

Corn – A Home Grown Heat Source

John W. Bartok, Jr., Extension Professor Emeritus
University of Connecticut, Storrs CT 06269-4087

Corn has joined the list of popular alternatives to fossil fuels. Its high heat value, ease of handling and ready availability in some sections of the U.S. have growers looking for information on cost, handling and equipment suppliers. Although burning corn isn't for everyone, a grower that is near a good supply may find that it can reduce the heating cost significantly. Let's start with an example.

A 200,000 Btu/hr corn furnace will provide the heat for a 25' x 96' double poly greenhouse in all except the northern tier of states and will burn about ½ bushel of corn per hour. Instead of 3,200 gallons of fuel or 4,400 ccf of natural gas costing \$5,000 to \$6,000 for the heating season, the 1,100 bushels of corn will cost from \$2,500 to \$4,000.

Now for a few basic facts to help you evaluate your own situation.

Corn weighs 56 pounds/bushel and has a heat value when dried to 15% moisture content of about 7,000 Btu/lb or 300,000 Btu/bu. In other words, assuming a furnace or boiler efficiency of 75%, one bushel is equal to 2.9 gallons of #2 fuel oil, 4 ccf of natural gas or 4.4 gallons of propane.

To burn efficiently in most heating systems, corn must be dried to a moisture content of 15% or less. Moisture contents higher than that will result in mold and fungus growth that can plug augers and bins. For each 1% increase in moisture content, the heat value is reduced 90 Btu/lb for the energy needed to evaporate the extra water.

Corn should also be clean. Pieces of husk, stalk, cobs, broken corn, stones and soil can cause problems with both the feed mechanism and burner. You should specify a NO. 2 grade of corn. This has a lower quality than No.1 that costs considerably more but will usually work fine in most heating plants. If you are purchasing corn directly from the field, you can clean it yourself with a device such as a SureKleen Corn Cleaner available from GrainFarmer.com or 573/225-5039 that will clean 100 – 200 bu/hr.

Corn is available from elevators, feed mills or directly from the farm. If you have extra land available, you might consider growing it yourself or having a local farmer grow it for you. How much you need will depend on the size of your greenhouse, where your operation is located, the desired night temperature in the greenhouse and the efficiency of the furnace or boiler. To replace a known quantity of fossil fuel with corn you can use the following formulas. These are based on an average fuel use efficiency (AFUE) of 75%.

Multiply no. gallons of #2 fuel oil by 0.345 to get bushels of corn.

Multiply no. of ccf of natural gas by 0.25 to get bushels of corn.

Multiply no of gallons of propane by 0.229 to get bushels of corn.

Dividing the value you get from the above calculation by 160 bu/acre, the average in the U.S., will give you the approximate number of acres that have to be grown. For example, a 20,000 sq ft gutter-connected greenhouse used 27,600 ccf of natural gas last year. How many acres of corn should be grown to replace the natural gas? ($27,600 \text{ ccf} \times 0.25 \text{ bu/ccf} = 6,900 \text{ bu}$). To get the number of acres - ($6,900 \text{ bu} \div 160 \text{ bu/ac} = 43.1 \text{ ac}$).

Storage is important. The corn has to be in a dry environment so that it can be handled freely. Bins, tanks, trailers and buildings are commonly used for storage. One bushel requires 1.25 sq ft of storage space. 100 lbs requires 2.25 sq ft. If all of the corn needed in the above example were to be purchased and stored before the heating season, it would require a building with 8,625 cu ft or a space of 20' wide x 44' long x 8' high.

To operate properly, the furnace or boiler has to be designed to burn corn. It usually has a storage hopper that is filled by hand or conveyor depending on the size of the unit. For example, the 200,000 Btu/hr furnace mentioned above may have a 12 to 20 bu bin, enough to provide heat for 24 hours or more. The corn is fed to the firebox with an auger or other conveying device. This is powered by a variable speed gearmotor that adjusts the rate of feed and therefore the rate of firing. A blower or compressor provides the oxygen needed for combustion. Air is needed through the pile to keep the fire burning. Ashes are usually pushed over the edge of the firebox to an ashpan. Flue gases are removed with either an insulated stainless steel pipe or if the unit is designed to remove the condensate heat, a pvc pipe may be used. Most units have either a pilot light or ignition system. The manufacturer's instructions should be followed in both the installation and operation. Many units made for corn will also burn wood pellets, wheat, rye or other grains.

Corn burns clean. There is less smoke than from wood as the fuel is drier. There is also less ash, 1% as compared to about 2% for wood and 5 – 10% for coal. Corn ash has some fertilizer and lime value so it can be spread on the garden. Corn, when burned, tends to produce a hard glassy slag that can coat the inside of the burner. It also produces hard chunks of silicon dioxide (clinkers) that need to be removed otherwise they will block the fire. With bottom feed systems, they are pushed up with the ash, whereas in top feed systems they have to be removed manually. Adding oyster shells will reduce their formation.

Most of the corn burner manufacturers make stoves for the residential market. There are a limited number that make units large enough for greenhouse use. The following is a listing of some that make furnaces or boilers larger than 200,000 Btu/hr:

Alternate Energy Products, Smithville OH – 330/669-2881 – www.cornStoves.com
Carroll Construction Co., Sears MI – 989/382-5650 – www.thecornburner.com
Heatmor, Warroad MN – 800/83407552 – www.heatmor.com
Ja-Ran Enterprises, Inc., Lexington MI - 810/359-7985 – www.ja-ran.com
Jackson Lumber Harvester Co., Inc. – Mondovi WI - www.jacksonlbrharvester.com
Pro-Fab Industries, Inc., Manitoba Canada – 204/364-2211 – www.profab.org
Pinnacle Stove Sales, Inc., Quesnel BC Canada – 250/992-5050 – www.pinnaclestove.com
Universal Grain Burner, Plymouth WI – 877/339-0061 – www.americanroyal.net
Year-a-round Corporation, Mankato MN – 800/418-9390 – www.year-a-round.com

Corn is a renewable fuel that can be an economical alternative where it is readily available. Compare the cost of the corn with the cost of your present fuel and factor in the cost of the burner and the extra labor for handling the corn and the ashes.