

Assessment of the Merits of Different Hydrogen and Fuel Cell Pathways for Energy Applications

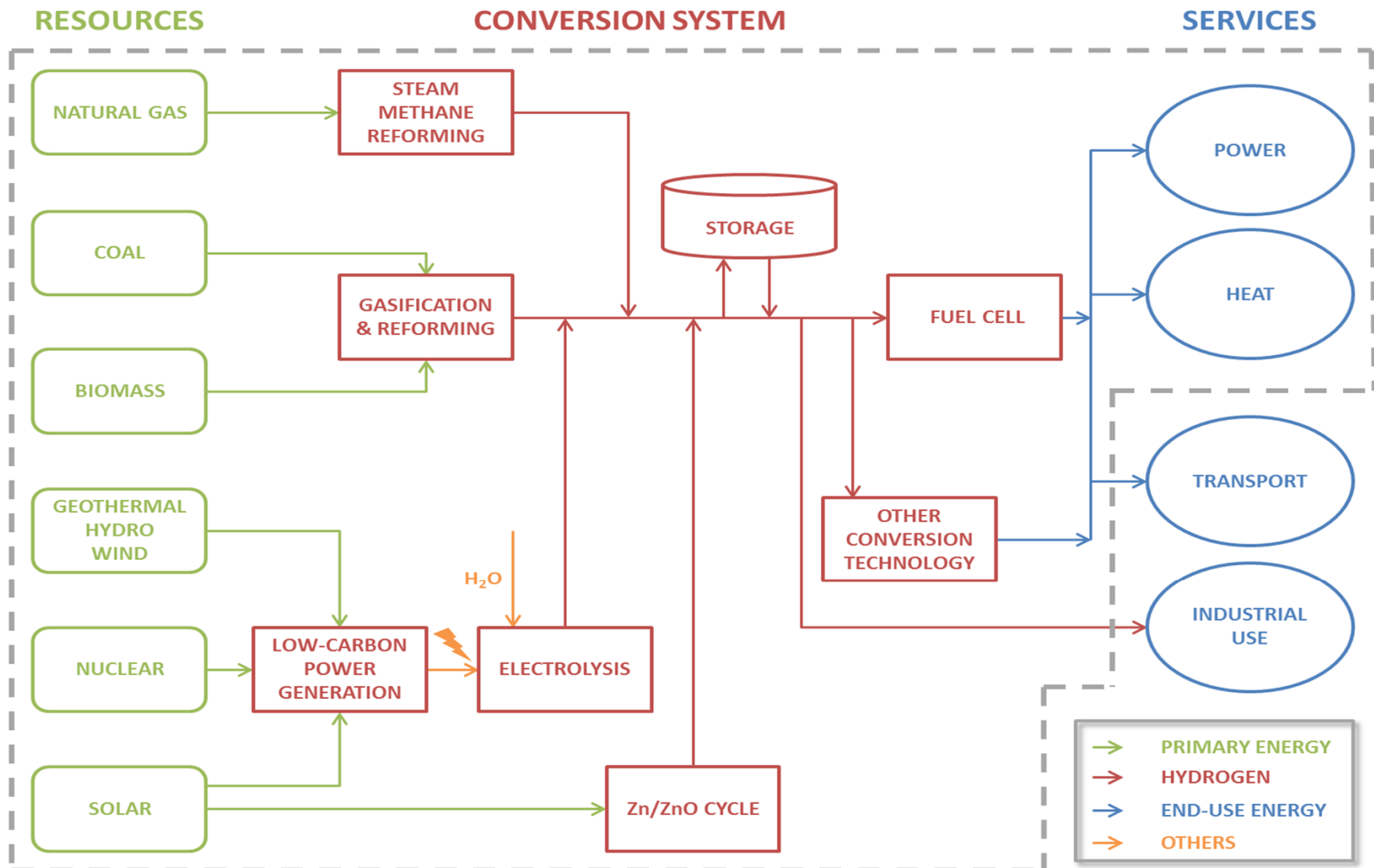
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Outline

- Background
- Merit Ranking Tool
- Conclusions

FCH = Fuel Cell and Hydrogen

What are stationary FCH applications?



FCH Technologies in Energy Applications

- New fuel cell and hydrogen (FCH) technologies and applications for the energy sector have been developed for about a decade.
- Some countries such as Japan, South Korea, US and Germany are leaders in demonstration projects and commercialization due to proactive national incentives and funding. Examples are:

In Germany

<http://www.callux.net>



In Japan

<http://www.tokyo-gas.co.jp/>

In Europe

<http://enefield.eu/>



Motivation

- Stationary 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 Technologies in the EU

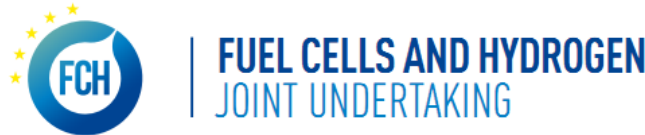
- Within the EU energy policies, FCH related topics are integrated in DG ENER.

- <https://ec.europa.eu/energy/>



- FCH Research & Development (R&D) activities are financed through a private-public partnership, the FCH Joint Undertaking, which is financed in case of energy applications by DG ENER & RTD.

- <http://www.fch.europa.eu/>



- The strengths and weaknesses of different world regions regarding FCH technologies were previously assessed by the INSIGHT_E consortium
 - I. Drmač, D. Jakšić, N. Karadža und et al. (2015): «Exploring the strengths and weaknesses of European innovation capacity within the Strategic Energy Technologies (SET) Plan».

