

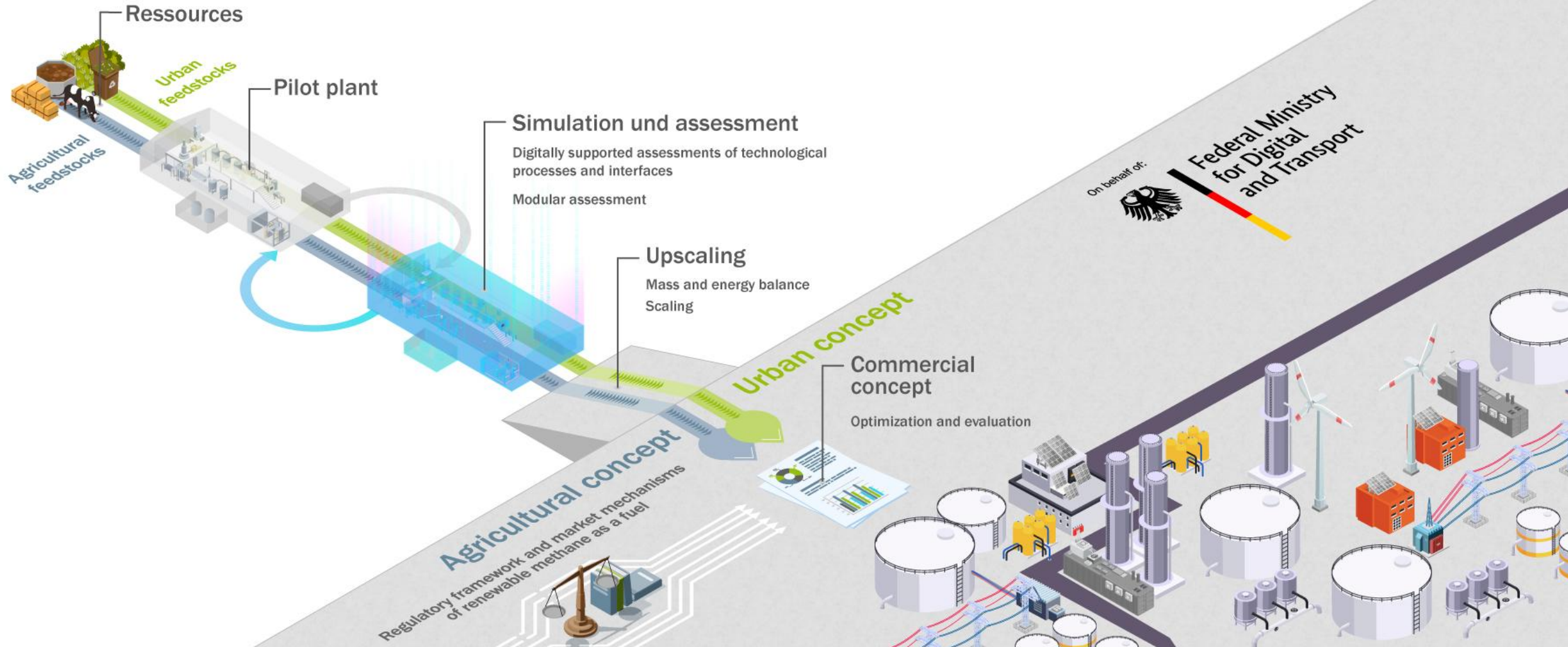


Effects of hydrothermal pre-treatment on the performance of a pilot scale biorefinery for renewable methane and value adding by-products

