

# Status report on Demonstration Plants for Advances Biofuels Production

## - Thermochemical Pathways

5th Stakeholder Plenary Meeting  
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## DISCLAIMER

**The presenter has gathered most of the information from contacts with project owners and technology suppliers and to some extent through the Internet.**

**Some deviations from factual situation may be presented.**

**The presentation does not claim to completely cover the given topic.**

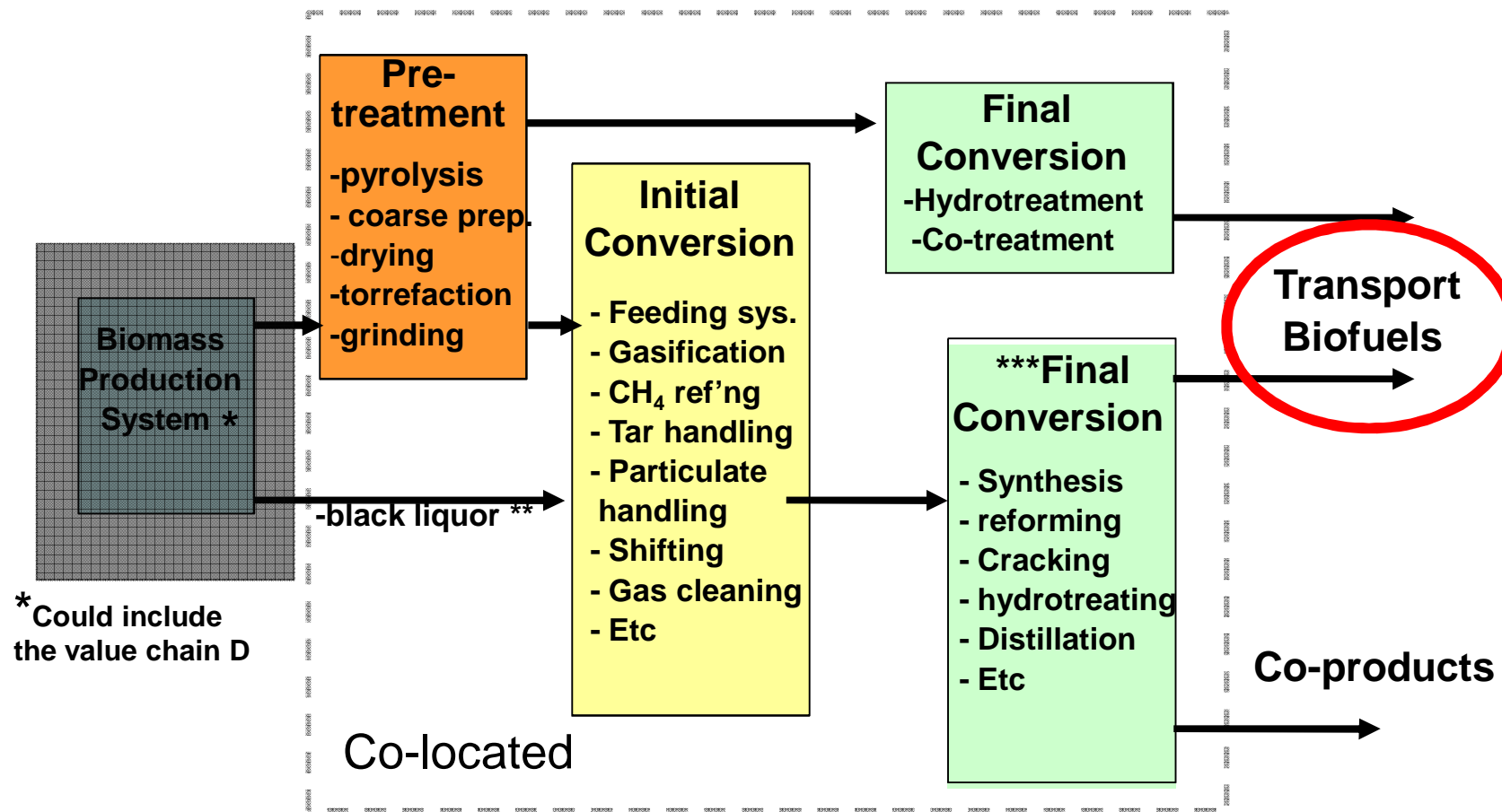
1. Synthetic fuels\* (oxygenates or hydrocarbons) through gasification.
2. Bio-methane through gasification
3. High efficiency heat & power generation through gasification
4. Intermediate bio-energy carriers through techniques such as pyrolysis and torrefaction

\* Includes fuels produced via synthesis of  $H_2 + CO$

## Project definition:

**Feedstock xx MW<sub>t</sub> / Main product / Start-up year**

# 1. Synthetic fuels (oxygenates or Hydrocarbons) through gasification



\*\* Black Liquor is an internal, energy-rich stream within pulp mill. No pre-treatment necessary before gasification.

