HEATING GREENHOUSES WITH BIOMASS
Greenhouses and biomass

Greenhouses, especially in cold countries, have huge energy needs for heating.

Biomass heating has the advantage of being a green and cost effective energy.

In most cases, governmental incentives are available to convert greenhouses from fossil fuels to biomass.

In some cases, the greenhouse owner is even able to produce some of his own fuel by using the residues of his greenhouse production as fuel for the biomass system.
Calculating the energy need

In Finland, the energy need for a greenhouse is calculated by using the following formula:

\[ E = S \times m \times \frac{(T_i - T_o)}{1000} \text{ (kW)} \]

- \( S \) = surface of the greenhouse in square meters
- \( m \) = multiplier
  - Single glass 11.0-12.0 W/m²/°C
  - Single plastic 9.5-10.0 W/m²/°C
  - Double plastic 6.0-6.5 W/m²/°C
- \( T_i \) = Internal temperature in the greenhouse
- \( T_o \) = Temperature outside the greenhouse

Example:

For a 1500m² greenhouse made with single layer plastic, if the outside temperature is -20°C and the inside temperature is set to +18°C, the output of the boiler needs to be:

\[ 1500 \times 9.5 \times 38 / 1000 = 541 \text{ kW} \]
How to choose the right size of biomass boiler

Biomass boilers are quite expensive compared to fossil fuel boilers when comparing the cost per energy output.

Usually for greenhouses, the best investment/savings-rate will be obtained by installing a biomass boiler with an output between 50 and 60% of the maximum energy need of the greenhouse. That way, the biomass boiler will cover approximately between 80 and 90% of the annual heating energy need.

A fossil energy can then be used for consumption peaks and will also act as a backup heating source. If the greenhouse is already built, most cost effective way is usually to keep the existing heat source for that function.

It is highly recommended to install a huge heat storage tank to decrease the output need of the boiler and to deal with daily consumption peaks (at dawn for example).

Picture: 500m³ heat storage tank of the organic greenhouse Ikaallisen Luomu. Maximum energy need 3MW, biomass boiler with 1.5MW output.
Available technologies for greenhouse biomass heating

Water boiler

Pros:
- Heat distribution network is easy to build even if there are many rooms.
- Precise temperature control.
- Can be connected to a heat-storage tank.
- Boiler with excellent efficiency.

Cons:
- Heat distribution network and radiators may be costly and needs a security system to avoid freezing.

Hot air furnace

Pros:
- Equipment investment is smaller.
- Heat distribution network is easy to build in a greenhouse and requires almost no maintenance (no water leaks that could be a problem).

Cons:
- Difficult to combine with other heating systems.
- No way to store the heat.
- Temperature control and homogeneous distribution are more difficult.
THANK YOU