EUBCE

Pilot-scale Evaluation of High-Temperature-Winkler® Gasification using Waste Wood as Feedstock

Philipp Eiden-Göbel, L. Römer, A. Saberwal, D. Toporov, A. Goel, J. Ströhle, B. Epple

The Hague, The Netherlands – 19-22 May 2026

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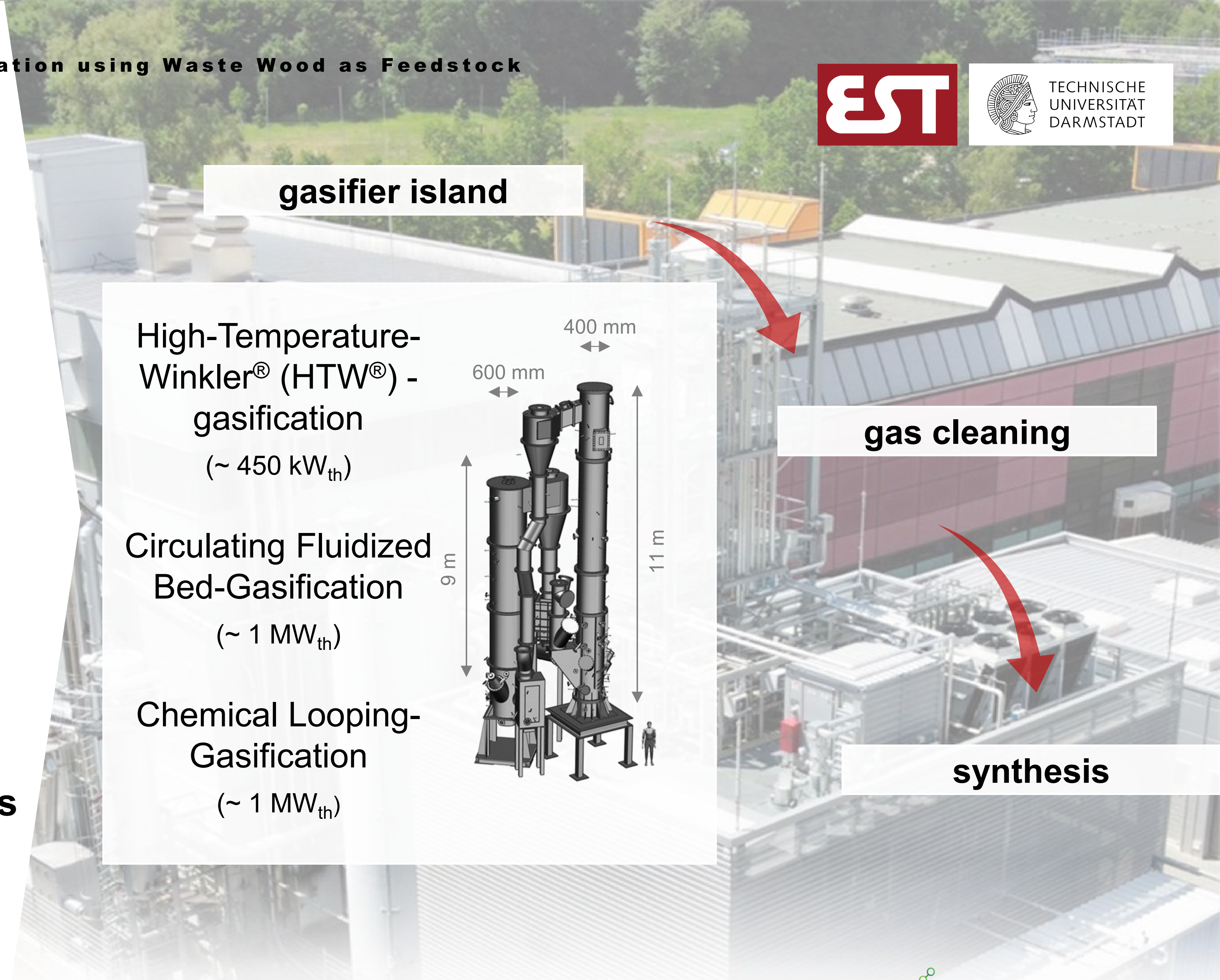
Crude oil

