



Viridiant Lecture Series: managing existing residential energy use

So, you want to lower your energy usage, but where do you begin? There is an optimal path for improving a home's energy use. Assessing current energy usage, issues with the home, as well as homeowner goals helps to form a logical plan for the home to make it comfortable, safe, and efficient. These goals and plans often overlap with utility company goals and energy efficiency programs, leading to a mutually beneficial path forward.



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managing existing residential energy use

quantify

- Understand a home's energy usage through benchmarking, bill disaggregation, or an energy audit.
- Identify issues with the home, such as uncomfortable rooms or moisture problems.
- Establish energy and water efficiency goals.

plan

- Follow the energy pyramid to determine the order in which to make improvements.
- The plan should address issues with the home early on and have a clear path toward achieving goals, whatever the timeframe may be to get there.

act

- Begin to implement the plan. It doesn't need to all get done at once!
- Look for utility company programs, rebates, and incentives to offset some costs or provide additional guidance.
- As changes to the home are made, consider tracking, or benchmarking, utility usage to make sure expected savings are realized.

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Residential buildings are responsible for 21% of U.S. energy consumption (eia.gov). Existing homes offer ample energy efficiency improvement opportunities, both for homeowners and utility companies. Each group has a vested interest in incorporating cost effective efficiency improvements into existing homes. While it may seem counterintuitive that utility companies want to reduce energy consumption, electric utilities have a strong motivation to encourage the most efficient usage of existing resources to delay or avoid costly investments in new power plants.

Dominion Virginia Power



Dominion offers Demand Side Management (DSM) programs to influence the amount and timing of electricity usage. By reducing use and shifting use away from peak usage times, Dominion is able to delay or avoid the need to add additional supply capacity in the form of new power plants to meet growing demand for electricity. The largest components of residential energy use are space heating and cooling. Due to this, Dominion's residential programs focus primarily on these areas, with rebates for home energy check-ups, heat pump tune-ups, heat pump upgrades, duct sealing, and appliance recycling. In addition to these rebates, some customers, based on income or age

qualifications, are eligible to receive a home energy assessment and energy saving products at no charge. Since 2010, Dominion has served around 200,000 homeowners with these programs and saved 1.96 million megawatt hours of electricity. Dominion also offers the EnergyShare program, which serves at-risk customers, including low-income, elderly, and disabled individuals. This program offers more services than the DSM programs. Bill assistance is available as well as weatherization. Notably, this program serves multifamily units and single family homes, though 90% of the participants have been multifamily. Since July 2015, over 14,000 participants have been served with over 10,000 megawatt hours of electricity saved. These programs and incentives offered by Dominion and other utilities are an excellent resource for homeowners that are undertaking energy efficiency improvements on their homes.

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Homeowner Efforts

There are four main steps to holistic residential energy efficiency efforts: [understand](#), [plan](#), [take action](#), and [continual assessment](#).

[Understanding](#) can come from several different methods. Regardless of how the information is gained, having a solid understanding of where energy is going in a home and specific issues that need to be addressed must happen before taking action. A better understanding of a home's energy usage typically comes from:

- **Benchmarking:** comparing a home's energy and water use to other homes like it. This provides context for how efficient (or not) the home is compared to others and can help identify what improvements should be tackled first. For instance, if a home has efficient water use but poor electricity use, electricity-using items should be addressed first. Benchmarking a home against itself can help with identifying any new issues or abnormalities with the home.
- **Bill disaggregation:** using utility bills and the weather data for a given time period, provides estimates of how much energy has been used towards heating, cooling, water heating, and baseloads. Again, this helps to focus on what areas offer the greatest potential for energy efficiency improvements.
- **Energy audit:** a top to bottom assessment of insulation levels, mechanical system efficiencies, windows, and areas of air and duct leakage. While benchmarking and bill disaggregation don't require a visit to the home, an energy audit does require an on-site inspection of the home.
- **Diagnostic testing:** typically done in conjunction with an energy audit, calibrated fans are used to assess the leakiness of the building envelope and duct work. This can be helpful in identifying areas to pursue air sealing and improvement can be quantified as the building envelope and duct work are improved.

