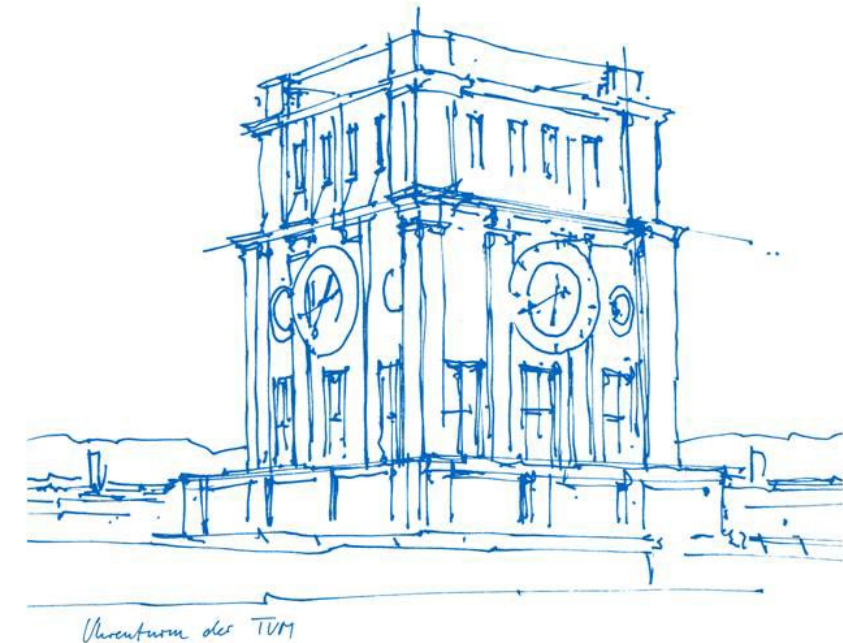


Waste-to-X: Two-Step Process for Thermochemical Recycling of Municipal Solid Waste and its Characterization



Simon Meilinger

Chair of Energy Systems
TUM School of Engineering and Design
Technical University of Munich



