



Up-date on the Gasification Technology

October 2010

IEA Bioenergy

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Facts at a glance

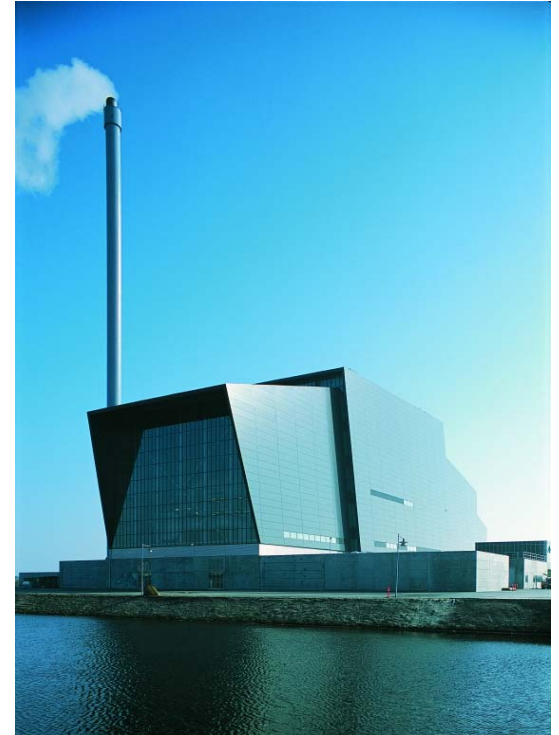


- ***Main office in Denmark***
- ***Founded in 1898***
- ***100% owned by The Babcock & Wilcox Power Generation Group Ltd., USA since 2000***
- ***350 employees***
- ***Turnover 100 million EUR***

Main Business Areas

- Waste to energy systems
- Biomass energy systems
- Gasification

- After sales service
 - Refurbishment/rebuilding
 - Components/parts
 - Inspection/analysis



Product gas

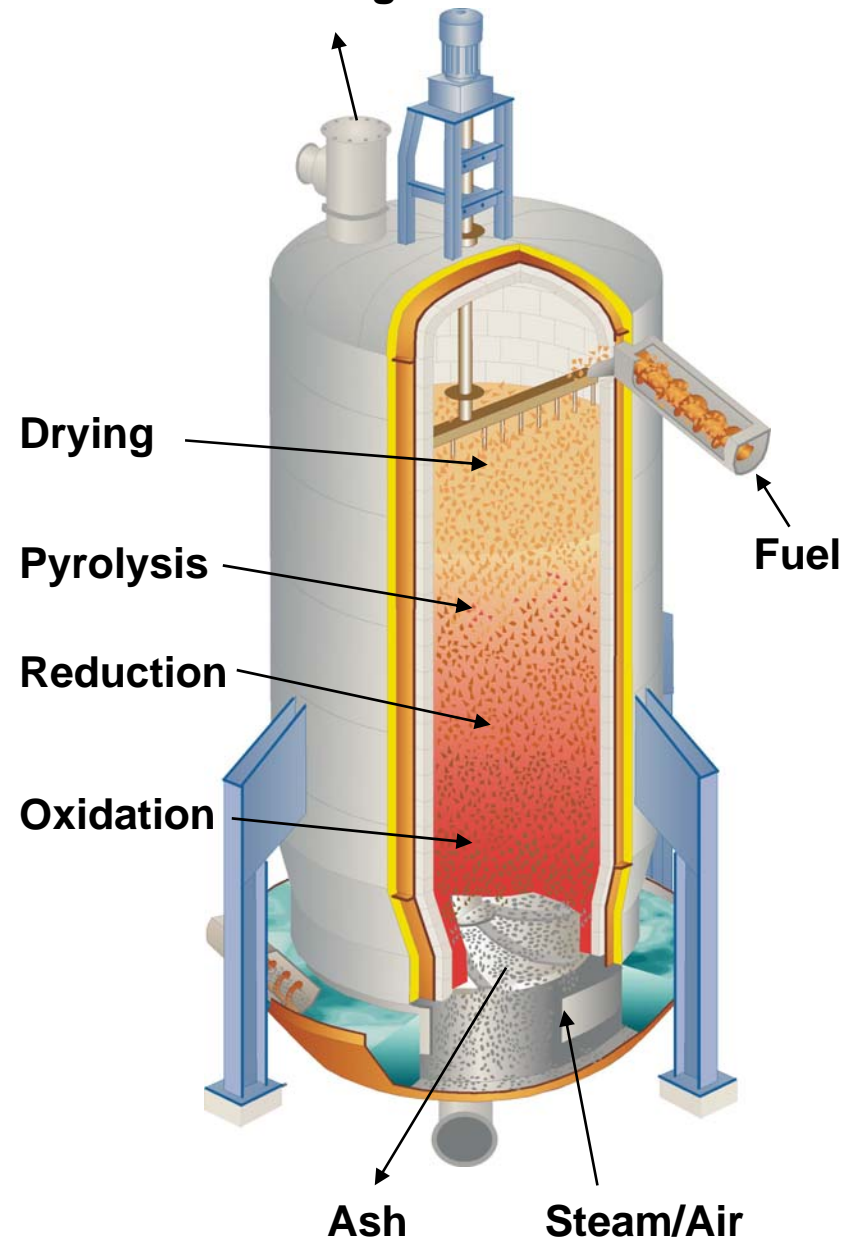
Up-draft gasification

Up-draft technology originally acquired from Dr. Gatzke

- A B&W Vølund research area since 1988

- Licensed to:

- JFE Engineering Corp. - Japan



The Harboøre CHP plant



- First of a kind – focus on having the overall concept working – not optimization of the performance
- Fuel: Woodchips. Moisture content: 35-55 %
- $3.5 \text{ MW}_{\text{th}} / 1 \text{ MW}_{\text{e}}$
- Commissioned in 1996
- CHP capability added in 2000
- Originally designed for district heating

