Assessing the Competitiveness of Hydrogen and Biofuels in European Transport

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World Energy Congress, 13 November 2007, Rome / Italy

Presentation Outline

1. Research Objective
2. Cost Analysis of Hydrogen and Biofuels
3. Modeling Framework
4. Scenario Analysis
5. Conclusions

Research Objective

1. Analysis of costs and prospects of hydrogen and biofuels for European transport (US H2A analysis, literature review)

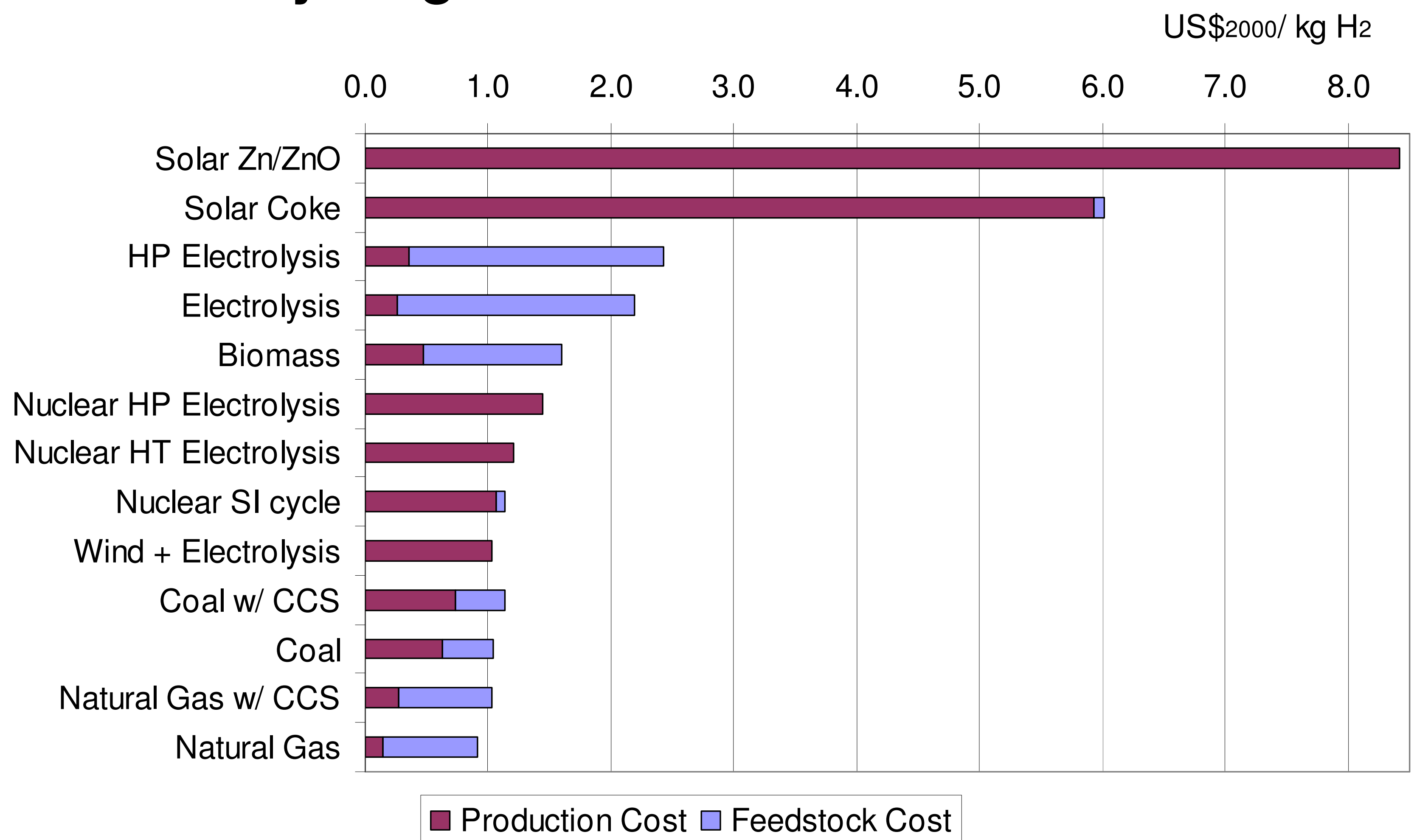
   → Modeling input

2. Understand the competitiveness of hydrogen and biofuels under CO_2 reduction policies, fuel subsidies and increasing oil prices

