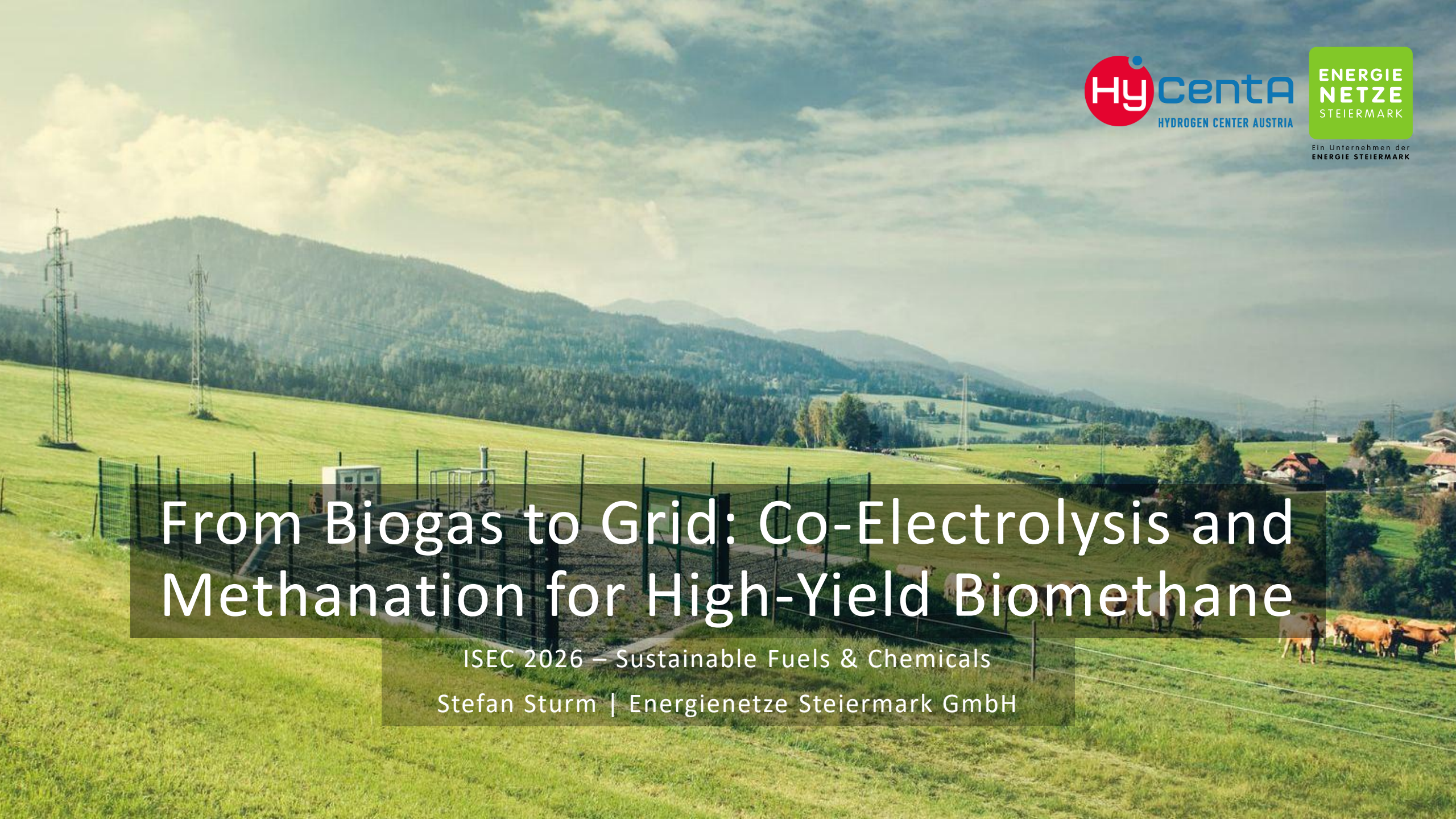

From Biogas to Grid: Co-Electrolysis and Methanation for High-Yield Biomethane

ISEC 2026 – Sustainable Fuels & Chemicals

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AGENDA

