Biomass Opportunities in Venezuela

LAMNET Workshop

Utilisation of Biomass – European Technologies and Expectations

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WIP

Energy - the basis of all life

- 2000 years ago - Roman empire
  - Annual specific energy consumption approx. 7.2 GJ/capita
- 18th/19th century - 1st industrial revolution
  - Annual specific energy consumption approx. 24 GJ/capita
- 20th century - 2nd industrial revolution
  - Annual specific energy consumption approx. 115 GJ/capita

Biomass as a *R*enewable *E*nergy *S*ource

Biomass

- consists of hemicellulose, cellulose and lignin plus water and minerals (ash)
- mainly has an approximate composition of
  - 45 to 50% carbon
  - 40 to 45% oxygen
  - 5 to 6% hydrogen
- and only small amounts of sulphur and nitrogen

Biomass as a *R*enewable *E*nergy *S*ource

Biomass is chemically converted and

stored solar energy

Biomass as a *R*enewable *E*nergy *S*ource

The characteristics of biomass and fossil fuels for energy production

Fuel	Moisture content (%)	Lower heating value (kWh/kg dry matter)	Ash content (% of dry matter)
Wood without bark	50 – 60	5.1 – 5.6	0.4 – 0.5
Bark	45 – 65	5.1 – 6.4	2.0 – 3.0
Forest residues (coniferous with needles)	50 – 60	5.1 – 5.6	1.0 – 3.0
Straw	10 – 25	4.0 – 4.2	3.0 – 5.0
Bagasse (South Africa, untreated)	aver. 69.5	aver. 1.8	aver. 1.7
Bagasse (ash incl. contaminants) treated	0 / 20	5.0 /3.9	1.0 – 3.0
Pellets	< 10	> 4.7	< 0.7
Coal	6 – 10	7.2 – 7.9	8.5 – 10.9

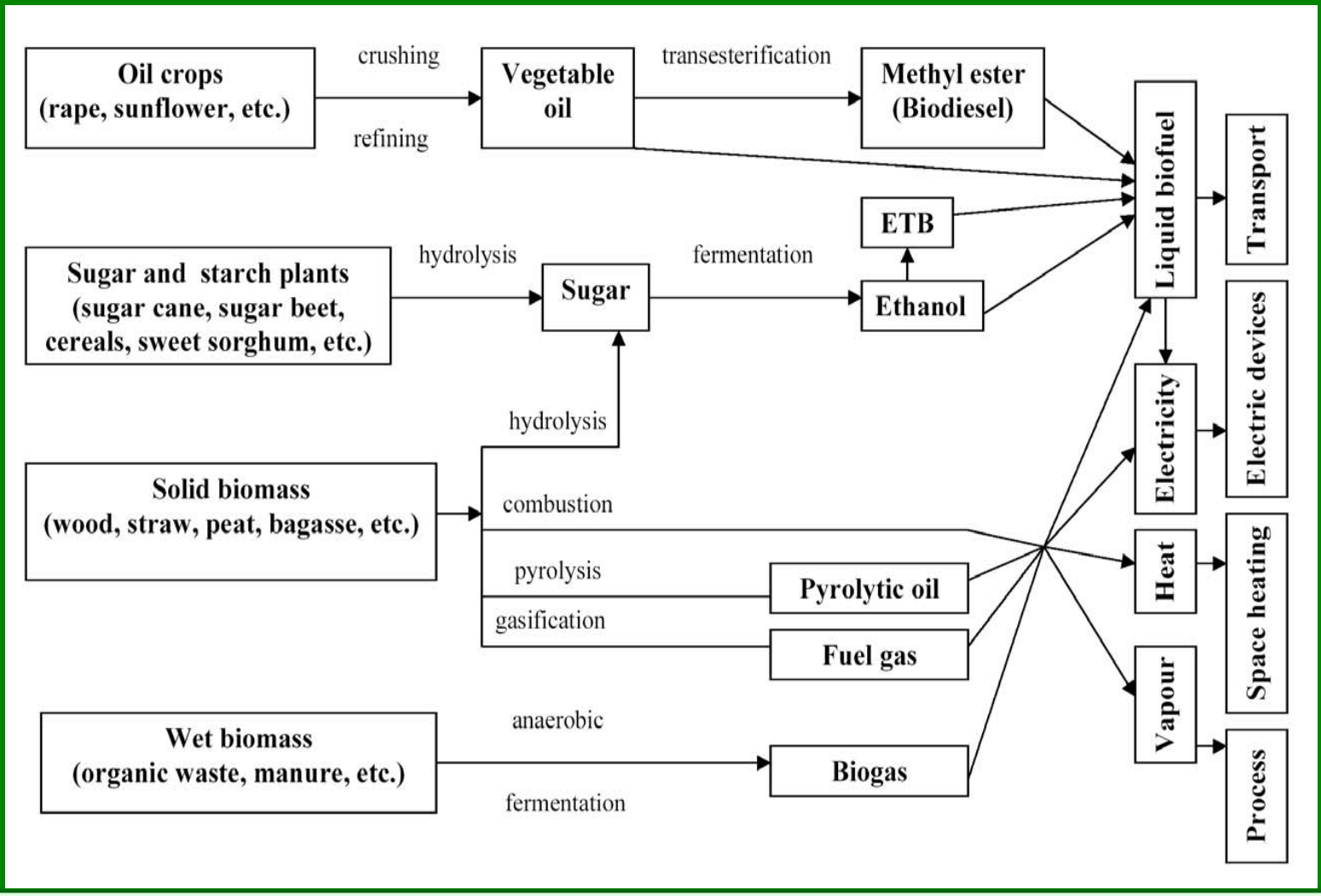
Biomass as a *R*enewable *E*nergy *S*ource

- **Alternatives for the production of biomass for energy**
  - **intensive production on highly productive agricultural land**
  - **extensive production on marginal land**
  - **biomass residues from forestry and set-aside land**

Biomass as a *R*enewable *E*nergy *S*ource

- **Benefits**
  - **Job creation - 6 to 15 jobs per 1,000 TOE bioenergy**
    - **in industry**
    - **in agricultur and forestry**
- **Constraints**
  - **competition in land utilisation**
  - **ecological risks**

