

The background of the slide is a faded, light blue image of a classical building facade. On the left side, there is a large, detailed sculpture of an owl, which is the symbol of the Vienna University of Technology. The owl is perched on a pedestal and has its wings spread. The building's architecture features classical columns and a pediment.

## **BioFiT & BioSNG & RD&D**

**Dr. Reinhard Rauch**

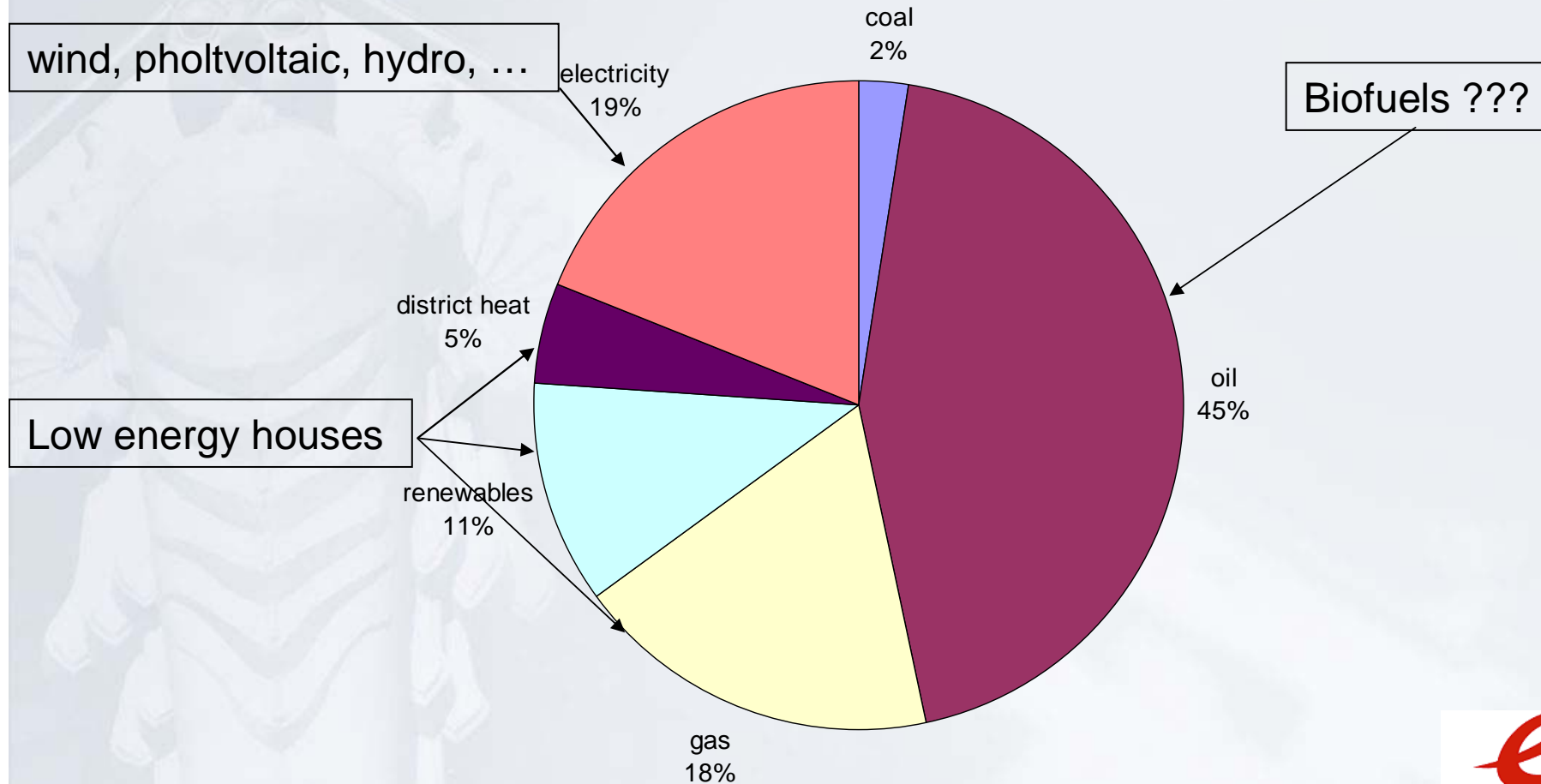
**Institute for Chemical Engineering**

**Vienna, University of Technology**

- Why biofuels and difference to fossil fuels
- Concept of Polygeneration
- Results from biomass CHP Güssing
  - Liquid Fuels by Fischer Tropsch Synthesis
  - Gaseous Fuels by Methanation

# Why Biofuels

## Energy Usage 2004 Austria



## Fossil fuels

- Central
- Large companies
- Well developed international market
- Well defined properties

## Renewable fuels

- Decentral
- Mainly small companies
- International market under development
- Heterogeneous fuel properties

