

Standardization of Megawatt Charging System (MCS)

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The Megawatt Charging System (MCS) is developed to allow for economic usage of electric heavy duty long-haul trucks.

$$\text{recharged energy [kWh]} = \text{charging power [kW]} \times \text{charging duration [h]}$$



500 – 700 kWh

Battery capacity depending on use case and vehicle application profile



100 – 150 kWh

Consumption per 100 km for fully loaded heavy duty vehicles



300 – 500 km

Real driving range without charging stop



45 min

Break time after 4,5 h long-haul heavy duty truck driving



≥ 1 MW

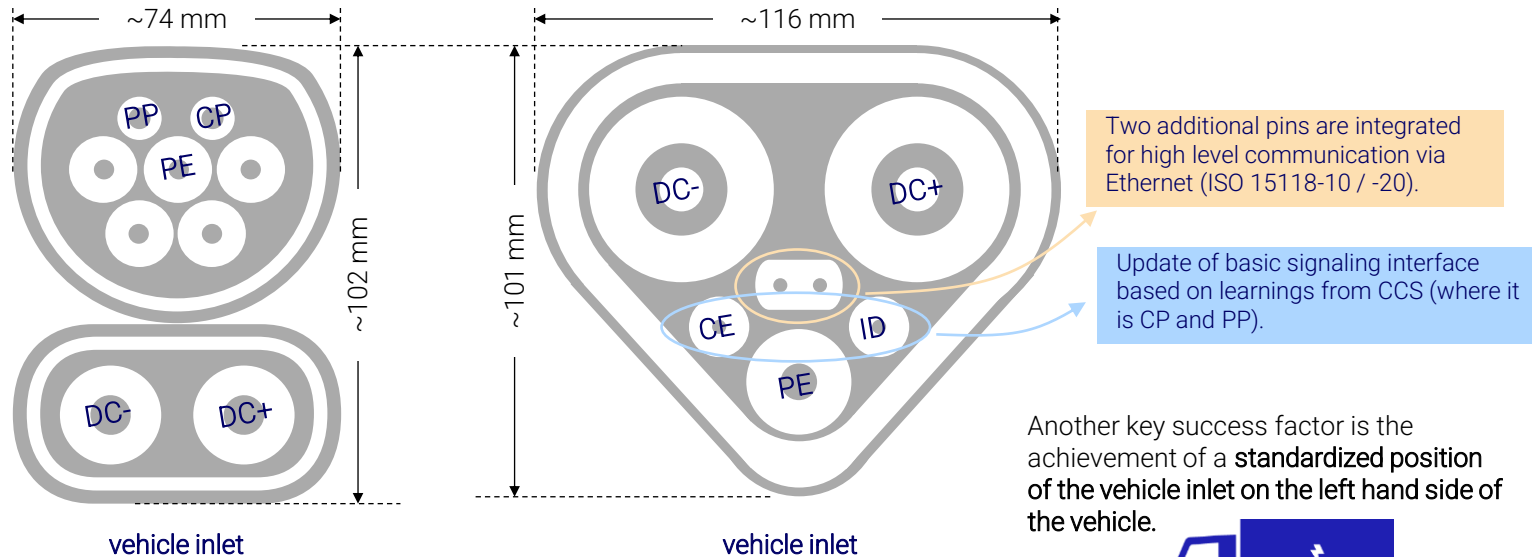
Charging power required to fully recharge within the break time

- Vehicles for long distance applications will be equipped with **battery capacities of several 100s of kWh**.
- The existing charging systems do not have sufficient charging power to **recharge the battery within the resting times of the drivers** (max. charging power of CCS is limited to ~500 kW).
- The goal of the Megawatt Charging System is to fill that gap to allow an **economic usage of electric heavy duty long-haul trucks**.



MCS has generally been derived from CCS, adapted where needed due to the higher power levels and optimized based on lessons learned.

General specs	Combined Charging System (CCS) 2	Megawatt Charging System (MCS)
Max. voltage	1,000 V (DC)	1,250 V (DC)
Max. current	500 A (DC)	3,000 A (DC)
Max. power	~500 kW	3,750 kW



The electric safety concept has been taken from CCS, some parameters needed to be adjusted for MCS.



