

Status report on Demonstration Plants for Advances Biofuels Production - Thermochemical Pathway

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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.

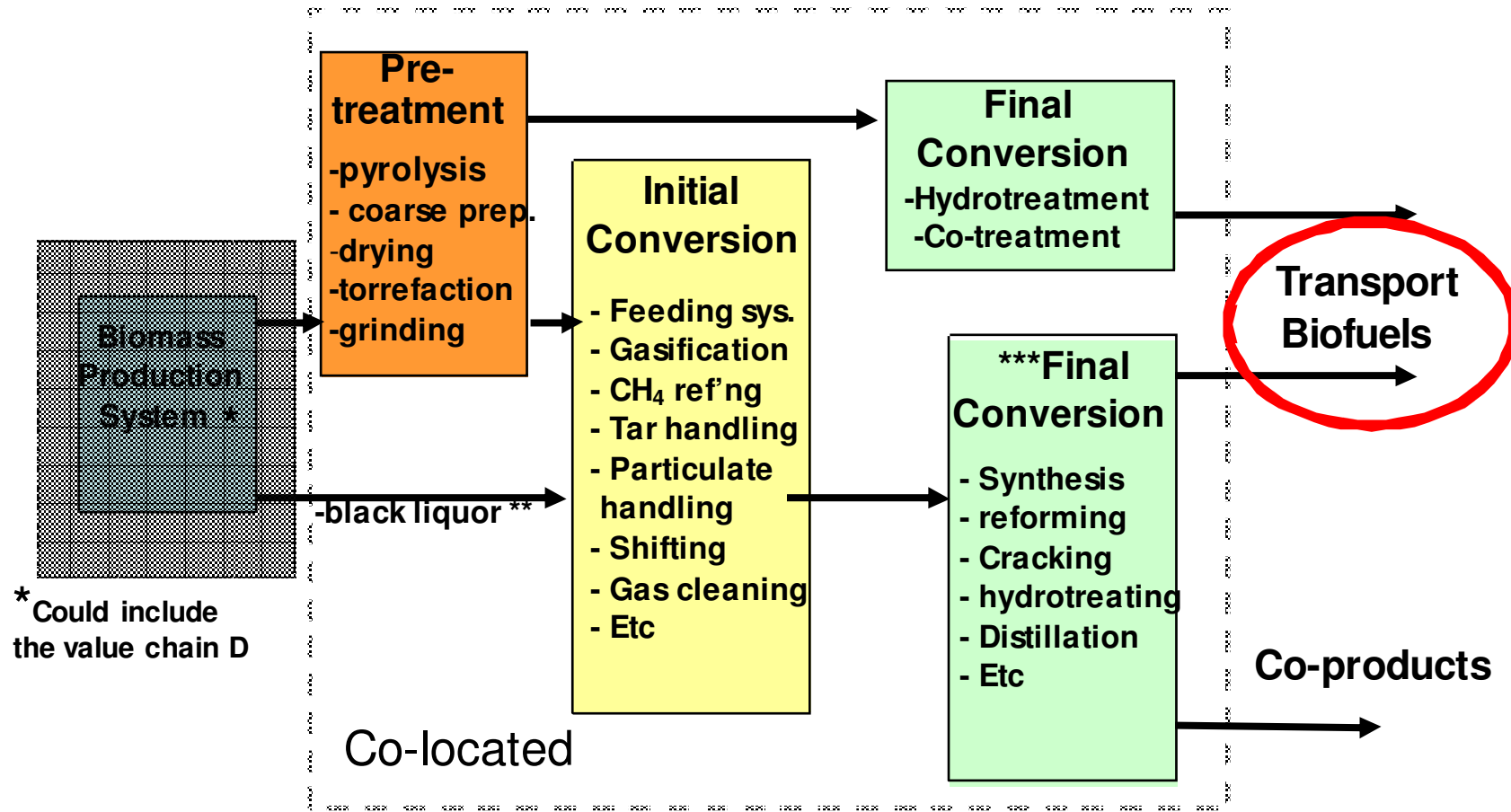
Some deviations from factual situation may be presented.

