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Öko-Institut e.V.
Institut für angewandte Ökologie
Institute for Applied Ecology

Decarbonisation of road transport

Comparison of technical options including electric road systems

Moritz Mottschall/

CEDR Workshop

Groß Dölln, 14.03.2016

Our Profile

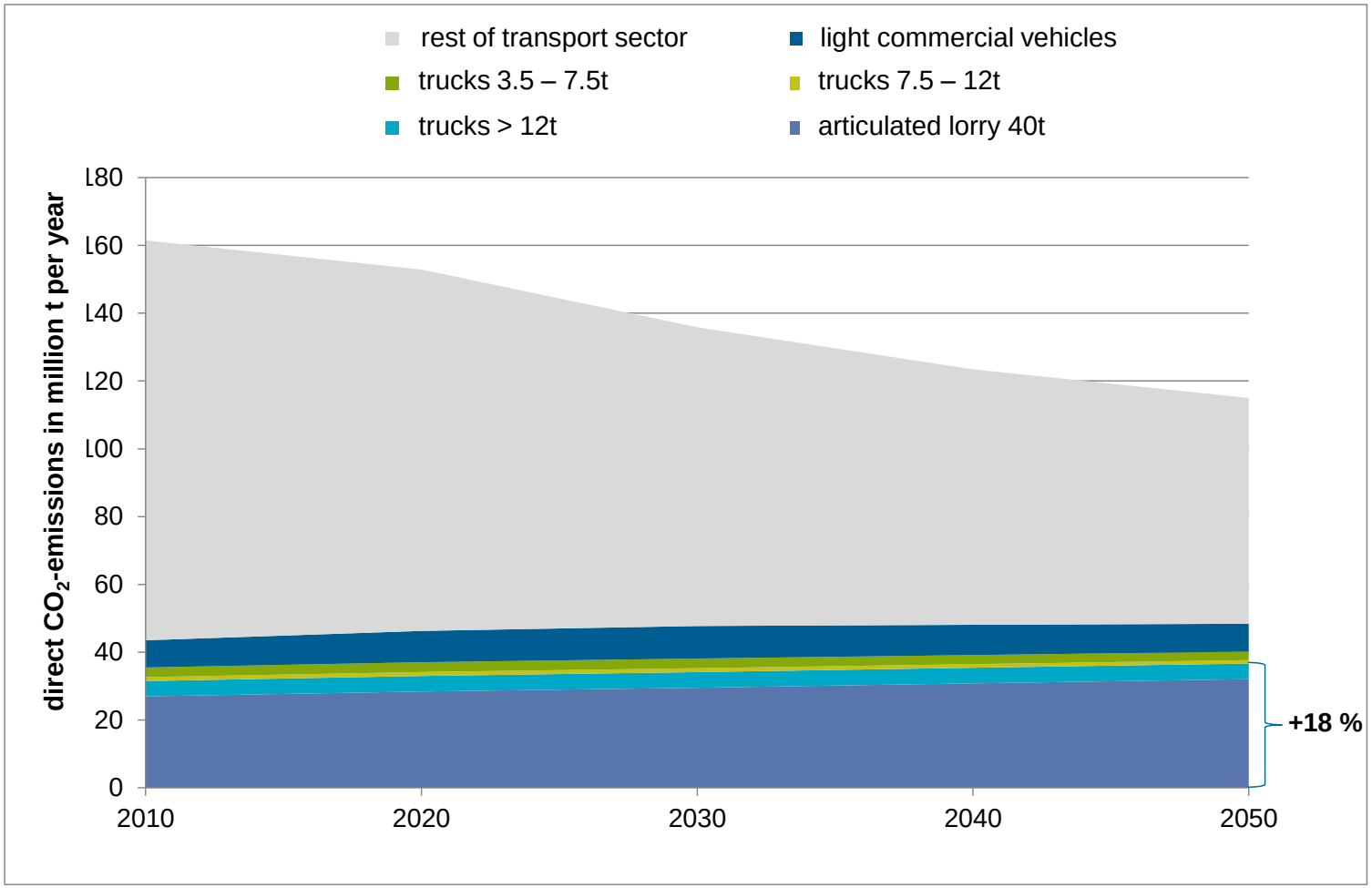
Oeko-Institut is a leading European research and consultancy institute working for a sustainable future.

