North Country Hospital Biomass Combined Heat and Power Demonstration Project

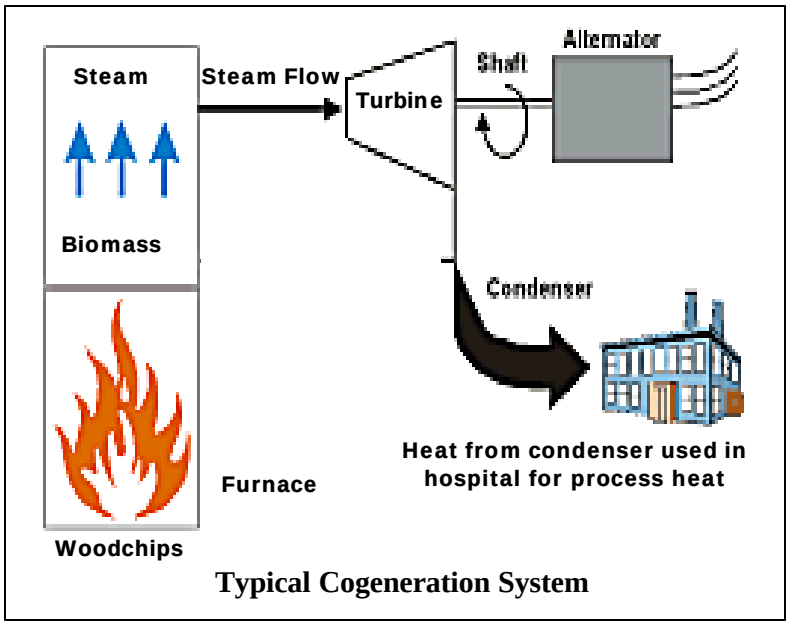
North Country Hospital in Newport, Vermont is a small acute care facility that serves 22 communities in two counties in Northeastern Vermont. It is typical of rural general hospitals across America, with 25 beds for in-patient care, an emergency room, a dialysis unit and critical outpatient services in 121,000 square feet. However, one thing that makes this hospital different is its biomass-fueled combined heat and power generation equipment. While more than two dozen schools in Vermont heat with biomass, North Country Hospital is the only hospital in Vermont, and one of only a handful in America, with a wood chip fueled-boiler that provides steam for heat, electric generation and for absorption chiller air conditioning.

North County Hospital, Newport, Vermont

When a North Country Hospital vice president first suggested in 1997 that a wood chip boiler might save on the hospital's energy bills, the hospital Board of Trustees began a series of very careful deliberations. After all, modern biomass heating technology is a very significant capital investment, and few, if any, examples exist of its use in hospital settings. But the administrator continued to promote the idea, and the hospital obtained a small grant from the Vermont Department of Forest, Parks and Recreation to undertake a preliminary feasibility study. The 1999 study showed a positive return on investment, but it was not compelling enough for the Board to put a biomass project at the top of the capital improvement list. The hospital desperately needed more space and the trustees focused their efforts on a capital campaign to build an addition.

North Country Hospital Biomass Combined Heat and Power Demonstration Project

When fuel oil prices began to climb in 2003, the Board reconsidered its initial decision. This time they looked into the feasibility of installing biomass combined heat and power (CHP) technology to offset both heating and electric costs rather than just a wood chip boiler. Combined heat and power, or cogeneration, is the on-site generation of electricity and recovery of useable heat from that generation. The recovered heat is used for space heating, cooling, cooking, cleaning or other uses. The steam produced from the biomass boiler can then be used for all of the same purposes as steam from a fossil fuel boiler including, heat, domestic hot water, sterilization, laundry, heat for absorption chilling and power production through a steam turbine and generator.



Typical Cogeneration System

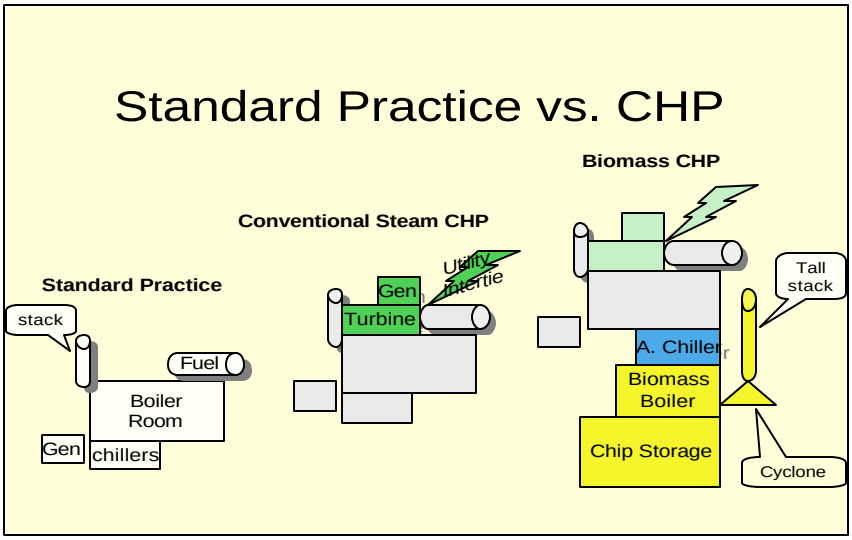
By design CHP is intended to improve energy efficiency, reduce total emissions, and save the facility money. Hospitals have long been advocated as excellent candidate sites for CHP by such federal agencies as the U.S. Department of Energy and the U.S. Environmental Protection Agency because of their "24/7/365" operation and demand for electricity and thermal energy. Logically, biomass CHP would meet the hospitals needs and create additional benefits for the forests and local communities by providing market-based incentives for forest management and creating local jobs.

