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Habitat For Humanity Case Studies

Florida Solar Energy Center

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FLORIDA SOLAR ENERGY CENTER®

CONTRACT REPORT

Building America Industrialized Housing Partnership (BAIHP)

Habitat for Humanity Case Studies

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ABSTRACT

This document is a compilation of four separate case studies of Habitat for Humanity affiliates who have adopted Building America principles of high performance as standard construction. This work was compiled by the Building America Industrialized Housing Partnership (www.baihp.org) for the U.S. Department of Energy to serve as a model for other affordable housing providers. BAIHP is led by the Florida Solar Energy Center of the University of Central Florida.

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1. Introduction

In order to achieve the Building America goals, Builder Partners generally pursue a course of actions that begins with a Prototype design and ends with a revised approach to standard construction. Within the Prototyping process, the Builder Partners work through the design phase using a systems engineering approach to identify and resolve problems before they manifest in the construction process. The construction of the Prototype is closely supervised to identify and resolve unexpected problems. The final phase of Prototyping is the evaluation of the house to determine if the performance goals have been met. The tasks of each phase are summarized below.

Prototype Design Phase:

- Work with a home energy rater to evaluate current practice to ensure that fundamental elements of combustion safety, durability, and indoor air quality are in place and get documented in the design documents, if they are not already included. It is imperative that these elements of high performance housing remain protected or are improved throughout the Prototyping process.
- Define goals
- Discuss goals with sub-contractors and construction staff
- Identify a cost effective package for meeting goals
- Discuss package with sub-contractors and construction staff
- Incorporate package into design documents for permitting.

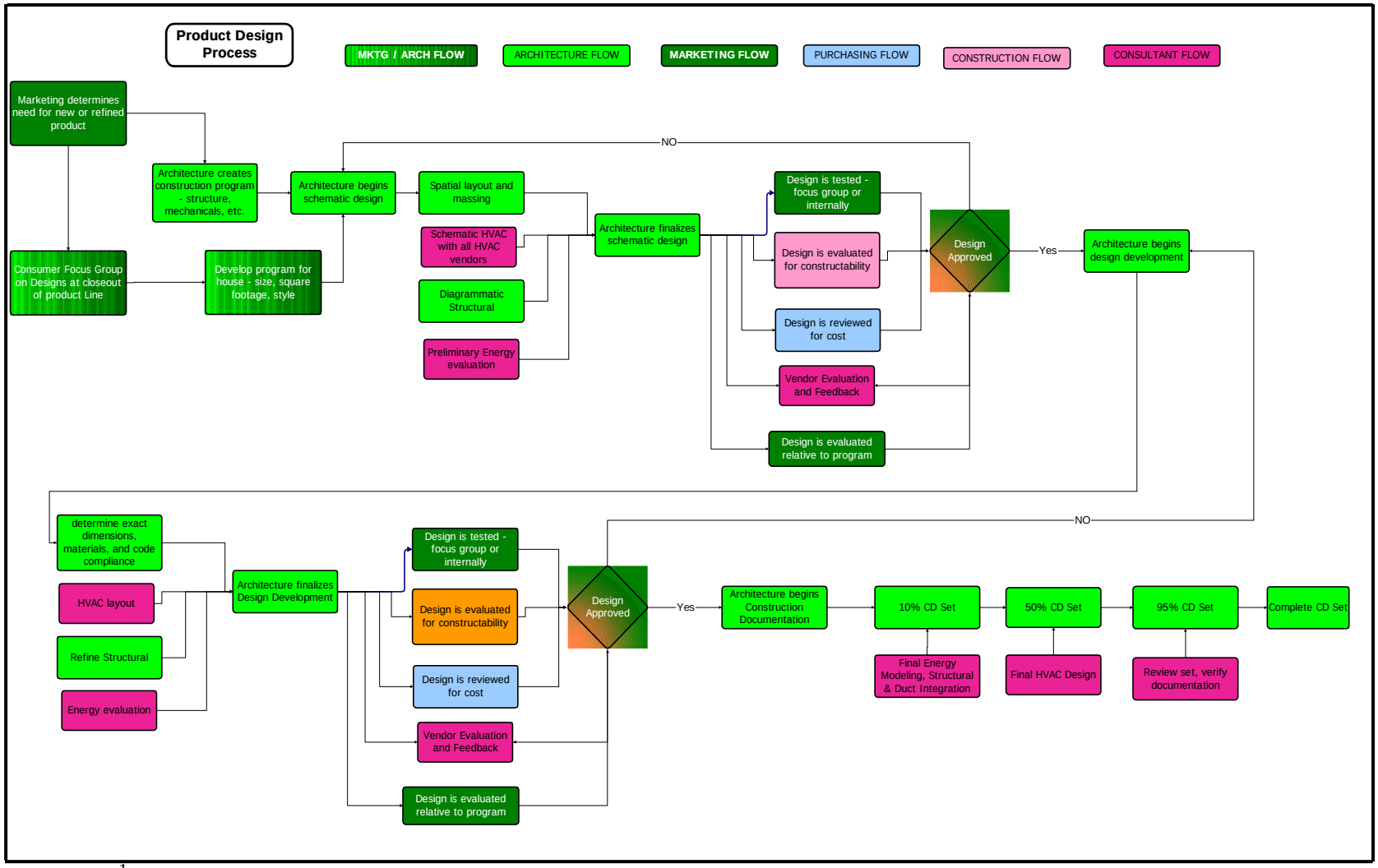
Prototype Construction Phase:

- Assign responsibility for each component of the package to sub-contractors/ construction staff
- Verify installation of each component of the package through inspection by rater or construction supervisor
- Document problems photographically

Prototype Evaluation Phase

- Conduct performance testing to verify targets have been met
- Review process with subcontractors and construction managers to determine any changes that are needed before implementing package in standard construction
- Relay information to design team
- Repeat process with a refined Prototype design

This process, sometimes referred to as an Integrated Design Process (*Figure 1*), is repeated until all issues have been successfully resolved to create a new approach for standard construction. Under this process the improvement package is, in effect, tested at a prototype level to reduce the risk of community scale failure. A discussion of Stage Gate 4 “Initial Community Scale Evaluation” criteria of DOE’s Stage Gate evaluation process follows.



- **Figure 1.[1] Model of the information flows and actions associated with an integrated design process (IDP)**

[1] IBACOS, Inc. KAAX-3-33410-06 B.2, Community Scale Process Research Results. Pittsburgh: IBACOS. November 2004.

II. Stage Gate Discussion

A discussion of all four of the HFH affiliates profiled in these case studies is included below for Gate 2 (Prototype House Evaluation) and Gate 3(Initial Community Scale Evaluation) for "Must Meet" and "Should Meet" criteria.

Stage Gate 2 Prototype House Evaluations: Test ability to integrate advanced systems with production building practices.

Must Meet - Source Energy Savings: Prototype homes must provide targeted whole house source energy savings based on BA performance analysis procedures and energy performance measurements

Discussed at "Gate 3, Must Meet Criteria, Source Energy Savings," below.

Must Meet - Prescriptive-Based Code Approval: Must meet prescriptive or performance safety, health, and building code requirements.

All four affiliates meet local code requirements through the permitting process and all four affiliates test their duct systems to ensure air tightness targets are met. All pass the thermal bypass inspection required for Energy Star which eliminates major compromises in the whole house air barrier. None of the affiliates are in high Radon risk zones. Only the Los Angeles affiliate faces combustion safety issues which they solve by using a high efficiency, direct vent gas furnace and a tankless, direct vent gas water heater. (All Pass.)

Must Meet - Quality Control Requirements: Must define critical design details, construction practices, training, quality assurance, and quality control practices required to successfully implement new systems with production builders and contractors.

Discussed at "Stage Gate 3, Should Meet – Quality Assurance," below.

Should Meet - Neutral Cost Target: The incremental annual cost (evaluated relative to builder standard practice, based on estimated mature market cost) when financed as part of a 30 mortgage, should be less than or equal to the annual reduction in utility bill costs relative to the BA Benchmark.

Discussed at "Gate 3, Must Meet Criteria, Neutral Cost Target," below.

Should Meet – Quality Control Integration: Health, safety, durability, comfort, and energy related QA, QC, training, and commissioning requirements should be integrated within construction documents, contracts, and subcontractor scopes of work.

Discussed at "Stage Gate 3, Should Meet – Quality Assurance," below.

Should Meet –Gaps Analysis: Should include prototype house gaps analysis, lessons learned, and evaluation of major technical and market barriers to achieving the targeted performance level.

Discussed at "Stage Gate 3, Should Meet – Gaps Analsyis," below.

Stage Gate 3 Initial Community Scale Evaluation: Test performance of final production building designs.

Gate 3, Must Meet –Source Energy Savings: Final production home designs must provide targeted whole house source energy efficiency savings based on BA performance analysis procedures and prior state energy performance measurements.

Target energy savings goals for Building America projects are delineated in Table 1. Houston and Lakeland are in the Hot-Humid climate, Central Oklahoma is in the Mixed-Humid climate, and Los Angeles is in the Hot-Dry Climate.

