

Grüngas25, 2. - 4.12.2025, Wels Austria

# Syngas Methanation

## A Cost-Effective Solution for flexible Integration of PtX into Biomethane Production

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confidential

# Challenge 1: Electricity Grid

10.5 TWh

→ Curtailed renewable energy in Germany in 2023

600 Mio.€

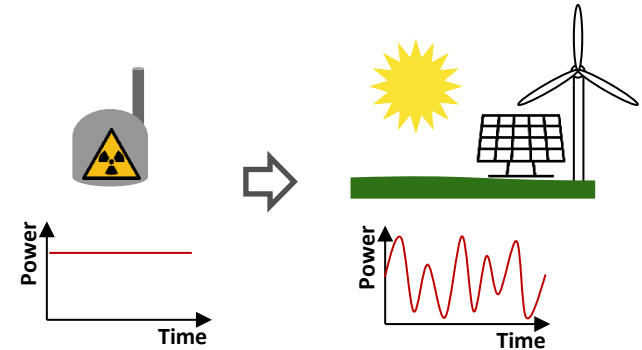
→ Associated cost

## Future development:

- High growth rate of renewable electricity generation in Europe
- More frequent and larger fluctuations in electricity production

## Potential solutions:

- Expansion of the electricity grids in Europe
- Coupling of energy sectors
- New storage technologies



# Challenge 2: Gas Grid and Decarbonisation

- ✓ Infrastructure
- ✓ Producers
- ✓ Customers

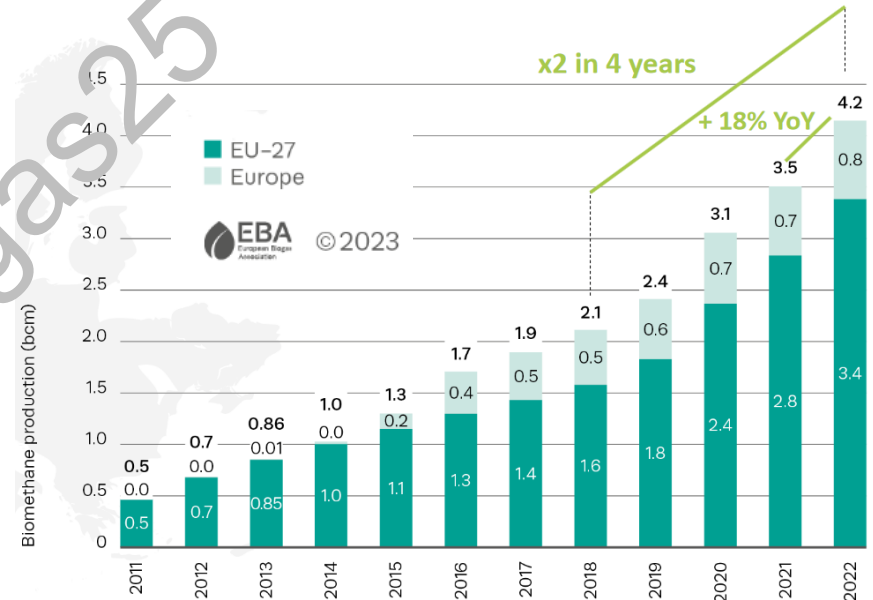
- Fast growth and high potential for biomethane production in Europe
- Use of local resources

