Energy Efficiency Renovations

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This 2,100 SF, formerly, four-bedroom, two, full-bath house was built in 1900. It had been a rental property for at least the previous 30 years when I began managing it in 2012. In 2017 I assumed the house and began a renovation of the structure where I now live with my teenage daughter. The house is now a duplex and is powered primarily by a 8.64 kWp system of 27 solar panels which provide electric power for light, heat pumps, an induction range, a lawn mower, various gadgets, a high efficiency washer/dryer, and a basement dehumidifier. The following is a summary of the ongoing efficiency renovations.

2012

NH Saves Energy Weatherization Program - $7,180.73 - PSNH Rebate = **$3,184**
https://nhsaves.com/rebates/energy-audits-weatherization/

- Basement Rim Joist - 3" flame retardant closed cell spray foam to basement rim joist
- Air Sealing - Reduce infiltration of a targeted 1000 CFM thru installed insulation as well as 14 man hours of blower door guided air sealing measures. Areas of concentration will be attic deck, attic access, exterior doors, door to bulkhead as well as to basement, mechanical and electrical penetrations throughout the home.
- Walls - Dense pack exterior walls of home with cellulose from the exterior, lead paint is present crew will be required to work lead safe, $600 lead safe surcharge. Follow BPI standards for installation of measures.
- Attic - Install necessary heat source barrier for bath fan, dense pack decked over rear attic and add additional R22 blown fiberglass to main attic.

2017 - 2018

Roof Structural Analysis - **$1,730** The City required a structural analysis of my attic to determine if your roof trusses will support the weight of the proposed solar system. I did this twice as I considered expanding the size of my system. Structural changes were recommended. This engineer prepared a thorough report that I found very useful.
Stephen C. Tarbox, PE ♦ 603-352-1488 ♦ sct@sctengineering.com

Roofing Replacement - $6,500 I took the opportunity to replace the roofing on the south side of the house at this time (preemptively) because of the tax subsidy. I would recommend the contractor.
Dale Guyer, Guyer & Son Roofing, 603-876-9915

8.64 KW Solar Electric System Installation - $28,669 minus 30% Federal Tax break = **$20,208**
craig@revisionenergy.com (603) 254-8700

The system produces roughly 8,957 of clean, renewable electricity annually and offsets about 9,432 lbs of carbon pollution each year. I am very happy with this significant solar energy investment. The oil truck has not come to my home in a year. Every day I use the SolarEdge software to see how many kW we are generating versus what we are using. These numbers have become a regular part of conversations with my daughter as we puzzle-out what caused a usage spike at, say 3 PM. By April I had run out of my stored kWs and had to go back to oil. My regular, monthly electric bill is $14. The fuel oil use for my 1,500 SF unit went from 600 gallons of #2 heating oil in 2016-17 to approx.145 gallons in 2018-19. This past year I added an induction stove/cooktop, a basement dehumidifier, an electric lawnmower and electric snowblower. It looks like I will have used close to 170 gallons.

The components of my current system are:

- (27) LG High Efficiency NeON 2 320 Watt Solar Module or equivalent
- (1) SolarEdge 7600w grid-tied solar electric inverter with Arc-Fault Protection and integrated RGM
- (27) SolarEdge P320 DC Optimizer for 60 Cell PV Modules up to 320w.
- (218) Upgrade to black anodized mounting rail (per foot)
- (6) Ecofasten flashed roof attachment kits

In a do-over, I would have found a way to finance an increased number of panels to the highest my roof could hold, possibly three more, removing the solar attic fans.

Passive Solar Utilities
Granite State Daylighting, (603) 606-1366,
https://granitestatedaylighting.com/

- **Attic Fan** - $1,350 (for two) - 30% = **$945** These fans are quiet and operate whenever the sun is out. While their efficacy is contested, they provide an outlet for the attic's heat without additional electrical conduit or the use of kWhs.

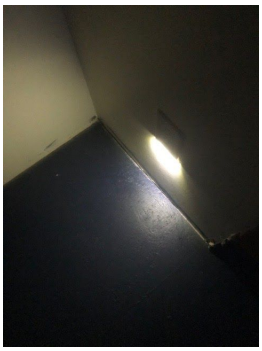
- **Solatubes** - $3,648 - 30% = **$2,554** I have three in my home. One at the top of the stairs, one in a bedroom closet and one in the bathroom. They provide passive, wonderful light through a series of prisms when the sun is out with or without a fixture

inside. They are installed on the high north side of my roof because I knew I needed the roof space for the solar panels and still provide wonderful interior light. Additionally:

- The Solatube in the bathroom is combined with a fan. The fan is not solar powered but the combination meant only one hole in the bathroom ceiling.
- A fun and fabulous side benefit is that both units qualified for the 30% federal tax rebate because they have a cigarette-sized, solar pack inside. This “solar pack” charges during the sunshine to create passive nightlights during the evenings.

