

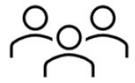
Renewable Hydrogen Online Workshop | 18th January 2024

Production of hydrogen and fuels from biogenic residues and waste

Prof. Dr.-Ing. Matthias Franke

The Fraunhofer Gesellschaft

World's largest organization for applied research



30 000 Staff



76 Institutes



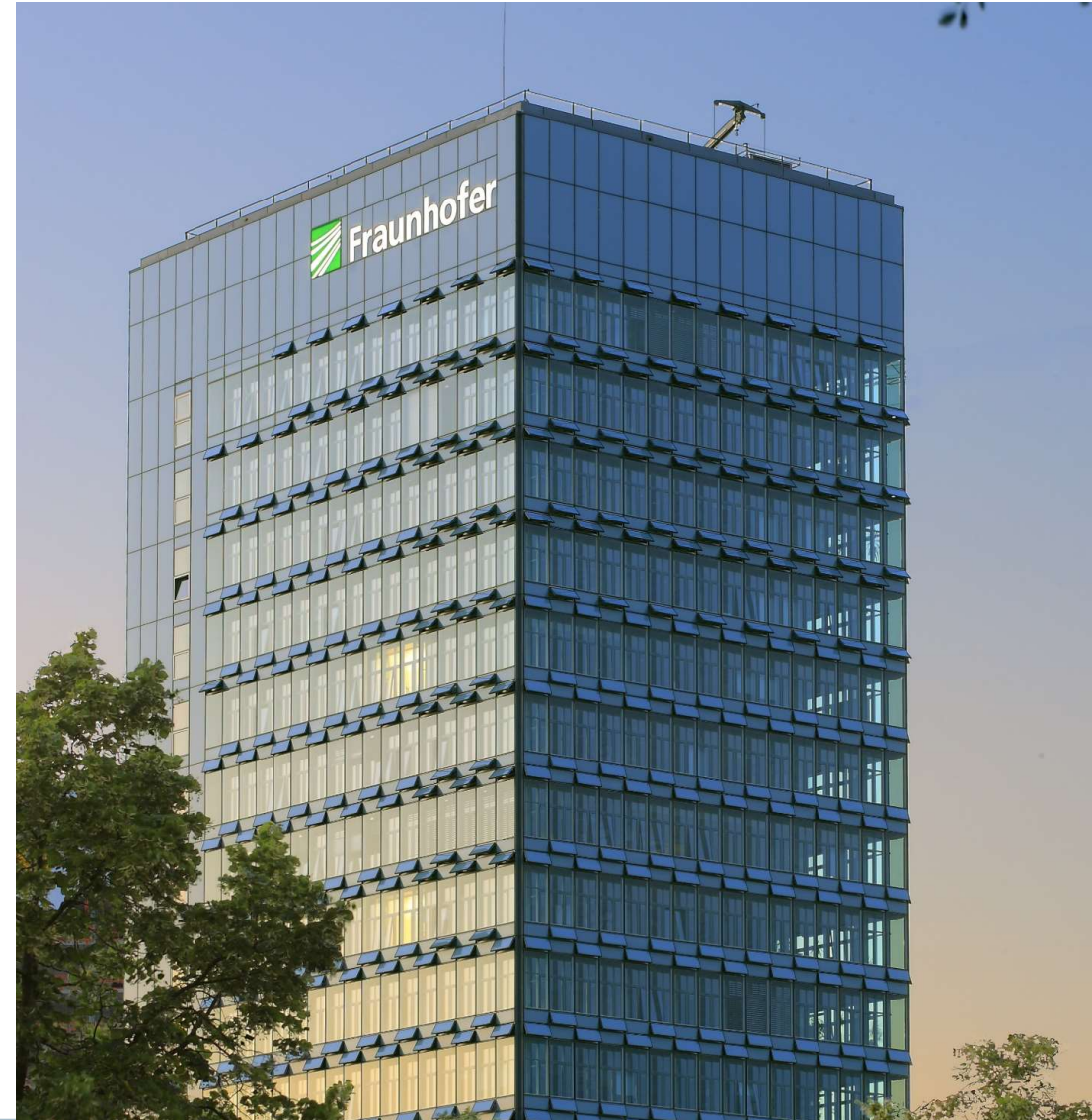
2,9 Bn.
Research volume
720 Mio.
Industrial research



