



19. November 2015

# Ladestandere til El-biler

Rasmus Theill – ABB

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**KASER (v. MOE A/S)**

**e-on**

Power and productivity  
for a better world™ **ABB**

# KASER 2015

## ABB Danmark

+140.000  
DK: 550

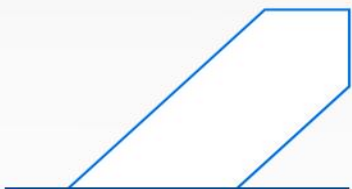


ansatte

Tilstede i



+100  
lande



\$ 40  
mia.  
ABBDKK 2,0 mia.  
(2014)

Kontorer

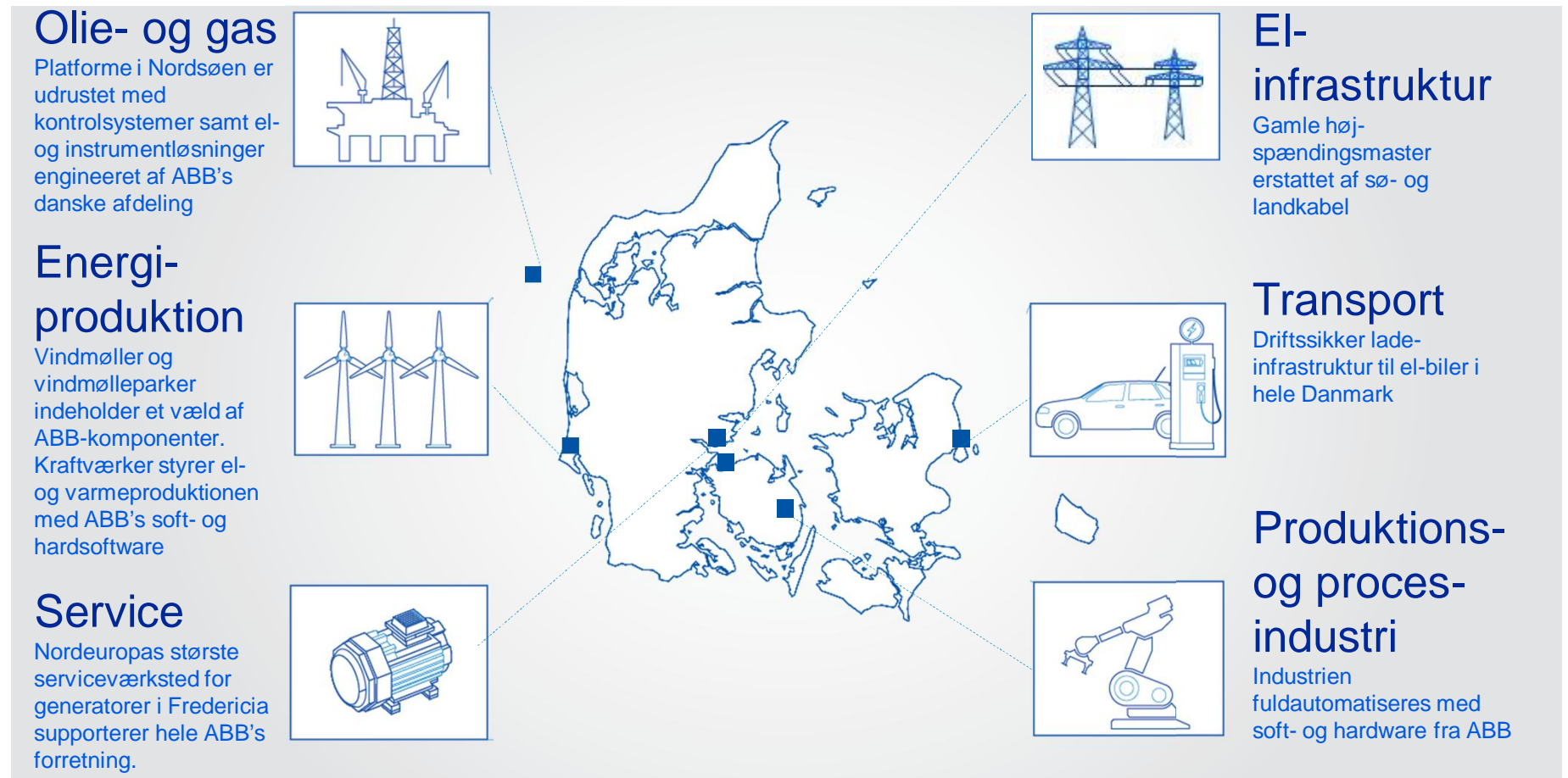


4 i DK

- Skovlunde (Hovedsæde)
- Odense (Motor og robotter)
- Fredericia (Forsyning)
- Esbjerg (Olie- & gas/ off- shore )

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## ABB Danmark



# KASER 2015

## Produkt Nyheder: On-line UPS



**Single-phase standalone systemer**

- 1 – 80 kVA
- Kompakt løsninger



**Tre-faset standalone systemer**

- 10 kVA – 5 MW
- Høj effektivitet
- Op til 10 parallelle enheder
- Lille footprint



**Tre-faset modulær systemer**

- 10 kVA – 3 MW
- DPA med intelligente power moduler
- Nemt at servicere med safe-swap moduler
- Optimal løsning for udvidelser.

# KASER 2015

## Produkt nyheder: Battery Energy Storage "ESI-inverter"

### Applikationer:

- Effekt kontrol (aktiv & reaktiv)
  - Kontrol af Cos phi/ PF
  - Aktiv harmonisk filtering (op til H50)
  - Symetrisk fase last (3 faset / 3 faset + N)
  - Peak udbedring
  - Spændingsregulering
  - Ø drift + Black start
  - Individuel fase effekt kontrol
- 
- Lithium ion batterier
  - 50kWh – 10MWh



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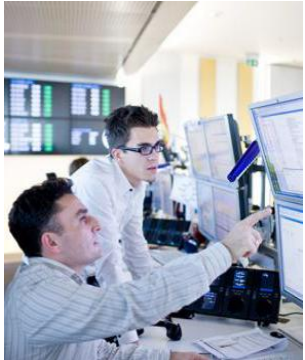
## Produkt nyheder: Sol Invertere

- 2kW – 1 MW invertere
- For større effekt behov kan invertere sammenbygges i container løsninger



Big or small, commercial or residential, utility or industry, ABB has the power to support you

# Introduction to E.ON



# E.ON – A sustainable solution for eMobility



**E.ON Danmark** has made a strategic **commitment** to supply only **sustainable energy** for e-Mobility



**We make clean energy better**





# A short introduction to E.ON DK e-Mobility

- E.ON DK purchased the largest Danish network of charge spots in Sept. 2013 and launched services 22nd March 2014
- We spent 6 months to prepare the network, our backend systems and a brand new product portfolio
- We have 1000+ public charge points located throughout Denmark – with the highest density in and around Copenhagen and Aarhus.
- Our infrastructure is state-of-the-art, our products are very competitively priced and we have a lean organization, which can adapt quickly to market trends.
- We believe that the key to success lies in our ability to establish strategic partnerships



# E.ON e-Mobility platform ...

Market driven products developed for regional markets and reused wherever E.ON has operation:

- Car sharing
- Leasing companies
- OEMs
- City charge & park
- Home products
- B2E products
- B2B products
- Simple payment systems
- SmartGrid/SmartCity integration



Access to E.ON infrastructure Europe wide with one card



Services via smartphone app's and web

- Swedish
- Danish
- German
- English



**e-on**



Torben Fog & Rasmus Theill, November 2015

# E-mobility

## El-bil ladetyper, projektering og beskyttelses metoder

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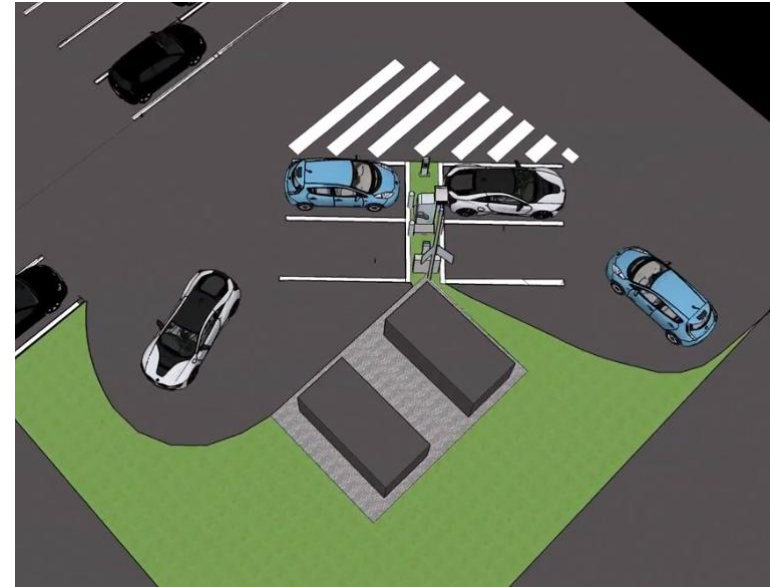
# Dimensioning



1 phase cars



3 phase cars

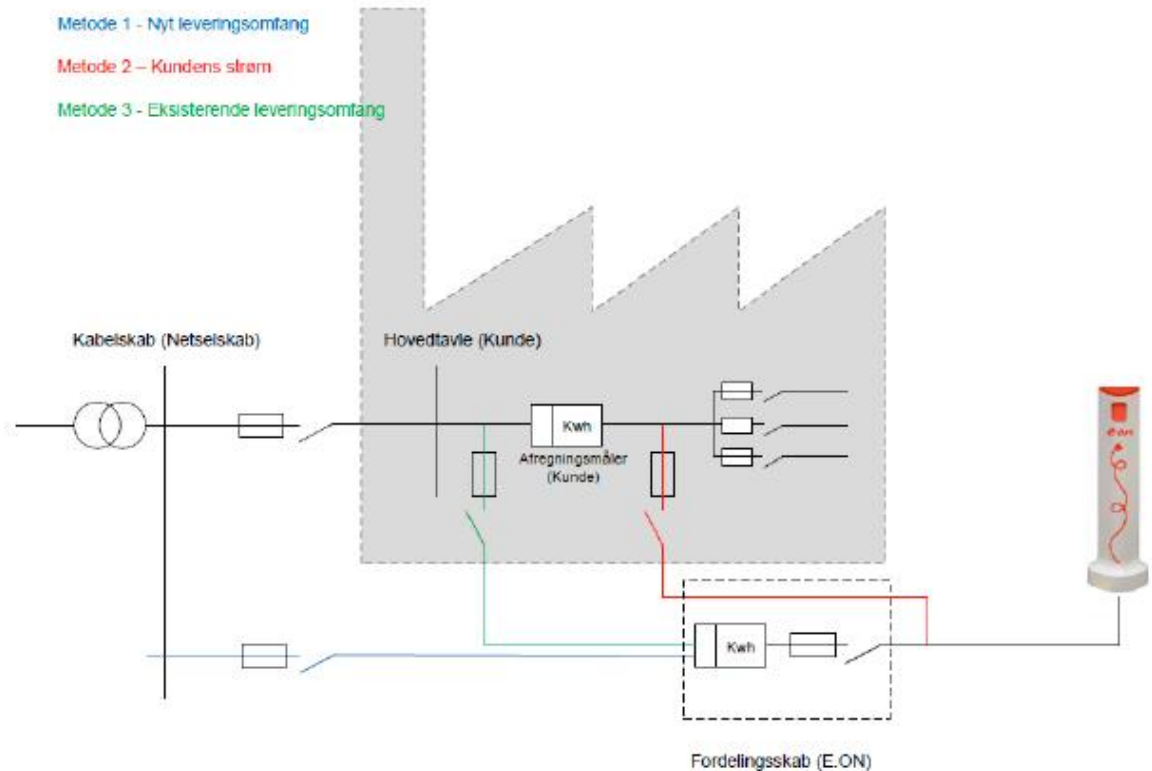


Charge points	Coincidence factor 1-phase	Coincidence factor 3-phases	1 phase	3 phases	Max output
2	1	1	1x32A 1x64A	3x32A 3x64A	11 kW 22 kW
4	1	1	2x32A 2x64A	3x64A 3x128A	11 kW 22 kW
6	1	1	3x32A 3x64A	3x96A 3x192A	11 kW 22 kW