Main biomass transformation routes



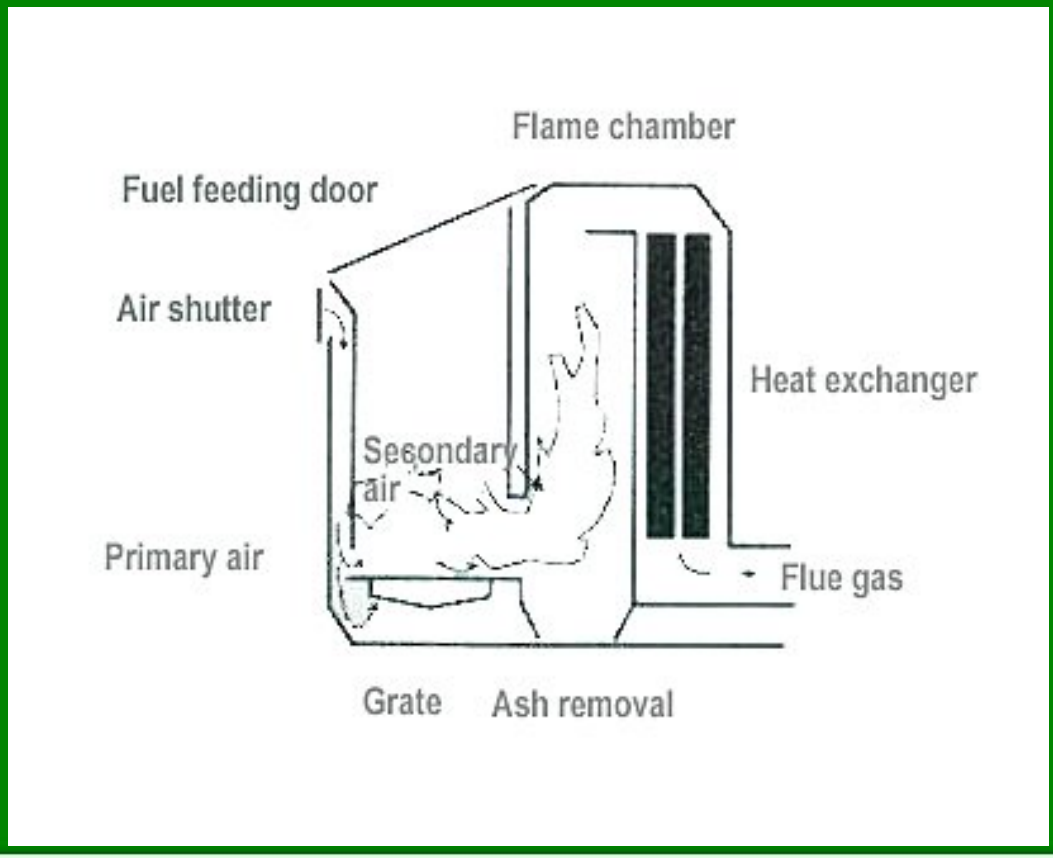
Main biomass transformation routes

- **Solid biofuels are used by around 90% for the production of heat.**
- **They can be transformed to energy and/or energy carriers by:**

1. **Combustion**
2. **Thermal treatment (Gasification)**
3. **Biological degradation (Biogas production)**

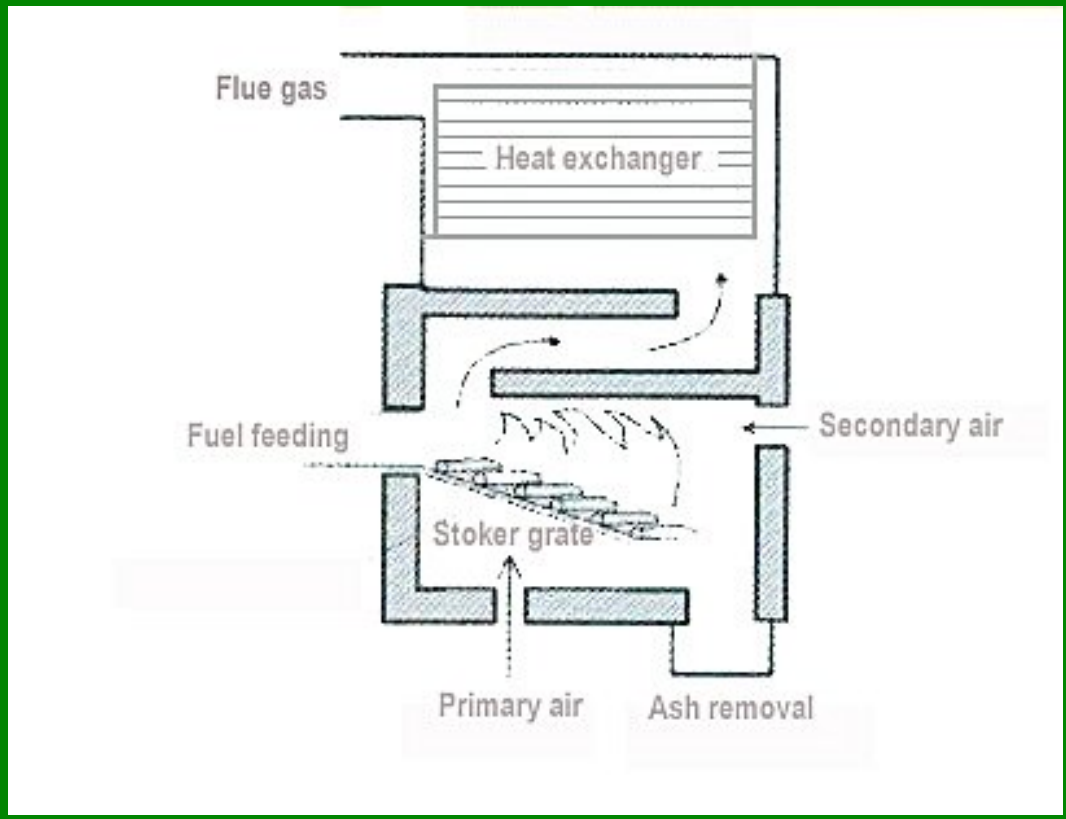
1. Combustion technology

Simple shaft furnace used for chips, logs, pellets, etc. mainly for domestic heating