   → Modeling analysis in a cost-optimization framework

Part 1: Cost Analysis

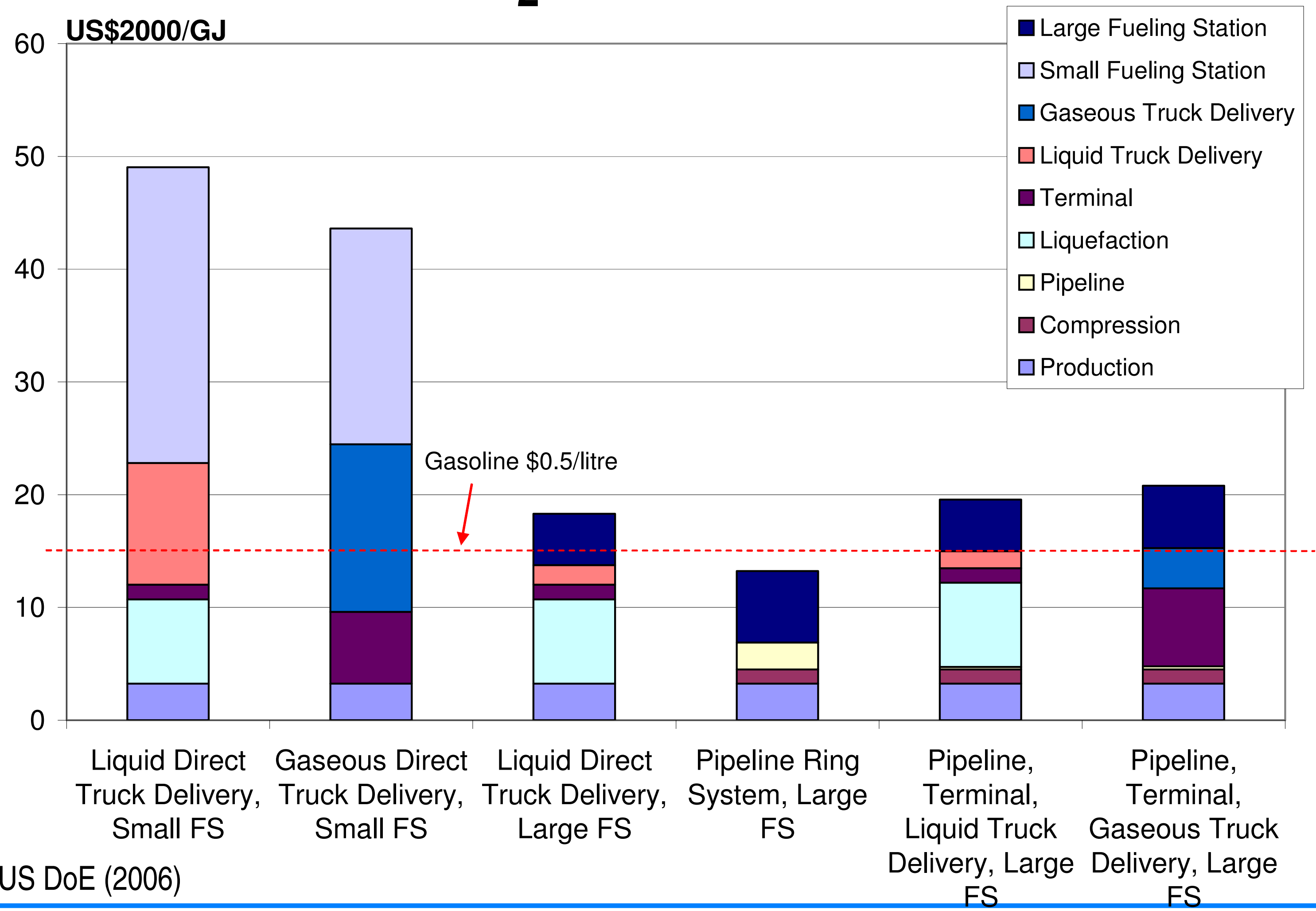
Hydrogen Production Cost in 2030



Note: Interest rate 5%

Sources: adapted from US DoE (2006) and Felder (forthcoming)

Cost of Delivered H_2 from Coal Gasification 2030



Source: US DoE (2006)

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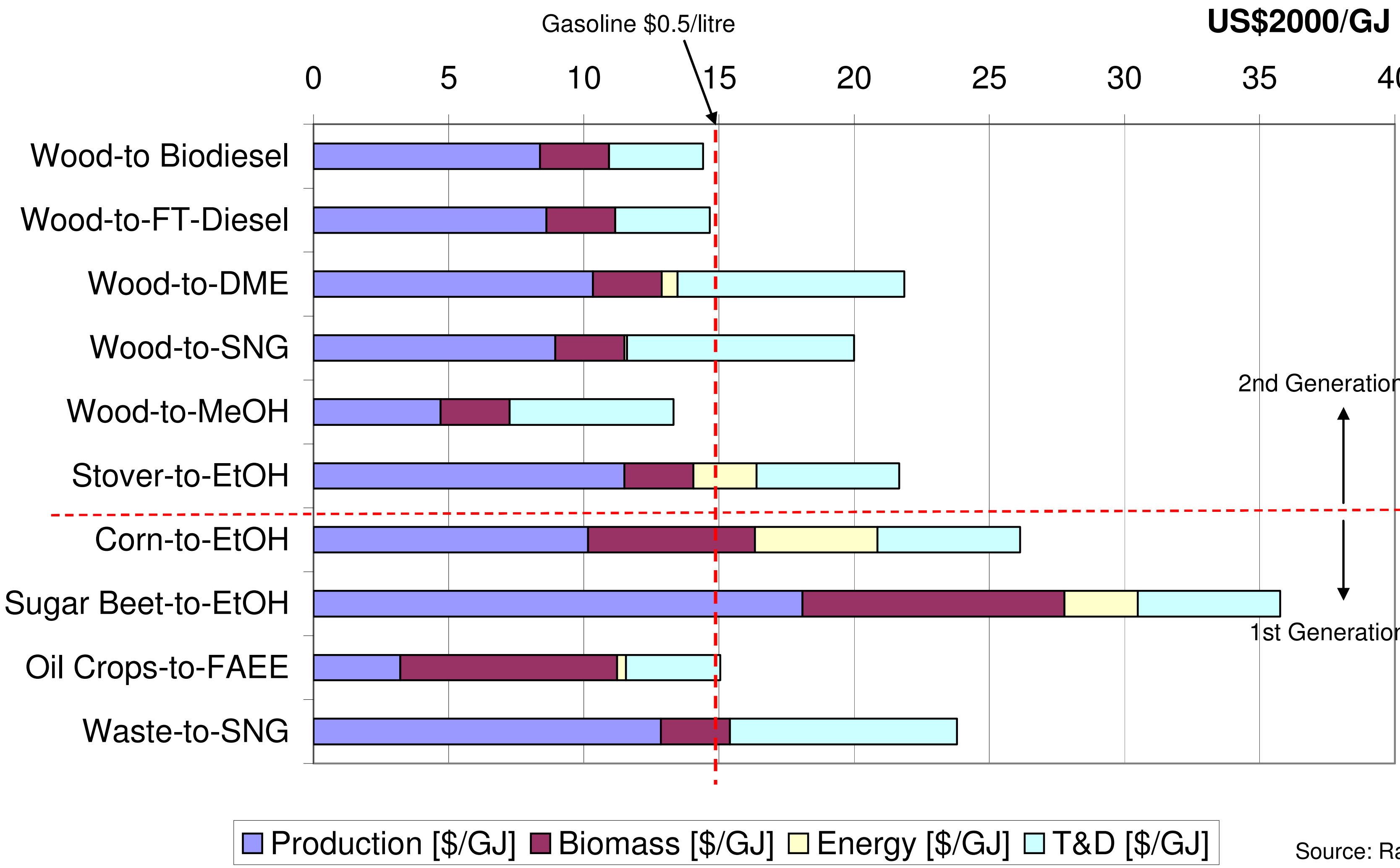
Biofuels Costs