# Dimensioning - example

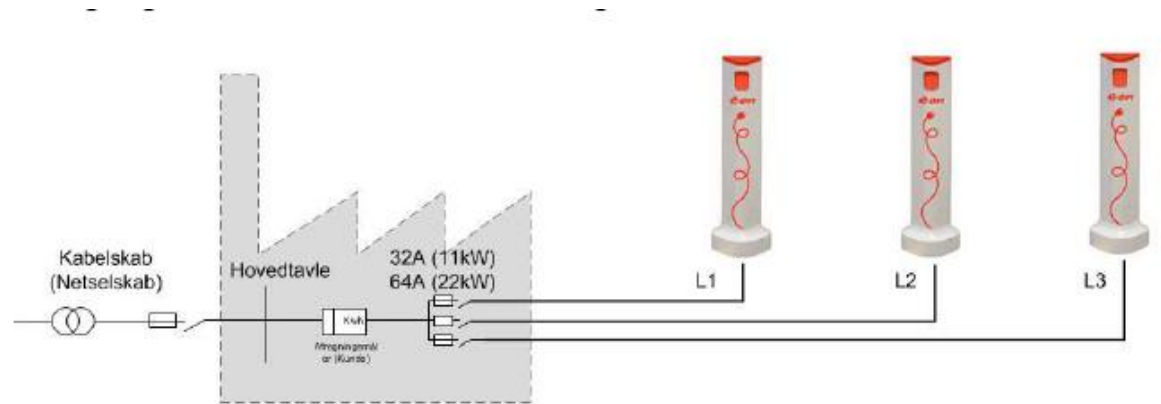
- Switchboard:
  - Sufficient space
  - Main circuit breaker
  - Max 50 ohm resistance to ground for Renault Zoe
- Cables:
  - Always use cable pipes for future needs / maintenance
  - Recommended cable dimensions is 5x16 mm<sup>2</sup>
  - Leave additional 1.5m cable for charger installation

## Tilslutningseksempler

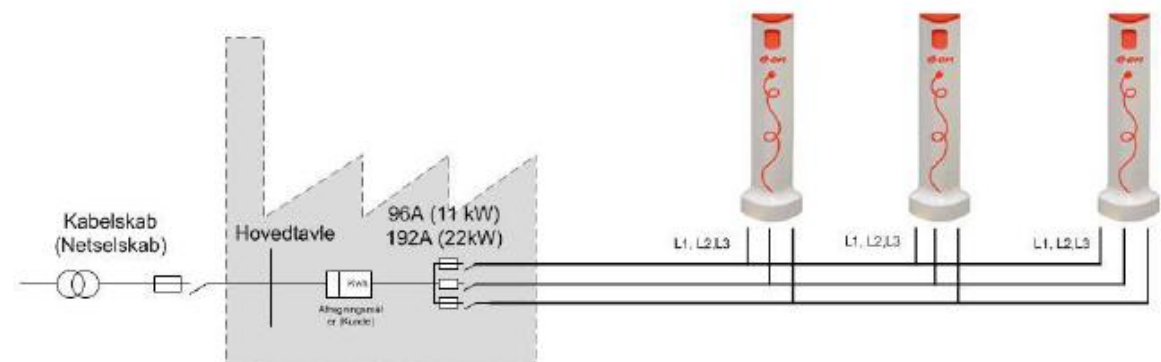


# Dimensioning - example

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# Types of EV chargers (AC)

- Public / B2B / B2G chargers:
  - Up to 2x22 kW
  - RCD A per socket (optionally with DC leakage detection)
  - MID meter per socket
- Single user charger (home, B2B, B2G):
  - With hanging Type 1 cable up to 16A, one phase (3.7 kW)
    - MCB & RCD A included. Meter included but not MID
  - With hanging Type 2 cable up to 32A, three phases (22 kW)
    - MCB & RCD external, MID meter included
  - With Type 2 socket up to 32A, three phases (22 kW)
    - MCB & RCD external, MID meter optional

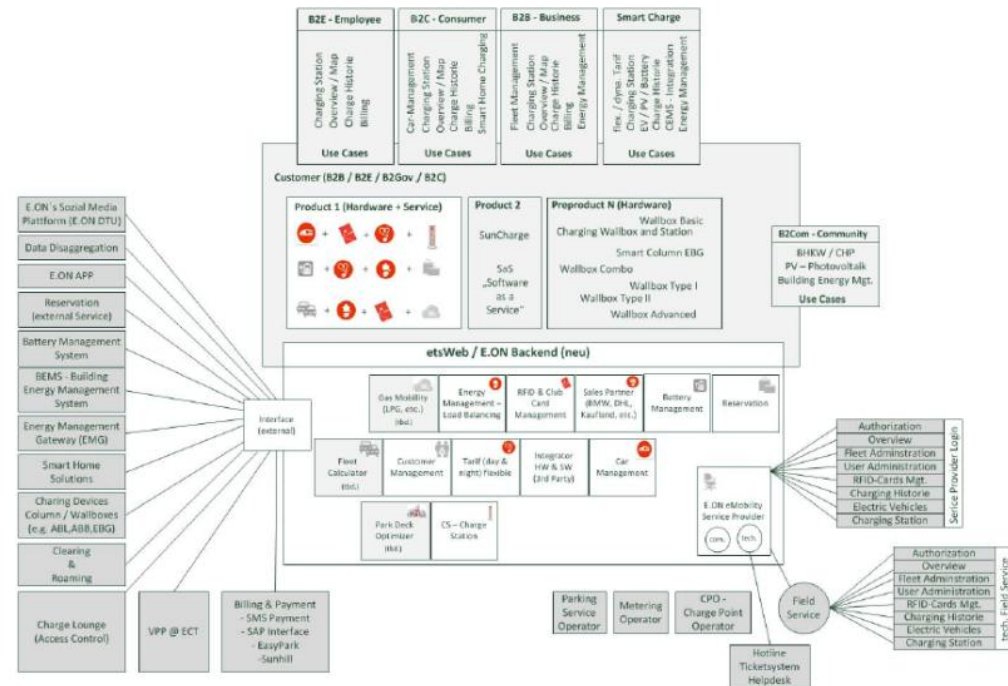


# Connected Services

- Commissioning
- Software updates
- Consumption measuring
- Access control (public/non-public/special customers)
- Payment & products
- Load management
- Fleet management
- Transparent services

## E.ON eMobility - digital Backend structure and future strategy



Use-Case Diagram





# Services included in our products



-  24/7 Customer support
-  Renewable energy in all public charge points
- 24/7 Monitoring of all charging through E.ON Network Operations Center
- Remote and on-site assistance if required
- Automatic software updates
- Access to public infrastructure network - quick chargers and 1000+ standard chargers



# Documents and assistance

- 'Klar til elbil – Tekniske specifikationer'
- Charger tech specs
- Deployment and installation department
- Working in many countries

## Technical Specifications

Power Input	Input Rating	230/400VAC, 56A Max, Single/Trn-Phase, 50Hz		
	Standby Power	< 5W		
	Connection and Wiring	L1, L2, L3, N and PE		
Power Output	Energy Meter	Optional MID Approved Single/Trn-Phase Meter		
	Output Rating	20kW Per Channel (400VAC at 25A), 50Hz		
	Cold Load Start	Random Startup Delay for Peak Protection		
Protection	Internal RCD	30mA Type A		
	Internal DC Leakage Sensor	Optional(6mA)		
	Internal Power Breaker	32A Curve C Per Channel		
	Additional Protection	Over Current		
		Short Circuit		
Over Voltage				
User Interface	Status Indicator	LED Standby/Charging/Fault		
	Audio	Two Tones		
	User Authentication	RF-ID	ISO14443 Type A/B (Mifare)	
HW interfaces	External DC Power Supply	5V		
	External Meter	Optional 12V/18V		
Communication	Wired	RS485		
	Wireless	External Modem	3G GPRS	
Deployment	OCPP	v1.5		
	Max Chargers Per Site	1000		
	Offline Grid Management	Supported		
Environmental	Local Grid Management	Supported		
	Operating Temperature	-25°C to +50°C		
Mechanical	IP Level	IP55		
	Physical Dimensions	Wall Mount (W x L x D)	557 x 214 x 279 [mm]	
	Weight	Core + Back Plate	12.6 [kg]	
	Outlet Interface	Type 2 Connector Per IEC 62196		
	Plug Lock	Present		
	Outlet Lock	Motorized Door		
	Enclosure Type	Indoor/Outdoor		
	Enclosure Mounting	Wall/Pole		
Regulation	Number of Charging Outlets	2		
	Certification	CE Mark		
	IEC Compliance	Z.F. Ready		
		General	IEC 61851-1/22 IEC 62196-1/2	
	Safety		IEC 60950-1/22 IEC 60439-1/3	
		EMC	EN 61000-6-1 EN 61000-6-3 EN 301489-1/3 EN 301489-7	
	R&TTe	EN 300330-2 EN 301511		



Klar til elbil - tekniske specifikationer

Denne instruktionsvejledning indeholder tekniske krav til den elektriske installation af E.ONs ladestander til elbiler.

E.ON Denmark A/S, Stroh Passes Allé 76, 2000 Frederiksberg, T. 70 27 05 77, [lundacattan@e-on.dk](mailto:lundacattan@e-on.dk)

