Karlsruher Institut für Technologie

BtL – the bioliq® process

Thomas Kolb, Mark Eberhard

Engler-Bunte-Institut, Chemische Energieträger – Brennstofftechnologie, EBI ceb
Institut für Technische Chemie, Vergasungstechnologie, ITC vgt
DVGW Forschungsstelle am EBI, Gastechnologie, DVGW gt

Straw

Fast pyrolysis

Slurry preparation

High pressure entrained flow gasification

Gas conditioning

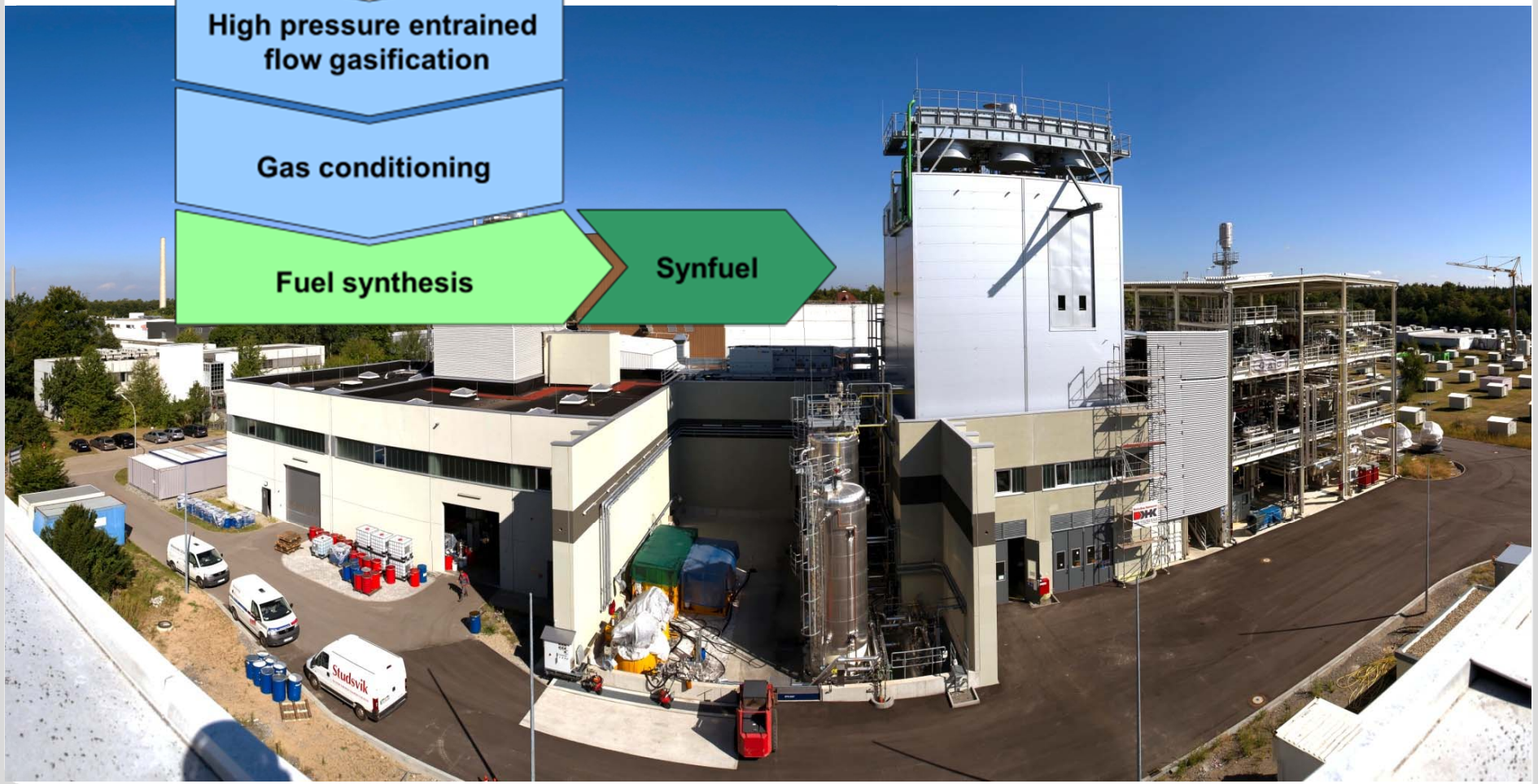
Fuel synthesis

Synfuel

Karlsruher Institut für Technologie

Bundesministerium für Ernährung, Landwirtschaft und Verbraucherschutz

FACHAGENTUR NACHWACHSENDE ROHSTOFFE e.V.



Engler-Bunte Institute, Fuel Technology
Institute for Technical Chemistry, Gasification Technology
DVGW Research Station, Gas Technology

The bioliq®-Process

Specific energy content [GJ/m³]