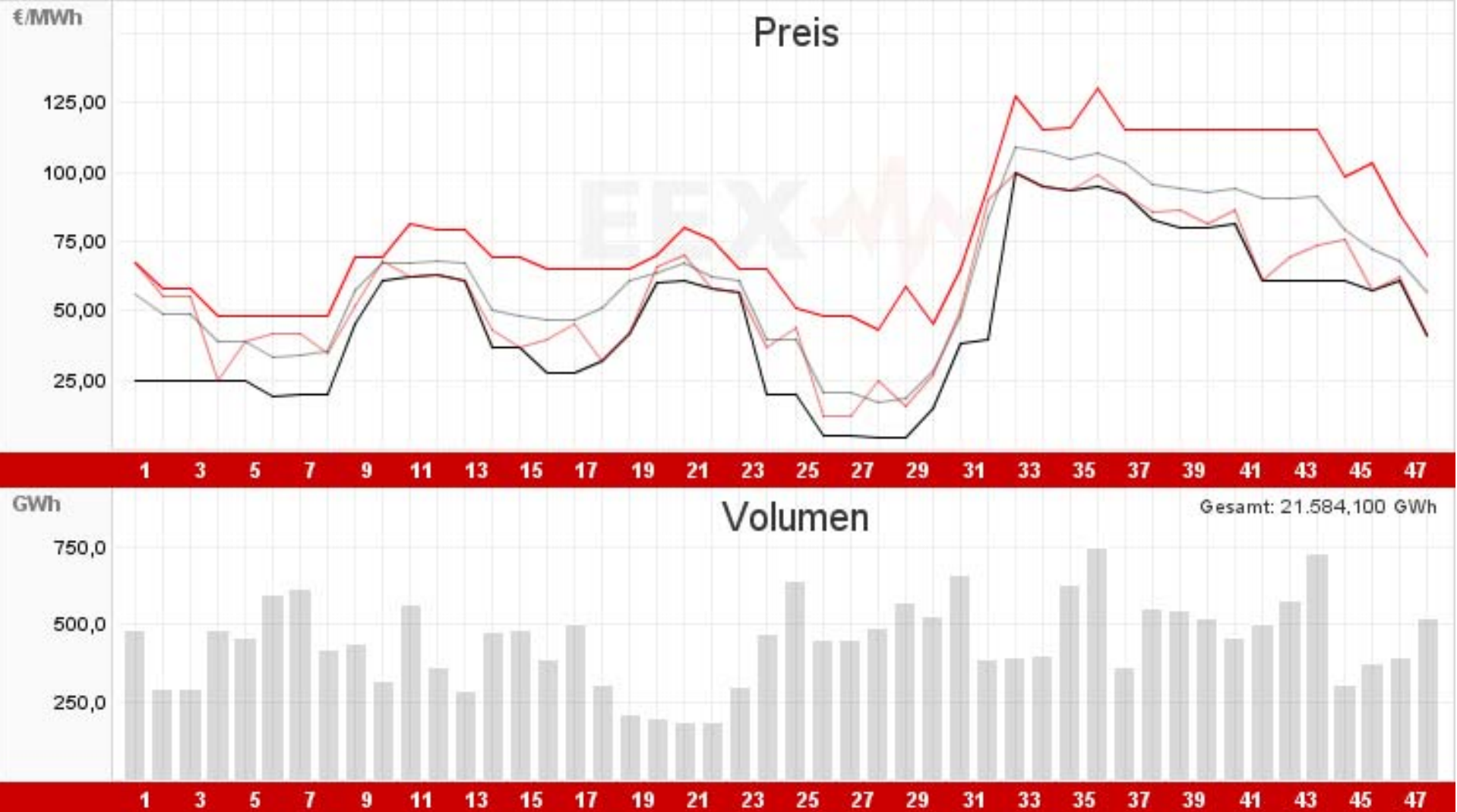
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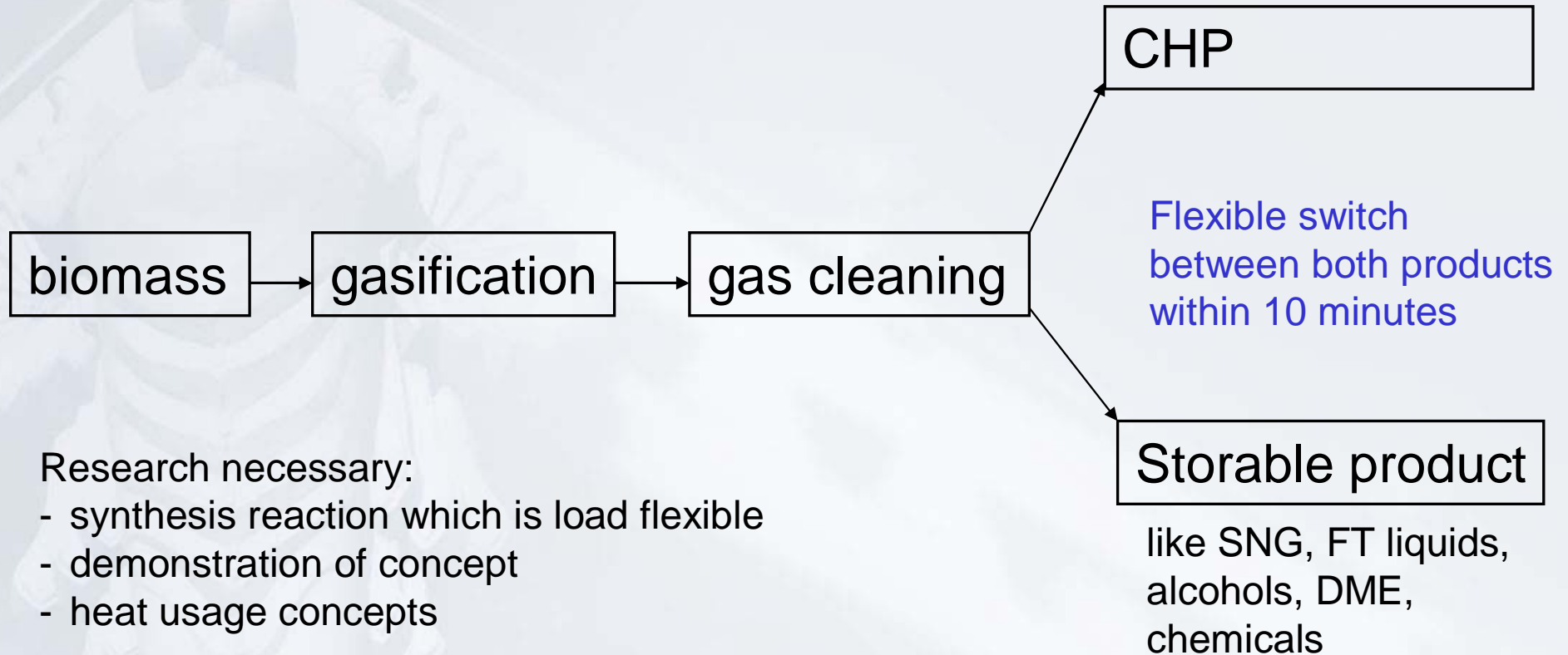
# Price of electricity at Leipzig stock exchange