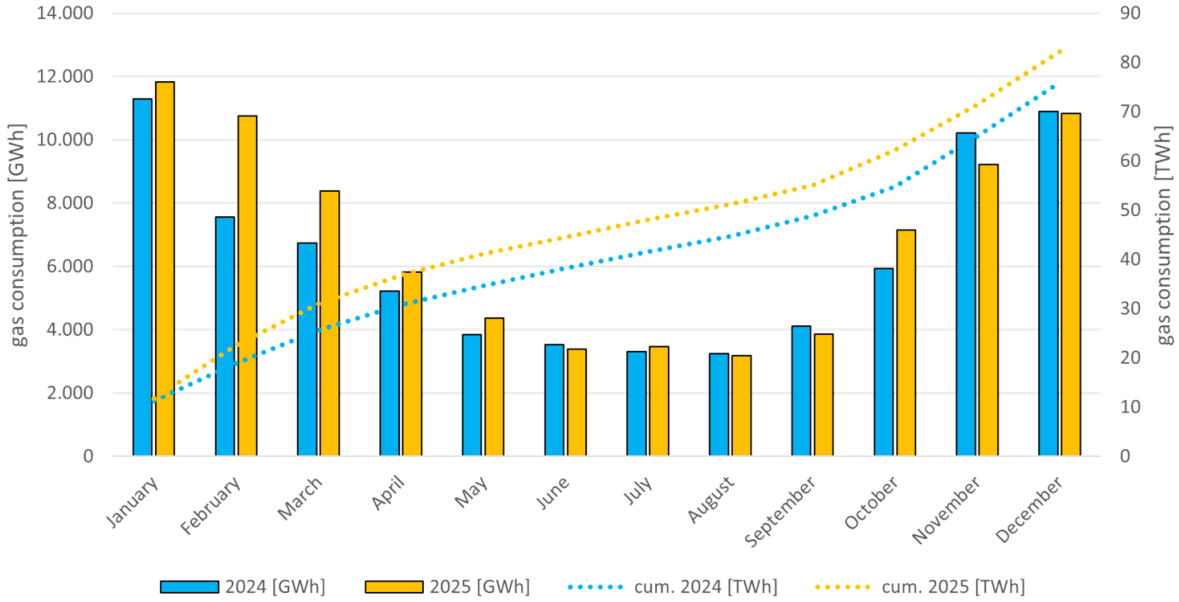
- Background & motivation
- Conventional biomethane injection
- Promising alternative pathway
- Conclusion and outlook

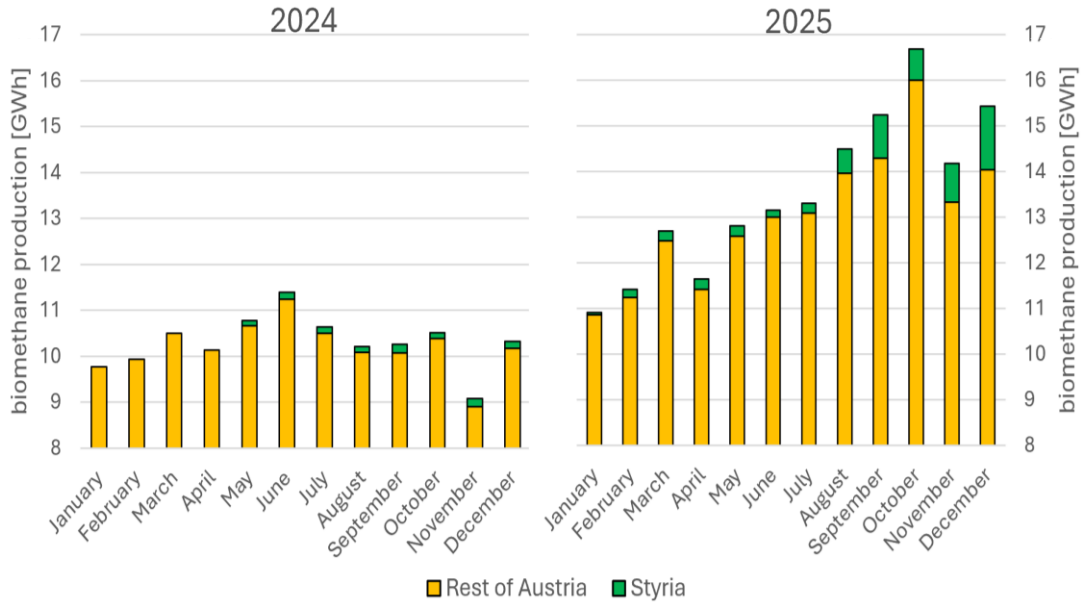
Why gas grids care?

