Greener Solutions Air

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Hello John,

I'm writing to document our intermediate energy audit, findings and recommendations for your home at 1234 Smith St, Jacksonville, Fla. and to discuss broad areas with potential for substantial improvement. Just as an energy audit considers the house as an integrated system; our recommended improvements operate as a system as well. Discussed below are multiple areas with solid potential for energy conservation.

I. Consumption Overview

We reviewed 12 months of electricity consumption, a total of over 29,000 kiloWatthours (kWh), costing about $4000 annually. Daily usage ranged from a high of approximately 115 kWh / day in July to a low of 55 kWh / day in February. That is fairly high for a 2 person household occupying a home of its age and size.

A JEA spreadsheet we use for estimation yielded a result that heating and cooling (HVAC) represents approximately 1/3 of your total energy usage, over $1000 annually. Interestingly, this electricity consumption does not include heating domestic water, normally second only to HVAC (heating and cooling) in energy use and cost. We discussed, in general terms, the large amount and high cost of propane, approximately 95% of which likely goes to your tankless water heater mounted outside the house.

Heating water using electricity normally uses anywhere from 5-15 kWh / day; that your electricity usage does not include water heating makes your usage rate seem higher still.

The 5 kW solar photovoltaic generating system planned soon should counteract or offset daily consumption by approximately 20 kWh / day, so there is ample room for conservation; little danger of producing more electricity than the home consumes.

II. Air Leakage

The blower door test result of 2800 CFM 50 Pa (Cubic Feet per Minute at 50 Pascals test pressure) showed that air leakage is slightly below our benchmark of 1 CFM 50 for each 1 square foot of living area. The test result of fewer CFM (2800) than square feet of living area (3100, main home) is a fairly decent result for a production house.

However, there is still considerable room for improvement – Given that this house is new enough to have incorporated both house wrap and fire code draft stopping, it should perform better than the benchmark. We insist our new construction projects perform under 0.50 CFM / SF, and I have tested production homes that perform nearly as well.

Part of the heating and cooling capacity—and thus energy consumption—is going into conditioning air that then leaks out of the home. New outside air replaces the lost air, and the new air must be heated, cooled or dehumidified, depending upon the season.
Significant sources of excessive leakage include:

a) Fireplace flue – yours seemed to be fairly tight under test.
b) HVAC ductwork - much all of your home's ductwork lies outside the "conditioned envelope"—that is the interior rooms and spaces that are heated and cooled. That means those ducts are subject to exterior weather conditions including very hot attics and / or cold damp crawl spaces. Any air that leaks from supply ducts is lost from the home and is replaced by raw outside air. Likewise, air leaks in return ducts draw in outside air, making the HVAC units work that much harder to maintain indoor temperature and humidity.
c) Ceilings and walls into vented attics - Your attics are vented via eave and upper vents. Sun warmed roof shingles turn attics into heat engines, drawing air into eaves and releasing it out upper vents. These airflows depressurize attics, causing them to draw conditioned air up out of house rooms via attic duct leaks, gaps around ceiling light fixtures, wall cavities, plumbing vent penetrations, electrical and media cable runs, and bath fans.

* NEXT STEPS:
Inspect and repair missing caulk or damaged seals around windows and doors. Gasket switches and receptacle plates. Insert child safe plugs into unused electrical outlets. Inspect and seal gaps in all ceiling penetrations – electrical boxes, plumbing penetrations can lights, duct register boots, etc.

Alternatively, consider retrofitting spray foam insulation in one or more of the home’s attics. Spray foam fixes several building envelope and HVAC issues all at once; see below for more on it.

III Duct Losses

As I wrote earlier, much of your duct systems are located outside of the conditioned area of the home. This causes significant losses in each of two areas:

a) Any air leaks into or out of ductwork represent conditioned air that is lost to the outdoors. This air is replaced by outdoor air which adds to the load on the systems.
b) Heat gain / loss from conduction - Ductwork is insulated but only to the extent needed to keep it from "sweating" like a cold drink on a hot day. R values are 6 or less. That means the systems and ducts gain or lose heat by conduction through thin insulation. This is a particular problem with ducts in hot attics - Ductwork carries 55-60 degree air through attics that may reach 140ÅãF every day in the summer. Systems with attic ductwork often lose one third of their output to the attic on hot days.