Table 1 Building America Goals for the Five Major Climate Regions in the United States

Target Energy Savings	Marine	Hot Humid	Hot-Dry / Mixed-Dry	Mixed Humid	Cold
30%	2006 (Completed)	2007 (Completed)	2005 (Completed)	2006 (Completed)	2005 (Completed)
40%	2008	2010	2007	2008	2009
50%	2011	2015	2012	2013	2014

Houston Habitat is building homes slightly better than Energy Star with an average HERS Index of 82 for 18% energy savings and thus *does not meet this criteria*; however, given the affiliate's requirement not to increase first cost, this level of savings appears to maximize potential.

Lakeland Habitat meets this criteria with BA benchmark savings of 33% .

Central Oklahoma Habitat achieves average HERS Index ratings of 56-58 (42-44% savings) as determined by the affiliate's home energy rater.

Los Angeles Habitat homes built during the 2007 Jimmy Carter Work Project exceed California energy code by 30% - twice the required savings for Energy Star in California – and they incorporate between 1.3 kW and 2.1 KW of PV per dwelling.

Gate 3, Must Meet –Market Coverage (includes projects from all teams): Must have a minimum of 5 builders with (1) a minimum of 10 homes per project and (2) a minimum of 5 homes completed by March/April.

Not applicable to this analysis; requires consideration of work by other teams.

Gate 3, Must Meet –Neutral Cost Target: The incremental annual cost of energy improvements, when financed as part of a 30 year mortgage, must be less than or equal to the annual reduction in utility bill costs relative to the BA Benchmark house.(*Mature market incremental first cost evaluated relative to builder standard practice.)*

Houston Habitat requires first cost neutrality (no increase in first cost) and is able to achieve 18% energy savings under this constriction. First cost is estimated at $600 per house which is off set by builder incentives under the local electric utility of $600-800 per house. (Passes for 18% savings.)

Lakeland Habitat builds a 30%+ BA benchmark saving home that generates approximately $463 in annual savings (compared to the Benchmark house) for approximately $1500 more in first cost. This translates to an annual mortgage increase of $50 based on 30 year, 0% interest builder financing which is standard for this builder. The first year positive cash flow of $412. (Passes)

Central Oklahoma Habitat also achieves first cost neutrality by offsetting the cost of its energy efficiency package with a state tax incentive and a donation from the local utility. Although the builder is a non-profit and does not pay state taxes, they are allowed to sell their tax credit on the

open market for 85 cents on the dollar. This generates a $3400 pool of funds for energy efficiency. To this is added a cash donation of $2000 from the local utility. (Passes)

The Jimmy Carter Work Project is an annual high-profile, accelerated build designed to draw attention to affordable housing issues. In 2007, volunteers built 30 Energy Star and LEED Gold certified dwellings during the JCWP led by the Los Angeles Habitat affiliate. However the cost of the package of improvements was offset with donations of building products and equipment and does not represent the standard construction of the affiliate. The cost of the homes to the buyers was the same as the affiliate's standard construction homes even though the homes achieve 30% energy savings over California energy code. This type of demonstration does not lend itself to neutral cost analysis since the basis for mortgage cost is historic data, not the actual cost of the home. (Fails.)

Gate 3, Should Meet – Marketability: Based on initial response from model homes, should be marketable relative to the value-added benefit seen by consumers at increased or neutral cost.

These four Habitat affiliates all cite the operating savings and improved durability as highly attractive to their buyers. These improvements shift limited financial resources from operating expenses into discretionary spending which potentially improves quality of life. (Pass)

Gate 3, Should Meet – Market Coverage: Project case studies should cover a representative range of weather conditions and construction practices major metropolitan areas in targeted climate region.

Three climate zones are covered by these case studies: Hot-Humid, Hot-Dry, and Mixed-Humid. (Pass)

Gate 3, Should Meet – Builder Commitment: Should demonstrate strong builder commitment to continued construction at current or future BA performance targets.

Houston Habitat has built in excess of 200 homes to this level of savings – 18%. (Pass - at this savings level.)

Lakeland Habitat has built approximately 60 homes with 30% BA Benchmark saving and will continue to build at this level of savings or higher. (Pass)

Central Oklahoma has adopted this package as standard construction. It achieves a HERS Index range of 56-58. (Pass)

2007 JCWP-Los Angeles Habitat has built 30 dwellings with 30% beyond California code energy savings plus PV; however, they will revert back to standard building practices at the conclusion of this project. (Fail)

Gate 3, Should Meet – Gaps Analysis: Should include a summary of builder technical support requirements, gaps analysis, lessons learned, optimal builder business practices, what not to do, documentation of failures, recommendations for policy improvements, and remaining technical and market barriers to achieving current and future performance levels

Habitat for Humanity builds homes with volunteer labor and some sub-contracted labor, specifically, the mechanical, electrical, and plumbing labor is generally sub-contracted. Case studies show that each Habitat affiliate adopted a package for energy efficiency that includes equipment and appliance efficiency improvements as well as envelope/load reduction improvements. Typically these include higher efficiency heating and/or cooling (depending on climate), Energy Star refrigerator (free from Whirlpool for all Habitat homes), sometimes

tankless gas water heating, low-E windows, thermal bypass inspection for insulation and air barrier integrity, interior air handler closets, and sealed and tested duct systems.