\*\*\* certain steps of final conversion may be located elsewhere

# 1. Synthetic fuels (oxygenates or Hydrocarbons) through gasification

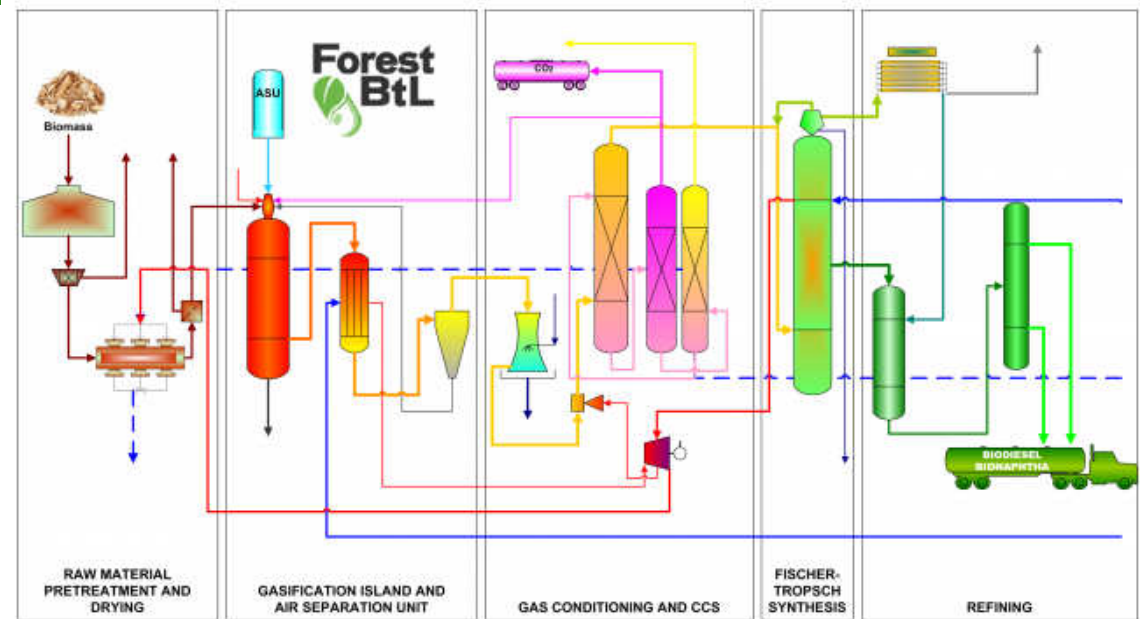
## The Forest BtL Project, FI

480 MW<sub>t</sub> / FT products / 2016-17

Gasification technology: Carbo-V

88 million € **NER300 grant**

FEED contract for Gasification & gas cleaning signed Jan 2013



Forest BtL flowsheet

## Bioliq® Project, DE

2 MW<sub>t</sub> / Synthetic Gasoline / 2013

Pyrolysis started 2008

Fast pyrolysis of straw+Gasification (5MW<sub>t</sub>) + DME/gasoline synthesis



Bioliq plant at KIT



# 1. Synthetic fuels (oxygenates or Hydrocarbons) through gasification

## Chemrec Projects, SE

### a. BioDME project

~3 MW<sub>t</sub> / DME / 2011

### b. Domsjö and Vallvik mills

~200 MW<sub>t</sub> / Methanol and DME / On hold (Currently awaiting new national regulation on biofuels)



Proposed Domsjö Site



The BioDME Project

## UPM Project

### a. Pilot testing at GTI, Chicago, USA

~5 MW<sub>t</sub> / syngas production / Ongoing

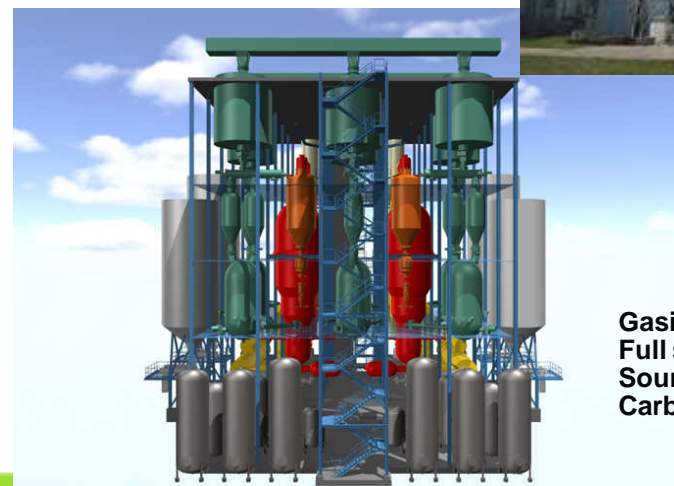
### b. Commercial Demonstration, FR

~300MW<sub>t</sub> / FT products(100 000 t/a) /

Investment decision 2014;

170 million € **NER300 grant**

Pilot tests in Chicago at GTI



Gasification Module  
Full sized plant  
Source: UPM, Andritz,  
Carbona

## The Woodspirit Project, NL

Forest resid / Methanol / Dec 2016

200 000 tpa Biometanol

Torrefied biomass into entrained flow gasif.