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Working group: Zero Emission Energy Technology





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# Biomass CHP Güssing

## design data

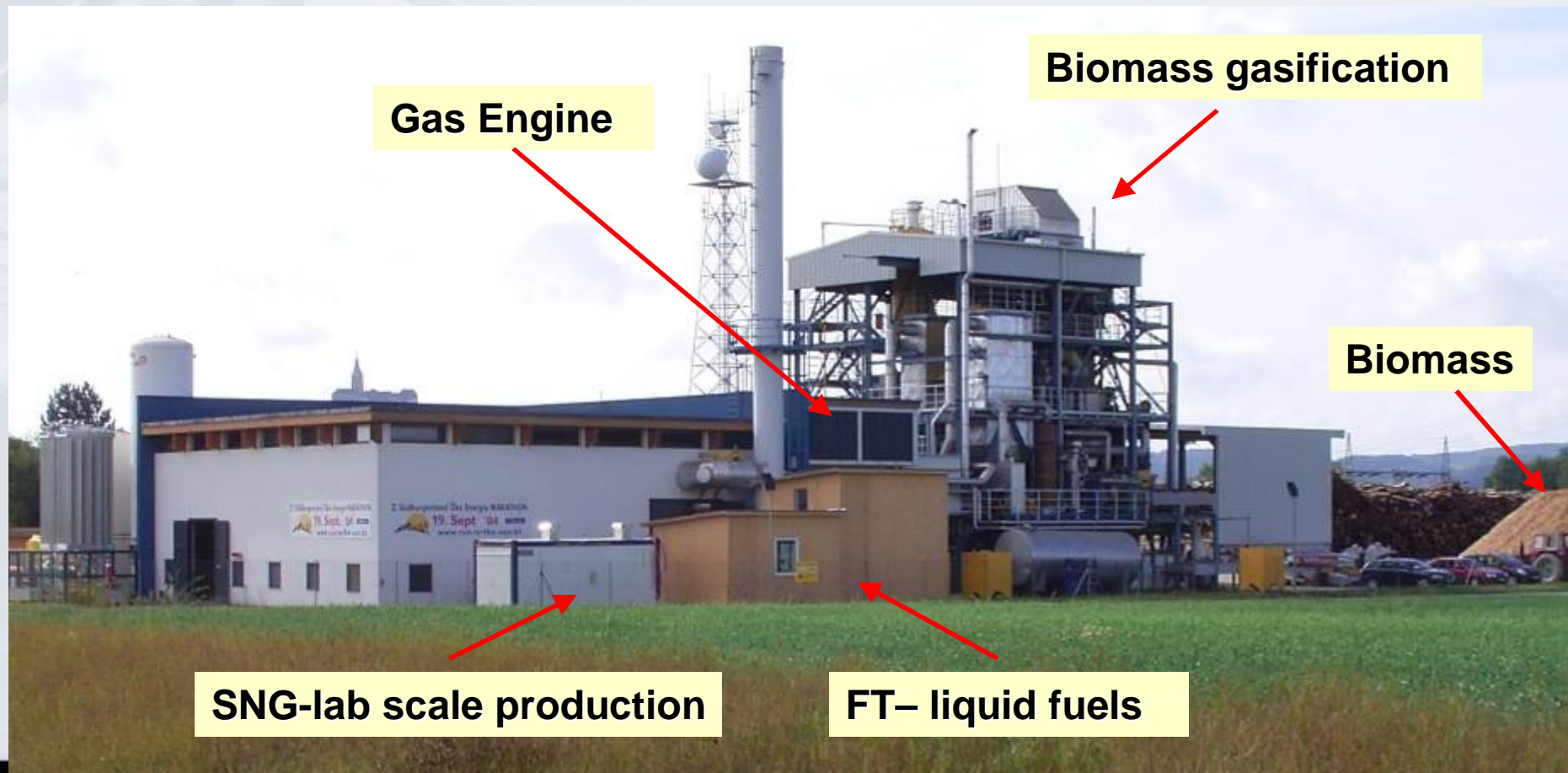


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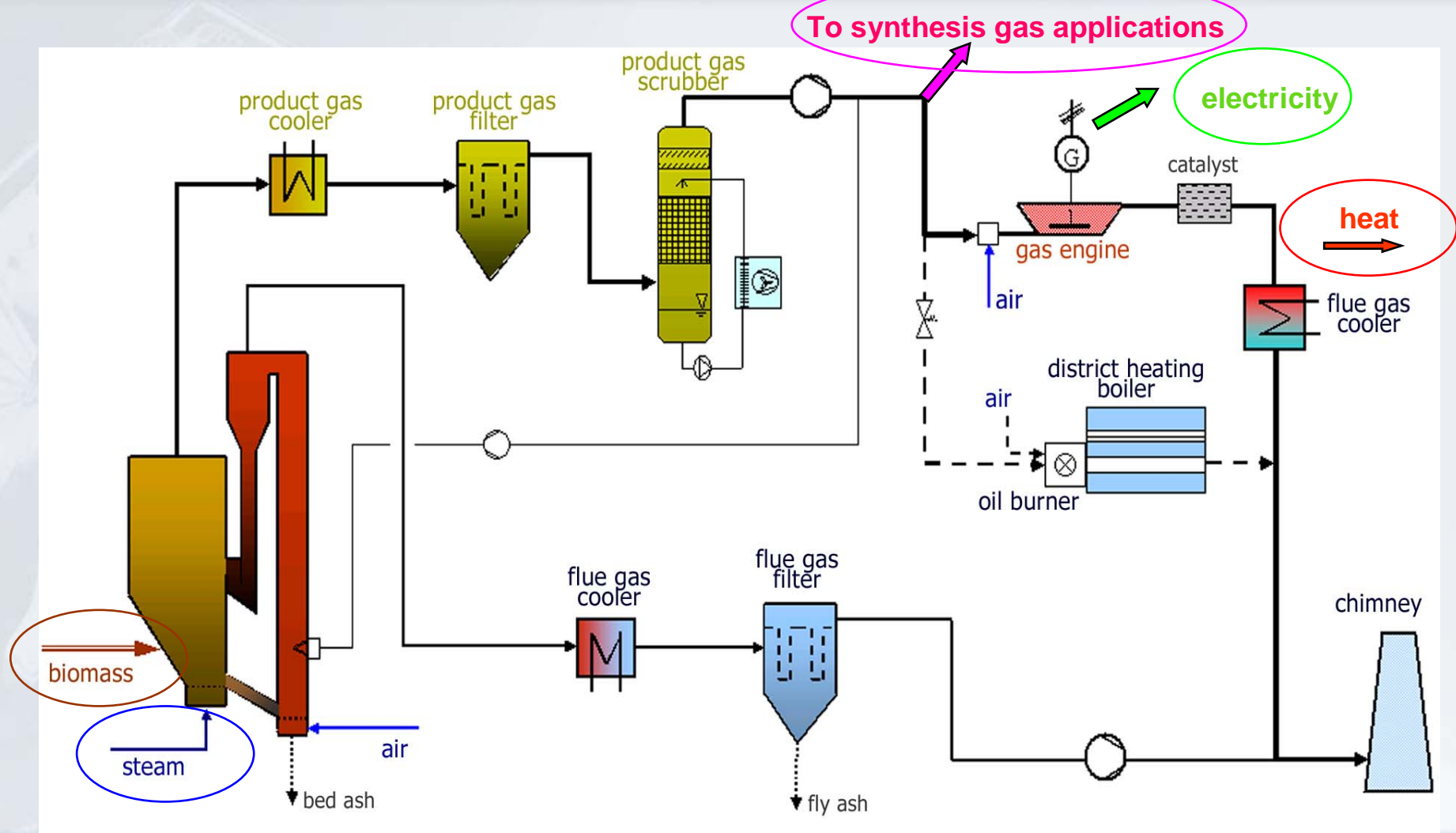
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- Start of construction September 2000
- Start up January 2002
- Fuel 2,2 to/h (Wood chips)
- Water content 15 % (35 %)
- Fuel power 8 MW
- Electrical power 2 MW
- Thermal power 4,5 MW
- Electrical efficiency 25 % (20%)
- Total efficiency 80 %
- Owner and operator Biomass Power Station  
Güssing Association

## Test plants – Renewable Synthetic Natural Gas (SNG), Renewable Liquid Fuels



# CHP-PLANT GÜSSING



# Gas Composition (after gas cleaning)



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Main Components		