**e-on**

# KASER 2015

## Lade historik



CHAdeMO

**2010**  
Stiftelse af  
CHAdeMO



**2010**  
Lancering af  
ABB Terra 51  
50 kW CHAdeMO lader

Fremtiden

Pilot  
projekt

CHAdeMO

Første  
Biler



**2010**  
Første 50 kW  
lader i EU

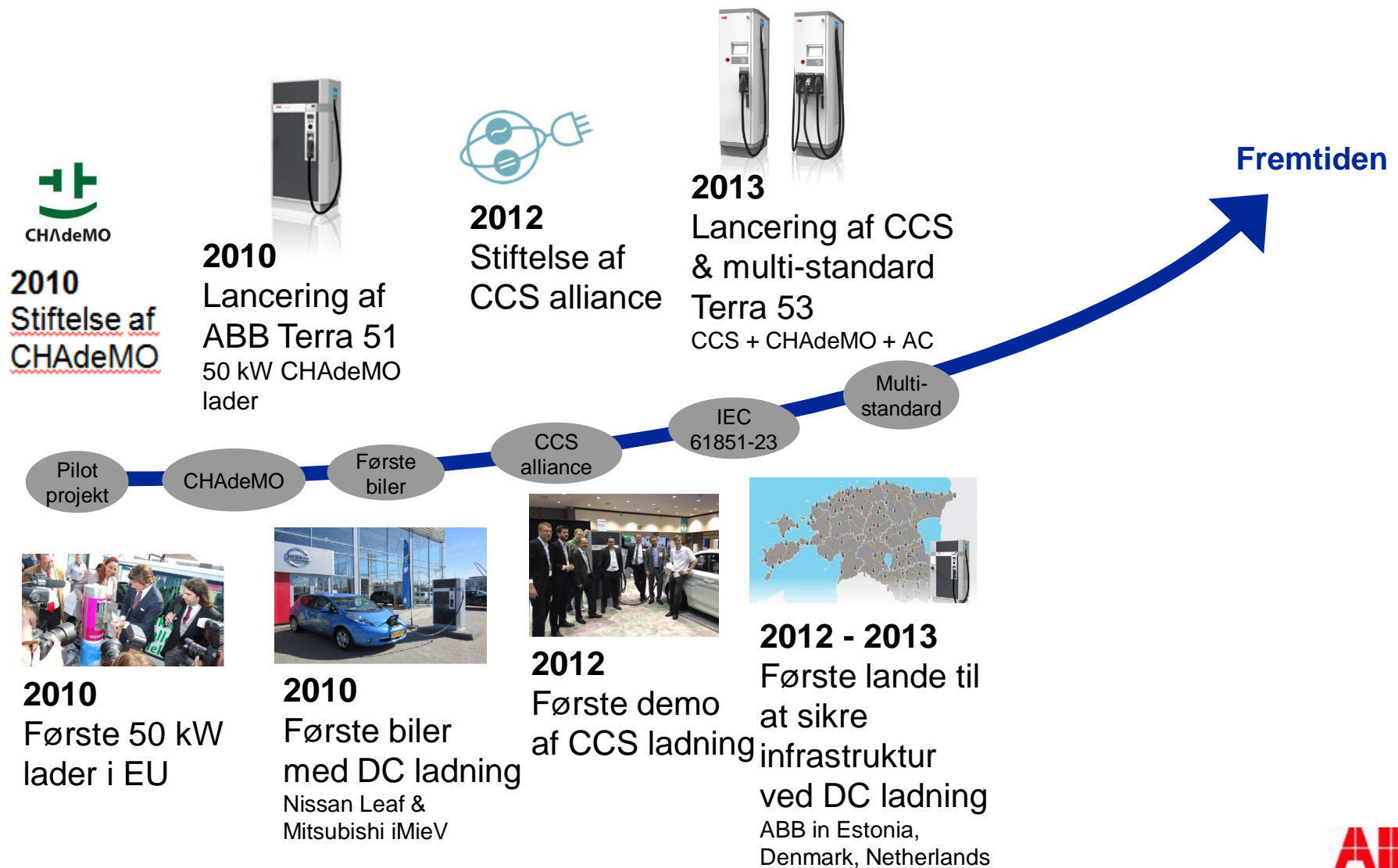


**2010**  
Første biler med  
DC ladning  
Nissan Leaf &  
Mitsubishi iMieV



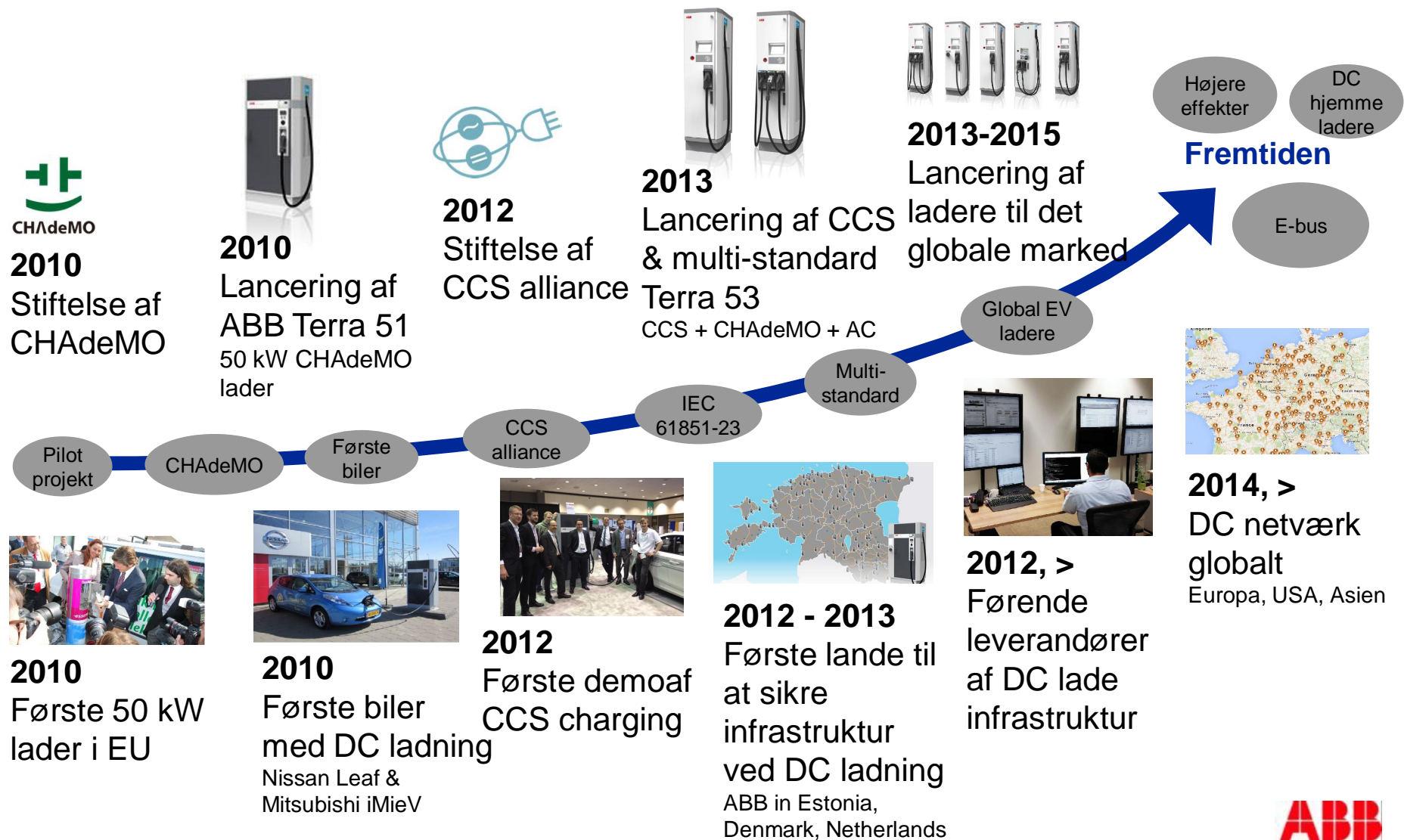
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## Lade historik



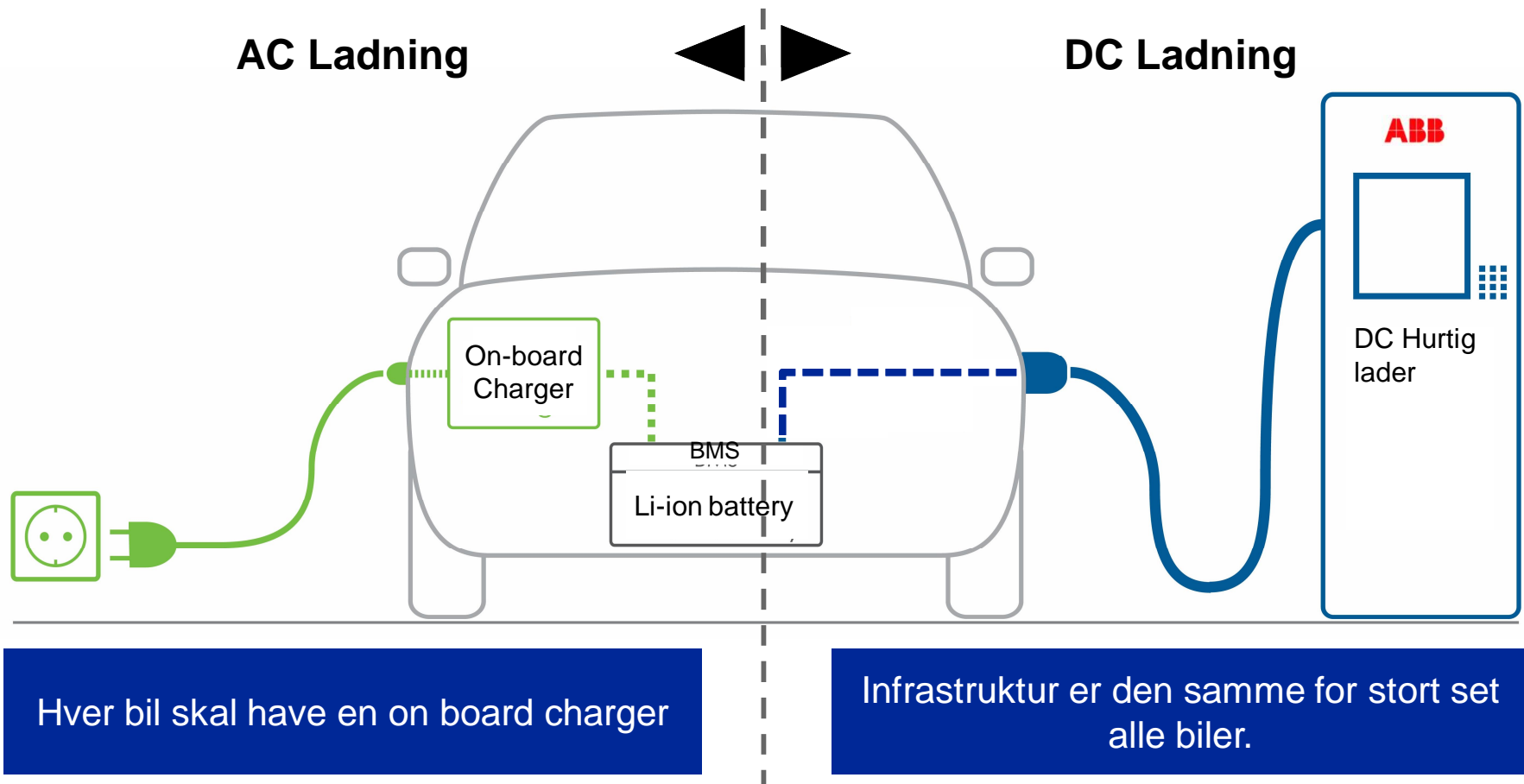
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## Lade Historik



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## DC ladning VS. AC ladning



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50kW CHAdeMO / 22-43 kW AC / 50kW CCS 2



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## 22-43 kW AC

22-43 kW AC, Type 2, mode 3

- Stikket er et Type 2 VDE-AR-E 2623-2-2 (Mennekes stik) som i Europa er i overensstemmelse med IEC 62196-2 standard
- Ladning med mode 3 sikkerheds relaterede signaler for AC ladning i overensstemmelse med IEC 61851-1.





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## CHAdeMO og CCS 2

### CHAdeMO:

- Japansk ladestandard udviklet af bl.a. The Tokyo Electric Power Company, Nissan, Mitsubishi og Fuji Heavy Industries
- Stik type: JEVS G105 (Japan Electric Vehicle Standard)



### CCS Combo 2:

- Combined Charging System
- Ladning med sikkerheds releterede signaler for DC ladning I overensstemmelse med IEC 61851-23.
- Combo 2 stik som er I overensstemmelse med IEC 62196-3.
- Kommunikations interface mellem bil og laderer baseret på ISO/IEC 15118 og den tyske DIN SPEC 70121.
- Udviklet af Audi, BMW, Daimler, Ford, General Motors, Porsche og Volkswagen



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## Tesla CHAdeMO adapter



- CHAdeMO adapter udviklet af Tesla

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## Forklaring af lade typer

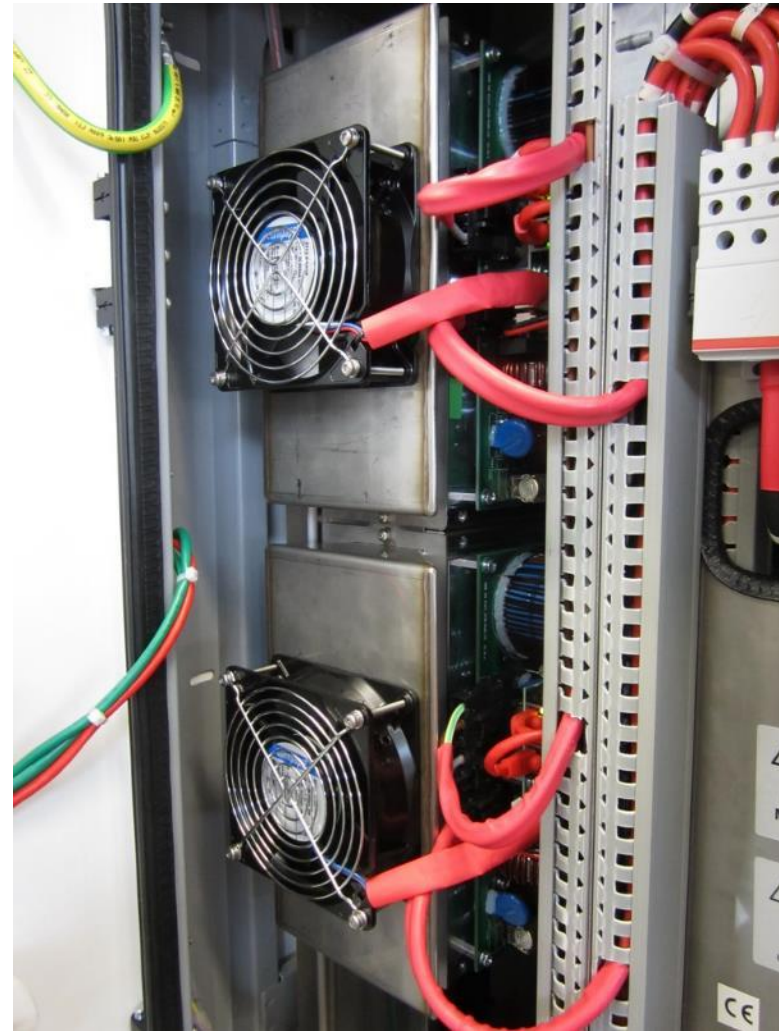


Terra **53** (50kW)  
Terra **23** (20kW)

- C** - (Combo) = Combined Charging Systems (CCS) - DC
- J** - (Japan) = CHAdeMO - DC
- Z** - (China) = GB - DC
- T** - (Socket) = Type 2 Socket - AC
- G** - (Grid) = Cable + Type 2 Connector - AC

