

A historical illustration of an electric tram. The tram is a large, open-sided vehicle with large spoked wheels, carrying several passengers. It is connected to an overhead power line system. The scene is set outdoors with trees and a utility pole. The Siemens logo and slogan are in the top right corner.

SIEMENS
Ingenuity for life

eHighway

Electrified heavy duty road transport

Unrestricted © Siemens AG 2017

[siemens.com/eHighway](https://www.siemens.com/eHighway)

How it works - Animation & Reality



<https://www.youtube.com/watch?v=zV2yZkRFBK0&t=7s>



<https://www.youtube.com/watch?v=WPEmBw7bLp8>

What key stakeholders say

Truck OEM CEO
"From a technical point of view we are ready today"

Road hauliers

- "Can we count on, also using renewable electricity directly via high efficient catenaries? [If not] The implications for costs are 'worlds' apart"



"Sweden and Germany agree to ... campaign at European level for the wider spread of this technology."
- Joint Declaration of the German and Swedish Governments in January 2017



Road Authorities

- 2 year assessment with German authorities laying the ground for field trials
- Approved within the existing Swedish rules and regulations

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↑ 
eHighway
Elektrisch in die Zukunft



Thank you for your attention



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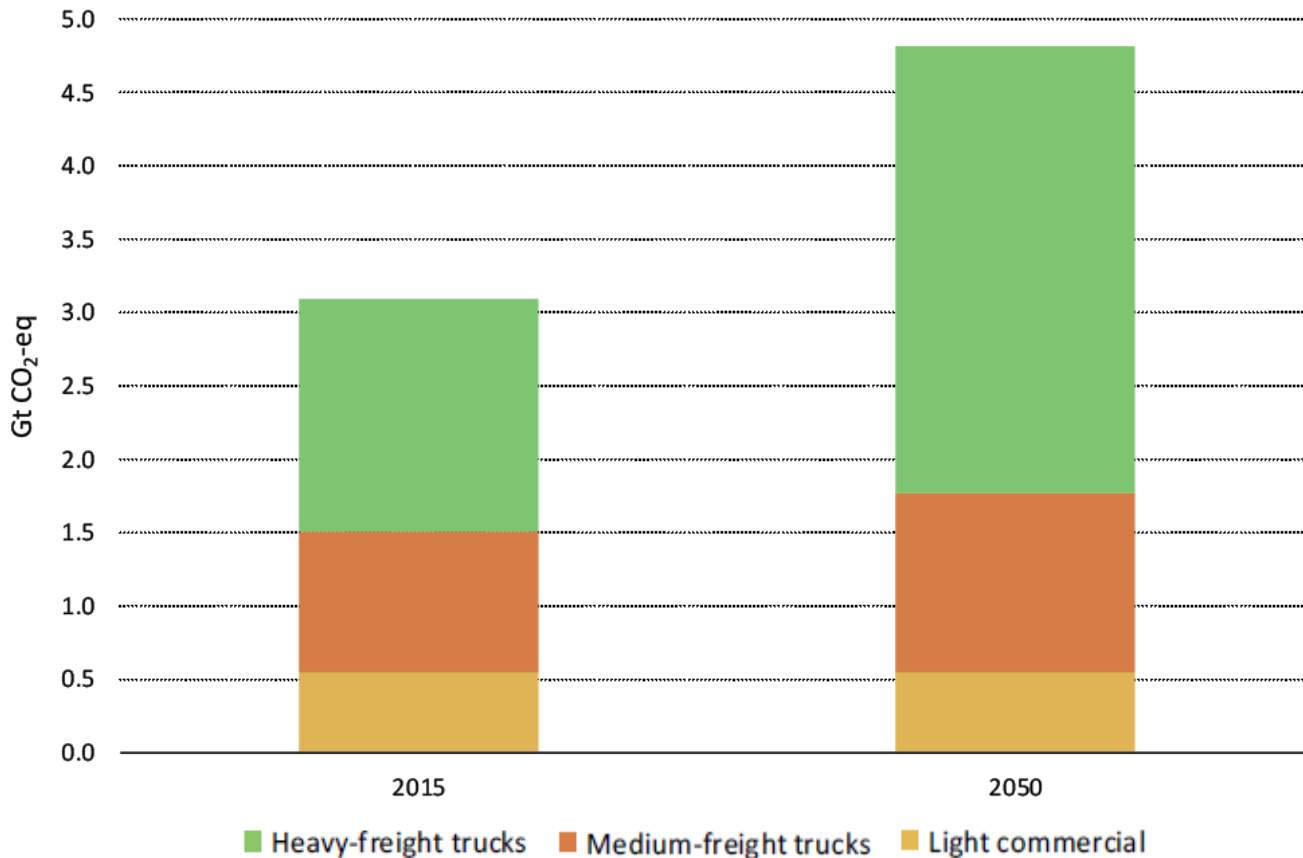
#eHighway

