

## Heating A Greenhouse with Wood Pellets and Corn

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**Summary:** Intervale Community Farm installed a 165,000 BTU biomass furnace in our transplant house in 2009. While initially we had some kinks and technical problems, ultimately it has become a predictable heat source that allows us to rely on biomass for about 80% of our heating needs in the March-May season. We burn both corn and wood pellets, each of which has its advantages and disadvantages. Overall, the cost of the unit, fuel, and labor are pretty close to that of propane at the prices we pay for fuels. The primary benefit of the furnace is that it has allowed us to move to a more sustainable and locally-derived fuel source; the primary disadvantage is more time, fussing, and less reliability than our propane furnaces.

**Why Biomass?** We moved to biomass heat after receiving the results of an analysis of the farm's energy use. Looking at the results, we found that a huge percentage 40% +/- went to one activity, heating the transplant greenhouse. At the time we were running biodiesel in our tractors, and were looking to use more sustainable sources of energy. We also had been feeling the upward trend in propane prices, and noticing that all of the info out there suggested that both wood pellets and shelled corn were commonly available at a much lower cost per BTU.

With those two considerations in mind, the biomass greenhouse heat seemed like a good option, and was made more attractive by a cost-share program through UVM Extension.

**Hardware:** Our greenhouse is a fairly standard 30'x96' pipe frame inflated poly structure, which we typically start up in early March and shut down the heaters at the end of May.

We installed an LDJ 620-10 Amaiz-ing Heat 165,000 BTU biomass furnace, on recommendation of other growers and technical professionals. At the time, the LDJ was the least expensive and easiest-to-use option readily available that other growers had some experience with. Ours is a natural draft unit designed for residential use, which we sited at one end of the greenhouse. Double and triple wall 6" metal chimney pipes straight up through the roof.

On the good advice of another grower, we removed only one of our two 175,000 BTU propane unit heaters when we installed the LDJ. While we knew we'd need the extra BTU capacity provided by a second heater during cold nights, we didn't realize we'd want the propane as a backup for warmer conditions.

**Cost:** The LDJ furnace itself cost around \$4600, with about \$400 in electrical and \$1500 in chimney pipe and fittings. The chimney would have been \$300-400 cheaper if I hadn't done it a first time with single wall pipe and then had to replace it. We spent another \$300 a couple of years later to purchase a beefier auger that the company made to better handle the load of nearly continuous burning, something not designed into the residential unit. The original auger twisted in half one cold night in April. It appears that LDJ units aren't wildly more expensive now; web listings have them around \$4900 plus freight. Wood pellets run \$275-310 per ton in bags, corn for us is \$300/ton in bags.

**Fuel:** Corn is often a little cheaper than wood pellets, and with a higher BTU per ton, so we get a bit more heat out of the furnace when we burn corn. We also have a great local farmer that is Johnny on the spot to deliver us fuel. The down side of corn is that it doesn't combust as cleanly and we get major clinker buildup in the burn pot that must be cleaned out regularly or the air channels plug up and combustion and heat output suffer.

Wood pellets, on the other hand, are usually a little more expensive than corn, and do not produce as much heat per ton, therefore reducing the total heat output of the furnace. They also are more prone to poor handling, leading to disintegrating pellets and combustion problems. The up side of wood pellets is that they don't produce clinkers, though they can produce a fair amount of ash if the quality is poor or the moisture level is high. Pellets are likely to be around in good supply through many heating dealers, based on the proliferation of residential systems.

Our current practice is to blend the fuels, 2/3 corn, 1/3 pellets. With our small scale of using 6-8 tons annually and filling the bin by hand each night, this isn't much additional work for us, and the burn performance is great. We find that we get the higher output of the corn (albeit less than pure corn), with the lower clinker and combustion complications of the wood pellets.

We found, as predicted by others, that better fuel equals better performance in the furnace. Our first year we were plagued by chimney problems. After working those out, we found we also had purchased a bad batch of pellets with an inordinate level of fines which were plugging up the augers, causing stacking in the hopper, and leading to poor burn performance. Now we pay more attention to high quality pellets and corn and are much more satisfied.

### **Considerations & Configuration, and how the unit works for us:**

Biomass (our version of it) can be tricky to manage during oscillating warm and cold weather, like a variably cloudy-sunny day in mid-later spring. We've found it better to shut down the LDJ for the day and use the propane in the event we need it. Otherwise we have lots of weird combustion, smoke, and sometime exhaust in the greenhouse.

We find that we need to clean the unit out in the burn chamber every 24 hours, or else the ash and/or clinkers build up to a point where they begin to interfere with combustion and operation.

Roof penetration for the chimney is a problem through an inflated poly roof. We have tinkered with and improved it, but still have dripping during heavy rains. It is probably worth it to put a rigid polycarbonate panel over a bigger section of the frame and route the chimney through that. LDJ now makes a power vented unit; this would likely be a better option, though one would need to be careful about how the exhaust would mesh with the intake louvers on a mechanical vent system.

### **Key Points:**

- Biomass may be cheaper in the long run if you burn a lot of fuel because you have a long heating season, a lot of volume, or aim for high temperatures. Obviously, fuel prices matter.
- Biomass is likely to require a lot more hands-on work of the tinkering or fussing variety, unless you have a very automated (i.e. expensive) unit.
- Good quality fuel will result in better performance.
- Biomass systems will occupy more space than petroleum heaters; in our case we have given up interior greenhouse space for the LDJ, feed hopper, and fuel storage.
- Be prepared to tinker with the biomass unit and greenhouse HVAC to make it work.