



The future of new ultra-fast charging technology



Power Electronics & Energy Storage event
14 juni 2022 | 1931 Congrescentrum 's-Hertogenbosch

ENERGY STORAGE
EVENT 2022



What will our future look like?

Vrijhouden voor
camerabeeld

“Worden wachttijden bij laadstations nieuw obstakel voor elektrische auto’s?” nu.nl

“Groot tekort aan snelladers voor elektrische auto’s” - RTL Nieuws

“The Lack Of EV Charging Stations Could Limit EV Growth” - forbes.com



Source: AD



Source: Autoweek



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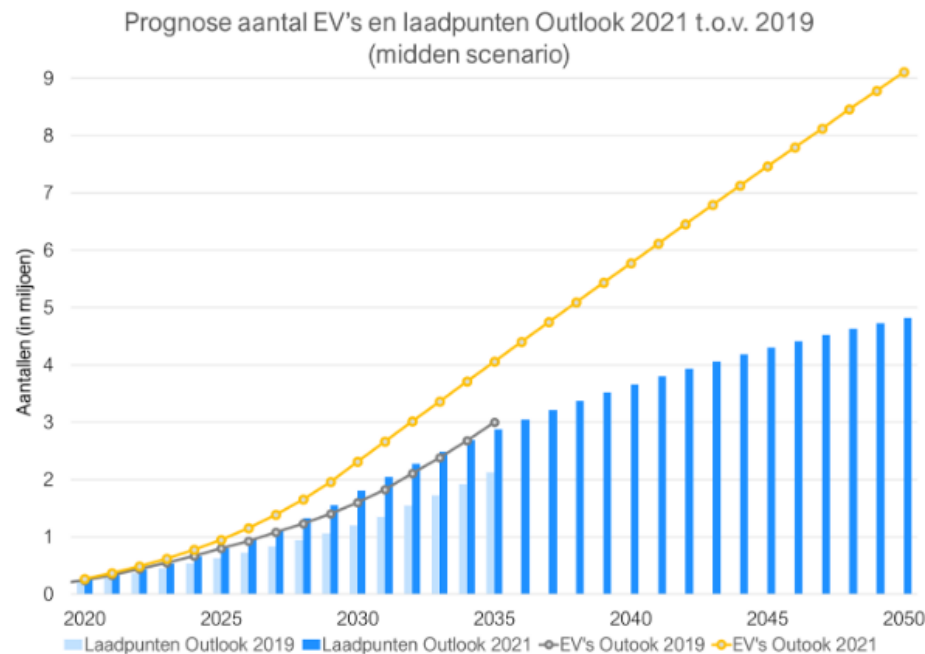
1st Challenge: Expected growth e-mobility

Vrijhouden voor camerabeeld

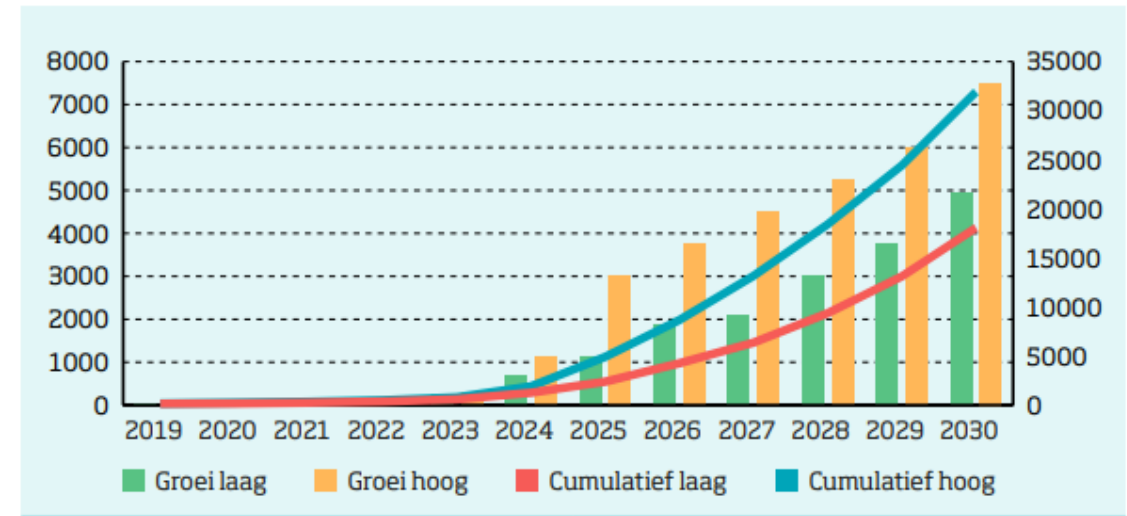
Glasgow Climate Pact:

2030 – 30% Zero emission vehicles

2050 – 100% Zero emission



Source: ElaadNL



Source: Natuurmillieu.nl

Commercial/heavy duty vehicles

2030 20.000 - 35.000

2050 150.000 100%

EV

2030 2.300.000

2050 9.000.000 100%



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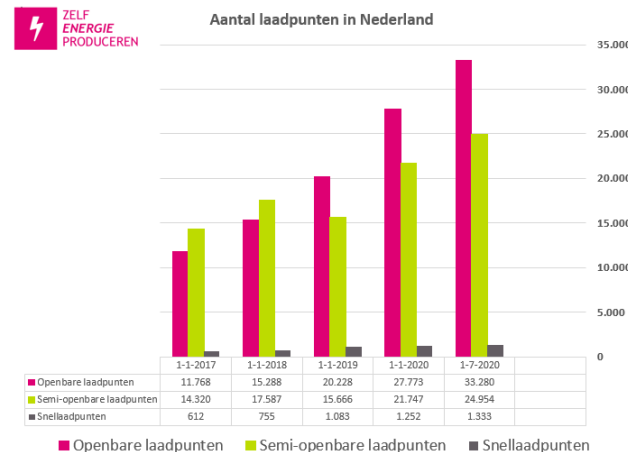
2nd challenge: Overloaded Dutch grid

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- Already a huge shortage grid capacity
- **Fast chargers with target charge 80% within 20-30 minutes**
 EV charging capacity: 50-80 kWh – 150kW
 Commercial vehicle charging capacity: 350-400kWh – 800kW
- **Example average future charge station:**
 20 EV 3 MW
 4 commercial vehicles 3,2 MW
Total capacity > 6MW
- **Required fast charging stations 2030**
 NL - 2.900 fast chargers in the Netherlands (including 115 for commercial vehicles) means
~ 10,8GW



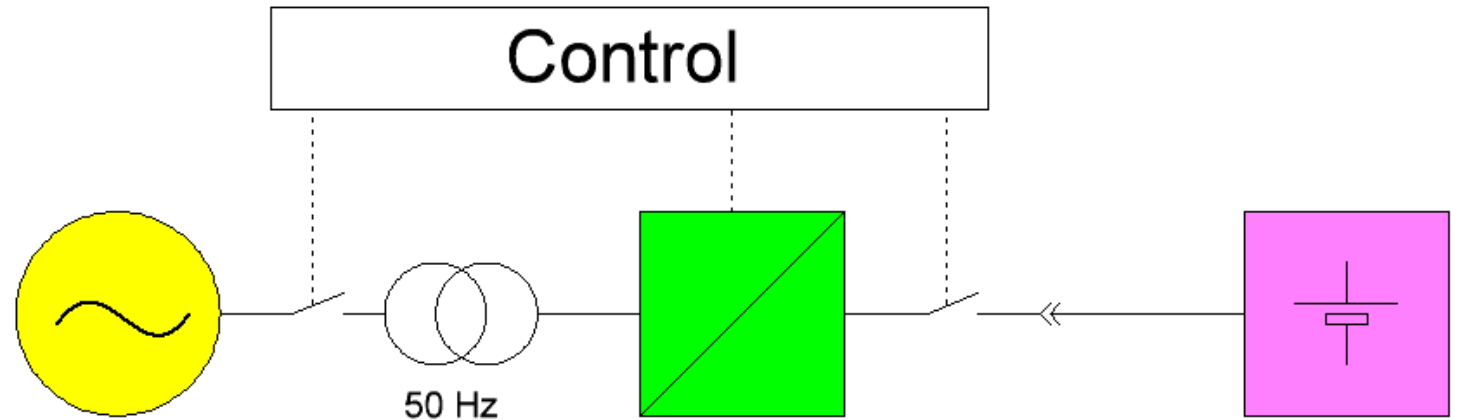
Source: regionale-energiestrategie.nl



Conventional Technology

Charge system with 50Hz transformer

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Transformer
Weight
Size
Total weight