Technical Support Requirements: These four Habitat affiliates all worked with a home energy rater and/or Building America researchers to evaluate standard construction, identify an improvement package, implement improvements in prototype homes, evaluate success of prototyping and finalize a standard for building improved homes.

Optimal Builder Best Practices: For all of the affiliates, having a committed and capable mechanical contractor is a corner stone of their success. Although scopes of work are useful for establishing expectations, they are not sufficient to ensure performance targets for duct air tightness will be met. The most effective procedure for ensuring duct air tightness targets will be met has been to test a recently completed duct system with the supervisor of mechanical contractor's team repairing any deficiencies identified, and re-testing to verify improvement. From this exercise, the mechanical contractor gains a first hand understanding of how the system will be tested and level of joint tightness is sufficient.

When sub-contractors are involved with insulation installation, training with the specific crews working on the house/s in question is required. Photographic guides that show "right" and "wrong" installations are helpful. Checklists and volunteer training can improve speed and accuracy of crews.

Documentation of Failures: Two of the affiliates (Houston and Lakeland) originally adopted interior duct work details using furred-down soffits running the length of the hallway and into the living space and kitchen over the cabinets; however, due to the precision required to implement these details in homes with 8' ceilings, both affiliates went back to the prevailing regional practice of putting duct work in the attic which is much easier to implement with a volunteer work force. The typical down fall of this detail is ensuring that the ceiling height under the soffit allows for clearance of pre-hung door frames. Since the size of the ductwork leaves very little clearance inside the soffit, the bottom of the soffit (hall ceiling) sometimes drops below the 6'10" required for the frame around a pre-hung door. However, this is not necessarily evident since the bottom of the soffit and the finish floor are not usually installed at the time of the mechanical rough. To reduce the impact of the harsh attic environment on the duct systems, both of these affiliates install a radiant barrier.

Gate 3, Should Meet – Quality Assurance: Should provide documentation of builder's energy related QA and QC processes.

All four affiliates define critical design details and construction practices in either design drawings and/or verbal communications with sub-contractors in pre-construction training which is supplemented with on-site training and discussion when necessary. Insulation and system quality assurance and control practices consist of rater and construction supervisor inspections such as the Thermal Bypass Inspection required by Energy Star. Duct system and whole house air barrier quality is assessed through testing with deficiencies identified and submitted to the construction supervisor.

III Conclusions

The case studies of these four Habitat for Humanity affiliates present community scale efforts with varying degrees of success as illustrated by Stage Gate Criteria Matrix in Table 2. While all of these Habitat affiliates are building homes of higher performance than typical regional, only one is successfully meets all of the Stage Gate 3 criteria – Lakeland Habitat for Humanity – which was included as a Case Study in the 2007 Joule report for the Hot-Humid Climate.

Table 2 – Stage Gate Summary for Habitat for Humanity Affiliates Profiled in BA Case Studies

Criteria	**Houston Habitat**	**Lakeland Habitat**	**Central Oklahoma Habitat**	**2007 JCWP, Los Angeles Habitat**
Climate Goal	Hot Humid – 30%	Hot Humid – 30%	Mixed Humid – 40%	Hot Dry – 40%
Stage Gate 2 *Must Meet – Source Energy Savings*	See Source Energy Savings below.	See Source Energy Savings below	See Source Energy Savings below	See Source Energy Savings below
Stage Gate 2 *Must Meet – Prescriptive-Based Code Approval*	Pass	Pass	Pass	Pass
Stage Gate 2 *Must Meet – Quality Control Requirements*	See Quality Assurance below	See Quality Assurance below	See Quality Assurance below	See Quality Assurance below
Stage Gate 2 *Should Meet – Neutral Cost Target*	See Neutral Cost below	See Neutral Cost below	See Neutral Cost below	See Neutral Cost below
Stage Gate 2 *Should Meet – Quality Control Integration*	See Quality Assurance below	See Quality Assurance below	See Quality Assurance below	See Quality Assurance below
Stage Gate 2 *Should Meet – Gaps Analysis*	See Gaps Analysis below	See Gaps Analysis below	See Gaps Analysis below	See Gaps Analysis below
Stage Gate 3 *Must Meet - Source Energy Savings*	HERS Index ~82	Benchmark Savings 30%+	HERS Index 56-58	30% beyond California Code
Stage Gate 3 *Must Meet Market Coverage (Includes projects from all teams)*	Not applicable to this analysis; requires consideration of work by other teams.			
Stage Gate 3 *Must Meet Neutral Cost Target*	Neutral first cost, possible up to $200 reduction in first cost	$412 first year positive cash flow compared to BA Benchmark	Neutral first cost, possible reduction in first cost	Special Project, mortgage not based on actual cost. Please see discussion.
Stage Gate 3 *Should Meet - Marketability*	Reduced operating costs and improved durability highly attractive to target audience			
Stage Gate 3 *Should Meet - Market Coverage:*	Three climate zones are covered by these case studies, see first line in this table.			
Stage Gate 3 *Should Meet - Builder Commitment*	Standard Practice 200+ houses	Standard Practice ~60 houses	Standard Practice < 50 houses	30 Prototype houses
Stage Gate 3 *Should Meet - Gaps Analysis and Case Studies*	Improvement packages include equipment and envelope improvements. Affiliates worked with home energy raters or Building America for technical support. Training and verbal instructions to sub-contractors, especially mechanical contractor, imperative to success. Failures limited to unfamiliar construction process associated with interior duct systems.			
Stage Gate 3 *Should Meet - Quality Assurance*	Critical design and construction details are generally not incorporated in construction documents but are communicated to responsible parties by the home energy rater or the construction supervisor coupled with on-site, hands-on training, visual aids, and inspections.			

