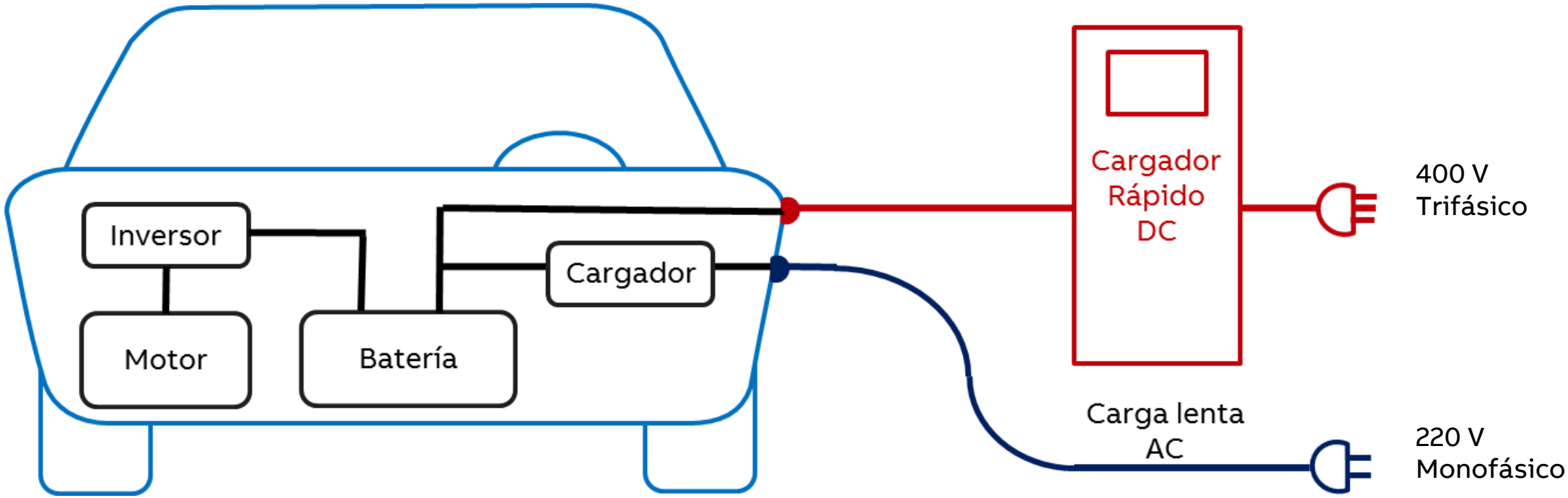
SEPTEMBER 6TH, 2018 / EP EVI

EV Infrastructure

Challenges, opportunities and key players / Applications and connected services

Electric Vehicle

AC and DC Fast Charging



Challenges and opportunities

- Inter operability / Standardization / Power
  - DC Fast charging standards for cars: Chademo, CCS 1, CCS 2, GBT (?)
  - DC Fast charging standards for Buses, Trucks, Heavy vehicles: CCS,(Overnight), OppCharge, CCS HP.

- Massiveness/ Delocalization / Segmentation
  - Service Stations (Storage tanks) versus…. Anywhere ?
  - Segmentation of offering according to customer needs, convenience, new services and business models.

- Regulation / Commercialization / Optimization
  - Commercialization of Energy or Value added Service.
  - Installation and Safety: Residential/Commercial use require certified EMC and earth fault protection as minimum.
  - Special tariff or direct negotiation as “Cliente Libre”.

Interoperability: Standards

Estándar	AC Tipo 2 Socket	AC Tipo 2 Cable	DC CHAdeMO (Japón)	DC CCS 1 (USA)	DC CCS 2 (EU)	DC GB/T (China)
Potencia	22 KW (+)	43 KW (+)	150 KW	150 KW	150 KW	150 KW
Voltaje Salida	400 V +/- 10%	400 V +/- 10%	50 – 500 Vdc	50 – 500 Vdc	50 – 500 Vdc	220 - 570 Vdc
Corriente @50 KW	32 A	63 A	125 Adc	125 Adc	125 Adc	125 Adc
Conexión a red	400 V, 112 A 77 KVA	400 V, 143 A 98 KVA	400 V, 80 A 55 KVA	480 V, 75 A 60 KVA	400 V, 80 A 55 KVA	380 V, 80 A 54 KVA
Comunicación			CAN	PLC	PLC	CAN
Región	EU, Asia, Aus	EU, Asia, Aus	EU, Asia, Aus	USA	EU, Asia, Aus	China
Fabricantes	Renault, Tesla, Mercedes, Daimler, Volvo, Opel	Renault, Tesla, Daimler, Mercedes	Mitsubishi, Nissan, Peugeot, Citroen, Kia	BMW, Audi, Volskwagen, Porsche, GM	BMW, Audi, Volskwagen, Porsche, GM	ByD, Geely
Conector						

