Energy Reduction

According to the auditors who did our EcoEnergy Retrofit assessment, we have saved 4.7 tonnes of greenhouse gases per year by implementing their recommendations. That's great, but we need to go further than that and reduce our power demand so that we might be in a position to generate our own power needs.

There was no way we were going to be able to afford a fabulous solar/wind hybrid power generating system in order to meet our power needs. We decided to invest what we could in solar & wood hot water and heat and as for power, well we'd simply need to reduce our demand or find other ways. Perhaps if we can get our usage down very low, then a smaller wind or solar power generating plant might be within reach?

That, of course, would also have to depend upon the sustainability of any alternative power system which is actually quite tricky to achieve.

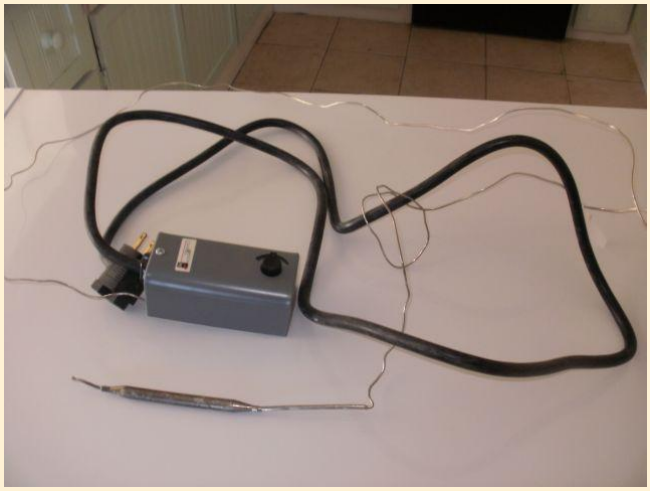
Our absolute lowest power consumption at the old house was 13 KWh per day (and to be honest, we didn't often get that low!). As you know, though, our aim in moving here was to improve on that and we've got it down to about 4 KWh per day now.

Here's some of the measures we've taken to reduce our power demand:

Eco Energy Retrofit (insulation & sealing)
Solar Heat
Solar Hot Water
Wood Heat
Wood Hot Water
Wood for cooking and boiling hot water in Winter
Woodgas for cooking and boiling hot water in Summer
Biogas for cooking an boiling hot water in Summer
Charcoal for cooking in Summer
Using cold water for laundry
Drying clothes by woodstove or outside on line
Energy efficient light bulbs
Energy Star appliances
Energy Star Windows
Switch off when not in use
Use of chest freezer adapted as a fridge
Switched off heating and hot water systems so no electrical pumps required

The only one that might require a little explanation is the chest freezer which is being used as a fridge. We use a thermocouple which plugs into the electrical outlet. The probe from the thermocouple goes inside the freezer chest. The freezer is set at it's highest setting, then plugged into the thermocouple. Then, by adjusting the dial on the thermocouple, you eventually get a desired temperature range. The freezer only 'kicks' in for about 60s every hour. This is sufficient to keep it cold enough to use as a fridge. Chest freezers are usually better insulated than fridges. They are top-opening so cold air isn't lost when the top is open (it sinks). Also not having an upright, front-opening door helps. OK, it takes a bit of getting used to using a chest freezer as a fridge, but we've got it pretty much sorted now, and it uses a tiny amount of power.

Thermocouple can be got from a home brewers shop. Beer makers often convert a freezer into a beer fridge called a 'kegerator' (now that's not a bad idea actually!) http://www.micromatic.com/draft-keg-beer/kegerator-conversion-kits-cid-785.html



We recently purchased a Kill-A-Watt device to get a clearer picture of what each appliance is using.

The converted freezer into a fridge used 100W in a 24 hour period!
The freezer used 500W in 24 hours
My laptop used 350W although I did use it a lot.

Eco Energy Retrofit

SAVED: 4.7 Tonnes of Greenhouse gases a year!!

At the time we purchased 'Red Sand Cottage' there were two schemes, one was from the Provincial Government of Prince Edward Island and the other was the Federal Government of Canada ecoENERGY Retrofit scheme.

The PEI Office of Energy Efficiency explained the various schemes to us. They told us about the federal grants and helped us to organise the audits and apply for the funding.

We applied to the Province for the scheme shortly after purchasing the property in the Fall of 2009 and had our first audit (the pre-retrofit energy evaluation) 24th Nov 2010.

The results of this audit showed our house rated 62 points on the EnerGuide scale and suggested that, if we implemented the recommendations in the report, we could increase this to 73.