IEC 61851-23 (CCS)

Provisions for basic protection	Provisions for fault protection	Provisions for special protection
Protection in absence of a fault	Protection in case of a fault	
Basic insulation ⁹ : – (solid) basic insulation – basic insulation by air – inside barriers or enclosures	For class I ¹ portions: – Protective separation between side A and side B ^{3,6} (8.105.5) – Protective equipotential bonding to accessible conductive parts (IEC 61140:2016, 5.3.3.2), for example, for metal housing ⁸ (8.105.1), in combination with: <ul style="list-style-type: none"> • for system A (AA.3.8.2): disconnection of the EV by triggering an emergency shutdown upon loss of protective equipotential bonding ⁷; • for system B (BB.14) and system C (CC.4.6): mechanical robustness of the equipotential bonding by both <ol style="list-style-type: none"> i) minimum cross section of the protective conductor, and ii) using a vehicle coupler according to the IEC 62196 series. – Electrically protective screening (shielding) between hazardous-live-parts and accessible surfaces of parts of insulating material (8.105.5). For class II ¹ portions: Double or reinforced insulation (8.105.5). Accessible SELV/PELV circuits: Protective separation between side B and the SELV/PELV circuit, or basic insulation and all of the conditions given in footnote ⁸ (8.105.5).	– Protective separation between side A and side B ^{3,6} (8.105.5) – Continuous continuity checking of the protective conductor and de-energization upon loss of continuity ^{2,4} (6.3.1.2) – For system B, the protective equipotential bonding withstands the short-circuit energy ¹ (8.105.11, Clause BB.14) – Perform an error shutdown when an asymmetric or symmetric insulation fault to protective conductor occurs, measured by the IMD ⁸ (8.105.1) – Multiple side Bs shall be separated from each other by basic insulation ^{2,7} (8.105.1) – Limitation of steady-state touch current (B) and impulse current (C ₁) ⁸ (8.101.4) – Limitation of Y-capacitance to 500 nF per rail ^{2,3} (8.105.3) + symmetrization



IEC 61851-23-3 (MCS)

Short circuit energy supplied by EVSE

- ≤ 30 kA and $\leq 1\,000\,000$ A²s
- EVSE triggers emergency shutdown within 1 s and switches off supply to EV within 4 ms

Short circuit energy supplied by EV

- ≤ 70 kA and $\leq 12\,000\,000$ A²s
- EV triggers emergency shutdown within 1 s and switches off supply to EVSE within 4 ms

MCS > CCS

Y-capacities

Voltage dependent between ~5,7 and 15 μ F for each side (EVSE side and EV side)

Overvoltages between DC+/DC- and PE

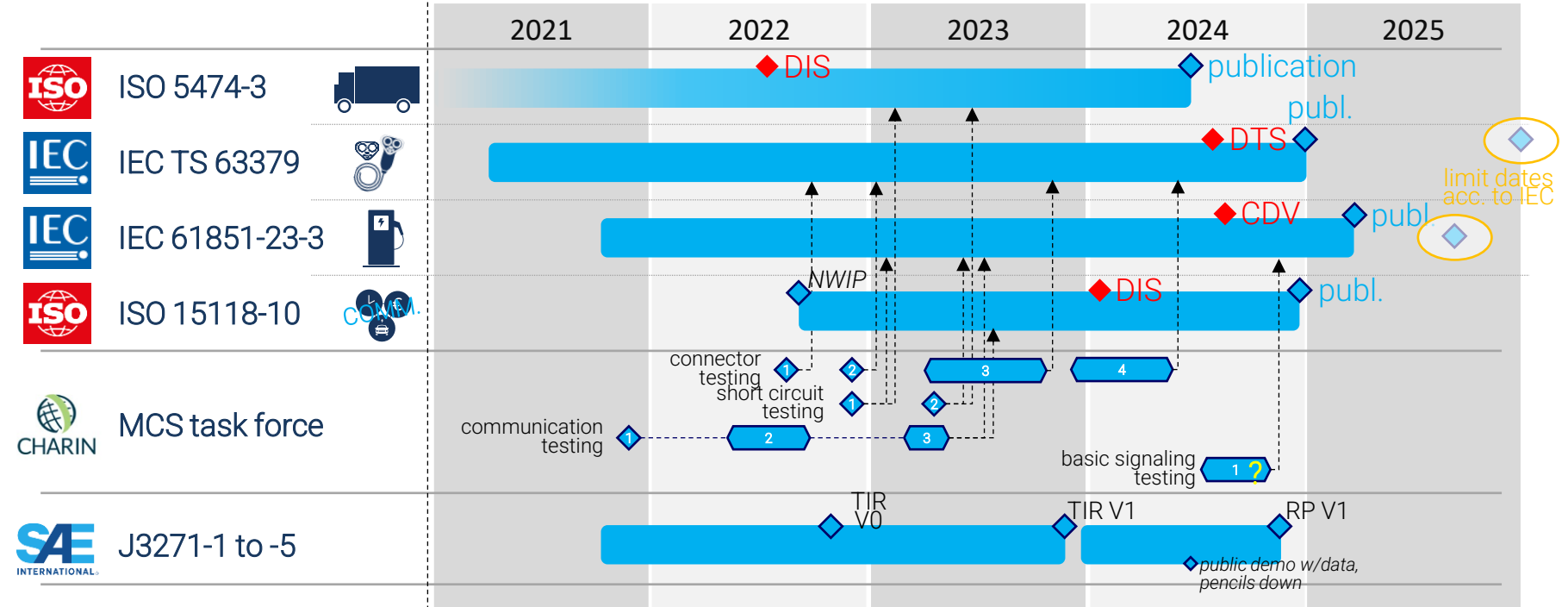
- Transient overvoltage of max. 2 500 V
- Short-term temporary overvoltage with durations up to 5 s of max. 1 980 V d.c.

