Woody Biomass for Energy in Michigan

TOPICS FOR DISCUSSION AND INQUIRY

BILL COOK, MICHIGAN STATE UNIVERSITY EXTENSION FORESTER

EXTENSION BULLETIN E-3092
JANUARY 2010

What is District Energy and How Does it Work?

District Energy (DE) systems use hot water or steam to heat *and cool* homes and businesses within a town or community. The basic components of a DE system are a heating plant (low-pressure boiler) and a closed underground pipeline system for water distribution. The generating plant produces the hot and cold water and pumps it into the grid.

Benefits of District Energy include:

- Possible conversion to renewable energy sources, such as woody biomass.
- Energy and system efficiency.
- Energy conservation.
- High reliability, low maintenance.
- Flexibility and adaptability.

Shredded wood used to supply a small district heating plant.

The heating plant can be configured to use woody biomass as a feedstock (chips, shreddings, pellets, etc.). Various configurations can utilize different combinations of renewable feedstocks, as well as traditional fossil fuels.

Buildings on the grid do not need their own furnaces or air conditioners so new buildings have reduced construction costs. District energy has been very reliable and cost-competitive.

If electricity generation capacity is added, then you have a Combined Heat and Power (CHP) plant. A CHP plant uses hotter steam and higher pressure boilers. It, too, can be configured to use a variety of feedstocks, including woody biomass.

District Energy plants can serve both small and large communities. The idea is not new. Thomas Edison built a system in Philadelphia. Many systems currently exist across North America. Historically, many were abandoned over time because of inexpensive fossil fuels. With growing price increases for fossil fuels and concerns about global climate change, District Energy systems that run on renewable fuels have drawn increasing interest.

The new heat plant was inaugurated in 2007 for a small town in Sweden. The 3.5 megawatt boiler is designed to use biofuels with a moisture content of 10 to 35 percent and is intended for fuels from the surrounding agricultural area. Feedstocks can include straw, willow plantation chips, and grain residues. During the initial period, mainly wood chips will be used. For top load and back-up an oil boiler using rapeseed oil is used. The district heating grid has a length of 3.3 miles, and the heat delivery is around 12,500 megawatt hours per year. The customers are apartment buildings, stores, industries, and family houses.

For communities interested in District Energy, clusters of large buildings might first be evaluated. Schools, colleges, municipal buildings, and industrial parks might be logical choices. Once cost savings are demonstrated, a large number of homes may wish to be tied into the pipeline grid.

In 2008, Traxys Corporation converted a conventional power plant in L'Anse, Michigan, to use woody biomass and sells the heat to a nearby forest products company.

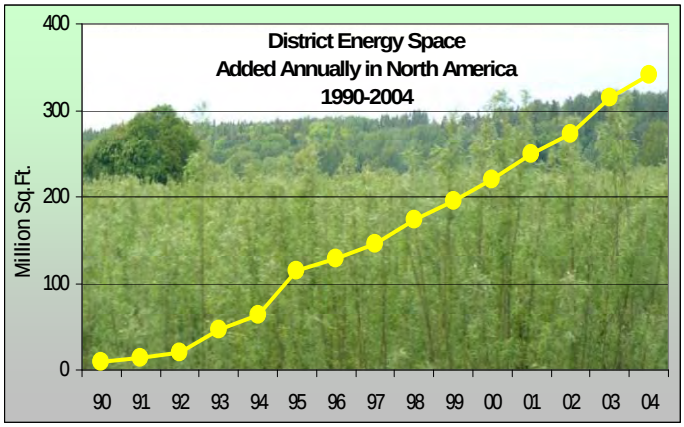
The technology for District Energy—primarily boilers and pumps—is readily available. Chillers remove heat from the water for air conditioning. Air quality equipment would need to be considered, and a pipeline grid engineered and constructed. An area for feedstock handling is necessary, such as room for trucks, feedstock storage, and movement of feedstock into a boiler. An assessment of feedstock costs and availability is essential, especially for woody or agricultural biomass.

In the past, District Energy was used to help maintain snow-free and ice-free conditions on sidewalks and public areas, as well as for building heat. In the near future, District Energy may be an economical option to provide renewable, sustainable, and clean heat (and cooling) for business, government, and residential buildings. In some countries, a large and increasing portion of heating energy already comes from woody biomass.

Willow genetics trial at the MSU Upper Peninsula Tree Improvement Center.

In Sweden, about 26 percent[1] of the nation's total energy consumption comes from renewable woody and agricultural feedstocks, much of that through District Energy. In the United States, biomass supplies about 3 to 4 percent of our energy consumption.[2]

Across North America, a number of landmark buildings are heated and cooled by District Energy grids, such as the IDS Center in Minneapolis, several prominent facilities in Toronto, Boys Town National Hospital in Omaha, downtown St. Paul, Minnesota, the Empire State Building, and the United Nations Headquarters. Most of the North American District Energy supplies heating and cooling to commercial and government buildings. Residential use runs less than 10 percent.[3]



Growth in committed space for District Energy heating and cooling across North America. Source: International District Energy Association, 2005.

In Michigan, District Energy is employed at several universities, including Michigan State University. Detroit, Ann Arbor, and Grand Rapids each have District Energy systems as part of their infrastructure.

In addition to providing renewable and economical heat, district energy plants can encourage establishment of local energy plantations and so promote economic activity near the heating plants. Retired farmlands can be brought back into production to help supply a heating plant with feedstocks. Plantations might include species such as willow, hybrid poplar, switchgrass, Miscanthus, or other agricultural products.

More information can be accessed through the International District Energy Association (IDEA) *www.districtenergy.org*

[1] Andersson, Kjell. 2008. A General Overview of Swedish Bioenergy Industry. Conference paper; "Sweden's Remarkable Transition to Renewable Fuels: Can It Happen Here, Too?" Feb. 26, 2008. Escanaba, Mich.
[2] U.S. Department of Energy, Energy Information Administration. 2008. Renewable Energy Consumption and Electricity Preliminary 2007 Statistics, Table 1. Available at *www.eia.doe.gov/cneaf/alternate/page/renew_energy_consump/table1.htm*]
[3] International District Energy Association. 2005. IDEA Report: The District Energy Industry, 35 p. (Figure 19). Available at: www.districtenergy.org.

maes research MICHIGAN STATE UNIVERSITY EXTENSION
Prepared by Michigan State University Extension
Upper Peninsula Tree Improvement Center, 6005 J Road, Escanaba, MI 49829 906-786-1575
For more information on MSU initiatives, visit the Office of Biobased Technologies at www.bioeconomy.msu.edu