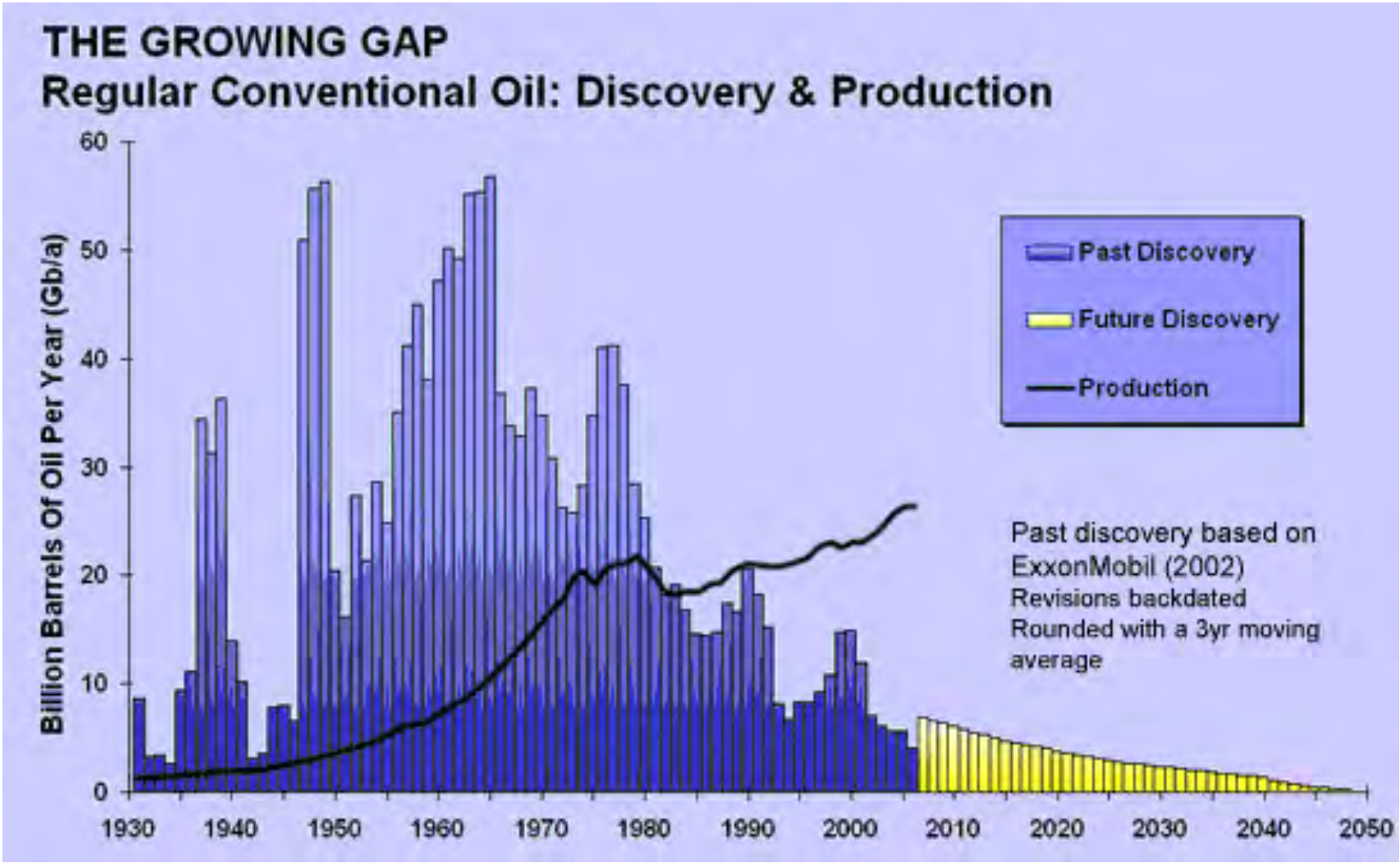
Electrification of heavy vehicles

HUBER+SUHNER
Excellence in Connectivity Solutions

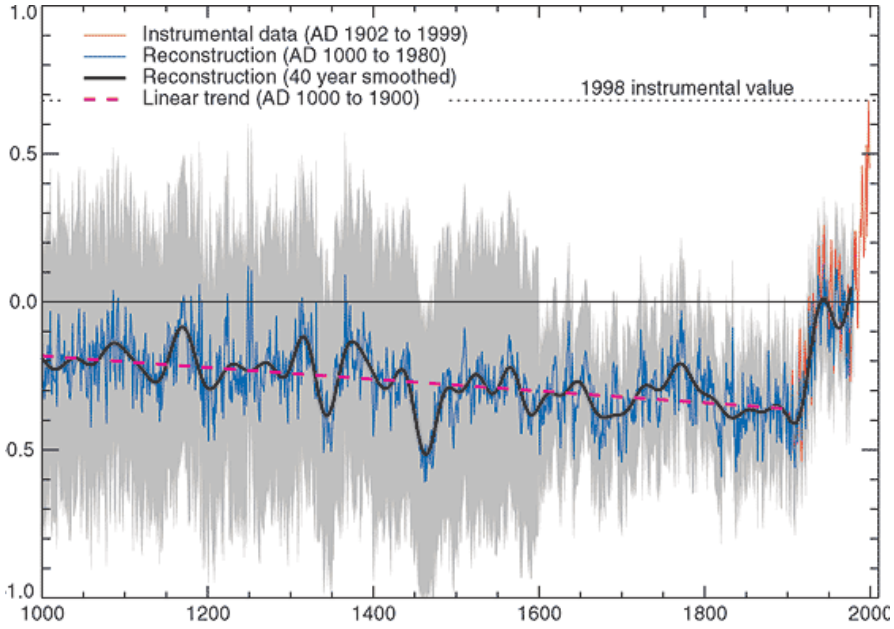
Agenda

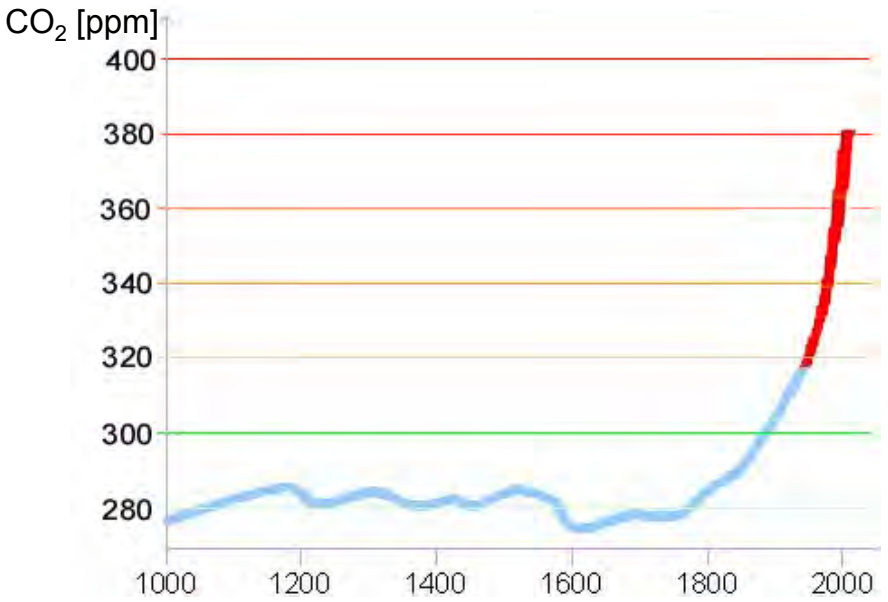
- Why electric mobility? Motivation?
- Electric Truck from e-force
- New components and suppliers enter the market
- International standardization
- Trends in electrification of heavy duty vehicles

Peak oil?


THE GROWING GAP
Regular Conventional Oil: Discovery & Production
Billion Barrels Of Oil Per Year (Gb/a)
60
50
40
30
20
10
0
1930
1940
1950
1960
1970
1980
1990
2000
2010
2020
2030
2040
2050
Past Discovery
Future Discovery
Production
Past discovery based on ExxonMobil (2002)
Revisions backdated
Rounded with a 3yr moving average

Carbon Dioxide Emissions?