Source: Ragettli (2007)

Part 2: Modeling Framework

European Hydrogen Model EHM

- developed at Paul Scherrer Institute
- MARKAL-class model
- „bottom-up“ energy-system model with detailed representation of technologies
- cost-optimization model: identifies least-cost solutions for the energy system under given sets of assumptions and constraints
- represents the energy system of EU-29

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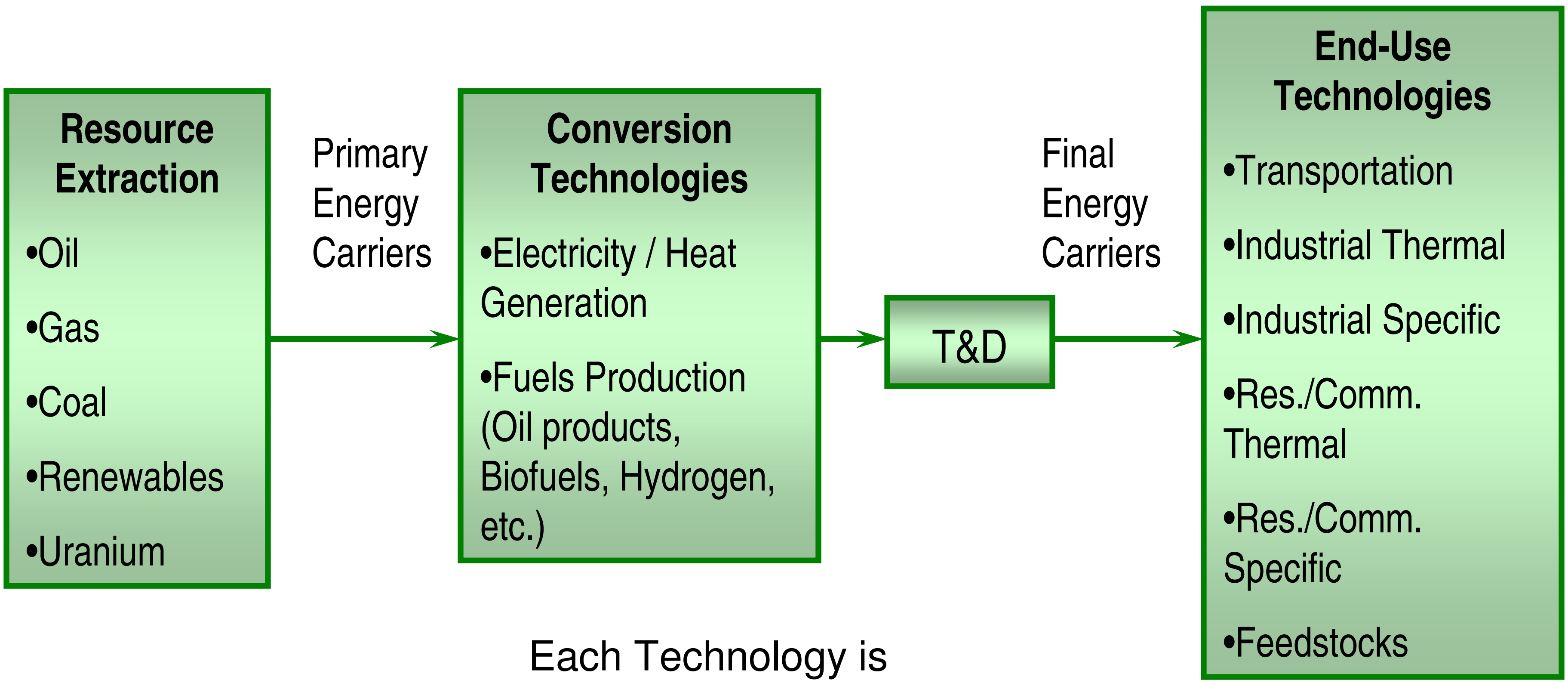
EHM Reference Energy System - Structure



Each Technology is represented by its costs and efficiency!

