ELCPD-12

JOE ELLWOOD

Electric vehicle charging

Infrastructure, market and connectivity

An ABB Specification Team Training Series Presentation

Knowledge Check

Learning objectives

- In line with the consultation which closed 7 October 2019, an understanding of the new building regulations
- Full consideration of the market, European open protocol standards and segmentation by product.
- Consideration of the difference between DC and AC charging within buildings
- The back office, connected services and solutions to run a charger network

Proposed changes to building regulations

Expected Q3 2021

New residential buildings

Chargepoint to be required in every building with off-street parking

Multi-dwelling buildings with more than 10 spaces to include cable routes for all spaces

New non-residential

Every new non-residential building and every non-residential building undergoing major renovation with more than 10 car parking spaces to have one chargepoint and cable routes for a charger for one in five spaces

Existing non-residential

At least one chargepoint in existing non-residential buildings with more than 20 car parking spaces (from 2025)

Product requirements

Minimum 7kW

Universal socket (untethered)

Mode 3 or equivalent

Smart functionality

New standards on energy smart appliances (PAS1878 and PAS1879)

Interoperability of public chargers

Full access to EV drivers

ABB and EV charging

ABB EV charging

Mission statement – EV Infrastructure team

We offer AC and DC charging solutions for Electric Vehicles…

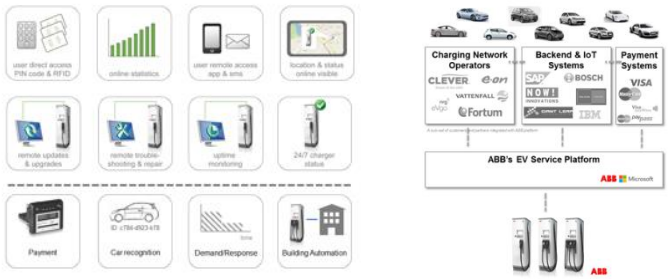
…from 3-600kW…

…based on standards…

…in all countries…

Present in
>85 countries

..with cloud connectivity..



…using ABB technology…

and ABB manufacturing.

ABB, eMobility and EV Charging

ABB's focus and investments in eMobility

ABB and Formula E

Together, Formula-E and ABB are defining the roadmap for electric mobility through motor sports.

Jaguar I-PACE eTROPHY Series

Jaguar I-PACE eTROPHY announces ABB as Official Charging Partner.

The I-PACE is 2019 World Car of the Year.

ABB provides custom-made, compact Terra fast chargers for the series

ABB is global charging partner for Car, Bus and Truck OEMs

Strong presence in China, USA and Europe

ABB offers end-to-end solutions for the complete value chain

Your one-stop shop for e-mobility infrastructure

AC chargers

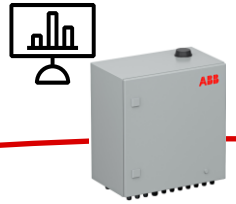
– Terra AC

DC fast chargers

– Terra systems

E-bus chargers

– HVC 150



Energy Management

– EV Site Solution

Integrated solutions

– Energy storage

– eHouse with chargers

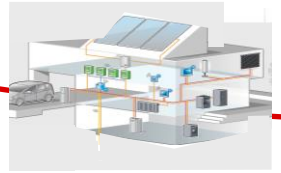
Substations

– Transformers

ABB's solutions will work together seamlessly throughout the whole value chain

Charging network software services

– ABB Ability



Building automation

– KNX, energy mngt.

Components

– DIN rail & LV and MV distribution boards

Renewable integration

– HVDC, solar, wind

Service

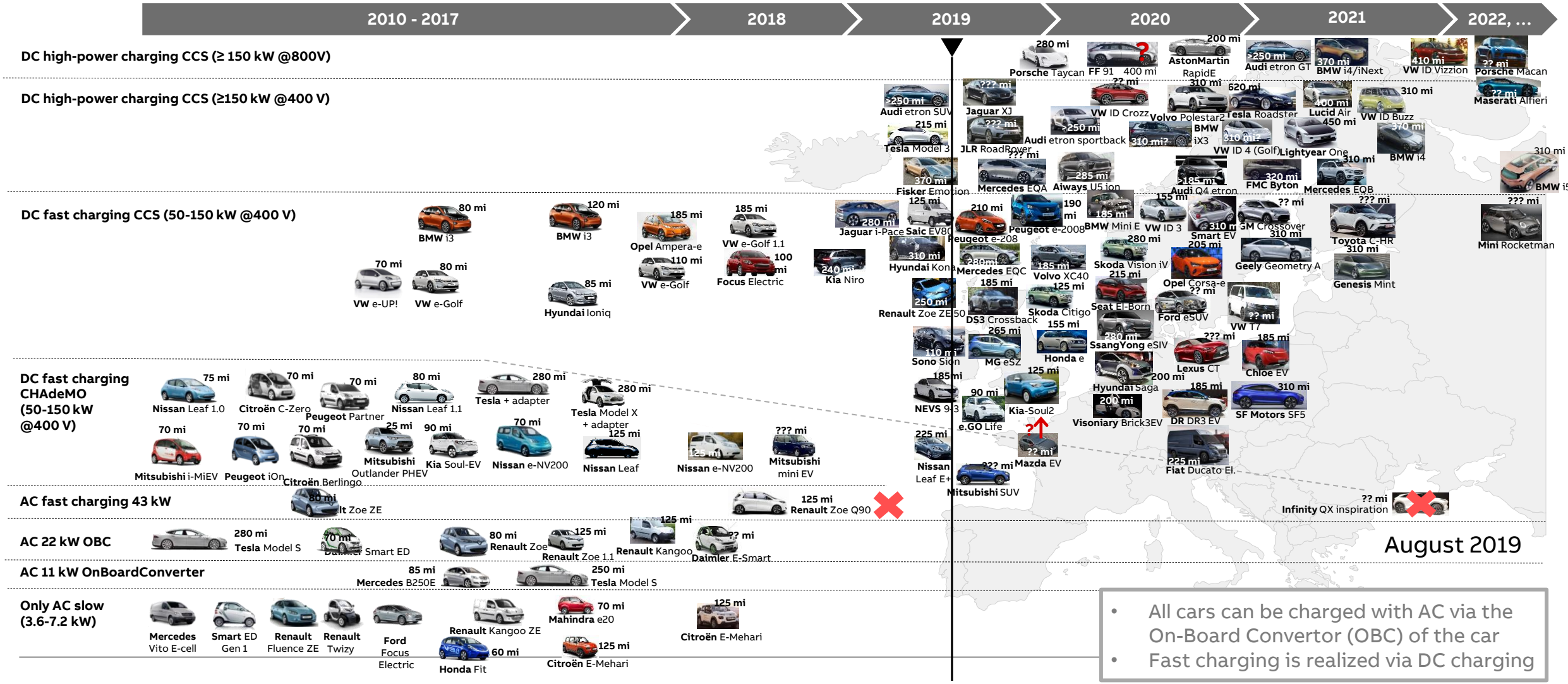
– Asset management

– Extensions, upgrades & retrofits

– Installation & commissioning

Market (cars & standards)

Follow the car through Europe, and open standard protocols



- All cars can be charged with AC via the On-Board Convertor (OBC) of the car
- Fast charging is realized via DC charging

ABB is following the Car-OEM's Fast Charging standards

20-100 kW CHAdeMO/ 22-43 kW AC/ 20-350 kW CCS 2

From Q4-2013 onwards
CCS 2

From Q4-2012 onwards
22-43 kW AC

Very roughly said: A standard in fact is defined as the combination of the physical connector + the communication protocol

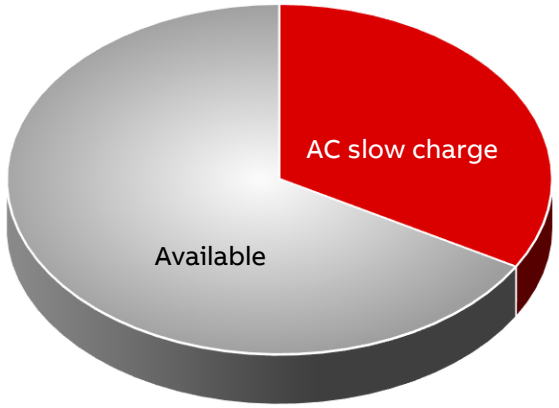
From Q4-2010 onwards
CHAdeMO

DC versus AC charging

Influence on range and availability by AC slow and DC fast charging

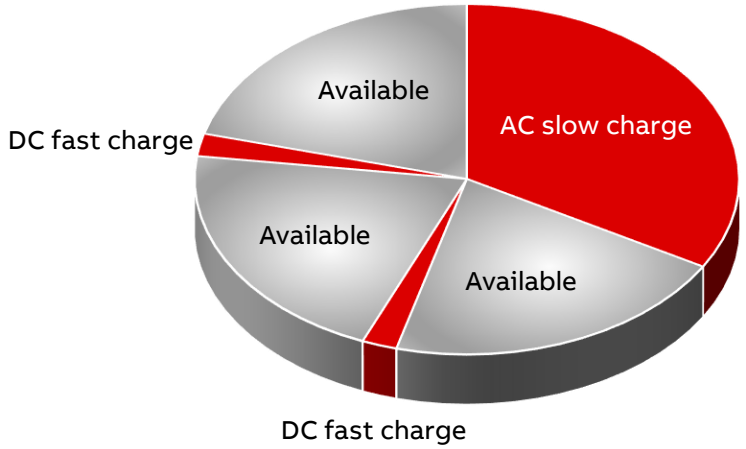
Possibility to strongly extend the range of a BEV by DC fast charging

Only AC slow charge (8 hrs)



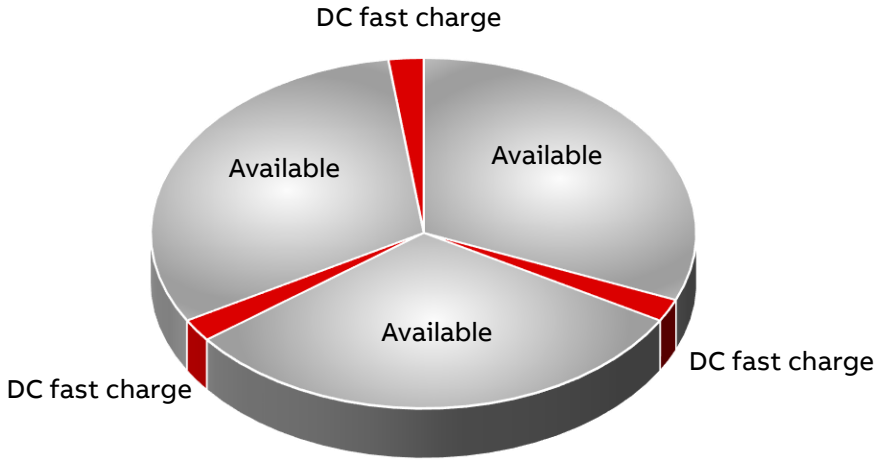
Availability 16 hours
Total range: 186 miles

