Karlsruher Institut für Technologie

Country Activities and Reports: GERMANY

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

Thomas Kolb

IEA Bioenergy: Task 33 Thermal Gasification of Biomass

(Brief Update November 2012)

Linde Engineering Dresden purchases CHOREN's Carbo-V®-Technology

Dresden, 9 February 2012 – Linde Engineering Dresden GmbH has acquired the Carbo-V® Technology of the insolvent Choren Industries GmbH, Freiberg from the insolvency administrator Dr. Bruno M. Kübler.

The Carbo-V® Technology constitutes a multi-stage biomass gasification technology. During the first process stage, the biomass reacting in a Low Temperature Gasifier (LTG) is converted to biocoke and carbonization gas. The second process stage comprises the partial oxidation of the carbonization gas that takes place in a High Temperature Gasifier (HTG), and during the third process stage, the biocoke is blown into the hot gas stream of the HTG. After suitable preconditioning, the synthesis gas produced may be subsequently processed to "green" products e.g., biofuel of second generation like biodiesel. It is possible that wood and wood-based biomass, that already today can be produced in an environment friendly way will be used as feedstock for the gasification process.

"In the future we plan to offer the Carbo-V® Technology as licensor and also as an engineering and contracting company for commercial projects on a strongly growing market", says Jörg Linsenmaier, managing director of the Linde Engineering Dresden GmbH.

The acquisition of the Carbo-V® Technology comprises all related patents and trademarks.

The parties have agreed that the purchase price will remain undisclosed.

Linde Engineering Dresden GmbH, a subsidiary of the Linde Group, is one of the global leaders in the field of design, supply and construction of chemical, gas, biotechnology and pharmaceutical plants.

http://www.the-linde-group.com/en/news_and_media/press_releases/news_120209.html

bioliq® Plant – Total View

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Institute for Technical Chemistry, Gasification Technology
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bioliq® Plant – State of Construction

	Stage 1	Stage 2	Stage 3	Stage 4
Process	Fast pyrolysis + BioSyncrude production	HP Entrained flow gasification	Hot gas cleaning + DME-synthesis	Gasoline synthesis
Product	BioSyncrude	Synthesis gas	DME	Gasoline
Capacity	2 MW (500 kg/h)	5 MW (1 t/h)	150 kg/h	50 l/h
Realization	2008 In operation	2012 In commissioning	2012 In commissioning	
Partner	Lurgi/Air Liquide MAT Mischanlagentechnik	Lurgi/Air Liquide	MUT Advanced Heating Chemieanlagenbau Chemnitz	

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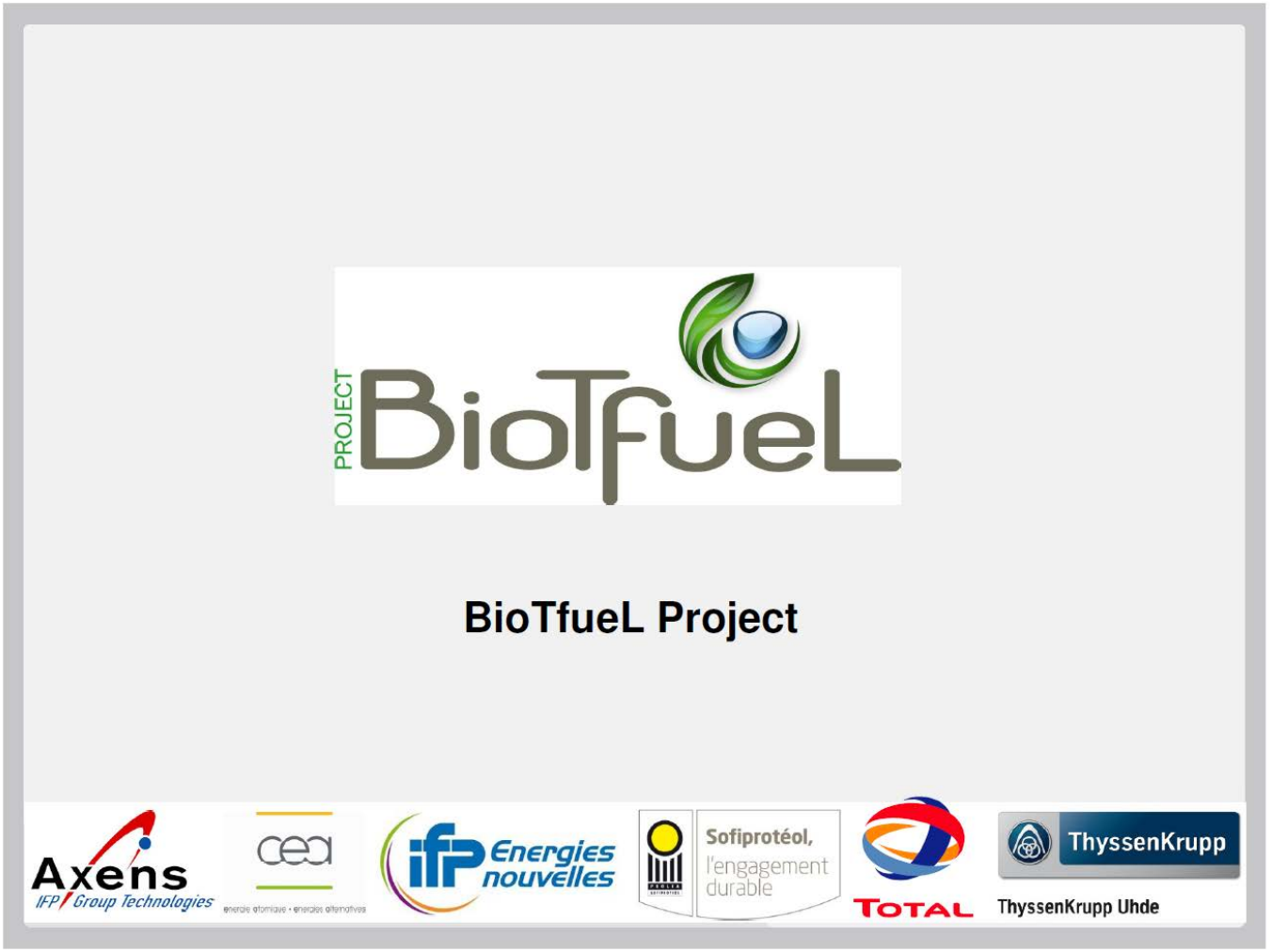
ThyssenKrupp Uhde: BioTfuel Project



Source: K. Radtke, SGG Gasification Seminar 2012

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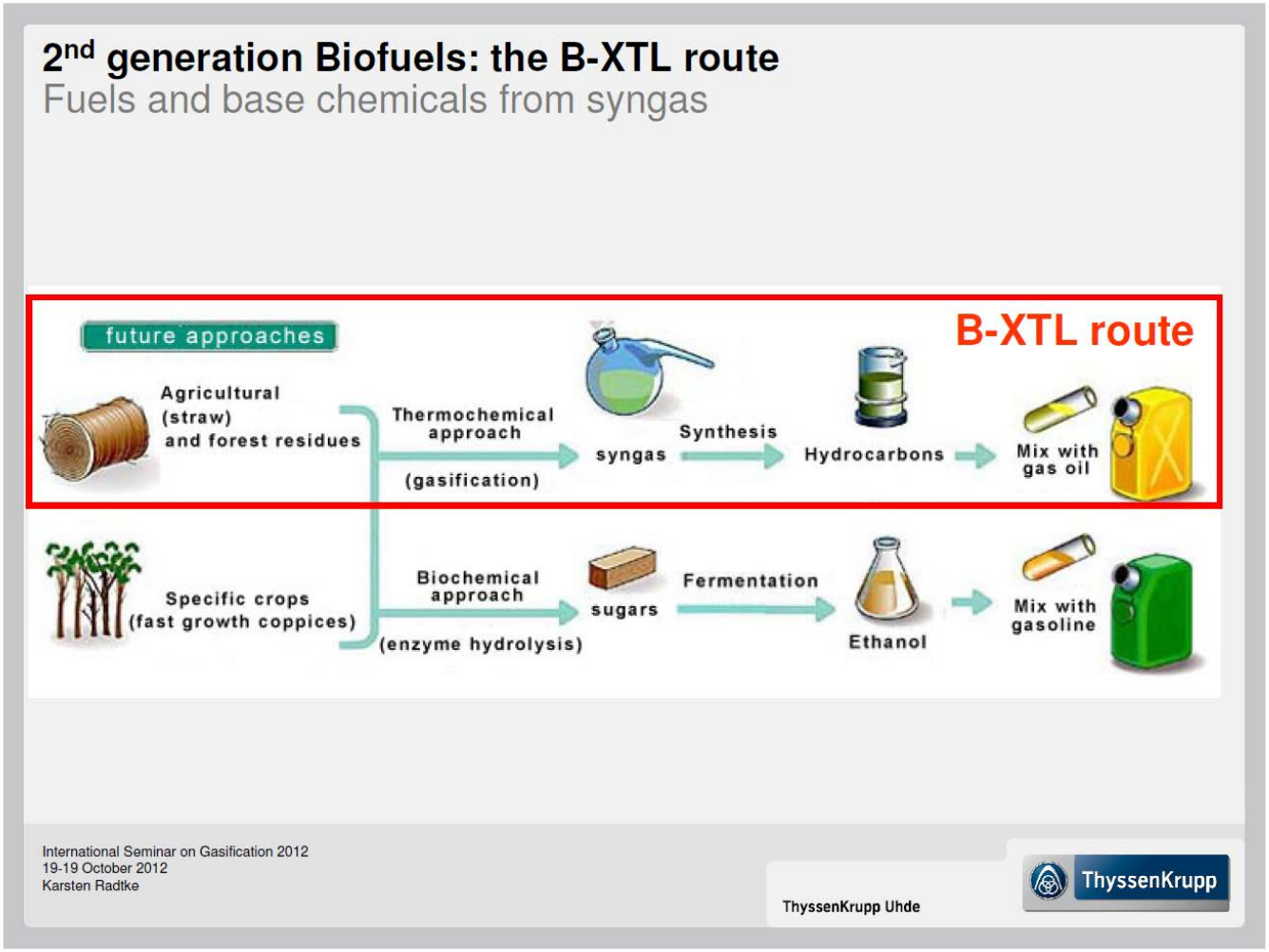
ThyssenKrupp Uhde: BioTfuel Project



