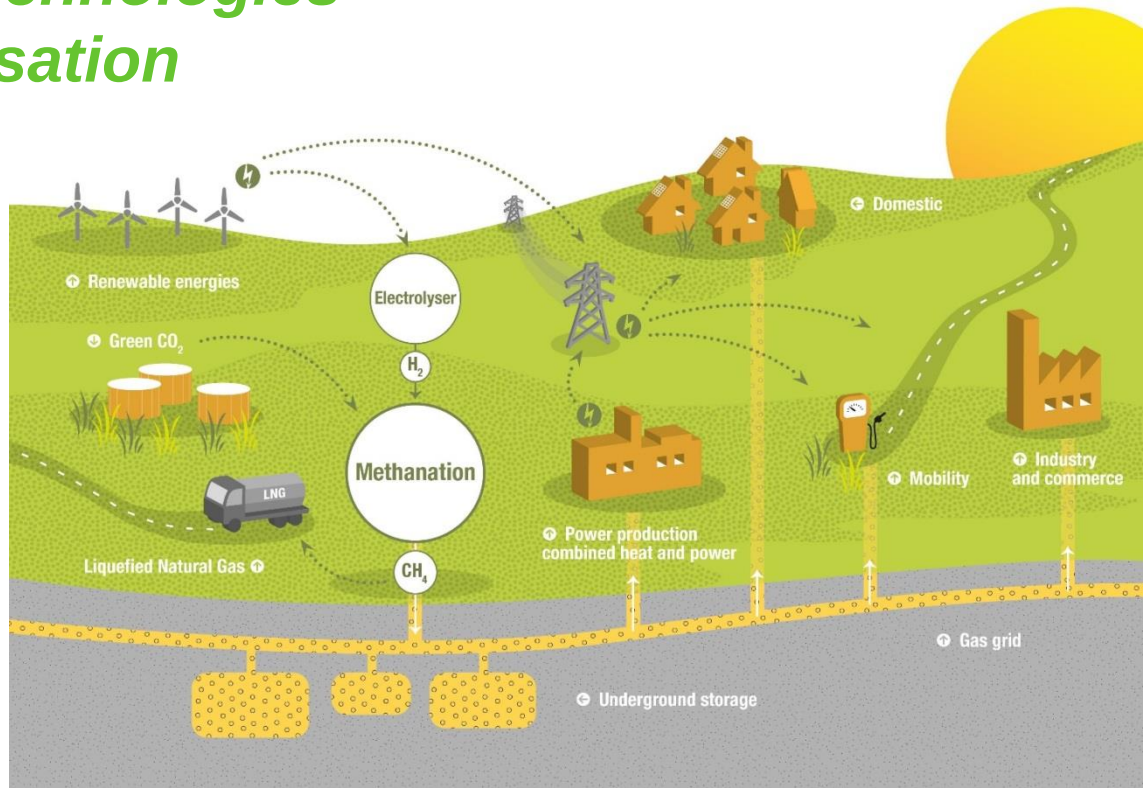
STORE&GO

Innovative large-scale energy STOragE technologies AND Power-to-Gas concepts after Optimisation

Project Overview



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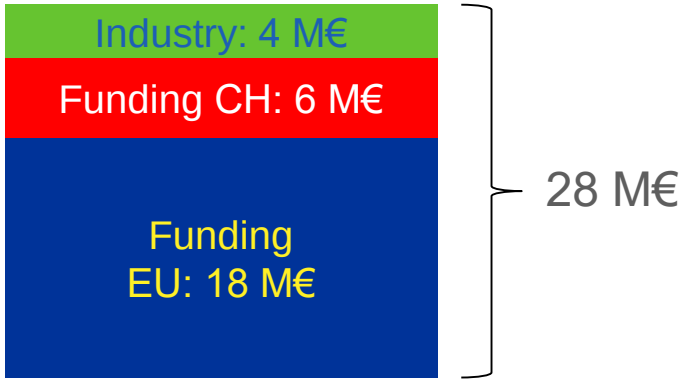
STORE&GO Key Facts

