Pursuit of a Net Zero Energy Home

Brakey Energy
your key to energy

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A net zero building is one where the amount of energy provided by on-site renewable energy sources is equal to the amount of energy used by the building. Brakey Energy owns a lakeside 3,200-square-foot log cabin rental property in southern Maine, and it is our goal to make it a net zero energy home by 2013 in order to better manage future energy costs[1]. This report discusses the steps we have taken and will take toward this goal. We hope that it will give you some ideas for reducing the energy consumption in your home.

This tightly built log home has a passive solar construction with a large window on the southern wall (shown at right) and only one small window on the northern exposure. It has forced air propane heat supplemented by a wood stove in the basement.

With respect to growing regional energy requirements, it takes years, even decades, to permit, finance and build new power generation facilities. However, it only takes minutes to reduce the energy consumption inside the walls of a home. In order to reduce energy consumption at this log home, we have already:

- Replaced most incandescent light bulbs with either compact fluorescents or LED's
- Used kill switches on power strips to turn off the power to clocks, TV's, radios, etc. when the home in unoccupied
- Conducted a "blower-in-the-door" test to determine the location of any air leaks and drafts
- Added to the roof insulation
- Replaced the hot water heater with a tank-less water heater
- Replaced the washer, dryer and refrigerator with new energy efficient models
- Removed some trees to increase the sunlight that reaches the windows.

Our future plans include:

- Replacing the remaining incandescent and compact fluorescent light bulbs with LED's
- Installing a geothermal heating and cooling system
- Installing a propane back-up generator
- Installing solar panels on the roof.

1 Today Maine's residential electricity costs 18¢ per kWh ($53 per million Btus). Propane costs $4/gallon delivered ($43 per million Btus). In northeast Ohio, residential electricity costs 13¢ per kWh ($40 per million Btus) and natural gas is around $10/Mcf delivered ($9.70 per million Btus). We fear these prices might double over the next five years.

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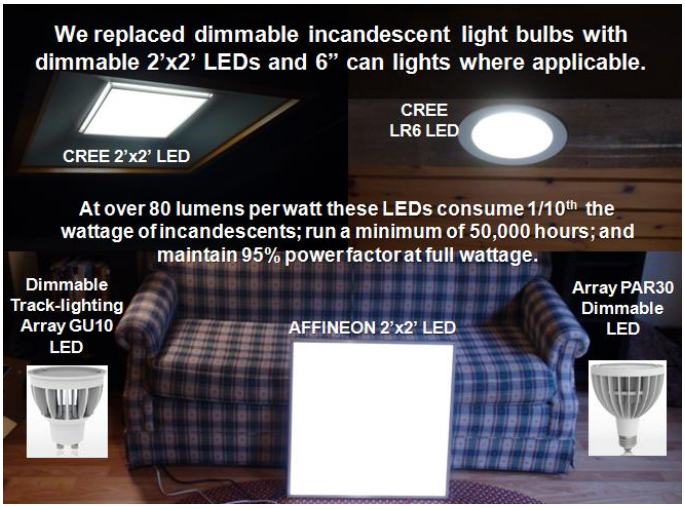
Lighting

There are close to 100 light sources throughout the cabin. They initially used incandescent light bulbs. Total household illumination approached 7,500 watts. Incandescent light bulbs have changed little in 130 years and waste 95% of the energy delivered to them. We eliminated all non-dimmable incandescent bulbs and replaced them with compact fluorescents. Though fluorescent technology is a significant improvement over incandescent, they still waste close to 80% of the energy they draw, have poor power factor, and have mercury contamination issues.

Light emitting diodes (LED's) are far more efficient. Screw-in LED bulbs are 90% efficient. Some brands have power factor close to unity like incandescent bulbs. Though they have a high initial cost, many of the higher quality LEDs last more than 50,000 hours. Both the master bathroom and office were ideal locations to install dimmable Affineon and CREE 2' by 2' LED's. We are also installing can CREE LR6 LEDs.



We are testing Nexxus's Array LEDs for all the dimmable track lighting. When dimmable LED chandelier candle bulbs become available in the near future, we will be able to enjoy warm radiant LED lighting throughout the entire vacation home. Entire lighting load will shrink from 7,500 watts of incandescent to less than 1,000 LED watts. Over the 50,000 hour life of LEDs the carbon footprint alone will be reduced over 240 metric tons.

Hot Water

The log home has its own endless supply of well water. With the addition of a whirlpool, second shower, energy efficient washer and dryer, our next challenge was to economically provide an ample supply of hot water.

The solution was to replace the standard 50 gallon propane-fired water heater with a Rinnai tank-less water heater. It can generate 5 gallons per minute of 130° water. It is 82% energy efficient when in operation 5% of the time. The Rinnai is 100% efficient the remaining 95% of the time.

With a traditional water heater, you are trying to maintain the desired water temperature around the clock even though hot water is only required intermittently. If you currently have an electric hot water heater, there can be dramatic savings in electric consumption by going to a tank-less water heater. If the water heater has a flame pilot, natural gas or propane is consumed to maintain the flame. Just keeping the pilot lit typically costs about $8 (natural gas) to $24 (propane) per month. Remember, a tank-less water heater only operates when hot water is needed. Our Rinnai might actually consume less energy than what was consumed by the flame pilot alone[2]! The other benefit is that you get all the hot water you want when you want it.

Geothermal Heating

Geothermal heating systems use the heat retained under the ground. These systems use a heat pump to transfer the heat from the ground water to provide heating, air conditioning and hot water in the home. Even during the Maine winters, the cold ground contains heat.

After adding some insulation in the attic of this log cabin, we have determined that the geothermal thermal system required would be sized at four tons. Depending upon the future geothermal technology selected, 10 to 20 amps at 240 volts will be needed to operate electric pumps and fans off of a 55 amp breaker. When we combine geothermal electrical needs with the balance of cabin's electrical requirements, we might consume 800 kWh per month.

Geothermal heating is economically viable almost anywhere. However, for an existing home, the costs are less where there is already a forced air heating system.

Back-up Generator

The property has its power lines buried underground. We intend to acquire an 8.5 kW Kohler (or equivalent) generator, fueled by propane, to be used in case of power outages. It could run the geothermal system and other critical appliances for 196 hours (about 8 days).

2 For more information on pilot lights, see: http://www.builditsolar.com/projects/conservation/pilotlights.htm

Solar

To achieve a net zero energy home, the solar generation has to be designed to exceed the average monthly electrical requirements. To begin this process, we have already removed some overgrown pine trees to the south and east of the cabin. This resulted in more radiant energy through the large south-facing window in the great room and makes solar power more feasible in the future. We are waiting for advances in solar panel technology and for price reductions before considering placing solar panels on the roof.

Next Steps

Dramatic strides toward reducing energy consumption have been made inside and outside this secluded lakeside retreat. In 2010 and 2011, we plan to install geothermal heating and backup electric generation. In 2012, we will review advances in solar technology and select the system that makes the best sense for our circumstances. With on-site renewable energy provided by the sun and ground water, we hope to approach zero net energy consumption from the grid.

More images and information on renting this lake-front log home can be found at:
http://www.krainin.com/kre4c.vacationrentals/eastcottages/urbrak.htm

MICA members interested in lakeside vacationing should call Brakey Energy directly for membership discounts.