Florida Solar Energy Center

A Research Institute of the University of Central Florida

Industrialized Housing Partnership
http:/baihp.org

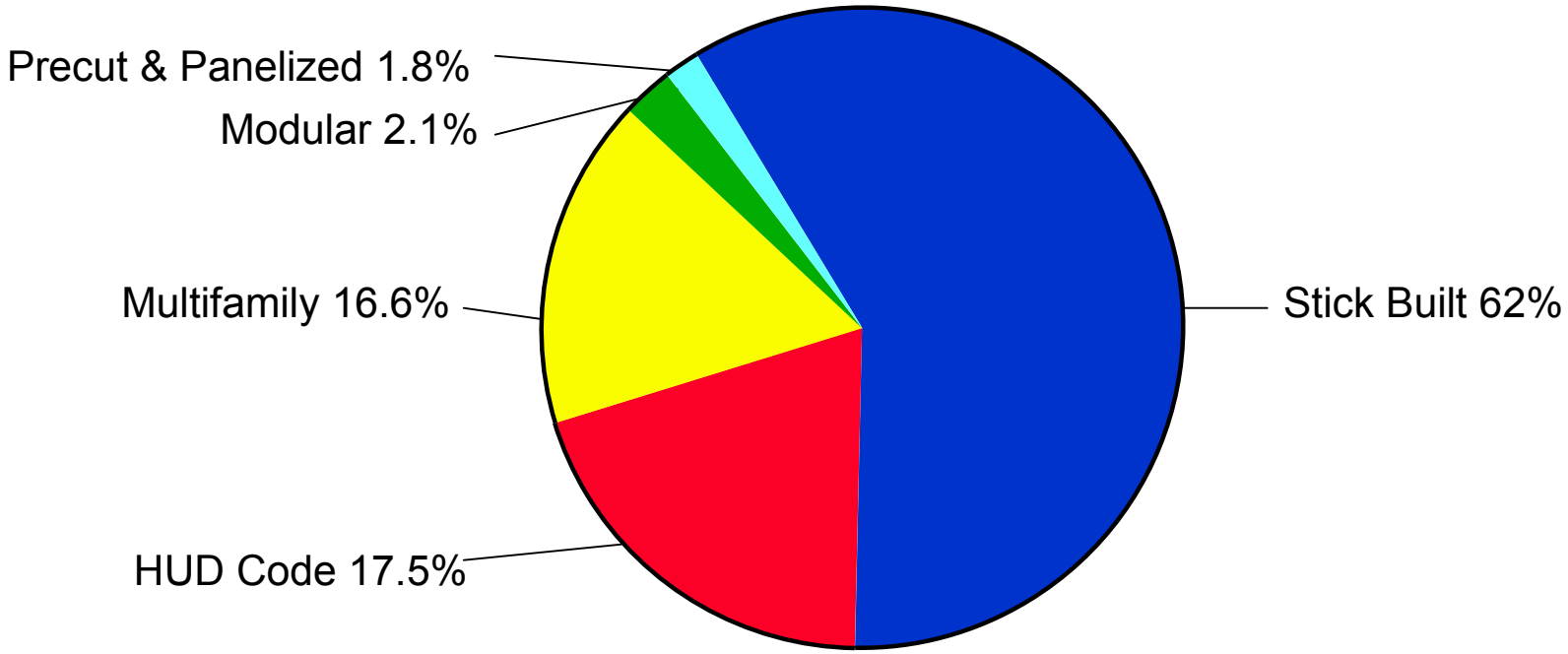
September 1, 1999 - October 31, 2004

Status: April 10, 2001

Building America

1999 Housing by Type

Census Data



Total Number of New Houses = 1,984,000

Sources: http://www.census.gov/pub/const/mhs/shipment.txt
http://www.census.gov/prod/www/abs/c25.html

Goal 1

Cost effectively reduce the energy use of industrialized houses by up to 50% and document through field monitoring.

Goal 2

Provide technical assistance that results in the construction of thousands of energy-efficient industrialized houses every year while enhancing indoor air quality, building durability, and construction productivity.

Goal 3

Make our partners pleased and proud to be working with us.

BAIHP Team

- Sponsors
  - U.S. DOE Office of Building Technology State and Community Programs
  - Florida Energy Office of the Florida Department of Community Affairs
  - Northwest Energy Efficiency Alliance
- Prime Contractor
  - Florida Solar Energy Center (FSEC) of the University of Central Florida (UCF)

BAIHP Team

- Subcontractors
  - Washington State University Energy Program with Oregon Office of Energy and Idaho Dept. of Water Resources
  - UCF Department of Industrial Engineering
  - American Lung Association of Central Florida
  - D.R. Wastchak LLC, Phoenix, AZ
  - Florida H.E.R.O., Gainesville, FL

Home Manufacturer and Builder Team Members

- American Energy Efficient Homes and Investments, Inc.
- Atlantic Design and Construction (Production builder)
- Barker–Coleman Communities (Production builder)
- Beck Builders
- Cavalier Homes (HUD Code manufacturer)
- Centex Homes (Production builder)
- Fallman Design and Construction

Home Manufacturer and Builder Team Members (Cont)

- Fleetwood Homes (HUD Code manufacturer)
- G.W. Robinson (Production builder)
- Habitat for Humanity International (Affordable housing builder)
- Landmark Homes (Production builder)
- Neuffer Homes and Development (Production builder)
- Palm Harbor Homes (HUD Code manufacturer)
- Southern Energy Homes (HUD Code manufacturer)
- Valley Manufactured Housing (HUD Code manufacturer)

Supplier Team Members

- Friedrich Air Conditioning
- Energy Conservatory
- Engineered for Life
- Hard Cast
- LaSalle Air Systems
- Nomaco, Inc.
- Owens Corning Sales, Northwest Region
- Tyvek Weatherization Systems
- York International, Mfg. Housing Division (Coleman Brand Equipment)

Other Collaborators

- American Lung Association of Florida
- ASERTTI
- Building Science Consortium
- Energy Rated Homes of Nevada
- Florida Power Corporation
- Hickory Consortium
- Home Builders Association/Mid-Florida
- North Caroling A&T University
- Pacific Northwest National Laboratory
- Portland Cement Association
- Stevens Associates (Home Ventilation Institute)
- Washington Manufactured Housing Association

BAIHP Task Leaders

FSEC

David Beal, Philip Fairey, Janet McIlvaine, Neil Moyer, Danny Parker, Rob Vieira

WSU

Mike Lubliner, Mike McSorley

UCFIE

Mike Mullens

PROJECT DIRECTOR: Subrato Chandra, FSEC

BAIHP Highlights

- 8,000+ Energy efficient homes
- Habitat for Humanity
- Moisture problems in HUD Code housing
- Field monitoring
- Unvented attics and “cool” roofs
- Green Housing
- Healthy Housing
- Innovations in manufacturing technology
- Portable classroms
- EnergyGauge USA

8,000+ Energy Efficient Homes Produced with BAIHP Technical Assistance

- **Homes manufactured to Energy Star or greater savings (HERS score=86)**

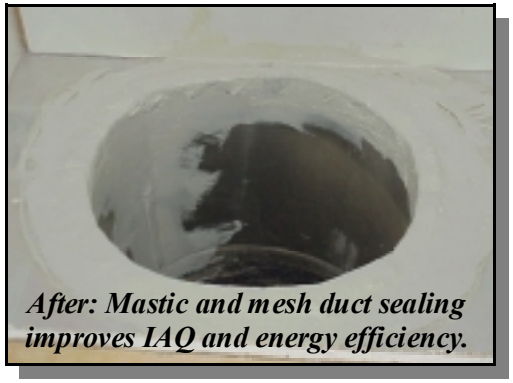
Homes by D.R. Wastchak, Phoenix, AZ	2,064	(through 3/01)
Homes by FL H.E.R.O, Gainesville, FL	249	(through 2/01)
Super Good Cents homes west of the cascades w/low energy ventilation systems	112	(through 7/00)
Palm Harbor Homes	005	(through 2/01)
Habitat for Humanity	018	(through10/00)
Subtotal	**2,448**	

- **Homes produced with a HERS score of around 85 (25% better than MEC, 30%-50% better than Hud Code)**

Other SGC/Natural Choice Homes	4,694	(through 1/01)
Energy Efficient Homes (PHH div. In NC)	1,259	(through 8/00)
Subtotal	**5,953**	

Transforming Manufactured Housing Duct Construction

Before: Tape failure at duct joint led to condensation, mold, and decay.



