



Volume 28, Number 2  
Fall 2010

# NORTHEAST SUN

The Magazine of the Northeast Sustainable Energy Association

## 2010 Sustainable Green Pages Directory

- **A Sneak Preview of the 2010 Green Buildings Open House**
- **The Trinitarian Congregational Church Renovation Project**
- **An Analysis of School Heating Fuel Splits with Data Loggers**
- **Smart Grids: The Promise and the Perils**
- **Commercial-Scale Biomass Boilers Market Growing in the Northeast**
- **Empowering Microfinance and Reducing Poverty with Solar Energy in Africa**



Wild Center building

The Wild Center

# Commercial-Scale Biomass Boilers Market Growing in the Northeast

BY DAVID DUNGATE

Approximately 38% of the total energy consumed in the US Northeast is used to heat and cool buildings. Most of this heat is currently supplied by gas, oil, and propane. However, renewables are playing an increasing role for heating buildings. According to the US Department of Energy, currently less than 5% of the thermal energy in the region is provided by renewables and more than 90% of that renewable energy comes from biomass (wood) heating.

Interest in switching from fossil fuel heat to wood heat is largely the result of the following factors:

- Volatility of fossil fuel prices vs. relatively stable prices for biomass
- Desire to reduce dependence on imported oil and support local energy independence
- Desire to reduce greenhouse gas emissions
- Availability of new user-friendly, high-efficiency boiler designs

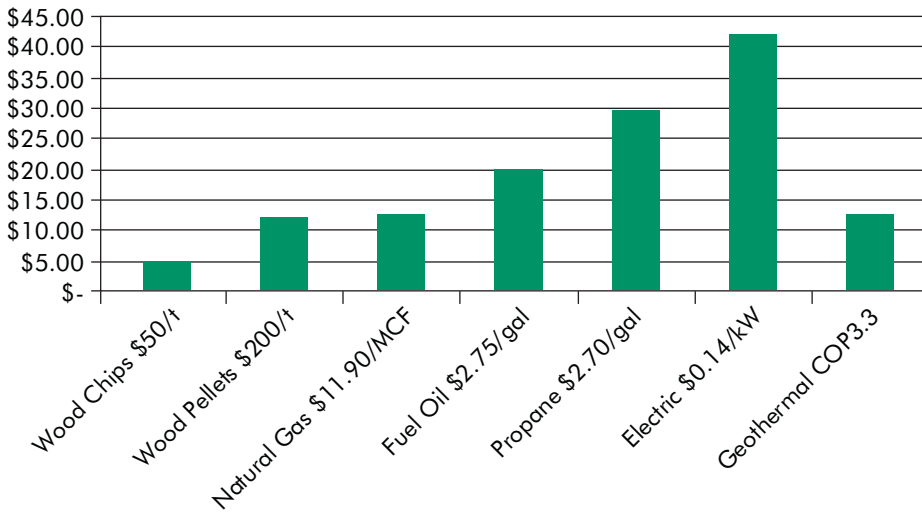
Until recently, most of the wood heating systems have been residential stove units and large scale boilers at industrial

## Heating Oil

As a region, the Northeast is highly reliant on heating oil. The region consumes 80.3% of all the heating oil in the US. In fact, each year the Northeast consumes about 5.5 billion gallons per year of heating oil. At a price of \$2.75 per gallon, this equals about \$15 billion per year that is spent on heating oil, of which 78% of this money leaves the region.

Source: US DOE.

**FIGURE 1**  
**Equalized Fuel Cost for Various Heating Systems in \$/MMBtu**



sites. In the last 20 years, European companies have developed and refined new boiler designs specifically targeted at the small commercial, institutional, and multi-family residential buildings at the scale of 0.25-3 million Btu. Until recently, this market was relatively ignored by the U.S. wood boiler industry. However, in the last few years, several US-based suppliers and manufacturers have begun introducing new commercial-scale, wood chip and wood pellet boilers to the market. Initially these advanced, high-efficiency boiler models have been imported from Europe, but some units are also now being manufactured in the US. Most of these European type boiler designs have thermal efficiencies of greater than 80% and are designed with control features to make them as user-friendly as conventional fossil-fuel boilers.