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

- A. Synthetic fuels* (oxygenates or hydrocarbons) through gasification.
- B. Bio-methane through gasification
- C. High efficiency heat & power generation through gasification
- D. Intermediate bio-energy carriers through techniques such as pyrolysis and torrefaction

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

A. 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

Choren Projects

a. Beta plant,

~45 MW_t / FT products / Under Start-up

b. Sigma Plan

~640 MW_t / FT products / Start-up 2016

c. Green-H₂ Plant

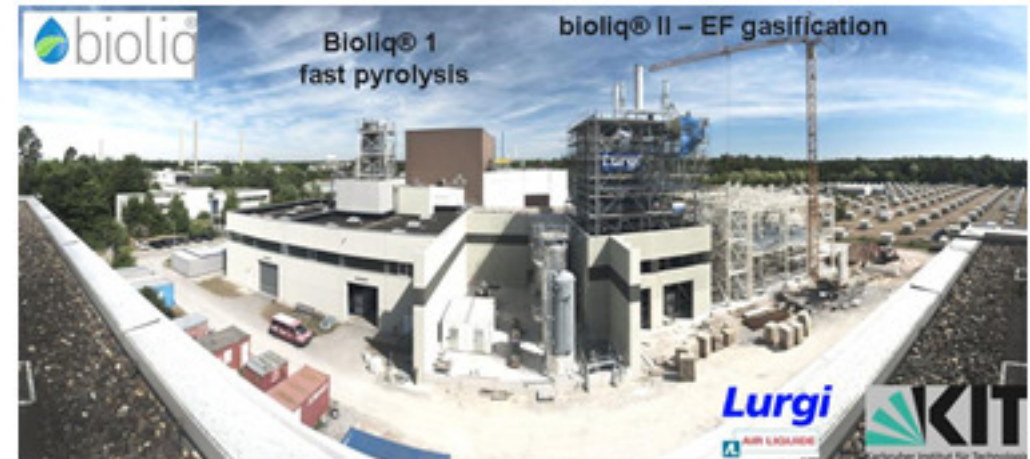
160 MW_t / H₂ / Start-up 2016



Bioliq® Project

2 MW_t / fast pyrolysis: Operational

5 MW_t EF gasification: Start-up 2012



Chemrec Projects

a. BioDME

~3 MW_t / DME / Start-Up

June 2011



Proposed Domsjö Site



The BioDME Plant in Piteå

b. Domsjö Biofuels

~200 MW_t / DME and Methanol / Start-Up 2014/15

UPM Project

a. Pilot testing at GTI, Chicago

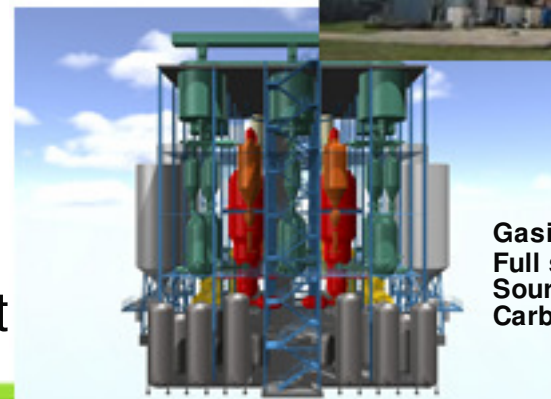
~5 MW_t / syngas production / Ongoing

b. Commercial Demonstration

~300MW_t / FT products(100 000 t/a) /

Start-Up 2015; Applied for NER300 support

Pilot tests in Chicago at GTI



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

VVBGC Project

~ 15 MW_t / clean syngas

Funding closure unsuccessful

Technical activities suspended

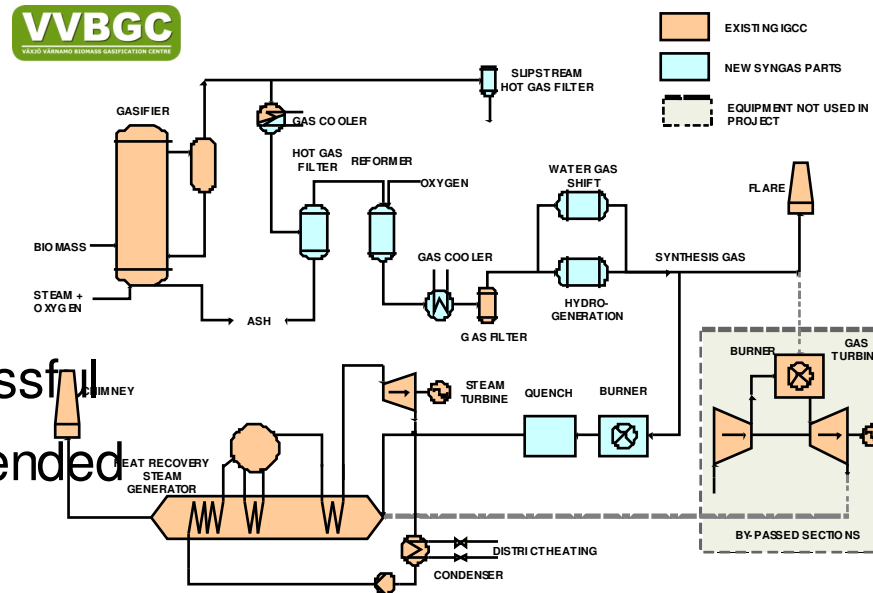


Illustration of extended plant

Neste-Stora Enso projects

a. Varkaus

~ 12 MW_t / 5 MW_t of syngas to reforming & cleaning / small part stream to FT wax / Test program completed 9/2011

