

IEA Bioenergy

Country Report Germany

Update

Task 33 Thermal Gasification of Biomass

Task meeting, June 5th 2019, Karlsruhe, Germany



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KIT – The Research University in the Helmholtz Association

**ENGLER-BUNTE-INSTITUT Fuel Technology, EBI ceb
Institute for TECHNICAL CHEMISTRY, Gasification Technology, ITC vgt**

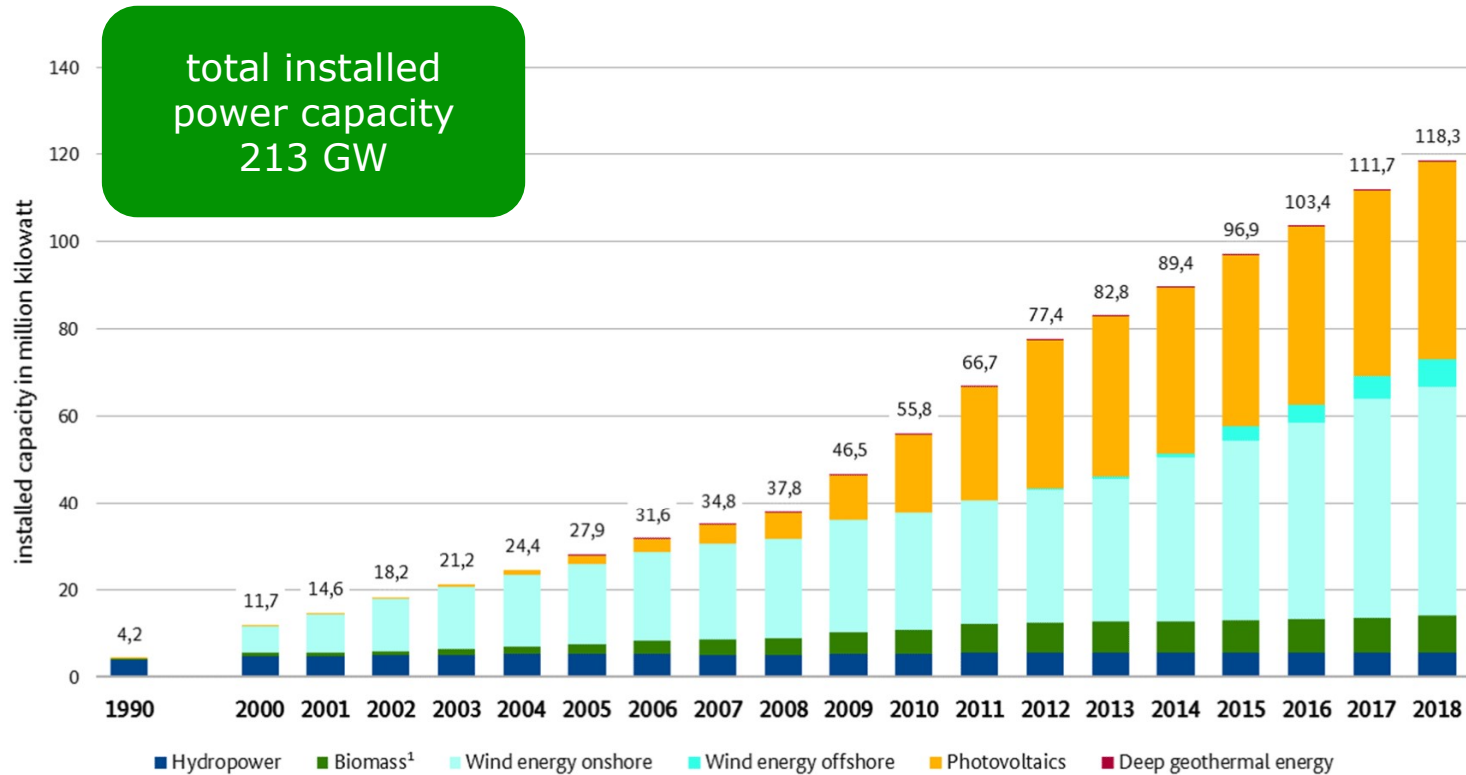


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→ 225 TWh
→ 37,8% of
overall gross
power generation

Development of installed capacity for renewables-based electricity generation in Germany

