

CCU for production of green methanol and upgrading of biogas

Dr. Francisco Vidal Vázquez – Institute for Micro Process Engineering (IMVT)

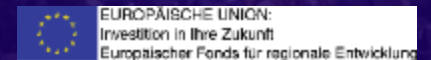
13.05.2022



**Process⁴
Sustainability**

**Cluster for climate-neutral
process industries in Hesse**

Supported by:





CCU for production of green methanol and upgrading of biogas

Dr. Francisco Vidal Vázquez – Institute for Micro Process Engineering (IMVT)

Participation of all scientists in teaching and research

Cultural diversity

Excellent research infrastructure

DEVELOPING SCIENTIFIC CAREER PATHS

The Research University in the Helmholtz Association

TRANSPARENT SERVICES FOR RESEARCH, TEACHING AND INNOVATION

KIT thinks and acts as ONE institution

Research-based teaching and learning

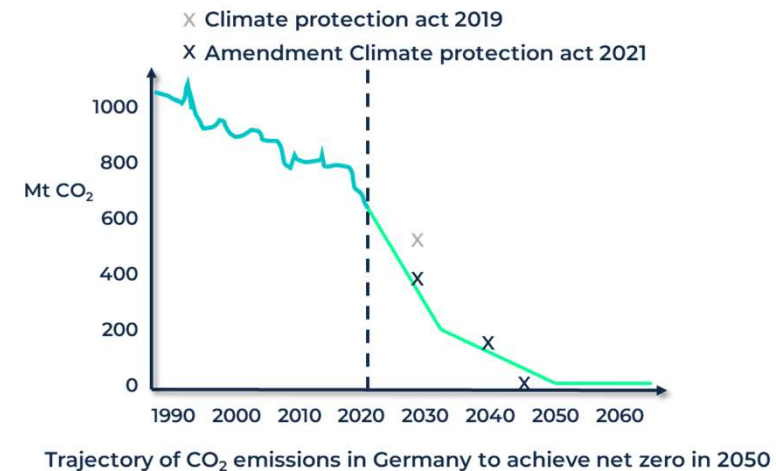
Energy
Mobility
Information

INNOVATION AS A STATUTORY MISSION

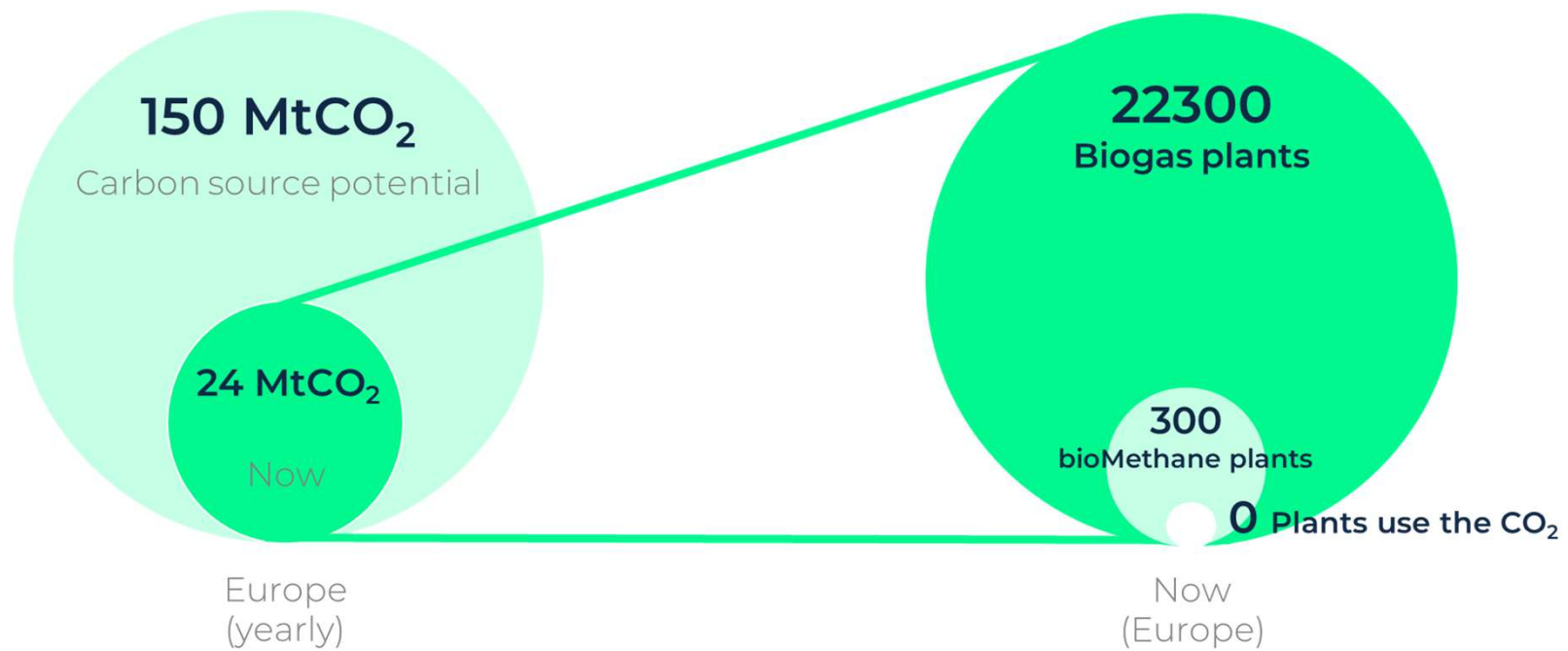
TOWARDS A LEADING POSITION IN EUROPE

Climate change forces phase-out of fossil carbon

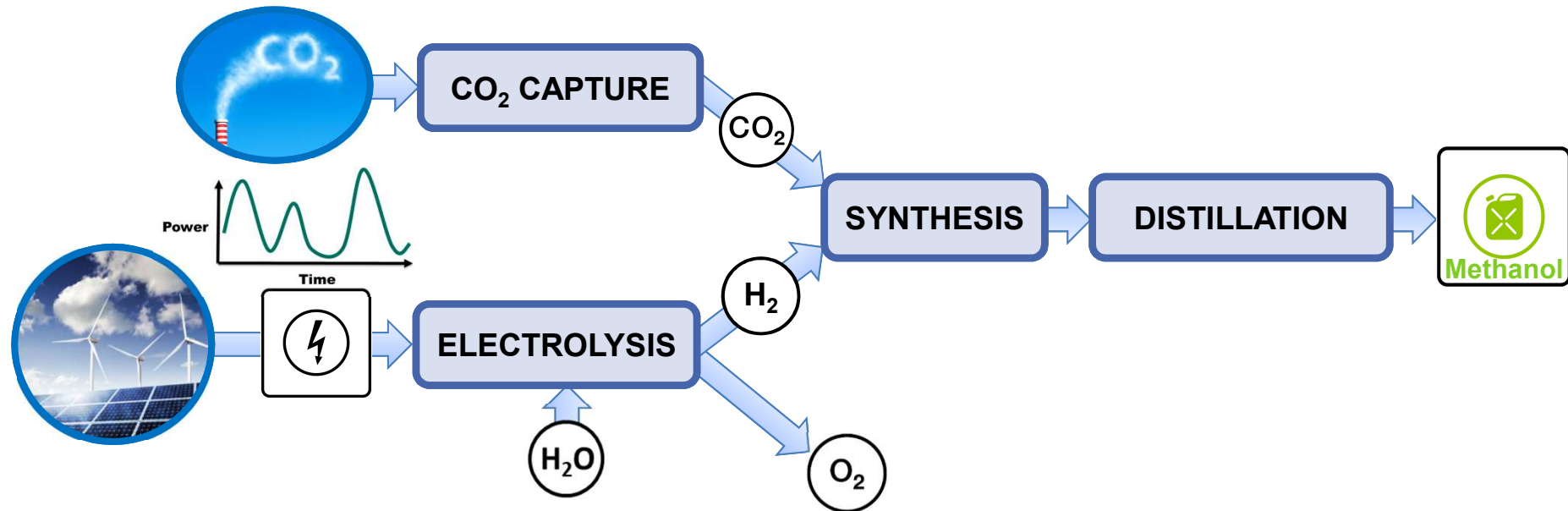
- Cut fossil-based CO₂ emissions
- Renewable carbon sources still unused
- Lack of cost competitive solutions
- Dependency on foreign natural gas and petroleum