After: Mastic and mesh duct sealing improves IAQ and energy efficiency.

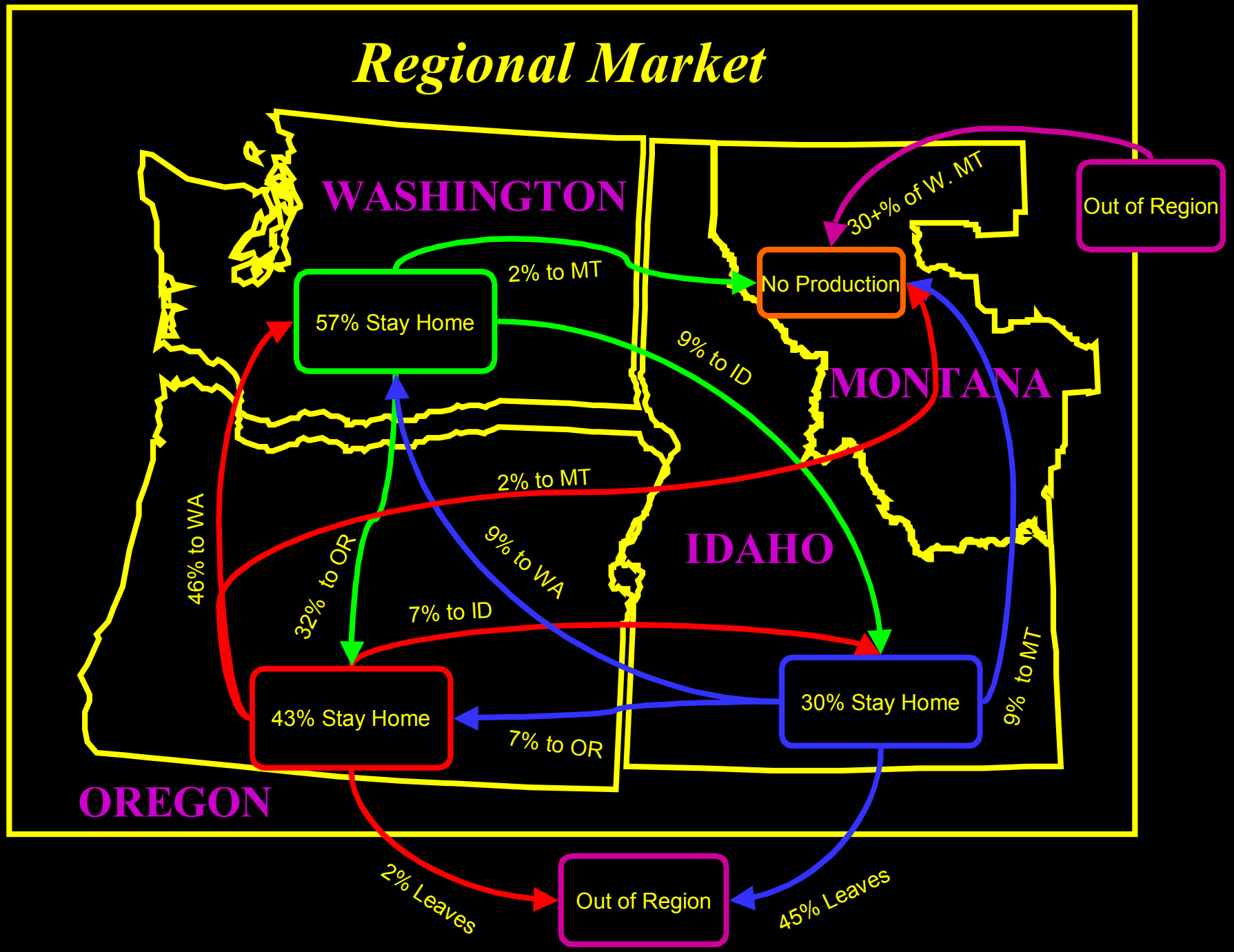
Team members producing houses with airtight ducts with mastic

Palm Harbor Homes	**11,000 homes/yr**
Cavalier Homes	**10,000 homes/yr**
Southern Energy Homes	**7,000 homes/yr**
Total	**28,000 homes/yr**

Building AMERICA

Super GOOD CENTS/Natural Choice

The Last Decade

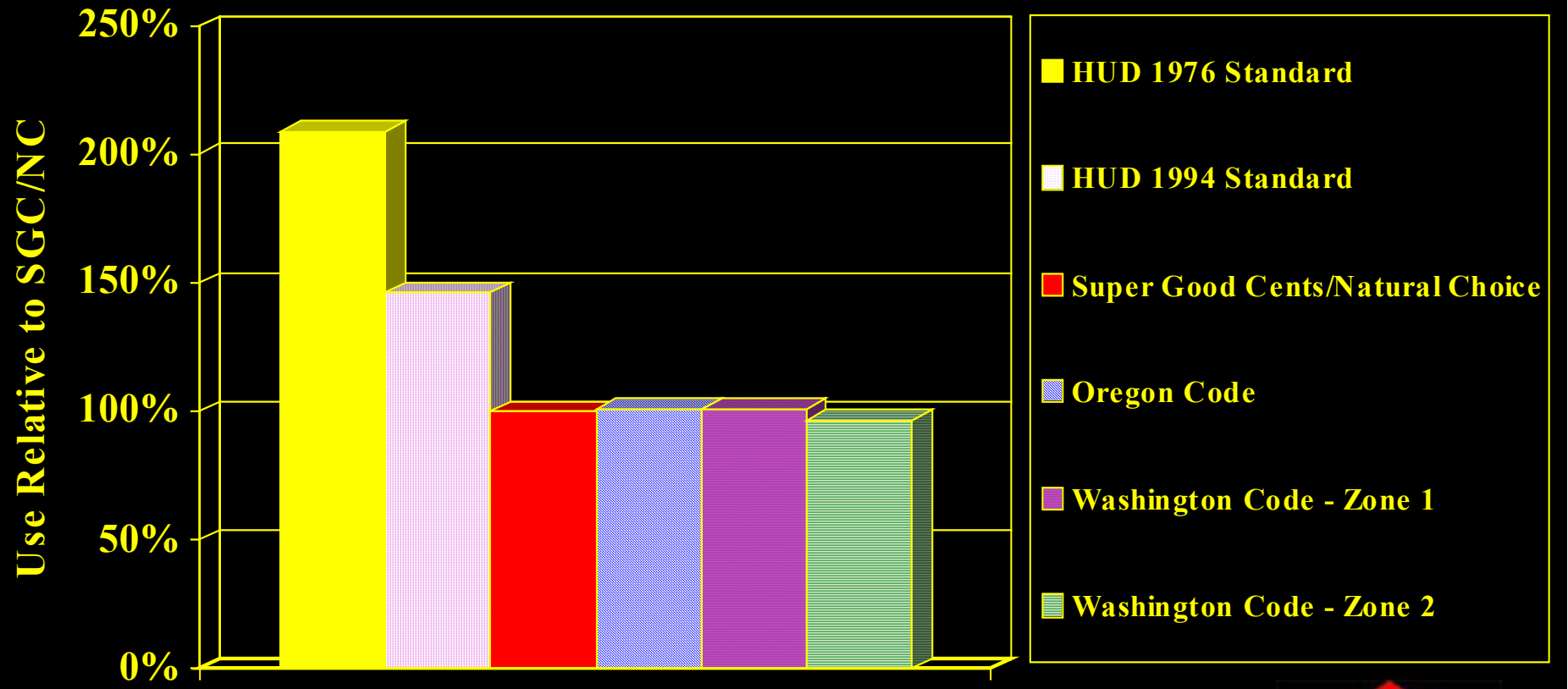

Regional Market
WASHINGTON
OREGON
IDAHO
MONTANA
57% Stay Home
43% Stay Home
30% Stay Home
No Production
Out of Region
Out of Region
2% to MT
9% to ID
30+% of W. MT
2% to MT
46% to WA
32% to OR
9% to WA
7% to ID
9% to MT
7% to OR
2% Leaves
45% Leaves