Regionally distributed biomass

Transportation distance

Straw 1,5

25 km

Slurry 15-25

de-central production of high energy intermediate products

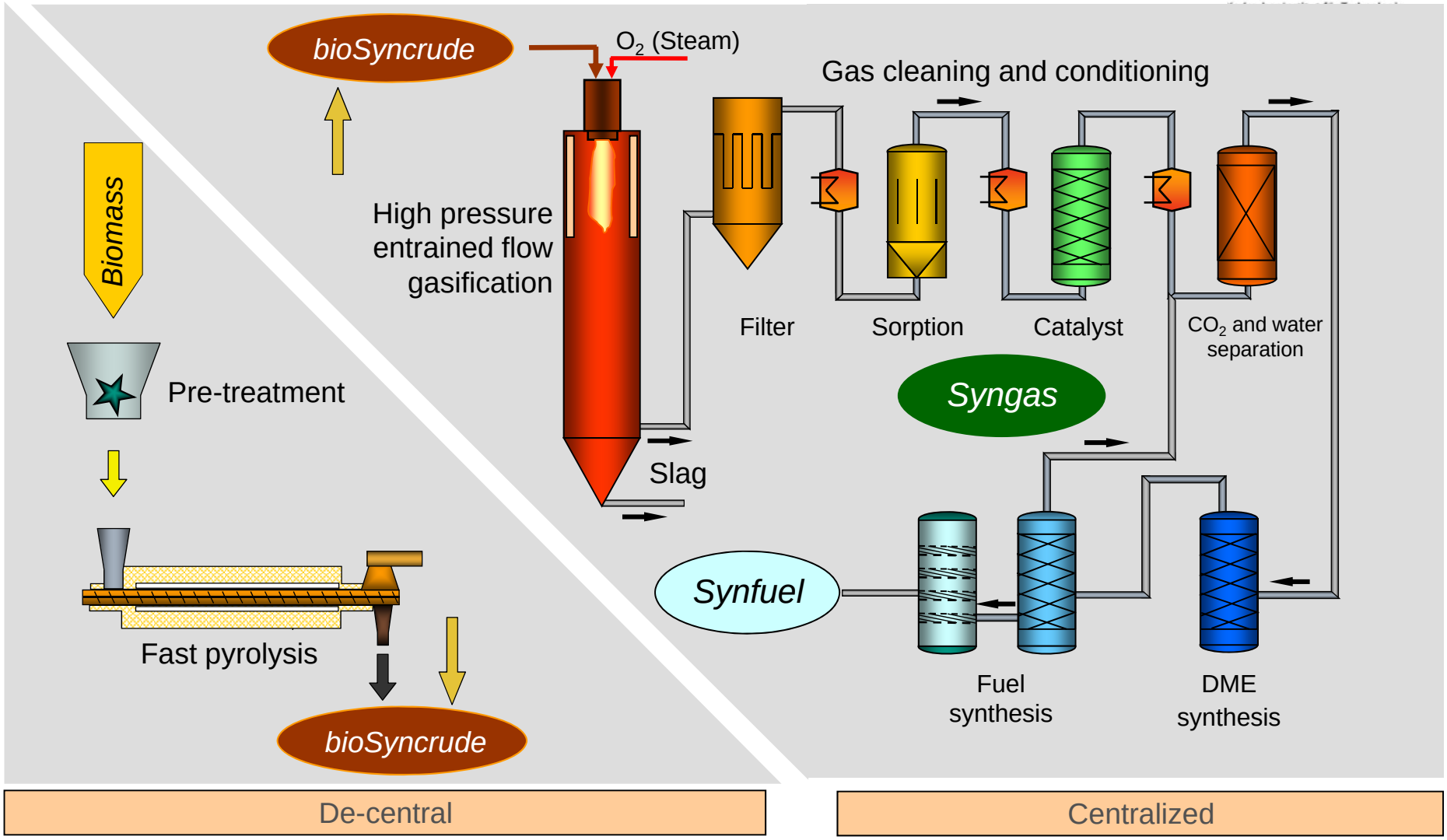
250 km

Fuel 36

central production of synthesis gas and fuel

Engler-Bunte Institute, Fuel Technology
Institute for Technical Chemistry, Gasification Technology
DVGW Research Station, Gas Technology

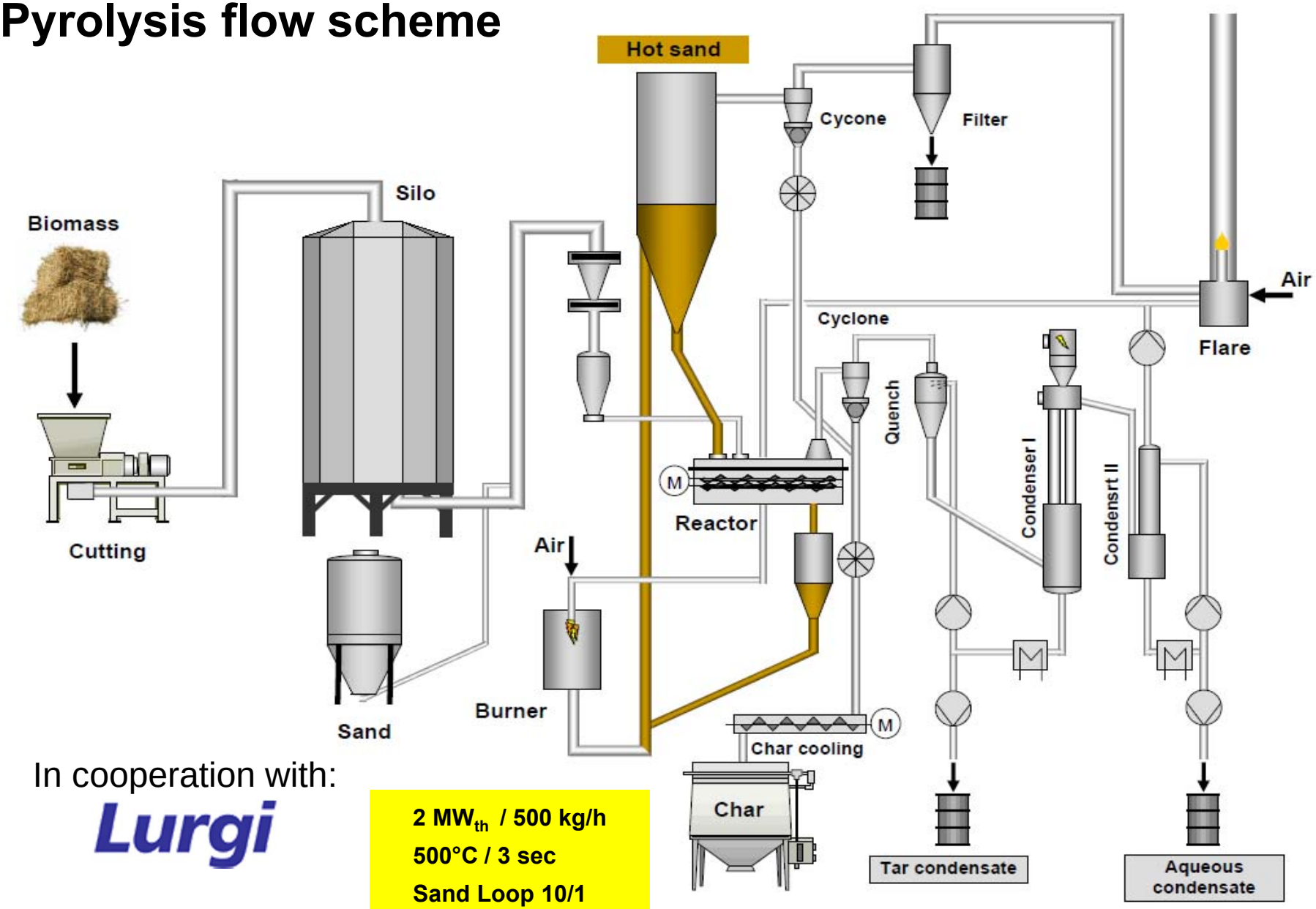
bioliq® process scheme



Source: Presentation of Dr. Dahmen, IKFT

Engler-Bunte Institute, Fuel Technology
Institute for Technical Chemistry, Gasification Technology
DVGW Research Station, Gas Technology

Pyrolysis flow scheme



In cooperation with:

Lurgi

2 MW_{th} / 500 kg/h
500°C / 3 sec
Sand Loop 10/1

Engler-Bunte Institute, Fuel Technology
Institute for Technical Chemistry, Gasification Technology
DVGW Research Station, Gas Technology

