

Identification of the role of fuel cells and hydrogen in the energy and transport sector

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Business from technology

Basics

- ü European Union, Japan, USA and other countries has recognised fuel cells and hydrogen technologies as one important pathway to a reliable and environmentally sound power and transport system for the future
- ü FCH JU is an important instrument for the European Strategic Energy Technology plan.
- ü USDOE has two large programs
- ü METI/NEDO in Japan
- ü Several European countries have their own programmes, the German one being the largest



Benefits

- ü **Power production with 50-60% electrical efficiency using hydrocarbon and biofuels would lower CO₂ emissions and reduce particle, SO₂ and NO_x emissions significantly**
- ü **Distributed generation can be taken to the source of biofuels thus avoiding expensive transport of fuels**
- ü **A transform to carbon free transportation would reduce CO₂ emissions in Europe with 40%**
- ü **The goal for well-to-wheel efficiency for fuel cell drive trains is 60%**
- ü **European target 2015 for driving distance between fuelling is 1000 km**



Problems

- ü **Cost of fuel cell systems**
- ü **Durability and life time still an issue**
- ü **Development is slow**
- ü **Increase of production capacity requires much capital**
- ü **Economic regression delays investments**
- ü **Battery driven electric vehicles new hype might slow investments to fuel cell based systems**