IV. Case Studies

The case studies following this page are available individually in the portable document format (pdf) online at www.baihp.org/habitat or from:

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March 29, 2008

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Habitat for Humanity in Houston, Texas: Building Energy Efficient Homes for Over a Decade

Since 1995, The **U.S. Department of Energy's Building America** program has provided technical assistance to Habitat for Humanity International and local Habitat affiliates interested in building energy efficient homes. Building America researchers help Habitat identify energy improvements that:

- are proven to be cost effective,
- are readily available in the market place,
- are appropriate for Habitat's volunteer construction crews, and
- do not place a maintenance burden on the homeowner.

Houston Habitat for Humanity

Building America began working with Houston Habitat in 1996 on the award-winning *Energy Affordable Home* program. In 1997, Building America certified the first Energy Star Habitat home, followed by a 100-home community of Energy Star homes in 1998. Houston Habitat has built more Energy Star homes than any other Habitat affiliate (300+) and was recognized with an Energy Star Homes Builder of the Year Special Recognition Award in 1999 and the Affordable Home Builder of the Year Award in 2006.

For three years, Houston Habitat has been receiving free home energy ratings from DPIS Engineering to certify their Energy Star homes (see specifications below.) Brannon King, DPIS Vice President, notes that three more Habitat affiliates have come to them for Energy Star ratings as a result of Houston Habitat's leadership.[3] Construction Manager Mike Owen notes that concern for long-term affordability and durability drive Houston Habitat's effort to build energy-efficient high performance homes. Owen says, "If we can make a house more affordable month to month, it effectively increases the home owner's income. And the attention to details in an energy efficient home enhance durability, especially the air sealing details which keep infiltration and moisture intrusion under control."

The Bottom Line

Owen estimates the cost of building Energy Star homes to be about $600 per house for higher efficiency air conditioning, better windows, extra foam, caulking, and insulation, and some additional staff time for quality control. This cost is offset by utility rebates, Owen explains, "We get about $600 to $800 per house for participating in our utility's builder incentive program for efficiency. If I can build an energy-efficient home and, at the end of the day, the net cost is $0 or I make money on it, why wouldn't I do that?"

RESNET
Residential Energy Services Network
www.natresnet.org

Brannon King
(281) 351-0048
www.dpis.com
DPIS Engineering, LLC

Volunteer Energy Rater – Habitat for Humanity – Building America – RESNET

Through the RESNET-Building America-Habitat Partnership, RESNET-certified raters provide one pro-bono Energy Star rating to a Habitat affiliate in their community. Look for the "Volunteer Energy Rater" emblem above in RESNET's online rater directory at: www.resnet.us/directory/raters_builders.aspx

Building AMERICA U.S. Department of Energy Research Toward Zero Energy Homes

For more information on Building America's Partnership with Habitat for Humanity, see www.baihp.org/habitat

Systems and Appliances

- SEER 14 AC (straight cool) with dual stage compressor
- 80% AFUE Gas Furnaces (or Heat Pump)
- Every duct system tested to ensure leakage does not 6 cfm per 100 ft2 of conditioned space
- Passive Outside Air ventilation to return plenum
- Whirlpool Energy Star Refrigerator
- Energy Star Ceiling Fans

Enclosure

- 2x4 Frame construction with R13 insulation with R4 rigid insulation
- R-30 Ceiling insulation with radiant barrier
- Low-E, double pane, aluminum frame windows (SHGC= 0.37; U-Value = 0.51)
- Tankless Water Heaters

HERS Index Average = 82 (85 or less required for Energy Star)

A Strong Energy Portfolio for a Strong America

Energy efficiency and clean, renewable energy will mean a stronger economy, a cleaner environment, and greater energy independence for America. Working with a wide array of state, community, industry, and university partners, the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy invests in a diverse portfolio of energy technologies.

