

EMPYRO – Fast Pyrolysis Demonstration Plant



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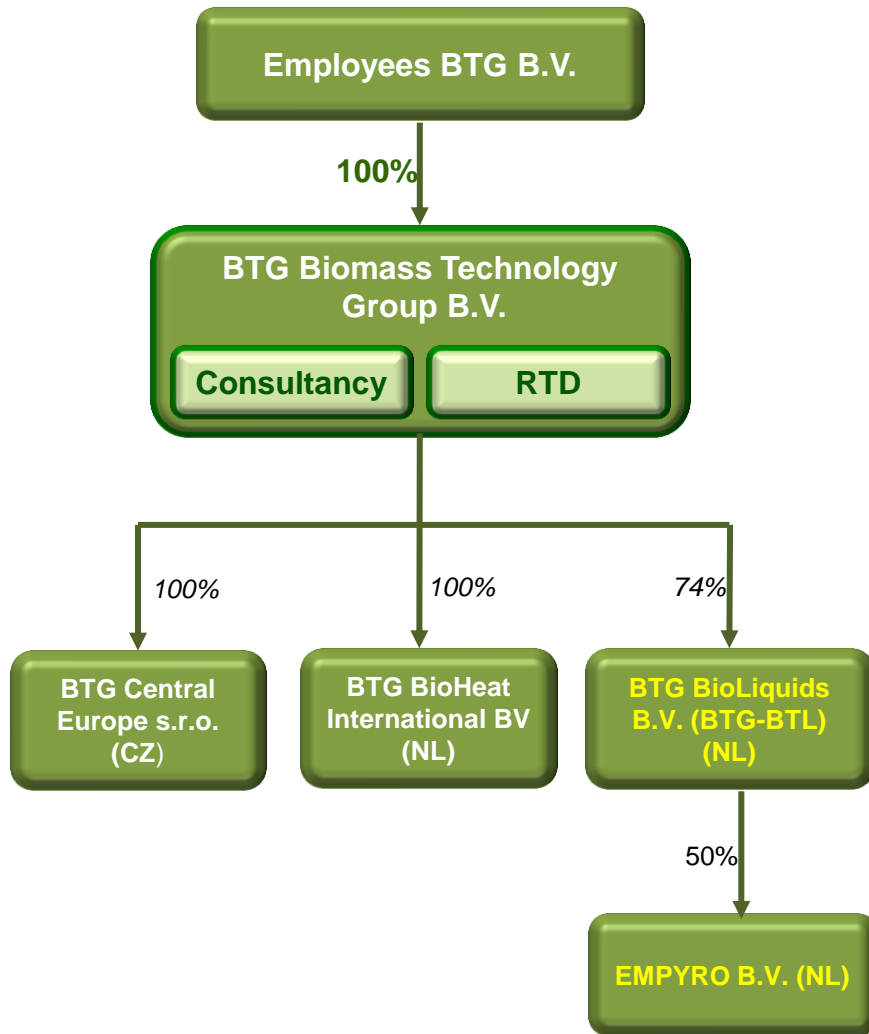
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Company Profile BTG

