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The steam from high-back-pressure steam cogeneration systems can be used for process heat and space heating.

The new system uses a coal-fired boiler that was modified to solve retrofitting space problems. The boiler generates steam to power a turbine that produces electricity. The turbine exhaust steam temperature is high enough to be used for process heat requirements and to provide space heating. The prototype system's net energy cost savings are \$250,000 per year.

Although the system was originally developed for the textile industry, it also applies to several other industries. Eight systems were in operation in 1989, saving about 10.8 trillion Btus. Energy savings for 2010 are estimated at 469 trillion Btus.

Organic Rankine Bottoming Cycle

In a conventional Rankine-cycle electricity generating system, water is alternately vaporized and condensed. These Rankine-cycle systems have been the mainstay of electric power generation for nearly a century. Large power-generating steam plants can attain efficiencies of about 39%. However, at heat source

temperatures below 700°F, steam systems become less efficient and are too expensive to use. Conventional steam Rankine-cycle systems, therefore, cannot be used to economically generate electricity from many industrial waste-heat streams.

DOE and Sundstrand Energy Systems developed and tested a new waste-heat electric power generation system consisting of a standard Rankine-cycle engine, an organic working fluid (toluene), a waste heat boiler, a waste gas flow-control valve, system controls, and an electric generator. The system is rated at 600–750 kilowatts, depending on the temperature and mass flow rates of the waste-heat stream. This organic Rankine-cycle system is suitable for use with many types of waste-heat sources: gaseous streams above 600°F, liquid streams above 550°F, and condensing streams above 500°F. It is also readily adaptable to a wide variety of solar and geothermal energy applications. One unit installed at a manufacturing plant saved 0.01 trillion Btus during 1989.