MCS = CCS

Overvoltages between DC+ and DC-

- Load dump: Long-term temporary overvoltage with durations longer than 5 s of max. 110 % of the maximum working voltage between DC+ and DC-
- Transient overvoltages: Max. the maximum working voltage of EV plus 500 V between DC+ and DC-

The current roadmap of the international MCS key standards indicated publications by 2025.



◆ DIS, CDV and DTS are the last stages that allows for technical changes.

KEY TAKE AWAYS

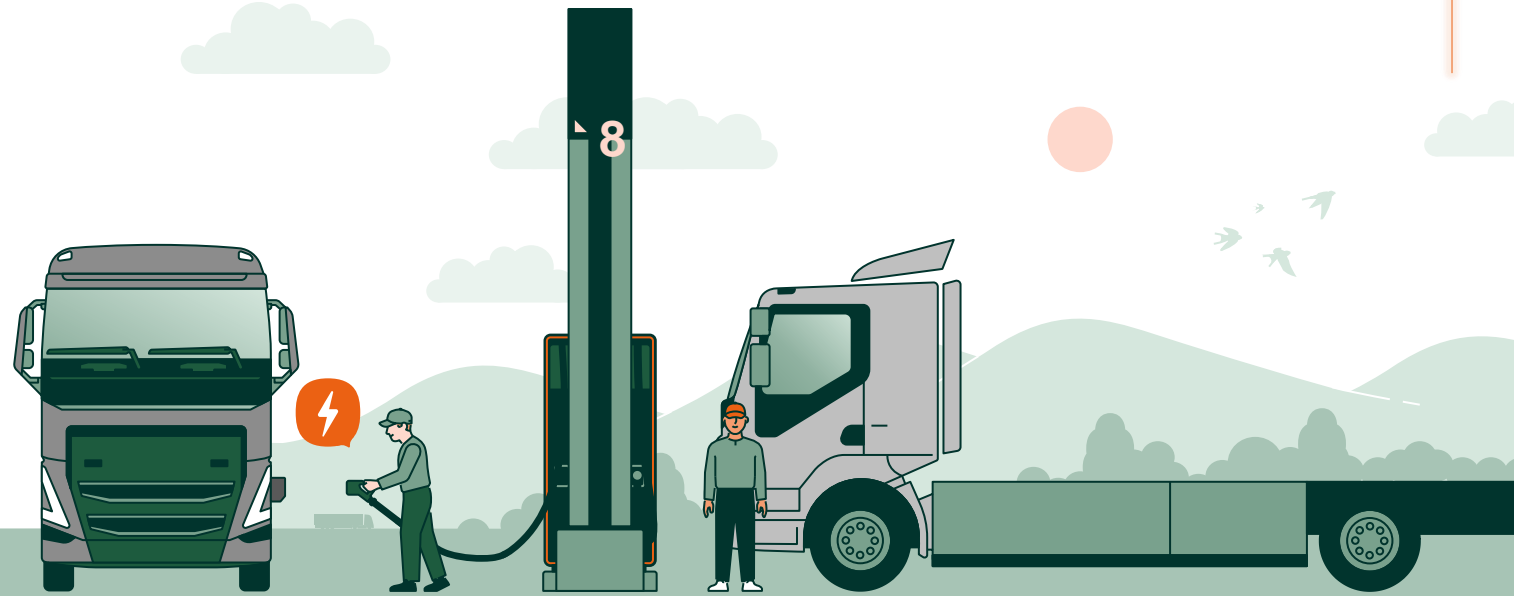
- *MCS is developed to support heavy duty long-haul applications*
- *MCS standards are specified for up to 3,75 MW*
- *Besides the communication, also parameters related to electrical safety have been adapted compared to CCS*
- *Standards will be published by the middle of 2025*