- 27 partners from 6 European countries
- Runtime: 03/2016 - 02/2020
- Erection and operation of 3 PtG demo plants
- Intensive cross-cutting activities



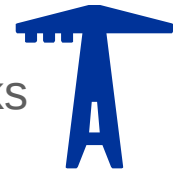
Focus on PtG plants with methanation;

Selection of 3 sites in Europe with existing electrolyser capacity

Overview of Activities

- Developing, erecting, operating and analysing 3 demo sites
  - Environmental impacts
  - Economic analysis
  - Optimized Operation schemes for gas grids

- Impact of PtG on the energy system
  - Benefits for operating distribution networks
  - Cost savings in transmission networks
  - Energy system simulations



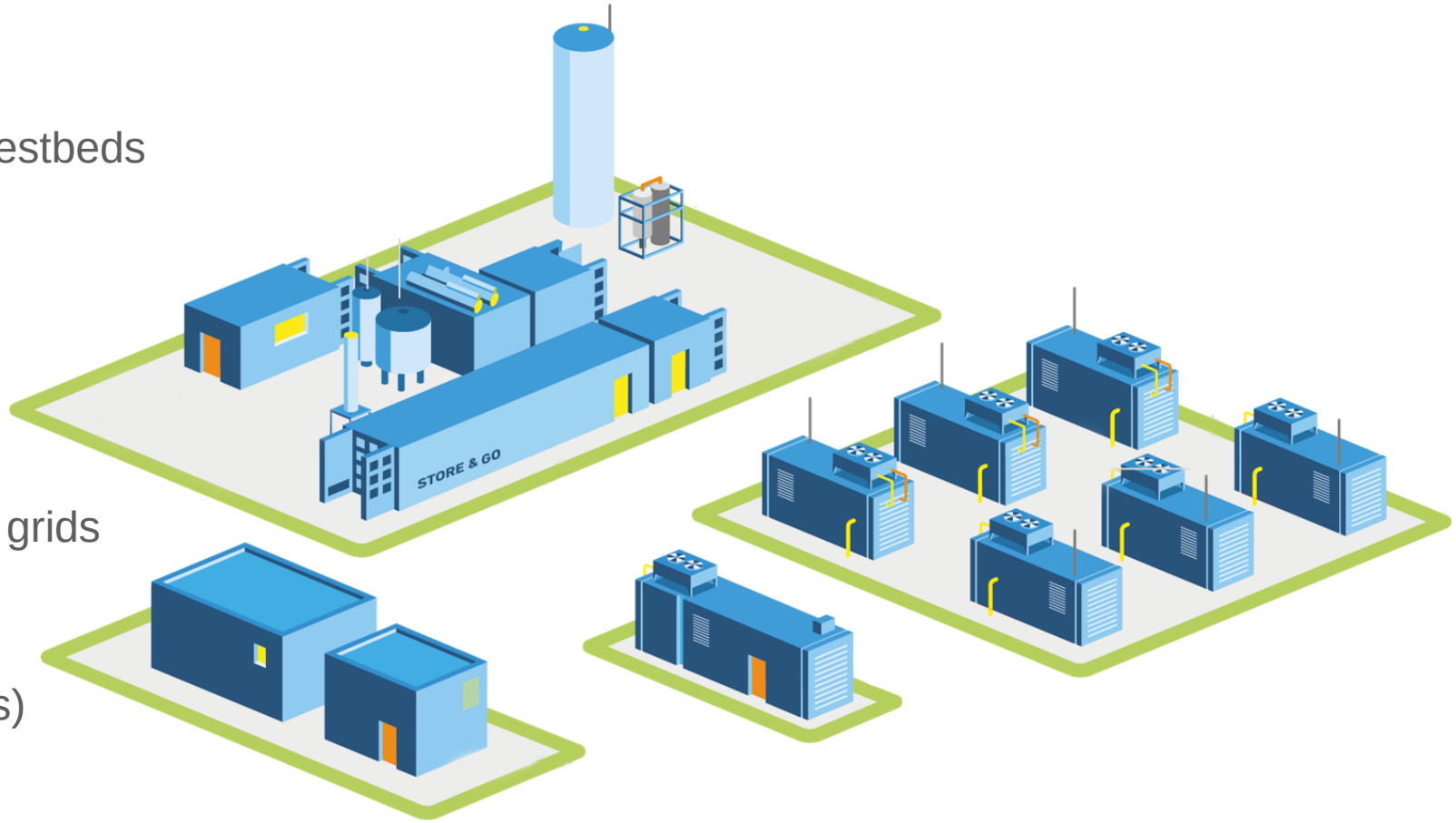
- Reducing barriers
  - Discovering legal and regulatory obstacles
  - Outlook on cost and technology development
  - Social acceptance