Source: K. Radtke, SGG Gasification Seminar 2012

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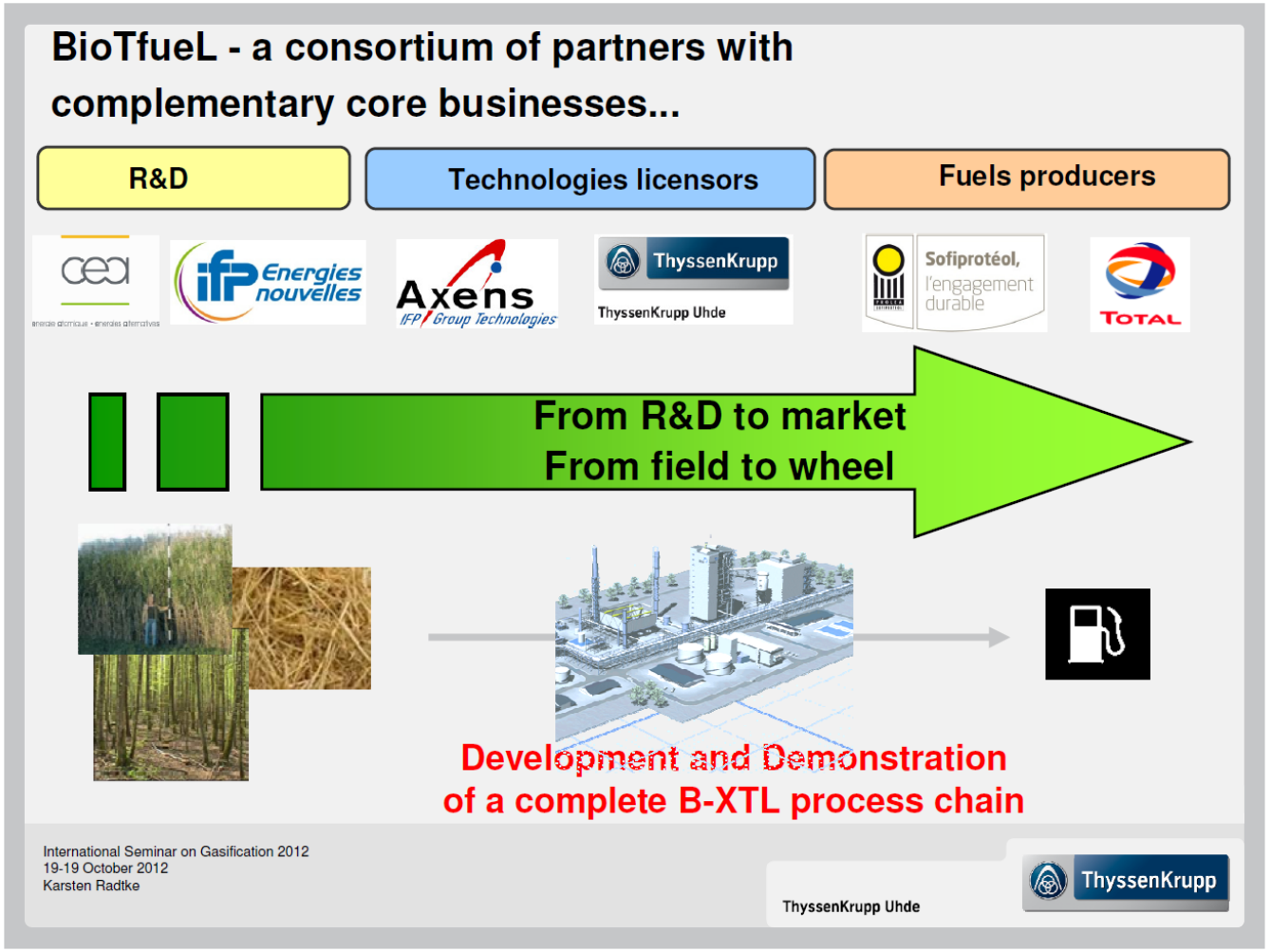
ThyssenKrupp Uhde: BioTfuel Project



Source: K. Radtke, SGG Gasification Seminar 2012

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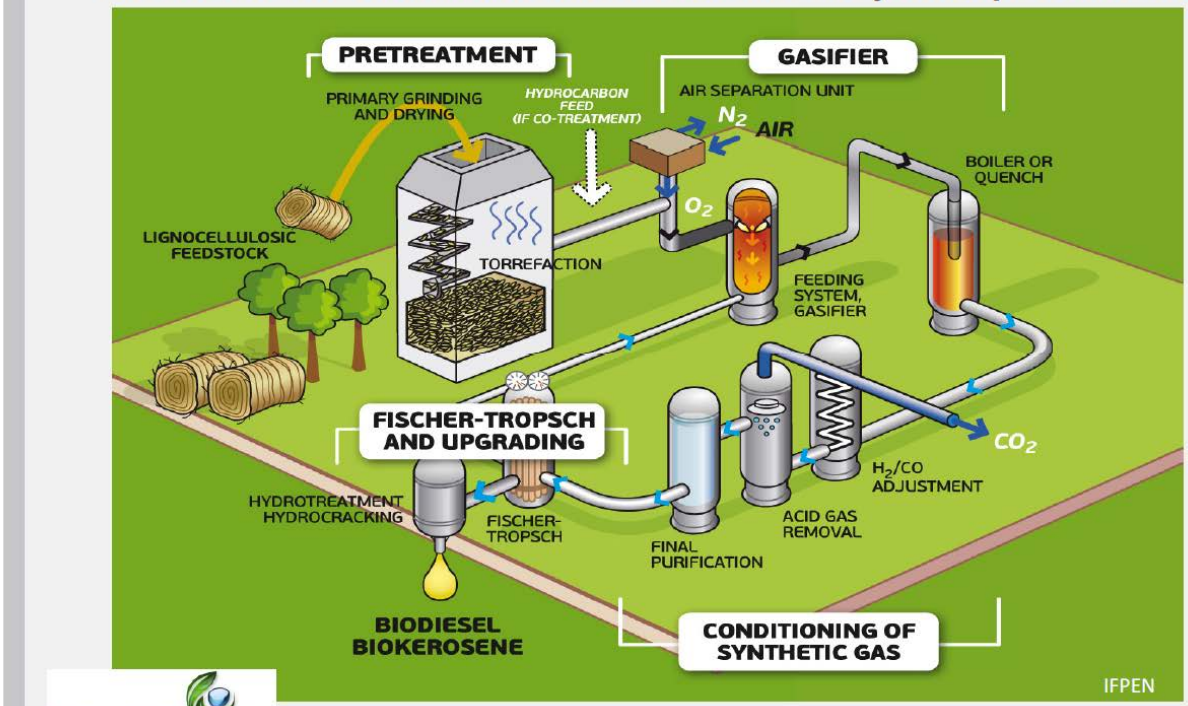
ThyssenKrupp Uhde: BioTfuel Project



Source: K. Radtke, SGG Gasification Seminar 2012

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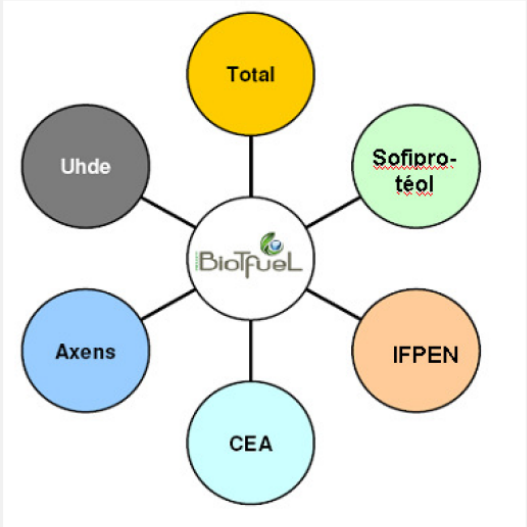
ThyssenKrupp Uhde: BioTfuel Project

