February 2014

Hi Gary:

Time sure flies. It has now been five years since Sue and I completed our deep energy retrofit of the '60s, two classroom schoolhouse. Perhaps your readership might be interested in an update on the home's performance, and lessons we may have learned?

In a nutshell, we are delighted with all aspects of the dwelling.

Livability and Comfort: One floor - no stairs and no steps. Major doorways are double wide. Ceilings are high throughout. Year round, interior temperatures are very stable, air quality is great. Natural lighting floods the interior. There are no chilly drafts, no roaring heating ducts, no banging radiators, and no growling furnace.

Wintertime Space Heating: It's super energy efficient! In a cold climate where winters of well over 7,000 HDD65 are typical (and there are always a few days in the -14 to -20 degrees F.), the total winter heating bill has been **$ 255** (the average of five recent winters). Peanuts!

The space heating spreadsheet model predicted that we would need about 60.5 million Btu of heat per winter. That sounds like a really big number, but without the insulation being more than R40 in the walls and nearly R60 in the ceiling, that number would have been bigger, even double or triple!

It was thought that about 30 million Btu might be collected with high quality triple pane windows, and 19 million Btu might be scavenged from internal gains and an HRV. This suggested that about 11.5 million Btu per year (or 3,400 kWh) would need to be supplied by purchased heating.

When designing the renovation, we examined various ways to supply this heat. We realized that electricity, fossil fuels and new hi-tech systems tended to involve escalating prices and stunning profitability, while old technology, the really old stuff, didn't wear out! People have been burning wood a very long time, and masonry heaters date back several hundred years – they must have got most of the bugs out.

With the idea of fresh baked breads, pastas, home made stews, casseroles, roasts and pizza from the bake oven - the masonry heater looked even better!

Ikea 'automatic dryer' adjacent to masonry heater.

The model predicted a net space heating need of about 3,400 kWh. Combined with a masonry heater efficiency of about 72%, this meant that the gross site heat needed to be slightly over 4,700 kWh. This is considerably less than a cord of firewood per year, and easily stored in the mudroom. Handling a lot of firewood every year can quickly lose it's shine, but, one cord is pretty trivial.

Of the 5 winters, several were rather mild in terms of temperature. That would normally suggest that purchased heating would tend to be somewhat lower. Such was not the case.

It appears that it's been slightly warmer - because it is becoming increasingly cloudier! Depending upon the winter month, one expects one day in three (or more) - to be sunny. Unfortunately, gradually over the five year period, the first half of the winter has become very cloudy, such that two sunny days per month have become pretty much the norm.

It was hoped that nearly 50% of the winter heating would come from the passive solar windows. It's not rocket science that numerous consecutive days without any sun will require almost daily firing of the masonry heater – which in turn increases the cost of purchased heating.

The latter half of the winter tends to be much sunnier. Even though it can be somewhat colder, with consecutive days of sunshine, often-times (even at 0 to 10 deg. F.), no supplemental heating is required.

Actual purchased site space heating averaged about 6,500 kWh per winter, which translates to about 4,700 kWh of actual net heat. Over 98% of that was wood, and the average wood consumption was 3,123 lbs per winter. That's still well less than a cord of firewood per year.

To put this in perspective, the 4,700 kWh is consumed over seven months (about 210 days or more). Thus the average winter heating need of the home (which is a good size of ~3130 sq. ft. exterior measure) is about 925 Watts, and seldom exceeds 3000 Watts even in mid-winter!

The five year average space heating cost of $ 255 is about 25% more than the model predicted for 2008-09. Then again $ 255 for 4,700 kWh of net heat equates to only 5.4 cents per kWh!

Had electric baseboard heaters provided this 4700 kWh, at our current average cost of $ 0.2442 per kWh, the space heating cost would have been about $ 1,150. It could be said that the masonry heater currently saves us about $ 850 per year! (and the windows and extra insulation – perhaps two thousand more!)

If a heat pump with a COP=3 had been used, the current heating need would be about $ 383 per year., a savings of about $ 765 per year. However, at current electricity prices, the entire savings may well be spent replacing the worn-out unit in about twenty years - if not earlier.

Worse still, here, electricity pricing is right out of control! Over the five years, firewood prices have increased by 2% per year, but electricity prices have increased by over 16% each year !!

While masonry heaters appear to be expensive, on-going maintenance costs are trivial, and expected life is measured

in real lifetimes – perhaps two or three! Greenhouse emissions are quite low, the fuel is essentially renewable and the bake oven is awesome!

The House in Summer: Summers here can be fairly warm. Portions of June and July can be quite hot! As the summer proceeds, excessive humidity tends to become problematic. Normally, heat and humidity are controlled with normal window cross-ventilation, and night-time flushing when humidity becomes oppressive. Quite honestly, it takes a long time for all that mass of concrete to warm up to uncomfortable temperatures. Fearing a possibility of mildew issues, we did purchase a mobile air conditioner/ dehumidifier. Over the five year period, it's been used a total of 15 days.

Let's look at Total Site Energy Consumption: Total site energy consumption (averaged over the five calendar years: 2009 to 2013) was 11,600 kWh per year. Depending upon the year, the total was as much as a thousand kilo-Watt-hours higher or lower than the average – mostly due to winter heating variation.

In terms of the various energy sources, 55% was solid fuel (wood), 40% was electricity, and 5% propane (mostly for the kitchen range). Electricity is used for lighting (almost entirely LED), HRV/ ventilation, the well pump, plug loads, domestic hot water heating, and the air compressor for the looms. It is not cost-effective to consider alternate energy sources for DHW as the well water is both very 'hard' and brackish, and thus corrosive to plumbing equipment. However, since January 2011, a BuildItSolar type solar hot water system has been introduced as a pre-heater to the electric DHWT. The situation for this solar water system is far from optimal, but has proven to be well worthwhile.

Electricity here involves 'time of use pricing', where 'peak' rates (even 'mid-peak' rates) are more than double 'off-peak' (evenings and weekend) rates. Effort has been made to push activities involving electrical consumption to 'off-peak' periods, and where feasible - eliminate the consumption entirely.

Despite the dramatically increasing electricity rates, monthly invoices tend to have ranged from about $ 80 per month early in the five year period, to about $ 100 more recently.

The cost of propane, averaged over the five years, has been a very modest $ 53 per year.

Overall, the average total cost of all home energy (including space heating and cooling) has been very reasonable (about $ 3.75 a day) – not even lunch money.

Bottom Line: We are delighted with the home!

Best Wishes
Sue & Gord
Adolphustown Schoolhouse