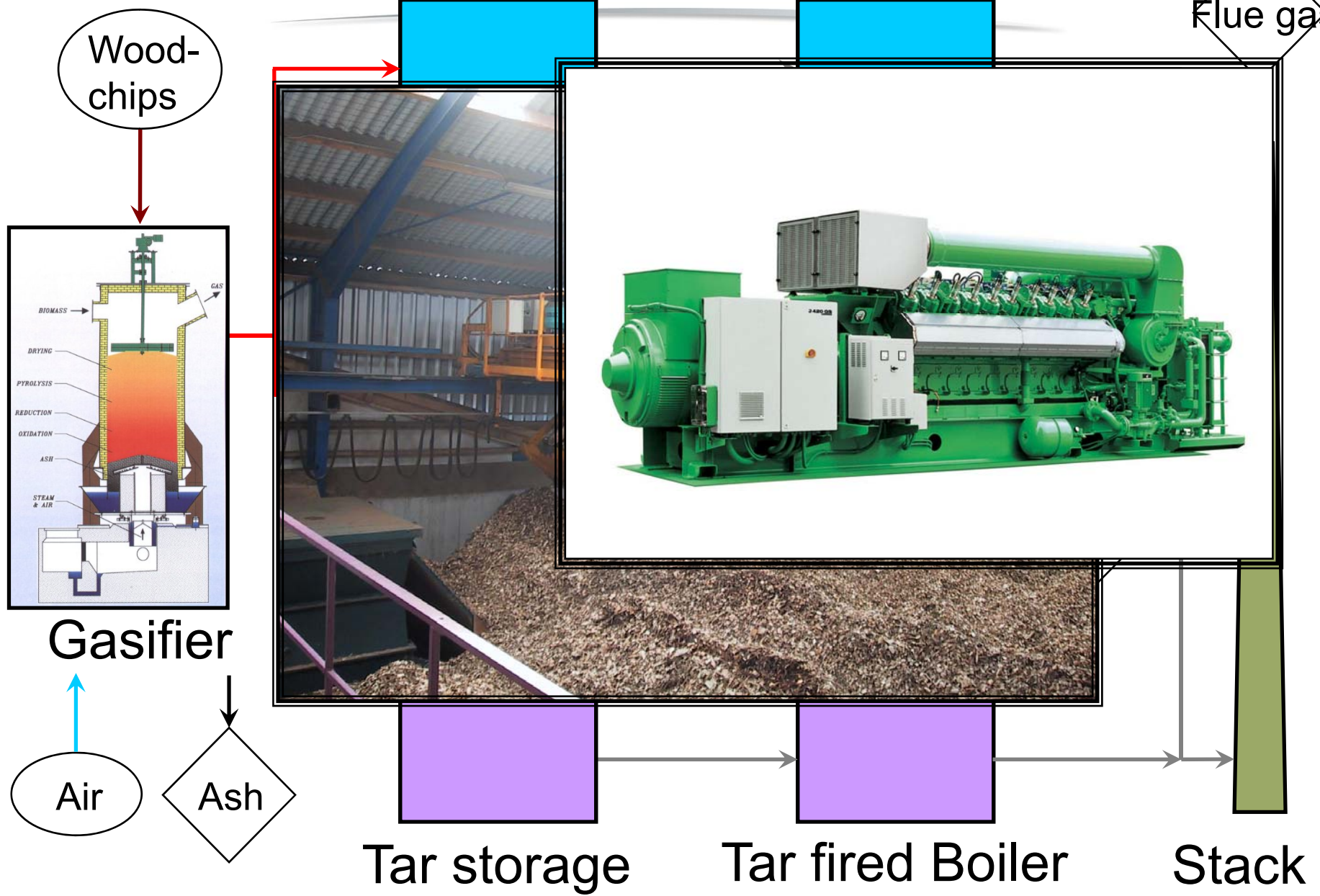
Experiences with up-draft gasifiers

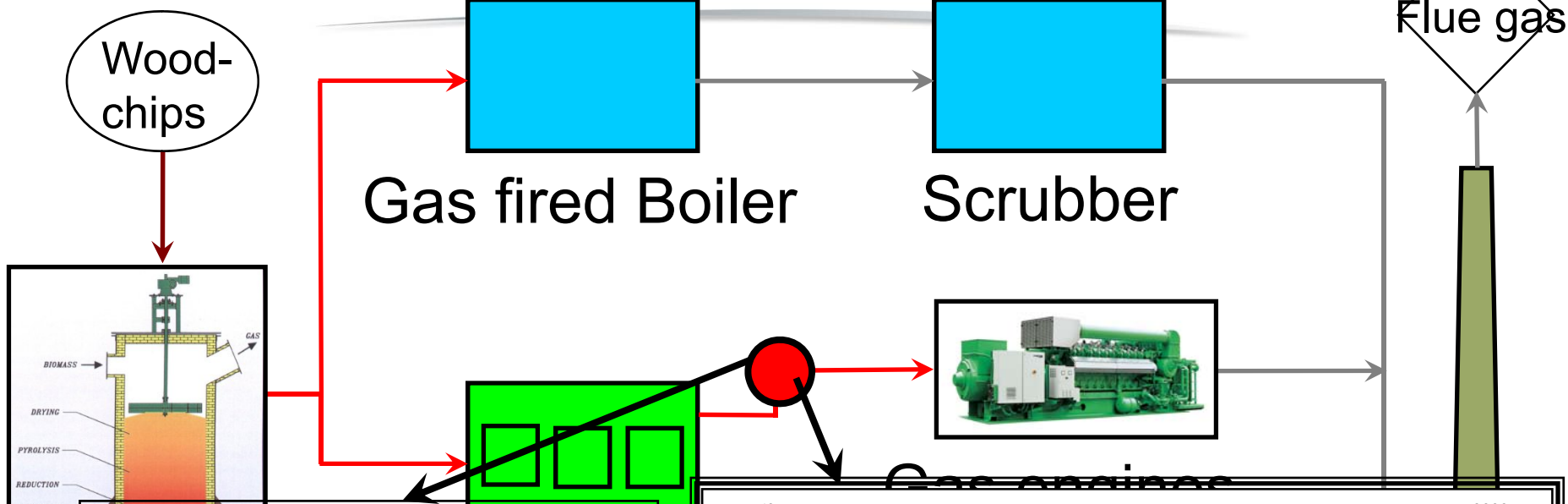
- **First pilot plant (1 MW) set up in 1989 at the Kyndby CHP. Dismantled.**
- **Mid 1990's: experiments on a 500 kW unit at Kommune Kemi – a Hazardous Waste facility. Dismantled.**
- **1993-96: Erection of the Harboøre plant. In operation.**
- **2006: Ansager plant - a 200 kW unit with a stirling engine. In operation.**
- **2007: Yamagata ($8 MW_{fuel}/2 MW_{power}$) plant in Japan by JFE. In operation.**
- **2008: Ishikawa ($2,5 MW_{power}$) plant in Japan by JFE. In operation**
- **2008 Daio paper 12MWth plant in Japan by JFE. In operation.**