Fast Pyrolysis Pilot Plant

Karlsruher Institut für Technologie

Biomass preparation

Fast pyrolysis

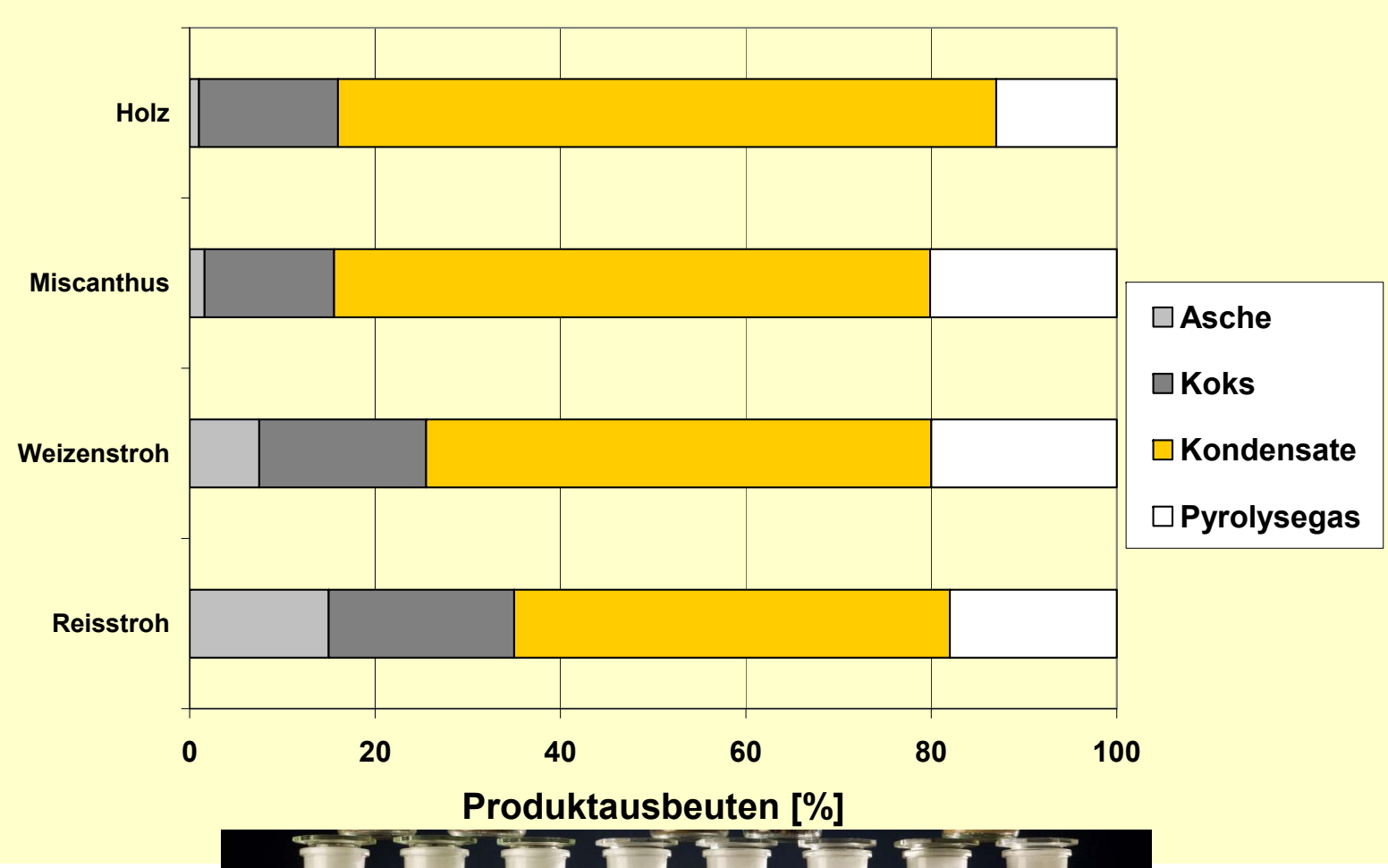
Pyrolysis product recovery

Feed stock storage

Biosyncrude preparation

Engler-Bunte Institute, Fuel Technology
Institute for Technical Chemistry, Gasification Technology
DVGW Research Station, Gas Technology

Fast Pyrolysis of different Feed Stock /Lab Scale

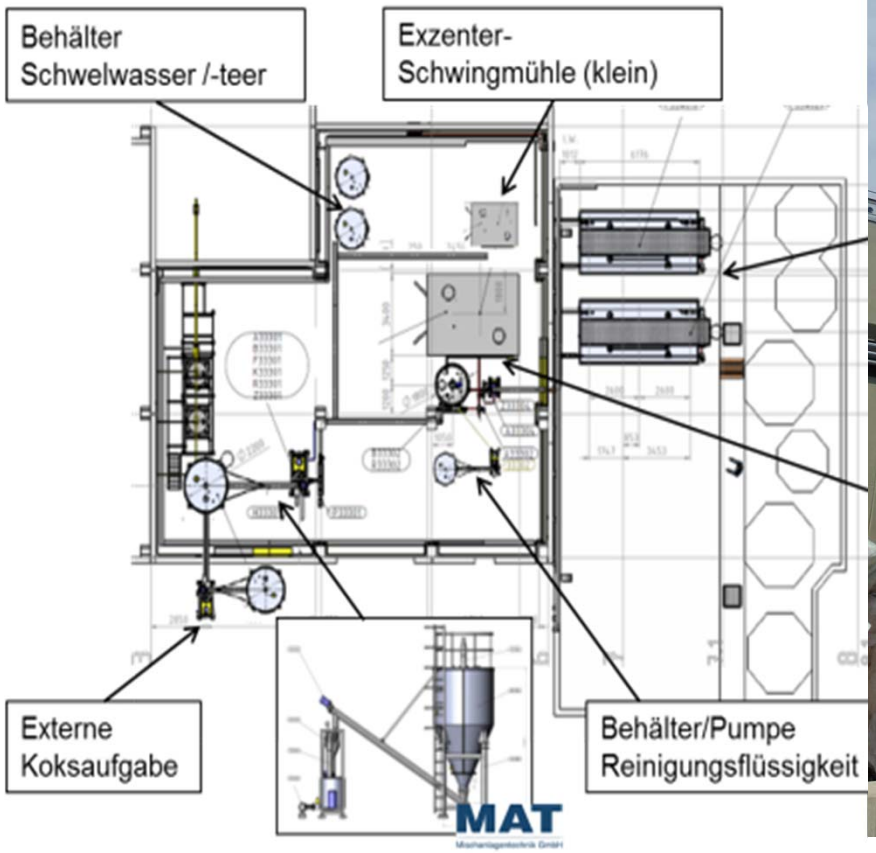


From lab scale experiment

Engler-Bunte Institute, Fuel Technology
Institute for Technical Chemistry, Gasification Technology
DVGW Research Station, Gas Technology