Using the knowledge gained from these measures, also consider specific issues in the home and goals. Are there rooms that are never comfortable? Moisture issues or mold? High bills certain months? Equipment that is nearing the end of its life? These issues, and the goals of the homeowners, provide needed context for developing a [plan](#) forward.

Example: Two similar homes, equally inefficient. Different issues, different goals, different plans.

House 1:

Issues - Three rooms that are never comfortable because they are over a moldy, vented crawl. Insulation in the floor has fallen and several ducts are disconnected.

Goals - Make the rooms comfortable again, then get the mold out of the crawl.

Solution: The mold will be remediated, crawlspace walls insulated instead of the floor, and duct work reconnected and sealed where possible. Supply air will be introduced to the crawl, turning it into a conditioned crawl. The uncomfortable rooms now have enough conditioned air going to them and the floors are always a comfortable temperature because they're over conditioned space.

House 2:

Issues - High electric usage when benchmarked to other homes and 18-year-old water heater that will need to be replaced soon.

Goals - Identify replacement equipment and homeowner identified goal to offset 50% of electric use with solar panels.

Solution: The current electric storage water heater will be replaced with a heat pump water heater, reducing the electric usage for water heating to a third of what it was before. Remaining incandescent bulbs are replaced with LEDs to further reduce their electric usage, as well as unplugging a second, rarely used fridge. These changes and replacing the water heater allow them to install a 3 kW solar system instead of a 4.8 kW one to cover 50% of their annual usage, saving \$3,800 in installation costs.

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Ready to [take action](#)? Knowing where to start with implementing efficiency measures can be confusing. By following the energy pyramid, improvements can be made in an order that builds upon previous improvements. Easy, low cost measures are implemented first, followed by measures with quick payback times. The pyramid finishes with more expensive measures with longer payback times, but the cost for items such as solar and HVAC should be reduced because of other measures previously implemented.

Behavioral, low cost, no cost

- Choose ENERGY STAR when making purchases
- Install LED bulbs
- WaterSense labeled toilets, showerheads, faucets, and aerators
- Heat pump tune-up

Air sealing, duct sealing, insulation

- Seal accessible duct work and seal metal boots to drywall/floor
- Air seal before insulating
- Add attic insulation
- Block and insulate kneewalls
- Condition/encapsulate crawl space

Water heating

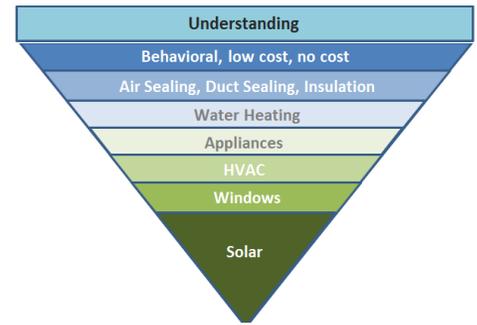
- Choose ENERGY STAR when replacing
- Insulate first few feet of hot water piping from water heater

Appliances

- Choose ENERGY STAR
- Also check Energy Guide to see total annual consumption

HVAC

- Have equipment sized (manual J) when replacing
- Choose high efficiency, but it doesn't have to be the best available
- Have a refrigerant charge test done



Windows

- If they're in good shape, restore and weather-strip instead of replacing
- Add storms to older windows
- If new ones are needed, look for a low U-value and low Solar Heat Gain Coefficient (SHGC)

Consider [continually assessing](#) energy and water usage through either software or hardware tracking. Software tracking typically uses data from monthly utility bills and will provide a way to track savings from improvements that have been made. Hardware tracking typically involves installing sensor in the panel box, but also provides continual and timely feedback on energy usage in the home. For more information on specific software tracking options and/or hardware, contact Viridiant. Viridiant understands that this process can be confusing and offers services to help you along the way, from an energy benchmarking calculator to bill disaggregation to audits to HVAC design. When you're ready to start your energy efficiency journey, let us know how we can help.