199 million € **NER300 grant**

Consortium of BioMCN, Siemens, Linde and VS Hanab



Site for the Woodspirit Plant

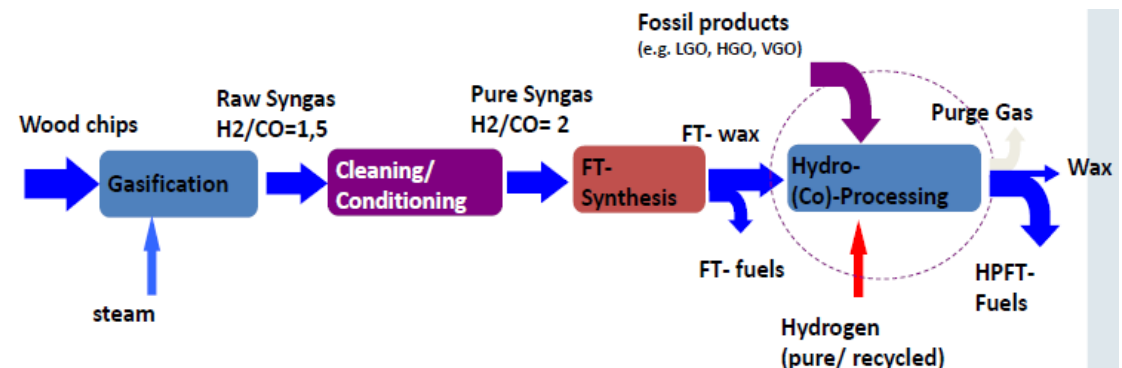
## FICFB techn. - Güssing Plant, AT

8 MW<sub>t</sub> / Heat and Power / 2002

H&P plant but also test site for

FT, SNG, higher alcohols and H<sub>2</sub>

Güssing FT production flow scheme

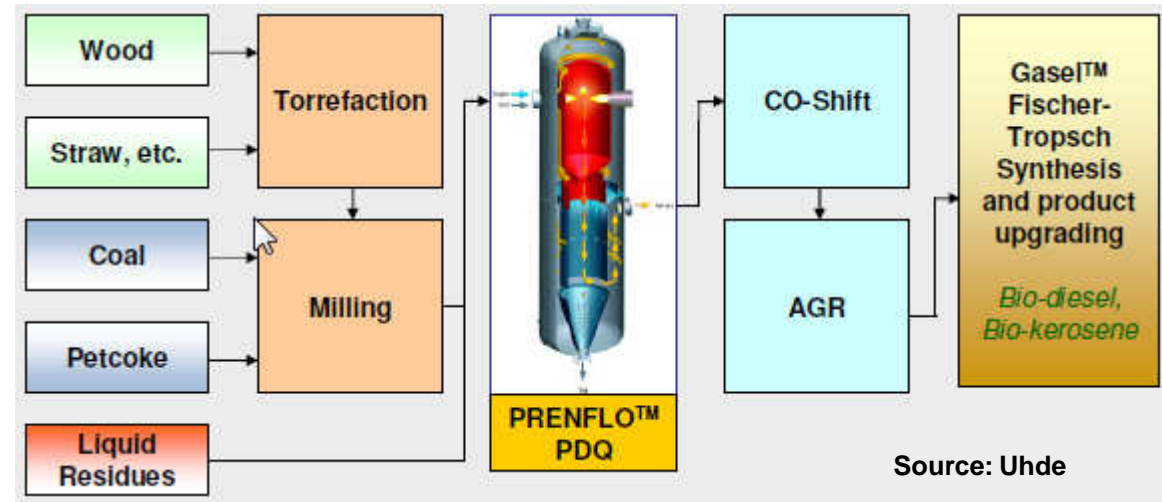




# 1. Synthetic fuels (oxygenates or Hydrocarbons) through gasification

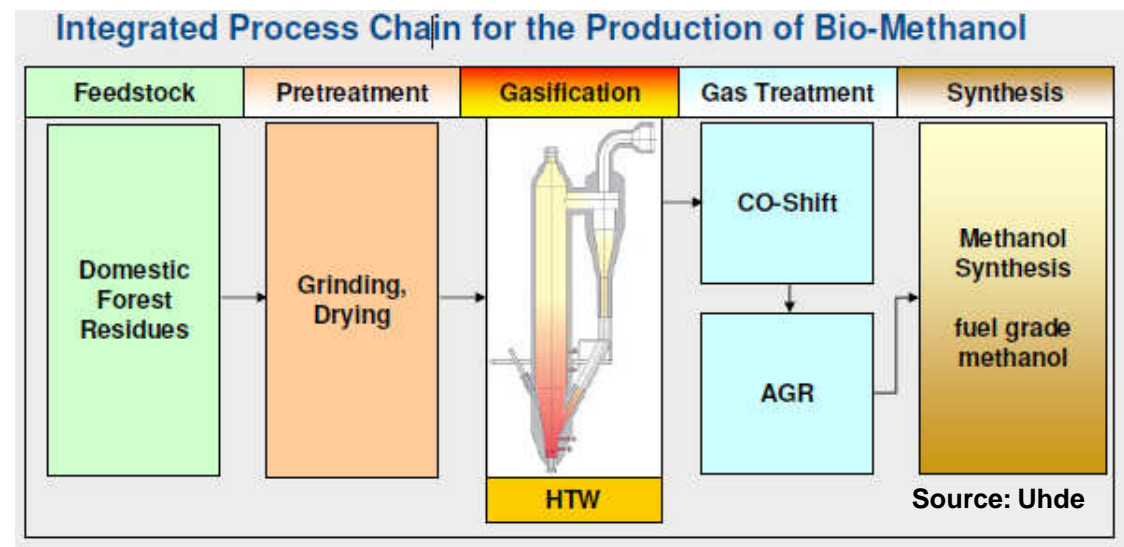
