

NDCEE

National Defense Center for Environmental Excellence



DoD Executive Agent
Office of the
Assistant Secretary
of the Army
(Installations and
Environment)

Army Energy Initiatives Zero-Energy Housing (ZEH) Concepts and Energy Surety

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The NDCEE is operated by:  *Concurrent Technologies Corporation*

Technology Transfer—Supporting DoD Readiness, Sustainability, and Transformation

Energy Initiatives: Zero Energy Housing Concepts Army Power and Energy Initiative

- Energy efficiency:
 - ↓ electricity use
 - ↓ costs
 - ↑ energy security
 - ↓ greenhouse gases
 - Improved occupant comfort
- Executive Order 13423
- Work is transferable across all Services and into the private sector

ZEH Concepts Demonstration

- 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

Zero-Energy Home:

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

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

Army Power and Energy Initiative

- Development of an energy security self audit model to be used by Army Installations to define and prioritize critical energy demands in the state of an emergency and identify installation energy vulnerabilities that need to be resolved.
- Identification of installation critical P&E needs, development of promising technologies that can be rapidly transitioned to the war-fighter at forward deployed bases, and assist installations in addressing and improving energy surety vulnerabilities identified in previously stated goal.

Installation Energy Surety Assessment: An estimated level of security or guarantee against the loss, damage, or default of electricity, heat, transportation, etc., from resources such as petroleum, coal, gas, wind, nuclear fuel, and sunlight that may affect an installations ability to sustain the mission.

Demonstration Sites

■ Zero Energy Housing Concepts

Ft Campbell, Kentucky:

- Assist with the design of ZEH by optimizing energy efficiency and sizing photovoltaics.

Schofield Barracks, Hawaii:

- 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.

■ Army Power and Energy Initiatives

Fort Leonard Wood, Missouri:

- Trial Validation of existing ACSIM Army Installations Energy Vulnerability Assessment Guide by information gathering and actively engage in assessment workshops.

Fort Sill, Oklahoma:

- Further validation of enhanced guide that will facilitate development of the Energy Surety Self-Assessment Model
- Identify Critical Energy needs within the installation and facilitate Technology Demonstration related to mitigating Energy Concerns.

Site 3 TBD

Ft. Campbell Family Housing (FCFH)

■ Phase I Results

- Identified technology portfolio to reduce energy use by 51%, saving \$800/home annually (with 4,455 homes planned for FCFH)
- Potential for \$3.5M in annual savings

■ Phase II: NDCEE/FCFH/IMCOM Southeast/ESTCP

Integrated Design: Optimizing interconnecting relationships to produce a high-performance and cost-effective project

