

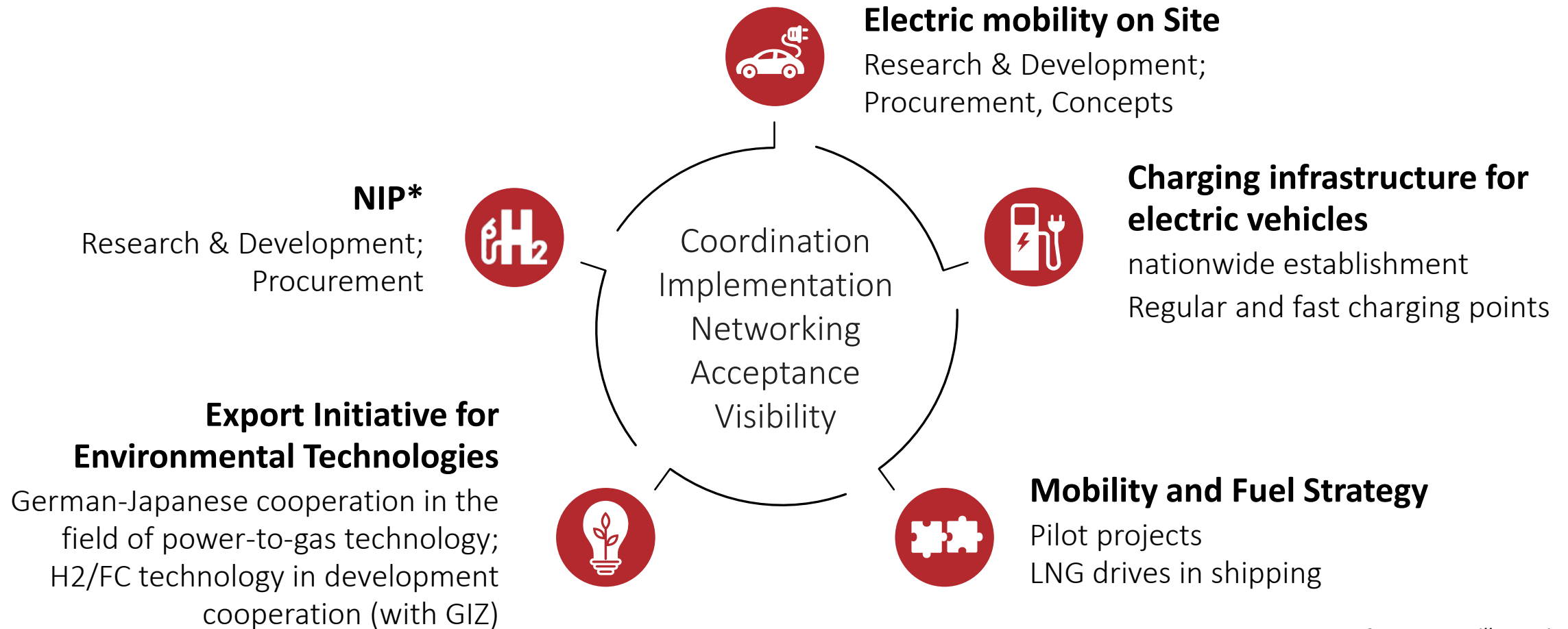
Brussels | October 8, 2019

Industrialization of water electrolysis in Germany

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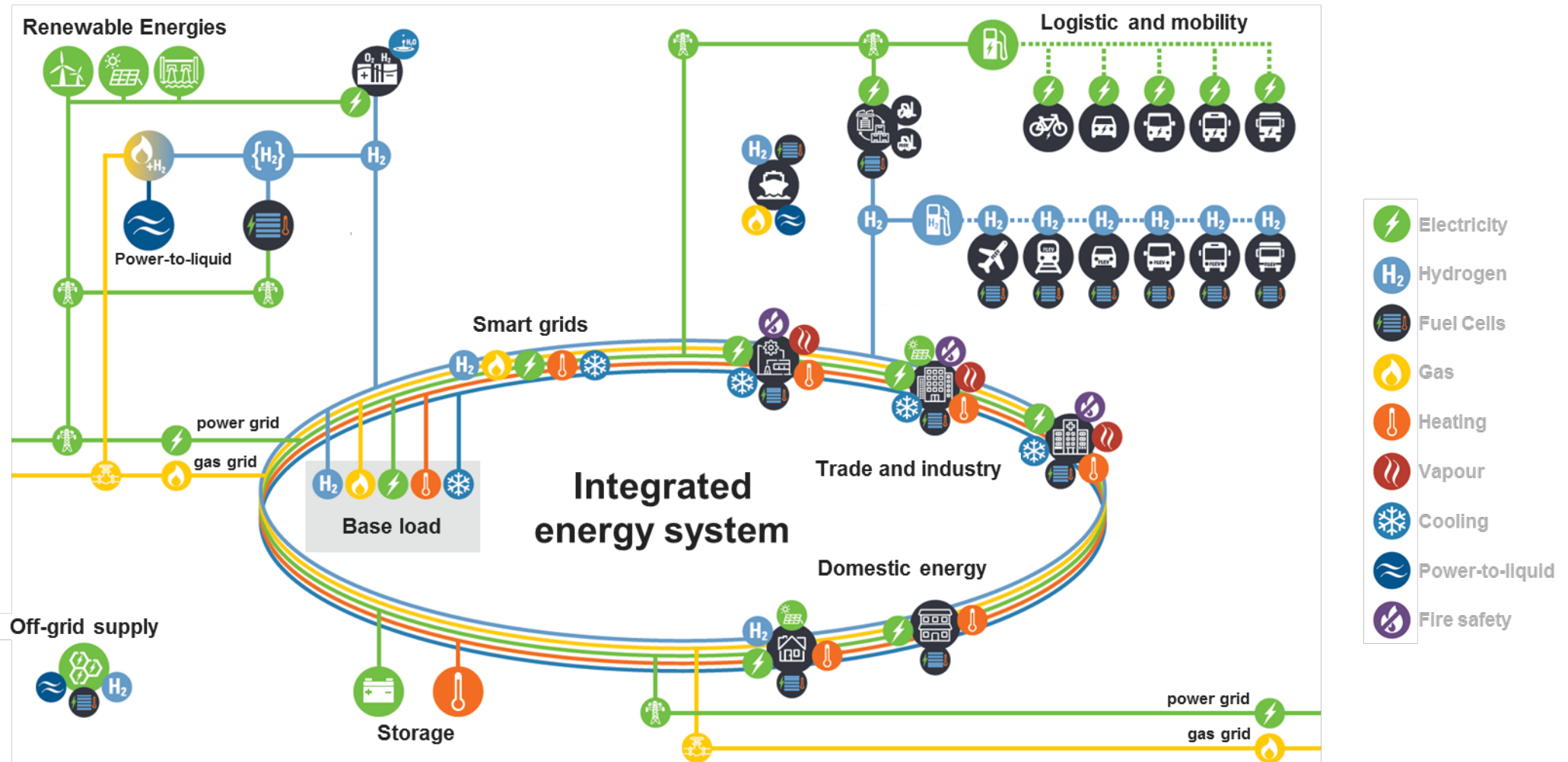
TOWARDS ZERO EMISSION MOBILITY

Integrated implementation of national funding programs by NOW GmbH



Source: own illustration

HYDROGEN IN THE INTEGRATED ENERGY SYSTEM



STUDY INDUSTRIALIZATION OF WATER ELECTROLYSIS



Industrialization of water electrolysis in Germany

Towards a GW industry for a successful transition of the energy sector to renewable energies



- ➔ Do we have a powerful WE industry to produce all the required GW?
- ➔ What has to be done now to be ready in the next years
- ➔ Recommendations for the German innovation program NIP 2

Commissioned by



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Study available at www.now-gmbh.de