- Austria gas grid demands and storage
  - Actual demand: ~75–82 TWh/a
  - ~73% of gas demand in large and medium-sized industry
  - Underground storage: ~90 TWh for seasonal balancing

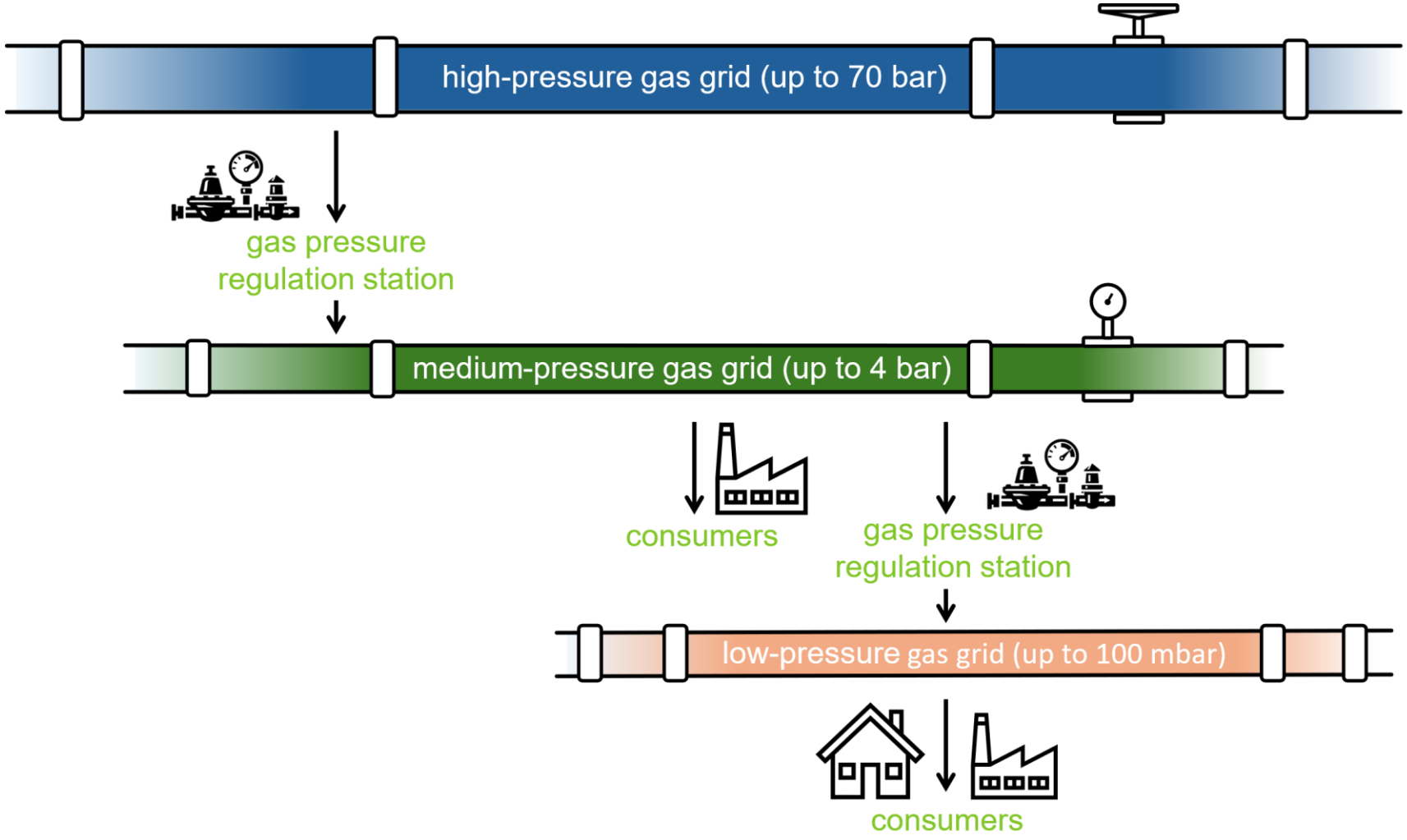
- Austria's potentials for renewable biomethane
  - Biomethane potential: 8-12 TWh/a (wet feedstock)
  - Biomethane injection largely untapped
  - Rising since Q1/2025 but still 0,2% of 2025 consumption