Interoperability: Multi Standard chargers

Terra 53 / Terra 54: Multi-standard chargers (50kW) – Input: 3x 400V

Available	Available	Available	Available	Available	Available
					
Terra 53/54 CT DC+AC Highway Charger	**Terra 53/54 CG DC+AC Highway Charger**	**Terra 53/54 CJ DC Highway Charger**	**Terra 53/54 CJG DC + AC Highway Charger**	**Terra 53/54 CJG DC + AC Highway Charger**	**Terra 53/54 CJT DC+AC Highway Charger**
50kW DC CCS-2 22kW AC	50kW DC CCS-2 43kW AC	50kW DC CCS-2 50kW DC CHAdeMO	50kW DC CCS-2 50kW DC CHAdeMO 43kW AC	50kW DC CCS-2 50kW DC CHAdeMO 22kW AC	50kW DC CCS-2 50kW DC CHAdeMO 22kW AC

Delocalization and Segmentation of EV charging

Charging service should match charging application and demand

Public and commercial EV Charging

AC / Home	DC / Building	DC / Building, EESS	DC / EESS, Heavy Vehicles
3-22 kW	20-25 kW	50 kW	150 to 350 kW+
4-16 hours	1-3 hours	20-90 min	10-20 min

Segmentation: Porsche's vision into high-end EV future

Mission-E concept demonstrates advanced possibilities

PORSCHE

Produkte Unternehmen Porsche Museum Motorsport Sport

Porsche Mission E: 600 hp, 500 kilometer driving range, 15 minutes charging time

Stuttgart. In presenting the Mission E at the IAA in Frankfurt, Porsche is introducing the first all-electrically powered four-seat sports car in the brand's history. The concept car combines the unmistakable emotional design of a Porsche with excellent per
fascinating s
All-wheel driv
minutes to re
control, some
position.

Drive system
The drive sys
magnet sync
sports car an

Together the two motors produce over 600 hp, and they propel the Mission E to a speed of 100 km/h in less than 3.5 seconds and to 200 km/h in under twelve seconds. In addition to their high efficiency, power density and uniform power development, they offer another advantage: unlike today's electric drive systems, they can develop their full power even after multiple accelerations at short intervals. The need-based all-wheel drive system with Porsche Torque Vectoring – which automatically distributes torque to the individual wheels – transfers the drive system's power to the road, and all-wheel steering gives precise, sporty steering in the desired direction. This makes the Mission E fit for the circuit race track; its lap time on the Nürburgring Nordschleife is under the eight-minute mark.

the innovative "Porsche Turbo Charging" system. Via the 800-volt port, the battery can be charged to approximately 80 per cent of its capacity in around 15 minutes – a record time for electric vehicles. As an alternative, the technology platform can be connected to a conventional 400-volt charging station, or it can be replenished at home in the garage via convenient inductive charging by simply parking over a coil embedded in the floor of the garage from which the energy is transferred without cables to a coil on the car's underbody.

Porsche 400/800V technology

- Porsche 400/800V technology allows charging at 400V & 800V DC chargers
- Charging at 800V opens up future possibility to reach charging powers of up to ~300 kW

https://presse.porsche.de/prod/presse_pag/PressResources.nsf/Content?ReadForm&languageversionid=545926

Power: The new high power CCS standard

CharIN core member from the start

HOME

CharIN e. V. welcomes member ABB

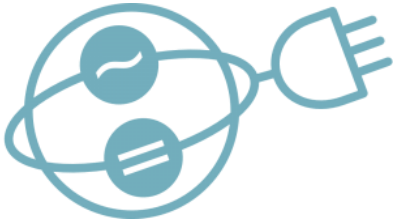
CharIN e. V. is happy to announce that ABB B.V. has been granted core membership in the association on 12th of November 2015. ABB B.V., which is based in the Netherlands, has joined CharIN e. V. as the first non-German member.

ABB is leading with Internet-based charging infrastructure, supporting all EV charging standards. ABB offers a total solution: specific charging solutions for any location type and connected services to enhance your business. The chargers easily connect to any service or payment application.