H <sub>2</sub>	%	35-45
CO	%	22-25
CH <sub>4</sub>	%	~10
CO <sub>2</sub>	%	20-25

Minor Components		
C <sub>2</sub> H <sub>4</sub>	%	2-3
C <sub>2</sub> H <sub>6</sub>	%	~0.5
C <sub>2</sub> H <sub>2</sub>	%	~0,4
O <sub>2</sub>	%	< 0,1
N <sub>2</sub>	%	1-3
C <sub>6</sub> H <sub>6</sub>	g/m <sup>3</sup>	~8
C <sub>7</sub> H <sub>8</sub>	g/m <sup>3</sup>	~0,5
C <sub>10</sub> H <sub>8</sub>	g/m <sup>3</sup>	~2
TARS	mg/m <sup>3</sup>	20-30

Possible poisons		
H <sub>2</sub> S	mgS/Nm <sup>3</sup>	~200
Mercaptans	mgS/Nm <sup>3</sup>	~30
Thiophens	mgS/Nm <sup>3</sup>	~7
HCl	ppm	~3
NH <sub>3</sub>	ppm	500-1000
Dust	mg/Nm <sup>3</sup>	< 20

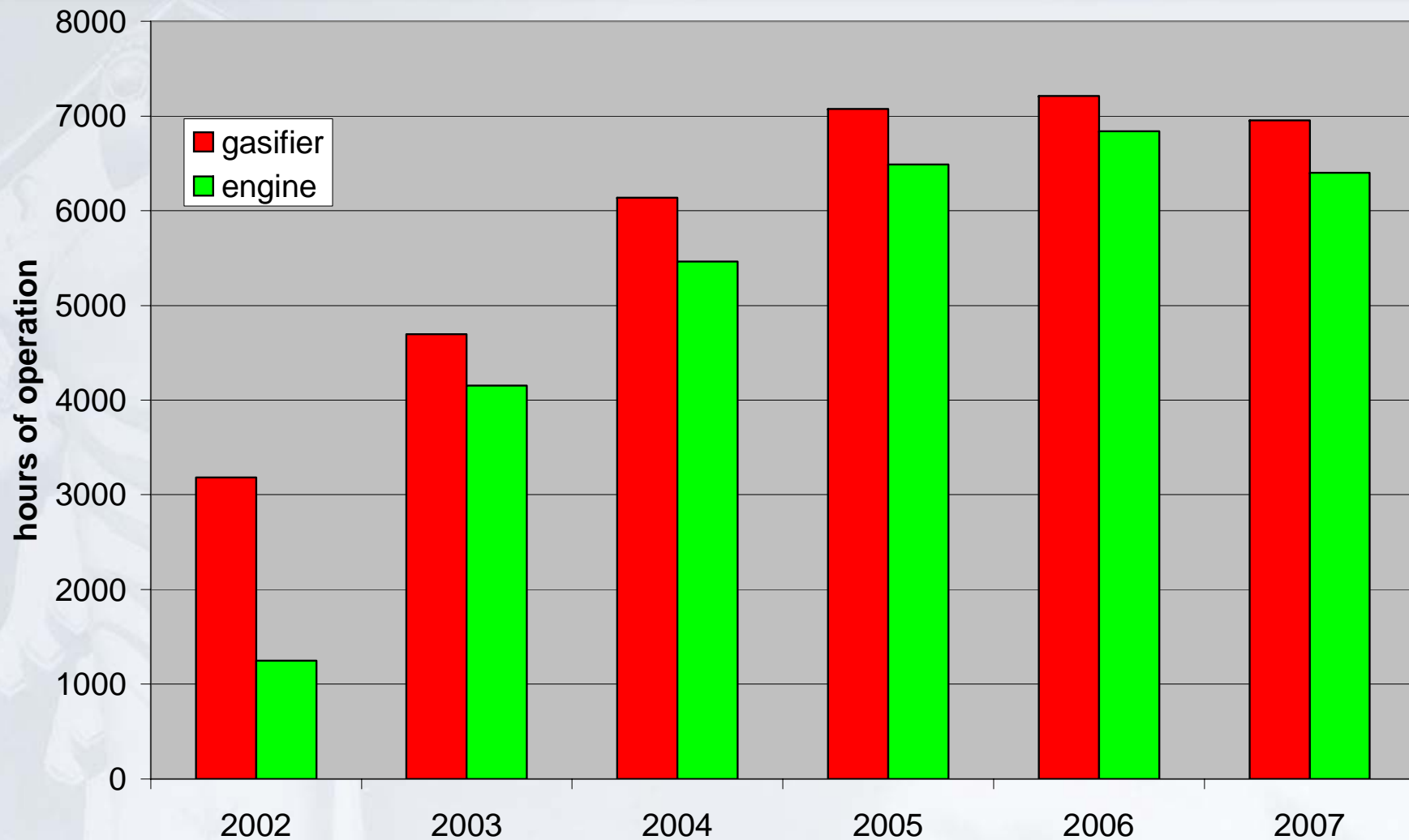
**H<sub>2</sub>:CO = from 1.5:1 to 2:1**

