



TECHNISCHE
UNIVERSITÄT
WIEN
Vienna University of Technology

IEA FORSCHUNGS
KOOPERATION

Country Report Austria

IEA Bioenergy Task33 Meeting

29. October 2015

Berlin, Germany

Dr. Reinhard Rauch, Dr. Jitka Hrbek

Institute of Chemical Engineering

Working Group Zero Emission Technology

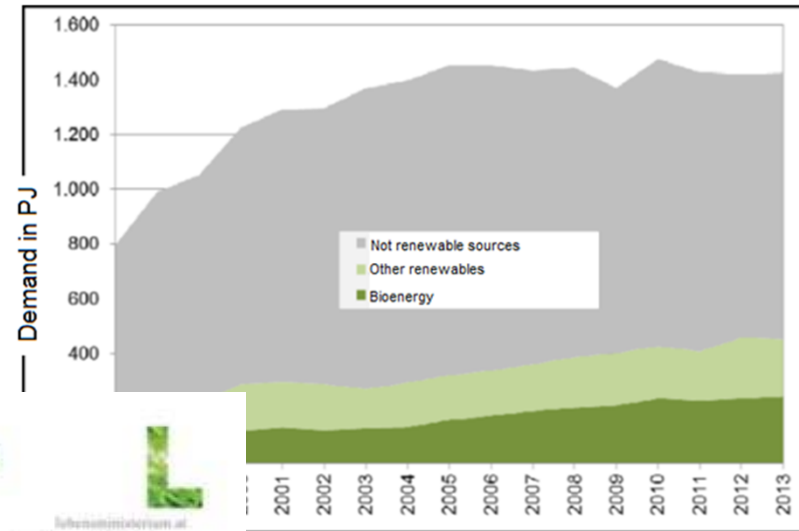
Prof. Hermann Hofbauer

Participation in IEA Bioenergy Task 33 is financed by

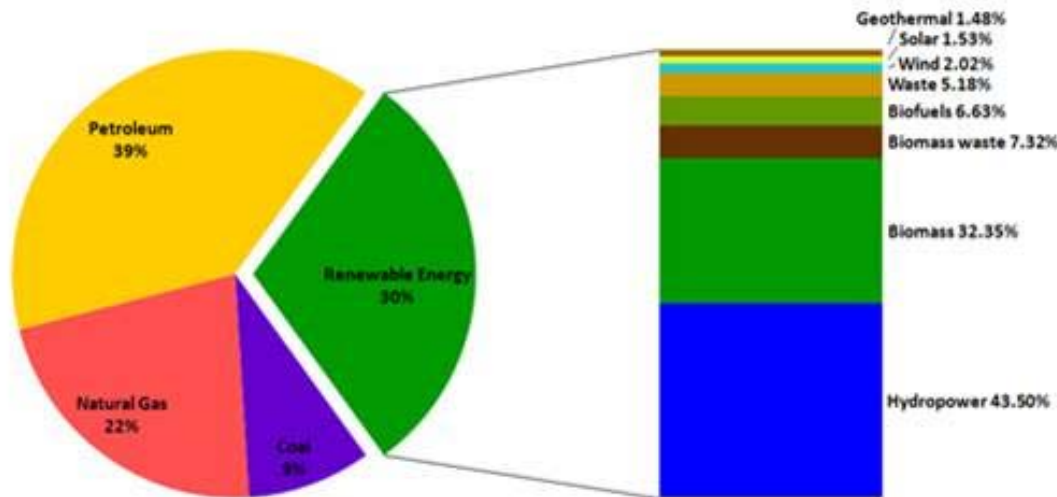


Content

- Statistics
- Research organisations
- Companies
- Implementations



Share of Renewable Energy in Austria

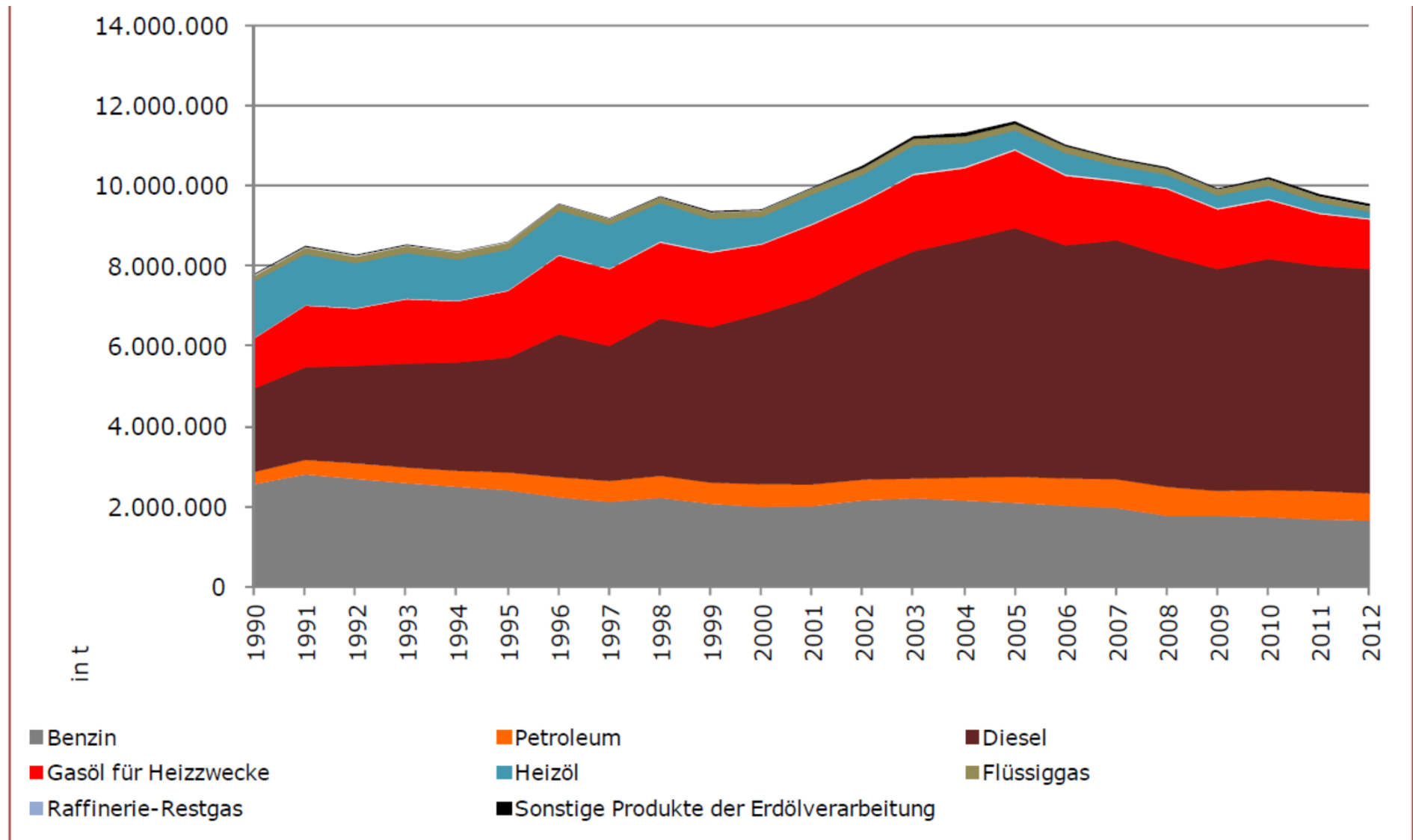


Source: Statistik Austria (2015)