Research and Development of Buildings

Our nation's buildings consume more energy than any other sector of the U.S. economy, including transportation and industry. Fortunately, the opportunities to reduce building energy use—and the associated environmental impacts—are significant.

DOE's Building Technologies Program works to improve the energy efficiency of our nation's buildings through innovative new technologies and better building practices. The program focuses on two key areas:

- **Emerging Technologies**
  Research and development of the next generation of energy-efficient components, materials, and equipment
- **Technology Integration**
  Integration of new technologies with innovative building methods to optimize building performance and savings

For more information contact
EERE Information Center
1-877-EERE-INF (1-877-337-3463)
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Building America U.S. Department of Energy

PATH Partnership for Advancing Technology in Housing

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FSEC-BAIHP-10

Bringing you a prosperous future where energy is clean, abundant, reliable, and affordable

March 29, 2008

Building America U.S. Department of Energy

Research that Works
www.buildingamerica.gov

RESNET Partnership with Habitat for Humanity: Oklahoma City

Since 1995, The **U.S. Department of Energy's Building America** program has been providing technical assistance to Habitat for Humanity International and local Habitat affiliates interested in building energy efficient homes. Building America researchers help Habitat identify energy improvements that:

- are proven to be cost effective,
- are readily available in the market place,
- are appropriate for Habitat's volunteer construction crews, and
- do not place an additional maintenance burden on the homeowner.

Building America recommends that Habitat affiliates striving to build high efficiency homes work with a certified home energy rater. In 2005, **RESNET-certified home energy raters** began a volunteer effort with Habitat affiliates. Each volunteer rater provides a free rating to a Habitat affiliate in their community, including infiltration and duct testing, and they make recommendations on next steps for increasing energy efficiency. RESNET members participating in this program have a "Volunteer Energy Rater" emblem (*shown at right*) in RESNET's online directory of certified raters at: http://www.resnet.us/directory/raters_builders.aspx

Central Oklahoma Habitat for Humanity (**COHFH**)
For some RESNET volunteers, the offer goes beyond the first free rating. Oklahoma Gas and Electric's Positive Energy Home Program™ provides pro-bono home energy ratings, tax credit calculations, and a donation of $2000 per house for energy efficient improvements to Central Oklahoma Habitat (COHFH) in Oklahoma City. In Oklahoma, a state tax credit of $4,000 is awarded to builders of new homes less than 2,000 square feet that are 40% or more above the 2003 International Energy Conservation Code. COHFH is entitled to this tax credit, however, as a non-profit organization, they do not use the tax credit. Instead, they sell the tax credit at the rate of 85 cents on the dollar generating $3,400 to further offset the cost of energy efficiency improvements including:

COHFH Heating and Cooling System

- Geothermal Heat Pump - Tranquility 20 Systems Donated By ClimateMaster (COHFH Pays For Installation And Drilling)
- Room-by-room Manual J Calculation
- Blower Door Infiltration Testing To Ensure Estimated Natural Infiltration Rate Of 0.35 Air Changes Per Hour Or Less
- Ducts Sealed With Mastic And Tested To Ensure Leakage </= 5 Cfm Per 100 Square Feet Of Conditioned Space

COHFH Enclosure

- 2x4 Frame construction, slab on grade with R-5 perimeter insulation
- Spray foam insulation in Wall (~R-13) with R-4 exterior rigid insulation
- Spray foam insulation at Roof deck (~R-19) in unvented attic
- Low-E, double pane, vinyl frame windows (SHGC=/< 0.4 U-Value =/< 0.35)

COHFH Lighting – 100% Compact Fluorescent Bulbs *(note: only 20% can be counted for Energy Star certification purposes)*

COHFH HERS Index ranges from 56-58 (85 or less required to meet Energy Star)

RESNET
Residential Energy Services Network
www.natresnet.org

OG&E

Steve Sullivan, Coordinator
Builder & Developer Programs
OG&E - Electric Services
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Through the RESNET-Building America-Habitat Partnership, RESNET-certified raters provide one pro-bono Energy Star rating to a Habitat affiliate in their community. Look for the "Volunteer Energy Rater" emblem above in RESNET's online rater directory at: www.resnet.us/directory/raters_builders.aspx

Central Oklahoma HFH Contact
Ann Felton (405) 232-4828

Building America U.S. Department of Energy Research Toward Zero Energy Homes

For more information on Building America's Partnership with Habitat for Humanity, see www.baihp.org/habitat

A Strong Energy Portfolio for a Strong America

Energy efficiency and clean, renewable energy will mean a stronger economy, a cleaner environment, and greater energy independence for America. Working with a wide array of state, community, industry, and university partners, the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy invests in a diverse portfolio of energy technologies.

