
General Goal

The CO_2 neutral Mobility



General Goal

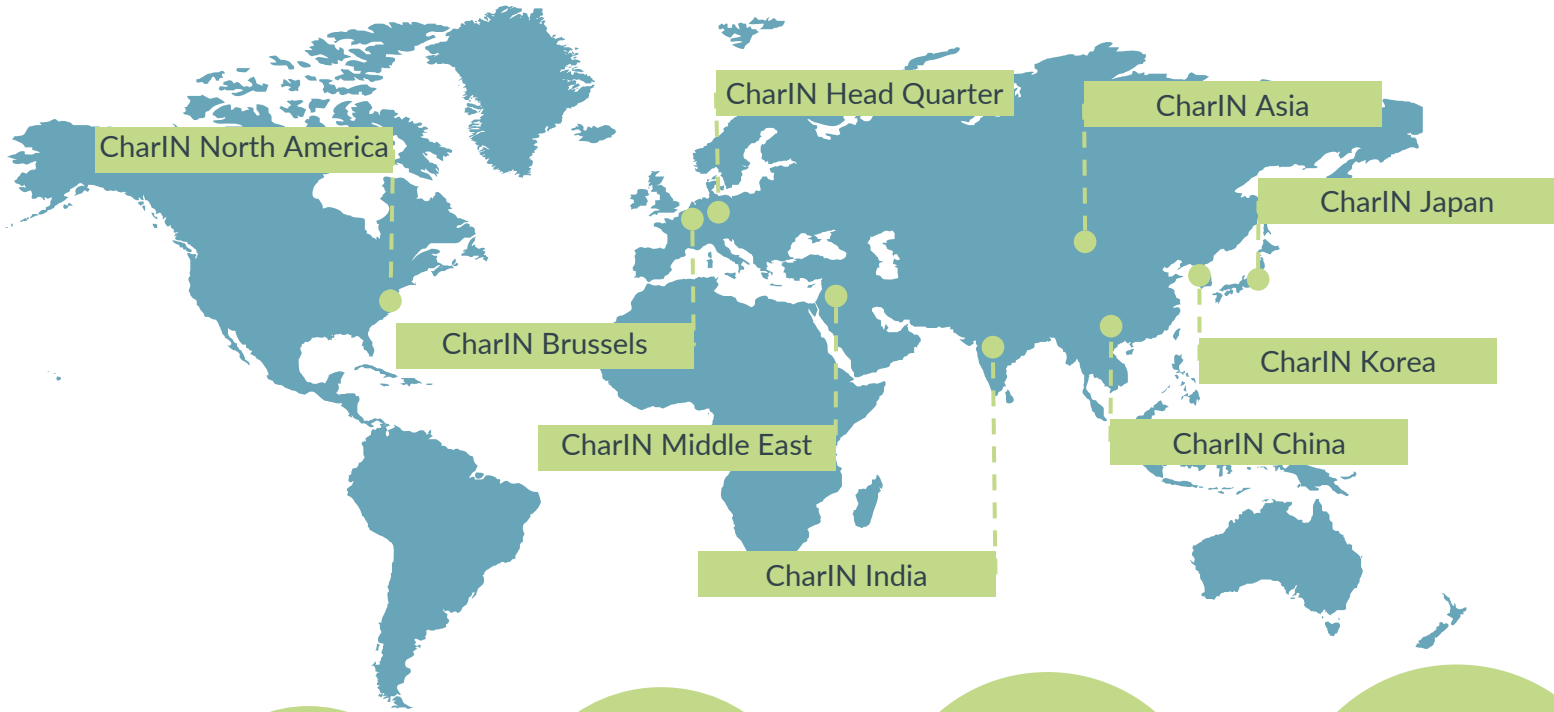
The CO_2 neutral Mobility



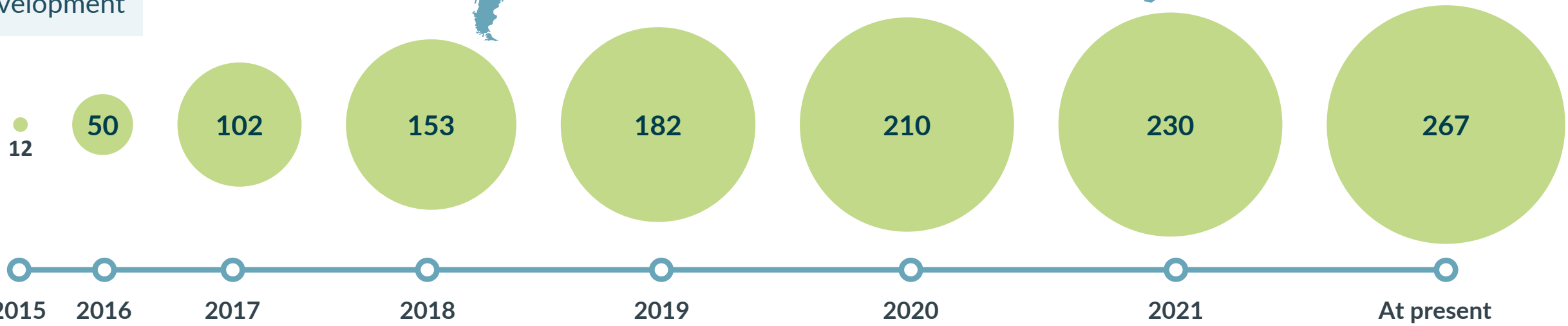
Status Quo CharIN

Retro perspective 7 years CharIN

Regional Offices



Member Development



CharIN's Value Chain

As of March 16, 2022

142 Core Members

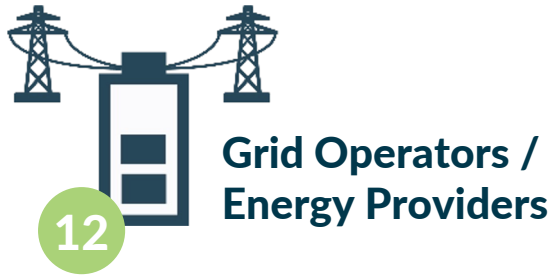
