




# New Trends in Energy

## Hydrogen and fuel cells

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Introductory lecture – Energy commodities and technologies

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# *Motivation for energy technology research and development*



# Why innovate?



## Energy Efficiency – Cost Efficiency

- The cheapest kWh is a kWh not generated
- Making the best out of the available resources

## Energy Security

- Resilient and robust energy system
- Taking advantage of domestic energy sources leads to reduced reliance on fuel imports

## Climate Change

- Transition to low-carbon economy

## Health and environment

- Reduced emission of air and water pollutants that adversely affect health



# *Hydrogen and Fuel Cells*

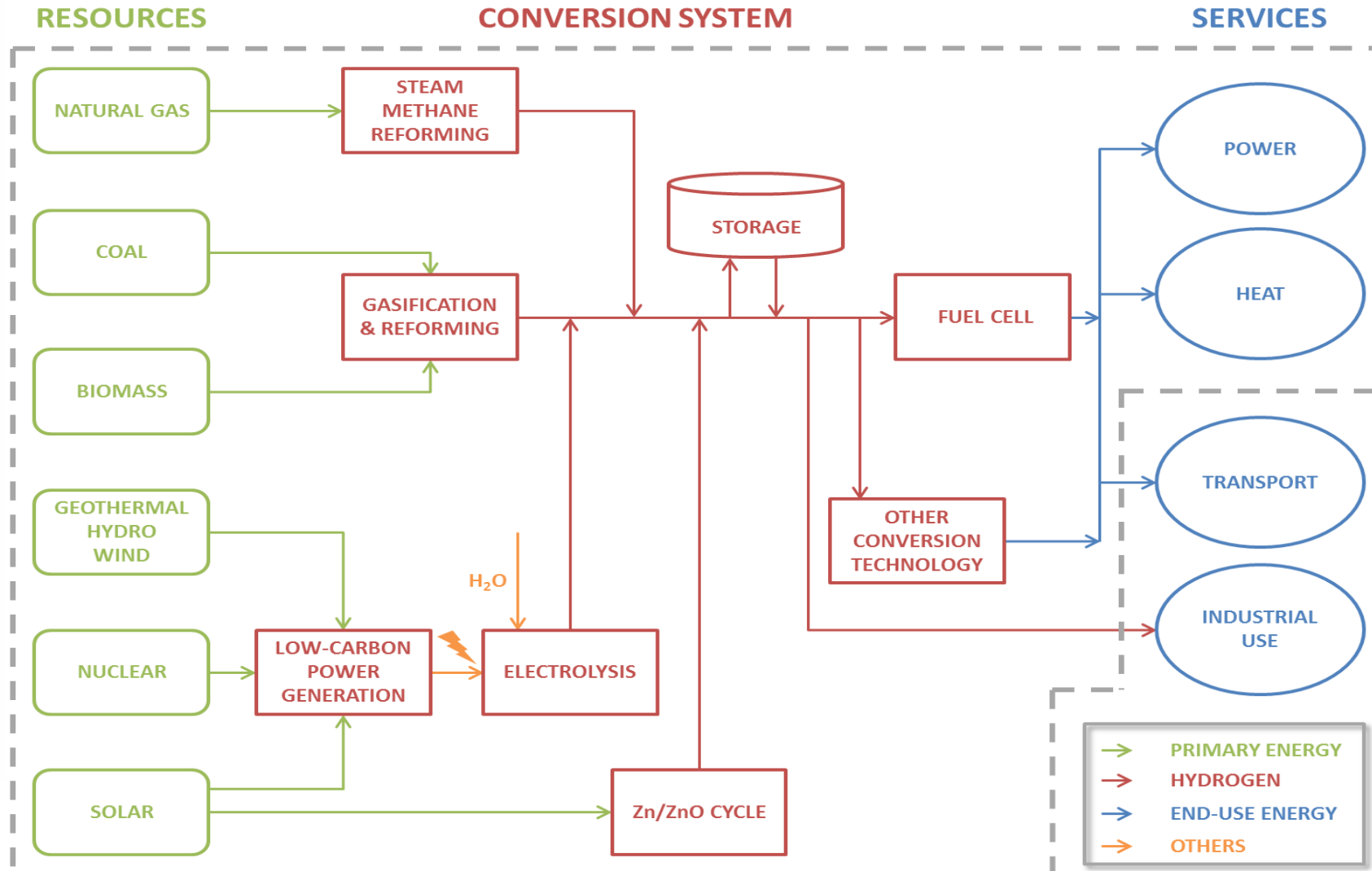


# Hydrogen and Fuel Cells



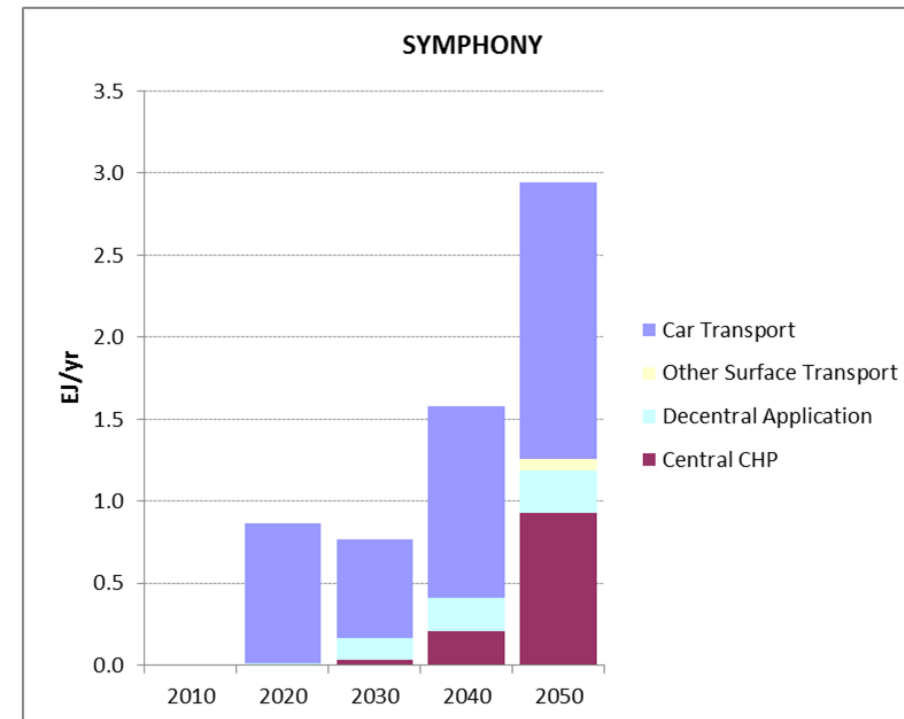
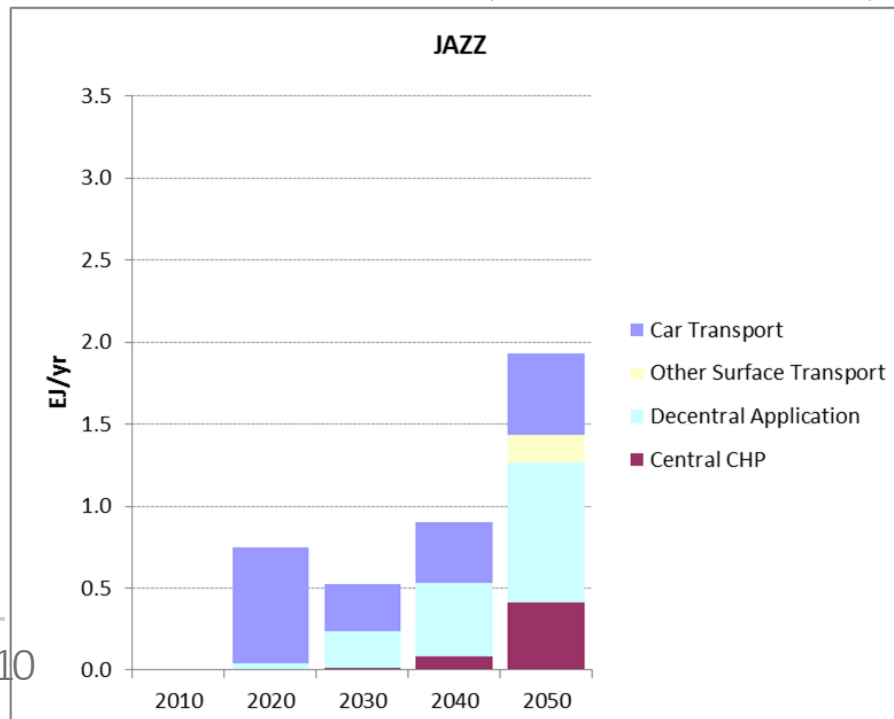
- Fuel cell and hydrogen (FCH) technologies and applications are considered as potentially significant elements in a future low-carbon energy system in the medium- to long-term perspective.
- Expected benefits are:
  - Mitigation of greenhouse gas emissions
  - Mitigation of local air pollution
  - High energy efficiency
  - Reduction of fossil fuel dependency
  - Promotion of technology exports

