OSE Progress Report for 2005-2006

version 1.1

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Abstract: We are forming an enterprise community focusing on open source technology for sustainable living. Part A is a review of OSE's first season at our land-based facility in Osborn, MO. The facility is leased and operated by Marcin and Brittany. Corresponding future direction based on the experience gained is described in Part B.

Part A: Past Work

Built Environment: The present facility consists of greenhouse space, living quarters, workshop, chicken house, and sprouting facility. This is shown in Figure 1.

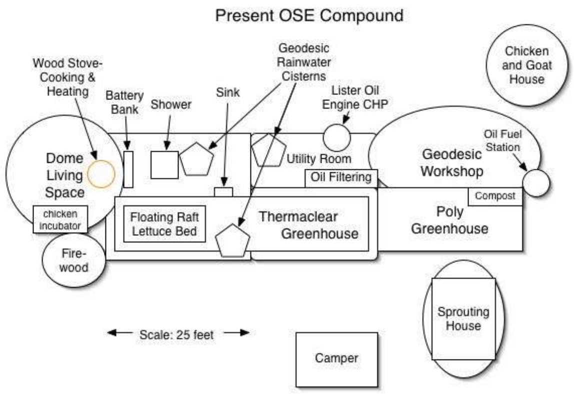

Figure 1. Diagram of the present OSE compound.

Our compound consists of a roundwood poly greenhouse, shown under construction in Figure 2. It is difficult to cover such an irregular structure. Lathing strips were eventually screwed down over the poly, and this is capable of withstanding 60 mile per hour winds that occur here several times per year.

Figure 2. Greenhouse under construction.

The rest of our non-greenhouse building focused on geodesic-like domes made from scrap pallet lumber. Triangles were made, and a dome was screwed together using only one size of construction member. This was done for the living space, chicken house, and 25 foot long workshop. Resulting structures could support people walking on the roof, the structure itself served as scaffolding, and the process is not physically demanding. For reliable water proofing, polyethylene and carpet was used to cover the frame, and the carpet was weighed down at ground level. Figures 3 and 4 show the workshop and living dome under construction.

Figure 3. Workshop under construction.

Figure 4. Living dome under construction.

Thermoclear[1] was used for another 50 foot long, modified A-frame greenhouse. We are pleased with the Thermoclear, even though it cost $1.75/sq foot after shipping. It is durable, such that it withstood brussels-size hail without problem. Figure 5 shows the Thermoclear structure before completion.

All together, the insulated living dome and stove provided comfort in the winter, without any leakage problems at the time. Figure 6 shows a comparison of the built environment in winter and summer.

__Energy__: We are currently fully powered off the electrical grid. We obtain sufficient power for computers and lights from two 85 watt solar panels, seen in Figure 7.

Figure 5. Thermoclear greenhouse structures.

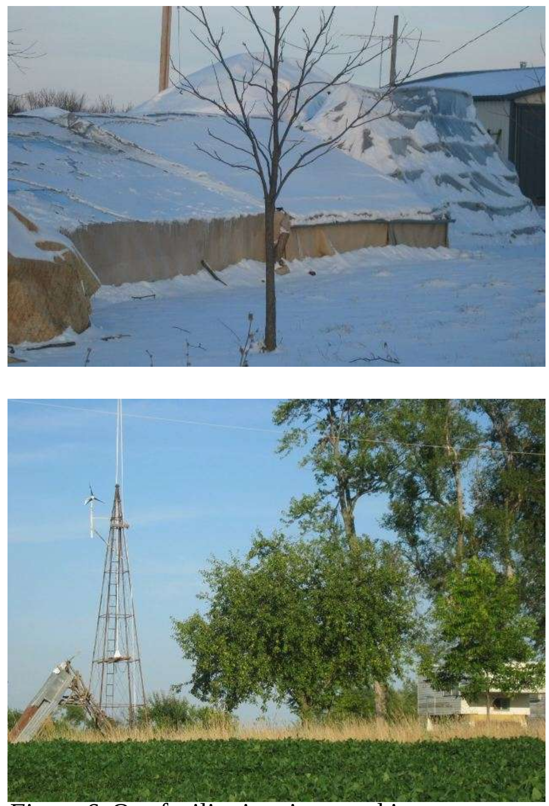

Figure 6. Our facility in winter and in summer.

Figure 7. We use two 85 watt panels for lights and computers.

Workshop equipment and all other devices are powered by a Lister 6 horsepower, 1 cylinder diesel engine with a 3 kW electric generator head, shown in Figure 8. This manual start system works well with filtered waste vegetable oil fuel.