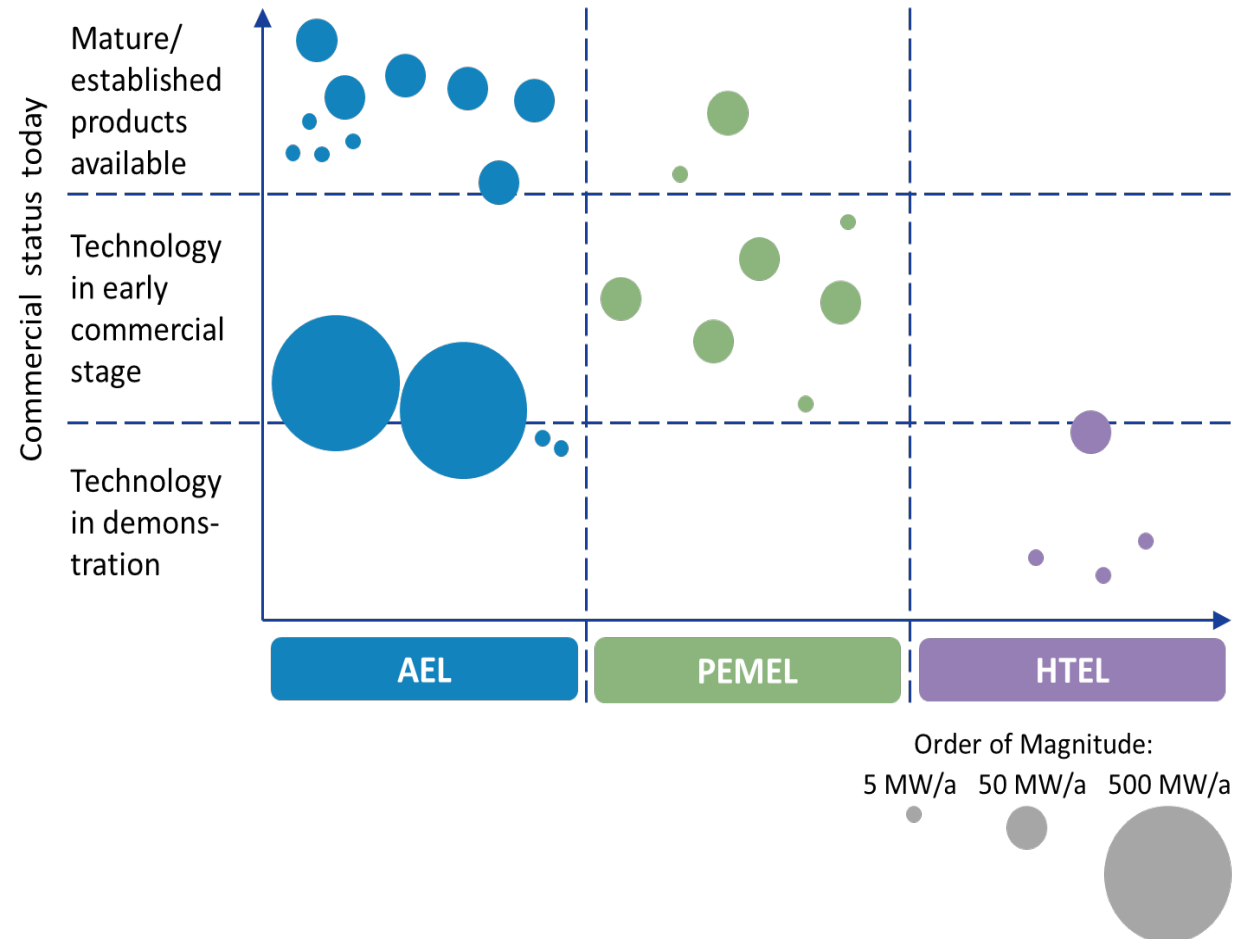
COMPREHENSIVE SURVEY WITH STAKEHOLDER INTERVIEWS

Key features:

- Sold EL capacity: ~ 100 MW/a
- Global sales : 100-150 Mio. €/a
- Direct employees: ~ 1.000
- Possible ramp-up in manufacturing capacity by 2020: ~ 2 GW

How do electrolysis system manufacturers work today?

- Standardized stack platforms
- Single order production
- 'Project-by-project' business without stock-keeping

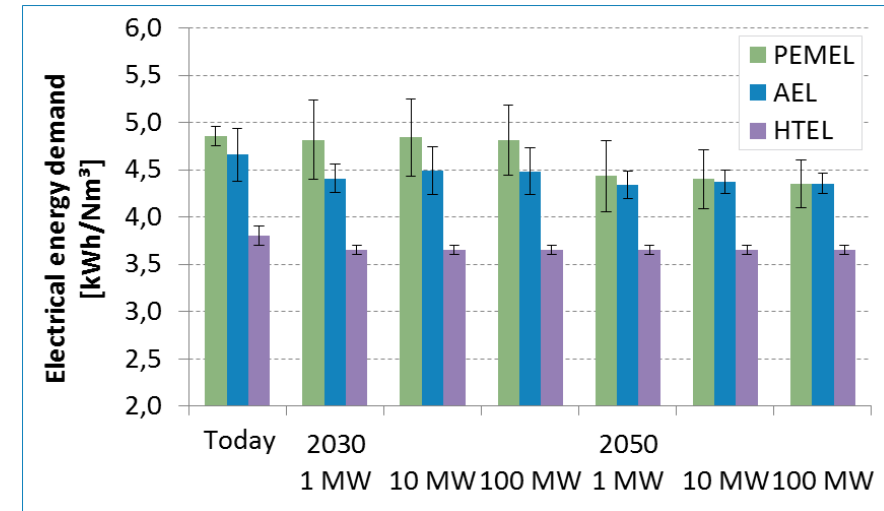


Possible production volume in 2020 per manufacturer, provided that corresponding market demand exists

