Off-Grid Farm Infrastructure

David Hastings
Waxwing Farm, Windermere, NS
3 Energy Efficient Projects at Waxwing Farm

- Coolbot powered by a photovoltaic (PV) system
- Wood-heated, thermal mass seedling bench in our greenhouse
- Solar Hot Air Food dehydrator
Solar-Powered Coolbot

Challenge:
Provide post-harvest storage of vegetables without the Grid.

How most farms do it:

• Standard compressor unit
• Coolbot
• Other: Chest-freezers, ice-packs, picnic coolers
COOLBOT™
Make your own Walk-in Cooler with a Window Air-conditioner

Store It Cold with CoolBot!
For Farmers, Florists, Meat Processors, Keg Coolers and Restaurants
Now running over 9,000 Coolers!
Keep your farm produce, flowers, fish, meat and beverages cool and fresh for money than a single repair bill on a normal walk-in cooler compressor while 30% or more in electricity

Storeitcold.com
9 ft by 9 ft cold room

Super insulated

5.5 of rigid and spray foam all the way around and floor in the summer

Cellulose insulation above the ceiling

Built on North side of house

Stores 100 bulb crates
- Added 2 PV panels
  - 270 Watts
- 540 Watts total
- Doubled battery size
- Upgraded charge controller
Cost

- $800 for Cool-bot and Air-conditioner
- $5600 for solar panels, charge controller, upgrade to newer batteries
Installed largest 110 V window air conditioner available

12000 Btu Kenmore
How did it work?

• Ran at 6ºC (44ºF) for 24 hours per week
  • Seemed cold enough for us
• Turned on when first greens were washed and ready to go in
• On until following morning when delivered
• Uses 250 W whenever running and 1000W when actively cooling
How did it work?

- If week was sunny or mostly sunny, batteries would recharge within the week.
- If there wasn't at least 3 days of sun during week, batteries would not completely recharge.

- Average energy use (June-Sept): 5 kWh/week
- Average Production: 2 kWh/day or 14 kWh/week
2 Adjustments to save energy

- Hung insulating blanket to reduce size of cold room to 2 ft x 9 ft
  - Still plenty of room for our summer needs
- Put air-conditioner on a timer at night
  - 1 hour on / 1 hour off
Conclusions

- Seemed well balanced for 1 day per week
- Very sunny summer = more solar power
- But, very warm summer = more cooling
- Could add more panels without upgrading other components
- Had hoped to use in fall to get temperature down for storage vegetables, but we haven't had much sun this fall.
Wood-heated Thermal Mass Seedling Bench

● Challenge:
  Provide consistent heat to start and grow seedlings without electricity

● How other farms do it:
  ● Electric heating coils buried in sand under bench
  ● Large air heater (often wood or oil)
24 x 12 Polycarbonate Seedling Greenhouse
Questions before we built it

- Will the stovepipe draw through a 16 ft long horizontal stovepipe?
  - Added fresh air intake
  - Can “prime” stovepipe at far end

- How close to surface should we put stovepipe to warm seedlings without cooking them?
  - Only about 2 inches below surface
  - Too close at stove end, just right at far end
How does it work?

- Can keep seedlings on bench above 18°C all night when outside temperature is below 0.
- Provides different temperature zones in greenhouse
- Doesn't provide as precise a temperature control as other methods.
- Very cheap to build. Cinder blocks and cement were only materials bought new. $200
How it can be used by others (untested ideas)

- Lengthened
  - Draws air horizontally 16 ft without problems
- 2 parallel stovepipes to increase area
Solar-Air Dehydrator

- Looking for ways to diversify offerings in the winter

- Challenge: Build food dehydrator that didn't use (much) electricity

- How others do it: small to large electric dehydrators
What we did

• Built a cabinet that holds nine 3 ft by 3 ft trays
• Connected to a Cansolair solar hot air panel
  • Panels are normally used for space-heating in winter
• Small 70 Watt fan with thermostat blows air through panel.
• Hot air flows down through cabinet and out exhaust
Beer cans painted black
Results so far

- Only built it in September so haven't used it summer when it will be most effective
- Tomatoes are hardest, possibly too much moisture for this dehydrator
  - Used in combination with electric dehydrator at neighbours
- Need multiple days of sunshine in a row
- Hot peppers worked well because not prone to rotting
- Herbs worked very well
Potential ideas (untested)

- Garlic curing with tops removed
- Popcorn
- Dry beans
- Onions for curing
- Spring crops to take advantage of long days around solstice
Dual purpose Summer/Winter

• Can mount Panel on house for winter heating and dehydrator for the summer
  • $500 Efficiency N.S. Rebate on purchase
• Can offset cost of heating squash storage in winter.
Conclusion

- Thanks to Energy Pilots Program at N.S. Dept. of Agriculture for cold storage and dehydrator funding
- Encourage organic farmers to look into energy funding
  - In Nova Scotia, it seems to be a fairly untapped source of funding to help trial ideas that might be too experimental to fund yourself.
  - Requirement is that projects be unique to the province.