BioTfueL main figures & objectives

- **BioTfueL project:**
  - **7** years programme [2010- 2016]
    - R&D = 7 years
    - EPC = 2 years
    - Test programs = 4 years
  - **6** partners
  - **2** sites for demo plants
    - Sofiprotéol Venette site
    - Total Dunkirk site
  - Budget = **112.7 M€**
    - Project Subsidies: 33.3 M€
      - ADEME: 30.1 M€
      - CRP: 3.2 M€



PICARDIE LA RÉGION

ADEME
Agence de l'Environnement et de la Maîtrise de l'Energie

International Seminar on Gasification 2012
19-19 October 2012
Karsten Radtke

ThyssenKrupp Uhde

ThyssenKrupp

Source: K. Radtke, SGG Gasification Seminar 2012

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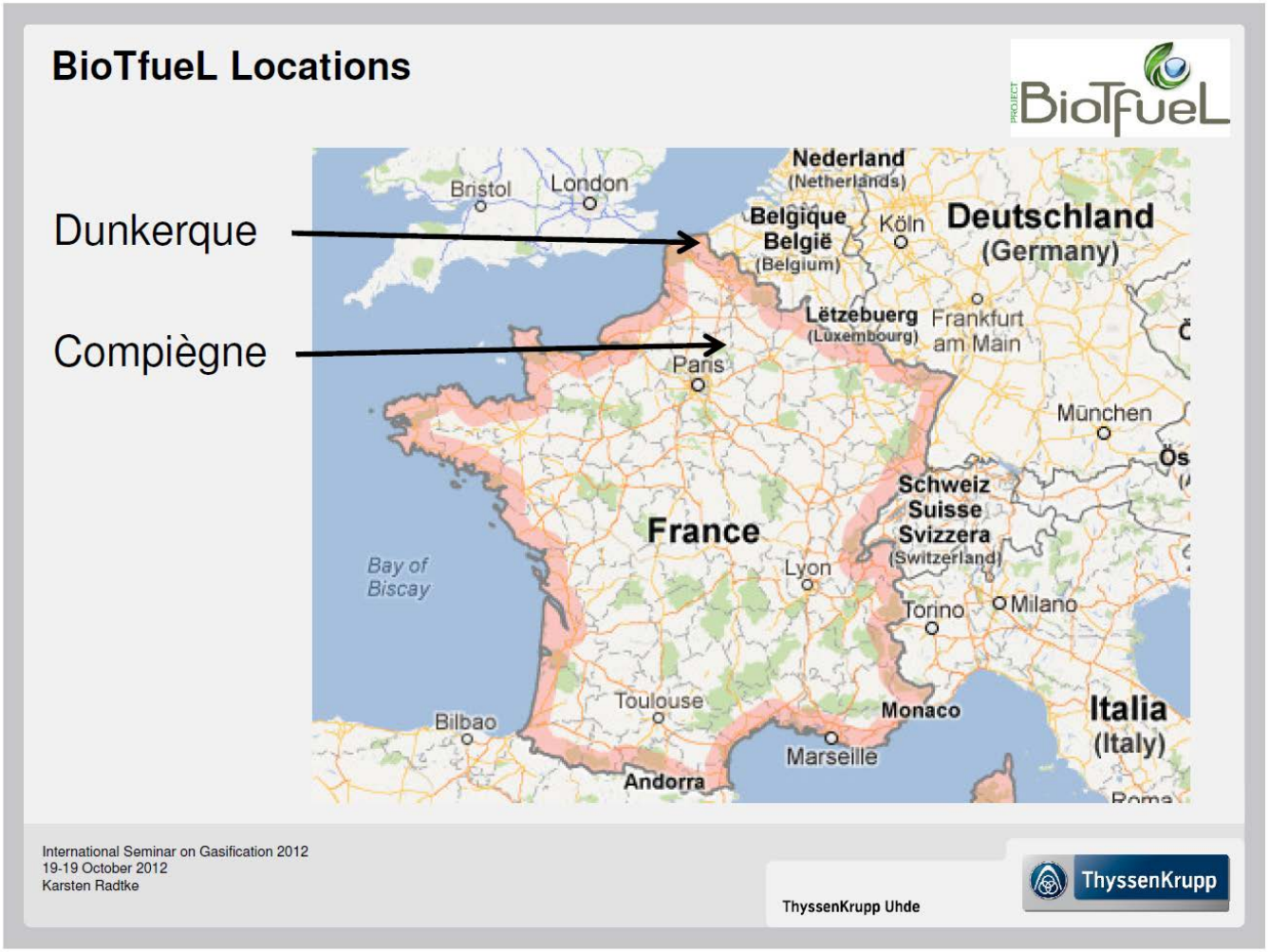
ThyssenKrupp Uhde: BioTfuel Project



Source: K. Radtke, SGG Gasification Seminar 2012

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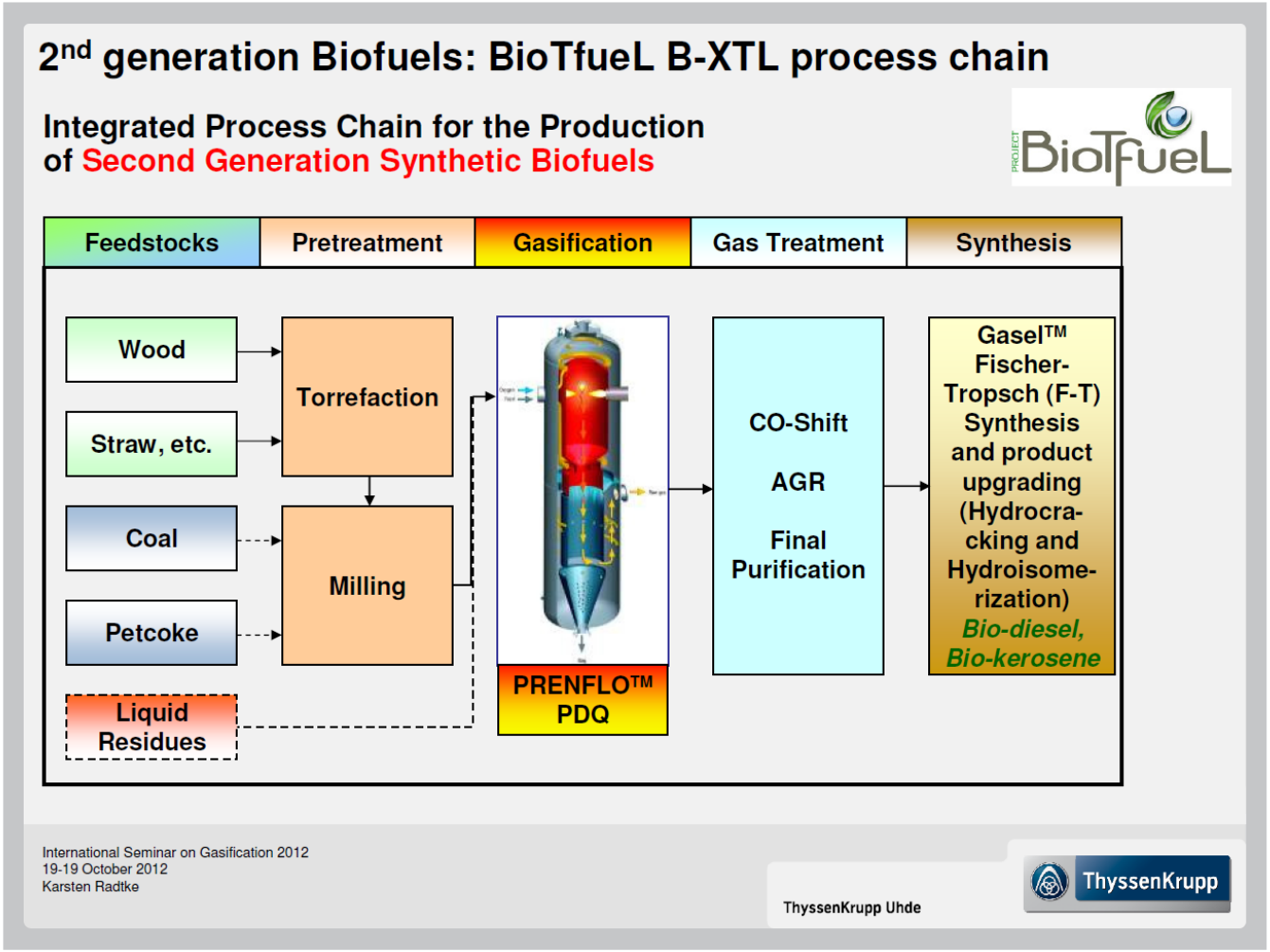
ThyssenKrupp Uhde: BioTfuel Project