# FCH Production and Use



# Hydrogen Scenario Analysis: Global

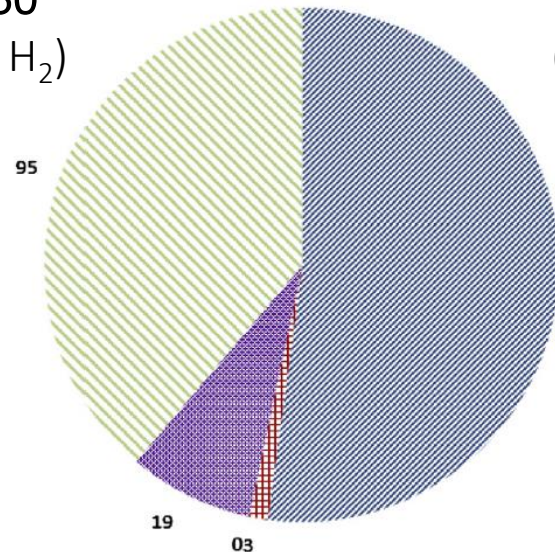
- WEC/PSI scenarios “JAZZ” and “SYMPHONY”
- The share of hydrogen in the total final consumption is marginal:
  - JAZZ: from 0.13% in 2025 to 0.27% in 2050
  - SYMPHONY from 0.18% in 2025 to 0.50% in 2050



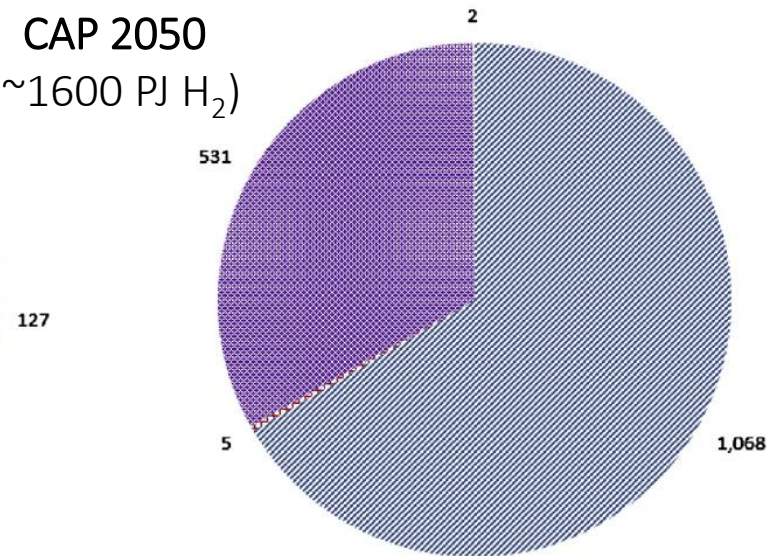
# Hydrogen Scenario Analysis: Europe

- JRC EU-TIMES scenarios “CPI” and “CAP”
- The share of hydrogen in the total final consumption is small:
  - CPI: very small amounts
  - CAP: from 1% in 2030 to merely 4% in 2050

CPI 2050  
(~250 PJ H<sub>2</sub>)