Research and Development of Buildings

Our nation's buildings consume more energy than any other sector of the U.S. economy, including transportation and industry. Fortunately, the opportunities to reduce building energy use—and the associated environmental impacts—are significant.

DOE's Building Technologies Program works to improve the energy efficiency of our nation's buildings through innovative new technologies and better building practices. The program focuses on two key areas:

- **Emerging Technologies**
  Research and development of the next generation of energy-efficient components, materials, and equipment
- **Technology Integration**
  Integration of new technologies with innovative building methods to optimize building performance and savings

For more information contact
EERE Information Center
1-877-EERE-INF (1-877-337-3463)
www.eere.energy.gov

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Energy Efficiency and Renewable Energy

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Habitat for Humanity – Building America Partnership: Jimmy Carter Work Project 1997-2007

Since 1995, The U.S. Department of Energy's Building America program has been providing technical assistance to Habitat for Humanity International and local Habitat affiliates interested in building energy efficient homes. Building America researchers help Habitat identify energy improvements that:

- are proven to be cost effective
- are readily available in the market place
- are appropriate for Habitat's volunteer construction crews
- do not place a maintenance burden on the homeowner

Jimmy Carter Work Project (JCWP)

Former President Jimmy Carter and his wife Rosalyn have a long history with Habitat for Humanity, a non-profit affordable housing provider that sells homes at zero interest and no profit to qualified buyers. Every year, President and Mrs. Carter work on a a special project with Habitat to draw attention to the need for affordable housing. The Carter's have selected domestic sites from the Blue Ridge Mountains to the shores of Lake Michigan and the streets of Harlem, from Florida across the Gulf Coast to Georgia, Alabama, and Texas and west to Los Angeles, the 2007 site. Building America has supported Habitat at many of the sites (*see list, right*) helping Habitat affiliates implement energy efficiency strategies that make affordable housing more affordable to live in.

Energy Star and Beyond

Recognizing this link between energy efficiency and long term affordability, Habitat for Humanity has embraced construction of Energy Star Homes as a Best Practice. Since 1997, hundreds of Energy Star homes have been built during the JCWP. However, in 2007, things got decidedly *greener*. These 30 dwellings (8 duplexes and 14 multi-family units) are the first Carter Project houses to be LEED Certified. Global Green USA and Gaia Development worked with the Habitat affiliate to identify and implement the green package which includes photovoltaic solar electric systems, designed and installed by GRID Alternatives (*see photo at right.*) Building America worked with Habitat and Alternative Energy Systems (a certified California Home Energy Rater) to certify the 2007 JCWP houses as Energy Star – a LEED prerequisite and important part of green building because it saves energy, conserves natural resources, and reduces air pollution – continuing the decade-long partnership between Building America and Habitat for Humanity.

2007 JCWP Green Features

- LEED Certified at the Gold Level (Pending)
- Close To Transit And Community Amenities
- Ducted Fresh Air Intakes and Exhaust
- Low Water Use Plumbing Fixtures
- Drought-Tolerant, Native landscaping
- On-site Storm water Management Systems
- Non-toxic Paints And Finishes
- See more at: http://www.jcwpla.org/jcwpla/

2007 JCWP Energy Features

- 95% AFUE Gas Furnace, No Air Conditioning
- Tankless Gas Water Heater
- Duct Systems Tested To Ensure Leakage Below 6% of Rated Air Flow
- R-19 Floor, R-13 Wall, and R-38 Ceiling Insulation
- Energy Star Refrigerator and Energy Star Ceiling Fans
- Low-E, double pane, vinyl frame windows (SHGC= 0.30; U-Value = 0.35)
- Blower Door Test to Ensure Infiltration (SLA) below 1.5
- 1.3 - 2.1 kW solar electric systems (PV Modules and Inverters)
- Average Improvement over California Energy Code = 32%
  (15% required to qualify for Energy Star in California)

Photo by GRID Alternatives.

Former President Jimmy Carter, center, at 2007 JCWP site in Los Angeles.

Carter Project Homes Supported/Rated by Building America		
Year	Site	Houses
1997	Lee County, KY	3 Energy Stars
1998	Houston, TX	100 Energy Stars
2000	Americus, GA New York City, NY	23 Energy Stars Volunteer Training
2003	LaGrange, GA Anniston, AL	22 Energy Stars 35 Near Energy Stars
2005	Benton Harbor, MI	23 Energy Stars
2007	Los Angeles	30 Energy Stars
		236 Total

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For more information on Building America's Partnership with Habitat for Humanity, see www.baihp.org/habitat

A Strong Energy Portfolio for a Strong America

Energy efficiency and clean, renewable energy will mean a stronger economy, a cleaner environment, and greater energy independence for America. Working with a wide array of state, community, industry, and university partners, the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy invests in a diverse portfolio of energy technologies.