- Current obstacles to accelerated expansion
  - Missing regulatory framework
    - "Erneuerbaren Gas Gesetz" – EGG
    - "Gaswirtschaftsgesetz" – GWG

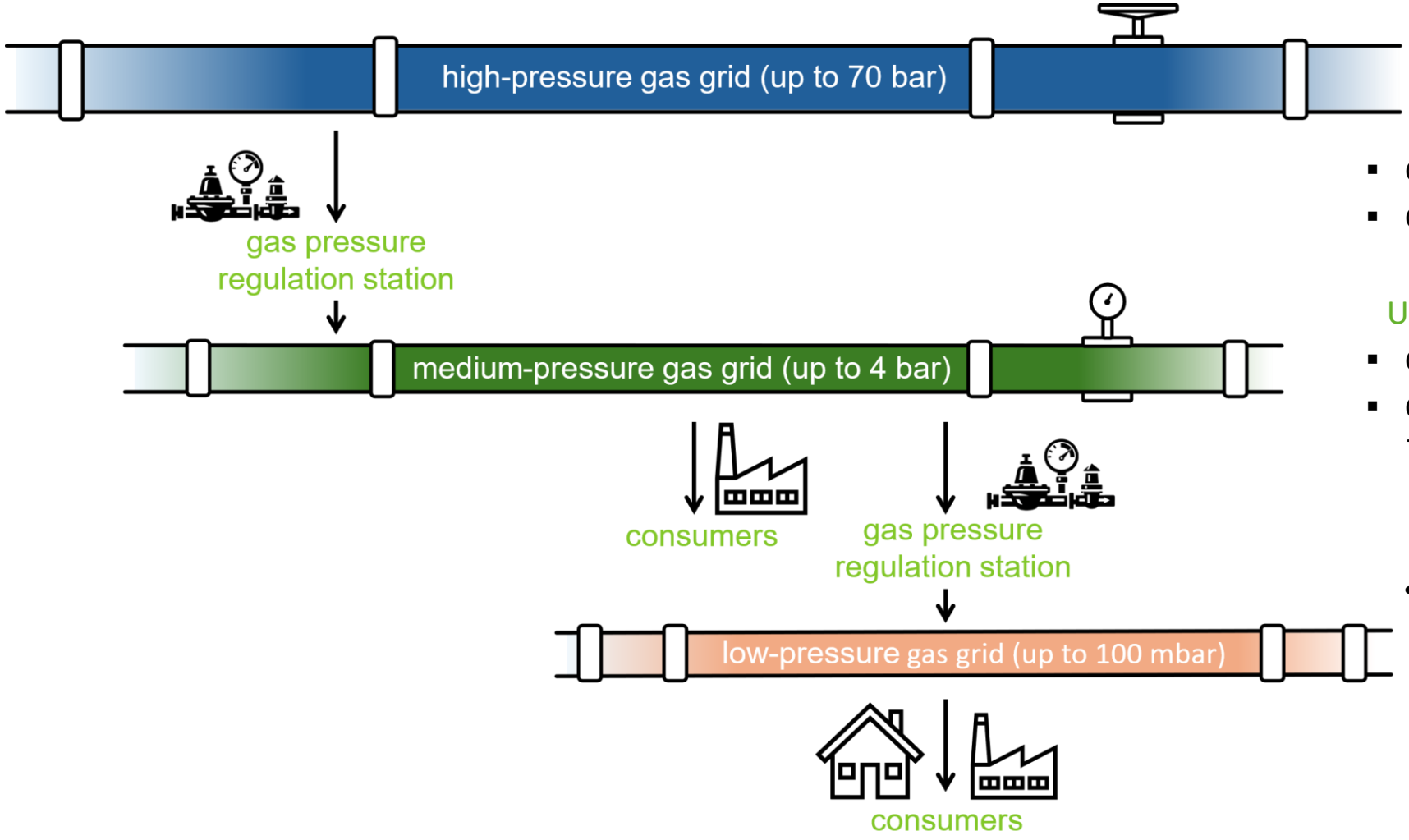




Conventional grid injection