## BioTfuel Project, FR

~ 12 MW<sub>t</sub> / FT products / 2014  
Fuel mix of fossil and renewable  
Including torrefied biomass



## Värmlandsmetanol, SE

~ 111 MW<sub>t</sub> / Methanol / 2017  
CFB Gasification

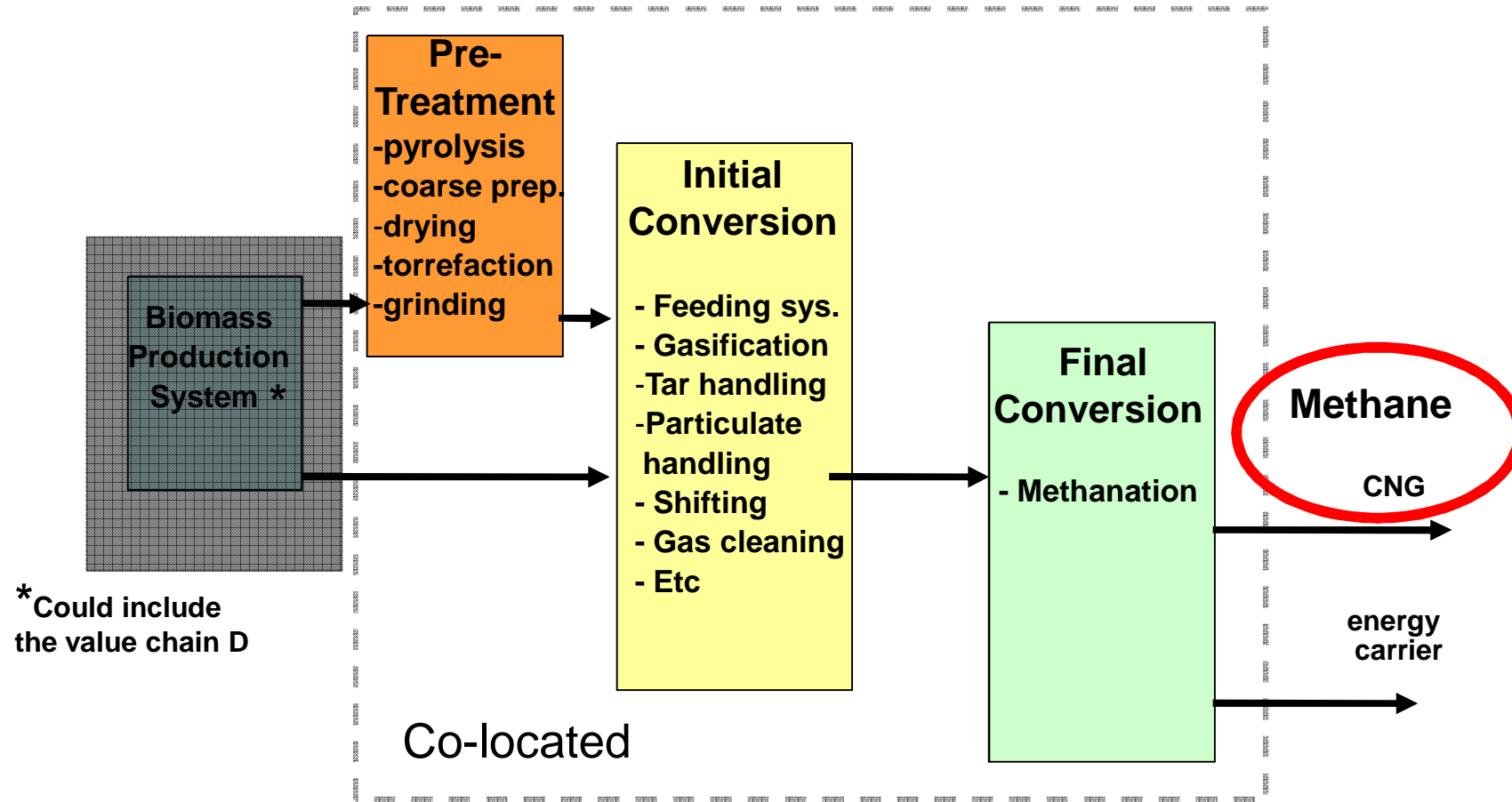




## Key R&D Areas

- Pre-treatment scale-up and cost
- Where is the system pressurized? (Biomass feeding system: Syngas compression; ...)
- Syngas purification technology and cost
- Overall integration

