eHighway
Designing and demonstrating an electric road system for efficient and sustainable road freight transport

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How the eHighway system works

https://www.youtube.com/watch?v=Z8l9ieoIazc

https://www.youtube.com/watch?v=zV2yZkRFBK0
Funded research projects supplement the currently executed projects on public roads in Los Angeles and Sweden

**Research Projects**

- **ENUBA (Germany)**
  - First research project with BMUB
  - Duration: 05/2010 – 09/2011

- **ENUBA 2 (Germany)**
  - Second research project with BMUB
  - Duration: 05/2012 – 12/2015

- **ELANO (Germany)**
  - Third research project with BMUB
  - Duration: 01/2016 – 09/2019

**Projects on Public Roads**

- **Los Angeles – Port Application**
  - One mile demonstration as connection to near-dock rail terminals for cargo vehicles for 6 months
  - Primary goal is to promote the implementation of zero emission goods movement technologies
  - Cooperation with Volvo trucks and local truck converter

- **Sweden – Highway Application**
  - Two kilometer demonstration on a public road between industrial area and port for 2.5 years
  - Overall aim is to evaluate Electric Road System options prior to introduction on road network
  - Cooperation with Scania trucks
How it works in Reality

https://www.youtube.com/watch?v=wuMVHA27Q2w
ICCT* sees electrification with contact lines as crucial for reaching deep decarbonization of HDVs

* ICCT = International Council of Clean Transportation

**Figure 6.** China, Europe, and U.S. lifecycle CO₂ emissions over vehicle lifetime (left axis) and per kilometer (right axis) by vehicle technology type.

Source: ICCT - Transitioning to zero-emission heavy-duty freight vehicles (2017) page 26
German industry association (BDI) recommends 4,000 to 8,000 km of overhead catenary lines as a cost-effective climate action for HDVs

Background
- BDI commissioned an independent BCG and Prognos report looking at all sectors of the economy
- Investigated the most cost effective ways to reach German climate goals: -80% and -95% GHG
- Involved 68 BDI-member associations and companies, 200 industry experts and 40 workshops

Major findings
- Reaching the 80% reduction is possible by pushing existing technologies to the max. Has economically positive effects, even if Germany acts alone.
- Reaching the 95% reduction goal touches the limit of what can be expected from technology and citizens. Only in joint action with G20 economies would this be economically manageable

Transport highlights
- Shift to rail leads to an increase by 88% of ton-km of freight activity on rail by 2050
- No additional biofuels for transport (other sectors will need biomass more and out-bid transport)
- PtX only in 95% scenario (due to high expected costs of fuel)

eHighway
- Building overhead catenary is the cheapest solution for HDVs, despite high infrastructure costs.
- Recommends building 4,000 km overhead contact line in the 80% scenario and 8,000 km in 95%
- Based on DE perspective. EU solution brings large synergies and is even more cost-effective
- Investment decision needs to be made by 2025, leading to first 400 km in operation by 2028.

Zero emission trucks are possible with renewable energy, but efficiency varies greatly

### Pathway

#### Electric Road Systems

- **Cost per km**: 60 km
- **Efficiency**: 77%
- **Example vehicle**: eTruck (Catenary-Hybrid)

#### Battery

- **Cost per km**: 48 km
- **Efficiency**: 62%
- **Example vehicle**: eTruck (Battery)

#### Hydrogen

- **Cost per km**: 24 km
- **Efficiency**: 29%
- **Example vehicle**: Fuel cell truck

#### Power-to-Gas

- **Cost per km**: 17 km
- **Efficiency**: 20%
- **Example vehicle**: Gas-truck

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1) Including storage
Source: German Ministry of Environment

100 kWh
6.0 ct/kWh

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Stumpe / MO TI EH
Pilot projects proving that zero-emission heavy road freight is both economical and practical is the next step

Argued in an Op-Ed in Sweden’s main business daily that Sweden should conduct pilot projects where whole fleets of trucks can show how the transition to sustainable road transport can happen. They also gave five examples of possible projects, with the first one on the list being a scaling up of the existing eHighway demonstration project in Gävle.

"Considering technology readiness, energy efficiency, and capital cost, the most feasible approach for the zero-emission technologies for long-haul trucks may be to deploy local or regional catenary systems. “

- Executive Summary


Hybrids make fast and broad infrastructure roll out possible, which in turn accelerates the uptake of zero-emission vehicles.

ERS is a back-bone that enables economical emission reductions with known technology.

ERS can accelerate the uptake of zero-emission solutions (e.g. would enable full-electric trucks with much less batteries, proven charging concept and no time-cost).

New vehicles sales by technology type in an Electric Road Systems scenario:

Source: European Climate Foundation – *Trucking into a Greener Future* (2018) page 9
Infrastructure on heavily use roads addresses significant part of heavy duty vehicle (HDV) emissions

Image: HDV density on BAB-network; Source: Verkehr in Zahlen 2012; TREMOD 2012

The analysis of the German road network leads to the following key messages:

1. **60%** of the HDV emissions occur on 2% of the road network (BAB = 12,394 km)

2. The most intensely used **3,966 km** handle **60%** of all ton-km on the BAB

Focusing first on the main freight transport routes, a significant decarbonization step can be achieved.

This approach can be applied all over the world.

**Sequence of messages**

1. **60%** of the HDV emissions occur on 2% of the road network (BAB = 12,394 km)
2. The most intensely used **3,966 km** handle **60%** of all ton-km on the BAB

**Notes**

- **BAB** = Federal freeways (12,394 km)
- **BS** = Federal roads (40,400 km)
- **LS** = State roads (86,600 km)
- **KS** = District roads (91,600 km)
- **GS** = Municipal roads (>420,000 km)

**Key messages**

- **60%** of HDV emissions occur on 2% of the road network (BAB = 12,394 km)
- The most intensely used 3,966 km handle **60%** of all ton-km on the BAB

**Infrastructure on heavily use roads**

- Addresses significant part of HDV emissions
- Focusing first on main freight transport routes
- Significant decarbonization step achievable
- Approach applicable worldwide

**Road categories**

- **BAB** = Federal freeways
- **BS** = Federal roads
- **LS** = State roads
- **KS** = District roads
- **GS** = Municipal roads

**Analysis**

- HDV density on BAB-network
- Source: Verkehr in Zahlen 2012; TREMOD 2012

**Image notes**

- HDV density on BAB-network
- Source: Verkehr in Zahlen 2012; TREMOD 2012

**Mapping**

- **Length of road network**
- **CO₂ emissions from HDV**
- **Urban roads**
- **Non-urban roads**
- **Federal freeways**

**Legend**

- **GS**
- **KS**
- **BS**
- **BAB**

**Key data**

- **60%** of HDV emissions
- 2% of the road network
- **BAB** = 12,394 km
- **3,966 km** handle **60%** of ton-km on the BAB

**Notes**

- **Infrastructure on heavily use roads**
- Addresses significant part of HDV emissions
- Focusing first on main freight transport routes
- Significant decarbonization step achievable
- Approach applicable worldwide
Surface freight density: 2010, 2030 and 2050

The potential of the eHighway technology ranges from closed shuttle applications to open highways solutions

**eHighway application cases**

**Shuttle transport**
- Solution for high frequency shuttle transport over short and medium distances (<50km), i.e. in ports or industrial areas
- 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

The development path of road electrification can echo that of rail electrification a century ago
Field Trials in Germany are a necessary next step for the development of the system.
First German eHighway Field Trial takes shape – Motorway A5 near Frankfurt Airport
Thank you for your attention

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