123 Regular Members

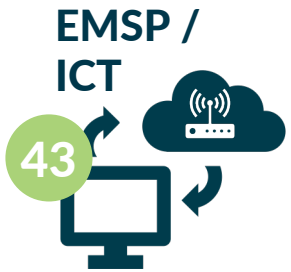
2 Associated Members

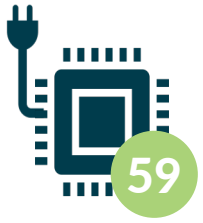
163 Europe

56 Asia / Australia

48 North America



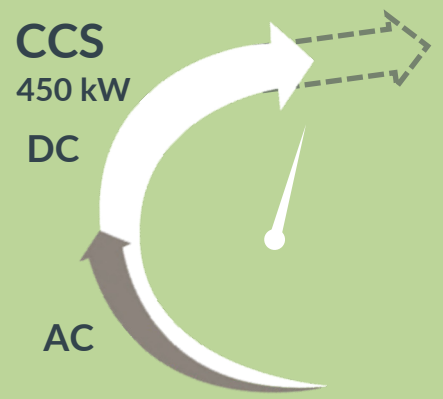




CCS Scope

Performance
up to

450 kW (CCS)
3.750 kW (MCS)



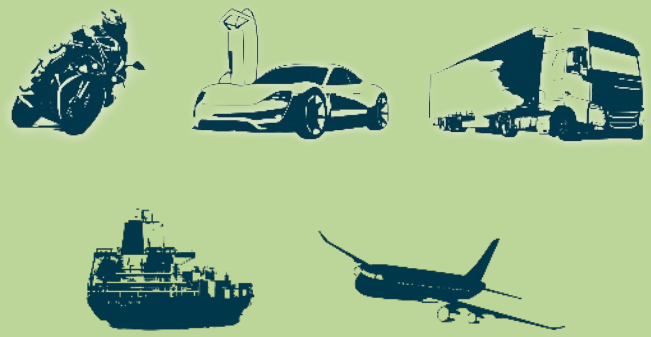
MCS
Megawatt Charging System
Up to 3.750 kW

