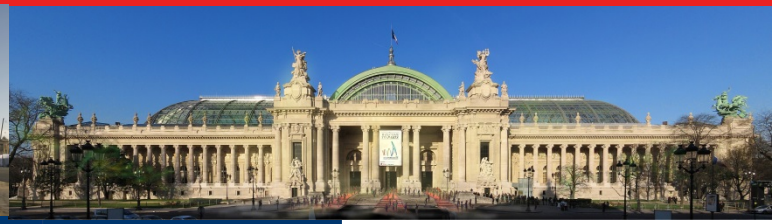
26th World Gas Conference

1 – 5 June 2015, Paris, France



WOC 5.4 - Study group report – **"Economic aspects".**

1. Global status for upgrading of biogas (2013)
2. Electrolyzing technologies (2013)
3. Injection of Hydrogen into the Natural Gas System (2014)
4. Economic aspect of Power to Gas (2015)

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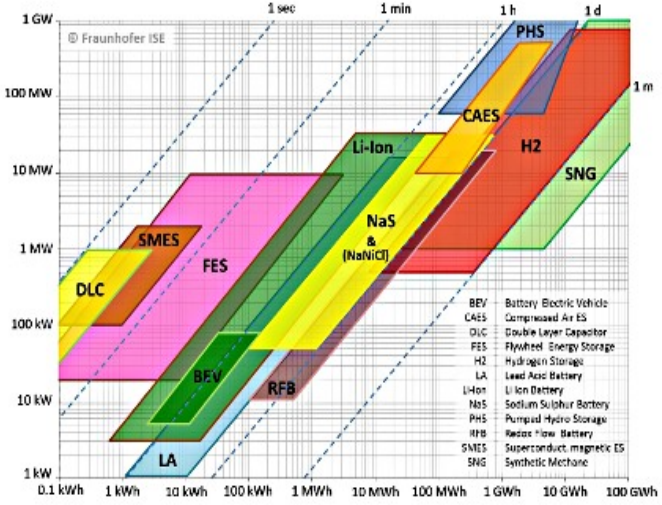
Why power-to-gas?

- The current energy system is not designed to cope with a large share of intermittent sources (wind and solar)
- Energy storage is considered as one of the greatest challenges for the energy sector
- Storage technologies must be assessed at the application level
- Hydrogen and methane storage (through power-to-gas) seems to be the only way to provide very large-scale and long-term storage requirements

Energy storage technologies[1]



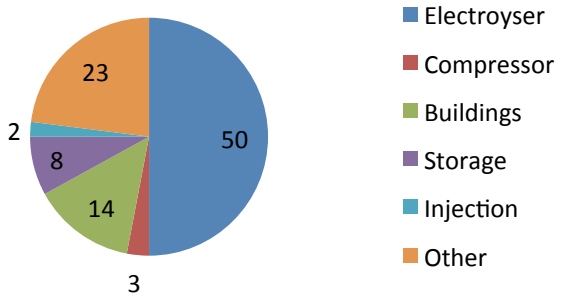
[1]Electrical Energy Storage, IEC Market Strategy Board Fraunhofer ISE, 2011

Economics of hydrogen production

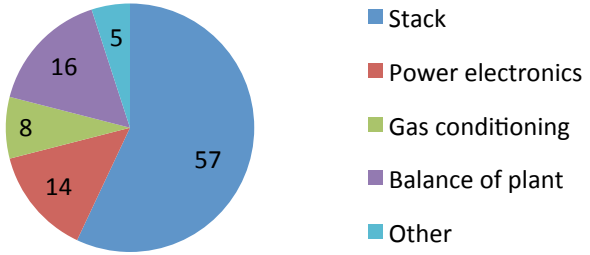
- Main cost parameters are the costs of electricity, investment in electrolyser and operational costs
- Possible income parameters for hydrogen are the sale of hydrogen and payment for delivering flexibility services

- Half of the costs of a power-to-gas plant are attributed to the electrolyser
- The electrolyser stack dominates the costs of the system

Investment costs power to gas plant (5 MW, 1.000 m3/h H2)[2]



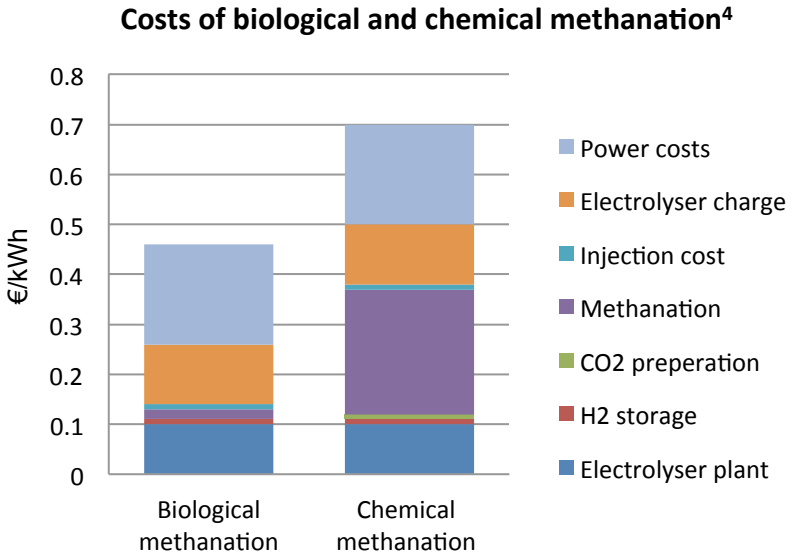
Cost break down for Alkaline electrolyser[3]



[2]DBI Gas and environment technology - Müller- Syring, DBI and Peter Franke, Bundesnetzagentur, 2011
[3]Electrolyser Capital Cost Study, NREL, 2008