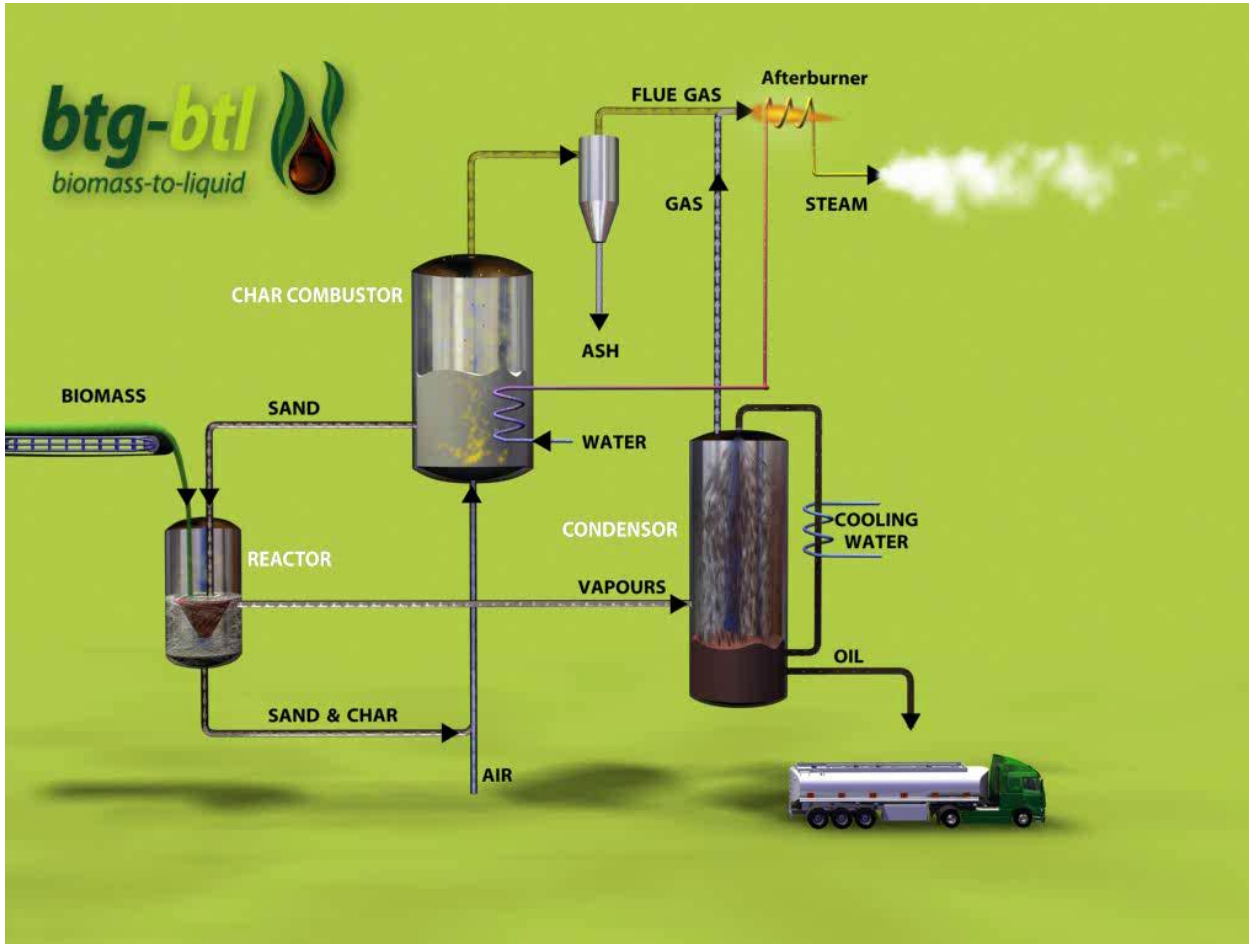
- BTG is a Small-Medium-Enterprise (SME) with its main office in Enschede, the Netherlands
- BTG existence started at the University of Twente in 1979;
- In 1987 BTG became an independent, private firm specialised in the process of biomass conversion into fuels, energy and chemicals;
- *Three main activities:*
 - Consultancy
 - Project development
 - RTD



Company Profile BTG



BTG Bioliquids Fast Pyrolysis Technology



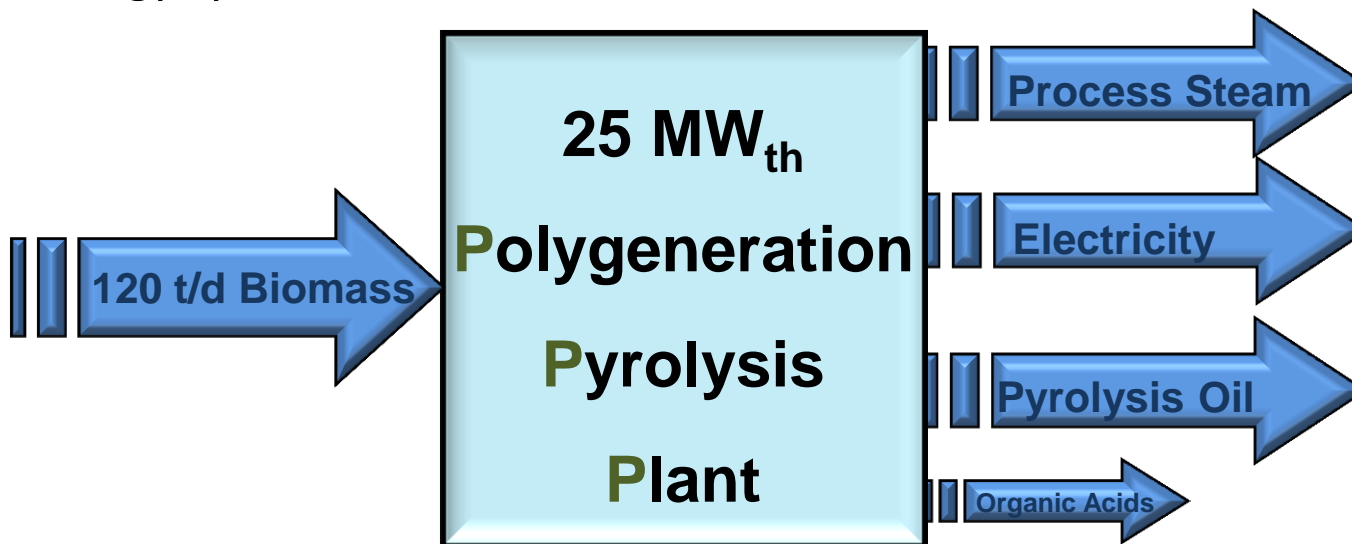
Specific features:

- ❖ No carrier gas;
- ❖ Mechanical mixing ('rotating cone');
- ❖ Char & gas utilised for process-heat and steam;
- ❖ No need for external energy

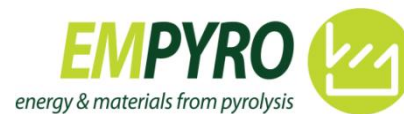
EMPYRO project - introduction

Polygeneration through pyrolysis: simultaneous production of fuel oil, process steam, electricity and organic acids:

- Design, built and demonstrate a 25 MW_{th} polygeneration pyrolysis plant to produce electricity, process steam and fuel oil from woody biomass.
- Determine the performance window of pyrolysis oil production process (availability, maintenance, operability, capital costs, etc);
- Demonstrate the use of pyrolysis oil in fuel oil or natural gas fuelled energy system.



Project Partners



Site



Biomass

- Initially, fresh or clean wood will be used ('A-wood');
- Permits also valid for contaminated wood ('B-wood');
- Size reduction at EMPYRO site
- 'Particle size' < ~3 mm
- Heat for drying obtained from with pyrolysis plant;
- Final moisture content < 7 wt%;
- Feedstock provided by different suppliers



Legislation & Permits

Permits required:

- Environmental Permit & Assessment (MER)
- Water permit
- Environmental permit
- Building permit
- Nature Conservation Law – Natura 2000

All permits have been obtained !!



Project site (AkzoNobel, Hengelo)

Soil cleaning at the project site required for obtaining all permits

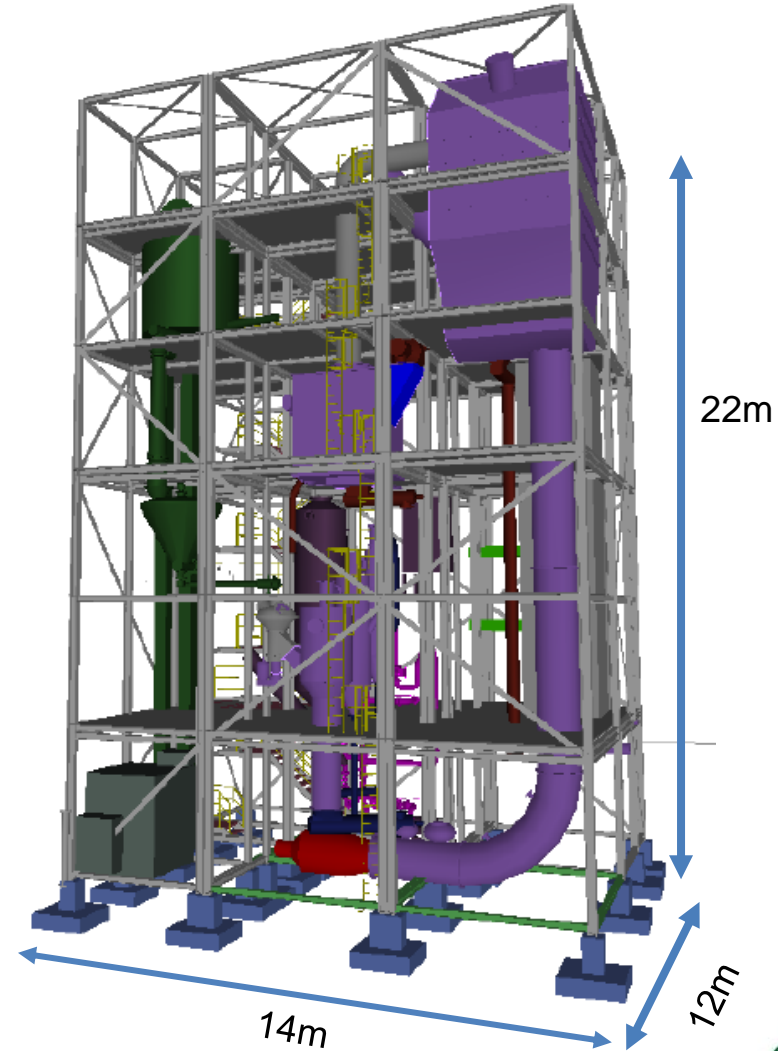
Engineering

Basic plant configuration:

- Single reactor
- BFB char combustor
- External sand cooler

Basic data of the plant

- Capacity = 5 t dry biomass/hr
- Oil Production = 3.2 t/hr
- Steam production = 6 MW
 - 4 MW internal use
 - 2 MW export to AkzoNobel
- Electricity production = 800 kW_e
 - Internal use
 - export to grid