Source: K. Radtke, SGG Gasification Seminar 2012

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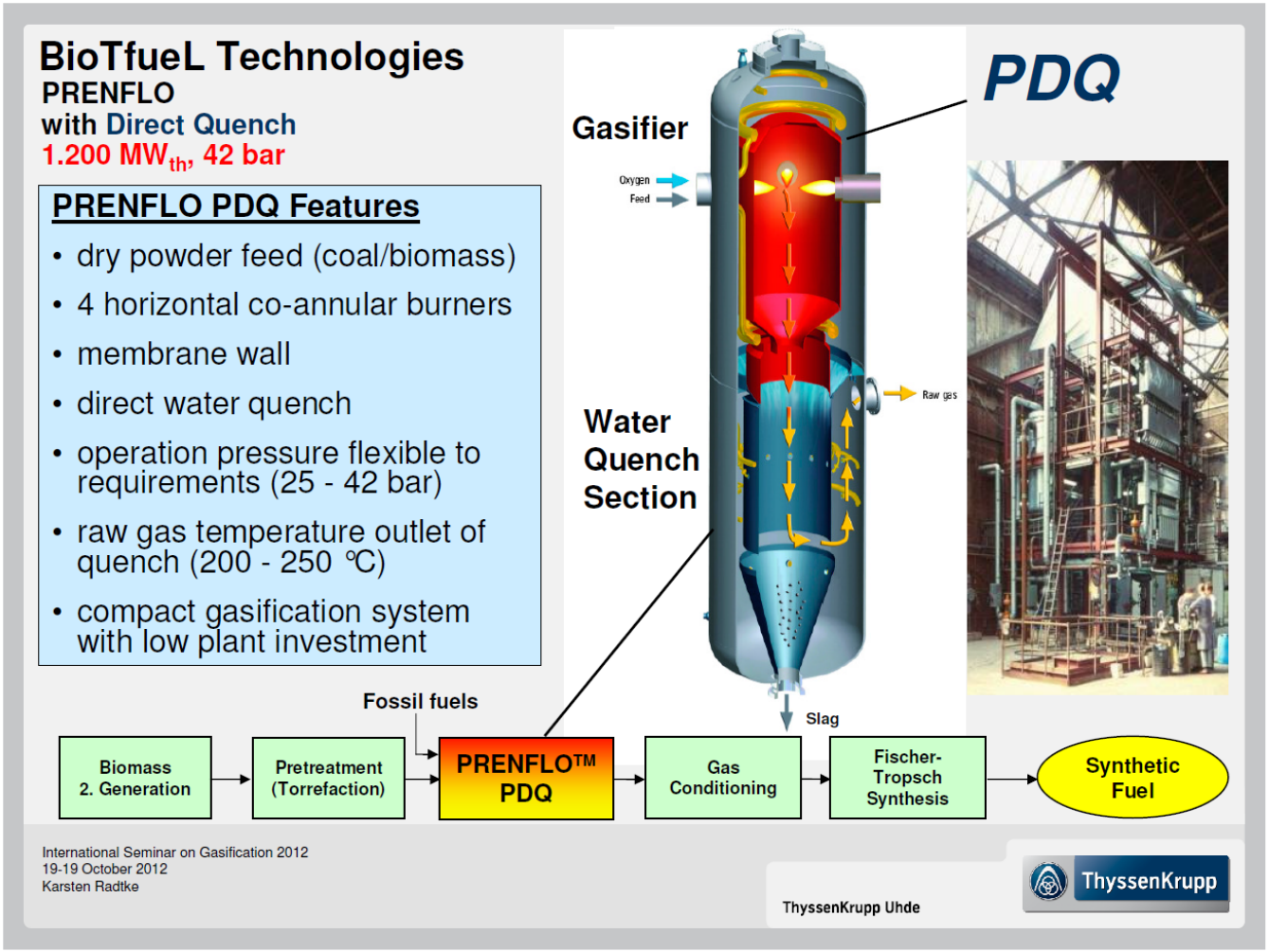
ThyssenKrupp Uhde: BioTfuel Project



Source: K. Radtke, SGG Gasification Seminar 2012

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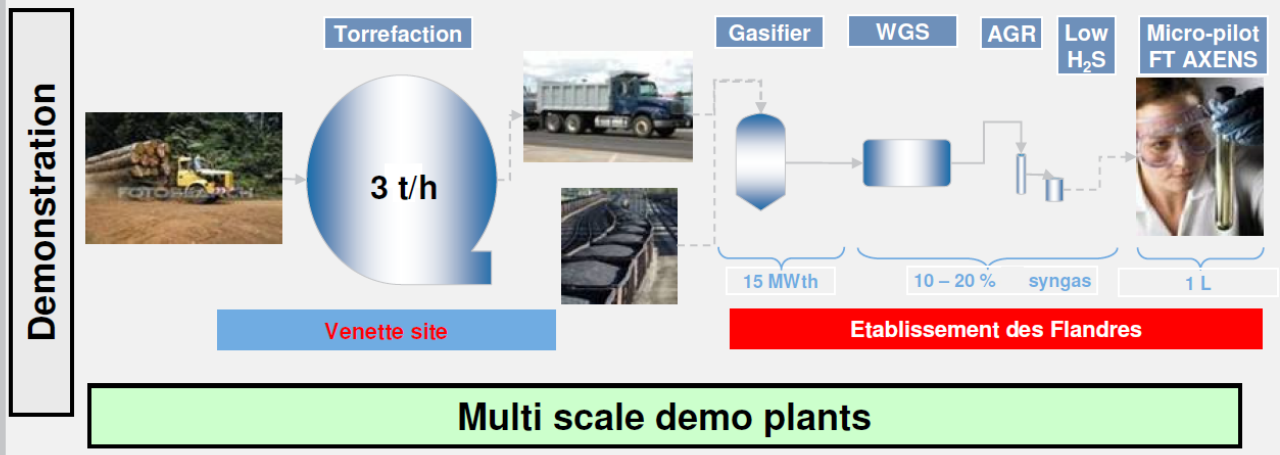
ThyssenKrupp Uhde: BioTfuel Project

BioTfueL main figures & objectives

- **BioTfueL demo plants:**
  - Multiple scale demo plants
    - to get scale-up data
    - to validate various scheme/configurations



International Seminar on Gasification 2012
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ThyssenKrupp Uhde

Source: K. Radtke, SGG Gasification Seminar 2012

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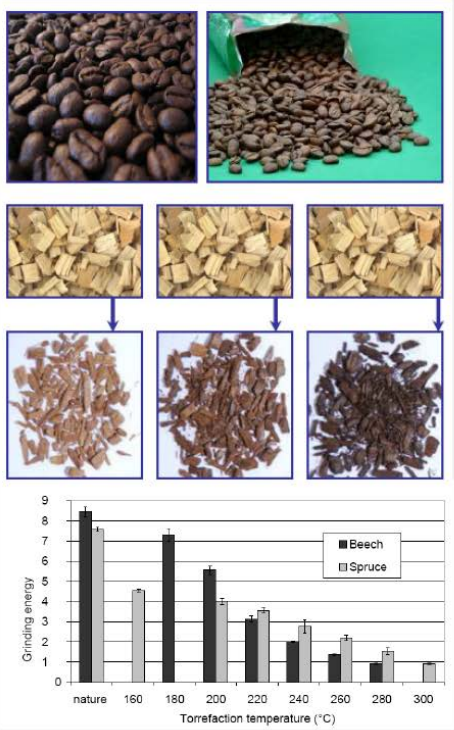
ThyssenKrupp Uhde: BioTfuel Project

BioTfueL Technologies

- **Biomass feedstock preparation:**
  - **Torrefaction**
    - ⇒ Improvement of feedstock properties for
      - fluidization
      - pneumatic transport
      - grindability with lower energy consumption
      - storage & transport (up to 800 kg/m³) + enhanced energy content
    - ⇒ Moderate process conditions
      - [250 – 300 °C]
      - ≈ atmospheric pressure



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Source: K. Radtke, SGG Gasification Seminar 2012

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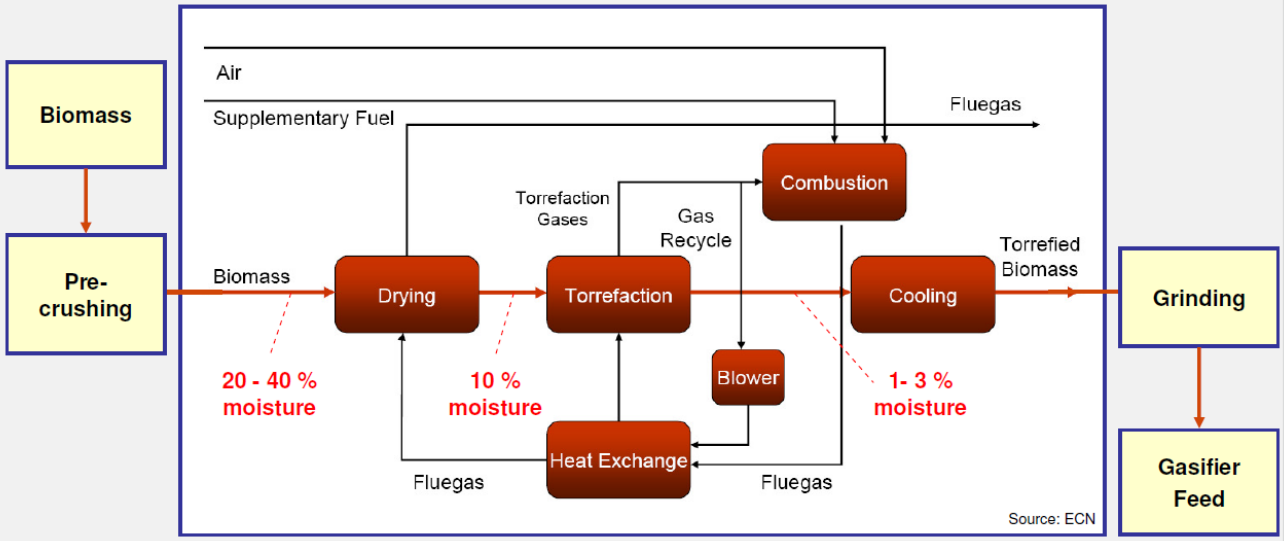
ThyssenKrupp Uhde: BioTfuel Project

