Benchmarking of European and U.S. Hydrogen Roadmapping Efforts (HyWays-IPHE): Socio-Economic Modelling and Stakeholder Involvement

Mark F. Ruth (NREL), Christoph Stiller (LBST), Fred Joseck (U.S. DOE), and Ingo Bunzeck (ECN)

on behalf of the HyWays-IPHE consortium

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HyWays-IPHE Project Objectives

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Benchmarking of Hydrogen Energy Roadmaps

- Objectives
  - Compare roadmapping and system analysis activities in Europe and USA (+other IPHE partners)
  - Improve understanding about the ongoing activities (common language, mutual understanding, alignment of int'l approaches)
- Comparison Activities
  - Pathways that are relevant in both regions
  - Basic technical and economic assumptions
  - Hydrogen pathway analysis results

  Presented earlier
  - Modeling approaches (economic impacts, technology learning, infrastructure and transition analysis, model interaction)
  - Stakeholder involvement in the roadmapping process
- Communication and Community-Building Activities
  - Involved institutional and personal exchanges to improve understanding
  - Involved continuous consultation of industry monitoring group

What is a Roadmap?

The HyWays-IPHE consortium's understanding of a hydrogen energy roadmap is:

A **joint endeavor** of industry, government, academia and the public, providing a structured process for a coordinated, long-term public and private effort in preparing, introducing and implementing hydrogen in the energy and transport system.

An **instrument for identifying the key technologies**, **products and markets, and foreseeable obstacles** to their development, introduction, and use, and the possible measures to overcome them.

An **assessment of expected impacts** on the market, society, and environment.

A **navigation tool** for strategic planning and implementation of research development, structural change and infrastructural investment.

An opportunity for communication between all involved stakeholders of different backgrounds, viewpoints, and interests in developing hydrogen (from its production, delivery, storage, dispensing to its application in final end-use).

Based on a combination of visions, pathway scenarios and systems modeling, it typically provides **a technical, economic and strategic analysis that may lead to a master plan** with a derived list of actions.

Roadmapping Activities That We Compared

- Program structure and stakeholder involvement
- Vehicle modeling
- Energy system models
- Economic impacts
- Resulting documents

Program Structure

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Nations and government entities choose different emphases of top-down and bottom-up program designs, some combination of approaches proves to be helpful

United States

Primarily government driven

DOE responsible for setting technological targets and supporting research

Industry groups, states & cities, HTAC, and NRC provide input

Project input from stakeholders including an annual project review meeting

Obvious connection between program goals and projects

Large national plan that has not been broken into regional plans

Europe

Primarily industrial stakeholder driven

A Joint Technology Initiative (JTI) calls for proposals and selects projects. It involves partners' cost-share (primary funding source), EC funding, and member states funding.

Initiative and supporting role of the European Hydrogen and Fuel Cell Technology Platform (HFP)

JTI will further define connections between goals and projects

Key role of Member-States and Regions with their own plans and selections

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Vehicle Cost & Performance Projection Comparison

- Different continents require different vehicle assumptions
  - HyWays – VW-Golf class
  - US – Mid-size passenger car
- Different portfolio and configurations of hydrogen fuel cell powered vehicles require to devise a common assessment framework (component level approach)
  - Hybrid hydrogen FC vehicle the only common vehicle assessed in both sides
  - Non hybrid FC in the EU, while PHEV investigated in the US
- Different learning methodologies emphasize the need for a harmonized methodology for accurate comparison:
  - EU: learning by doing assuming previous 10,000 produced vehicles
  - US: 3-D: learning by searching, economies of scale, learning by doing
- Cost is highly dependent upon market size
  - Learning function dependent upon technology, market size, market history (growth rate)
  - Estimating global markets is better than national market because learning is made by multi-national OEMs