30 Spin-Offs / year



350
Patent applications / year



Fraunhofer UMSICHT

Institute for Environmental, Safety, and Energy Technology



Oberhausen / North-Rhine
Westphalia



Sulzbach-Rosenberg /
Bavaria

- **7th largest** Fraunhofer Institute
- **622** Employees
- Operating budget 2022: **78 million €**

Fraunhofer UMSICHT – Focus of our activities

Research fields, technologies and industry services



Carbon Management

Circular Economy



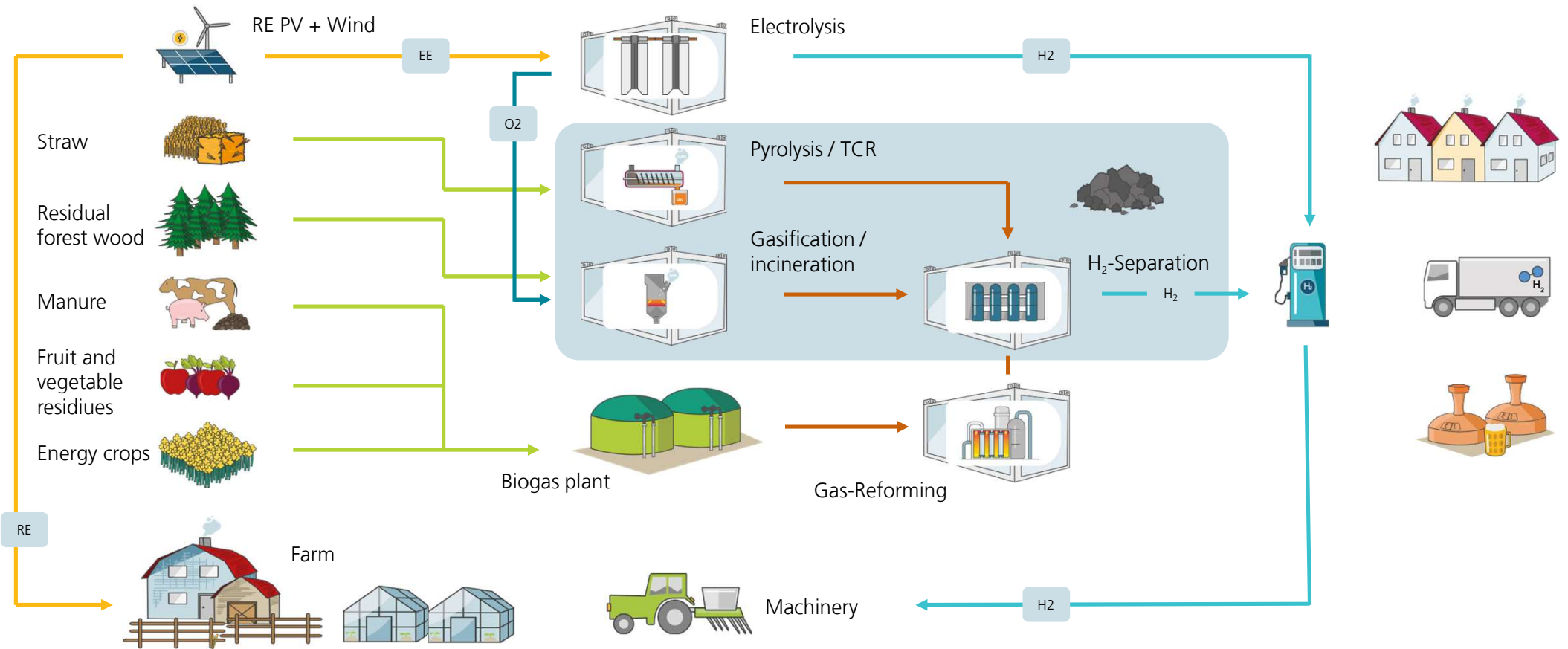
Local Energy Systems

Green Hydrogen



Pathways of Hydrogen Production