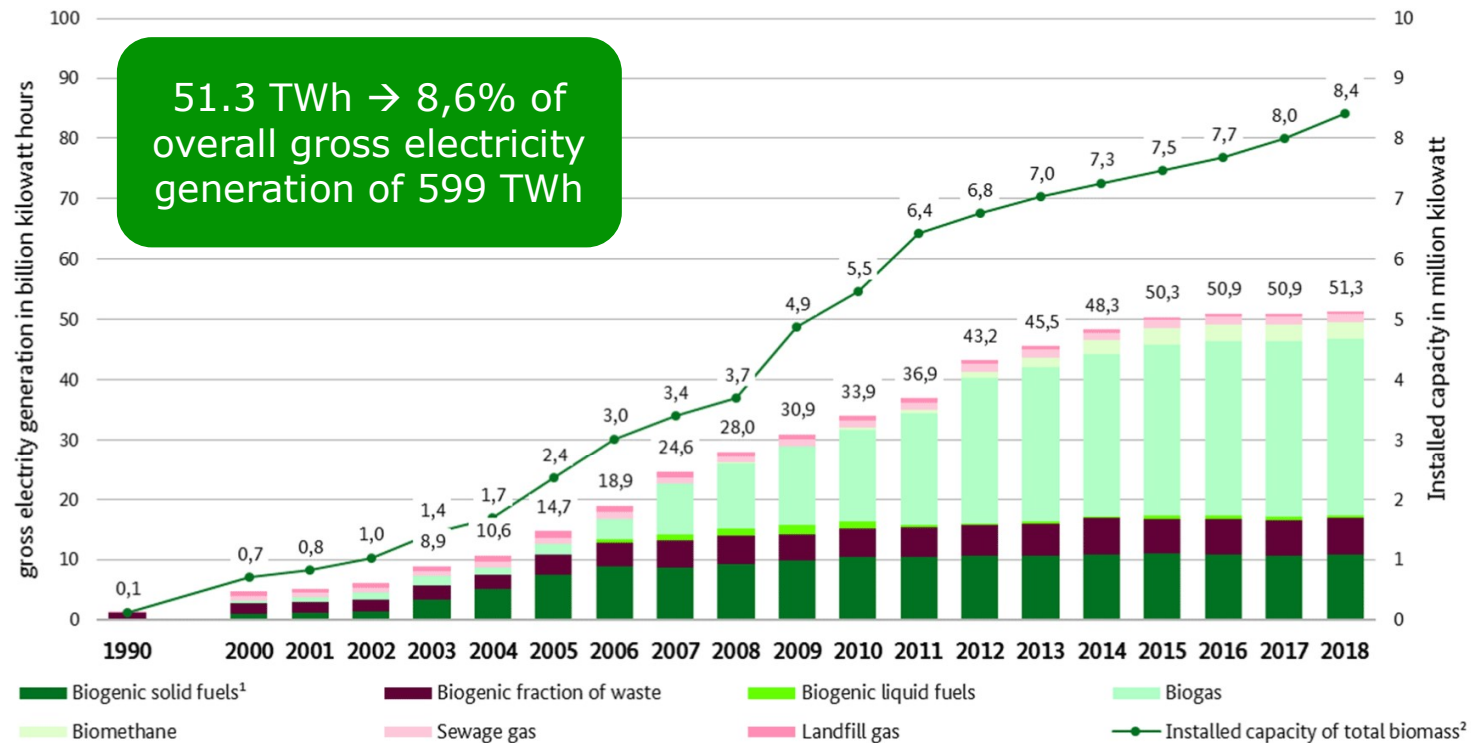


¹ incl. solid and liquid biomass, biogas, biomethane, sewage gas and landfill gas, excl. biogenic fraction of waste

BMWi based on Working Group on Renewable Energy-Statistics (AGEE-Stat); as of February 2019; all figures provisional

Source: <https://www.erneuerbare-energien.de/EE/Redaktion/DE/Bilderstrecken/entwicklung-der-erneuerbaren-energien-in-deutschland-im-jahr-englisch.html>

Development of electricity generation and installed capacity of biomass plants in Germany