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## Terra 53 og Terra 23



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## Installations krav

- Kabel type: 400V, 50Hz, 3P+N+PE. Der er ikke krav til skrærmet kabel.
- Hvis der anvendes skærmede kabler skal disse monteres til PE skinnen i begge ender.
- Anbefalede stikledning: 4 x 70mm<sup>2</sup> + 70mm<sup>2</sup>. (Dette skal dog endeligt dimensioneres af rådgiver/installatør hvis der er særlige forhold der skal tages højde for.)
- Maksimal kabel dimension er 95 mm<sup>2</sup>.
- PE lederen skal have samme kvadrat som faselederne.
- Maksimal forsikring er 160 A grundet interne fortrådninger.
- Mulighed for derating, hvis der ikke er behov for det fulde effekt behov.
- Mindste forsikring for fuld last:

Charger Type	Fuse size
<b>T53 CG/CT/CJG/CJT</b>	125 A
<b>T53 C/CJ</b>	100 A
<b>T23 CG/CT/CJG/CJT</b>	63 A
<b>T23 C/CJ</b>	32 A

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## Simultan ladning

- DC-DC er ikke muligt
- AC-DC og DC-AC er muligt
- Nr. 2 bil ankommer: Lader tjekker det faktiske forbrug på første bil
- Nr. 2 bil starter når >50% af output effekten er ledig
- Nr. 2 bil starter med så stor lade strøm som muligt
- Nr. 2 bil stiger i lade effekt som bil 1 aftager

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## Simultan ladning

- CHAdeMO protokol tillader ikke simultan ladning
- Når nr. 1 bil er Chademo, vil effekten ikke gå ned
- Best case: Nok effekt for bil nr. 2 alligevel (dette er meget sandsyneligt)
- Worst case: Ikke nok effekt til rådighed hvilket medfører at bil nr. 2 ikke lader. (Ikke særligt sandsyneligt)
- Når bil nr. 2 er en CHAdeMO og starter med en lade effekt >50%, vil effekten aldrig stige
- Best case: Ladning starter med mere end 50% (dette er meget sandsyneligt)
- Worst case: Ladning fortsætter på 50% effekt, hvilket medfører at ladningen tager længere tid end simultan ladning (Ikke særligt sandsyneligt)
- Ved simultan ladning skal der forsikres med 160A, da effekt optaget nu er =

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## Simultan ladning

Fuse size	T23 CT/CJG	T53 CT/CJT	T53 CG/CJG
3x16A	2 <sup>nd</sup> start when >50%	2 <sup>nd</sup> start when >50%	2 <sup>nd</sup> start when >50%
3x25A	2 <sup>nd</sup> start when >50%	2 <sup>nd</sup> start when >50%	2 <sup>nd</sup> start when >50%
3x32A	2 <sup>nd</sup> start when >50%	2 <sup>nd</sup> start when >50%	2 <sup>nd</sup> start when >50%
3x63A	Sufficient power (>97%)	2 <sup>nd</sup> start when >50%	2 <sup>nd</sup> start when >50%
3x80A	Maximum power	2 <sup>nd</sup> start when >50%	2 <sup>nd</sup> start when >50%
3x100A	Maximum power	2 <sup>nd</sup> start when >75%	2 <sup>nd</sup> start when >50%
3x125A	Maximum power	Maximum power	Sufficient power (>85%)
3x160A	Maximum power	Maximum power	Maximum power



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## Beskyttelses bryder og indstillingsværdier



Maksimalafbryder med type B fejlstrømsbeskyttelse					
Strøm	Motor kW	Brydeevne	Følsomhed	Varenumre	
				Type	Nummer
56-80A	40	36kA	0,03-1A	XT3N 250 TMD 80+RC B*	DKABB26100567**
88-125A	63	36kA	0,03-1A	XT3N 250 TMD 125+RC B*	DKABB26100392**
112-160A	80	36kA	0,03-1A	XT3N 250 TMD 160+RC B*	DKABB26100482**
140-200A	100	36kA	0,03-1A	XT3N 250 TMD 200+RC B*	DKABB26100393**
100-250A	125	36kA	0,03-1A	T4N PR221 LS/I+RC223*	DKABB26100417**
250A	125	n/a	0,03-1A	RC223/4 T4 250 4P*	1SDA054956R1***

Ovenstående er alle selektive med tidsindstilling fra 0-3 sek.  
Ønskes ekstra terminaler til fejlstrømsmodulet, skal der bruges T4-terminaler - også til XT3-løsningerne. På bryderen kan der monteres tilbehør som hjælpekontakter, terminaler m.m.

### Indstilling af maksimalafbrydere

Brydere skal indstilles til følgende værdier:

- Termorelæ= MIN gælder DC ladere og er svarende til 112A, MAX gælder DC+ AC ladere svarende til 160A.
- Korttidsudløser= fast indstillet til  $10 \times I_n$ .
- Følsomhed for fejlstrømme= Så højt BIB testen tillader det. (Installatøren skal beregne dette iht. den målte overgangsmodstanden til jord).
- Tidsforsinkelse= 0,3
- Frekvensfilter= 400Hz

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## Forsyningstavle til ladestationer

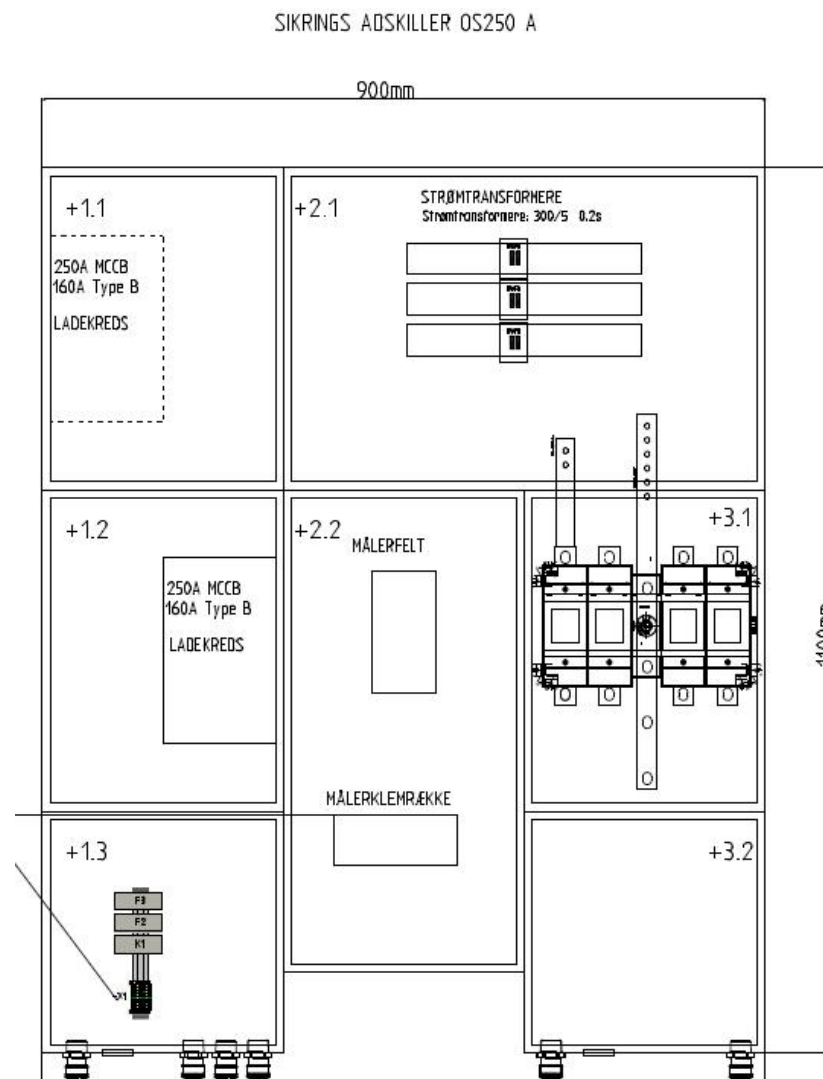
- Mulighed for udvidelse af en DC charger.
- Mulighed for udvidelse af en AC charger.
- Integreret bryder og afbryder for lys.
- Indgangsbryder/ skal afklares med forsyningselskabet.
- El måler.



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## Tavle tegning til forsyningstavle

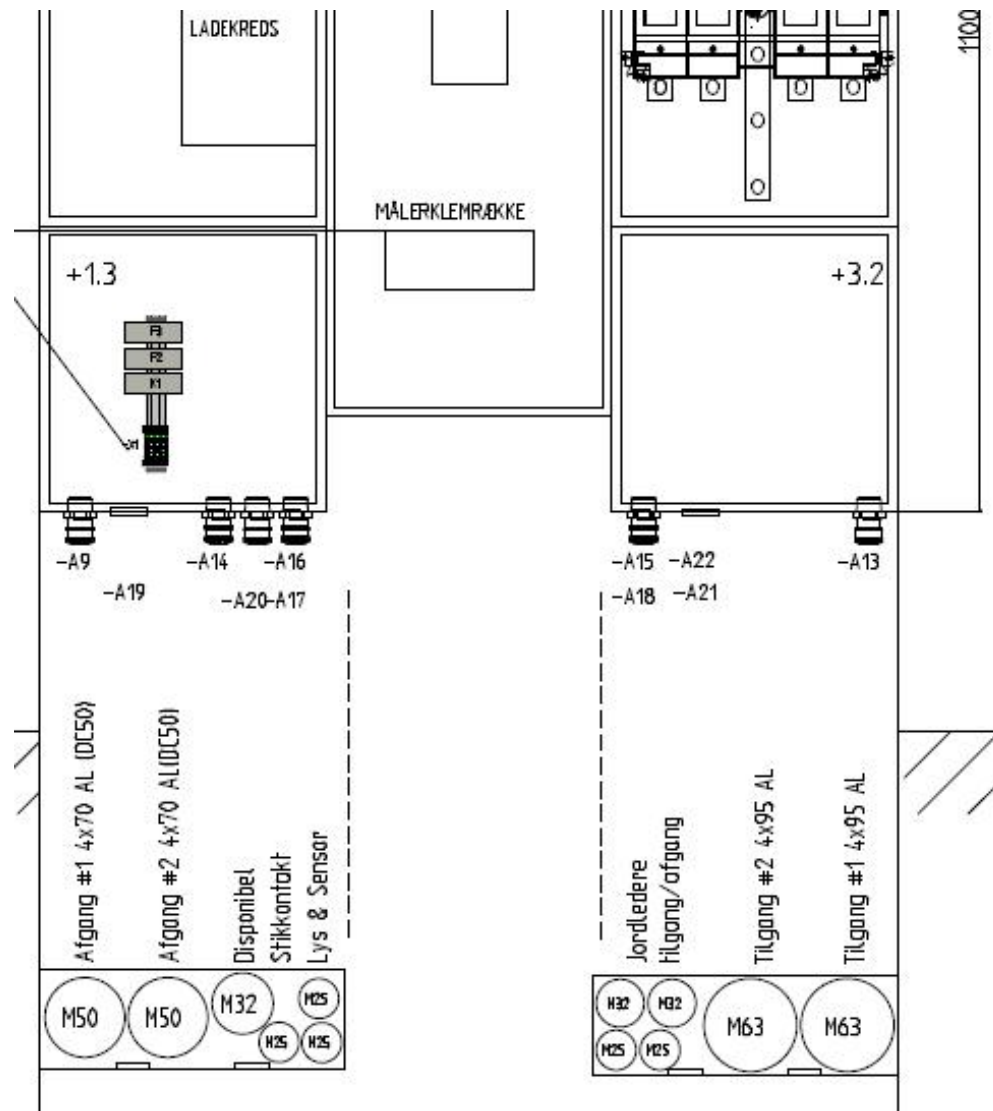
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- El måler.



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## Tilslutning af forsyningstavle

- Forberedt til 2 forsyningskabler Ø95mm<sup>2</sup>
- Forberedt til afgangskabler Ø70mm<sup>2</sup>



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## Terra 53 CJG, tekniske specifikationer



Operating temperature	-10°C to +55°C, option: -35 °C to +55°C
Environment & protection	Outdoor, IP54
Compliance and safety	CE / CHAdeMO
Input voltage range & Max. current	400VAC +/- 10% (50 Hz), 125 A
Efficiency	>94% at nominal output power
Maximum DC output power	50kW
Maximum DC output current	120 A (CHAdeMO), 165 A±5% (Combo)
Maximum AC output power & current	22 kW, 32A (Zoe & Smart compatible)
Output DC voltage range	50 (CHAdeMo) /200 (Combo) V - 500V
DC plug type(s)	JEVS G105 & Combo 2
AC plug type	IEC 62196, Type 2, mode 3 charging
Network connection	10/100 Base-T Ethernet (OCPP) GSM/GPRS/3G/CDMA/EVDO
Operational noise level	45 dBA
Mass	400kg
Size (D x W x H) in mm	760 x 525 x 1900

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## CCS / Multi-standard chargers (50kW)



Terra 53 C DC Highway Charger	Terra 53 CT DC+AC Highway Charger	Terra 53 CG DC+AC Highway Charger	Terra 53 CJ DC Highway Charger	Terra 53 CJG DC + AC Highway Charger	Terra 53 CJT DC+AC Highway Charger
50kW DC CCS-2	50kW DC CCS-2	50kW DC CCS-2	50kW DC CCS-2	50kW DC CCS-2	50kW DC CCS-2
	22kW AC	43kW AC	50kW DC CHAdeMO	50kW DC CHAdeMO	50kW DC CHAdeMO
				43kW AC	22kW AC
15-30 min.	15-30 min.	15-30 min.	15-30 min.	15-30 min.	15-30 min.

