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UK's Green Team Solar decathlon: UK team heads to D.C.

by Campbell Wood

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Lexington, KY - During April, in an industrial building on a street behind the UK football stadium, engineering and architecture students with yellow hard hats worked on a large steel framework – thick beams welded together to form an 800-square-foot space. Upon this framework, under the guidance of UK faculty experts, the students will build a solar-powered house. In October, it will be mounted on a rig and driven to the National Mall in Washington, D.C., where it will compete in the U.S. Department of Energy's 2009 Solar Decathlon. UK was one of 15 U.S. universities awarded entrance to the competition, along with an additional five entrants from outside the United States.

Nearly 125,000 people toured the Decathlon's Solar Village at the Washington Mall in 2007. The competition is the brainchild of Richard King, who has been with the Department of Energy (DOE) since 1986. The overarching goal is to make solar power cost-competitive in the energy marketplace by 2015. The program invigorates research and development in universities across the United States, bringing together engineering and architecture students with top experts to meet the challenge, ensuring that the next generation of professionals will have a good grasp of energy efficiency and renewable energy for building design and construction. This is the fourth Decathlon, which happens every two years.

Don Colliver, professor of bio-systems in the UK Ag-Engineering Department; Greg Luhan, associate dean in the College of Design, and Chike Anyaegbunam, associate professor in the School of Journalism, met with Business Lexington to talk about the project. It's an interdisciplinary endeavor engaging engineering, architecture and communications students.

To compete in the Decathlon is a huge undertaking, said Colliver, who has 20 years of experience in energy efficiency. He attended the 2007 Decathlon as the representative of the American Society of Heating, Refrigerating and Air-Conditioning Engineers and gave guided tours of the 20 solar houses to Kentucky state government officials. "I got encouragement from people with the Kentucky state energy offices," Colliver said. "I was told we ought to give it a shot." He heads the project.

The journey to date has involved many people and a few stages. In the fall of 2007, Colliver and Luhan wrote the proposal, which they submitted to the DOE and its National Renewable Energy Laboratory. In January of 2008, UK was awarded entrance to the Decathlon. An Open Ideas Competition engaged building professionals, solar energy researchers and research centers throughout the commonwealth to submit ideas and preliminary designs for the Decathlon. Hundreds of ideas came in and led to an exhibit at UK in March. Then came the Design Competition, which was restricted to UK students. Faculty gave an intensive workshop in design basics to 135 students. They were divided into 39 teams, each team charged with creating a design. A panel of 12 outside experts selected the five best designs. A design integration team with architecture, engineering and communications students worked last summer to study the five winning designs and develop a single design, which was submitted to DOE in June 2008. "Don and I worked together to evaluate that design," said Luhan. "Then we set out a series of performance values and criteria that we want the house to achieve in order to gain the most points in the competition."

The Solar Decathlon has 10 contests or categories. One of those categories is Net Metering. The Solar Village will be linked up to a local energy grid set up for the event. Each solar house will have a meter, and if the meter shows the house's performance goes beyond net-zero, generating more electricity than it consumes during the contest, it will gain more points.

To maximize the house's performance, achieving maximum energy efficiency came first. Ten-inch thick walls with insulation made from crop residues derived from soy, corn husks and rice hulls combined with a "triple-insulated, high performing, Low-E coated glazing system," – that is, extremely efficient windows and skylights – combine to produce an average R-value of 40 for the walls. The ceilings and floors will have an R-value of 60. The south-facing windows are made of electrochromic glass, also called smart glass, which controls the passage of light and heat, cutting down on air conditioning

and heating demands. A Demand Control Ventilation system with temperature sensors will eliminate excessive ventilation, which would raise energy consumption. GE provided Energy Star appliances, some of them Energy Star Tier 3, which are 30 percent more efficient than standard Energy Star. There are exterior sensors measuring wind speed and temperature. Inside the house, 47 temperature sensors, 15 electrical flow sensors, five humidity sensors and five water flow sensors will monitor the performance of all the systems. Six teams of engineering students worked with Colliver on the different engineering facets, always in cooperation with the design side of the effort.

Atop the roof is an 800-square-foot, single-axis-tracking solar array that can be adjusted to angle for maximum sunlight absorption during the different seasons. The photovoltaic panels used are among the highest efficiency panels on the market, and are the same kind as installed on the Forrestal Building, the DOE headquarters in Washington. A solar hot water system is mounted on the house's south side.

Another category of the competition is Market Viability, which includes the appeal of the design. Teams of architecture students have designed the building and its interior for adaptive living, making it an "Aging in Place" house. They studied the Americans with Disabilities Act and made the house fully accessible, with an entrance ramp onto the deck, no interior steps or thresholds, counter tops in the kitchen and a sink in the bathroom that can be raised or lowered, and support bars and ledges where needed – with all of it designed to please the eye. They drew on Shaker design by placing pegs on the wall from which hang wood art objects, which turn out to be folded chairs. A dining table, seating up to eight people, glides out of an interior wall with legs that lower to support it. There's a fold-down desk in the bedroom and an entertainment center in the living room.

The project is rife with ingenuity. "Every time there was an opportunity for some kind of invention or innovation, we took advantage of it," said Luhan. He said the project has created spin-offs of product development, new materials research and rapid deployable structures technology. The building will be a prototype and a "demonstration of proof of concept." That proof will lead to increasing demand for energy efficiency and renewable energy, and the building industry will follow.

The UK solar house will be displayed at the National Mall and open to public visits from October 9 through October 13 and October 15 through October 18. It will also be visible in the coming months somewhere yet to be determined on the UK campus, after it is weatherized and moved outdoors for completion. During the 2010 Alltech Equestrian Games, it will serve as Lexington's Visitors Center. And it will serve as a laboratory for continuing education and refinement of its systems for UK engineering and architecture students.