

# BIOMASS ENERGY INSTALLATIONS

*SUSTAINABLE AND EFFICIENT ENERGY FROM BIOMASS*



# BIOMASS FIRED ENERGY INSTALLATIONS



*SUSTAINABLE AND EFFICIENT  
ENERGY FROM BIOMASS*

## *FLEXIBILITY AND RELIABILITY*

*HoSt energy installations can be fired with a great range of biomass fuels such as RDF, wood, straw, chaff, olive pulp, chicken manure or other (organic) waste.*



Biomass such as wood, straw, chaff or other organic residues are available in large quantities. Using biomass as a fuel is significantly cheaper than natural gas and diesel.

HoSt, founded in 1991 by Holec and Stork and since 1999 an independent company, is active in designing, building, operating and maintenance of biomass fired energy installations. The combustion technology is highly flexible in applicable fuels such as: moisture contents ranging from 10% to 55% and fuels with low ash melting points like straw, chaff, manure, olive pulp, chicken manure and RDF (Refused Derived Fuel). HoSt is able to supply flue gas cleaning to minimize NO<sub>x</sub>, sulphur, chlorine, dust and other pollutants to meet required emission standards.

## WHY CHOOSE A HOST COMBUSTION INSTALLATION?

- FUEL FLEXIBILITY
- HIGH EFFICIENCY
- HIGH RELIABILITY
- COMPETITIVE PRICING

## HoSt energy installations

HoSt supplies biomass fired installations ranging from 1 MWt to 50 MWt. For capacities above 25 MWt, two separate combustion lines are installed allowing cost effective road transport and reducing the height of the building envelope. This modular approach also provides greater installation flexibility for our clients.

## Fuel flexibility

The installation can be fired using a great range of biomass fuels. For example fuels with:

- Moisture content ranging from 10% to 55%.
- Particle size up to 15 cm.
- Low ash melting point: fuels such as contaminated wood, straw, chaff, chicken manure, RDF and other organic waste.

## High availability

The HoSt installations show an availability of 92% up to 94% in practice.





## OPTIMAL COMBUSTION

A flexible process and optimal combustion is realised through intelligent configuration of the furnace and the temperature control system in various combustion zones. This is achieved by:

- Applying grate zones with independent control of primary air intake and recirculating flue gasses, allowing the temperature in each grate zone to be individually controlled.
- Gasifying the fuel on the grate. The flammable gas is combusted above the fuel bed in three stages:
  1. Just above the grate by injecting primary air under the grate.
  2. Further above the grate by injecting secondary air. Flue gasses are injected in order to control the temperature.
  3. In the venturi – a highly turbulent zone – by adding tertiary air. In this way the combustion temperature can raise up to 1000 °C so that complete combustion occurs with very low  $C_xH_y$ , CO and  $NO_x$  emissions.
- A robust moving floor, chain conveyor and feed-in system suitable for various biomass fuels with particle size up to 15 cm.

## Multi-fuel talent

Due to the zone-controlled combustion process the temperature of the grate is kept low and the temperature in the second combustion phase is maintained at a higher temperature. The low grate temperature allows a greater variety of biomass fuels with low as melting point to be processed. This might include wood (with leaf), compost, straw, chaff and similar biomass waste products.

## High efficiency with low emissions

The zone-controlled combustion process results in a high efficiency, complete combustion, with low emissions of  $C_xH_y$ , CO and  $NO_x$ . The high efficiency is achieved by minimising stack losses and keeping the flue gas flow low. The low flue gas flow is achieved through optimal combustion that resulting in  $O_2$  concentrations of 3.5% to 5% in the flue gasses.

## Minimal maintenance costs

The furnace concept has a positive effect on maintenance, in particular:

- Long grate lifetime due to low grate temperatures.
- Ash disposal system is insensitive to failure, due to a robust and wet chain conveyor. This system is robust and relatively insensitive to rocks, ash agglomerates and other contaminants that may be present in the fuel.
- Fully automated ash disposal system. Ashes at the end of the grate, ash falling through the grate and ash from the first phase flue gas cleaning (multi-cyclone) are collected in the wet ash disposal system.
- The wet ash disposal system minimises the dust forming in the boiler building. This has a positive effect on the life time of control systems and electric drives.