Input: 3x 400V

# KASER 2015

## CCS / Multi-standard chargers (20kW)



**Terra 23 CT**  
**DC**  
**Commercial Charger**

- 20kW DC CCS-2
- 22kW AC
- 30-60 min.



**Terra 23 CJ**  
**DC**  
**Commercial Charger**

- 20kW DC CCS-2
- 20kW DC CHAdeMO
- 30-60 min.

Input: 3x 400V

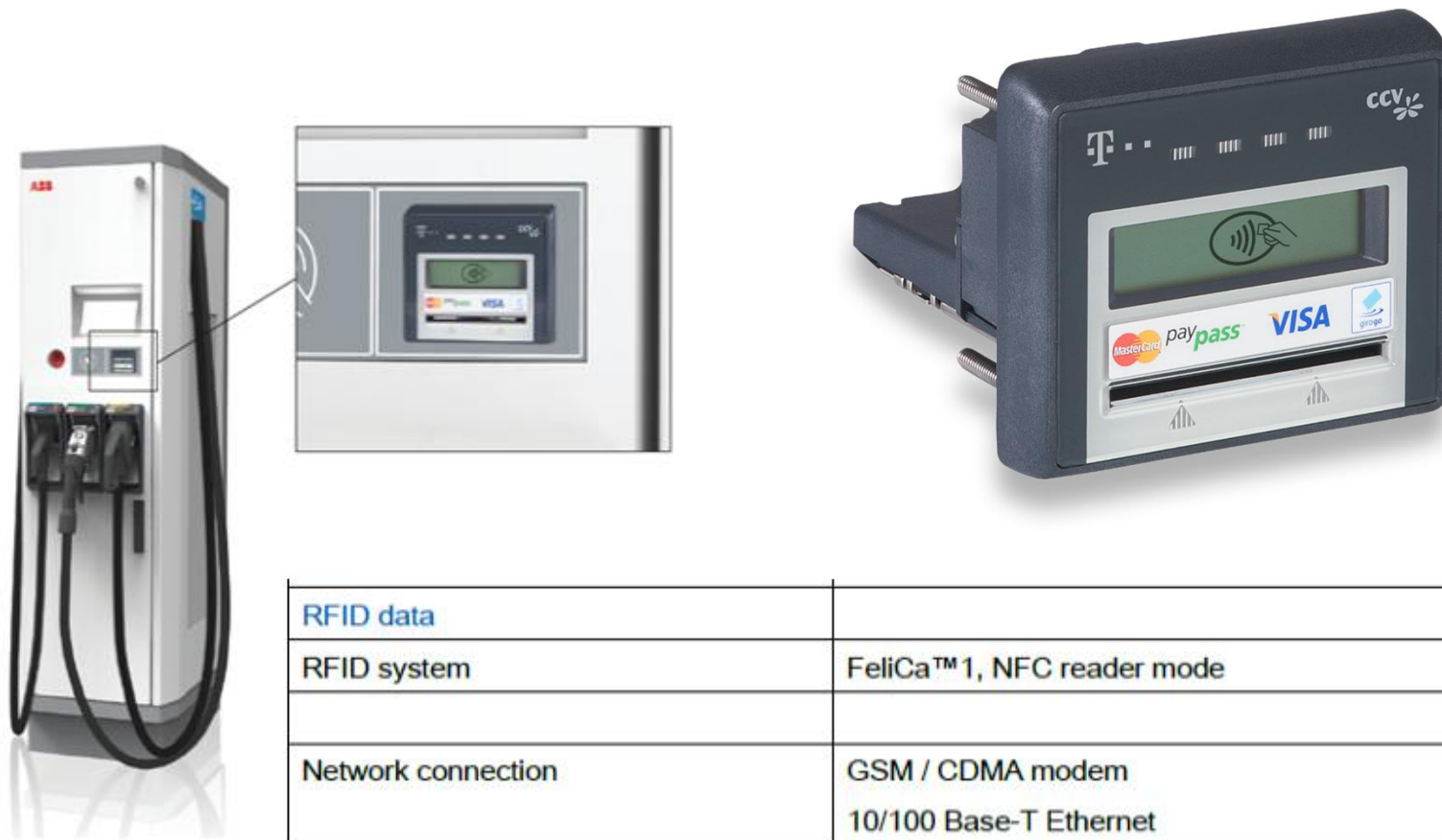


**Terra 23 CJG**  
**DC + AC**  
**Commercial Charger**

- 20kW DC CCS-2
- 20kW DC CHAdeMO
- 22kW AC
- 30-60 min.

# KASER 2015

## Terra 53 CJG, tekniske specifikationer



RFID data	
RFID system	FeliCa™1, NFC reader mode
Network connection	GSM / CDMA modem 10/100 Base-T Ethernet





November 2015

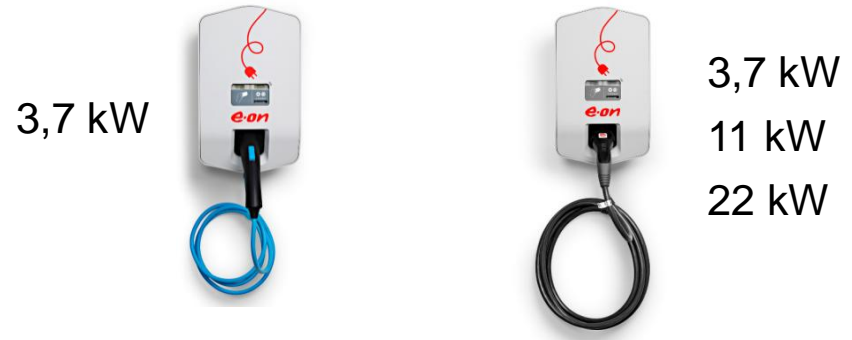
# E-mobility Eksempler på installationer

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# Home charging

- 3,7 kW – 16A, 1 phase
- 11 kW – 16A, 3 phases
- 22 kW – 32A, 3 phases
  
- RFID access or open
  
- Installation methods

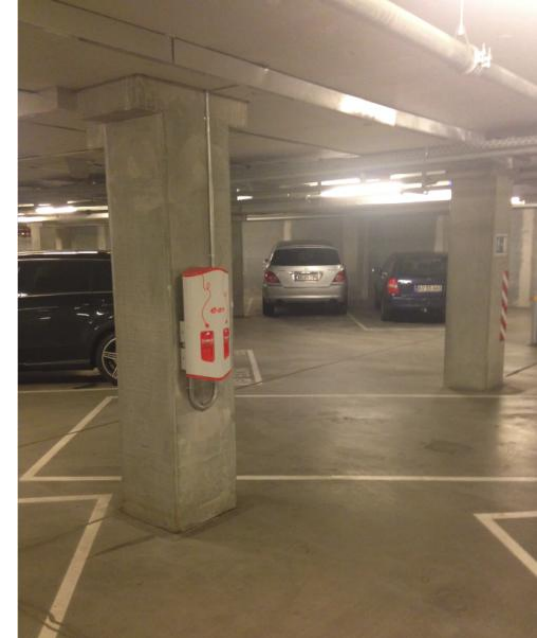


<b>HOME CHARGE SPOT</b>	Single Outlet Type 2  H2-1S32A3PT2
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# Business charging

- 1x3.7 kW – 16A, 1 phase
  - 1x11 kW – 16A, 3 phases
  - 1x22 kW – 32A, 3 phases
  - 2x11 kW – 32A, 3 phases
  - 2x22 kW – 64A, 3 phases
- 
- Guest charging
  - Company car charging
  - Employee charging
  - Individual pricing
  - Direct customer billing



# Municipality fleets

- In use 24/7
- High uptime a 'must have' requirement
- Access closed for outsiders or semi-public
- 11 kW wall-mount chargers on a pole
- Cable inside pole to control panel
- MCB / RCD on switchboard
- 2x11 kW and 2x22 kW standing chargers
- 10 mm<sup>2</sup> and 16 mm<sup>2</sup> cables
- Tenders and pitfalls, future expansion and upgrades
- Detailed planning important



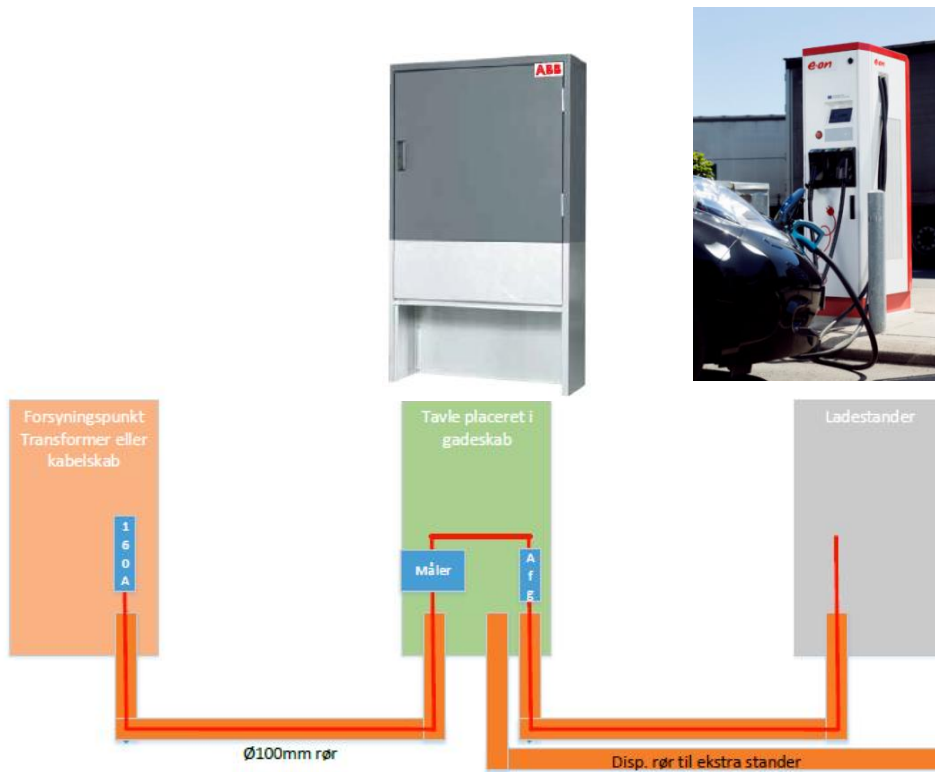
# Public charging

- Charging for all customers and non-customers
- 2x11 kW – 32A, 3 phases
- 2x22 kW – 64A, 3 phases
- Permissions and seasons



# Example: Quick chargers on motorway

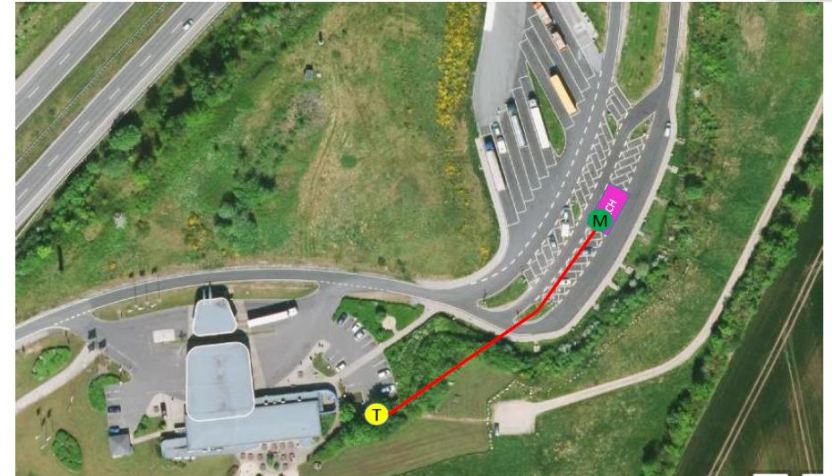
- Installation 3x160A
- 50 kW CCS
- 50 kW CHAdeMO
- 43 kW AC