Coal

Biomass

Fuels

Chemicals



High-Temperature-Winkler® (HTW®) - gasification

(~ 450 kW_{th})

Circulating Fluidized Bed-Gasification

(~ 1 MW_{th})

Chemical Looping-Gasification

(~ 1 MW_{th})

400 mm

600 mm

9 m

11 m

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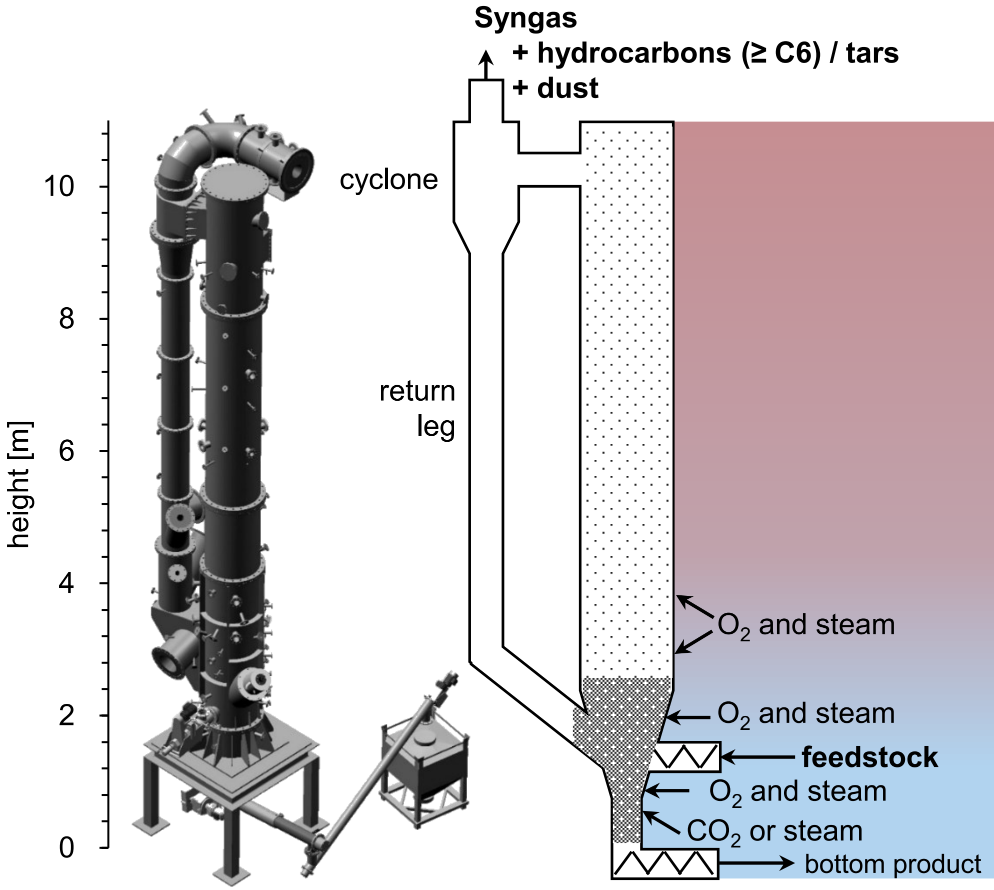
HTW®-Gasifier



Post gasification zone (PGZ) – 800 to 1100 °C

→freeboard

→conversion of hydrocarbons

→conversion of fixed carbon (entrained dust)