Back ups

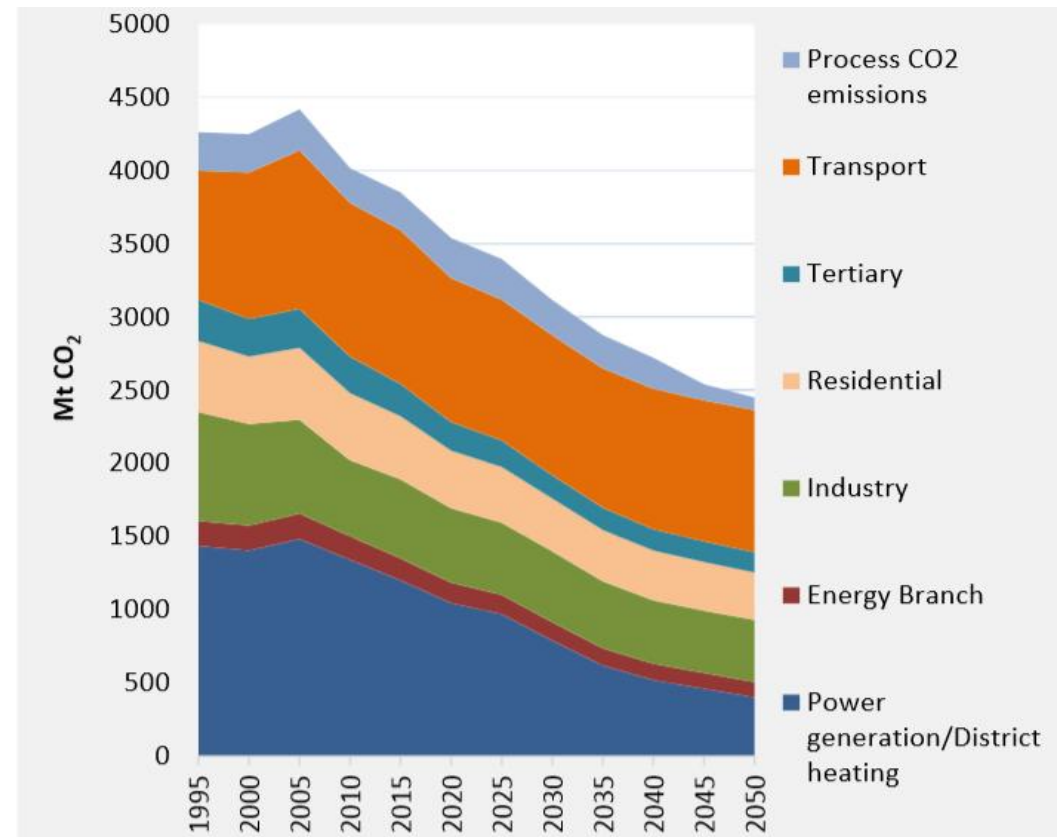
Road freight emissions trends make it clear: Solutions for decarbonization are needed