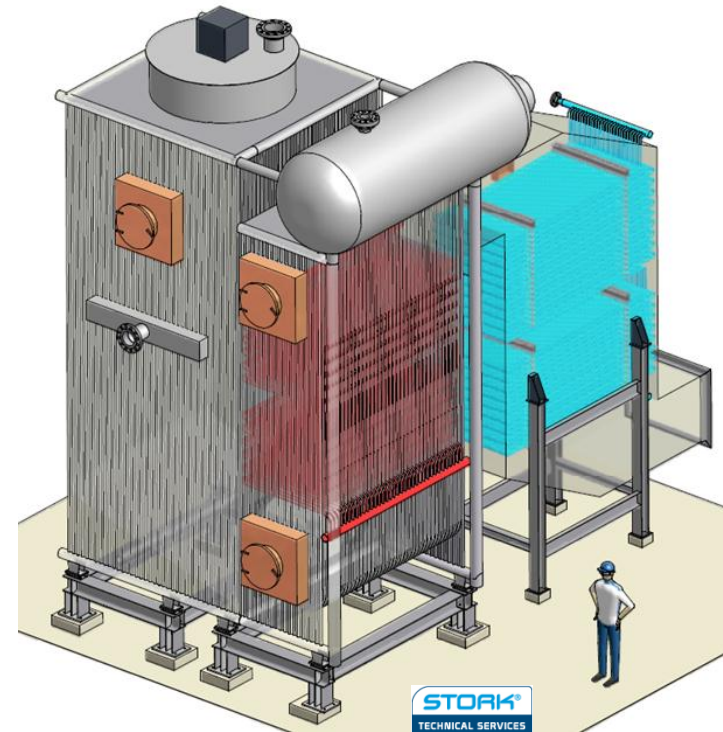


Engineering



Pyrolysis Oil Applications

- *Oil production forecast:*
 - 6,000 t/yr in the 1st year
 - 22,000 t/yr in the 3rd year.
- *Primary applications:*
 - Replace natural gas in district heating systems
 - Replace liquid fuels (LFO/HFO) in industry
 - Replace liquid fuels in peak boilers
- *Additional opportunities:*
 - Turbine (Twente University / OPRA)
 - Diesel engine CHP



25 t/hr Process steam boiler for co-firing natural gas and pyrolysis oil.

Finances - investment

Indicative overview Project investments (EMPYRO):

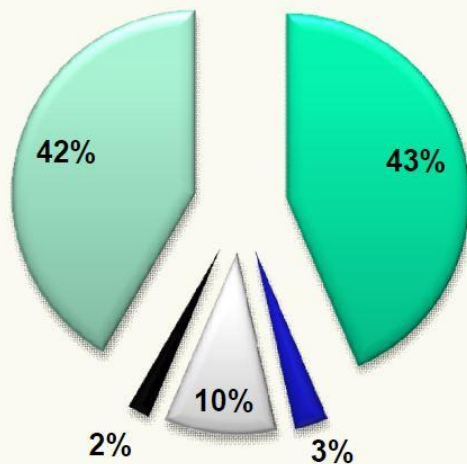
Pyrolysis plant	7,5	M€	44%
Flue gas cleaning & E-generation	3,6	M€	21%
Biomass pretreatment & storage	1,2	M€	7 %
Other (utilities, civil....)	2,7	M€	16%
Total investment	15	M€	
Contingencies	2	M€	12%
Total project costs	17	M€	

Finances – oil price

Indicative pyrolysis oil price (EMPYRO):

Pyrolysis oil	300	€/ton
	18	€/GJ
	Biomass costs ~ 80 €/ dry ton !	

Cost breakdown



- Feedstock
- Other variable costs
- Personnel cost
- Other fixed cost minus income from sales co-products
- Finance costs (incl. equity and depreciation)

Finances – SDE scheme

- Pyrolysis Oil at 300 €/ton can not compete with natural gas and coal in Netherlands, and financial incentives required.

SDE+ scheme 2012-2013:

- Promote renewable heat and electricity (all options)
 - Liquid biomass (including pyrolysis oil) included as a separate category;
 - Incentive for a period of 12 years;
 - Applications only possible if all permits are obtained;
 - Fixed maximum budget (2012: 1.7 billion euro);
-
- Heat & Power production by EMPYRO-plant has already been approved for SDE+ incentive

Summary

- Engineering of the 5 ton/hr pyrolysis plant has been completed;
- Biomass contracts have been established;
- The plant will be installed in Hengelo, the Netherlands on the premises of AkzoNobel;
- All permit procedures have been completed;
- Commercial guarantees now available for pyrolysis oil burners;
- EMPYRO obtained SDE⁺ incentive approval for its heat and power production
- Financial close expected in coming months;
- Start operation expected in summer 2014.

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