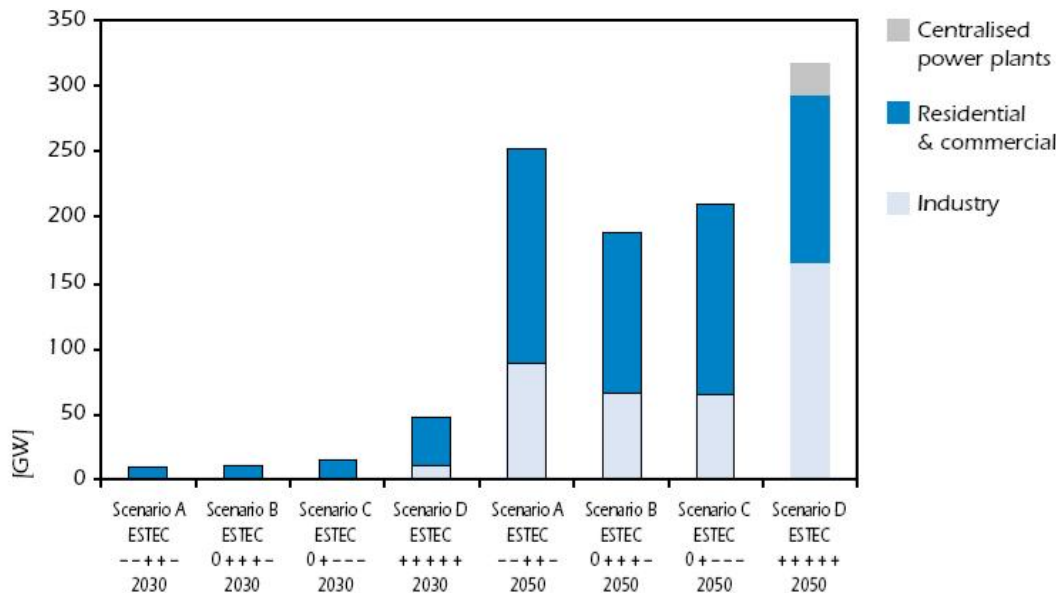
Fuel Cell Power capacity-scenarios

ü **EU snapshot.**

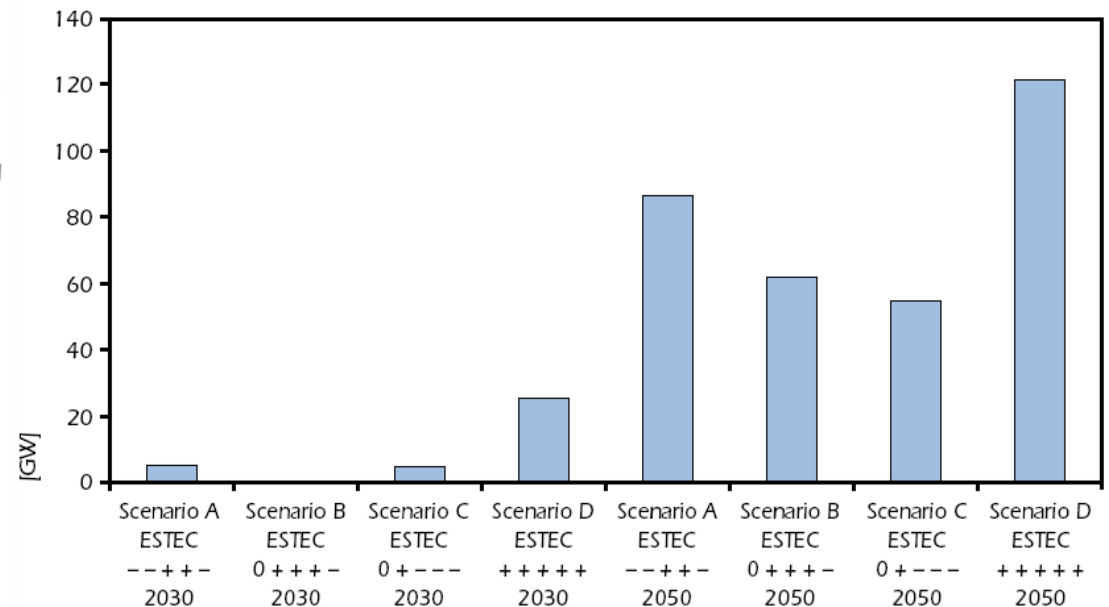
	Stationary FCs Combined Heat and Power (CHP)
EU H₂/ FC units sold per year projection 2020	100,000 to 200,000 per year (2-4 GW _e)
EU cumulative sales projections until 2020	400,000 to 800,000 (8-16 GW _e)
FC system cost target	2.000 €/kW (Micro) 1.000-1.500 €/kW (industrial CHP)

ü **Prospects for hydrogen and fuel cells. IEA, Paris, 2005:**

Global stationary fuel cell capacity by sector in the ESTEC scenarios



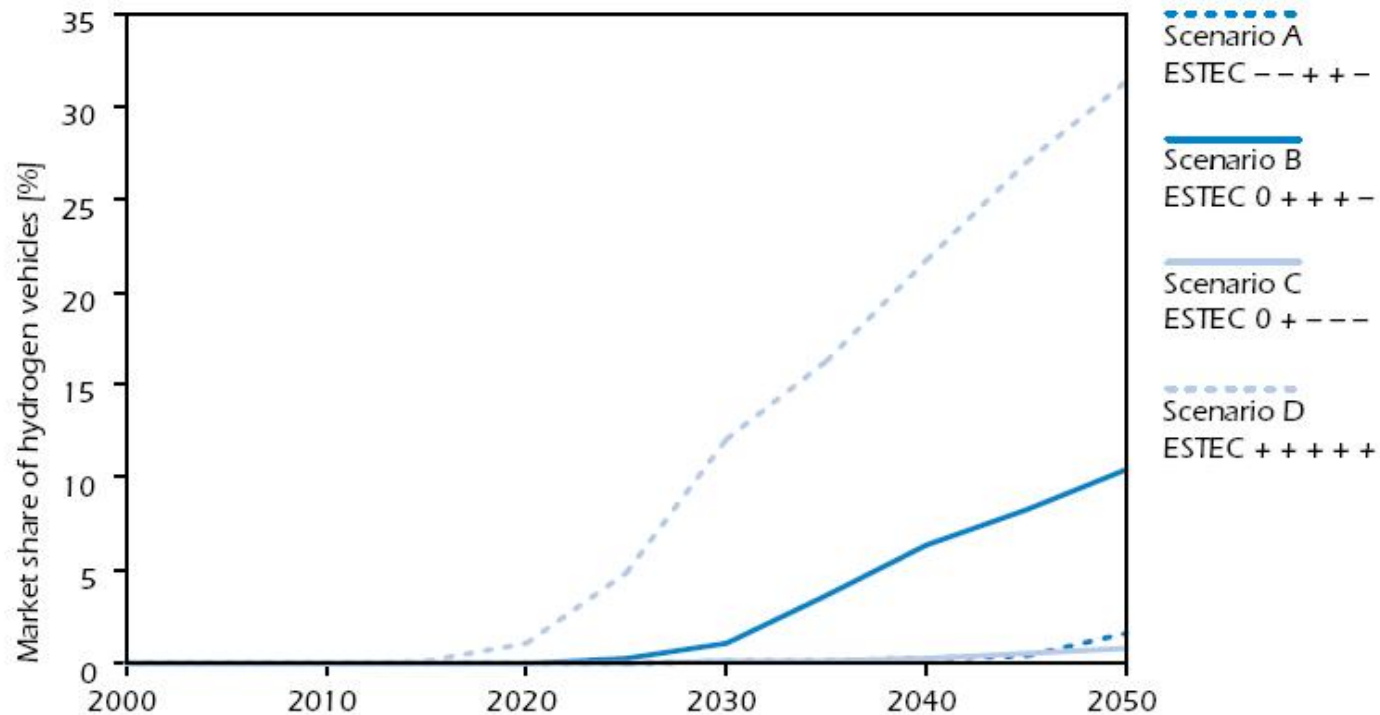
Stationary fuel cell capacity in OECD Europe in the ESTEC scenarios