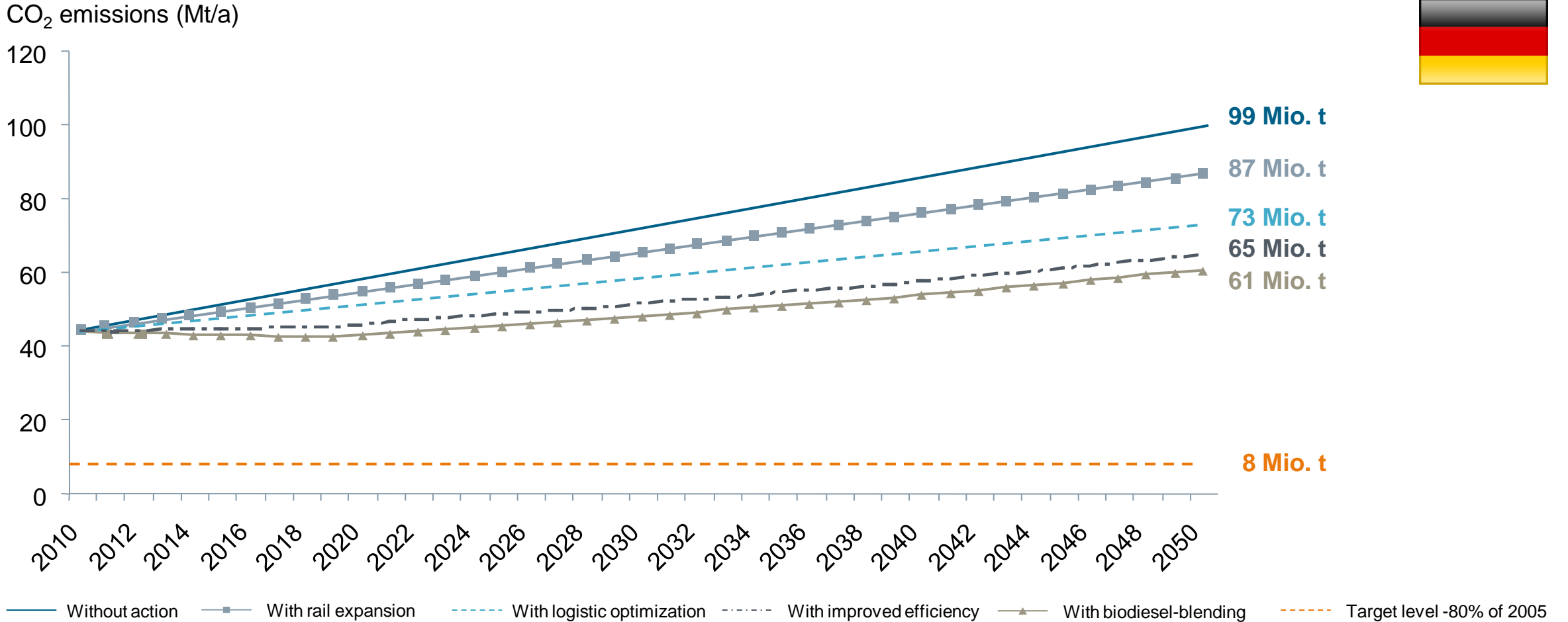
Based on latest policy announcements, **global heavy road freight** is forecast to emit 3 Gt CO₂ by 2050.



Transport will increasingly be the biggest challenge for decarbonization in **Europe**.

