

Biomass-Fired Combined Heat and Power (CHP) Plants

In Austria the majority of biomass-fired combined heat and power (CHP) plants are presently in operation in the paper and pulp industries (large-scale units in 10 companies, biomass fuels are especially black liquor and bark), and about 10 plants in wood-processing industries. This small number of CHP plants, compared to the total energy use from biomass in Austria, can be attributed to a lack of technologies for small-scale applications and a lack of economic impulses, because the buy-back rates for electricity are on average lower than the prices paid for heat supply. On the other hand, thermal biomass utilization for heat production in wood-processing industries and biomass district heating systems permanently increases. Due to its decentralized population structure and densely wooded landscape, Austria has a high potential for the implementation of decentralized biomass-fired CHP plants. However, staff and financial resources for small-scale CHP units are usually limited. Therefore, decentralized biomass CHP plants should feature automatic operation without malfunctions, good partial-load behavior and low maintenance requirements.

Recently some innovative technologies for electricity production in the power range of up to 2 MWe_{el} have been newly developed or improved, thus rendering them suitable for application in biomass-fired CHP plants. Such plants should normally be operated on a heat-controlled basis in order to achieve high overall efficiency. In this study various CHP technologies have been investigated, evaluated and compared with respect to technical (operating characteristics and additional resources, process control, maintenance requirements, environmental aspects, state of development) and economic (investment and electricity production costs) aspects. Two technologies for electricity production from solid biomass in decentralized plants are presently on the market: the steam-turbine process and the steam-engine process. Three innovative technologies, the steam screw-type engine process, the ORC process and the Stirling engine process, have attained a high level of development and demonstration units are planned for the near future. Fixed-bed gasifiers with gas engines and circulating fluidized-bed gasifiers with gas engines or gas turbines could also reach the demonstration level, provided that technologically efficient and economic solutions for the producer gas cleaning system can be found. The direct (inverse) gas-turbine process and the externally fired gas-turbine process (hot-air turbine process) are still at a low level of development.

The technologies mentioned above are suitable for all segments of application in decentralized biomass-fired CHP plants in a power range of up to 2 MWe_{el}, some technologies can also be used in larger units. All technologies still have great potential for technical and economic development. Full exploitation of these potentials will increase the efficiencies and lower the costs of these processes. In the case of small serial production further cost reductions can be achieved. The cheapest technologies for decentralized electricity production from solid biomass cause specific additional investment costs

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(compared to a conventional biomass-fired heating plant with the same heat output as the CHP plant) of about 20,000 ATS/kWh_{el}. Depending on the amount of full-load operating hours and the biomass fuel price, biomass-fired CHP plants can produce electricity at costs of 0.5 ATS/kWh_{el} or higher. The steam processes and the ORC process are presently the cheapest systems available.

To increase the economic competitiveness of CHP plants based on renewable resources, higher electricity buy-back rates (compared to the present situation) are of great importance. The recently passed Austrian Electricity Management and Organization Act ("EIWOG") provides that by 2005 an additional electricity production (in comparison to 1998) from national renewable resources (without hydro-electric power) in the amount of 3% of the overall quantity of electricity delivered to end users in 2005 should be achieved. This electricity production target from renewable resources corresponds to 1,500 GWh/a. Furthermore the local governments are forced to fix buy-back rates for electricity produced on the basis of renewable resources. Biomass has the highest potential of all renewable energies available in Austria. The "EIWOG" target can be fully reached by biomass-fired CHP plants. Typical fields of application for biomass-fired CHP plants are wood-processing industries, district heating systems, industries with a high process heat demand, and co-combustion of biomass in existing fossil fuel-fired power plants. In Austria all these applications have a considerable potential for realization.

In order for biomass-fired CHP plants to cover 80% of the "EIWOG" target and achieve an average of 4,000 full-load operating hours per year, a total electric capacity of 300 MW_{el} would have to be installed. Taking into consideration the time required for the planning and building of biomass-fired CHP plants, it becomes obvious that timely decisions are required in order to keep the specified schedule.

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