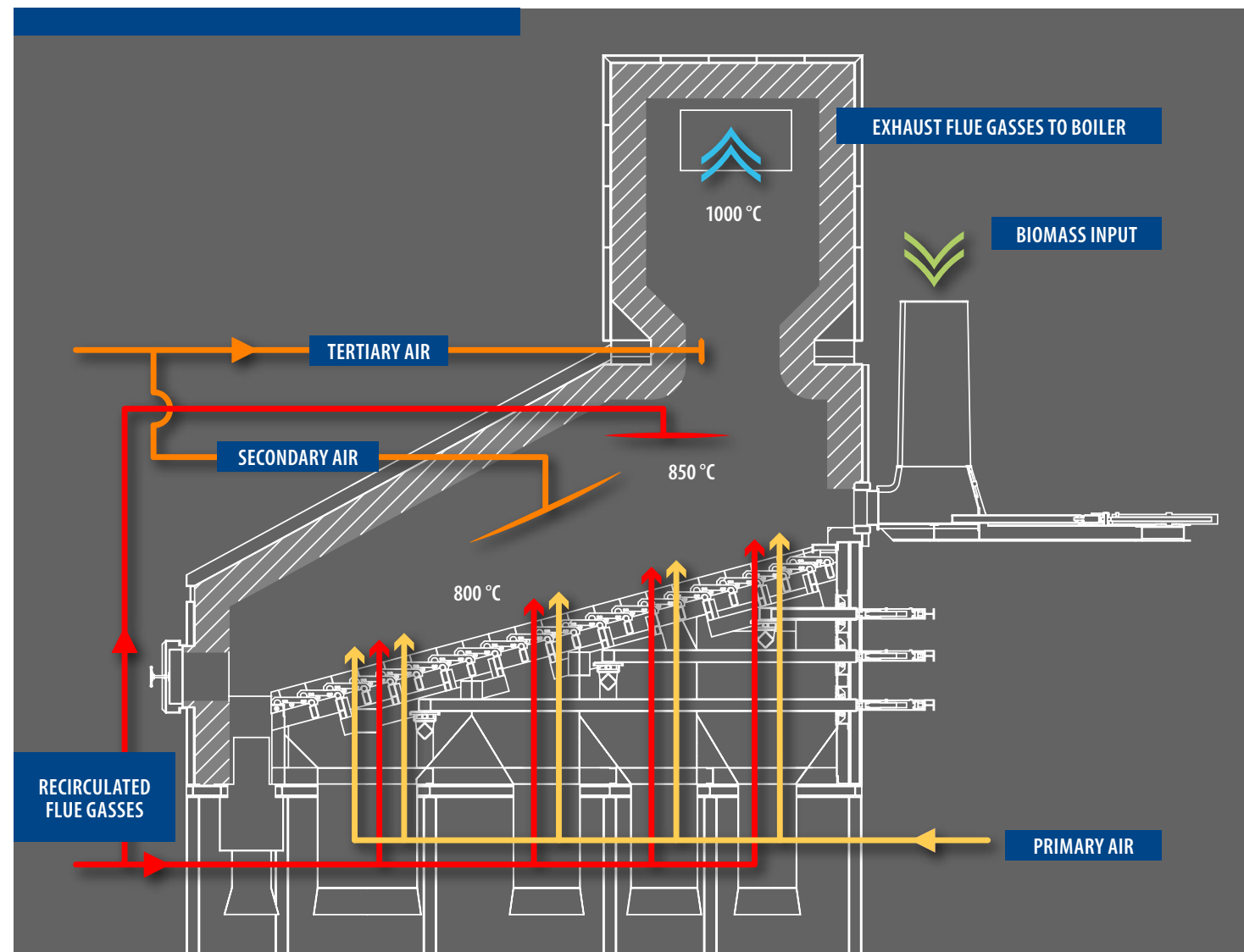
## High availability

HoSt installations have demonstrated practical availabilities between 92% and 94%, often with an availability of in excess of 8,200 operating hours per year. This high availability is achieved by:

- A robust design from moving floor and fuel conveyance through to the feed-in system. Possible contaminations do not lead to downtime.
- A grate with low maintenance requirements due to low grate temperatures.
- An absence of horizontal combustion chambers results in no additional cleaning stops due to dust accumulation, as opposed to boilers with horizontal labyrinths where it is necessary.
- Optimizing the boiler for minimum fouling and by equipping the boiler with an automatic cleaning system.