Global warming?

The amount of snow and ice on the earth is decreasing!

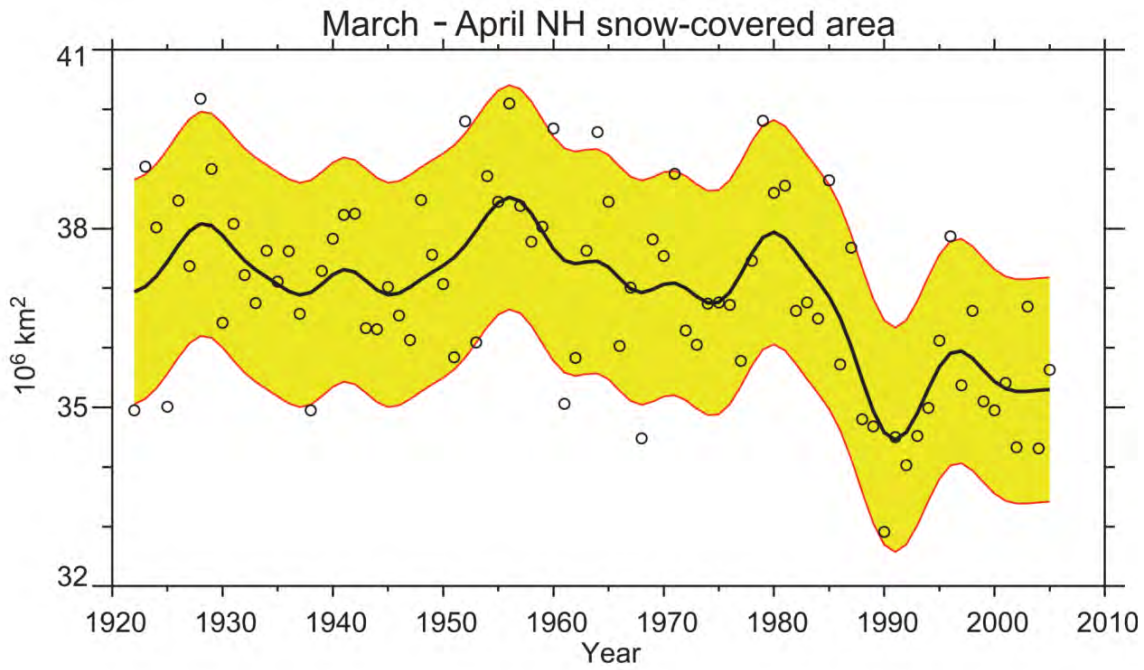


Figure 4.2. *Update of NH March-April average snow-covered area (SCA) from Brown (2000). Values of SCA before 1972 are based on the station-derived snow cover index of Brown (2000); values beginning in 1972 are from the NOAA satellite data set. The smooth curve shows decadal variations (see Appendix 3.A), and the shaded area shows the 5 to 95% range of the data estimated after first subtracting the smooth curve.*

Source: IPCC Fourth Assessment Report (AR4)

Efficiency?

- Average consumption of oil per person: 2 litres per day
- Worldwide consumption: 14 billion litres per day
- 50% goes into mobility!