Operational status

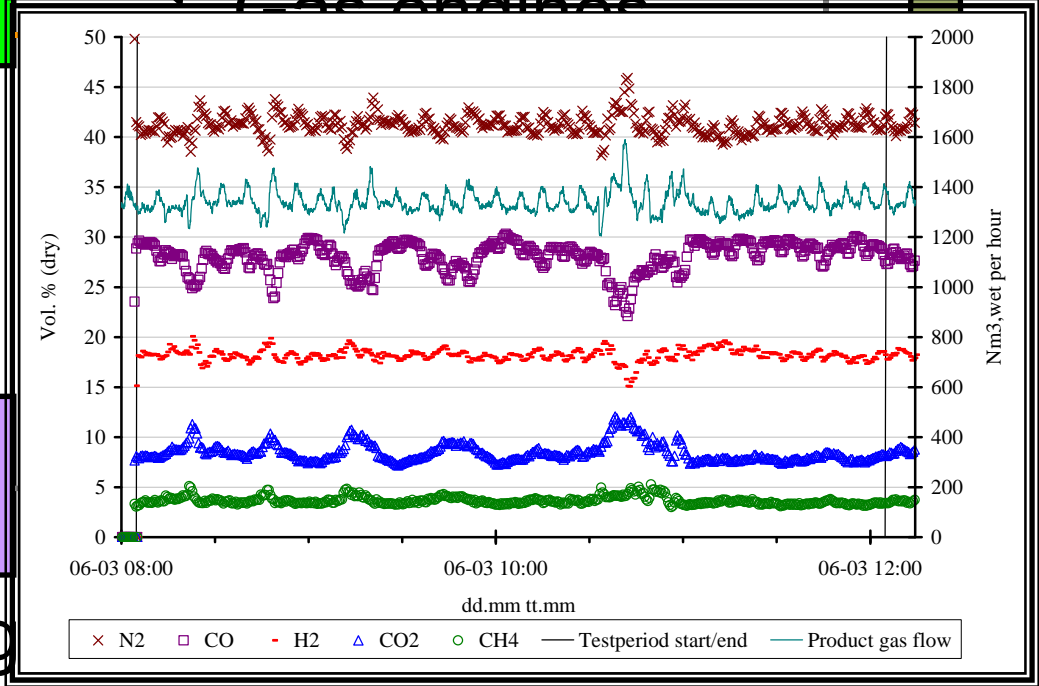
- ***Gasifier operated for more than 120 000 hours***
- ***Gas engines operated more than 80 000 hours***
- ***More than 36 000 MWh supplied to the power grid***
- ***Present power production: more than 500 MWh per month***

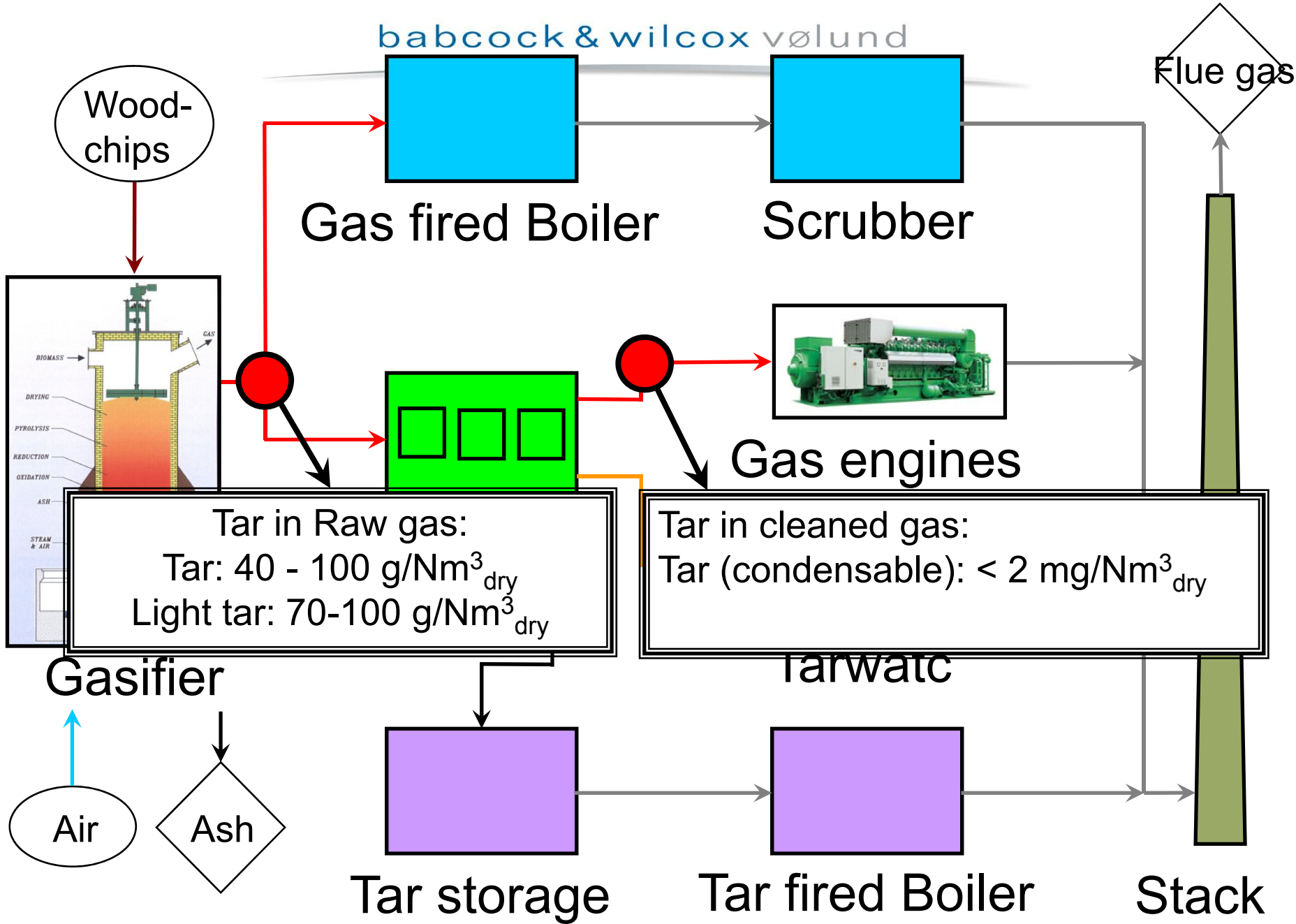
Flue gas



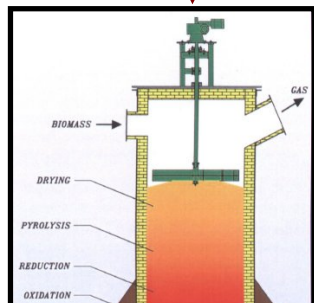


Gas composition:
 H_h 6.5-7 MJ/Nm³_{dry}
 18-19 % H₂
 27-30 % CO
 7-10 % CO₂
 3-5 % CH₄
 < 0.5 % O₂



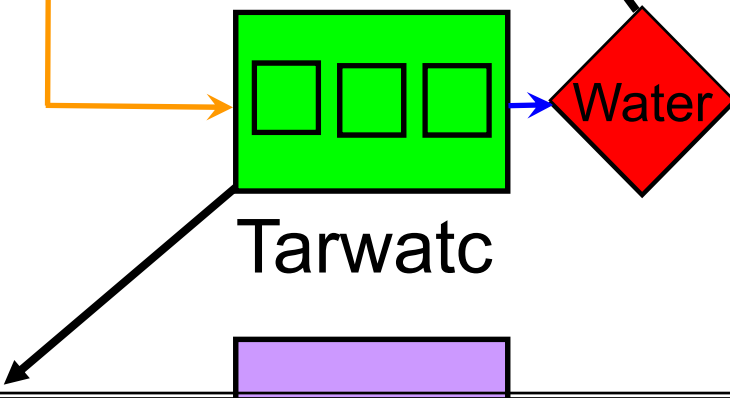
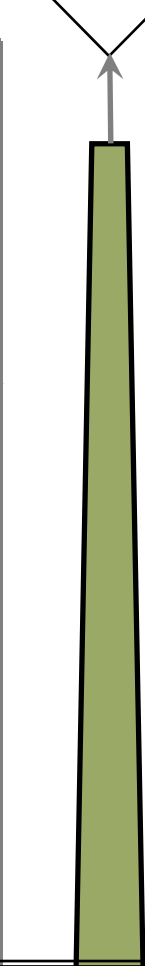


