Betrieb einer Bioraffinerie im Pilotmaßstab

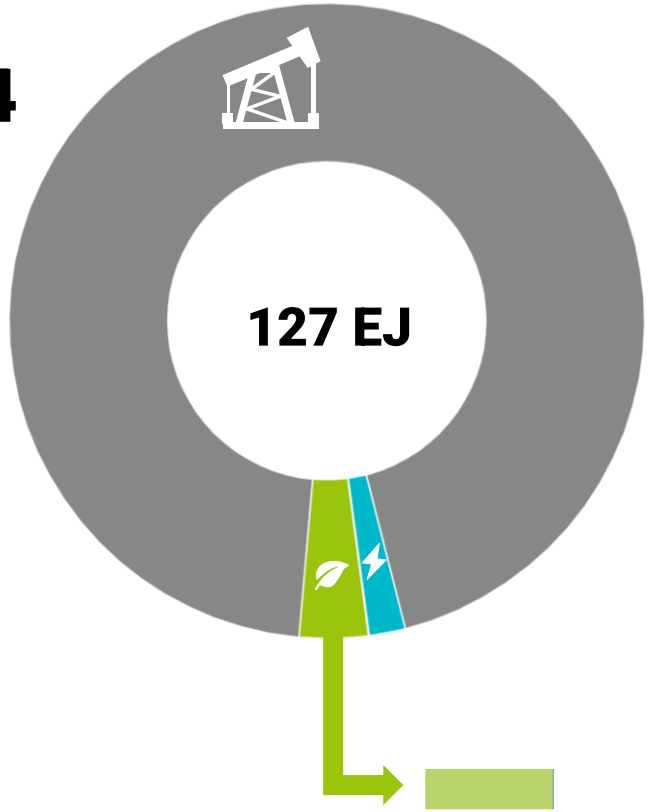
zur Herstellung von erneuerbarem Methan aus biogenem CO_2 sowie weiterer wertschöpfender Produkte aus Nebenströmen