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European Hydrogen Model EHM

- detailed representation of hydrogen and biofuels production & delivery pathways
- detailed, but still stylised <u>personal</u> transport sector
- calibrated to year 2000 statistics from IEA
- based on an updated IPCC-SRES B2 scenario („middle-of-the-road“)
- 10 year time steps until the year 2100
- exogenous technology learning assumptions

General Key Modeling Assumptions

- We use European biomass potential only (7.2 EJ)
- No biomass or biofuels imports considered
- Low oil prices assumed as
  - $US\$_{2005}$ 60/bbl in 2050 (old IEA projections), and
  - $US\$_{2005}$ 80/bbl in 2100
- Interest rate 5%

Key Modeling Assumptions in Transport

- Exogenous cost reduction assumptions for all vehicles
- Fuel cell costs assumed
  - US$ 250 /kW at market launch in 2020, and
  - US$ 40 /kW 50 years later due to learning progress
- Share of 1% of total market for new personal vehicles at market launch
- Maximum growth rate car technology of 10% per year

Scenario Analysis

Scenario Analysis

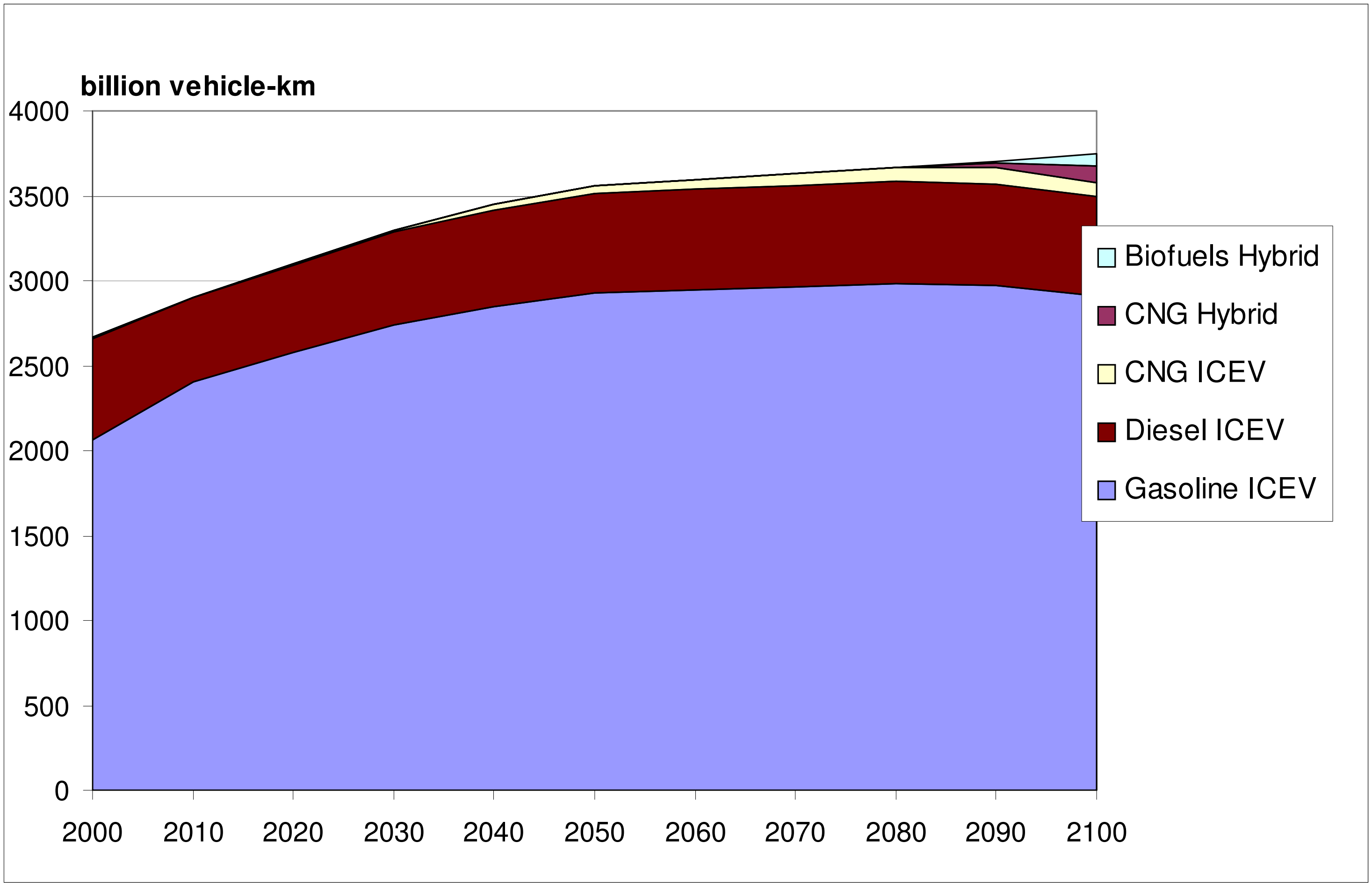
1. Baseline Scenario under given set of assumptions

