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## **THE OFF-GRID, ZERO EMISSION BUILDING AT FSU**

### **Request**

The Sustainable Energy Science & Engineering Center (SESEC) at Florida State University (FSU) respectfully requests \$130,000 to build the Off-Grid, Zero Emission Building (OGZEB), a prototype living/working area that will serve as a test bed for the development of new alternative energy technologies. The OGZEB will also provide valuable experience for the construction of a similar building that will be prepared for the Solar Decathlon 2009, a biannual international collegiate competition held by the National Renewable Energy Laboratory (NREL).

### **Purpose of the Project**

The OGZEB involves the design, construction and operation of a completely solar-powered building. An 800 square foot building, the OGZEB will be partitioned so that 600 square feet will be a two-bedroom, graduate style flat with the remaining 200 square feet serving as office space. This arrangement will allow for the building to serve as an energy efficient model for campus designers in student living and office space. More specifically, though, the building will serve as a prototype for developing and implementing cutting edge, alternative energy technologies in both residential and commercial settings. Additionally, the OGZEB is expected to cost approximately \$300,000, or \$375 per square foot. To put this figure into perspective, the top ten houses from the Solar Decathlon 2005 competition averaged 600 square feet at a cost of \$550 per square foot.

### **Project Description**

Since the sun is not a constant source of energy throughout the entire day, excess energy will need to be generated to provide energy storage that allows power to be continuously supplied to the house during non-daylight hours. The most common solution to this problem is the use of high efficiency batteries for energy storage. This approach has been, and continues to be, the de facto solution used by the teams in the Solar Decathlon. However, high efficiency batteries are extremely expensive and they have a limited lifetime. Alternatively, the OGZEB will use excess energy from photovoltaic (PV) panels, also known as solar panels, to produce hydrogen through the use of a highly efficient water electrolysis device that is currently being developed at SESEC. This hydrogen will be stored until it is required, at which time it will be fed to an innovative fuel cell, which is also being developed at SESEC. This project will not be the first to use hydrogen as an energy storage medium, but it will be the first to employ innovative hydrogen technologies that are not currently commercially available.

The hydrogen will also be used to address the biggest consumers of energy in a building: space heating, cooling and the generation of hot water. Through combustion in a furnace, the hydrogen will provide sufficient heat for space heating and will also generate sufficient heat to use advanced ammonia absorption technology for air-conditioning. The hot water will be generated through the use of an on-demand hot water heater that will be modified to use hydrogen as its working gas. The use of hydrogen to meet these needs is unique to this project. Using an ammonia absorption cycle is also an original concept, especially considering that one does not exist for a building this small.

High efficiency electronics and lighting, along with good insulation, can greatly reduce the energy needed to make the atmosphere in the building comfortable and enjoyable. The OGZEB will include low energy, spectrally selective windows, LED lighting, low air infiltration and extensive use of passive solar heating.

Environmental consciousness is also considered during the design and construction of the OGZEB. Every attempt will be made to build the home with recyclable materials that are not detrimental to the environment during their creation and use. In fact, the design and construction of the OGZEB will be guided by the LEED (Leadership in Energy and Environmental Design) Green Building Rating System, which has been developed by the United States Green Building Council (USGBC/[www.usgbc.org](http://www.usgbc.org)). The LEED system is based on well-founded scientific standards and emphasizes state-of-the-art strategies for sustainable site development, water savings, energy efficiency, materials selection and indoor environmental quality. LEED certification, which includes design and construction reviews, will be pursued for the OGZEB so that it can proudly be referred to as a “green building.”

The students and staff of SESEC, in close collaboration with the campus designers at FSU, will design the OGZEB so that it meets all of the above-mentioned goals, as well as any federal, state, local and university building codes. The students and staff of SESEC will carry out the basic construction of the home, such as the framing and the plumbing. Contracted professionals will perform the more advanced construction, such as the building wiring. Construction on the OGZEB is anticipated to begin during the summer of 2006 with project completion expected during the spring of 2007.

## **Conclusion**

The successful completion of the OGZEB will accomplish a number of goals. First, it will provide SESEC with a test bed for the further development of alternative energy based technologies that can be implemented in residential and commercial applications. Second, it will provide FSU with a “green building” that demonstrates both graduate student housing and office space without burdening the local utility system. Such a building is likely to garner positive national attention because it is being built as a practical demonstrator and not for competition purposes. Third, it will provide the students and staff of SESEC with the experience required to be competitive in the Solar Decathlon 2009, the proposals for which must be submitted during the fall of 2007.

Lastly, and possibly most important, the OGZEB will expose the students at FSU and the citizens of Tallahassee to the benefits of “green” building and engineering, as well as alternative energy sources. This type of exposure is necessary to change public opinion and overcome some of the negative stereotypes that have been promulgated regarding these types of technologies.

### **Description of the Solar Decathlon Competition**

The long-range goal of this competition is to develop and demonstrate solar powered homes in which the whole house levelized energy cost is \$0.10/kWh by 2015. University teams must submit an extensive proposal to participate in the Decathlon, and only twenty teams are selected to compete. Each of the selected teams designs and builds a 500 – 800 square foot modular home that must be powered entirely through solar energy. For the competition, the home must be moved from its construction site to Washington, D.C., where it is scored based on ten specific tasks. On average, the top ten houses from the Solar Decathlon 2005 competition averaged 600 square feet at a cost of \$550 per square foot. As mentioned above, the OGZEB will be at the upper size limit (800 square feet) with a lower projected cost (\$375 a square foot). This significant savings is the result of using cutting edge technology not found in any of the previous Solar Decathlon homes.