Franziska Müller-Langer und Philipp Knötig | Pressefahrt 2026 | 22. April 2026

World energy demand in transport

Need of factor 10 more renewable fuels in the next 25 years

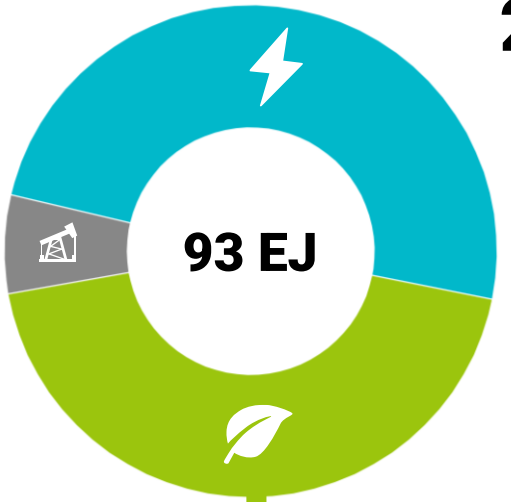
2024

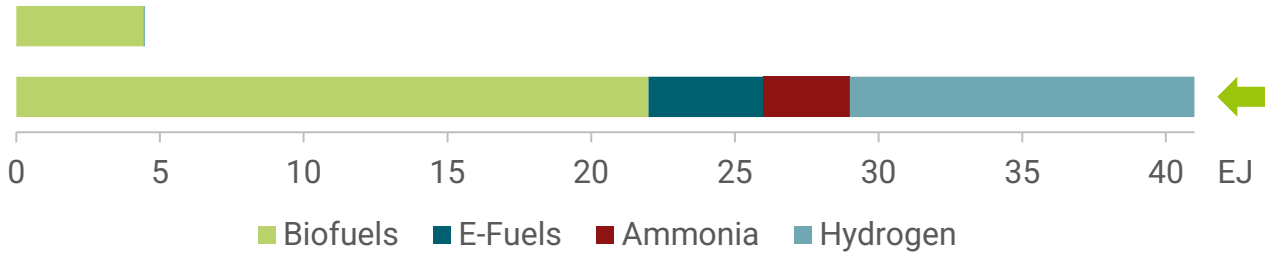


Key factors

- Avoidance
- Modal shift
- Electrification
- Renewable fuels

2050



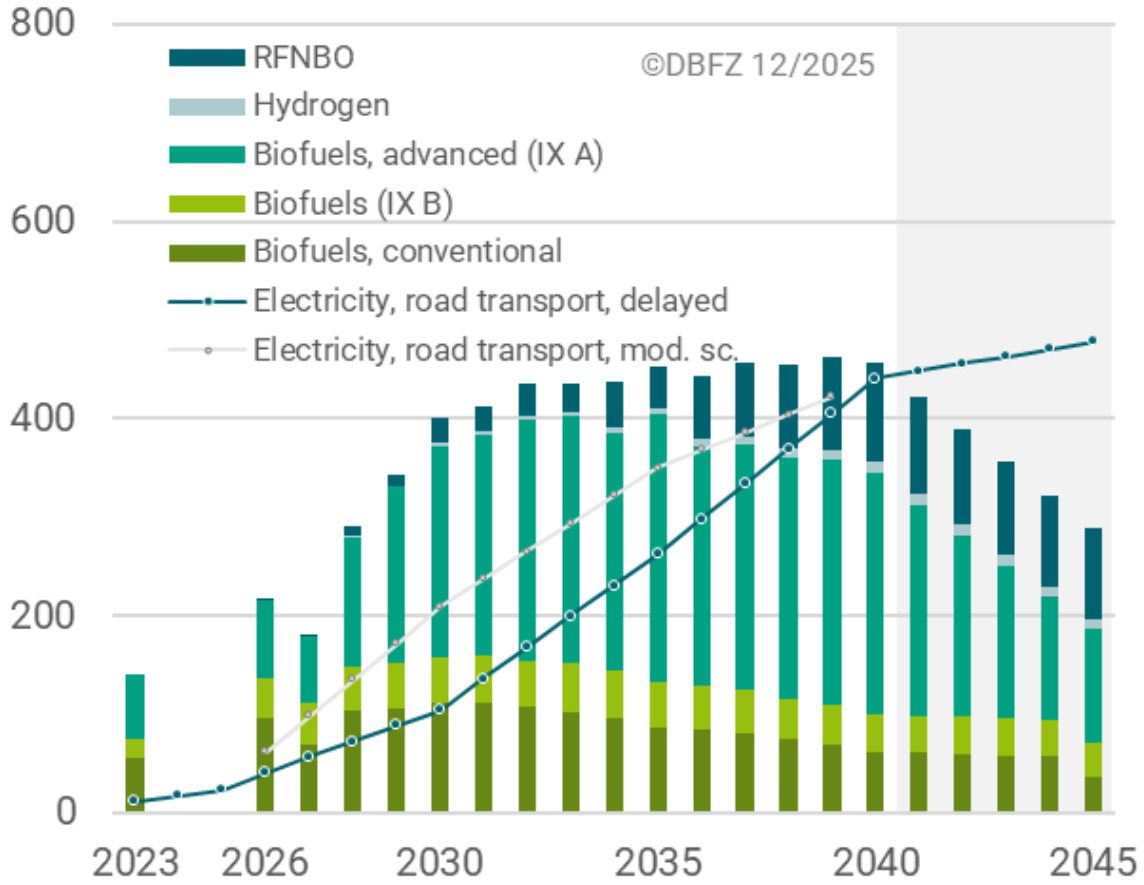


Data based on IRENA World Energy Transitions Outlook (2022). Mueller-Langer et al. FOTF 2026

GHG quota for transport fuels in Germany

Fuel demand in land transport

Moderate scenario [PJ]



Scenario features

Total final energy demand (2040): 1,400 PJ, moderate electrification and high fuel demand

Renewable fuel demand

Demand of 400 PJ by 2030
(of which nearly 30 PJ RFNBOs)
Demand of more than 450 PJ by 2040
(of which more than 110 PJ RFNBO)

Climate target in the transport sector

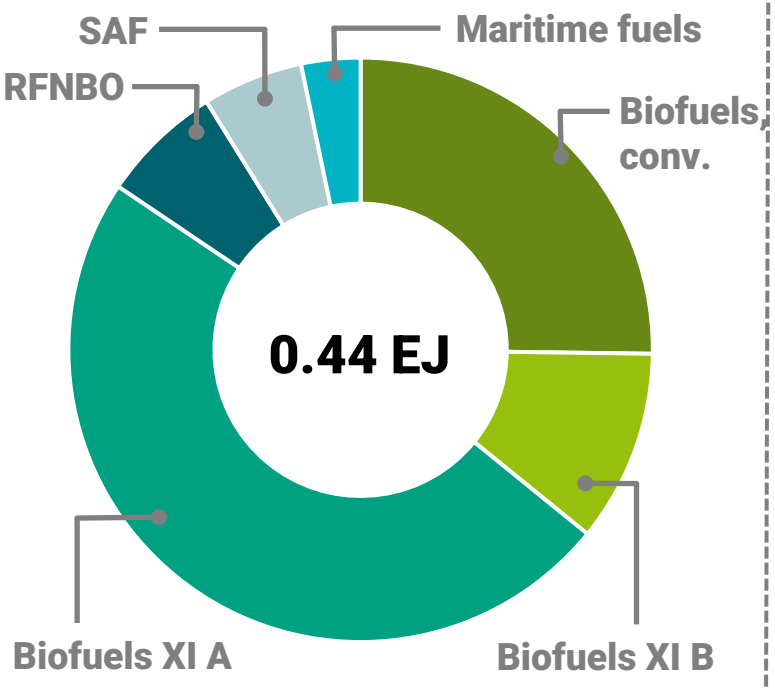
Gap of 520 million t of CO_2eq. by 2040
(fossil fuel use still amount to 500 PJ)

Update as of 01/2026

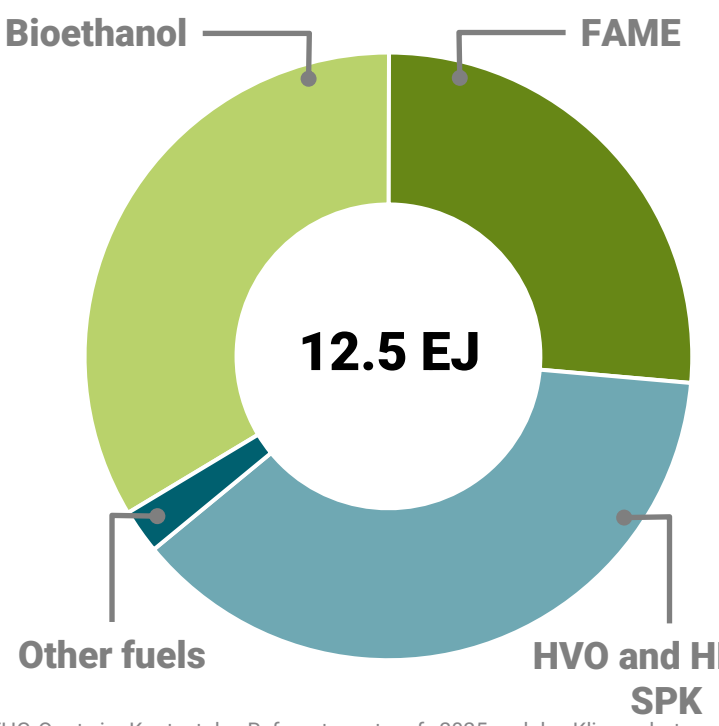
Source: adapted from Naumann, K.; Etzold, H. Müller-Langer, F. (2025): Hintergrundpapier | Szenarien zur THG-Quote im Kontext des Referentenentwurfs 2025 und des Klimaschutzgesetzes bis 2045. Leipzig: DBFZ. 07/2025.