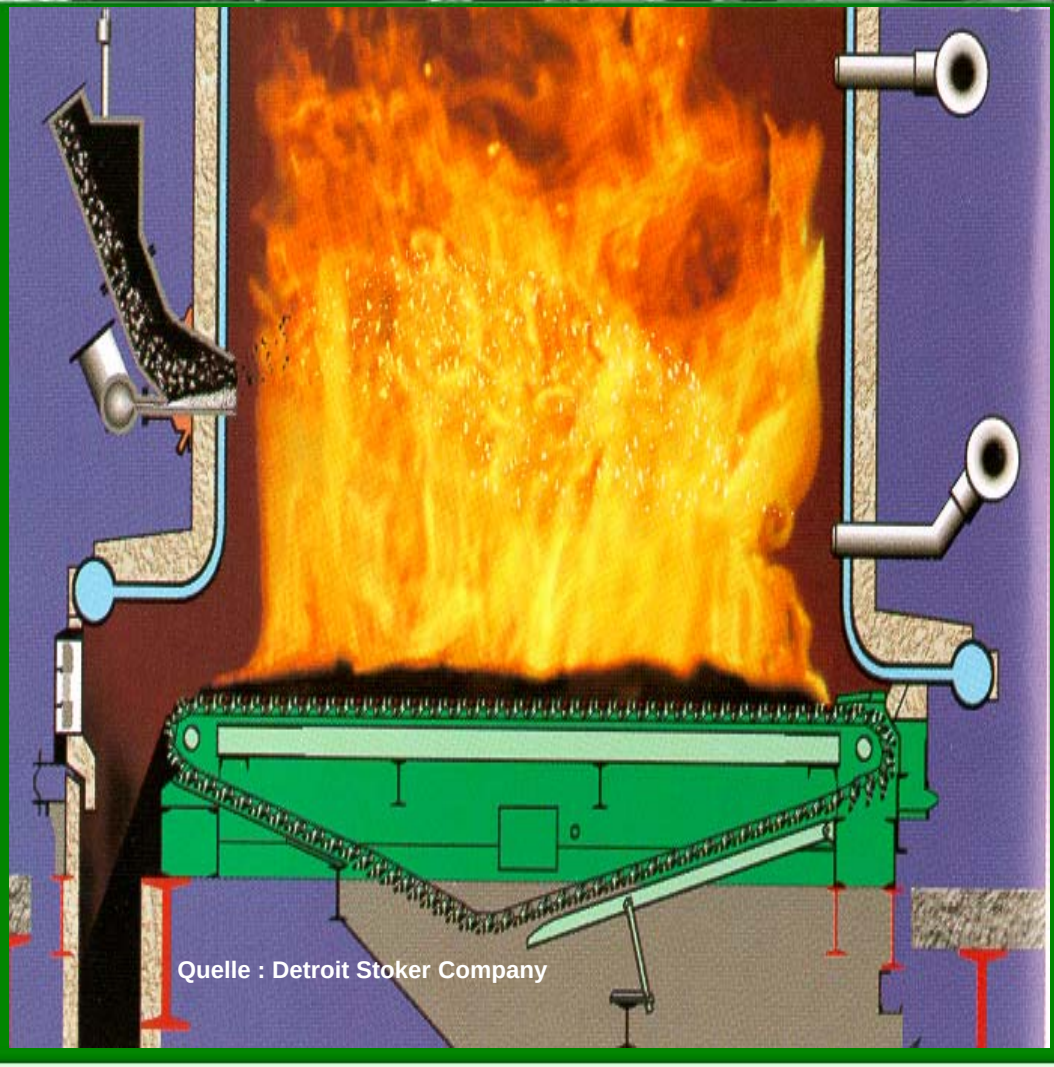


1. Combustion technology

Grate furnace as is used for bigger energy demand and also for incineraton

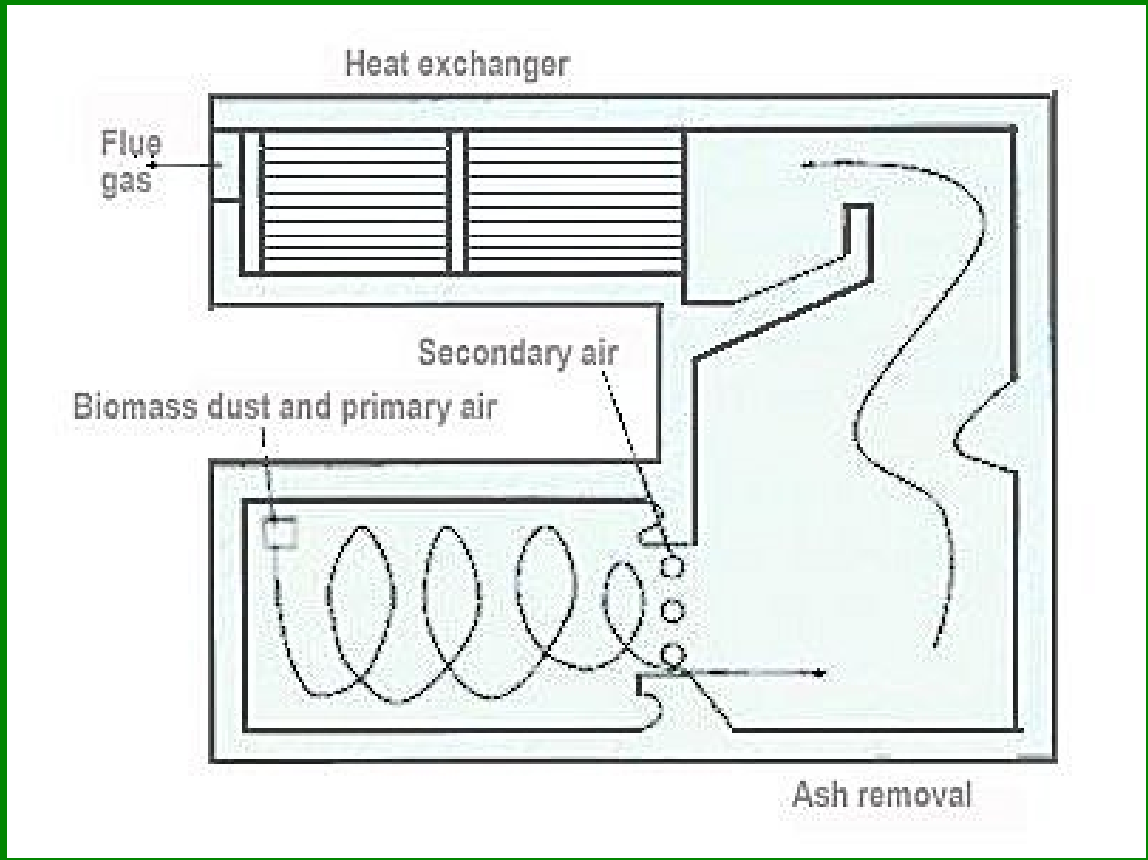


Medium/large scale grate furnace



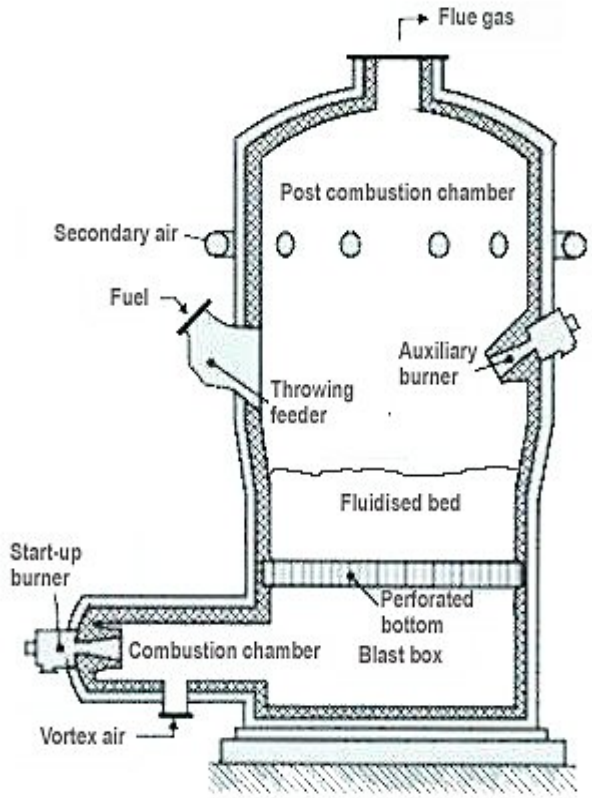
1. Combustion technology

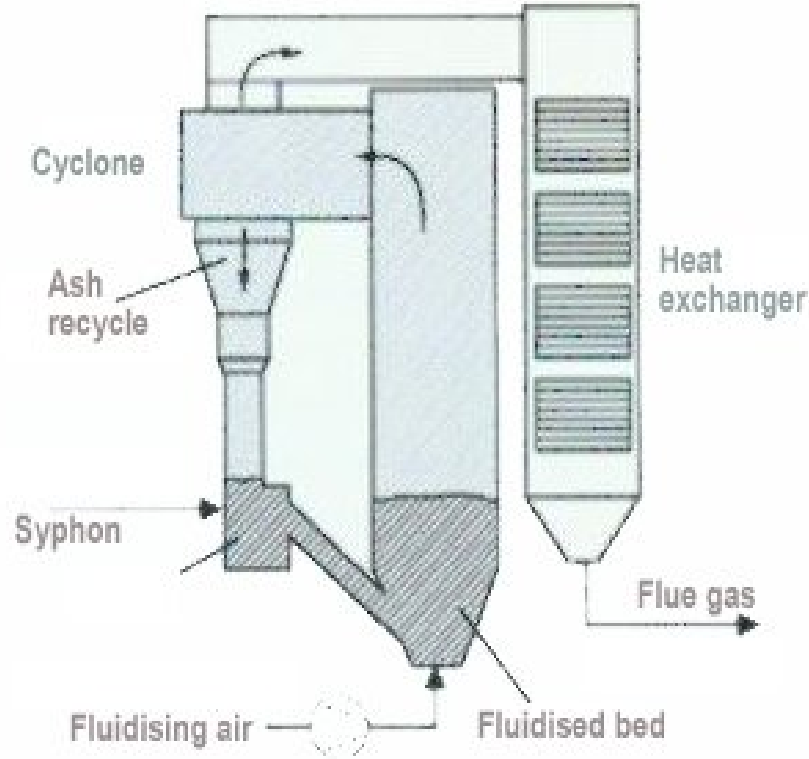
Dust injection muffel furnace



