eHighway
The efficient and cost-effective solution for heavy duty road transport
Energy security, environmental & economic benefits are achieved by cutting fuel consumption – but how?

Hybrid Technology Prospects

Potential fuel saving

- Refuse truck: 25 - 35%
- Long haul truck: 5 - 8%
- City bus: 20 - 35%
- Wheel loader: 20 - 50%

Consumption breakdown:
- Long haul: 37%
- Others: 37%
- Utility: 5%
- Buses: 9%
- Construction: 13%

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Long haul is the largest and most difficult challenge in reducing HDV fuel consumption

Long haul should be the priority for development activities.
Possible development of CO₂-emissions from road freight in Germany

Source: German Ministry of Environment (BMU)
Possible development of CO₂-emissions from road freight in Germany

Source: German Ministry of Environment (BMU)
EU road-freight emissions are a major challenge

Explanation for project ENUBA (Elektromobilität bei schweren Nutzfahrzeugen zur Umweltenlastung von Ballungsräumen)\(^1\)

- Freight traffic in Germany is expected to grow by 116% from 2005 to 2050 (Progtrans study conducted for Bundesministerium für Verkehr, Bau und Stadtentwicklung, BMVBS)

- Goal of the EU-Commission:
  Reduce CO\(_2\)-Emission from transport by 60% of 1990 level by 2050

- Logistics optimization and capacity investment of rail system cannot significantly reduce heavy duty road transport

- Heavy duty road transport is responsible for a third of overall transportation-related CO\(_2\)-emissions – technical solutions are still absent

\(^1\) Translation: Electromobility for heavy commercial vehicles to decrease environmental pollution in urban agglomerations
Investigation showed overhead contact line system had advantage in functionality, cost and safety

Overview alternative concepts

External power supply
- Contactless
  - Linear s. motor concepts
  - Inductive power supply
- Conductive
  - Ground based contact line
  - Overhead contact line

On-board storage
- Electricity
  - Fuel cell
  - Capacitors
  - Battery
- Alternative fuel
eHighway innovatively combines mature and well-proven technology components

- Rail electrification
- Operation systems
- Electric / automated vehicles
- Intelligent traffic solutions
- Rail automation
- Operation system
- Road electrification
- On-board equipment
- Smart roads
Siemens eHighway Technology

Film clip
The eHighway infrastructure is able to integrate a wide range of drive train technologies

Range of drive train integration possibilities

**Hybrid concepts**

- **Types of combustion engines**
  - Diesel engines
  - Gas engines: Compressed natural gas or liquefied natural gas

- **Parallel hybrid**
  - Combustion engine as primary power source
  - Supplementary electric engine, power supply via catenary system

- **Serial hybrid**
  - Full power electric drive
  - Combustion engine e.g. as range extender or generator

**Full electric concepts**

- **Full electric operation**
  - Fuel Cell
  - Batteries
  - Ultra capacitors

- **Recharging schemes**
  - In-drive via catenary system
  - Stationary via plug-in

- **Combination of on-board storage and continuous power supply**
  - Increased lifetime of storage systems
  - Zero emission last mile operation

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eHighway – electrification of hybrid trucks via an overhead catenary system brings many benefits

eHighway system description

**Siemens eHighway**
An approach to electrified heavy duty road transport, which reduces emissions, is economically feasible and efficient

- Optimized efficiency due to direct energy transmission
- Energy recuperation and exchange between decelerating and accelerating trucks, excess brake energy feed-in into power grid possible
- Safety of catenary system operation has been proven in various road traffic applications (e.g. trolley buses, tramways)
- Experiences from rail and tramway underline extensive life-cycles and low operation and maintenance costs
- Swift integration into existing traffic infrastructure and no concessions on operation of alternative vehicles
Siemens eHighway test track

Film clip
Main eHighway applications include shuttle as well as mine transport and long-haul traffic

Potential eHighway applications

**eHighway application fields**

**Shuttle transport**
- Solution for high frequency shuttle transport over short and medium distances (<50km)
- Lower fuel consumption and longer lifetime
- Reduction of air and noise pollution

**Electrified mine transport**
- Connection of pits and mines to storage or transit locations
- Minimization of harmful emissions
- Sustainable, clean and economical mine operation

**Electrified long-haul traffic**
- Economical and sustainable alternative for road freight transport
- Significant reduction of CO₂ emissions
- Substantial cost savings for freight carriers
eHighway is developing quickly and is ready for commercial use in near future