**Electrification and H<sub>2</sub>-economy is a good thing...**

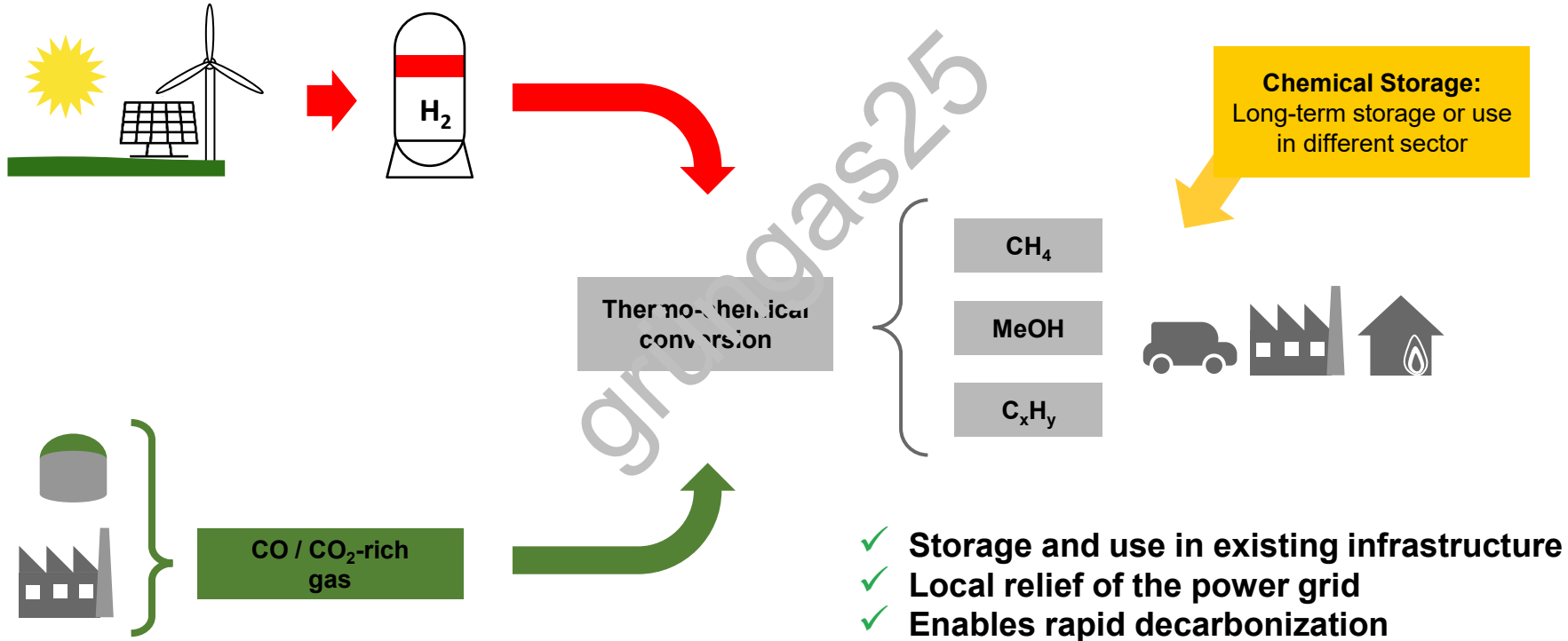
**... BUT ...**

**... methane will also play a role in future!**

European biomethane production in EU-27 and Europe

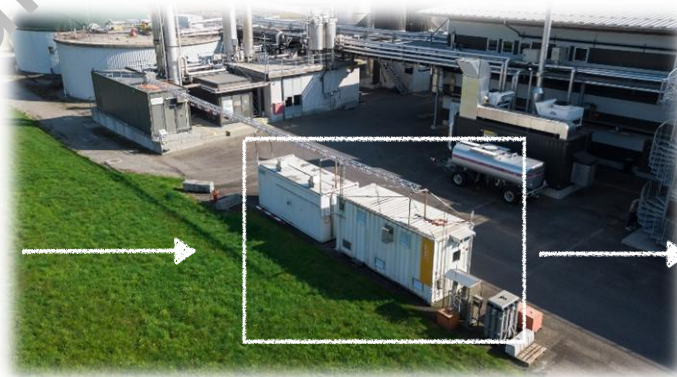
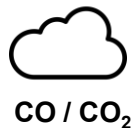


# Part of the Solution: Sector Coupling by PtX



# Agenda

- Technology to synthesize CO<sub>2</sub>-neutral energy carriers
- Application cases for the technology
- Newest experimental results
- Pre-Commercial project

