

Net zero

Insights from Western North Carolina home builders

□ AMY MUSSER □

What is a net-zero energy home? A net-zero energy home is simply a home that produces as much energy throughout the year as it consumes. A home can only truly be considered net zero energy after the first year and there are utility bills showing that the goal has been met. The inset bar chart shows net monthly energy use and production for our personal house, which generates electricity using solar photovoltaic (PV) panels on the roof. In the spring and fall when we are not heating or cooling, we produce more energy than we use. When we use air conditioning in the summer, we are close to even. Production is lowest in the winter when we are also using a lot of energy for heating, so we use more than we produce during those months.



The photo above shows a home using four forms of solar: solar PV, solar hot water, passive solar, and solar clothes drying. Passive solar design is popular with net-zero energy home builders. It's definitely not a requirement, but since these homes have to be oriented for South-facing roofs anyway, it can capture that free heating energy from the sun. Amy Musser photo

Monthly net energy use and production for a net zero energy home

Recognizing a need to identify homes with the potential to achieve net-zero energy, the Green Built North Carolina certification defines a new net-zero energy home as one having a HERS index (including solar PV) of less than 15. The HERS rating is like a "miles per gallon" sticker for a home, with a HERS of 100 being approximately code, and a HERS of zero being a net-zero energy home with typical American appliance usage. The Green Built NC program opted to include homes with a HERS 15 or lower because they recognized that individual "mileage may vary", and many energy-conscious homeowners in the area were reaching net-zero performance with less solar than the typical American would need. They also recognize homes that reach a HERS of 55 or lower that don't have solar but have a conduit and South-facing roof appropriate for future solar as "net-zero ready."

The Green Built NC net-zero designation became available in October 2015, and since then 7 homes have completed certification as net-zero energy and one home has achieved net-zero ready certi-

fication. Prior to the net zero certification becoming available, we know of at least 15 homes in the area that would qualify with a HERS score of less than 15.

Local strategies to build net-zero energy homes

Not all net-zero homes are small, but it really helps. Smaller homes use less energy and require less solar to become net zero. There are net-zero energy "tiny houses" in the program, but there are also several in the 1,200 square foot range. These small homes are able to achieve net zero status with 4 to 5 kW of solar PV, which at current prices would cost approximately \$14,500 to \$18,000. There are larger homes in the program, but they require more solar. Typically homes in the 2,000 to 3,000 square foot range have required 6 to 8 kW of PV to achieve net zero energy status.

Insulation

Many net-zero homes are "super-insulated." All of the net-zero homes we've worked with have more insulation than the code minimum, but builders have a variety of philosophies on how far to go. The building shell and insulation are typically the longest-lived parts of the home so it makes sense to spend more on these since they will save money for a long time. But there is a "law of diminishing returns" and after a certain point, it makes sense to save some money for solar. Our generic advice would be to exceed code, but you don't need to use unconventional materials or techniques (unless you want to). It's helpful to have a design that's easy to build and air seal and to use spray foam insulation where you may have tricky details. Home designs that allow the water heater and ductwork to be located in conditioned space also pay big divi-

dends. Leaky homes use a lot more energy, so all builders of net-zero energy homes pay particular attention to airtightness. A blower door scores of 1.5 air changes per hour or less is typical for these homes.

Efficient heating and cooling

Efficient building systems are also important. These systems don't last as long as the home itself, but heating and cooling systems do matter. Larger homes and those without access to natural gas often use geothermal heating and cooling systems. Minisplit heat pumps are popular for smaller homes. The new variable speed compressor systems like the Trane Greenspeed offer a great solution for homes in between that need a full-size system but can't make the jump to geothermal.

Water heating

Water heating is a source of significant energy use, and an easy



Author's Site Sage

way to save energy. Heat pump water heaters are the most popular choice in net zero energy homes. These move heat from the indoor air to the hot water, dehumidifying the room they're located in and heating water at about three times the efficiency of regular electric water heaters. Natural gas tankless water heaters are also a popular choice, and have about the same operating cost and carbon emissions as heat pump water heaters. Solar domestic hot water systems are still a good choice, but many homeowners find that the heat pump water heater supplemented with more rooftop PV is more cost-effective overall and lower maintenance.

The choice of whether to use gas in a net-zero home is a complex one. Most homeowners expect ultra-low bills in net-zero energy homes, so it makes sense not to add a second utility. Natural gas service comes with a monthly service charge, which can be a significant addition to energy cost. Also, most of the locally available utility buy-back programs for solar PV won't pay homeowners for generating more electricity than they consume, so mixing fuels can make it difficult to get paid for all of the electricity homes generate. If there's a desire to cook on gas, consider instead an induction cooktop, which are as controllable as gas and have additional safety benefits. There are times when it can make sense to add gas to a project. If the home will need to operate on a backup generator, having a gas furnace is desirable. Gas is also one of the best ways to manage long cold-weather periods in off-grid homes.

The role of appliances

Lighting and appliances account for nearly half of the energy use in typical homes, and make up an even greater percentage in homes that are designed for net-zero energy. Using all compact fluorescent or LED (no incandescent, halogen

or Edison) lightbulbs is something every net-zero energy home should do. Major appliances should be purchased with the ENERGY STAR label. The most important appliances to buy ENERGY STAR are the clothes washer, dishwasher, computers and electronics. Limiting the number of refrigerators and freezers to the minimum needed also helps keep energy use in check.

The role of occupants

An efficient occupant is the most important part of a net-zero energy home. You definitely don't have to suffer with uncomfortable thermostat settings and four-minute military showers. But turning off lights and appliances when you're not using them and being vigilant about finding "phantom loads" (appliances that use energy even when turned off) is absolutely critical to success. The difference can easily be worth 2 to 3 kW of PV on the rooftop, which translates into thousands of dollars of upfront cost. We recommend using a monitoring system like the Energy Detective or the Site Sage. The graphic above is from the Site Sage in my home, which allows me to easily see which circuits are using the most energy and where my phantom loads are located.

Site Sage monitor to help identify energy use by circuit

Net-zero energy living isn't mainstream yet, but it's also not difficult or out of reach. The other good news is that energy efficiency isn't an all-or-nothing proposition. Any of these strategies can be applied to any home, and you will see savings and help the environment. So there's no need to wait until you can go fully net zero to get started.

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