b. Full Scale Demonstration

Applied for NER300 Support

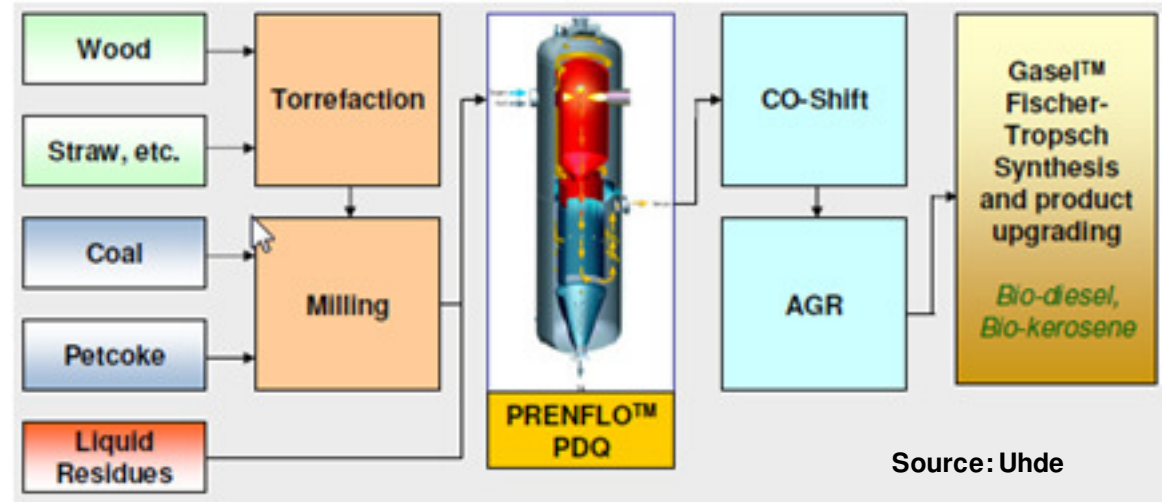


StoraEnso Pilot Plant

A. Synthetic fuels (oxygenates or Hydrocarbons) through gasification

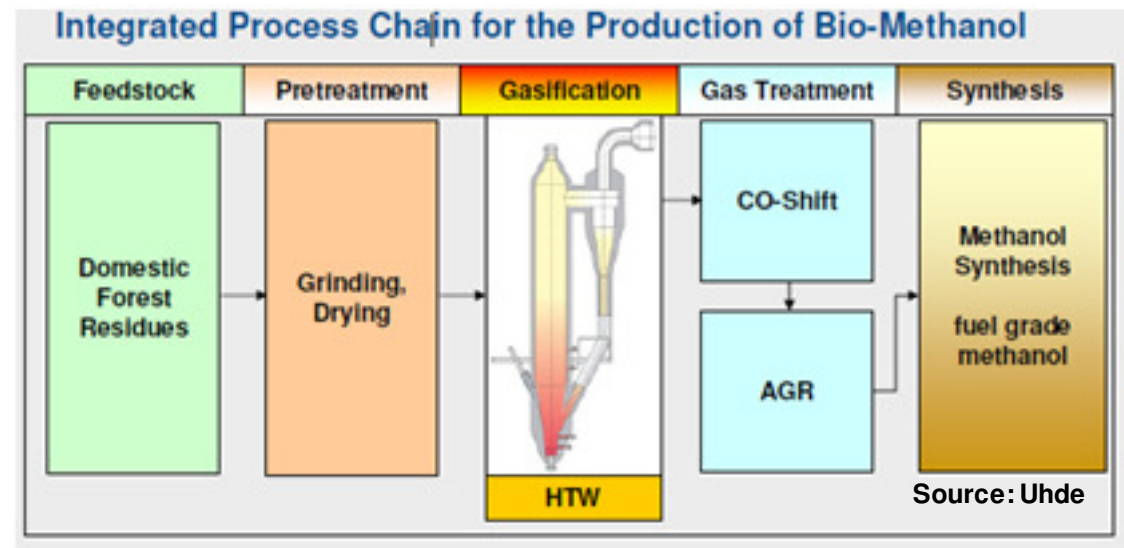
BioTfuel Project

~ 12 MW_t / FT products / 2013
 Fuel mix of fossil and renewable
 Including torrefied biomass