Since virtually no state or federal incentive programs have targeted commercial biomass heating, the early adopters of this technology have been commercial customers who are paying high fossil fuel costs (mostly oil or propane) and are in communities where there is ready access to forest resources (see Figure 1).

High efficiency and low emissions are linked results of advanced wood boiler designs. With gasification-type boilers,

the fuel is first heated with limited air to release the volatile components in the wood (tars, creosote and carbon monoxide) and then secondary air is added in a controlled dose to completely burn the released gases. Much of the particulate emissions from the burning of less sophisticated wood heating systems comes because the combustion is not

fully optimized. With complete combustion, the main emissions that are left are inorganic salts comprised of calcium and magnesium, which are much less noxious than unburned organic pollutants. As a result, there is no black smoke from modern biomass boilers and virtually the only time that emissions are seen is on cold days when moisture vapor in the exhaust can be seen as it condenses. The US EPA is in the process of finalizing new rules for commercial-scale wood boilers which will push the industry to further reduce emissions and eliminate poorly performing wood boilers from the marketplace. These new rules are scheduled to be finalized in December 2010.

When wood is harvested from sustainably managed forests, the net greenhouse gas emissions from biomass thermal are favorable. Although carbon dioxide emissions are released when wood is burned, it is equivalent to the carbon emissions that would be released if the wood was left to decay in the forest or released during a forest fire. When fossil fuels are burned, carbon dioxide is re-released from long-term geologic storage.



**1.7 million Btu per hour boiler supplied by ACT Bioenergy.**

The Wild Center

When wood heat from a sustainably managed forest replaces fossil fuel carbon, the release of the geologic carbon is avoided by accessing carbon that is already cycling within the atmosphere.

Much of the biomass used for heating is a by-product of other wood manufacturing processes. If this wood was not burned for fuel, much would end-up in landfills where it can degrade anaerobically and release methane which is a 25 times more potent greenhouse gas than carbon dioxide. When wood is cut for fuel, it is typically the lowest value wood, which cannot be used for plywood, dimension lumber, or pulp. It generally comes from the residues from another manufacturing process or from clean urban wood wastes or tree trimmings. Providing a market for these low value species creates revenue that helps cover the costs of forest management, such as removing invasive species and diseased trees, forest fire protection, replanting, and ensuring good forest diversity. A market for low value wood means resources to better manage the whole forest for recreation, wildlife, and commercial benefits.

Using solid fuel for biomass is one of the most efficient ways to use the energy in wood. The energy consumed to produce the wood chip and wood pellet fuel is about 1%–3% of the total energy available in the final fuel compared with fossil fuel refining which 10%–15% and creating liquid fuel such as corn ethanol from biomass consumes even more energy. Since solid fuel can readily be used for space heating, it makes sense to save liquid and gaseous fossil fuels for uses such as transportation, where solid wood fuel is not readily substitutable.

Many small commercial-scale combustion systems have been optimized to burn wood pellets dry. Pellets are made from compressed sawdust. The advantages of the pellets include: minimal moisture content, resulting in an ability to burn hotter and cleaner than wet wood chips which helps increase efficiency and reduce emissions. The pellets also have a rela-



The Wild Center

**Wild Center solar thermal array.**

tively high density compared with wood chips. At the same moisture content, pellets are about 2.5 times denser than wood chips which improves transportation efficiencies and reduces the space required for storage. Also, with the drier fuel, it is possible to have a more compact combustion chamber which is easier to modulate and typically costs less than a system designed to burn green (> 30% moisture content) wood chips. Some of the new small scale commercial systems will also burn chips < 30% moisture which have many of the same advantages for pellets, but are lower cost than pellets. With various options and configurations available, customers can optimize a system to best meet their needs.