Fuel demand, capacities and bioenergy potential

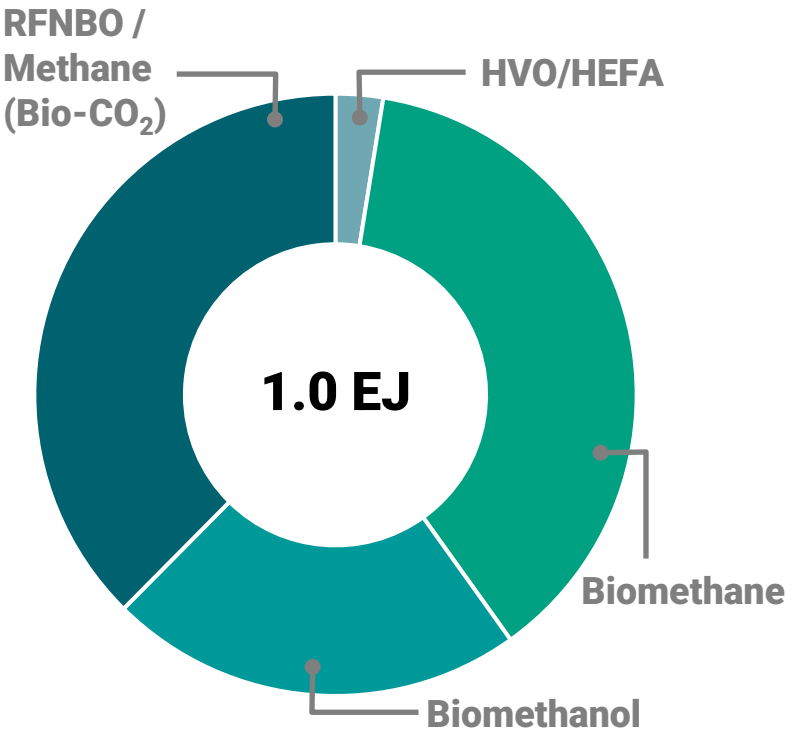
German fuel demand
(acc. to GHG quota, RFEUA, FEUM)



World fuel capacity
(in operation and projected)

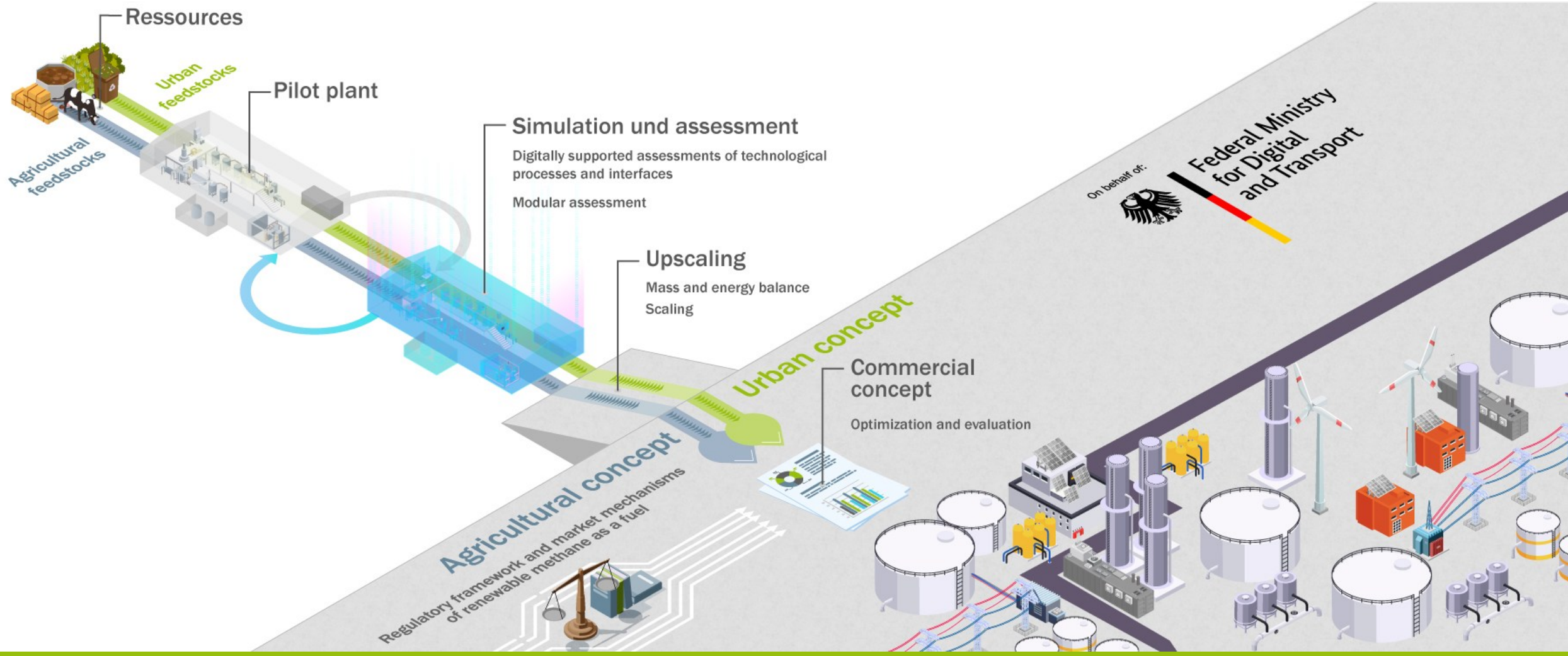


European bioenergy potential
(non food, balanced in fuel output)