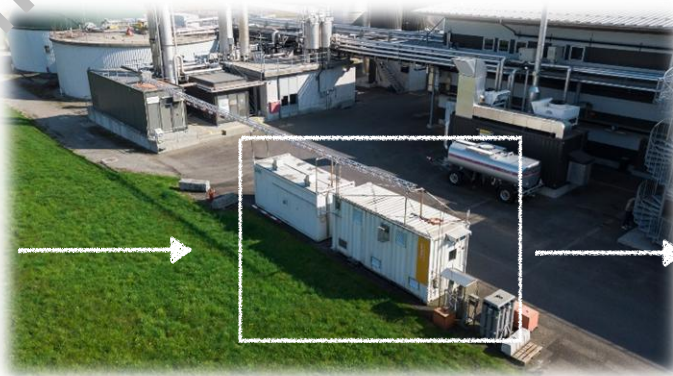
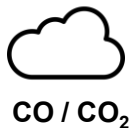


renewable  
energy carrier



# Our Company

- Founded in 2020
- Start-up, 10 persons
- Based in Switzerland
- Engineering partner for the design and construction of turn-key methane and methanol synthesis plants



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## Background: Two Research Institutes

### Paul Scherrer Institute (PSI)

- Long-term research in wood gasification and methanation
- Gas analysis
- Development of the methanation technology, esp. in combination with biogas upgrading and gasification → Ref.: Project in "Güssing" for 1 MW<sub>SNG</sub> based on gasification gas as feedstock (2008)
- Technology exclusively licenced to AlphaSYNT



### University of Applied Science OST

- Operation of PtX plants
- System integration

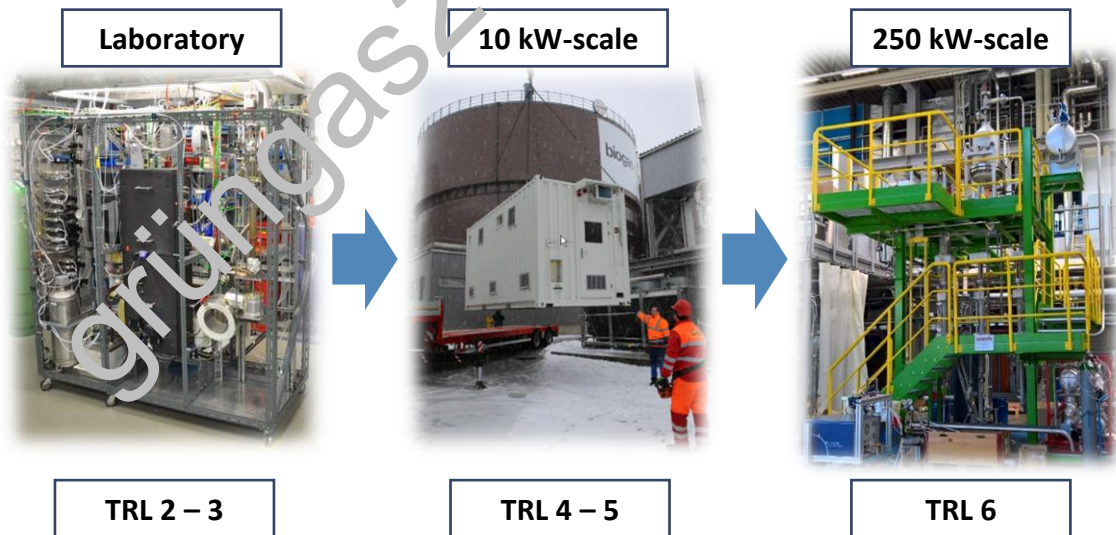
# Research facilities at PSI



→ Research facilities in different scales

→ Current focus:

Scaling issues, hydrodynamics of fluidized beds, methanol synthesis

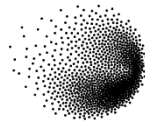


TRL: Technology readiness level / Technologiereifegrad (Scale: 1 – 9)



