Modern biomass systems are equipped with process control systems supporting fully automatic system operation. The design of a DH system is always based on the system's heat load, and the choice of heat production technology is based on the required capacity and planned fuel mixture. For biomass-based DH boilers, several different furnace technologies are available, with varying technical characteristics and applications, depending on boiler capacity and biomass type and properties (for example, ash and moisture content).

For DH systems, the following technologies can be used:

- Grate furnaces are typically used for systems whose capacity is less than 20 MWth where the primary fuel is woody biomass. The efficiency is usually in the range of 65–98%. Because combustion conditions (that is, the distribution of the fuel over the grate surface) are not as homogenous as for other technologies, low emission levels can only be achieved with sophisticated process control, and by installing flue gas cleaning systems (such as baghouse filters, electric precipitators, and multi-cyclones).
- Underfeed stokers are used for small capacities (below 6 MWth) and they use woody biomass (efficiency 80–85%). They guarantee low emissions at partial load due to good fuel dosing; however, since they are controlled mechanically, they are relatively inflexible with regard to particle size, and can be used only with fuels with a high ash melting point.
- Bubbling fluidized bed combustion (BFB) furnaces are used only for high capacities (over 20 MWth) due to the high investment cost. Their average efficiency is 90–98%.106 They offer the significant benefits of low oxides of nitrogen emissions, high thermal efficiency, and great flexibility with regard to biomass (except for particle size, which must be kept to less than 80 millimeters). However, they have the drawback of high amounts of dust in the flue gas flow.
- Circulating fluidized bed combustion (CFB) furnaces offer the same benefits of high efficiency (97.5–99.5%)107 and low emissions that BFB furnaces do, but with improvements due to the high level of turbulence. They have the drawback of high investment costs (they are economical only over 30 MWth), and they must be fed with smaller particles (40 millimeters or less).
- Pulverized fuel combustion, which is the standard technology in coalfired power plants, presents high performance regarding load control and flexibility. However, it needs very small

particles (less than 10–20 millimeters) and requires an extra start-up burner (pulverized boilers operate at 95% efficiency).

Technologies for Biomass CHP

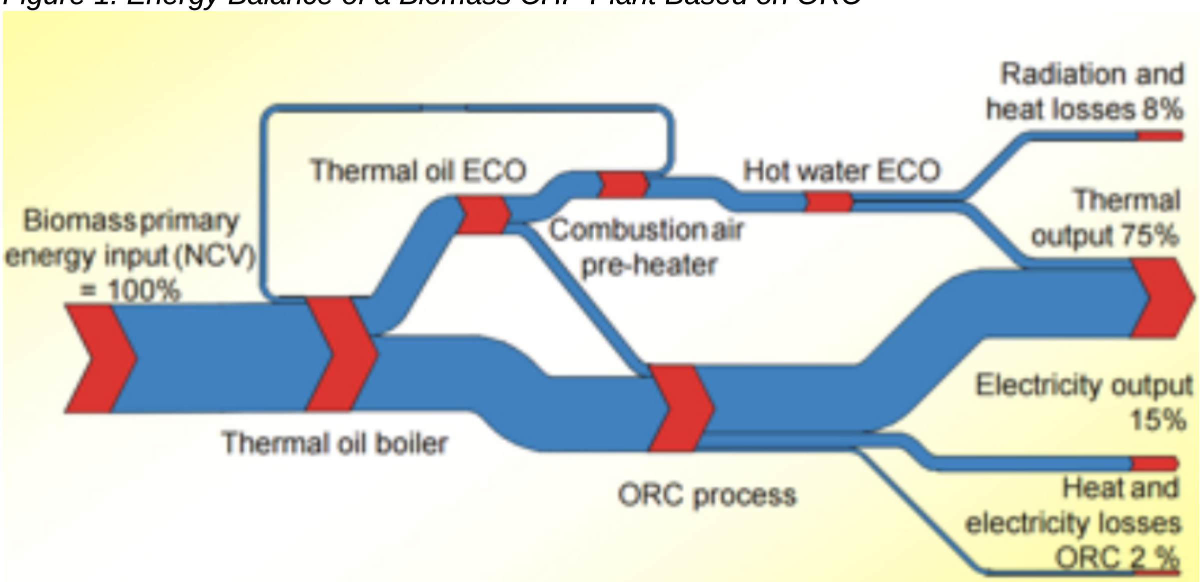
Cogeneration, also known as combined heat and power (CHP), is the simultaneous generation of heat and power, both of which are used. CHP units have better total efficiency than conventional energy systems, since better exploitation takes place and energy is used to produce heat as well. Key benefits that CHP provides compared to conventional (HOB) thermal energy production include less fuel to produce a given energy output, and reduction of emissions of greenhouse gases and other air pollutants (because less fuel is burned).

Typical fields of application for CHP technologies are wood-processing industries, district heating systems, and industries with a high process-heat demand.

Considering the typical size of the district heating plants, the most suitable technology for application in the district heating systems of the Western Balkans, for small-scale biomass CHP production, is the organic Rankine cycle (ORC). It is by far the most used technology for biomass CHP in Europe. The nominal electric capacities of ORC modules for biomass CHP plants range from 200 electrical kilowatts (kWe) to 15 electrical megawatts (MWe).

Since biomass CHP plants are usually operated in a heat-controlled mode—for both economic and energetic reasons—the partial load behavior and the partial load efficiency of the ORC process is very important. At 40% of the net electric power of the ORC unit, the net electric efficiency still amounts to 85% of the nominal value.

Figure 1: Energy Balance of a Biomass CHP Plant Based on ORC



Source: Obernberger and others 2004

This circumstance is a substantial advantage of the ORC process in comparison to steam turbines, which show a stronger efficiency decrease at partial load.

Operating experiences have shown that the ORC technology is a technologically feasible application for medium-scale biomass CHP plants. More than 200 CHP plants based on ORC technology are in operation in Austria, the Czech Republic, Finland, Germany, Italy, the Netherlands, Poland and Switzerland.