# Increase of Availability of the Plant



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# Biomass CHP Oberwart



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A faint, grayscale background image of a classical statue, possibly a figure from mythology or history, with a large, ornate headpiece and a draped garment.

**Renewable liquid fuels**

**Fischer-Tropsch Syntheses**

# Fischer Tropsch Syntheses

## Fischer-Tropsch BioFiT

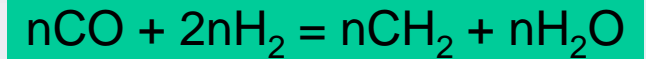
Slurry bed reactor

Temperature 200-300°C

Pressure 20-30 bar

Capacity ~ 10 Nm<sup>3</sup>/h

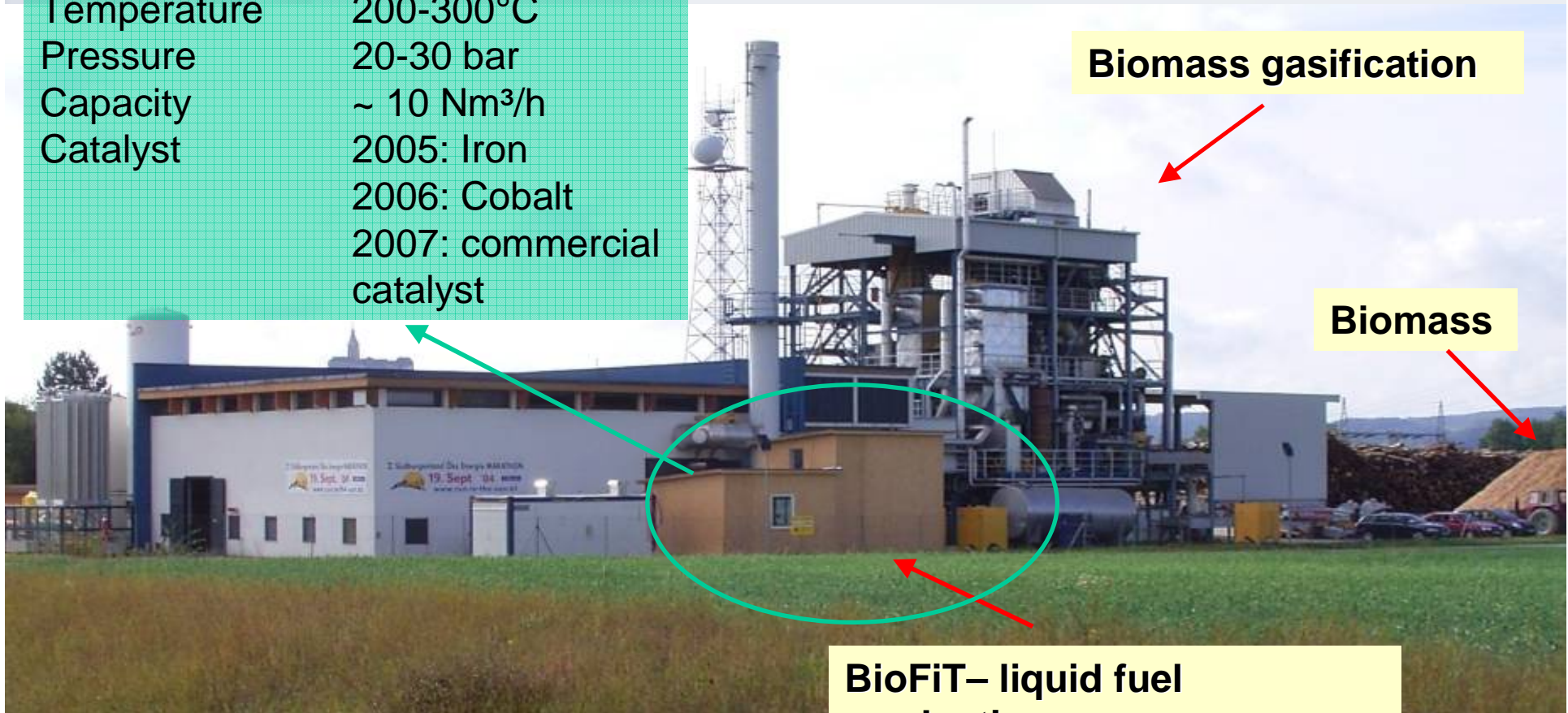
Catalyst  
2005: Iron  
2006: Cobalt  
2007: commercial  
catalyst