Goals of today's Presentation

Short Presentation of Chair of Energy Systems



H2 Living Lab – ChemDelta Bavaria

Integration of hydrogen based technologies into industry



**Proposed Two-Stage Process for Thermochemical
Recycling**

Chemical potential – scope – research topics – progress



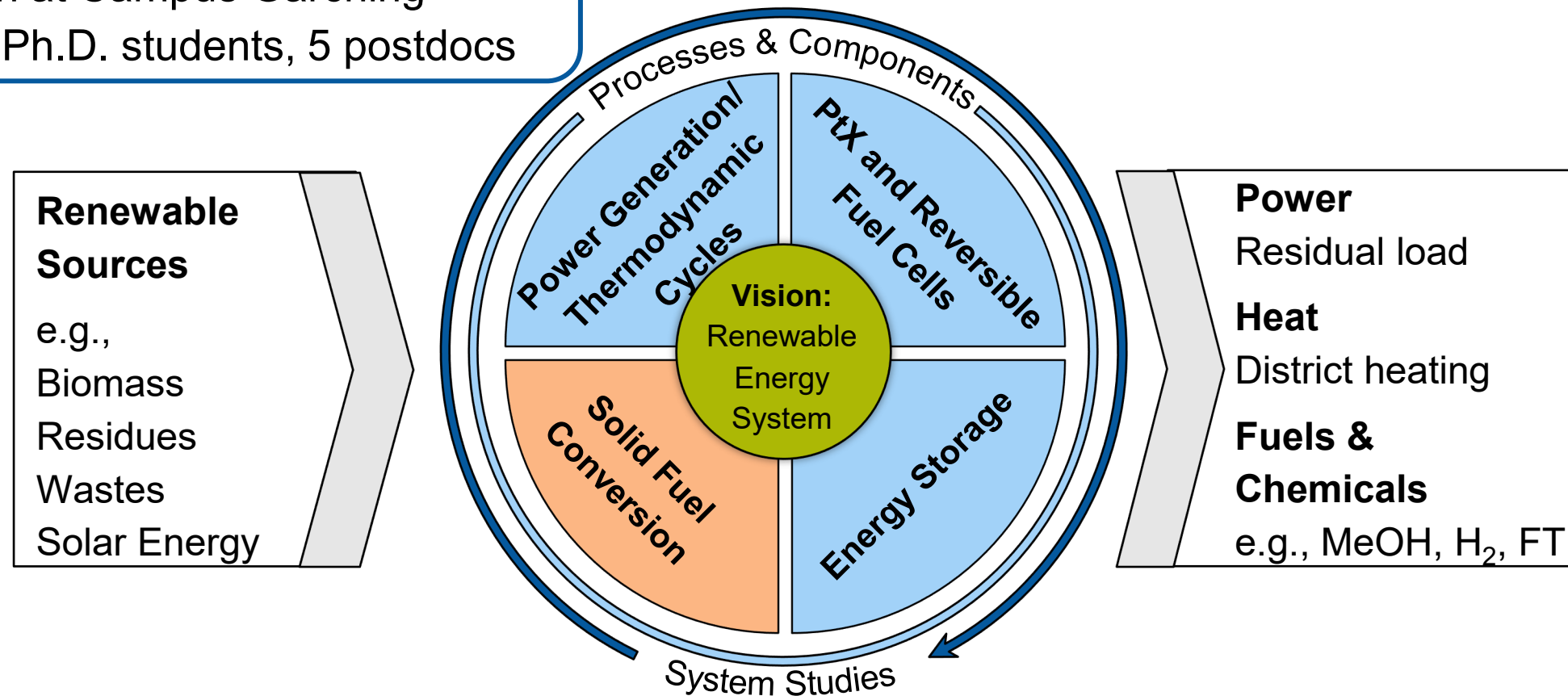
Municipal Solid Waste

Fuel analysis of a heterogeneous feedstock



Chair of Energy Systems at TUM

- Head of Institute: Prof. Dr.-Ing. Hartmut Spliethoff
- Located near Munich at Campus Garching
- Scientific staff: ~ 40 Ph.D. students, 5 postdocs



Project: H₂-Reallabor Burghausen – ChemDelta Bavaria

From Energy System Optimization to Technology Demonstration in Modular Container Units

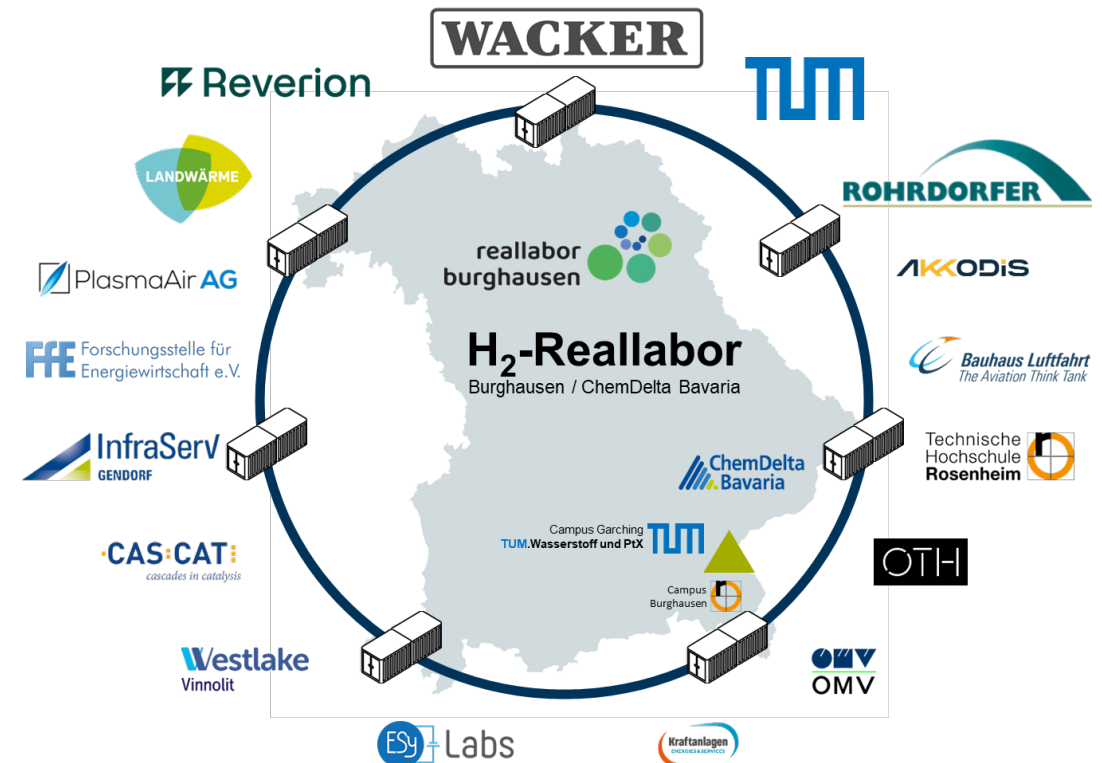
Motivation:

Defossilisation of the ChemDelta Bavaria and integration of hydrogen technologies

➔ Improving the utilization of available energy

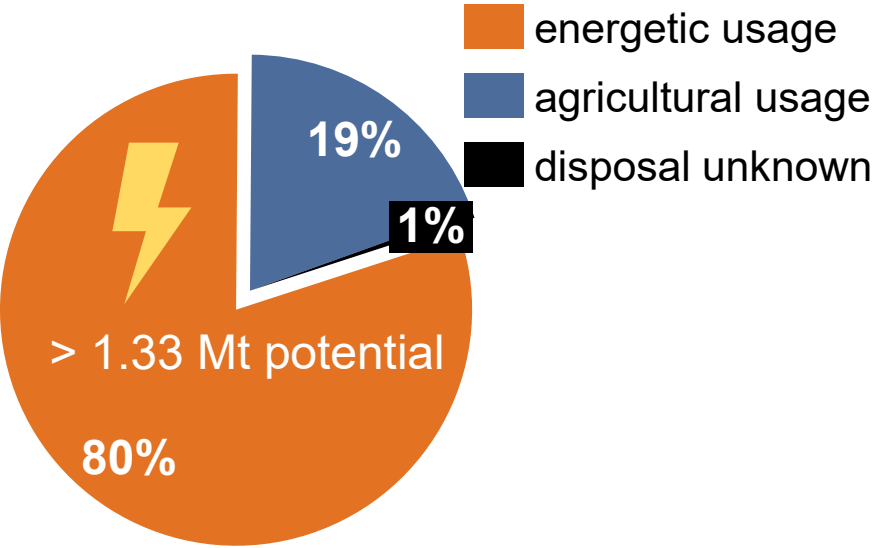
Research focus:

- Energy system analysis of the ChemDelta Bavaria
- Power-to-X: Improvement of amine scrubbing columns and methanol synthesis reactor design
- Development of rSOC and CO₂-Electrolysis
- Investigation on plasma gasification and rotary kiln pyrolysis