Thank you!

Michael Scholz

MegaWatt charging meets the grid – challenges and their impact in the speed of roll out

Building the right charging ecosystem



Founded in
July 2022

**With a clear commitment to
electrification &
zero emissions road transport**

DAIMLER
TRUCK



TRATON

Our Ambition

Deploy at least **1700 Charge Points**
within the first **Five Years** of operation

5
Years

1.700
Charge Points

500
mEUR

Offices in Amsterdam (NL) & Arnhem (NL)



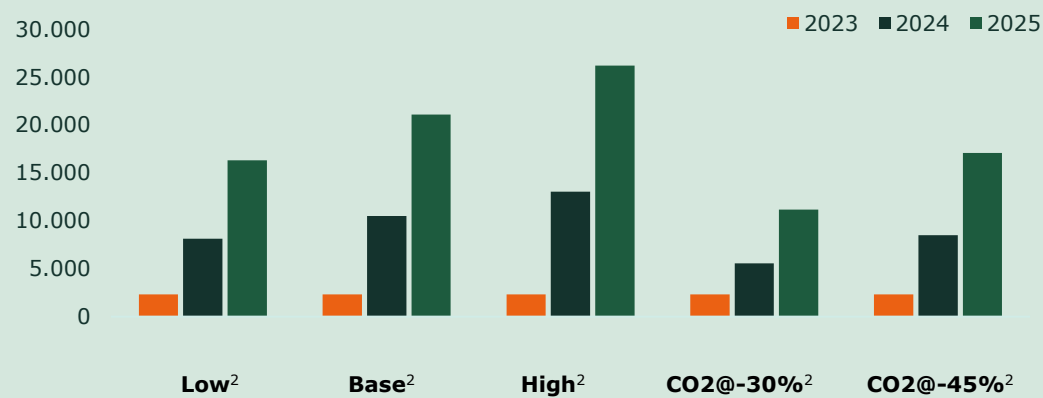
Offices in **14 additional countries** are open



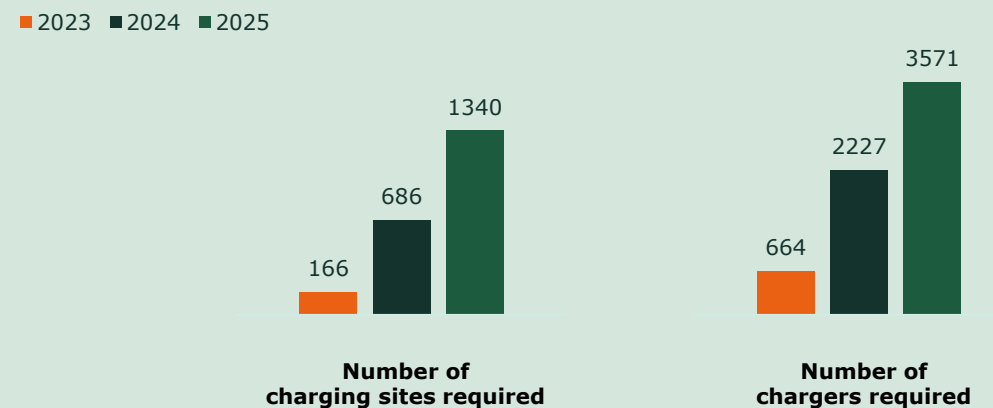
175+ employees (August 2024), growing to **200+** by 2024

Meeting the charging needs in upcoming years

Total number of eHDT



Public charging infrastructure need based on eHDT market growth EU27



¹ S&P data actual eHDT

² Milence prediction

Our **Network**

**Focus on the Netherlands,
Germany, France, Belgium,
Sweden and Norway**



Expansion

across at least 15 markets
by 2027 by building at least **1.700 high
performance charging points**



First Milence site is operational since December 2023 in **Venlo, Netherlands**, additional ones to opening soon.