Biogas have huge potential

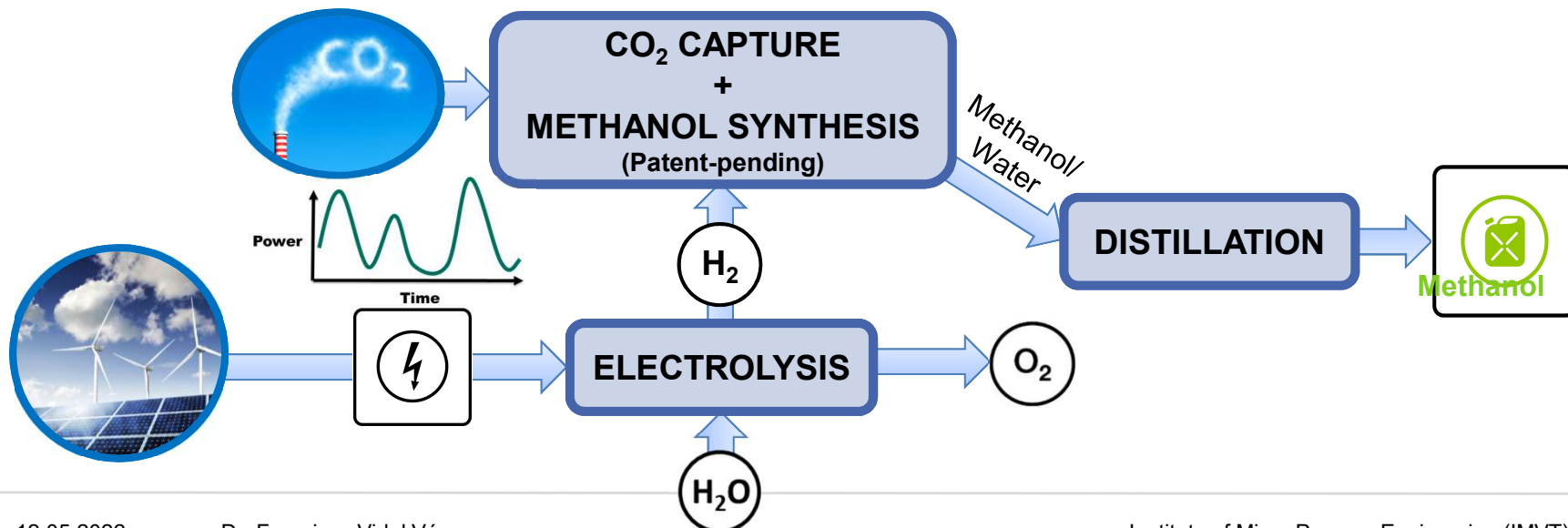


Power-to-Methanol Technology



Our Power-to-Methanol Technology

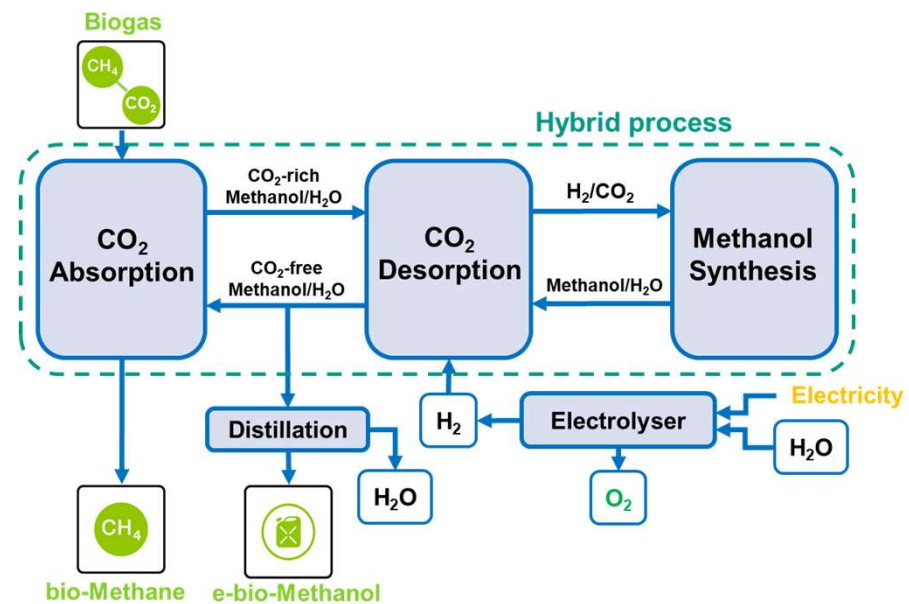
- Technological key points:
 - Decentralized
 - Patent-pending process for CO₂ capture and conversion into methanol.
 - No plant operators (remote monitoring)
 - CO₂ from exhaust gases (>5 vol-%)
 - Dynamic operation to use solar and wind energy as main power source



Our Power-to-Methanol Process

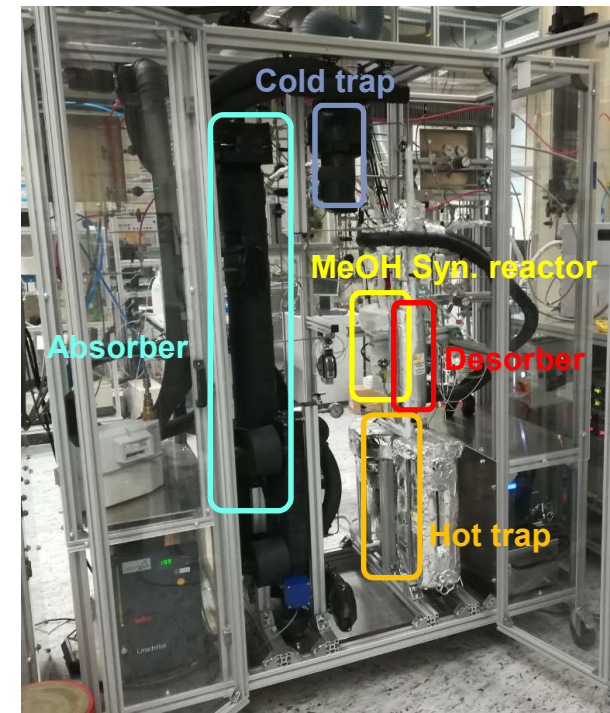
- Main process characteristics:
 - Methanol/Water as CO₂ solvent
 - H₂ for enhancing CO₂ desorption
 - Temperature and pressure levels:
 - Minimizing energy consumption
 - Minimizing compression requirements

- Advantages:
 - Lower energy demand per kg CO₂ (30 % less energy demand than amine-based capture)
 - Lower required equipment
 - No need of additional CO₂ solvent



Proof-of-Principle: CO₂-Capture and Methanol Synthesis

- Proof-of-principle work:
 - Process simulations
 - Experimental work (CO₂ capture and methanol synthesis, separately)
- Patent filed in August 2020