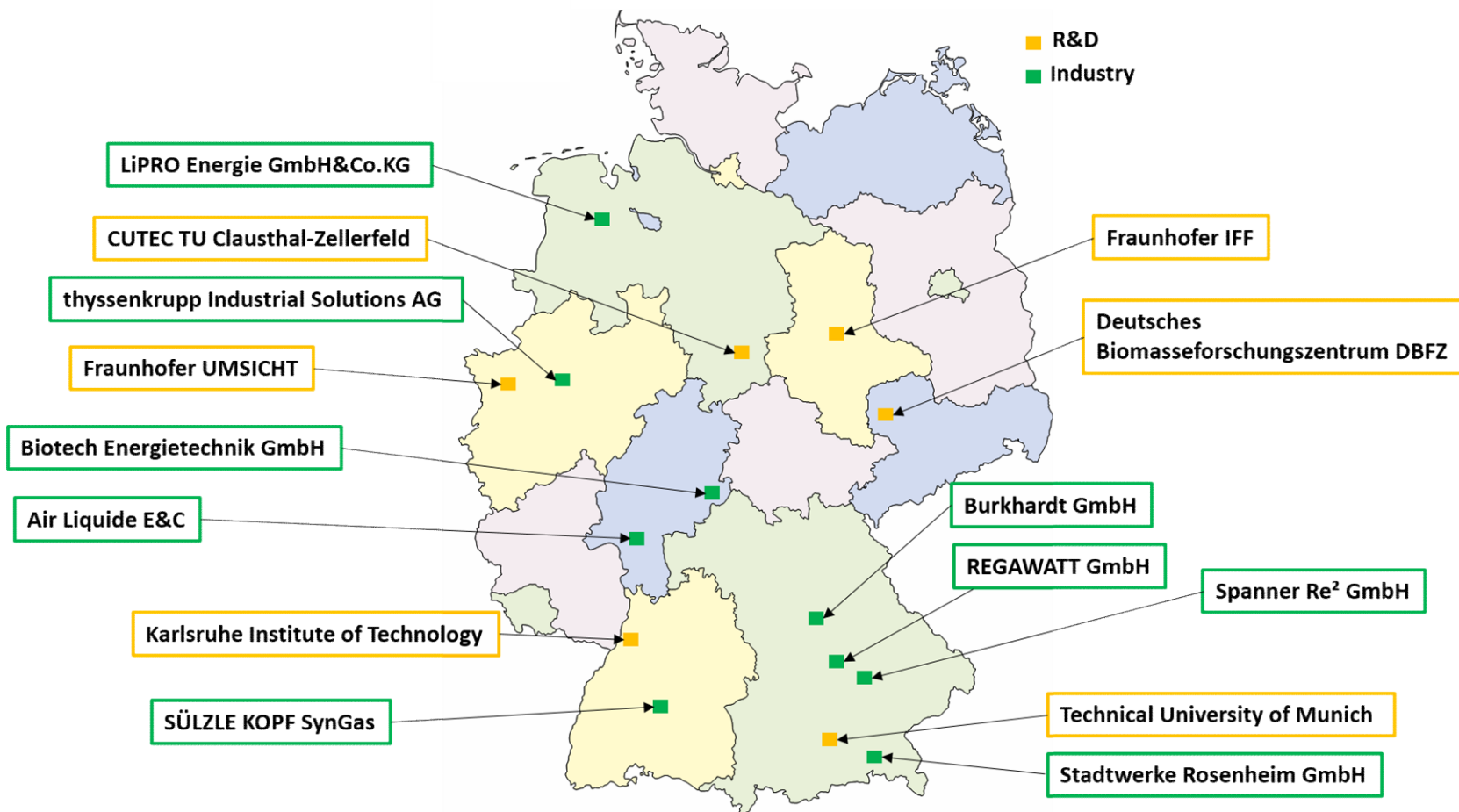


¹ incl. sewage sludge; ² without installed capacity of waste incineration plants

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The biomass gasification map of Germany



Biomass gasification plants

Manufacturer	Technology	Feedstock	Grid feeding plants	Note
Biotech Energietechnik GmbH	Fixed-bed process, co-current	wood chips	3	
BR Engineering GmbH (CH)	Fixed-bed process (optional: moving bed) in combination of co-current and countercurrent flow	Unadulterated wood, wood chips, other biomasses (among others hogged fuel)	2	<ul style="list-style-type: none"> • Since 1997 • Cold gas efficiency: up to 90% • Production of biochar • USP: proven for demolition wood/ ash free of char
Burkhardt GmbH (D)	Fluidized bed process in co-current flow	Pellets	240	<ul style="list-style-type: none"> • Since 2011 • wood gas cogeneration plants • wood gasifier with downstream CHP • Electric efficiency of more than 30 %
Glock Ökoenergie GmbH (A)	Fixed-bed process, co-current	wood chips	13	<ul style="list-style-type: none"> • Since 2010 • Distributing countries: D, A, CH
Holzenergie Wegscheid GmbH (D)	Fixed-bed process in co-current flow	Unadulterated wood, briquettes & maxi-sized pellets, wood chips	120	<ul style="list-style-type: none"> • Distributing countries: EU, JP, CA, ID, CH
ReGaWatt GmbH	Fixed-bed in counter-current flow	Wood chips from various sources up to 30 % bark and landscape management chips	6	<ul style="list-style-type: none"> • Since 2010 • Distributing countries: EU

Source: Fördergesellschaft Erneuerbare Energien e.V. (FEE), Industry Guide Thermochemical Biomass Gasification, Berlin, Germany, July 2015 ; [Update 2019](#)