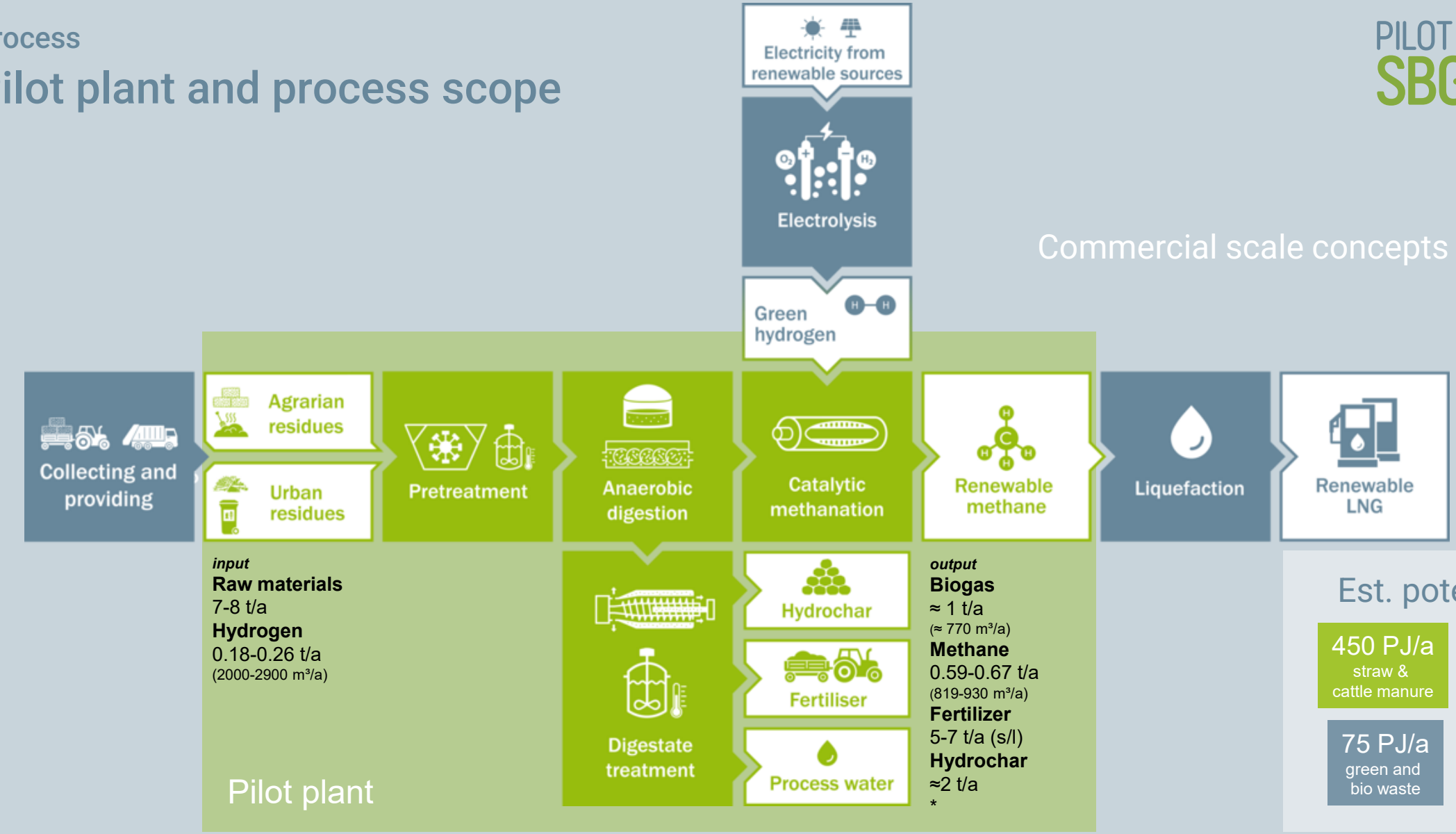
Sources: adapted from Naumann, et al. (07/2025): Hintergrundpapier | Szenarien zur THG-Quote im Kontext des Referentenentwurfs 2025 und des Klimaschutzgesetzes bis 2045., online available: https://www.dbfz.de/fileadmin/user_upload/Referenzen/Statements/DBFZ_HP_Szenarien_THG_Quote.pdf; Schröder et al. (2025): Marktkennzahlen. In: Schröder, J.; Görsch, K. (Hrsg.) (2025). Erneuerbare Energien im Verkehr: Monitoringbericht. Leipzig: DBFZ. and Naumann et al. (10/2024): Hintergrundpapier. Bio2x. Online available https://www.dbfz.de/fileadmin/user_upload/Referenzen/Statements/Hintergrundpapier_Bio2x_Okt_2024.pdf
Mueller-Langer et al. FOTF 2026

Scope


Ressources
Urban feedstocks
Agricultural feedstocks
Pilot plant
Simulation und assessment
Digitally supported assessments of technological processes and interfaces
Modular assessment
Upscaling
Mass and energy balance
Scaling
Urban concept
Commercial concept
Optimization and evaluation
Agricultural concept
Regulatory framework and market mechanisms of renewable methane as a fuel
On behalf of:
Federal Ministry for Digital and Transport

Process

Pilot plant and process scope



input
Raw materials
7-8 t/a
Hydrogen
0.18-0.26 t/a
(2000-2900 m³/a)

output
Biogas
≈ 1 t/a
(≈ 770 m³/a)
Methane
0.59-0.67 t/a
(819-930 m³/a)
Fertilizer
5-7 t/a (s/l)
Hydrochar
≈2 t/a
*

Commercial scale concepts

Est. potential[1]

450 PJ/a
straw & cattle manure

75 PJ/a
green and bio waste

36%
Total diesel consumption in Germany

m³ - standard cubic metre; * Rough approximation from the mass balance. Biogas, fertiliser and hydrochar amount and composition depend on the raw material origin and quality; **for the first commercial size plant concept results from lab scale preliminary tests were used since the pilot plant was still in commissioning.

Source: [1]Naumann, K. et al. (2024): Fokusheft Standortanalyse und Ressourcenverteilung für erneuerbares LNG im Verkehr (in preparation)