AC slow charge (8 hrs) +
2x DC fast charge (each 30 min)



Availability 15 hours
Total range: 560 miles

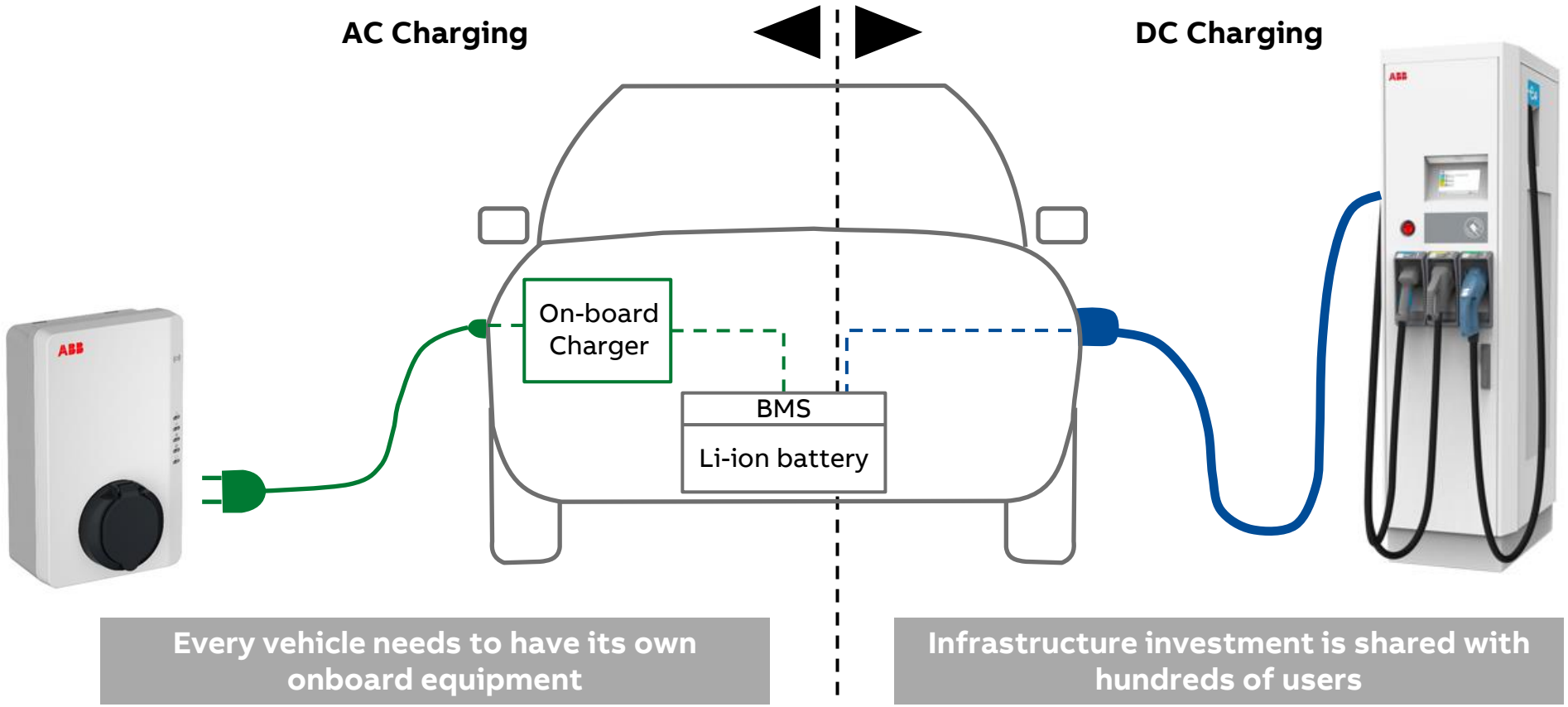
Extreme: for e.g. fleet owners:
3x DC fast charge (each 30 min)



Availability 22.5 hours
Total range: 560 miles

AC charging versus DC charging

On-board versus Off-board equipment



Market segments & products

Public and commercial car charging – Use cases

Charging service should match charging application and demand

Public and commercial EV Charging

AC destination	DC destination	DC Fast	DC High Power
7-22 kW	20-25 kW	50-150 kW	150 to 350 kW+
4-16 hours	1-3 hours	20-90 min	10-20 min
			
– Office, workplace – Home – Multi family housing – Hotel and hospitality – Overnight fleet – Supplement at DC charging sites for PHEVs	– Office, workplace – Hotel and hospitality – Parking structures – Dealerships – Urban fleets – Public or private campus – Sensitive grid applications	– Retail, grocery, mall, big box, restaurant – High turnover parking – Convenience fueling stations – Highway truck stops and travel plazas – OEM R&D	– Highway corridor travel – Metro ‘charge and go’ – Highway rest stops – Petrol station area’s – City ring service stations – OEM R&D

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	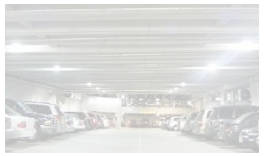		
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AC Wallbox

Product features

Built in safety
- overcurrent
- overvoltage, undervoltage
- ground fault
- Surge protection

Metering
- Built in energy meter (1% accurate)
- *MID option*
- Power management / smart charging

connectivity
- 1 x Ethernet,
- 1 x Bluetooth 5.0
- Wi-Fi
- *4G option*
- OCPP1.6
- RS485

Authentication
- Smartphone
- *RFID option*

Prepared features
- 2x Ethernet (daisy chain)
- ISO 15118 (plug & charge and V2G)
- PTB certification
- Display

APP
- Authentication & control of the charging
- Configuration of the charger & a charger network

Installation
- 40 A supply (7 kW 1 phase, 22 kW 3 phase)
- Type A RCD – one needed per charger
- 6 mm^2 – 10 mm^2 cable

Pedestals and accessories

Plastic adapter box

Plastic box on a standard 60 mm pole with ground plate

- Room for 5 x 4-slot DIN rail components
- IP54
- Sold with and without pole
- Can hold one or two chargers back-to-back
- Space saving cost efficient solution

Metal pedestals

Metal, free standing

- Room for 6 x 4-slot DIN rail components
- IP54
- Offers a big space for customized foiling
- Can hold one or two chargers back-to-back
- Basic versions without DIN rails available for 1 or 2 chargers

Other accessories: extra RFID cards, spare cables and charge cables (T2-T2 and T2-T1)

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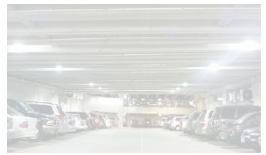			
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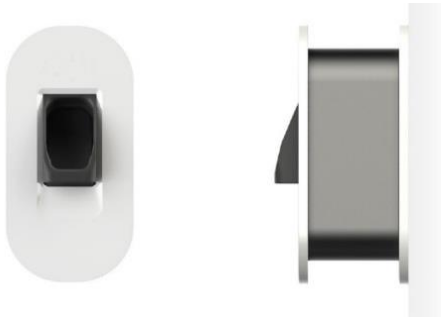
ABB Terra DC Wallbox 24

Versions



This 920 V DC wallbox is available in the following configurations:

- Single outlet CCS2
- Dual outlet CCS2 + CHAdeMO

Available with 3.5m or 7m cable

EMC Class B

The connector holders for outside use have to be ordered separately

ABB Terra DC Wallbox 24

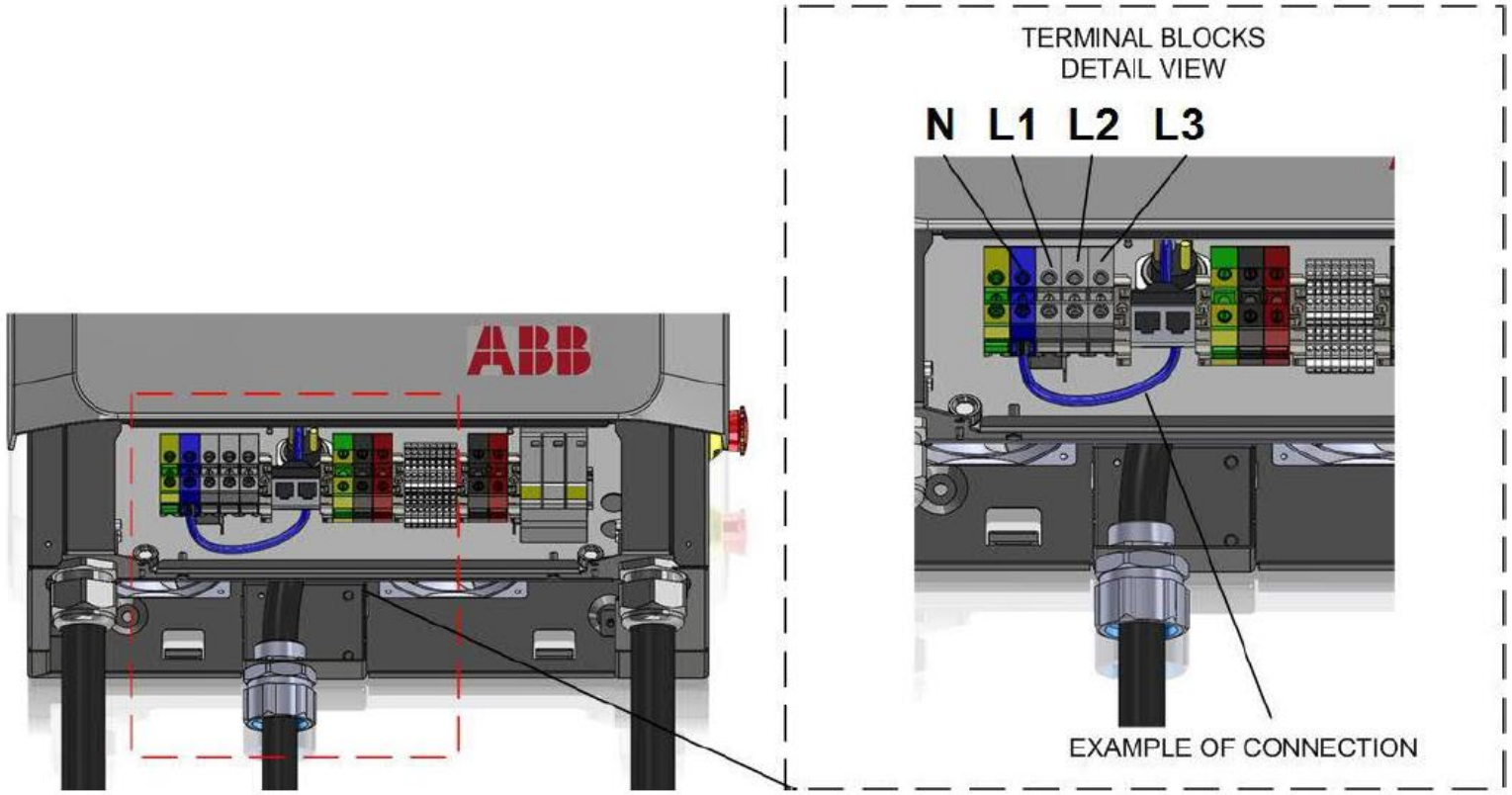
Installation

If RCD is required, then a Type B high immunity device should be used

40 A supply

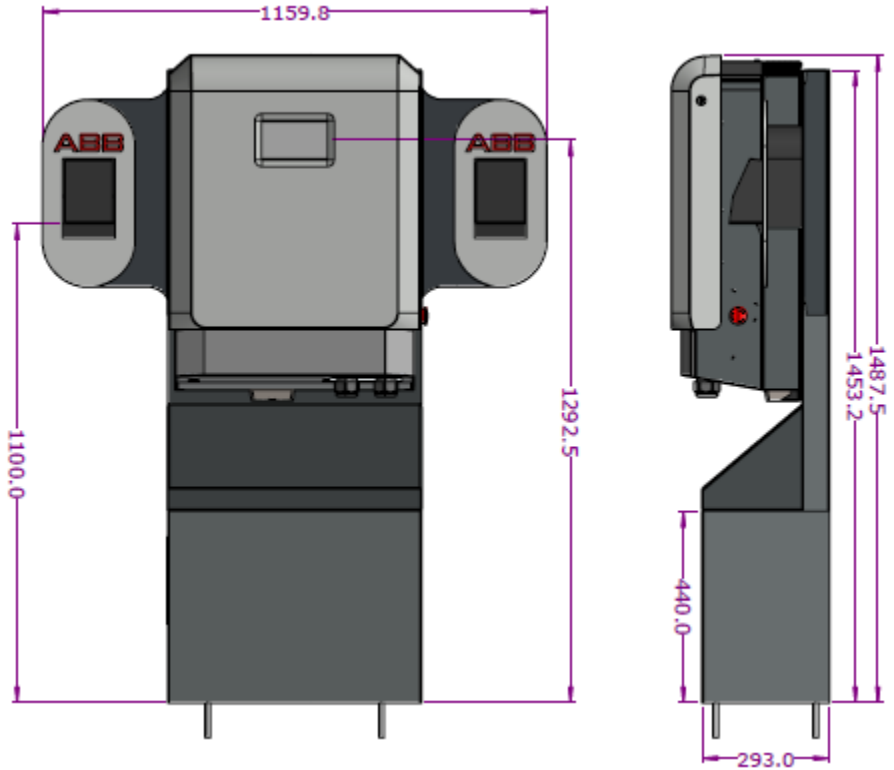
Cable CSA – maximum 35 mm^2

Cable diameter 22 – 32 mm



Accessories

Pedestal



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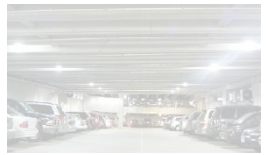	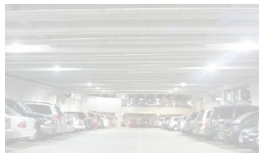		
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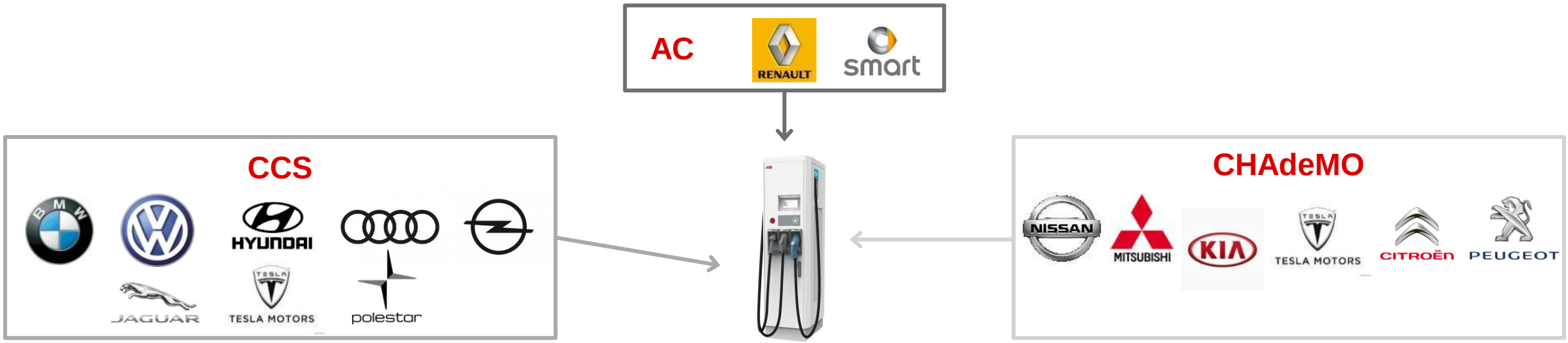
Multi-standard charger solution Terra fast chargers

General explanation of naming convention



Terra **2**4	(20kW)	**C** - (Combo) = Combined Charging Systems (CCS)	- DC
Terra **5**4	(50kW)	**J** - (Japan) = CHAdeMO	- DC
Terra **9**4	(90kW)	**Z** - (China) = GB	- DC
Terra **12**4	(120kW)	**T** - (Socket) = Type 2 Socket	- AC
Terra **18**4	(180kW)	**G** - (Grid) = Cable + Type 2 Connector	- AC

HV = High Voltage

CCS: 200-920 V

CHAdeMO: 150-500 V

Terra x4

High Voltage Charger: for cars with drive trains of 400 V and 800/900 V

Available for the Terra 54, 94, 124 and 184

Voltage range

- CCS: 200 - 920 V
- CHAdeMO: 150 - 500 V

Fit for CCS-charging of:

- Standard cars with 400V drive-train
- Premium, high voltage cars with 800/900V drive-trains
- eTrucks
- eBusses

Passenger cars

Sportive cars

eBus & eTrucks

Terra 94/124/184 are available only as High Voltage
Terra 54 is available in both standard and High Voltage variants
Terra 24 is available only as standard voltage range

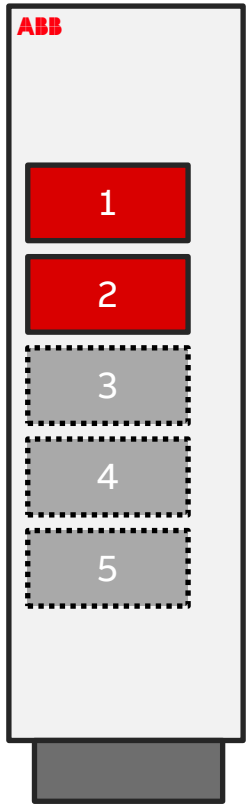
Terra EV Fast Charger

Power modules and upgradability

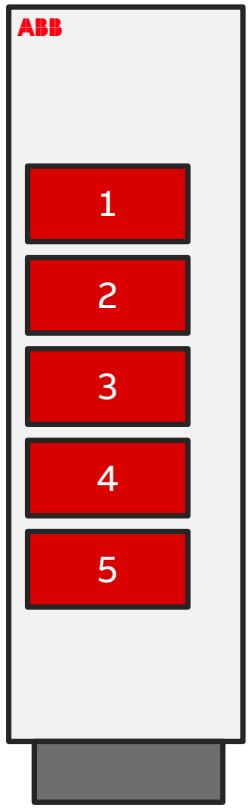
Installed power module

Slot available for upgrade

Terra 24

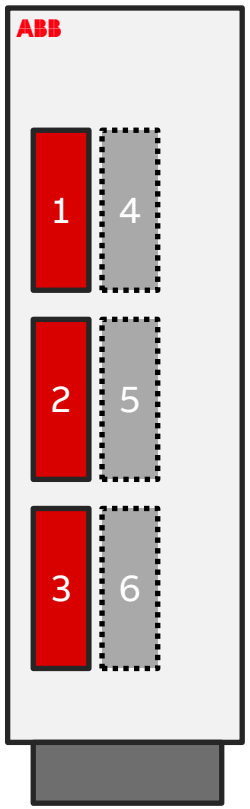


Terra 54

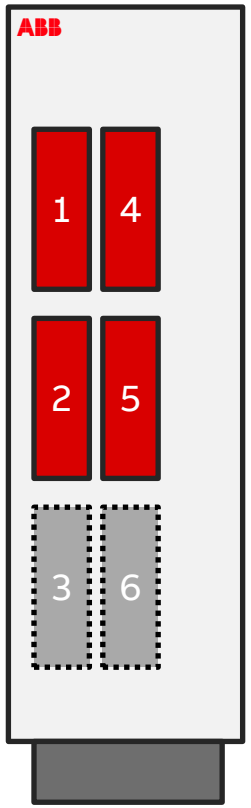


- Based on 2 (Terra 24) and 5 (Terra 54) 10 kw power modules
- Almost 10.000 chargers installed worldwide
- Terra 24 is upgradable to Terra 54
- Terra 54 is available also in High Voltage variant (150-920 Vdc)

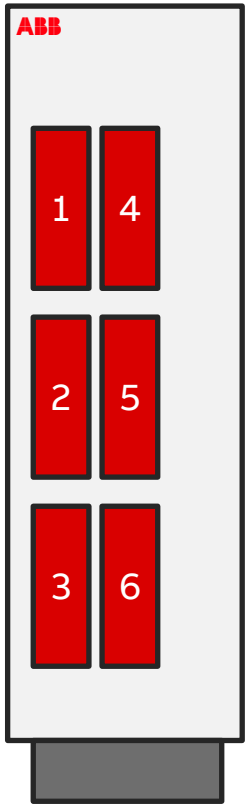
Terra 94



Terra 124



Terra 184



- Based on new 30 kw power modules
- Terra 94 and 124 upgradable to higher power rating, up to 180 kW
- Terra 54 cannot be upgraded to the new power modules due to different rating of the electrical components
- Terra 94-124-184 provide High Voltage capability (150-920 Vdc)