Figure 8. The Lister 6 hp, 1 cylinder diesel engine, with waste vegetable oil delivery system.

This system cost $1600 on eBay and will likely last for the next 100 years with minimal service. The greatest challenge in setup was bolting the 800 pound device to a concrete slab. In the winter we had an electric fuel line switcher, which switched the fuel from diesel to vegetable oil as soon as the engine turned on. We managed to start the engine directly on vegetable oil when the temperature was as low as 50 degrees F, though will great effort. The engine starts easily directly on oil when the temperature is 70 degrees.

The solar cells and the Lister are connected to our battery bank, shown in Figure 9.

Figure 9. Twelve volt battery bank with reserve capacity of approximately 900 amp hours (~9 kWhr). Standard 40 amp automotive battery charger is in the back. The long structure above the batteries is a homemade voltage switcher from 12 to 120 volts DC.

When the sun shines, the batteries are charging constantly. Whenever the Lister is on, it goes through a commercial battery charger (Chicago Tools from Harbor Freight, $79). We can run our chain saw, circular saw, power drill, metal cutoff saw, and floor drill without a problem using the Lister directly. We use a 120 volt, 2 kW inverter with our batteries to generate AC electricity from our batteries. All the devices above work well with the inverter (Figure 10), except for the metal cutoff saw, which overloads our inverter.

Figure 10. 2 kW inverter from Harbor Freight, $149.

We currently have a basic oil filtering setup shown in Figure 11.

Figure 11. Basic oil filtering setup, showing the settling tank with two outlets, filter, and visor tube for checking oil quality.

The key is multi-week settling of the waste vegetable oil to allow the separation of contaminants, followed by filtering with a 10 and 2 micron woven cotton filter element.

We use an Air 403 high speed wind turbine until it broke in a two-day windstorm. The formerly working turbine is shown in Figure 12.

Figure 12. The Air 403 wind turbine.

Transportation: The Chevy 1983 6.2L Diesel Suburban has been converted to straight vegetable oil operation. The 6.2 liter injection pump broke twice already. We reinstalled it from a junkyard find for $50 plus 3 days of our time the first time. We bought the second one from Craig's List[2] for $70 and had a super mechanic install it for $50. We now know that the 6.2L rotary injector pump makes the 6.2L diesel engine a poor choice for vegetable oil conversion due to its intolerance to higher fuel viscosity. The pump's drive shaft snapped in half in our case. The pump that we took out is shown in Figure 13.

Figure 13. Original 6.2L diesel injection pump.

We decided that we will operate the Suburban only if the weather is 70 degrees F or higher if we want to be powered by straight vegetable oil:

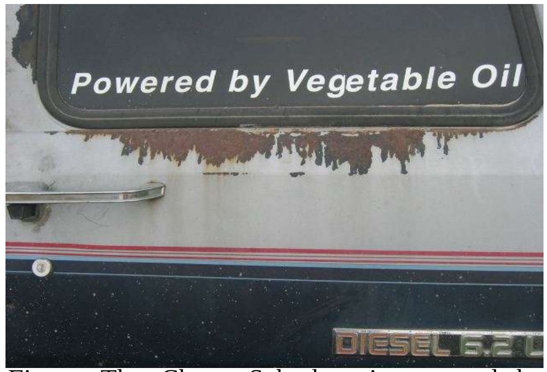

Figure. The Chevy Suburban is powered by vegetable oil.

Our present vegetable oil system consists of a priming pump mounted on our second tank (Figure 14) , an in-line electric heater, a Webb filter-heater and fuel switching valve (Figure 15).

Figure 14. Priming pump mounted on the vegetable oil tank.

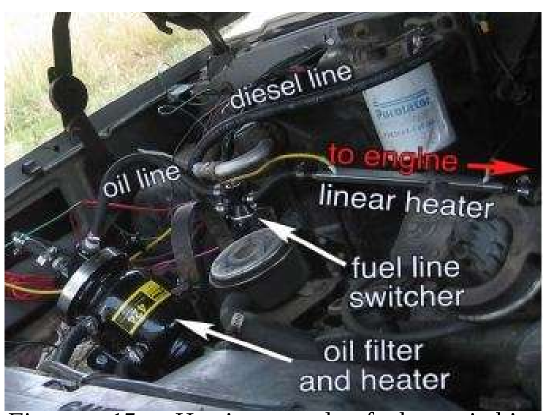

Figure 15. Heating and fuel switching components of the vegetable oil conversion.