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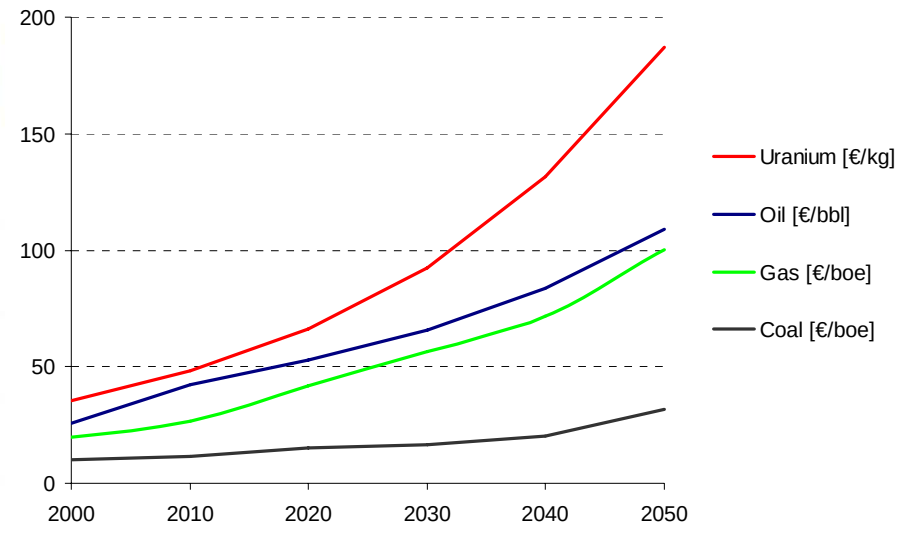
Comparison of energy prices

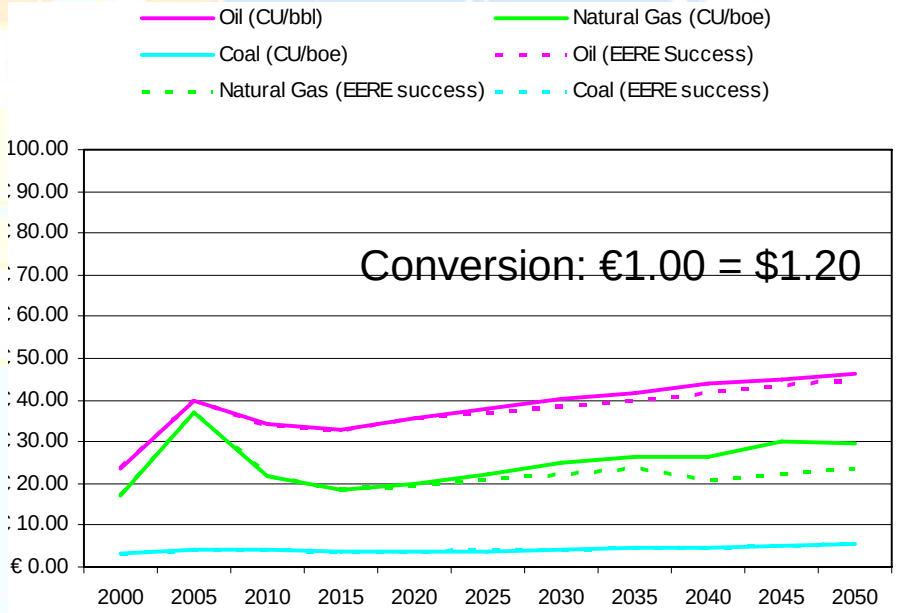
Prices of Energy Supplies

HyWays



Exogenous source

US Markal



Endogenous Calculation

⇒ Consistent energy supply costs are important for project selection. Changing them too often will cause too much disruption of projects that should be selected.

⇒ External drivers (i.e., world markets) are important but difficult to consider in a regional model.

Comparison of hydrogen production-technology mixes

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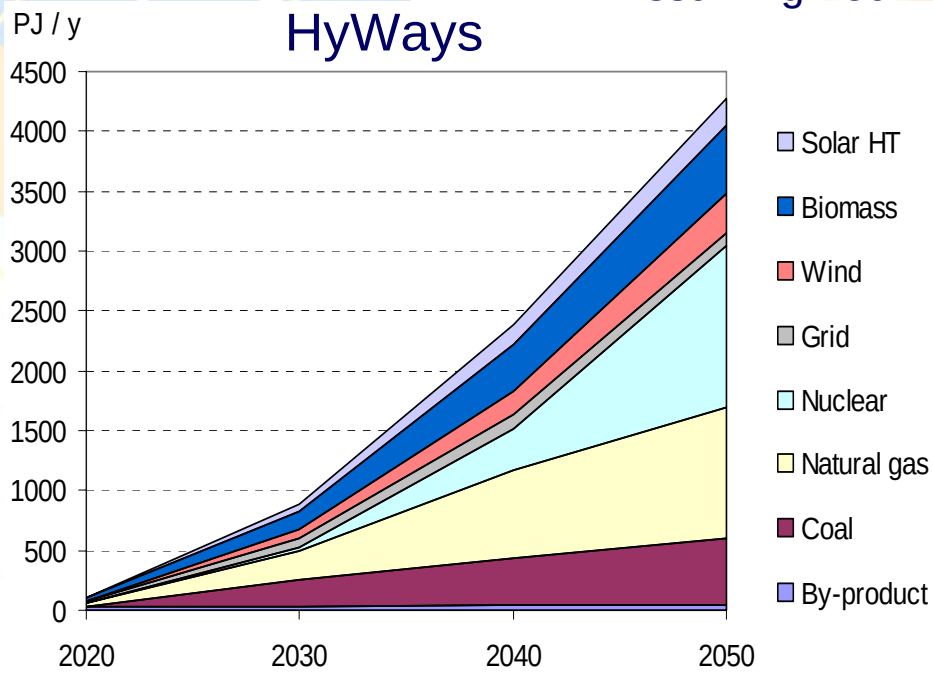
Hydrogen Production Mixture
Assuming Technology Success

