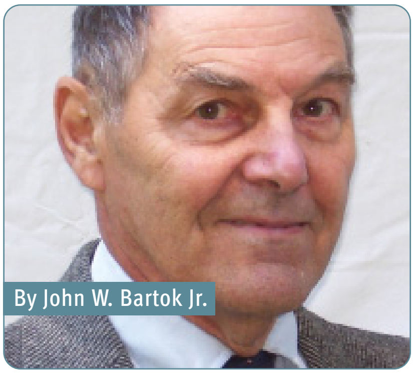
# Burning wood may offer heating savings




FUEL WOOD, WASTE WOOD AND BIOMASS are potential alternative sources of heat for greenhouses. The best sources include tree tops and cull trees from logging operations, slabs from sawmills, trimmings and take-downs by arborists and grower-owned woodlots. These can be in the form of solid wood, chips or hogged fuel. An adequate supply at a low cost is needed to pay for the additional cost of the equipment and operation compared to conventional fossil fuels.

## Wood-combustion basics

Combustion of wood has three requirements: fuel, air and heat. If any one of these is removed, burning ceases. When all three are available in the correct proportion, combustion is self-sustaining because the wood releases more than enough heat to initiate further burning.

The rate at which wood burns is controlled by the amount of air. A lack of air causes wood to smolder and produce pollutants. Too much air will cool the fire and waste heat.

Another important aspect of combustion is the energy content of the fuel. This is normally expressed in British thermal units (Btu). Energy content is greatly affected by the moisture content and weight of the wood. For example, hardwood and softwood at 50 percent moisture will contain about 4,700 Btu per pound. The same wood at 20 percent moisture will contain about 6,200 Btu per pound.

Hardwood has about twice the weight as softwood and twice the heat content. The same is true with wood chips — 4,000 Btu per pound green (50 percent moisture content) and 7,400 Btu per pound dry (10 percent moisture content).

## Stages of burning

In the burning process, wood goes through three stages. (All three stages can be present at the same time.)

**Stage 1.** The wood is heated to evaporate and drive off the moisture. The heat generated does not provide greenhouse heat.

**Stage 2.** Starting at about 500°F the wood starts to break down chemically and volatile matter is vaporized. The vapors contain 50-60 percent of the heat value of the wood. These vapors have to be heated to 1,100°F to burn. If not, smoke is generated that can coat heat exchange surfaces and chimneys with creosote.

**Stage 3.** Once the volatile gases are released, the remaining material (charcoal) burns at temperatures above 1,500°F.

## Fuel quantity

The amount of fuel needed depends on many factors, including heat required by the greenhouse, furnace efficiency, fuel type and moisture content. If you know your operation's fossil fuel consumption, you can estimate the firewood or chips you will need.

## Estimating wood needed

| Present fuel usage | | | Wood needed | |
|---|---|---|---|---|
| Fuel oil (gallons) | Propane (gallons) | Natural gas (therms) | Dry cordwood, cord (20%) | Wood chips, ton (45%) |
| 10,000 | 15,000 | 13,800 | 74 | 194 |
| 20,000 | 30,000 | 27,600 | 148 | 389 |
| 30,000 | 45,000 | 41,400 | 222 | 584 |
| 40,000 | 60,000 | 55,200 | 296 | 778 |
| 50,000 | 75,000 | 69,000 | 370 | 973 |

Values are based on 75 percent heating system efficiency for fossil fuels and 70 percent efficiency for solid fuels.

## Equipment selection

A wood-fired heating system is a major investment that should be selected to give efficient operation for many years. It pays to spend a little more on the initial investment to buy a unit that will reduce fuel handling, increase efficiency and provide a safer operation. When selecting a system consider these options.

**Size.** In many operations, it is best to size the wood unit to carry the baseload, 60-80 percent of maximum heat loss. Too large of a unit may create inefficiencies in fuel usage and excess smoke and pollution. Modular units will allow for expansion of the growing area and greater fuel efficiency during mild weather.

**Furnace (hot air) or boiler (hot water).** Most units are boilers as it is easier to get the heat where you need it with a hot-water system. Water can be modulated for root-zone heating or spring and fall heating.

**Firewood or chips.** There is little savings from solid fuel if you have to pay the homeowner rate. Solid wood may be available from landscapers and arborists at little or no cost but requires time to get it sized to fit the firebox.

Larger fuel wood units require handling several hundred pounds of wood a day. Chips and sawdust are delivered in bulk and are automatically fed to the firebox. For these, a long-term supply source and a storage area are needed.

**Indoor or outdoor location.** Location inside the greenhouse or head house results in shorter supply piping. An outdoor installation can be located close to the wood storage. It also keeps the smoke away from the greenhouse.

**Lined or unlined firebox.** A firebrick-lined firebox will usually burn hotter, create less smoke and is more efficient than an unlined one, especially if it has a water jacket.

**Gasification.** In these units, volatiles are driven off in an oxygen-deprived chamber and then moved through a burner nozzle where they are superheated and mixed with air for complete, even combustion. The increased efficiency of this two-stage process produces greater economic benefits and shorter payback.

**Natural or forced draft.** The chimney on a natural draft unit needs to be tall to get adequate draw on the fire. A forced draft maintains a hotter, more efficient fire and decreases smoke, creosote and ashes. This reduces the need for a water jacket with a large capacity as temperature recovery time is reduced.

**Primary and secondary air supplies.** Choose a unit with both primary and secondary air supplies. Many new designs have electronic controls that regulate the rate of firing, draft inducers that provide the right amount of air, heat storage that absorbs extra heat and heat reclaimers to capture the heat of combustion before it escapes up the chimney.

**Duel-fuel capability.** Some units are available with fossil-fuel burners for starting the wood and also providing backup if the solid fuel fire goes out.

**Local and state codes.** Larger units usually have to meet emission codes for particulate matter, carbon dioxide and other pollutants. In some states, such as Connecticut, outdoor wood furnace installation and operation are regulated.

## CONTACT INFORMATION

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