On-Farm Energy Case Study
Outdoor Wood Boiler for Greenhouse and Farmstead Heat
Blais Farm – Springfield, VT

David and Jennifer Blais grow 38 acres of vegetables, strawberries, flowers and herbs along the Connecticut River in Springfield, Vermont. They market through their farm stand and to nearby supermarkets, other farmstands, and a wholesale distributor. Blais Farm has four plastic-covered quonset-type greenhouses used for bedding plant and greenhouse tomato production, totaling 8,000 square feet. Since 2003, these structures as well as a 600 square foot barn (used for equipment storage and vegetable packing) and a 1,200 square foot home have been heated with an outdoor wood boiler (OWB). Prior to that, they used about 2,500 gallons of #2 heating oil annually to heat these structures.

Outdoor wood boilers burn firewood and are located outside of the structures they are heating. The formal name for an OWB is "outdoor wood-fired hydronic heating appliance." They are also known as outdoor wood furnaces and water stoves. Conventional OWBs consist of a firebox surrounded by a water jacket, a weatherproof cabinet and a short smokestack.

The outdoor wood boiler at Blais Farm is from Central Boiler, Greenbush, MN (www.centralboiler.com). It is one of largest models they make, the Classic CL7260, with a 764-gallon water reservoir and a firebox that measures 72x60x40 inches. It is located well away from the house and road, at the edge of a field by the greenhouses. Insulated underground pipe carries hot water from the furnace to the various structures and into heat exchangers that release the heat.

A system of valves and circulator pumps is used to create 'zones' that direct the hot water to the locations where heat is needed. The house and barn is one zone, and the greenhouses are another, which is then split up into sub-zones to separate the hot water flowing to them. The first greenhouse is started around March 1st, the other are not heated until April 1st. The OWB has automatic controls that regulate the air flow and operation of the optional blower. David programs the water temperature to the hottest level, 195 degrees F, when operating the greenhouses, to provide sufficient heat.

During the height of the heating season, the OWB burns a cord a night on the coldest nights. David loads the boiler full with 1/3 cord of wood at about 4 pm, then again at 10 pm, and once more at about 2 am. Fortunately this does not go on for too long. “You get a little ugly when you don’t sleep at night” says David.

The boiler cost about $9,000 and the total system cost was $25,000. David bought the system from a local OWB distributor who was not able to provide much technical assistance, so he had to design his system and install it himself, working with a local plumber. They made a series of changes to the system over time to make it work better. “It was ‘farmed-up’ so it still needs improvement” says David.

Hot water from the OWB is delivered to heat exchangers in the greenhouses.

In hindsight, David would have used a better-insulated underground pipe even though it costs more. He used pipe with an R-40 insulation value from the furnace to the greenhouse, and that works well, but the pipe that runs from the furnace to the house is only R-12, and that results in a 20-degree drop in water temperature over that run. The heat loss from that R-12 pipe sometimes melts snow at ground level even though the pipe is buried 4 feet deep. David plans to dig up that pipe and replace it.

Other improvements to his system would be larger circulating pumps to move the hot water more effectively, and a better system of heat exchangers in the greenhouses.

Because David works a logger in the winter, he has access to low-cost wood as scraps left over from his logging jobs or unwanted logs purchased directly from landowners for $10-$20 cord. Otherwise he has to buy logs, which have increased in price a lot in recent years. When he bought the OWB several years ago, a truckload of logs, about 7 to 8 cords, was $400-$500; now the cost is about $1,200. David has what is needed to process his low-cost logs into fuel, including a skidder, log splitter, chain saws, dump truck, and some extra farm labor. He uses 40 to 50 cords of wood a year in the OWB.

David feels that his OWB burns pretty clean because he runs it hot, and he tends to burns a 50/50 mixture of hardwood and softwood. The unit smokes when it is first started up but not after that unless it is fed with green hemlock or pine. David does not like to use really dry wood because it burns too fast. According to the EPA, many older models of OWB emit high levels of fine particulates in the smoke they generate, even when operated properly.

If OWBs are used to burn wet or treated wood, scrap, or garbage, they generate even more smoke and emit additional toxic chemicals. Short chimneys and reduced draft of OWBs can also cause smoky conditions near ground level. These factors raise concerns about health risks from OWBs. As a result, many states have regulations associated with OWB use, so be sure to check with your state before buying and installing an OWB.

A standard method to test and evaluate the emissions and efficiency of OWBs was established in 2007 by the U.S. EPA, and many new boilers have been designed to burn more clean and efficient. Outdoor wood boilers with emissions equal to or less than 0.60 pounds of particulate per 1 million Btu of fuel burned qualify for the EPA Outdoor Wood-Fired Heater program, see www.epa.gov/woodheaters.

When the system was first installed, heating oil cost $2.20/gallon, so 2500 gallons cost $5,500. Estimating David's wood cost at $50/cord in materials and labor, and assuming 50 cords were consumed, his annual fuel savings was $3,000. At that rate the payback was just over 8 years on the OWB heating system. This past year, heating oil cost $4/gallon, so David's annual fuel savings was $7,000. Payback on the heating system would be 3 ½ years at that price.

"This system is not the future," says David, "it's a band-aid until something better comes along. But it's helped keep us in business. I wouldn't do this if I didn't have a skidder, the bobcat do the logging jobs. And I'm not sure I want to be splitting 40 cords of wood and feeding the boiler when I'm 70 years old!"

Vern Grubinger, 10-24-08