Delaftale 22, Harte Nord, Esbjergmotorvejen 646, 6000 Kolding

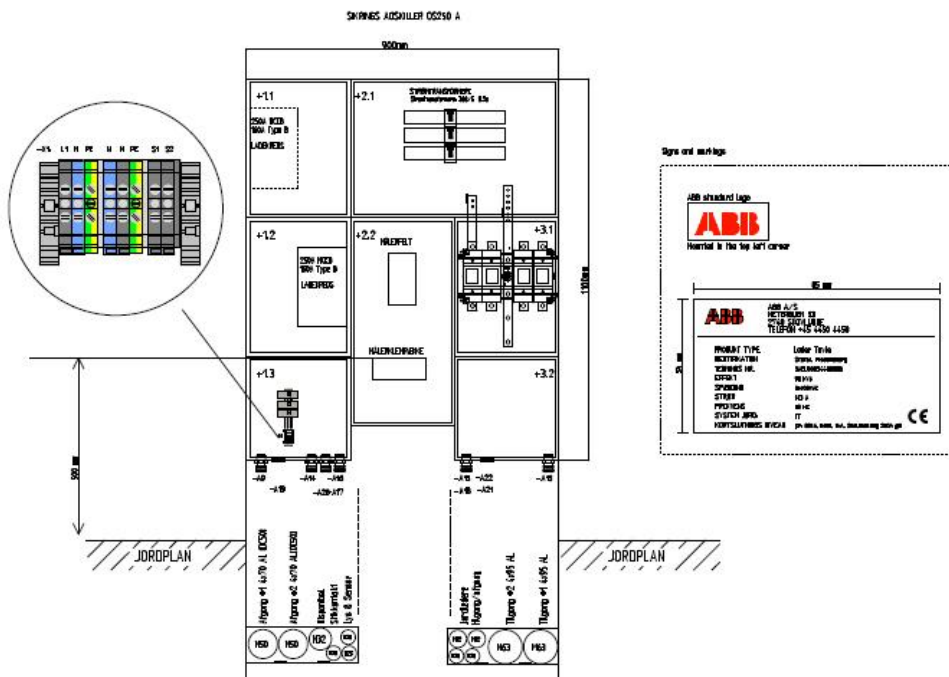
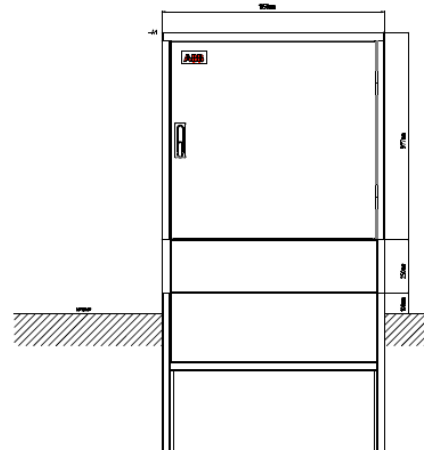


Delaftale 8, Himmerland Øst, Himmerland Motorvej Øst 9541 Suldrup



# Example on Statoil chargers

- Installation 3x125A
- 50 kW CCS
- 50 kW CHAdeMO
- 43 kW AC



# Installation of quick chargers





# De største internationale ABB referencer



- Estland: ca. 200 Fast chargers siden Feb 2013
- E.ON & Clever i Danmark: 100+ Fast chargers
- Fastned i Holland: 100+ Fast chargers
- NRG Evgo I USA: 150+ Fast chargers

# De Danske ABB referencer



- E.ON i Danmark: 40+ Fast chargers
- Clever i Danmark: 70+ Fast chargers
- DTU i Danmark: 5+ Fast chargers
- VW, Nissan, SEV: 5+ Fast chargers

# ABB DC fast charge installationer 2010 - 2015



- **Lande:**

Australia, Austria, Azerbaijan, Belgium, Canada, China, Chili, Colombia, Croatia, Czech, **Denmark**, Egypt, Estonia, **Faroe Islands**, Finland, France, Germany, Greece, **Greenland**, Hong Kong, Hungary, India, Ireland, Italy, Japan, Jordan, Latvia, Liechtenstein, Lithuania, Malaysia, Mexico, Monaco, The Netherlands, New Zealand, Norway, Poland, Romania, Russia, Singapore, Slovakia, Slovenia, South Africa, South Korea, Spain, Sri Lanka, Sweden, Switzerland, Taiwan, Thailand, Turkey, United Kingdom, USA.

- **Total 3.500 solgte Fast chargere.**





November 2015

# E-mobility Pause ca 30 min “Hands On”

**e-on**

Power and productivity  
for a better world™ **ABB**



Jonas Kehr, November 2015

# E-mobility Future Trends

**e-on**

Power and productivity  
for a better world™ **ABB**

# Different business cases for charging infrastructure

Each case will move to the next level in 2016-2020

**Home & office charging**



**Metropolitan infrastructure**



**Highway infrastructure**



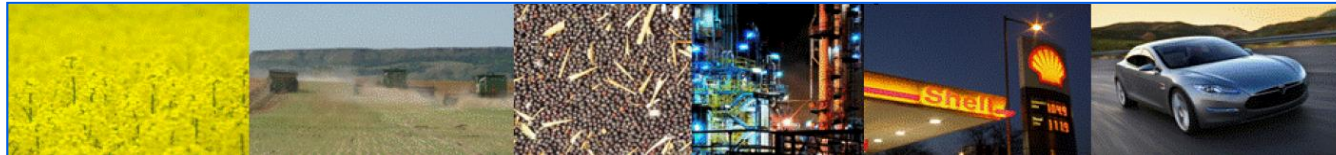
**E-bus infrastructure**



# Well-to-wheel efficiency of alternative fuels

## Range per year per m<sup>2</sup> of land

### Biofuel: **7km**



Most efficient energy crops (palm oil, sugar cane) deliver **0.5L/m<sup>2</sup>** including sowing, fertilizing, harvesting, refinement and distribution.

A vehicle drives 15km/L, so 0.5L gives **7km range**.

### Hydrogen: **160km**



A solar panel delivers **105 kWh/m<sup>2</sup>**.

After electrolysis, compression and distribution **63kWh** goes into the tank.

The fuel cell generates **31.5kWh** of electricity. The vehicle drives 5km/kWh, so 31.5kWh gives **160km range**.

### Electric: **380km**



A solar panel delivers **105 kWh/m<sup>2</sup>**.

After distribution, charging and storage in the battery, **77kWh** is available to the motor.

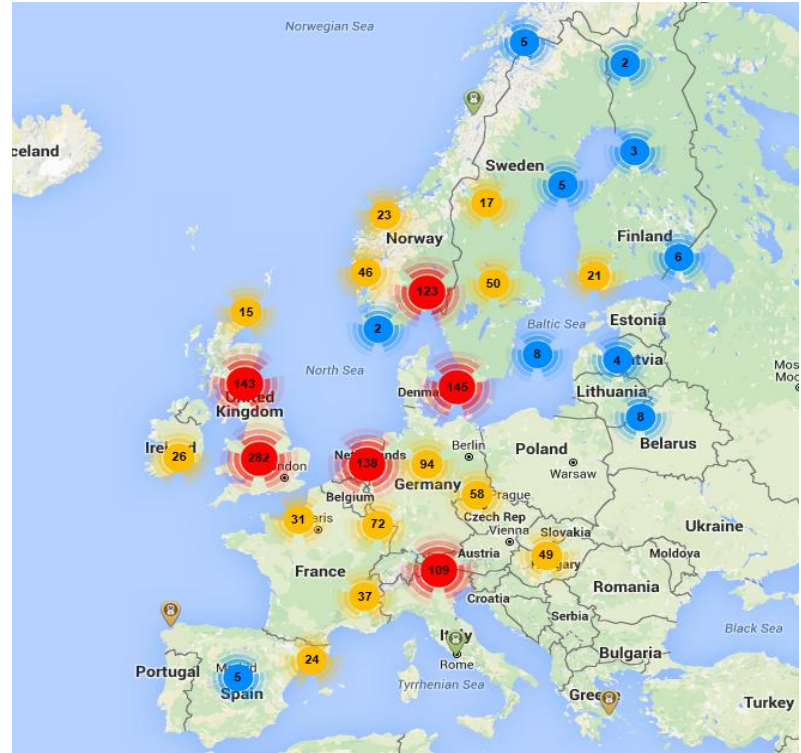
An EV drives 5km/kWh, so 77kWh gives **380km range**.

# DC-Fast Charging is happening in Europe

2.364 CHAdeMO / 1.555 CCS fast charging stations in Europe (per 17/11/2015)



[www.chademo.com](http://www.chademo.com)



<http://ccs-map.eu/>





# ABB is global charging partner for Car OEM's

**VOLVO** - R&D partners

**BMW** - R&D partners  
- DC fast chargers at dealers

**VW** - R&D partners  
- DC fast chargers at dealers

**PORSCHE** - R&D partners  
- DC Wallbox

**Audi** - R&D partners

**RENAULT** - R&D partners

**KIA** - DC fast chargers at dealers

**TOYOTA** - R&D partners

**Ford** - DC charging testing & R&D

**HONDA** - R&D partners

**GM** - DC charging testing & R&D

**CHANGAN** - R&D partners

**NISSAN** - R&D partners  
- DC fast chargers at dealers  
- Cooperation Dong-Feng

**DONG FENG**

**BAIC Group** - R&D partners

**SAIC MOTOR** - R&D partners

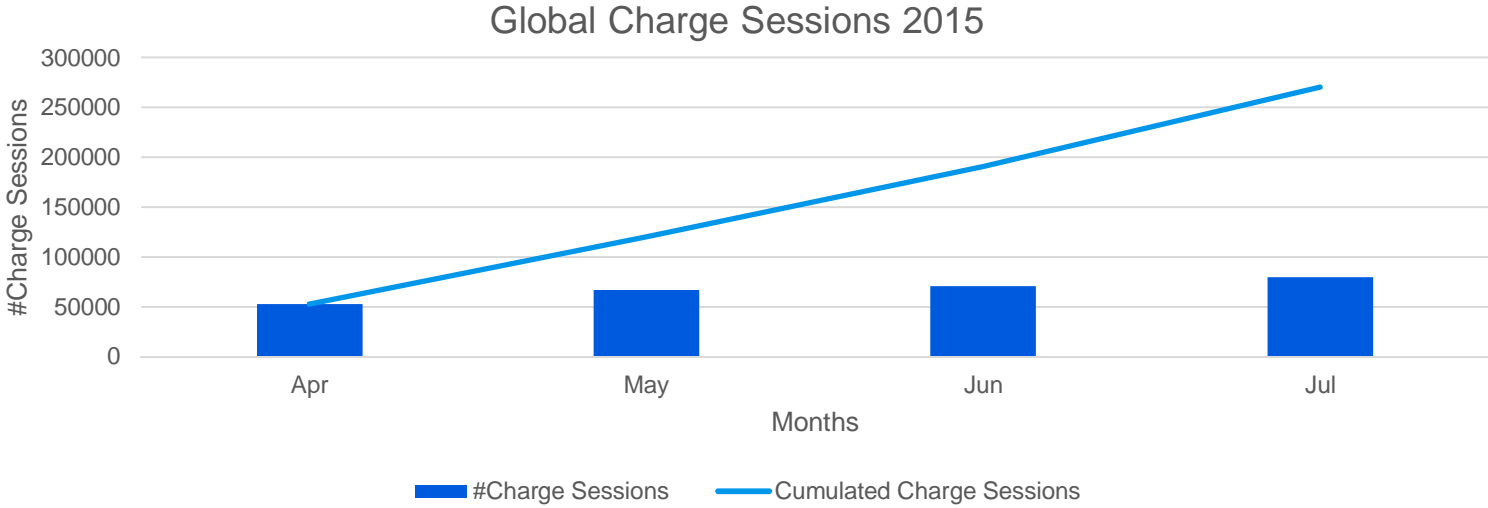
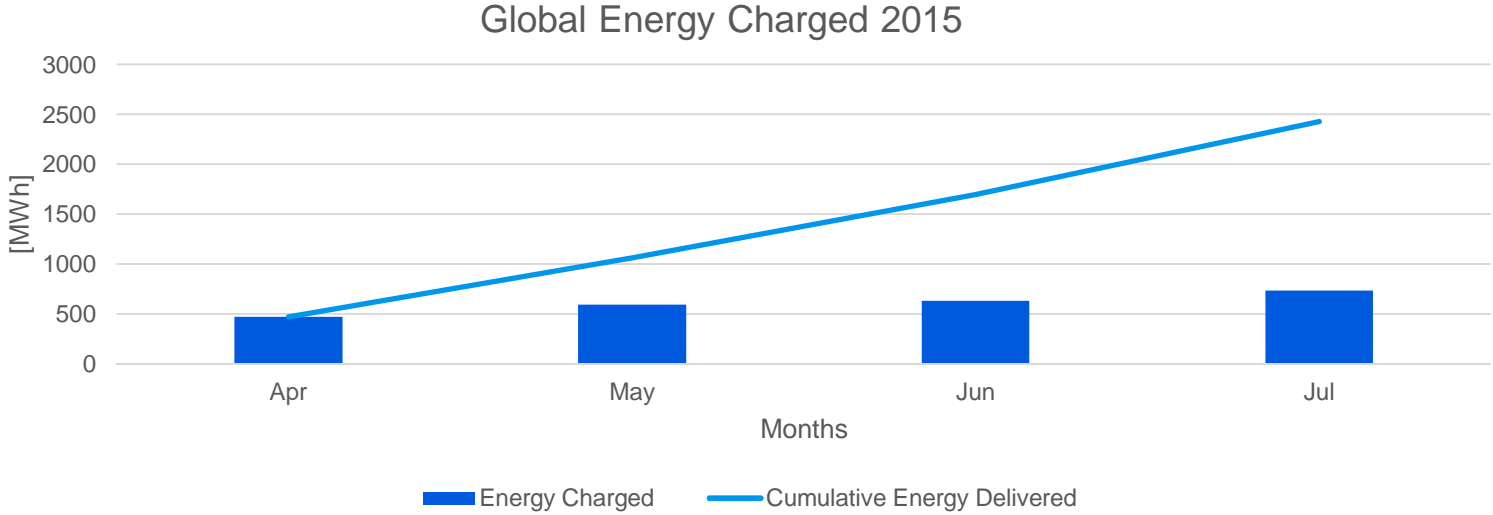
**BYD** - R&D partners  
- DC wall box for Denza EV