Fields to be developed





Sustainable carbon from biomass

The TCR[®]-Technology

Valorization of biogenic residues

TCR - Functional principle

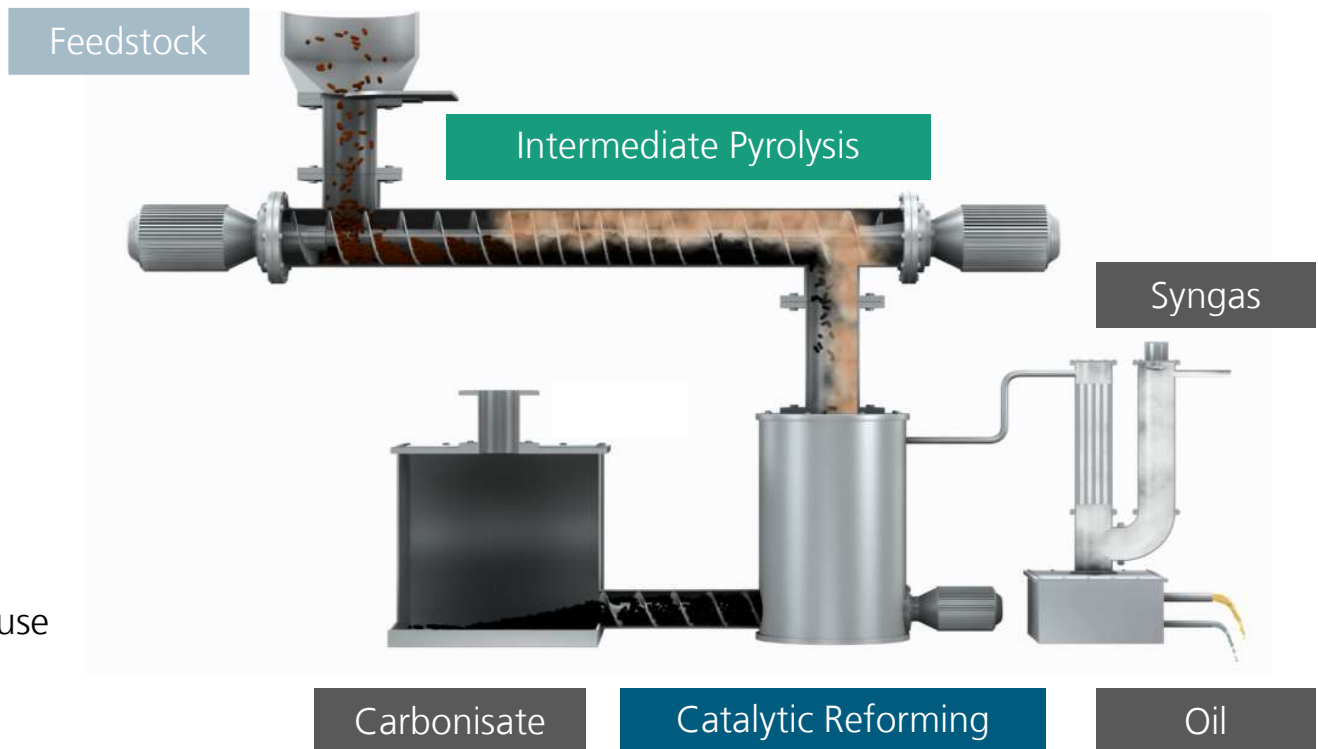
Intermediate pyrolysis with integrated catalytic reforming step

Use cases and outcome

- Utilization of biogenic residues
- Decentralised application possible
- Products with near-zero carbon footprint

Products

- Syngas with up to **45 % green hydrogen**
- Oil with high thermal stability for processing into standard fuels
- Coal for soil application / storage / energetic use