120 kVA/50 Hz
383 kg
660 x 330 x 710
>600 kg

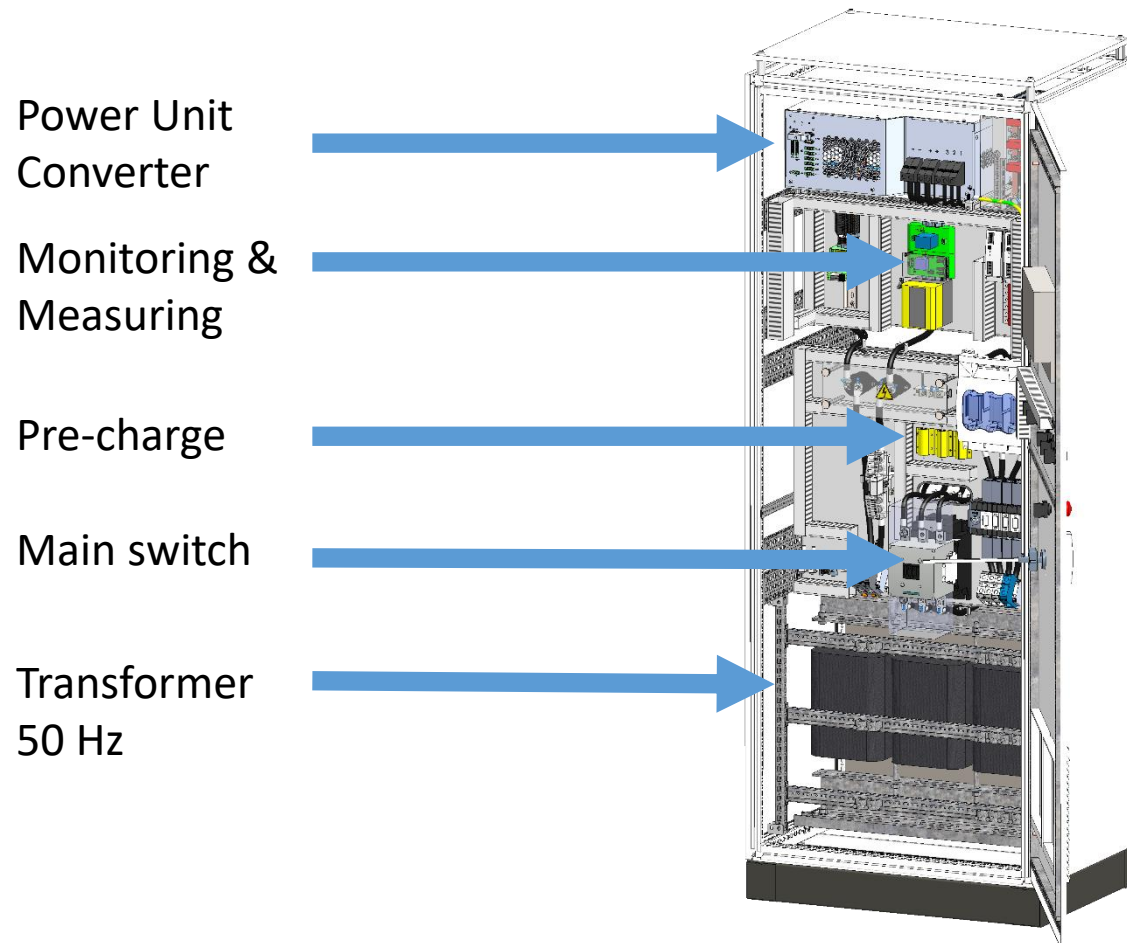


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Conventional Technology

Design of a 120kW charger with 50Hz transformer



Advantages

- Robust isolation transformer
- Proven power electronics technology (IGBT)

Disadvantages

- Large
- Heavy
- Noises from switching frequency
- Transformer costs
- Integration of an energy storage for more charge points only via AC-Grid



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Biggest main challenge



Improvements



Design requirements:

1. 50% smaller design
2. Noises <50dB(A) (Quiet street)
3. Power >750kW
4. Scalability
5. AC or DC supply
6. Efficiency
7. Energy storage capability
8. Good maintainability and availability, all parts should be replaceable in less than 30 minutes



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Better Solution Goals and Approach

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Design requirements:

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Approach:

- Substitution of the 50 Hz transformer
- SC with higher switching frequency (>16 kHz)
- High power stacks 125kW each
- Modular design
- Flexible design with two types of converter modules
- SC with low switching losses
- DC-link connection
- Less parts and easier accessible parts

- Compact design
- Noise
- High power
- Modularity
- Flexibility
- Efficiency
- Storage capability
- Maintainability