Integrated design - mixed-humid climate - resident conservation incentives

Expected Results

Reduce energy use by at least 70%

Use of on-site renewable energy meeting remaining demand

Reduce Energy-related pollutants by 50,591 pounds per year per home

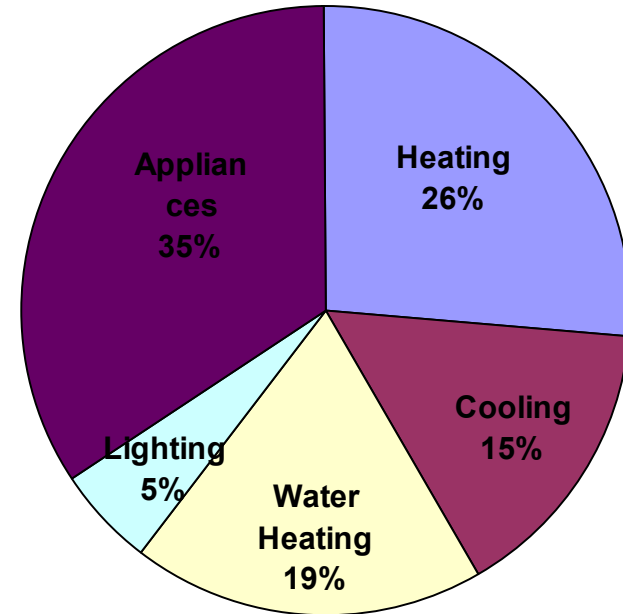
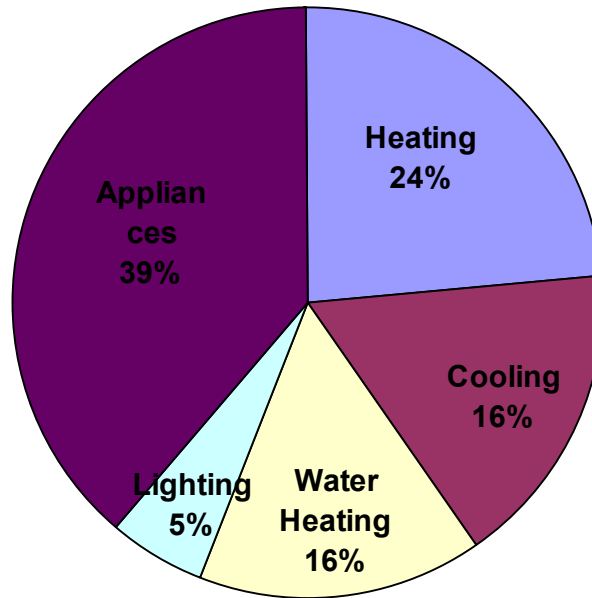
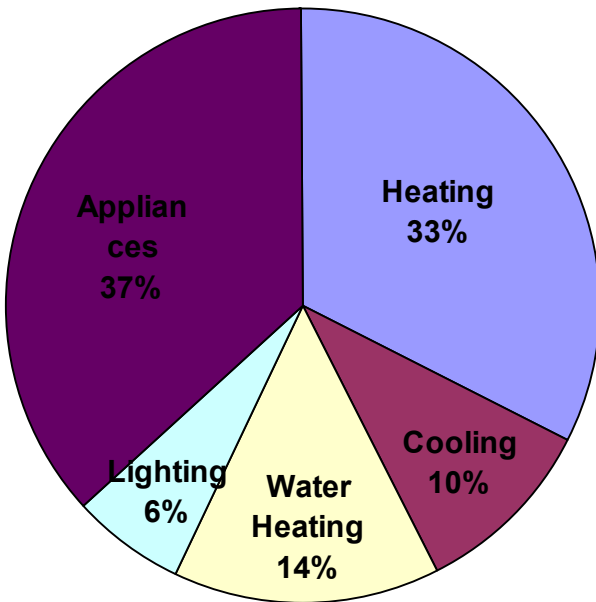
Transferable Results

Comparison of Baseline Modeling Results to DOE RECS Data (by Census Division)