Why It's Important

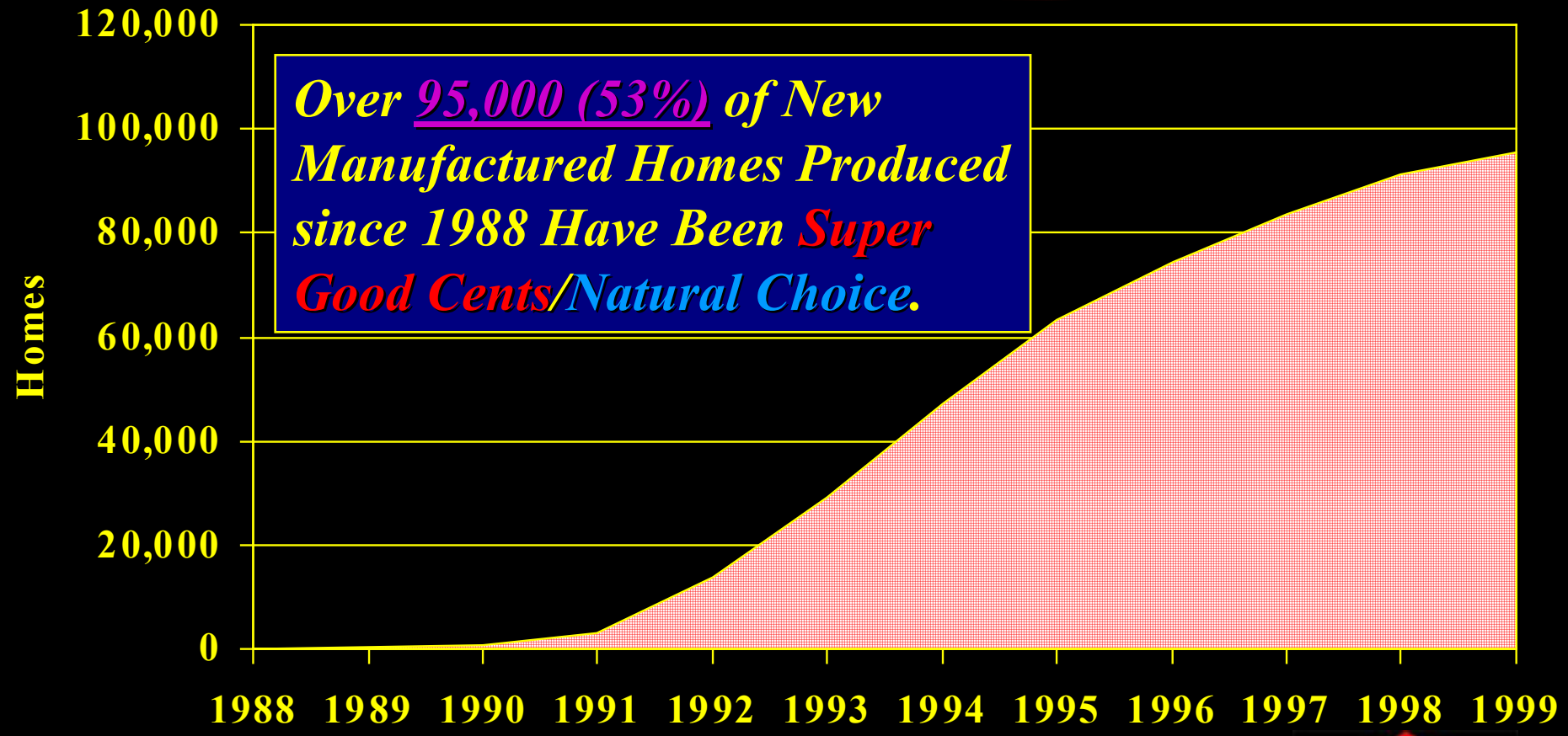
- Manufactured Homes represent ***45% to 50%*** of all new electrically heated homes in the Northwest.

- The HUD Thermal Standards ***do not*** capture all cost-effective electricity savings.

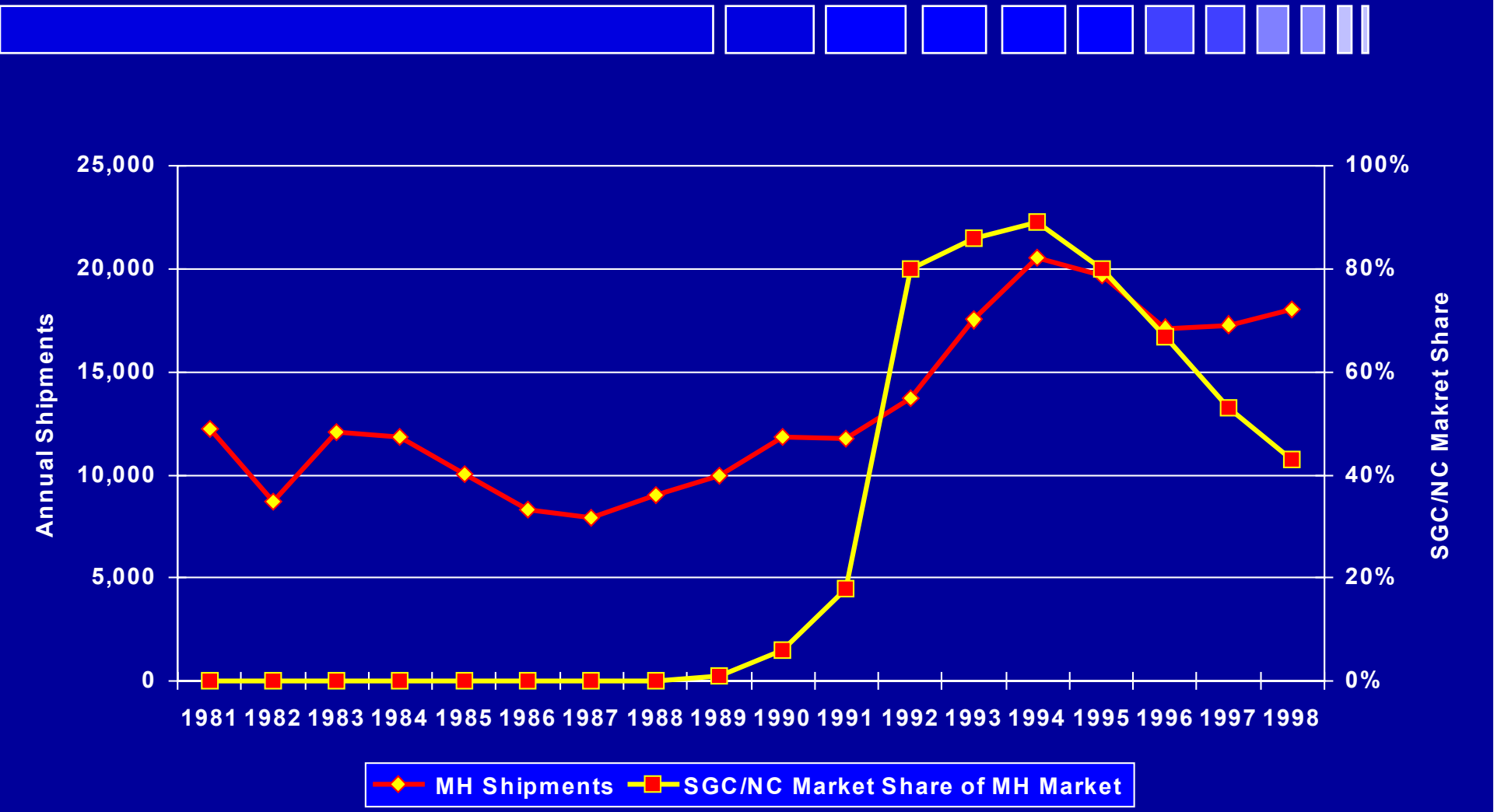
Super Good Cents/Natural Choice vs. Site Built Energy Codes



What We've Accomplished - Energy Efficient Housing



Northwest Manufactured Housing Shipments and SGC/NC Market Share 1981 - 1998



Homes by Florida H.E.R.O.