# Fluidised bed technology

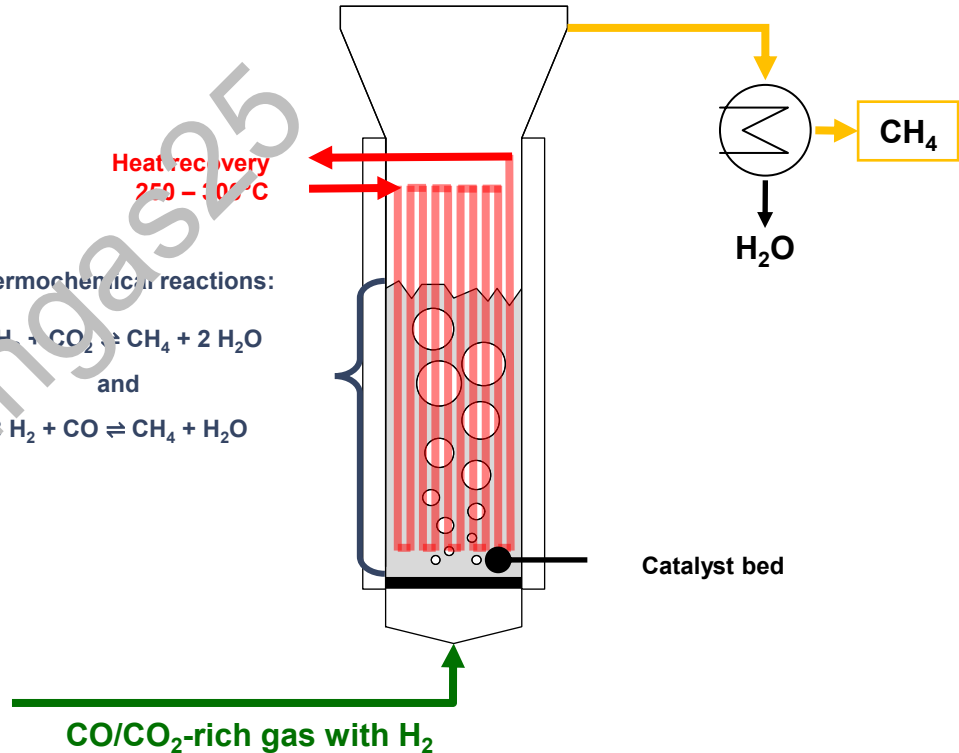
- Exclusively licenced by PSI
  - Constant circulation of the catalyst
- Good mass & heat transfer
- Almost isothermal operation at the thermodynamic optimum



PSI

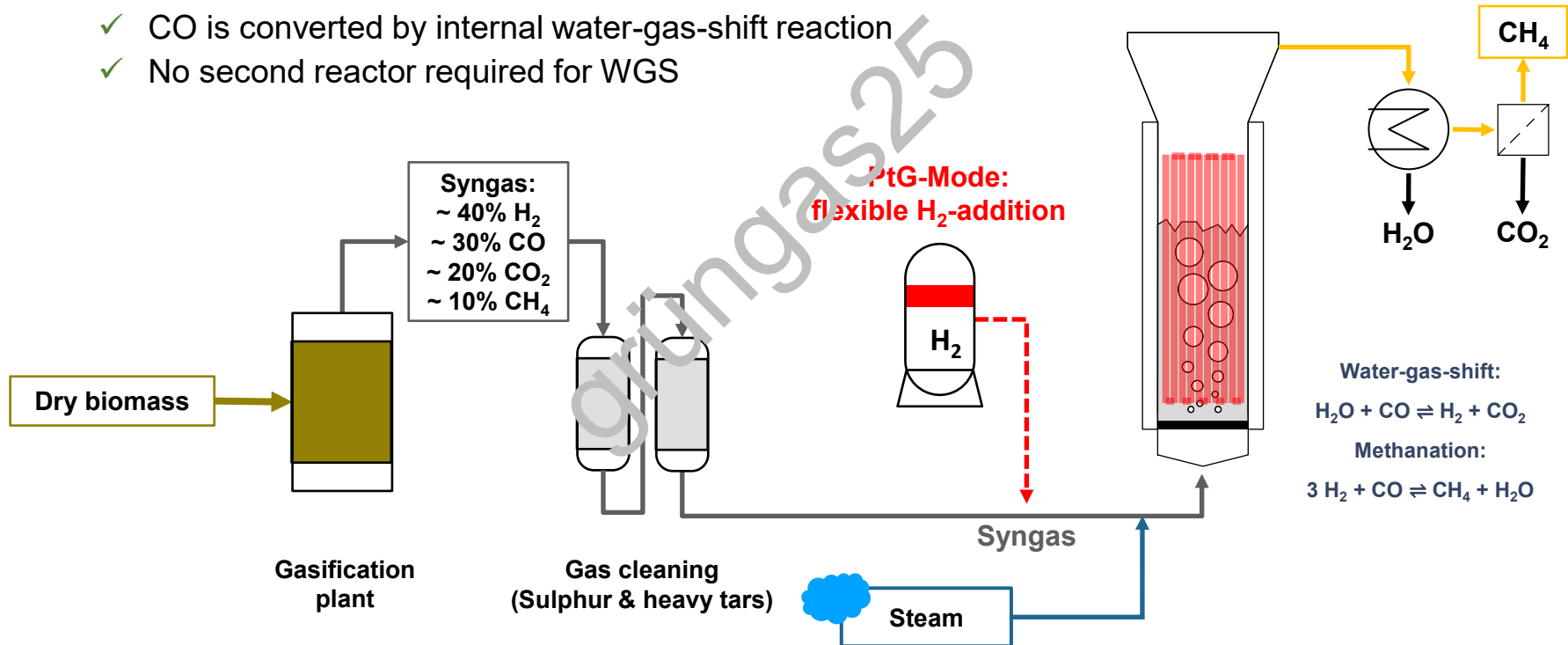
Feed gases	Main constituents
pure CO <sub>2</sub>	CO <sub>2</sub> + H <sub>2</sub>
pure CO	CO + H <sub>2</sub>
Biogas	CH <sub>4</sub> , CO <sub>2</sub> + H <sub>2</sub>
Syngas	H <sub>2</sub> , CO, CO <sub>2</sub> , CH <sub>4</sub> + H <sub>2</sub> O