Positive response

Project
- Signed development cooperation with SCANIA
- 2.1 km with road realistic conditions including curves, sign post, etc and equipped with traffic management systems
- Demonstration on public road and/or in commercial use project planned

Market
- Several potential applications in Scandinavia
- Strong interest in California, port of LA
- Positive feedback from Asian market
- Independent reports confirm the potential of the system
Early adopters
How and where eHighway is beginning to catch on

Germany  Sweden  Southern California
Germany
Government backing eHighway and wider interest

Project phases

ENUBA

ENUBA2

Description

- BMU* and Siemens start EUNBA in 2010 with the objective “to examine whether heavy goods vehicles for road freight transport could be converted to electric, contact wire-based operation, and to demonstrate the technical feasibility of the system on a test track. “

- BMU* report on result in 2012: “ENUBA project has certainly laid the foundations for an innovative, ecologically oriented concept for the transportation of goods “

- Started ENUBA2 in 2012 with the main goal of creating a total system for contact wire electric operation of heavy vehicles for goods transportation on public roads

  - Scania cooperation to develop the technology and producing vehicles for commercial use

  - In-depth investigation of the technical, economical and ecological aspects, together with BMU, BMVBS (Ministry for Transport) and expert institutes

Independent support

- The Association of German Freight Transport (BGL) is pushing for the development of commercial vehicle technology that is independent of fossil fuel. BGL sees ENUBA as “especially promising“

- The expert advisory council (SRU) to the federal government on environmental topics analyzed how Germany can reach its green-house gas emissions goal. They concluded that even after reducing the need for transport and shifting freight to rail there will remain a need to change the energy use in road freight. This makes eHighway a “very promising option”

*BMU: – Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit - German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety
Trafikverket (the Swedish Transport Administration) initiated an Innovation Procurement Process (IPP) for demonstration projects with electric road systems for heavy traffic.

Aim of the call:
Realization of demonstration projects for electrified roads for heavy vehicles as basis for deciding whether to introduce electric roads as part of Sweden’s road transport network.

Four Phase Approach:
- Phase 0: Expression of interest, qualification process
- Phase 1: Concept description
- Phase 2: Detailed design
- Phase 3: Creating a demonstration system

Preliminary budget of 11,5 M€

Preliminary Schedule:
- 11.07.13: Phase 0 - Call issued
- 26.10.13: Submission of Application
- Dec. 13: Phase 1 - Submission of concept description
- Feb. 14: Phase 2 - Awarding detailed design
- April 14: Submission of detailed design
- Nov. 14: Phase 3 - Start realisation
- Feb. 15: Contract
- 2015-2017: Demonstration, operation

Go/NoGo
## Southern California
Shuttle transport and regional scale up

<table>
<thead>
<tr>
<th>Demonstrator</th>
<th>Near-dock rail connection</th>
<th>Interstate-710</th>
<th>Regional connection</th>
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<tbody>
<tr>
<td><img src="image1.png" alt="Map" /></td>
<td><img src="image2.png" alt="Map" /></td>
<td><img src="image3.png" alt="Map" /></td>
<td><img src="image4.png" alt="Map" /></td>
</tr>
<tr>
<td><strong>Length:</strong> ~1 mile</td>
<td><strong>Length:</strong> ~5 miles</td>
<td><strong>Length:</strong> ~22 miles</td>
<td>~30 miles of East-West Freight Corridor (EWFC)</td>
</tr>
<tr>
<td><strong>Timeline:</strong> 2015</td>
<td><strong>Timeline:</strong> 2016-2019</td>
<td><strong>Timeline:</strong> 2020-2030</td>
<td>Planned before 2035</td>
</tr>
<tr>
<td><strong>EH-Vehicles:</strong> 4</td>
<td><strong>EH-Vehicles:</strong> 400</td>
<td><strong>EH-Vehicles:</strong> 46,000</td>
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- First public demonstration project part of a larger regional network plan

Source: POLA/POLB strategic plan 2019
Source: I-710 Draft EIR/EIS
Source: SCAG regional transportation plan
Summary

Siemens “eHighway” concept

- Hybrid-electric trucks with active pantograph for connecting to overhead wires
- Commercial truck development ongoing together with e.g. Scania
- Near-term first demonstration on public road and/or commercial use
- Reduces dependence on oil and is a low-CO$_2$ alternative for the decarbonisation of transport
- Especially viable for single transport routes with high heavy-duty traffic rates (e.g. harbors, mine transport)
- Compatible with and complementary to other alternative fuel technologies

Electric heavy-duty transport for road-based freight is technically feasible and realistic for many applications and transport routes
Thank you for your attention
Contact

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