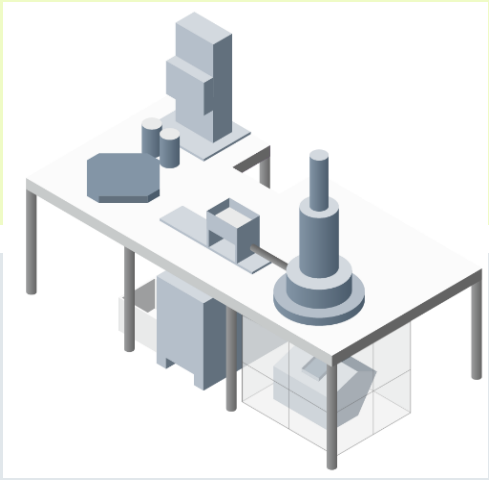
Input materials

Hydrothermal (pre-)treatment

Hydrothermal pre-treatment and carbonization

Input **Conversion** **Output**

Biomass



to digester

Digestate

Hydrochar

Anaerobic fermentation| Line 2

Anaerobic fermentation| Line 3

Anaerobic fermentation| Line 1

Anaerobic digestion

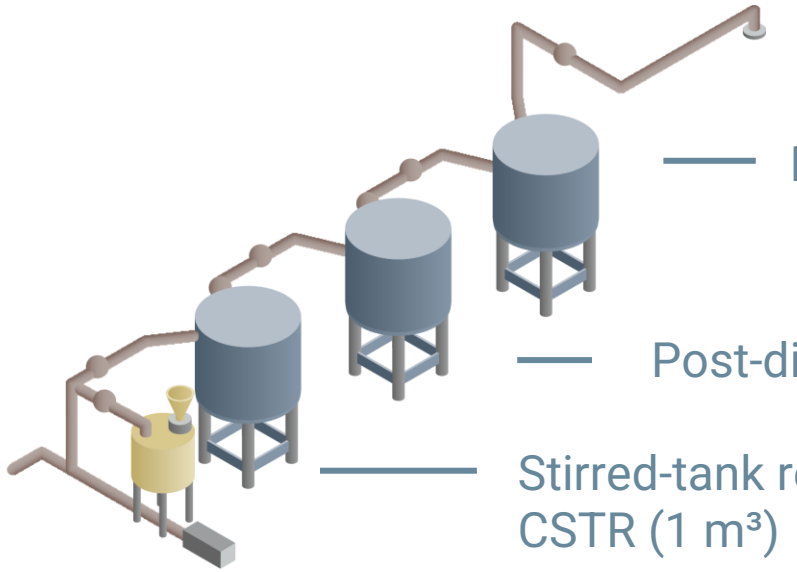
Comparison of different reactor lines

Inputs:
Wheat straw
Cow manure

Biomass

Dry matter fed:
CSTR: 8 $\%_{TS}$

Hydrothermal Reactor



Digestate storage

Post-digester

Stirred-tank reactor
CSTR (1 m³)