2. Impact of a 50% CO_2 reduction target by 2050

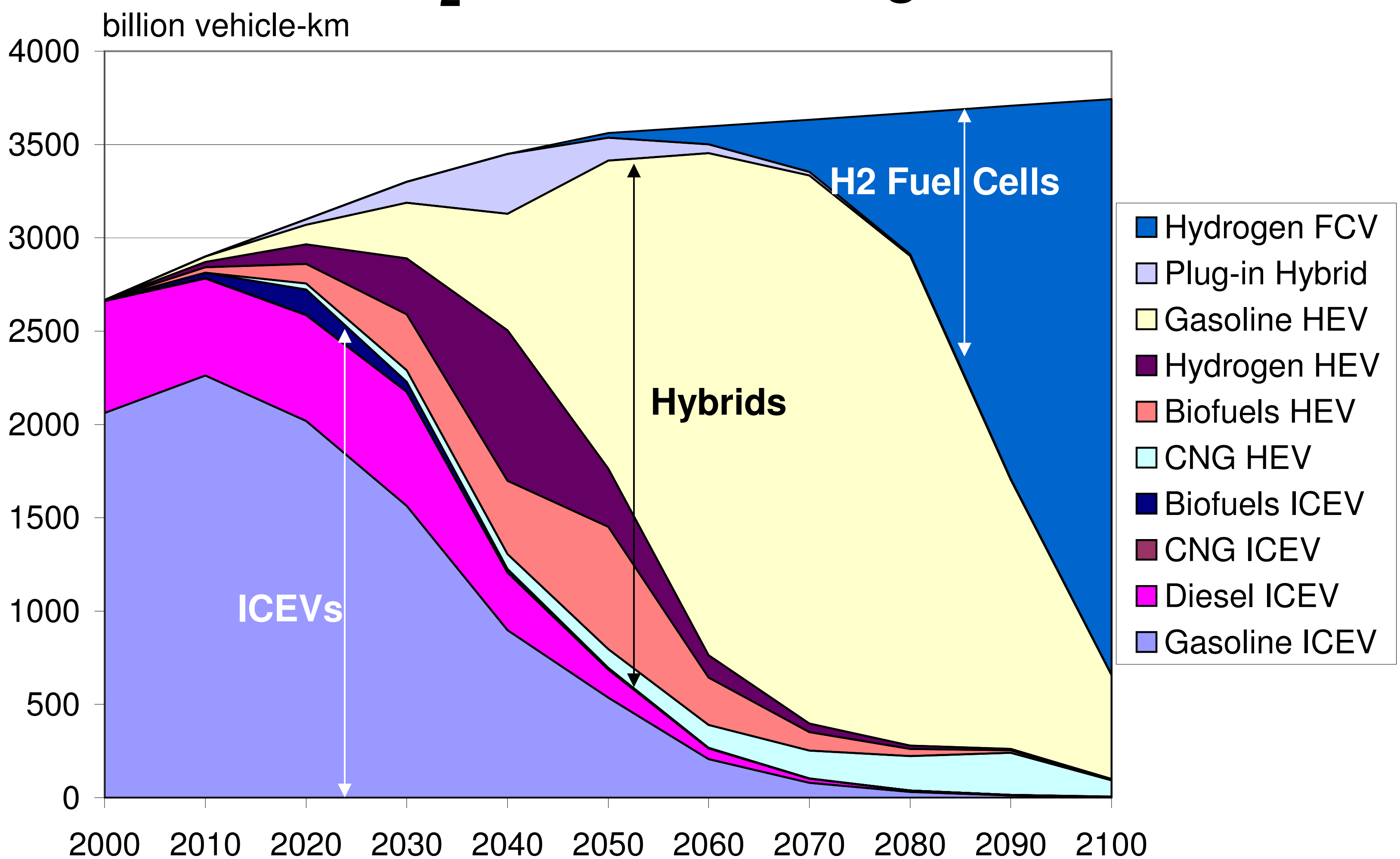
    - Additional higher oil prices and fuel subsidies as of 2010