Bubbling bed – 650 to 750 °C

→homogeneous temperature profile

→release of volatiles & conversion of fixed carbon

→bed inventory: ash and char

→temperature below ash softening point

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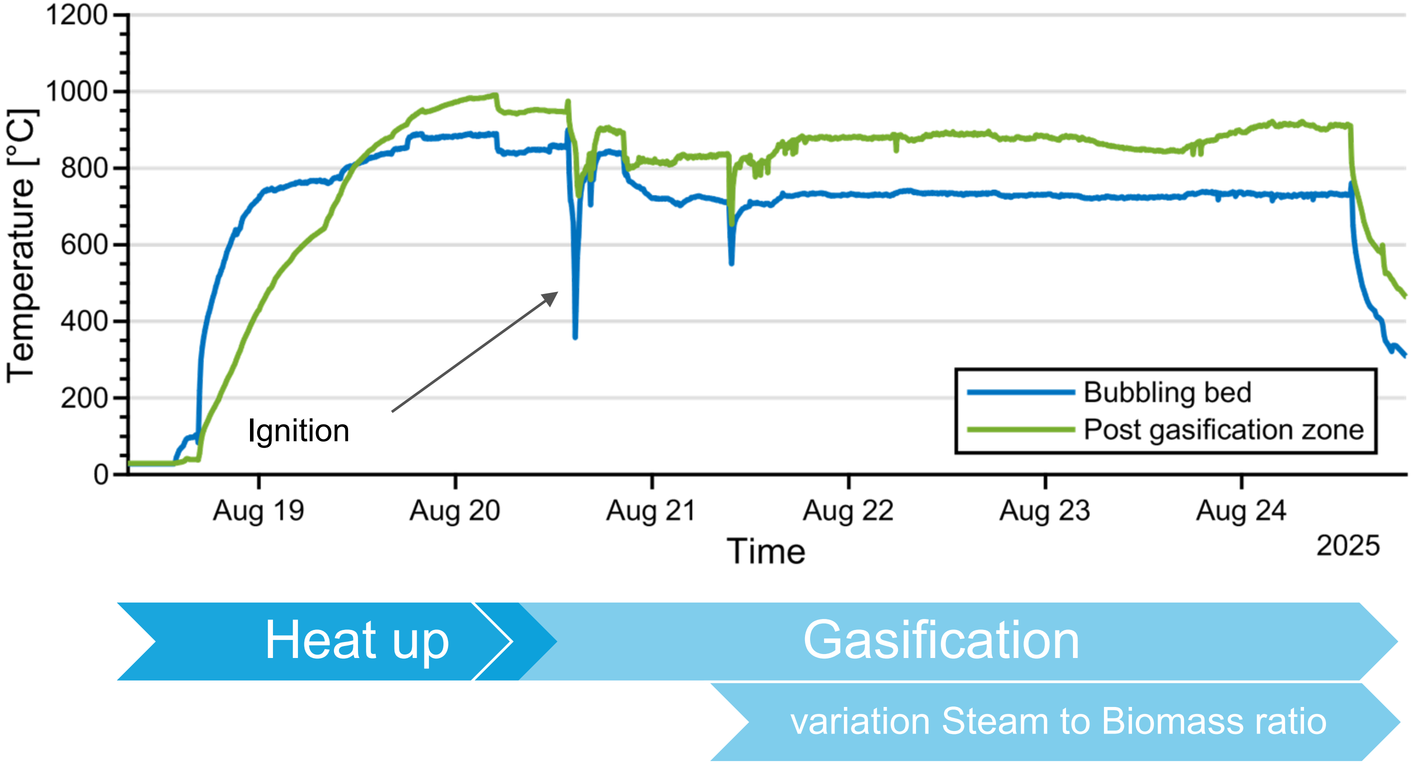
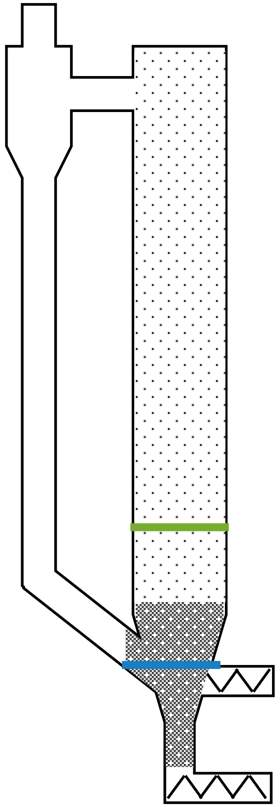
HTW® Gasification