Värmlandsmetanol

~ 111 MW_t / Methanol/ 2014



Güssing Plant

Test site for

FT technology: 2 technologies in lab scale tests

Higher alcohols: 1 technology in lab scale test

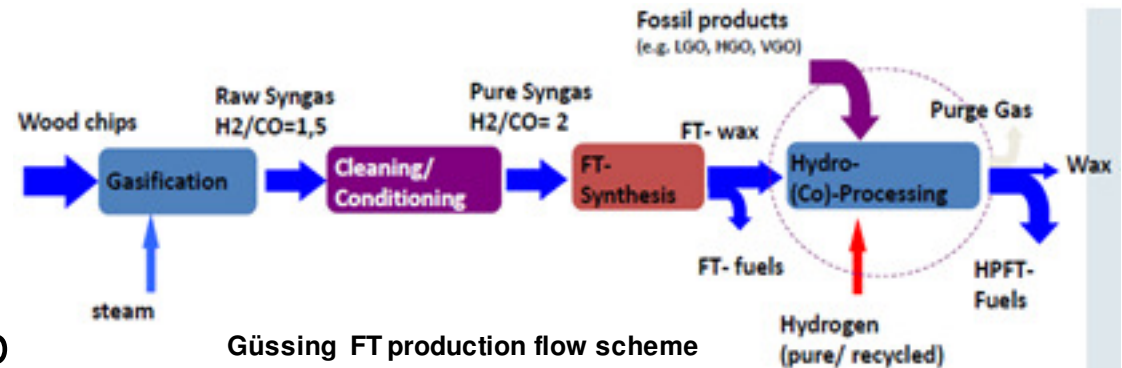
Examples of NER300 Project

Holland (Siemens/Linde): Fuel grade Methanol project: 400 kt/ y

Sweden (Rottneros): 2 fuel grade Methanol Projects: 230 and 140 kt / y

Finland(Metsäliitto/Vapo): A third* FT Project: > 100 t/y

* Besides two projects mentioned earlier

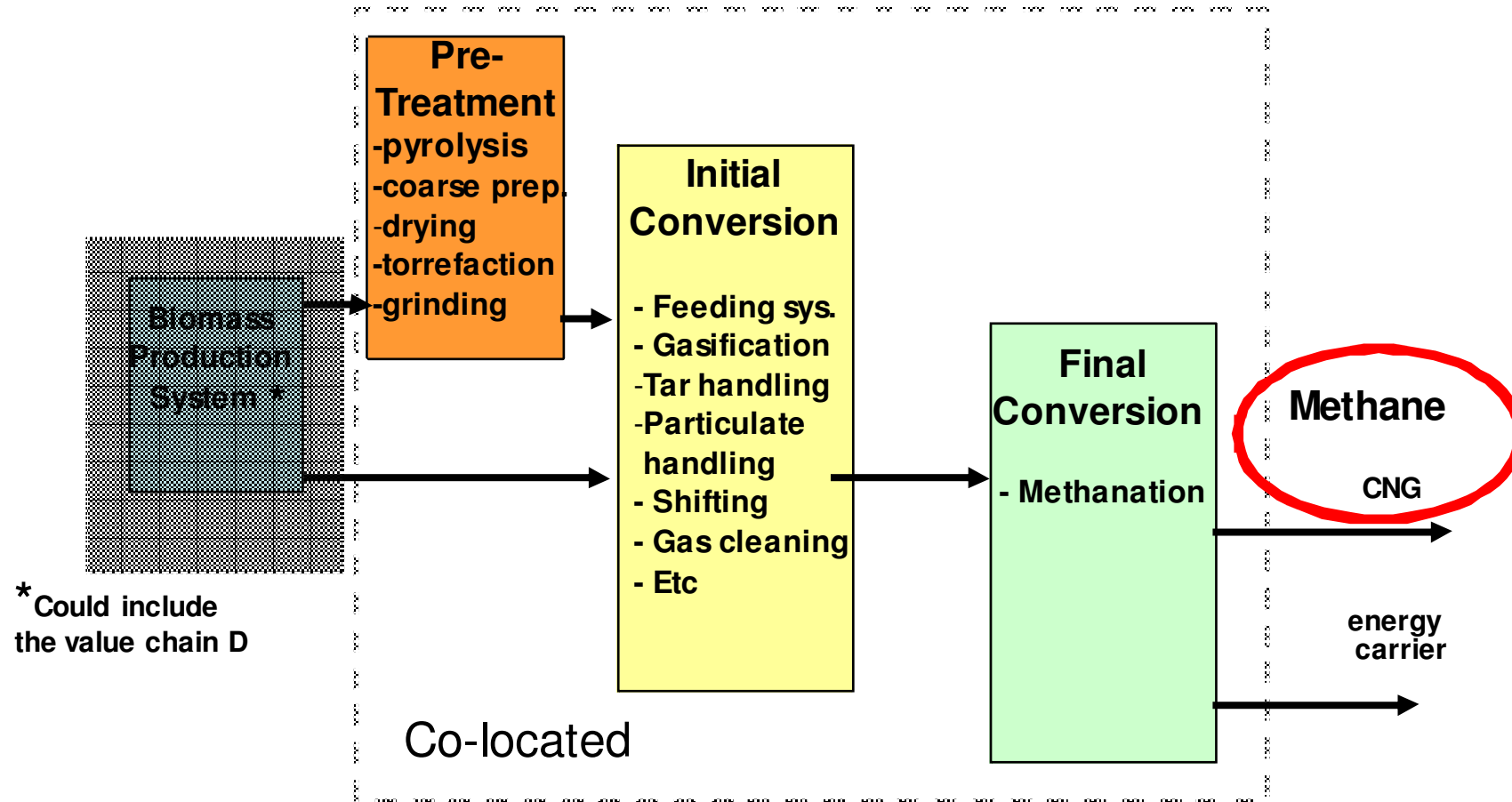


Location of one of the Swedish projects: Rottneros Vallvik pulp mill