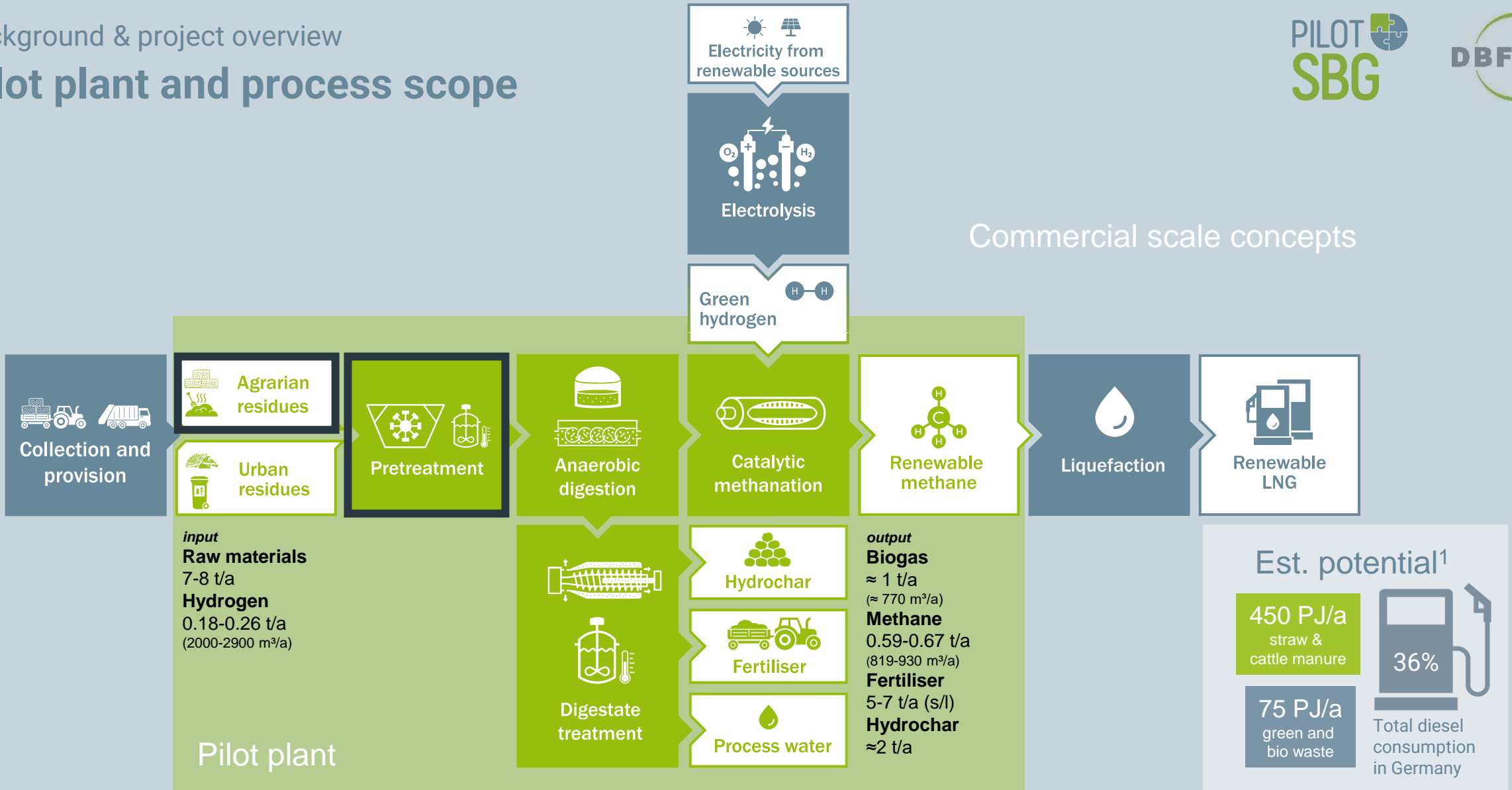
Philipp Knötig, Dr. Marcel Pohl, Hendrik Etzold | Biorefineries Department, Deutsches Biomasse Forschungszentrum gemeinnützige GmbH

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From pilot to commercial scale concepts



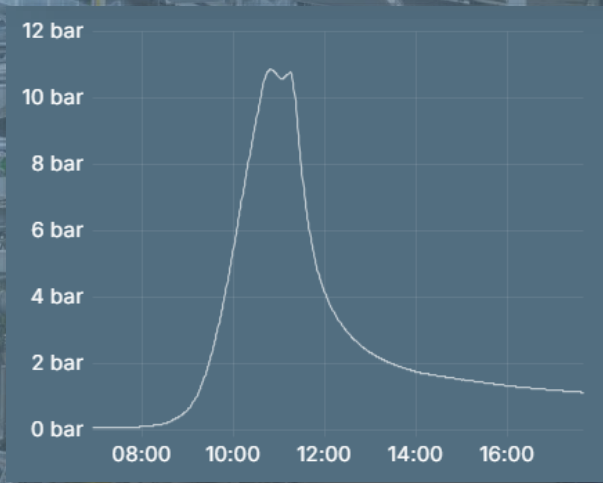
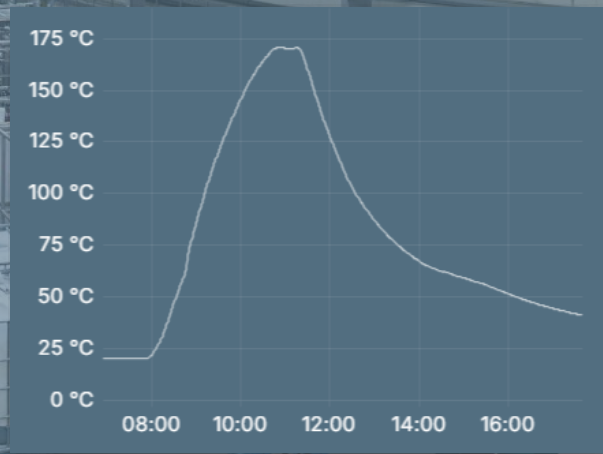
Pilot plant and process scope



m³ - standard cubic metre; Rough approximation of the mass balance. Biogas, fertiliser and hydrochar amount and composition depend on the raw material origin and quality