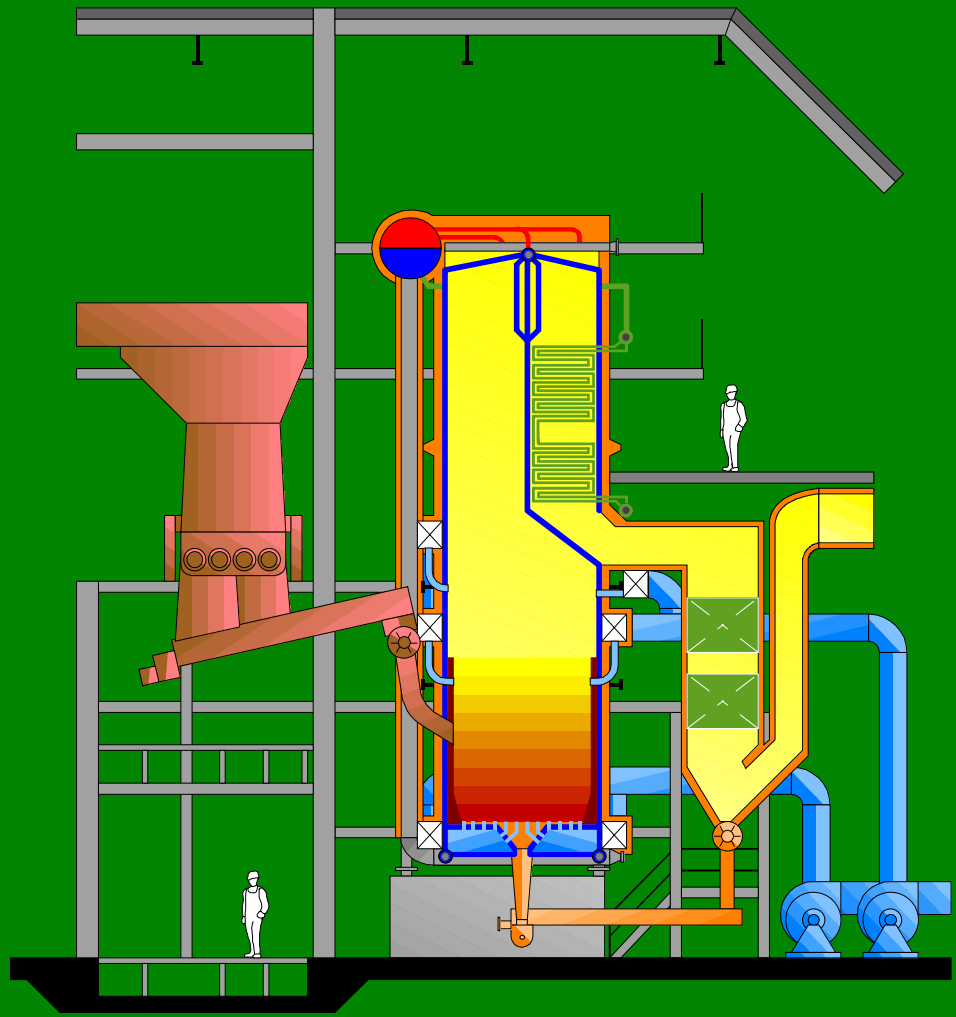
1. Combustion technology

Fluidised bed combustors





Medium/large scale fluidised bed furnace



1. Combustion technology

Power plants / CHP plants consist of

- Fuel storage
- Combustion unit
- Steam production
- Heat production
- Electricity generation
- Additional steam utilisation and/or condensation