BioSyncrude

Production / Storage



Slurry Specification

- 2 fractions organic & water
- solids up to 40 wt.%
- ash up to 10 wt. %
- organic acids (e.g. formic / acetic acid)
- alcohol (e.g. methanol)
- chloride up to 1 wt.%

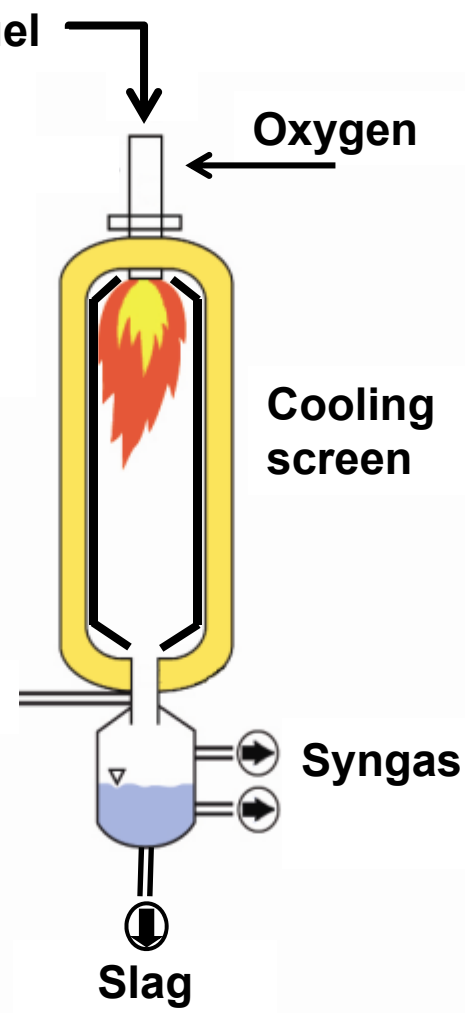
- dynamic viscosity $50\ mPas < \eta < 5000\ mPas$
- density $1000\ kg/m^3 < \rho < 1500\ kg/m^3$
- Particle size $90\% < 100\ \mu m$
- pH $2 < pH < 7$

Organic condensate
30% solids

High Pressure Entrained Flow Gasification

➔ Fuel/ Load / Product – Flexibility

- Coal
- Residues
- Biomass
- Waste



Flexibility
Load / Product
Efficiency

heterogeneous
high ash content
flexibility

- Fuels, BtL
- Chemicals
- Hydrogen, H_2
- Electricity / Heat, IGCC

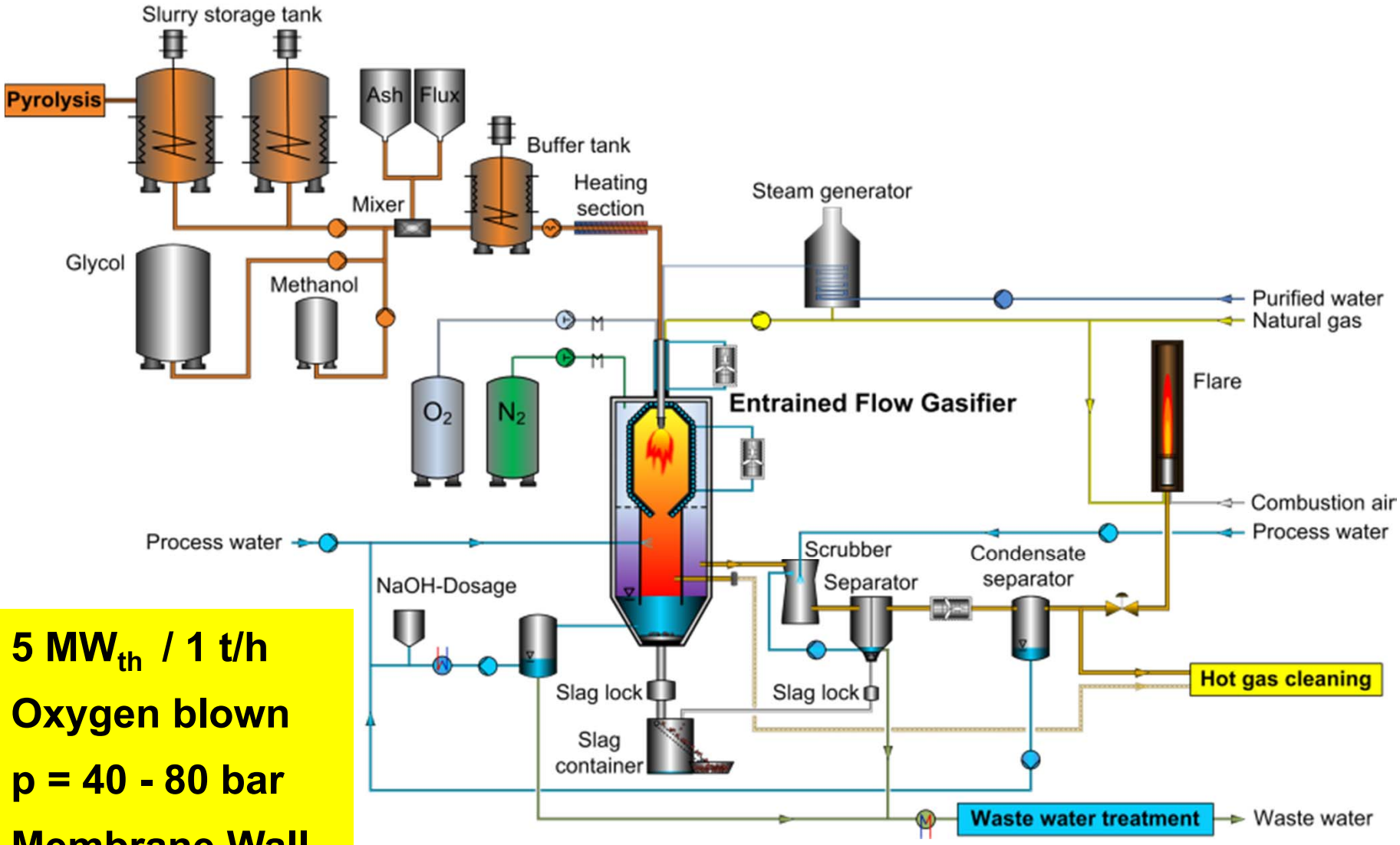
Engler-Bunte Institute, Fuel Technology
Institute for Technical Chemistry, Gasification Technology
DVGW Research Station, Gas Technology

bioliq® Entrained Flow Gasifier

- Confirmation of Funding FNR / Sept. 2008
- Contract signed KIT-Lurgi / Dec. 2008
- Mechanical Completion / Oct. 2011
- Completion of Commissioning / July 2012
- First Flame / Aug. 2012
- Stable Operation with Liquid Fuel 80 bar / Dec. 2012
- Performance Test with Model Slurry / Jan 2013
- First Test Run July 2013