Type	Subdivision (builder)	Total	To Date	Next 12mos
SFD	Mentone (Atlantic Design)	454	200	75-100
Town Homes	Monticello (HKW Enterprises)	112	100	12
Town Homes	Williamsburg (HKW Enterprises)	154		35-50
Apartments	Lewis Place (Lewis Place)	112	112	0
SFD	Cedar Grove II (City of Gainesville)	139	44	30+
SFD	Willowcroft (Spain Construction)	34	7	10+
SFD	Granite Park (All American Homes)	39	4	10+

Building AMERICA

Homes by Florida H.E.R.O. (Cont.)

Type	Subdivision (builder)	Total	To Date	Next 12mos
Mixed	Union Street Station (McGurn)	51	51	0
SFD	Town of Tioga (Dibros)	?	?	10+
SFD	Top of the World (Kenneth Colen)	120	4	75+
SFD	Cobblestone (G.W. Robinson)	275	0	10
SFD	Heathcliff (Beck Builders)	?	1	?
SFD	Brookfield (? ?)	139	17	15+
	Other small builders			150+
			Total	420+

Homes by D.R. Wastchak LLC

Phoenix, AZ Market – Cost Sharing by Southwest Gas

CONTINENTAL HOMES	Total	Complete	Next 12 mos
Mesquite Canyon	949	854	95
Meridian Point	537	199	231
Crystal Gardens	285	54	117
Adobe Highlands	403	351	52
Ironwood	230	156	74
Wildcat Ridge	261	248	13
Canyon Trails	611	49	318
Mesafield	62	19	43

Building AMERICA

Roster of Tested and Rated Homes

Building America Industrialized Housing Partnership

FLORIDA SOLAR ENERGY CENTER®

SAVING THE EARTH. SAVING YOUR MONEY.

ID Number:	PHH-FLR1PA 2
Project Number:	
Date Completed:	10/00
HERS Rating:	89.8

Living Area:	1600
Address:	563 Chance Dr.
	Lakeland, FL 33809
Community:	Meadwood Homes
Builder:	PHH Plant City
Rater:	David Beal
Rater Phone:	407-638-1433

Test Results

House CFM50:	
House ACH50:	
Ducts CFM25 total:	36
Ducts CFM25 (to out):	0.1
Pressure Pan Supply Avg:	N/A
Pressure Pan Return Avg:	N/A

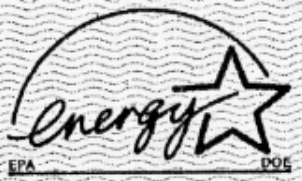
Energy Efficient Features

Roof/Attic/Ceiling:	Under Attic R-33, Rad.B
Walls:	R-19
Floors:	Raised R-11
Duct System:	R-6
Windows:	DBL, Tint
HVAC:	SEER 12, HSPF 7.5
Appliances:	one refrigerator
Lights:	flrct area 221 incndt are
Water Heater:	Electric EF .87
Solar System:	none

Other Features/Comments

Home Won Plant City Builder's Association's Parade of Home's Home of the Year

Certificate of Validation



The home built by

Palm Harbor Homes/Plant City

at 563 Chance Dr., Lakeland FL
has been certified to be compliant with the U.S. Environmental Protection Agency's

ENERGY STAR® Homes criteria.

ENERGY STAR Homes use at least 30% less energy for heating, cooling and water Heating than comparable homes built to the Model Energy Code.

The U.S. EPA hereby recognizes Palm Harbor Homes/Plant City for its contribution in reducing pollution through energy efficiency.

Signed:

Brian Ng
ENERGY STAR Homes
Customer Services Coordinator
www.energystar.gov/homes

Date: October 12, 2000

Home Energy Rating: 89.8 (out of 100)
Verification Organization:
FSEC/BAIHP

Roster of Tested and Rated Homes

Building America Industrialized Housing Partnership

FLORIDA SOLAR ENERGY CENTER®

SAVING THE EARTH, SAVING YOUR MONEY

ID Number:	AD5-25
Project Number:	
Date Completed:	10/00
HERS Rating:	86.7

Living Area:	1916
Address:	7220 SW 80 Terrace
	Gainesville, FL 32608
Community:	Mentone
Builder:	Atlantic Design
Rater:	Florida H.E.R.O.
Rater Phone:	(352) 336-2060

Test Results

House CFM50:	1305
House ACH50:	4.1
Ducts CFM25 total:	N/A
Ducts CFM25 (to out):	N/A
Pressure Pan Supply Avg:	0.16
Pressure Pan Return Avg:	0.23

Energy Efficient Features

Roof/Attic/Ceiling:	Under Attic R-30
Walls:	R-13
Floors:	slab on grade
Duct System:	R-6
Windows:	DBL, Clear
HVAC:	SEER 12, AFUE .8
Appliances:	one refrigerator
Lights:	
Water Heater:	Gas EF.59
Solar System:	none

Other Features/Comments

This BAIHP partner was honored as the EPA Energy Star Small Builder of the Year.

Certificate of Validation

This certifies that the home built by

Atlantic Design & Construction

at 7220 SW 80 Terr., Gainesville, FL

satisfies the **ENERGY STAR® Homes** criteria of the U.S. Environmental Protection Agency. ENERGY STAR Homes use at least 30% less energy for heating, cooling and water heating than comparable homes built to the Model Energy Code.

The U.S. EPA hereby recognizes Atlantic Design & Construction for progress in reducing pollution through energy efficiency.

Signed:

Sam Rashkin
ENERGY STAR Homes
Program Manager

Date: October 24, 2000

Home Energy Rating: 86.7 (out of 100)
Verification Organization:
Florida HERO / BAIHP
15220 NW 5th Avenue
Newberry, FL 32669

Roster of Tested and Rated Homes

Building America Industrialized Housing Partnership

Florida Solar Energy Center®

Saving The Earth. Saving Your Money.

ID Number:	mtc-87
Project Number:	
Date Completed:	07/00
HERS Rating:	89.7

Living Area:	1552 SF
Address:	260 NW 50th Blvd.
	Gainesville, FL 32607
Community:	Monticello
Builder:	Millpond Dev. Corp.
Rater:	Florida H.E.R.O.
Rater Phone:	(352) 336-2060

Energy Efficient Features

Roof/Attic/Ceiling:	R-30
Walls:	R-13, R-3
Floors:	slab on grade
Duct System:	R-6
Windows:	DBL, Clear
HVAC:	SEER 12, AFUE 0.78
Appliances:	one refrigerator
Lights:	
Water Heater:	Natural Gas EF 0.56
Solar System:	none

Test Results

House CFM50:	524
House ACH50:	2.3
Ducts CFM25 total:	32
Ducts CFM25 (to out):	N/A
Pressure Pan Supply Avg:	N/A
Pressure Pan Return Avg:	N/A

Other Features/Comments

This 113 unit townhouse development include the following features in all of the homes. All duct work and air handlers are located within the conditioned space. All homes are serviced by a combination hydronic heating system. All homes are serviced by

Roster of Tested and Rated Homes

Building America Industrialized Housing Partnership

FLORIDA SOLAR ENERGY CENTER®

SAVING THE EARTH. SAVING YOUR MONEY.