Lab set-up at the IMVT

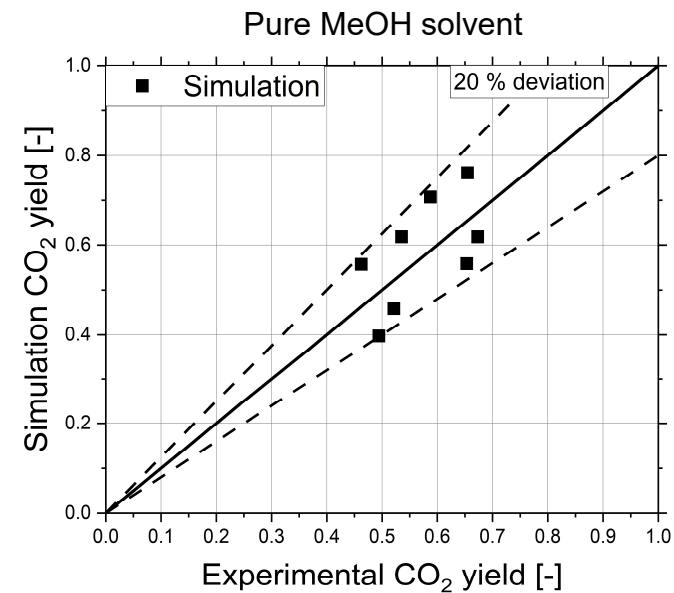
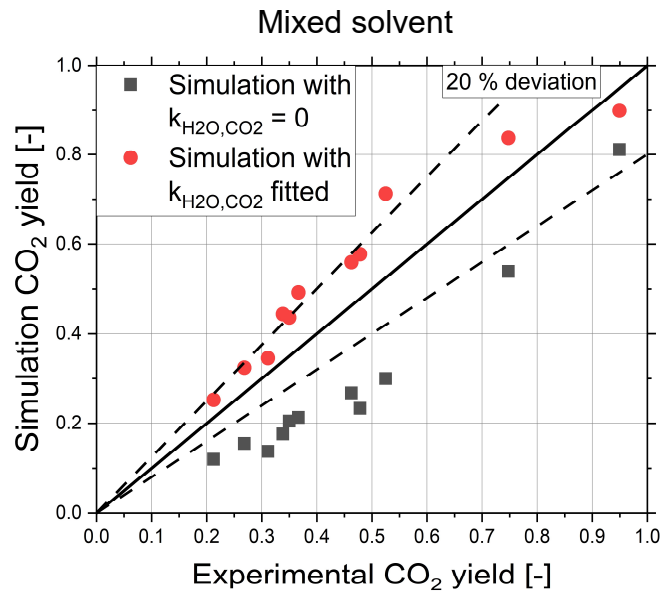
Proof-of-Principle: Experimental work on CO₂ capture

- Experiments with methanol and methanol-water solvent

Varied parameter	Level 1	Level 2
T _{abs} [°C]	-	+
p _{abs} [bar]	-	+
T _{des} [°C]	-	+
p _{des} [bar]	-	+
Solvent	MeOH/H ₂ O	Pure MeOH

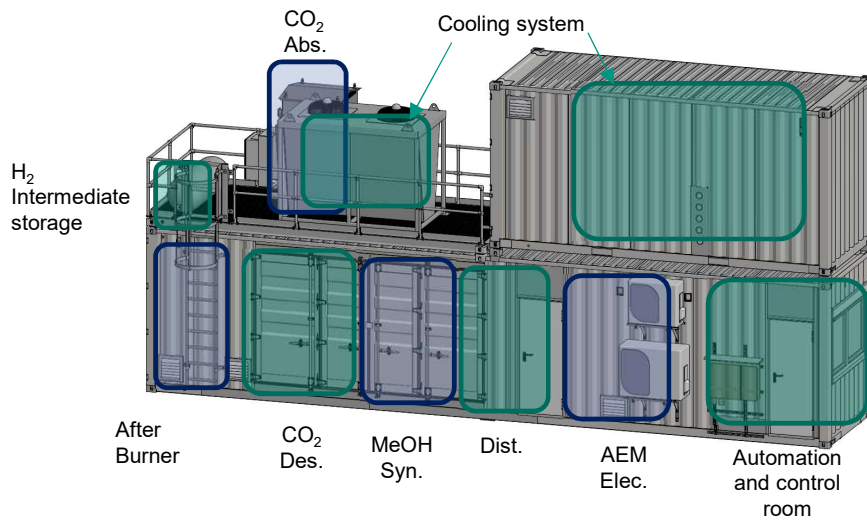
Proof-of-Principle: Exp. vs Sim. Results