## 2. Bio-methane through gasification



### ECN / HVC Project, NL

12 MW<sub>t</sub> / Fuel Gas + SNG(10%) / 2014

MILENA and OLGA technology

### FICFB techn. – Güssing, AT

8 MW<sub>t</sub> / Heat & Power / 2002

Test (=>2009): Side stream converted to SNG

SNG (1 MW<sub>t</sub>) now restarted

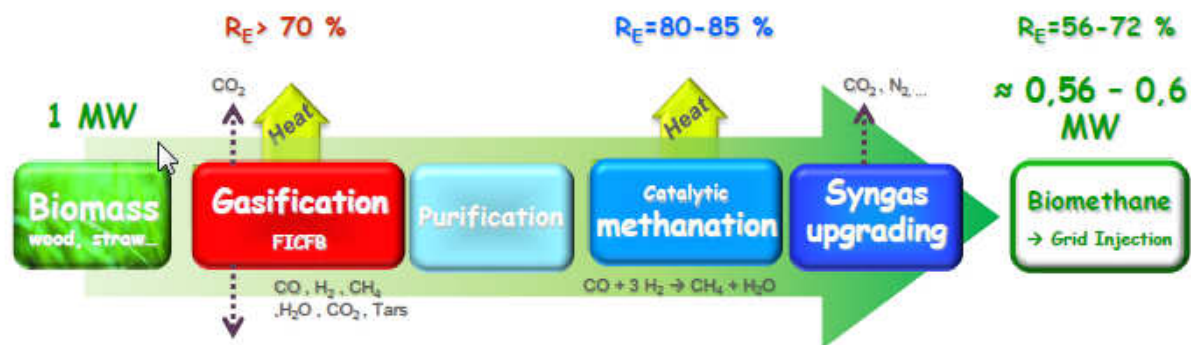
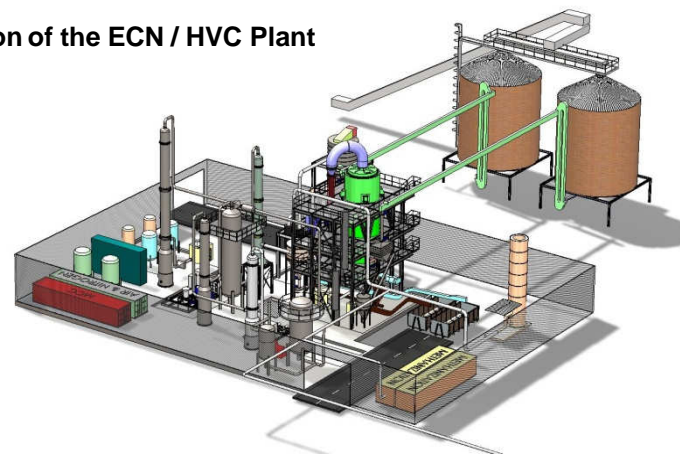
Three other plants (AT, DE) producing H&P in operation. One planned also for SNG production

### GAYA Project, FR

Decentralized SNG for transportation application

1 MW<sub>t</sub> / SNG / 2013

Illustration of the ECN / HVC Plant



### GobiGas – Gothenburg Energy, SE

#### Phase 1

Wood pellets / 20 MW<sub>t</sub> of SNG / 2013

FICFB techn. (type Güssing)

#### Phase 2

Biomass / 80 – 100 MW<sub>t</sub> of SNG / 2016

59 million € **NER300 grant**



### E.On Bio2G Project, SE

Biomass for ~200 MW<sub>SNG</sub> / SNG / On Hold

4 years to plant completion after decision;