Waste Wood Pellets
Shrinkage start temp 980-1080°C





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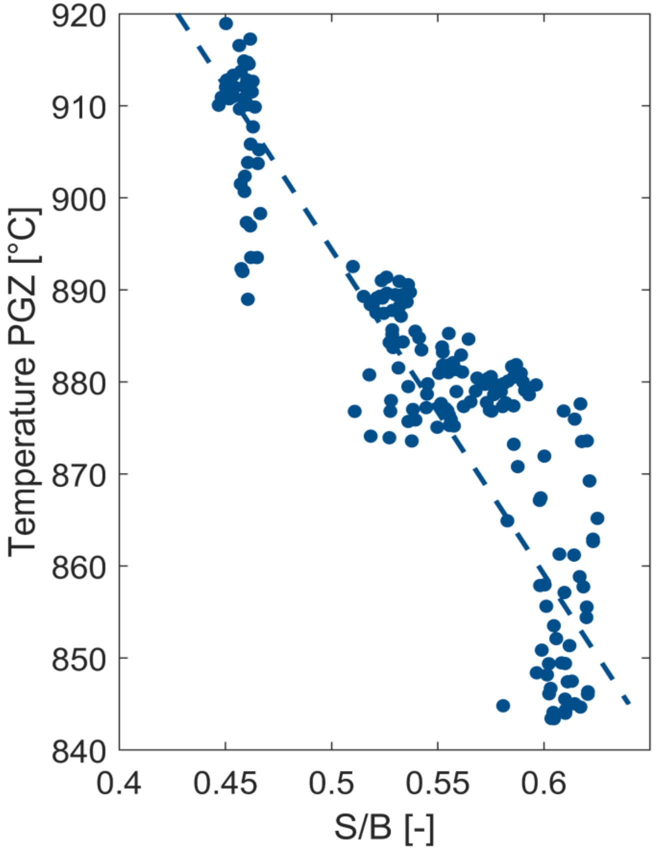
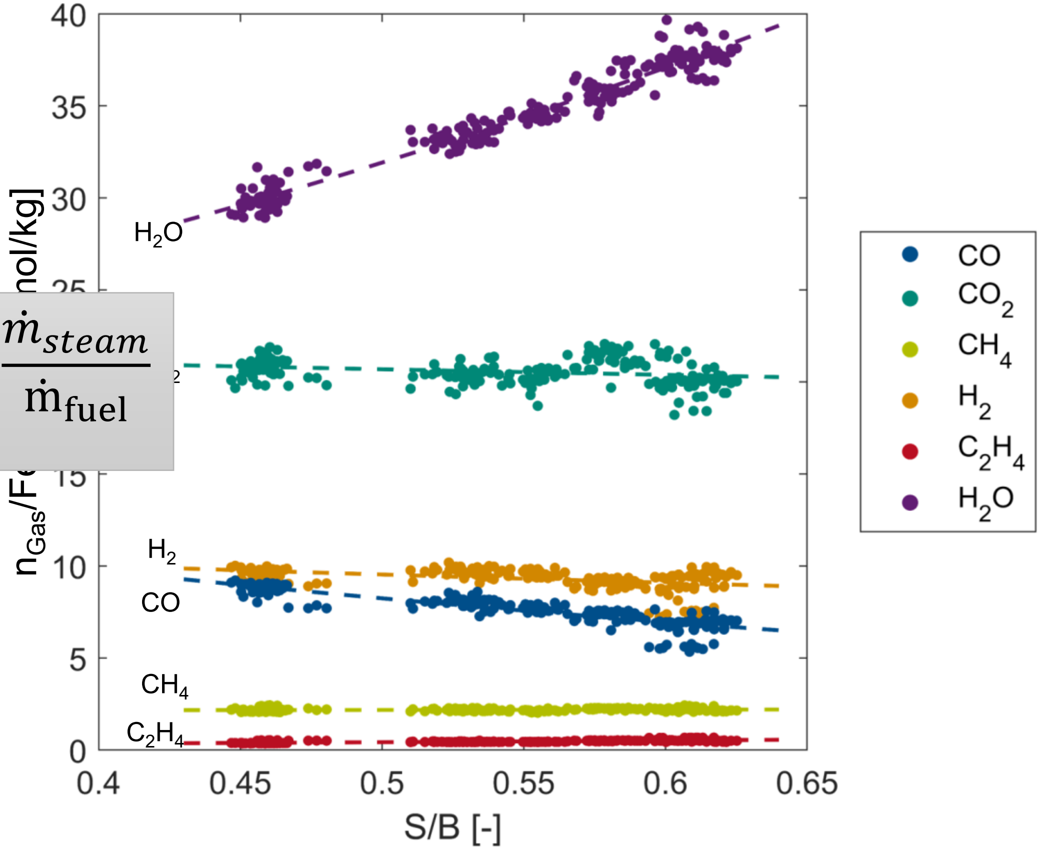
Influence Steam to Biomass Ratio



