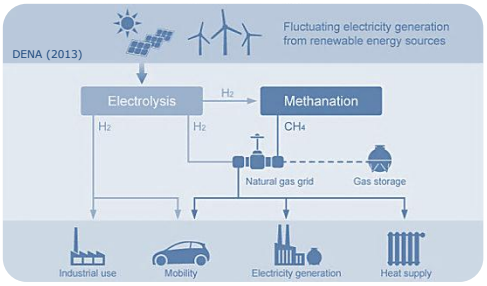
NORTHSEA POWERTOGAS | DNV·GL

KEY FIGURES POWER-TO-GAS TECHNOLOGY 2014



Power-to-gas refers to the conversion of electrical power into a gaseous energy carrier. Practically this means that electricity is converted into hydrogen (H_2) by electrolysis, with a possible sequential process of methanation (CH_4) by the synthesis of hydrogen (H_2) and carbon dioxide (CO_2):

- Electrolysis: $2H_2O(l) \rightarrow 2H_2(g) + O_2(g)$
- Methanation: $CO_2(g) + 4H_2(g) \rightleftarrows CH_4(g) + 2H_2O(l)$

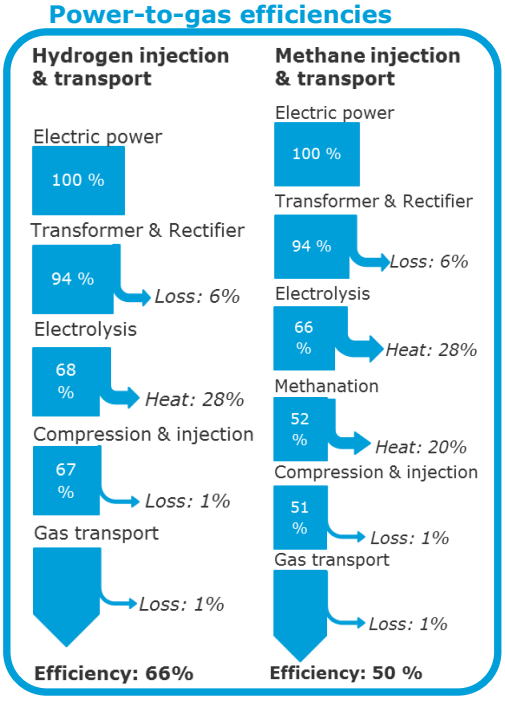
Electrolysis characteristics

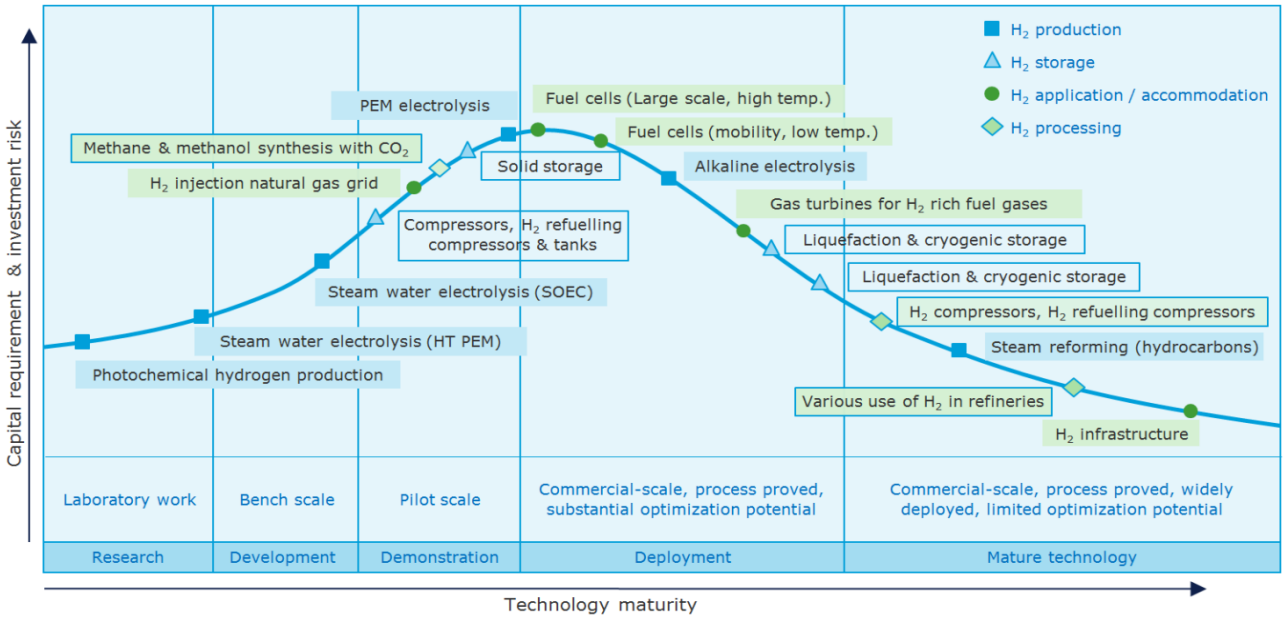
Description	Alkaline	PEM (2020)	Unit
Caloric value H_2	3.53	3.53	kWh/m^3 (HHV)
Caloric value H_2	12.7	12.7	MJ/m^3 (HHV)
Power load ranges	20 - 100	0 - 100	%
Ramp time (hot)	0.3	10	%/sec
Cold start time	< 60	< 10	minutes
Energy efficiency	67 - 82	75 - 85	%
Technical lifetime	90,000	30,000	hrs
Capital costs	1,200–2,500	700 – 1,500	EUR/kWe
Operational costs	50 – 100	30 – 80	EUR/kWe/yr