Biomass gasification plants

Manufacturer	Technology	Feedstock	Grid feeding plants	Note
LiPRO Energy &CO KG (D)	Pyrolysis with moving bed	wood chips	9	<ul style="list-style-type: none"> • Since 2016
Spanner Re ² GmbH	Fixed-bed process in co-current flow	Unadulterated wood, forest chips (at 30 kWel), wood chips	>700	<ul style="list-style-type: none"> • Spanner Re² wood cogeneration plants • Since 2008 • Distributing countries: D, A, CH, I, CZ, SLO, LV, CDN, GB, FIN, HR, J, PL
Stadtwerke Rosenheim GmbH & Co. KG	Fluidized bed and tiered process, combination of co-current and eddy flow (Rosenheimer Process)	Unadulterated wood, wood chips	1	<ul style="list-style-type: none"> • Since 2015 • Distributing countries: DE, AT, I
SynCraft (A)	Tiered process in co-current flow (floating fixed-bed)	Unadulterated wood, tree and shrub cuttings, waste wood class A, wood chips	6	<ul style="list-style-type: none"> • By-product bio char • Fuel flexibility • No additives needed • Electric efficiency 30 %
Xyloenergy GmbH	Fixed-bed process in co-current flow	Unadulterated wood, wood chips	1	<ul style="list-style-type: none"> • capacity via 100 % diesel/ bio-diesel as well; • utilization of waste wood • Distributing countries: EU

Source: Fördergesellschaft Erneuerbare Energien e.V. (FEE), Industry Guide Thermochemical Biomass Gasification, Berlin, Germany, July 2015; [Update 2019](#)

Biomass gasification plants

Hersteller	Technologie	Feedstock	Grid feeding plants	Note
Ettenberger GmbH & Co. KG	Tiered gasification process in combination	Unadulterated wood, wood chips, short rotation plants	3	Gasifiers sold to Biotech
KOPF SynGas GmbH & Co. KG	Fluidized bed process	Sewage sludge (10 % moist. cont.)	2	• Since 2000
Wood Gasifier System Werner	Fixed-bed process in co-current flow	Unadulterated wood, wood chips	1	
Ligento green power GmbH	Fixed-bed process in co-current flow	Unadulterated wood, residual wood from forestry, short rotation plants, wood chips	2	bankrupt
Meva Energy (S)	Entrained flow in co-current flow	Unadulterated wood, wood chips, pellets, saw dust, husks, straw	1	
Qalovis GmbH	Fixed-bed process in co-current flow	Unadulterated wood, residual wood from forestry and landscape conservation, wood chips, pellets	1	bankrupt
URBAS Maschinenfabrik GmbH (A)	Fixed-bed process in concurrent flow	Unadulterated wood, wood chips	19	• Since 2008

Source: Fördergesellschaft Erneuerbare Energien e.V. (FEE), Industry Guide Thermochemical Biomass Gasification, Berlin, Germany, July 2015; Update 2019

Industry Activities

Blue Energy Syngas CHP

TU WIEN Institute of Chemical Engineering Working Group Synthetic Biofuels

bioenergy2020+

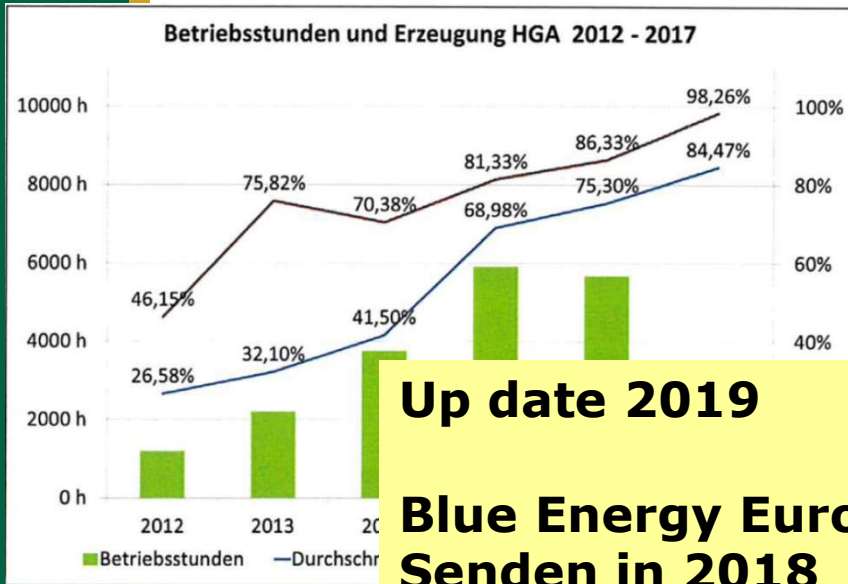
Biomass gasification plant Senden/Ulm, DE



repotec

Start of the construction

12/2009



Up date 2019

Blue Energy Europe took over Holzgas-Heizkraftwerk Senden in 2018

Blue Energy Syngas GmbH provides heat for SWU Stadtwerke Ulm/Neu-Ulm.