Our most common form of transportation remains the Bajaj Legend scooter, which we call the Black Phantom, shown in Figure 16. At this point, one mirror snapped off, the alternator shaft snapped and was fixed for $400, speedometer and odometer went out, and the entire electrical system went out so that we use the kick start instead of electronic ignition.

Figure 16. The Bajaj Legend scooter.

We went so far as to put a hitch ball on it. We built a trailer for the hybrid electric VW Beetle conversion that we are currently working on, and the same trailer, shown in Figure 17, may be used with the Bajaj. It was used successfully on back roads to fetch oxygen cylinders for oxy-acetylene cutting.

Figure 17. Power trailer frame for the VW Beetle hybrid electric vehicle conversion.

The 1969 VW Beetle conversion is in progress. The motor is in the form of a modular, framed unit that will be used interchangeably with the Beetle and our forthcoming utility tractor. At present, the Advanced DC 12 kW continuous, 54 kW maximum, motor[3] is mounted on the transmission of the Beetle (Figure 18).

Figure 18. Advanced DC L91-4003 motor mounted on the VW Bug.

We have experimented with capacitative current limiting control of the motor with a 6.6 kW continuous generator, but found that the capacitors, shown in Figure 19, were too small because of the low efficiency of the motor at a power below 6 kW. The generator, shown in Figure 20, is from China, and its voltage regulator broke for the second time. We decided to give up on such a disposable generator.

Figure 19. Capacitors used in initial testing of the electric motor.

Figure 20. Generator used in initial testing of the electric motor.

Water Resources: We were connected to city water until the pipes froze in winter. We will not be reestablishing the connection because of the pollution in the water. Currently, we are using stored water from our cisterns, and limited quantities come from rainwater collection, shown in Figure 21.

Figure 21. Rainwater collection cisterns.

Food: We currently produce our own eggs, goat milk, feta cheese, kefir, sprouts, and mesclun mix. We also cooperate with the Bread of Life Bakery[4] for our bread supply.

We built an incubator, shown in Figure 22:

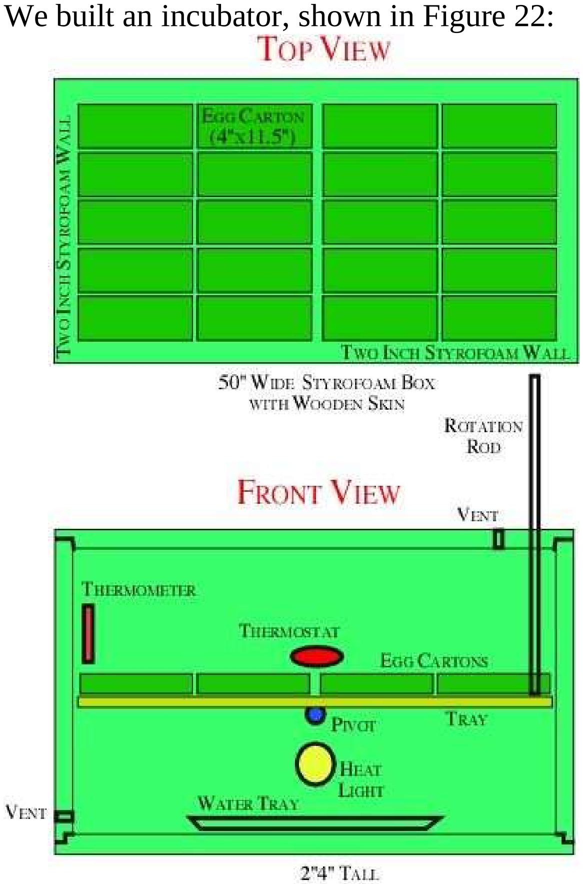

Figure 22. Chicken incubator with 240 egg capacity.

The trays are mounted on a central pivot, and the pivot is moved three times daily for 18 days, from which point the eggs are moved into the hatching area at the bottom of the incubator. Some hatchlings are shown in Figure 23.

Figure 23. Seven new pips.

The incubator has a standard incubator thermostat, which turns on 75 watts of light bulbs and a 12 watt blower simultaneously for heating and air circulation.

We have 20 hens, 2 roosters, 75 baby chicks, and 1 milk goat. The goat (Figure 24) produces 1 gallon of milk per day.

Figure 24. The milk goat.

We grow sprouts in trays lined with linen cloth. After 1 day of soaking and 6 days of growing, the sprouts look like those shown in Figure 25.

Figure 25. Alfalfa sprouts.