Biomass fuelled small District Heating Unit

Biomass fuelled Heat Production

A general layout of CHP-power plants

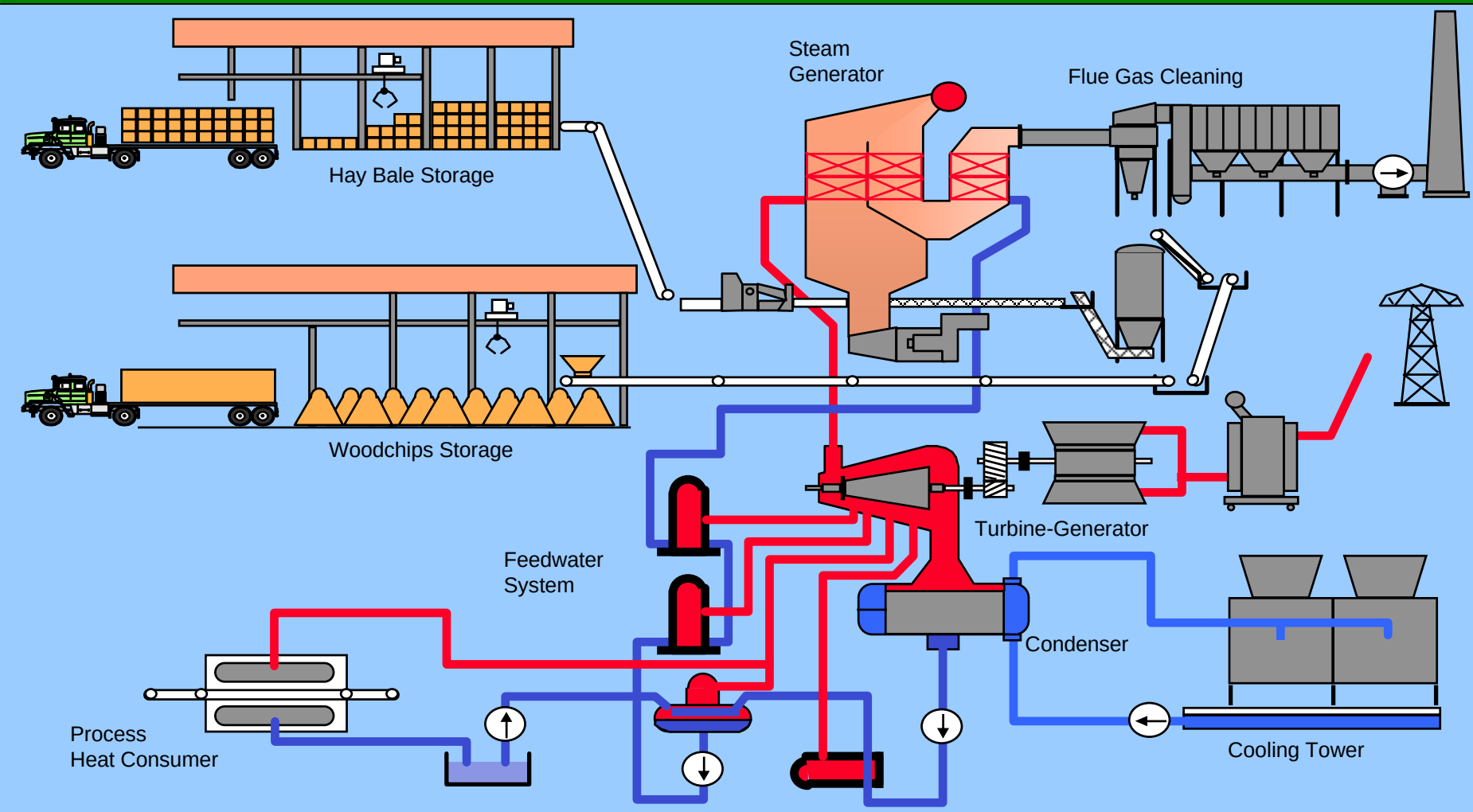
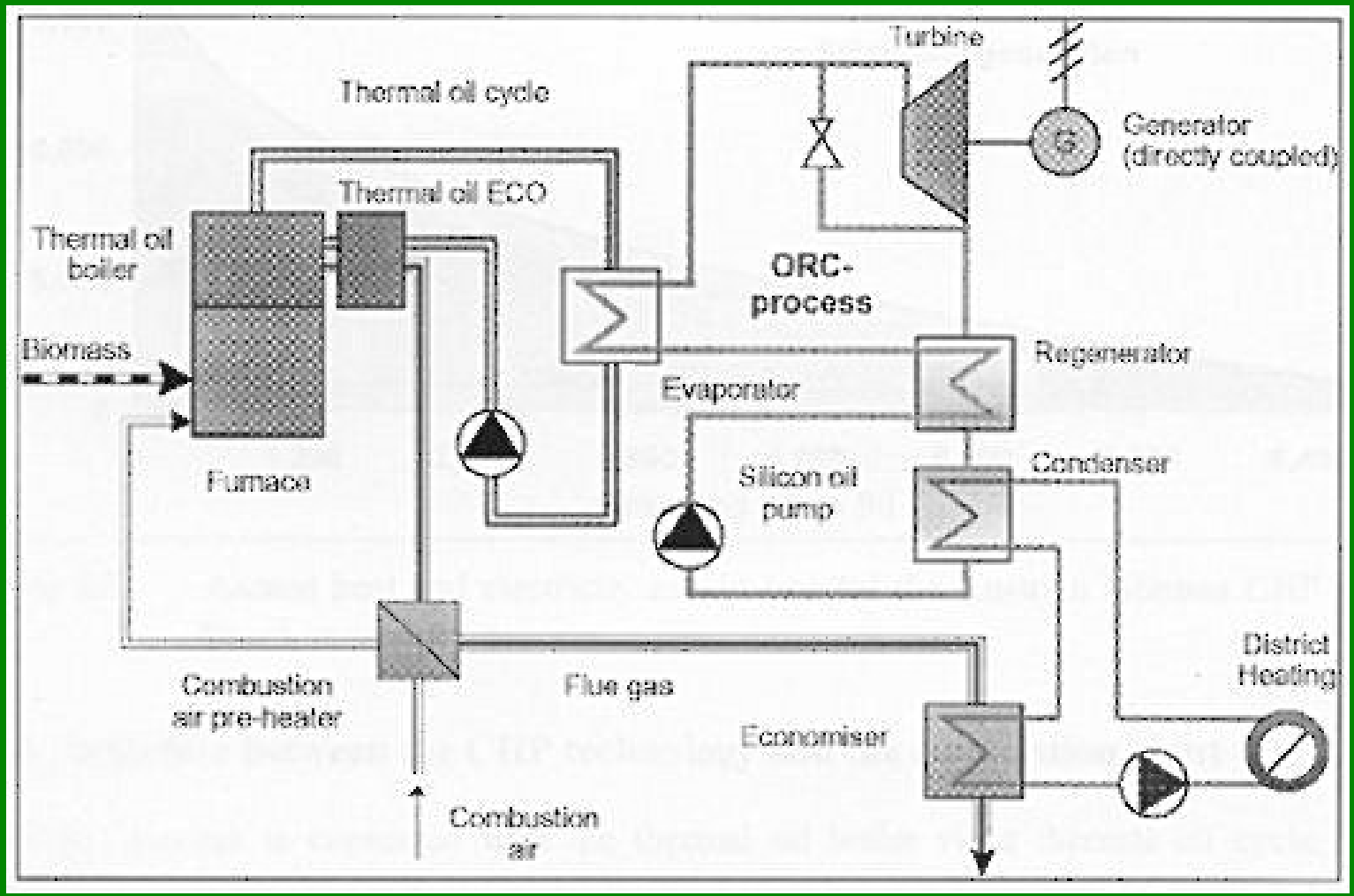
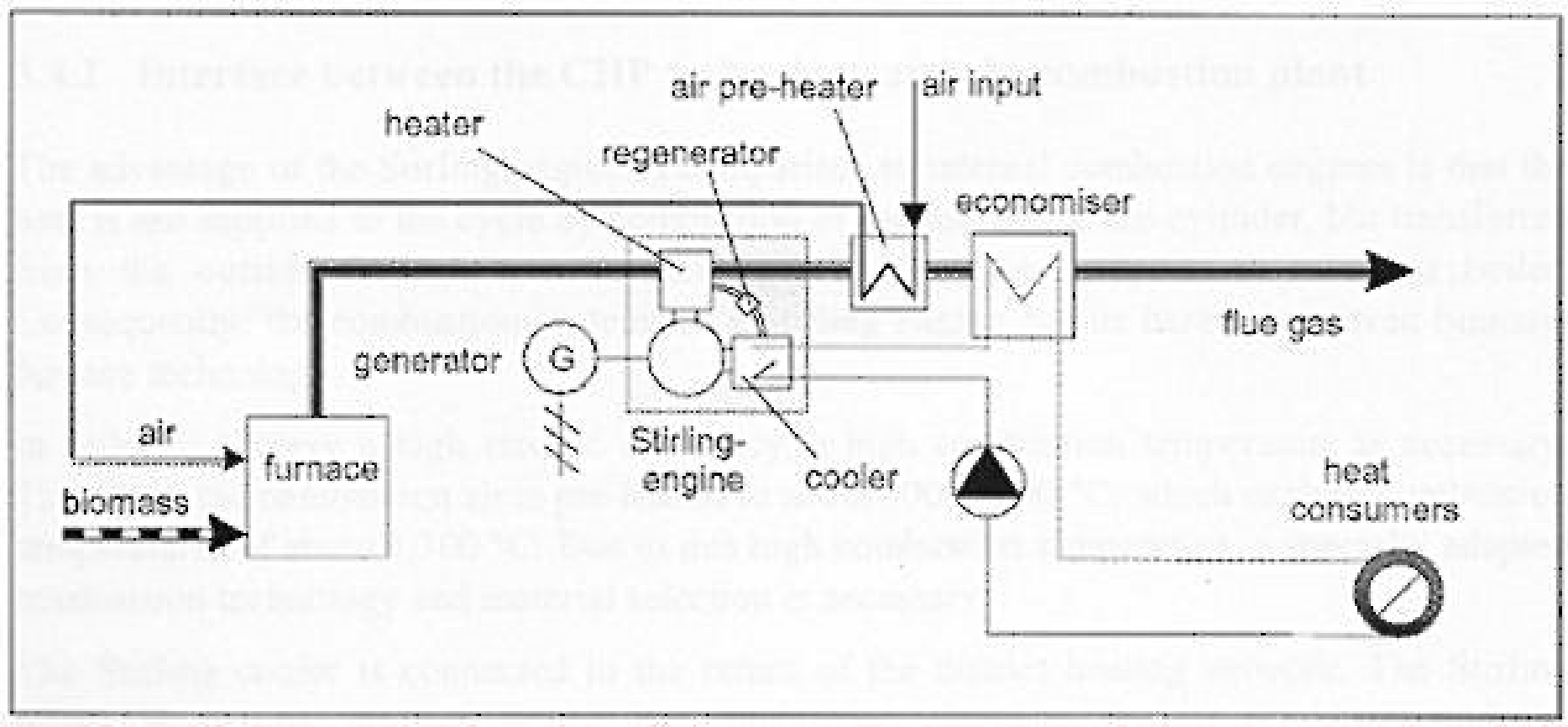