3. Impact of a more stringent CO_2 reduction target: 60% reduction by 2050

Baseline Scenario: Personal Transport EU-29

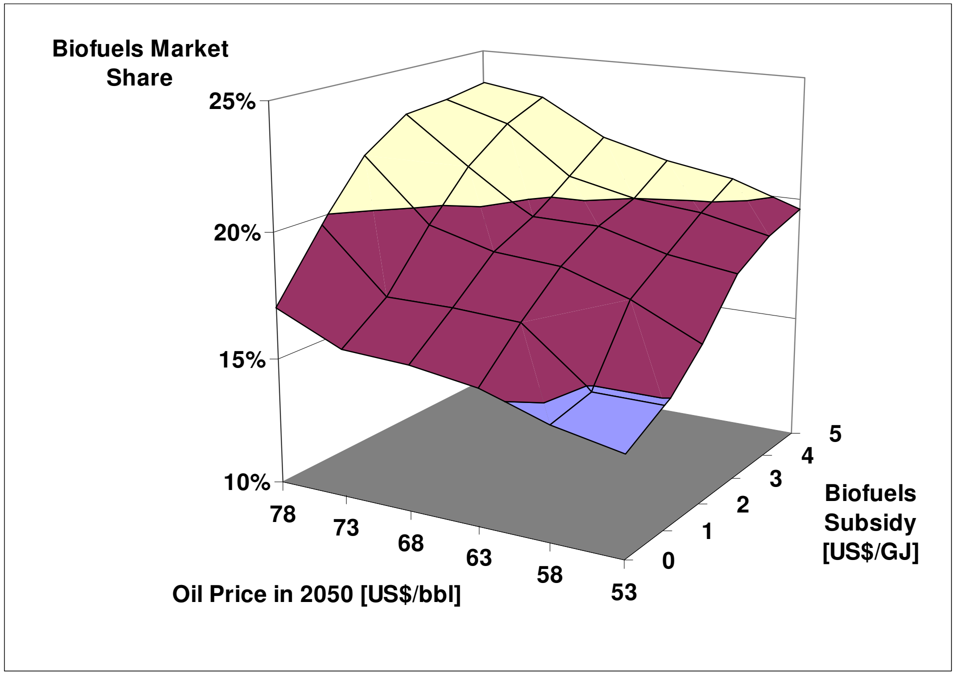


50% CO_2 Reduction Target in 2050

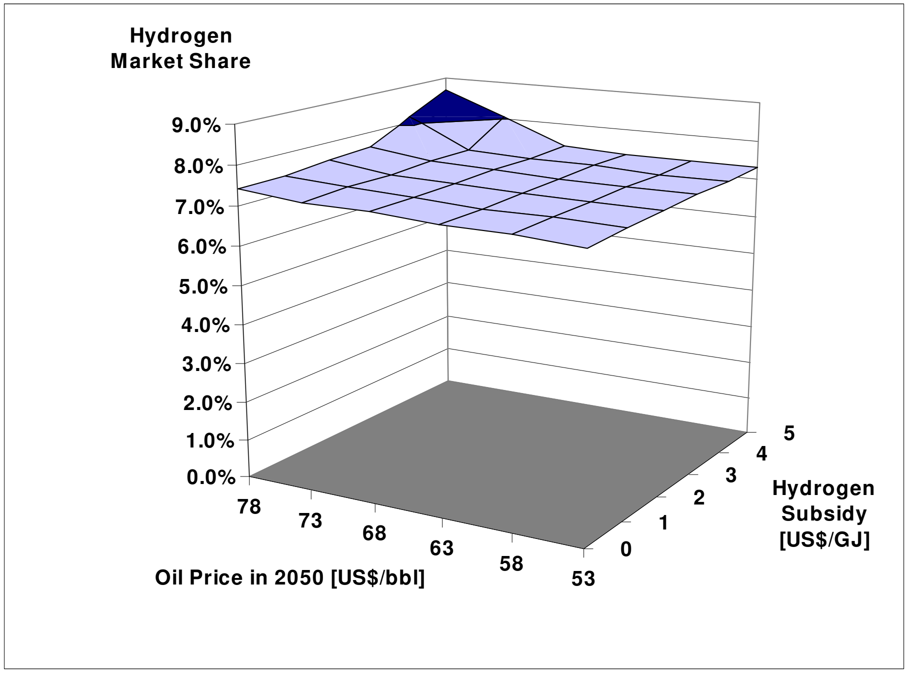


Mid-term Impacts of Oil Price and Fuel Subsidies

Biofuels in 2050

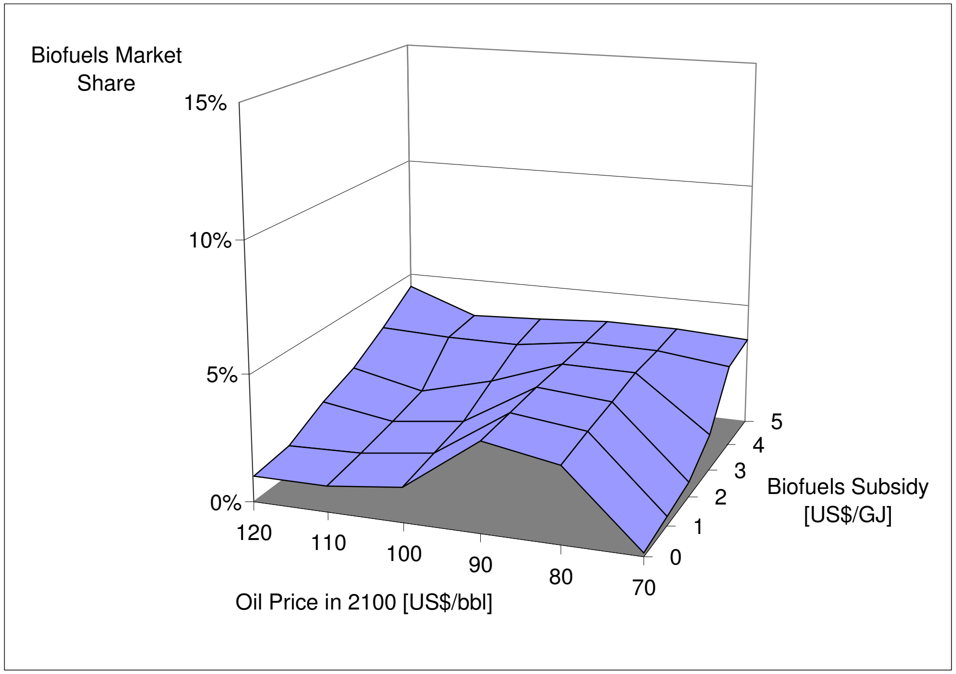


Hydrogen in 2050

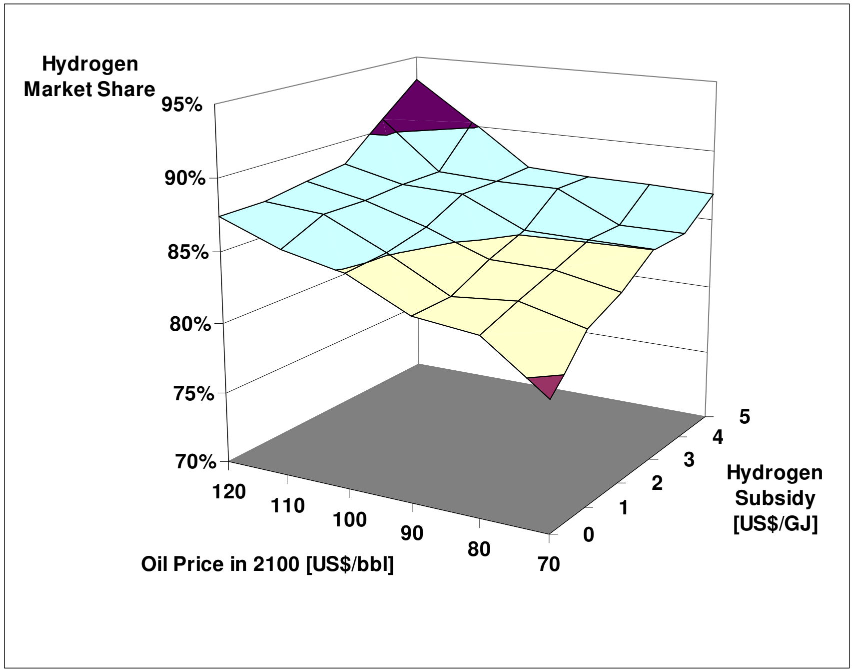