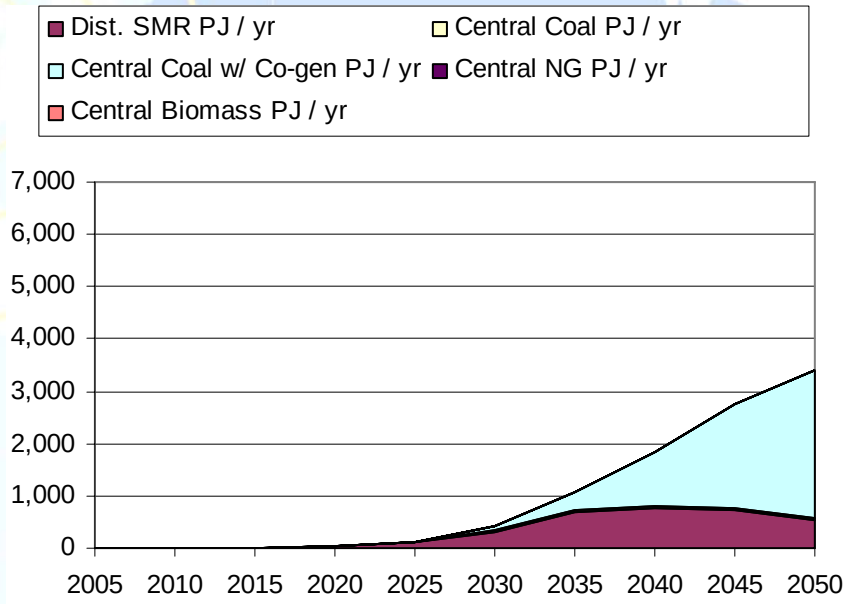
HyWays



Vehicle penetration set exogenously

Mix constrained by workshop results

US Markal



Endogenous least-cost calculation using single- region model with nested logit function

⇒ Endogenous vehicle penetration identifies the impact of assumptions and conditions, but the results may neglect the views of the stakeholders.

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Macro-Economic Estimates – Employment Studies

- Both the EU & the US used an input output approach (EU to 2030; US to 2050)
  - Division of Economy into manufacturing and demand sectors
  - FC technology had to be integrated in the I/O model
- EU also used a CGE model to analyse GDP effects
- The US model is more detailed in its disaggregation of employment by sector and type
- Both sides calculate disaggregated results, the EU for the 10 HyWays countries, the US for 5 regions of interest
- The EU model is integrated in the harmonized HyWays framework
  - Results are available for each of the 10 countries
- Both sides looked at international competitiveness
  - Which role will the EU/US play in the FC markets?