Thermochemical reactions:  
 $4 \text{H}_2 + \text{CO}_2 \rightleftharpoons \text{CH}_4 + 2 \text{H}_2\text{O}$   
 and  
 $3 \text{H}_2 + \text{CO} \rightleftharpoons \text{CH}_4 + \text{H}_2\text{O}$



# Application 2: Syngas Methanation

- ✓ CO is converted by internal water-gas-shift reaction
- ✓ No second reactor required for WGS



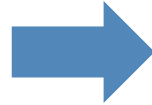
# Experimental Test



Laboratory

TRL 2 – 3

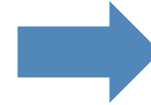
✓ Kinetic studies



10 kW-scale

TRL 4 – 5

✓ Field experiments  
✓ 1000h – tests at biogas plant  
✓ 1000h – test at gasifier plant



250 kW-scale

TRL 6

Test at industrial scale:  
flexible H<sub>2</sub>-addition

# Experimental Test



- Experiments performed in collaboration with Paul Scherrer Institute

## Tests performed:

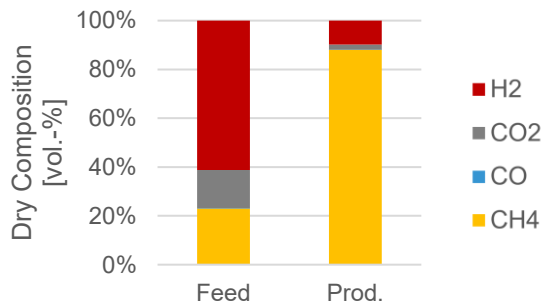
- 1) Direct methanation of biogas
- 2) Syngas methanation  
...without H<sub>2</sub> addition  
...with H<sub>2</sub> addition



# Experimental Results

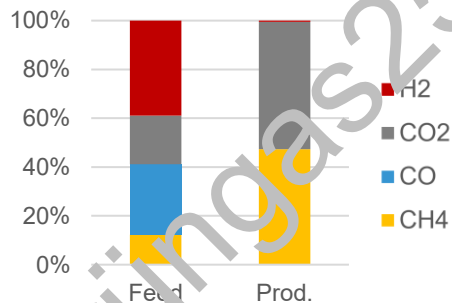


**PtX: Direct Methanation of Biogas**



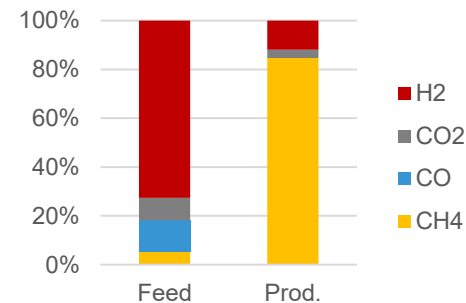
	Feed gas	Prod. gas
H <sub>2</sub>	61.0%	9.8%
CO	0.0%	0.0%
CO <sub>2</sub>	15.6%	2.0%
CH <sub>4</sub>	22.9%	87.8%