Conventional grid injection



Raw biogas composition

- CH_4~52 vol%
- CO_2 ~46 vol%

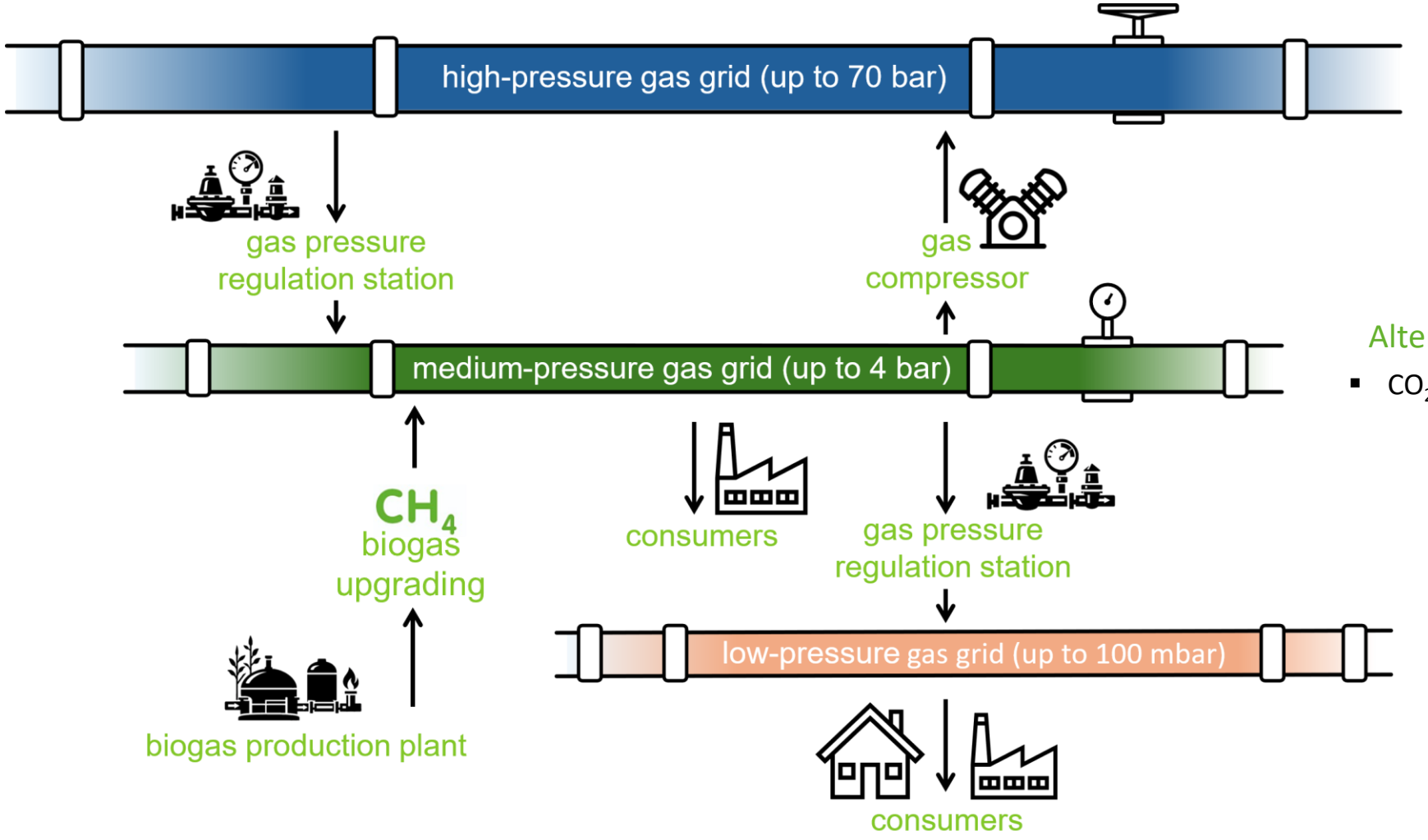
Upgrading to grid-quality biomethane

- CO_2 is separated
- CO_2 typically vented