- Highest CO₂ yield achieved = 0.95

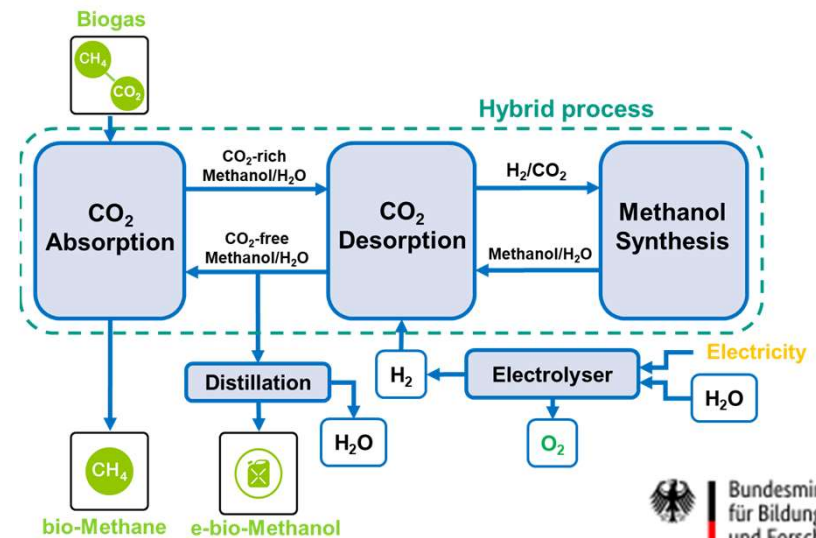


Proof-of-Concept Plant

- Development of a fully automated Power-to-Methanol (PtM) pilot plant
 - Scale-up to container size (50 liters/day of methanol)
 - Construction of a container plant as part of the Sector Coupling project (BMBF)
 - Commissioning of the plant in the beginning of 2023



3D-Drawing of the Proof-of-Concept plant (Energy Lab 2.0)