**Syngas methanation, no H2 addition**



	Feed gas	Prod. gas
H <sub>2</sub>	38.9%	0.5%
CO	28.9%	0.0%
CO <sub>2</sub>	19.9%	52.1%
CH <sub>4</sub>	12.3%	47.4%

**PtX: Syngas methanation, with stoichiometric H2 addition**



	Feed gas	Prod. gas
H <sub>2</sub>	72.5%	11.9%
CO	12.6%	0.0%
CO <sub>2</sub>	9.2%	3.4%
CH <sub>4</sub>	5.5%	84.7%



# Experimental Tests: Conclusion

- ✓ Exactly same reactor concept can be used to convert biogas and syngas
- ✓ CO can be fully converted
- ✓ Gasification and syngas methanation allow methane production from biomass
- ✓ Flexible H<sub>2</sub>-addition is possible.
  - ... it increases the methane output (and carbon-efficiency)
  - ... it can serve as a way to locally convert excess electricity



## Hybrid Biomethane Production from Integrated Biomass Conversion

### Goals

- Demonstrate an innovative pathway for the efficient and cost-effective production of biomethane in industrial environment.
- Deploy a first-of-its-kind value chain for biomethane production using low-grade biomass residues and sludge digestate from anaerobic digester plants.

**Project duration: Nov. 2022 – Dec. 2026**

# Project partners and funding



**Total budget:  
15 Mio. €**



**Funded by  
the European Union**

## Project funded by



Schweizerische Eidgenossenschaft  
Confédération suisse  
Confederazione Svizzera  
Confederaziun svizra

Swiss Confederation

Federal Department of Economic Affairs,  
Education and Research EAER  
**State Secretariat for Education,  
Research and Innovation SERI**