  → lost biogenic carbon for fuels

In case of low demand

- Biomethane can be compressed and stored

Conventional grid injection vs. alternative pathway

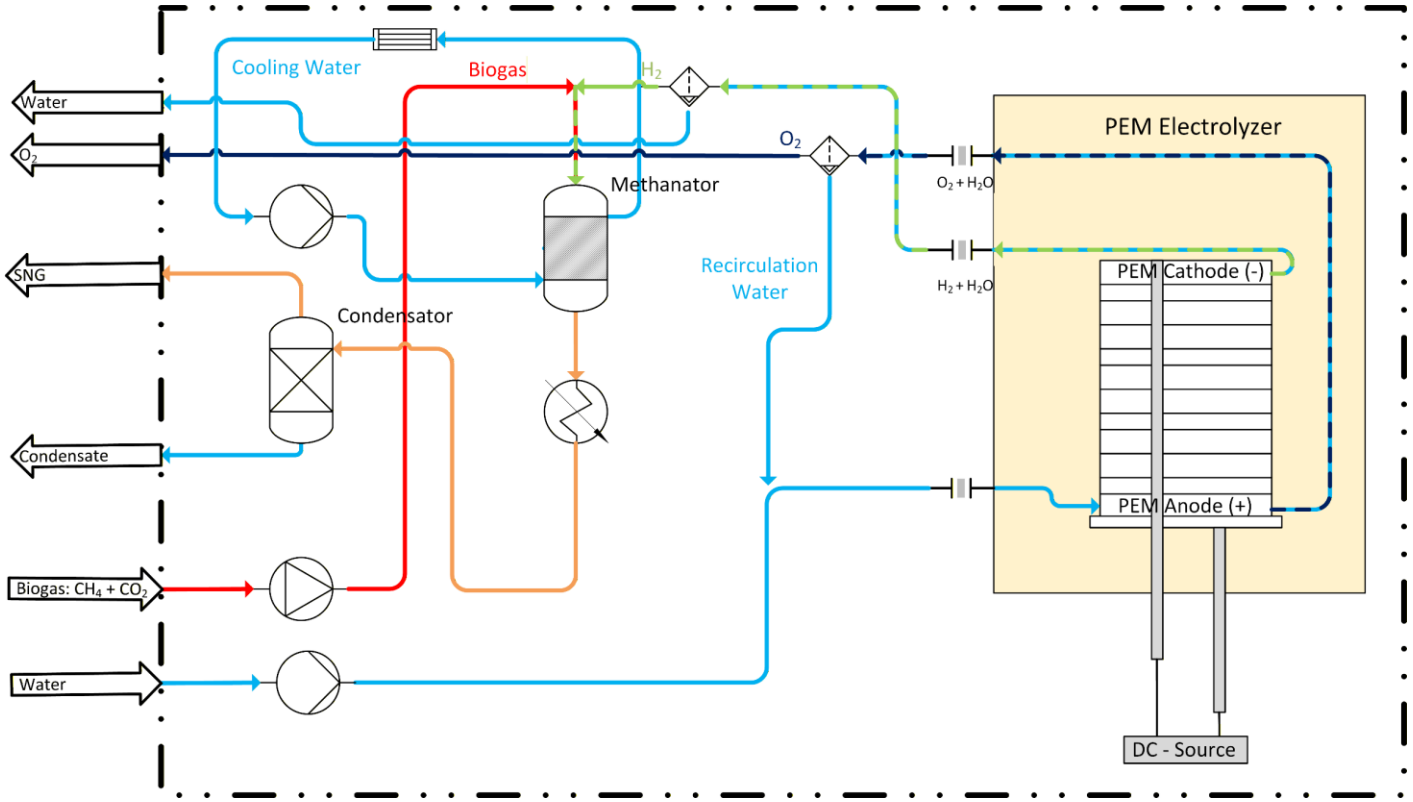


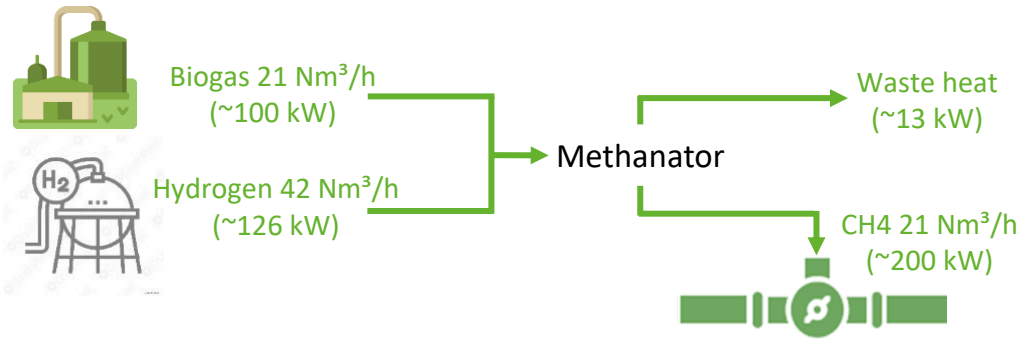