ID Number:	AD2-01
Project Number:	
Date Completed:	07/00
HERS Rating:	86.8

Living Area:	1623 SF
Address:	6728 SW 81st Street
	Gainesville, FL 32608
Community:	Mentone
Builder:	Atlantic Design
Rater:	Florida H.E.R.O.
Rater Phone:	(352) 336-2060

Test Results

House CFM50:	1186
House ACH50:	4.4
Ducts CFM25 total:	N/A
Ducts CFM25 (to out):	N/A
Pressure Pan Supply Avg:	0.18
Pressure Pan Return Avg:	0.2

Energy Efficient Features

Roof/Attic/Ceiling:	R-30
Walls:	R-13
Floors:	slab on grade
Duct System:	R-6
Windows:	DBL, Clear
HVAC:	SEER 12, AFUE 0.78
Appliances:	one refrigerator
Lights:	
Water Heater:	Natural Gas EF 0.56
Solar System:	none

Other Features/Comments

This developer/builder continues to include provision for the introduction of fresh air through a filtered duct chase from under an eve or porch to the return side of the distribution system. This also helps to maintain a positively pressurized home.

Roster of Tested and Rated Homes

Building America Industrialized Housing Partnership

Florida Solar Energy Center®

Saving The Earth, Saving Your Money

ID Number:	USS305
Project Number:	
Date Completed:	10/00
HERS Rating:	86.0

Living Area:	1058
Address:	201 Southeast 2nd Aven
	Gainesville, FL 32601
Community:	Union Street Station
Builder:	Charles Perry Constructi
Rater:	Florida H.E.R.O.
Rater Phone:	(352) 336-2060

Test Results

House CFM50:	1012
House ACH50:	6.4
Ducts CFM25 total:	59
Ducts CFM25 (to out):	N/A
Pressure Pan Supply Avg:	N/A
Pressure Pan Return Avg:	N/A

Energy Efficient Features

Roof/Attic/Ceiling:	none
Walls:	R-13
Floors:	raised conc. R-19
Duct System:	R-6
Windows:	DBL, Clear
HVAC:	SEER 10, HSPF 7.2
Appliances:	one refrigerator
Lights:	132SF fluorescent
Water Heater:	Electric EF .9
Solar System:	none

Other Features/Comments

Homes by D.R. Wastchak LLC

Phoenix, AZ Market – Cost Sharing by Southwest Gas

BEAZER HOMES	Total	Complete	Next 12 mos
Estrella Mountain Ranch	80	24	40
Estrella Vista	106	85	21
Summerfield	297	202	65
Silverton II	162	57	73
Ashton Ranch	336	302	34
Wildflower	299	120	135
Cimmarron II	48	29	19
Terralea	192	38	115
Acacia Landing	349	17	175
Cypress Landing	286	0	143

Building AMERICA

Homes by D.R. Wastchak LLC

Phoenix, AZ Market – Cost Sharing by Southwest Gas

RISING STAR HOMES	Total	Complete	Next 12 mos
Citrus Heights	63	60	3
PULTE HOME CORP			
Superstition Foothills Horizon	70	67	3
CENTEX HOMES			
Desert Star	178	0	62

Building AMERICA

Homes by D.R. Wastchak LLC

Phoenix, AZ Market – Cost Sharing by Southwest Gas

HACIENDA BUILDERS	Total	Complete	Next 12 mos
Santa Rita Ranch	103	36	46
Sundance Ranch	211	84	84
Parkwood Ranch East	72	29	29
Roseview	132	59	59
Mountain Vista Ranch	82	53	25
Corte Sierra	213	53	107

Building AMERICA

Homes by D.R. Wastchak, LLC

Phoenix, AZ Market – Cost Sharing by Southwest Gas

TREND HOMES	Total	Complete	Next 12 mos
Paradise Views	207	52	104
Cambridge Estates	564	23	316
Ironwood II	179	18	107
Arlington Estates	395	40	237
Coronado Ranch	114	6	51

Homes by D.R. Wastchak LLC

Phoenix, AZ Market – Cost Sharing by Southwest Gas

REPUBLIC HOMES	Total	Complete	Next 12 mos
Rancho Paloverde Estates	108	16	49
COUNTRYWALK HOMES			
Wildflower	32	5	21
Sandalwood	60	12	42
ASTANTE LUXURY COMMUNITIES			
Bella Tierra	40	4	12
Gilbert Commons	55	5	17

Total number of homes projected for the next 12 months **3,137**

Building AMERICA

Roster of Tested and Rated Homes

Building America Industrialized Housing Partnership

FLORIDA SOLAR ENERGY CENTER®

SAVING THE EARTH. SAVING YOUR MONEY.

ID Number:	ph08
Project Number:	
Date Completed:	06/00
HERS Rating:	88.9

Living Area:	1968 SF
Address:	6646 N.W. Grand Ave.
	Glendale, AZ 85301
Community:	Palm Harbor Village
Builder:	Palm Harbor Homes
Rater:	Daran Wastchak
Rater Phone:	(480) 350-9274

Test Results

House CFM50:	1135
House ACH50:	
Ducts CFM25 total:	61
Ducts CFM25 (to out):	15
Pressure Pan Supply Avg:	N/A
Pressure Pan Return Avg:	N/A

Energy Efficient Features

Roof/Attic/Ceiling:	R-38
Walls:	R-19
Floors:	R-22
Duct System:	R-6
Windows:	U=0.53, SHGC=0.62
HVAC:	SEER 12, strip heat
Appliances:	
Lights:	
Water Heater:	Electric
Solar System:	none

Other Features/Comments

Roster of Tested and Rated Homes

Building America Industrialized Housing Partnership

FLORIDA SOLAR ENERGY CENTER®

SAVING THE EARTH, SAVING YOUR MONEY

ID Number:	DRW12
Project Number:	
Date Completed:	12/00
HERS Rating:	88.6

Living Area:	2,286
Address:	16728 W. McKinley St.
	Goodyear, AZ 85338
Community:	Canyon Trails - Talon Te
Builder:	Continental
Rater:	D.R. Wastchak, L.L.C.
Rater Phone:	(480) 350-9274

Test Results

House CFM50:	1895
House ACH50:	5
Ducts CFM25 total:	96
Ducts CFM25 (to out):	N/A
Pressure Pan Supply Avg:	N/A
Pressure Pan Return Avg:	N/A

Energy Efficient Features

Roof/Attic/Ceiling:	Under Attic R-30
Walls:	R-13
Floors:	slab on grade
Duct System:	R-4
Windows:	DBL U=.64, SHGC=.52
HVAC:	SEER 12, AFUE .8
Appliances:	N/A
Lights:	N/A
Water Heater:	Gas or Electric
Solar System:	none

Other Features/Comments

Certificate of Validation

This certifies that the home built by

Continental

at 16728 W. McKinley St., Goodyear, AZ

satisfies the **ENERGY STAR® for Homes** criteria of the U.S. Environmental Protection Agency. ENERGY STAR labeled homes use at least 30% less energy for heating, cooling, and water heating than comparable homes built to the Model Energy Code.

The U.S. EPA hereby recognizes Continental for its contribution in reducing pollution through energy efficiency.

Signed:

Brian Ng
ENERGY STAR for Homes
Customer Services Coordinator

December 22, 2000

www.energystar.gov

Verification Organization:
D.R. Wastchak LLC / BAIHP

Roster of Tested and Rated Homes

Building America Industrialized Housing Partnership

FLORIDA SOLAR ENERGY CENTER®

SAVING THE EARTH. SAVING YOUR MONEY

ID Number:	DRW16
Project Number:	
Date Completed:	12/00
HERS Rating:	88.6

Living Area:	1,400
Address:	16738 W. Melvin St.
	Goodyear, AZ 85338
Community:	Canyon Trails - Palomin
Builder:	Continental
Rater:	D.R. Wastchak, L.L.C.
Rater Phone:	(480) 350-9274

Test Results

House CFM50:	1160
House ACH50:	5.2
Ducts CFM25 total:	85
Ducts CFM25 (to out):	N/A
Pressure Pan Supply Avg:	N/A
Pressure Pan Return Avg:	N/A

Energy Efficient Features

Roof/Attic/Ceiling:	Under Attic R-30
Walls:	R-13
Floors:	slab on grade
Duct System:	R-4
Windows:	DBL U=.64, SHGC=.52
HVAC:	SEER 12, AFUE .8
Appliances:	N/A
Lights:	N/A
Water Heater:	Gas or Electric
Solar System:	none

Other Features/Comments

Certificate of Validation

This certifies that the home built by

Continental

at 16738 W. Melvin St., Goodyear, AZ

satisfies the **ENERGY STAR® for Homes** criteria of the U.S. Environmental Protection Agency. ENERGY STAR labeled homes use at least 30% less energy for heating, cooling, and water heating than comparable homes built to the Model Energy Code.