	Primary production (thousand toe)		Share of total, 2013 (%)				
	2003	2013	Solar energy	Biomass & waste	Geothermal energy	Hydropower	Wind energy
EU-28	104 094	191 951	5.5	64.2	3.1	16.6	10.5
Belgium	708	2 929	8.4	79.7	0.1	1.1	10.7
Bulgaria	952	1 826	7.5	65.0	1.8	19.2	6.5
Czech Republic	1 663	3 640	5.2	87.2	0.0	6.5	1.1
Denmark	2 252	3 240	2.1	68.1	0.2	0.0	29.5
Germany	12 614	33 680	9.6	70.8	0.4	5.9	13.2
Estonia	667	1 122	0.0	95.7	0.0	0.2	4.1
Ireland	235	766	1.5	41.0	0.0	6.5	51.0
Greece	1 538	2 487	20.1	43.1	0.5	21.9	14.3
Spain	9 195	17 377	15.4	39.6	0.1	18.2	26.7
France	15 521	23 073	2.1	64.5	1.0	26.3	6.0
Croatia	800	1 499	0.6	50.1	0.5	45.9	3.0
Italy	9 999	23 500	8.6	45.3	21.3	19.3	5.5
Cyprus	48	109	64.1	16.3	1.4	0.0	18.3
Latvia	1 728	2 137	0.0	87.8	0.0	11.7	0.5
Lithuania	794	1 288	0.3	92.1	0.1	3.5	4.0
Luxembourg	41	107	8.2	75.5	0.0	9.6	6.6
Hungary	906	2 074	0.4	90.3	5.4	0.9	3.0
Malta	0	10	72.6	27.4	0.0	0.0	0.0
Netherlands	1 625	4 294	1.6	86.3	0.6	0.2	11.3
Austria	6 130	9 466	2.4	56.2	0.4	38.1	2.9
Poland	4 150	8 512	0.2	91.1	0.2	2.5	6.1
Portugal	4 241	5 621	2.0	55.4	3.2	21.0	18.4
Romania	4 002	5 561	0.7	68.8	0.5	23.1	7.0
Slovenia	714	1 071	2.6	56.7	3.6	37.0	0.0
Slovakia	651	1 467	3.8	67.3	0.4	28.4	0.0
Finland	7 887	9 934	0.0	88.2	0.0	11.1	0.7
Sweden	12 389	16 770	0.1	63.4	0.0	31.5	5.0
United Kingdom	2 642	8 404	4.3	61.7	0.0	4.8	29.1
Norway	10 277	12 458	0.0	10.0	0.0	88.7	1.3
Montenegro	0	389	0.0	44.7	0.0	55.3	0.0
FYR of Macedonia	313	304	0.3	52.0	3.0	44.8	0.0
Albania	620	812	1.5	24.8	0.0	73.7	0.0
Serbia	1 750	1 989	0.0	55.7	0.2	44.1	0.0
Turkey	10 021	13 718	5.8	33.0	19.2	37.2	4.7

Source: Eurostat (online data codes: ten00081 and nrg_107a)

Fuel consumption in Austria



Austrian Research Organisations

Graz University of Technology – Institute of Thermal Engineering

- Heat pipe reformer (former Technical University Munich, Prof. Jürgen Karl changed to University of Erlangen, Germany, work is still going on in Graz)
- Small scale CHP with heat pipe reformer
- Distributed SNG production
- **Fixed bed gasification**
- Health, Safety and environmental issues for gasification systems

Joanneum Research Graz - Department of Energy Research

- Life Cycle Assessment
- Microchannel FT technology

MCI – University of Applied Sciences for Environmental-, Process- and Biotechnology, Innsbruck

- Multi-staged fixed bed gasification systems

Bioenergy 2020+ (location Wieselburg)

- 1st and 2nd generation biofuels
- Representative of Austria in IEA Bioenergy Task 39 liquid biofuels
- Secretary of IEA Advanced Motor Fuels

Austrian Research Organisations

Bioenergy 2020+ (location Güssing) together with TU Vienna

- Production of FT liquids
- Production of Hydrogen (as polygeneration in Oberwart and full conversion in Güssing)
- Mixed alcohols
- BioSNG
- Waste gasification in FICFB gasifier

Vienna University of Technology, Institute of Chemical Engineering

- R&D in dual fluidised bed steam gasification (G-volution)
- Production of Fischer Tropsch fuels
- Production of hydrogen for refineries
- Scientific Partner in Bioenergy 2020+
- Representative of Austria in IEA Bioenergy Task 33 Thermal Gasification of Biomass

Austrian companies

- **Andritz including AE&E** (Andritz Energy & Environment)
 - No activities with FICFB, has still patent
 - Involved in Skive (over Carbona)
 - www.andritz.com

- **AGT Agency for Green Technology**
 - Low Temperature Conversion (LTC) is a thermo catalytic decomposition process operating without air supply
 - <http://www.agt-international.eu/>

- ~~▪ **Cleanstgas** (Clean staged gasification)
 - joint venture between EBNER Industrieofenbau and KWB Biomasseheizungen
 - affordable, decentralized, efficient power plants to supply the base load of heat and power
 - www.cleanstgas.com~~

- **GE Jenbacher**
 - <http://www.jenbacher.com>

- **Güssing Renewable Energy (GREG)**
 - FICFB gasifiers for CHP, BioSNG and other synthesis (sister company of the biomass CHP Güssing)
 - <http://www.gussingrenewable.com/>

Austrian companies

- **Repotec**
 - Engineering of FICFB gasifiers for CHP, BioSNG and other synthesis (Güssing, Ulm, Göteborg)
 - <http://www.repotec.at>