Key R&D Areas

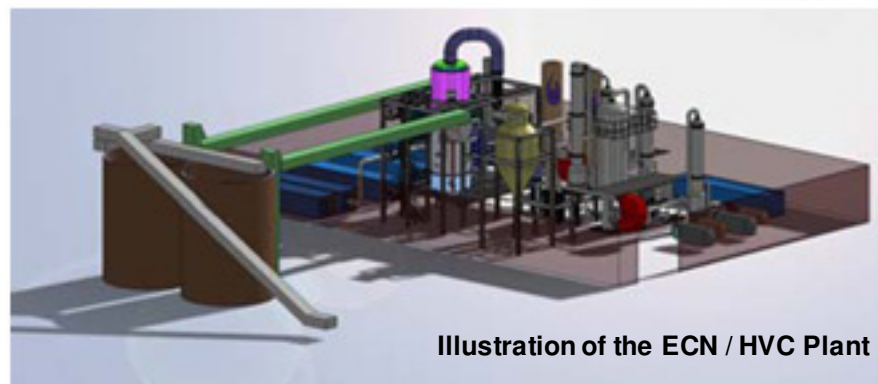
- Pre-treatment scale-up and cost
- Where is the system pressurized? (Biomass feeding system: Syngas compression; ...)
- Syngas purification technology and cost
- Overall integration

B. Bio-methane through gasification



ECN / HVC Project

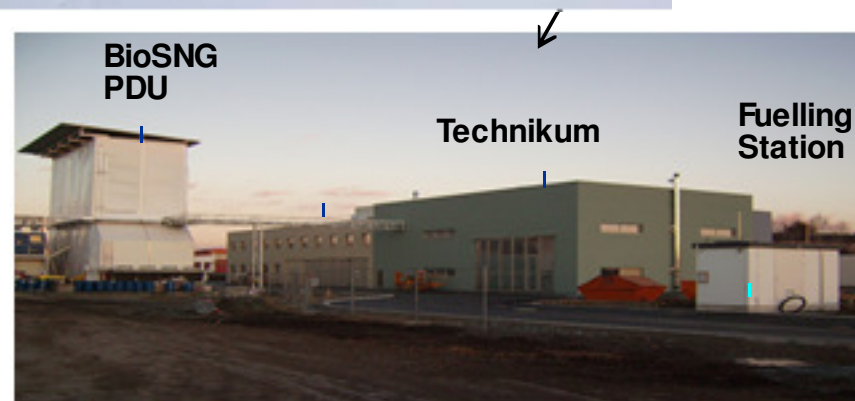
12 MW_t / SNG / 2013



Güssing Plant

8 MW_t / Heat & Power / 2002

Test (=>2009): Side stream converted to SNG
Technology selected for first step in GoBiGas



SNG pilot at Güssing

GAYA (GdF – Suez)