Added Value

Extended Functionality
Plug and Charge
Vehicle to grid &
Vehicle to home

Worldwide

Asia
Europe
North America
Middle East



Scope of application

Motorbike
Car
Bus | Truck
Airplane
Ship

CCS - global, cross industry, and holistic

One System for all: Combined Charging System (CCS)

- **Interoperability** by using ISO15118
- **Comprehensive infrastructure** incl. High Power Charging (HPC) stations
- **Customer Comfort** (e.g. Plug and Charge, Automated Charging)
- **Creation of an open PKI ecosystem,** enabling the further Plug and Charge rollout
- **Megawatt Charging System (MCS)** for commercial vehicles, suitable for air/maritime transport
- **Vehicle to Grid Management (V2G)** with reverse power transfer

Charging System Standards worldwide

Advantages of ISO 15118 Communication Protocol

Charging System	Communication Protocol	DC	AC	TLS	PnC	SCF	BiDi	WPT	ACD
CCS 1 CCS 2 MCS (Global)	ISO 15118-20 Ed1 (Q1 2022)	✓	✓	✓	✓	✓	✓	✓	✓
	ISO 15118-2:2014 Ed. 1	✓	✓	✓	✓	✓	X	X	X
	DIN SPEC 70121:2014 Ed. 2	✓	X	X	X	X	X	X	X
CHAdeMO 3.0 (Japan)	Tbd (ChaoJi-2, CAN 11bit*)	✓	X	X	X	✓	✓	X	X
CHAdeMO (Japan)	IEC 61851-23/24 (CAN 11bit*)	✓	X	X	X	X	✓	X	X
ChaoJi (China)	Tbd (ChaoJi -1, CAN 29bit*)	✓	X	X	X	✓	?	X	X
GB/T (China)	GB/T 27930 (CAN 29bit*)	✓	X	X	X	X	X	X	X

AC – Alternating current charging
ACD – Automatic connection device
BiDi – Bidirectional charging
DC – Direct current charging
*Limited bandwidth due to CAN bus based physical layer
PnC – Plug & Charge
SCF – Smart charging function
TLS – Transport Layer Security
WPT – Wireless Power Transfer

ISO 15118-20 Ed. 1 adds additional features and charging methods
For the first time, implementation of ISO 15118-20 Ed. 1 will serve all use cases to enable seamless introduction of electric vehicles.

Levels of Grid Integration

Charging System	Communication Protocol	DC	AC	TLS	PnC	SCF	BiDi	WPT	ACD
CCS 1 CCS 2 MCS (Global)	ISO 15118-20 Ed1 (Q1 2022)	✓	✓	✓	✓	✓	✓	✓	✓
	ISO 15118-2:2014 Ed. 1	✓	✓	✓	✓	✓	x	x	x
	DIN SPEC 70121:2014 Ed. 2	✓	x	x	x	x	x	x	x

- There are many levels of Grid Integration that can generate value
- CCS with ISO/ISO 15118-20 is the key enabler of Grid Integration and is ready for V2G
- This technology is prepared for a wide range of use cases.