- **SynCraft Engineering GmbH**
 - <http://www.syncraft.at>

- **Urbas**
 - fixed bed gasification
 - <http://www.urbas.at>

- **Xylogas**
 - fixed bed gasification
 - <http://www.xylogas.com>

- **ZT Lettner**
 - <http://www.zt-lettner.at>

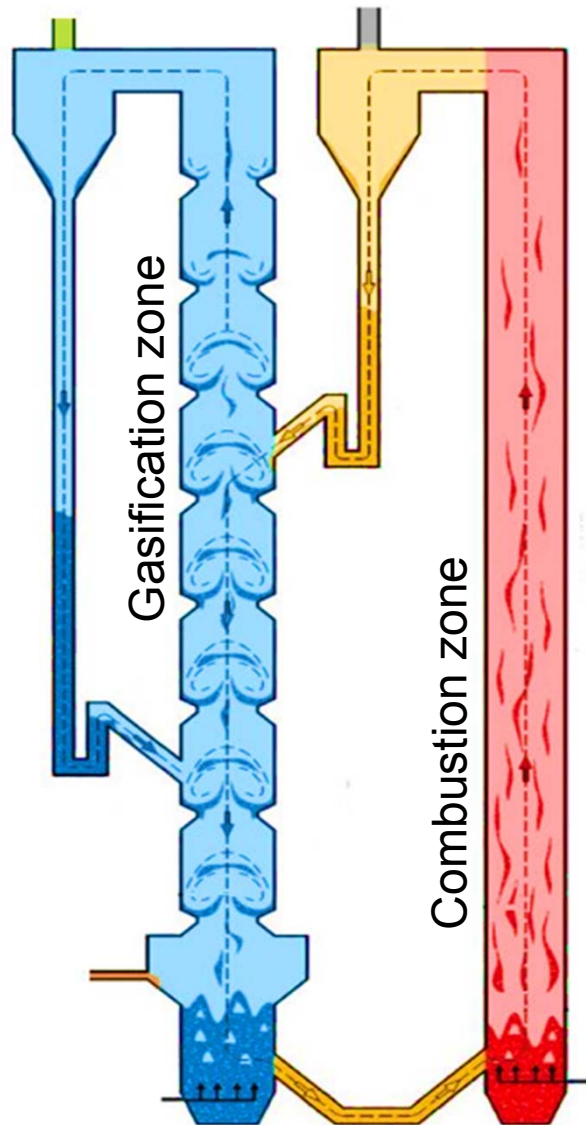
Commercial FICFB gasifiers

Location	Usage / Product	Fuel / Product MW, MW	Start up	Supplier	Status
Güssing, AT	Gas engine	8.0 _{fuel} / 2.0 _{el}	2002	AE&E, Repotec	Operational
Oberwart, AT	Gas engine / ORC / H ₂	8.5 _{fuel} / 2.8 _{el}	2008	Ortner Anlagenbau	Operational
Villach, AT	Gas engine	15 _{fuel} / 3.7 _{el}	2010	Ortner Anlagenbau	On hold
Senden/Ulm, D E	Gas engine / ORC	14 _{fuel} / 5 _{el}	2011	Repotec	Operational
Burgeis, IT	Gas engine	2 _{fuel} / 0.5 _{el}	2012	Repotec, RevoGas	Operational
Göteborg, Sweden	BioSNG	32 _{fuel} / 20 _{BioSNG}	2013	Repotec/ Valmet	Operational
California	R&D	1 MW _{fuel}	2013	GREG	Operational
Gaya, France	BioSNG R&D	0,5 MW _{fuel}	2016	Repotec	Under construction
Thailand	Gas engine	4 _{fuel} / 1 _{el}	2016	GREG	Under construction