Costs of methanation

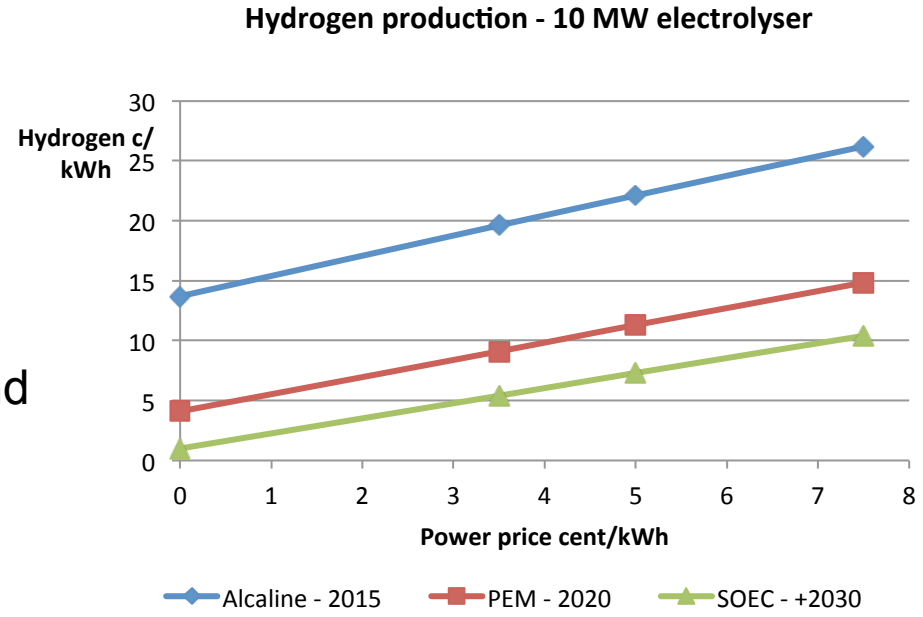
- Methanation can be executed chemically or biologically
- It seems that the biological process will be the most economical way to produce synthetic methane in the future
- The major cost difference between the chemical and biological process is the absence of a catalyst in the biological process



[4]Analyse der kosten erneubarer gas, Ludwig-Bolkow-Systemtechnik GmbH, 2013

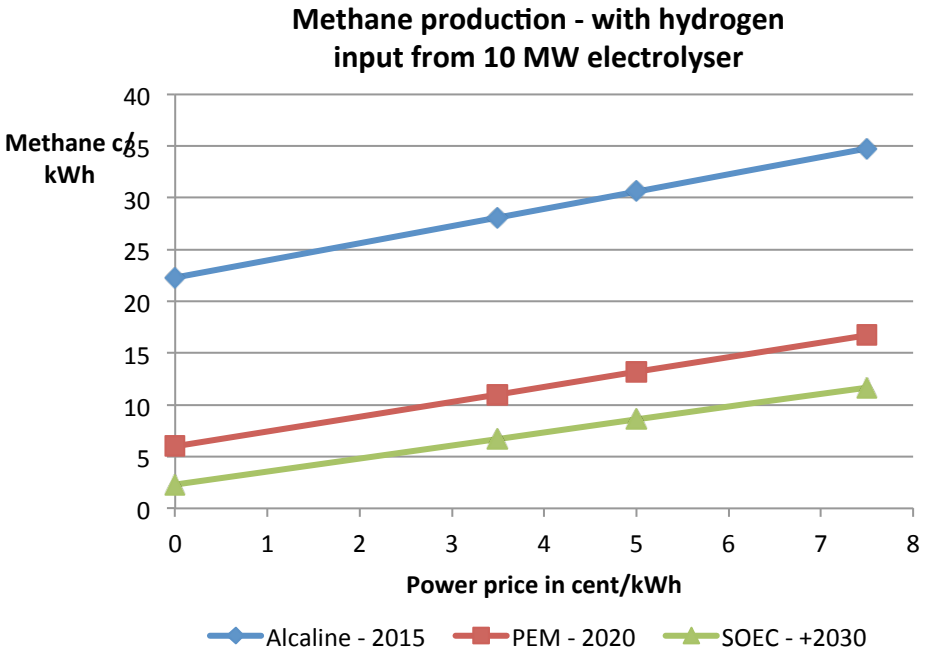
Cost perspective – hydrogen production from electrolysers

- Calculations have been made for three cases for the period 2015-2030
  - Alkaline electrolyser
  - PEM electrolyser
  - SOEC electrolyser
- 10MW electrolyser plant with 4,000 running hours
- Different power prices (7.5, 5, 3.5 and 0 euro cent/kWh)
- The price of power is an essential factor for hydrogen production



Cost perspective – methane production

- Calculations have been made for a methanation unit receiving hydrogen from a 10MW electrolyser
- Lowest possible methane costs post-2030 (SOEC) are in the range of 2.3-11.7 euro cent/kWh
- The costs for CO2 are not included
- The assumption is that the costs of the electrolyser and methanation unit will reduce significantly in the future



Conclusion

- The concept of power-to-gas is still at an early stage of development
- The power-to-gas concept distinguishes itself from other energy storage options because;
  - it offers other benefits such as cost-effective transmission through the existing gas infrastructure,
  - avoidance of expensive expansion of the electricity infrastructure and
  - contribution to the green transformation of energy sectors with renewable gas (hydrogen and/or methane)
- Power-to-gas is not considered a cost-effective option in the short term
- However, positive business cases are possible in specific situations with favorable (local) conditions
- The development of new efficient and low-cost technologies is important for the success of power-to-gas