- A non-profit association founded in 1977
- Offices in Freiburg, Darmstadt and Berlin
- Clients: European Union, national and state-level ministries, companies, foundations and non-governmental organizations

Background

- Ambitious climate protection goals: Reduction of GHG-emissions in Germany (80% to 95% until 2050)
  - Emission “budget” is used in agriculture and industrial processes.
    - **Full decarbonisation of the transport sector is needed.**
- Long term forecasts show increasing demand of road freight transport
- Limited potential of energy efficiency of conventional trucks
  - Technical measures: e.g. improved aerodynamics, increased engine efficiency, hybridization
  - Management: e.g. speed reduction, reduction of empty trips, increased utilization

CO_2-emissions of the transport sector until 2050



Source: Scenario results of the TEMPS-Modell. Transport demand based on „Verkehrsprognose 2030“, -30 % fuel consumption of new Trucks in 2050

Alternatives to fossil fuels in road transport: Carbon neutral fuels (Biofuels/ PtL)

- **Advantages:**
  - well known vehicle technology and use of existing infrastructure
  - safety
- **Disadvantages:**
  - air pollutant emissions
  - low engine efficiency, energy losses in fuel production
  - limited potential of biomass and competition with food production (biofuels)
  - CO_2-source needed
  - competition with other modes of transport: high demand for liquid fuels in aviation and navigation

Alternatives to fossil fuels in road transport: Hydrogen (PtG) in fuel cell vehicle

- **Advantages:**
  - No air pollutant emissions
  - Efficiency above ICEV
  - No CO_2-source is needed

- **Disadvantages:**
  - High vehicle costs (fuel cell stack and H_2-storage)
  - Energy losses due to electrolysis and liquefaction
  - Safety might be an issue

Alternatives to fossil fuels in road transport: Direct use of electricity

- **Advantages:**
  - high engine efficiency
  - Direct use of renewable energy possible
  - No air pollutant emissions

- **Disadvantages:**

  Battery only electric vehicles:

  - not feasible for long haul transport (Electric driving range of 500 km requires an 8t battery)

  Electric Road Systems (e.g. overhead catenary):

  - Increased vehicle costs (pantograph, hybrid drivetrain) and infrastructure costs
  - New infrastructure components might increase the vulnerability