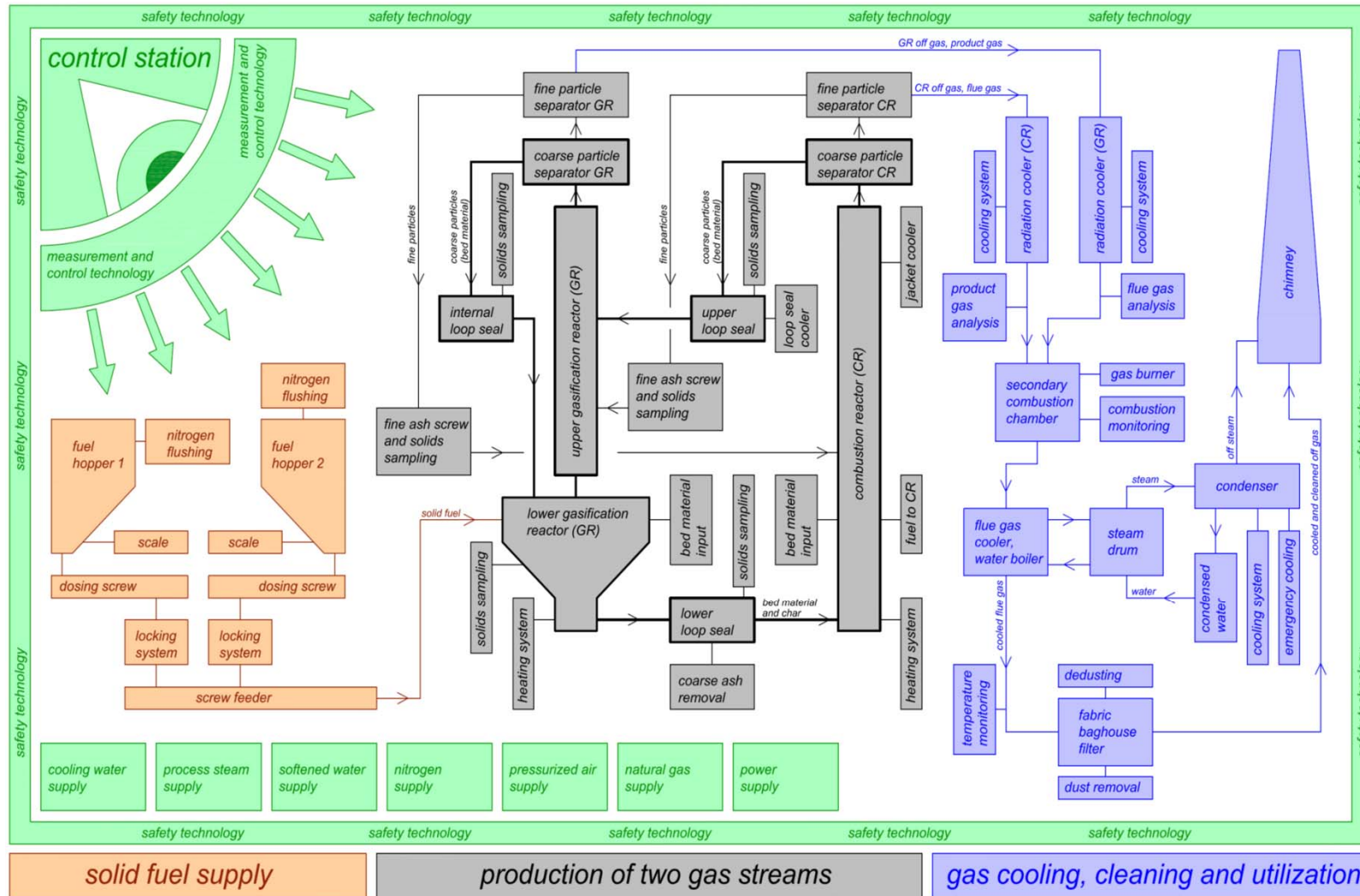
Commercial CHP gasifiers

- Companies active in Austria

Company	Output kW el/th	Technology
Christof Group REP	13/31 20/45	Fixed bed
Spanner RE ²	20/48 30/73 45/108	Fixed bed
Syncraft	180/270 280/550	Staged gasification
Urbas	150/300 280/550	Fixed bed
Xylogas	50/105 220/410 440/870	Fixed bed
Holzenergie Wegscheid	125/230	Fixed bed
Fröling	50/107	Fixed bed
Burkhard	180/240	Fixed bed



- no more limit in scaling-up, as there is no stationary fluidized bed anymore
- excellent gas-solids contact between catalytic bed material and product gas, so lower tar content
- increases of residence times for fuel particles as well as gases with regard to gas-solids interaction
- solids residence time distribution resembles a cascade of stirred vessels (dispersed downward movement of solids)
- 100 kW pilot plant at Vienna, University of Technology is in commissioning phase



- **Dual fluidized bed plant size:**

- Height: 7.5 m
- Base area: 35 m² per floor

- **Engineering:**

- 70 Detailed design plans
- 20 Lay-out plans

- **Measurements for PLC:**

- 105 Temperatures
- 70 Pressures
- 13 Volume/mass flows
- 4 Level indicators
- 22 Values of gas analyses
- 5 Speeds of rotation
- 2 Measurements of weight



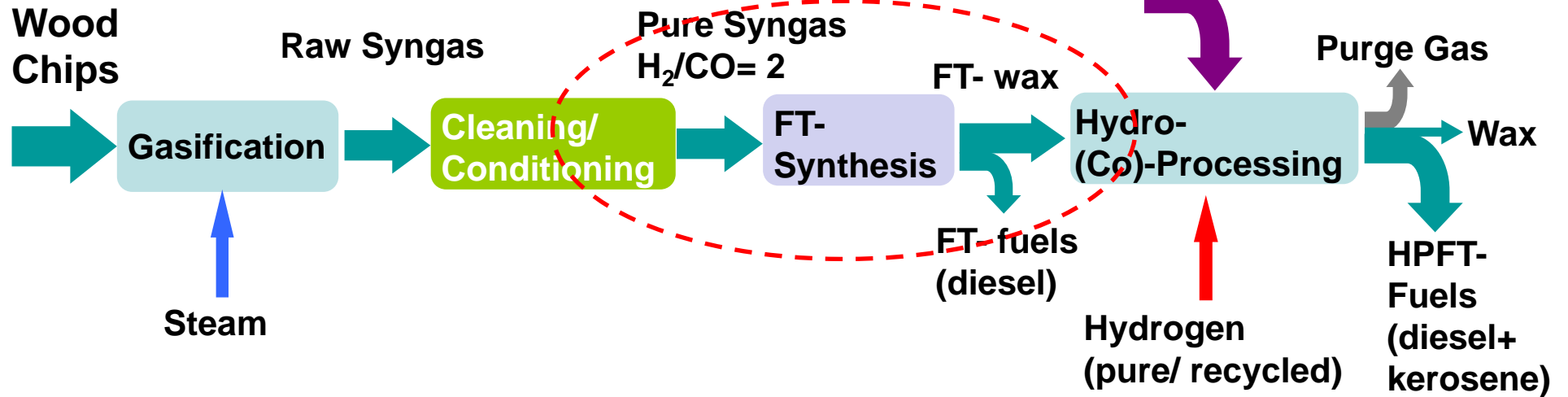
Synthetic Biofuels (FT- Route)



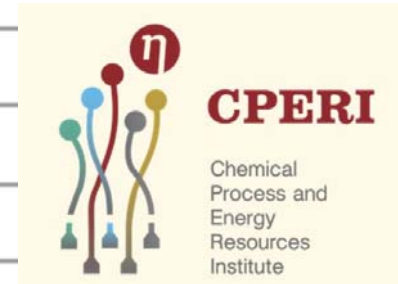
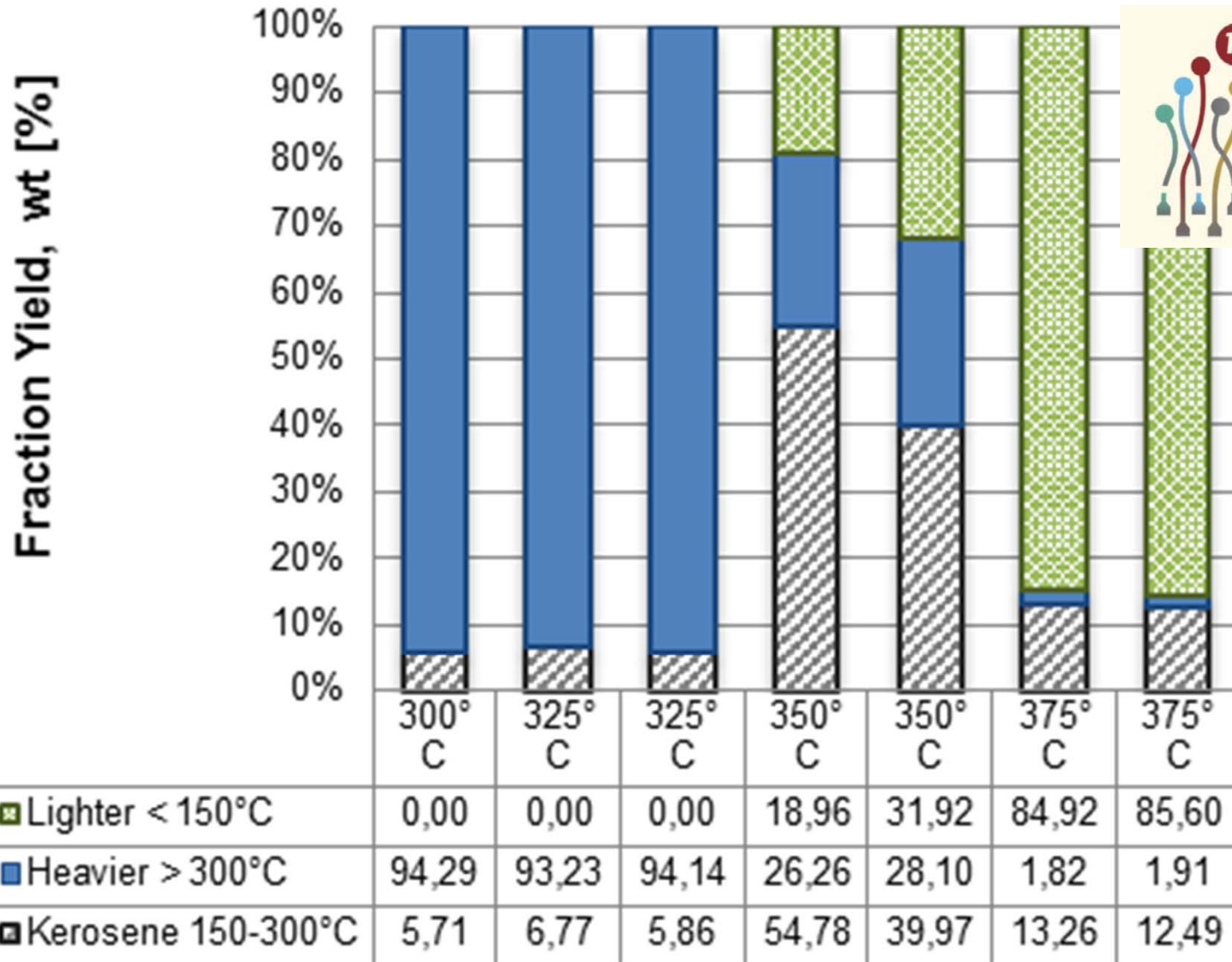
Cellulose
Hemicellulose
Lignin



