

UNIVERSITY OF SOUTH FLORIDA

Energy Efficient Technologies and The Zero Energy Home Learning Center

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Description: The project is to create and evaluate an affordable residential scale Zero Energy building that will function as an exhibition of energy efficiency and Zero Energy Home [ZEH] technology on or near the University of South Florida campus. The project will feature the most cost-effective combination of renewable solar energy with high levels of building energy efficiency. The building will incorporate a carefully chosen package of the latest energy-efficiency technologies and renewable energy systems to achieve the most successful and reliable results.

The building will utilize Photovoltaic solar electricity and solar domestic hot water heating systems using the grid as an energy storage system, producing more energy than needed during the day and relying on the grid at night. Plug-in hybrid automobile technology offers a promising means of providing distributed energy storage for such homes but has not been sufficiently tested. Using a systems approach to couple zero energy home technology with PHEVs we will explore opportunities to develop marketable products that meet Florida's energy and environmental goals.

Budget: \$344,600

Universities: USF, FSU, UF, UCF

Student support: Mario Rodriguez continued as a Student Assistant from 10/1 until the present

Sean Smith began as a Student assistant from January 2011

Jean Frederic Monod began as a Student assistant from January 2011

External Collaborators: Palm Harbor Homes, Hees and Associates Structural Engineers, David Young Landscape Architect

Progress Summary

Design Development was completed in November of 2010. The 889 square foot Zero Energy House Learning Center is a flexible, modular, pre-fabricated, net zero energy prototype that can adapt easily to different site situations and client needs. The key factor shaping the design approach is Florida's mild climate and an indoor outdoor lifestyle. FLeX House combines the wisdom of vernacular Florida houses, ZEH research, with cutting edge technologies to make a holistic systems engineering based, zero energy building package. The project will feature the most cost-effective combination of energy-efficiency technologies and renewable energy systems. The ZEHLC will serve as a teaching and learning tool on campus while promoting the use of ZEH technologies throughout the southeastern US.

The prefabrication process maximizes efficiency and quality control and reduces waste when compared to the site built counterpart. Once fabricated, the main body of the house can be shipped to the site on a single truck minimizing transportation costs. The main body contains sliding modules that are deployed from the main body to complete setup at the site quickly with a minimum use of equipment and labor. The modular system is easily expandable and reconfigurable according to the wants and needs of the client and the site situation.

The plan is laid out on the east west axis to maximize shading and natural ventilation and minimize direct solar gain. Because of the hot climate, the living spaces focus on the cooler, north side of the site. The

entire north wall, composed of sliding glass panels can be opened combining the interior living spaces, the exterior deck and the garden into one continuous indoor/outdoor space. The interior space can be left open with a continuous flow from the kitchen to the master suite/office area, or it can be partitioned to separate the living and bedroom areas for privacy and to create two separate thermal zones for energy conservation.

Building Envelope- Designing an envelope that works equally well throughout the year combining an optimum level of insulation, resistance to air infiltration, transparency for daylight, and flexibility, is a challenge in Florida's hot humid climate. Flex house incorporates a double skin system. The outer skin or "umbrella" is composed of cypress [a locally grown wood] louvers that provide complete shade for the building envelope for most of the year and allow the sun in for passive heating on a selective basis. The umbrella is also the support structure for the solar array that consists of Photovoltaic panels for electrical generation and solar thermal panels for water heating. The inner skin, the building envelope, is composed of structural insulated panels with a corrugated metal exterior finish. Metal is an ideal material for this climate because of its high reflectivity and low thermal mass. Because the umbrella provides complete shade and there is a relatively low average indoor-outdoor temperature differential in Florida, the envelope is relatively thin with a modest insulation value. All of the glazed surfaces are double pane, low e glass insulating glass.

Clean Renewable Energy- As a net zero energy house FLeX House utilizes Photovoltaic panels for site based, clean renewable energy generation. The grid tied 5 kW array will send electricity back to the municipal electric utility grid during peak hours of generation and FLeX House will take electricity from the grid in the evening or on cloudy days. Over the course of a year the net consumption from the grid will equal zero.

Water conservation and collection- Flex House is equipped with low flow fixtures to conserve water. Rain water is diverted from the roof into a cistern where it is stored and used for irrigating the organic vegetable garden.

Energy efficiency- To keep energy consumption to a minimum FLeX House includes high efficiency energy star rated appliances. To reduce the amount of energy required for lighting, FLeX House was designed to make the best use of natural day light for its interior spaces with large glazed areas on the north and south facades and light colored interior finishes that reflect the light and brighten the interior spaces. At night highly efficient LED and compact fluorescent lights will provide illumination. Shading devices are designed to control the amount of direct sunlight that hits the glazing system reducing heat gain through windows and doors. Energy efficiency is also related to the operation and monitoring of building systems. The house employs whole building systems control and diagnostic software that monitors more than 35 channels of data (i.e. temperature, humidity, power, occupancy schedules, window operation incidences, etc.) to make the owners aware of when and where energy is being used and when systems are malfunctioning resulting in excessive energy usage.

Mechanical Systems- The HVAC system consists of a heat pump and solar thermal panels that circulate chilled or heated water to two interior fan coils to cool or heat the house. The energy recovery ventilator [ERV], by precooling the outside supply air, allows the chilled water system to run more efficiently. The ERV combined with a liquid desiccant dehumidifying system allows the fan coil temperatures to exceed the dew point while still maintaining good indoor air quality.

Durability- Flex house is designed to meet Florida's demanding hurricane code. All exterior finish materials have been tested for impact in hurricane winds and have obtained the required Florida product

approvals. The building skin is durable, galvanized corrugated metal and the wood lovers are made from cypress which has a natural resistance to rotting and intrusion from insects. In the off season the bedroom and entry modules can be slid back into the main body of the house and the entire exterior can be shuttered to protect the house from the weather and vandalism.

Construction Documents were completed in March and a contract between Beck Construction and USF was finalized. Beck construction is currently lining up subcontractors and ordering materials. Construction will begin on 4/19 and last until the first week of August.

New collaborations		
Florida Power and Light TECO	Sponsor	\$10,000
OUC	Sponsor	\$10,000
Progress Energy	Sponsor	\$10,000
USF COE	Sponsor	\$10,000
UCF	Sponsor	\$20,000
Wells Fargo	Sponsor	\$16,000
CSI	Sponsor	\$15,000
Solar World	Sponsor	\$500
Bosch	Sponsor	Gift in Kind
Sothern Cypress Manufacturers	Sponsor	Gift in Kind
Simpson Strongtie	Sponsor	Gift in Kind
Kohler	Sponsor	
Dupont	Sponsor	Gift in Kind
Pella, CWS	Sponsor	Gift in Kind
Lithonia	Sponsor	Gift in Kind
Beck Construction	Industry Partner	

Proposals					
Title	Agency	Investigators/ Collaborators	Funding requested	Duration	Date submitted
TechnologyFee Grant	USF	Stanley Russell Mark Weston Yogi Goswami	\$223,462	1 year	3/15/2011