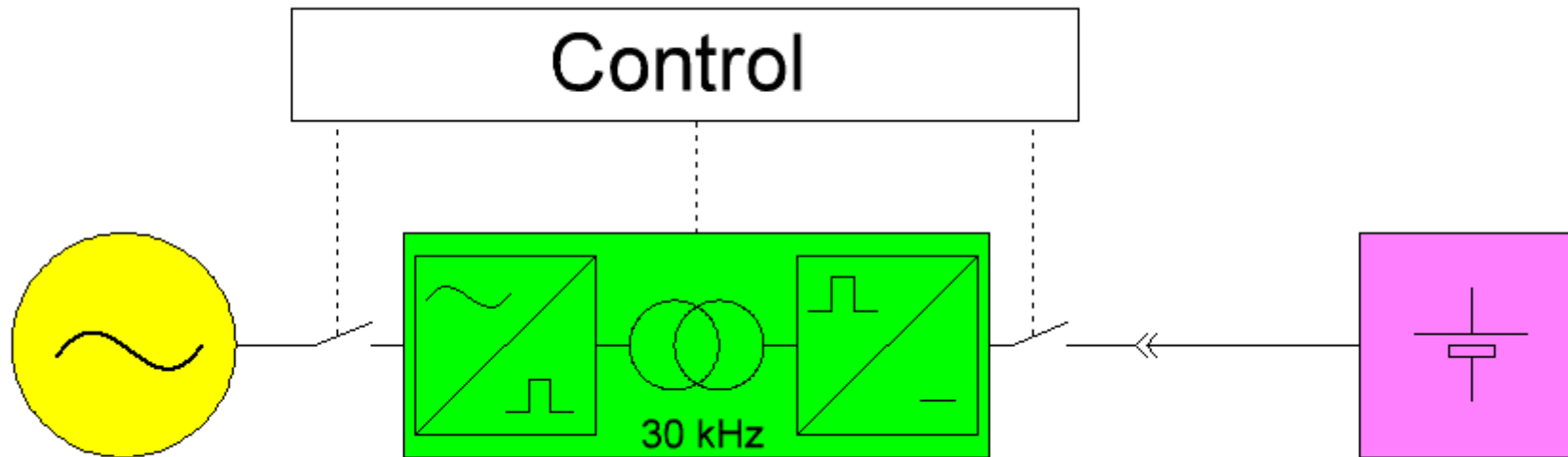
SC - Semiconductor



State-of-the-art Solution

Charge technology with mid-frequency transformer

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Transformer

Weight

Size in mm

Total weight.

50 Hz

100 kVA

383 kg

660 x 330 x 710

>600 kg

30kHz

100 kVA

15 kg

295 x 142 x 130

300 kg

- ✓ Compact design
- ✓ Noise
- ✓ High power
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Modular Design, less Parts

Charge technology with mid-frequency transformer

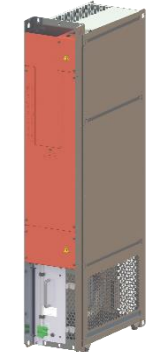
Vrijhouden voor camerabeeld

Feed-In from an DC supply

Precharge



DC-Input



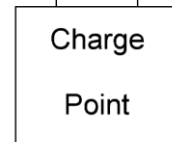
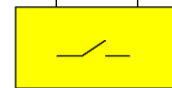
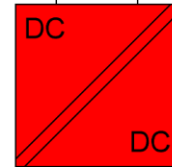
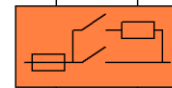
DC-Output



Output Switch



400...850 V DC



- Stackable DC/DC Converter → **125 kW**
- Increased power due to parallel operation
- Modular assemblies