Terra EV Fast Charger

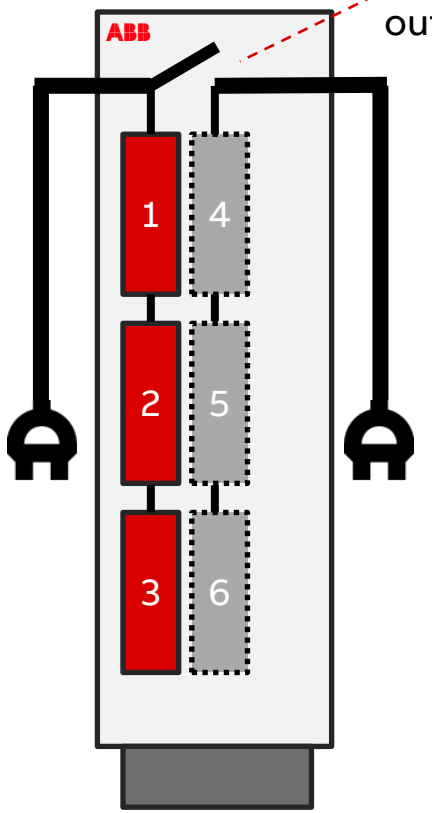
Power modules layout

Installed power module

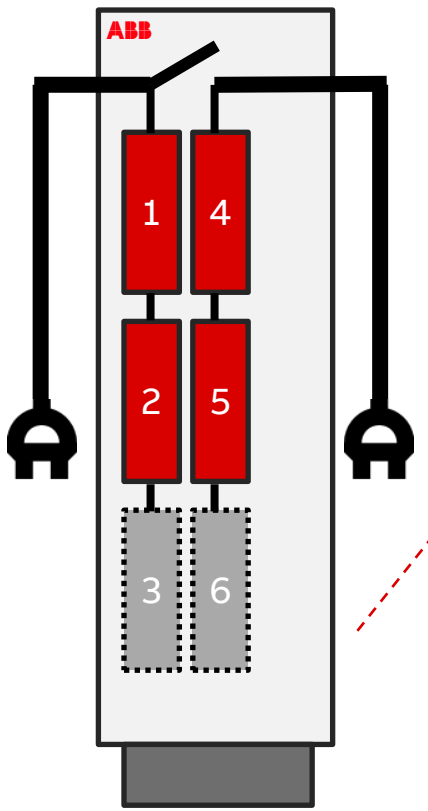
Slot available for upgrade

Terra 94

Mode 1 - Full power on outlet 1 OR outlet 2



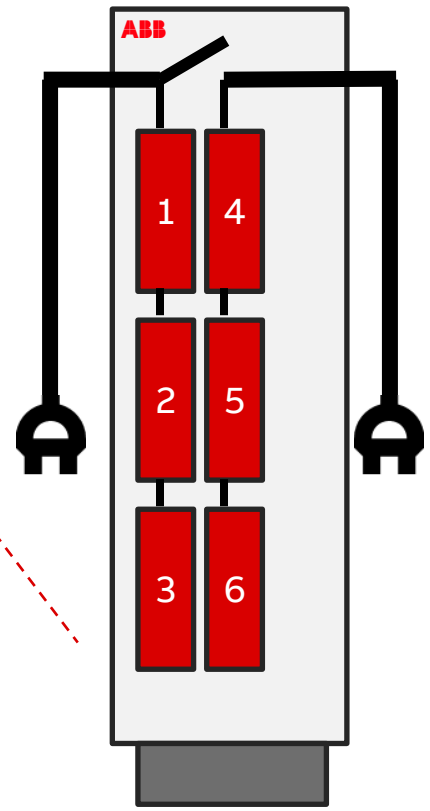
Terra 124



Mode1 - Full power on outlet 1 OR outlet 2

Mode 2 – Each outlet can deliver up to 50% of total power

Terra 184

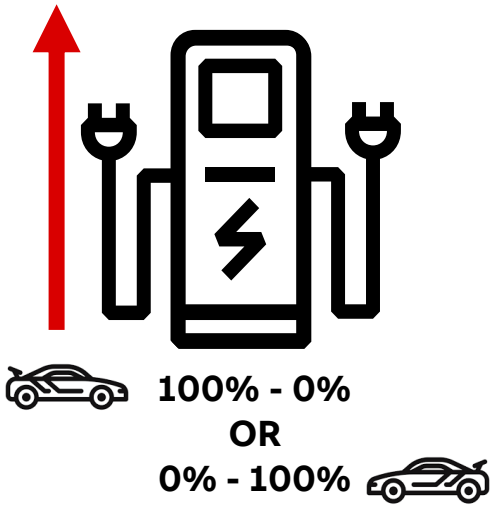


Terra EV Fast Chargers

Power allocation strategies

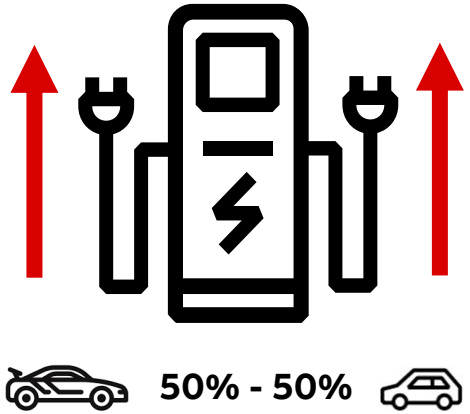
Q3/4 2021

Sequential



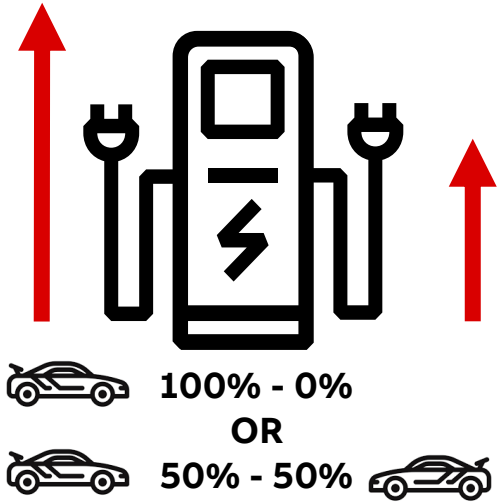
Outlet 1 OR 2 always charge at up to 120 kW (Terra 124) or 180 kW (Terra 184). The outlets are mutually available.

Concurrent



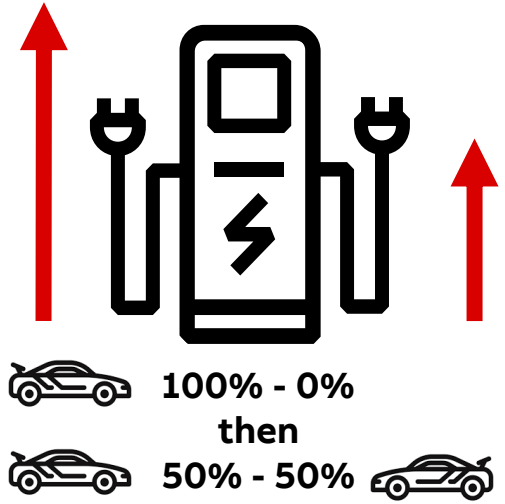
Outlet 1 and 2 can always charge at up to 60 kW (Terra 124) or 90 kW (Terra 184). Both outlets always available.

Dynamic (FIFO)



If EV-1 can charge at more than 60 kW (Terra 124) or 90 kW (Terra 184), the charger allocates all the power to that EV. Outlet 2 is not available during the charging session.
Otherwise, both outlets are available delivering up to 60 kW (Terra 124) or 90 kW (Terra 184).

Dynamic (SHARE)



If EV-1 can charge at more than 60 kW (Terra 124) or 90 kW (Terra 184), the charger allocates all the power to that EV. Outlet 2 is available and if a second EV connects, the power is shared equally, up to 60 kW (Terra 124) or 90 kW (Terra 184).

The different modes of operation can be selected via ABB Web Portal
Mode 1 supported by all models of Terra x4
Mode 2,3,4 supported only by Terra 124 and Terra 184

Highway and metropolitan segment

Terra 54(HV): CE-approved 50 kW Multi-standard chargers – Input: 3x 400V, some possible configurations:

Terra 54(HV) C DC Charger	Terra 54(HV) CJ DC Charger	Terra 54(HV) CT DC+AC Charger	Terra 54(HV) CG DC+AC Charger	Terra 54(HV) CJT DC+AC Charger	Terra 54(HV) CJG DC+AC Charger	Terra 54(HV) CJG DC+AC Charger
50kW DC CCS-2	50kW DC CCS-2 50kW DC CHAdeMO	50kW DC CCS-2 22kW AC	50kW DC CCS-2 22kW AC (also in 43kW AC)	50kW DC CCS-2 50kW DC CHAdeMO 22kW AC	50kW DC CCS-2 50kW DC CHAdeMO 22kW AC	50kW DC CCS-2 50kW DC CHAdeMO 43kW AC
						
Available	**Available**	**Available**	**Available**	**Available**	**Available**	**Available**

Terra 54HV

Installation

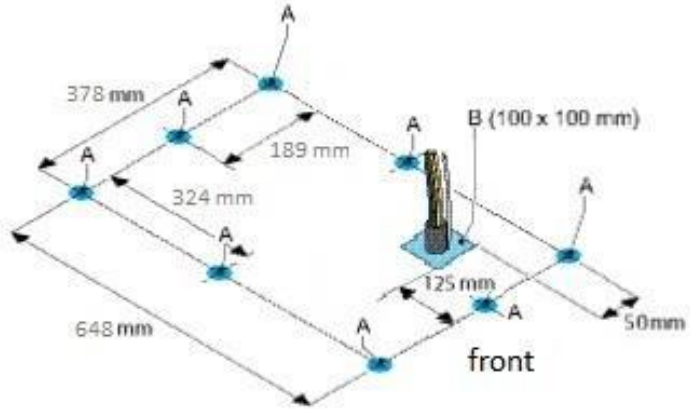
Cable diameter: 35-45 mm

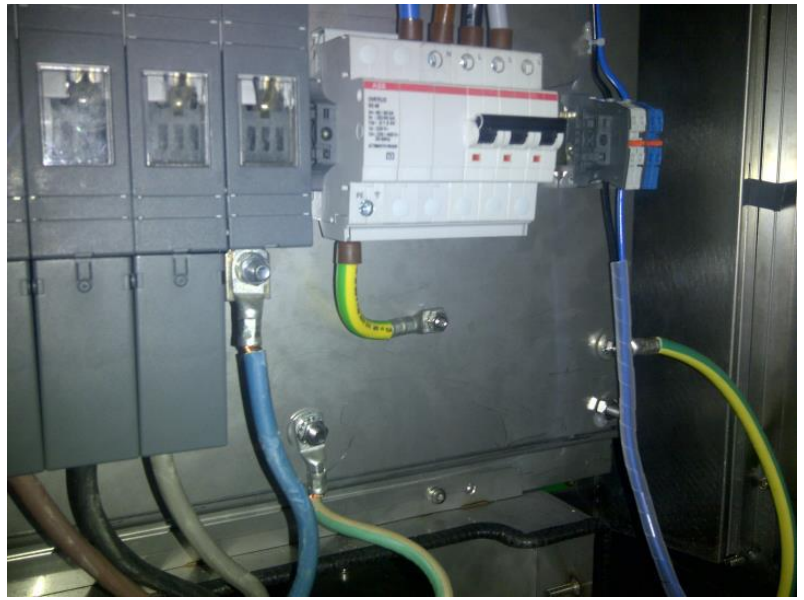
Earth and neutral connections, maximum 95 mm^2 via M8 lugs

Units with AC charging have built in Type B RCD. Any upstream RCD should also be Type B, with high immunity

Input AC rating:

- 50 kW: 88 A (DC outlets) – 143 A (DC + AC outlets)
- 90 kW: 140 A (DC) – 170 A (DC + AC)
- 120 kW: 187 A (DC) – 217 A (DC + AC)
- 180 kW: 280 A (DC) – 310 A (DC + AC)





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4-16 hours	1-3 hours	20-90 min	10-20 min
			