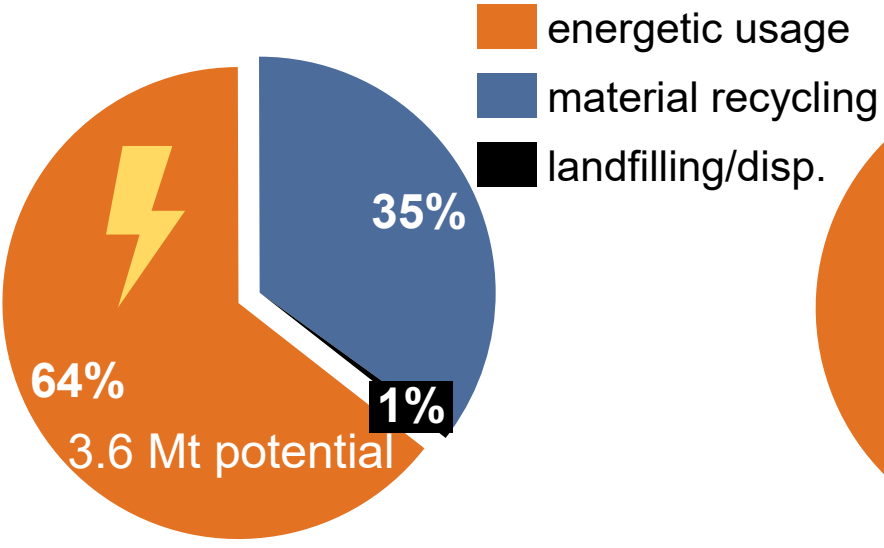
Germany: Potential Waste-to-X Streams

Sewage Sludge - 2022



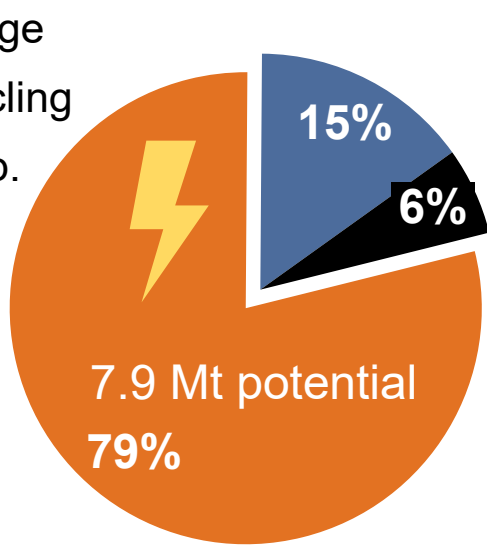
1.7 Mt sewage sludge (dry basis)

Plastic Waste - 2021



5.6 Mt plastic waste

Waste Wood - 2016



10.0 Mt waste wood

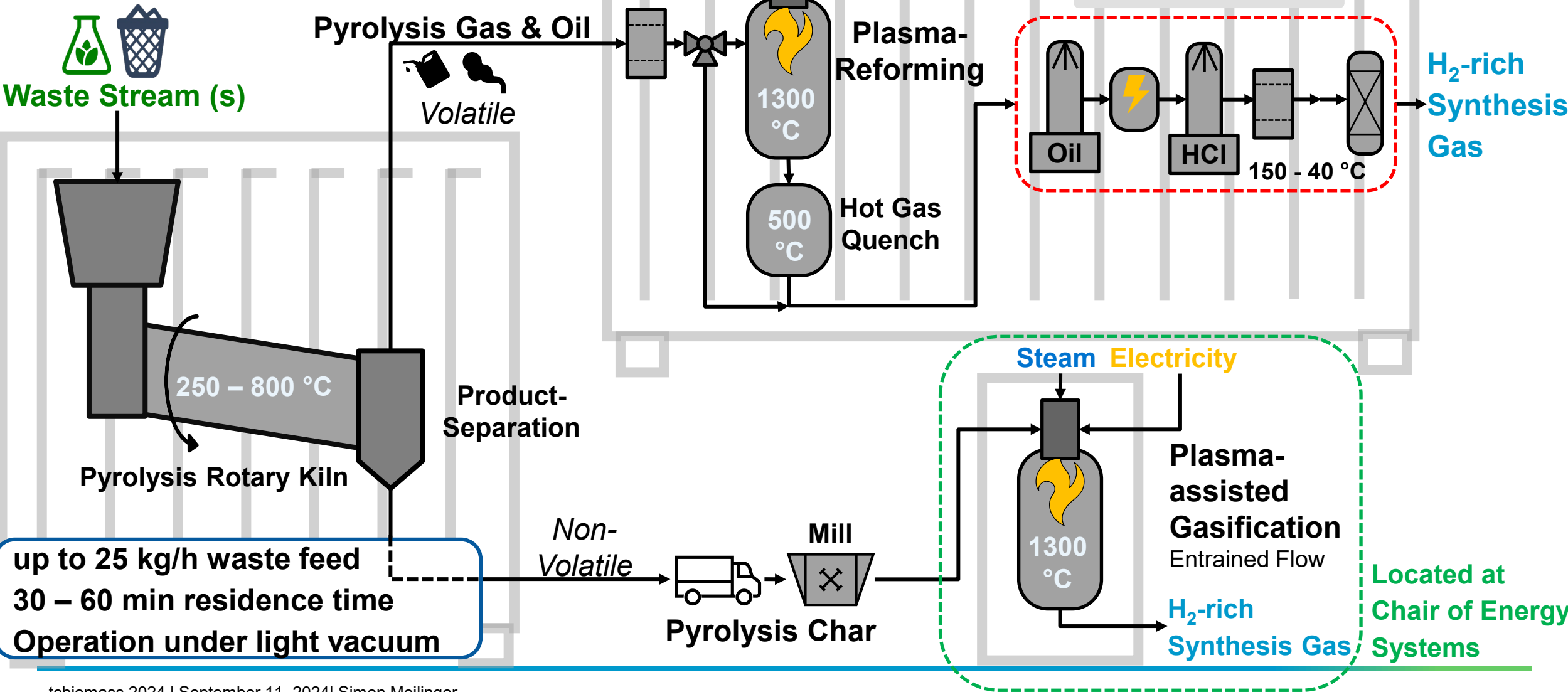
Substitution of fossil carbon in circular economy