Today's challenges

1

Location acquisition

- Availability of suitable locations along key logistics routes is limited.
- Scalability for optimal network coverage and development is crucial.

2

Dealing with power supply

- Large grid connections are not always available or have long lead times.
- An optimized power distribution is key to create reliability and energy efficiency. Designs needs to be suitable for growth.

3

Future proof - network engineering

- Space for all the equipment is limited, optimizing is needed for most locations.
- The hubs must adapt to evolving technology, including advancements in charging standards, battery technology, and truck design.

The right network on the right routes



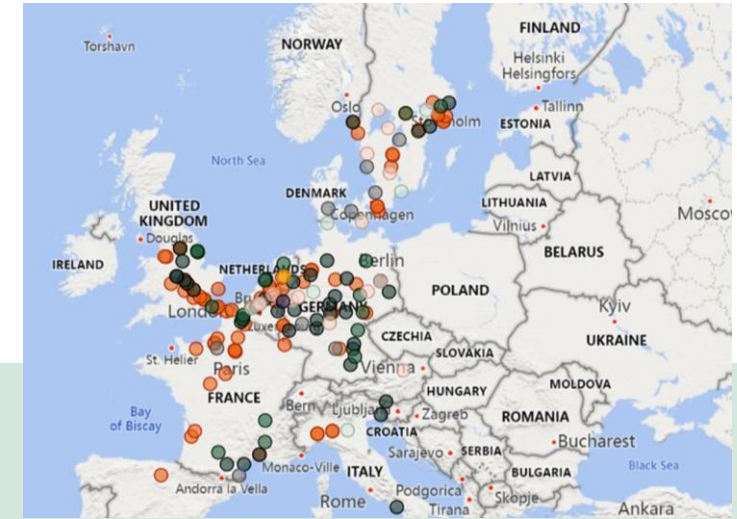
Trans-European Transport Network (TEN-T)

To support a fast transition to electrification, the first charging hubs must be developed along core network of the trans-European transport network.



AADTT (Annual Average Daily Truck Traffic) and why does it matter

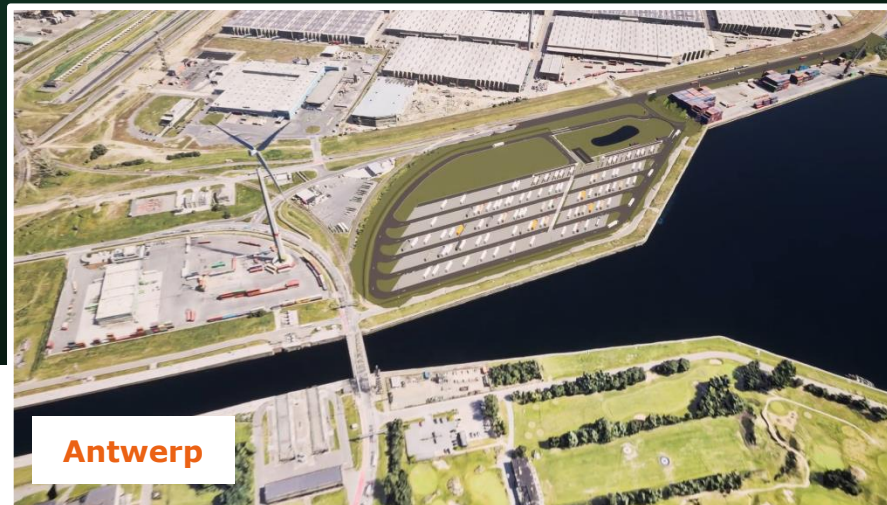
We consider the AADTT information to select the right locations as and create predictions for upcoming years.



Connecting the dots

Looking at the corridors and connecting the insights allows us to be there where the demand will be and ahead of it.