	Grid-compliant Charging	Level 1 - V1G **Controlled Charging**	Level 2 - V1G/H **Cooperative Charging**	Level 3 – V2H **Bidirectional Charging**	Level 4 – V2G **Aggregated (bidirectional) charging**
Description	• EV and EVSE are compliant with the local requirements, guidelines and regulations. • This level only considers charging events from grid to EV. • The charging power is below thresholds, requiring controllability / load management by the DSO.	• The charging event can be influenced regarding the charging power and can be shifted in time remotely by DSO (with highest priority), CPO, EV user, EV or home energy management (HEM). • The EV is capable to wake up for defined start/stops. • Reaction timings are defined. • EV/EVSE, HEM consider variable power settings.	• EV and EVSE negotiate a charging profile based on various drivers (monetary incentives or grid constraints) mainly w/o user interaction (also aggregation); tariff tables etc; mobility need taken into account • Aggregation(local, per charging spot)	• Energy transfers between EVs battery and the home / customer system. • Energy transfers are motivated by sustainability or economical reasons (storage and usage of power, generated by local PV panels or similar). • Supports behind the meter (BTM) use cases	• The EV and the EVSE fulfil functions that go beyond the customer's own energy system (bidirectional energy transfers, aggregators qualification, full balancing market services, economic interests of the EV owner). • Supports in front of the meter (FTM) use cases • Swarm qualification/ aggregation across larger area (entire state or country)
Technical requirements:	• Various local regulations per country (e.g. grid codes, IEC61851-1, IEC 60364 series, …)	Local regulations EV and EVSE • PWM signal, IEC 61851 • DIN-SPEC 70121 (for DC) EVSE and grid (Utility, CPO, …) • OCPP 1.6 • Demand-response • Opt-out possibilities	Local regulations EV and EVSE • ISO/IEC15118 Ed1 • Telematics EVSE and grid • OCPP 1.6f • See level 1 • ToU	Local regulations EV and EVSE • See level 2 • ISO/IEC15118-20 EVSE and grid • See level 2 • EEBus • Many requirements still missing	Local regulations EV and EVSE • See level 2 EVSE and grid • See level 3 • Many requirements still missing

Grid connection — **Grid integration**

EV – electric vehicle, EVSE – electric vehicle supply equipment, DSO- distributed system operator ,CPO – charge point operator

Why MCS?

The motivation to develop a Megawatt Charging System

Quick charging of **large batteries**

Charge 200-600 kWh batteries in 20-30 minutes
→**power levels exceeding 1 MW are required**

No **sufficient and safe** charging solution available

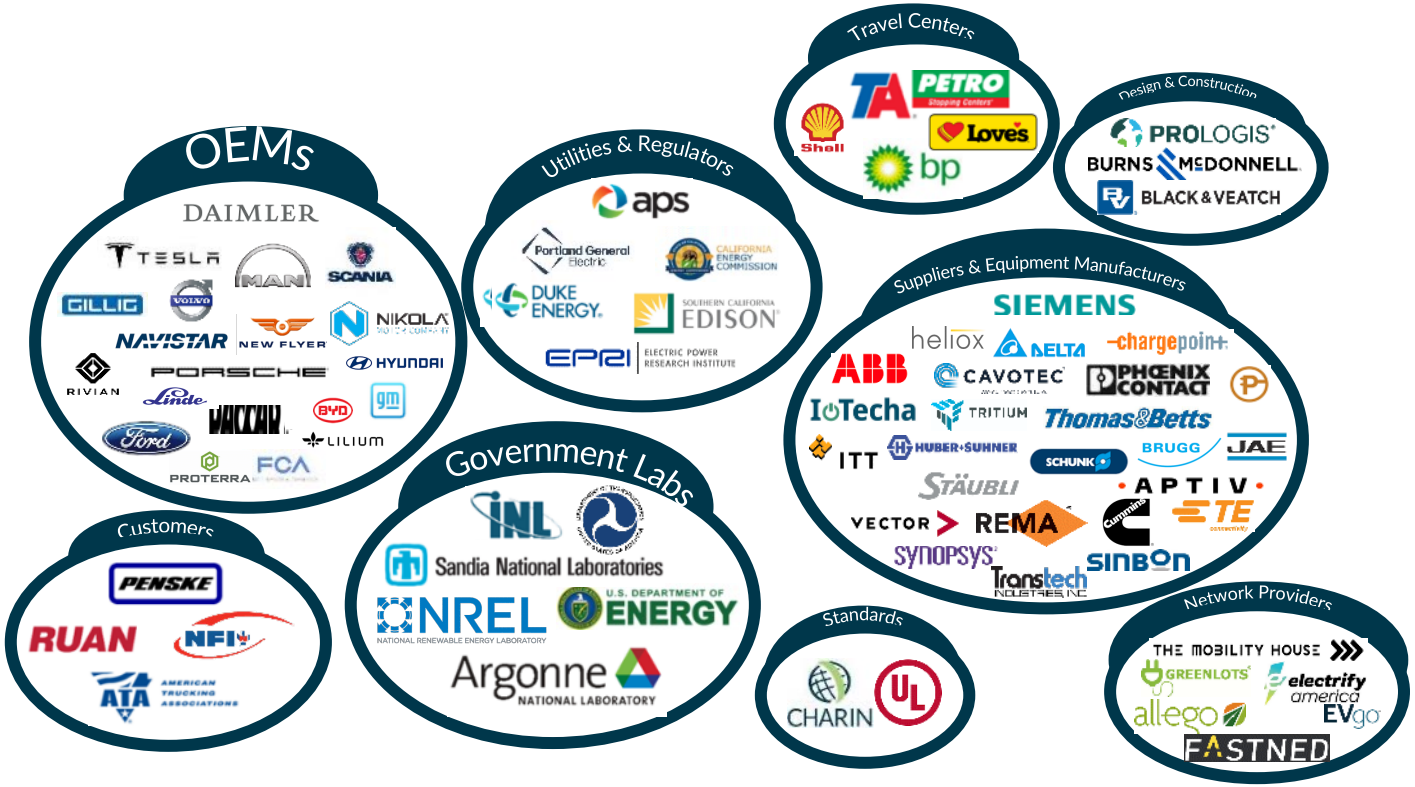
Common development of a solution that is adopted by all relevant players