Input materials





Hydrothermal (pre-)treatment



Anaerobic fermentation| Line 2

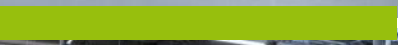


Anaerobic fermentation| Line 1

Methanation



Gas storage & flare



Methanation





Digestate treatment



Digestate treatment

Solid-liquid separation

Screw press

Decanter centrifuge



Liquid-liquid separation

Ultrafiltration

Reverse osmosis



Effects of hydrothermal pre-treatment on Anaerobic digestion

Campaign 1



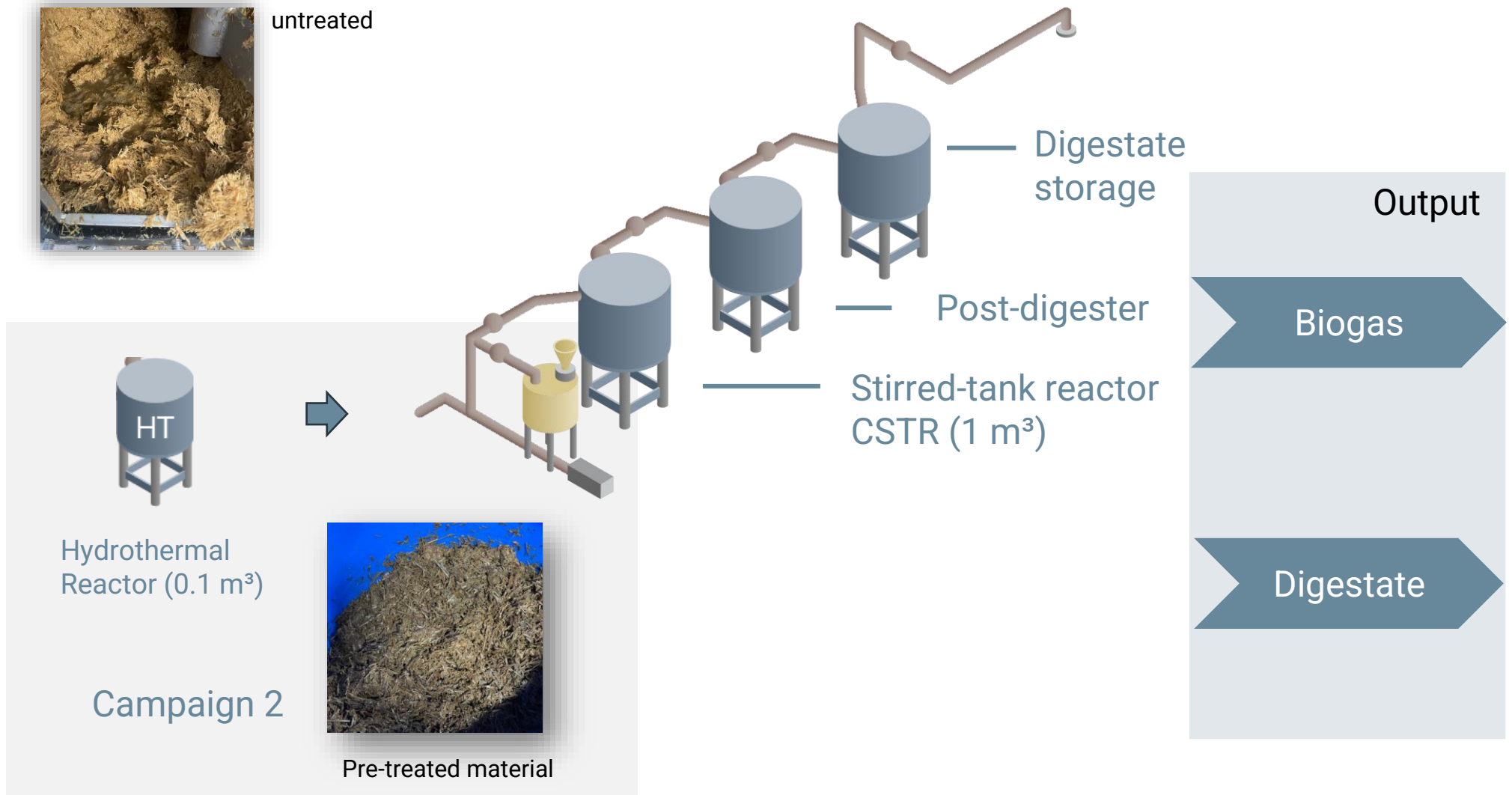
untreated

Input

Wheat straw
Cattle manure

Biomass

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

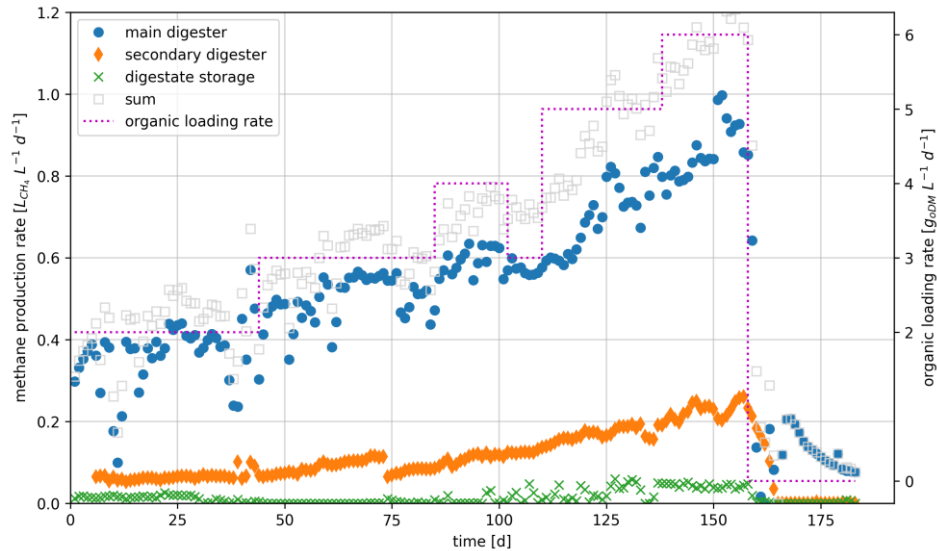


Output

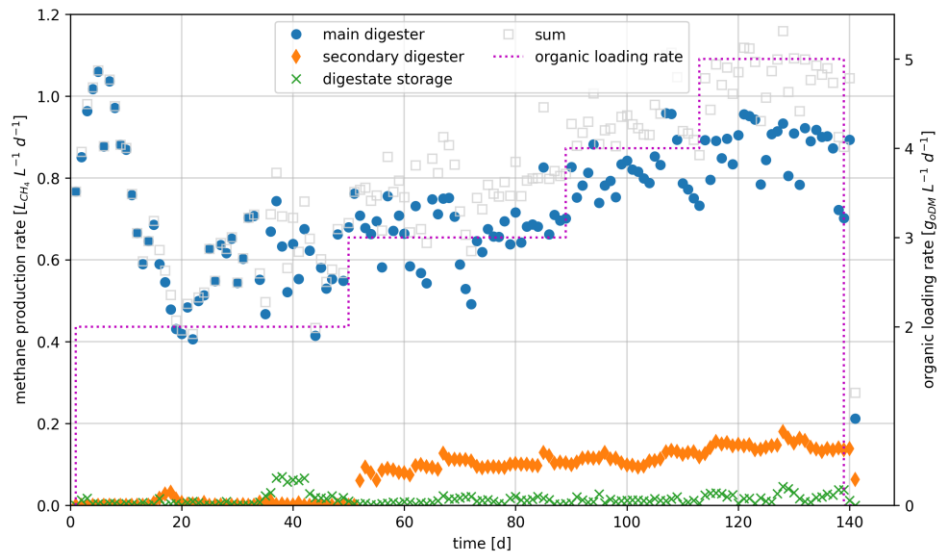
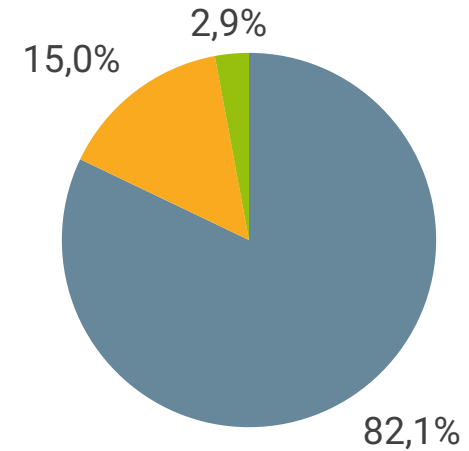
Biogas

Digestate

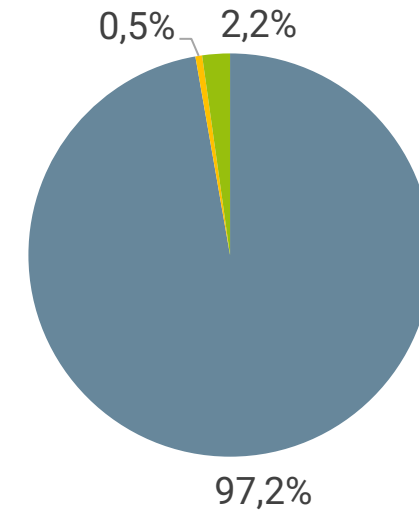
Anaerobic digestion: methane production rates [L L⁻¹ d⁻¹]