The Hubs



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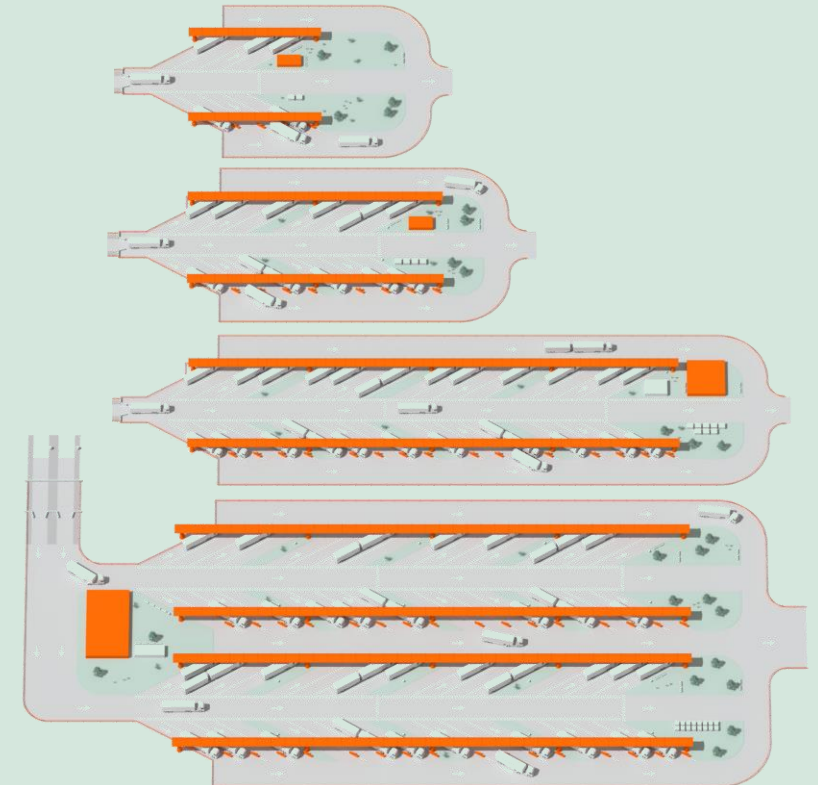
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The Milence site

Based on modular building blocks

	Small	Medium	Large	Extra Large
Grid connection	MV Connection 3-6 MVA	MV Connection 8-12 MVA	MV/HV Connection ~20 MVA	MV/HV Connection >20 MVA
Charging bays	8	16	32	64
Overnight	4 bays @ 200 kW	6 bays @ 200 kW	12 bays @ 200 kW	24 bays @ 200 kW
Breaktime	4 bays @ 1,2 MW	10 bays @ 1,2 MW	20 bays @ 1,2 MW	40 bays @ 1,2 MW
Green bay (Technical area)	2	4	8	16
Dimensions without extra long-haul parking	5000 - 7500 mt ²	7000- 9500 mt ²	>14000 mt ²	>23000 mt ²



Vending modules



1 Coffee and tea vending machine
1 snack and beverages vending machine

Sanitary modules



2 toilets (1 for disabled)
1 shower

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Megawatt charging

Pain points for scalability



Design

- Input voltage – 400VAC
- Power density
- Single connector per charge post.
- Load factor, i.e., ratio between PU capacity and number of connectors



Installation

- Civil works for cable trenches
- Electrical integration of different components in the charging site