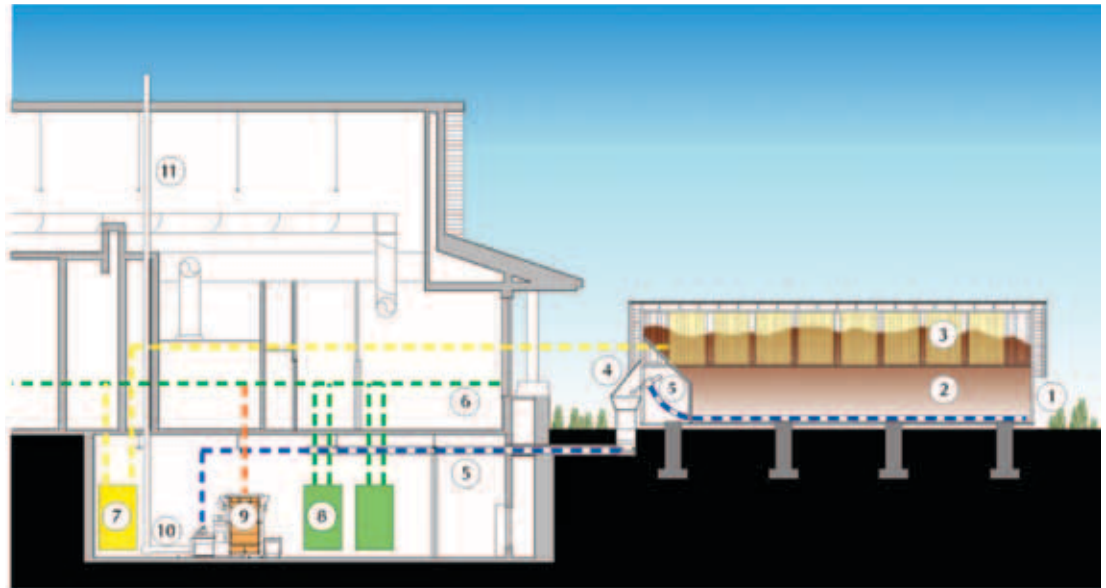
The Wild Center—The Natural History Museum of the Adirondacks—recently installed a 1.7 MMBtu per hour wood pellet boiler manufactured by ACT Bioenergy of Schenectady, New York as part of their ongoing commitment to showcase renewable energy technologies. The Wild Center facility includes 54,000 square feet of exhibit and meet-

ing space and is a LEED Silver certified building. A unique feature of the project integrates the pellet boiler with 300,000 Btu per day capacity of solar thermal panels. The goal is that in the summer, the solar panels will provide most of the hot water required for the commercial kitchen and when there is a space heating need the pellet boiler will provide the heat supplemental solar support when available.

The pellet boiler will replace the propane used by two propane boilers with a total of capacity 3.5 MMBtu/h that were originally installed at the Center and will remain in place as redundancy. Because there are very few days when the peak design capacity of 3.5 MMBtu/h is used, it is expected that the 1.7 MMBtu/h wood pellet boiler will be able to replace 80% to 90% of the propane consumption. By having a smaller-sized wood boiler, the capital costs of the system are decreased and the boiler will operate in the zone of peak efficiency most of the year. Modern wood boilers can typically operate in a zone of peak efficiency between 30% to 100%

**FIGURE 1**  
**Wild Center Boiler System**

1. Re-used storage container
2. 30 tons of wood pellets
3. Solar thermal panels
4. Pellet distribution display
5. Wood pellet delivery auger
6. Existing museum heating loop
7. Solar thermal storage tank
8. Existing propane fired boilers
9. New wood pellet boiler system
10. Emissions testing equipment
11. Chimney



CS Arch

of their design capacity. Therefore, the 1.7 MMBtu/h boiler will efficiently operate when boiler loads are 500,000 Btu per year or greater. This means the boiler can start earlier and operate longer in the heating season than a larger boiler that has a higher minimum output.