AD

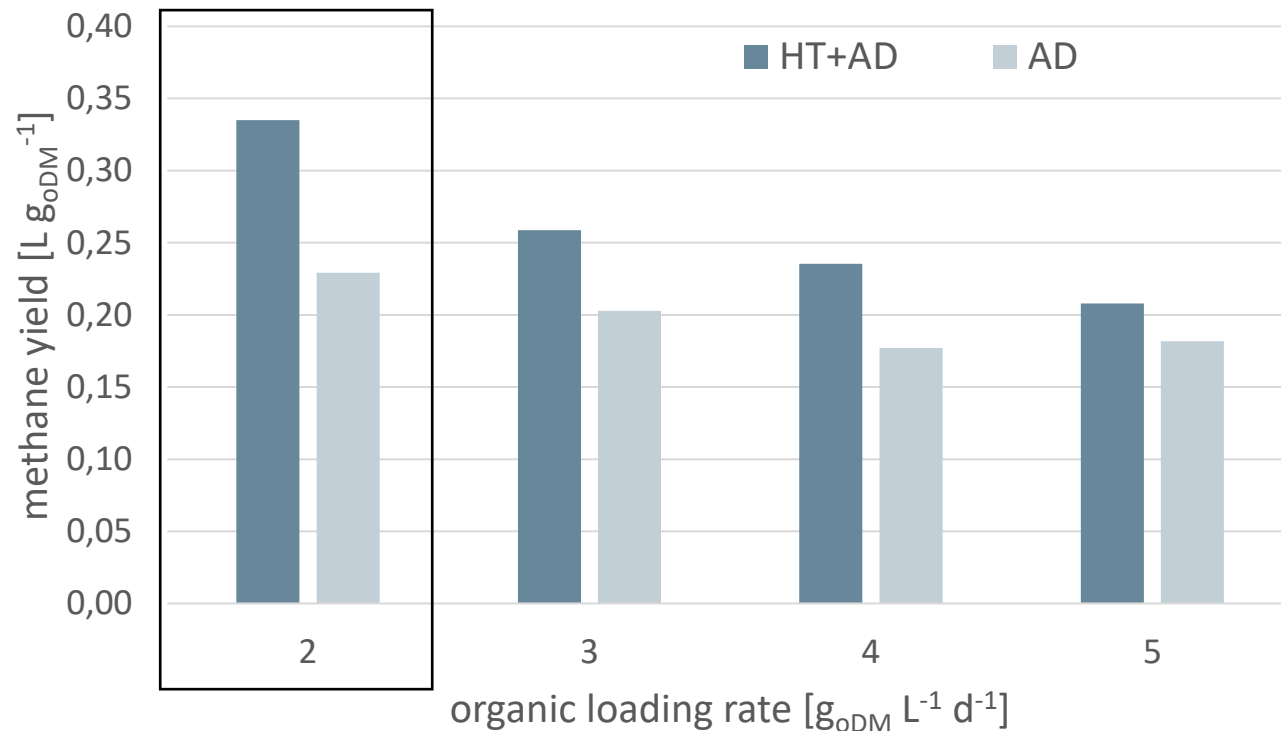


HT+AD



■ main digester ■ secondary digester ■ digestate storage

Effects of hydrothermal pre-treatment on Anaerobic digestion



Pros:

- Promising ORL 2 – methane yield significantly increased (roughly 50%)
- Reduced power consumption of feeding pumps by 5-29% (biggest reduction when fed with fresh substrate)
- Decrease of noise level of the pumps → less mechanical stress → longevity of equipment
- No emergency maintenance necessary due to clogging during campaign 2 → Handling of wheat straw less difficult

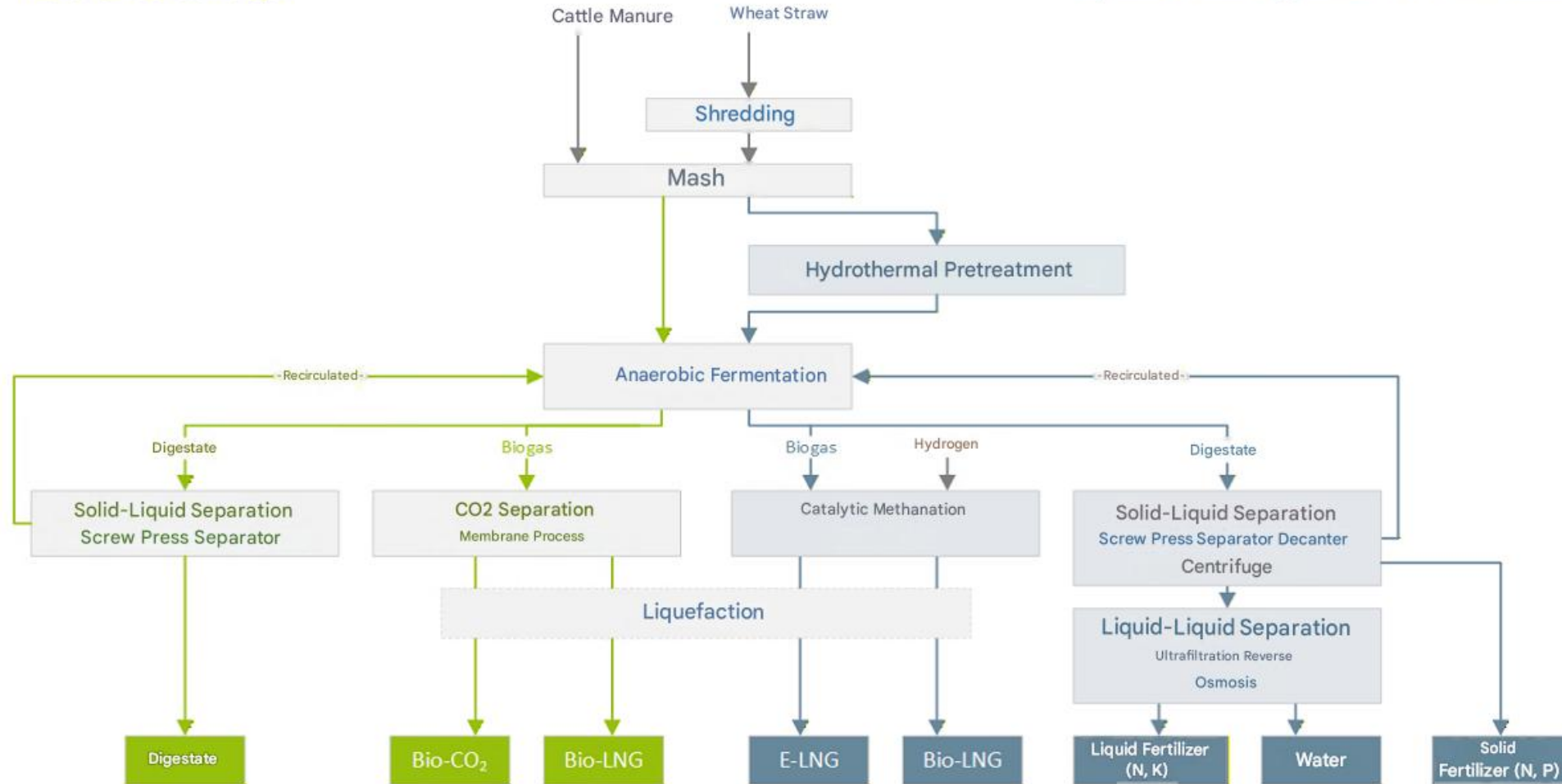
Cons:

- Investment of high pressure reactor technology
- More technology, more maintenance & operation costs
- Process with high heat demand



Reference Concept

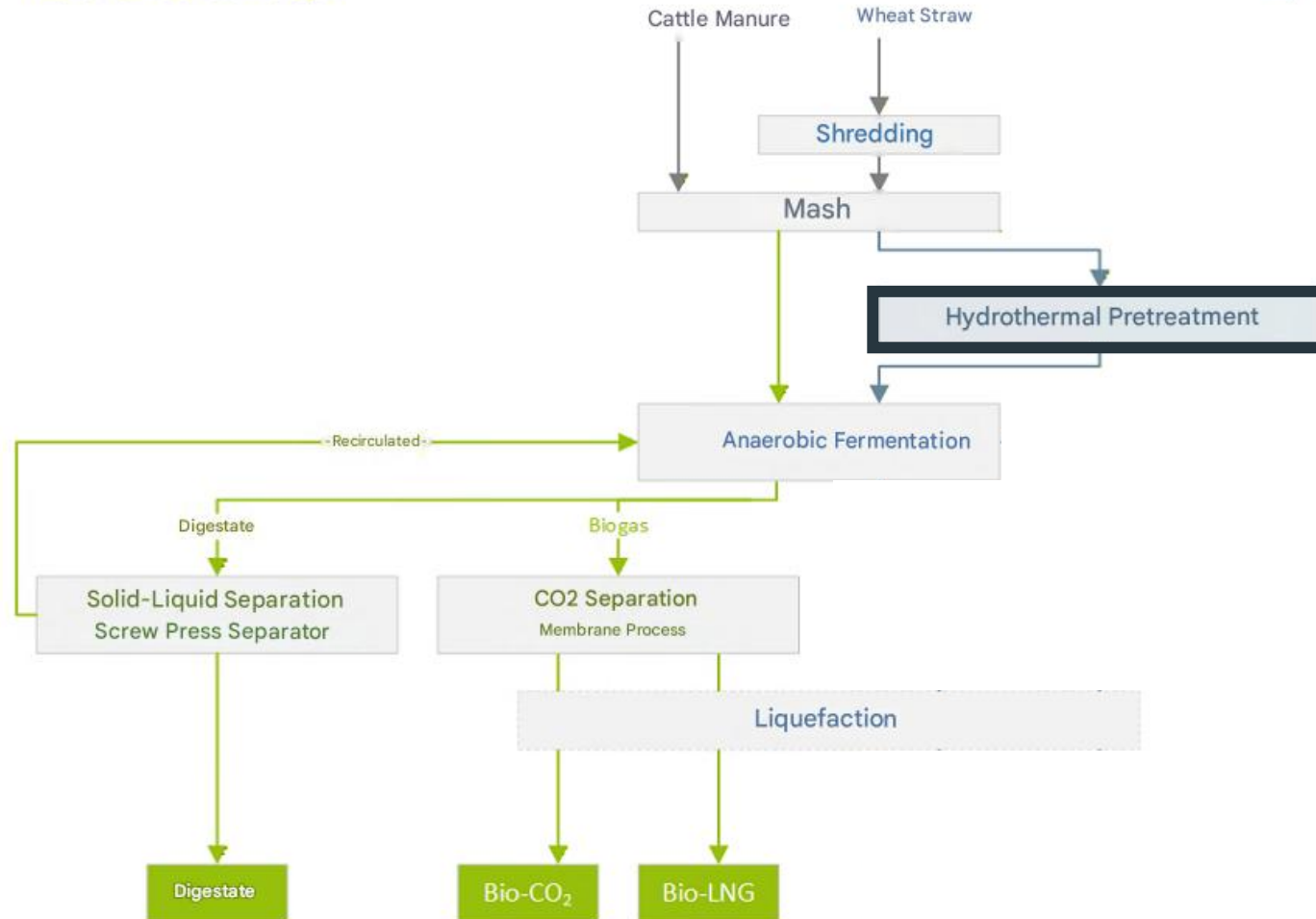
Optimization Approaches Pilot-SBG



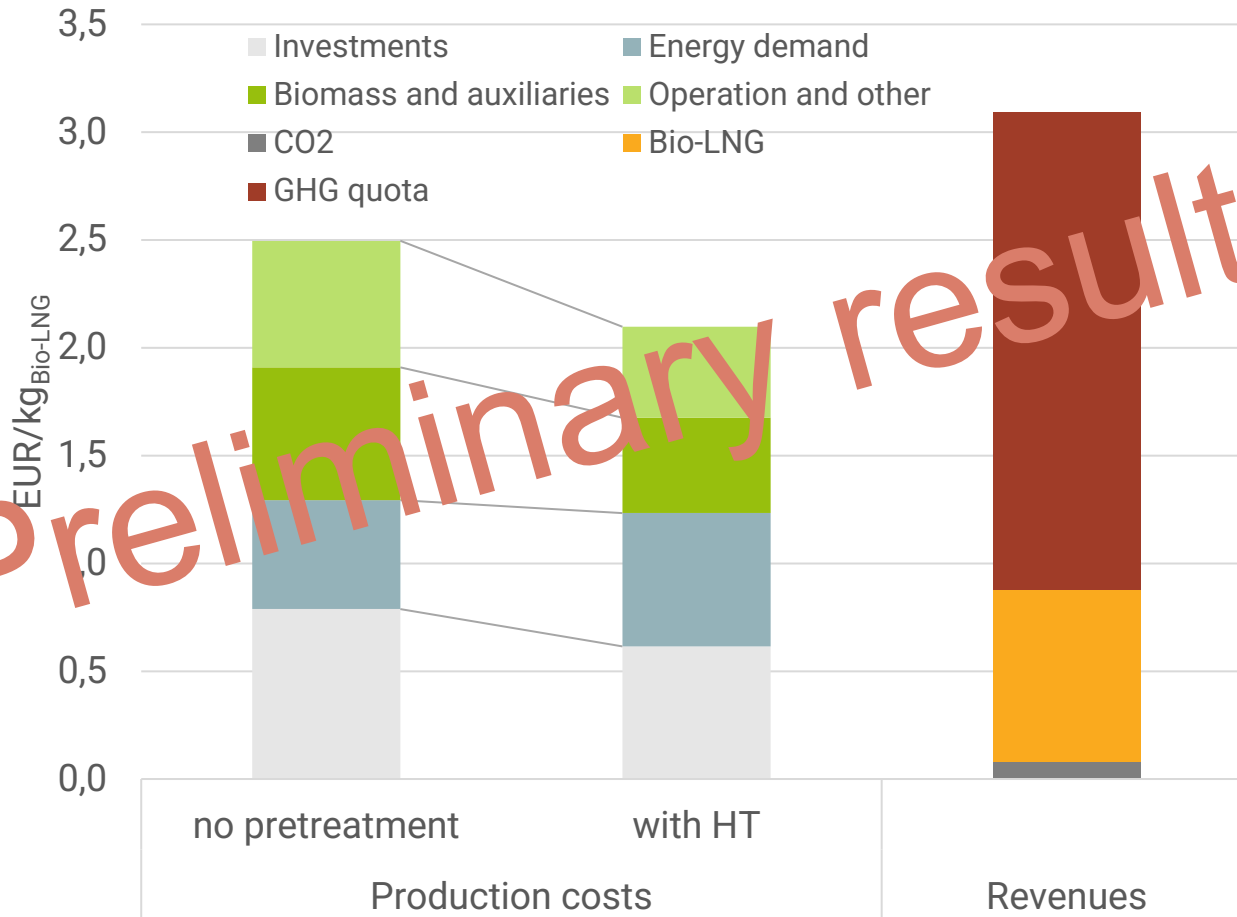


Reference Concept

Optimization Approaches Pilot-SBG

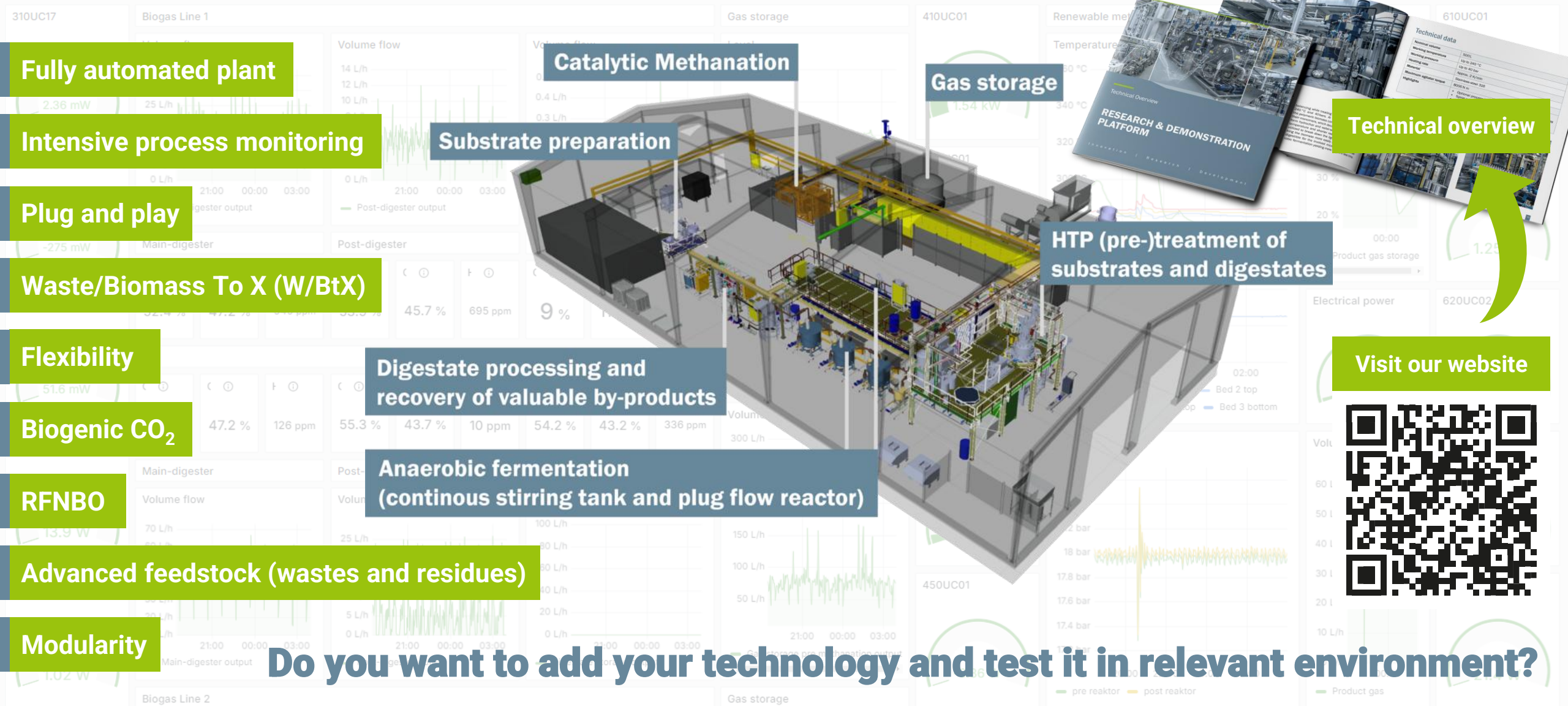


Effects of hydrothermal pre-treatment on Market | Costs and revenues



- **Economic and environmental assessment is currently in progress**
- HT pretreatment leads to approx. 16% decrease in production costs
- GHG quota revenues have a high positive impact on the business case