ABB's Internet connected chargers enable fast global service and pro-active maintenance. ABB has years of experience in creating, installing and maintaining charging infrastructure, including several nationwide charger networks.

ABB markets several charging stations which support the CCS standards.

We offer a warm welcome to our Dutch colleagues and look forward to shape the future of CCS together.



- CharIN is the organization to develop high power CCS (150-350 kW)
- Wide coalition of automakers support (BMW, VW, Audi, Porsche, Ford, Opel/GM, Daimler)
- ABB was core member of the organization from the start

EVgo (USA) and ABB to deploy nation’s first high-power charging station

Press Release 2017-02-27 by EVgo and ABB on HP Charging in the US

- US Market leader in fast charging, EVgo, commissions nation's first ABB high-power EV fast charging station for the next generation of electric vehicles.
- The high-power fast charging system features a maximum charging rate of 150kW – providing a charge which is three times faster than what is available today.
- The installed system has the potential to reach charging speeds of up to 350kW with an upgrade

http://www.abb.com/cawp/seitp202/5e9fc4adc9ed06a2c12580d40045e18a.aspx

Usability tests with ABB high power charger capable of 150/350 kW

April 2017: in the Netherlands and in the USA

- Usability test have been made in the USA and I the Netherlands to get feedback on the design ideas of the final charge posts
- Items like
  - Cooling unit
  - Cooled cables
  - Handling
  - Etc.

  have been discussed in detail.
- The outcome is being used to tune the final design

Interoperability: eBus and Heavy Vehicles

Namur & Charleroi, BE
TEC
- 15 x HVC 150P

Trondheim, NO
Trondelag
- 8 x HVC 450P

Ostersund, SE
Nettbus
- 2 x HVC 300P

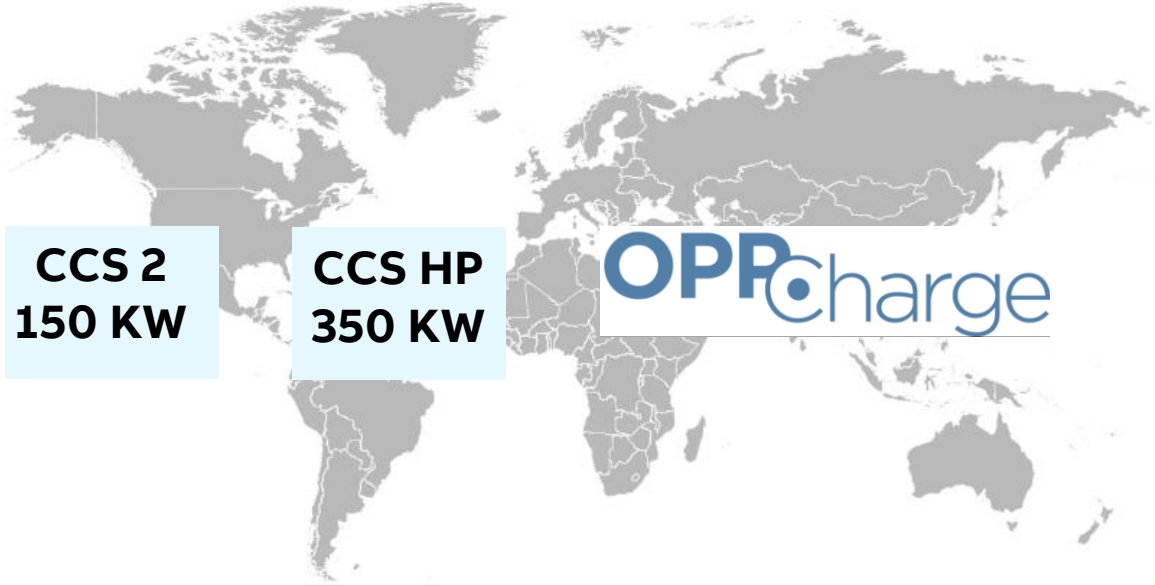
Gothenborg, SE
Volvo Busar
- 1 x HVC 150P
- 1 x HVC 300P
- 1 x HVC 150C
- R&D

Luxembourg, Lux
Ville de Luxembourg
- 4 x HVC 150P

MDDI & Sales Lentz
- 4 x HVC 150P

Harrogate, UK
Transdev
- 3 x HVC 300P

La Rochelle, Fra
Transdev
- 3 x 150kW CCS2



Södertälje, SE
Scania Buses
- 1 x HVC 300P
- R&D test track

Plattsburgh, USA
Novabus
- 1 x HVC 300P

STL, Laval, Canada
1 x HVC 450P

Singapore
- NTU Test track
- 2 x HVC 300P

Munich, DE & AT
MAN Truck & Bus
- 7 x HVC 150C
- R&D

Interoperability: eBus and heavy vehicle charging: 50 kW – 600 kW

Overnight and on-street opportunity charging

- Automated connection system
- High power DC transfer to bus
- Wireless communication to bus
- Based on
  - EN/IEC 61851-23
  - ISO/IEC 15118
  - OPPcharge compatible