**Biomass gasification**

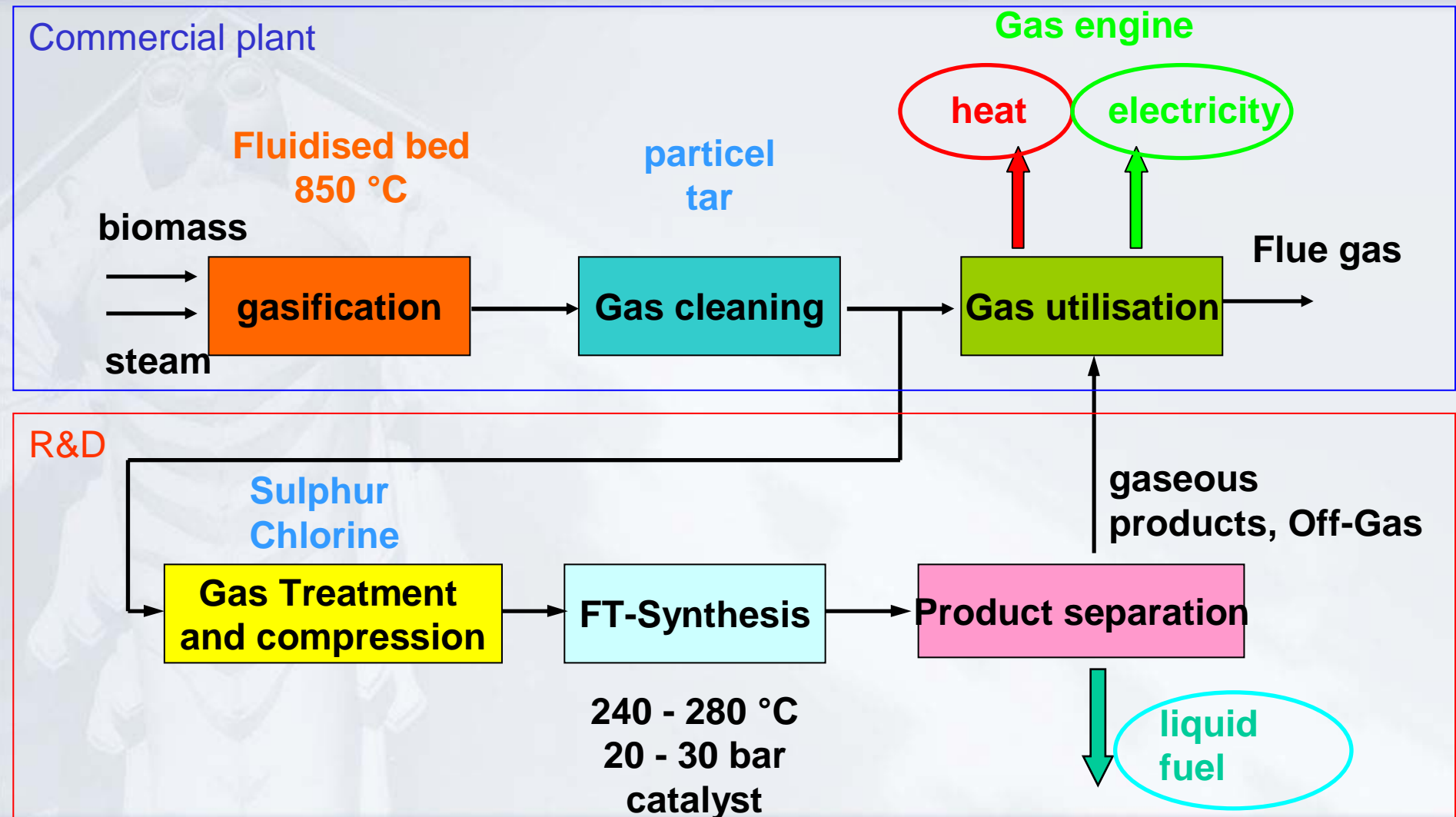
**Biomass**

**BioFiT– liquid fuel  
production**





# Schema of FT Syntheses



# Properties of FT Diesel



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Properties	Unit	EN 590:2004		Results of FT Diesel
		min	max	
Cetane number	-	51,0	-	75-85
Density at 15 o C	kg/m <sup>3</sup>	820	845	770-790
Polycyclic aromatic hydrocarbons	%(m/m)	-	11	< 1
Total aromatics content	%(m/m)	-	-	< 1
Sulphur content	mg/kg	-	50	< 5
Flash point	°C	>55	-	87 to 91
Carbon residue	%(m/m)	-	0,30	< 0,03
Ash content	%(m/m)	-	0,01	< 0,0015
Water content	mg/kg	-	200	200 to 300
Total contamination	mg/kg	-	24	2 to 4
Copper strip corrosion (3h at 50 °C)	rating	class 1		class 1 a
Oxidation stability	g/m <sup>3</sup>	-	25	< 5
Lubricity, corrected wear scar diameter	m m	-	460	340 to 360
Viscosity at 40oC	mm <sup>2</sup> /s	2,00	4,50	2.3 to 2.5
Oxidation stability	g/m <sup>3</sup>	-	25	< 12
Cold Filter Plugging Point, (CFPP)	°C	-	-20	-5 to 0

The background of the slide features a faded, high-angle photograph of a modern building with a prominent glass facade and a series of white, curved architectural elements.