- Market prices for 2026 are still under development (assumption 400 EUR/t_{CO2eq})

Technology and fields of research



Fully automated plant

Intensive process monitoring

Plug and play

Waste/Biomass To X (W/BtX)

Flexibility

Biogenic CO₂

RFNBO

Advanced feedstock (wastes and residues)

Modularity

Technical overview

Visit our website



Do you want to add your technology and test it in relevant environment?

Integrated biorefinery for renewable fuels, chemicals and by-products

Flexibility in feedstock and operation conditions with plug and play options

Do you need to scale up your lab scale fermentations?



5x 1m³ CSTR
1x 0.5m³ PFR



Platform chemicals through hydrothermal treatment or char for sequestration.

500-L-Reactor (240 °C / 40 bar);
with Steam generator
and high pressure injection



E-fuels from captured CO₂, biogas,
syngas; catalyst testing and more ...



Adsorption unit
Fixed bed methanation
reactor
Product gas cleaning



Technical scale
research biogas plant

Fully automated,
2x 180 m³ CSTR, 50 m³ PFR,
postdigester + digestate storage,
mechanical pretreatment ...

Screw press
Chamber filter press
Ultra-/Nanofiltration
Reverse osmosis



You need down streaming for your fermentation broth?



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More research on upscaling,
economics, educt potentials, etc.