Currently awaiting new national regulation on biofuels





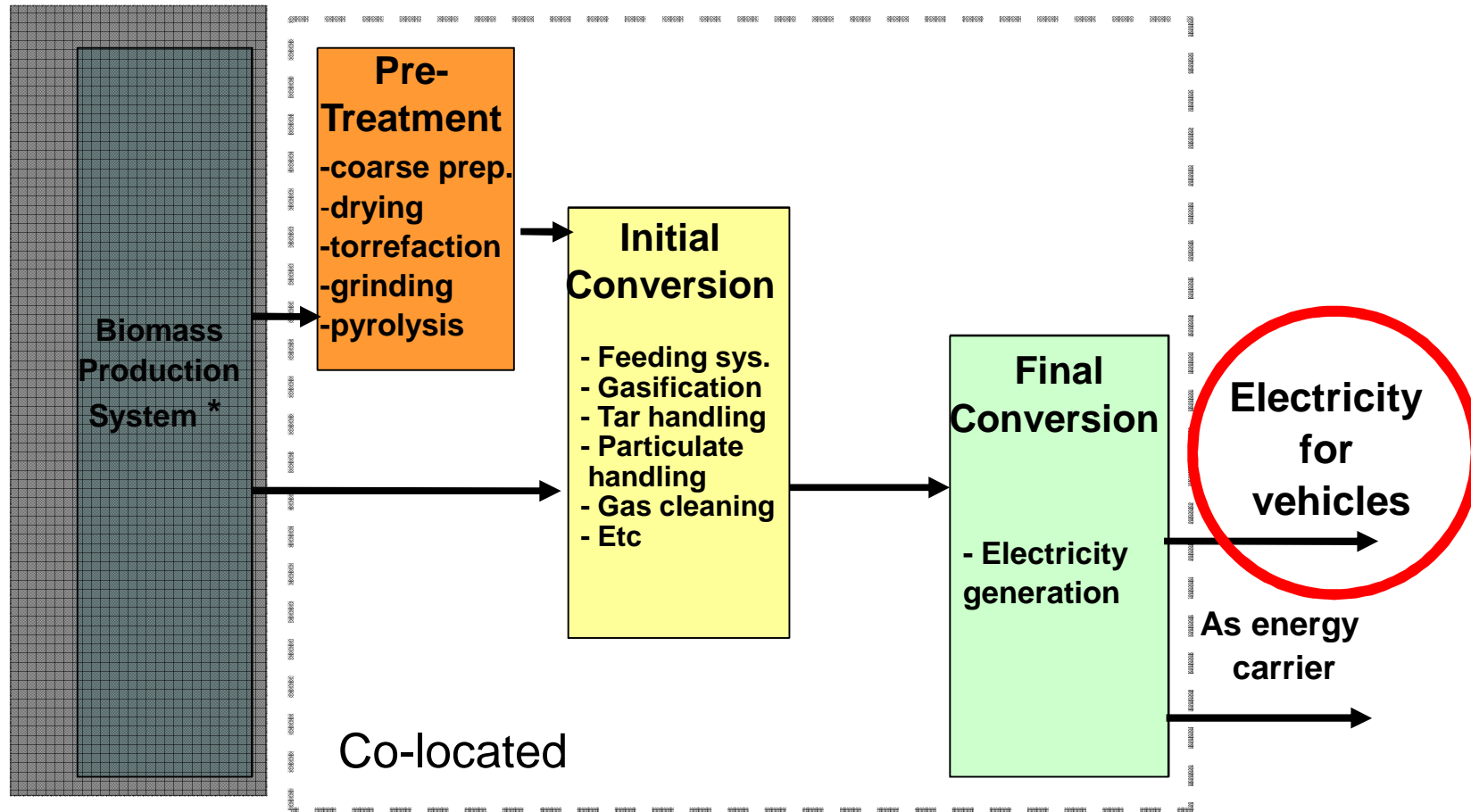
### Key R&D areas

- Pressurization. Where is the process pressurized?
- Gas conditioning and purification technology and cost
- Efficient distribution
- Compatibility with pipeline gas quality

<b>Product</b>	<b>Pretreatment</b>	<b>Type of gasifier</b>	<b>Number of</b>
<b>FT, Methanol, DME, synth. gasoline</b>	<b>Drying, 2 Torrefaction, 2 Pyrolysis w dry feeding, 1</b>	<b>- Entrained Flow with dry feed -CFB with dry feed All HP</b>	<b>3  2</b>
	<b>Pyrolysis, 1 Other *, 1</b>	<b>Entrained Flow with wet feed All HP</b>	<b>2</b>
<b>SNG ("biogas")</b>	<b>Drying, 4(5) (Pellets, 1)</b>	<b>CFB (direct or indirect heating) LP or HP</b>	<b>5</b>

\* black liquor from pulp mills

# 3. High efficiency heat & power generation through gasification



\* Could include the value chain D

## FICFB techn. Güssing Plant, AT

8 MW<sub>t</sub> / Heat & Power / 2002

(3 more plant in operation and

2 in EPC phase, 10-25 MW<sub>t</sub>)