Wood-chips

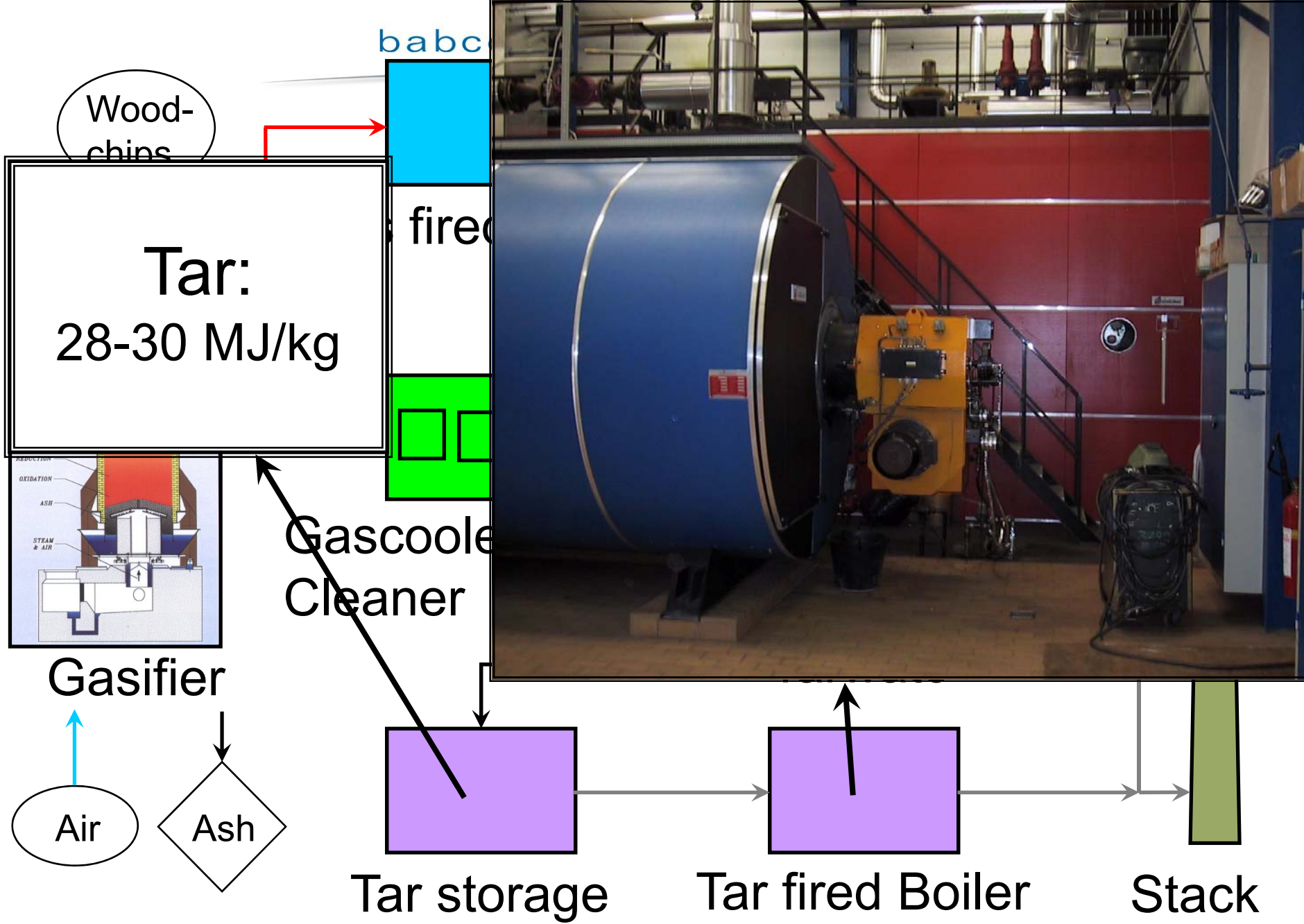


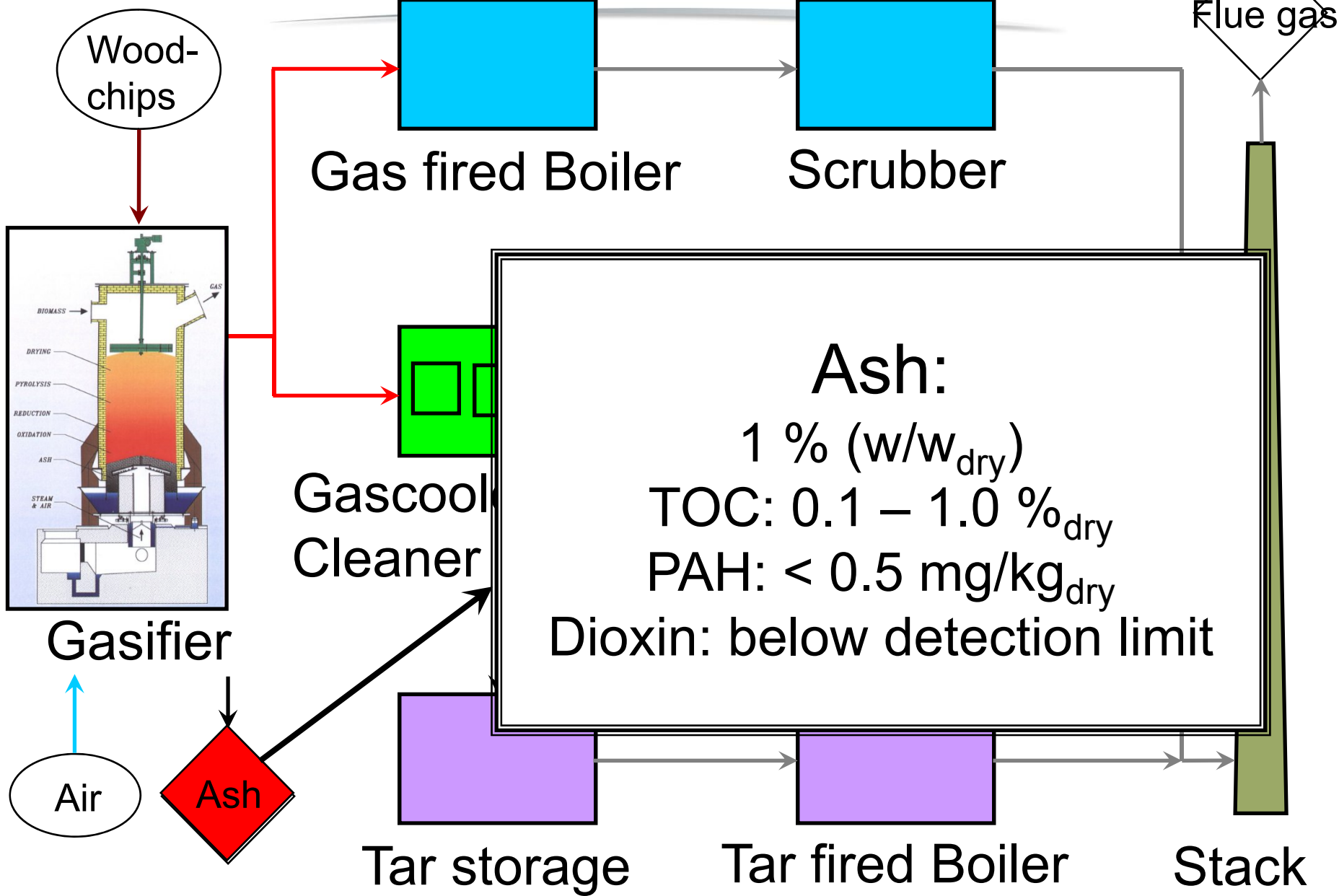
Wastewater as condensate
without additional treatment:
0.1-0.2 m³/h
pH 5-7
COD 10 - 100 mg O₂/l
N_{total} 1 - 100 mg/l
Acetic acid 1 - 15 mg/l