Fuel Cell transport

- **IEA predicts 0-90% in 2050 but:**
- **Prospects for hydrogen and fuel cells. IEA, Paris, 2005:**

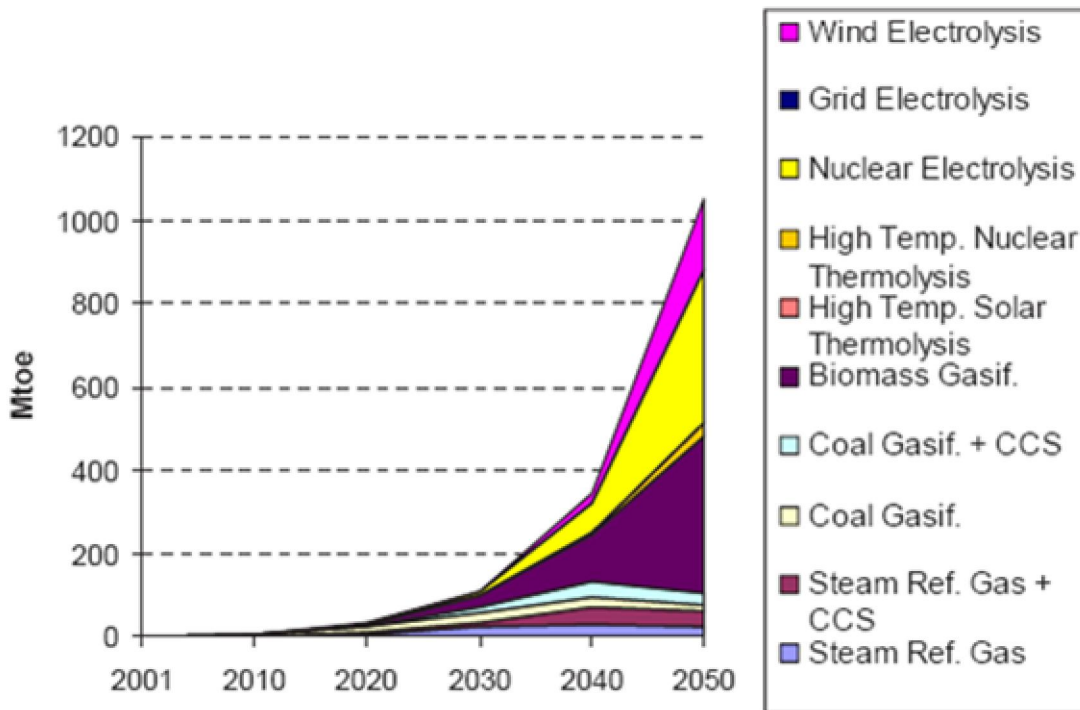
Share of hydrogen-fuelled vehicles in the passenger car and light/medium truck markets



