



NDCEE

National Defense Center for Energy and Environment

Demonstration of Zero-Energy Housing (ZEH) Concepts at Army Installations

Ms. Heidi Anne Kaltenhauser, *CTC*



DoD Executive Agent

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Presentation Highlights

- ZEH and why the Army is interested
- NDCEE work with the Army
- Demonstration findings to date

Zero-Energy Housing

- Designed to maximize occupant well-being while minimizing energy requirements
- Combines energy-efficient technologies and construction techniques with renewable energy systems (e.g., photovoltaics)

$$\text{Energy Consumption}_{\text{house}} = \text{Energy Generation}_{\text{house}}$$

ZEH Drivers

- In FY06, 300,000 DoD homes used 11 trillion BTUs of electricity at a cost of \$254M
- Executive Order 13423, Energy Policy Act of 2005, and Army policy require more energy-efficient/less polluting buildings
- Energy efficiency leads to reduced electricity use and costs, increased energy security, reduced greenhouse gases, and potentially an improved living environment

Task Overview

- Evaluate the applicability, accuracy, and usefulness of energy modeling to predict energy consumption associated with baseline conditions and candidate energy-saving technologies.
- Evaluate ZEH-related technologies on their ability to cost-effectively reduce energy consumption in newly constructed and historic homes.



Working with Military Housing Developers/Managers

- Enabled by Residential Communities Initiative (RCI)
 - Objectives
 - Eliminate inadequate military housing
 - Eliminate deficit
 - Approach
 - Military Housing Privatization Initiative: 1996
 - Obtains private expertise/ capital to solve housing problems
 - Oversight
 - 50-year lease – all resources revert to Military at end of lease
 - Portfolio and Asset Management
- Equipment and construction costs provided by Army Hawaii Family Housing

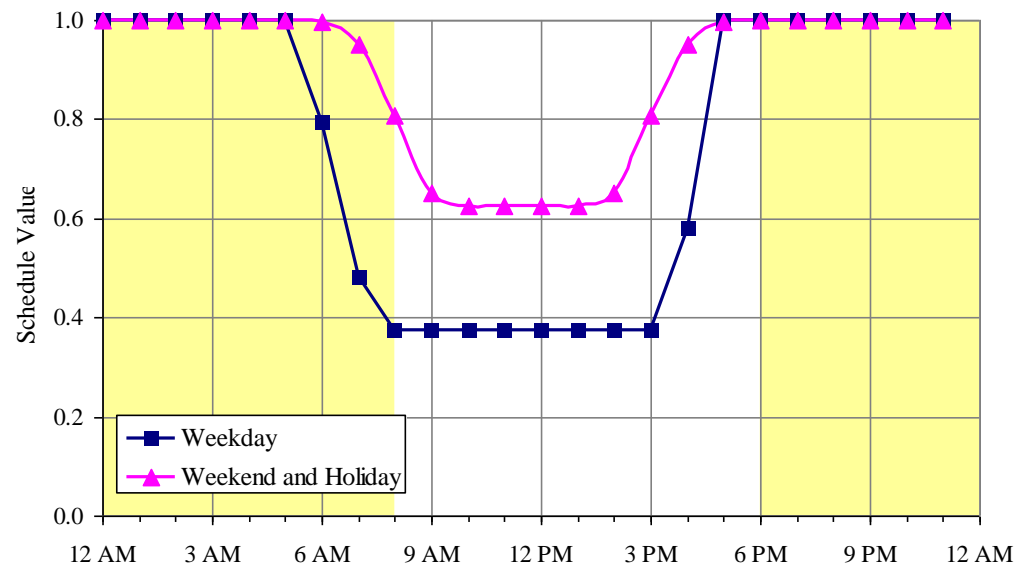
ZEH Concepts Demonstration Approach

- Identify technology integration opportunities within RCI developments to achieve zero (or near zero) energy homes
- Team with RCI development partners and coordinate with Army Installation Management Command to ensure success
- Conduct energy modeling and analysis to determine high-performance, cost-effective technology integration strategies
- Demonstrate and validate costs/benefits to include energy, cost, environmental, and operational performance

Energy Modeling via eQUEST

Computer-based tool that simulates a building's energy usage

- Optimize the building design
- Allow the design team to prioritize investment strategies



Occupancy Profile

Weather Data - Building Envelope -
Internal Gains - Schedules - Systems

Accomplishments

- Identified 14 low-cost technology integration strategies to improve energy efficiency for 7,900 new and renovated “historic” homes
- Conducted energy analysis using commercially available modeling software to evaluate alternative strategies
- AHFH is installing 3 technologies, and the NDCEE will monitor to demonstrate and validate performance
 - Radiant barrier in walls
 - Low absorptance house coating
 - Increased ventilation (solar attic fans)

Computer Simulation - Shading Study



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Preliminary Energy Modeling Results

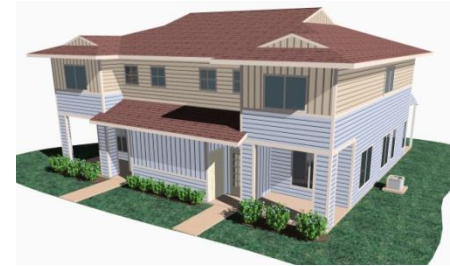
Technology/Design Element	Annual Energy Savings per House*
Passive Ventilation	Up to \$200
Active Ventilation	Increased costs
Window Shading	\$200 - \$400
Radiant Barriers – wall and roof	Could not model
House Coating	Up to \$150
Increased Insulation – walls and roof	Minimal impact
Thermal Mass – ceiling and floor	Minimal impact
Building Orientation	Up to \$150

*All Calculations based on \$0.175/kWhr; Capital costs not included.