The gasification-type boiler design manufactured by ACT Bioenergy has controls that constantly monitor building heat demands and modulate the boiler operation to meet those demands. ACT is the first in the Northeast to manufacture a high-efficiency boiler based on advanced European boiler designs. The boiler's control system allows it to be operated independently or to work with the building automation system (BAS). These controls allow the boiler's target output temperature to be adjusted based on the measured outdoor air temperature and to determine the sequencing of the various boilers when there is a demand for heat.

The ACT Bioenergy pellet boiler uses pellets manufactured in Massena, New York by Curran Renewable Energy. The wood pellets are the first to be certified by the Forest Stewardship Council

**A vision to achieve  
25% renewable-based  
heating in the region  
by 2025 has been  
developed.**

(FSC) which ensures that the mill and the forests where the company sources its wood are well-managed to ensure long-term productivity and to conserve biodiversity.

The pellet storage container is one of the most interesting features of the project. Conceived and designed by CS Architecture of Albany, the container is constructed from a recycled 40 foot long ocean shipping container which is rotated 45 degrees and balanced on its edge. The container now has a "V" bottom for pellets to flow downward into a collection auger that sits at the bottom of the "V". Three hatches were installed on the top of the container for filling the container with pellets. A flexible auger transports the pellets about 30 yards from the container to the boiler which is housed in the basement of the facility. A small

"intermediate" storage bin inside the boiler has an infrared sensor which measures the depth of the pellets in the bin and calls for pellets from the main storage when required (see pictures of boiler system and solar thermal array).

The container roof now also makes a perfect angle for mounting the solar thermal panels. The New York Solar Energy Industries Association (NYSEIA) awarded the project the "Best Building Integrated/Innovative" category in the 2010 6KC Awards which recognizes the best solar projects in New York State.

**System Economics**

In the 2009-10 heating season, the Center paid an institutional rate of \$1.70 per gallon for propane. Replacing this propane with wood pellets at \$185 per ton reduces the fuel costs by approximately 38% and reduces carbon dioxide emissions by more than 300 tons per year. The project costs were supported with a \$300,000 grant from the New York State Energy Research and Development Authority (NYSERDA) which has supported the project as a demonstration project of clean energy technology.

The expected simple payback for the project is five to seven years without any state incentives.

### **Emissions Monitoring**

As part of the NYSERDA support for the project, Clarkson University's Center for Air Resources Science and Engineering was engaged to test the boiler emissions. The results of the testing was that the pellet boiler emissions were more than five times lower per unit of heat output than the EPA's residential "White Tag" program for the best performing residential wood boilers. As a result, there are no visible smoke emissions from the stack. Infrequently a white plume is visible when the air is cold enough for moisture in the exhaust to condense.

The Wild Center's high rate of visitation means the new project will be explained to a large audience that will be able to see the heating technology up close. Visitors will be able to see the pellets on their journey from the storage vessel to the boiler. The interpretation of the system will be added to the museum's New Path exhibit, which showcases elements of green design and how these features benefit the health of the human and natural world.

The Northeast, with its cold climate and historic dependence on expensive fossil fuels for heating, coupled with the availability of new high-efficiency, user-friendly biomass boiler designs, make the region an area primed for significant growth for biomass heating in the next few years. A vision to achieve 25% renewable-based heating by 2025 has been developed and additional information on biomass heating in the Northeast is available at [www.biomass thermal.org](http://www.biomass thermal.org) and [www.nebioheat.org](http://www.nebioheat.org). ■

---

*David Dungate is president of ACT Bioenergy, llc and Director of the New York Biomass Energy Alliance. He is a NESEA member.*