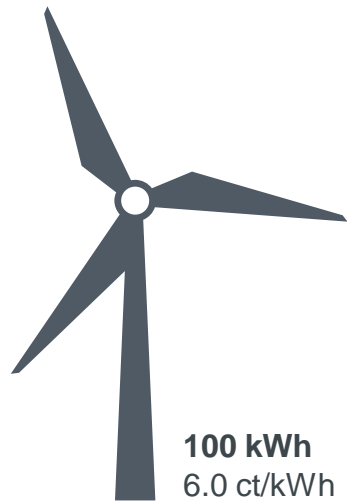


Measures to reduce road freight CO₂ emissions



Source: German Ministry of Environment (BMU), March 2013

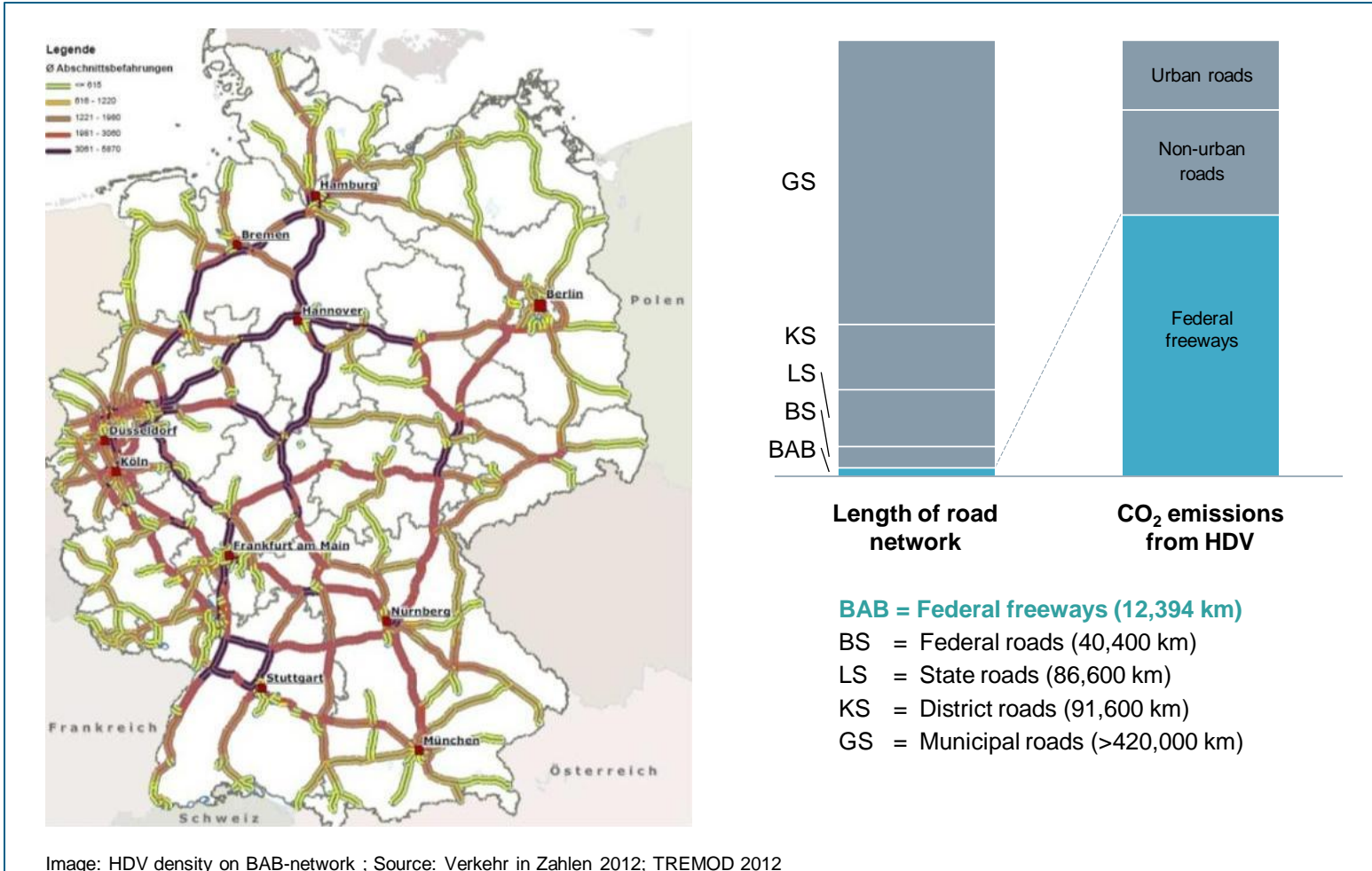
Zero emission trucks are possible with renewable energy, but efficiency varies greatly