Temporary shut-down in 2019 → profitability analysis

Source: Energie aus Pflanzen 3/2017

Source: <https://www.augsburger-allgemeine.de/neu-ulm/Warum-das-Sendener-Holzwerk-still-steht-id53137721.html>

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www.ieabioenergy.com

Industry activities:

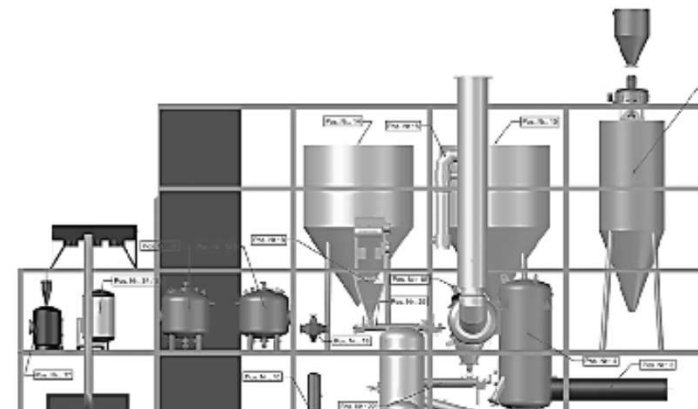
Kundenanlage Koblenz

Neueste Technologie aus 15 Jahren F&E und Erfahrung aus Balingen & Mannheim

SÜLZLE
KOPF

Klärschlamm	4.500 t/a Trockenschlamm
Nutzbare Wärme	525 kW
Stromerzeugung	440 kW

- Inbetriebnahme 2016
- Neues, 2-stufiges Verfahren für saubereres Syngas und geringeren Betriebs- und Wartungskosten
- Derzeit Basic- und Detail Design
- Baubeginn Ende 2015



Commercial plant for Sewage Sludge

comissioning ongoin

- **525 kW heat**
- **440 kW electrical power**

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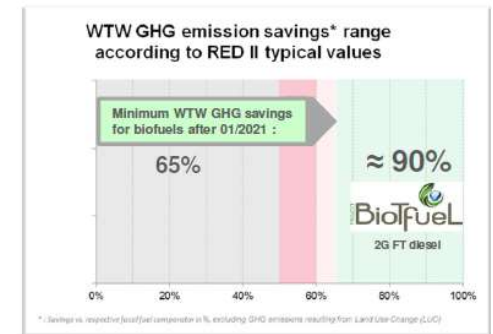
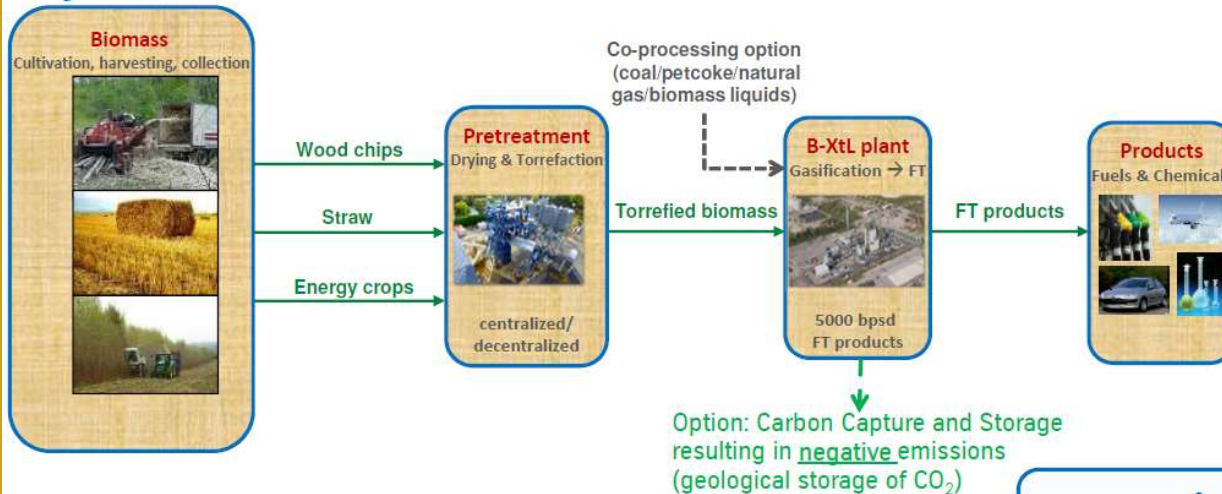
www.ieabioenergy.com

Industry activities: BioTfuel-Projekt

Integrated B-XtL Chain Performances



Key features



- ✓ Carbon foot print: reduction up to 90% (> 100% with CCS)
- ✓ Energy yield > 50 %
- ✓ Polygeneration possible: renewable electricity & heat, renewable H2
- ✓ CAPEX ≈ 700 M€ (ISBL investment cost for 5000 bpsd capacity)
- ✓ Production cost: ≈ 1 €/L (highly dependent on feed cost and integration)

- Bio-naphtha
 - Ideal feedstock for renewable petrochemicals
- Bio-kerosene
 - ASTM D7566 certified bio jet fuel
- Bio-diesel
 - High cetane
 - Low particles emissions

23.05.2019 / N. Ullrich



Industry activities: BioTfuel-Projekt

BioTfuel-Dunkirk / Demoplant for Milling, Gasification, Gas Cleaning and FT

The demonstration plant in Dunkirk has been built to demonstrate the grinding and gasification of torrefied biomass and fossil feedstock in an entrained-flow reactor as well as the syngas conversion and cleaning for Fischer-Tropsch application.