KPI: ENERGY DEMAND AND STACK LIFETIME

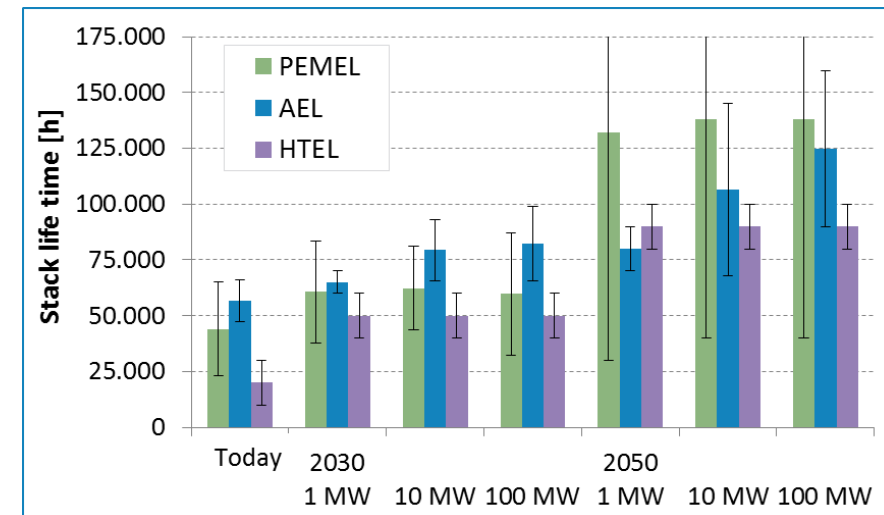
Electr. energy demand

- Feedback partially contradictory (respondents applied different system boundaries)
- PEMEL higher than AEL → adjusted in 2050
- HTEL shows better (electrical) efficiency
 - But steam is required (ca. 200 °C)
- No substantial improvement in 2030/50



Stack life time

- Stack life-time in operating hours
- Uncertainties (see standard deviation)
- Ambitious expectations in this survey
 - 20 – 30 years @ 4.000 h/a (full load)
 - Missing confirmation from literature
- Stack replacement required over total life-time



Black bars indicate the standard deviation.

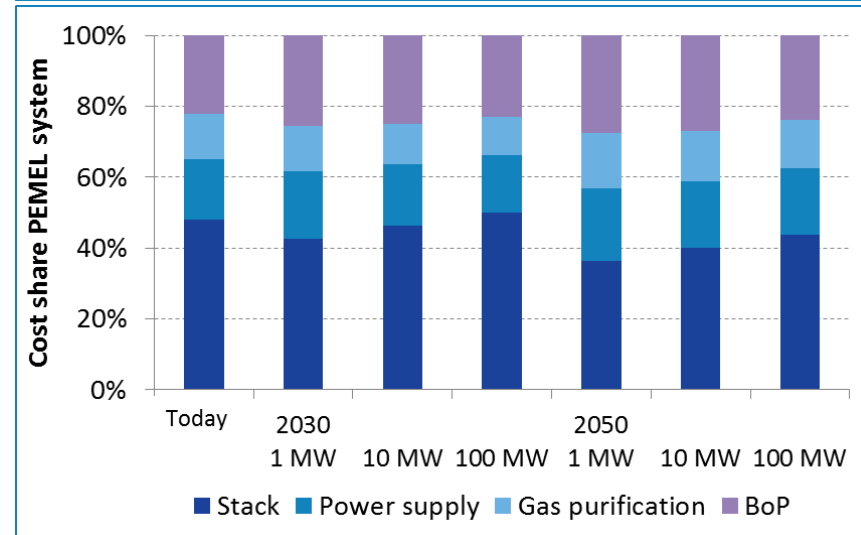
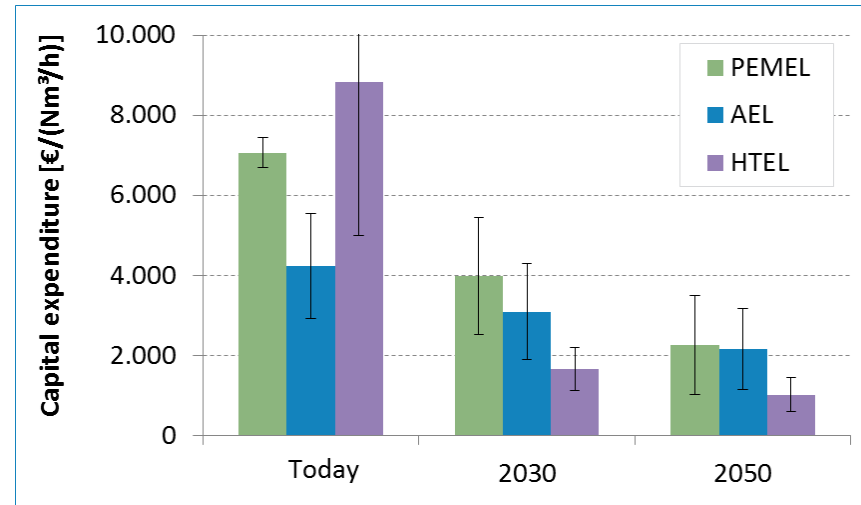
KPI: CAPEX AND COST SHARE

CAPEX

- Low CAPEX still main selling point!
 - Price pressure on the market with tenders for large systems
- Future cost parity between PEMEL and AEL
- Ambitious CAPEX projection for HTEL
 - Potentially low cost, but high uncertainty