Flue gas



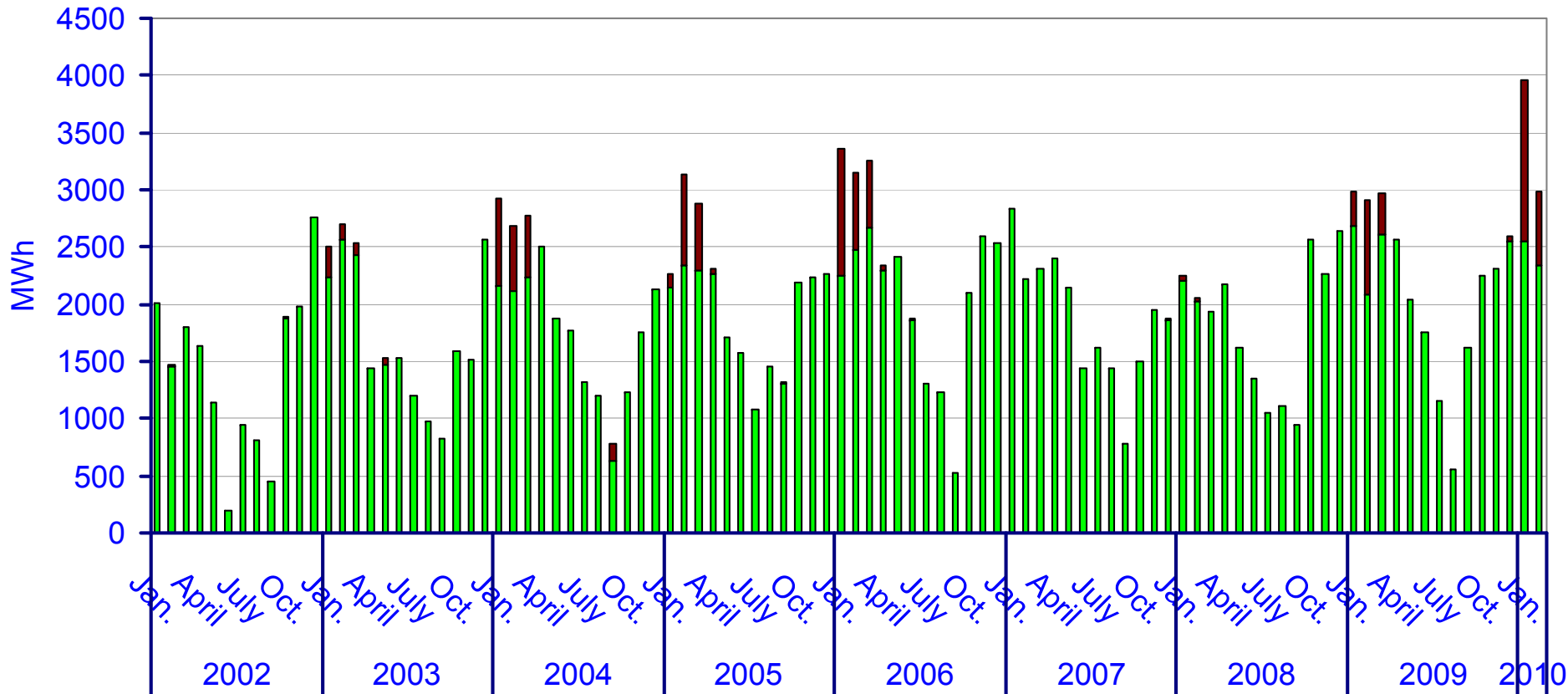
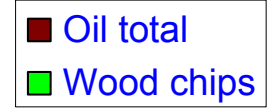
Thermal treatment of waste water
contaminated with organics.