TCR - Feedstocks

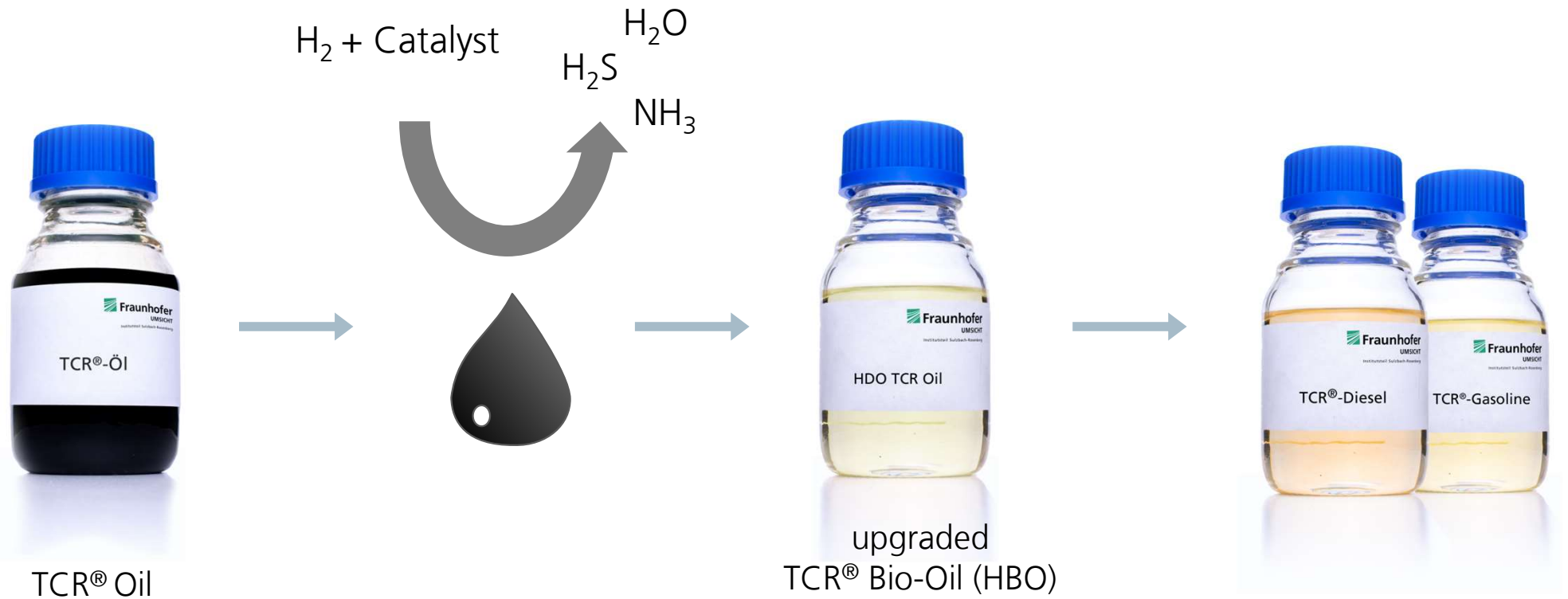
High potential of input materials

- Variable biomass, biogenic residues, bio-waste and mixtures (>70% DM) can be used as feedstock
- More than **90 biogenic waste materials** already tested
- **Examples:**
 - Agricultural residues
 - Digestate
 - Sewage sludge
 - Spent grains
 - Paper residues
 - Leaves
 - Biowaste
 - ...