– Office, workplace – Home – Multi family housing – Hotel and hospitality – Overnight fleet – Supplement at DC charging sites for PHEVs	– Office, workplace – Hotel and hospitality – Parking structures – Dealerships – Urban fleets – Public or private campus – Sensitive grid applications	– Retail, grocery, mall, big box, restaurant – High turnover parking – Convenience fueling stations – Highway truck stops and travel plazas – OEM R&D	– Highway corridor travel – Metro ‘charge and go’ – Highway rest stops – Petrol station areas – City ring service stations – OEM R&D

ABB High power charging 2018-2025

Toward 15 minute charging – 250 miles driving

Current specification, subject to standardization

Operating voltage range:	CCS:	200 – 920 V_{Dc}
	CHAdeMO:	150 – 920 V_{Dc}
Current:	CCS:	375 A (with 1 power cabinet)
		500 A (with 2 power cabinets)
	CHAdeMO:	200 A
Max. peak power level:	350 kWp	
Charging cable & connector:	CCS 1&2:	Small diameter, active liquid cooling
	CHAdeMO:	conventional

ABB High power charging 2018-2025

Towards 15 minute charging – 250 miles driving

Terra 54

Terra HP – 1 cabinet

Terra HP – 2 cabinets

3½x more power

50 kW → **175 kW_p**

7x more power

350 kW_p

3x higher current

125 A → **375 A**

4x higher current

500 A

Dynamic DC:
patented by ABB

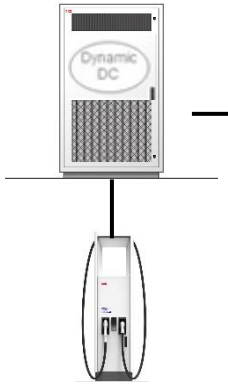
Power expansion
1 cabinet expansion

2 cabinet expansion


ABB's Dynamic DC: A future proof & field upgradeable system

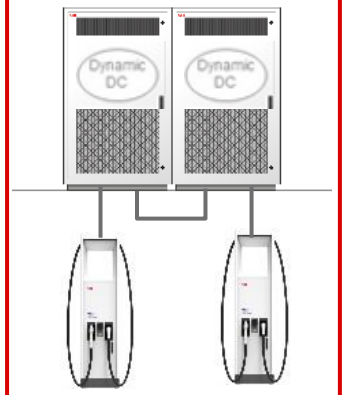
Power sharing between power cabinets (expected November 2019)

175 kWp
Single system



Upgrade

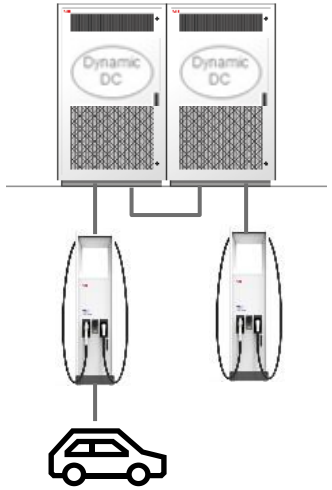
2 x 175 kWp
Dual system



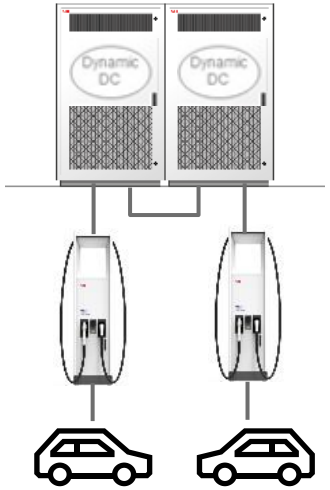
Dynamic DC

175 kWp for two normal cars simultaneously

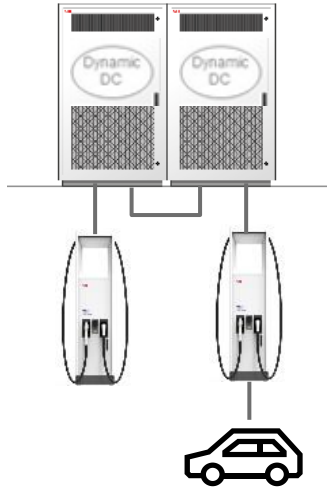
350 kWp available on each charge post for high-end cars



350 kWp
high-end car



175 kWp **175 kWp**
normal cars



350 kWp
high-end car

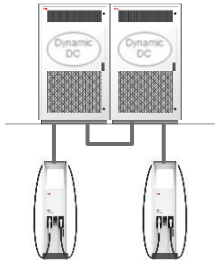
ABB’s Dynamic DC: A future proof & field upgradeable system

Power sharing between power cabinets

175 kWp
Single system

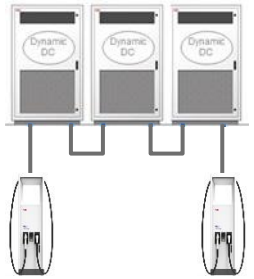
Upgrade

2 x 175 kWp
Dual system



Upgrade

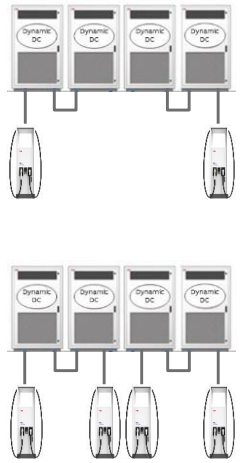
3 x 175 kWp
Triple system



Upgrade

Upgrade

4 x 175 kWp
Quadruple system



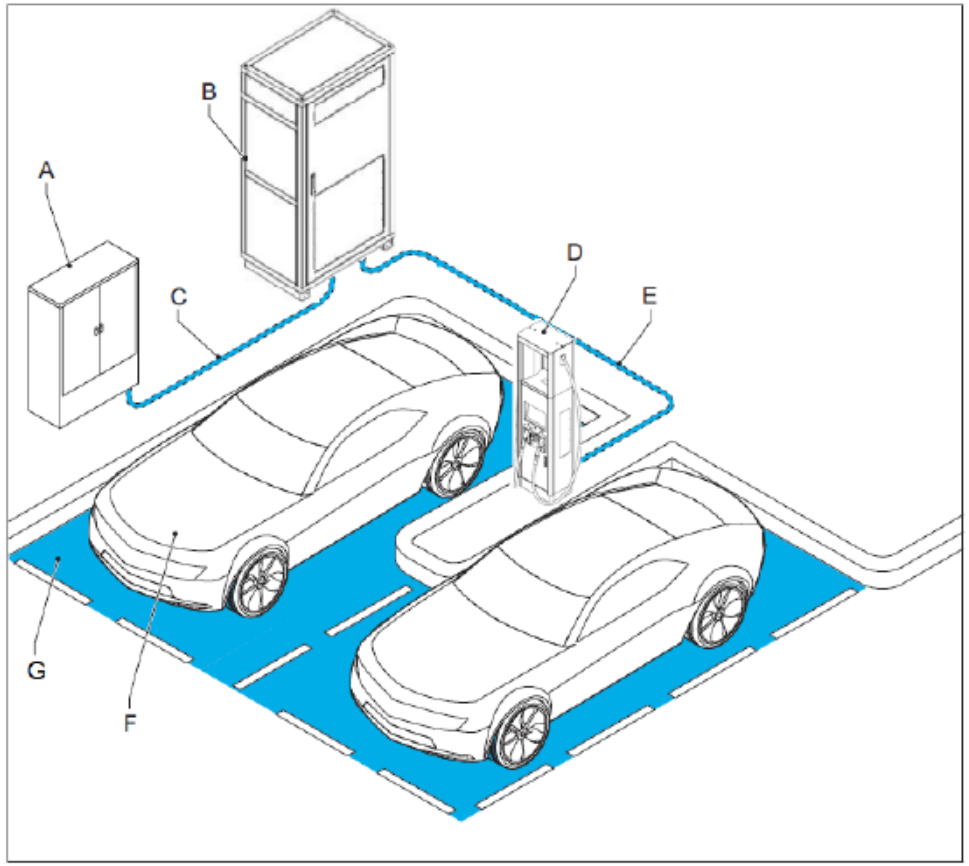
More BEVs with higher charging power on the road

2017 | 2018 | 2019 | 2020 | 2021 | 2022

Build up network & functionality according to market growth

High Power charging

Installation - overview



A. LV power distribution cabinet
B. Power cabinet – 175 kW (Terra HP 175)
C. Input power cables in cable conduit
D. Charge Post
E. Cables between Power Cabinet and Charge Post in cable conduits
F. Electric vehicle
G. Parking space for charging

AC cable to Power Cabinet: maximum 240 mm^2

DC cable between Power Cabinet and Charge Post:
185 mm^2 – 240 mm^2 (for 350 kW)
Maximum length 60 m

AC supply to DC cabinet – 320 A (for 175 kW)

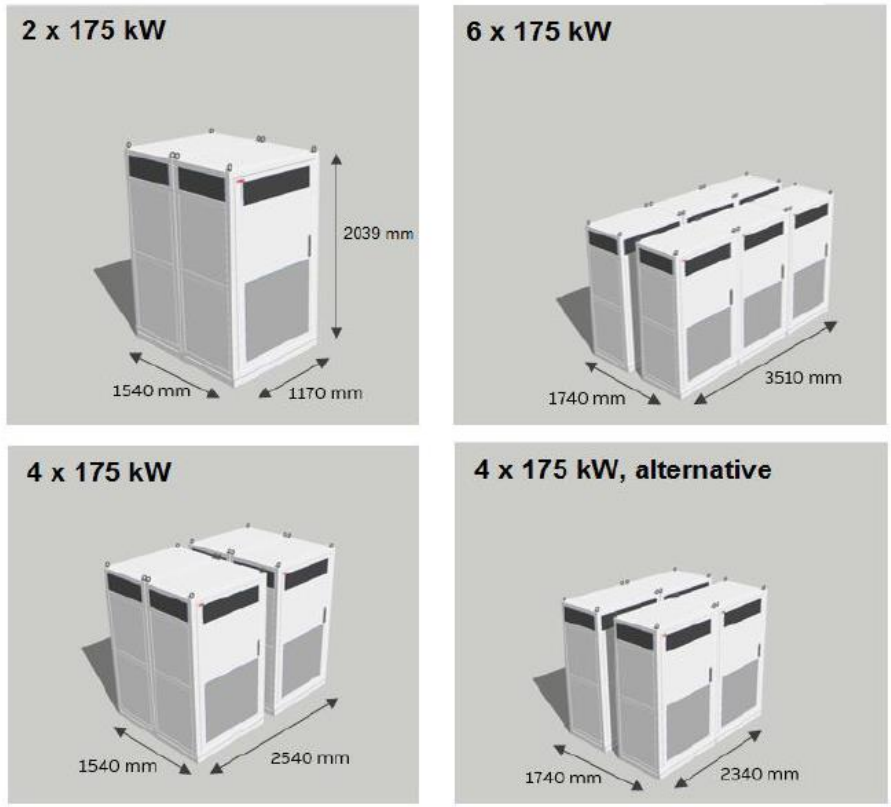
Type A RCD (100 mA) built into Power Cabinet. Need for upstream device to be determined by electrical designer.

[1] 50-90% depends on exact time of arrival/ departure moment of both cars, SOC, etc.