Long-term Impacts of Oil Price and Fuel Subsidies

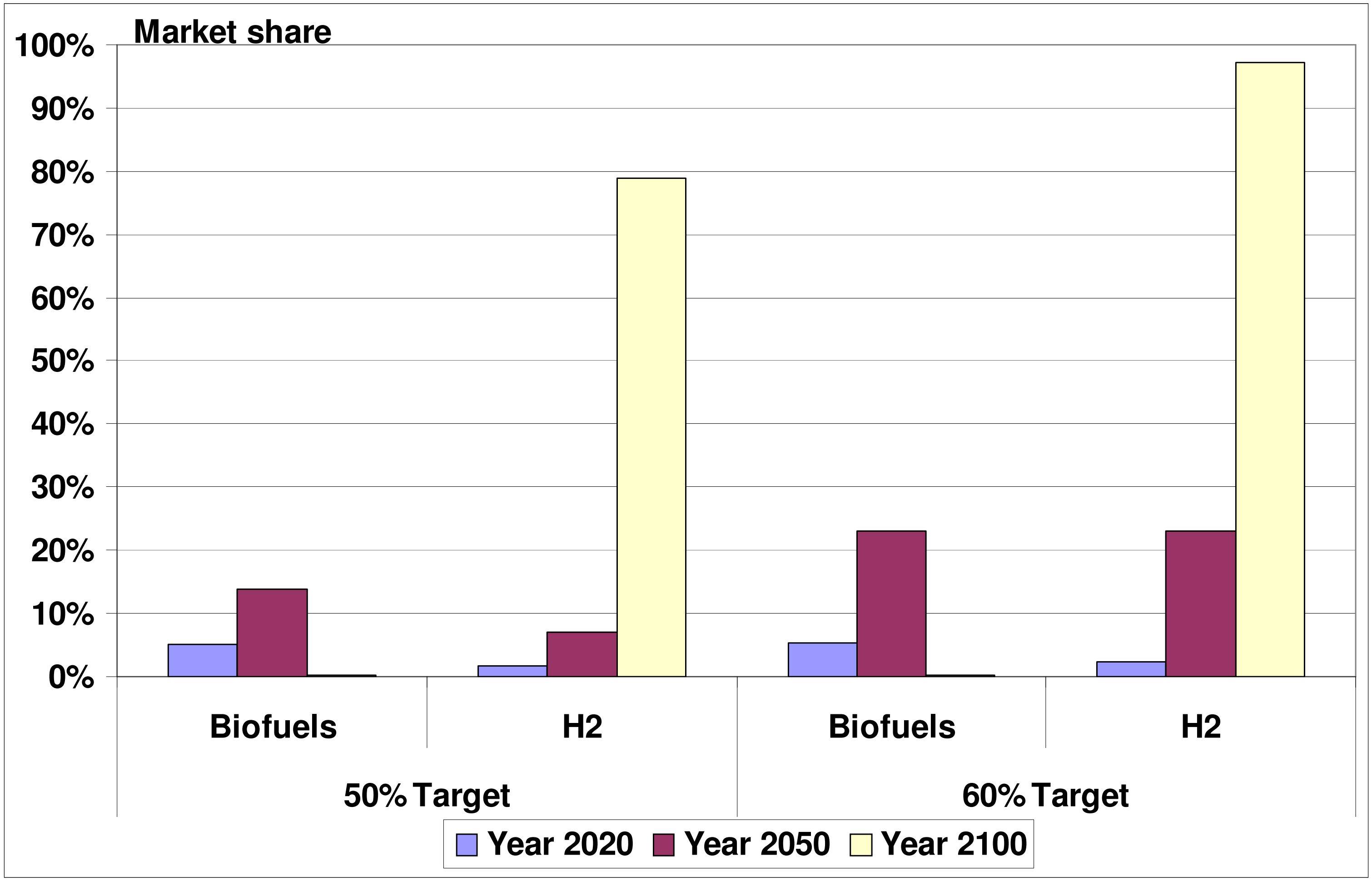
Biofuels in 2100



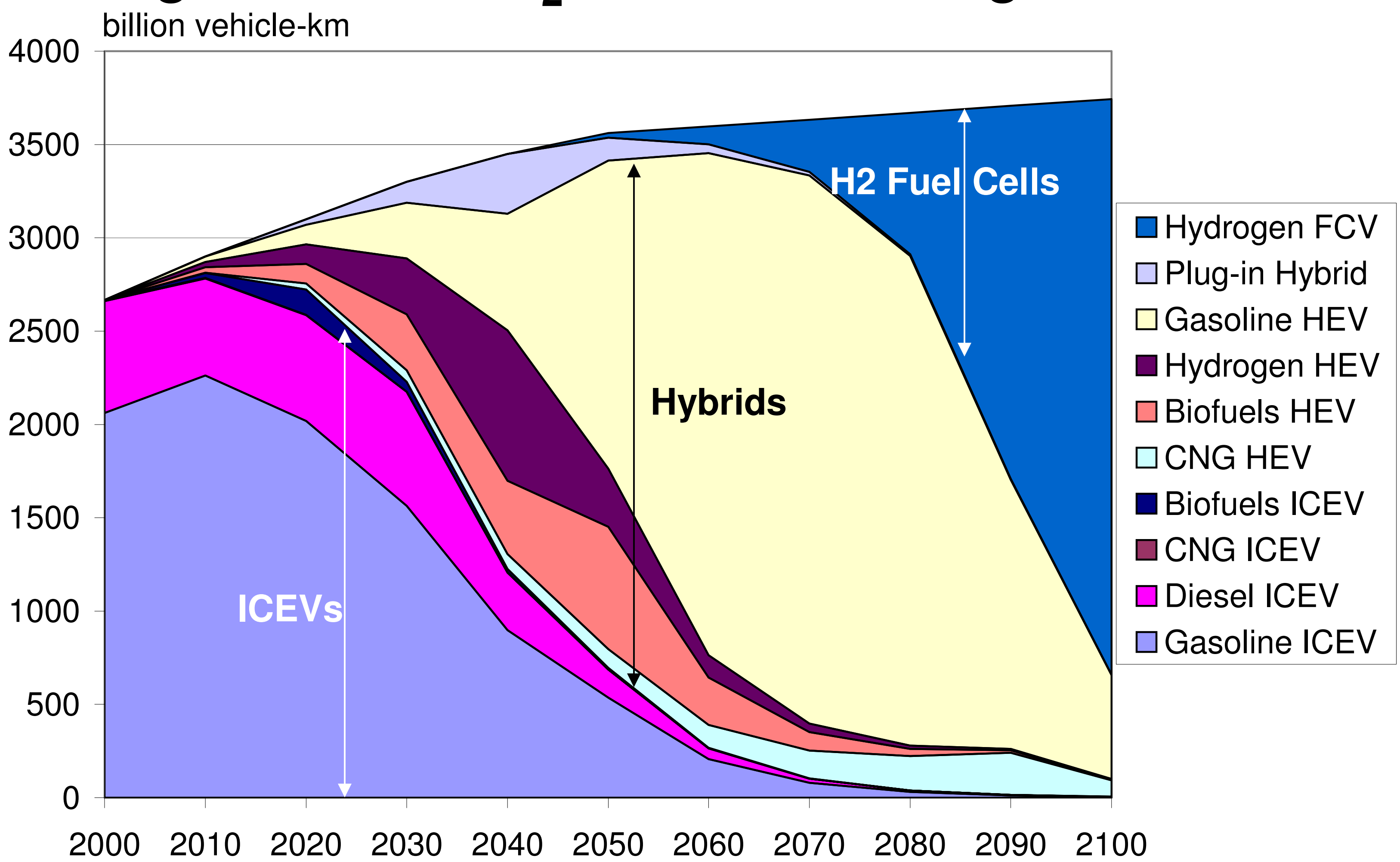
Hydrogen in 2100



More stringent CO_2 Targets in 2050



Again: 50% CO_2 Reduction Target in 2050



Conclusions

- The lower the costs of the fuel cell become in a foreseeable future, the better the prospects for hydrogen in transport
- CO_2 reduction policies support the penetration of hydrogen and biofuels in transport.
  - ➢More stringent CO_2 reduction targets increase the competitiveness in particular of hydrogen in transport
- Subsidies as well as high oil prices can increase the competitiveness for such alternative fuels, particularly for biofuels in the mid-term
  - ➢Note: here only moderate oil price increases were assessed

Thank you for your attention