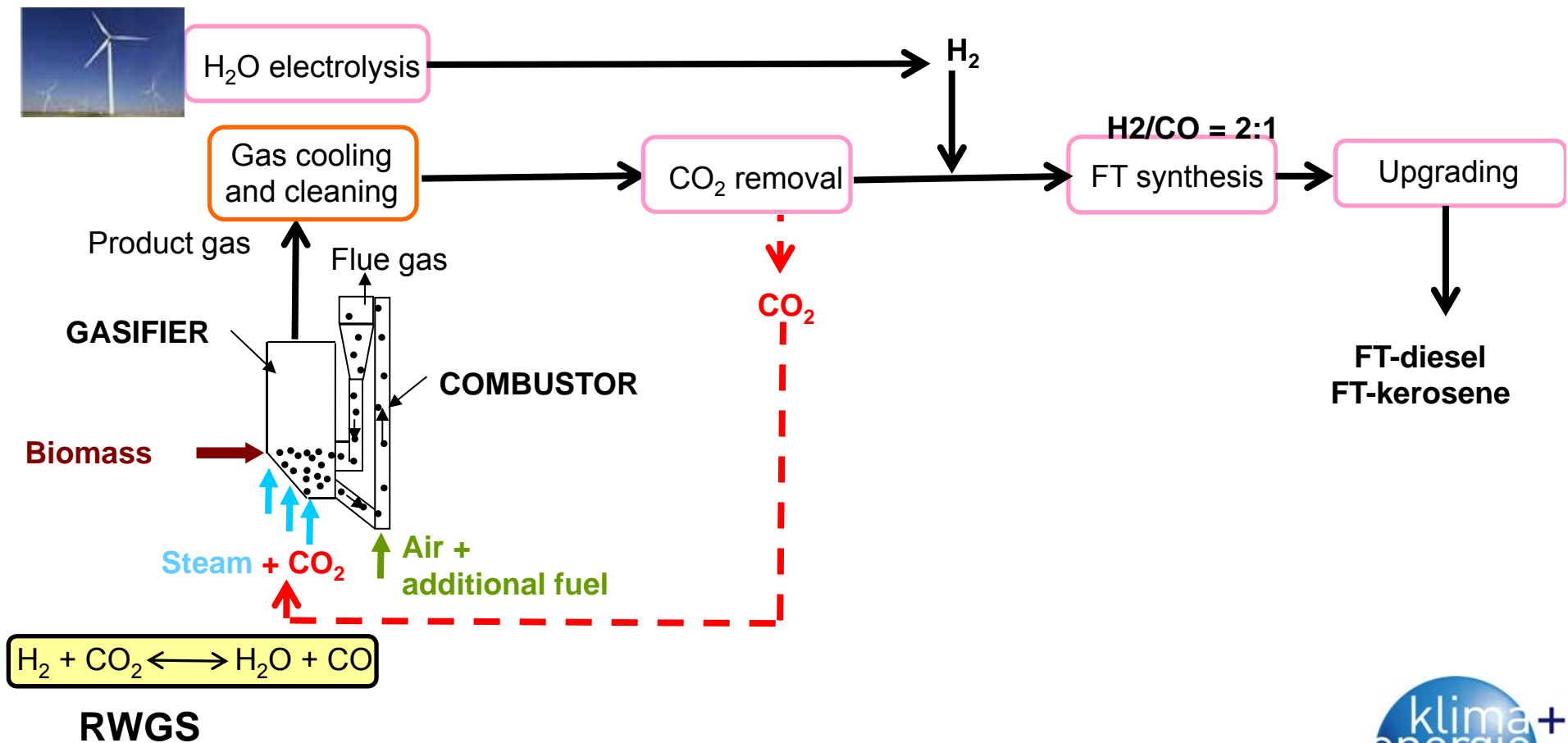
i/n- paraffins
(hydrocarbons)



Kerosene from Wood

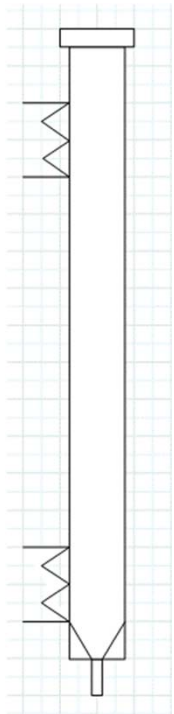


Conversion of wind and photovoltaic to transportation fuels



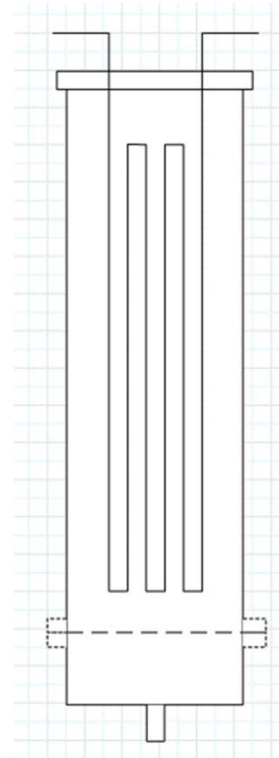
Slurry Reactor: scaling up to 1bpd

- The actual reactor setup in the pilot plant



- One through flow without recycling of offgas.
- Ratio height diameter $H/D \approx 20$.
- Coupled heating devices.
- Conical gas distributor geometry.