To put this into perspective, the average rating for a similar type house on PEI was 63 (so we were marginally below). The highest rating achieved by the most energy-efficient houses in this category is 78.

If we implemented the recommendations we would be able to reduce the production of greenhouse gases by 4.7 tonnes per year. We had 18 months to complete the work to qualify for an ecoENERGY Retrofit homes grant.

Not only that, there were the grants available from the Federal Government which would also help.

Of course, the real savings will come from the energy savings and the improved comfort level, so we decided to go right on ahead!

Here is a summary of the recommendations in our pre-retrofit energy evaluation:

Retrofits	Federal Incentive	Potential for Energy Savings	Potential Rating Improvement
Basement/Crawl Space Insulation Increase wall insulation by a minimum of R-24 Seal all basement header area and increase basement header insulation by min R-20	$1250	***	6.8 points
Attic/Roof Insulation Increase from R11.9 to min R-50	$750	**	3.1 points
Domestic Hot Water System Install a CSA compliant solar domestic hot water system	$1250	**	1.8 points
Air Sealing Improve air tightness of house by 10% to achieve an air change rate per hour of 4.53 at a pressure of 50 Pa	$190	*	0.1 points
Heating System - replace wood burning appliance with a clean-burning model	$375	-	0
Water Conservation - replace toilets with low/dual flush	$65	-	0

There was one other recommendation, i.e. for a drain water heat recovery (DWHR) system. We had been very keen to install one of these and were most disappointed when the installers said we had insufficient basement height for the installation - a huge disappointment!

However, we went ahead with the remaining recommendations. We insulated the loft and basement and sealed/insulated electical ceiling fixtures, electrical outlets, electrical box and wire penetration, exterior pipe penetration, baseboard trims and mouldings, window frames, door frames, chimney, attic hatches & basement headers, mainly using weatherstripping and caulking together with insulation materials.

Originally, our home had a natural air change rate of 5.03 ac/h @ 50 Pa (air changes per hour). This was determined by the blower door test which also gives an Equivalent Air Leakage Area (ELA). The larger the ELA is, the leaker the house. Ours was 1157.0 square centimeters, which represented a hole of 179.3 square inches in the building envelope, equivalent to having a window of 1.2 square feet open at all times !!

When the work was finally completed, we arranged to have our second audit carried out. This confirmed that we had achieved a rating of 73 and put us in the top 5% of this group of houses. (However, since that time, we have also improved the wall insulation by R-12 and made many other modifications and no doubt will continue to do so).

- The efficient wood stove we installed wasn't a very expensive one, but that alone is capable of heating the entire bungalow. Because of the level of insulation, only a very small number of logs is required to bring the house up to temperature. Heat loss is slow.
- We have not had the oil heating system switched on since installing wood stoves. However, it could be useful if we ever need to go away in the winter time.
- We also usually use our cookstove which has been set up to heat hot water as well as cook, heat the home, dry clothes, boil the kettle, etc.
- The solar hot water works on any sunny day of the year (outside temperatures immaterial!), wood heat supplements this when there is no sun. We have used absolutely no oil or electricity to heat the water during the winter. It might be possible that we will need to supplement the solar in the summer if there is no sun but if it is too hot for a fire.

We are very grateful that the schemes existed to enable us to make these modifications to our home. It meant that we could retrofit an existing home and easily bring it to a very high energy efficient standard.

Solar Heating

This is the Solarsheat solar heater attached to a south (more or less) facing wall of the cottage.

As soon as the sun shines (and it doesn't matter how cold it is outside) the solar pv driven fan kicks in and warm air floods into the home.

We find it exceeds the manufacturers claims about how the area it is capable of heating. Along with the passive solar measures we have implemented, this can warm up the entire cottage on a sunny day.

Link: Solarsheat

Another option is the Cansolair made in Newfoundland out of recycled cans. We were very keen on it, but opted for the solarsheat because the entire unit (including fan) could be run entirely on solar energy.

As usual, you can make your own if you are suitably clever enough (we aren't!). I will try to recall some of the best links, but in the meantime do a search for DIY thermal siphon, or 'make your own solar heater' or similar and you should come up with some good options.

The solar heater is something we've saved up for over the years and only recently managed to get one installed. There are other alternatives.

For several years we managed with the Clear Dome Solar Thermal drapes (and we still intend to use them).

The fabric is dark and does have the effect of darkening a room as well as reducing the view. This photograph shows how the view is reduced, though not eliminated. However, if it is a room which is not in use during the day time this can be a useful and budget concious option. As soon as sunlight strikes this 'fabric' it heats up and heat radiates into the room.