Combined efforts

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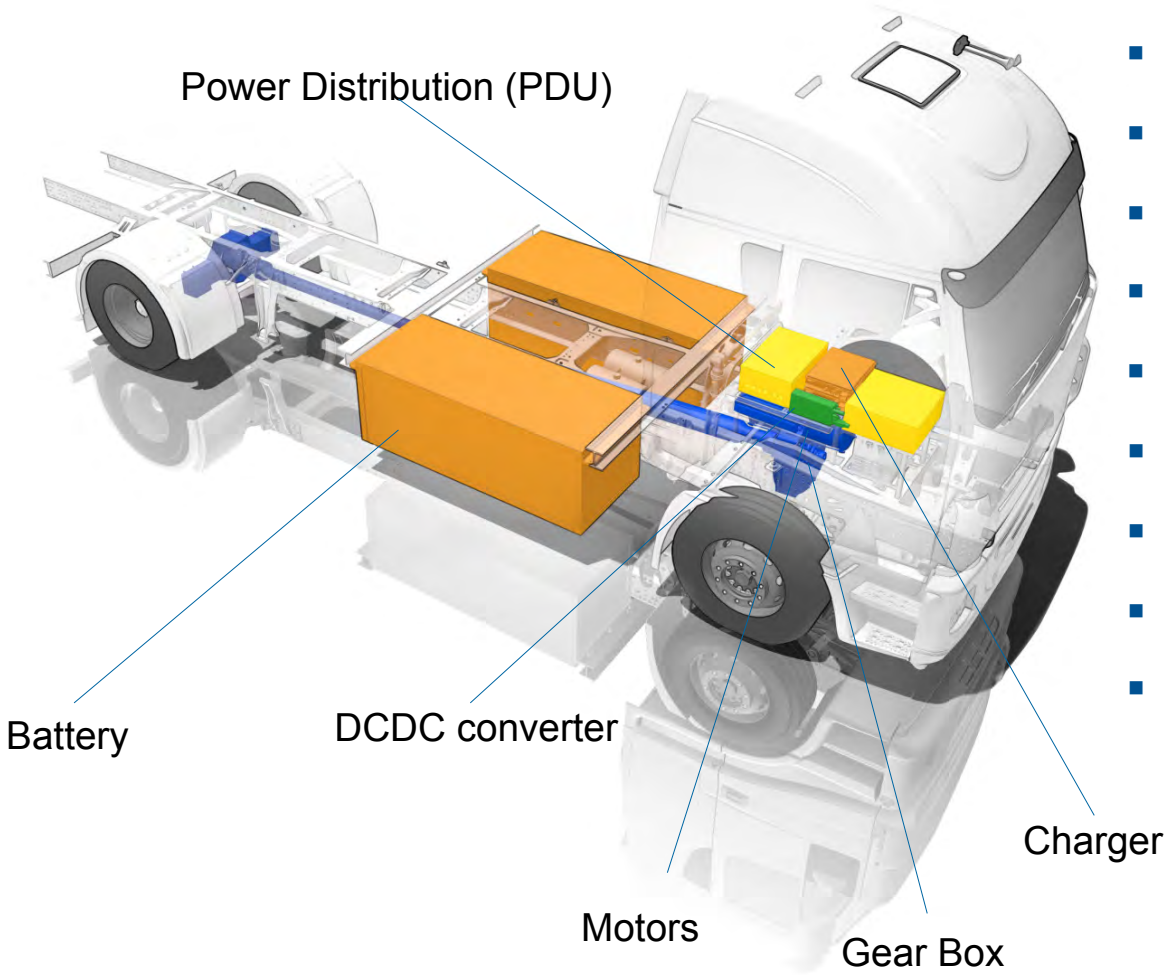
Eforce Electric Truck

- 18to Truck
- Based on IVECO Stralis model
- Full electric drive

Technology



- 2 synchronous motors (408Ps)
- 2x120 kWh LiFePo Batteries
- Time to charge: 6h
- Battery exchange: 5 Minutes
- Consumption: 70-120kWh/100km
- Range: 200-300km
- Top speed: 90km/h
- Gear: single speed
- Permitted load: 10’000kg