Dunkirk Demo Plant

- Total industrial site
- Multi scale for a safe scale up
- Gasification 15 MWth (3 t/h torrefied wood)
- Gasifier in operation since 2019



23.06.2019 / N. Ullrich



Industry activities: BioTfuel-Projekt

BioTfuel - Venette Torrefaction Demo Plant

The demonstration plant for biomass preparation in Venette has been built to convert the raw biomass into a suitable feed for the selected entrained-flow gasification process and includes biomass torrefaction as well as optional pelletization and all relevant storage and feeding sites.



Venette Demo Plant

- Avril industrial site
- Size 5 t/h feed
- Different kind of biomasses to be prepared



23.05.2019 / N. Ullrich



Industry activities: BioTfuel-Projekt

Actual Status of Vennette Torrefaction Demo Plant

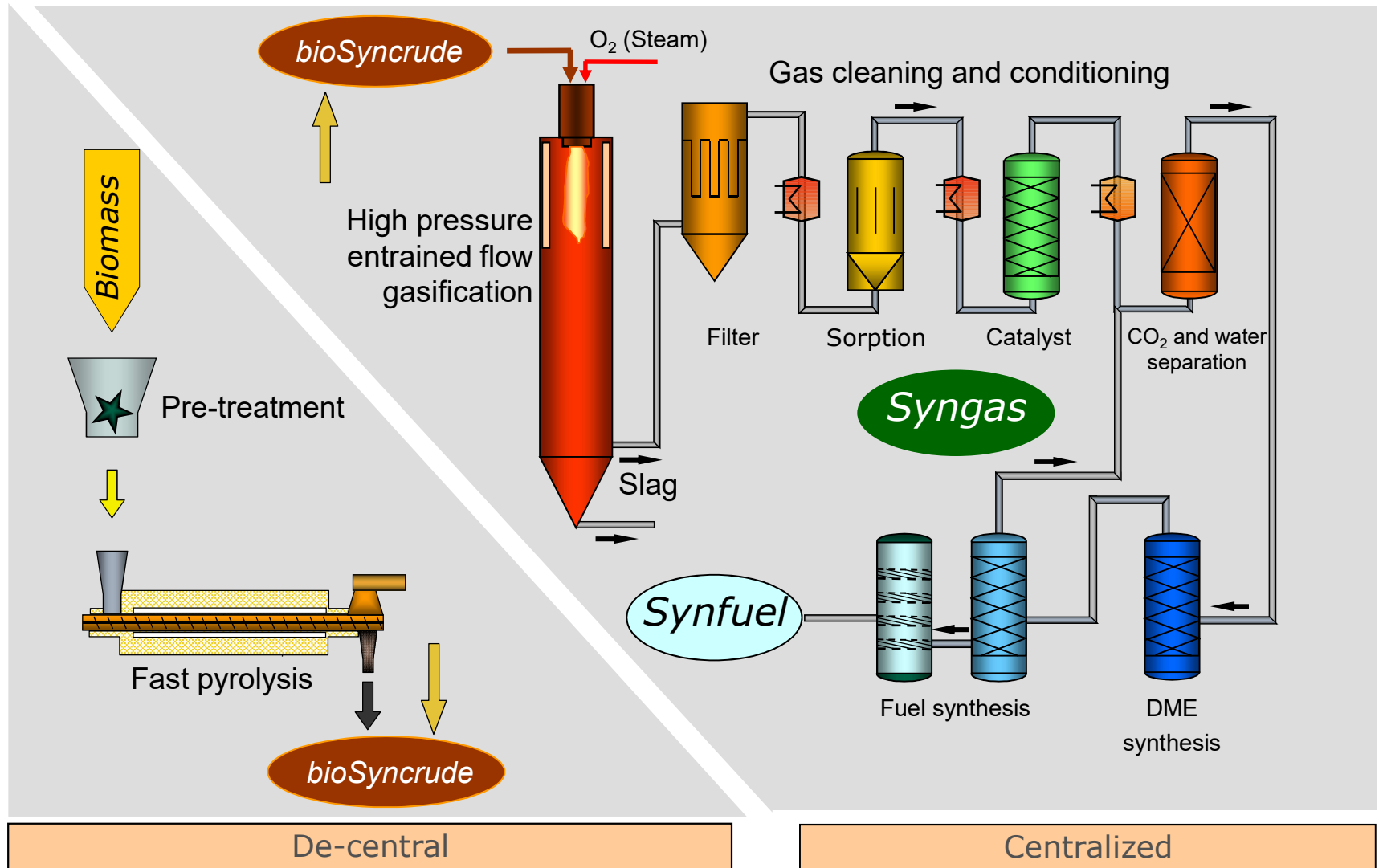


First successful operation of the torrefaction plant at 2 t/h of woodchips under drying and torrefaction operating conditions