Alternative pathway - biogas upgrading

- CO_2 is used for higher biomethane output

Current concept at the “renewable gasfield”

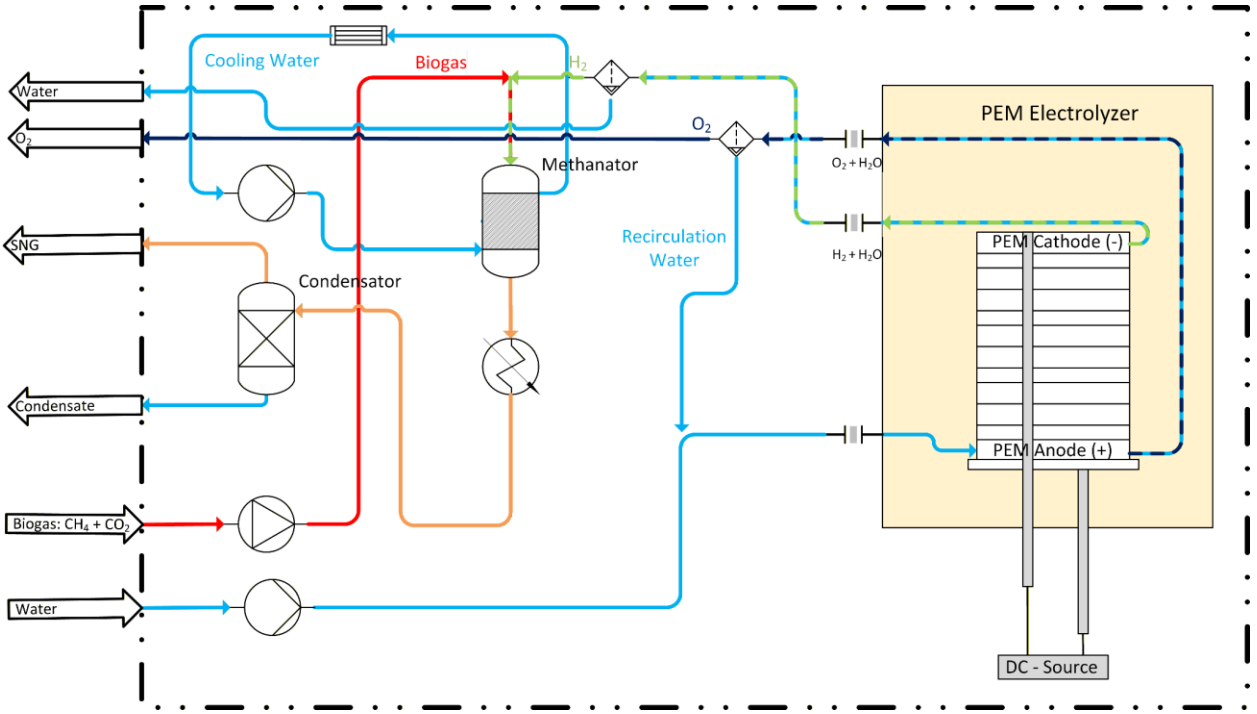
Smale scale demonstrator (Gabersdorf)