Potential for chemical recycling of heterogeneous feedstocks

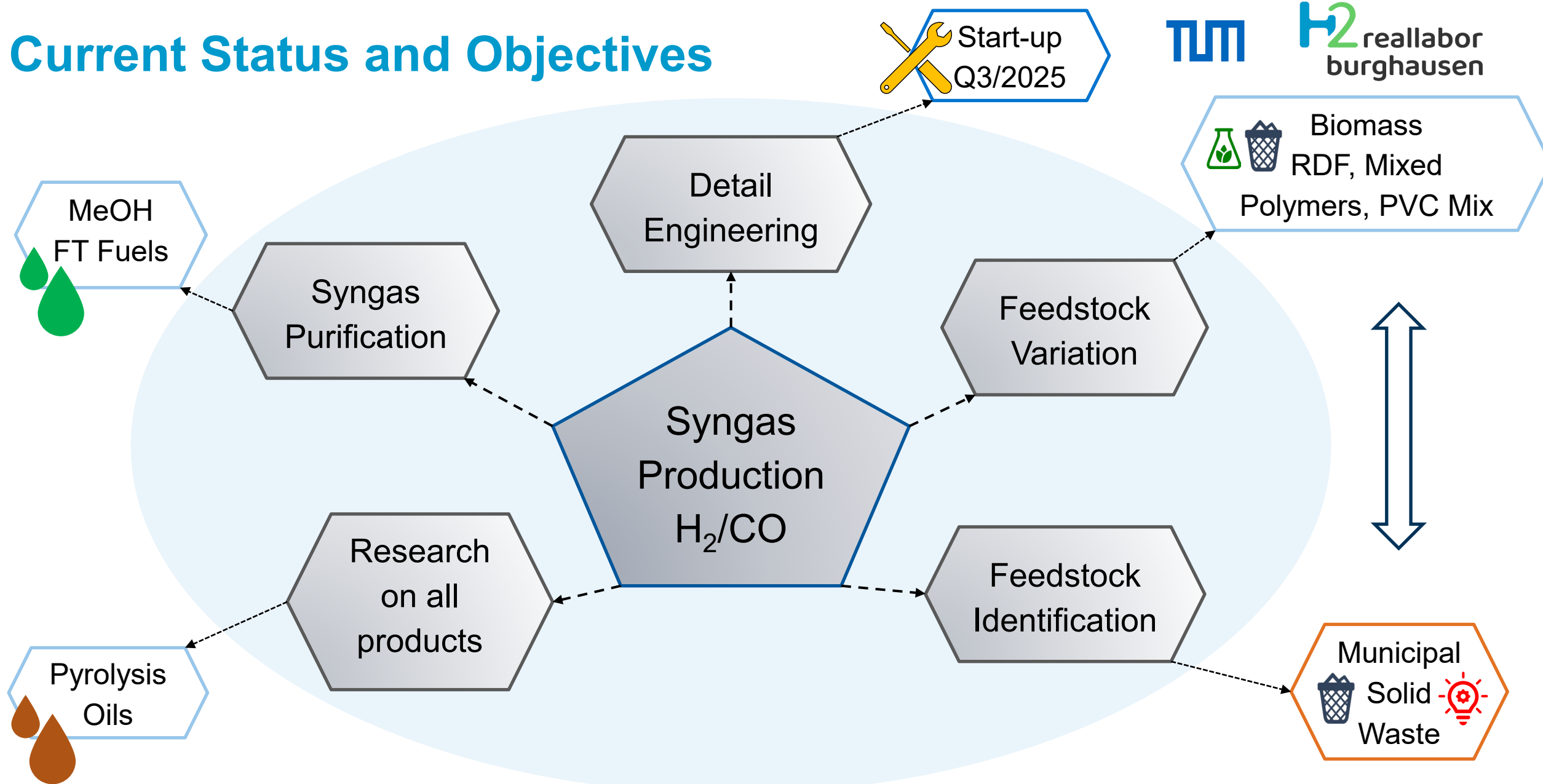
Synthesis of valuable chemicals

H2-Living Laboratory - Circular Economy

