Contribution of alternative fuels and power trains to the achievement of climate protection targets within the EU27

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Delhi, 21 January 2010

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Overview

- Introduction
- The TIMES PanEU Model
  - General information
  - Transport Sector
  - Fuel Pathways
- Results of GHG-Reduction Scenarios
- Conclusion

Introduction

Problem statement and motivation

- **Necessity of reducing greenhouse gas emissions in order to mitigate climate change**
  i. Limitation of global warming by max. 2°C agreed on UN climate conference (Copenhagen 2009)
  ii. EU plans to reduce CO_2-emissions by 20% until 2020 compared to 1990 (EU Climate and Energy Package 2008)
- **Several EU-wide and national measures to promote the use of alternative fuels and power trains, e.g.:**
  i. EU Biofuel directive: 10% biofuels in diesel and gasoline consumption in 2020
  ii. National Development Plan for Electric Mobility (Germany): 1 mill. electric vehicles until 2020, 5 mill. until 2030

Objective

- **Analysis of the cost optimal contribution of the transport sector to GHG-reduction**
  i. Watching the Transport sector as part of a total energy system
  → interactions with other sectors
  → detailed modeling of fuel production pathways (inclusion of all well to tank emissions)
- **What fuels and technologies are applied in the transport sector?**

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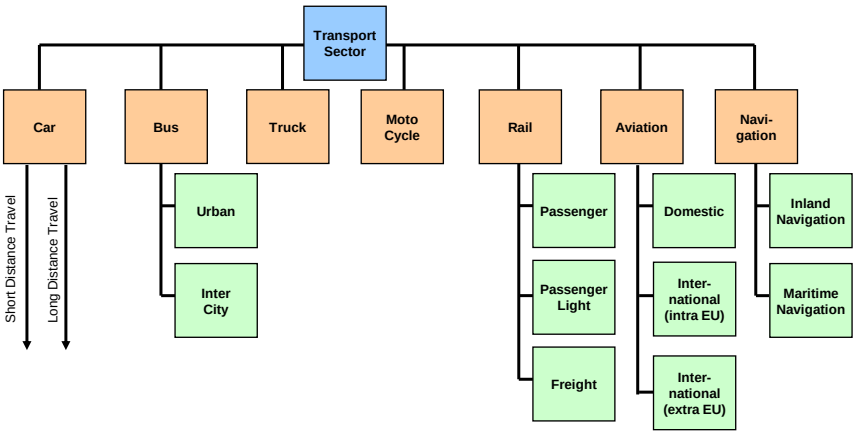
The TIMES PanEU model

General information

- **Partial equilibrium, technology oriented bottom-up model.**
- **30 regions (EU 27 + NO, CH, IS)**
- **Time horizon: 2000-2050**
- **12 time slices (4 seasonal, 3 day level)**
- **Modelled sectors:**
  i. Conversion, production
  ii. Residential sector
  iii. Commercial sector
  iv. Agriculture
  v. Industry
  vi. Transport
- **Greenhouse gases: CO_2, CH_4, N_2O**
- **Others pollutants: SO_2, NO_x, CO, NMVOC, $PM_{2.5}$, PM_{10}**