Image of a CHP power plant

Innovative small scale power generation – Organic Rankine Cycle



Innovative small scale power generation - Stirling Process

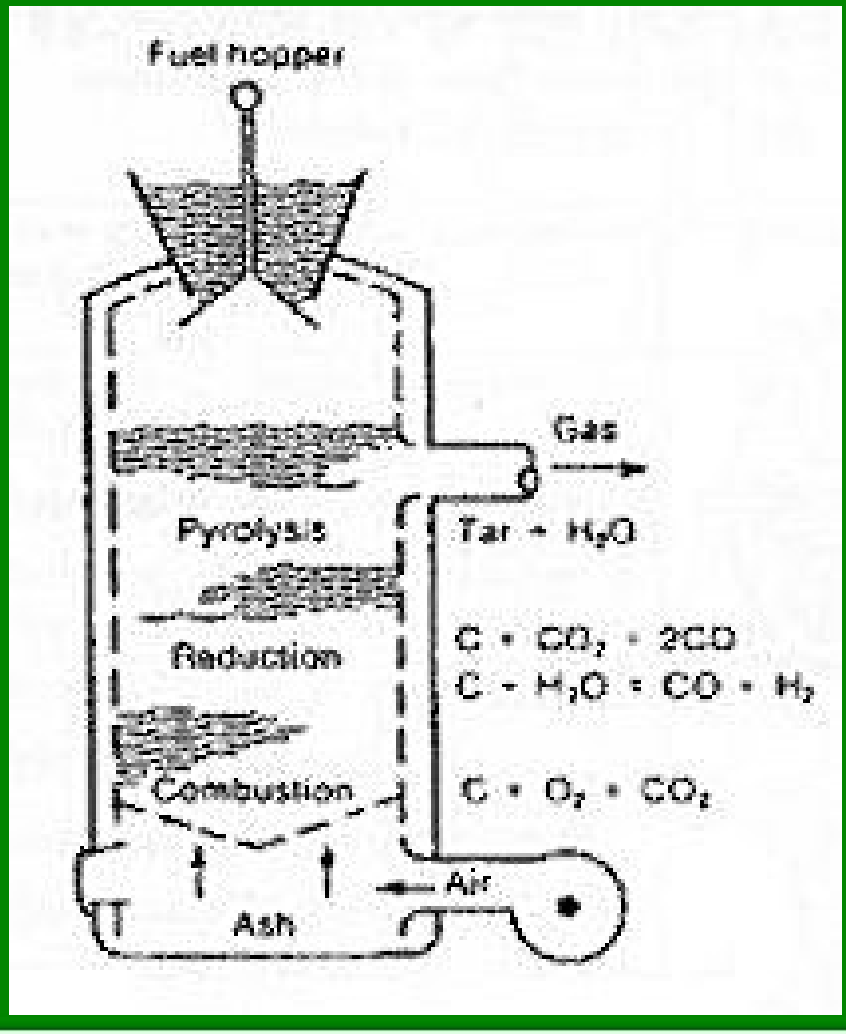


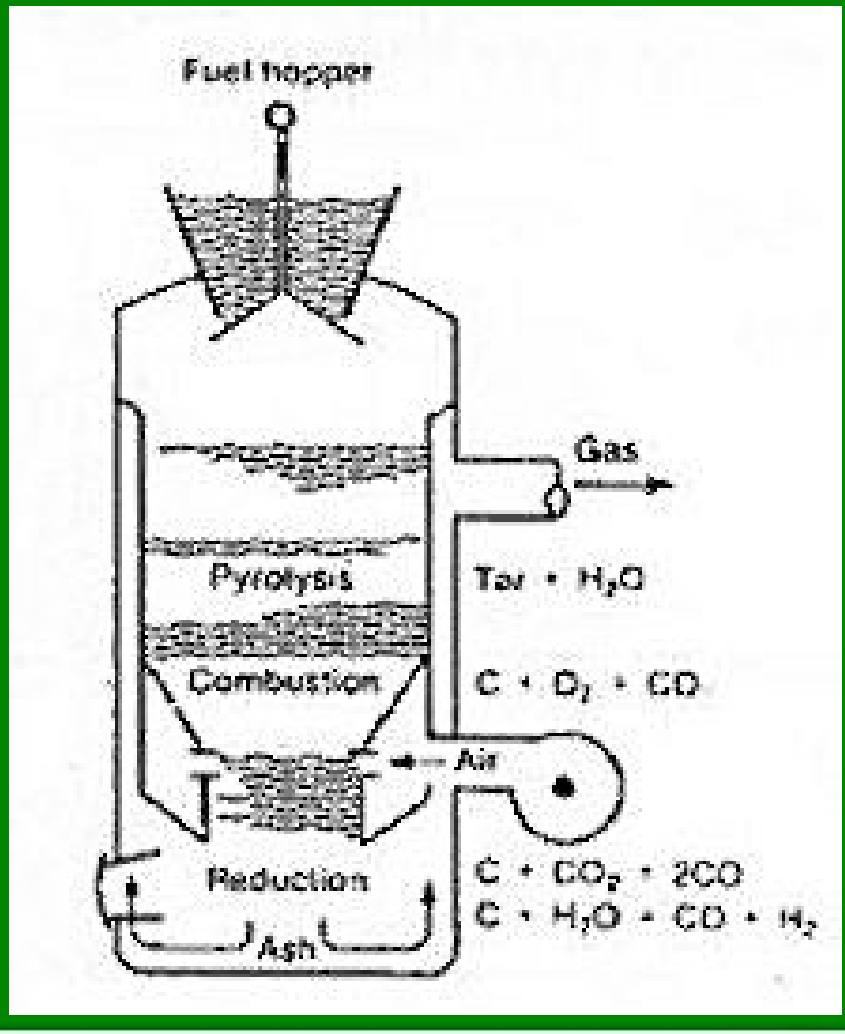
Main bioenergy transformation routes

- **Solid biofuels can be transformed to energy and/or energy carriers by:**

  1. **Combustion**
  2. **Thermal treatment (Gasification)**
  3. **Biological degradation (Biogas production)**