- Market uptake
  - Analysis of future demand of ‘green gases’
  - Macro-economic costs and benefits of the PtG
  - A European PtG roadmap

Demo Sites at a Glance

- 3 demo sites offer highly diverse testbeds
  - **Methanation technology**
  - Network type
  - CO_2 source
  - RE source

- Fully integrated in existing energy grids
- 2 sites: injection into gas grid,
  1 site: liquefaction to “LNG”,
  or LRG (Liquefied Renewable Gas)



Demo Site Falkenhagen, Germany

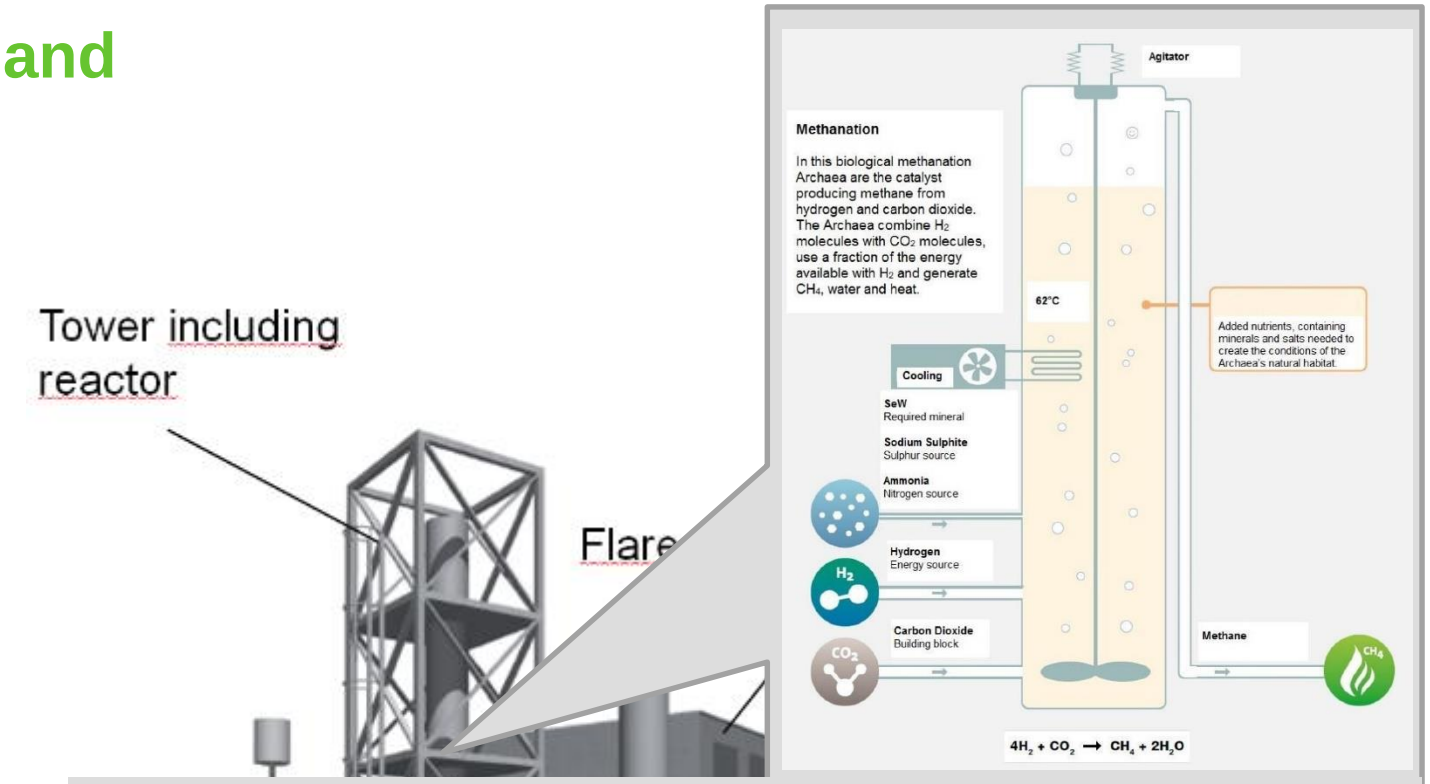
- Plant size: 1 MW
- Catalytic methanation
- CO_2 from bioethanol
- SNG injection in transportation grid
- thermal integration with veneer mill