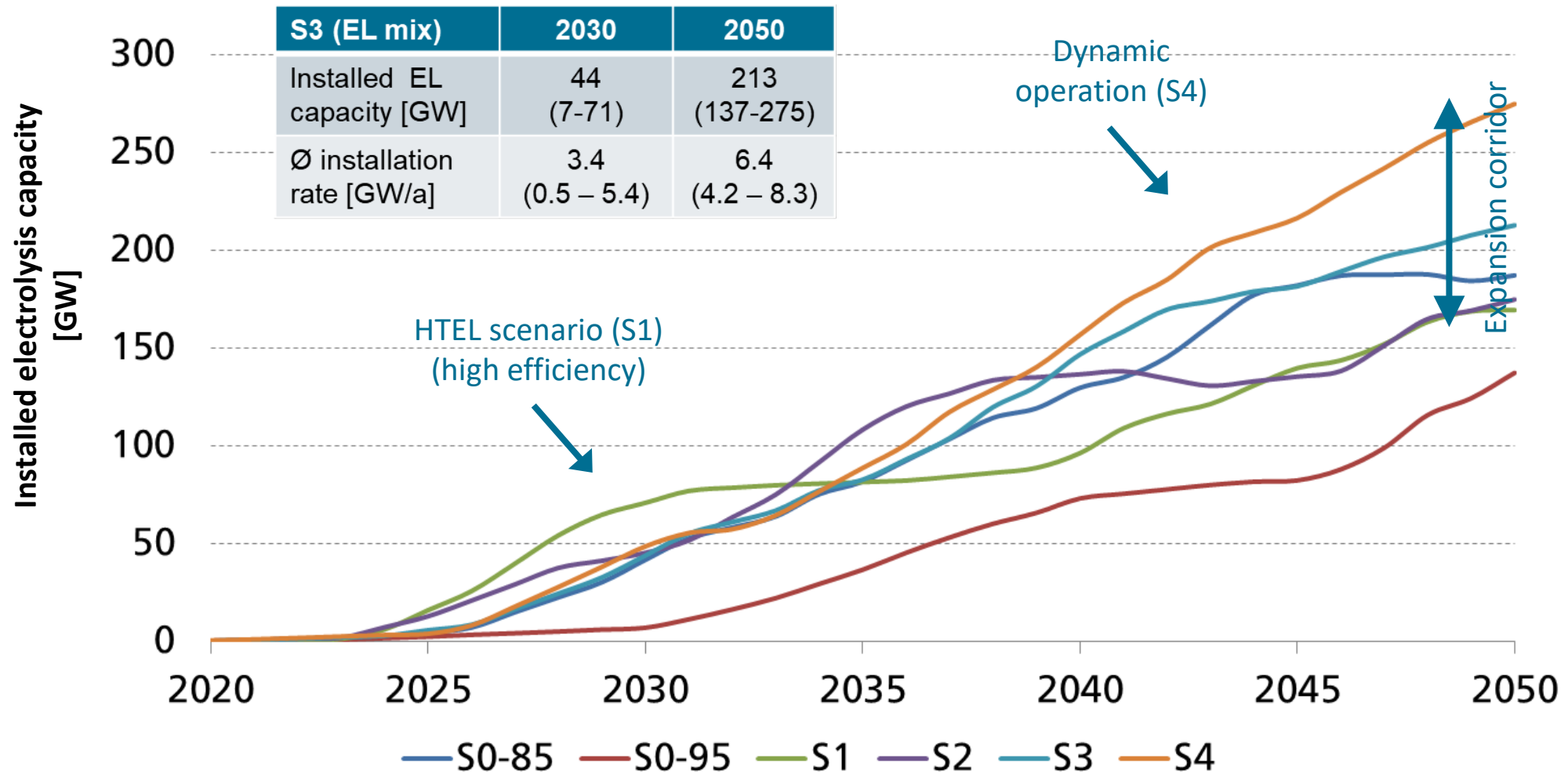
Cost breakdown

- Feedback in agreement with literature
 - Stack dominant, but less than 50 %
 - Power supply 2nd major cost contributor
 - Stack share increases with system size
- Similar results for AEL systems
- Insufficient responses for HTEL systems