Megawatt Charging System

Motivation and Scope

A CharIN Task Force was formed in March 2018 with the following purpose statement:

MCS “**Define** a new **commercial vehicle high power charging system** to maximize customer flexibility”



Requirements (excerpt)

- **Single conductive plug**
- **Max 1.250 VDC**
- **Max 3.000 ADC**
- **PLC+ ISO/IEC 15118**
- **Capable of being automated**
- **Cyber-Secure**
- **V2X** (bi-directional)

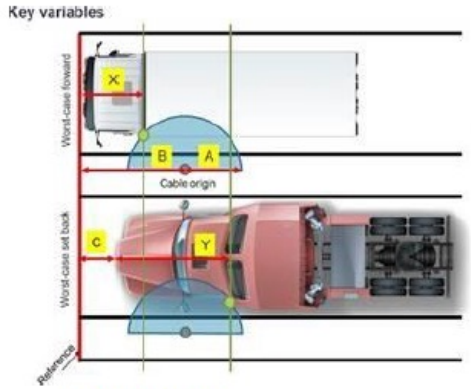
MCS Requirements

Fields of activities

VEHICLE INLET POSITION

CharIN survey (7 OEMs) resulted in the following recommendations for the **position of the vehicle inlet:**

- Inlet on **left hand side** (for both, right hand drive and left hand drive)
- **Min**. distance from bumper (X): **2m**
- **Max**. distance from bumper (Y): **4.8m**
- Roughly **hip height**...



SOURCE: CharIN

CABLE HANDLING

CharIN test event for ergonomics showed quite **positive results regarding handling and connecting** (potential for improvement, of course).

SOURCE: https://www.charin.global/technology/mcs/

The MCS connector is designed by paying attention to the facilitation of **automated systems**. Standards for automated systems are currently developed in IEC 61851-26/ -27 and ISO 5474-5.

TEST AND VALIDATION

For **high charging power > 350 kW**, PLC acc. ISO 15118-3 muss proof its robustness via physical layer and interoperability tests.