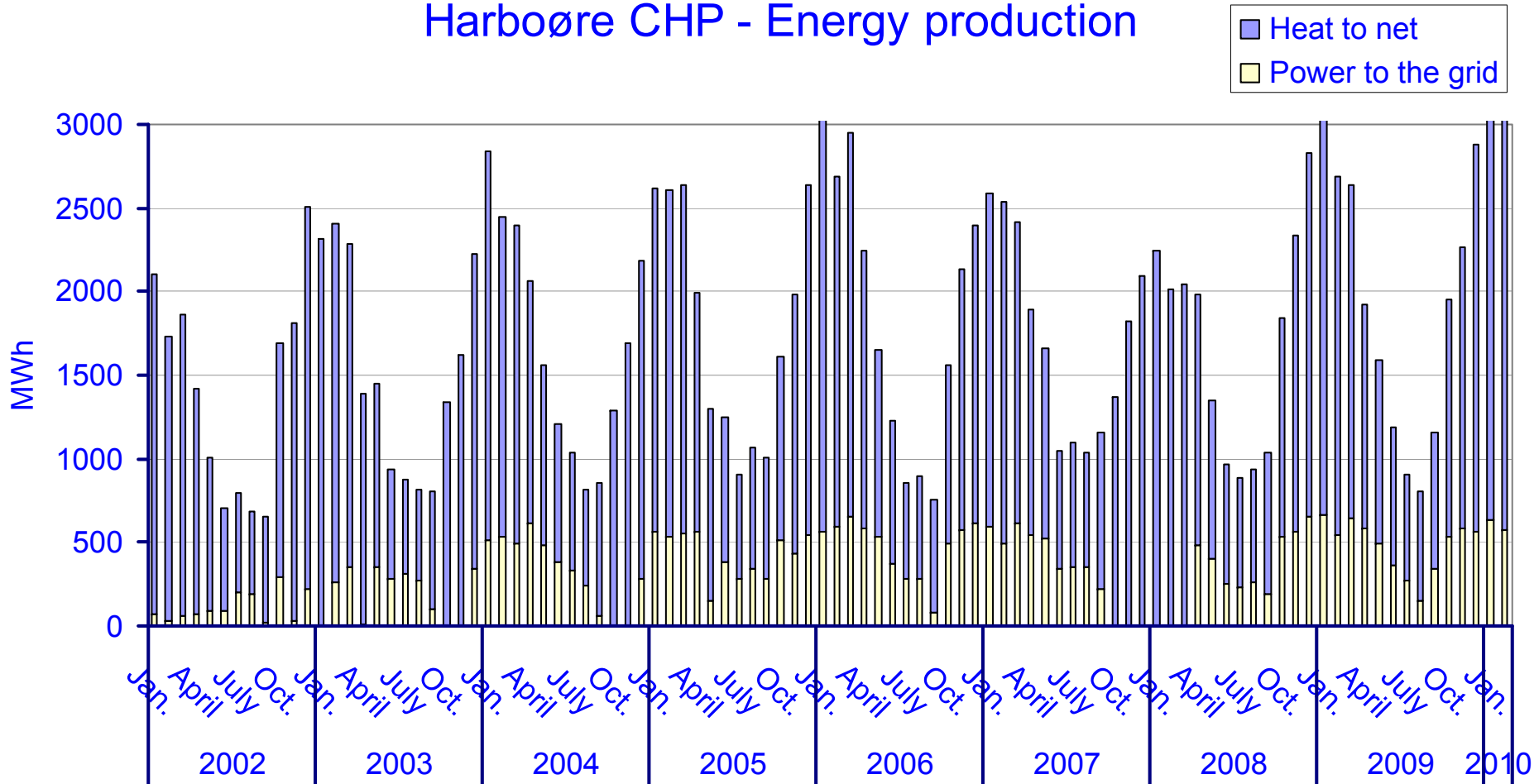
Harboøre CHP – Fuel consumption

Harboøre CHP - Energy source

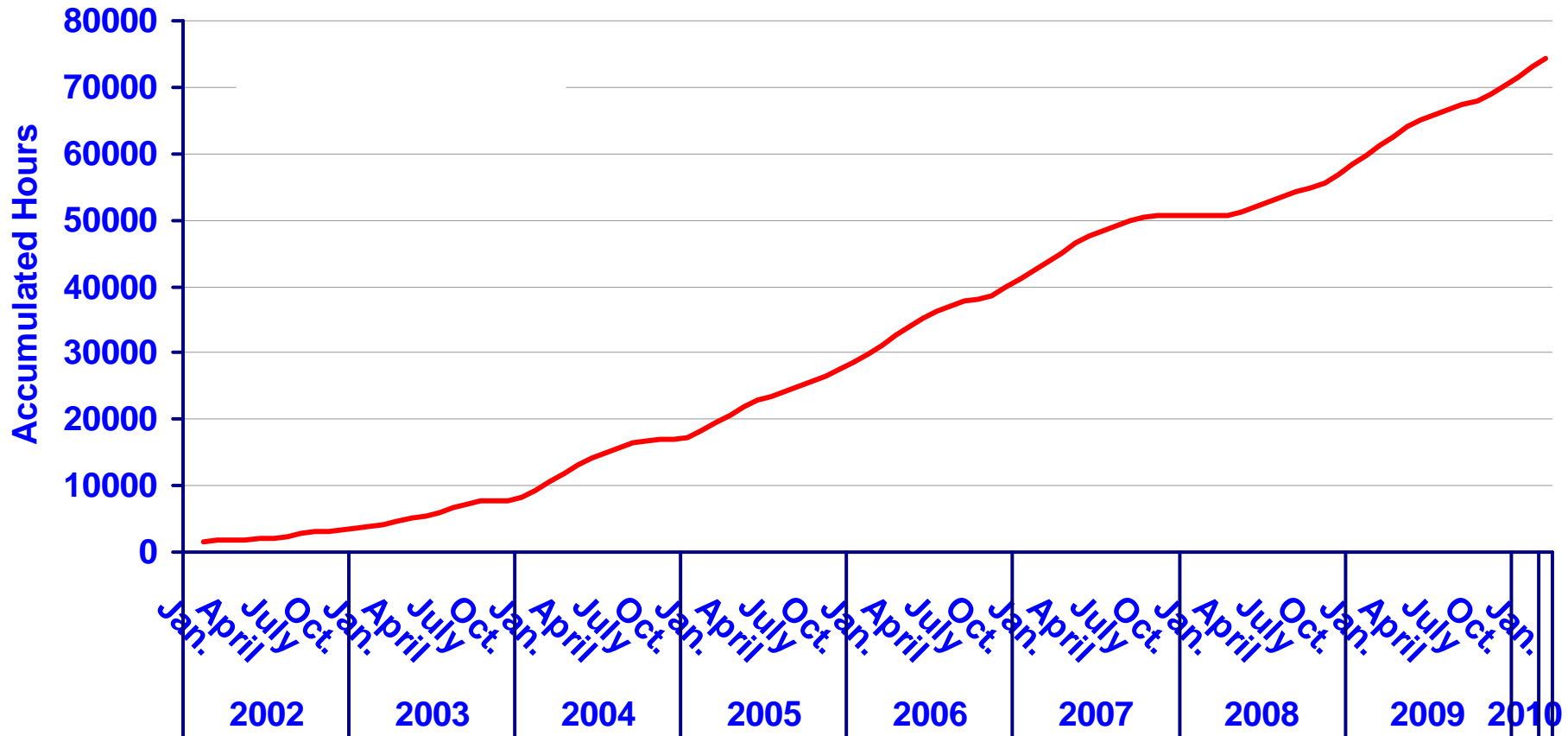


Harboøre CHP – Energy production

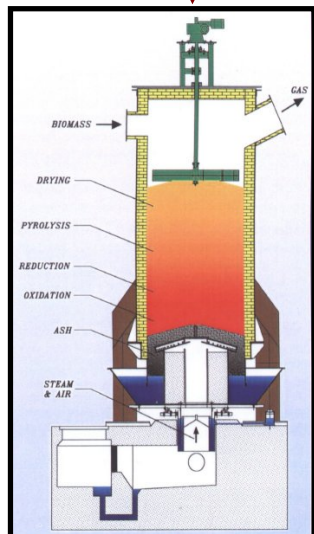
Harboøre CHP - Energy production



Harboøre CHP – Gasengine operation



Wood-chips



Gasifier

Air

Ash

Heat: Test ~ 100 %

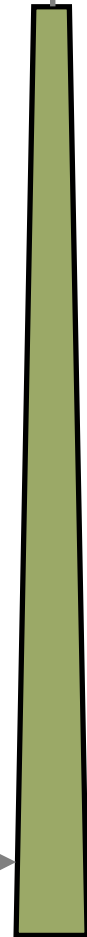
Gas fired Boiler

Scrubber

Power: Test: 28 %_{gross}
 2006 average: 23 %_{gross}
 Heat: Test: ~ 55 %_{gross}
 2006 average: 57 %_{gross}