Research and Development of Buildings

Our nation's buildings consume more energy than any other sector of the U.S. economy, including transportation and industry. Fortunately, the opportunities to reduce building energy use—and the associated environmental impacts—are significant.

DOE's Building Technologies Program works to improve the energy efficiency of our nation's buildings through innovative new technologies and better building practices. The program focuses on two key areas:

- **Emerging Technologies**
  Research and development of the next generation of energy-efficient components, materials, and equipment
- **Technology Integration**
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Habitat for Humanity in Lakeland, Florida: High Performance Houses since 2000

Since 1995, The U.S. Department of Energy's Building America program has been providing technical assistance to Habitat for Humanity International and local Habitat affiliates interested in building energy efficient homes. Building America researchers help Habitat identify energy improvements that:

- are proven to be cost effective
- are readily available in the market place
- are appropriate for Habitat's volunteer construction crews
- do not place a maintenance burden on the homeowner

Lakeland Habitat's Commitment

In 2000, Lakeland Habitat for Humanity worked with Florida H.E.R.O., a Building America sub-contractor, to build its first high performance home. Since the completion of this first home, which won a special $20,000 grant from the Walt Disney Corporation, Lakeland HFH has built about 60 homes that exceed Energy Star requirements by 20-30%. In 2007, they built their first LEED Certified Green Home. Their standard practice (see bulleted list below) saves about 30% in whole house source energy use compared to the Building America Benchmark. The construction management team works with volunteers and the mechanical contractor to ensure the energy efficiency package is implemented in every house. Building America conducts the Thermal Bypass Inspection and tests the duct system.

The Whole Picture

Designing, detailing, and building high performance housing requires the cooperation of decision makers, construction managers, sub-contractors, and crews. The package of high performance features in all Lakeland Habitat homes includes components for occupant health, safety, and indoor air quality; moisture control for durability; energy efficiency, and comfort (see bulleted lists below.) The components of the package work together, although each is an effective step toward improved long-term performance.

The Bottom Line

Lakeland Habitat estimates the first cost of the package to be $1500. Annually, this adds $50 to a 30 year, 0% mortgage (typical financing terms for Habitat.) Estimated annual energy savings of about $150 create positive cash flow in the first year of occupancy. For a more in-depth case study of these homes, see "Lakeland Habitat" at www.baihp.org/habitat.

Occupant Health, Safety, and Indoor Air Quality

- All electric homes – no combustion safety risks.
- *Air Flow Control*: Ducts are meticulously sealed to prevent unintentional air flow between the duct system and unconditioned spaces
- *Ventilation:* Ducted, filtered, and dampered passive outside air ventilation system with air flow of ~25 cfm. *(System not appropriate outside hot-humid climate.)*
- *Relative Humidity:* Kitchens and bathroom exhaust fans are ducted to the outside to remove humidity generated by cooking and bathing.

Moisture Control for Improved Durability

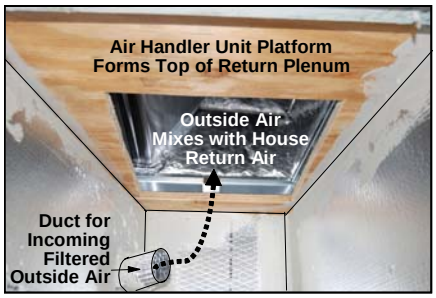
- Controlling relative humidity levels reduces wear and tear on the air handler
- Continuous exterior air barrier (house wrap sealed at the edges and seams) keeps humid outside air away from components of the building envelope

Energy Efficiency and Comfort

- SEER 14, HSPF 8+ Heat Pump with duct system sealed with mastic and tested
- Interior air handler closet with ducted central return
- Double pane, vinyl frame, low-E windows
- Existing shade trees preserved when possible (see photo, above right)
- Radiant Barrier below roof decking, R-30 Ceiling insulation, R-13 Wall Insulation
- Thermal Bypass Inspection and blower door test on every house
- Water heater timer, Energy Star Refrigerator, 20% CFL Lighting
- Tight ducts, reduced infiltration, and controlled relative humidity all improve comfort
- Right sized air conditioning coils (Manual J) further improves humidity control

Lakeland Habitat for Humanity home.

Wall insulation installed with no gaps or compression.



Return plenum with ventilation duct. ~25cfm of outside air enters return plenum when air handler is operating

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