CAP 2050  
(~1600 PJ H<sub>2</sub>)



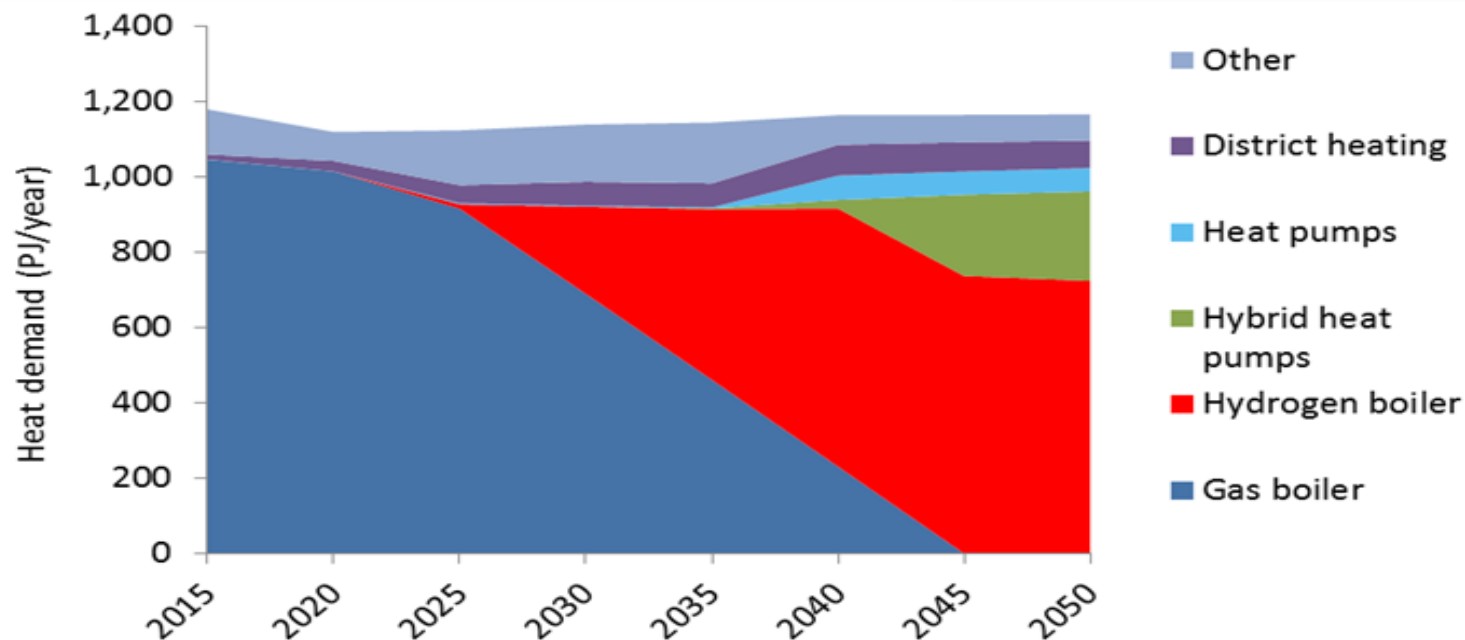
Industry
  Residential
  Commercial
  Transport
  Other sectors

Source: Sgobbi et al. (2016)



# Hydrogen Scenario Analysis: UK

- E4Tech/UCL scenarios “Critical Path” and “Full Contribution”
- The share of hydrogen in the total final energy:
  - “Critical Path”: 1% in 2040
  - “Full contribution”: 60% of residential buildings and 50% of the industry sector supplied by H<sub>2</sub> in 2050; similar for services



Source: Hart et al. (2015)



# Hydrogen Scenario Analysis: Conclusions



## Insights from the scenario studies

- Significant **deployment of H<sub>2</sub>** (>10% of final energy consumption) is probably in the **post-2025** period (if at all).
- The scenarios with **large deployment** of H<sub>2</sub> have two features:
  - Strong uptake in the **transport sector**
  - **High carbon price**
- A **strategic positioning** towards H<sub>2</sub> is needed for larger deployment.



# Changelog and attribution



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