



Demonstrating Zero Energy Homes at Fort Campbell, KY

**OFEE Environmental Symposium West
June 08**

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Description of Project



- ▶ **Fort Campbell Family Housing LLC is investing \$500k to design and construct ~10 zero energy homes**
- ▶ **IMCOM-SE and Fort Campbell obtained \$854k from DoD ESTCP to validate cost and performance**





Problem Statement



- ▶ **DoD perspective: unpredictable energy costs are killing us!**
 - 300,000 DoD homes used 11 trillion BTUs of electricity at a cost of \$254M in FY06.
 - Southeast Region energy costs increased from \$163M to \$209M FY04-FY06 – a 28% unprogrammed increase

- ▶ **Industry Perspective, FCFH and Actus Lend Lease:**
 - Identify and develop opportunities
 - Manage risk
 - Maintain high occupancy rates
 - Compete worldwide
 - Ensure corporate longevity – sustainability!



About Zero Energy



- ▶ Zero Energy Homes produce as much – or nearly as much – energy as they use
- ▶ US Department of Energy “Building America” program
 - Partnership with industry to demonstrate potential
 - Hundreds of homes built since 2003
 - Most in California, Arizona, Nevada
 - Most at high end, though prototype Habitat and double-wide are being built
 - Monitoring of the homes’ cost and performance

Six Homebuilder Teams

- ConSol
- Davis Energy Group
- NAHB
- Steven Winter Assoc.
- Building Science Corp.
- IBACOS, Inc



About Zero Energy



- ▶ **DOE's ZEH initiative shows that it is technically feasible**
 - the question is how to do it cost effectively in different regions of the country and with traditionally-sized homes
- ▶ **ZEH success depends on:**
 - energy efficient design and construction
 - on-site renewable energy generation, and
 - energy conservation practices by the homeowners
- ▶ **This project will test the ZEH concept:**
 - in a mixed-humid climate
 - **With resident conservation incentives: residents required to pay cost above established baseline unique to each home**

Performers



THE COMMUNITY
OF *Choice*

FORT CAMPBELL FAMILY HOUSING



NDCEE

National Defense Center for Environmental Excellence



Technical Approach



- ▶ **Use energy modeling to identify ways to reduce annual energy use by 50-70%**
- ▶ **Incorporate renewable energy systems to provide 100% of the home's annual energy requirements**
- ▶ **Educate residents**
- ▶ **Compare costs and performance of two ZEH versus two conventional homes**



Technical Approach



Task 1 – provide technical assistance and modeling to the Architect of Record (Mar 08 - Jan 09)

LEGEND	
JNCO	180 Units
SNCO	290 Units
CSM	51 Units
TOTAL: 521 Units	
Retail & Community Center	



Design charrette scheduled for May 08!!





Technical Approach



Task 2 – Construction and Monitoring: document construction techniques and costs, install monitoring equipment, educate residents, and commission

(Jan 09 – Jan 10)





Technical Approach



Task 3 –Performance Validation (Jan 10 – Dec 10)

- ▶ **Factors to be measured**
 - Energy consumption, cost and use patterns
 - Environmental impacts, including indoor environmental quality (humidity, temperature, air pollutants)
 - On-site energy production
 - Maintenance costs and man-hours
 - Occupant comfort and satisfaction
 - Life-cycle, net present value, simple payback and return on Investment (ROI) analysis



Technical Approach



Task 4 – Technology Transfer (Mar 08 – Dec 11)

- **Installation advisory committee for “tech transfer on the fly”**
- **Present lessons learned to-date at a major building industry conference every year**
- **Disseminate our results via on-line case studies**
- **Actus Lend Lease will apply to the 145,000 homes they manage worldwide**



Potential Benefits



- ▶ **Calculated savings of \$5 million per year if applied to all 4,455 housing units planned for Fort Campbell, at 70% energy use reduction**
- ▶ **Potential savings at net zero energy depend on decreased technology costs, increased energy costs, and/or additional economic incentives**
- ▶ **100,000 gallons reduced water consumption per home per year for electric power generation (NREL report: Kentucky “near zero” home)**
 - **445 million gallons/year for all Ft. Campbell homes**
- ▶ **50,000 pounds reduced air pollutants per year per home associated with energy production, distribution and use**
 - **CO₂ emissions reduced 44,406 pounds per year per home**
 - **Over 222 million pounds of pollutants (~198 million lbs of CO₂) reduced for all 4,455 homes**



“...advances in technology will halve the price of solar-panel installations in as little as three years...By 2014, solar system prices will be competitive with conventional electricity... Deutsche Bank says.”
(USA Today, 27 Aug 07)

Long term ZEH ROI depends on costs of renewables falling – crystal ball stuff



Questions?





Backup Slides



Technical Risks



- ▶ **Primary risk comes from maintenance and occupant behavior in the ZEH**
 - somewhat mitigated by education and training
- ▶ **Cost and technical risk is low because the technologies employed are already commercially available**
- ▶ **Schedule risk is similar to other construction and demonstration/validation projects**
 - mitigated with disciplined project management



Methodologies



- ▶ **Energy consumption, environmental impacts, operational effectiveness, and life-cycle costs will be modeled and measured for each of the test and conventional homes:**
 - Energy 10 software to model energy use of technology options
 - Life-cycle costs will be calculated IAW ASTM and DoD standards
 - Environmental impacts/benefits will be calculated IAW ISO14040-series on life-cycle assessment and other international standards
 - Greenhouse Gas Emissions (GHG) accounting will follow GHG Protocol
 - Water consumption for power generation will incorporate DOE factors
 - Construction costs will be documented directly during construction
 - Energy consumption and indoor environmental conditions—temperature, humidity, and indoor air pollution—will be documented with data loggers and transmitted via high-speed internet
 - Energy costs will be captured from utility bills passed to FCFH
 - Maintenance costs will be recorded for all four homes by tracking man-hours required to maintain each home
 - Occupant comfort and satisfaction will be documented through a periodic survey developed by PNNL and used extensively by Navy



Cost Estimate



Total ESTCP funding request: \$854K over 4 years

Performer	FY08 (\$K)	FY09 (\$K)	FY10 (\$K)	FY11 (\$K)
IMCOM-SE / Fort Campbell	10	10	10	10
NDCEE/subs	199	204	125	187
PNNL		30	30	30
FCFH	0	0	0	0
Actus	0	0	0	0
Total	209	244	165	227

Leveraged funding that will be provided by project partners: \$970K



Transition Plan



- ▶ All of Task 4 is devoted to Technology Transfer
- ▶ The proposed demonstration project will allow **detailed analysis and documentation of ZEH** that has not been published to-date
- ▶ We will present lessons learned to-date at a major building industry conference every year
- ▶ We will disseminate our results via on-line case studies and ESTCP Cost & Performance report on the ESTCP, National Association of Home Builders, DOE's FEMP High Performance Building database and "Building America" websites
- ▶ Actus Lend Lease will apply to the 145,000 homes they manage

Schedule of Milestones



Tasks	2Q CY08	3/4Q CY08	1/2Q CY09	3/4Q CY09	1/2/Q CY10	3/4Q CY10	1/2Q CY11	3/4Q CY11
1 - Project Mgmt & Design								
2- Design/Construction/ Monitoring Setup								
3 - Performance Monitoring & Validation								
4 - Technology Transfer								
Reporting		DP					FR C&PR	