2. Gasification technology



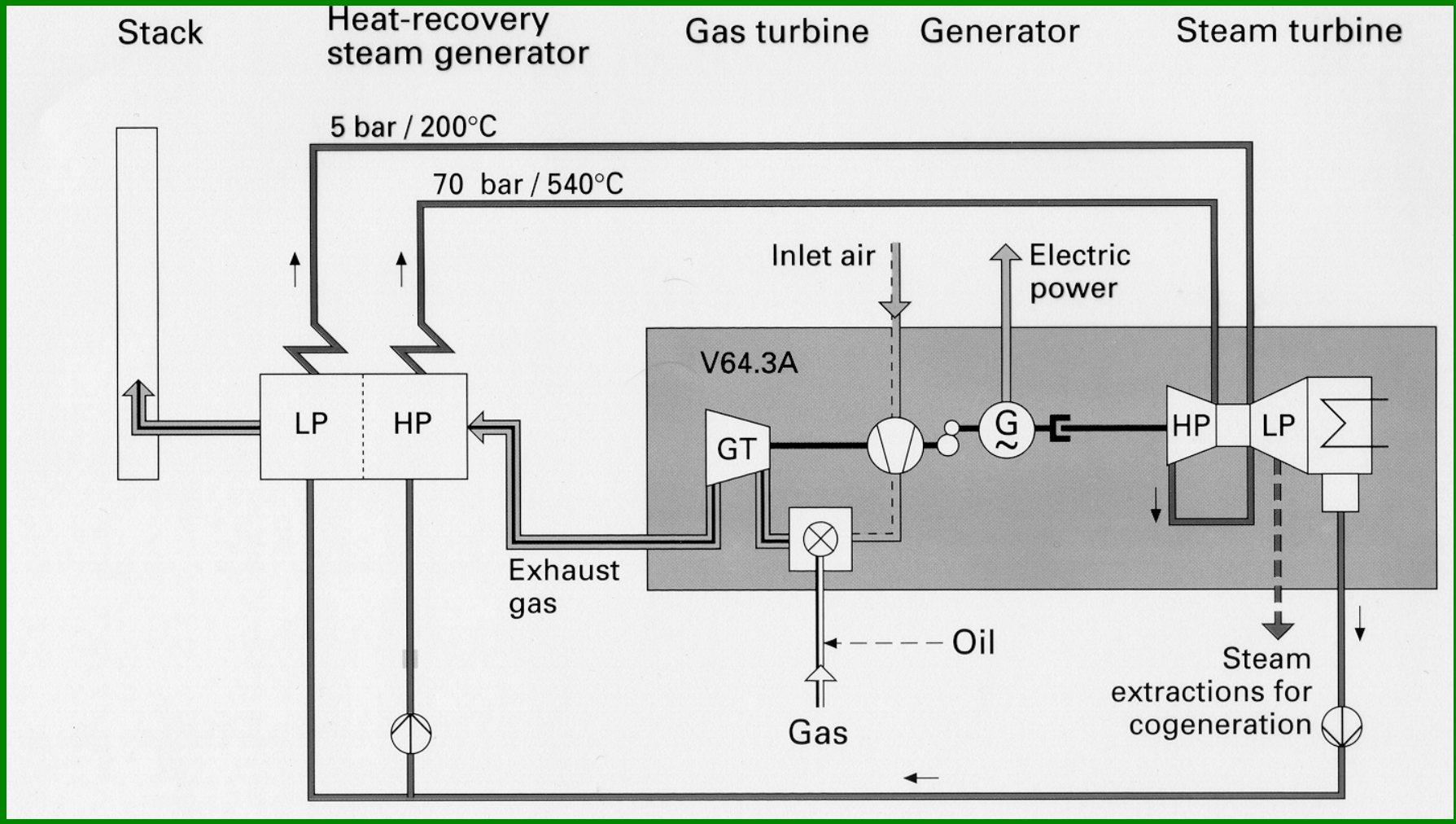


Biomass as gaseous fuel can be used

- stationary
  - by producer gas fuelled to engines and/or turbines
  - by producer gas fuelled to combustion units in order to improve efficiency and to reduce emissions level
- for transportation
  - by modified engines and by steam reforming / hydrogen / fuel cell systems
- distributed via feed-in

2. Gasification technology

Novel solutions – Gas and Steam - cycles



Novel solutions - A realised GaS-power station

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3. Biological degradation

Utilisation of Biomass with high moisture content

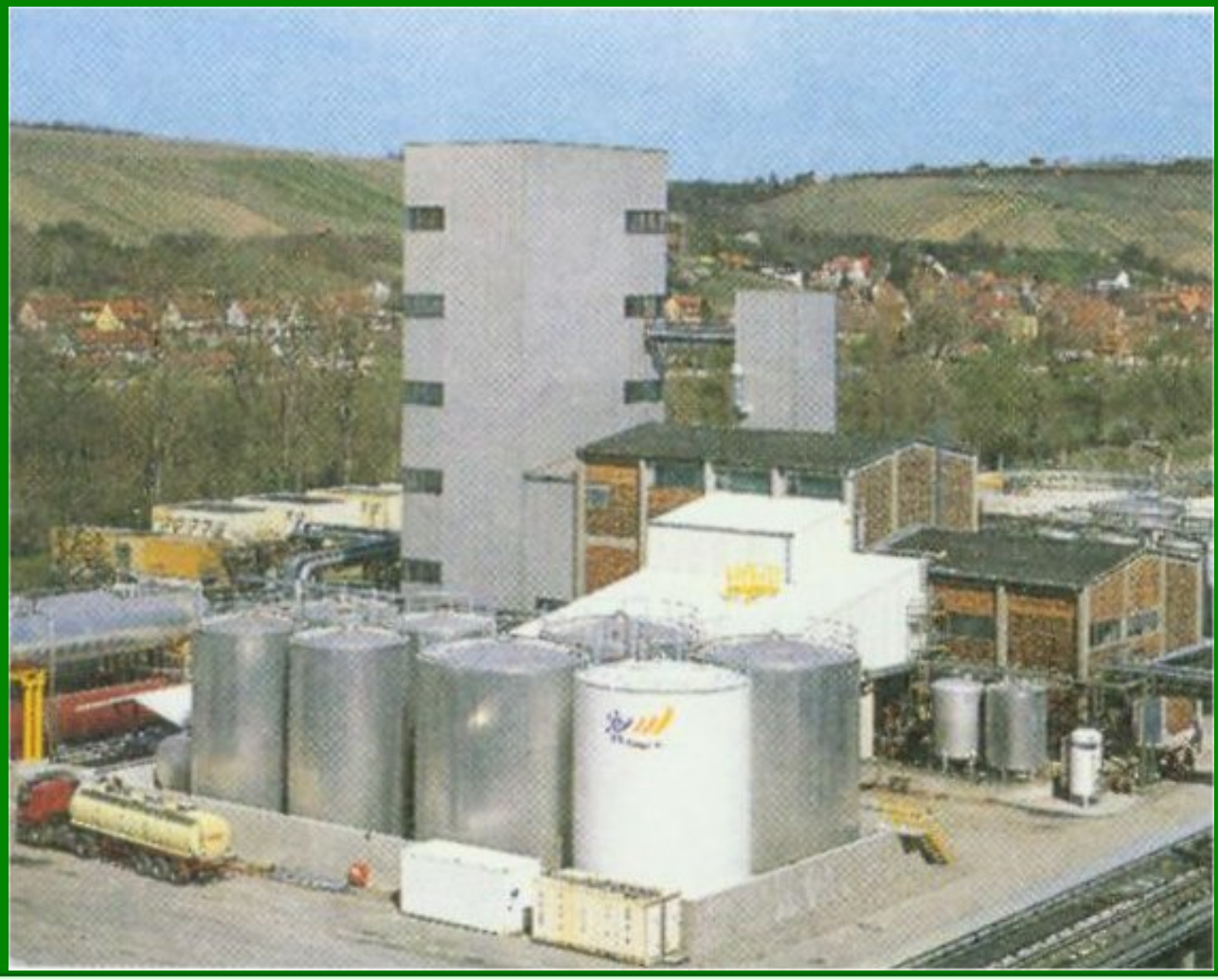
- Anaerobic digestion is a well proofen means for producing gas from liquids containing solid biomass in small quantities, e.g. manure, sewage sludge, etc..
- The produced biogas consists mainly of methane and carbon dioxide.
- After desulphurisation the gas can easily be used.