**Renewable natural gas**

**Synthetic natural gas (BioSNG)**

# Methanation

## Methanation (BioSNG)

Fluidized bed reactor

Temperature 300-350 °C

Pressure 1-5 bar

Capacity ~ 10 Nm<sup>3</sup>/h

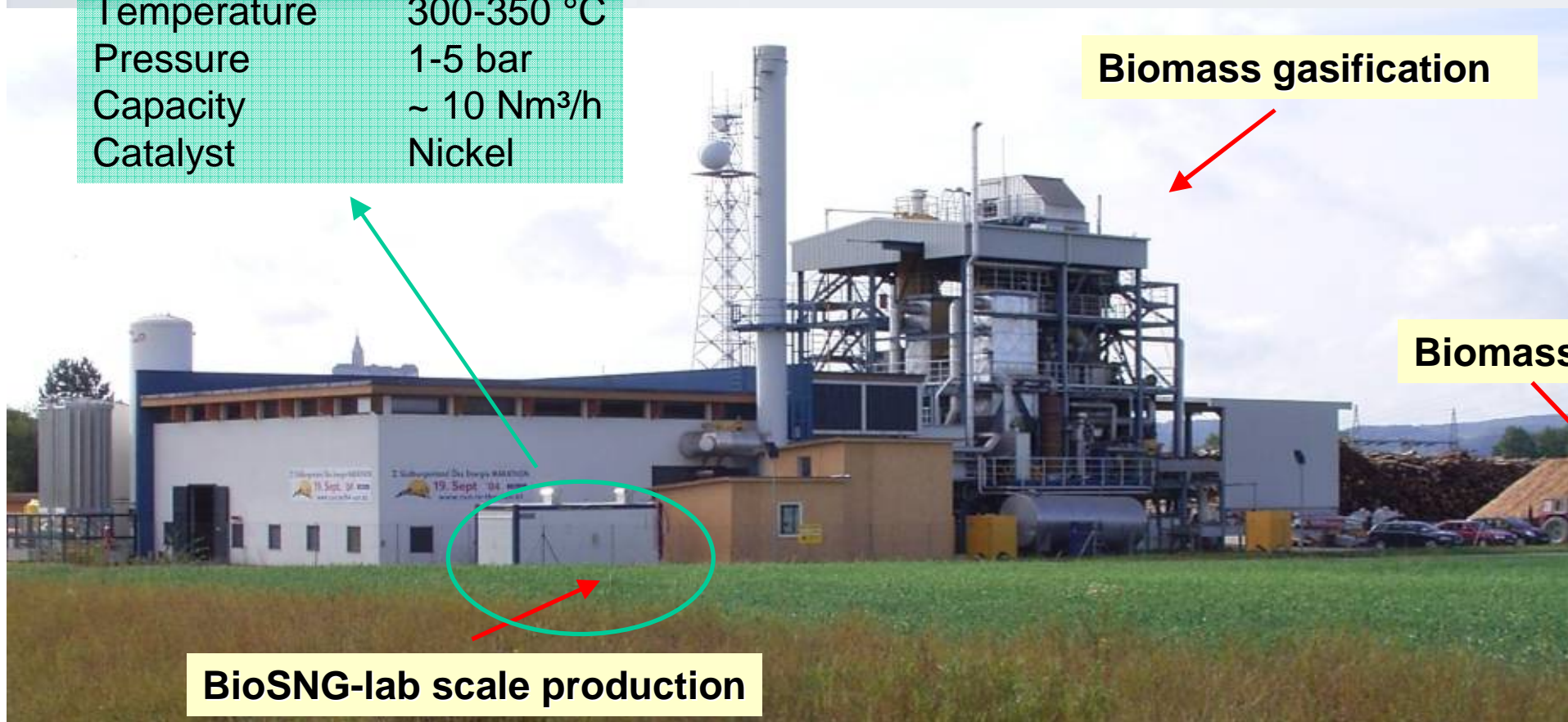
Catalyst Nickel



Biomass gasification

Biomass

BioSNG-lab scale production

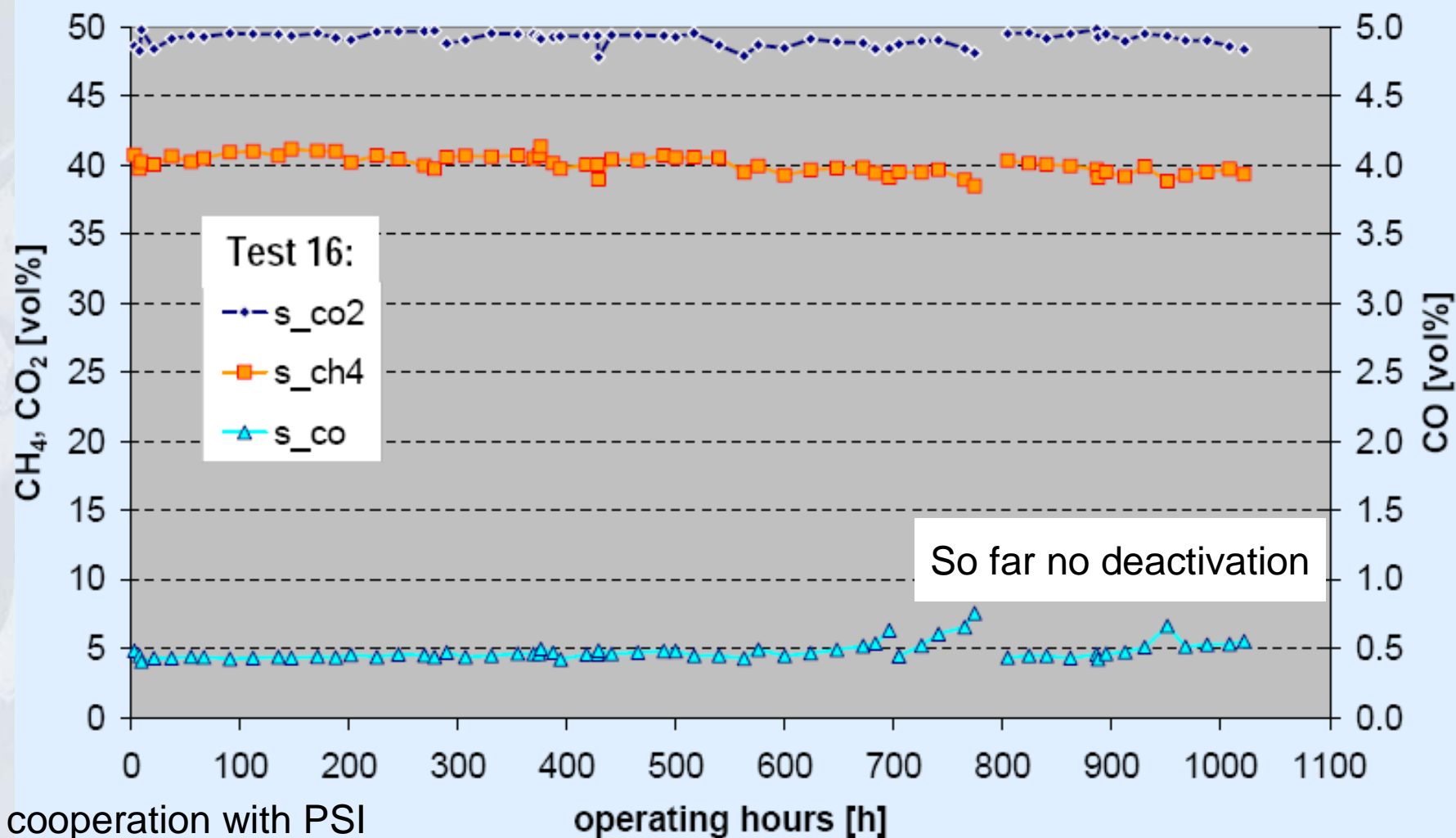


# Results BioSNG lab scale



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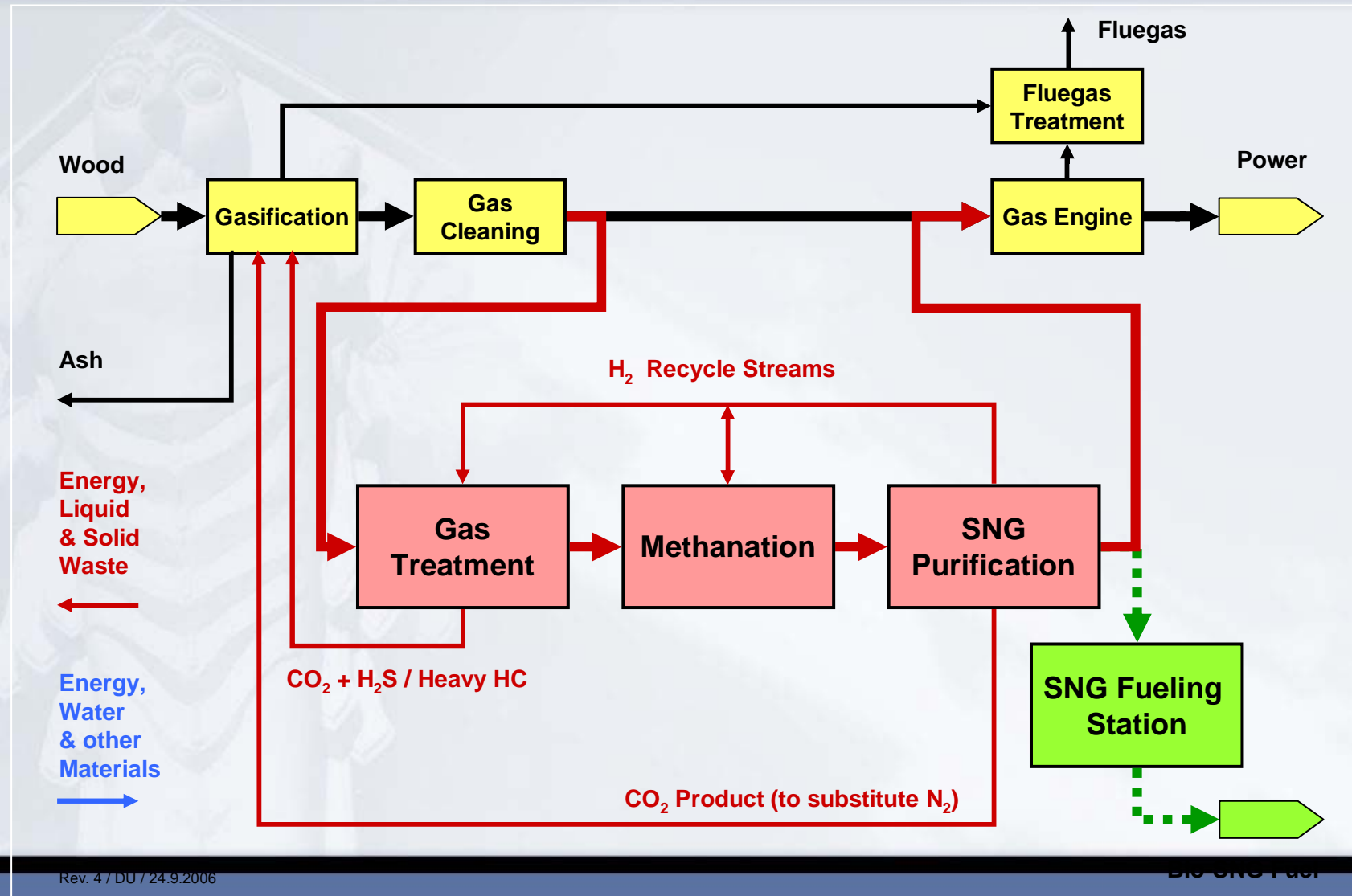
In cooperation with PSI

# Schema BioSNG demonstration



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# 1MW BioSNG demonstration plant



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- Successful scale up of a dual fluidized bed steam gasification system from laboratory to industrial scale (**within 10 years**)
- Industrial plant available with
  - High electrical efficiency (> 30 % with combined gas engine and ORC-process)
  - No solid residues (without ash, carbon content <0,5 %)
  - No liquid condensates
  - European emission requirements are met
  - High availabilities (>93 %)
  - Next plant is under commissioning (10 MW<sub>fuel</sub>)
- High potential for biofuels (BioSNG, BioFiT)
  - BioSNG, most suitable, 1 MW (100 m<sup>3</sup>/h BioSNG), start up demonstration at the moment
  - BioFiT, research ongoing



# Information



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<http://www.ficfb.at>

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