Pathway	Range Cost per km	Efficiency WTW	Example vehicle
Electric Road Systems 	60 km 19 ct/km	77%	
Battery 	48 km 20 ct/km	62%	
Hydrogen 	24 km 55 ct/km	29%	
Power-to-Gas 	17 km 70 ct/km	20%	

1) Including storage
Source: German Ministry of Environment

Infrastructure on heavily use roads addresses significant part of heavy duty vehicle (HDV) emissions



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


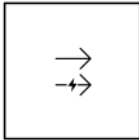
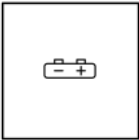
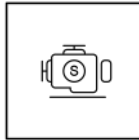
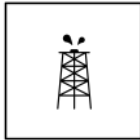

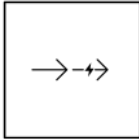
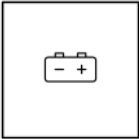
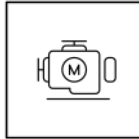



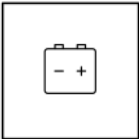
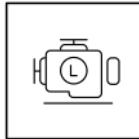


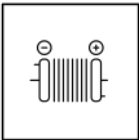


- 60%** of the HDV emissions occur on 2% of the road network (BAB = 12,394 km)
- The most intensely used **3,966 km** handle **60%** of all ton-km on the BAB

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

This approach can be applied all over the world.

Compatible with and complementary to other alternative fuel technology

The eHighway hybrid truck can be configured to suit specific applications

Truck types	Drive system	On-board source of electricity	Combustion engine	Non-electrical source of energy
 <p>Tractor truck (2 axles)</p>	 <p>Parallel-hybrid</p>	 <p>Battery (small)</p>	 <p>Engine (small)</p>	 <p>Diesel</p>
 <p>Tractor truck (3 axles)</p>	 <p>Serial-hybrid</p>	 <p>Battery (medium)</p>	 <p>Engine (medium)</p>	 <p>Bio-fuel</p>
 <p>Rigid truck (2 axles)</p>	 <p>Full electric</p>	 <p>Battery (large)</p>	 <p>Engine (large)</p>	 <p>CNG/LNG</p>
 <p>Rigid truck (3 axles)</p>		 <p>Fuel cell</p>		 <p>H₂</p>
 <p>Rigid truck (4 axles)</p>				