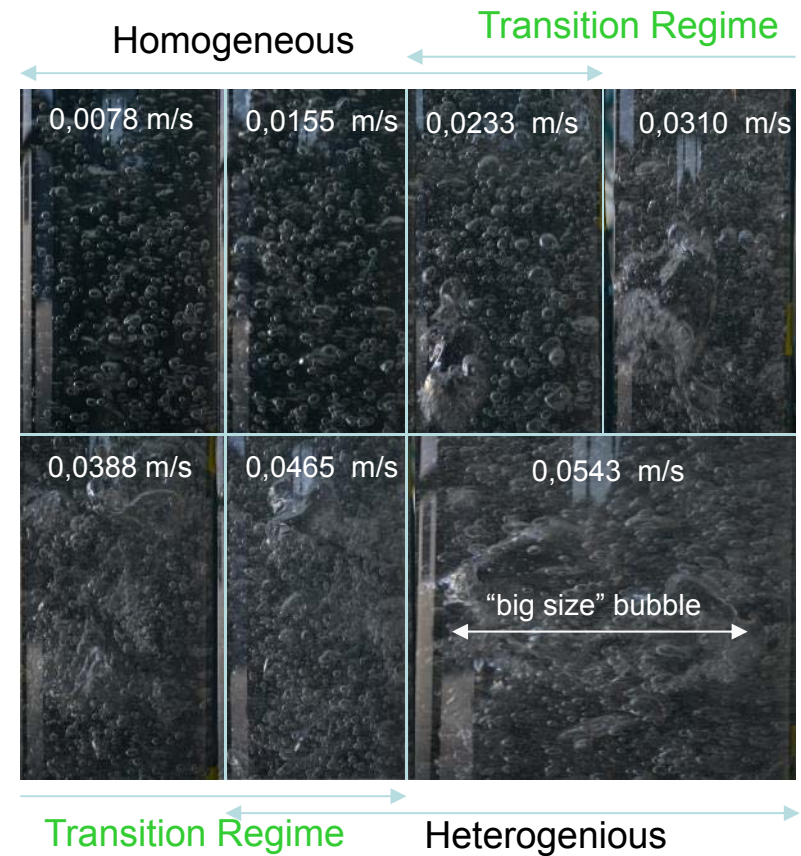
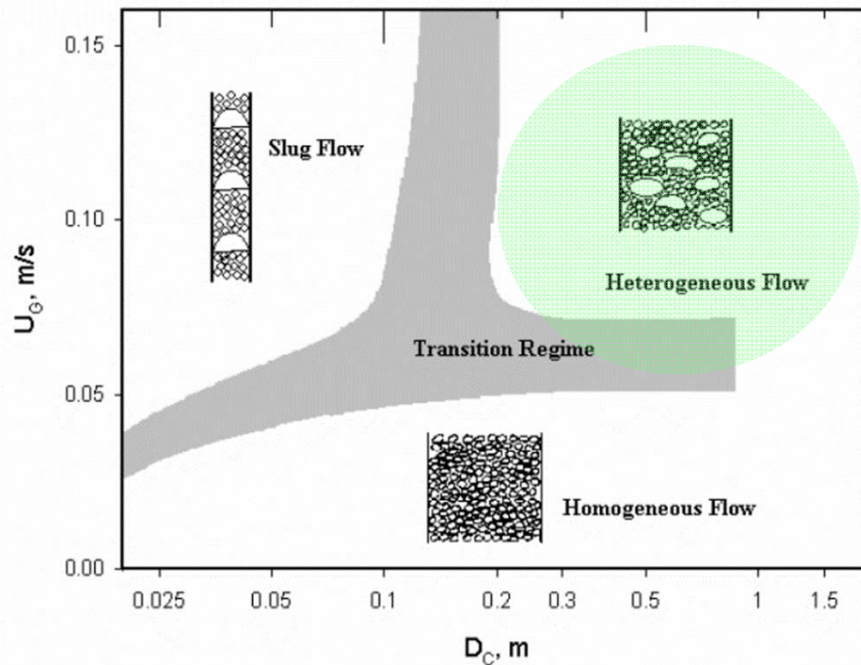
- What is our aim?



- Reactor for different flow configurations:
 - One Through Flow
 - With Recycling of Offgas
 - Recycling + Steam Reforming
- Height/Diameter ≈ 7 .
- Integration of a heating exchanger system.
- Flat gas distributor geometry.

- Different Flow Regimes**

Typical Flow-Regime Map for the Bubble Column Reactor (1)