Engler-Bunte Institute, Fuel Technology
Institute for Technical Chemistry, Gasification Technology
DVGW Research Station, Gas Technology

bioliq® Entrained Flow Gasifier



5 MW_{th} / 1 t/h

Oxygen blown

p = 40 - 80 bar

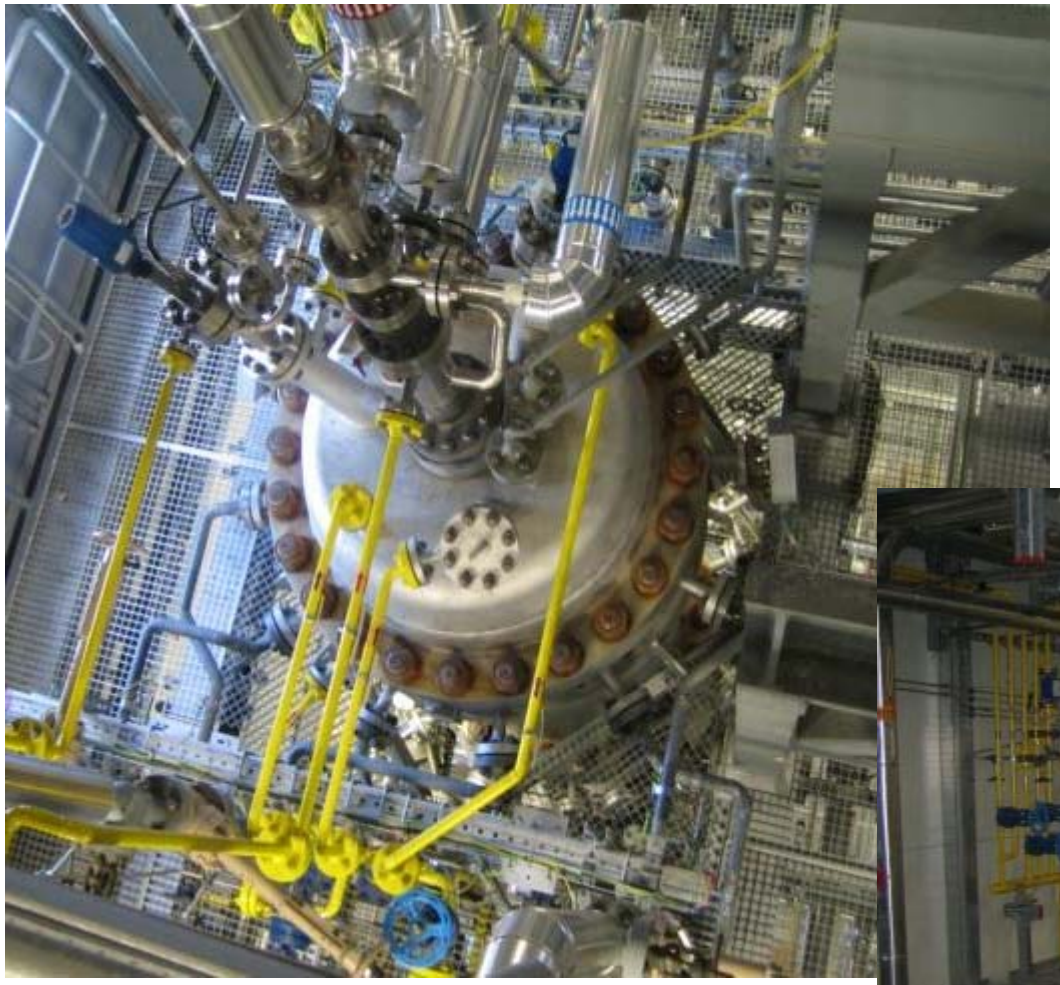
Membrane Wall

Engler-Bunte Institute, Fuel Technology
Institute for Technical Chemistry, Gasification Technology
DVGW Research Station, Gas Technology

bioliq® II

Tankfarm & Slurry Pump

bioliq® EFG



Gasifier Top
40bar configuration

Quench upper section

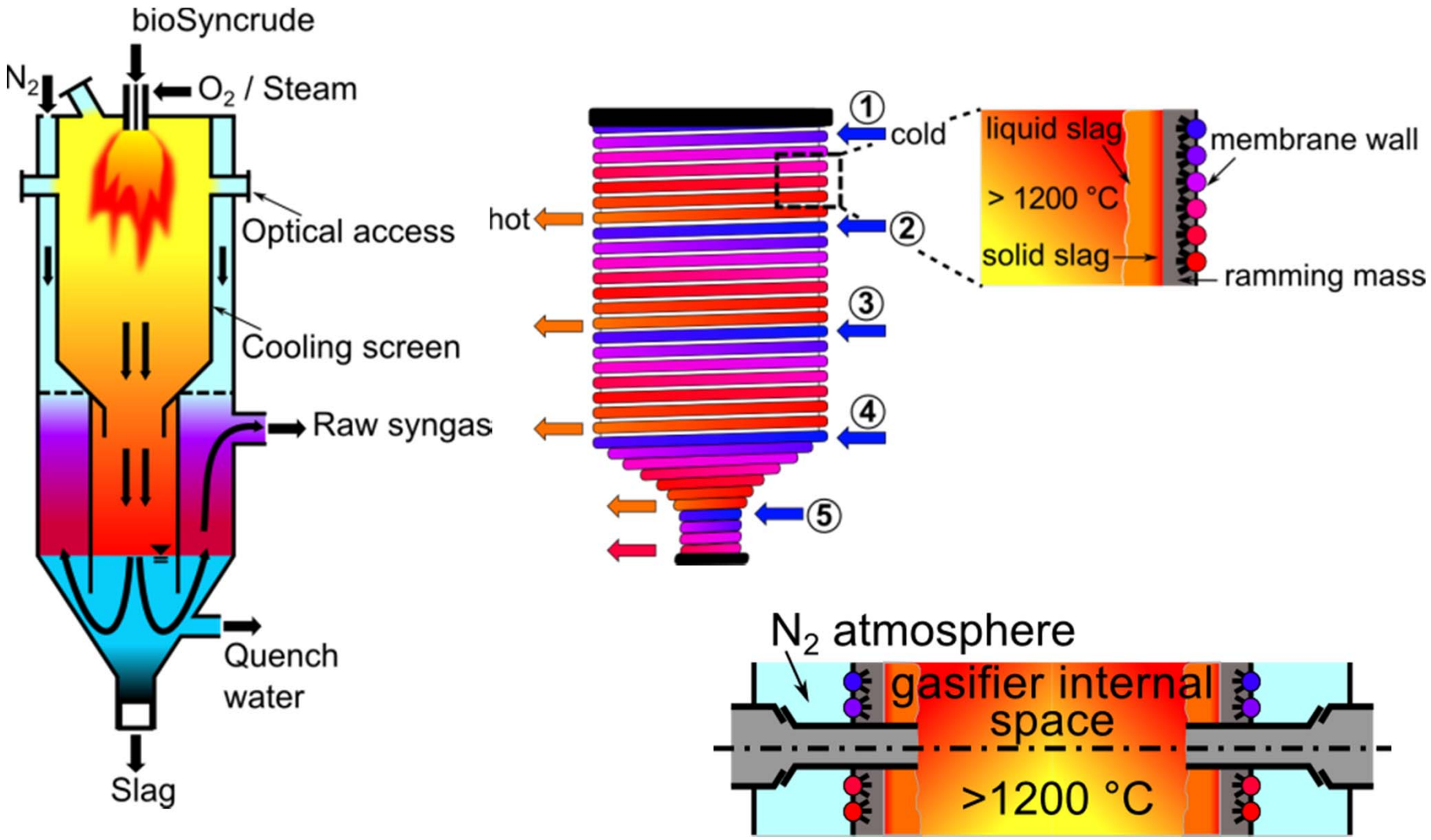
Engler-Bunte Institute, Fuel Technology
Institute for Technical Chemistry, Gasification Technology
DVGW Research Station, Gas Technology