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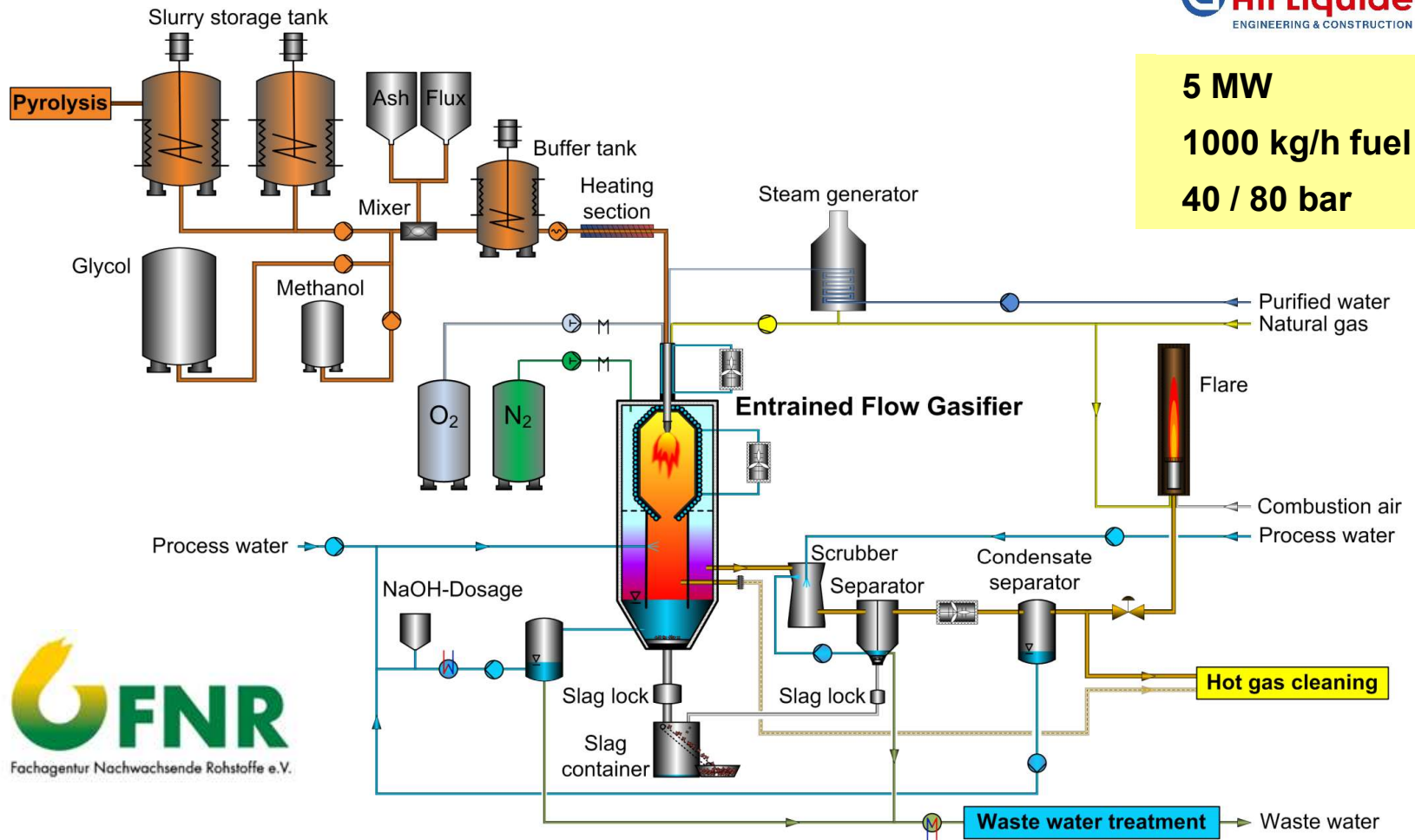
State of the bioliq[®]-Project



State of the bioliq[®]-Project



5 MW
1000 kg/h fuel
40 / 80 bar



State of the bioliq[®]-Project

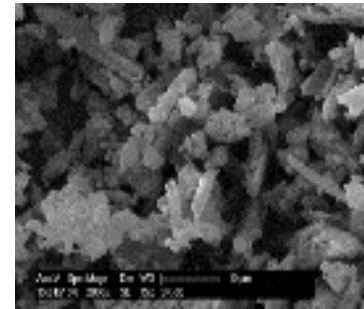
Fuel flexibility

Liquid phase:

- BioSyncrude: straw based pyrolysis oil
- Wood based pyrolysis oil
- Glycol as surrogate fuel