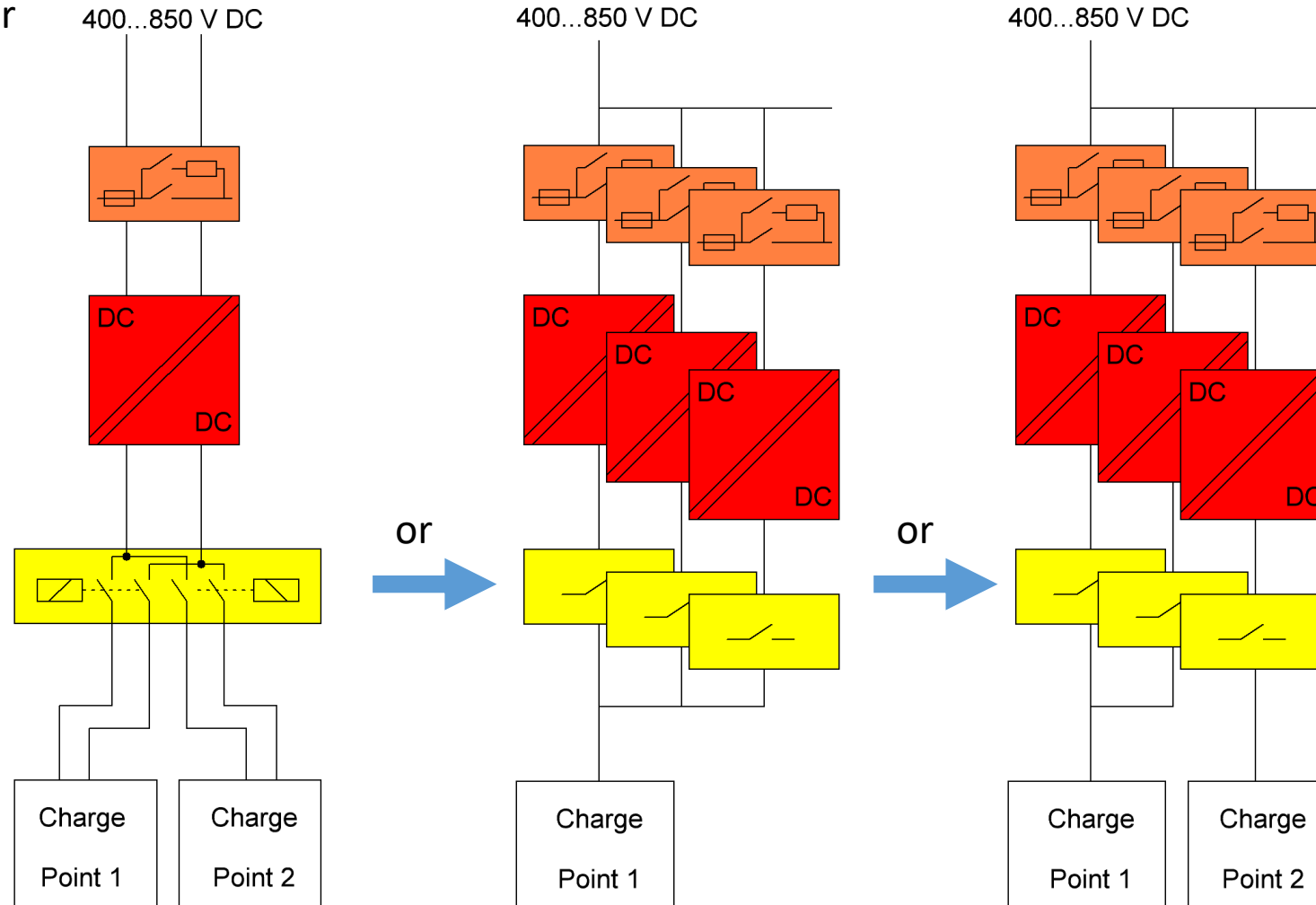
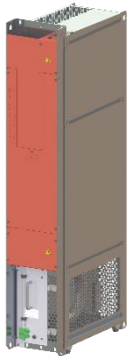
- ✓ Compact design
- ✓ Noise
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Flexible Connection Switchbox on output side

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- Flexible supply of one or more charge points
- Double-pole disconnection



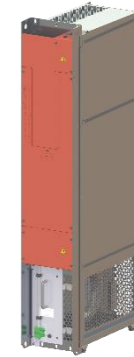
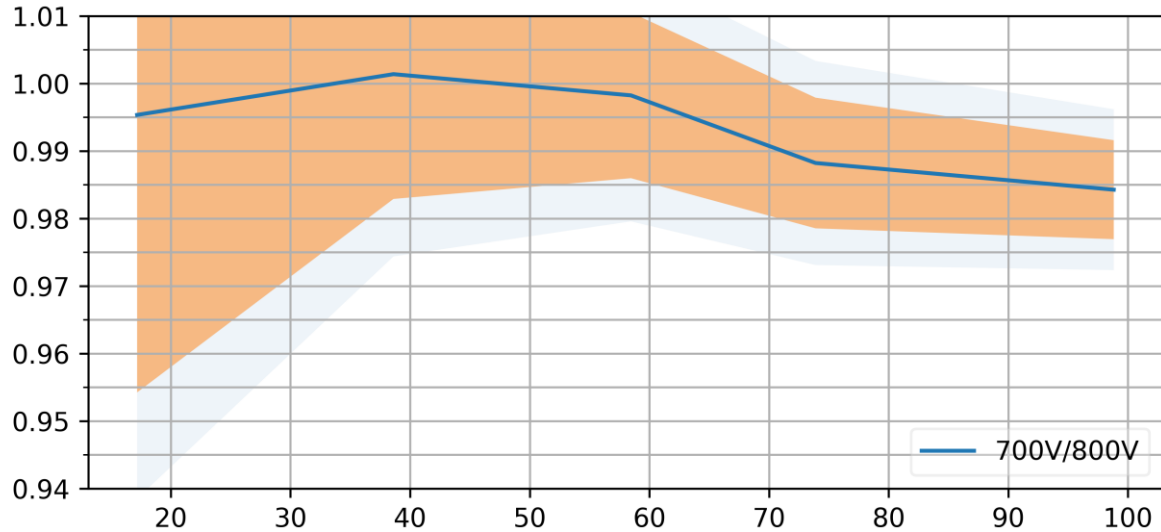
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Efficiency:

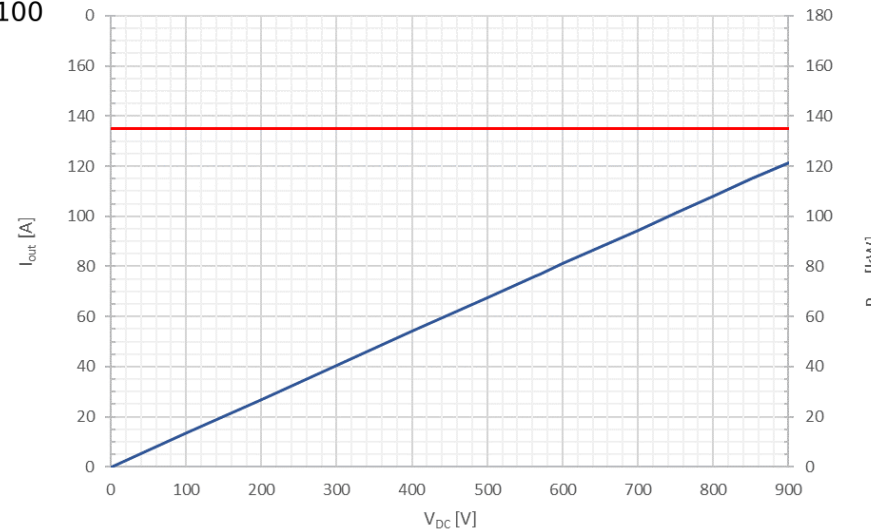
DC/DC Converter with galvanic isolation

Vrijhouden voor camerabeeld



- ✓ Compact design
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Continuous operating range
(blue power; red current)

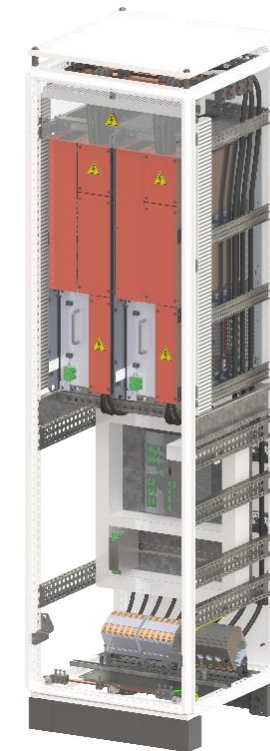
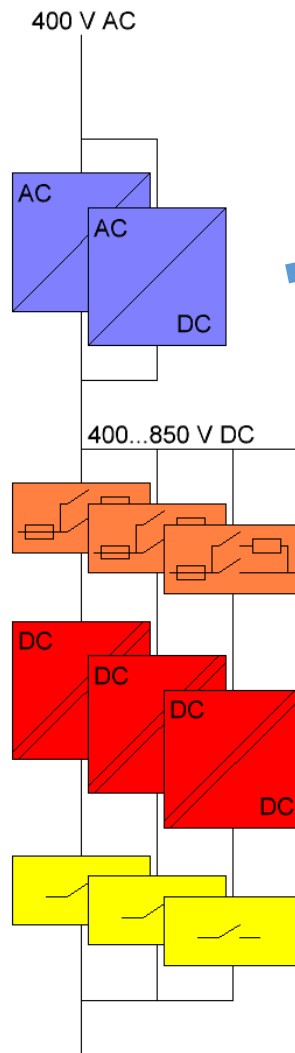
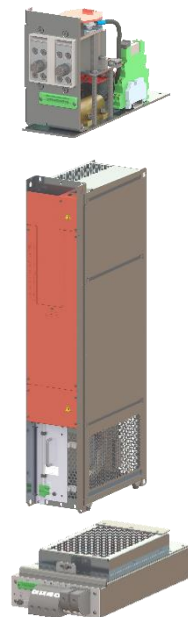