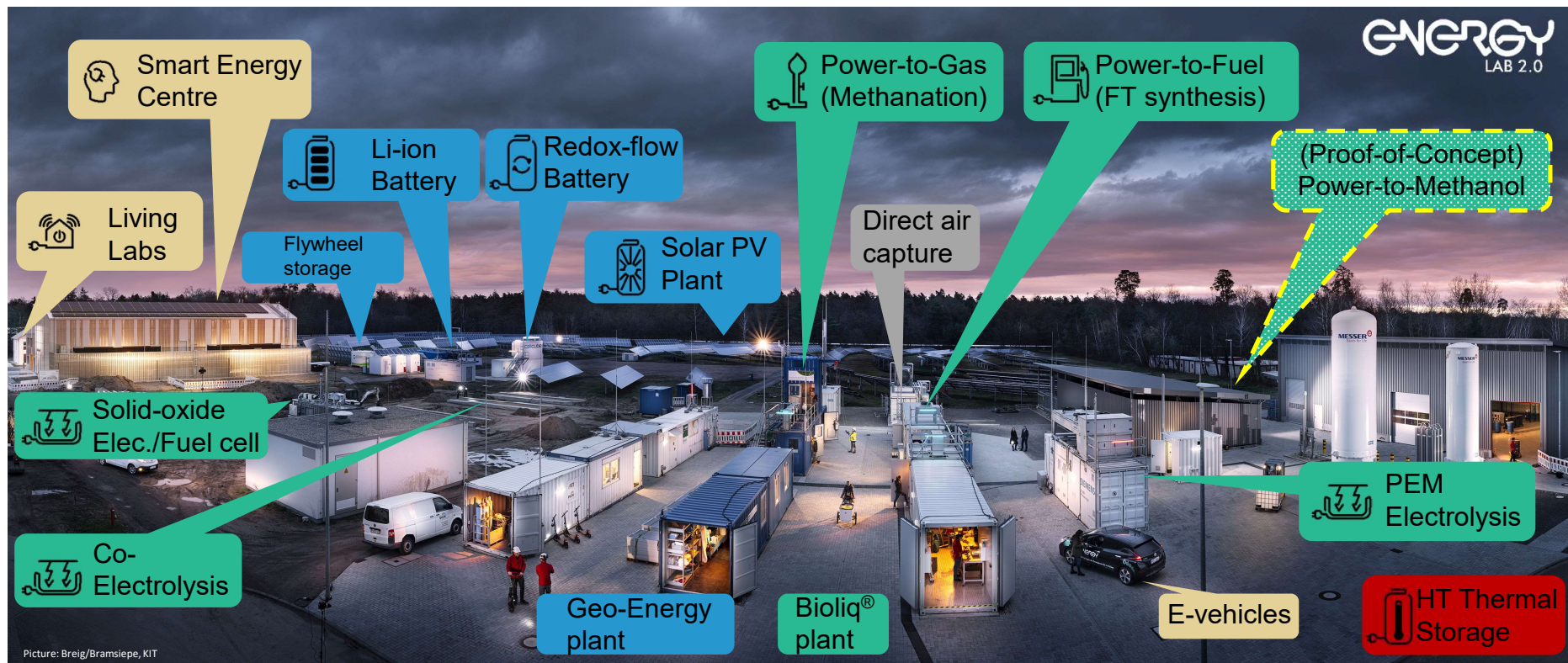


Proof-of-Concept Plant



- Collaboration between:
 - Institute for Micro Process Engineering (IMVT):
 - Project management
 - Process development and plant design
 - Plant construction
 - Project, Process and Quality Management (PPQ) service unit:
 - Finance and quality management
 - Institute for Automation and Applied Informatics (IAI) and Institute for Astroparticle Physics (IAP)
 - Design, construction and optimization of the process control and automation

Proof-of-Concept Plant in the Energy Lab 2.0



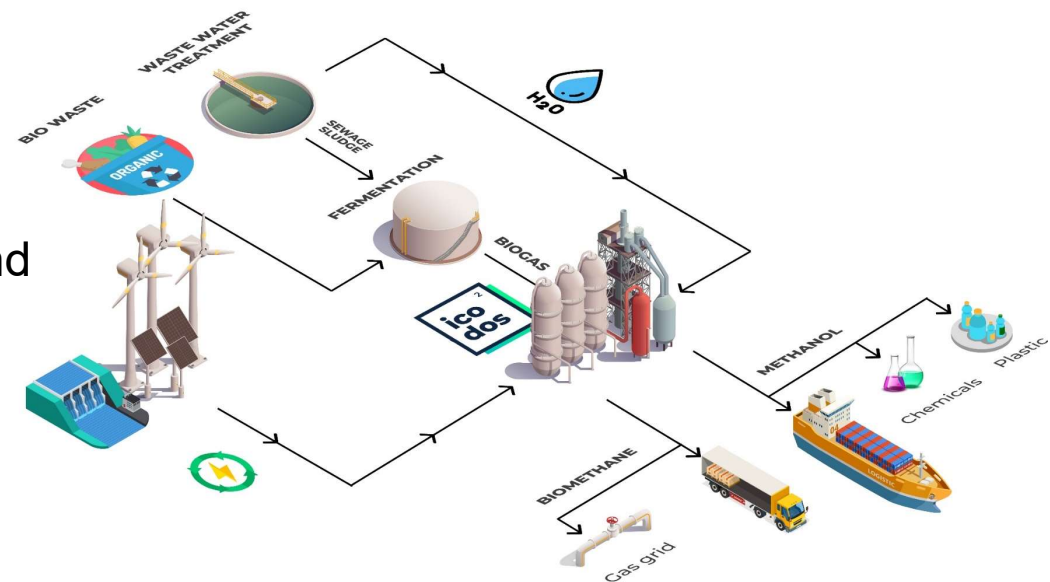
Technology transfer



■ ICODOS – Intelligent Carbon Dioxide Solutions

■ Planned Spin-off for the commercialization:

- Fully integrated
- Fully automatized
- Dynamically operated
- Building up the team
- Developing business model and market entry
- Looking for seed-financing





Thank you!



Visit us at the KIT stand in the Hannover Messe
(30. May – 2 June)