For info on this see Clear Dome Solar

We believe it's possible to build your own solar heaters, but don't know how to do it ourselves yet!

Solar Hot Water

The solar hot water system consists of two panels and a solar pv panel which drives the pump.

During our time running a B&B we had many people using hot water in our home, usually up to 10 at a time. During the winter we usually let our rooms out to students at a nearby college, so year-round we always had a 'house-full'. We used this same solar hot water system (we've moved it here now) and we only ever needed to purchase 1/4 tank of oil a year to supplement the hot water during the warm months when we didn't have the wood furnace going. Pretty amazing since this is Atlantic Canada - we are completely happy with our solar hot water system.

It works anytime the sun shines and it doesn't matter how cold the outside temperature gets. Sunshine = hot water, even in winter.... in fact you can sometimes get more hot water in the winter as we do get a lot of sunny winter days.

Biochar

Biochar is considered to be a soil amendment which is beneficial to the soil. For more information on Biochar.

Biochar is here under the Alternative energy heading because of the method we are using to obtain it at the moment. We are making small amounts of biochar as a by-product of summer cooking.

Woodgas - Charcoal - Biochar

We are able to start with wood, cook once, create charcoal, cook again and then produce biochar. The entire process is carbon negative and also enhances the soil.

The first stage of the procedure is to use woodchips in a woodgas stove to cook and boil water. The by-product of this procedure is charcoal.

The Sampada Wood Gasifier and the Sarai Cooking System are made by Samuchit working in association with ARTI (Appropriate Rural Technology Institute).

We will be promoting the work of ARTI to visitors to our site.

So we are working with the Sampada Wood Gasifier Stove, but there are alternatives. One is to make your own and there are lots of examples of how to do this, do a search and see YouTube videos on the subject.

Another good resource and a different type of gasifier stove WoodGas Info from the Biomas Energy Foundation (BEF).

The Sampada Wood Gasifier Stove

A portable stove with 3 components:

1. Fuel Holder
2. Stove Body
3. Pot Holder

The fuel holder, made from mild steel with holes at the bottom. A central rod has holes at the top. There are legs at the bottom of the fuel holder.

This is placed firmly onto the ground and half-filled with loosely-packed wood pieces or twigs. It will hold between 1 and 1.5 kg of wood pieces. Larger biomas briquettes or pellets can also be used, although small pellets tend not to work as well because this type of stove needs good air supply around the fuel pieces.

The fuel is lit from the top using your preferred method of ignition and wait for the fire to get going.

There will be a little smoke at the outset. Once the fire is going well, the stainless steel outer cylinder (stove body) is placed carefully around the fuel holder and rests on the legs. The pot holder goes on top and it is then possible to rest the cooking pot onto the assembly.

After about 10 minutes the gasification sets in and there should be no further smoke. At this point the flames come through the top holes of the fuel holder central rod.

When the flames die down the stove body is removed, and water poured over the charcoal. When dried this can be used like ordinary charcoal.

1 kg wood burns for about 30-40 minutes.

1 kg wood produces about 250g charcoal.

This stove can be used in India to actually cook and generate an income at the same time. The cost of 1 kg of wood is Rs.2 and the value of the charcoal by product is Rs 2.5, so it's possible to make a profit of Rs 0.5 per kg wood in addition to being able to cook in an environmentally friendly and healthier way.

In our case, the charcoal is then used either in the outdoor charcoal barbecue for cooking OR used in the Sarai to cook rice, pasta, potatoes and vegetables. The by product of this process is Biochar.

The Sarai Cooking System

The Sarai Cooking System won the Ashden prize

This is the stove grate where a layer of charcoal is lit.
We have the medium size which uses 100-125g of charcoal, which is sufficient for coking a meal for 5 people.

The lid is put on the stove grate.

Three sections of cooking pots.

The food that requires the longer cooking is put into the bottom compartment.

Water goes inside the container and the lid is secured.The charcoal burns for about 45 mins, after the charcoal goes out the unit can remain sealed for a further 15 minutes to complete cooking.

A small amount of biochar is left as a by-product.

Biogas

The Biogas Digester we are using is the ARTI Biogas Plant which won the 2006 Ashden Award....

Watch a video about the ARTI Biogas Digester here

ARTI (Appropriate Rural Technology Institute)

Details in brief:

* Size: 1 m3 digester
* Capacity: upto 2 kg kitchen waste
* Quantity of gas produced: upto 1 kg biogas, capable of replacing 250 gm of LPG.

Depending on type of cooking done, either breakfast or one meal can be cooked entirely on biogas.

Using Biogas for Cooking and Lighting

Biogas Cooking Stove

Biogas Lamp