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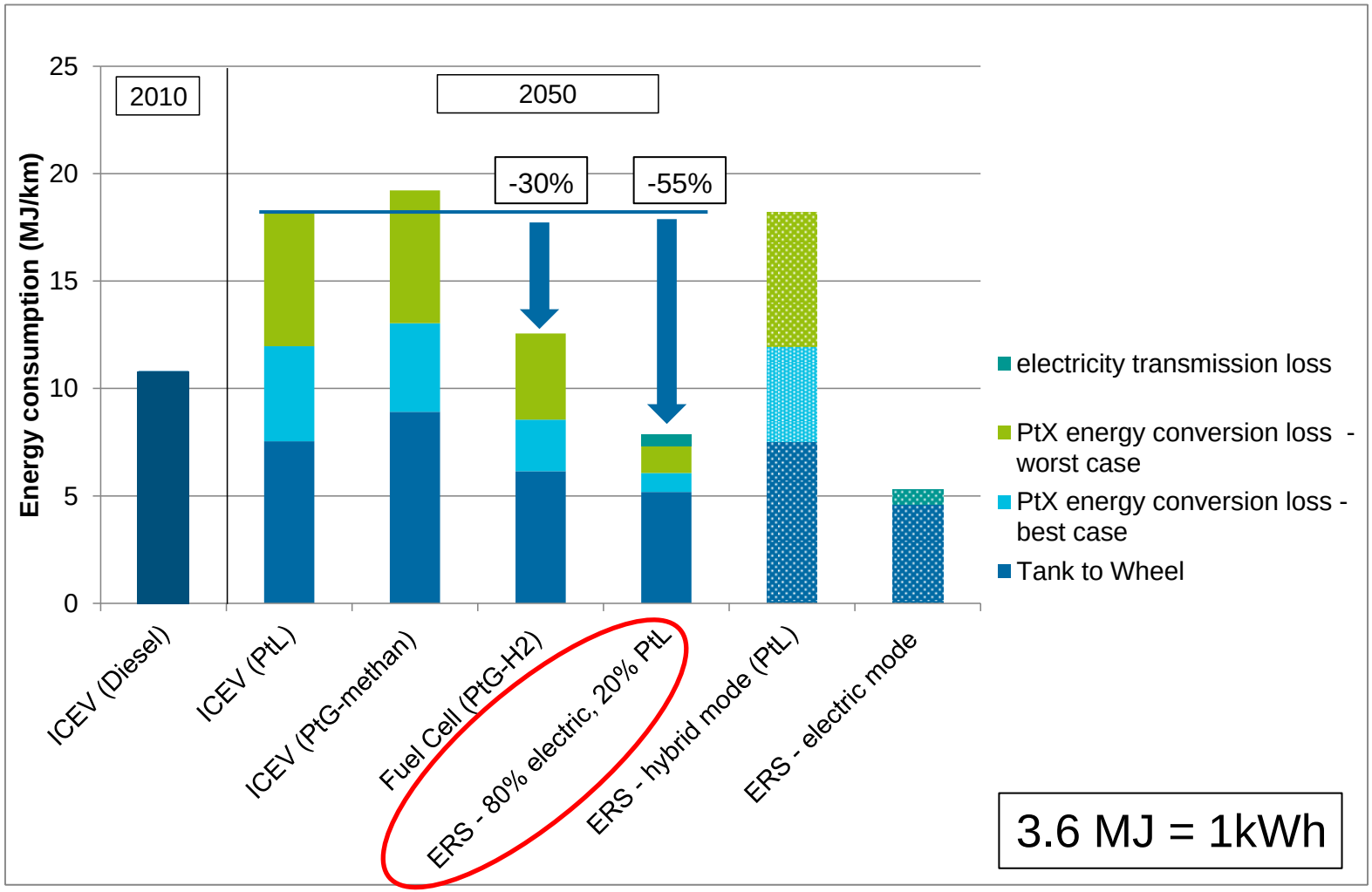
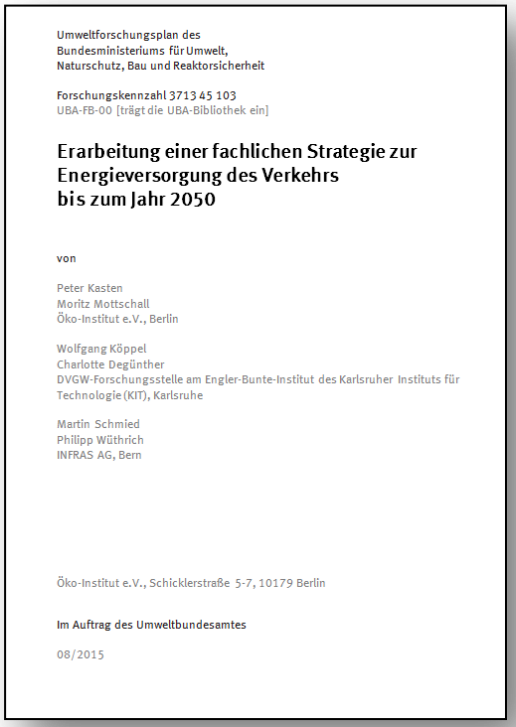
Energy efficiency of trucks in 2050 by vehicle concepts and type of fuel



Study: “Determining an expert strategy for the energy supply of the transport sector up to 2050”

- Comparison of the costs of different energy scenarios and options for a greenhouse-gas-neutral transport sector in 2050.
- Scope: Road- and rail transport, navigation and aviation
- 4 different energy scenarios
- Calculation of the economic costs of:
  - energy supply
  - energy infrastructure
  - vehicles