* NEXT STEPS
This intermediate energy audit did not incorporate duct leak testing or airflow analysis. Those additional measurements would help quantify the extent of losses and potential gains from effort to seal and balance ductwork.

Spray foam insulation, mentioned above, would seal the attic(s) and bring the ductwork into the conditioned, thermal and pressure envelopes of the home. This greatly reduces duct losses caused by both leakage and heat conduction.

IV. HVAC Sizing and Other Issues

Your home's three (3.5 ton, 2 ton, 1.5 ton) 5 year old SEER 13 series Lennox heat pumps are merely middle-aged but are experiencing accelerated corrosion of outdoor coils. This may result from any of salt air, pool chlorine or manufacturing defect. I have unconfirmed information that Lennox is making some allowances for this phenomenon for similar models, but have not yet been able to confirm that. This corrosion reduces efficiency and capacity

This intermediate energy audit did not incorporate heating and cooling load calculations but experience suggests that the existing systems are oversized by up to 1 ton each. Oversized systems cycle more often, reducing efficiency and limiting dehumidification. Tonnage cools a house right down fast, but it takes run time to adequately dry a home, and oversized units will not run long enough, particularly at night or during cloudy weather.

* NEXT STEPS

First of all, remove all vegetation within 12" of all sides of outdoor units for proper airflow. Prior to any system replacement, ensure a careful heating and cooling load calculation is performed and the system sized according to the calculated results. Avoid contractors who seek to upsize "just in case".

In the course of the load calculation, consider the effect of spray foam insulating one or more attics. It is quite likely that the entire main home could be cooled with a single 4, possibly 3 ton two stage system with zones for upper and lower floors. We routinely achieve 800-1000 SF per ton in retrofits, 1200-1500 SF per ton with new construction.

The studio, now overblown by a 1.5 ton system with inadequate ductwork, would almost certainly benefit from a 9,000 Btuh minisplit ductless. That would make far less noise, cool and dehumidify more evenly at twice the efficiency (SEER 20-27) of the present system at an installed cost of approximately $2k.

Taken together heating and cooling could be operated at less than half present cost, less noise, and greater comfort.

V. Solar Heat Gain

Your house is fairly well situated as to overhangs and shading. A detailed load calculation, coupled with fenestration coefficients (energy ratings) of present windows, may identify some windows cost feasible to retrofit solar film.

VI. Hot Water

You presently operate a propane-fired tankless water heater. While that system is among the most expensive ways to heat domestic water, natural gas is expected to be available soon. The delivered cost per Btu should drop by half or more.

The studio / garage contains a conventional storage electric resistance tank heater.

* NEXT STEPS

Investigate whether present main unit may be converted to burn natural gas via a different metering orifice. Ensure that the water heater temperature set point is no higher than necessary for comfortable bathing, typically 115-120*F. Consider shutting off power to the garage / studio water heater to save 1-1.5 kWh / day standby loss.

If present tankless unit fails early, is not convertible to natural gas or natural gas fails to become available, another option would be to replace the studio unit with a hybrid heat pump water heater and use a demand-based recirculation system to mitigate distance to main house.

Hybrid heat pump water heaters operate at 1/3 the cost of conventional electric water heaters, . the cost of propane water heaters and provide useful cooling and drying of whatever room they occupy.

For all heaters insulate exposed sections of the cold water line leading into the water heater – that line is warm to the touch owing to natural convection; insulating it will reduce standby heat loss.

VII. Lighting

I observed a mixture of incandescent CFL, and LED lighting. CFLs and LEDs use 75 - 80% less power for the same light output. Note also that the energy wasted by incandescent lamps adds to the heat load the HVAC has to remove. LEDs are somewhat more efficient than CFLs and promise to be both mercury-free and longer lasting, but they command a premium price not yet justifiable through energy savings alone.

