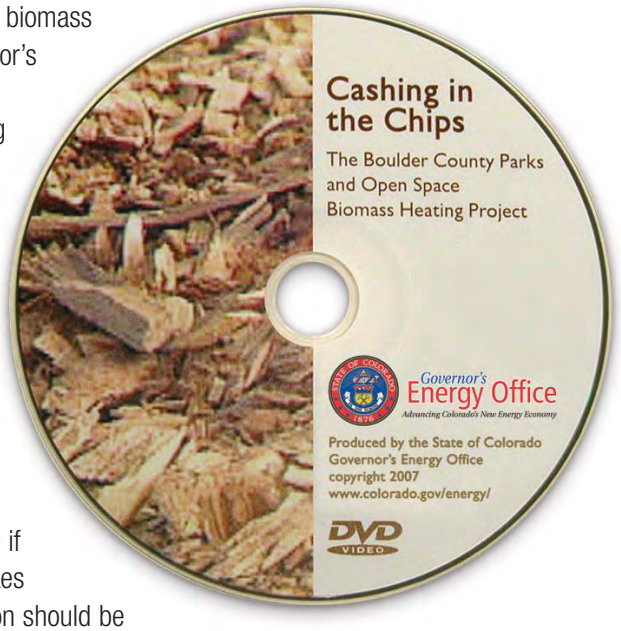
Governor's Energy Office
Advancing Colorado's New Energy Economy

Is a Biomass-fired Heating System Right for Your Facility?

Evaluating and Implementing Biomass Heating

Summary of Steps to Biomass Heating



This document is a supplement to the biomass heating video produced by the Governor's Energy Office (GEO). Its purpose is to present the steps involved in analyzing and installing a wood-fired heating system in Colorado. The primary focus is on the feasibility of burning wood chips for heating commercial, industrial, educational, and other large facilities.

Following is a brief outline of that process.

- **Quick Assessment**
  The purpose of this step is to see if a wood-fired heating system makes sense for your facility. A discussion should be held with operation and maintenance staff, management, and other affected parties to determine the level of support for biomass heating. A quick economic analysis should be performed to estimate capital costs relative to potential annual savings.

- **Educate Yourself**
  If the concept of biomass heating passes the quick assessment, it's time to learn more about biomass heating systems. Review manufacturers' websites and literature; talk to others with knowledge of biomass heating (including GEO), and consider scheduling an appointment to visit similar installations in your region.

- **Assess the Local Biomass Resource**
  Research the cost and availability of biomass fuel in your area, keeping in mind that long haul distances increase chip cost. Search for potential suppliers that could deliver woodchips to your facility. You will eventually need to select a supplier whose delivery vehicles are compatible with your chosen system and can provide an adequate supply of chips for at least as long as it takes to achieve a full return on investment for the complete heating system.

- **Consider a Feasibility Study**
  If you're serious about using wood chips to heat your facility, consider having a feasibility study performed by a firm with experience in biomass heating systems. The study will cover most of the topics in this document and provide a detailed economic analysis of wood heating vs. conventional fuel.

Zach Price operating chipper.
(Photo by Jim Gleason)

Chad Julian, Boulder County Forester, stands among wood chip piles.
(Photo by Zachary Price)

Loader filling chip bin. *(Photo by Therese Glowacki)*

Chip bin and conveyor belt. *(Photo by Randy Coombs)*

Biomass boiler and natural gas back-up boiler.
(Photo by Randy Coombs)

- **Determine Appropriate System Size**
  A wood heating system should be sized based on your peak load. Compared to an under-sized system, an oversized system will not perform as well, will be less efficient, and will have higher emissions. You will almost always require a supplemental boiler, using a conventional fuel, that will be sized to meet the peak load. A wood-fired boiler sized at 50 to 80% of the peak load can still meet 90 to 95% of the annual load. A smaller system will have lower capital costs and will operate more efficiently than will a large system. An economic analysis can be used to determine the optimal size of the wood-fired system.

- **Estimate Heating Energy Use**
  Estimate heating energy use and expenses for a wood-fired system and for a system using an alternate fuel (natural gas, propane, heating oil, etc.). The annual cost of wood vs. an alternate fuel will be a factor in the economic analysis, and will be used to estimate air emissions, ash production, fuel storage requirements, and wood delivery schedules.