$$S/B = \frac{\dot{m}_{steam}}{\dot{m}_{fuel}}$$



Thermal load: 430 kW_{th}
Lamda: 0.34

NOTE: The higher CO_2 content in syngas compared to a commercial pressurized HTW® facility is mainly due to greater heat losses and lower gasification agent temperatures at the TU Darmstadt unit, requiring higher O_2 injection. In addition, the relative contribution of flushing CO_2 is higher at this small scale.

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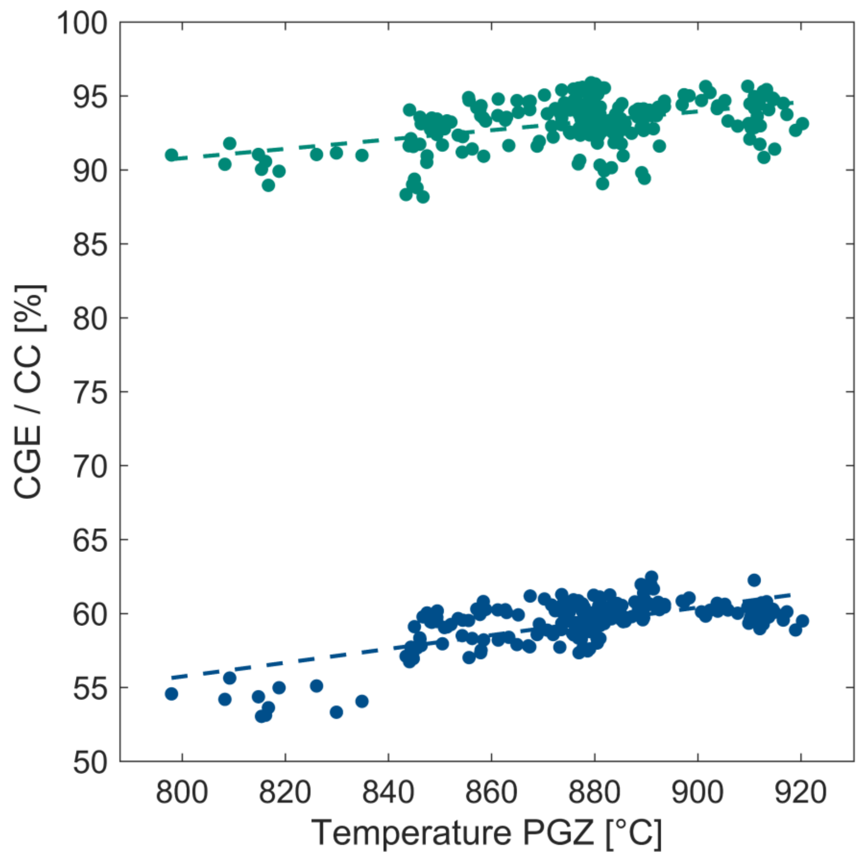
Cold Gas Efficiency and Carbon Conversion