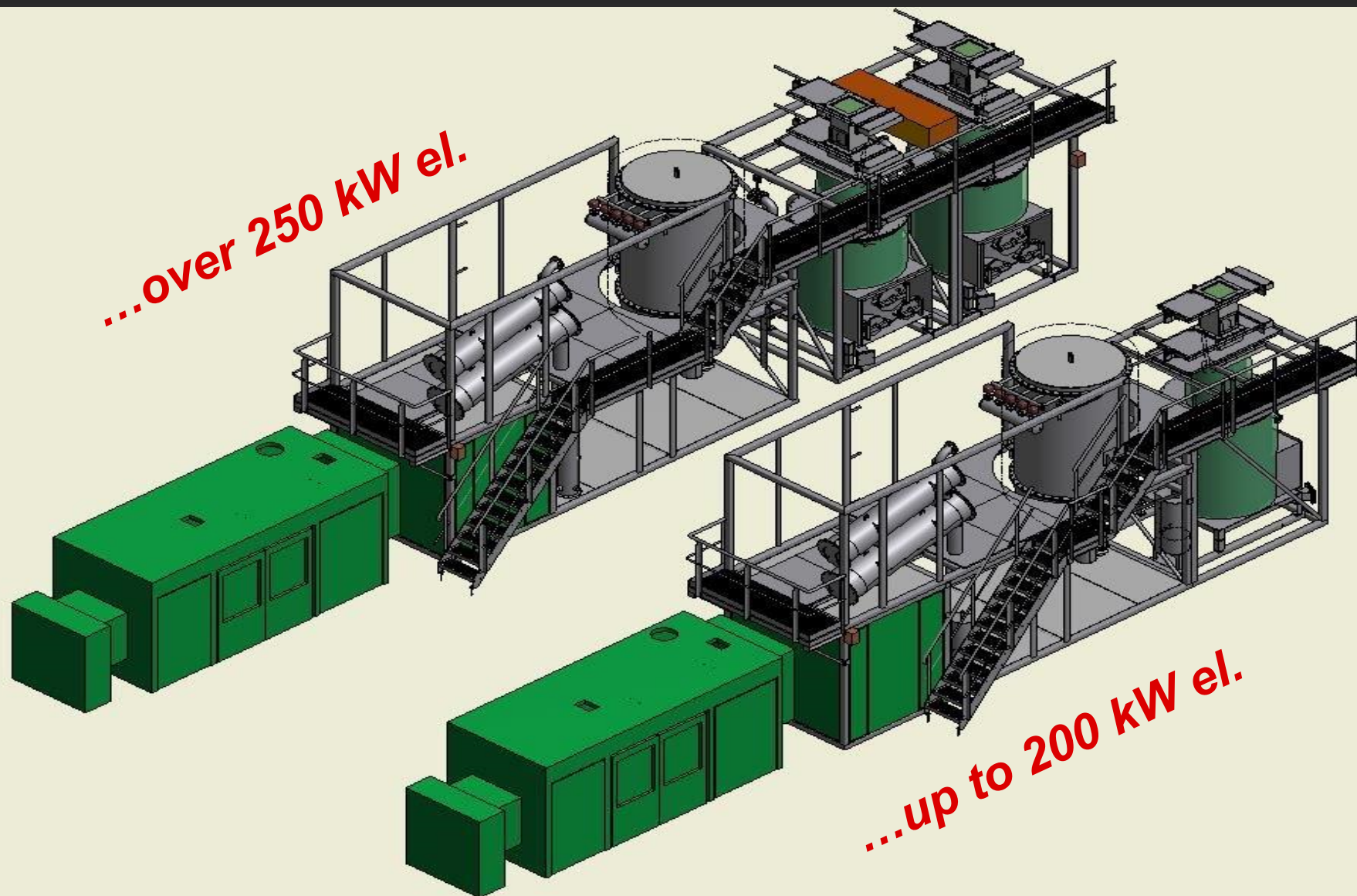


Commercial CHP gasifiers



Commercial CHP gasifiers

Location	Product kW	Start up
Ruden, AT	150el./300th. 70el./150th.	Development since 2001
Eberndorf, AT	2x120el. + 70el./650th.	2006-2008
Neumarkt, AT	2x120el./580th.	2008
Sulzbach-Laufen, DE	130el./280th.	2009
Neukirchen, AT	2x140el./600th.	2011
Konstanz, DE	140el./300th.	End of 2011
Mallnitz, AT	250el./550th.	11/2013
Balingen, DE	150el./280th.	12/2013
Berlin, DE	2x150el./560th.	04/2014
Cogen Srl., Terni, IT	199 el./350th.	07/2014
Calvello, IT	199el./350th.	09/2014



...over 250 kW el.

...up to 200 kW el.

Holzstrom GmbH – Neukirchen (A)

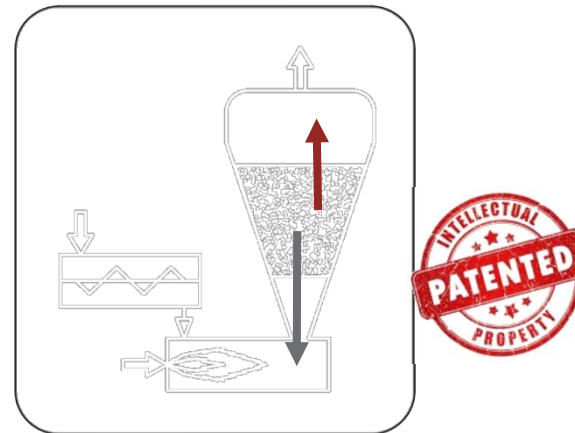
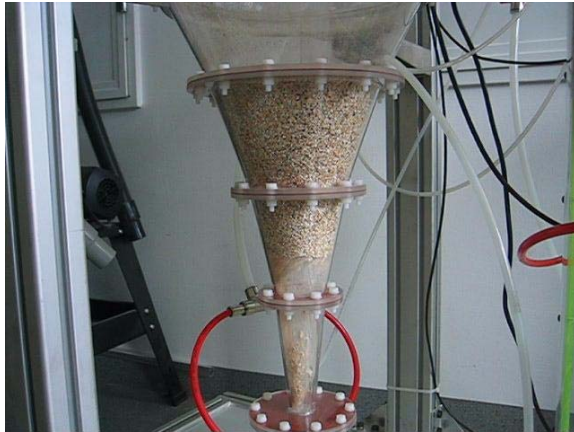
2x140 kW_{el.}

2x300 kW_{th.}

*District
heating*



About the company



- Founded in 2007
- Development, Planning and Realization of biomass gasification plants called CraftWERK
- Spin-off MCI / tyrolean university of applied sciences

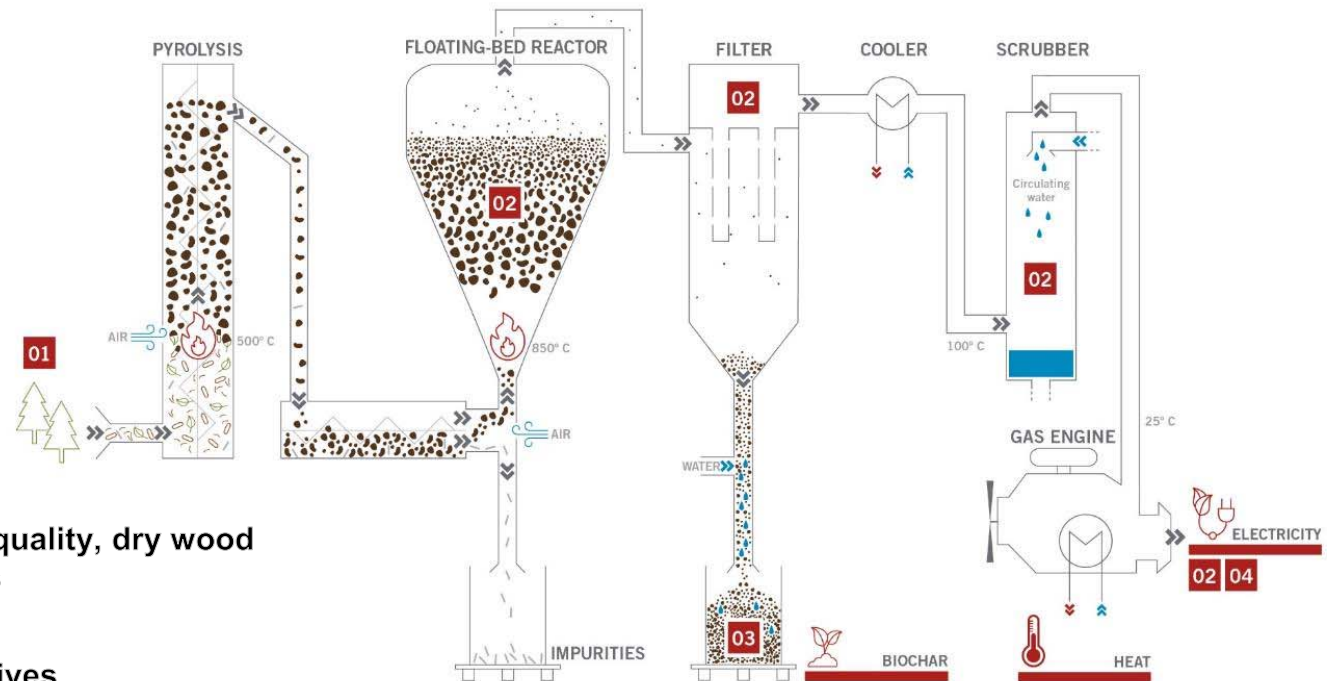
SynCraft provides wood-gas power plants
in a range from