- **Wood Handling and Wood Quality Issues**
  Wood quality includes wood chip size, moisture content, and cleanliness (i.e., free of foreign objects, like rocks). The chip size will be specified by the wood-fired equipment manufacturer. Moisture content of freshly-chipped wood will be about 50%, meaning that a pound of fuel will contain about one-half pound of wood and about one-half pound of water; wood that's dried to 20% moisture content will burn better and result in more efficient combustion. One way of dealing with wet wood is to establish a variable scale of wood cost based on moisture content so that you won't be paying for water. Dirt, rocks and other foreign objects mixed with the wood will damage fuel conveying equipment, increase air emissions and ash production, and result in large "clinkers" in the fire box. These foreign objects can also damage the fire grate and thus increase maintenance requirements. One good way to minimize this contamination is to chip the wood directly into a trailer or other container and dump that container into the fuel bunker. Chipping onto the ground and scooping that into a truck mixes dirt and rocks with the chips.

- **Economic Evaluation**
  Analyze the potential cost-effectiveness of using biomass for heating your facility. Study the economics of using biomass for heat, specific to your facility. Determine and compare capital costs for a traditional system and a wood-fired system, including any necessary building modifications. Estimate annual costs for both systems.

- **Decide Whether to Proceed with Wood-heating**
  Once you've gathered sufficient information, make the decision to install a biomass system, if it meets your needs and demonstrates cost effectivity. Using the results of your analysis, weigh economic and other criteria to decide whether installing a biomass system makes sense for you.

- **Evaluate Air Emissions from Wood Burning**
  Estimate air emissions from a wood system, based on energy use and emissions factors that should be provided by considered manufacturers. Research air quality regulations and obtain air permitting through the Colorado Department of Public Health and Environment, Air Pollution Control Division (303-692-3100).

- **Estimate Ash Production**
  Wood produces from 0.5 to 2 percent ash, depending on wood type and component; e.g., wood, bark, needles, etc.. Estimate ash production by multiplying percentage by annual wood use. The ash can be used as a beneficial soil additive.

- **Promote Public Discussion of Biomass Heating**
  Fully involve decision-makers and the general public during planning, and as you make your decisions and conclusions, particularly if the system will be installed in a public building, such as a school. Many people don't know how clean and efficient modern wood-burning systems are, or they don't fully understand all of the public benefits of using waste wood or, for example, beetle killed wood for heating.

- **Create and Distribute Bid Documents**
  Produce wood-system specifications and solicit bids from system manufacturers and installers.

- **Select a System**
  Review the bids, select the system that best suits your requirements and fine-tune the options and system components.

- **Apply for Permits**
  Apply for any required construction and air emissions permits. File an Air Pollutant Emission Notice (APEN) with CDPHE, if necessary. If the project can demonstrate the ability to pass an opacity test and will release low amounts of emissions, a permit may not be necessary.

- **Design Boiler- and Chip-building**
  Work with the selected biomass system vendor to design the new, or modified, boiler and chip room or building.

- **Arrange for Chip Delivery**
  Work with one of the selected chip suppliers to arrange chip delivery for initial startup and testing (see the following description). Work with U.S. Forest Service and Colorado State Forest Service foresters and local contractors to assess your local supply opportunities.

- **Install the Selected System**
  The system manufacturer will usually coordinate with your general contractor to install the system, perform initial startup procedures, confirm proper operation, and train the future operator.

Inside the fuel box. (Boulder County staff photo)

Overview of County site and biomass boiler central heating plant, including emissions. (Photo by Therese Glowacki)

- **Operate and Maintain the System**
  System operation and maintenance consists of starting the fire (this is usually only necessary at the beginning of the season, or after significant maintenance), ordering chips, possibly moving chips around on-site, raking out ash (this can be done without completely shutting down the burner), lubricating bearings and wear points in the fuel-handling system, inspecting for damage (if foreign objects or large pieces of wood have become mixed with the chips) and cleaning equipment. You must perform regular system maintenance, monitor system performance, and keep good records to document its effectiveness.

System Manufacturers and Other Useful Websites

Colorado Biomass for Thermal Useage Program
www.colorado.gov/energy

Biomass Combustion Systems Inc.
www.biomasscombustion.com

Biomass Energy Resource Center
http://www.biomasscenter.org

CHIPTEC
www.chiptec.com

Garn
www.dectra.net/garn

Grove Wood Heating, Inc.
Pleasant Grove, Prince Edward Island.
Canada C0A 1P0. (902) 672-2090

King Coal
www.kingcoal.com

KMW Energy
www.kmwenergy.com

Messersmith
www.burnchips.com

Northline Industries
www.northline.net

SolaGen
www.solageninc.com

Western Woodfuels, Inc.
www.westernwoodfuels.com/biomass.html

Tarm
www.woodboilers.com/pellet-boilers.asp

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GEO's mission is to lead Colorado to a New Energy Economy by advancing energy efficiency and renewable, clean energy resources.