- Industrial quality power cabinet
- 150kW, 300kW, 450 & 600 kW modular
- Redundancy per each 150 kW module
- 200-920 VDC
- Galvanic isolation
- Remote management

Optimization

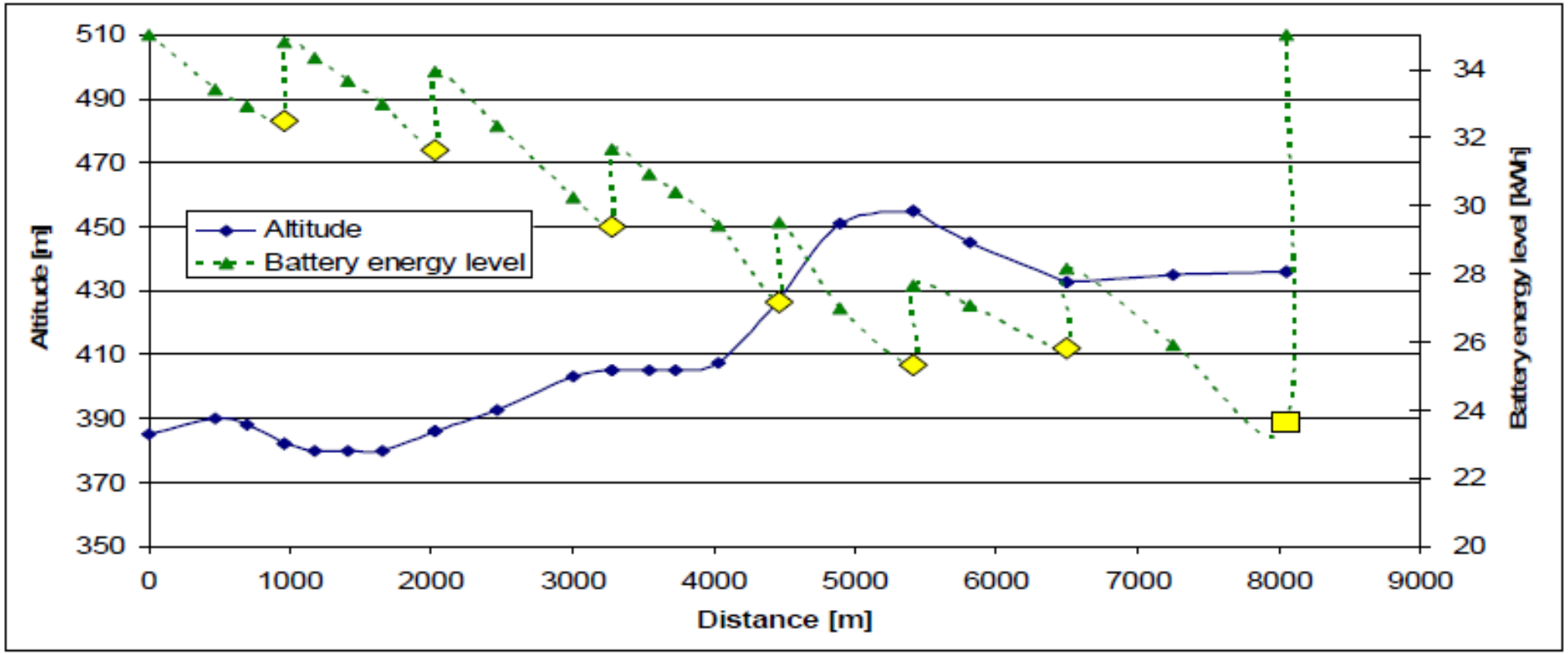
Optimizing the size of the battery (TOSA Line 23, Geneva)

A full electric bus system designed according to operation and total cost of ownership requirements:

Timetable: high-power in-route charging at some bus stops and short layover time at terminal à same driving hours and commercial speed as a diesel fleet
High-passenger capacity: All technology on the roof (all floor for passengers) for articulated and double-articulated buses.
Long-life battery: thanks to in-route charging principle, the high-power/low energy battery pack is used in its optimal operating range
Grid: Connection fee and energy cost optimized through embedded peak shaving functionality
Frequency and BRT: in-route charging (15'') while passengers are disembarking-embarking at some bus stops and layover time compatible with high frequency lines (up to 4'000 pass./hours)
Light infrastructure at depot: Either free parking after fast (2-4mn) high power charging upon arrival or low-power (50kW) mutualized charging for four buses.
Homogenous fleet: TOSA bus configuration (e.g. battery size) is line independent. The line profile determine the required infrastructure.