BioTfueL Technologies

- **Biomass feedstock preparation:**
  Technology Route - Torrefaction



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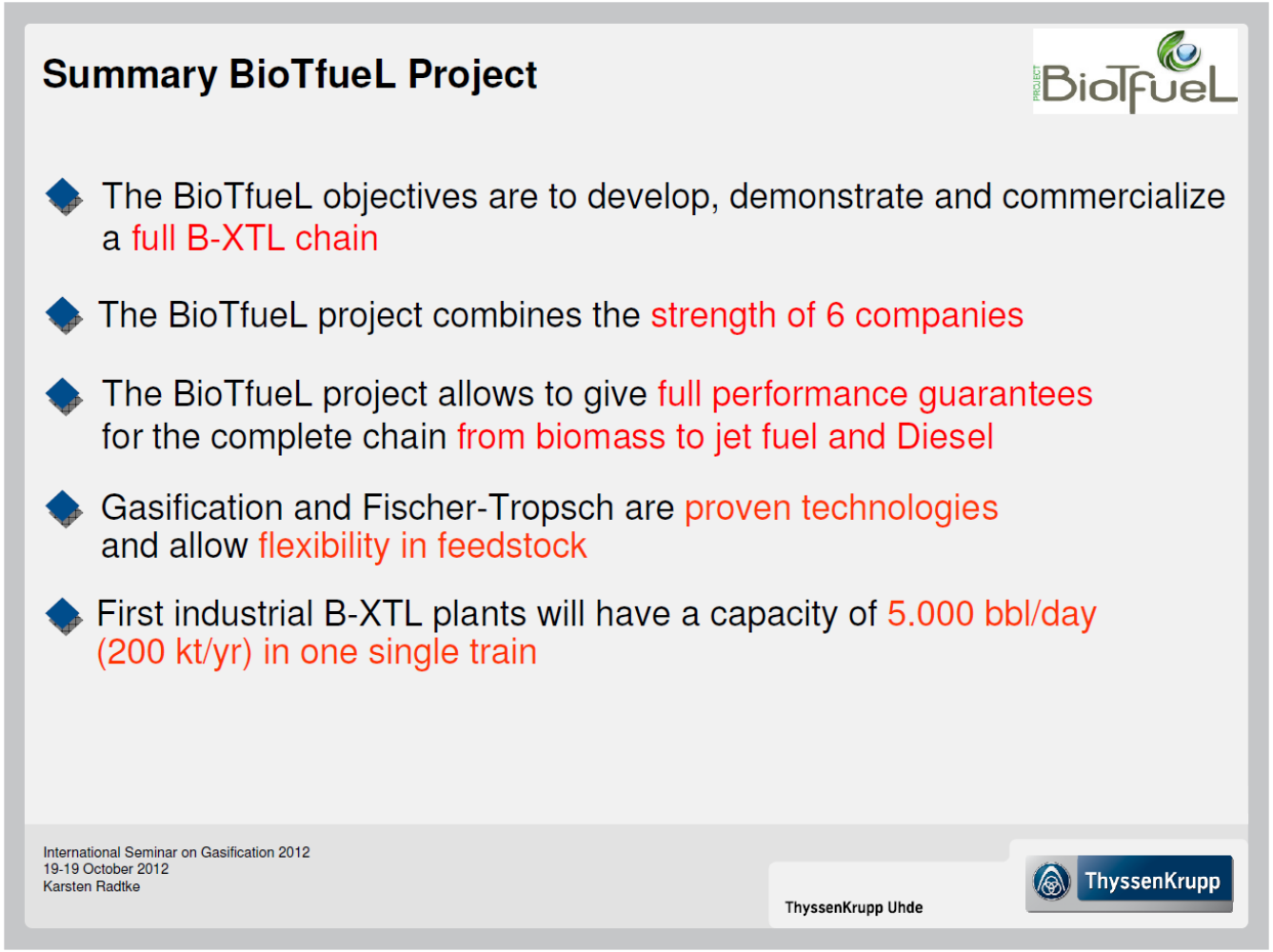
ThyssenKrupp Uhde: BioTfuel Project



Source: K. Radtke, SGG Gasification Seminar 2012

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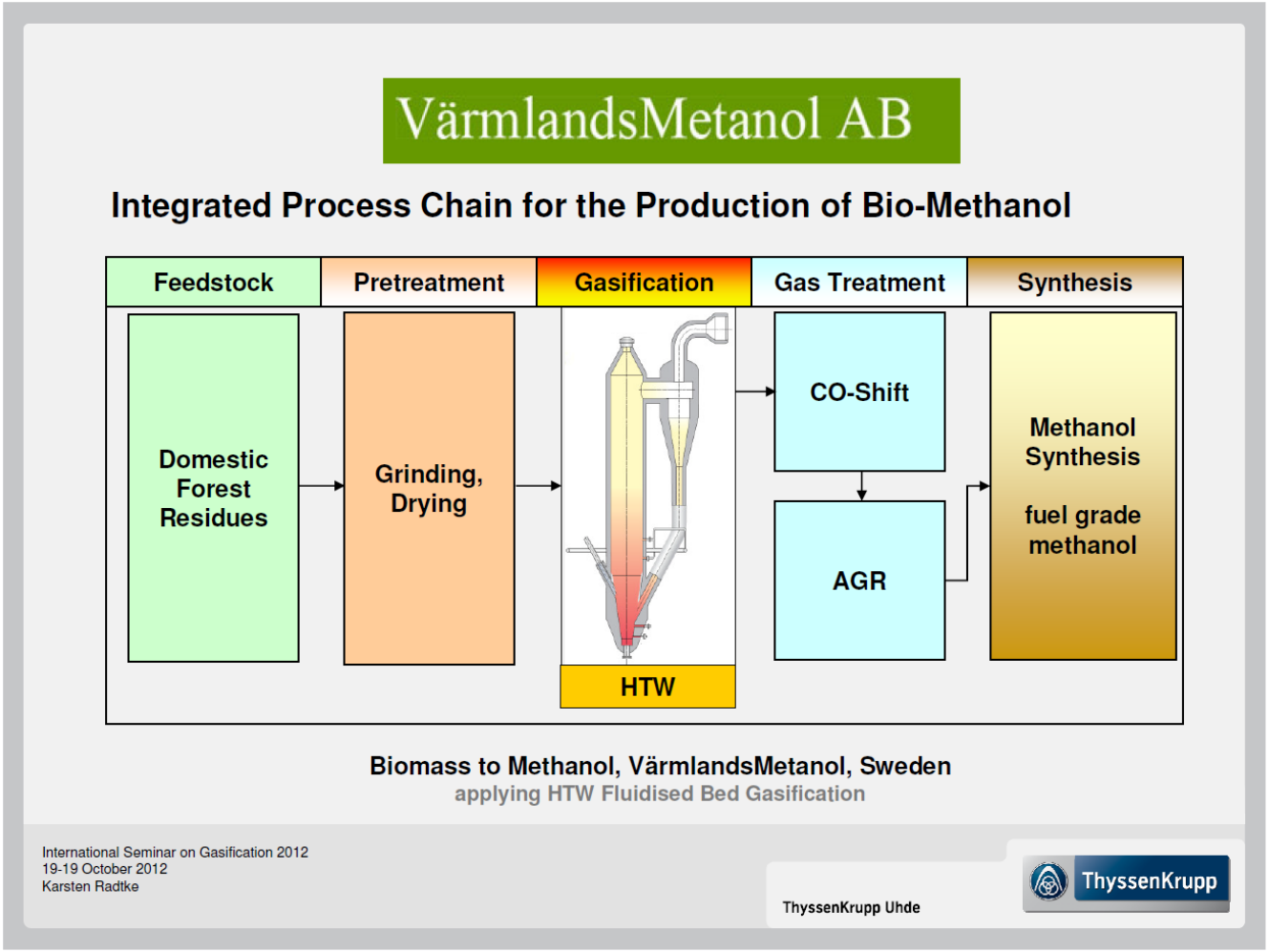
ThyssenKrupp Uhde: VärmlandsMetanol Project