Output

Biogas

Digestate

Methanation

Gas storage & flare

PILOT SBG

DBFZ

Methanation

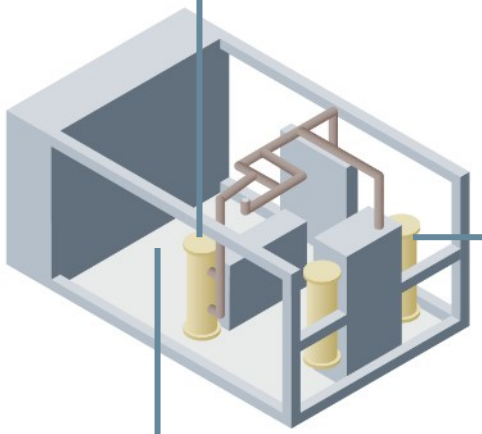
Catalytic methanation

Layout & design

Input

Biogas

Hydrogen



Stage 1:
Biogas cleaning

Stage 2:
Methanation

Stage 3:
CO_2 removal

Output

Renewable methane


PILOT SBG
DBFZ
Digestate treatment


Digestate treatment

Digestate treatment

Solid-liquid separation

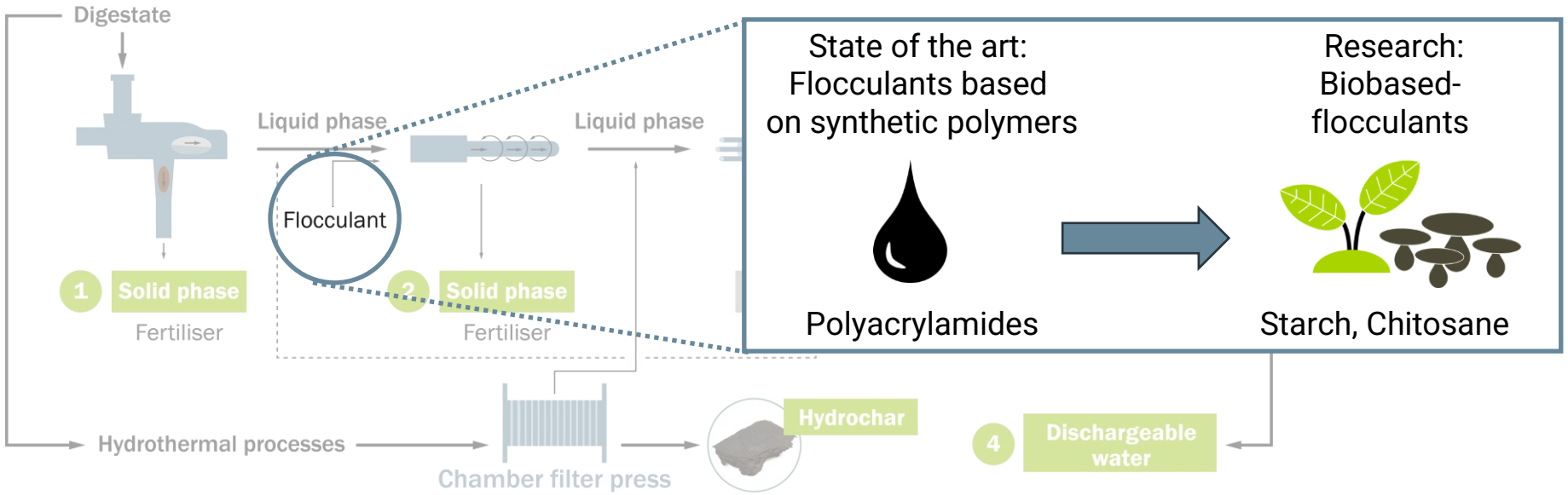
Screw press

Decanter centrifuge

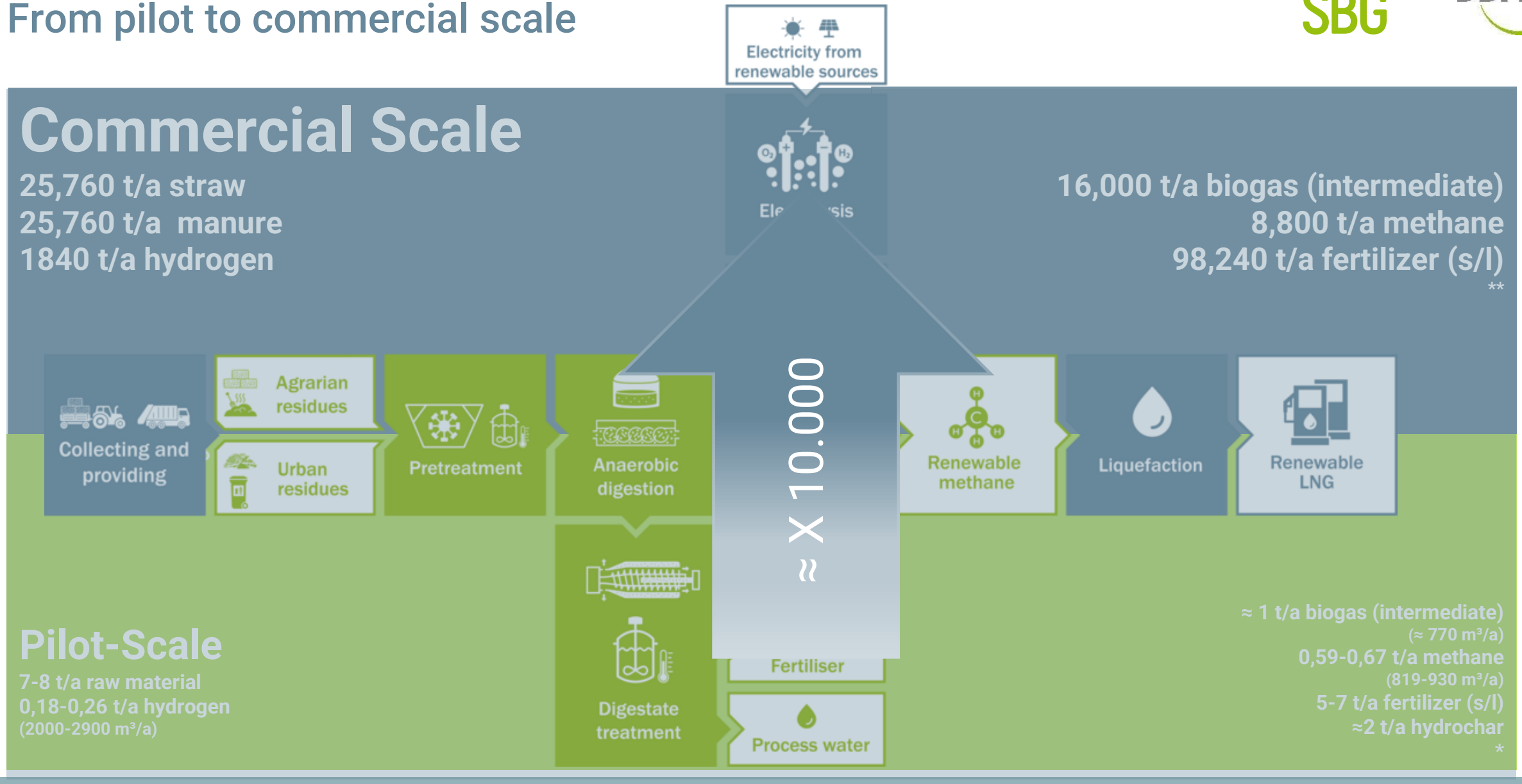
Liquid-liquid separation

Ultrafiltration

Reverse osmosis

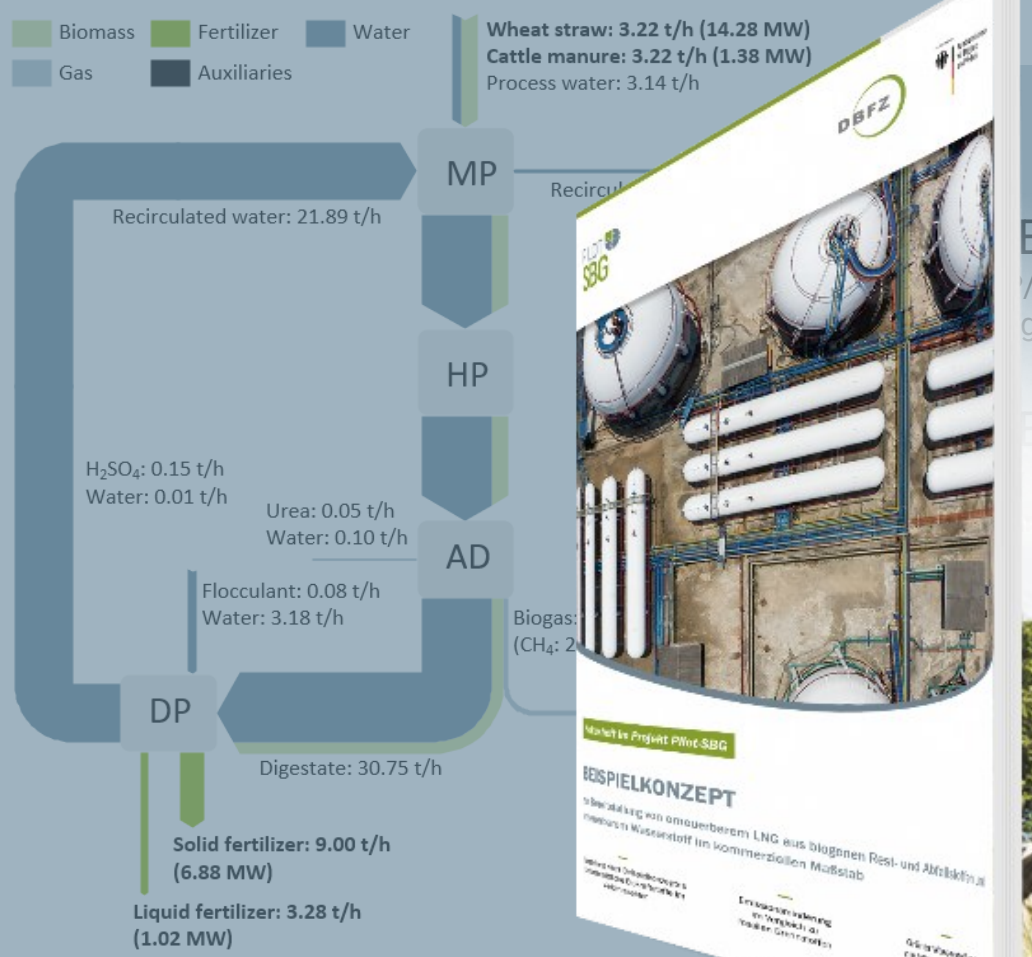


From pilot to commercial scale



m³ - standard cubic metre; * Rough approximation from the mass balance of the engineering phase of the pilot plant. Biogas, fertiliser and hydrochar amount and composition depend on the raw material origin and quality; **for the first commercial size plant concept results from lab scale preliminary tests were used since the pilot plant was still in commissioning.