Several additional factors contributed to moving along the North Country Hospital as a "first-of-its-kind project." First, the hospital received a feasibility study grant from the Vermont Economic Development Authority. The study indicated that the biomass CHP was a feasible project with a four-year simple payback and a 26 percent return on investment. The total estimated project cost was $1.5 million. Second, the hospital received a federal grant of $250,000 to help fund the project. Third, since the project was considered an expansion of a boiler plant, a Certificate of Need was not required. With these incentives and the very favorable payback, the Board chose to move ahead with the project. The new biomass combined heat and power unit was up and running by mid-2005.

North Country Hospital Biomass Combined Heat and Power Demonstration Project

How Biomass CHP Works

Biomass CHP is a step up from conventional steam driven CHP systems. Biomass CHP uses the same equipment as a conventional fossil fuel CHP system including back-up fossil fuel boilers to provide heat during downtimes. Since a typical wood system is designed with a redundant backup, the wood boiler can be sized at or even slightly less than peak design loads. The back-up fossil fuel boilers can easily provide supplemental heat during the coldest weather. This keeps biomass equipment costs down and means the biomass boiler will more frequently operate at highest efficiencies. Added to the existing fossil fuel heating system are wood chip fuel storage, wood fuel handling equipment, and a properly sized wood chip boiler with its own stack and boiler controls and its own pollution control equipment. This additional equipment means considerably more mechanical room space is needed – up to 3,000 square feet or more. The chip storage also must be carefully located on the site to allow for tractor-trailer load deliveries of fuel.



Schematic showing the additional space needed for a CHP and a biomass CHP

In addition to the need for added space and equipment, biomass CHP will require added operations and maintenance time, and as much as a half-time staff person to manage the system and to make sure the boiler is cleaned and operating properly. The payoff is that wood chip fuel, if it is locally available, is about one-third the cost per Btu as fuel oil and one-half the cost of natural gas. These savings can be substantial if a facility uses a significant volume of fossil fuels. Biomass is also a renewable fuel that reduces greenhouse gas emissions and benefits the local economy.

Although the hospital may not have intended it to be, the North Country Hospital project should be considered a demonstration project. With little experience on which to model the biomass cogeneration system, the hospital's initial configuration was less than optimal. An oversized biomass boiler was designed to produce more steam than was required for heating in order to power the steam turbine and produce electricity. To accommodate the additional steam, a "radiator" was constructed on the hospital's roof, but it failed after a year in use. In late 2005, the aging central chiller was replaced with an absorption chiller that runs off of the steam produced by

the biomass boiler. That change has been a big success. The chiller cost $568,000, but it was considered to be part of the normal equipment replacement schedule. Ironically, the hospital's largest steam load of the year now comes during the summer time. The system requires a dedicated staff person to monitor outputs and to operate the system efficiently. These tasks do not demand substantial time, but do require a person who is technically competent and able to manage the system for efficiency and maximum output.

LESSONS LEARNED

North Country Hospital fuel storage, boiler plant, and tall stack

While not designed as an ideal configuration, this North Country Hospital project has demonstrated that biomass CHP can be successfully implemented by a hospital and has proved that hospital staff can effectively operate a steam turbine and electric generator. This trail blazing effort has demonstrated the value of steam absorption cooling. While wood costs were higher than projected and contracting for wood fuel requires more time than originally anticipated, significant savings have resulted. Since installation, the hospital has saved approximately $102,000 per year in electrical costs and $128,000 per year in heating fuel costs. The Btu's produced from biomass are about 1/3 the cost of Btu's produced from a conventional oil-fired boiler. The more heat load they can run off of the biomass boiler, the more they save in operating costs. The hospital is now looking to add more steam load and is currently evaluating whether its laundry dryers and the sterilizers can be run from the heat produced by the boiler.

When asked what he liked best about this project, the administrator who launched this initiative responded "I feel this project has helped to stabilize the financial future of the hospital. My only regret is that we didn't do it sooner."

Disclaimer: This case study was prepared under a Cooperative Agreement (# F-CNGPRC07-15) between the Vermont Department of Forests, Parks and Recreation, and the CONEG Policy Research Center, Inc. The comments and views expressed do not necessarily reflect the views or opinions of the State of Vermont, its agencies, or the Center.