Methanation characteristics

Description	NiO-based	Biological	Unit
Calorific value CH_4	10	10	kWh/Nm^3 (HHV)
Calorific value CH_4	35.8	35.8	MJ/Nm^3 (HHV)
Energy efficiency	70 - 85	80-85	%
Cold start time	< 30	< 10	minutes
Technical lifetime (catalyst)	25,000	N/A	hrs
Capital costs	500 – 1,500	150 – 650	EUR/kW$_{methane}$
Operational costs	40 - 180	30 – 140	EUR/kW$_{methane}$/yr

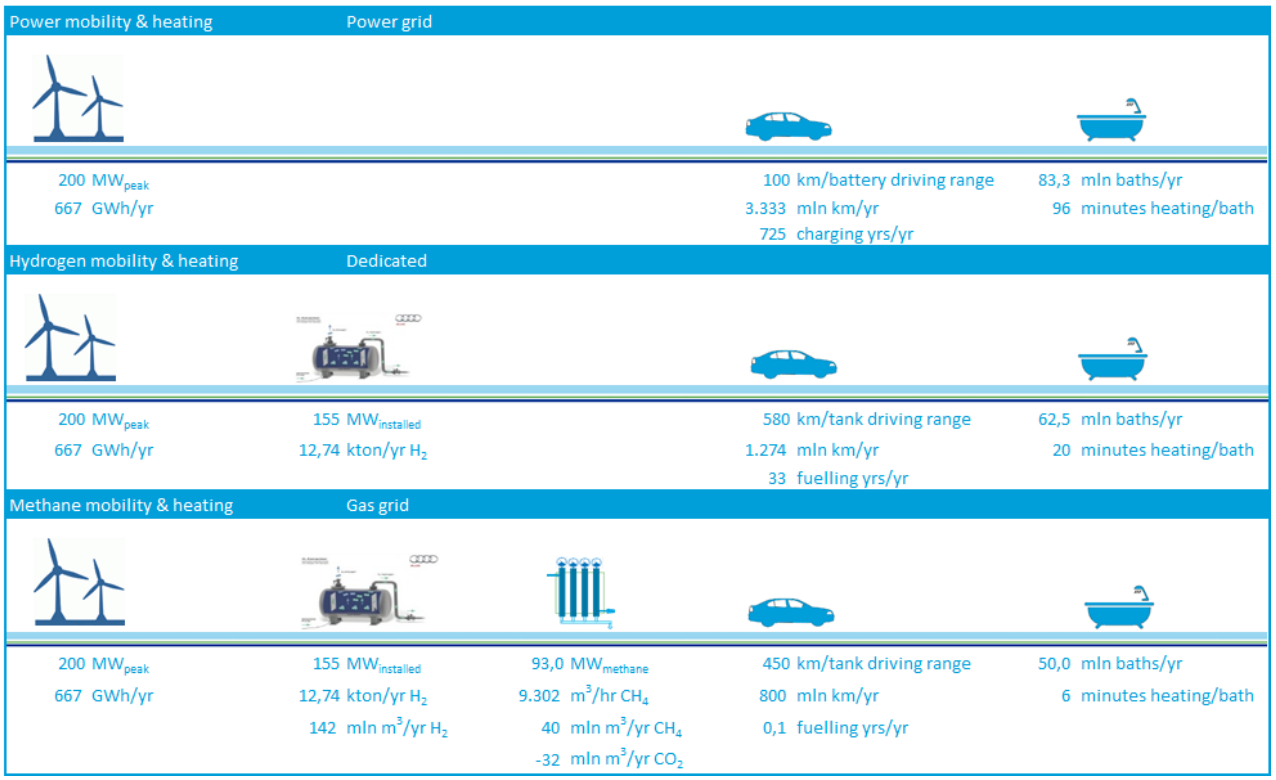
Power-to-gas efficiencies





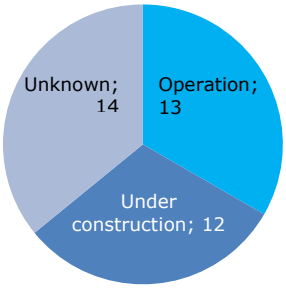
DNV GL, Energieweg 17, 9743 AN Groningen. On behalf of the North Sea PtG platform www.northseapowertogas.com.

Key figures power-to-gas – North Sea Power to Gas Platform

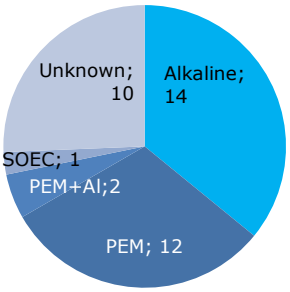


Current power-to-gas application (July 2014)

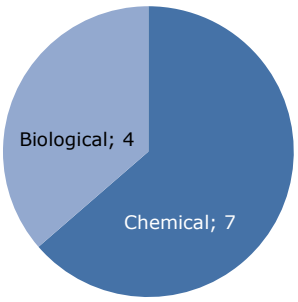
Number of (demo) plants
Total installed: 24.4 MW



Electrolysis technology



Methanation technology



Main challenges for PtG

- Mid-/long-term system role vs. short-term untenable business case
- Stakeholder's discordance about gas systems' hydrogen tolerance
- Legal & institutional barriers hampering market development
- Competitive technologies

NORTHSEA POWERTOGAS

The North Sea Power to Gas Platform is a joint body, based on an integrated network of stakeholders, which aims to explore the viability of power-to-gas in the countries surrounding the North Sea area. We are achieving this by sharing knowledge, company specific expertise and experiences in periodic workshops and joint projects on specific knowledge gaps.

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