– **Latest operational experiences**

- Total operation time: 802 hours
- SNG-Injection : more than 7.500 m³ of SNG
- Gas Quality: >96 % CH_4, <2% H_2, <2% CO_2

Demo Site Solothurn, Switzerland

- Plant size: 700 kW
- Biological methanation
- CO_2 from waste water
- Urban gas distribution grid

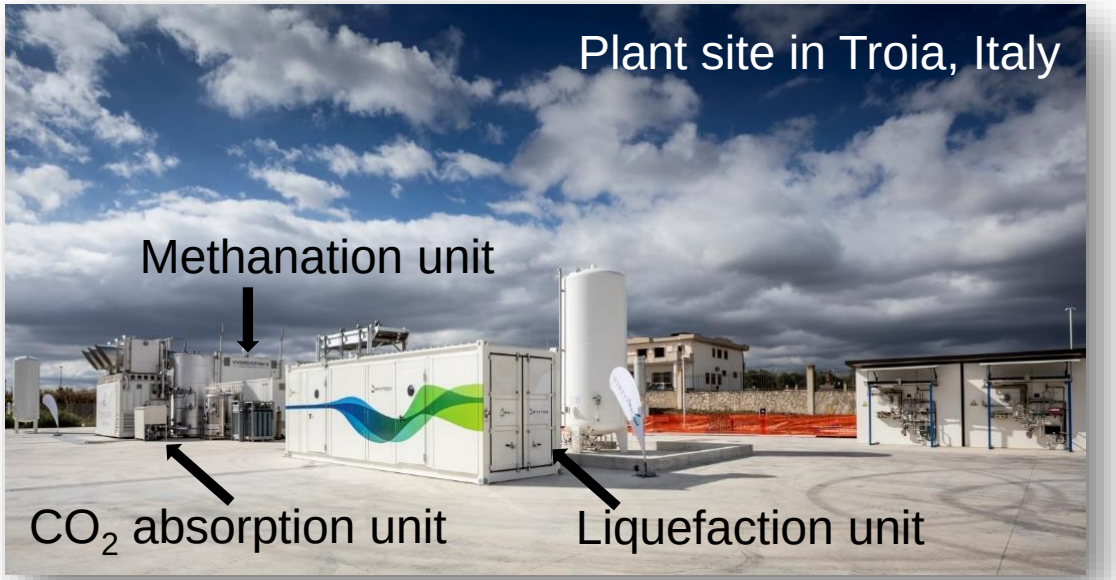


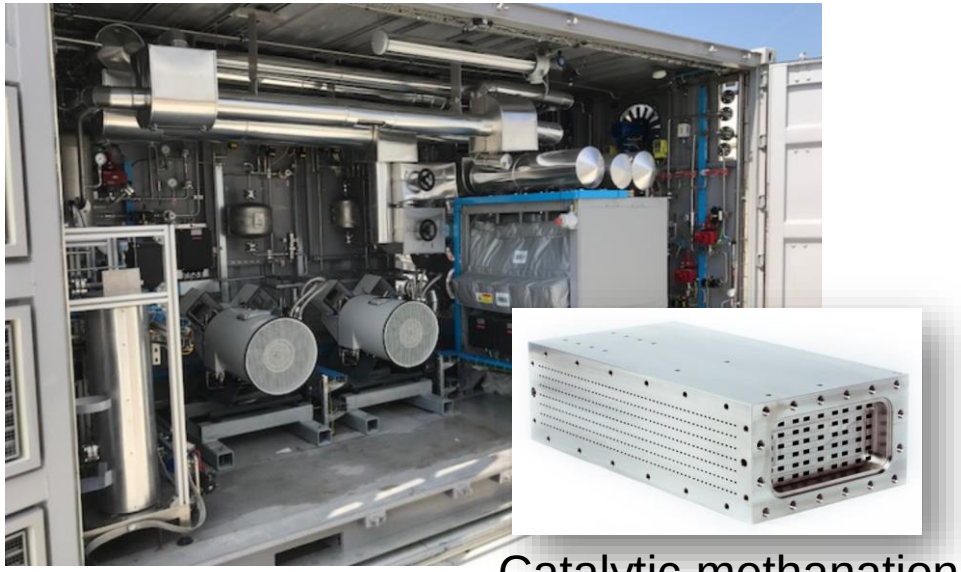
– **Latest operational experiences**

- Total operation time: 860 hours
- SNG-Injection : more than 9.600 m³ of SNG
- Gas Quality: >96 % CH_4

Demo Site Troia, Italy

- Plant size: 200 kW
- Catalytic methanation
- CO_2 from air
- Liquefaction to “LNG”





Catalytic methanation
„milli“-reactor

Latest Operational Experiences

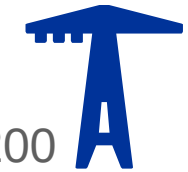
- Process chain to “LNG” validated in April 2019
- Total operation time: ~150 hours
- Production of SNG: > 600 m³
- Gas Quality: >96 % CH4

Key Findings from Cross-Cutting Activities

- Operating and analysing 3 demo sites
  - All sites produce high-quality methane
  - Integration into daily grid operation feasible
  - Experiences and expectations are analysed

- Reducing barriers
  - Future need highly dependent on political and economical conditions
  - Political framework is not yet ready for market uptake of power-to-gas
  - Social acceptance of PtG good; can be boosted by stated support from authorities