Optimization

Opportunity charging – Optimizing the size of the battery (extreme TOSA case)



EV fast charging development

Key players

- Government
- Automotive / OEMs
- Energy Sector.
- Commercial / Building
- Retailers
- Industry → Mining

Government

First nationwide fast charging network by Estonia

Nationwide charging network with 165 ABB's Terra 53 multi-standard fast chargers

Automotive

20kW DC Wallbox for Porsche

Automotive

Installations at Dealers of Volkswagen and BMW Group



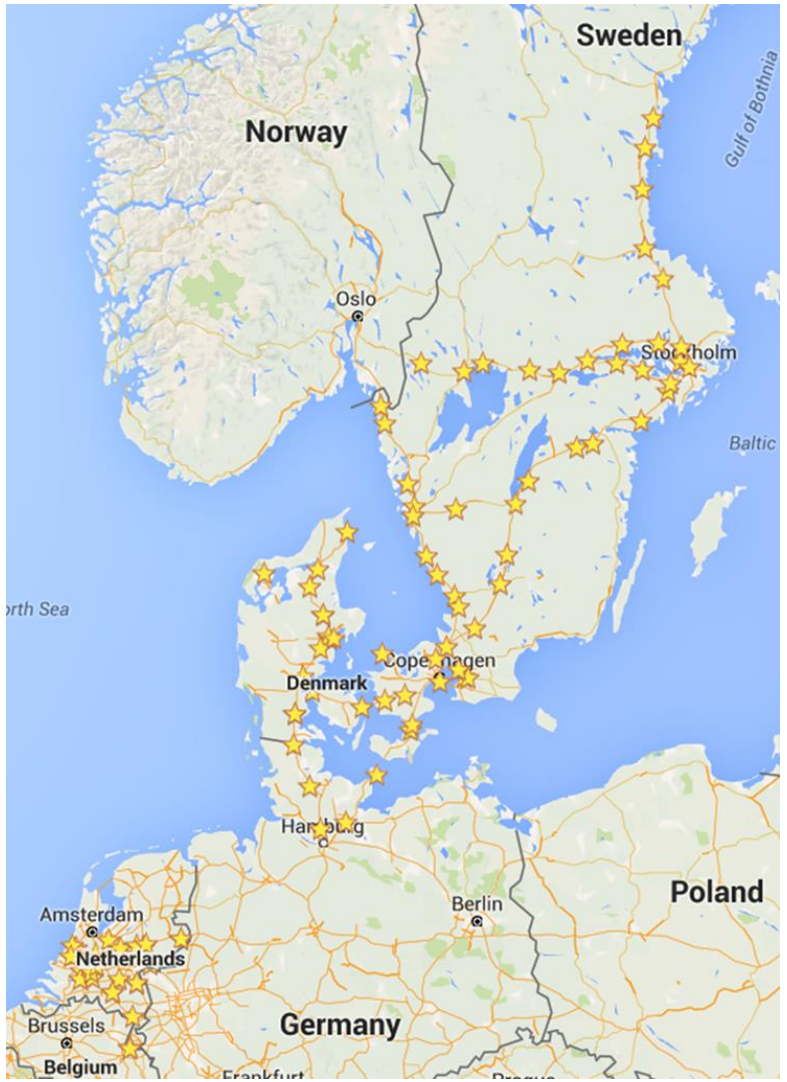

Automotive

Electrify America (VW) deploying +300 Fast charging points in USA

Terra HP with dynamic charging to provide multiple connections from 50 (CCS 2) to 350 KW (CCS HP)

Energy Sector

First international fast charging network



155 ABB's Terra 53 multi-standard fast chargers installed by Utilities of Sweden, Denmark, Germany and Netherlands

Energy Sector

First fast charging network in Argentina by YPF with 220 points in Buenos Aires

BMW i3 / CCS 2

Nissan Leaf / Chademo

Chevrolet Volt / CCS 1

Tesla Model S / AC

220 ABB's Terra 53 multi-standard fast chargers to be installed at 110 YPF service stations in Buenos Aires

Commercial / Building

International supermarket chain Lidl invests in a major expansion of fast EV chargers

EU wide expansion of ABB's Terra 53 multi-standard fast chargers at Lidl stores in Sweden in November 2016

Interoperability at Industry: EV charging for Mining

Pick Ups, eBuses, Trucks, Scoops, …..