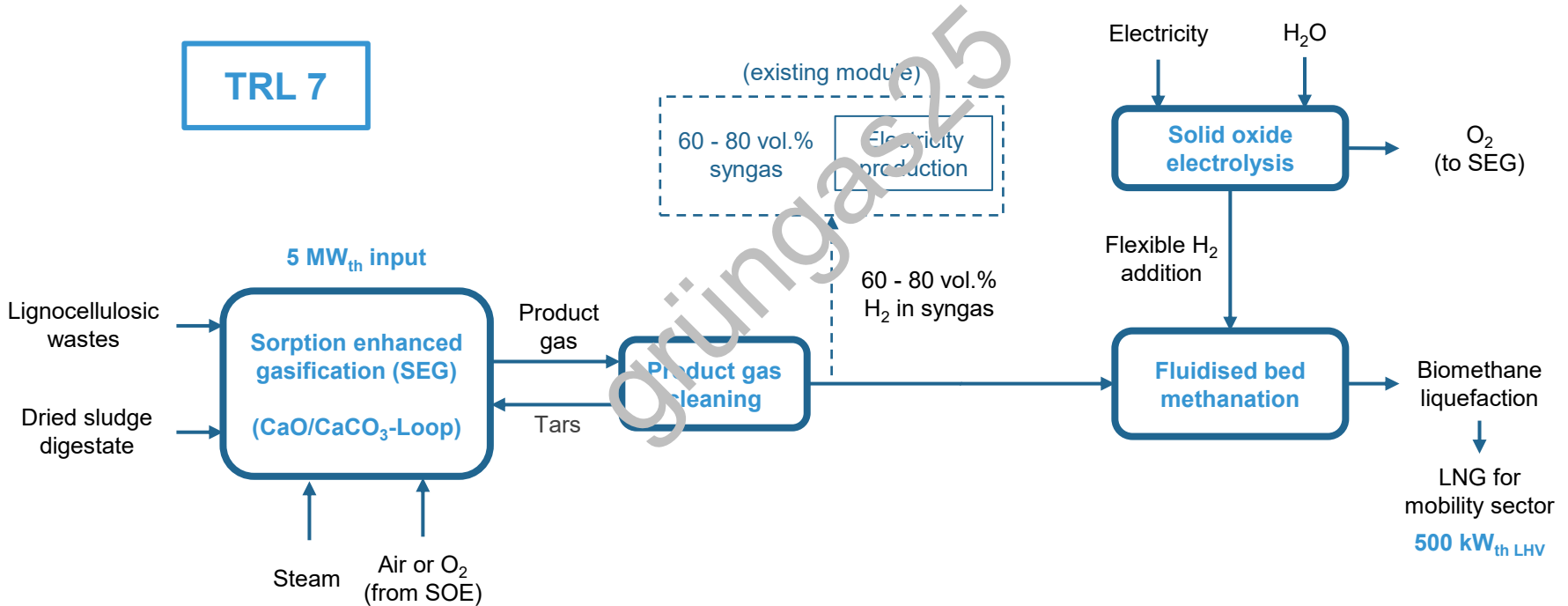
# Work packages

- WP1 – Project management
- WP2 – Feedstock and logistics
- WP3 – Sorption enhanced gasification (SEG)
- WP4 – Adaptable methanation
- WP5 – Scaled-up gasification unit
- WP6 – Biomethane liquefaction
- WP7 – Sustainability assessment
- WP8 – Communication & Dissemination



**Demonstration at TRL 7**

# Basic schematics of the demonstrator





# The main demonstration site

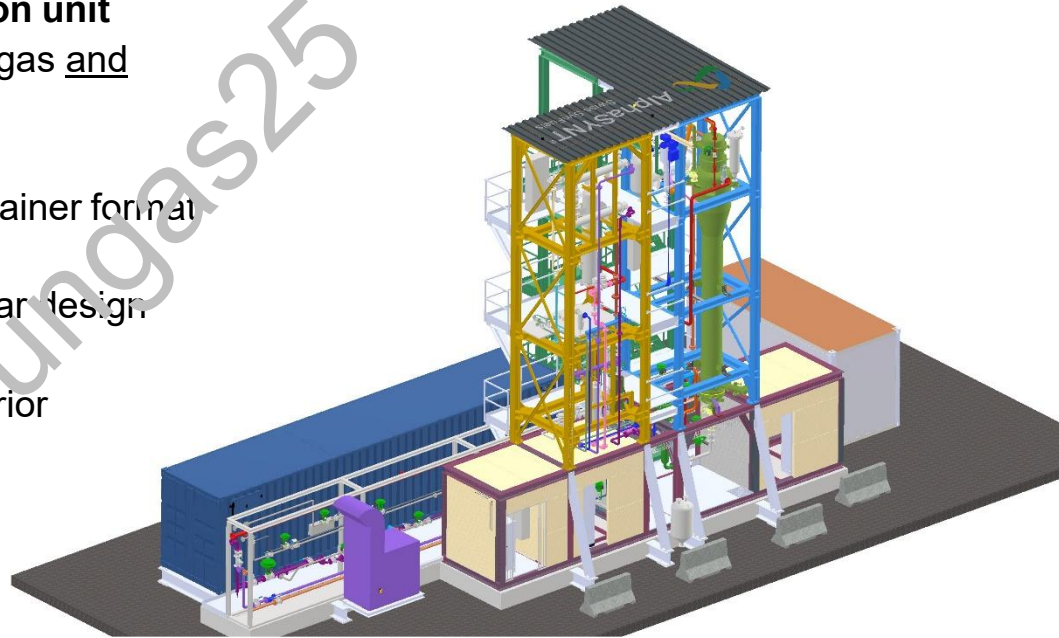


**Tondela (Viseu)**  
**Portugal**

- Retrofit of an existing circulating fluidised bed (CFB) gasifier
- Biomethane production capacity of 500 kW<sub>th LHV</sub>

# AlphaSYNT Services in HYFUELUP (and Beyond...)

- **Bubbling fluidised bed methanation unit**  
capable of methanation of producer gas and  
flexible hydrogen addition
- Prototype for further systems in container format
- Easy transportation thanks to modular design
- Attractive cost structure due to superior  
technology for syngas methanation



# Fluidised Bed Methanation...

... is a way to couple energy grids

... can locally convert excess electricity

... can offer a quick way to decarbonize  
the gas grid

# Thank you for your attention

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