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A number of manufacturers now make stoves which will burn shelled corn. Although similar to wood stoves, these new stoves have been specifically designed to burn a dry granular fuel, such as shelled corn. Corn burning stoves usually have a combustion air fan and a fuel stoker, both of which are not common in standard wood stove construction.

Why burn corn?

In Ontario we have an abundant source of dry shelled corn. The corn used as a fuel in stoves does not have to be Grade No. 1, but can be of lower quality. There are however two requirements of this corn fuel:

1. The shelled corn must be dry, preferably 15% moisture content or less. Corn which is higher in moisture will have a lower heat value per unit weight than "dry" corn. Moist corn may also cause flow problems through the fuel loading auger.

2. The shelled corn must be free of fines. Dirty corn which has a lot of fines and cob pieces will cause problems with the fuel loading auger.

The storage, moving and handling of grain corn has evolved to a point where there are very few unknowns. Every year farmers harvest, dry, convey, and store millions of bushels of corn. The equipment to do all these things is readily available. Consequently putting a corn storage system together for a home heating set up is possible with augers, conveyors and storage bins which are readily available.

Two reasons it is so attractive as a heat source are that dry shelled corn is so easily handled and in plentiful supply. Shelled corn also has a high heat energy per unit weight. Here's how shelled corn measures up to other solid fuels.

Table 1. Heat Energy of On-Farm Fuel Sources

Shelled Corn	7000 BTU/lb (16,200 kJ/kg) at 15% Moisture Content
Straw	6550 BTU/lb (15,200 kJ/kg) Air Dried
Corn Stover	7540 BTU/lb (17,500 kJ/kg) Air Dried
Wood	8000 BTU/lb (18,500 kJ/kg) Air Dried

You can see from this table that shelled corn has heat energy close to that of wood.

Basics of Corn Stoves

Corn stoves are specifically designed to burn a granular fuel. Because this fuel is metered into the burning chamber, most stoves have a storage hopper to contain a supply of fuel. In some ways corn burning stoves are very similar to pellet burning stoves. In both cases, corn and pellets are very dense. Consequently, neither of these fuels will burn readily in an open pile in a fire chamber.

To get these fuels to burn, some manufacturers use a small combustion chamber into which the corn is fed and combustion air is pumped through. The corn can be either dribbled into this combustion chamber from above, or it can be stoked into the chamber from below by means of an auger. The feed rate of this auger can be adjusted to regulate the amount of corn burned, which in turn controls the amount of heat produced. The second requirement for burning to occur is oxygen. In order to support combustion, oxygen is blown into the combustion chamber by means of a small fan. The combustion air is usually brought in from outside, not room air. This combustion chamber is actually quite small and could easily fit into a child's lunch box.

As corn burns it produces a clinker. Because of the small size of the combustion chamber the clinker should be removed daily. With practice, the removal of the clinker can be done without having to shut down and then relight the stove. A specially designed poker is used to upend the clinker, then tongs are used to remove it.

Inside the stove, a heat exchanger is used to remove heat from the flue gases and heat the room air. A fan is used to move the room air through the stove where it is warmed. This fan may also help in moving the heat further away from the stove.
A different style of corn stove also exists which does not use augers to feed in the corn or fans to provide combustion air or move heated air to the room. By careful design, these stoves will burn corn at the bottom of a hopper and radiate heat to the surrounding room. Unlike the previous type where electricity is used to stoke the fire and move the heat to the room, these stoves are not affected by electrical power outages.

The type of flue pipe required to vent the exhaust gases from the stove will depend on the design of the stove or corn burning appliance. These flue pipes can range from those commonly used in wood stoves to through-the-wall vent pipes which actually preheat the combustion air by removing heat from the flue gases. Follow the manufacturer's recommendations regarding the type of flue pipe required. It is best to keep the flue pipe as short and straight as possible (keep the number of elbows to a minimum) to maximize the stove's performance.

Types of Stoves

A number of different manufactures are presently making corn burning stoves. They are available in a variety of sizes and styles. Here are some of the configurations available:

- Stove (some can be modified as a fireplace insert)
- Space heater
- Hot air furnace
- Hot water boiler

The size of fuel hoppers also varies greatly. This hopper size can range from holding one day to ten days supply of fuel.

One thing to consider with the freestanding stove or space heaters is the surface temperature of exposed metal parts. This is especially important if there are small children in the house.

Cost of Heating with Corn

Before you can accurately compare heating with corn to other heating fuels you have to look at a number of factors. Not only is price of the fuel important, but also the heating efficiency of the heating system and the energy content of a unit of each fuel.

Here is a formula which you can use to calculate your cost per Million BTU's of useable energy. This formula takes into account all these factors:

- Cost per unit of fuel
- Energy content per unit of fuel
- Seasonal heating efficiency

Cost per Million BTU's of useable energy =

(Cost Per Unit Of Fuel x 1,000,000) ÷ (Energy Content Per Unit Of Fuel (BTU) x Seasonal Heating Efficiency)

Where: Cost per unit of fuel is in Dollars Energy Content Per Unit of Fuel in BTU's Seasonal Heating Efficiency is in decimal form ie (70% = 0.7)

Example: Lets look at an example where you are using corn at $2.50 per bushel in a stove which has a seasonal heating efficiency of 60%. What is the cost per million BTU's of useable energy?