The U.S. EPA hereby recognizes Continental for its contribution in reducing pollution through energy efficiency.

Signed:

Brian Ng
ENERGY STAR for Homes
Customer Services Coordinator

December 1, 2000

www.energystar.gov

Verification Organization:
D.R. Wastchak LLC / BAIHP

Habitat for Humanity

- **Task Leader – Janet McIlvaine**
- **Training with HFH International**
  - 1½ Sessions conducted in 3 of Habitats 8 Regions (NW, SE, and NE)
  - Top 70 Affiliates Conference
  - HFH 25th Anniversary (Fall 2001)
  - Lecture, Field Work, and Hands On Labs

Building AMERICA

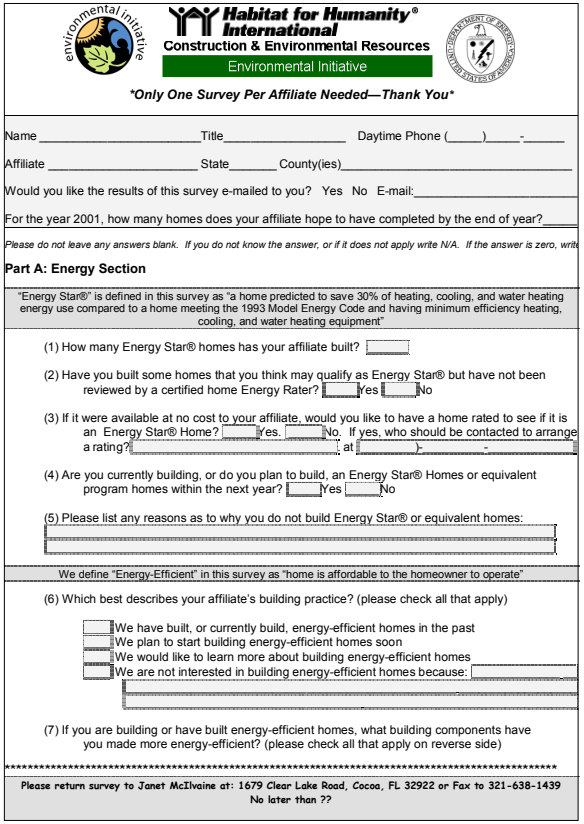
Habitat for Humanity

- **Design Assistance to Habitat Affiliates**
  - Florida, Arizona, North Carolina, West Virginia, South Carolina, Washington, Missouri, & 2000 Carter Project in New York and Georgia
- **Exemplary Projects**
  - Lakeland Habitat (FL) HERS Score: 89.8
  - Homeowner reports 75% reduction in utility bills

Building AMERICA

Habitat for Humanity

- **Survey of Affiliates**
  - Head count of energy efficient Habitat homes nationwide
- **Energy Star Examples**
  - Typical Habitat Construction
  - 18 Cities
  - Peer Review in Progress



Habitat for Humanity® International
Construction & Environmental Resources
Environmental Initiative

Only One Survey Per Affiliate Needed—Thank You

Name _____Title_____ Daytime Phone (_____)_____-_____

Affiliate _____ State_____County(ies)_____

Would you like the results of this survey e-mailed to you? Yes No E-mail:_____

For the year 2001, how many homes does your affiliate hope to have completed by the end of year?_____

Please do not leave any answers blank. If you do not know the answer, or if it does not apply write N/A. If the answer is zero, write

Part A: Energy Section

"Energy Star®" is defined in this survey as "a home predicted to save 30% of heating, cooling, and water heating energy use compared to a home meeting the 1993 Model Energy Code and having minimum efficiency heating, cooling, and water heating equipment"

(1) How many Energy Star® homes has your affiliate built? _____

(2) Have you built some homes that you think may qualify as Energy Star® but have not been reviewed by a certified home Energy Rater? _____Yes _____No

(3) If it were available at no cost to your affiliate, would you like to have a home rated to see if it is an Energy Star® Home? _____Yes. _____No. If yes, who should be contacted to arrange a rating? _____ at _____-_____-_____

(4) Are you currently building, or do you plan to build, an Energy Star® Homes or equivalent program homes within the next year? _____Yes _____No

(5) Please list any reasons as to why you do not build Energy Star® or equivalent homes:

_____

_____

We define "Energy-Efficient" in this survey as "home is affordable to the homeowner to operate"

(6) Which best describes your affiliate's building practice? (please check all that apply)

_____We have built, or currently build, energy-efficient homes in the past
_____We plan to start building energy-efficient homes soon
_____We would like to learn more about building energy-efficient homes
_____We are not interested in building energy-efficient homes because: _____

_____

_____

(7) If you are building or have built energy-efficient homes, what building components have you made more energy-efficient? (please check all that apply on reverse side)

****

Please return survey to Janet McIlvaine at: 1679 Clear Lake Road, Cocoa, FL 32922 or Fax to 321-638-1439
No later than ??

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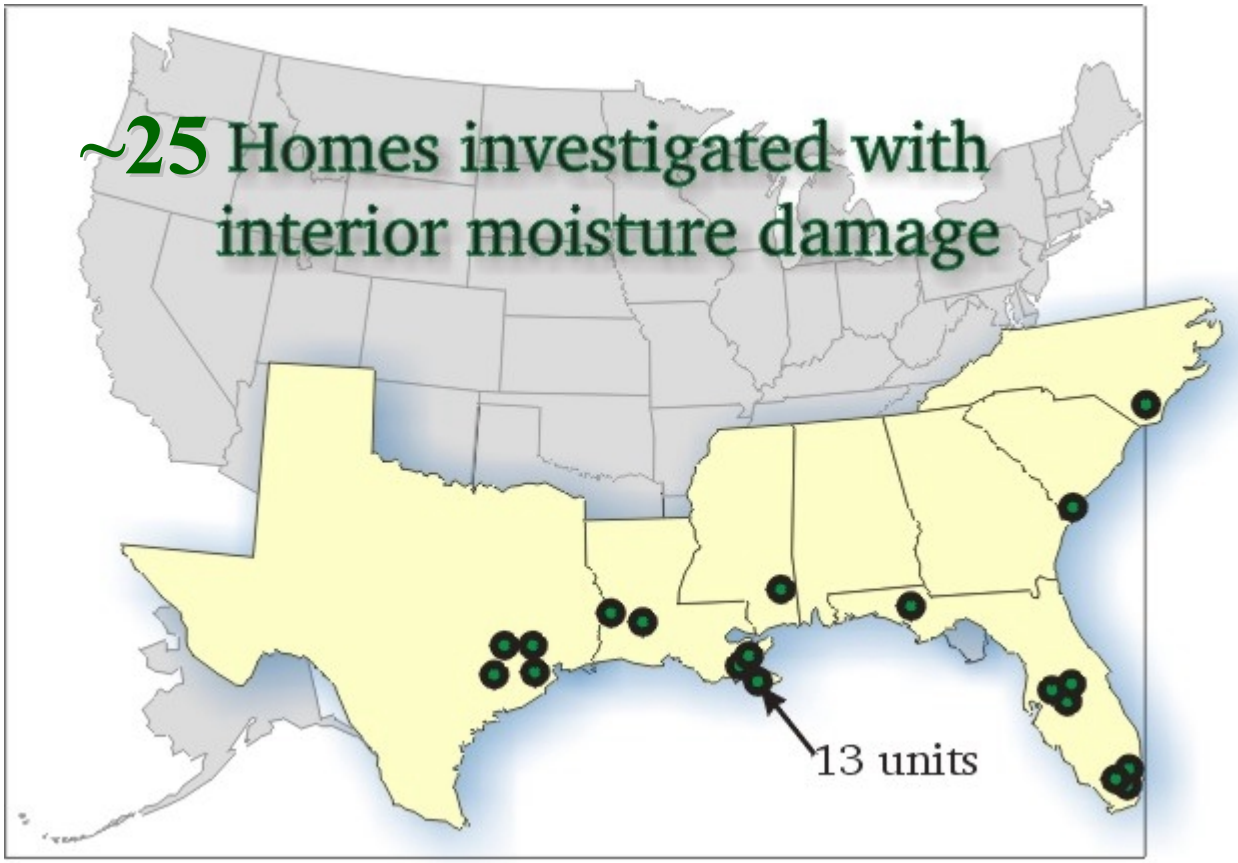
Moisture Problems In HUD Code Homes