bioliq® II

Quench & Slag Handling

Engler-Bunte Institute, Fuel Technology
Institute for Technical Chemistry, Gasification Technology
DVGW Research Station, Gas Technology

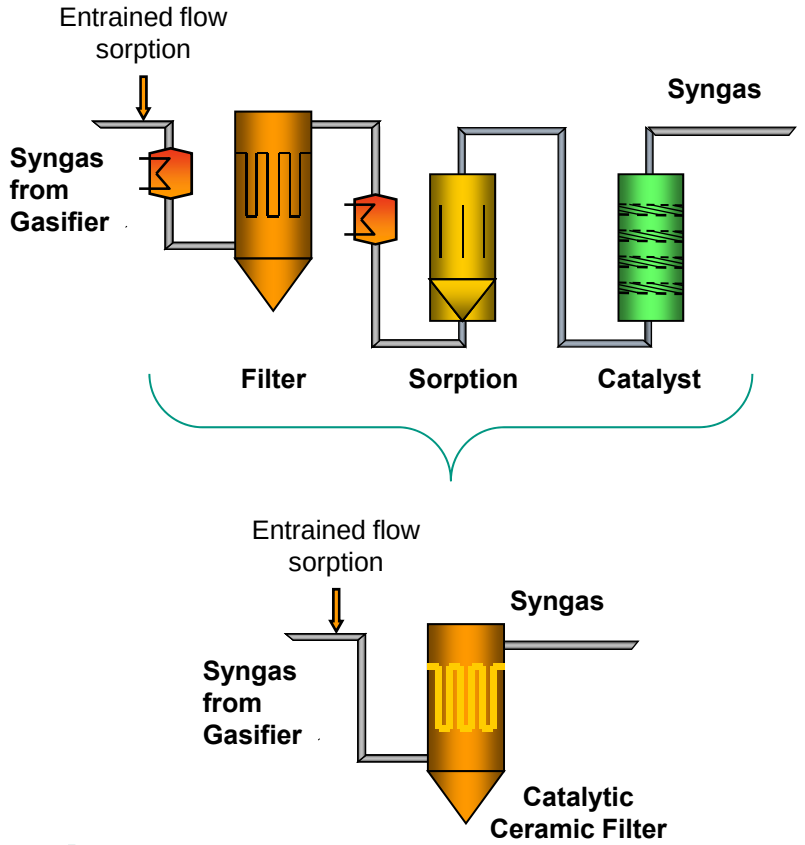
bioliq® Gasifier ➔ Prozess Optimization



Engler-Bunte Institute, Fuel Technology
Institute for Technical Chemistry, Gasification Technology
DVGW Research Station, Gas Technology

High Temperature - High Pressure (HTHP) Syngas Cleaning

- Compact horizontal ceramic filter for particle removal with CPP recleaning
- Dry sorption of sour gases (HCl, H_2S) and alkalines
- Catalytic conversion of organics and N-species (HCN, NH_3)
- CO_2 separation (optional)
- 700 m³/h STP synthesis gas (40 m³/h at 80 bar, 800 °C)



⇒ Energy Savings ca. 10% compared to state-of-the-art gas cleaning

⇒ Process Integration

⇒ Chemical Quench

Engler-Bunte Institute, Fuel Technology
Institute for Technical Chemistry, Gasification Technology
DVGW Research Station, Gas Technology

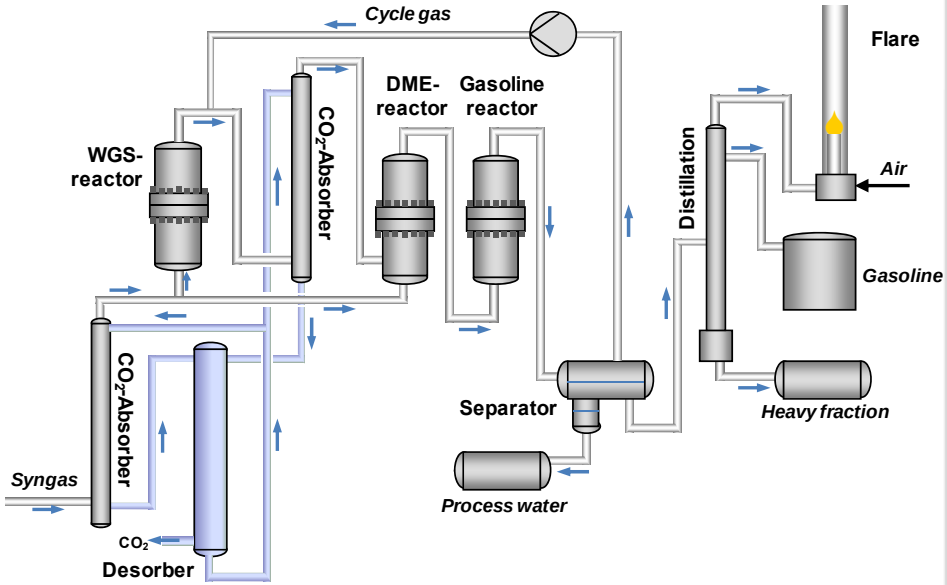
bioliq® HTHP Syngas Cleaning

Engler-Bunte Institute, Fuel Technology
Institute for Technical Chemistry, Gasification Technology
DVGW Research Station, Gas Technology

DME and Fuel Synthesis

DME-synthesis

- One step DME synthesis
- Innovative isothermal reactor
- Temp. 250 °C, pressure 60 bar