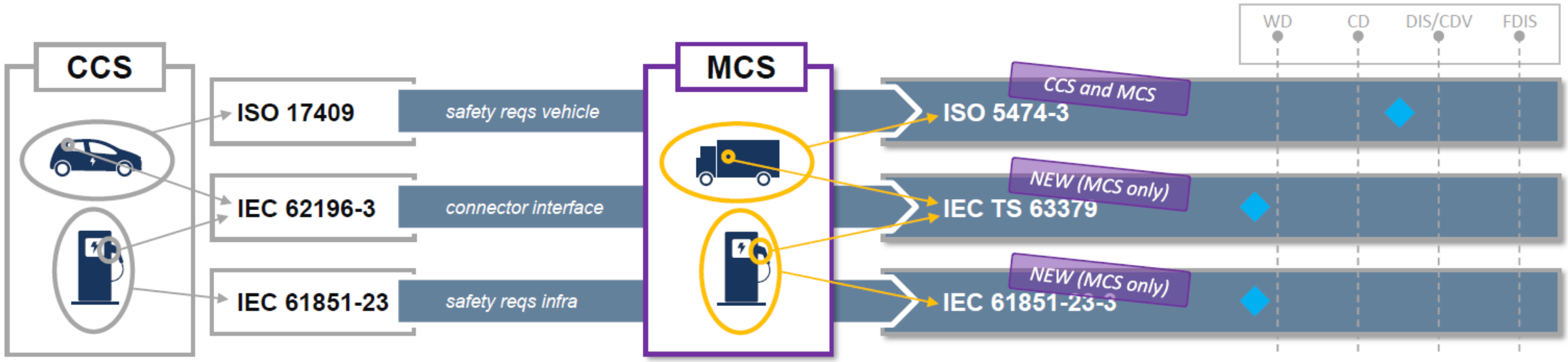
- ✓ **Physical layer test succeeded** in August 2021. Test executed by FTZ[1].
- ✓ Q2 2022 Test running by FTZ
- ✓ **Short circuit test** to be done within 2022 with the University of Dresden.

- ✓ **Interoperability test succeeded** within the North American CCS/MCS CharIN Testival in 2021

1) Forschungs- und Transferzentrum e.V. an der Westsächsischen Hochschule Zwickau

(Inter-)National Groups involved

CCS standards are taken as a baseline to derive the standards for MCS



MCS is currently developed to achieve **1250V and 3000A** (https://www.charin.global/technology/msc/).

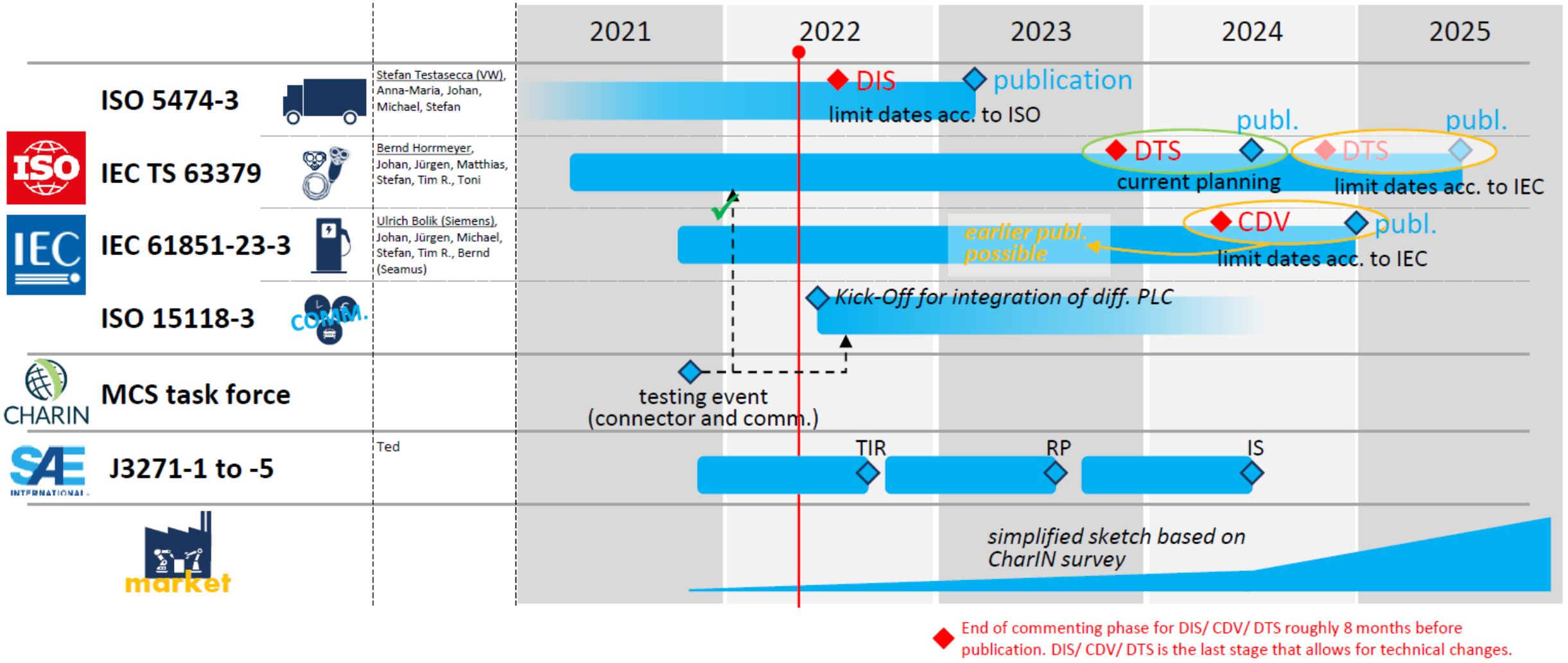
Compatibility of charging control and PLC will be provided. Optional integration and upgrade capability supported.