Solid phase:

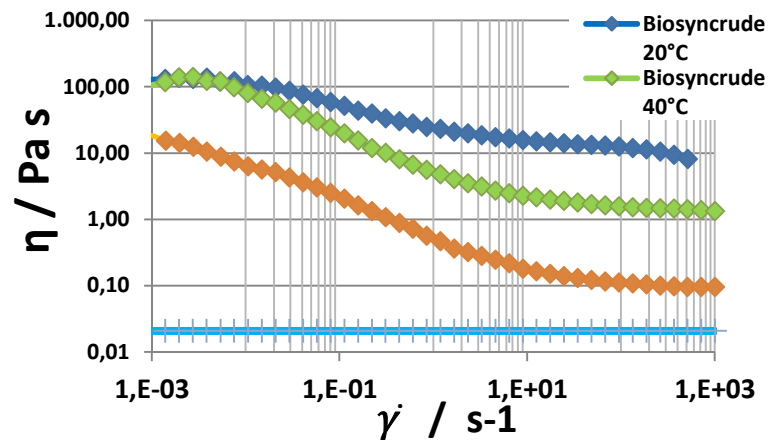
- Coke: Straw and wood based
- Ash: straw / glass



Coke



Pyrolysis Oil

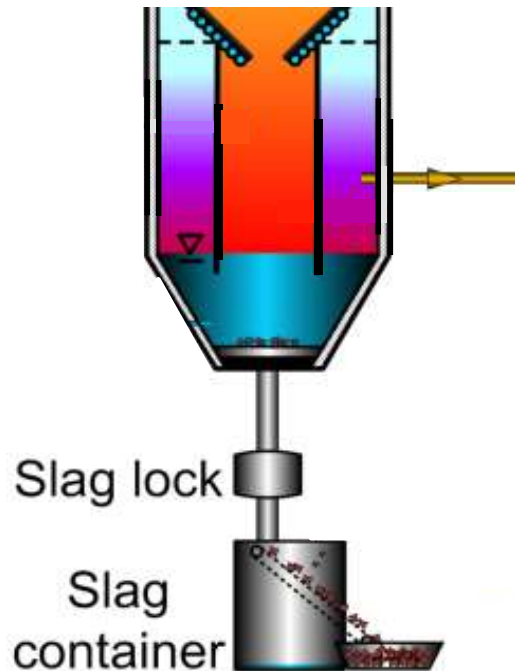


Design specification:

- LCV 14 – 22 MJ/kg
- Solid content < 30 %wt
- Ash content 3 - 10 %wt
- dp 90 % < 100 μ m / max 1 mm
- Viscosity < 1 Pas

State of the bioliq[®]-Project

Slag discharge



Challenge:

frequently clogging
at quench cone



caused by slag lumps



Solution:

Adjust slag viscosity and
flow temperature by variation of of:

- reactor temperature
- additives



Integration of a slag crusher



State of the bioliq[®]-Project

Slag discharge



State of the bioliq[®]-Project

Technical details campaign Nov/Dez 2018

- ❑ Petrol production from straw based pyrolysis oil
- ❑ Test run to determine the the optimum operating point for wood based pyrolysis oil under influence of Na-based fluxing agent

Technical details campaign March 2019

- ❑ Test run to determine the the optimum operating point for glycol based Modelslurry
- ❑ Pre tests for the investigation of the catalytic properties of sodium

Technical details campaign May 2019

- ❑ Test run to determine the the optimum operating point for glycol straw coke based Modelslurry under influence of Na-based fluxing agent
- ❑ Petrol production für reFuels

State of the bioliq[®]-Project

- Gasoline production campaign for the whole process chain in May 2019 for R&D cooperation program reFuels

→ Production of 720l fuel

- Next Gasoline production campaign planned in November 2019

R&D&D examples reFuels



An initiative of Baden-Württemberg Ministry of Traffic within the Strategic Dialog of Automotive Industries

- Synthetic fuels application project with partners from automotive industry, automotive supply industry, and mineral oil industry
- Gasoline and diesel fuels based on Methanol-to-gasoline (bioliq, biomass based) and Fischer-Tropsch (CO₂-based, EnergyLab2.0, INERATEC)
- Launched in January 2019, 20 Mio. EUR project cost, 24 months



Audi

DAIMLER



PORSCHE



BOSCH — **EnBW**

BorgWarner



Eberspächer

INERATEC

**Freudenberg
Sealing Technologies**

L'orange
YOUR POWERFUL INJECTION

MAHLE

MWV MINERALÖL
WIRTSCHAFTS
VERBAND e.V.

**Energy Power
Systems** **CAT**

HUMMEL
MANN+



KOLBENSCHMIDT

miRO



Baden-Württemberg
MINISTERIUM FÜR VERKEHR

KIT
Karlsruher Institut für Technologie
coordination

The End

IEA Bioenergy



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