Practicality

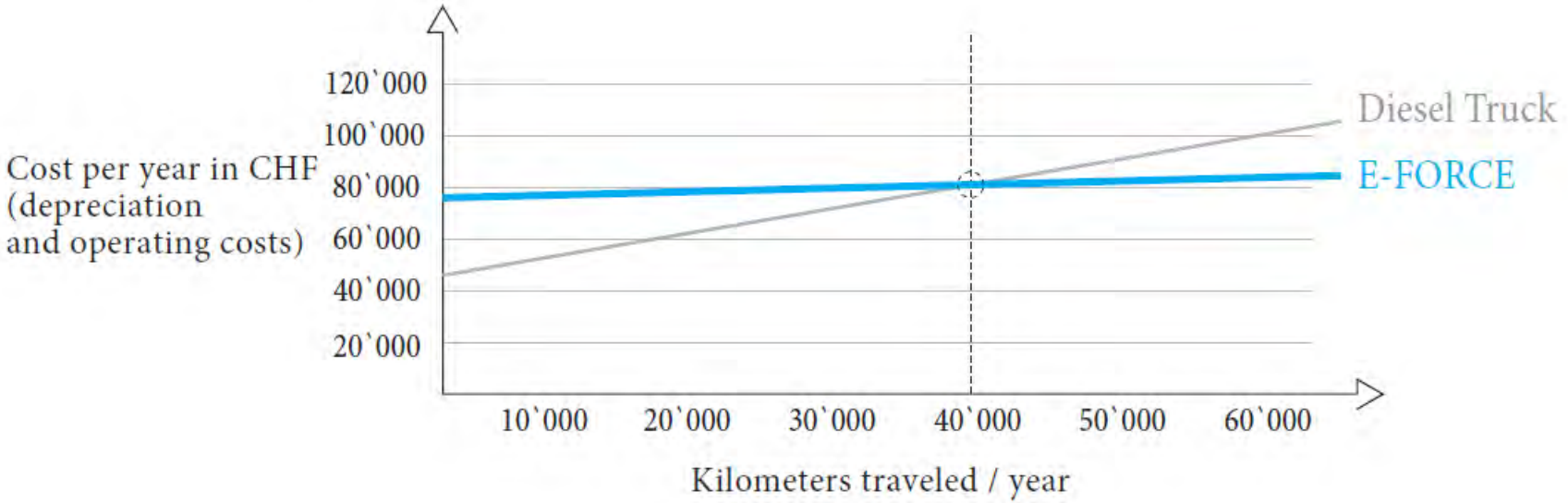
Ideal for urban use, because:

- High max torque
- Low noise (max. 45dB)
- Sufficient range
- Sufficient loading weight
- Easy to handle

Ecology

- No CO_2 emissions
- No emission of harmful substances such as sooty particles
