

Prediction in 2000: small-scale biomass systems for use in rural/urban areas

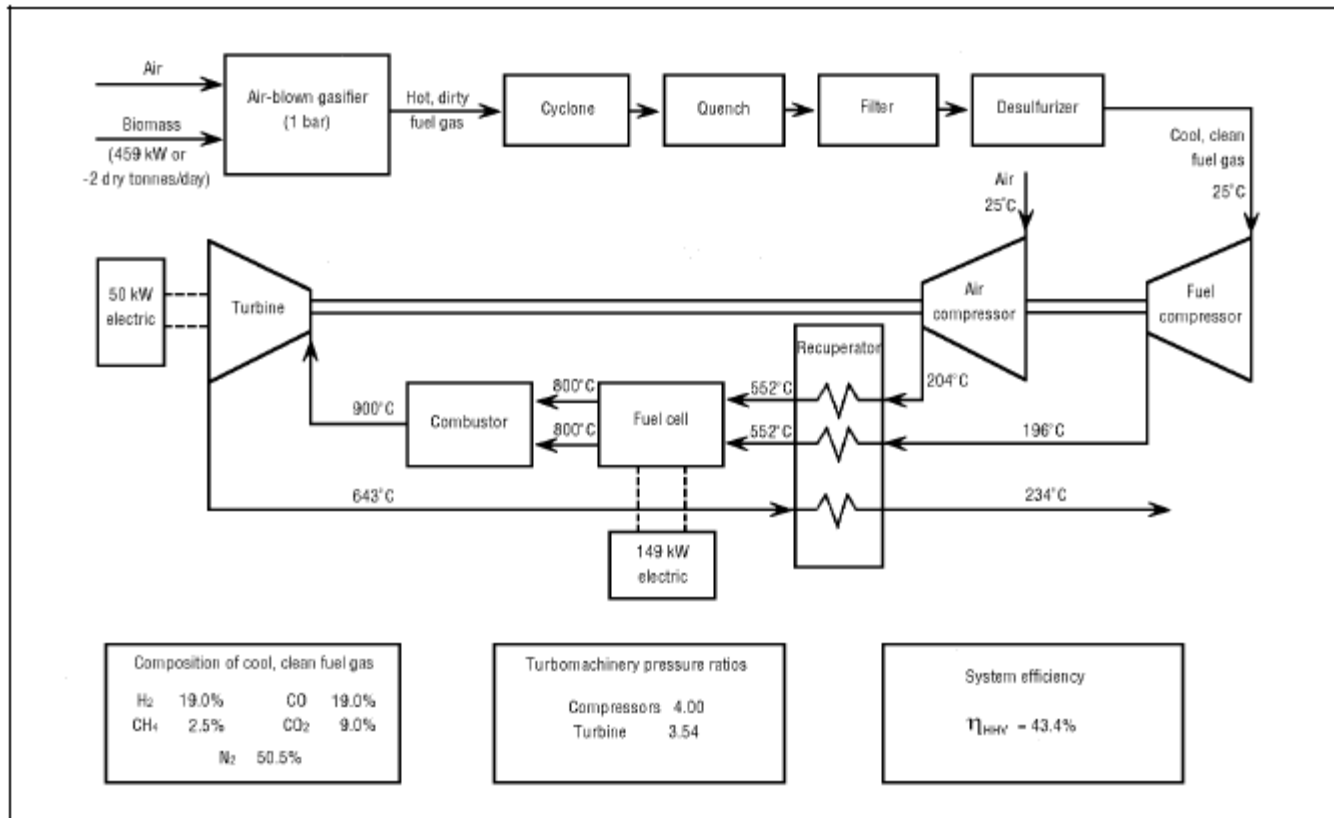


Figure 1. Solid oxide fuel cell/gas turbine power plant powered by biomass gasified in an air-blown gasifier.