Storable energy as tar:
 Test: 10-17 %
 2006 average: 13 %

Flue gas



Stack

Advantages

- ✓ High efficiency
- ✓ High potential for further developments
- ✓ Flexibility
- ✓ Turn-down ratio
- ✓ Fast ramping



B&W Vølund gasification

Licensee JFE – Japan:

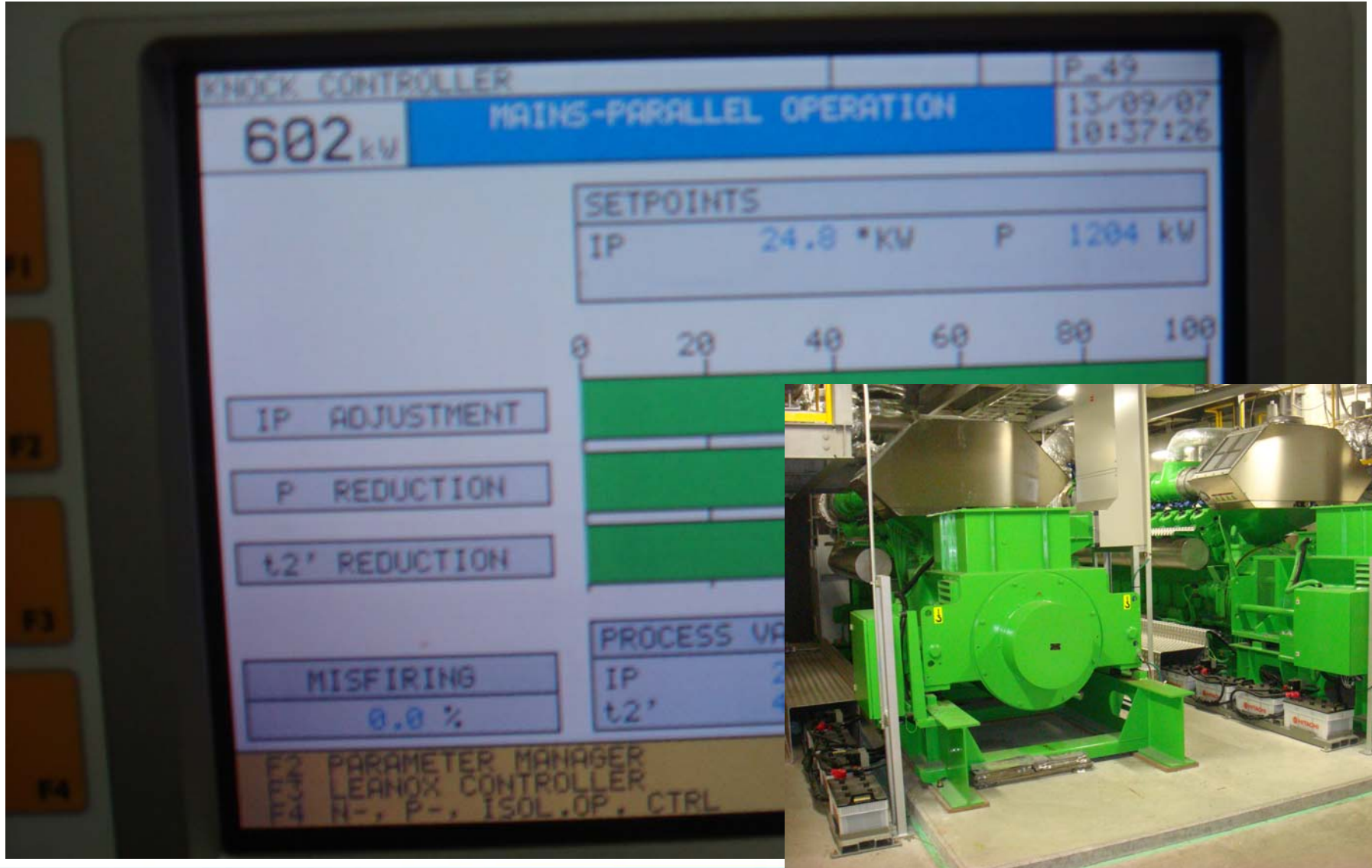
- Yamagata plant in operation (8 MWth)
- Ishigawa plant in operation (9 MWth)
- Daio plant in operation (12 MWth)



Yamagata – a 2 MWe plant



Autumn 2007 at Yamagata (2 MWe)