We started a hydroponic lettuce production[5] in the fall of 2005. Lettuce was started in 2x3 foot tubs in perlite, shown in Figure 26.

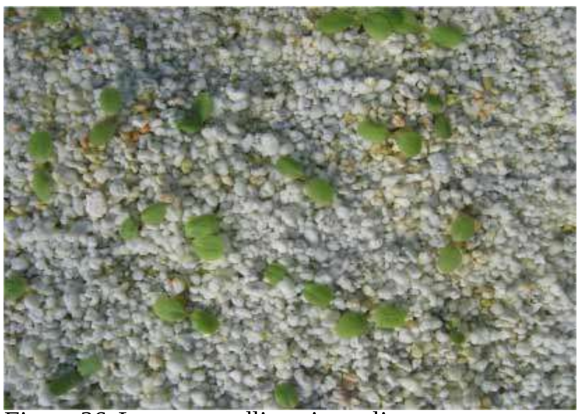

Figure 26. Lettuce seedlings in perlite.

The seedlings were transplanted after 10 days onto floating rafts and placed in tubs of water:

Figure 27. Lettuce transplants onto floating styrofoam rafts.

After 4 weeks, the same raft looks like those shown in Figure 28.

Figure 28. Floating raft hydroponic lettuce after 4 weeks of growing time.

This technique is simple on a small scale. All that is required is daily aeration of the beds, manually or with an aquarium pump, and the proper mixing of the 3 chemical fertilizer components from HydroGardens.[6] The plants come out exceptionally healthy, as seen by the foliage and the fibrous, white roots:

Figure 29. Healthy root system of the hydroponic lettuce.

Growth stopped in winter, as the greenhouse was not heated and froze on sub-zero temperature nights. Frost does not kill the lettuce, we found, even when complete freezing of the plant occurred and the water started to freeze. The lettuce came back to life on warm days, though it did not grow much.

We decided to pursue lettuce growing even in subfreezing temperatures, simply by heating the water in the beds. For this, we made a 15x6 foot water trough. We made this by first rototilling, staking the perimeter, leveling the ground, and building the sides, so that we could lay down a layer of carpet and polyethylene. The bed was leakproof, though the greatest challenge was dealing with inferior quality of 6 mil poly. Some of this poly had holes due to clumping and thinning of the plastic resin in manufacture. The final bed with small transplants looked like this:

Figure 30. 15X6 foot bed with floating raft lettuce.

We heated the entire bed from initial 40s to high 70s. We made a heating system from 60 feet of 3/8 inch inner diameter type K copper tubing, which we used as a heat exchanger inside a stove. We pumped water through this exchanger, and saw a 10 degree rise in water temperature per hour. The water volume in the bed was approximately 300 gallons. This heat exchanger coil is shown in Figure 31.

Figure31. Heat exchanger coil inside a stove for warming up the lettuce bed.

The heat exchanger worked successfully, and we thought we would master growing lettuce in freezing weather simply by heating the water bed, not the air. Then we were hit with a plague of aphids. We used a manual pump sprayer with water, pepper water, and garlic water. This showed relative success, at the time expense of 20 minutes per day. Once we thought the aphids were conquered, the lettuce did not show one bit of improvement in its health. We assumed that the chemical formula must have gotten off-balance, so the entire system needs reworking. We found that floating raft hydroponic production is easy to start and maintain on the scale of individual tubs, but, but difficult at a larger scale due to pests and longer-term nutrient contamination.

Our 200 fruit tree orchard has been pruned and is starting to bloom. One tree is shown in Figure 32.

Figure 32. A peach tree in bloom.

Many of the 3 year old trees have been pruned for the open-center growing form, such as shown in Figure 33.

Figure 33. Fruit tree with open-center pruning.

We are currently putting in a 4000 square foot raised bed garden. We are using stakes to hold up a bed border made from carpet. We are subsequently filling the beds with soil and straw. The beds in progress are shown in Figure 34.

Figure 34. Garden beds and part of orchard in the background, Spring 2006.

We are currently building a sprout house. It will be a temperature controlled environment in an underground, earth bermed structure. The construction beginnings are shown in Figure 35.

Figure 35. The beginning of sprout house construction.

1 http://www.regal-plastics.com/regal/lexan/thermoclear.htm
2 http://www.craigslist.org/
3 http://www.evmotors.com.au/products/l91.html
4 http://www.ruralmissouri.org/06pages/06FebBread.html
5 http://www.sourceopen.org/wiki/?pagename=OpenSourceEcology.Hydroponics
6 http://hydro-gardens.com/