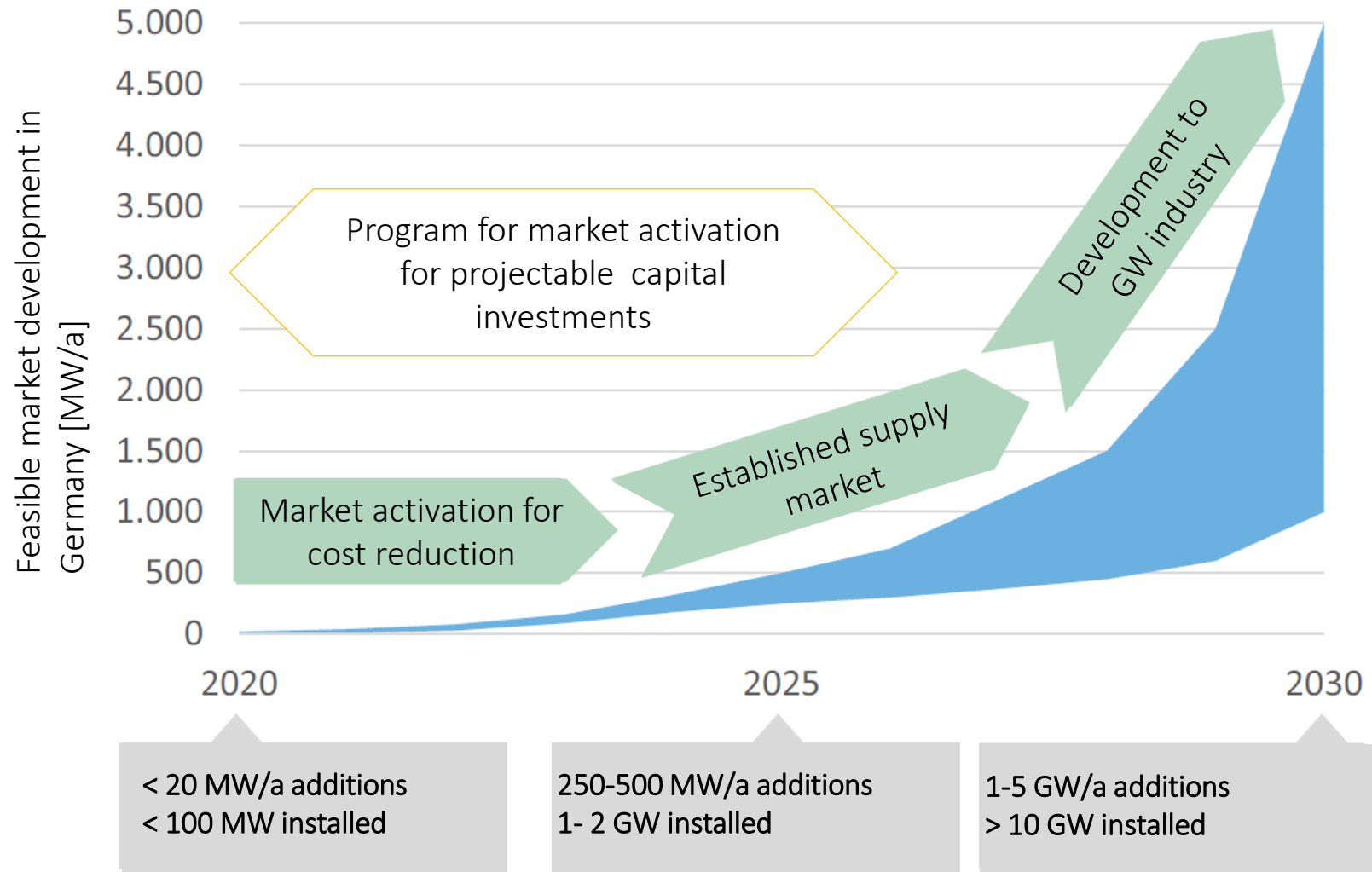


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