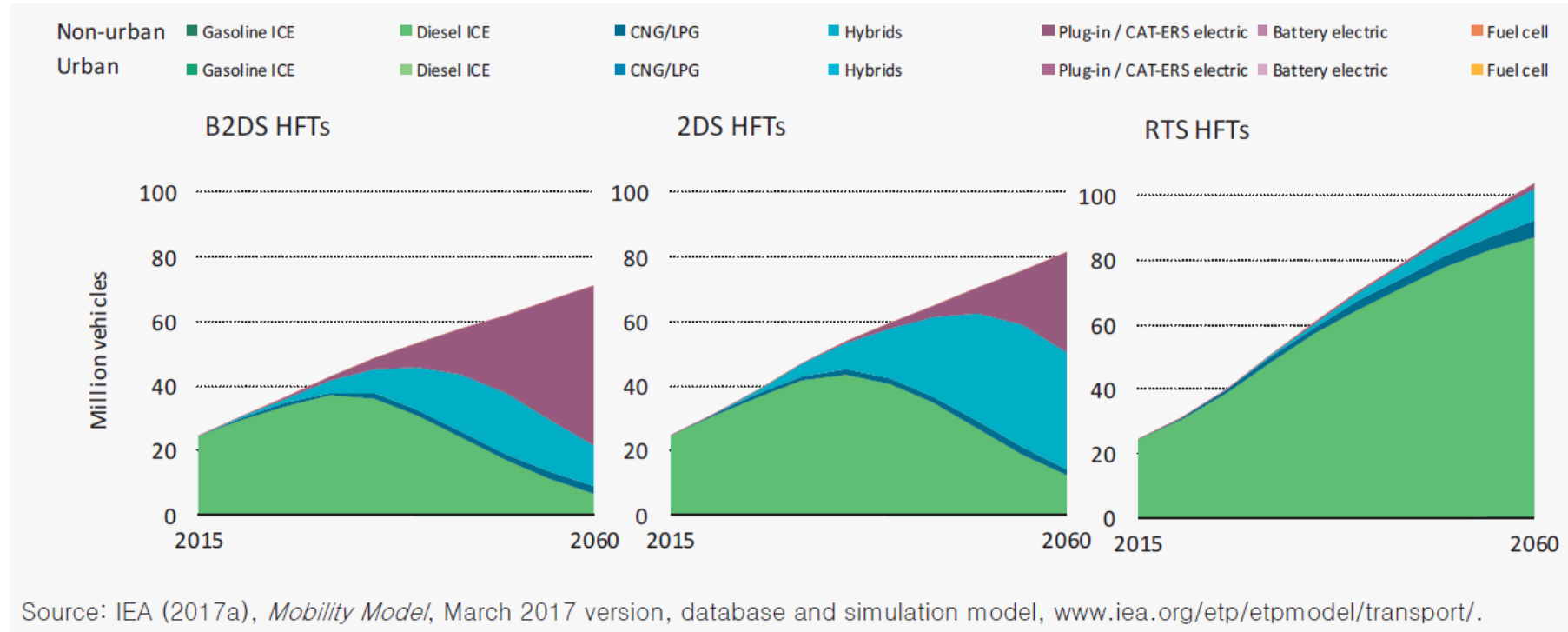
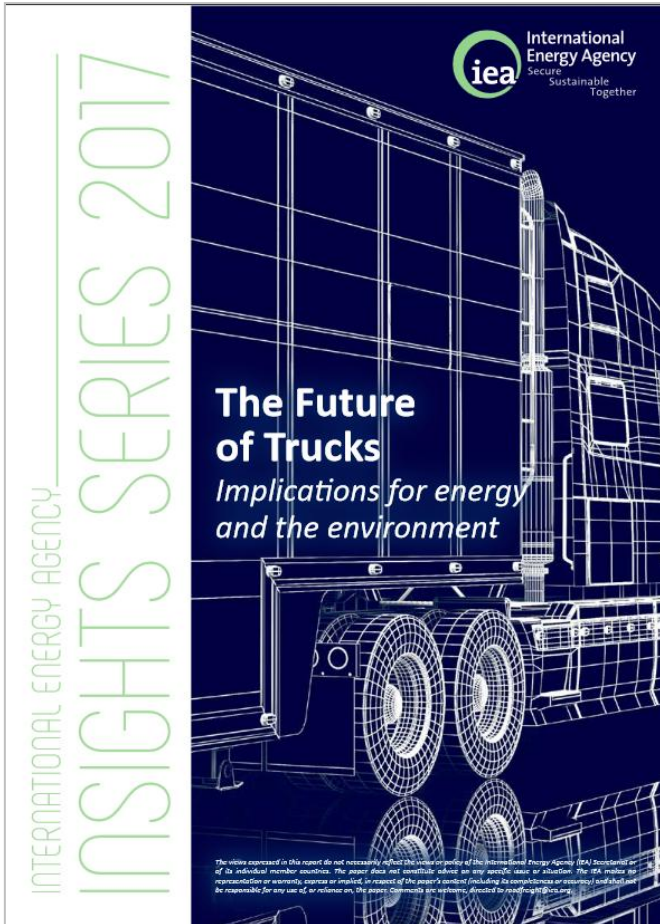
eHighway is developing quickly and is ready for commercial use in near future