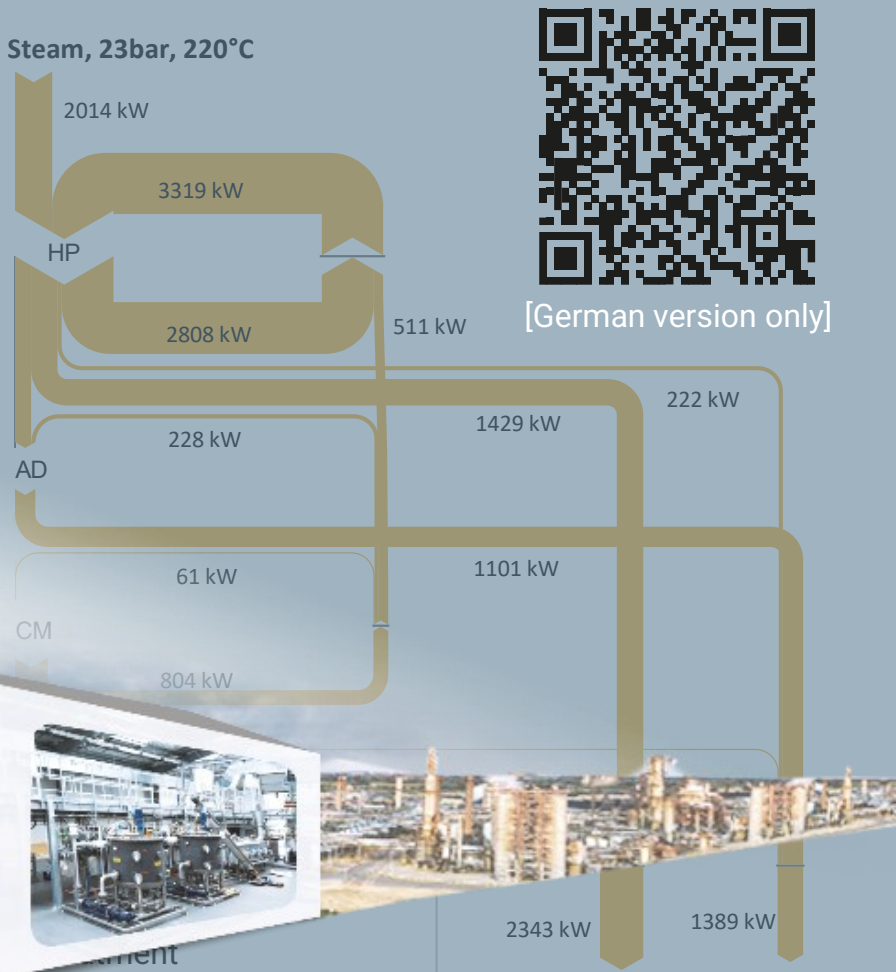
Mass and energy balance | commercial scale



Results

EM = 18,3%; 45,4%
/K fertilizer; considering all
ganic content)

EE = 16,9%

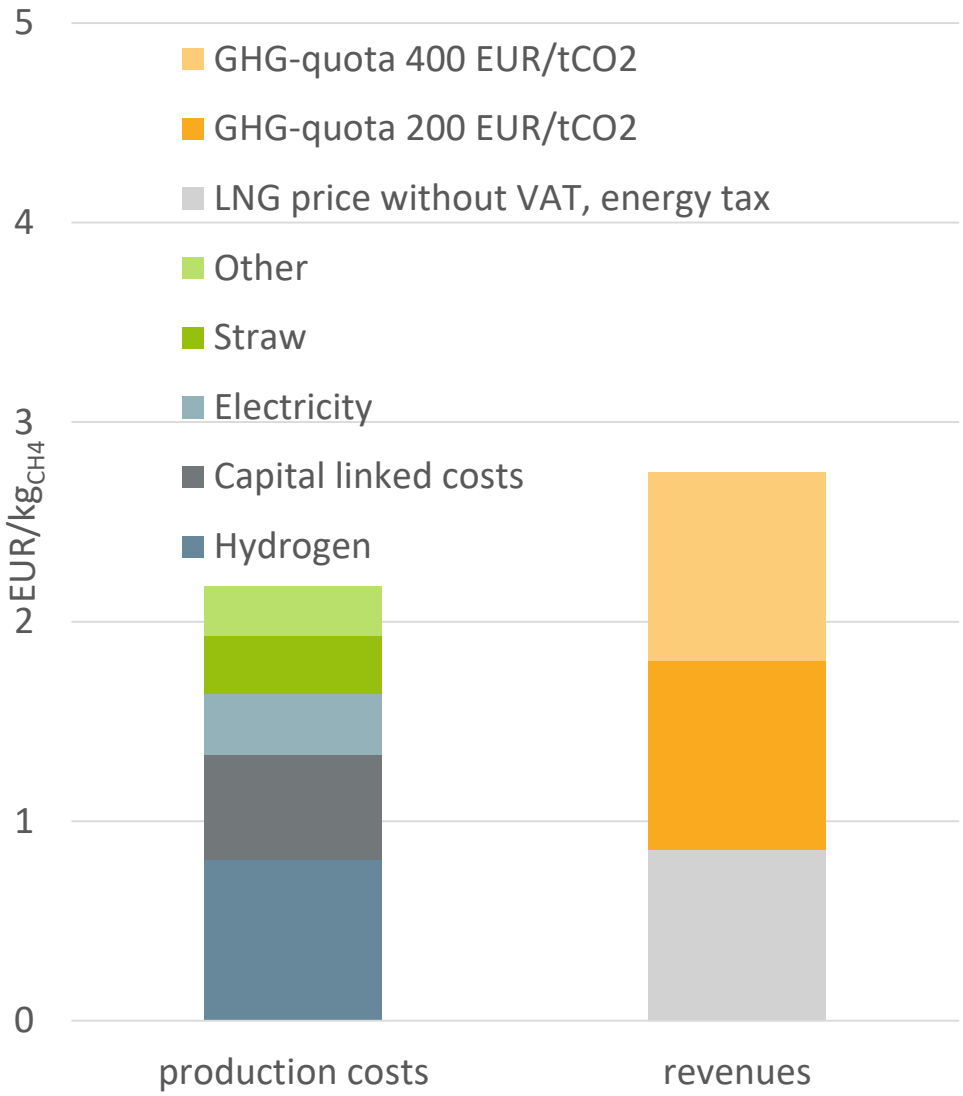


[German version only]