$$CGE = \frac{\sum \dot{m}_{j,syngas} * LHV_j}{\dot{m}_{fuel} * LHV_{fuel}}$$

with j H_2, CO, CH_4, C_2H_4

$$CC_{Gas} = \frac{\int_{t_0}^{t_1} \dot{n}_{c,syngas} dt}{\int_{t_0}^{t_1} \dot{n}_{c,fuel} dt}$$

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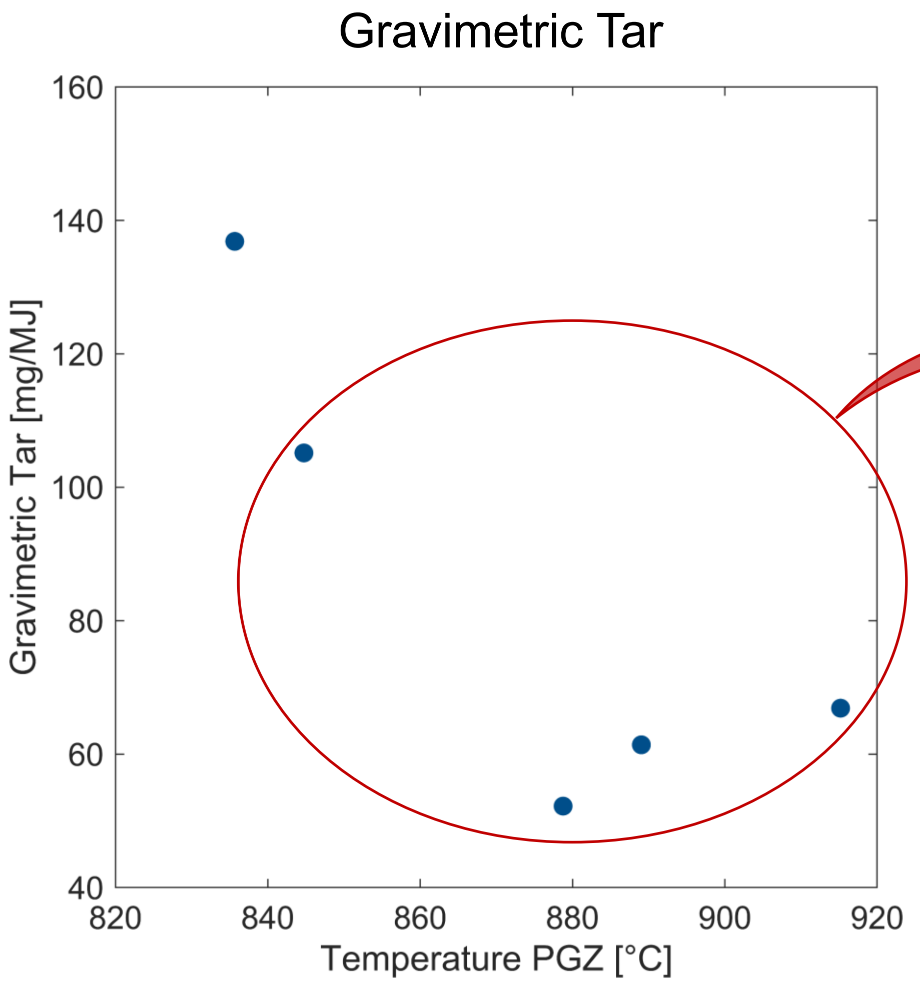
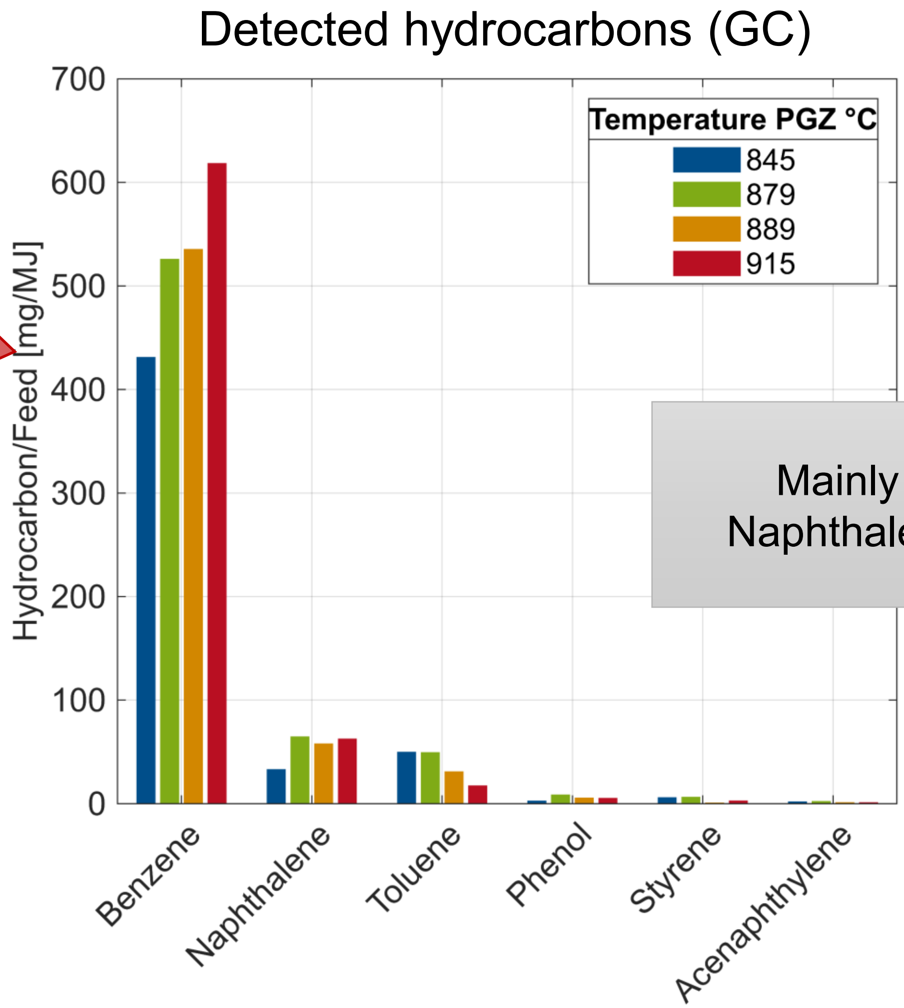
Hydrocarbons





Mainly Benzene, Naphthalene, Toluene

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Conclusion

✓ **Proof of Concept: Waste Wood as Feedstock**

- Stable process demonstrated for >100h using more than 8 tons feedstock
- Influence of reducing S/B
  - Enhances
    - Temperature, Syngas Yield, CC, CGE
  - Reduces
    - Long chain-hydrocarbons

⌛ **Outlook**

- Optimize lambda and S/B-ratio for an industrial gasifier
- Data is used for Life Cycle Assessment and 1D-Simulation
- Compare with chemical looping gasification

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M.Sc Philipp Eiden-Göbel

Technical University of Darmstadt

Institute for Energy Systems and Technology

Mail: philipp.eiden@est.tu-darmstadt.de

Phone: +49 6151 16 22672

Otto-Berndt-Straße 2, 64287 Darmstadt / Germany

www.est.tu-darmstadt.de

THANK YOU

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BioMeGaFuel, project N° 101147737

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