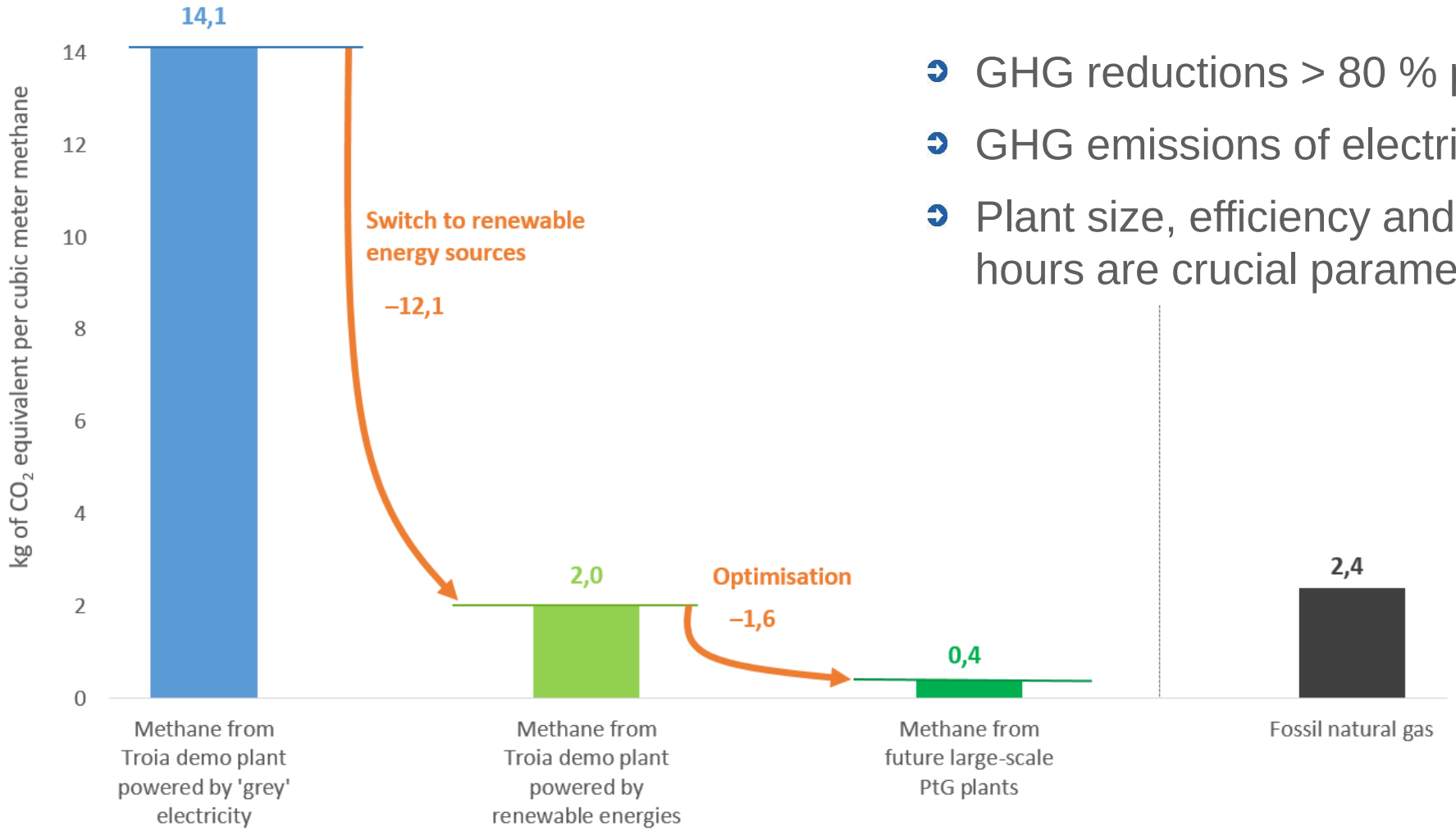
- Impact of PtG on the energy system
  - Most scenarios show relevant need for power-to-gas (CH_4) in the range of 50 - 200 GW in Europe; optimistic up to 660 GW, covering 75% of gas demand.
  - PtG (independent of CH_4 or H_2 target) beneficial for operation of electricity distribution and transmission grids



- Market uptake
  - High generation potential for renewable gas (CH_4) within EU, e.g.:
    - 500 - 2500 TWh from biomass fermentation*
    - PtG with CO_2 from fermentation: another 250 - 1200 TWh