Container Setup



Current Status and Objectives



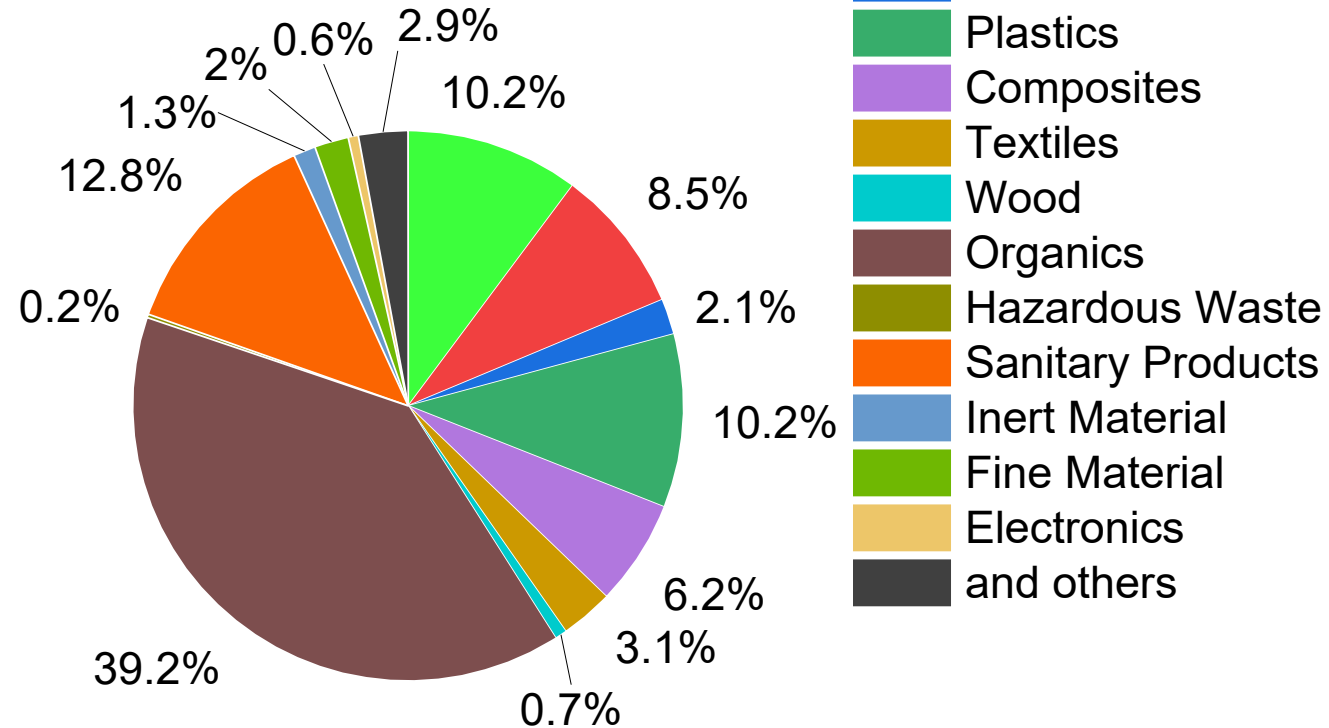
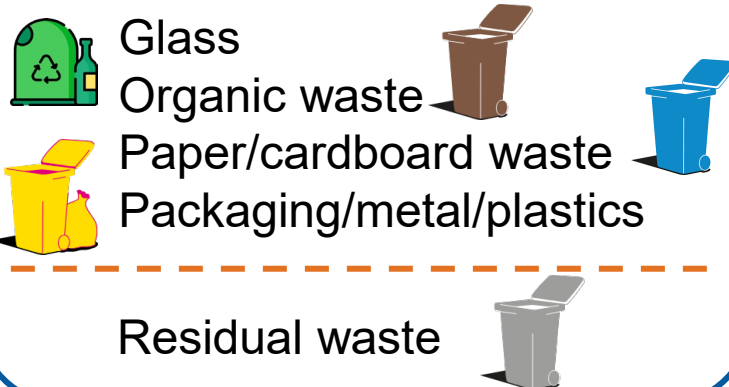
Identified Feedstock: Municipal Solid Waste (MSW)