Goal & Scope

- The goal of the study is:
 - to assess stationary FCH energy applications and pathways in the short- to mid-term (2020-30) and mid- to long-term (2040-50)
 - Technology assessment
 - Energy systems scenario studies
 - to create a basis for decision-making processes and for the design of energy policies
- Restrictions:
 - Synergies with transport applications are discussed
 - Non-energy sectors (e.g. industrial use) are not considered
- There are two main outputs:
 - Microsoft Excel Merit Ranking Tool
 - Report

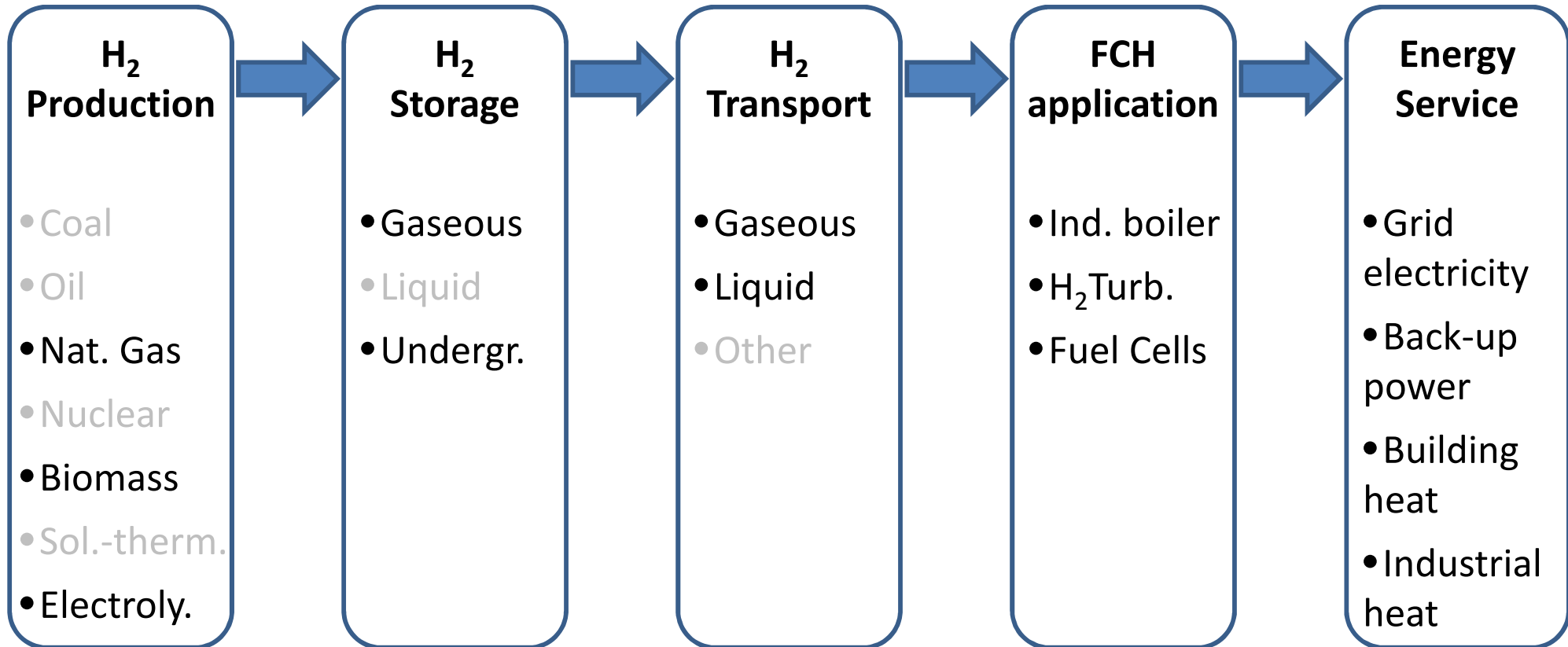
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FCH Technologies for Heat and Power

FCH technologies can be allocated to 5 steps, which – concatenated to pathways - supply 4 different energy services.



Merits

- Levelized costs
- Marginal CO₂ abatement costs
- CO₂ emissions
- Maturity
- Flexibility
- Regulatory risk
- Public acceptability

Key Parameters

- Time period
- Electricity price
- Natural gas price
- Biomass price
- Hydrogen prices
- CO₂ price

- Interest rate
- Electricity CO₂ intensity
- H₂ use in other sectors
- TRL threshold
- VR share over the system peak
- Public acceptability

Application in Case Studies

- How does a specific FCH pathway perform with respect to other possible pathways and different merits?
- What FCH pathways are possible and interesting for a country or region with particular characteristics?
- How can the availability and performance of specific FCH technologies evolve over time?
- What are the possible FCH pathways under a specific set of economic, political and social boundary conditions (i.e. in a specific scenario)?

Demonstration Merit Ranking Tool

- Overview of the tool
- Demonstration of case studies

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Concluding Remarks

- The merit ranking tool includes H₂ generation, storage, transport technology options, and FCH applications, together with the corresponding pathways.
- They are contrasted against gas-fired counterfactual technologies based on a set of seven merits.
- The user can adjust the values of a set of key parameter assumptions to explore the role of the corresponding storyline for the ranking of the FCH technologies and pathways.
- The analysis illustrates the competing nature of the selected merits under the (local) conditions under consideration.
- The (subjective) interpretation of the response of the merit ranking tool is up to the decision-maker.

Thank You for Your Attention!

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 - Warren Schenler (PSI)
 - Christian Bauer, Xiaojin Zhang (PSI)
- Policy report:
http://insightenergy.org/static_pages/publications#?publication=37
- Merit ranking tool:
http://www.insightenergy.org/system/sis_tables/files/000/000/004/original/Copy_of_INSIGHT_E_PR_FCH_Merit_ranking_tool.xlsx?1480095195