- Low emission of fine particles
- Low noise

Economics



- Low energy consumption
- Low cost of operation
- Low cost of repair
- Suspension of tax (e.g. LSVA in Switzerland)

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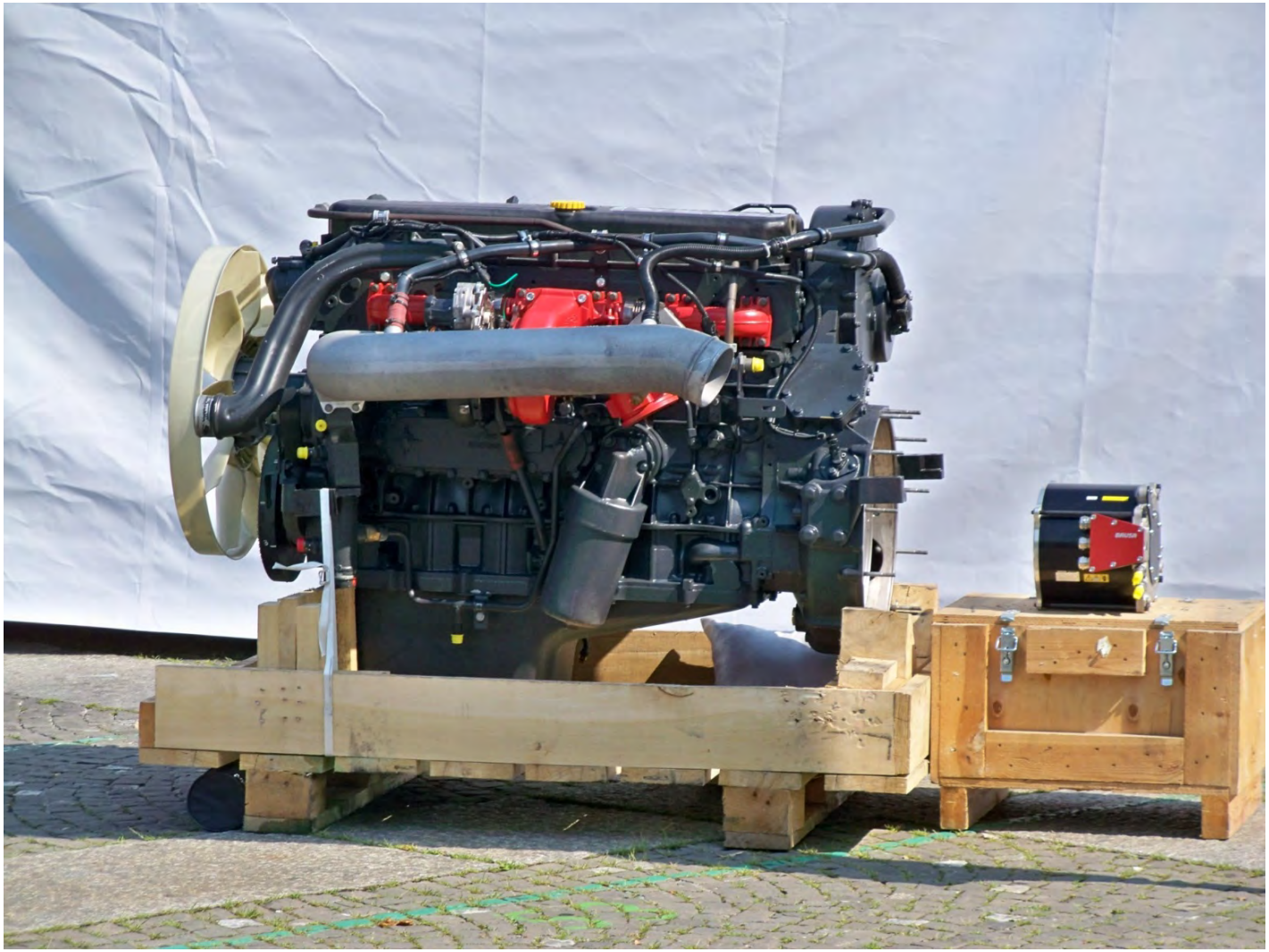
Diesel versus electric motor