Anaerobic Digestion Unit

Biomass as a liquid fuel can be used

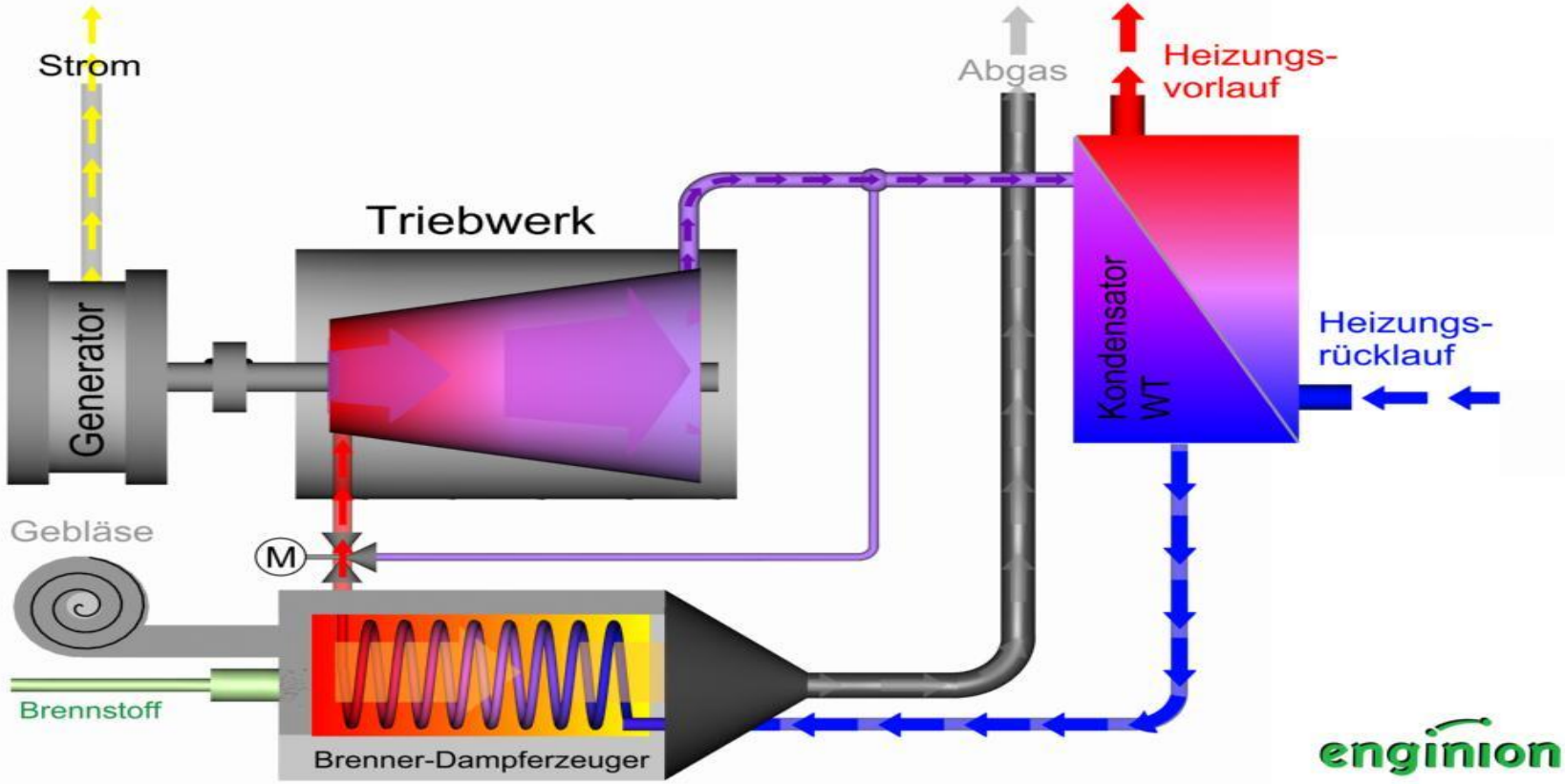
- as native vegetable oil
- or biodiesel derived from vegetable oil
- as alcohol
- as bio-crude oil

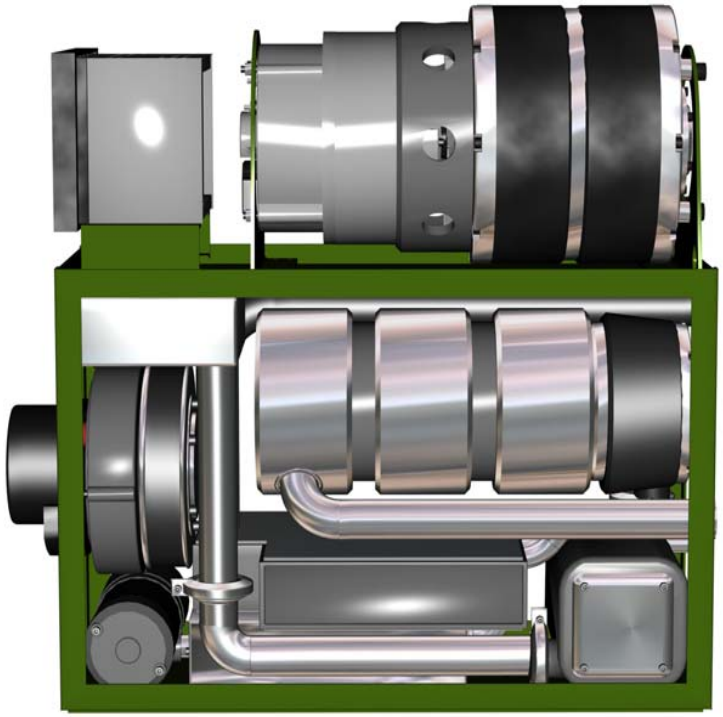
Biodiesel plant in Germany



Bioethanol plant in China

SteamCell Funktions-Schema





Energy - the basis of all life

The contribution of RES to the world energy supply in 2040 – Advanced International Policy Scenario (Projections in Mtoe)

	2001	2010	2020	2030	2040
Total Consumption in Mtoe (IIASA)	10038,3	10549	11425	12352	13310
Biomass	1080	1313	1791	2483	3271
Large hydro	222,7	266	309	341	358
Small hydro	9,5	19	49	106	189
Wind	4,7	44	266	542	688
PV	0,2	2	24	221	784
Solar thermal	4,1	15	66	244	480
Solar thermal electricity	0,1	0,4	3	16	68
Geothermal	43,2	86	186	333	493
Marine (tidal/wave/ocean)	0,05	0,1	0,4	3	20
Total RES	1364,5	1745,5	2694,4	4289	6351
RES Contribution	13,6%	16,6%	23,6%	34,7%	47,7%

Energy - the basis of all life

RES contribution to the world energy supply in 2040 – AIP Scenario

Energy - the basis of all life

The perspective of growth rates of RES until 2040 - AIP-Scenario

	1996-2001	2001-2010	2010-2020	2020-2030	2030-2040
Biomass	2%	2.2%	3.1%	3.3%	2.8%
Large hydro	2%	2%	1%	1%	0%
Small hydro	6%	8%	10%	8%	6%
Wind	33%	28%	20%	7%	2%
PV	25%	28%	30%	25%	13%
Solar thermal	10%	16%	16%	14%	7%
Solar thermal electricity	2%	16%	22%	18%	15%
Geothermal	6%	8%	8%	6%	4%
Marine (tidal/wave/ocean)	-	8%	15%	22%	21%

Further information through:

WIP – Renewable Energies

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