185kW electric / 296kW thermal up to
324kW electric / 496kW thermal

under the brand name

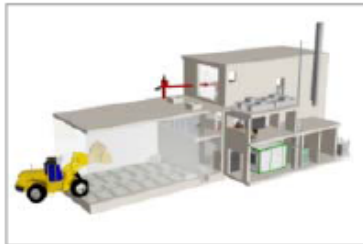
CraftWERK

Technology



- 1 Operates on low quality, dry wood chips including bark and fines**
- 2 No need for additives.
Still the condensate is as clear as water and free of tar**
- 3 By-product
premium quality charcoal**
- 4 30% overall electric efficiency
due to high-tech gas engines**

References



CraftWERK / Innsbruck / AT

Currently under final approval together with 3 other plants in Austria. Commissioning 2016.



CraftWERK / Dornbirn / AT

The plant in Dornbirn has been commissioned December 2014. In its first year of operation it is about to reach an availability of 87%.



CraftWERK / Vierschach / IT

The plant in Italy has been our first commercial plant that has been added to an existing 1.2 MW biomass boiler in 2011/12. In commercial operation since April 2014.



CraftWERK / Schwaz / AT

The Alpha plant has been built in 2009 on the site of the Stadtwerke Schwaz and is since then used as development platform for our technology.

8TH INTERNATIONAL CONFERENCE ON APPLICATION OF BIOMASS GASIFICATION

FEE DAS INNOVATIONSNETZWERK
Fördergesellschaft
Erneuerbare Energien e.V.

MCI
MANAGEMENT CENTER
WIEN VIENNA

IEA Bioenergy

8:00 Registrierung & Kaffee
Registration and coffee

9:00 Eröffnung & Begrüßung
Conference opening and welcome
Dr. Günther Herdin, FEE
Dr. Andreas Altmann, MCI
Dr. Reinhard Rauch, IEA

BLOCK 1 Chancen und Perspektiven der
Biomassevergasung

SESSION 1 Opportunities and prospects of
biomass gasification

Moderation Dr. Günther Herdin

9:15 Das kommerzielle Potenzial der vergasungs-
basierten KWK-Anlagen in Europa
*Potential of gasification-based CHP plants
for European commercialization*
Gustav Melin, President European
Biomass Association AEBIOM (EU)

9:45 Chancen der thermochemischen
Vergasung von Biomasse im
liberalisierten Energiemarkt
*Opportunities of thermochemical biomass
gasification in a liberalized energy market*
Prof. Jürgen Karl, Friedrich-Alexander-
Universität Erlangen-Nürnberg (D)

10:15 Das große Potenzial der
Holzgaskraftwerke - Strom,
Grundlastwärme und Rohstoffflexibilität
*The great potential of wood-gas power
plants - Power, base load heat and fuel
flexibility*
Marcel Huber, MCI (A)

10:45 Weiterentwicklung der Zweibett-Wirbel-
schicht-Dampfvergasung an der TU Wien
*Development of dual fluid gasification
process at TU Wien*
Dr. Johannes Schmid, TU Wien (A)

11:15 Kaffeepause
Coffee break

BLOCK 2 Typische Anwendungen der
Biomassevergasung in der EU

SESSION 2 Typical applications of biomass
gasification in the EU

Moderation Dr. Reinhard Rauch

11:45 Das GoBiGas Projekt - Biomethan aus
Waldrestholz - von der Vision bis zur
Realisierung
*The GoBiGas Project - Biomethane from
Forest Residues - from Vision to Reality*
Lars Andersson, Göteborg Energi (S)

12:15 Aktueller Status der Biomasse-
und Abfallvergasung in Spanien
*On-Going status of biomass and waste
gasification in Spain*
Prof. Alberto Gómez-Barea,
University of Seville (E)

12:45 Holzvergasung in Finnland und
Skandinavien (IEA Task 33)
*Wood gasification in Finland and
Scandinavia*
Dr. Ilkka Hiltunen, VTT (FIN)

13:15 Mittagspause
Lunch break

14:15 Wirtschaftliche und rechtliche
Rahmenbedingungen der
Biomassevergasung in Italien -
Status quo und Ausblick
*Economic and legal framework
for biomass gasification in Italy -
status quo and outlook*
Gerd Huber, SYNECO (I)

BLOCK 3 Erfahrungsberichte europäischer
Anlagenbetreiber

SESSION 3 Experiences from European
plant operators

Moderation Dieter Bräukow

14:45 Erfahrungen zum Betrieb einer
SynCraft-Anlage
Experiences from a SynCraft plant operator
Tobias Ilg, EnergieWerk Ilg (A)

15:05 Erfahrungen zum Betrieb einer
ReGaWatt-Anlage
Experiences from a ReGaWatt plant operator
Johann Köck, Bio-Energie Holmernhof (D)

15:25 Erfahrungen zum Betrieb einer
URBAS-Anlage
Experiences from a URBAS plant operator
Johann Wurhofer, HolzStrom (A)

15:45 Kaffeepause
Coffee break

16:15 Erfahrungen zum Betrieb einer
Spanner Re²-Anlage
Experiences from a Spanner Re² plant operator
Dzintars Avots, Green Energy Systems (LV)

16:35 Erfahrungen zum Betrieb einer
Burkhardt-Anlage
Experiences from a Burkhardt plant operator
Will Green, Edge Renewables (GB)

16:55 Erfahrungen zum Betrieb einer
Holzenergie Wegscheid-Anlage
*Experiences from a Holzenergie Wegscheid
plant operator*
Andrej Gyergyek, Zaga-Zora (SLO)

17:15 Fragen und Diskussion mit dem Publikum
Questions and discussion with the audience

17:35 Zusammenfassung und Ausblick
Summary and outlook
Prof. Tobias Zschunke,
Hochschule Zittau/Görlitz (D)

18:00 Ende der Veranstaltung
End of the event