AD: anaerobic digestion
CM: catalytic methanation
DP: digestate processing

Source: Röder, L. S.; Nitzsche, R.; Etzold, H.; Oehmichen, K. (2024). Beispielkonzept zur Bereitstellung von erneuerbarem LNG aus biogenen Rest- und Abfallstoffen und erneuerbarem Wasserstoff im kommerziellen Maßstab: Fokusheft im Projekt Pilot-SBG. Leipzig: DBFZ. 31 S. ISBN: 978-3-949807-06-0. DOI: 10.48480/jsct-z879

Market | Costs and revenues

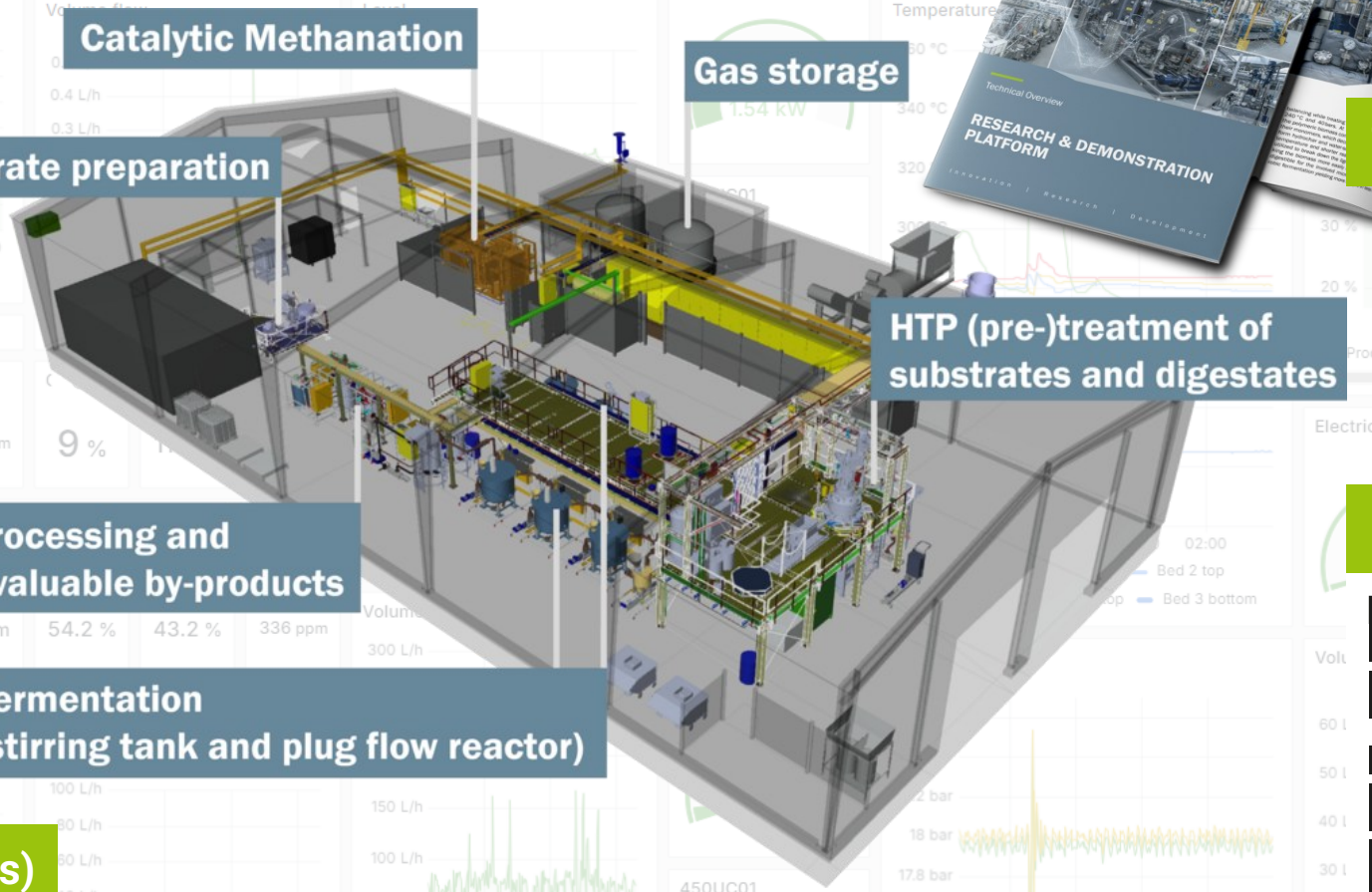


- GHG quota revenues have a high positive impact on the business case.
- Regulatory changes drive rising prices by end of 2025 (400 EUR/t_{CO2}).
- From 2026 onward, double counting for advanced biofuels ends.
- Market prices for 2026 are still under development.

Source: Röder, L. S.; Nitzsche, R.; Etzold, H.; Oehmichen, K. (2024). Beispielkonzept zur Bereitstellung von erneuerbarem LNG aus biogenen Rest- und Abfallstoffen und erneuerbarem Wasserstoff im kommerziellen Maßstab: Fokusheft im Projekt Pilot-SBG. Leipzig: DBFZ. 31 S. ISBN: 978-3-949807-06-0. DOI: 10.48480/jsct-z879

Technology and fields of research

- Fully automated plant
- Intensive process monitoring
- Plug and play
- Waste/Biomass To X (W/BtX)
- Flexibility
- Biogenic CO_2
- RFNBO
- Advanced feedstock (wastes and residues)
- Modularity



Technical overview

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#greenhydrogen #GHGquota #biomass #greenbiorefinery
#sustainability #bioeconomy #pilotplant #innovation

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