Highest priority research item of the HUD code industry

Collaborating with MHRA

Palm Harbor Homes have not had a single problem home in 2000 after incorporating BAIHP guidelines

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Moisture Problems In HUD Code Homes

- **Leads to energy waste as homeowners lower a/c setpoint to be comfortable (1° lowering of SP = ~10% increase in cooling energy use.**
- **Causes…**
  - Vapor "barrier" on cold side (interior)
  - Thermostat set below outside dewpoint
  - Oversized A/C or constant operation of blower or clogged condensate drain
  - Long-term negative pressures
    - Duct leaks
    - Door closure
    - Exhaust fans
  - Crawlspaces poorly vented or with standing ground water or lacking ground cover

Moisture Problems Investigated In The Field

Taped plenum failure (looking up)

Flex duct sealing failure

Mold stain: result of neg. pressure

"Drowned duct": H2O in insulation

Moisture Problems Investigated In The Field

Overhead ducts cooling floor

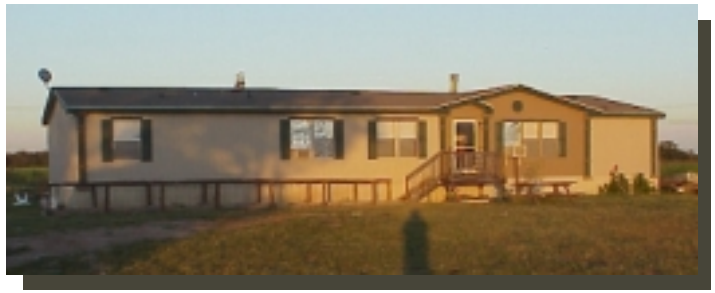
Belly board sealing failure

Mold stain of vinyl flooring

Warped vinyl covered flooring

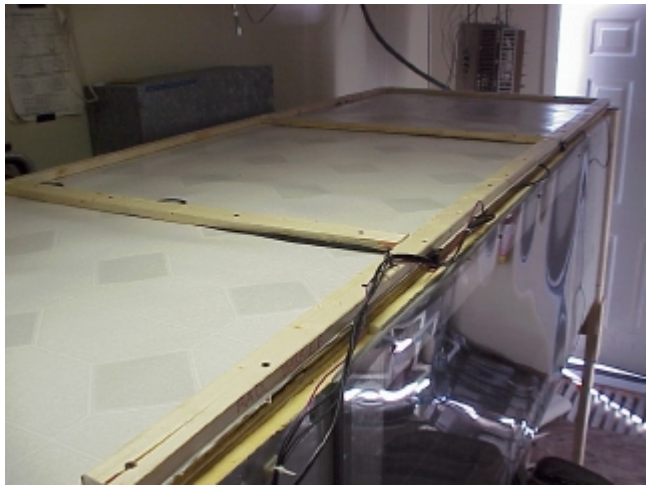
Finding Solutions: 1 Home

Wall damage - High cooling bills - Fireplace problems



- 2100 sqft 4-bedroom 3-bath
- Building airtightness
  - CFM50 = 3245 (1.54 cfm50 per square foot)
- Duct airtightness
  - $CFM25_{total}$=430 (20.5% floor area)
  - $CFM25_{out}$ =328 (15.6% floor area)
- Pressure differentials: House wrt Outside

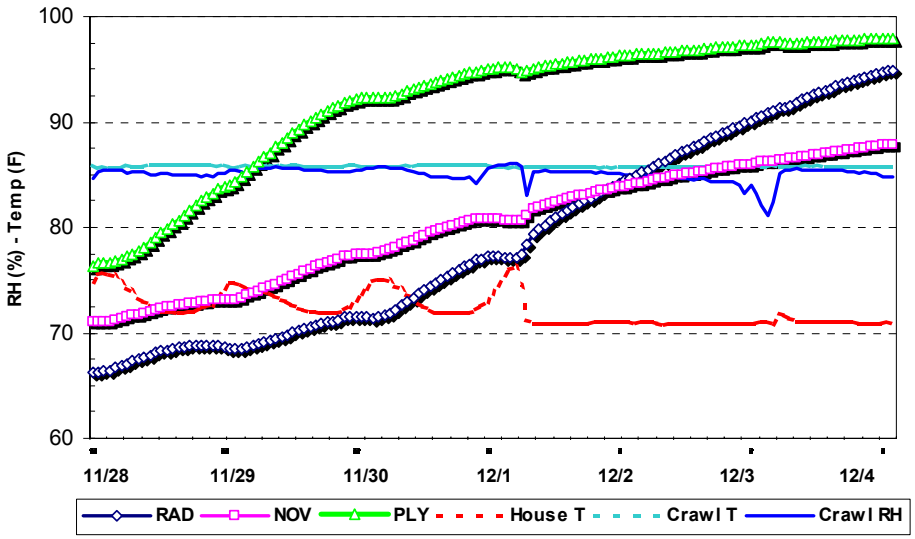
  (ideally all Δ P=0.0)
  - all fans off ……. 0.0 pa
  - air handler on …….. -5.6 pa (0 to –3 typical)
  - master suite door closed …. -7.0 pa (0 to –4 typical)
  - all interior doors closed ….. -8.0 pa (0 to –5 typical)



Floor Moisture Experiment

Surrounding conditions maintained at 72F, interior conditions at 85F – 85%

Decking materials: Radiant barrier plywood, "Novadeck", plywood.



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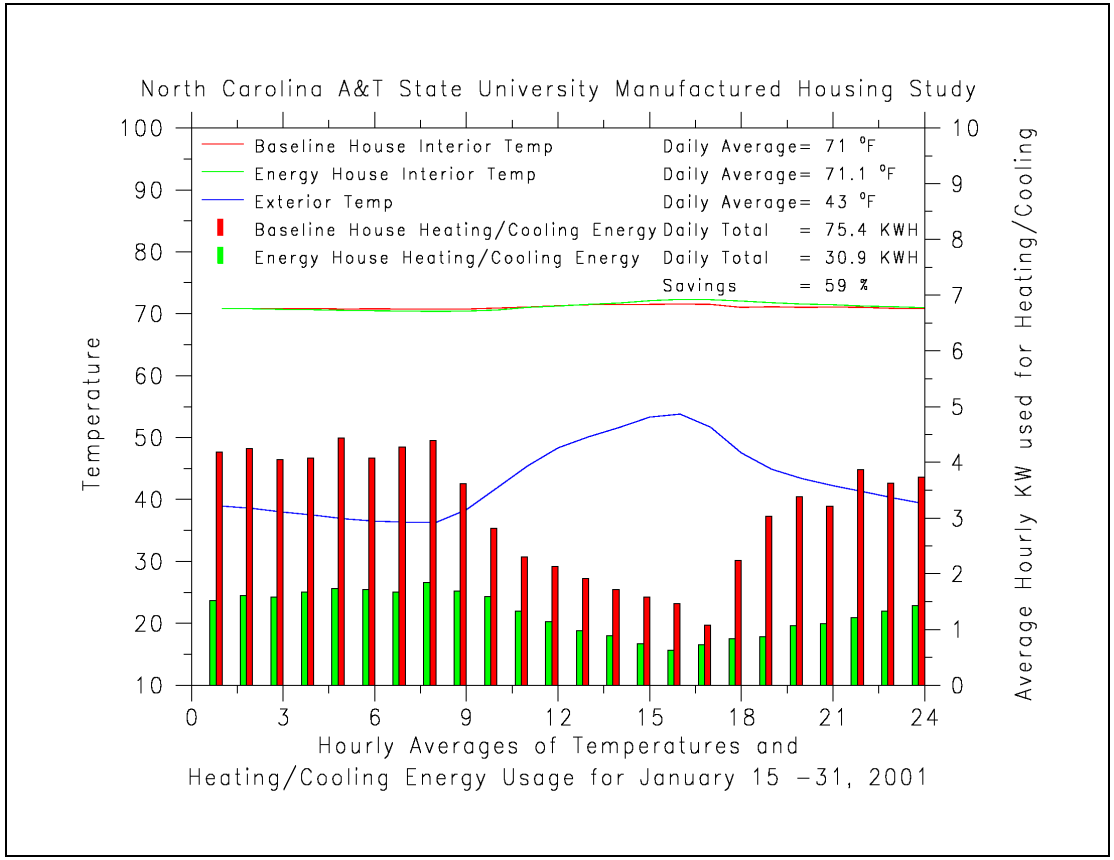
Field Monitoring