The TIMES PanEU model

Structure of the transport sector

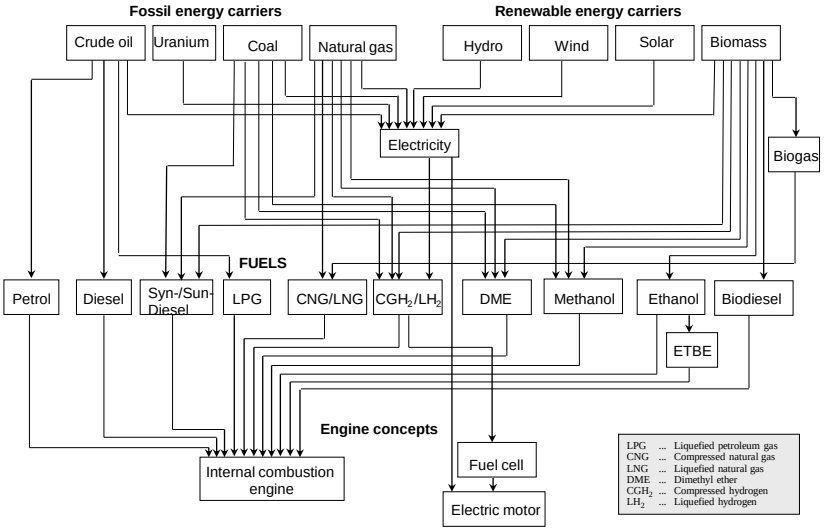


Modeled fuels and power trains

Technology / Category	Car	Bus	Truck	Motocycle	Rail	Aviation	Navigation
Gasoline	+*	+*	+*	+*		+	
hybrid	+*		+*				
plug-in hybrid	+*						
Diesel	+*	+*	+*		+*		+*
hybrid	+*	+*	+*				
plug-in hybrid	+*						
LPG	+						
Heavy fuel oil							+
Kerosene						+	
Natural gas	+*	+*	+*				
Ethanol (E85)	+	+	+				
hybrid	+		+				
plug-in hybrid	+						
Biodiesel	+	+	+				
Biogas	+	+	+				
hybrid	+	+					
plug-in hybrid	+						
FT-Diesel (BtL, GtL, CtL)	+	+	+			+	
Electricity	+			+	+		
Methanol IC	+	+	+				
Methanol FC	+						
Dimethyleter	+	+	+				
Hydrogen (g) IC	+						
Hydrogen (g) FC	+	+	+				
hybrid	+	+	+				
Hydrogen (l) IC	+						

+ implemented
* Blending of biofuels and synthetic fuels possible
FC: Fuel cell
IC: Internal combustion engine
BtL: Biomass to liquid
GtL Gas to liquid
CtL: Coal to liquid
Fossil fuels
Biofuels
Fuels derived from either fossil or renewables sources

Modeled fuel pathways

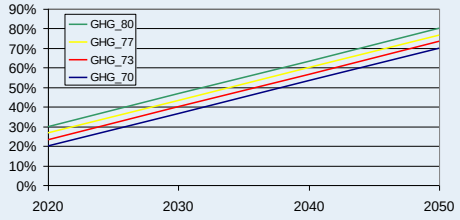


Scenario definition and assumptions

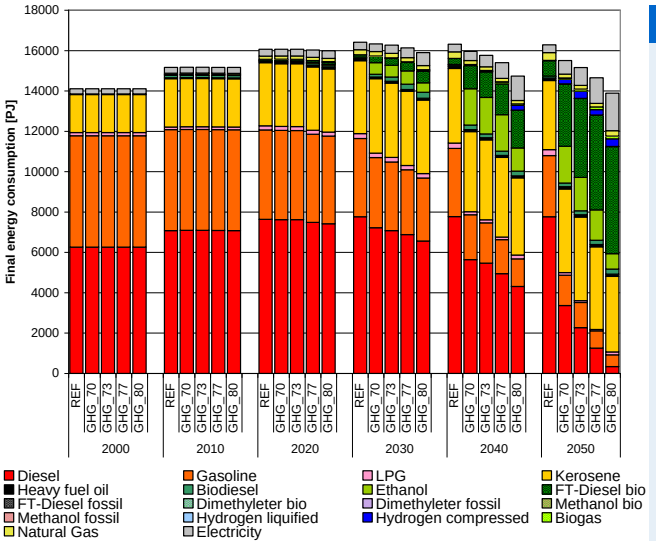
General assumptions

- Energy prices according to WEO 2009
- Reduction of CO_2-emissions in the ETS sector by 21% until 2020
- Restrictions to the use of nuclear energy
- No consideration of EU biofuel directive

Scenario	Description
REF	Business as usual (Reference case)
GHG_70 GHG_73 GHG_77 GHG_80	Reduction of GHG emissions related to 1990



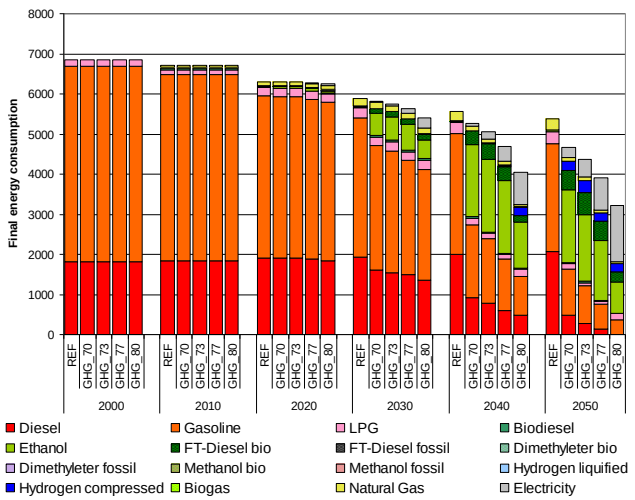
Final energy consumption transport sector



