Left: Equinox House in Urbana, Ill., is powered by a grid-tied solar photovoltaic array. Right: Ben (blue jacket) and Ty (third from the right on second row) on the porch of Elementhouse with the University of Illinois' 2007 Solar Decathlon team.

Net Zero Energy Project

By Ty Newell, Member ASHRAE; and **Ben Newell,** Associate Member ASHRAE

This is the first of a series of columns that discuss the design, construction and operation of the Equinox House, a net zero energy residence located in Urbana, Ill. Equinox House is powered by a grid-tied solar photovoltaic array designed to supply 100% of its annual energy requirements.

The solar array is sized to provide energy for 6,000 to 8,000 miles (9656 km to 12 874 km) of electric vehicle transportation. The ground mount 8.2 kW solar photovoltaic array, operational since February, has provided energy for building the house.

The goal of these columns is to provide ASHRAE Journal readers with information related to the design and construction of a net zero energy building. Our system of solutions is not the only way to achieve net zero, and we have encountered bumps along the way. The good news is that solar energy for powering residential buildings and electric vehicle transportation is available and affordable now.

Can or should solar energy be implemented into every new or existing house? No. Do other problems exist that must be resolved to make renewable energy-powered homes the majority of the market? Yes. The primary message we hope to convey is that the technology, tools and knowledge to move the housing market in this direction are available today. And, renewable energy powered, zero energy buildings create many new market opportunities for HVAC&R industries.

Solar Decathlon

Over the past three decades, exciting developments in building sciences and solar energy systems have progressed to a state where cost-effective solar-powered residences are now a reality. The Solar Decathlon, sponsored by the U.S. Department of Energy since 2002, has been a great inspiration for many and is a foundation for many of the ideas and experiences incorporated into Equinox House.

ASHRAE has been a sponsor and strong supporter of the Solar Decathlon, which to date has provided an educational opportunity for more than 15,000 college students. During the 2009 Solar Decathlon, more than 300,000 people toured the collection of 20 solar homes brought to the National Mall in Washington, D.C.

Authors Ty and Ben were members of the University of Illinois' 2007 Solar Decathlon team with Ty as a team advisor, and Ben as a construction team member. The Solar Decathlon provided them with firsthand experience of bringing together the skills needed to design and construct a solar house. The array of ideas brought to the competition by all teams is fertile ground for anyone wanting to build a solar powered home.

For example, Equinox House will implement a computerized electrical distribution panel brought to the 2009 Solar Decathlon by the Cornell team. The Solar Decathlon website (www.solardecathlon.gov) contains links to detailed design drawings, equipment specifications and many other facets of the designs.

Equinox House

Central Illinois is a challenging climate that experiences some of Minnesota's arctic blasts and Louisiana's heat and humidity. Equinox House is superinsulated with 12 in. (300 mm) thick structural insulated panels (SIPs) and supersealed (0.37 ach at 0.20 in. w.c. [50 Pa]), resulting in a house whose energy is dominated by the occupants and their activities rather than climate.

Some questions to be addressed in future columns include: How do the energy requirements of a superinsulated and supersealed house compare to those of a modern, conventional house? How much does the effort to superseal a house cost, and what is the payback? Are the thick walls and roof economically justified? How do appliances affect energy requirements and comfort conditioning? How much energy is required to build a house, and can the solar energy system designed to operate the house build the house as well? How do windows and window features impact the energy and cost of the house? What is the energy impact and cost of a concrete slab floor, and should it be insulated?

Ty and his spouse Debra wish to live in Equinox House for many years. As engineers, our decisions impact multiple generations. The authors hope the experiences and information provided in these columns will be helpful to ASHRAE Journal readers.

Meet the Authors

Ty (father of Ben) has worked in solar energy, energy efficiency and resource conservation throughout his career as a faculty member at the University of Illinois at Urbana-Champaign, and now as part of a small HVAC&R research and development firm.

His interest in solar energy and building energy research was spurred by a visit to a newly constructed solar house at Ohio State University in 1975.

Ty was a project engineer at a local factory and visited the OSU solar house as part of a tour sponsored by the local ASHRAE chapter. A young mechanical engineering professor, Stan Mumma, led the tour.

After completing his master's and Ph.D. in 1980, Ty spent 27 years on the faculty at the University of Illinois.

Ben graduated from the University of Illinois in 2002, and is president of Newell Instruments, a small technology firm he started with Ty. He grew up playing in the Solar Energy Lab with graduate and undergraduate students in Ty's research group.