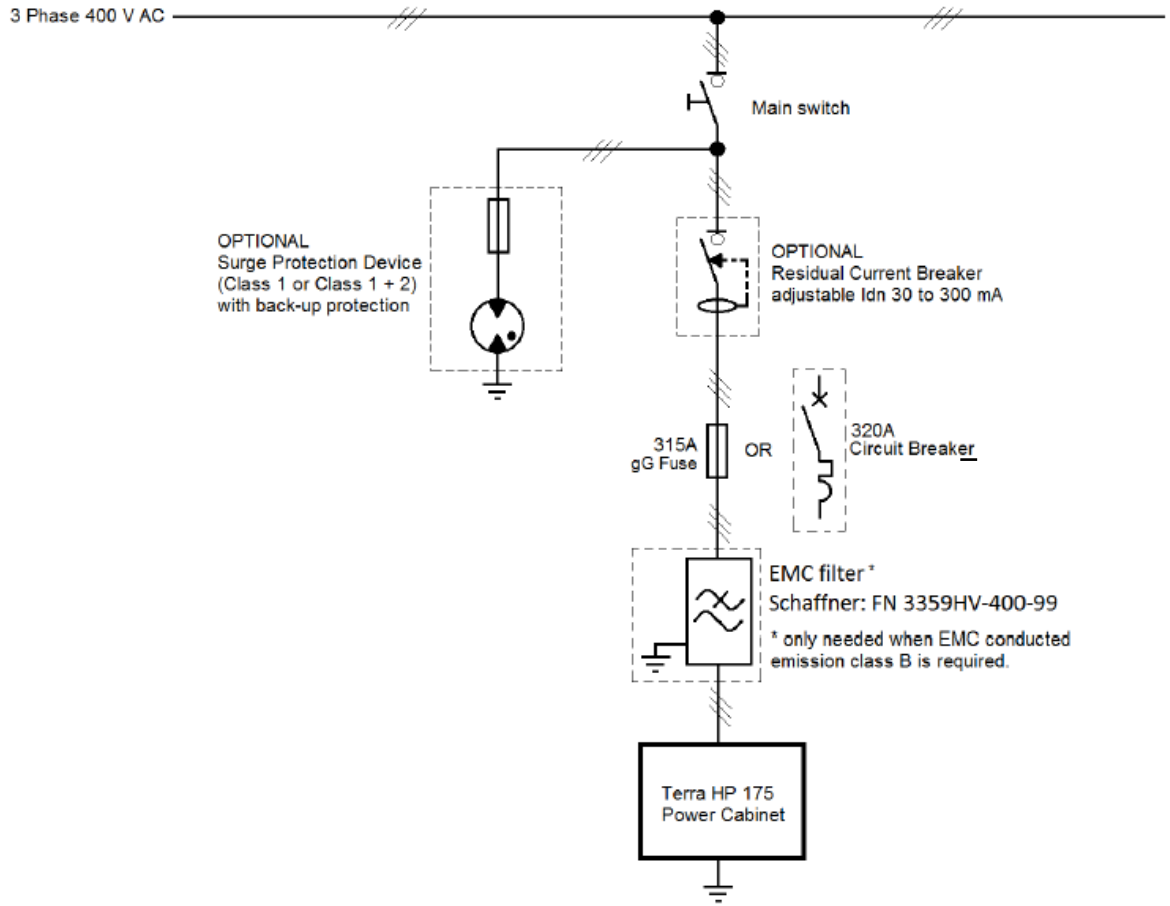
High Power charging

Installation

Positioning of multiple cabinets



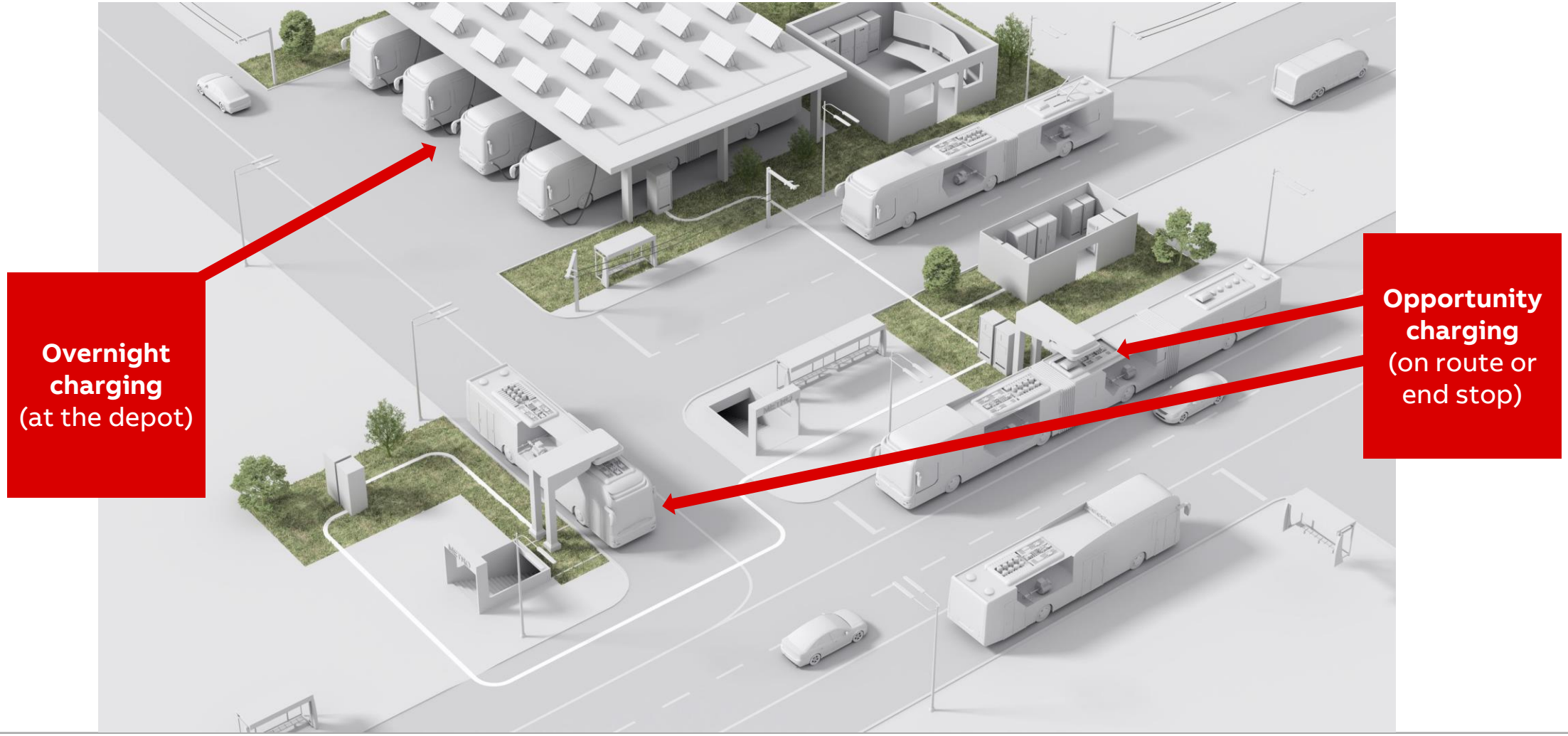
Electrical connection to power cabinet



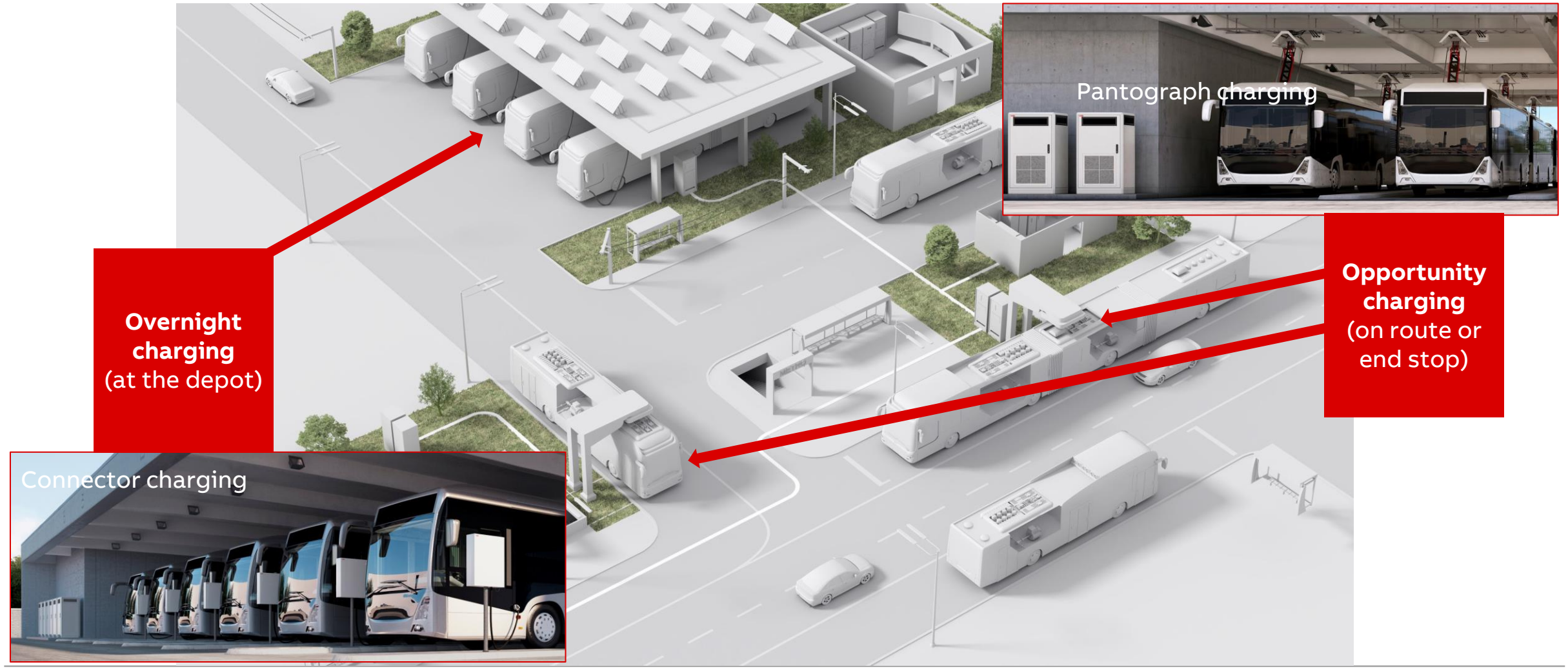
[1] 50-90% depends on exact time of arrival/ departure moment of both cars, SOC, etc.