Decentralized SNG for transportation application

1 MW_t / SNG / 2013



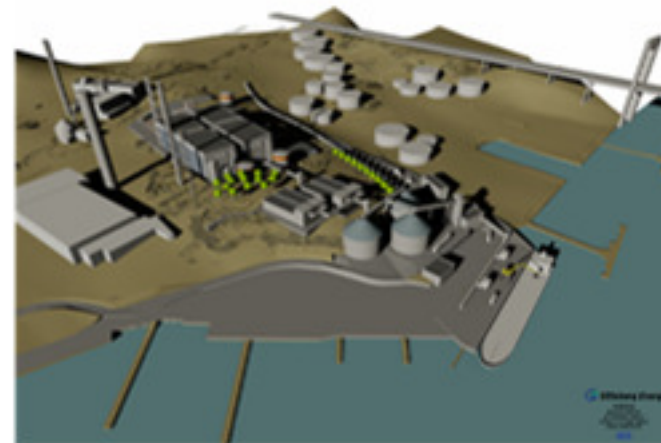
GobiGas – Gothenburg Energy

a. Phase 1,

20 MW_t of gas / SNG / 2013
(Construction started)

b. Phase 2

80 – 100 MW_t of gas / SNG / 2015-16,
(NER Application)



GoBiGas Project, Phase 2

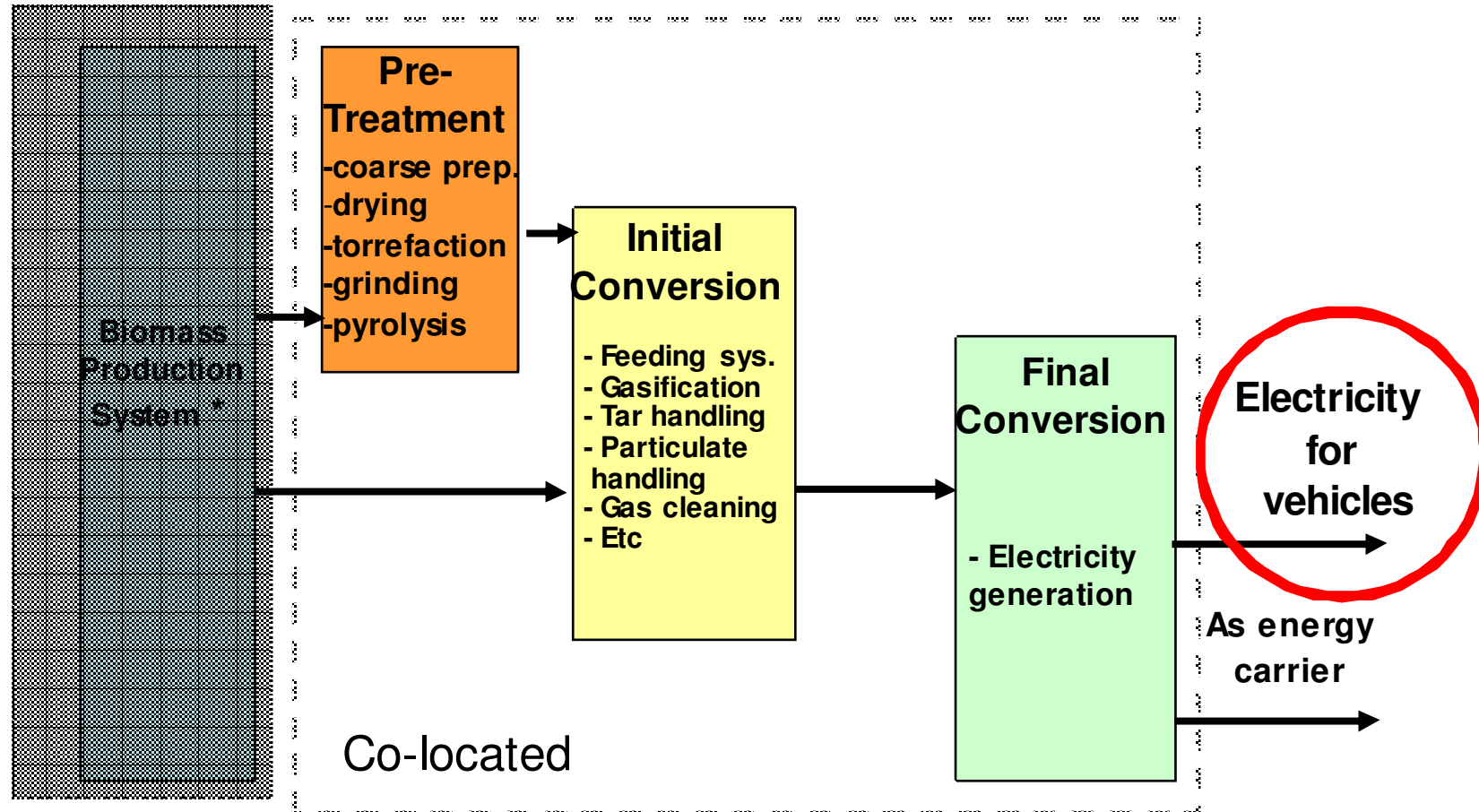
Examples of NER300 Project

Sweden (E.On): 200 MW SNG plus
district heat

Key R&D areas

- Pressurization. Where is the process pressurized?
- Gas conditioning and purification technology and cost
- Efficient distribution