TCR - Products

Thermal stability of TCR-Oil opens the path for hydrotreatment



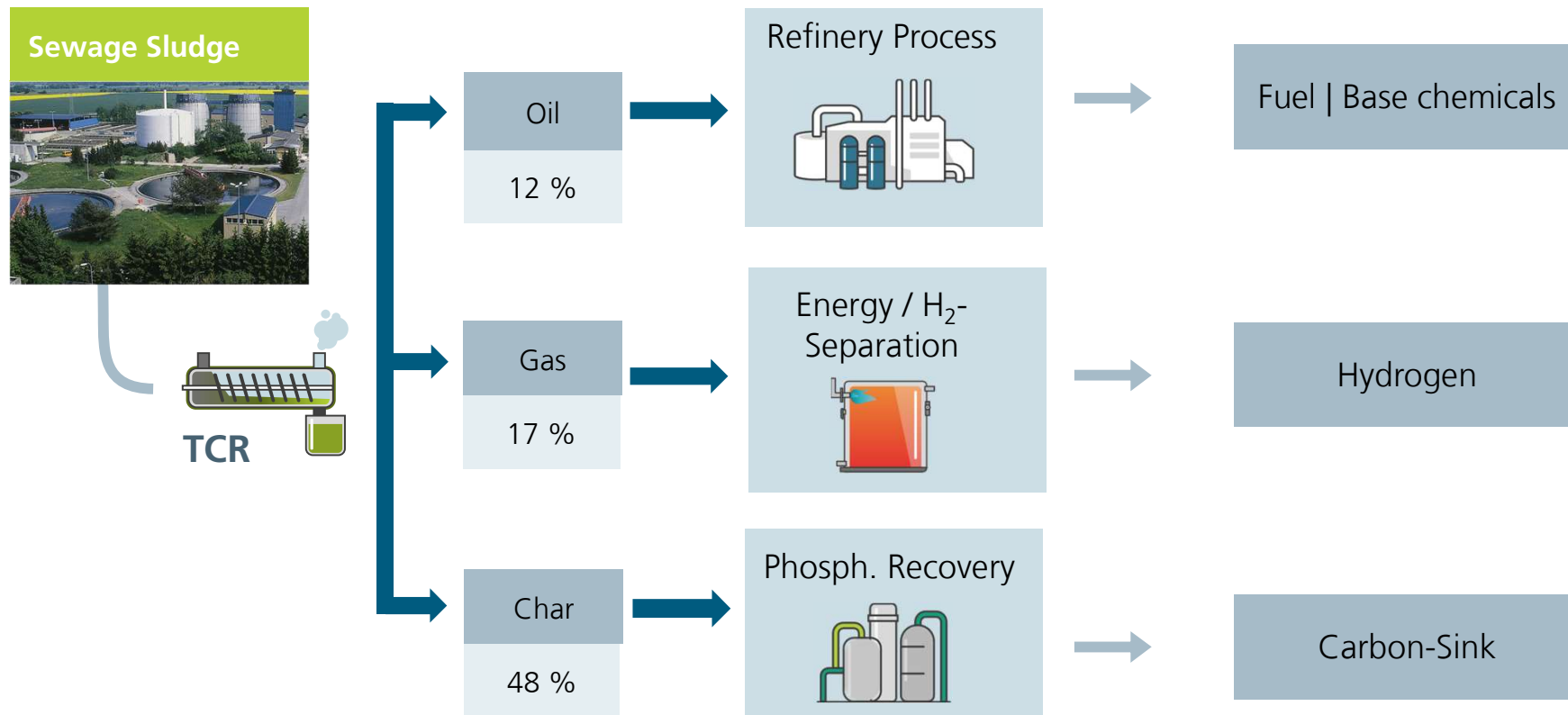


Car tour through europe