Atmospheric indirect gasification and gas engines



## Skive Plant, DK

19.5 MW<sub>t</sub> / 11.5 MW Heat & 6 MW Power / 2011

Max input: 28 MW<sub>t</sub>

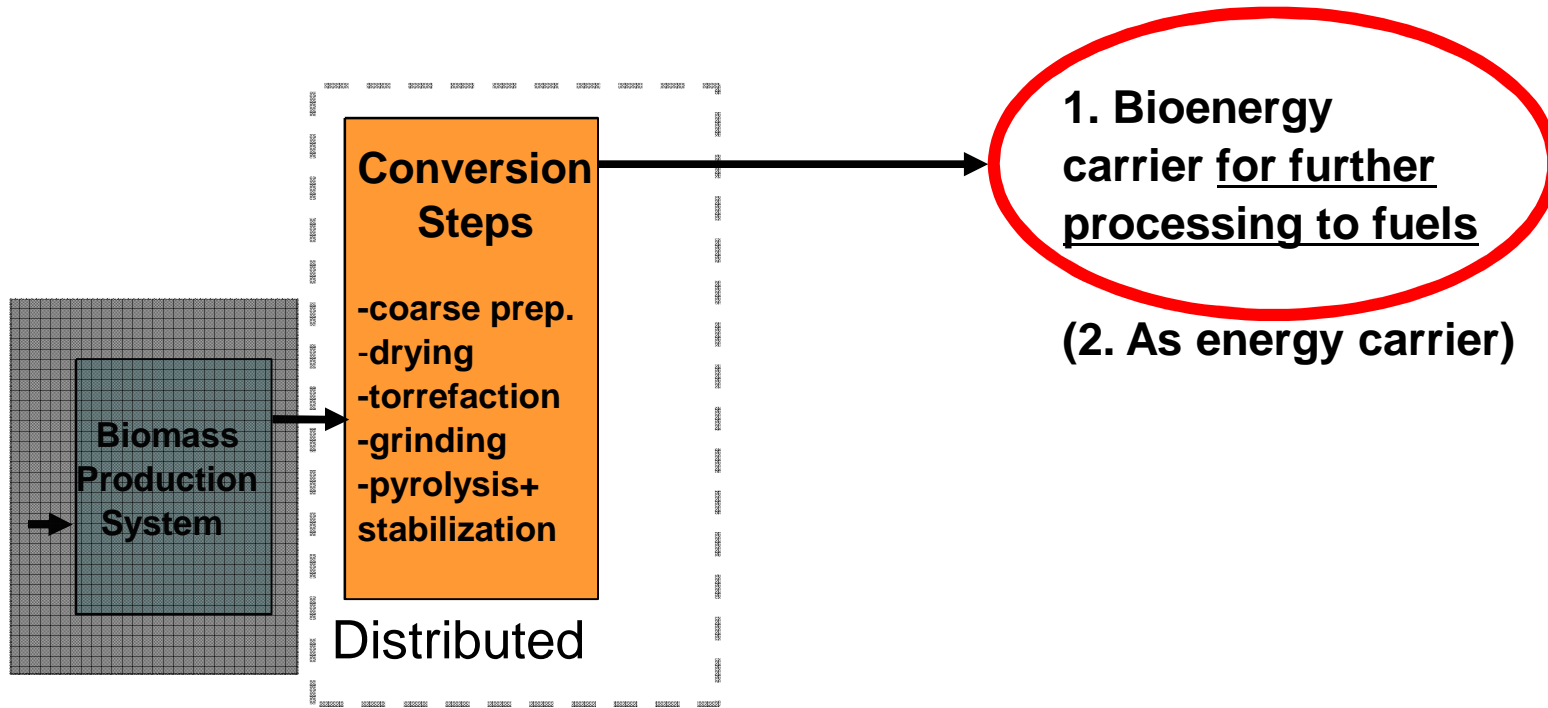
Atmospheric direct gasification and gas engines





## Key R&D areas

- Pre-treatment scale-up and cost
- Fuel gas purification technology (hot gas filtration and tar removal at HT)
- Overall energy integration



## PYROLYSIS

### Fortum Joensuu Plant, FI

Forrest residue / 50 000 t/y pyrolysis oil /  
end 2013

VTT/Metso integrated technology

### KIT (former FZK), DE

Part of Bioliq project (see Value Chain 1)