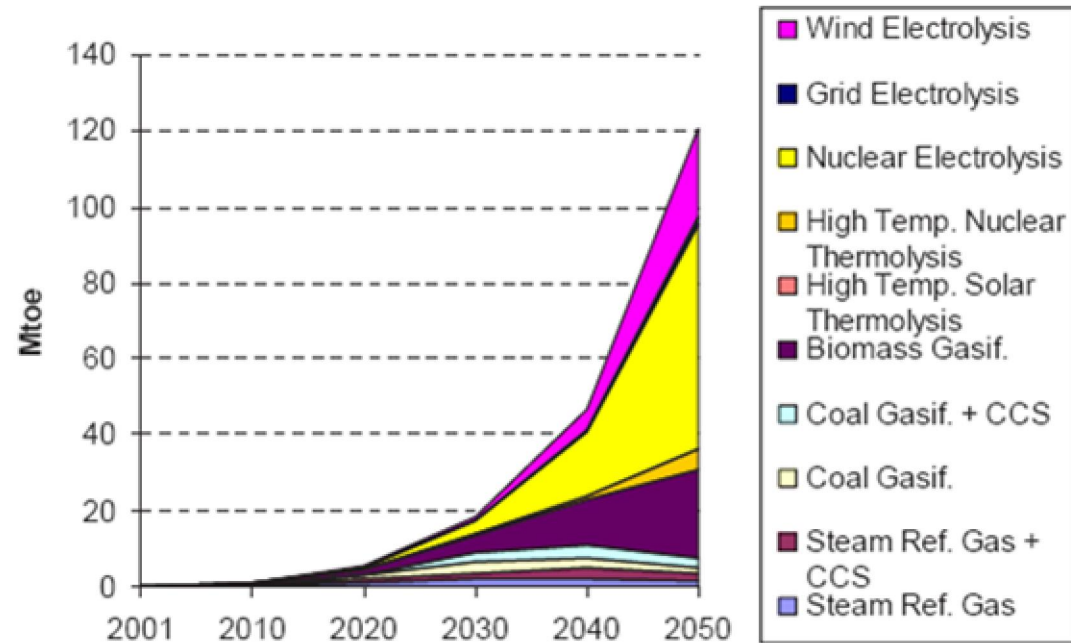
Hyways the European Hydrogen Roadmap, Final Report of the EU Integrated Project HyWays, European Commission 2008.

	2010	2015	2020	2030	2050
Phases	<p>Technology development with focus on cost reduction</p>	<p>Pre-commercial technology refinement & market preparation</p> <p>Start of commercialisation</p>	<p>HFP Snapshot 2020</p> <p>◆ materialisation of first impacts</p> <ul style="list-style-type: none"> • New hydrogen supply capacities partially based on low carbon sources • improvement in local air quality • More than 5% of new car sales H₂ & FC 	<p>HyWays Snapshot 2030</p> <p>◆ Hydrogen & FC are competitive</p> <ul style="list-style-type: none"> • Creation of new jobs and safeguarding existing jobs (net employment effect of 200,000 – 300,000 labour years) • Shift towards carbon-free hydrogen supply • More than 20% of new car sales H₂ & FC 	<p>H₂ & FC dominant technologies high impact</p> <ul style="list-style-type: none"> • 80% of light duty vehicles & city buses fuelled with CO₂ free hydrogen • reaching more than 80% CO₂ reduction in passenger car transport • In stationary end-use applications, hydrogen is used in remote locations and island grids
Targets	<p>LHPs facilitate initial fleet of a few 1,000 vehicles by 2015</p> <ul style="list-style-type: none"> • PPP "Lighthouse Projects" • Increase R&D budgets to 80 M€/year • Financial support for large scale demonstration projects 		<p>Vehicles:</p> <p>2.5 million of fleet</p> <p>Cost</p> <p>H₂: 4 €/kg (50 €/barrel)</p> <p>FC: 100 €/ kW</p> <p>Tank: 10 €/kWh</p>	<p>Vehicles:</p> <p>25 million of fleet</p> <p>Cost</p> <p>H₂: 3 €/kg (50 €/barrel)</p> <p>FC: 50 €/ kW</p> <p>Tank: 5 €/kWh</p>	
Required Policy Support Actions	<p>Develop H₂ specific support framework</p> <ul style="list-style-type: none"> • Create / support early markets • Implement performance monitoring framework • Long term security for investing stakeholders • Education and training programmes • Harmonisation of regulations codes and standards 	<p>H₂ specific support framework</p> <ul style="list-style-type: none"> • In place before 2015 at MS level • Deployment supports, e.g. tax incentives of 180 M€/year • Public procurement • Planning and execution of strategic development of hydrogen infrastructure 		<p>Gradual switch from hydrogen specific support to generic support of sustainability (2020 →)</p>	<p>Incentives provided through general support schemes for sustainability</p>
	2010	2015	2020	2030	2050

Production according to *World Energy Technology Outlook - 2050: WETO-H2.* European Commission, Brussels, 2006



Technology mix in world hydrogen production



Technology mix of hydrogen production in Europe

Questions to be answered

- ü1. How are the national programs seeing the penetration of fuel cells in the coming years (2020 and 2050)
- ü2. What do we think that the influence of fuel cells (and hydrogen) will be on the CO₂ emission reduction in the future
- ü3. What are the obstacles to fuel cell and hydrogen penetration
- ü4. What are the national programs doing to overcome those obstacles