Source: K. Radtke, SGG Gasification Seminar 2012

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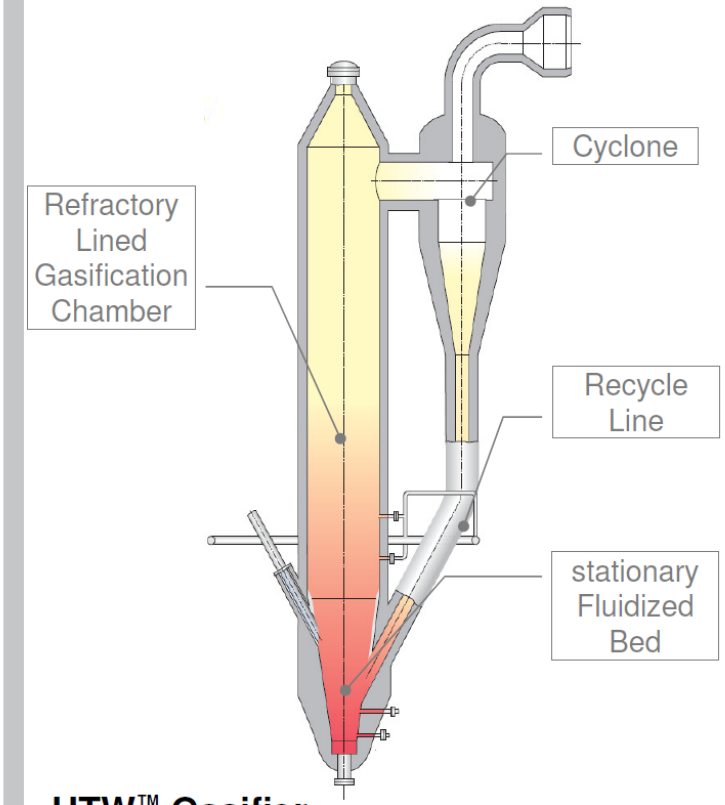
ThyssenKrupp Uhde: VärmlandsMetanol Project



HTW ™

HTW™ Gasification Rt1

- Pressurised, fluidised bed
- Temperature: 800 - 1000 °C
- Pressure: 10 - 30 bar
- Operates below ash melting point (ideal for coals with high ash melting point, biomass, lignite, waste)

Current VärmlandsMetanol Project, Sweden:

- Biomass to Methanol plant
- Feedstock: Domestic forest residue
- Grain size: < 4mm for biomass

International Seminar on Gasification 2012
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Karsten Radtke

ThyssenKrupp Uhde

ThyssenKrupp

Source: K. Radtke, SGG Gasification Seminar 2012

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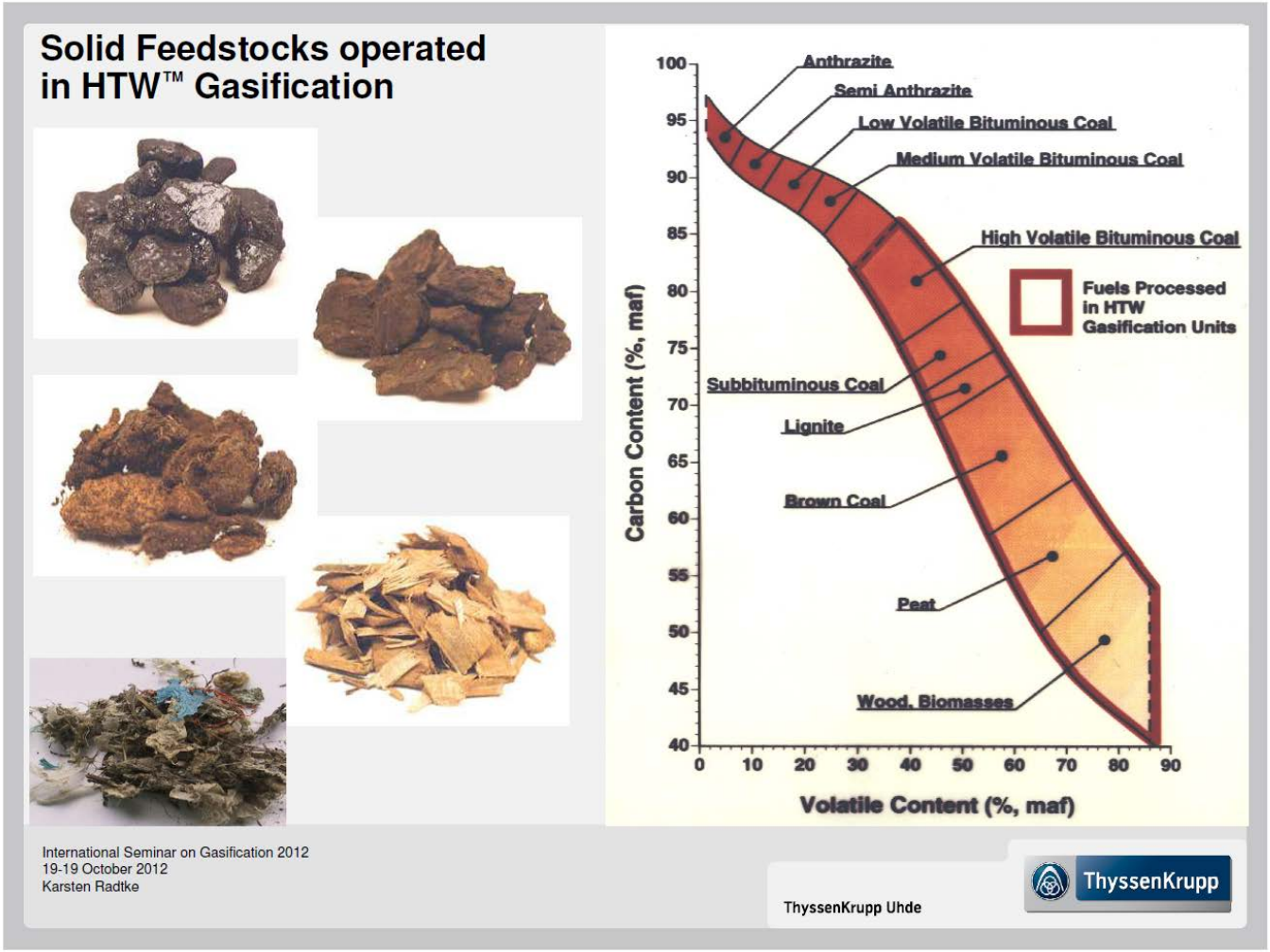
ThyssenKrupp Uhde: VärmlandsMetanol Project



Source: K. Radtke, SGG Gasification Seminar 2012

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ThyssenKrupp Uhde: VärmlandsMetanol Project

VärmlandsMetanol, Sweden
HTW Biomass to Methanol Project

Uhde selected as technology supplier and EPC contractor

Plant Capacity:
100,000 t/a of fuel grade methanol + district-heating 15 MW_{th}

Feedstock:
Domestic forest residue, ~25 t/h

Process:
Fluidized bed gasification (HTW)
(eq. 111 MW_{th})

VärmlandsMetanol AB

International Seminar on Gasification 2012
19-19 October 2012
Karsten Radtke

ThyssenKrupp Uhde

Source: K. Radtke, SGG Gasification Seminar 2012

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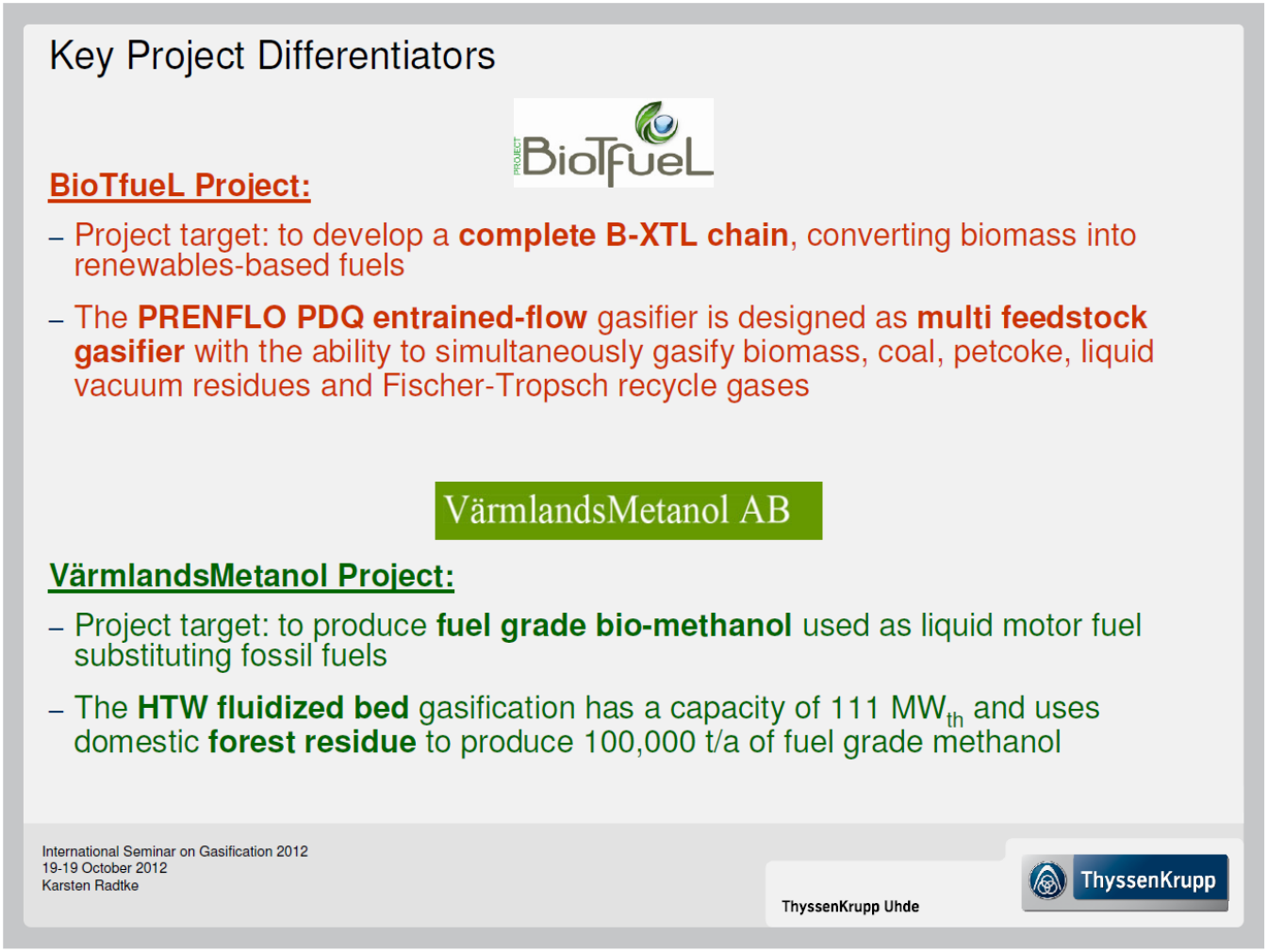
ThyssenKrupp Uhde: BioTfuel Project / VärmlandsMetanol