Conceptual parameters are tried to be kept as close as possible to support/ease coexistence of both systems in a vehicle.

The **increased charging power results in several adaptation needs**.

(Inter-)National Groups involved

Timelines for development of international standards



High Power Charging for trucks - Project HoLa - Germany

Project Description

The project is funded by the German Federal Ministry. Installation and operation of the first Megawatt charging stations for trucks in Europe.

Consortium partners

Fraunhofer
technische universität dortmund
Technische Universität Berlin
p3
Bauhaus-Universität Weimar
heliox
SIEMENS
SCANIA
ABB
EnBW
VOLVO GROUP
DAIMLER
MAN

Associated partners

VDA Verband der Automobilindustrie
TANK & RAST GRUPPE
TRATON
IONITY
e.dis
MEYER&MEYER
Universität Stuttgart Institut für Arbeitswissenschaft und Technologiemanagement IAT
Netze BW Sparte Dienstleistungen

Charging hub at motorway service area

Charging hub at logistics center

Timeline

O9/21	Project kick-off
03/22	Concept finalization
Q1/23 and	Start of site construction infrastructure installation
Q1/24	Start of CCS pilot operation
Q3/24 operation	Start of MCS pilot
Q4/24	Concept confirmation
12/24	Project final

One system for all

CCS and MCS

Interoperable

Global

DC-Connector

Communication

AC Charging	Fast Charging (FC)	High Power Charging (HPC)	Megawatt Charging System (MCS) > 2MW
Type 2	CCS	CCS	MCS
ISO 15118 PWM	ISO 15118 PLC	ISO 15118 PLC	ISO 15118 PLC

MCS

Charging future at a glance

Summary

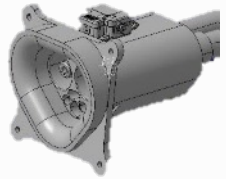
- ✓ **internationally standardized**
- ✓ **charging systems covering all AC and DC power classes**
- ✓ **Increased power**
- ✓ **Intelligent**
- ✓ **Interoperable**
- ✓ **Integrated & connected**
- ✓ **International**
- ➢ **Popular with enough charging stations**
- ➢ **Strategically aggregated**

AC Charging

Fast Charging (FC)

High Power Charging (HPC)

Megawatt Charging System (MCS) > 2MW



Thank you for your kind attention!

Any questions?

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