HyWays Employment Study Results

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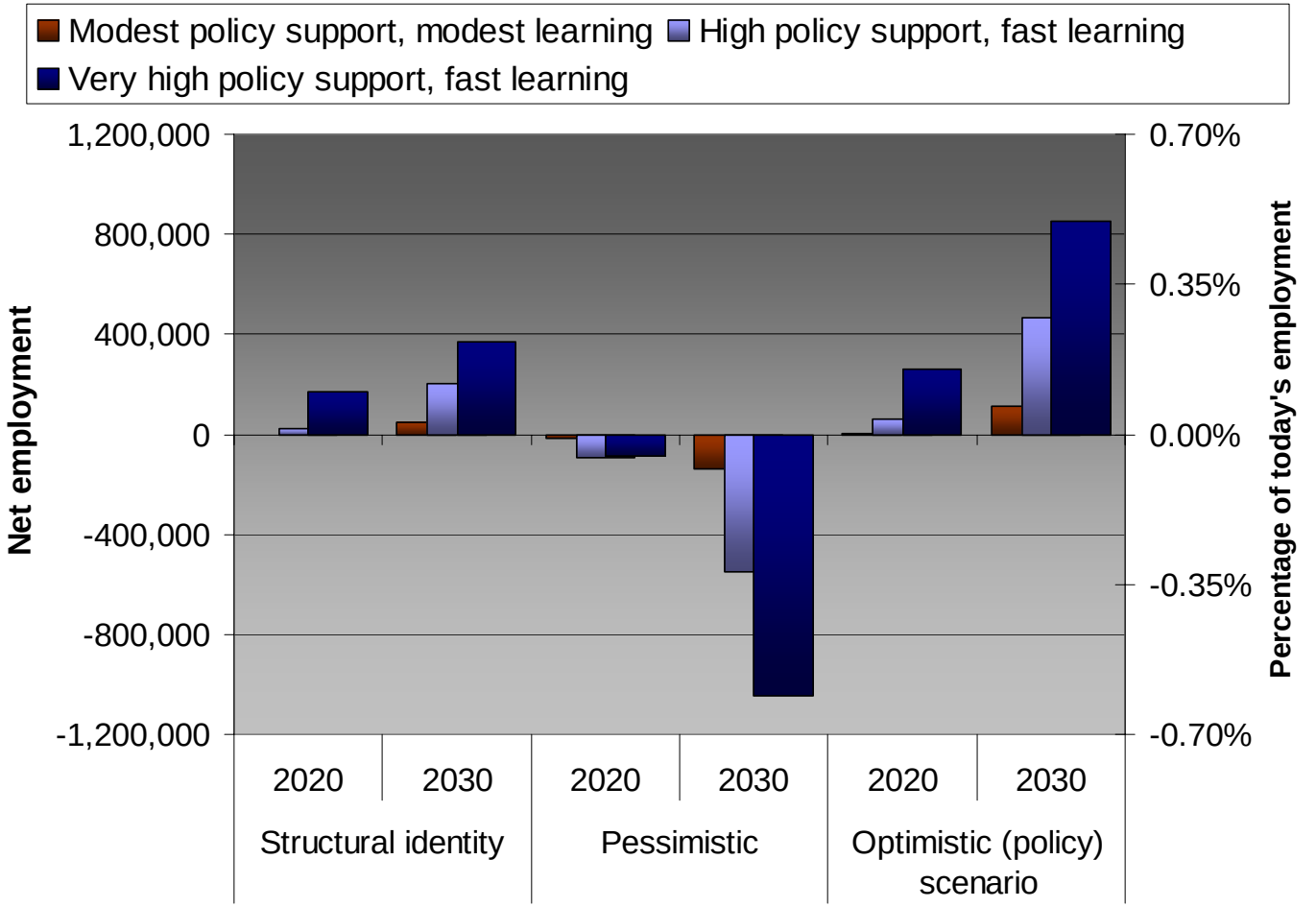

- Small gains in GDP and employment if Europe maintains the same import/export shares for H_2 technologies as for comparable conventional technologies (Structural identity scenario)
- If not, consequences are significant

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Resulting Documents

- US
  - Roadmap identifies key issues and challenges and potential for penetration
  - Posture Plan identifies DOE roles, activities, targets – Execution Plan
  - Available at http://www.hydrogen.energy.gov/library.html
- HyWays
  - Roadmap
  - Action plan
  - 2-page summary, executive summary, background documents, etc.
  - Available at http://www.hyways.de/

Conclusions

- On both sides, all stakeholders were involved in the roadmapping process; however, the format was highly dependent upon the region's culture.
- The set of models was largely consistent although the assumptions and approaches varied.
  - Vehicle size and technology
  - Energy prices and how they were modeled
  - Role of government in constraining markets (energy mix)

- **Detailed report available online**

  http://www.hyways-iphe.org/WP3

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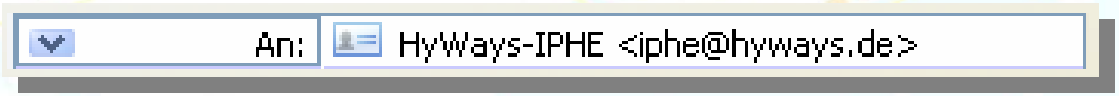
Thanks for your attention.

For further questions: Write to



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