Development project

- Test track of 2.1 km with realistic highway conditions
- Cooperation with e.g. Scania and Volvo
- Technical assessment of complete system by TU Dresden & BAST (the German Federal Highway Research Institute)
- Analysis of the economic and ecological impacts by German federal ministries lead to announcement of field trials in 2017
- Several public reports have confirmed positive results: UBA (Sept 2015), Öko-Institute (Nov 2016), IRU (March 2017), IEA (June 2017 and July 2017)
- Project-specific analysis always necessary

IEA's recommended policy scenario foresees 36% of the world's heavy freight trucks to be using this technology by 2050



Source: IEA (2017a), *Mobility Model*, March 2017 version, database and simulation model, www.iea.org/etp/etpmodel/transport/.

Source: [IEA - Energy Technology Perspectives \(2017\)](#) [pay wall]

Source: [IEA - The Future of Trucks \(2017\)](#) page 124

Speech by the president of BGL, an association representing many German trucking Co's, given at their 2016 Meeting, w/ the Transport Minister attending

Sehr geehrter Herr Bundesminister, an dieser Stelle wird deutlich, welche Sorgen wir im Gewerbe in Bezug auf den Klimaschutz und die Ziele des Entwurfs zum Klimaschutzplan der Bundesregierung haben. Wie wird sich die Politik entscheiden? Bekommen wir nur die

überschüssigen Strommengen, wenn die Sonne scheint und der Wind stark bläst zur Kraftstofferzeugung zugewiesen? Oder dürfen wir damit rechnen, dass auch wir mit Oberleitungen regenerativ gewonnenen Strom hocheffizient direkt nutzen können? Dazwischen liegen kostenrechnerisch „Welten“. Wenn es tatsächlich so sein sollte, dass im Jahr 2050

...which in English translates as:

Honored Mr. Federal minister, at this point it becomes clear, the concerns we in the industry have in regards to climate protection and the goals of the draft climate plan of the federal government. Which way will the policies go? Will we only get the surplus electricity, when the sun shines and winds are strong, to generate synthetic fuels? Or can we count on, also using renewable electricity directly via high efficient catenaries? The different implications for costs are „worlds“ apart.

External assessment ... ecologically and economically beneficial

Umweltforschungsplan des
Bundesministeriums für Umwelt,
Naturschutz, Bau und Reaktorsicherheit

Forschungskennzahl 3713 45 103
UBA-FB-00 [trägt die UBA-Bibliothek ein]

**Erarbeitung einer fachlichen Strategie zur
Energieversorgung des Verkehrs
bis zum Jahr 2050**

von

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Im Auftrag des Umweltbundesamtes