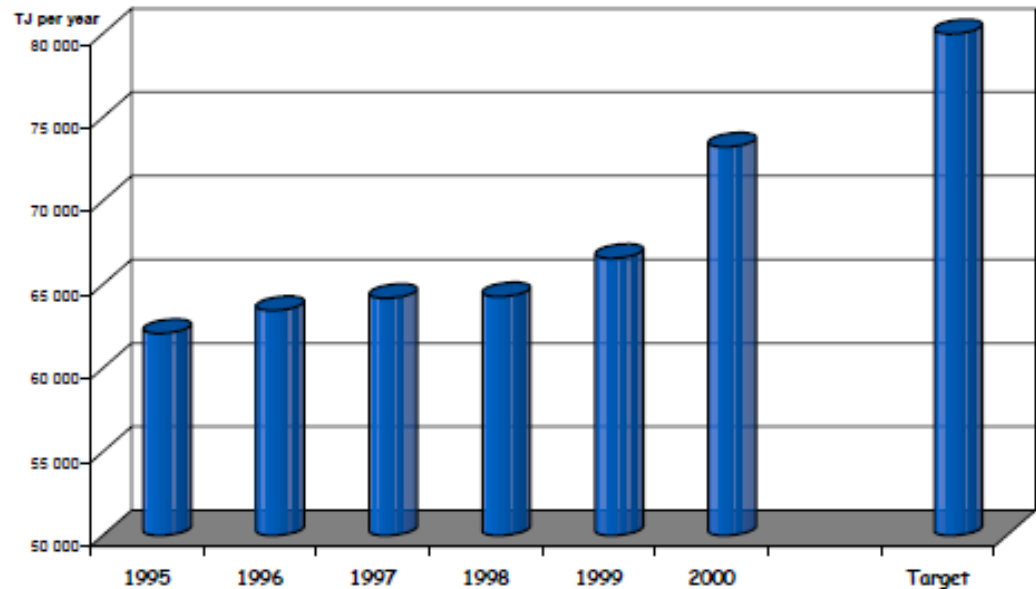
Kartha, Kreutz and Williams. Energy for Sustainable Development (2000)

Development of biomass utilisation in Bavaria

Results

Thanks to the large-scale promotion of technology Bavaria has in recent years considerably improved the infrastructure for utilising biomass as an energy source for all product lines. Nowadays approx. 2.3 million tons of biomass are used for energy purposes in Bavaria which is equivalent to 3.3 % of the primary energy requirements. Today's infrastructure is made up as follows:

- 265 biomass heating and combined heat and power plants in operation (111 of which received financial support)
- 1.76 Mio. small combustion plants for wood and other types of biomass
- 1,650 agrarian biogas plants



Small-scale biomass in Finland, Denmark, Sweden, 2004 Update

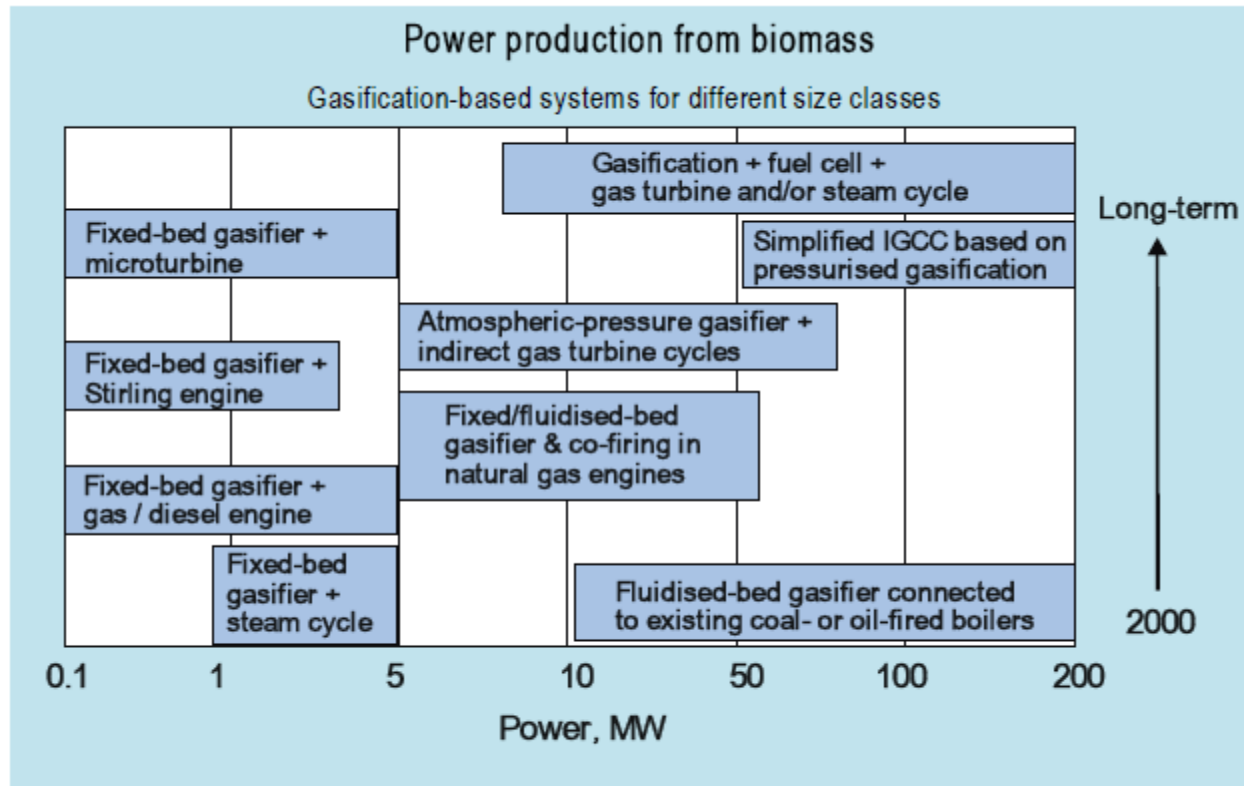


Figure 1. Gasification technologies for different power plant size classes.