Corn Cost = $2.50 per bushel
Energy content per bushel = 7000 BTU/lb x 56 lb/bu. = 392,000 BTU
Seasonal Heating Efficiency = 60% = .6

Dollars per Million BTU's Useable Energy =

(Cost per unit of fuel ($) x 1,000,000) ÷ (Energy Content Per Unit Of Fuel (BTU) x Seasonal Heating Efficiency)

=($2.50 x 1,000,000) ÷ (392,000 x .6)

= $10.63

Therefore to supply one million BTU's of heat to the house costs $10.63 when this stove operates at 60% efficiency, burning corn at $2.50 per bushel. The average older home requires approximately 100 million BTU's of useable energy per year. When you do the calculations for your situation, keep in mind that the price charged per bushel of corn may vary from the market price when small quantities are purchased. Check the prices carefully before doing these calculations.

Table 2. Heat Content and Heating Efficiency of Various Fuels

Fuel Type	Energy Content per Unit	Seasonal Heating Efficiency
Shelled Corn	7000 BTU/lb. (16,200 kJ/kg)	70% - 85%
56 lb./Bushel	392,000 BTU/56 Pound Bushel	
48 lb./Bushel	336,000 BTU/48 Pound Bushel	
Furnace Oil	36,700 BTU/L (38,700 kJ/L)	70% - 85%
Propane	25,300 BTU/L (26,900 kJ/L)	70% - 85%
Natural Gas	35,700 BTU/M3 (37,700 kJ/M3)	70% - 85%
Electricity-Resistance	3413 BTU/KWh (3600 kJ/kwh)	100%
Air Source Heat Pump	C.O.P. = 2.75	275%
Water Source H.P.	C.O.P. = 4.0	400%
Wood	8000 BTU/lb. (18,500 kJ/kg)	60%

Limitations of Burning Corn for Heat

Possibly the first and most important limitation of corn as a fuel is the stove itself. If the stove uses augers to feed the corn into the combustion chamber and fans to maintain combustion and move heated air to the room then an electrical power interruption will shut the stove down. Very simply with this style of stove, no electrical power means no heat from your corn stove. Some stoves require a manual reset after a power interruption, as a safety feature.

Second, since most house layouts do not allow the free movement of air through the house, a centrally located stove will not heat the whole house. If this is your case, size the stove to heat the room where the stove is located. Oversizing the stove will result in the room housing the stove becoming unbearably hot.

Stove Buying Criteria

When purchasing a corn stove there are some questions which you should answer:

1. (What is the heat output of the stove? Do you know how much heat you require to maintain the heated space at the desired temperature?
2. If you are trying to heat your whole house with a stove or space heater, does the house layout allow for the convective movement of heat through the whole house? Most newer houses are not built to allow convective air movement.
3. What is the size of the fuel hopper? Will it require filling on a daily, weekly or biweekly schedule?
4. What is the seasonal heating efficiency of the corn stove?
5. Does the unit meet UL and CSA standards?
6. Does the unit have hot exposed surfaces which could cause burns to skin?
7. What type of exhaust venting is required? Does it require a chimney with a flue liner or can a combination flue/fresh air vent pipe be used?
8. Are you prepared to clean out the clinker daily and clean the heat exchanger of ash on a weekly basis?
9. Will the stove handle granular solid fuels other than shelled corn? This is important in the event that the economics of burning corn become unattractive or an alternative low cost pelleted fuel becomes available.
10. Will this corn burning appliance be a primary heat source or act as a supplementary heat source? Stoves with small fuel hoppers will not keep a house warm for long periods of time, unattended.
11. How will corn be stored for winter operation?

Why heat your home with a Pinnacle Pellet Stove?

Biomass technologies use renewable biomass resources to produce an array of energy related products including electricity, liquid, solid, and gaseous fuels, heat, chemicals, and other materials. Bio-energy ranks second (to hydropower) in renewable U.S. primary energy production and accounts for three percent of the primary energy production in the United States. (U.S. Department of Energy)

- It took more than 4 million years to create fossil fuels, oil, gas and coal.
- It takes 40 years to grow mature trees.
- It takes only 4 months to grow a crop of grain.

PINNACLE CORN BURNING HEATERS, AN ALTERNATE ENERGY SOURCE THAT YOU AND THE ENVIRONMENT CAN LIVE WITH ... COMFORTABLY.

- They burn 20% HOTTER than wood WITHOUT all the smoky smell, messy clean up, lighting problems, and overall effort to keep burning!!!

- You will be ABSOLUTELY AMAZED at how EASY Pinnacle Corn Stoves are to use!!!

- They are simple to light, and with our optional patent pending Energy BOOST System, you can heat your home for up to 48 HOURS WITHOUT LIFTING A FINGER!!!

- All you have to do is pour the corn kernels in the hopper and FORGET ABOUT IT!!! It doesn't get any EASIER!!!

- Clean up is also a BREEZE!!! Since PINNACLE Corn Stoves burn MORE EFFICIENTLY than wood stoves or pellet stoves, what little ashes are left can fit in a coffee mug!!!

- These corn burning heating stoves are truly the MIRACLE HEATING SYSTEMS of the NEW MILLENNIUM!!!

- Burning shelled corn as a fuel can be a feasible way of dealing with the high prices of more conventional fuels such as fuel oil, propane, natural gas, coal, and firewood. Utilizing corn as a fuel does not compete with the food supply needed for nourishment throughout the world. While it is recognized that malnutrition is a serious global problem, the world is not experiencing a food production problem. Instead the world faces political challenges associated with providing infrastructure systems for food distribution and storage.