**DAIMLER**

**ABB**

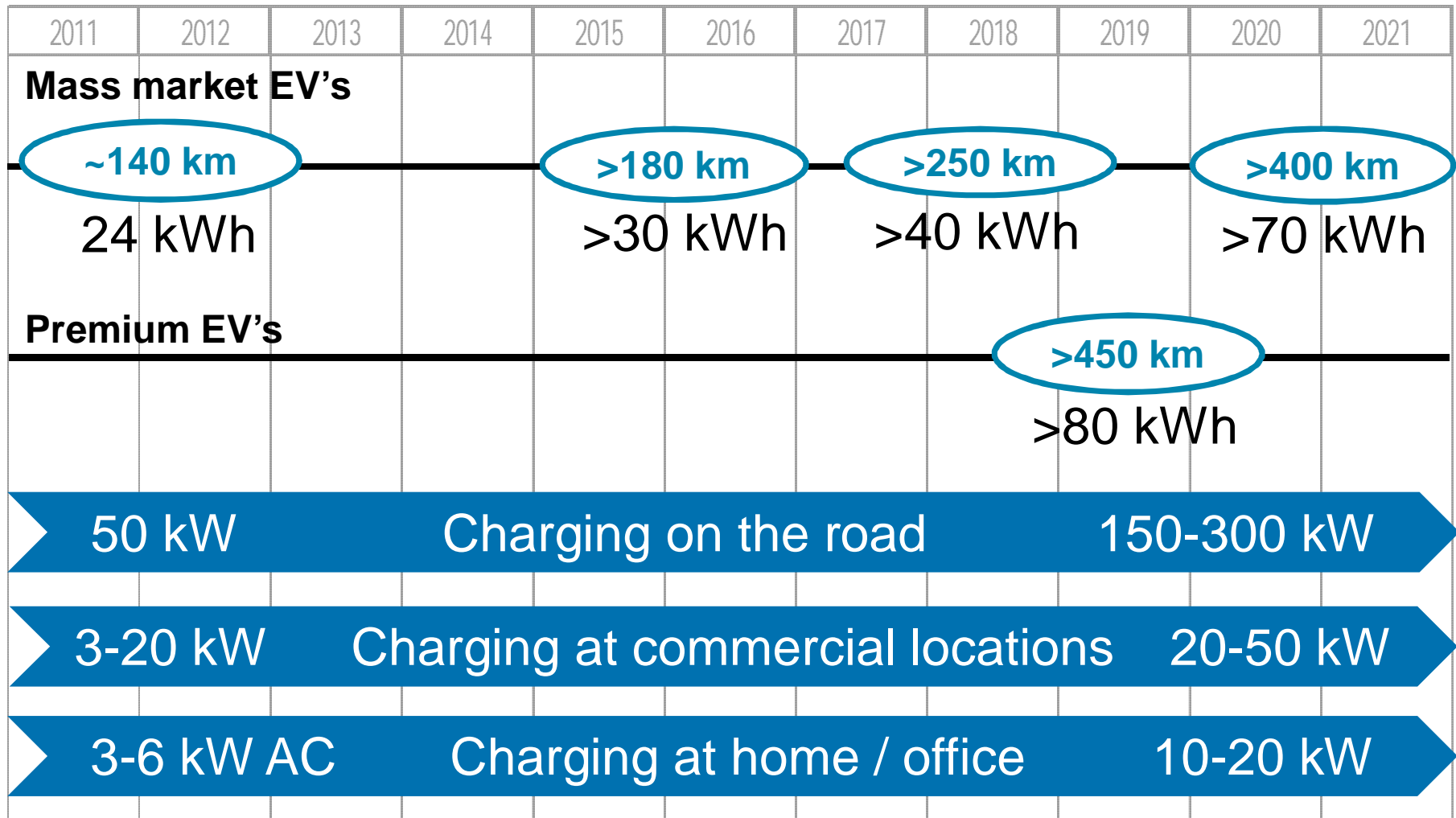
# DC Fast Charge Statistics

## Use of Installed Base April 2015 – July 2015

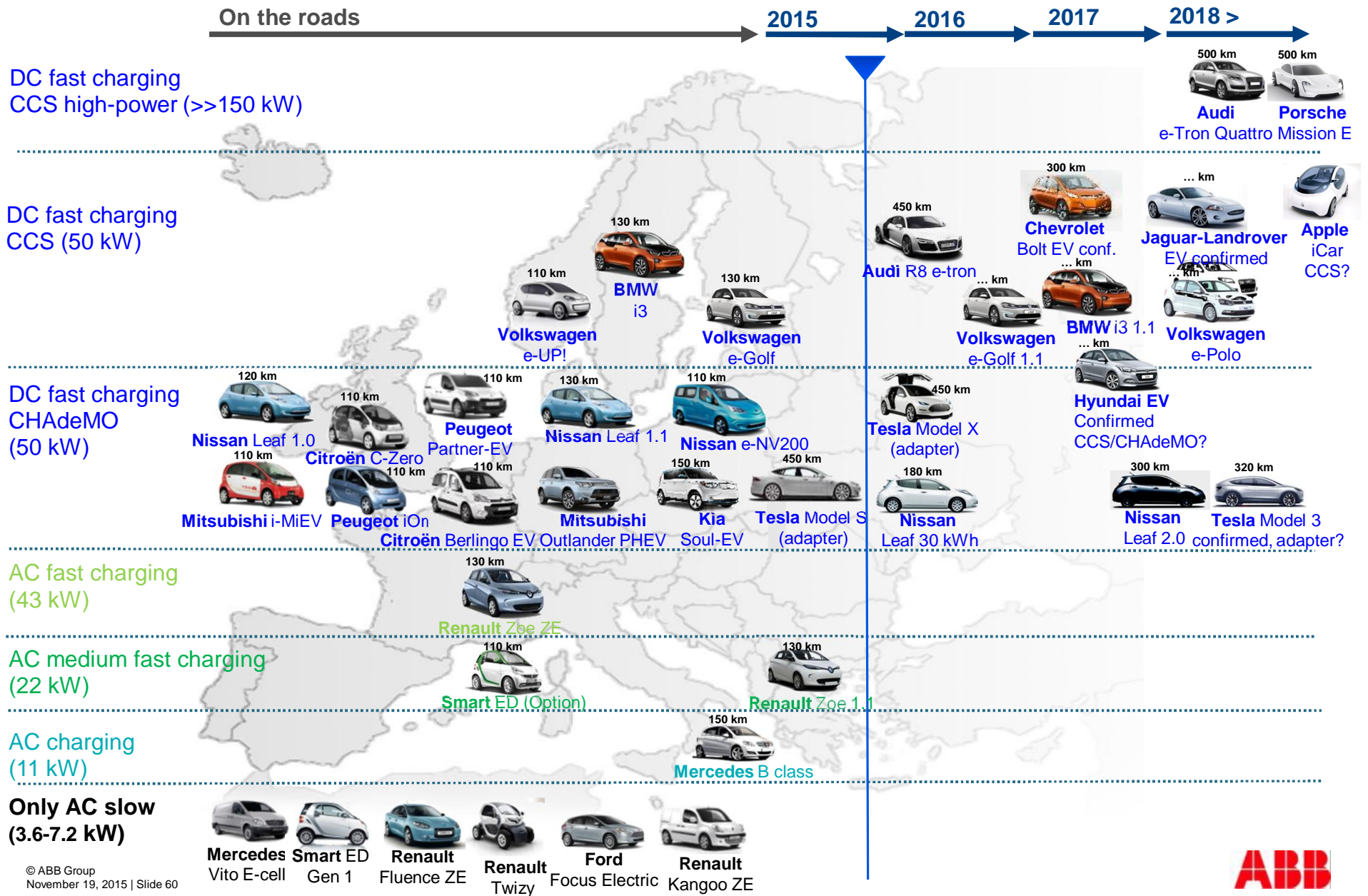


# Driver: The EV range roadmap for EU, USA, APAC

## Batteries get bigger, range gets longer



# Follow the car through Europe: Which car, when?



# Key car developments for EU region

## Step-by-step range improvement, long range in future

Mainstream segment



### Updated Leaf available in EU from Dec 2015

- Nissan Leaf update with 30 kWh battery (up from 24 kWh)
- 170-200 km “real” driving range
- 50 kW charging



### 2016-2017 expected: more small EV's with 30-45 kWh

- More mass market EV's with 30-45 kWh battery
- 170-250 km “real” driving range
- Mainly 50 kW charging capability

Premium

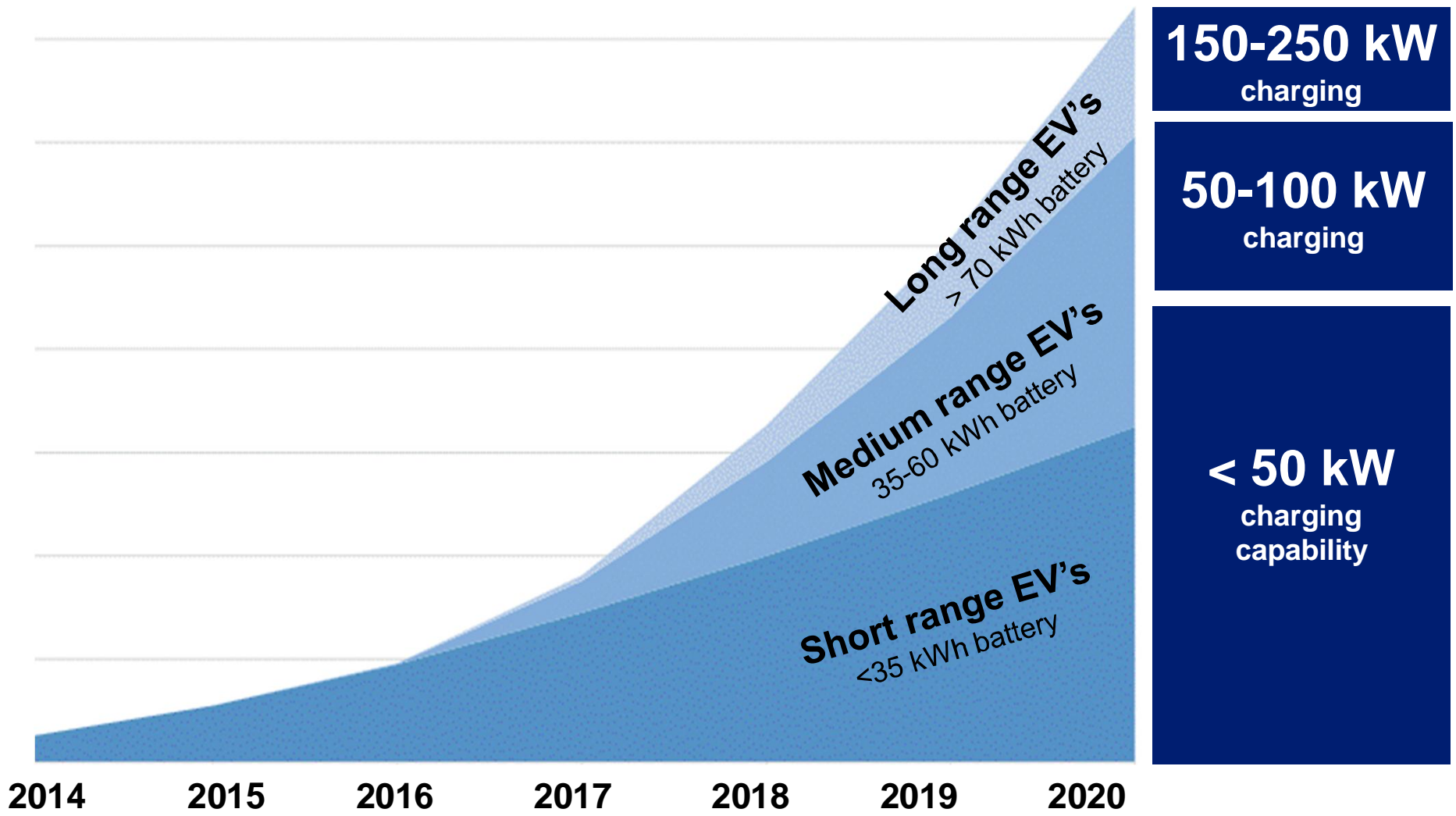


### Long range EV's from 2018 / 2019

- Audi & Porsche long range premium EV's
- > 450 km “real” driving range
- 150-250 kW charging (also 800 V)