Feed-In through AC/DC converter

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AC/DC Converter

- Sinusoidal current consumption
- Increased power due to parallel operation



- ✓ Compact design
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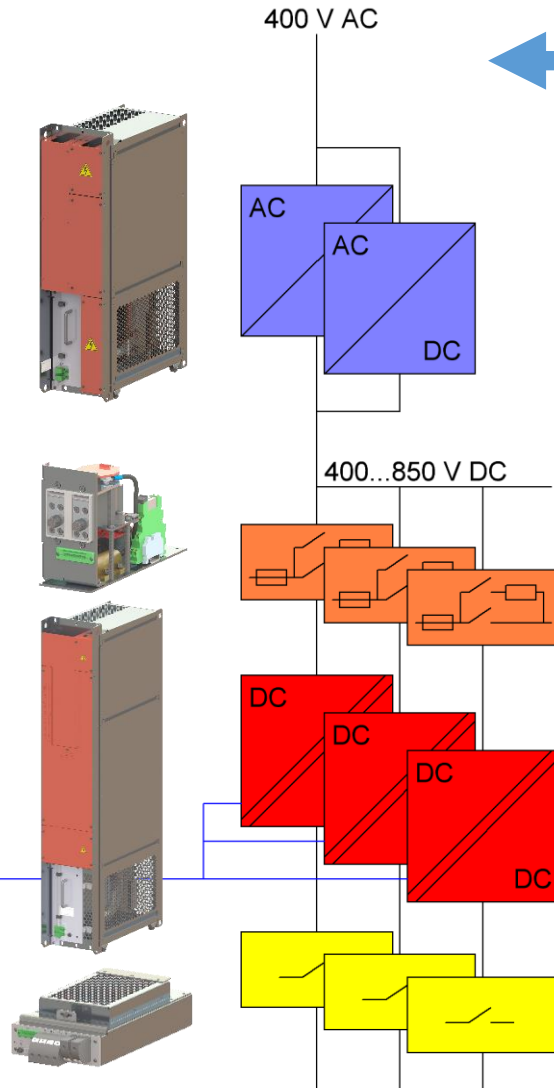
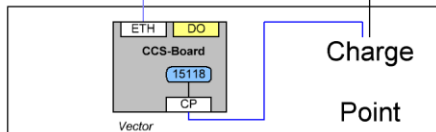
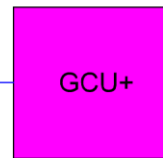
Charge System

General Control Unit –
Main communication interface
for charge stations



CANopen

PROFI
NET



← 400 V or 690 V AC

← 400 ... max. 1200 V DC

Vrijhouden voor camerabeeld

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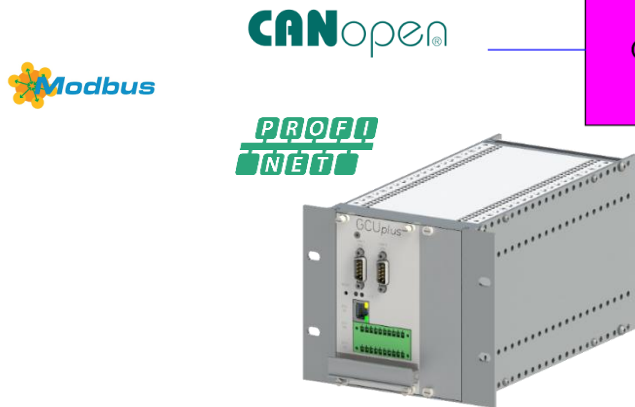


IEC 61851-23
CCS (ISO 15118)
OCPP

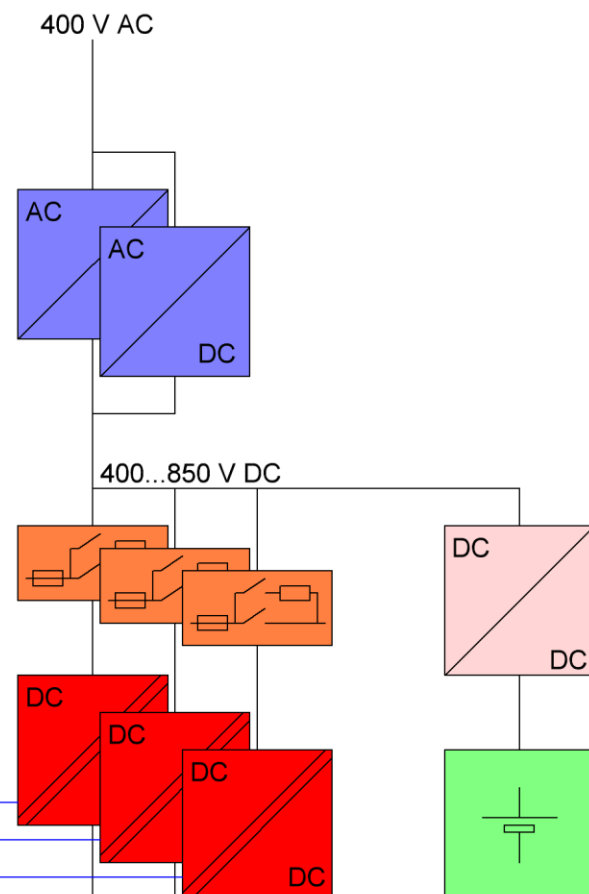
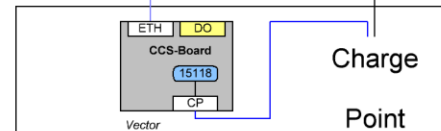
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Storage Capability