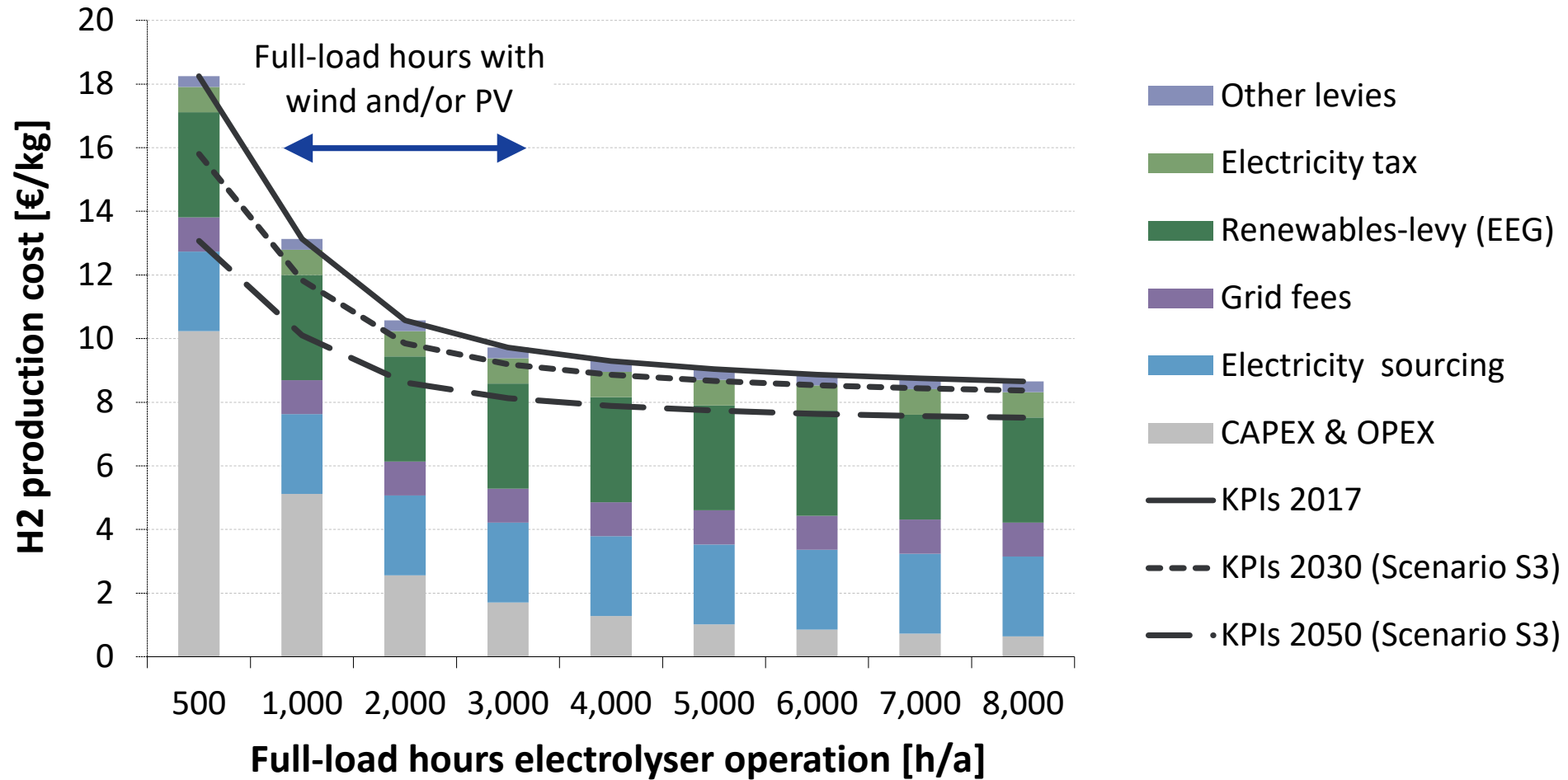
REQUIRED ELECTROLYSIS CAPACITY FOR GERMANY