Commercially Available Systems

Forest Products Laboratory

Specifications (Based on Latest Model)

- Electrical power: 5- to 100-kW_e modules
- Thermal: ~70k to 1,500k Btu/h (20 to 400 kW_{th})
- Electrical efficiency: 15% to 18%
- Combined heat and power (CHP) efficiency: 55% (with predrying chips); 75% (without predrying chips)
- Footprint: 5 by 5 m (16 by 16 ft)
- Weight: ~1,500 kg (~3,300 lb)
- Gas composition (~): 0% O₂, 20% H₂, 20% CO, 7% CO₂, 2% CH₄, balance N₂
- Gas: 5 MJ/m³ (~150 Btu/ft³), <15 ppm tars/particulates
- Fuel conversion: ~1.5 kg/kWh (1200 lb per 24 h for 15 kW_e)
- Dispatchable power (on backup fuel): Within 30 s
- Full cold startup on wood gas: ~30 min
- Turndown ratio: >10:1 (efficient operation down to 10% of full power)
- Startup/backup fuel: LPG (propane, butane)

Economics (Example Cost Analysis)

- Estimated full-scale capital production costs: \$1,800/kW (\$27,000 for BioMax 15)
- Assumed value of electricity: 12¢/kWh
- Payback time (operating 16 h/day, 300 days/year): 3.1 years, excluding cost of chips and labor (minimal)



Commercially Available Systems

Cratech Inc.

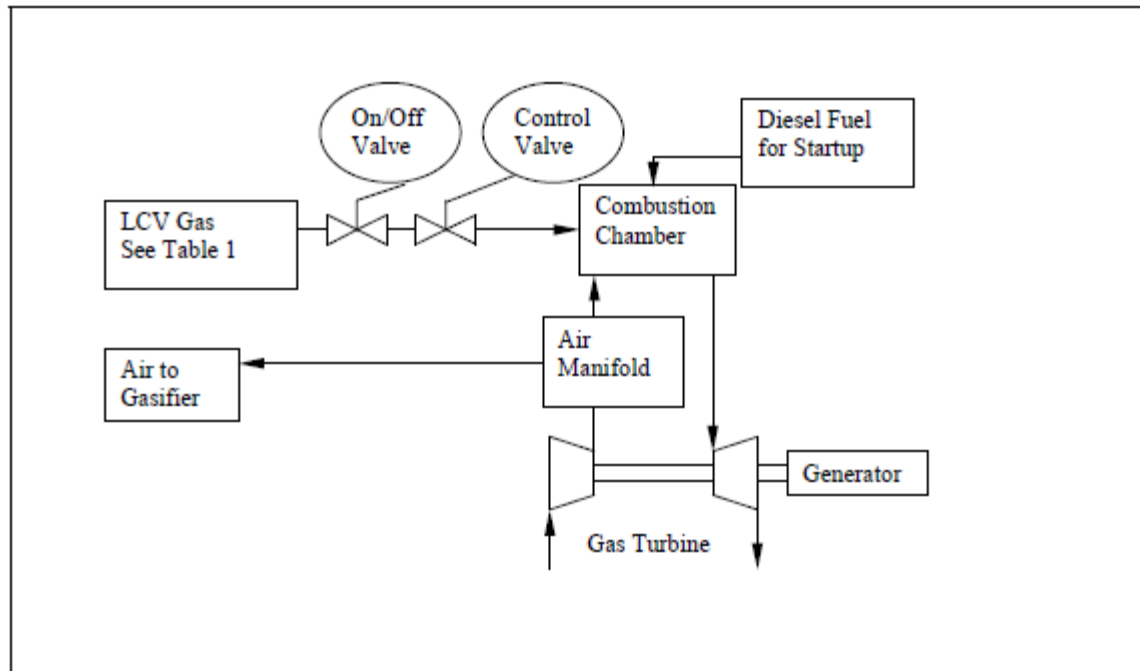


Figure 2. Gas Turbine Fuel Control Scheme.

Single Household-Scale

Heating costs of biomass fuels versus fossil fuels