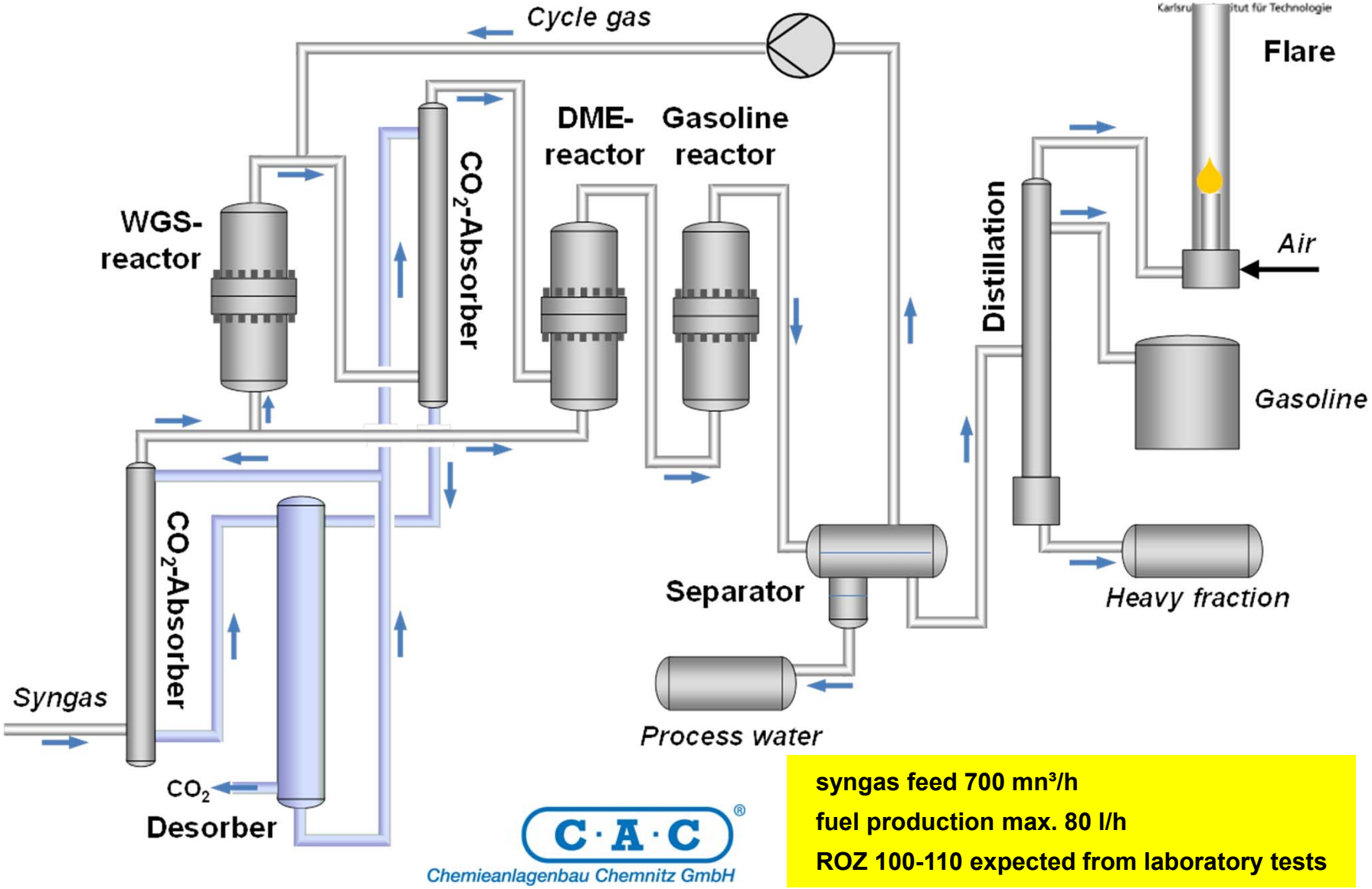


DtG-synthesis

- Zeolithe catalyzed dehydratization, oligomerization and isomerization
- Temp. 350 - 450 °C, pressure 25 bar
- Recycling of unconverted gas
- Gasoline stabilization

Engler-Bunte Institute, Fuel Technology
Institute for Technical Chemistry, Gasification Technology
DVGW Research Station, Gas Technology

Flow sheet Synthesis



syngas feed 700 mn³/h

fuel production max. 80 l/h

ROZ 100-110 expected from laboratory tests

Engler-Bunte Institute, Fuel Technology
Institute for Technical Chemistry, Gasification Technology
DVGW Research Station, Gas Technology

Synthesis Pilot Plant

Performance Test June 2013
Acceptance July 2013

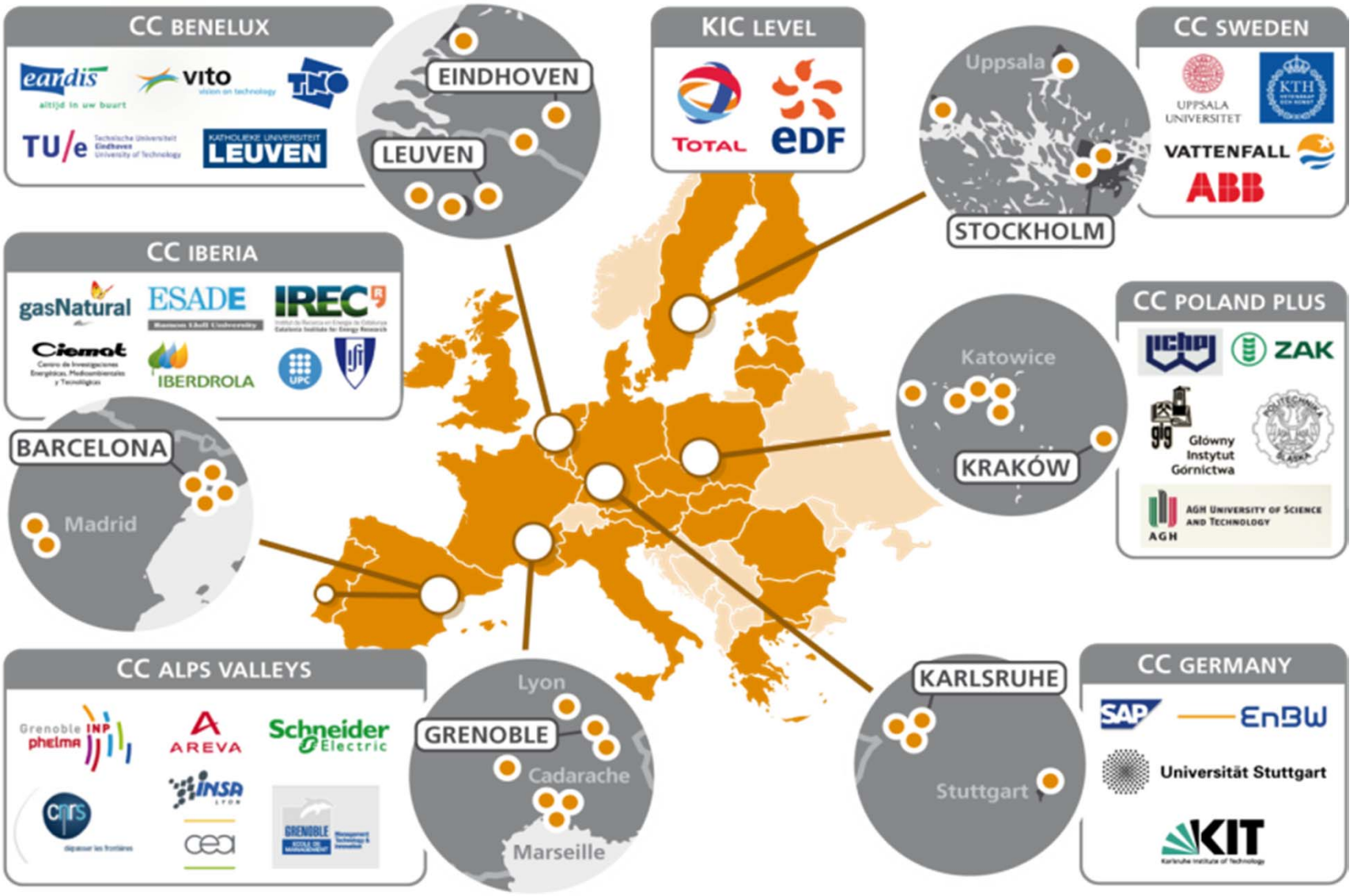
Engler-Bunte Institute, Fuel Technology
Institute for Technical Chemistry, Gasification Technology
DVGW Research Station, Gas Technology