eBus Charging

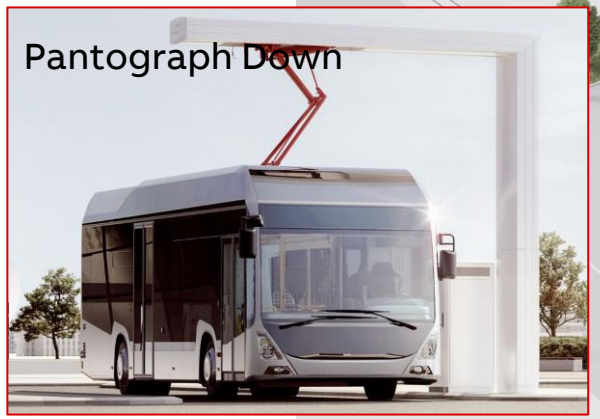
eBus charging landscape



eBus charging landscape



Electric bus charging landscape



3 main ways of charging buses

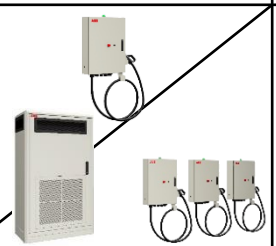
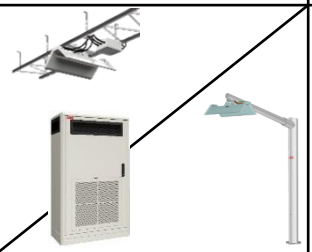
ABB supports all standardized solutions supported by main Bus OEMs

CCS 2 connector

Pantograph Up (PU)

Pantograph Down (PD) - OppCharge

HVC Product portfolio

	24kW	50kW	100kW	150kW	300kW	450kW	600kW
Connector							
	DC-Wallbox	Terra 54HV	HVC 100C 1-3 depot box	HVC 150C 1-3 depot box			
Pantograph Down							
				HVC 150PD kit / HVC 150PD	HVC 300PD	HVC 450PD	HVC 600PD
Pantograph Up							
		Terra 54HV PU	HVC 100PU-S / HVC 100PU	HVC 150PU-S / HVC 150PU	HVC 300PU	HVC 450PU	HVC 600PU

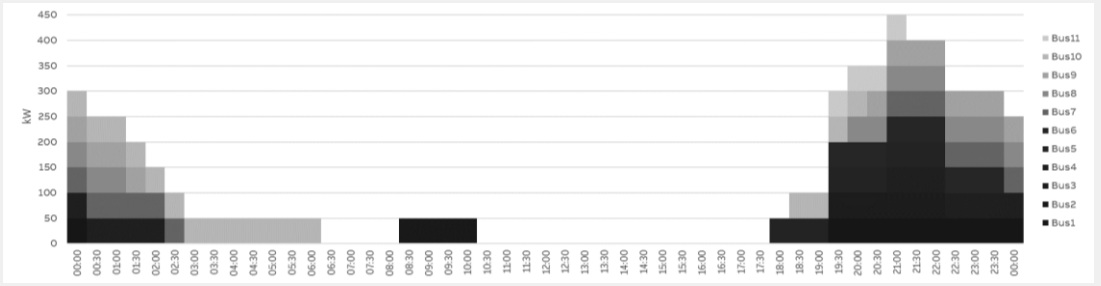
Local Interface based on OPC UA

Why onsite load management?

Business case example

Without load management:
Charging of 11 vehicles @ 50 kW
Peak consumption: 450 kW

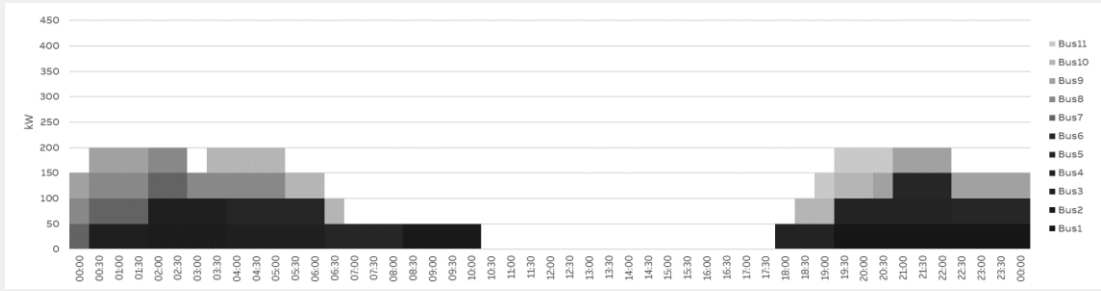
Annual Energy Cost: 31,500€



- 55 %

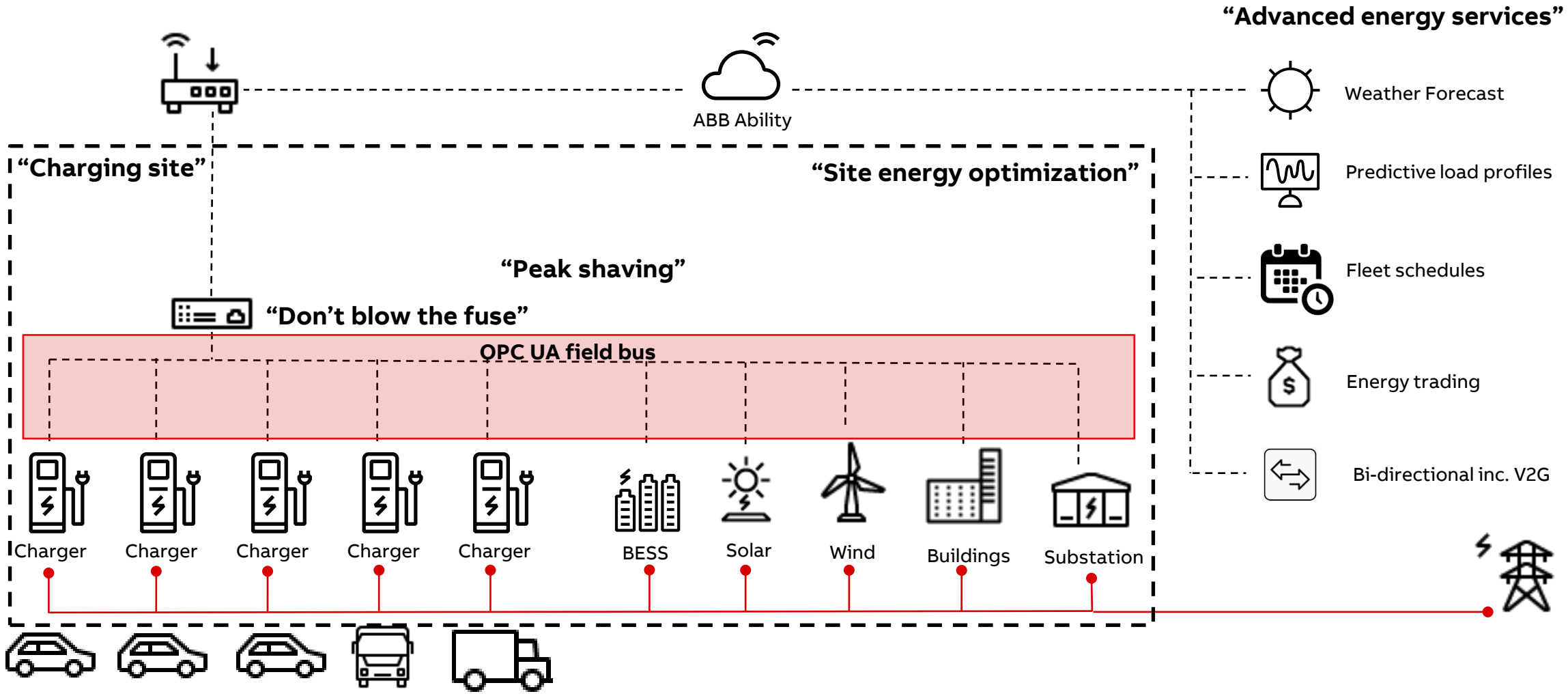
With load management:
Charging of 11 vehicles @ 50 kW
Peak consumption: 200 kW (- 55 %)

Annual Energy Cost: 14,000 €



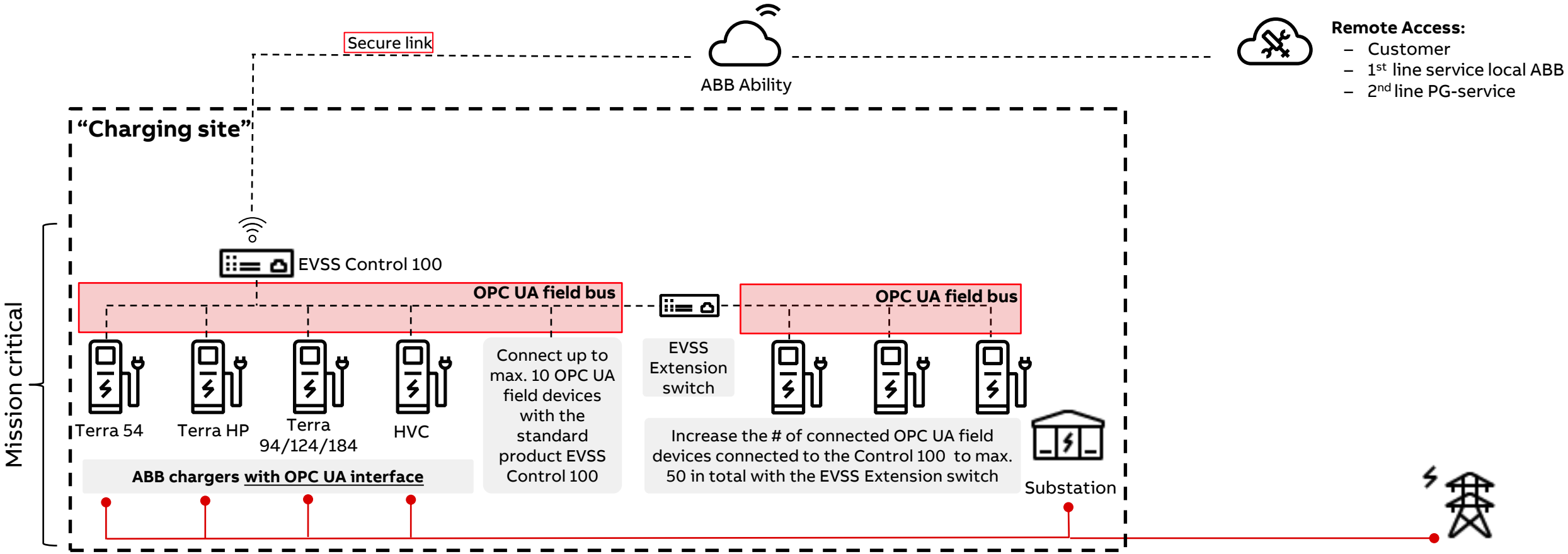
CAPEX Savings	30,000 €	(~ new 300 kW transformer + construction)
OPEX Savings	~ 17,500 €/year	(70 €/kW/year peak price)
ROI	Immediate	

Clear need for local interface used by many industries



Onsite load mangement

"Don't blow the fuse" with EVSS Control 100



Connection to back-office & payment systems

Manage, monitor and connect to your business

Run a successful and profitable business with connected ABB chargers

Connectivity is needed to:

1. Monitor and operate a network of chargers
2. Get paid for charge sessions
3. Help EV-drivers in case of questions
4. Maintain and service chargers at the lowest cost

Reliable 24/7 connectivity is fundamental for the commercial operation of a network of chargers!