# Cumulative EV population estimate EU

In 2020 most EV's on the road have < 50 kW capability



# Main trends in the coming years

## Many more locations and multiple chargers per site



Fastned in  
Netherlands  
2-3 chargers/site



Venucia Guanzhou  
>4 chargers/site



NRG-EVGO in USA  
2-3 chargers/site



City ring charge hub in  
Norway: 10 (!) DC fast  
chargers on 1 site

# Premium long range EV's from 2018 onwards >450 km range, charging power of 150-250 kW

Premium



## Long range EV's from 2018 / 2019

- Audi & Porsche long range premium EV's
- > 450 km “real” driving range
- 150-250 kW charging
- Charger must also supply 800V cars
- CCS standards change required



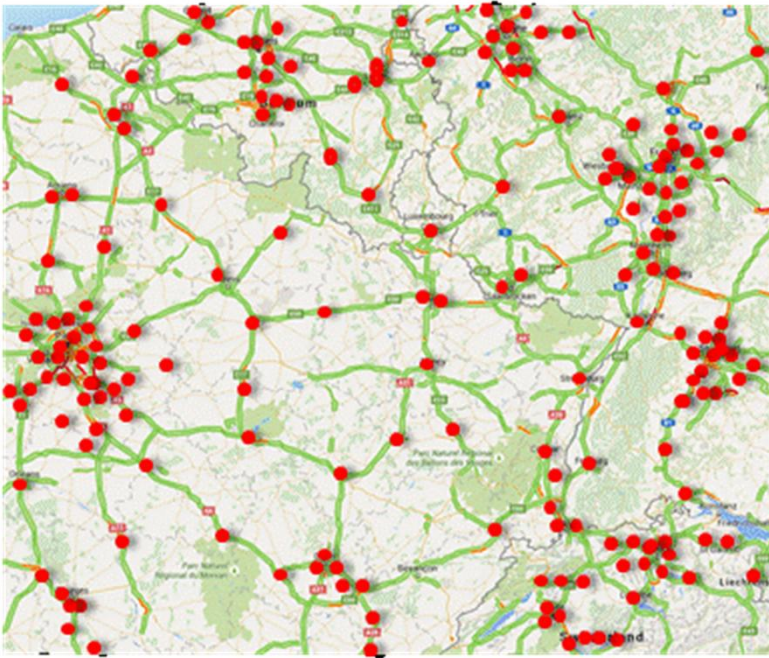
# ABB in the lead for high power standard CCS standard changes required for power >150 kW

Standard	Spec	Max charging power for EV car	Remark
CHAdeMO	50-500V, 125A	~50 kW	???
CCS 1/2	200-500V, 200A	~95 kW	Investigation to >>150 kW initiated CCS standard change will take ~2 years
GB/T	200-500V, 250A	~120 kW	???

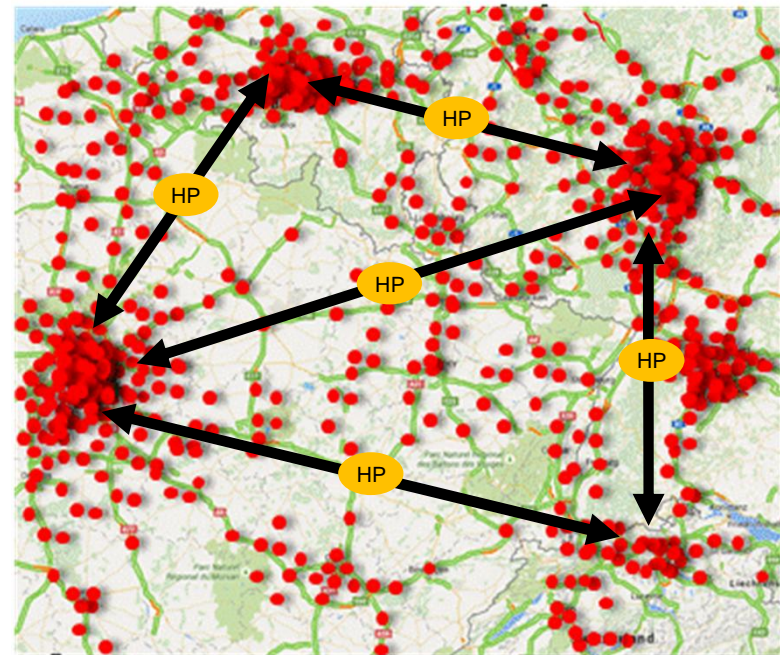
- 150 kW - 300 kW of power, up to 800V
- Same plug, change of standard required for safety & product certification
- Standard changes will take ~2 years
- Until ~2017 most EV's sold will have < 50 kW DC charging capability

# Different business cases for fast charging

## Dense networks vs. high power long distance corridors



● = 50 kW fast charger



● HP = High power fast charger (>150 kW)

● = 50 kW fast charger

### Today

- Short distance small EV's
- 100-150 km range
- 50 kW charging networks are growing

### >2017

- Fast growth of medium distance small EV's (150-300 km)
- Higher density 50 kW networks
- Introduction long distance premium EV's (>400 km range)
- High power corridors between cities

# First “High power ready” sites

## Preparing for the future & offering 50 kW solution today



- First “high power ready” site in Germany under SLAM project
- 2 x 50 kW charger installed
- Transformer prepared for >150 kW

### Fastned prepares for 300 kW charging

Posted September 28, 2015 by [Charles Morris](#) & filed under [Newswire](#), [The Infrastructure](#).



Automakers are touting ever-faster charging speeds – Audi and [Porsche](#) both showed concept cars at this month’s auto show in Frankfurt that they claim will be able to charge at speeds of up to 300 kW – and Dutch charging network operator [Fastned](#) is determined to be ready.

Fastned, which operates 38 stations in the Netherlands and is adding one new station per week, is making sure that all locations have grid connections with at least 630 kVa available. A theoretical EV that could handle this much juice could add 400 km of range in 15 minutes, according to Fastned.



- Fastned in Netherlands prepares some locations for future high power
- 2 x 50 kW charger installed
- Transformer prepared for >600 kW



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GET DAILY CHARGED NEWS

# DC-Wallbox

## 10-20kW / Project with Car OEM's



- ABB is working on a number of projects with Car manufacturers, like Porsche in Europe and Denza in China on DC-Wallboxes of 10 and 20 kW. Status: In production.
- The DC-Wallboxes are supplied with the car.
- A generic DC-Wallbox was shown on the eCarTec in Munich in October 2013, and is targeted in for Q1-2017.





November 17<sup>th</sup>, 2015

# eBus fast charging solutions

ABB Global Product Group Electric Vehicle Charging Infrastructure

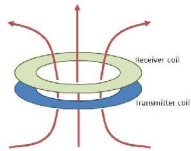
# Comparison of technologies

## Conductive fast charging is practical and cost efficient



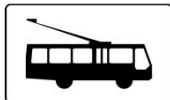
### Overnight charging

- Large and heavy battery inside vehicle
- Reduced passenger capacity



### Inductive charging

- Low energy efficiency
- High cost & weight inside vehicle
- High vehicle cost & complexity
- Expensive installation & maintenance



### Overhead wires / trolley

- Higher infrastructure cost
- Higher maintenance cost
- Visual quality problems in cities



### Hydrogen

- High cost busses
- High cost infrastructure
- Safety considerations



### Conductive fast charging

- Low cost & weight components inside vehicle
- Low vehicle cost & complexity
- Efficient energy transfer
- Robust & proven technology

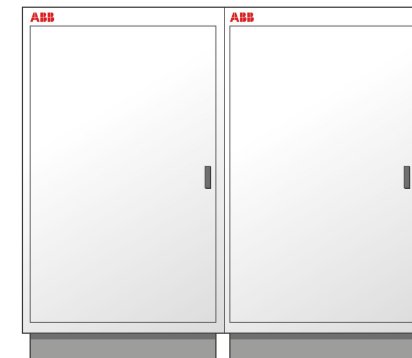
# A practical fast charging solution for e-busses

## Reliable, scalable, based on industry standards

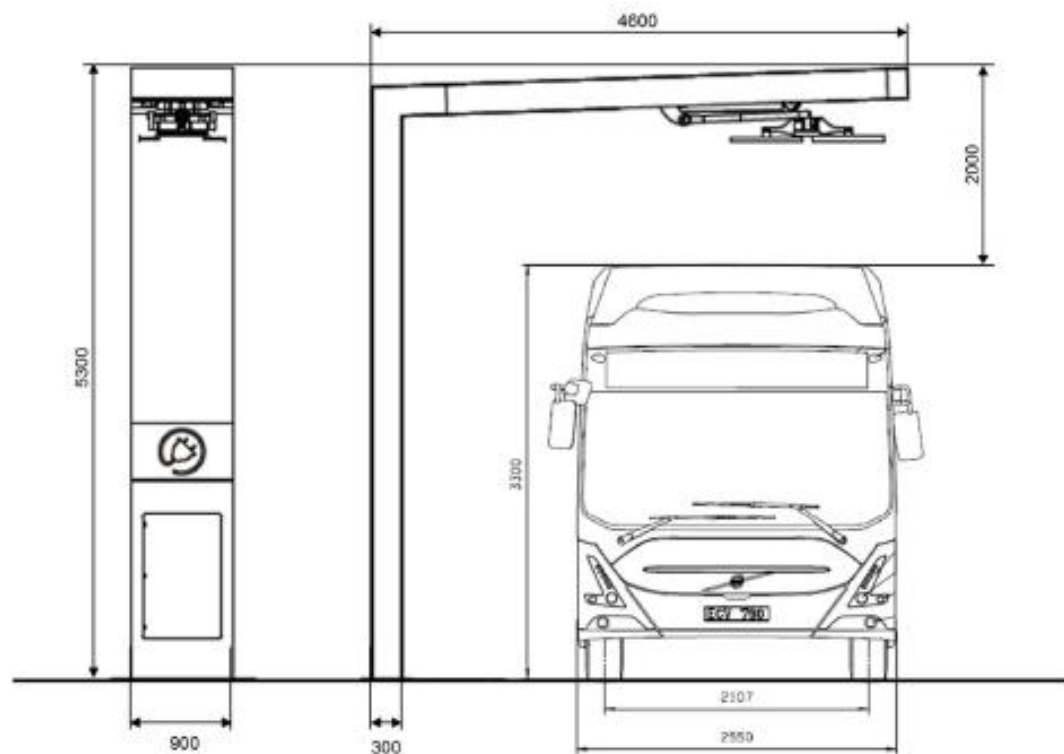


- Automated connection system
- High power DC transfer to bus
- Wireless communication to bus
- Based on
  - EN/IEC 61851-23
  - ISO/IEC 15118

- Industrial quality power cabinet
- 150kW, 300kW & 450 kW modular
- 400-850 V<sub>DC</sub>
- Galvanic isolation
- Based on EN/IEC 61851-23



# Charge mast with pantograph Standard ABB mast design





# Charge mast with pantograph

## Standard ABB mast design at Nordhavn st.



# Different business cases for charging infrastructure

## Summary

### Home & office charging



7-20 kW

### Metropolitan infrastructure



20 - 50kW

### Highway infrastructure



50 - 250kW

### E-bus infrastructure



150 - 450kW

*e.on*

**ABB**

**Tak for i dag**