Daimler Trucks & Buses: Commercial Urban E-Mobility

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Commercial vehicle e-mobility addressing several topics: CO₂ emissions and Local Air Quality

CO₂ emissions of commercial vehicles divided by different missions: 3 main segments cover 60% of all CO₂ emissions

- Long Haul: 40.9%
- Regional Delivery: 12.9%
- Service Delivery (3.5-7.5t): 11.4%
- Coaches: 6.6%
- Urban Delivery: 3.4%
- City Buses: 8.3%
- Construction: 12.2%
- Heavy Duty distribution traffic: 12.2%
- Public transportation: 3.4%

Commercial vehicle sector is highly diverse in terms of size and mission

Sources: AEA (2011)

Relative subdivision according to total CO₂ emission per year (EU 27, 2010)
The time is right
... as battery technology is improving

Forecast for development of battery performance and cost

<table>
<thead>
<tr>
<th>Year</th>
<th>Cost</th>
<th>Performance</th>
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<tbody>
<tr>
<td>1997</td>
<td>500 €/kWh</td>
<td>80 Wh/kg</td>
</tr>
<tr>
<td></td>
<td>down by factor 2.5</td>
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<tr>
<td>2009</td>
<td>200 €/kWh</td>
<td>200 Wh/kg</td>
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<tr>
<td></td>
<td>up by factor 2.5</td>
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</table>
Why does e-mobility work now?
The time is right ... as battery technology is improving

- Battery capacity
- Range
- Payload
- Cost
- City bans

(Daimler Trucks & Buses: Commercial Urban E-Mobility / Dr. M. Schuckert / Nov. 2016)
The Development of Fuso Canter E-Cell

- **Introduction**
  - Canter Eco Hybrid

- **FUSO Canter E-Cell@IAA**

- **2nd Generation Canter E-Cell**

- **Fleet test**
  - Portugal
  - Stuttgart

- **Timeline**
  - 2006
  - 2010
  - 2014
  - 2015
  - 2016
The Fuso eCanter
Agile and flexible for light duty distribution

Lithium-ion batteries with capacity of 48.4 kWh:
- Test range of about 100 km
- Different battery capacities for different applications available

Powerful electrical engine with 110 kW and 650 Nm
- Permanent magnet engine, 400 V
- Max. torque at wheel: 4,330 Nm
- Traction force @ wheel: 18° slope rate
- Liquid-cooled, increased durability and efficiency
- Serving as generator for recuperation
State-of-the-art quick charging system

On board

- Standard household plug and quick charging
- Charging time between 7 hours to only 1 hour
Innovative electrified components ...  
... combined with standard components for maximum reliability

Innovative - e.g. the high voltage (HV) net:
- Heater unit for cab
- Power steering pump
- Air conditioning compressor

Take-over drivetrain components from conventional Canter:
- Chassis
- Comfort cabin
- Propeller shaft
- Differential and axle gear
Fleet test in Portugal: 50,000 km driven without major failures or breakdowns

**Extensive fleet tests of electric trucks in Portugal - experiences:**

- Capable of dealing with hot weather conditions
- 50,000 km driven without failures or break downs
- 1,000 Euro cost saving per 10,000 km compared to a conventional truck

Presently ongoing field tests in Stuttgart area ...
The Mercedes-Benz Urban eTruck
A completely new concept for heavy duty distribution

3 battery packs
- Placed inside frame
- Protected against side impact
- Lowering center of gravity: Increased rolling stability
E-Axle: Core of an efficient drivetrain
Portal axle for truck application: 200 mm ground clearance

HV Electric Drive,
ZF AVE 130-400 VAC modified

- PPpeak 2 x 125 kW / PCont 2 x 60 kW
- Max. motor rotation: 11,000 rpm
- Max. torque: Mmax 2 x 500 Nm

Significant advantages compared to central E-motor

- 11.5 tons permissible axle load – same as conventional drivetrain
- Additional space for batteries
- Installation of additional drive axles possible
Charging concept
Direct Current (DC) charging with external station

Rapid charging – extremely important for heavy duty trucks

External charging unit offers several advantages

- Saving vehicle weight
- Saving costs for customers
- Standardized charging connector, no adapter needed: Combo-Standard, Type 2 *
Current perception shows large potentials to raise energy content of batteries with equal assembly space until 2030.
Daimler Buses active in the field of E-Public Transport for more than 40 years

- O 520 Cito: 368 vehicles
- Citaro F-CELL Gen. 2: 21 vehicles
- Citaro BlueTech Hybrid: 91 vehicles
- Citaro F-CELL: 36 vehicles, >2,150,000 km
- Citaro F-CELL-Hybrid: 23 vehicles, >700,000 km
Daimler Buses focuses on TCO optimized vehicles and emission free driving for city bus application

**Nearly Emission Free**
- Benchmark TCO & fuel economy Euro VI products
- Continuous CO₂ optimization
- Downsizing
- Compact hybrid
- Diesel & NGT drivetrain

**Partly Emission Free**
- Only partly emission free driving possible < 30km
- Full size plug-in hybrid

**Emission Free**
- Zero emission driving for city traffic
- E-Mobility Platform Citaro
- E-CELL & F-CELL vehicles
Summary

**Challenges still ahead**

- Batteries still too expensive – significant cost reduction still necessary
- Lifetime of batteries under HD applications
- Heavy duty requirements to be addressed
- Customers need to adopt to technological performance
- Charging infrastructure still very expensive and for HD not yet available
- TCO advantage not yet given in every segment......and many more...

**Conclusions**

- Especially for inner city applications E-Freight could become a competitive alternative to conventional drivetrains
- Vehicle costs are still very high and much dependent on required range
- Customers required to build up new Competences
- Governments at least for the next years need to support these activities
  ......still quite a long way to go