RECS Data
Midwest, East
North Central

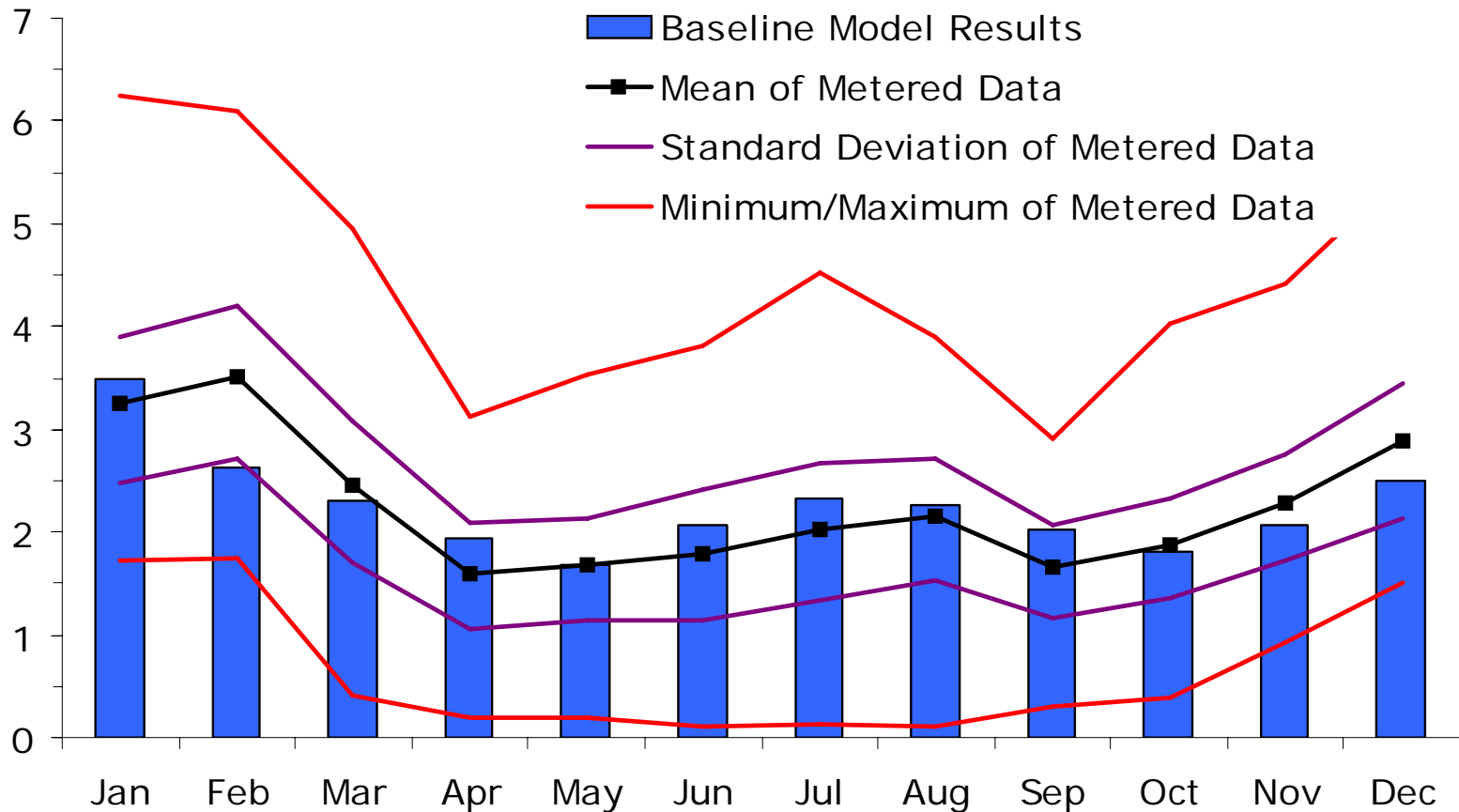
RECS Data
South, East
South Central

Ft Campbell
Baseline Energy
Model



RECS: Residential Energy Consumption Survey

Comparison of Baseline Results to Metering Data



Ft. Campbell – Evaluated Technologies

Orientation	45 degree changes	North			
Hot Water	GSHP assist	Tank			
Appliances	Energy Star	High efficiency			
Doors	Metal insulated, wood frame	French doors			
Lighting	Incandescent	Fluorescent	Daylighting	CF	
Roofing	Asphalt	Rubber	Concrete	Metal	
Insulation	R13 batt	Spray foam	ICP	SIP	
HVAC	Heat pump	Improved SEER	GSHP	2 zone GSHP	
Wall Construction	Various stud sizes	Wood studs	Steel studs	SIP	ICF
Attic Space	R30 blown + RB	Vapor retarder	Attic fan	RB drape	R45 blown

Largest savings

Army Hawaii Family Housing (Schofield Barracks)

- 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
 - Most promising strategies: passive ventilation, natural or artificial shading, and reflective coatings
- AHFH will install 2 to 4 technologies, and NDCEE will monitor to demonstrate and validate performance

Schofield Barracks – Preliminary 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

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

Path Forward

- ZEH concepts
 - **Ft Campbell: Begin ESTCP project in 1st Quarter 2008**
 - **Schofield Barracks**
 - Refine preliminary modeling of proposed energy saving technologies/features
 - Install 2-4 technologies and complete proof of concept to verify energy modeling as a tool for residential home design
 - Calculate overall cost savings (energy savings – technology capital costs)
- Army Power and Energy Initiative
 - **Site Assessments - Perform three site assessments to develop & validate the Installation Energy Surety Audit Model.**
 - Assess potential On and Off Post Energy Concerns, consequences of potential energy disruptions, and perform integrated analysis and prioritize the results for future actions.
 - Develop an Energy Surety Audit Model that can be tailored to each installation.
 - **Identify Critical Needs by determining any Critical P&E Need that requires technological solution demonstrations.**
 - **Some potential P&E systems may include:**
 - Waste-to-Energy System
 - Micro-turbine Fueled by Anaerobic Digester Gas (ADG)
 - Modeling & Simulation of potential Microgrid Networks
 - Validation of Microgrid Model

Energy Initiative Stakeholders

- Engineer Research and Development Center-Construction Engineering Research Laboratory (ERDC-CERL)
- Installation Management Command (IMCOM)
- Schofield Barracks
- ZEH concepts
 - Ft. Campbell Housing
 - Army Hawaii Family Housing (AHFH)
 - Actus Lend Lease
 - URS
- Army Power and Energy Initiative
 - Fort Leonard Wood, Missouri
 - Fort Sill, Oklahoma
 - Assistant Chief of Staff for Installation Management (ACSIM)
 - Note: Future Installations will be selected based on Critical Needs Identification

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