Source: K. Radtke, SGG Gasification Seminar 2012

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ThyssenKrupp Uhde: Sundrop Fuels Project

“Drop-in” Biofuels Production Facility in Louisiana, USA, applies HTW Gasification

Sundrop Fuels and Uhde Corporation of America sign FEED and License Agreement

Longmont / Pittsburgh / Dortmund, May. 25, 2012

Colorado-based Sundrop Fuels, Inc. has signed a comprehensive Front End Engineering and License Agreement with Uhde Corporation of America for design of what will be one of the first renewable gasoline production facilities in the world. As part of the agreement, Sundrop Fuels has selected ThyssenKrupp Uhde’s High-Temperature Winkler (HTW) process for biomass gasification as a key element of the plant. The fully integrated production plant will convert biomass by means of commercially available gasification, gas purification, methanol synthesis and methanol to gasoline (MTG) processes into affordable, immediately usable renewable gasoline. Construction of the “drop-in” biofuels plant located near Alexandria, Louisiana is scheduled to begin late this year.

The contracts were concluded between Sundrop Fuels and Uhde Corporation of America, which belongs to the ThyssenKrupp group. Uhde Corporation of America is business partner of ThyssenKrupp Uhde GmbH, Germany.

The Sundrop Fuels project will uniquely combine natural gas with wood-waste biomass for the generation of environment-friendly and sustainable clean transportation fuels. The plant will have a capacity of approximately 3,500 barrels of ultra-clean, grade gasoline per day and is planned to begin operation in late 2014. Long lead items will be ordered within the next few months.

Source: http://www.uhde.eu/en/press/press-releases/single-view/archive/2012/may/25/article/drop-in-biofuels-production-facility-in-louisiana-usa-applies-htw-gasification.html

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SWU Stadtwerke Ulm CHP Demo Plant

Institute of Chemical Engineering
Working Group Synthetic Biofuels

bioenergy2020+

Biomass gasification plant Senden/Ulm, DE

repotec
renewable power technologies

Start of the construction	12/2009	
Actual status	commissioning	
Fuel	Wood chips	
Input	14,3	MW_{fuel}
Output	5,0	MW_{el}
	6,2	MW_{th}
Total efficiency	78	%
Overal investment	33	Mio. €

Source: R. Rauch, SGG Gasification Seminar 2012

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agnion Heatpipe Reformer

The agnion Heatpipe-Reformer.

A Promising Concept for Small Scale Gasification.

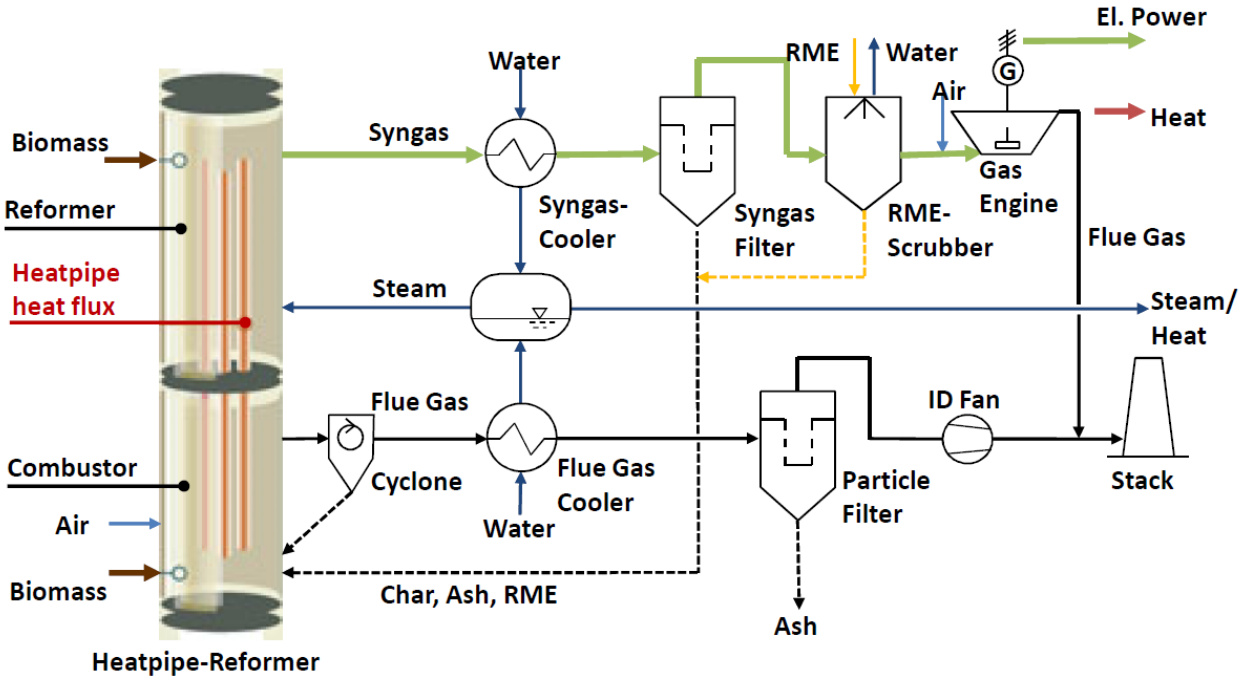
Thomas Kienberger

agnion Technologies GmbH
Sperl-Ring 4
D-85276 Hettenshausen
www.agnion.de

Source: T. Kienberger, SGG Gasification Seminar 2012

agnion Heatpipe Reformer

Flow Chart of Heatpipe-Reformer Technology with CHP Application



Source: T. Kienberger, SGG Gasification Seminar 2012

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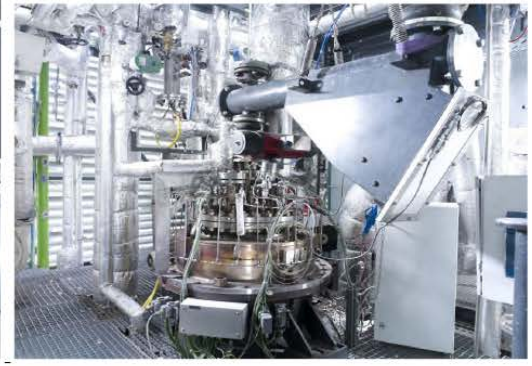
agnion Heatpipe Reformer

Pilot Plant Pfaffenhofen

agnion

- > 10.000h operation experiance
- 500 kW_{th} Input (Pellets)
- 100-140 kW_{el} Output
- Research facility for CHP application and SNG synthesis



Source: T. Kienberger, SGG Gasification Seminar 2012

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agnion Heatpipe Reformer

Commercial Demonstration Plant Grassau

- Location: Grassau (Germany)
- Partner: Biomassehof Achental
- Subsidies: BMU
- 1.3 MW_{therm} 400kW_{el} 600kW_{Heat}
- Fuel: Start-up with pellets then change to wood-chips
- Official inauguration: May 2012

- Hours of operation reformer: approx. 1200h
- Hours of operation gas-engine: approx. 1000h

Source: T. Kienberger, SGG Gasification Seminar 2012

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Spanner HOLZ-KRAFT® Plants

Spanner Re2

Spanner HOLZ-KRAFT® Plants

Field Experiences of the Spanner Re2 Gasifier System
for Small-Scale CHP Production