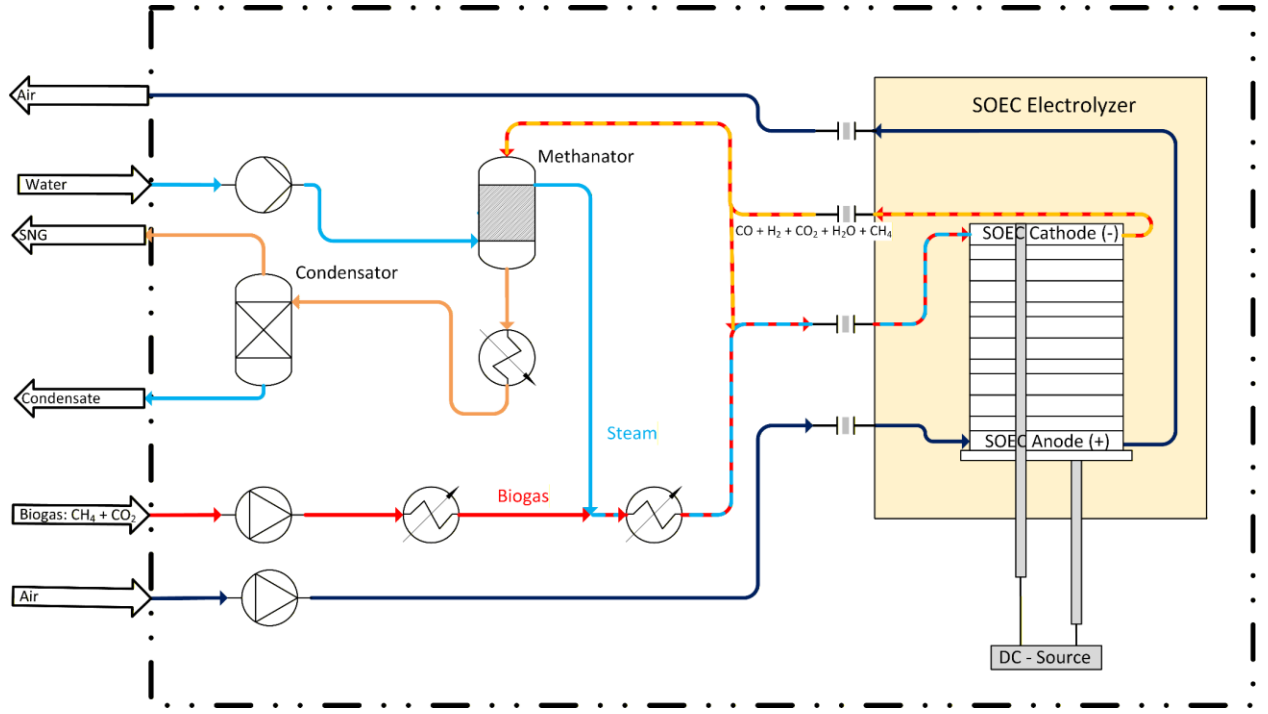
Technology comparison – biogas upgrading

H_2 electrolyis (PEM) - CO_2 methanation (Gabersdorf)



- CO_2 methanation process:
  $CO_2 + 4\ H_2 = CH_4 + 2\ H_2O$ (ΔH_{298} = -165 kJ mol^{-1})
- Using PEM-Electrolyser to produce H_2
- Heat of the methanation process can't be used directly

Co-electrolysis (SOE) - CO methanation (alternative)



- CO methanation process:
  $CO + 3\ H_2 = CH_4 + H_2O$ (ΔH_{298} = -206 kJ mol^{-1})
- Using SOEC-Electrolyser to produce syngas via co-electrolysis
- High potential for thermal energy integration

Conclusion and Outlook

Single cell SOE modelling

- Electrochemical
- Gas transport
- Thermal

Single cell

System-level

Simulation-based study

- Modular system-level simulation framework coupling SOEC cell models with balance of plant and heat integration
  - Filtered impurities and separated CH_4
  - Recirculation of product gas - Avoid H_2 or CO feed

Research topics

- Direct use of “filtered" raw biogas
- Reversible operation
- Economic feasibility analysis
- Proof of principle and upscaling
- Further optimization of heat integration

Outlook

First Results

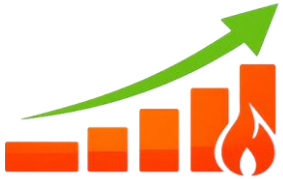
Potentials located

- Min. ~ 20% energy saving in comparison to existing demonstrator

Take-home messages

Biomethane can easily be integrated into existing gas grid

SOEC + methanation unlocks additional renewable methane by utilising biogenic CO_2 instead of venting it



Heat integration at the right temperature level is the dominant efficiency lever in SOEC-based concepts

Gas grids and storage provide flexibility to balance surplus production and seasonal demand

THANK YOU

Questions & discussion

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