C. High efficiency heat & power generation through gasification



* Could include the value chain D

Güssing Plant (FICFB gasifier)

8 MW_t / Heat & Power / 2002

(2 more plant in operation and

2 in EPC phase, 10-25 MW_t)

Värnamo Project

18 MW_t / 9 MW Heat & 6 MW Power

Operated by Sydkraft 1996 – 1999

on behalf of developer Bioflow Oy*

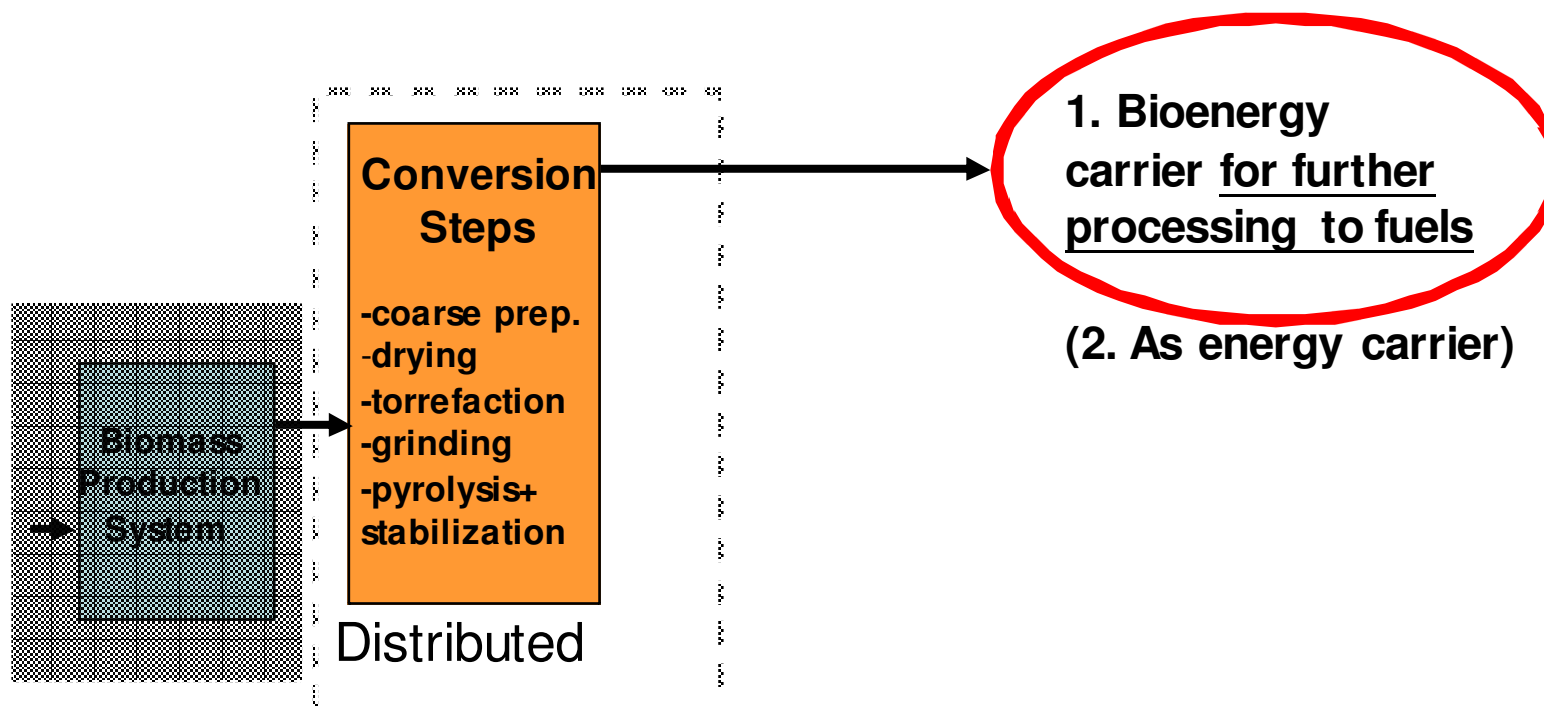
Plant bought by VVBGC AB in 2004

*JV composed of E.ON Sweden and Foster Wheeler



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

VTT, UPM, Metso, Fortum integrated process

Pilot: 7 t/d verified; 80 tons produced; 40 t tested in small boiler

KIT (former FZK)

