



John McDermott photos

Design elements of a net-zero home

▣ BY JOHN McDERMOTT ▣

Building a green or sustainable home is becoming a common practice in Western North Carolina. Taking the home to the level of net-zero energy is now within reach for many green building projects. Having a net-zero energy (NZE) home means that the total amount of energy used per year is roughly equal to the amount of renewable energy (RE) created on site. This RE can be generated by wind, solar, geothermal and/or hydro systems. In our region, passive solar, photovoltaic and solar thermal panels are the most popular choices due to excellent solar availability and affordability. Thus, solar energy as a basis for creating a NZE home will be the focus of this article.

The Intergovernmental Panel on

Climate Change notes in its latest assessment that "... many RE technologies have demonstrated substantial performance improvements and cost reductions in the past ten years." For example, since 2008, the price of solar panels has fallen more than 75 percent, while performance has improved significantly. With net metering capability from local utility companies, solar electric production no longer has to be stored in expensive batteries. Further savings can be achieved by pooling buying power through programs such as the successful "Solarize Asheville Campaign."

Combining these advancements in technology and local competitive pricing with generous tax credits from federal and state governments (up to 65 percent of installation costs) makes net zero building very

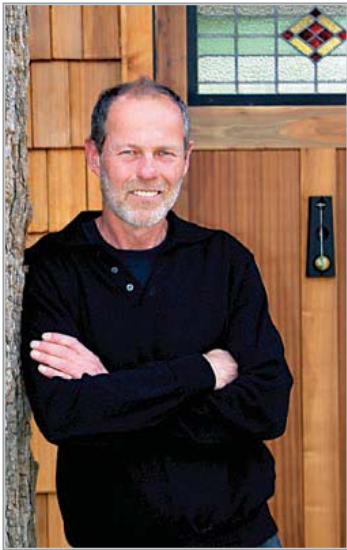
attractive. Here we will offer creative ideas for energy conservation through mechanical components, building design, and human behavior.

Conservation through mechanical components

We know a few things about energy: it is mainly produced from fossil fuels, it is expensive, and its cost will continue to rise in the future. Focus attention when homebuilding on major energy consuming components such as heating, cooling, and hot water, which can constitute up to 60 percent of a home's utility bill. The following can help conserve precious resources.

Heating and cooling: A geothermal heat pump can heat, cool,

and, if equipped with an optional desuperheater, can supply the house with extra hot water. The system utilizes the constant temperature of the earth as the heat exchange medium instead of the outside air temperature. This allows the system to reach remarkably high efficiencies of 300 to 600 percent. Relative to air-sourced heat pumps, geothermal systems are quieter, have over twice the life expectancy, need little maintenance, and do not depend on the temperature of the outside air. Combining the generous state and federal tax credits along with the energy savings, the return on investment for new construction is just a few years. All HVAC ductwork should be designed to be within the insulated envelope or conditioned space of the house. This will



eliminate energy losses due to heat transfer and air leakage from the ductwork to the outside.

Water heating: For maximum energy savings, combine a heat pump water heater with the desuperheater option on the geothermal heat pump, or utilize solar thermal panels. The hot water tank needs to be centrally placed to bathrooms and kitchen to minimize hot water runs (thermally insulate), or a well insulated half-loop water recirculation system should be considered.

Lighting: CFL (compact fluorescent lighting) and LED (light emitting diode) lighting use 75 to 90 percent less energy than standard incandescent and halogen bulbs. Currently, local utility companies offer attractive subsidies on energy efficient bulbs, making this choice super affordable.

Energy conservation through human behavior

Be conscious of your electric use and save up to 25 percent of total energy use in your home. Here are a few common sense pointers:

- Use water saving plumbing fixtures and limit shower time.
- Lower the hot water tank temperature to 120° F or less.
- Turn off lights when leaving the room and use dimmers where possible.
- Use energy efficient front loading washing machines that utilize very high spin cycles to lower moisture levels in clothes, then air dry your washed clothes whenever possible.
- Maintain an indoor air temperature of 58 to 68 F in the winter heating periods and 75 to 79 F during the cooling months. Keep your relative humidity less than 60 percent to avoid growing indoor mold and musty odors.
- Reduce your indoor cooking during the summer air conditioning season – try more outdoor grilling.

Ventilation: Energy-efficient, air-tight homes require mechanical ventilation to maintain indoor air quality. There are many different ventilation systems to consider, but the most energy efficient is ERV (energy recovery ventilation).