Helmholtz Virtual Institute for Gasification Technology

Towards Sustainable Energy Systems

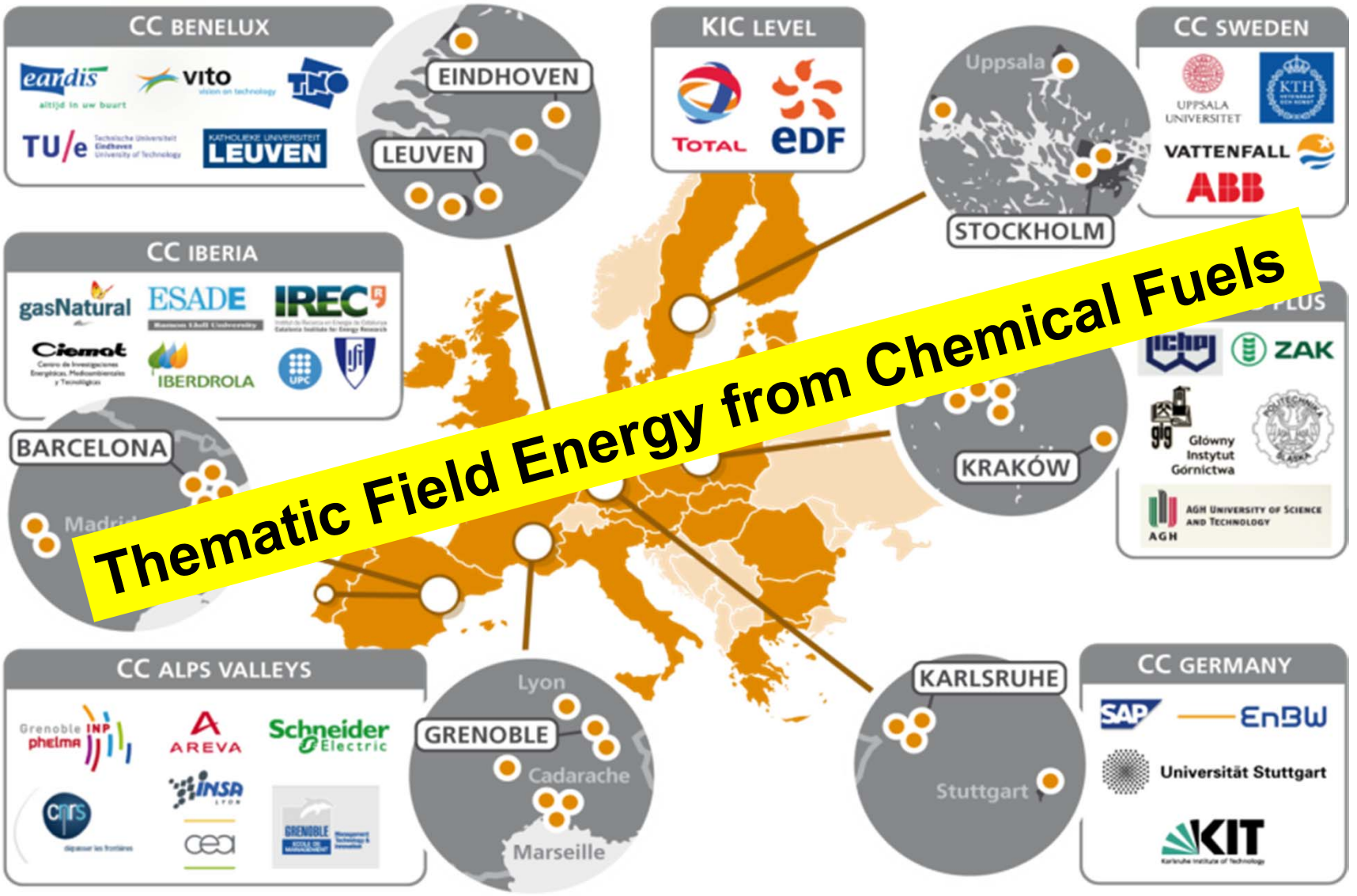
Thomas Kolb, Manfred Aigner, Reinhold Kneer, Michael Müller, Roman Weber

KIC InnoEnergy – Partners from 6 co-locations



Engler-Bunte Institute, Fuel Technology
Institute for Technical Chemistry, Gasification Technology
DVGW Research Station, Gas Technology

KIC InnoEnergy – Partners from 6 co-locations



Engler-Bunte Institute, Fuel Technology
Institute for Technical Chemistry, Gasification Technology
DVGW Research Station, Gas Technology

FACHAGENTUR NACHWACHSENDE ROHSTOFFE e.V.

Lurgi

Bundesministerium für Ernährung, Landwirtschaft und Verbraucherschutz

KIT Karlsruher Institut für Technologie

C·A·C® Chemieanlagenbau Chemnitz GmbH

MUT ADVANCED HEATING

MAT Mischanlagentechnik GmbH