General Control Unit –
Main communication interface
for charge stations



IEC 61851-23
CCS (ISO 15118)
OCPP



Advantages

- Adaptable to different voltage sources due to modular design
- Redundancy due to parallel switching
- Easy integration of energy storage (e.g. Batteries)

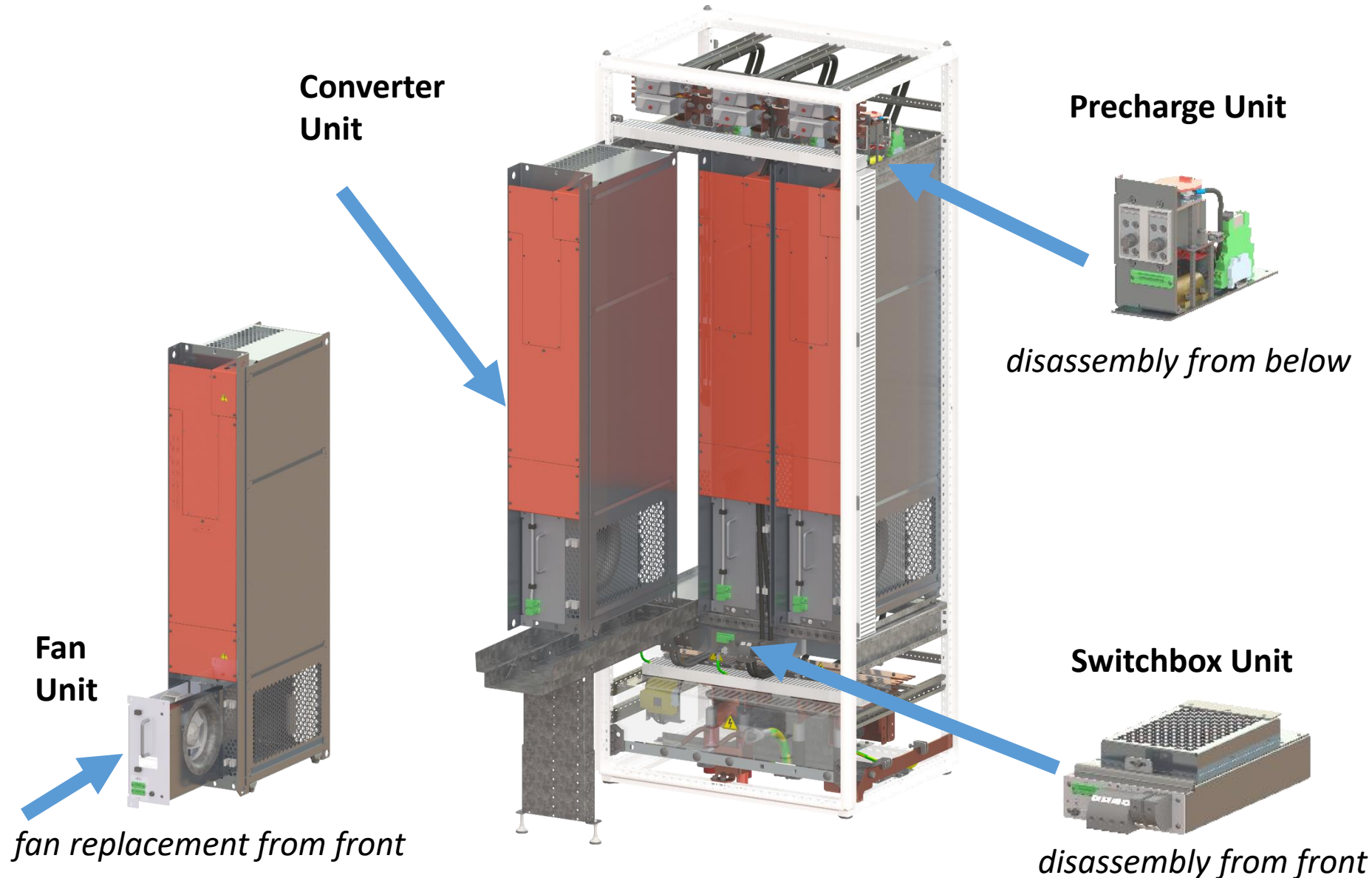
Vrijhouden voor camerabeeld

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Maintainability



Vrijhouden voor
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- ✓ Compact design
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Example



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Lessons learned and opportunities

- A need for compact scalable **Megawatt Charging System**
- Smaller grid connection by **Energy storage capability, Smart charging and more efficient systems**
- **Low noise emission** usage for urban and high populated areas
- **Easy maintainable**, few components all accessible from the front

Next steps/ opportunities:

- Connection to renewable sources or fuel cell
- Vehicle 2 Grid functionality



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Visit us at booth 4



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