47 Mt MSW collected in Germany in 2021

620 kg/capita of MSW in Germany

→ 4th place in European Union

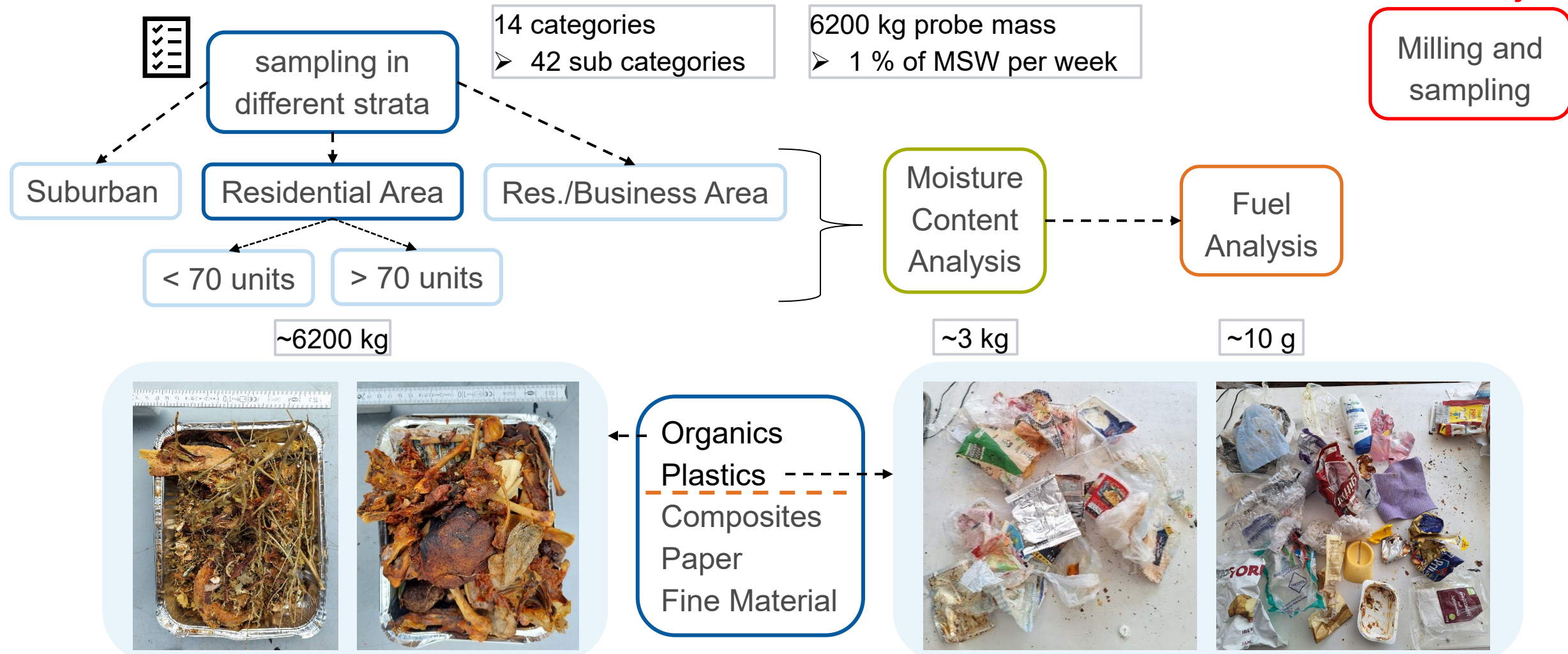
Waste Separation System



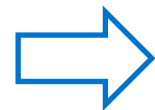
Household waste analysis in
Munich - 2016

Survey of household MSW composition in Munich,
Germany (>1.4 Mio citizens)

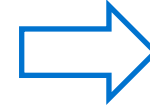
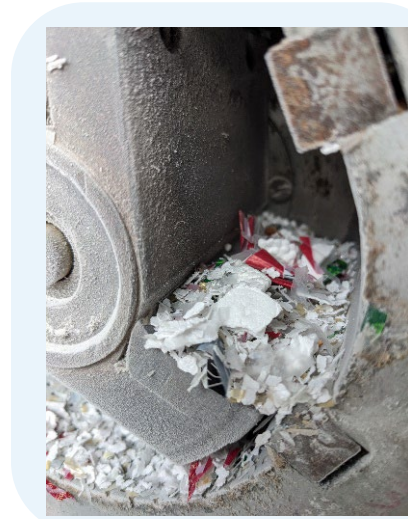
Sampling Process for Munich MSW Analysis 2023