CCS 2

OPPcharge

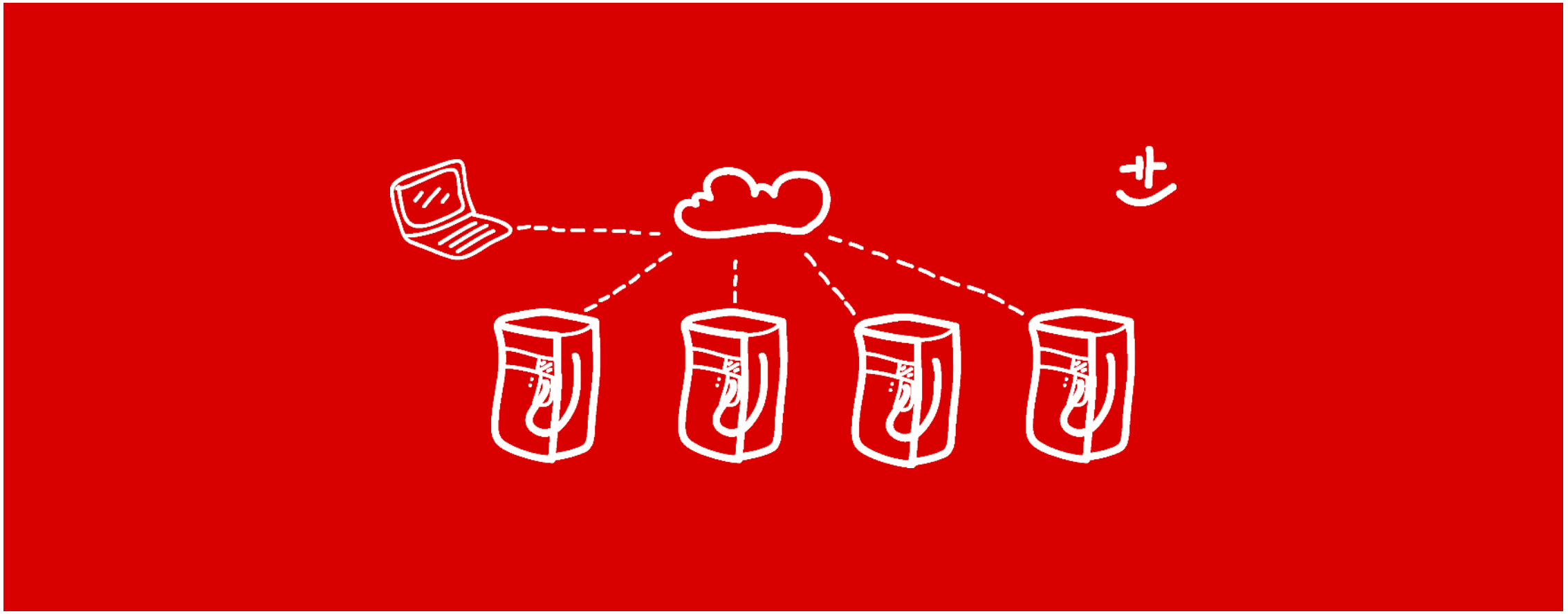
CCS 2 / CCS HP

CCS 2 / CCS HP

OPPcharge

ABB

Connected Services, ERP & payment systems



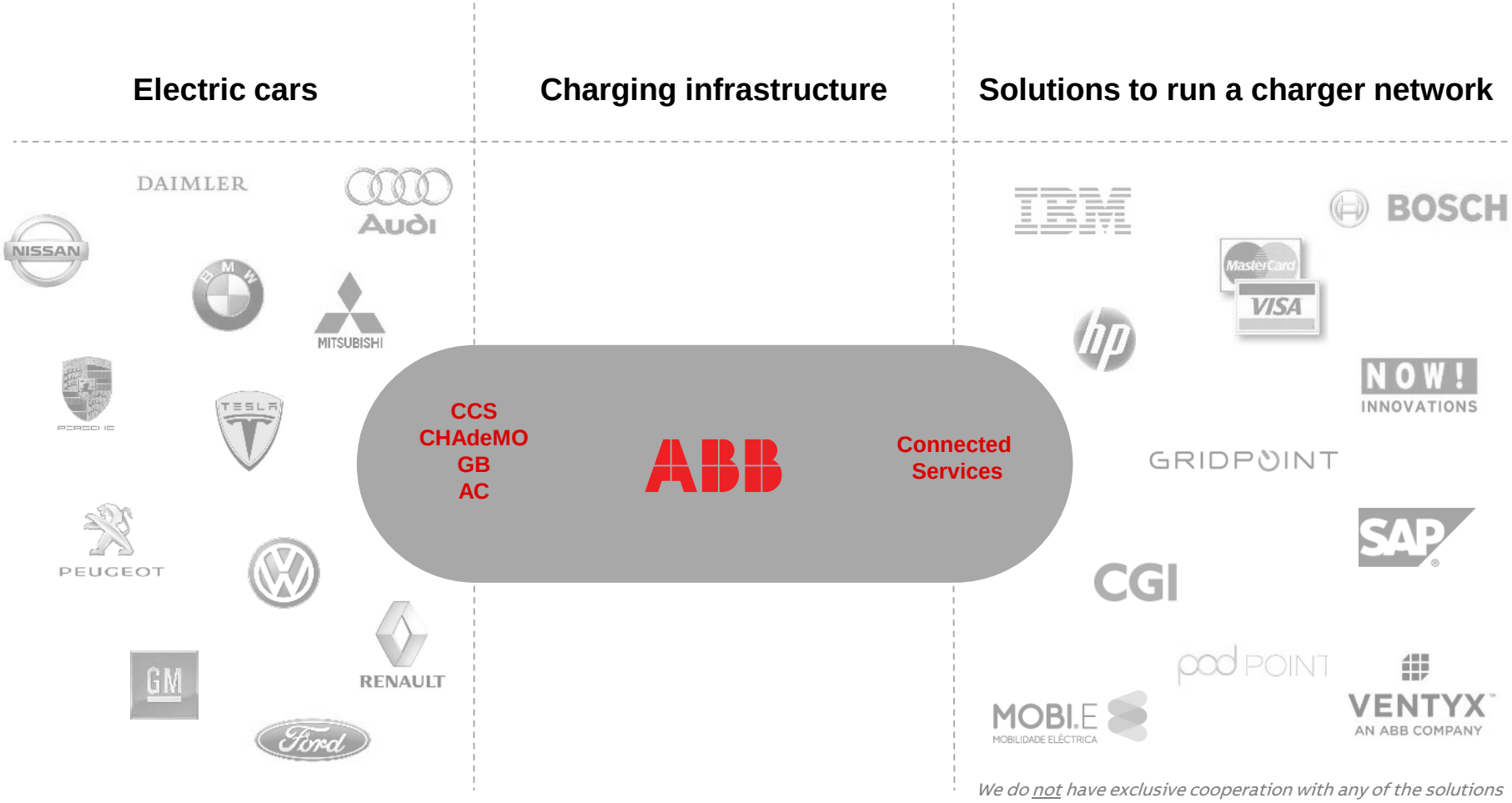
Connected Services

Connectivity is needed to:

- Monitor and operate a network of chargers
- Get paid for a charge session
- Help EV-drivers in case of questions
- Maintain and service a charger at lowest cost