Mitsubishi Heat Pumps - H2i Hyperheat M-Series, 15,000 BTU/H Wall-Mounted Heat Pump System, 2 heads inside and one, 2-head condenser outside. $11,220

Finishing the unfinished ½ of my home’s second floor required a source of heat as the ductwork of the original forced air system did not extend to the area. A heat pump was a logical solution. As I came to understand what was possible given Mitsubishi’s upgrade to the more powerful systems and my proposed kW budget, I ended up purchasing a “head” for each floor of the house. These come with both heat and air conditioning --which I had never considered before. This Mitsuibishi unit offers 100% heating capacity at 5 degrees fahrenheit and 70-81% heating capacity at -13 degrees fahrenheit. I installed two “heads” inside, one upstairs and one downstairs with one 2-head condenser outside. They are a different type of heat than a forced-air furnace or hot-water registers. The temperature changes over a longer period of time. With them and the home’s insulation, I keep my home between 62 and 66 degrees. This is comfortable because there are no drafts in the house. Unfortunately they were not cheap and there was/is no tax incentive for their purchase in NH. However, this decision has allowed me to create a very satisfying 69% of my home’s heat with solar power in 2018-9 and 63% in 2019-20 in addition to providing all of the general electricity needs of the home.



Other Efficiency Tools

SNAPPOWER Switch Lights www.snappower.com Tiny LED lights and sensors are part of an outlet cover. They provide just enough light to see the floor/doors/stairs for approx.10 cents per year.

Hanging Laundry - Two types of clothes hangers are very helpful and don't require moving when vacuuming. This is a "must" with our home of adopted, furry pets. The hangars provide year-round hang-drying capacity and a bit of additional winter air moisture. I use the inside or the outside hangar depending on the day and type of laundry.

The inside one is called a "Beadboard Drying Rack". I purchased mine from Ballard Designs online at www.ballarddesigns.com At $250 each, it was not cheap but there are different sizes and styles appropriate for many spaces. They sometimes go on sale.

The outside one is a "Leifheit". They have several models as well. I chose the 83100 Telefix 100, Wall Mount Retractable Clothes Drying Rack, 8 Drying Rods.

2019

Interior Window Storms - approximately $75 each

I have an aversion to cold drafts of air and the loss of heat they signify. These first interior storm "non-wind-ows" were expertly crafted by a fine carpenter in town. My daughter and I painted them and then wrapped them in plastic. They are then placed inside the interior frame of each of the home's original, bay windows. This first photo shows one in the process of being created. I now have six for the home's two sets of bay windows. I look forward to creating a slightly less refined version for the rest of my original windows in time. They have foam/felt weatherstipping and they fit very exactly, so they have tiny handles to remove them in the spring as. I appreciate that they can be reused each year, do not require double sided tape on the trim and do not

loosen over the winter months. It is lovely to not have drafts and as mentioned earlier, this allows me to be comfortable at reduced temperatures of 62-65 degrees.

This second photo shows the interior storm installed. It is almost indiscernible from the existing frame, even four months after creation and placement.

Induction Range
Korvin Appliance Inc., (603) 352-3547,
https://www.korvin1.com

A propane range came with the house. I had had it serviced once by our terrific local appliance company, Korvin Appliance. They had warned me that it was over 20 years old and that replacement parts were no longer available. Accordingly, I had planned ahead by having an electric range service installed during the home renovation. When new problems started again I was prepared to look at options. Frigidaire had been offering induction ranges for some time. They were very expensive, $4-5K and loud. Luckily it was now some years later and the price from these same *local folks* was $1,200. Done. It is pretty to look at. We are still learning how to cook with the electric aspect but I am very satisfied with the safety features of the cooktop: no flame, the power goes off as soon as the pot is lifted off of the surface. It's glass surface is very easy to clean. I do wish that the smaller "burner" was up front instead of in the back as our smaller household means that this is the one I use the most and it is a bit irritating to have to reach over the larger "burners". All that said, I'm delighted to have been able to remove the propane tank and ongoing propane purchases from our lives.

In summary, and as I posted on my Healthy Home Habitats webpage this week with a picture of my Monthly electric bill:

*"**My $13 June Electric Bill***
OK, so:
● I am willing to let the interior of my house get to 78 degrees in the summer, this happens only on consecutive 90 degree days,
● I have a daily summer routine of dropping/opening our top window sashes every night and closing them tight in the early morning, with heavy drapes for the south-facing ones.
● I hang my clothes to dry, 99% of the time.
● Most importantly I was adamant in FIRST taking part in the NHSAVES program,

partnering for an absolutely necessary, initial weatherization program where they paid for 1⁄2, up to $4,000 of recommended insulation measures. And then,
● I made very specific investments in 27 solar panels and a double-headed, Mitsubishi Hyper-Heat unit with a 15-year payback period or ROI along with
● Five other separate solar-powered elements: Solatubes &
● I used half a tank of oil in my standard furnace during the coldest parts of last winter.

But still, this has been my electric bill every month for two years now. This is the charge for having my electric utility store my solar energy. To me this is crazy satisfying, and completely worth the fuss. I'm looking for ways to share how I'm doing it with others who may be interested in aspects that fit into their life/house."

I look forward to additional steps to increase this home's efficiency and hope to find ways to inspire others to do so as well.