Connected Services are required to successfully run a commercial charger network

The ABB Ability platform: years of experience and thousands of connected EV chargers

ABB's connectivity offering helps EV Charge Point Operators to

- Remotely monitor and configure charge points
- Adapt business and pricing models over time
- Keep charging infrastructure up-to-date with the latest software
- Support EV drivers in case they have issues
- Service the equipment efficiently and with minimal operational effort
- Increase charger uptime and the reliability of the charging network
- Build a scalable and flexible charging infrastructure
- Minimize investments in IT Infrastructure & Backend Software

Reliable 24/7 connectivity is fundamental for the commercial operation of a network of chargers!

Positioning connected services

Electric cars

Audi
BMW
DAIMLER
Ford
GM
MITSUBISHI
NISSAN
PEUGEOT
PORSCHE
RENAULT
TESLA
VW

Charging infrastructure

CCS
CHAdeMO
GB
AC

ABB

Connected Services

Microsoft Azure

ABB Ability™

Solutions to run a charger network

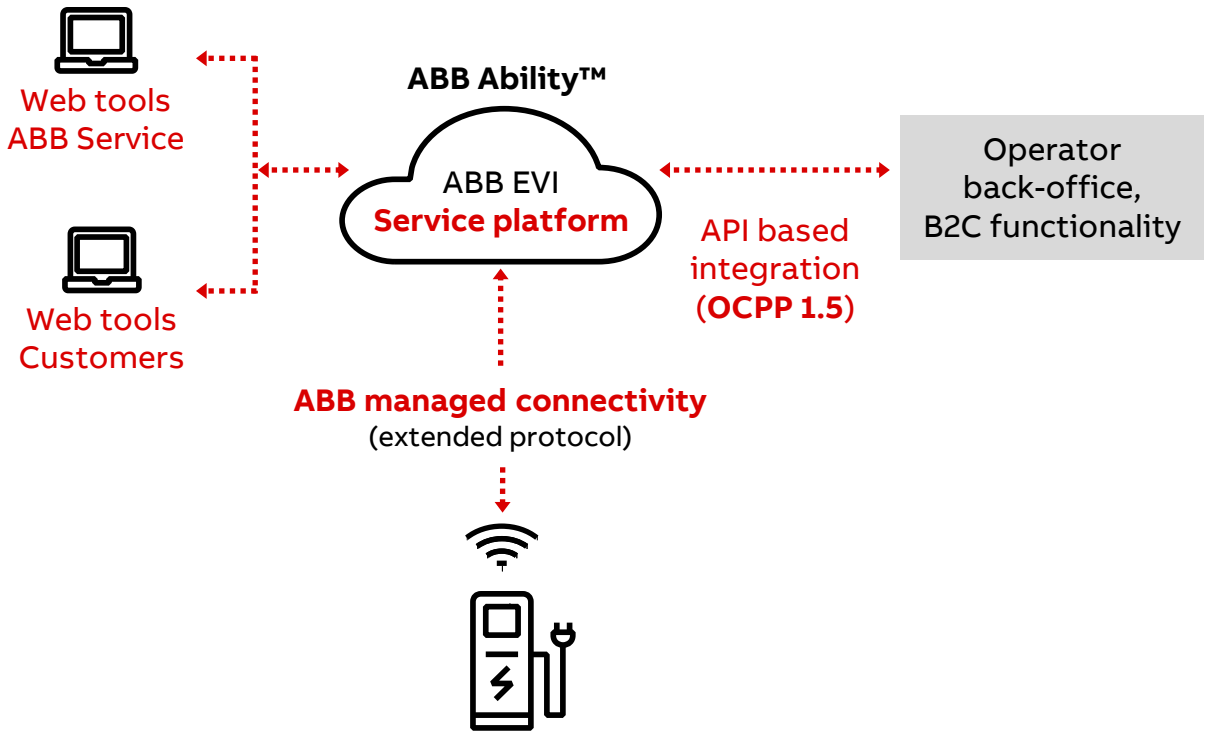
MasterCard
VISA
VIRTA
BOSCH
Fortum
NTT DATA
GRIDPOINT
intercharge
CGI
has·to·be eMobility
chargecloud
pod POINT
GIANT LEAP TECHNOLOGIES
MOBI.E MOBILIDADE ELÉCTRICA
greenlots
VENTYX AN ABB COMPANY

ABB does not have exclusive cooperation with any of the solutions

Digital integration of an ABB EV charger

OCPP 1.5 API compared to Direct OCPP 1.6

OCPP 1.5 API



Direct OCPP 1.6 via Dual Uplink

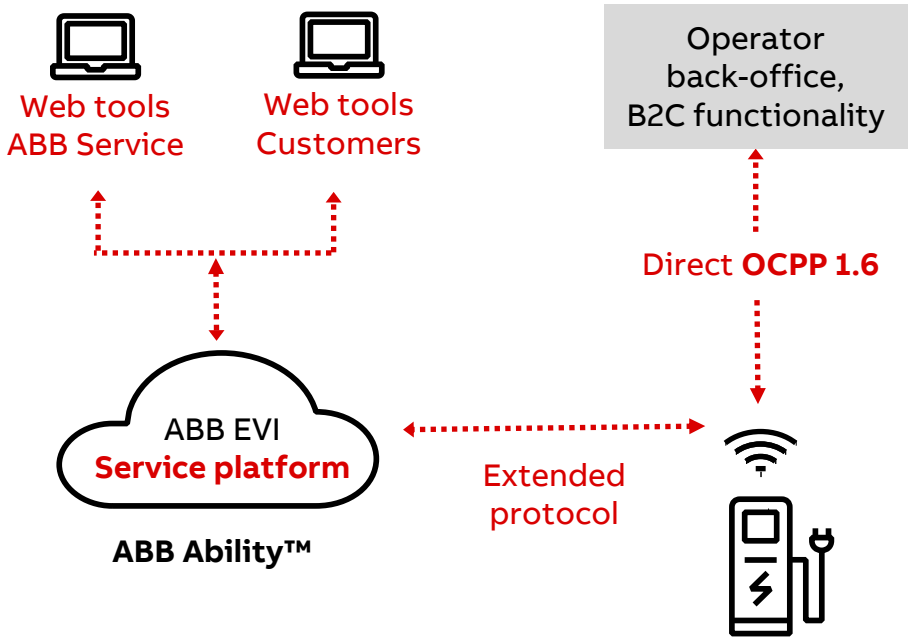
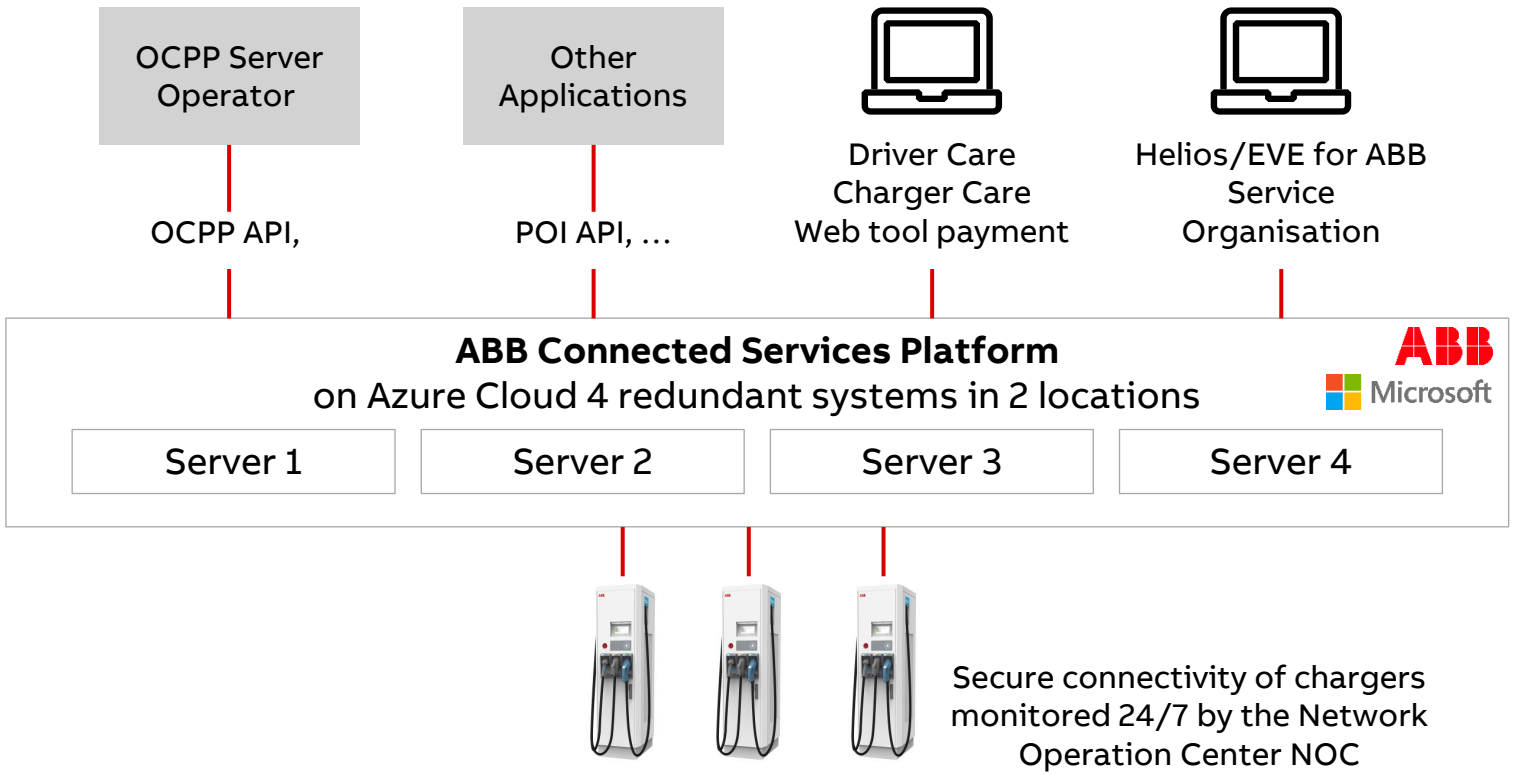


ABB Connected Services Platform

High level architecture



Platform **enables** customers and partners to integrate with the ABB chargers via web tools and APIs and to launch new/ innovate services

Worldwide availability of the Connected Services Platform ensuring stability, global scalability and advanced, innovative features for ABB customers & partners.

Best-in class Charging Stations for all charging protocols (CCS, Chademo, GB) and for all markets

Knowledge Check

Summary

- Changes to building regulations will mandate EV chargers in most new buildings
- Selection of charger depends on budget and desired charge time
- Increasing power (reduced charge time) of chargers in line with longer range of Evs
- Public rapid chargers to accept debit / credit card payments and move towards interoperability
- Connectivity of chargers to allow remote software updates, diagnostics and facilitate back office management


ABB