Operation – Overall system efficiency is poor

- Copper losses
- Conversion losses
- Cooling losses



Maintenance

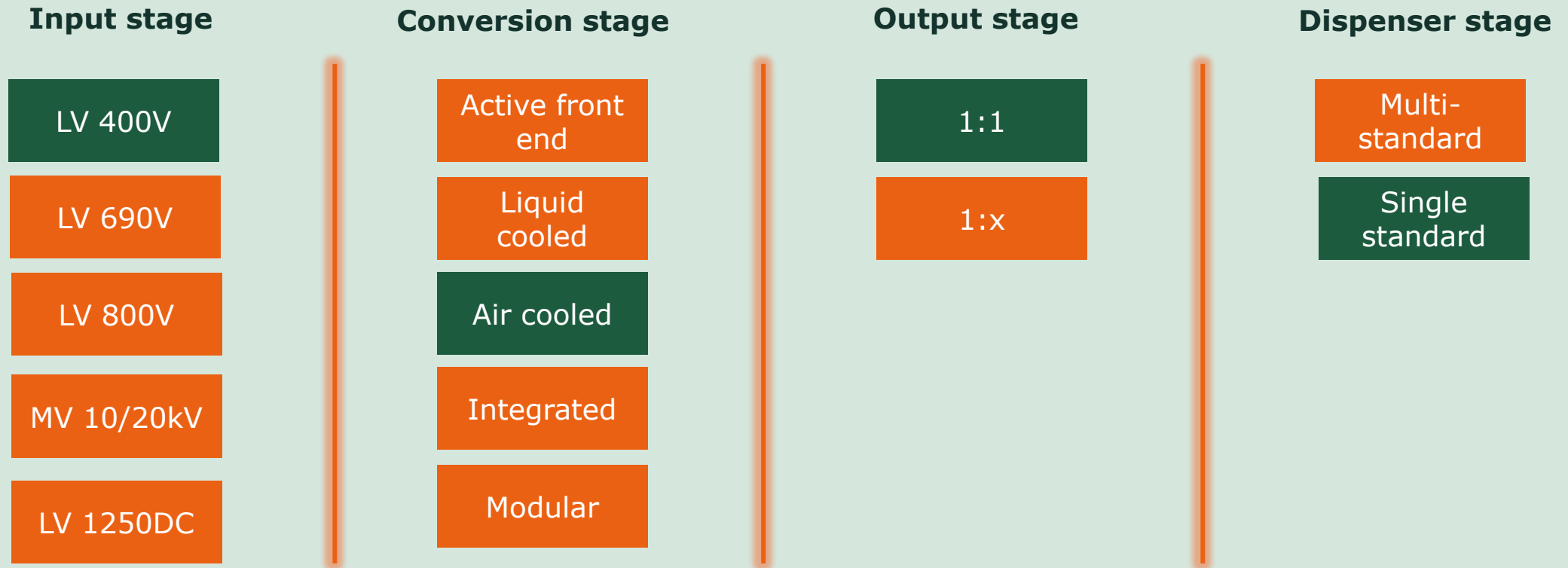
- Complexity and required skills (MV vs LV) for current market practice



Megawatt charging

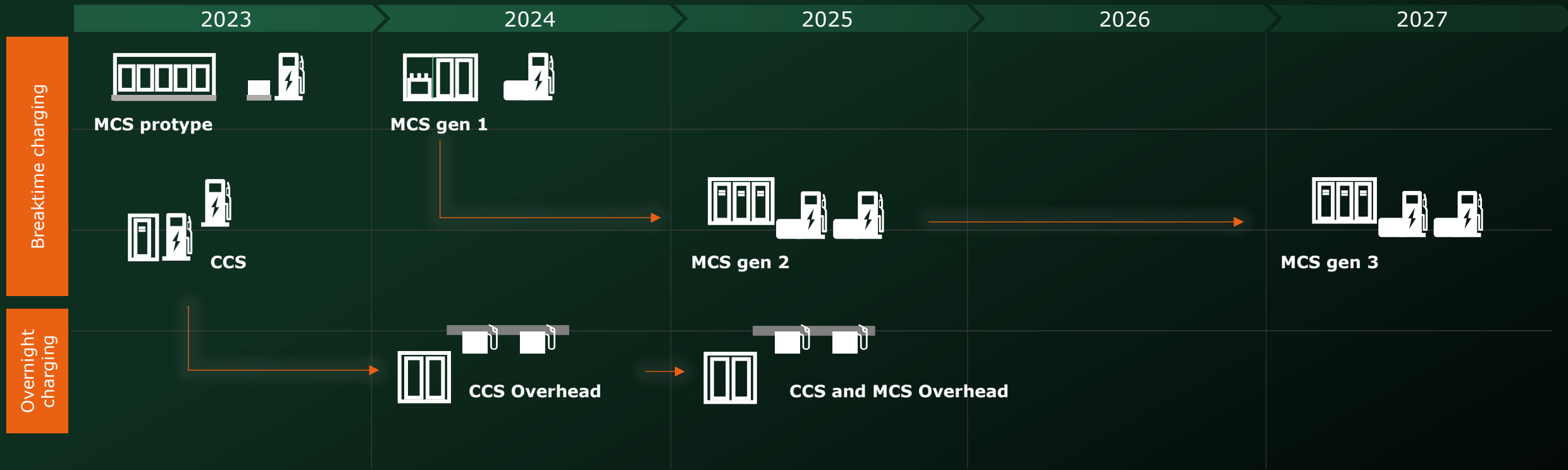
Charger architecture configurations

There are four parts of the charging architecture that require technology push so that scalability for the LHV charging can be ensured from a business perspective.



What we need? More power density and higher voltage

Technology roadmap





Alejandra Fabian
Power and
infrastructure

Thank you!