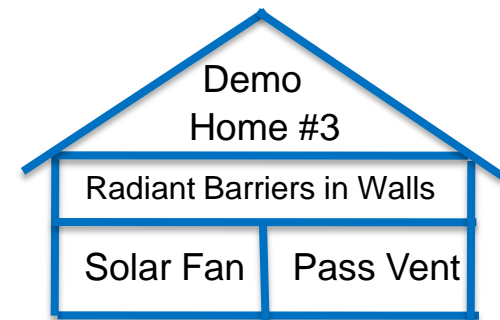
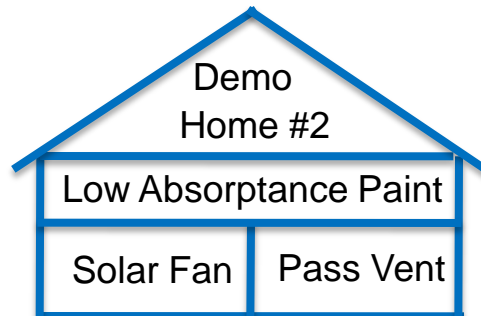
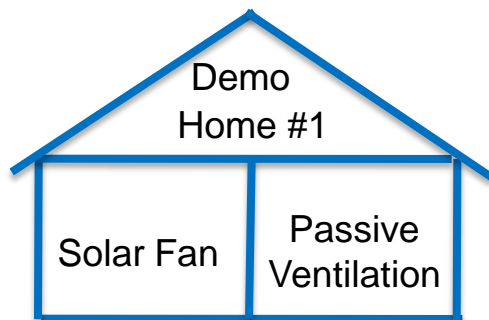
New Construction Demonstration (Duplex)

Demonstration Homes

- Same Street
- Same Orientation
- Similar Family Size



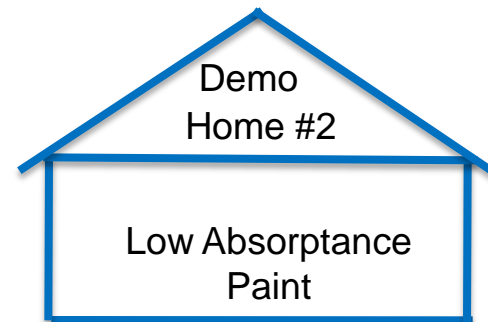
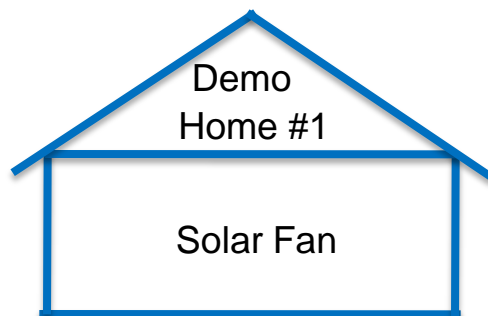
1 Control Home
Standard
Construction



Historical Homes



1 Control Home
Original Construction



Path Forward

- Monitor homes
- Validate overall cost savings (energy savings – technology capital costs)
- Determine energy performance and validate modeling as residential design tool

ZEH Concepts Summary

- The NDCEE's demonstration/validation of innovative technologies is improving the Army standard for military housing
 - Enhancing quality of life for soldiers and their families
 - Supporting the design and construction of sustainable, high-performing buildings
 - Reducing operating costs while achieving sustainability goals
 - Reducing energy and water consumption, air emissions, and construction debris sent to landfills

***Benefits the soldier, the RCI development partner,
and Army stewardship***

Project Stakeholders

- Army Hawaii Family Housing (AHFH)
- Actus Lend Lease
- Schofield Barracks
- Engineer Research and Development Center-
Construction Engineering Research Laboratory (ERDC-
CERL)

Contact Information

NDCEE Technical Monitor

Task: 0440 - FY05 Sustainable Installations Initiative

Name: Dr. Chris Rewerts

Organization: ERDC-CERL

E-mail: chris.rewerts@us.army.mil

Phone Number: (217) 373-5825

NDCEE Project Manager

Name: Ms. Donna Provance

Organization: CTC/NDCEE

E-Mail: provance@ctc.com

Phone Number: (919) 303-4323

NDCEE Technical Lead

Name: Ms. Heidi Anne Kaltenhauser

Organization: CTC/NDCEE

E-Mail: kaltenha@ctc.com

Phone Number: (502) 897-7815

www.ndcee.ctc.com

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