Dipl. Ing. Thomas Bleul, Managing Director



11.10.12 Spanner HOLZ-KRAFT 1

Source: T. Bleul, SGG Gasification Seminar 2012

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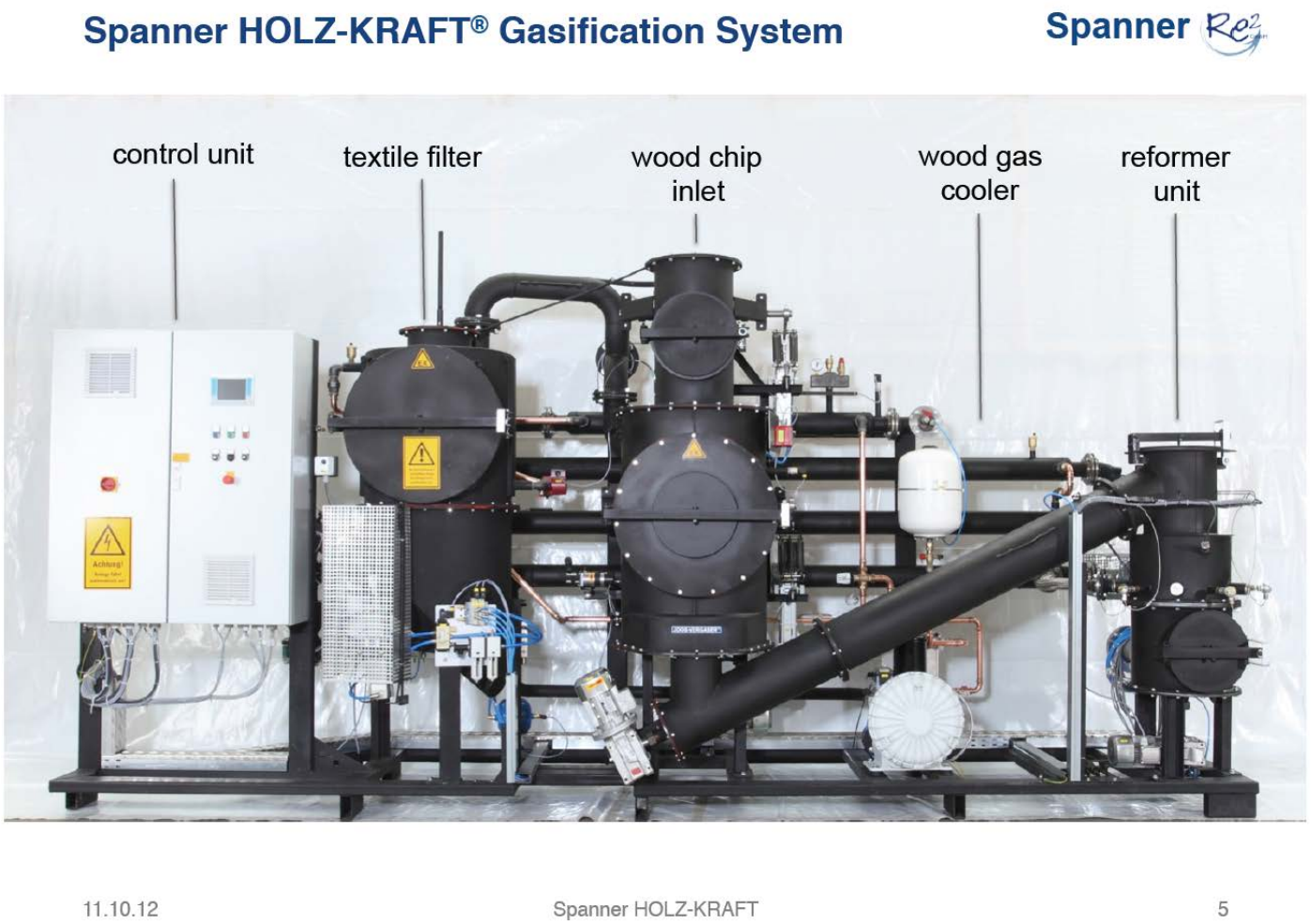
Spanner HOLZ-KRAFT® Plants



Source: T. Bleul, SGG Gasification Seminar 2012

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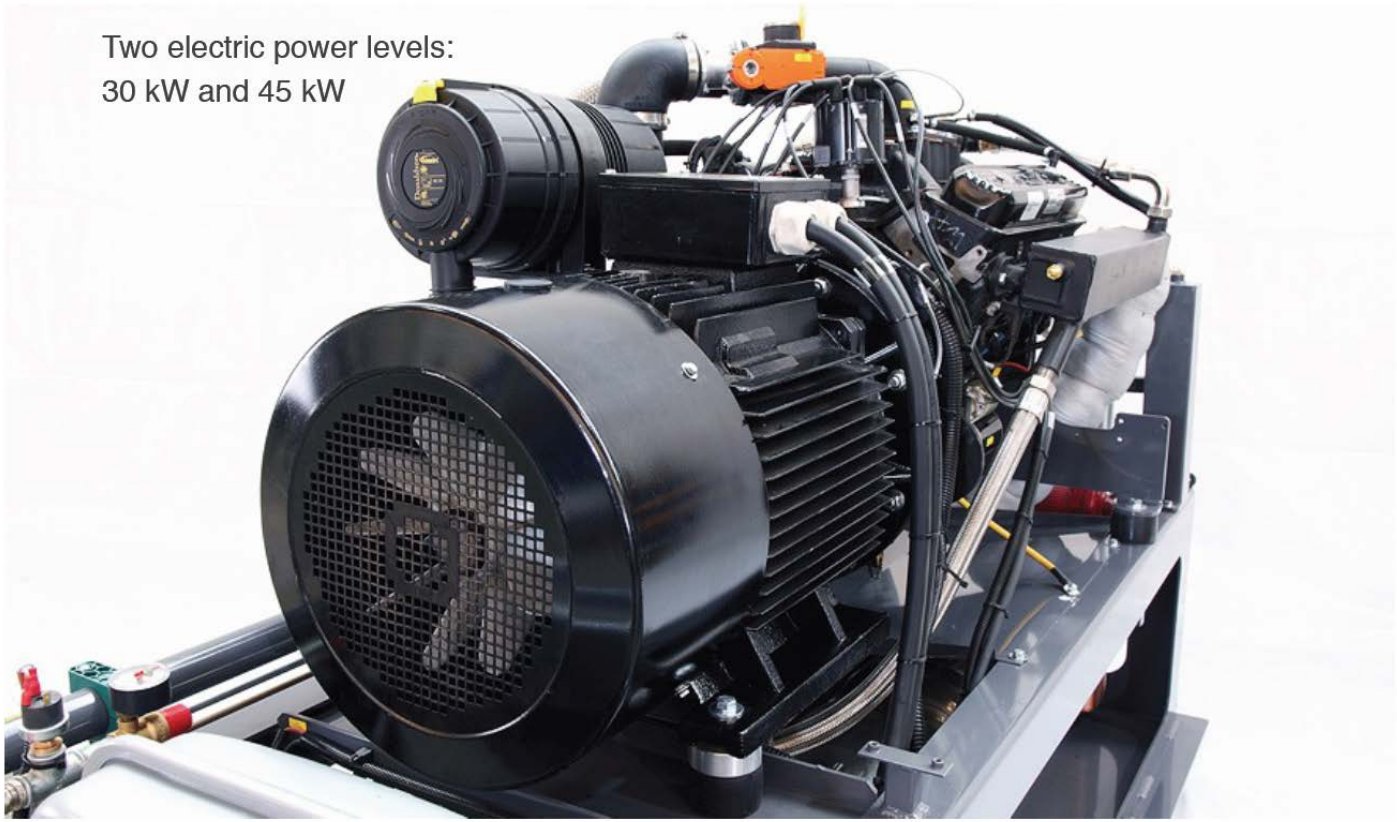
Spanner HOLZ-KRAFT® Plants

Spanner HOLZ-KRAFT® Cogeneration Unit

Spanner



11.10.12 Spanner HOLZ-KRAFT 6

Source: T. Bleul, SGG Gasification Seminar 2012

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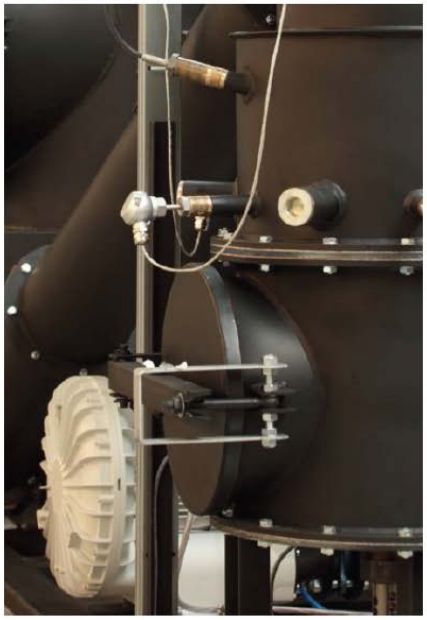
Spanner HOLZ-KRAFT® Plants

Spanner HOLZ-KRAFT® Technology

Spanner Re²



reformer unit
✔ no tare

wood gas cooler
✔ no condensate

wood gas filter
✔ no soot

Result: quality of wood gas sustainably suitable for internal combustion engines.
Proven technology over >1.000.000 cumulated operating hours at customer sites.

11.10.12 Spanner HOLZ-KRAFT 7

Source: T. Bleul, SGG Gasification Seminar 2012

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Spanner HOLZ-KRAFT® Plants

Spanner Re²

Achievements

- Over 130 plants delivered to customers
- Over 8.000 operating hoursper year of full utilization achieved by customers having a high demand for heat all year round
- Over 20.000 operating hours achieved by first plants installed in 2009, all of them on one single internal combustion engine
- Over 1.000.000 operating hours of total field field experience accumulated

Source: T. Bleul, SGG Gasification Seminar 2012

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