50,000 Liters of climate neutral Diesel
from sewage sludge

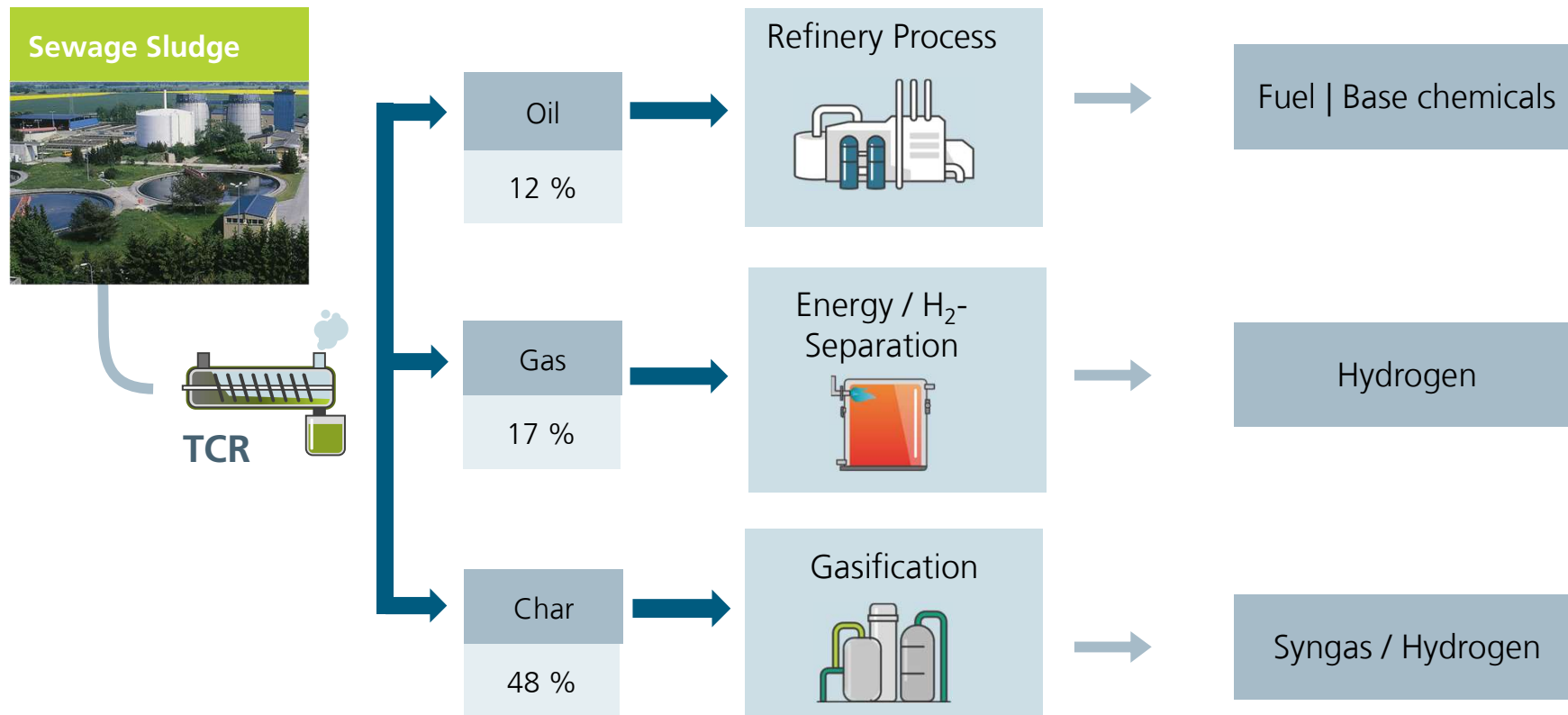
Example: Sewage Sludge as Feedstock for TCR-System