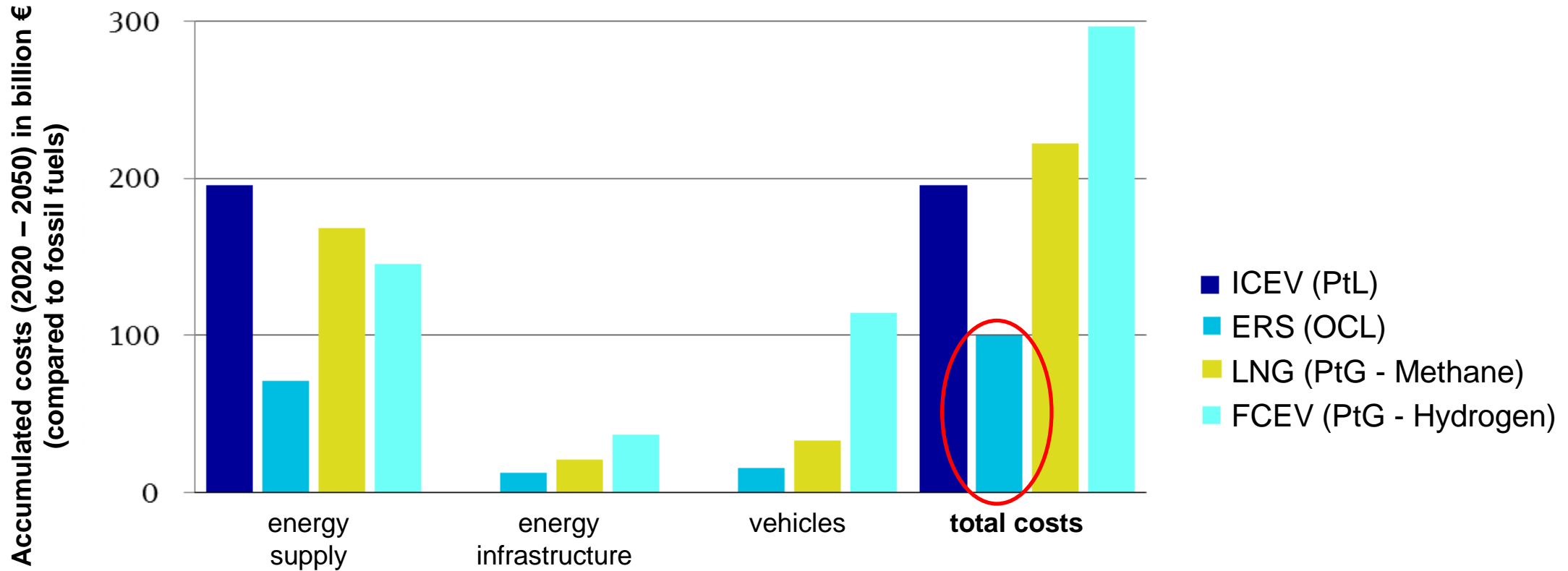
08/2015

The German Federal Environment Agency (UBA) commissioned the independent German Öko-Institute to make a comprehensive strategy for traffic energy supply until 2050:

- published in Nov 2016 ([source](#))
- covers all modes of transport
- refers to following options for long haul road freight transport
 - Carbon neutral fuels (sustainable biofuels, synthetic fuels from renewables)
 - Fuel cell electric vehicle (hydrogen from renewables)
 - Direct use of electricity (electric road systems)

Example : costs of carbon neutral long haul road freight transport (see next slide)

External assessment ... ecologically and economically beneficial



Key assumptions:

- Length of electric network: 4,000 km; Infrastructure costs: 2.2 million €/km; Maintenance 2.5% of investment per year
- Additional vehicle costs: per today 50,000 € / truck; per 2050 19,000 € per truck; share of direct electric traction: 60% in 2050

Where are we now?

Sweden – Operation started



- **Innovation Procurement Process for demo projects by Trafikverket**
- **Field trial (2 years) started June 2016**
- **Overall aim:** evaluate ERS-options prior to introduction on road network
- **Scania as truck OEM**, second truck will join operation July 2017

USA – trucks ready



- **eHighway** to reduce emissions of port links on **1-mile** infrastructure near ports in L.A. and Long Beach
- **Cooperation with Volvo Trucks** and local truck converters
- **Contract with South Coast Air Quality Management District** testing for at least 6 month in 2017

Germany – field trials announced



- **Cabinet of the German Federal Government** – decided on field trial of eHighway ERS in call 10/2015
- Project decision for Federal States Schleswig-Holstein and Hesse
- **Hesse contract awarded to Siemens**, Schleswig-Holstein still pending
- **Construction approx. 2018 // field trials approx. 2019**

Field Trials in Germany are a necessary next step for the development of the system

Routing



Quelle: Bundesministerium für Umwelt, Naturschutz, Bau und Reaktorsicherheit / Grafik: DVZ



Copyright: Straßenbauverwaltung Baden-Württemberg, 2017

The path forward focuses on the electrification of highly frequented routes



eHighway application fields

Near term

Long term



Shuttle transport



Mine transport



Long haul traffic

The development path of road electrification can echo that of rail electrification a century ago