Spring 2009 at Ishigawa

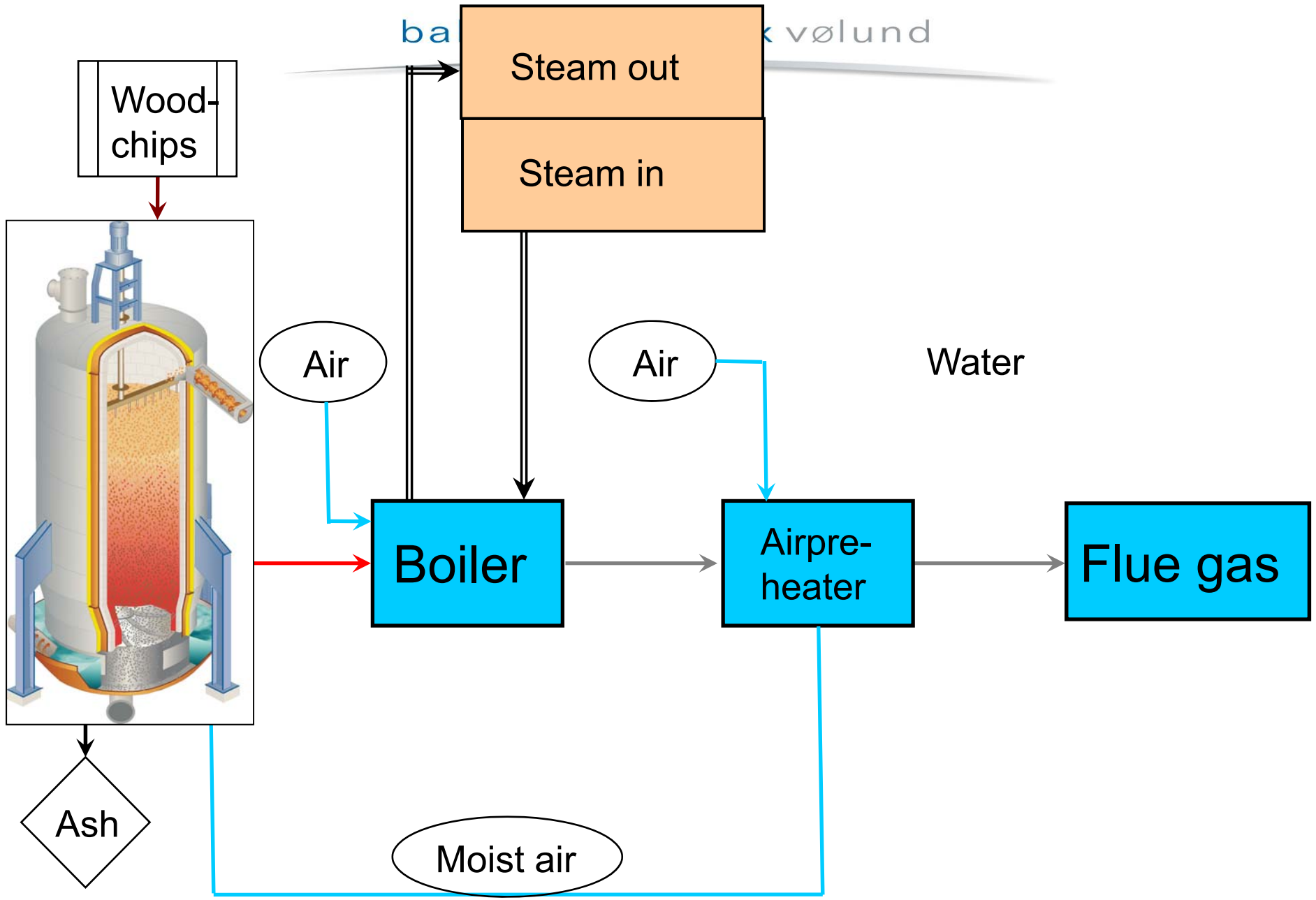


Spring 2009 – Fuel for Daio plant

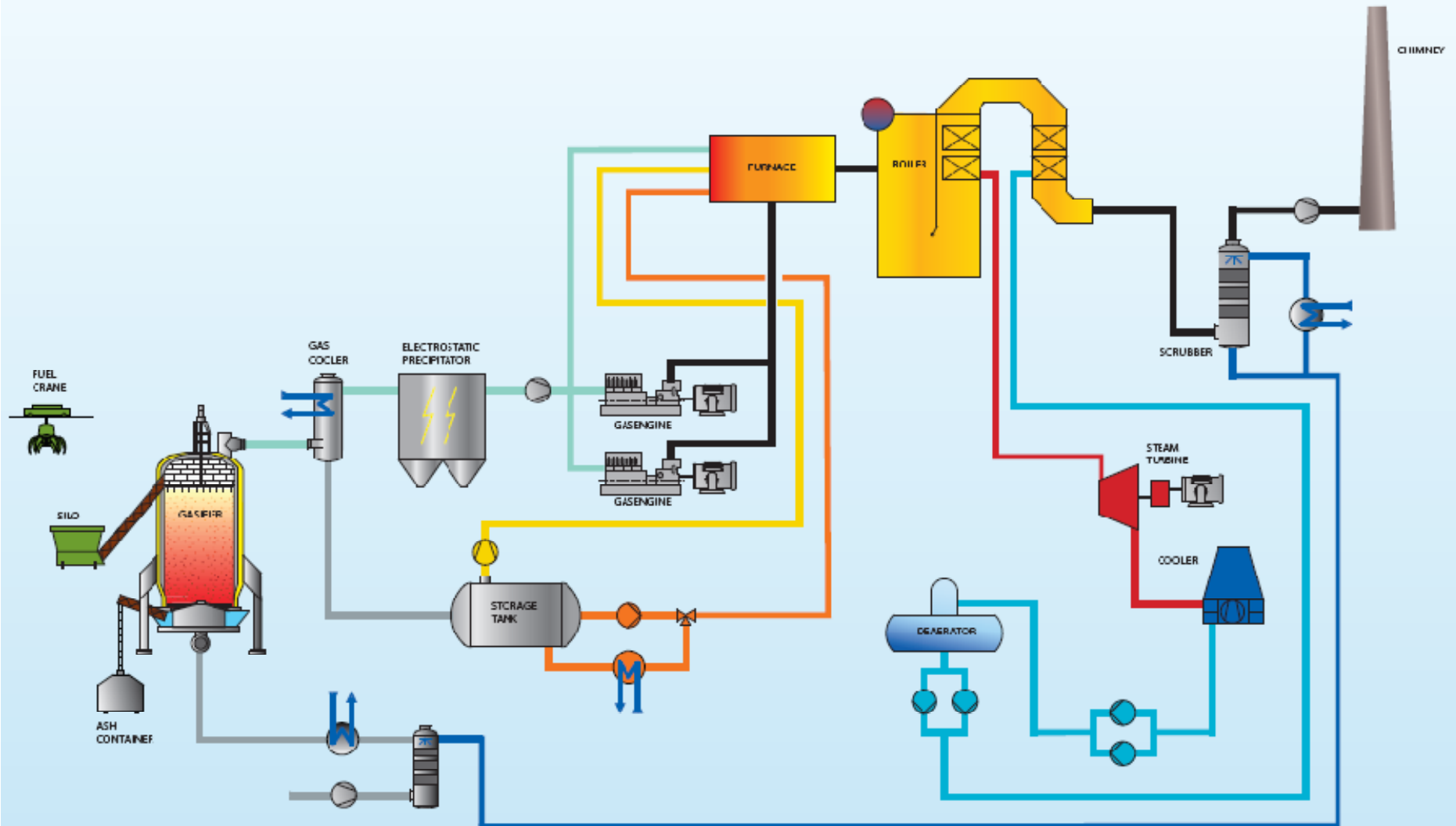


Commercialising the technology: Concepts

- Combined heat and power stations
- Burnable gas generator
- Wasteboost – external superheater for Waste fired power plants
- Combined cycle gasifier based power station



Combined Cycle Gasifier - Process



Financial and technical figures 2MWe

4-6 MEUR/MWe installed

$\eta_e = 28\%$ CHP

$\eta_{th} = 55\%$ CHP

Bio oil = 13%

1 week per year for maintenance

O&M excluding manpower but including wearparts,
consumable, service, office cost, insurance

225.000 EUR per year

Financial and technical figures 5MWe

4-5 MEUR/MWe installed

$\eta_e = 38\%$ CCGP

1 week per year for maintenance

O&M excluding manpower but including wearparts,
consumable, service, office cost, insurance

375.000 EUR per year

General for Fuel

Wood chips, rounded and homogenous and with a good 'sliding effect':

Ash content, approx.	%	0 – 2
Ash softening temperature	°C	>1000
Apparent density	kg/m ³	200-300
Moisture content	%	35 – 55
Heat value, lower	MJ/kg	8.4 – 11.6

Challenges

- Location with subsidies on the feed in tariff
- Location with heat or steam demand
- All the crock around the world gives a bad rumor

B&W

vølund

www.vølund.dk