Milling and Sampling



Cutting Mill (Retsch®)
Thermomix®



Organic



Fuel
Analysis



Sample
Splitter

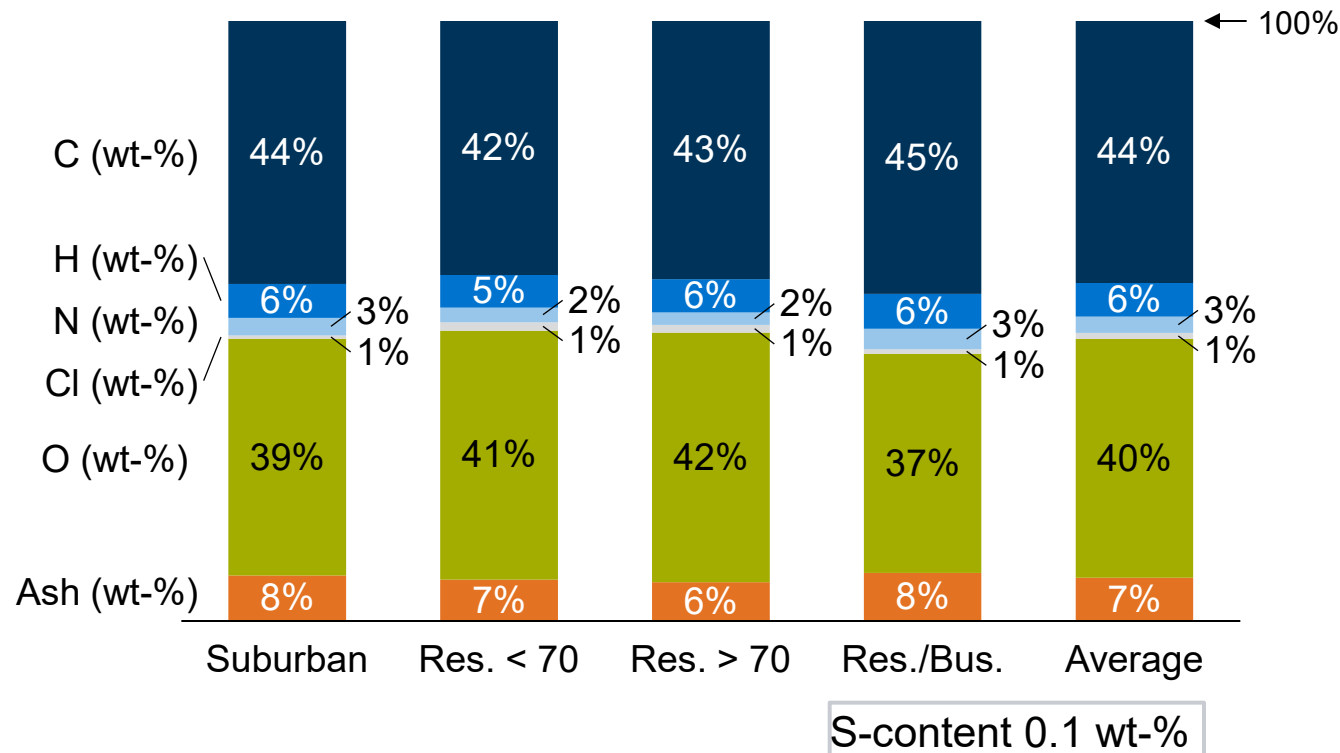


Cryogenic
Milling



Preliminary Results for Organic Fraction and Further Steps

Ultimate Analysis



Similar elemental composition in spite of stratification

Preparation and analysis
of remaining fractions

Creation of model
feedstock based on data

Experimental investigation

- Syngas quality
- Heteroatom behavior



Thank you very much!

Any questions?

Acknowledgements

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¹Chair of Energy Systems, ²Regenerative Energy Systems, Technical University of Munich, Germany

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Symbols

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