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

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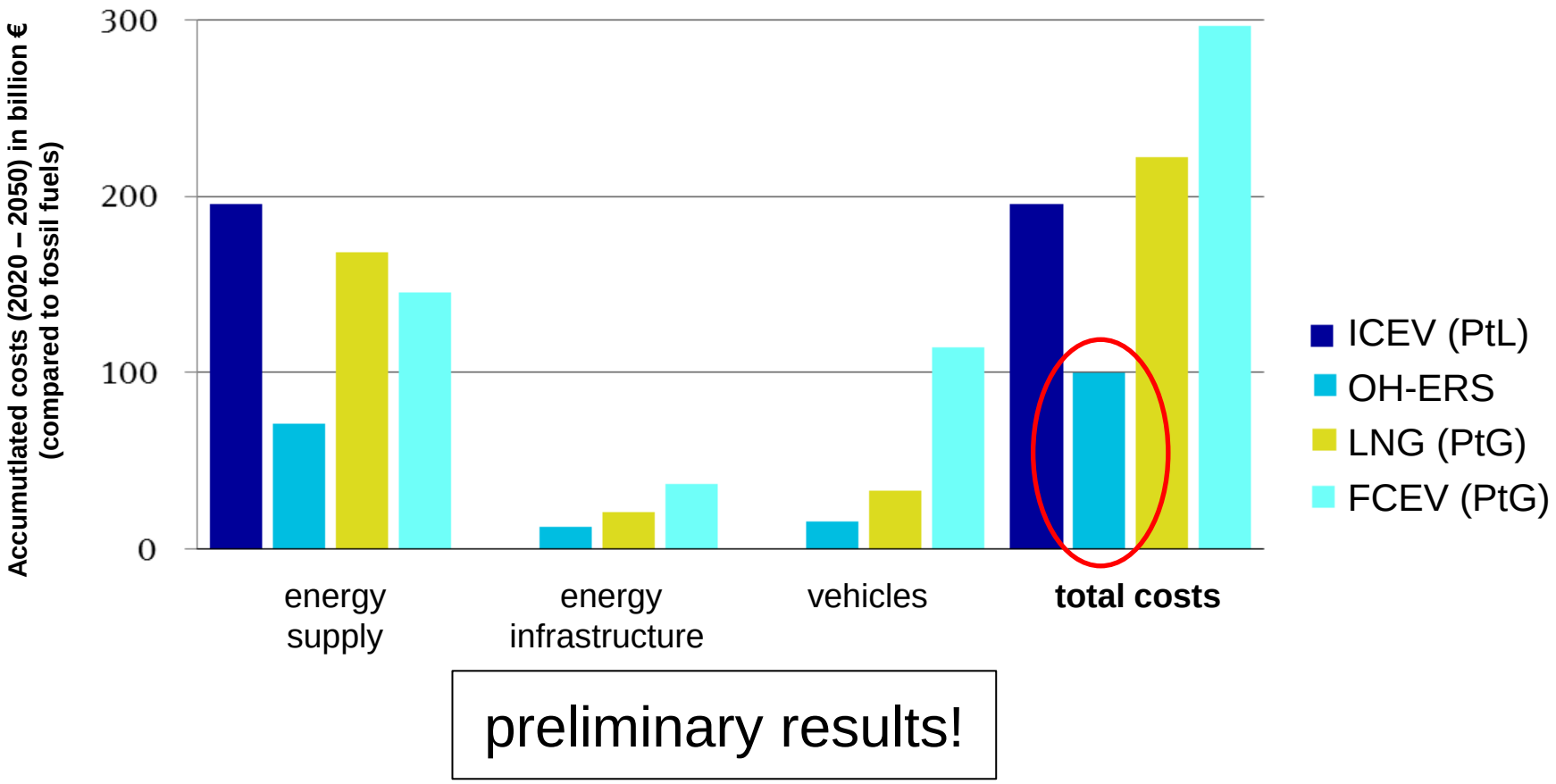
Im Auftrag des Umweltbundesamtes

08/2015

Work in progress!

Economic costs of carbon neutral long haul road freight transport in Germany until 2050



Source: "Determining an expert strategy for the energy supply of the transport sector up to 2050"; work in progress!

Summary

- The decarbonisation of the transport sector is necessary.
- Possible options include the use of carbon neutral fuels (biofuels, PtX) and the direct use of electricity in electric road systems.
- The total economic costs of an overhead-line-ERS are below other options of decarbonisation.
- Advantages of conductive electric road systems:
  - High energy efficiency
  - (local) reduction of air pollutant emissions
- Challenges of electric road systems:
  - International solutions are necessary.
  - New infrastructure components may increase the vulnerability of the road system.

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Vielen Dank für Ihre Aufmerksamkeit!
Thank you for your attention!

Haben Sie noch Fragen?
Do you have any questions?