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

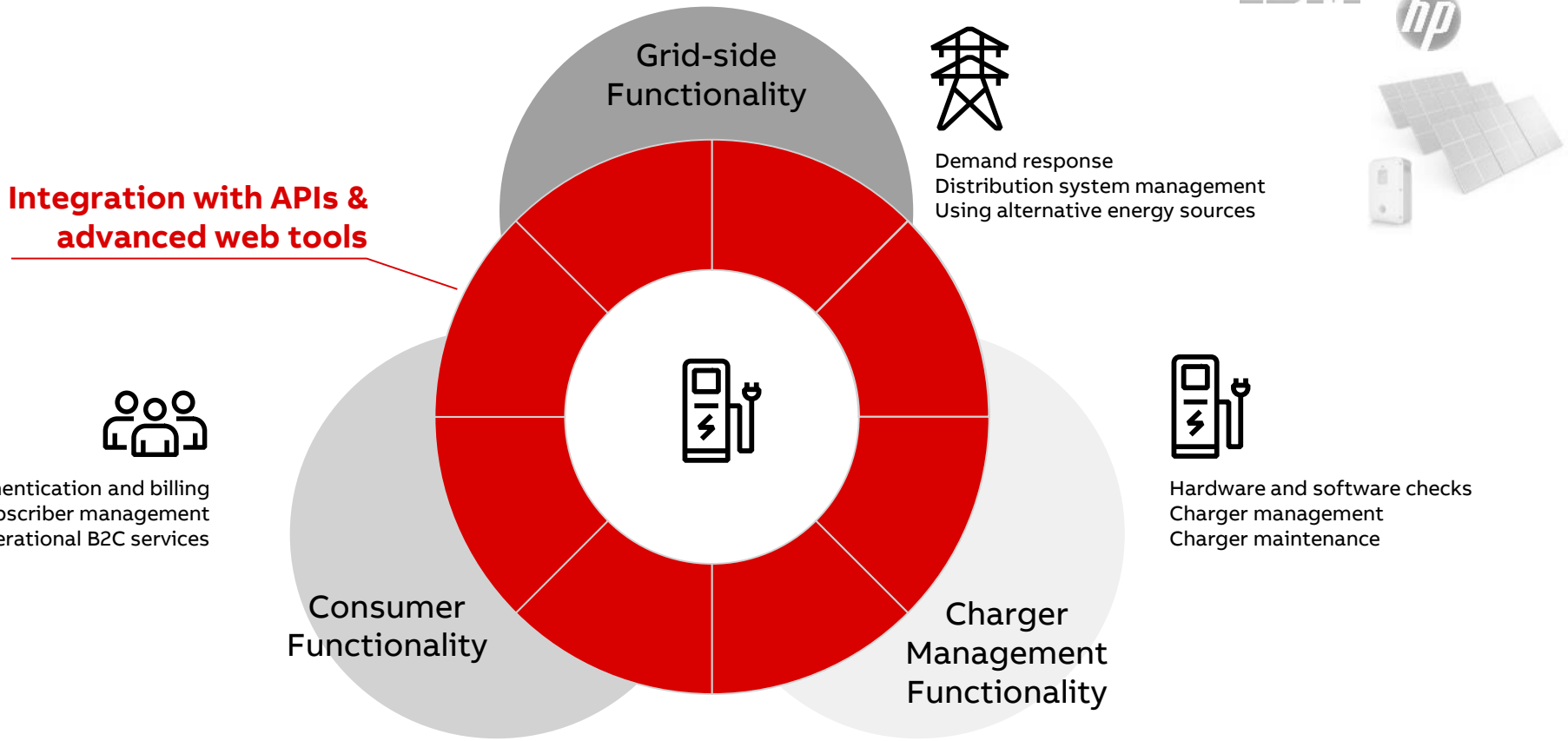
Positioning Connected Services



We do not have exclusive cooperation with any of the solutions

Platform based integration of an ABB EV charger

Enabling you to face the dynamic challenges of the industry



EVCI Global Service

Charger Care and Internet of Things, Service and People

ABB is able to diagnose more than 90% of the service cases remotely,
solving over 60% of these cases without any on-site intervention.

This results in significant savings on down-time, travelling, transportation, man-hours and resources.
Charger Care increase the safety, profitability and availability of our customers charging network.

The result is best customer experience at low total cost of ownership!

Network Operations Center (NOC)

Proactively monitoring status of chargers

Advantages of ABB Connected Services Platform:

- Reliable connectivity
- 24/7 monitoring of network status
- Remote software updates
- Compliance with communication standards / OCPP

Payment solutions for ABB DC Fast Chargers

Payment Terminal

Main features

- Payment via credit card and NFC
- Low operational and transactional costs
- Field upgrade for any Terra 54, Terra 53 and Terra 23
- Payment upfront per charging session
- Automatic cancellation of payment in case of problems during first minutes of charging
- Operator control via ABB Web modules
  - Setting price per outlet
  - Transaction overview (successful and canceled ones)
- Default RFID functionality can be maintained

EVCI Global Service

Service Concept

Optimum Charger Availabilit

Owner, Operator and Service Partner

- User and Charger Support
- Support all driver and charger related cases with ABB web modules and APIs
- Escalate cases to Local Service ABB
- Tools: Driver Care, Charger Care, OCPP and APIs

Local Service ABB

- Local Technical Support
- Responsible for SLA
- Support all charger related cases with ABB web Modules
- Escalate cases to GTS
- Tools: Helios

Global Technical Support Network Operation Center

- Global Technical Support
- Develop solutions and offers based on experience from 5000+ chargers serviced world wide
- Support all escalated cases with ABB web Modules
- Located in The Netherlands

It is all about making your business work

We are looking forward to empowering you!