# COMBUSTION TECHNOLOGY





# BIOMASS FIRED BOILERS

## Cylindrical flame tube boiler

HoSt supplies cylindrical flame tube boilers. In this type of boiler the shell is filled with water and the flue gasses flow through the flame tubes. For improved cleaning, the first part of the boiler is equipped with a radiation section where the flue gasses are being cooled before they flow through the flame tubes. The cooling in the radiation section prevents harsh and hard to remove ash depositions in the flame tubes.

In addition, for regular cleaning the cylindrical boilers can be equipped with compressed air soot blowers to minimise the number of production stops.

## Horizontal cylindrical hot water boilers

Horizontal cylindrical boilers are cheaper. However, their disadvantage is that more production time is lost for the stops required for cleaning.

For this reason HoSt prefers to supply vertical hot water boilers.

## Vertical cylindrical hot water boilers

In the vertical hot water boilers the flue gasses initially flow downwards through a radiation section. The flue gasses are reversed into vertical pipes when they reach the bottom of the boiler. Due to the vertical orientation the soot blowers clean the pipes more efficiently. In this configuration the soot always falls vertically, in the flow direction or the opposite direction, and is unable to deposit again which is a frequent issue with horizontal flame tube boilers.

## Cylindrical steam boilers

Horizontal cylindrical boilers are often used for steam production up to 32 bar as a cost saving measure. The flue gasses are first cooled in the radiation cooler before they enter the flame tubes. At pressures up to 20 bar the radiation cooler is integrated in the boiler. However for pressures in excess of 20 bar another radiation cooler, a larger room of membrane walls, is installed before the boiler inlet.

## Water tube steam boiler

In a water tube steam boiler, water flows through the pipes and the flue gasses pass around the pipes. Water tube steam boilers are applied above 32 bar and with difficult fuels.

This type of boiler can be cleaned automatically and with ease. High pressure steam is blown, with a lance, between the pipes to remove dust. In this way the water tube bundles are cleaned thoroughly.

Difficult fuels with a lot of sodium and potassium, such as straw, chicken manure and pulp, tend to deposit a harsh stone kind of deposition on the pipes. Cleaning is therefore an important issue and a major advantage of the water tube boiler.

For specific fuels with a very low ash melting point (and with RDF), the boiler is built in two sections. The first section is a cooled membrane section; a radiation cooler. The flue gas with fly ash is cooled in this section to prevent harsh stone-like ash deposits in the pipe bundles. The second section is made from evaporator pipes.



## ADVANTAGES OF HOST BOILERS

- MINIMISED PRODUCTION STOPS
- DESIGNED TO PREVENT FOULING
- EASY TO CLEAN
- COMPACT
- QUICK INSTALLATION



# FLUE GAS CLEANING

To complement the installation HoSt also supplies the flue gas cleaning systems. HoSt is widely experienced with various flue gas cleaning systems for installations fired with both clean fuels and waste stream fuels.

## In accordance with local regulations

All systems are equipped in the first stage with a multi-cyclone filter to remove dust. In the second stage the flue gas cleaning takes place. The applied flue gas cleaning technique is strongly dependent on the type of fuel and local emission regulations. The emission requirements often determine the type of filtering system.

A flue gas condenser is applied when the dust emission requirement is lower than 100 mg/Nm<sup>3</sup> and with clean fuels. An electrostatic filter is applied till 20 mg/Nm<sup>3</sup>. A bag house filter is applied where stricter requirements need to be met.

## Chemical contaminations

An absorbent-injection is applied where chloride, sulphur or other chemical contaminations need to be removed. An absorbent-injection is always equipped in combination with a bag house filter. The absorbent, bicarbonate or lime, is selected based on the desired cleaning temperatures and concentrations of the chemicals. Active carbon can also be dosed if required.

## Low NO<sub>x</sub> emissions

A special combustion technique is applied in a HoSt installation that keeps NO<sub>x</sub> emissions relatively low. However, if NO<sub>x</sub> emissions are high, should there be high nitrogen concentrations in the fuel or if local emission requirements are strict, then we can provide additional measures as needed.