ERV is both an energy recovery and a humidity balancing process when exchanging indoor and outdoor air. Most ERV systems can recover about 70 to 80 percent of the energy of the indoor air and deliver that energy to the in-

coming air. ERV vents could replace bathroom venting systems and possibly kitchen venting systems, further reducing exterior wall penetrations and offsetting the cost of the ERV.

Appliances: Simply choose energy star-rated appliances that are listed on the government sponsored website: www.energystar.gov.

Energy conservation through building design

Windows: The strategic placement of windows is crucial in a passive solar house. Design for an overall window to floor ratio of about 18 percent, with 12 to 14 percent on the south side. Minimize the window area of east, west, and particularly the north side of the house. South-facing windows

continues on, page 38



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continued from page 37

should have a Solar Heat Gain Coefficient (SHGC) of 0.5 or greater, in conjunction with appropriate overhangs, to allow for passive solar heat gain in the winter months and shading in the summer months. The remainder of the glass should be a low E 366 double or triple pane filled with argon/exotic gas with a U-value of .15 to .28.

Thermal mass: For successful passive solar design, interior thermal mass is a critical element to maintain steady indoor temperatures by storing the solar energy to later be released during cold winter evenings. A popular, low maintenance, and economical choice is concrete floors with a thickness of three to four inches. Other high density thermal mass materials could be natural stone, steel (I-beams), or thick granite countertops.

Super insulated structure: Strive for at least 40 percent higher R-values than the local building code requires. For example, use a rigid foam of > R10 on the exterior walls, over 2x6 studs that are filled with fiberglass batt or cellulose insulation. This wall profile will greatly reduce any thermal bridging. Use a rigid foam such as polyisocyanurate or spray foam in the roof areas, soffits, and band board.

Air tight envelope: Use a continuous air barrier with all the cracks, holes, and exterior envelope penetrations systematically sealed or caulked. Blower door test results should be less than 1.5 air exchanges/hour @ 50 pascals (inside/outside pressure differential).

HERS Index: Home Energy Rating System (HERS) index is the building industry standard for measuring a home's energy efficiency. Hire a certified Energy Rater early in your project to assess your home's energy performance. A NZE home would have a score of 0. Currently, the local utility company has attractive rebates up to \$4,000 based on the home's HERS score.

Energy production

Now that we have reduced our energy demand to a minimum, we must generate an equal amount of energy in order to balance to net-zero.

Passive solar: If your home site has a southern orientation, utilizing a passive solar design has many

benefits. It is economical to install: follow the North Carolina design guidelines and receive a 35 percent tax credit for associated costs. A good passive solar design can reduce winter heating requirements by 50 percent, and it provides an abundance of natural light, reducing lighting costs. There are no moving parts and it therefore requires little maintenance. Finally, a passive solar design has an aesthetic appeal, as it brings nature into your home through the materials used and ample views of the outdoors.

Active solar: We all like the convenience and comfort of electricity for lighting, appliances, and electronics. In our NZE house, we will need to generate this electricity. Photovoltaic solar panels are economical to install and new designs are increasingly efficient. Solar thermal panels can heat water for domestic purposes, and excess energy could be used to heat the home.

Woodstove and wood burning techniques: Most environmentalists cringe at the concept of burning wood, but in Western North Carolina, with abundant wood resources such as dead rotting trees producing CO₂, wood is a viable means of generating supplemental heat for the home. The trick is to burn clean! Start with firewood that is split into small pieces, seasoned outside for more than two years under cover, and use a newer, high efficiency European wood stove (with more than 75 percent efficiency). With these techniques, one rarely has smoke (or particulates) billowing out of the chimney. And it certainly beats coal-fired electricity in terms of efficiency and pollutants.

Final thoughts: National governments have made limited progress in reducing greenhouse gas emissions. Recently, the EPA proposed a 30 percent reduction in carbon polluting emissions from electrical power plants by the year 2030. Our planet can not wait any longer for action in fighting global warming. We as individuals can make real progress now by taking personal responsibility and reducing the energy use in our homes.

John McDermott founded Green Acres in 2010, a net zero energy eco-community in southeast Asheville. His vision is a sustainable community with organic gardens, orchards, and energy efficient contemporary homes. Perhaps best known locally as co-founder of Highland Brewery, the first Asheville microbrewery, John also created Bola Design to showcase his contemporary furniture and home accessories.

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