

**On-Farm Energy Case Study
Waste Vegetable Oil for Heating Greenhouses
Old Athens Farm – Westminster, Vermont**

Mike Collins and his wife Rebecca Nixon own and operate Old Athens Farm, located in southeastern Vermont. Fresh market organic vegetable and berries are grown on 2 acres, and their 10,000 sq. ft. of greenhouses produce tomatoes, cucumbers, lettuce, eggplant, and other crops. Sales are to local farmers markets and wholesale accounts.



The three greenhouses require heating from late winter through late spring, at different times depending on the crops they hold. In the past, over 3,000 gallons of number 2 heating oil was required, but over the years Mike has worked to reduce his heating costs by installing alternative energy systems, including a homemade wood boiler. In 2005 he started using waste vegetable oil as a fuel and by 2008 it was his primary heat source, and he burned approximately 4,000 gallons.



In 2005, Mike purchased two Clean Burn CB 3500 waste oil furnaces (www.cleanburn.com) for about \$5,000 each from Sandri Oil (www.sandrisunoco.com) in Greenfield, MA. These units retail for about \$7,600 now. They are rated at 350,000 Btus maximum and are designed to burn waste motor oil but have performed satisfactorily with waste vegetable oil, although they require frequent maintenance to keep them running consistently.

“If you get one of these units I wouldn’t throw out your old heater,” says Mike, “You might need it as a back up.” Installing the units cost about \$1,000 each for the plenum to distribute the hot air, the stove pipe stack, copper fuel line, and fittings.

After he collects the waste vegetable oil from local restaurants, mostly in 5-gallon plastic jugs, Mike pours it into 275-gallon plastic totes and allows it to settle outdoors. Later he pumps oil from the top of these totes into 55-gallon drums, leaving behind the sludge that can cause problems in the heating system. These drums are later moved inside and the oil is allowed to settle once again before being pumped into the 275-gallon ‘end tank’ that feeds the furnace. The sludge is burned in Mike’s wood-fired boiler that is used to provide ground-heat.



The Clean Burn system delivers oil under pressure from the tank to the burner, unlike conventional fuel oil furnaces. A pump sucks on top of the end tank sucks up oil and pushes it at 8.5 psi through the fuel line to the furnace. There is a screen on the pick-up, then a stainless steel filter, and another filter in the pump. Mike says some sludge still comes through the line once in a while. He cleans the filters about twice a year; more often if any waste oil is poured directly into the end tank without settling. A vacuum gauge in the line after the filter tells if it's getting clogged.

Once the oil gets to the burner, a compressor forces it through a nozzle and a spinner head that vaporizes it for combustion. A squirrel cage blower moves air into the combustion chamber and provides a forced draft. You can adjust the amount of air going into the chamber and thus the flame length. "You want it about 30 inches long, all the way to the back of the burn chamber without touching the back of it" says Mike, "but you don't want the flame to sparkle with unburned material, so you might have to make it a little shorter and hotter. The manual tells you how to make these adjustments."

One problem Mike has had with these units is clogging on the inside of the burner as a result of the 'shellac' that forms from the waste vegetable oil, gunking everything up. After the system went down several times, usually in the middle of the night, Mike now performs preventative maintenance by cleaning the spinner head and nozzle every week, or after 75 hours of operation. He scrapes off the gunk with a knife and washes parts in hot water, which takes about an hour. He also keeps spare burner nozzles on hand. This has avoided sleepless nights tending the furnace, although once the pump itself failed and there was nothing he could do about that on short notice.



The nozzle and fan inside the burner tend to gunk up and must be cleaned regularly

Most of the waste vegetable oil is collected during the growing season, as part of Mike's vegetable deliveries, so extra trips are avoided. The oil comes from restaurants within a 10 mile radius of the farm. Mike only works with restaurants that change their fryolater oil frequently, so it is relatively clean, and that use unhydrogenated oil, so it remains a liquid at relatively cold temperatures, down into the 20's F. However, when the oil is that cold it is dense, so an electric barrel heater is needed in order to move it around. The oil to be fed into the heater must stored be inside so it is warm enough to flow easily. Mike keeps about 900 gallons of oil inside during the heating season.

Collection of the waste oil takes about 100 hours of additional labor and management per year. The heaters require about 2 hours of maintenance each week during the peak heating season. This results in extra labor costs between \$1,000 and \$2,000 annually depending on hourly labor rate. "Right now I don't have to pay for the oil, but I figure it costs me about 50 cents a gallon to handle it, and another 50 cents a gallon in system maintenance."

Assuming that the waste oil costs \$1/gallon to deal with, and that it replaced 3,000 gallons of fuel oil, Mike's savings in winter 2005-06 was about \$3,600 compared to paying \$2.20/gallon for No. 2 oil. In winter 2007-08, with the cost of fuel oil at \$4.00/gallon, the savings was about \$9,000. The additional cost of the oil furnaces also has to be considered, amortized over their life expectancy of more than 10 years, but "the payback is pretty quick" says Mike.

The wood-fired boiler that's used to provide hot water for heating the soil can also be used to heat a couple of the greenhouses in an emergency. In addition, Mike keeps a back-up fuel oil furnace in another greenhouse.

One constraint to this system is the limited availability of high quality waste vegetable oil in many communities. Mike works closely with just a few small family restaurants, and they are dedicated to managing and saving their oil for him to use as fuel, in part because of their good relationship as buyers of his produce. In the beginning though, restaurants have to be trained about the quality and handling of waste vegetable oil to be used as fuel.

"This system is worth it for me because I have a reliable supply of good oil based on solid relationships" says Mike. "But you need to think twice about it because the supply is limited and demand is growing. Grease-car hippies and others are after it. It's pretty depressing when you go to pick up your oil and someone's stolen it."

Vern Grubinger 10-20-08