* NEXT STEPS
Continue replacing lamps used more than a few minutes per day with CFLs or LEDs. Pay attention to color temperature rating when selecting replacement lamps. Color temperatures of 2700 – 3000K most closely resemble the warm white light emitted by oldstyle incandescent bulbs. Color temperatures of 4000 – 7000K tend to have a sharper bluer light output. They are slightly more efficient but not as pleasant in some rooms.
Do not hesitate to return lamps to retailers if the light quality fails to meet expectations.

VIII. Laundry

The clothes dryer is a fairly late model unit incorporating a moisture sensor. This prevents overdrying clothes and reduces energy consumption. The clothes washer is a newer front loading model with no center agitator and a fast spin cycle. This is a reasonably efficient combination.

* NEXT STEPS
Continue washing with the coolest possible wash water and fastest spin cycle consistent with clothing requirements and cleaning results

IX. Refrigeration

You have a large built in refrigerator in the main kitchen and an older top freezer in the garage. The main kitchen refrigerator likely uses quite a bit more electricity than a comparably-sized standard top freezer model. Garage fridges use above average power whenever garage is warmer than normal room temperature. Garage fridges also tend to use excess energy since they are typically older models. Refrigerator efficiency, driven by DOE and Energy Star standards, has risen dramatically in recent years.

fridge to use much power, its glass door, pleasing to the eye and useful for keeping watch over the wine supply, isn't well insulated. In addition small wine coolers, bar and college fridges are not nearly as efficient as full size models when adjusted for volume. I've measured dorm fridges that use almost as much as full sized models with 8x more capacity.

* NEXT STEPS
Consider consolidating garage refrigeration to the main kitchen unit. Measure all refrigerators' usage using the loaned Kill-A-Watt meter.

X. Communications and Media

We discussed telephone, computing and media equipment that uses some power whenever plugged in, even though the item is supposedly "off", that is, not actively performing its main function. These so-called "phantom" or "vampire" are typically individually small, ranging from 1 to 20 Watts, but their use is 24/7/365, and they collectively can add up to quite a bit. A single Watt of standby load costs more than a dollar per year.

* NEXT STEPS
Look for items that run warm to the touch even while off. That heat is a sign of excess power use while off. The Kill-A-Watt meter is an excellent tool for ferreting out the vampires.

XI. Pool Pumping

Pool pumping is one of the largest home electricity users, often exceeding water heating and sometimes even HVAC. We recommend fully variable speed pool pumps able to be fine-tuned to individual pools' needs. Two speed pool pumps, now required by Florida code, offer marked improvement as long as they are set up to maximize use of the lower speed.

You had the good fortune to retrofit an upgraded 2 speed pump to your 10,000 gallon pool following an insured loss. I measured the pool pump's power usage to be around 600 Watts on low speed vs. over 2200 Watts at high speed, and low speed appeared to properly circulate the pool water.

* NEXT STEPS
Assuming proper circulation, it it generally only necessary to "turn" (pass through filter) the entire pool's volume once per day, less during cooler weather. In addition, the screen porch both shades and reduces biological loading of the pool water; both effects reduce pumping needs. At 30 GPM, your 10,000 pool is "turned" in 5-6 hours.

Consider pumping the pool on low speed twice per day 2 hours at a time in winter, 3 hours spring and fall, and 4 hours in high summer. Make sure this is consistent with water quality and chlorination system needs.

Transitioning from 4 hours high speed, 4 hours low speed to an average of 6 hours low speed only would save 7.6 kWh / day, approximately $1 per day. That change alone represents 10% of your total usage.

Conclusion

Thank you for taking the time to meet me and hosting me in your home.
Please let me know your measurements of individual "plug" loads using the loaned Kill-a-Watt electricity meter.

Please contact us with specific questions about this report or implementing any of the recommendations herein.

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Curt Kinder

Managing Engineer
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