Bioliq project stage 1 for gasification

(see Value Chain A)

Other Projects

There are a great number of technologies in advanced stage of development specially in the US. Two main pathways for product:

- ❖ upgrading to automotive fuels through e.g. hydrotreatment etc
- ❖ As an ordinary liquid fuel



Metso Pilot Plant

TORREFACTION

ECN

Runs a pilot (50 kg/h)

Plans a demo at 1-5 t/h for start up 2012

BioTfuel

3 t/h / energy carrier / 2012

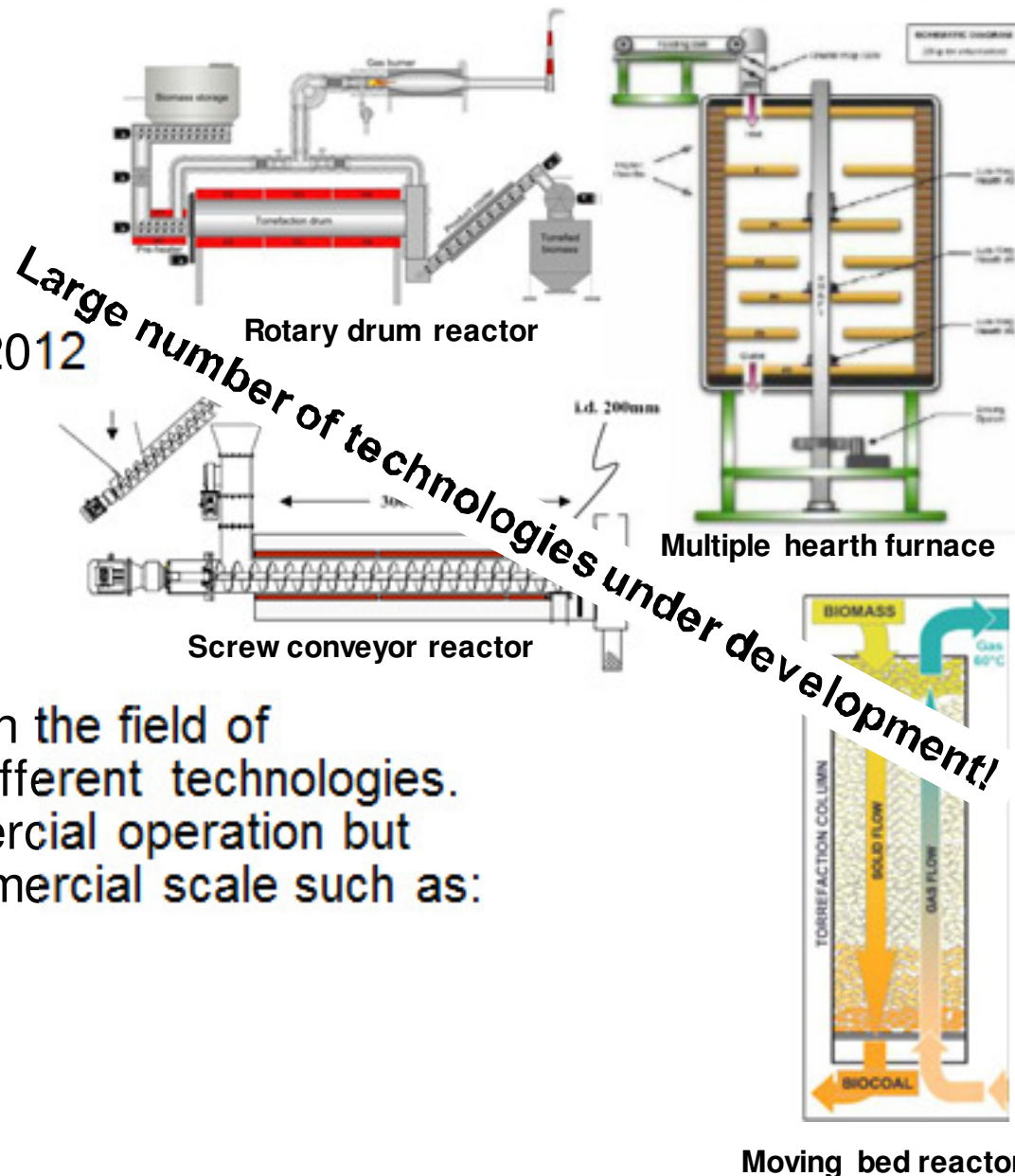
Other Projects

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: 60 kton/y

Torr Coal: 35 kton/y

Stramproy Group: 45 kton/y



Key R&D areas

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