### Pyrogrot Project, SE Forrest residue / large PO plant / end 2015

31 million € **NER300 grant**

Feedstock secured

Pre FEED Phase

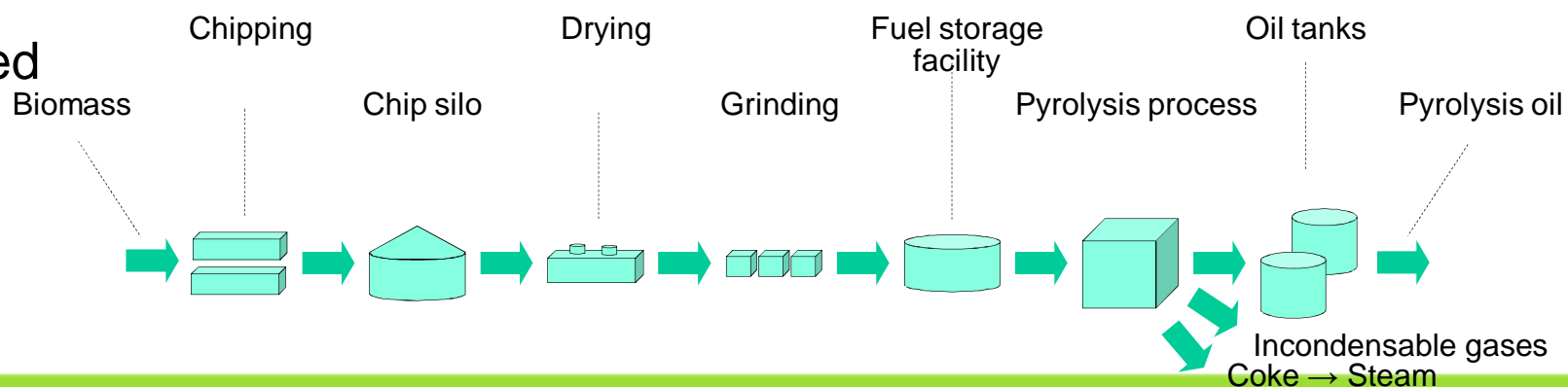


Illustration of Fortum demonstration plant, Joensuu, Finland



# PYROLYSIS

## Btg, NL

### a. Pilot

~1 MW<sub>t</sub> / Pyrolysis oil / 1998

### b. Demonstration, NL

~25 MW<sub>t</sub> / Pyrolysis oil / 2014



Illustration of Btg's planned demo in Hengelo, NL



## TORREFACTION

### ECN Project, NL

Runs a pilot (50 kg/h)

1t/h demo started up 2012, DK

### BioTfuel, FR

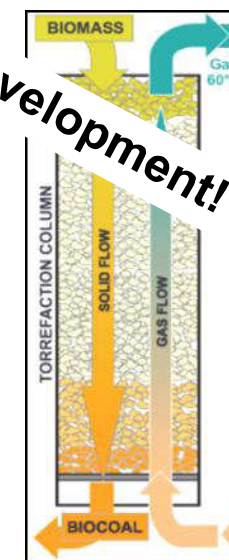
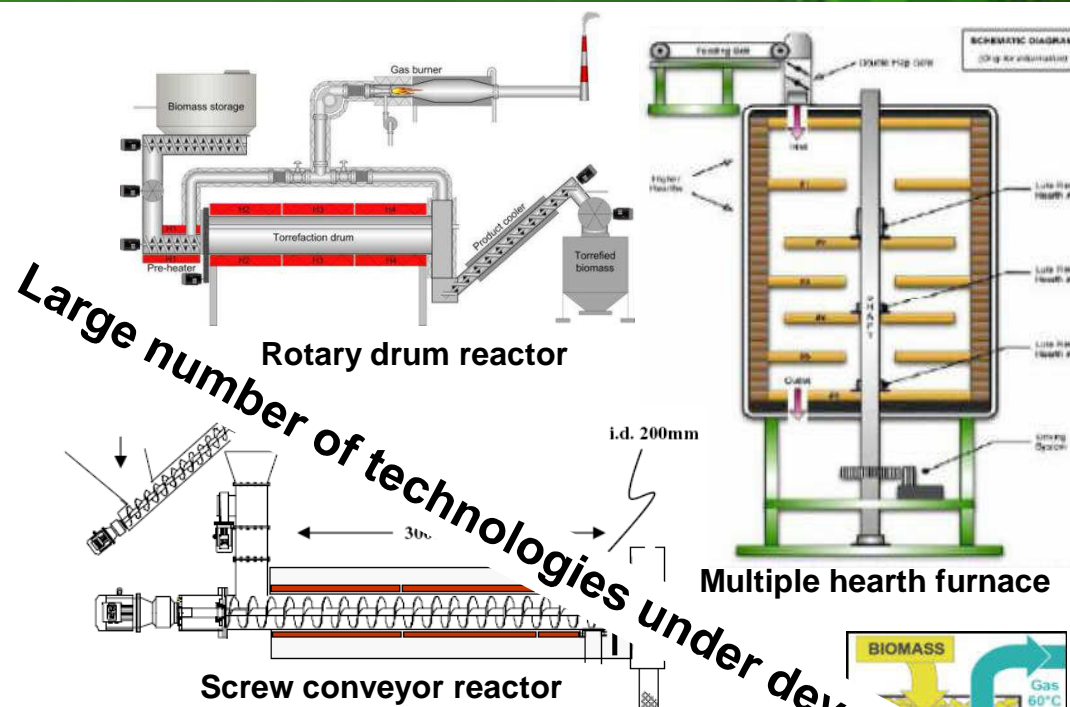
3 t/h / energy carrier / 2014

### Other Projects

There are a great number of actors in the field of torrefaction technology utilizing different technologies. There are still no plants in commercial operation but some demonstrations are in commercial scale such as:

Topell, NL: 60 kton/y in operation

Stramproy Group, NL: 90 kton/y in operation



Moving bed reactor

### Key R&D areas

- Scale-up
- Cost reduction
- Pyro-oil stability
- Product quality