



Evaluating Wood Fuel for Greenhouse Heat

Wood is truly a renewable resource. Forest stands in many areas have been increasing over the past few years. In many states, forested area is more than 50% of the total land area. Management and improvement of this resource can improve the quality of the lumber harvested and supplement our energy needs.

Cordwood, pellets and chips are sources of biomass that are most readily available. When considering using these as a heat source, availability, cost, storage and handling need to be evaluated. A good starting point is to consider how much heat it will take to keep the greenhouse warm.

A modern, well-constructed, energy efficient greenhouse located in the central to northern part of the nation will require about 75,000 Btu/sq. ft. of floor area if heated to 60°F all winter. A 10,000 sq ft greenhouse will require about 750 million Btu (MBtu). Table 1 gives the fuel quantities and approximate cost for heating this greenhouse. It also provides formulas so that you can compare the cost of the different fuels based on the price in your area. Biomass fuels are comparable to natural gas but much less expensive than propane or fuel oil.

Table 1. Approximate fuel needs and estimated fuel cost for heating a 10,000 sq ft greenhouse*

<u>Fuel</u>	<u>Quantity of fuel needed</u>	<u>Unit price</u>	<u>Cost</u>	<u>Formula for estimating cost/MBtu**</u>
Natural gas	16,120 ccf	\$1.10/ccf	\$17,132	MBtu = \$/ccf x 13.3
Propane	17,950 gal.	\$1.75/gal	\$31,413	MBtu = \$/gal x 14.4
Fuel oil	11,860 gal	\$2.50/gal	\$29,650	MBtu = \$/gal x 9.6
Cord wood	83 cords	\$125/cord	\$10,375	MBtu = \$/cord ÷ 12
Wood chips	593 cu yds	\$15/cu yd***	\$ 8,895	MBtu = \$/cu yd ÷ 1.5
Wood pellets	101 tons	\$180/ton	\$18,180	MBtu = \$/ton ÷ 12.8

*for a greenhouse located in the central to northern part of the U.S. and heated to 60°F night temperature

**based on 75% heating system efficiency

***equivalent to \$55.50/ton

Cordwood – A cord of wood is a pile 4’ x 4’ x 8’ or 128 cubic feet. Hardwoods (oak, hickory, maple, ash) are preferred and contain about twice the heat value of softwoods (pine, spruce, hemlock). Green or fresh cut hardwood weighs about two tons per cord and contains 16 to 24 million Btu’s. If allowed to air dry for six months it will lose about 150 gallons of moisture.

Growers with a woodlot usually cut wood in the off season to keep employees busy. Some growers contract with logging crews to purchase the tops of trees that have been cut for lumber. These are usually handled in log lengths with about 6 – 7 cords/truck load. In some

areas, utility tree trimming crews and arborists have large quantities of wood that they provide to growers at minimal cost.

Considerable work is involved in getting this wood into a form that will fit into the firebox of the heating system. On cold nights, the boiler usually has to be loaded in late evening and then again early in the morning. Handling 50 to 100 cords of wood several times before it gets burned provides plenty of exercise.

Wood chips – To reduce the labor involved with burning wood, chips may be a good alternative. Chips are usually sold by the cubic yard or ton. They are produced in the woods as whole tree chips, at the sawmill or woodworking shop as mill chips or by arborists, utility companies and recycling centers as waste wood chips. Whole tree and mill chips are usually fairly uniform in size (about 1" x 2" x ½"). These feed well in chip handling equipment. Waste wood chips may contain twigs, branches, lumber and odd size pieces that tend to plug boiler feed conveyors. Some growers that get free waste wood chips run them through a sizing grinder to get them to a uniform size.

A question I frequently get is "How much land does it take to supply a wood fired boiler?" Mature forest land will contain about 2000 cubic feet of wood per acre. At 60 lbs/cu ft for hardwoods, this amounts to about 120,000 lbs/acre. At 50% moisture content for whole tree chips, the heat content is about 4,300 Btu/lb. This then gives about 516 MBtu/acre if the forest was clear cut. Our example 10,000 sq ft greenhouse that requires 750 MBtu would then consume the wood on about 1.5 acres.

Wood pellets – These are formed from ground up biomass, dried and compressed into ¼" diameter by 1' long, wood pellets and provide a convenient material that feeds easily into the burner. At 8,200 Btu/lb, wood pellets have a heat value more than double that of chips. Their moisture content is less than 10% and ash content less than 0.5%. In recent years supply has been ramped up to meet demand and many new companies have come on line.

A recent improvement in handling has been the introduction of bulk delivery. Typically bulk feed delivery trucks are used to blow pellets through a hose into bulk feed bins. The pellets are then conveyed to the boiler as needed. An alternate handling method now available is a modified super sack, similar to the bulk bags used for growing media delivery. Bulk delivery reduces the cost of pellets and the handling labor.

Fuel is only one component of supplying heat to a greenhouse. The cost of the boiler installation, operational labor and maintenance have to be added. Still with the significant savings in fuel cost, wood and biomass offer an attractive alternative as fossil fuels become more difficult to obtain and the price increases.

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