Key findings

- until 2020, only marginal influence of GHG reduction target on transport FEC
- biofuel consumption in 2020 lower than postulated by EU directive even with high GHG reduction target
- GHG reduction leads to growing consumption of biofuels from 2030 onward
- increasing use of electricity and hydrogen in 2040 and 2050 at stronger GHG reduction targets

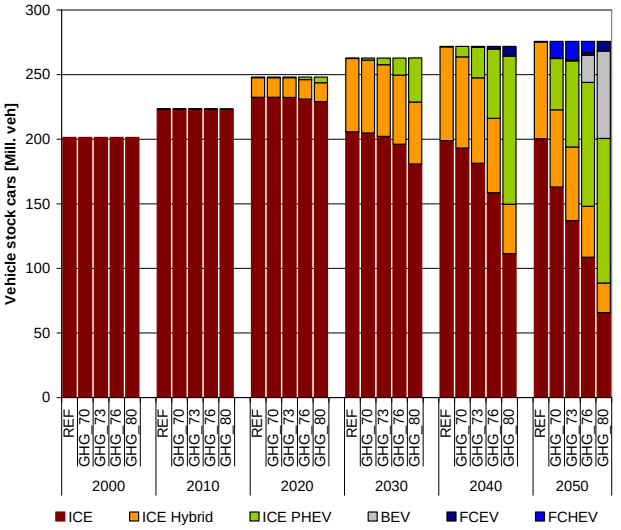
Final energy consumption cars



Key findings

- GHG reduction target leads to growing use of 2nd generation biofuels (especially ethanol) from 2030 onward
- strongly increasing electricity consumption in 2040 and 2050 with high GHG reduction targets
- Deployment of fuel efficient propulsion technologies leads to sharply decreasing final energy con-sumption in GHG reduction scenarios

Deployment of alternative power trains for cars

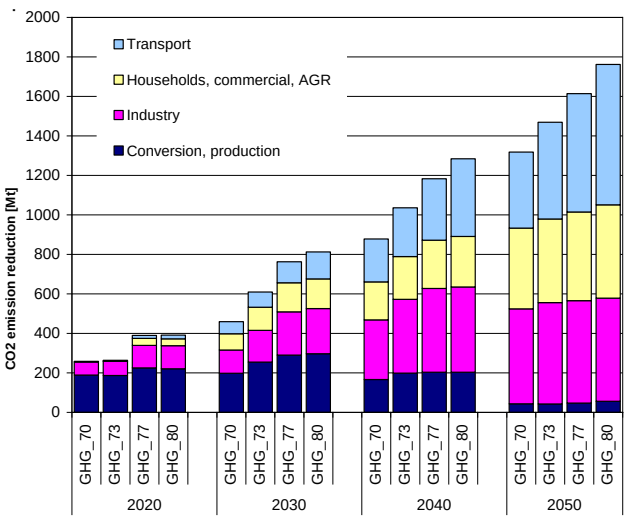


Key findings

- PHEV are the most important alternative to conventional ICEs in GHG scenarios
- BEV are used only at very high GHG reduction targets in 2050
- Few FCEV and FCHEV are employed in 2050, decreasing share at higher GHG reduction targets

ICE: Internal combustion engines
PHEV: Plug-in Hybrid electric vehicle
BEV: Battery electric vehicle
FCEV: Fuel cell electric vehicle
FCHEV: Fuel cell hybrid electric vehicle

Reduction of CO_2 emissions compared to REF



Key findings

- Low contribution of the transport sector to emission reduction until 2030
- With a strong reduction target, transport sector becomes the biggest emission reducer in 2050
- Conversion, production and industry achieve biggest emission reduction until 2030
- Decreasing reduction of conversion, production after 2030 because of rising electricity demand and H_2 production

Conclusions

Key findings

- Until 2030, GHG reductions are realized mainly in other sectors
- From 2040 onward, the transport sector contributes strongly to GHG reduction
- The contribution of biofuels to GHG reduction in 2020 is much lower than requested by the EU biofuel directive
- After 2020, biofuels are increasingly used for GHG reduction, mainly in road freight transport
- PHEV prove to be a highly requested technology for GHG reduction from 2040 onward
- BEV are used only at high GHG reduction targets in 2050
- Hydrogen plays a minor role for GHG reduction

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Thank you for your attention

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