Urea-injection in the furnace can be applied to reduce the NO<sub>x</sub> emission down to approximately 50%. If an even lower NO<sub>x</sub> emission is required, then a de-NO<sub>x</sub> system is installed downstream to further reduce NO<sub>x</sub> concentrations.



The type of flue gas cleaning system is wholly dependent on dust emission requirements

Cleaning system	Multi-cyclone	Flue gas condenser	Elektrostatic filter	Bag house filter
Maximum dust emission	< 150 mg/Nm <sup>3</sup>	< 100 mg/Nm <sup>3</sup>	< 20 mg/Nm <sup>3</sup>	< 5 mg/Nm <sup>3</sup>





# CHP INSTALLATIONS



1 - 12 MWe  
1 - 50 MWt



HoSt supplies biomass fired CHP installations of 1 MWe up to 12 MWe and 1 MWt up to 50 MWt. Installations greater than 6 MWe are built in two combustion lines in combination with one larger efficient steam turbine. The advantage of the modular setup is that the boilers, with a width of 4.2 m, can still be transported by road.



## ADVANTAGES HOST CHP INSTALLATIONS

- High electrical efficiency obtained by a high pressure water tube steam boiler in combination with an efficient multi stage steam turbine.
- 20% to 30% higher net electricity yield than a comparable installation based on an ORC (Organic Rankine Cycle). Achieved by a low own electricity consumption and a high boiler efficiency.
- High availability of the installations in excess of 8,200 running hours a year, equivalent to an availability of 94%.
- Extra high electrical efficiency during the summer due to a lower temperature of the heating water, allowing the steam in the turbine to expand further and therefore generate more electricity.
- Fuel flexibility: from sawdust to wood particles up to 15 cm, from moisture contents of 10% to 55%, even suitable for fuels with a low ash melting point.
- High availability and at the same time very price competitive.



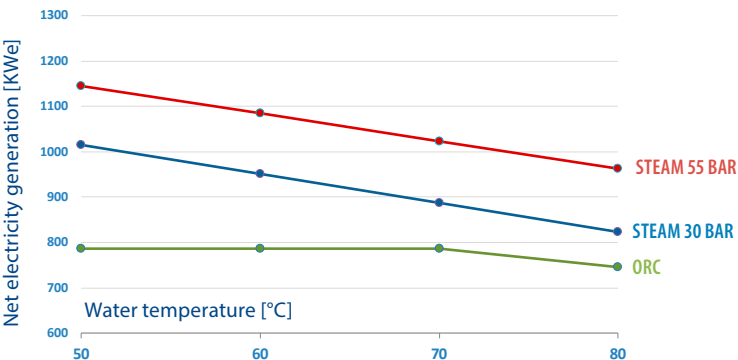
## High efficiency

The electrical efficiency of a HoSt steam cycle is much higher than an ORC (Organic Rankine Cycle). The difference increases significantly for installations above 1 MWe. Up to 40% more electricity can be generated by a steam cycle due to:

- 30% higher cycle efficiency.
- Lower parasitic electrical consumption. The thermal oil pump of an ORC consumes up to 10% of the generated electricity.
- Higher boiler efficiency due to a lower flue gas flow in combination with a lower stack temperature.

HoSt has the highest steam cycle efficiency when compared with other suppliers due to:

- High pressure and temperature steam in combination with an efficient multi stage turbine and an optimized process integration.
- Low stack losses due to a low flue gas flow, achieved by an innovative combustion technology with a low oxygen surplus.
- Low parasitic energy consumption due to low pressure losses in the system.



## THE EFFICIENCY MAKES THE DIFFERENCE

### Net electricity generation

	Winter	Summer
Electricity generation	1 MWe	1 MWe
Water temperature	90°C	65°C
Furnace capacity	6,06 MWt	5,29 MWt
Boiler capacity	5,29 MWt	4,61 MWt
Steam production (55 bar, 475°C)	6,5 ton/u	5,7 ton/u



HoSt is the biggest supplier of biomass energy systems in the Netherlands and one of the biggest in Europe.

HoSt also designs and supplies:

- Biogas installations for sewage sludge, food processing industry waste, agricultural waste and manure.
- Biogas upgrading systems.

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