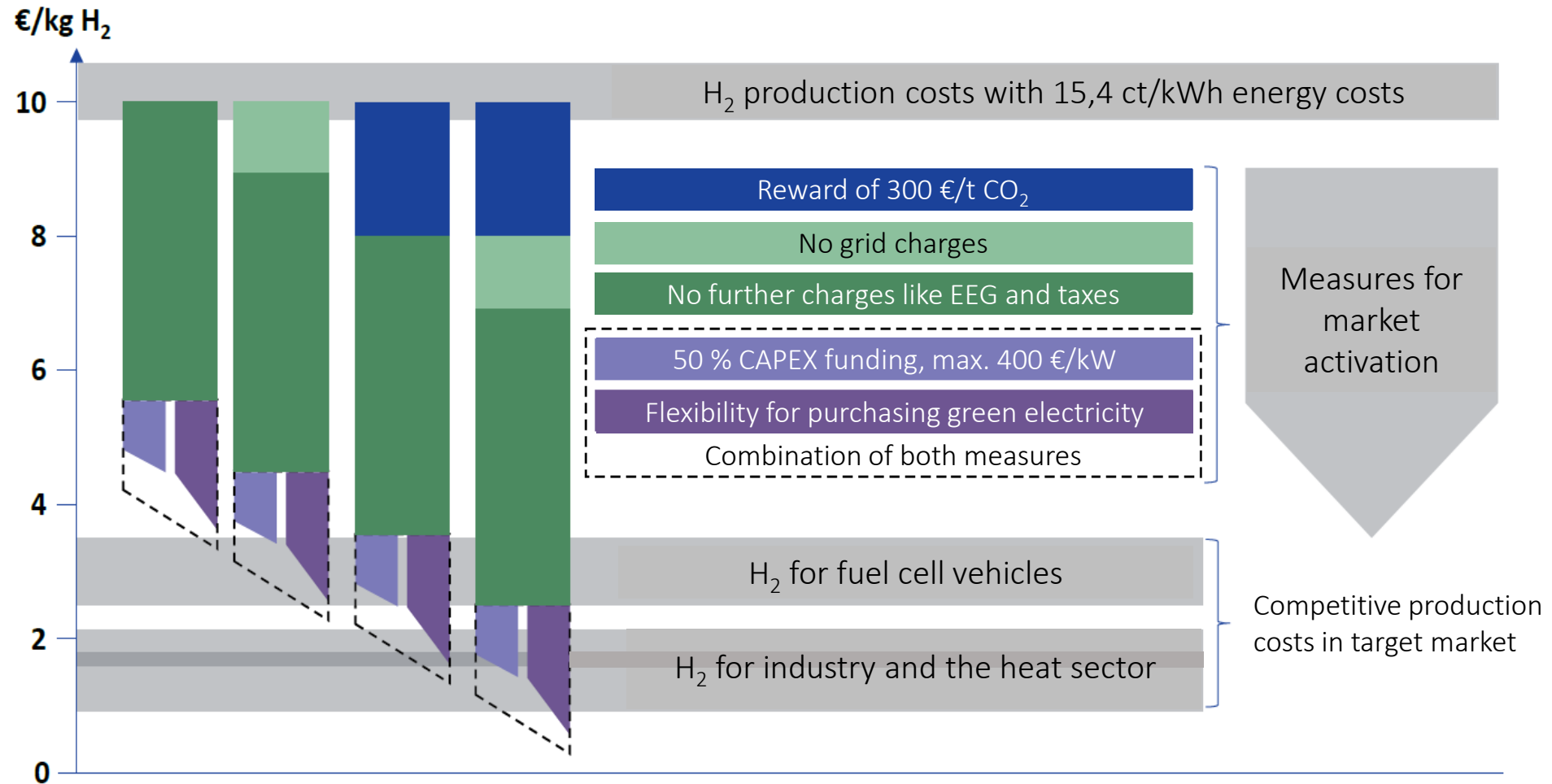
REQUIRED ELECTROLYSIS CAPACITY FOR GERMANY



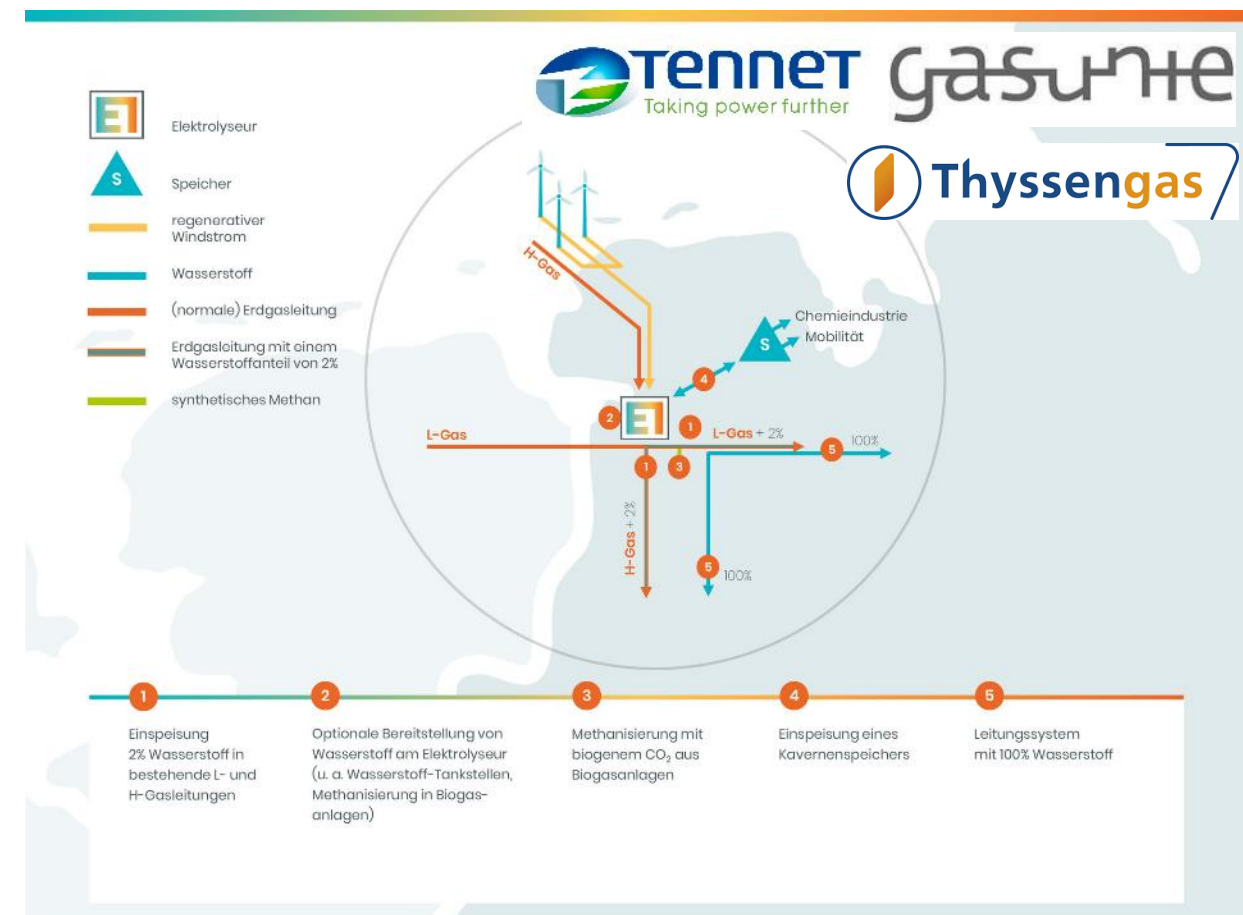
COST ASPECTS FOR HYDROGEN PRODUCTION



COST ASPECTS FOR HYDROGEN PRODUCTION



INTEGRATION OF 100MW SYSTEMS AS INNOVATION



Thank you for
your attention!



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