*assuming that 1/3 of technical potential is used

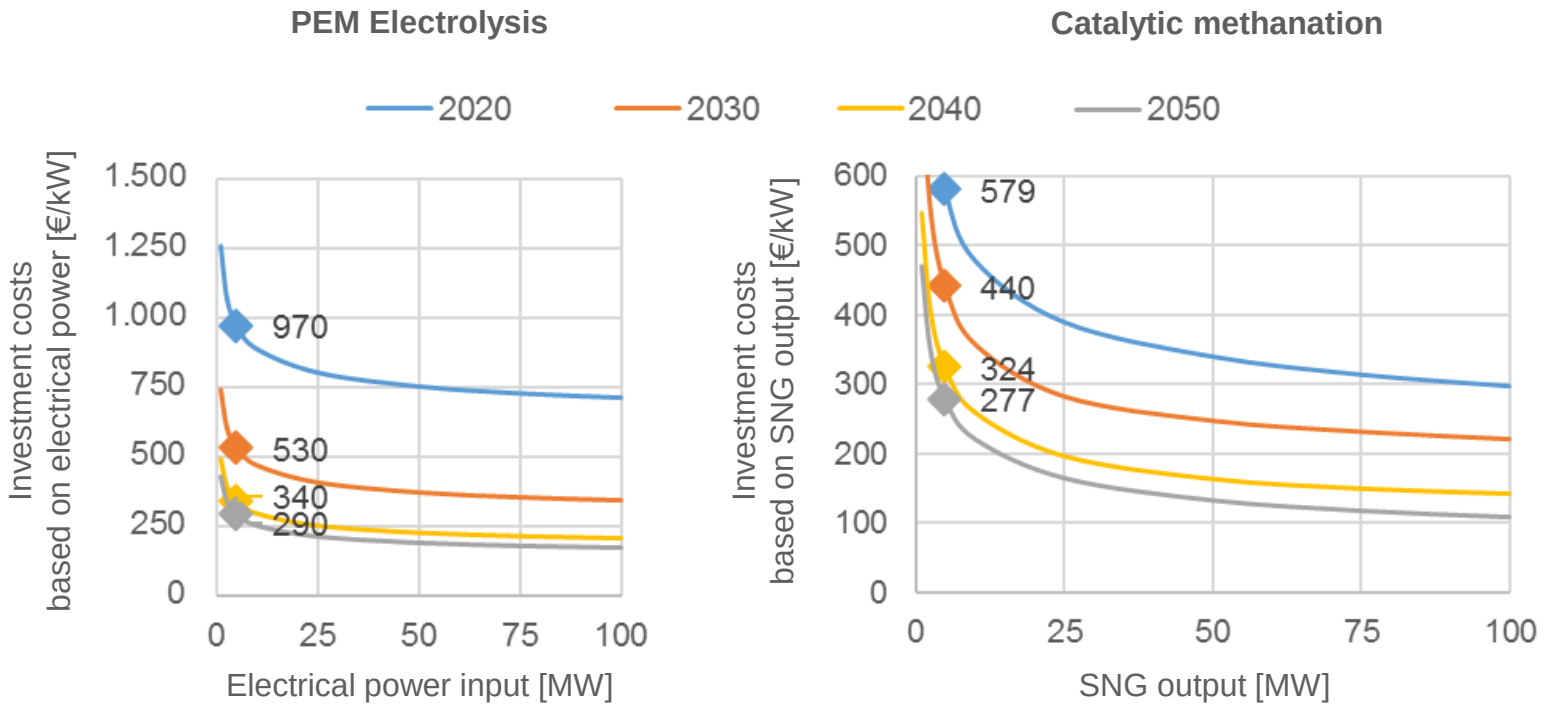
Selected Results: CO_2 Footprint of PtG-methane



- GHG reductions > 80 % possible
- GHG emissions of electricity mix are key
- Plant size, efficiency and operation hours are crucial parameters

Calculations by partner EPFL

Selected Results: Expected Cost Decrease



- Cost development related to scaling effects and technological learning
  - Left: electrolysis systems
  - Right: methanation systems

- Assumptions, EU in 2050:
  - 1240 GW electrolysers installed
  - 550 GW methanation units installed

Calculations by partner EIL

Outlook until project end in February 2020

- Gathering of operational hours and experiences at the demo sites
- Finalization of demo site operation assessment
- Conclusion with scientific conference on February 17-18 of 2020 in Karlsruhe

Thank you for your attention!