Mass balance and Product Utilization

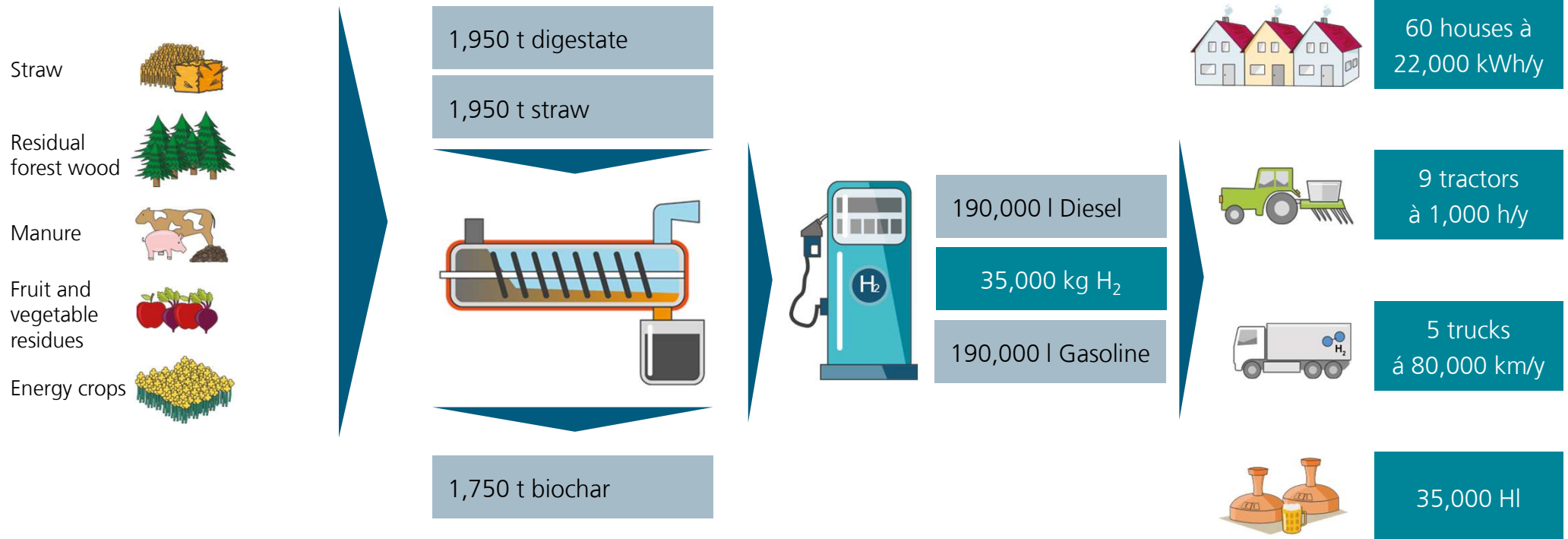


Example: Sewage Sludge as Feedstock for TCR-System

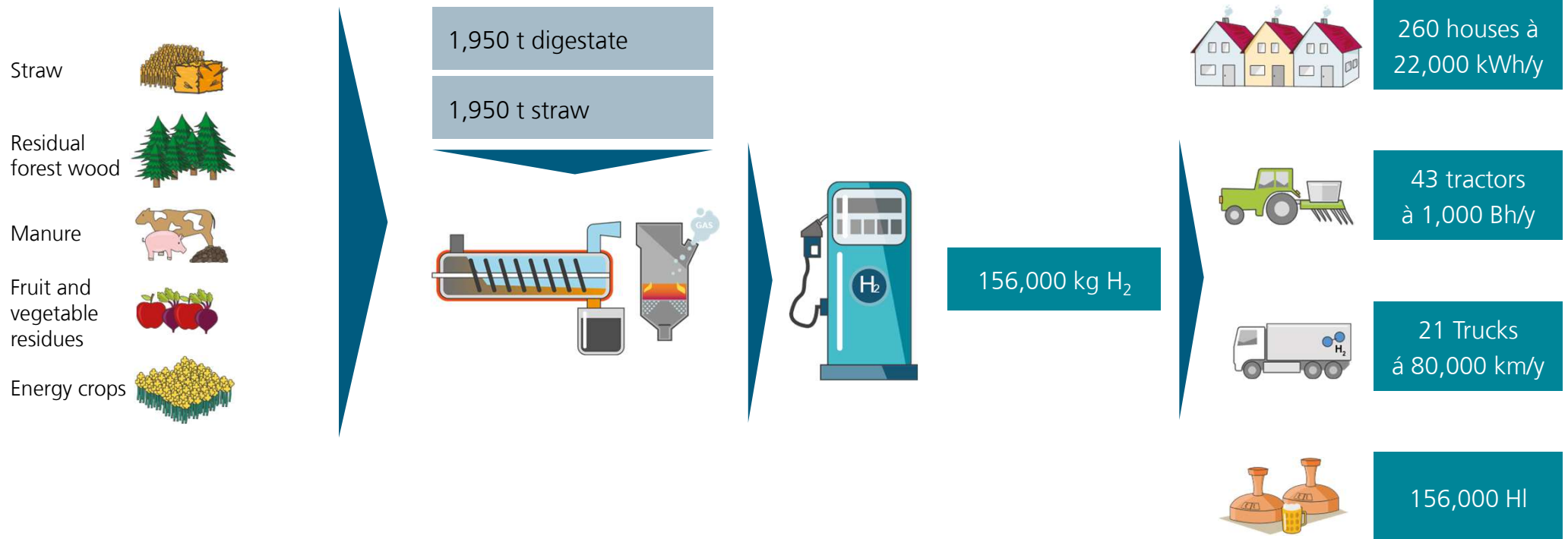
Mass balance and Product Utilization



Exemplary scenario TCR



Exemplary scenario TCR + Gasification



Current development

Integrated H₂-production from residual
and waste biomass



Activities of Fraunhofer UMSICHT in South America

Brazil, Chile, Argentina

Brazil

Partnership with SENAI / ISI
Biomass: Delivery of 2 TCR-Systems
for Waste biomass conversion and
H₂-production.

Fraunhofer Office in Brazil

<https://www.brazil.fraunhofer.com>



Brazil

Project Ashes:
Thermochemical
processing of
residues from
bagasse

Chile

Project SeMoBioEnergy. Utilization of
Agricultural and Forest Residues.
Construction of a semi-mobile TCR-plant.

Fraunhofer Representative in Chile

Fraunhofer Chile Research (FCR)
<https://www.fraunhofer.cl/en.html>



Argentina

Project Phy2Climate:
Clean biofuel production
and phytoremediation
solutions from contami-
nated lands. Pilot Site La
Plante, San Juan

Many thanks for your kind attention!



Fraunhofer Institute for
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Technology UMSICHT



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