Typical components in electric drives

Electric Motor

Battery

Power Inverter

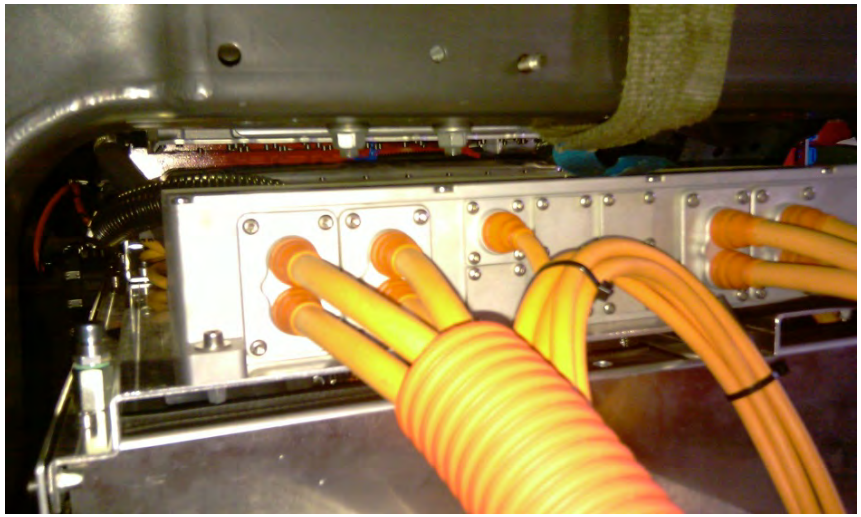
DC/DC Converter

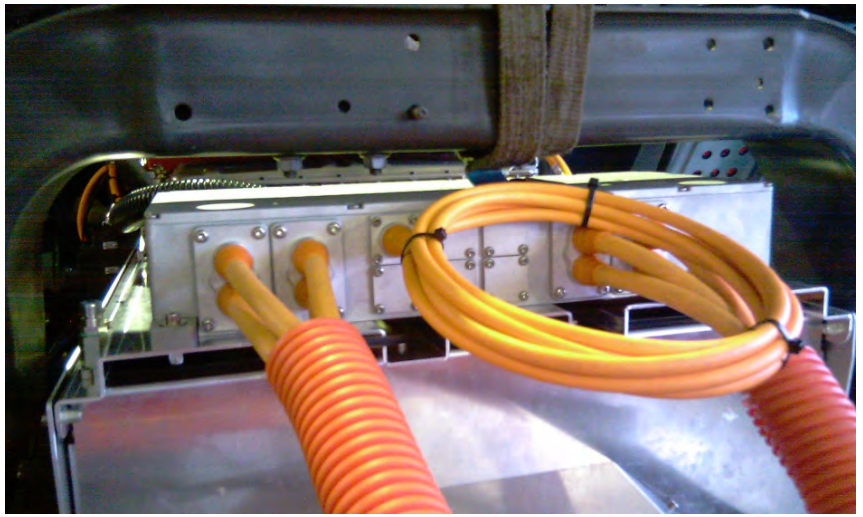
Power Distribution

Charging Module

Photos: Kind permission of Brusa Elektronik AG

HUBER+SUHNER customized power distribution box





- Compact and customized box (size restrictions)
- Robust connection system (vibration, electro magnetic compatibility)
- High voltage cables (RADOX®)

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Trends in cable standardization (1)

- Current international specifications: ISO 6722, ISO 14572
- OEM specifications are mainly based on ISO 6722
- ISO 6722 mainly defines cables up to 60V (600AC and DC)
- Little experience with higher voltages
- New structure to incorporate “high voltage” requirements needed for electric vehicles

Trends in cable standardization (2)

IEC voltage range	AC	DC	defining risk
High voltage (supply system)	> 1000 V	> 1500 V	electrical arcing
Low voltage (supply system)	50 – 1000V	120 – 1500V	electrical shock
Extra-low voltage (supply system)	< 50 V	< 120 V	low risk

Source: Wikipedia, IEC 60038

Trends in cable standardization (3)

Part 1: Terminology
Part 2: Test methods
Part 3: Dimensions and requirements for **30V a.c. or 60V d.c.** single core **copper** conductor cables
Part 4: Dimensions and requirements for 30V a.c. and 60V d.c. single core **aluminium** conductor cables
Part 5: Dimensions and requirements for **600V a.c. or 900V d.c., 1000V a.c. or 1500V** d.c. single core copper conductor cables
Part 6: Dimensions and requirements for 600V a.c. or 900V d.c., 1000V a.c. or 1500V d.c. single core aluminium conductor cables
Part 7: Dimensions and requirements for 30V a.c. or 60V d.c. round, sheathed, screened and unscreened multi and single core copper conductor cables
Part 8: Dimensions and requirements for 30V a.c. or 60V d.c. round, sheathed, screened and unscreened multi and single core aluminium conductor cables
Part 9: Dimensions and requirements for 600V a.c. or 900V d.c., 1000V a.c. or 1500V d.c. round, sheathed, screened and unscreened multi and single core copper conductor cables
Part 10: Dimensions and requirements for 600V a.c. or 900V d.c., 1000V a.c. or 1500V d.c. round, sheathed, screened and unscreened multi and single core aluminium conductor cables

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Legislation and governmental support

Low Emission Zones in Germany and Denmark (Environment Zones)

LESSONS FROM NORWAY'S ELECTRIC CAR PUSH

China announces new electric car subsidy program

Wednesday, September 18, 2013 Share

$19 million New York Truck Voucher Incentive Program Launched

> Projekte zur Emissionsverminderung im Inland

Ein Modul der Mitteilung des BAFU als Vollzugsbehörde zur CO_2-Verordnung

London tightens up congestion charge in attempt to drive out diesel

Definitions for electrified vehicles

Type	Energy	Drive
Conventional	Fuel from tanks	Combustion motor
Serial-Hybrid	Fuel from tanks	Electric motor
Parallel-Hybrid	Fuel & Electricity	Combustion & electric motor
Range-Extender	Fuel & Electricity	Electric motor
Pure electric	Electricity	Electric motor

Pure electric trucks for urban routes

Hybrid trucks

Only the sky is the limit

Only the sky is the limit

What is the right solution…?

Thanks

eforce one

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Excellence in Connectivity Solutions