- Side-by-side manufactured homes at NCATU, Greensboro, NC
- Fleetwood-Coleman experiments
- Centex Homes
- Portable classrooms in Washington & Idaho
- WSU Energy House
- Hoak residence
- Please visit www.infomonitors.com

1528 SF Side-by-Side Homes w/Simulated Occupancy
NC A&T University, Greensboro, NC

Characteristic	Standard	Building America
Floor/wall/ceiling insulation	R-11/11/20	R-13/22/33
Windows	single/storm	low-E
Ducts	taped	mastic
HVAC	SEER 10+ strip	SEER 12 heat pump
A/C size (tons)	3.0	2.0
Water heater	electric	solar

Building America Goal Achieved !

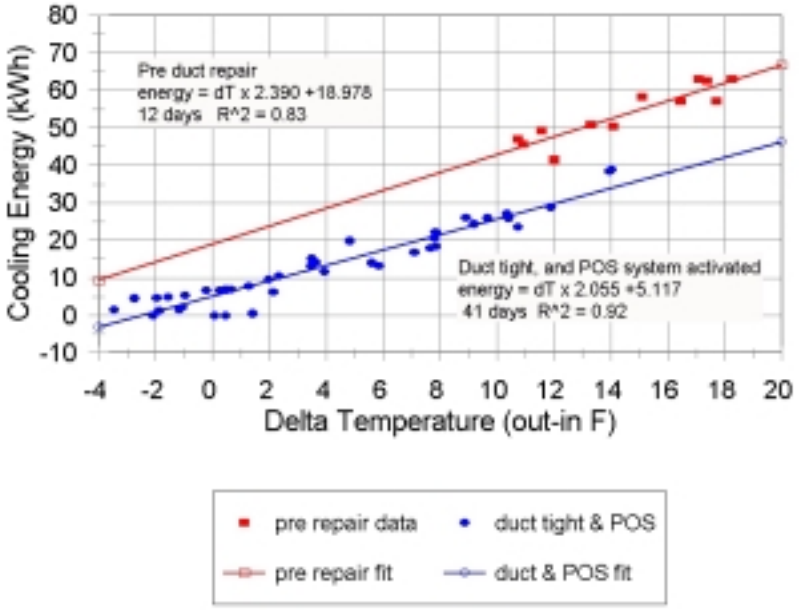


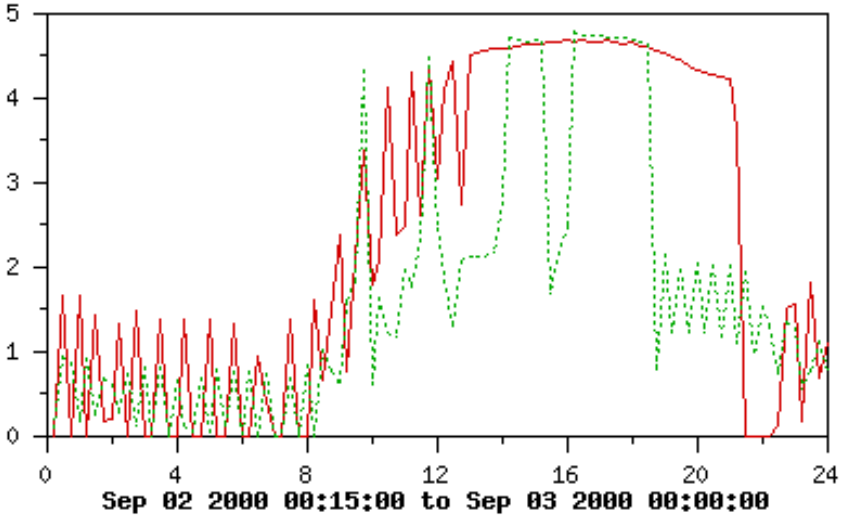
Monitoring Fleetwood Homes & Coleman Evcon

Duct Leakage Effects

- Energy use
- Airflow delivery
- Pressure differentials

2-Speed A/C Performance





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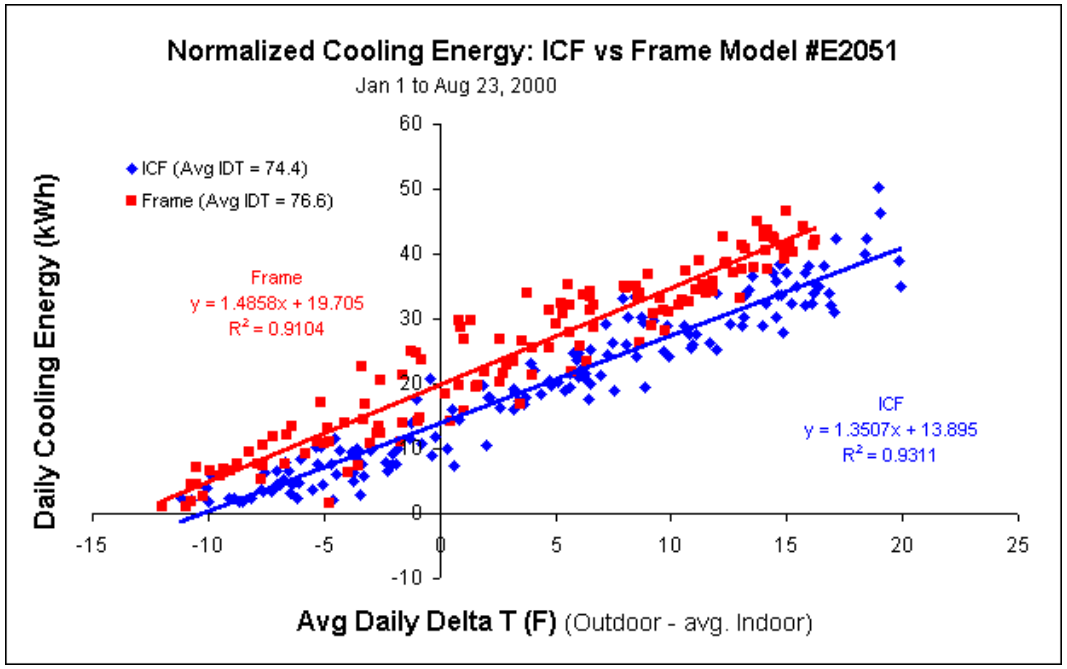
Centex Homes

- Two pairs of occupied homes monitored in Dallas, TX over summer 2000 and winter 2000-2001
- Each pair has one conventional and one insulated concrete form (ICF) home

Centex Homes Results



Approximately 20% cooling energy savings from ICF for these 2-story homes.

Cool Roofs

- **Funded primarily by Florida Power & Light Co.**
- **7 Habitat homes monitored in southwest Florida (Ft.Myers)**

• Standard dark shingles with standard ventilation (RGS)

• Light colored shingles with standard ventilation (RWS)

• Terra cotta direct nailed S-tile roof (RTB)

• White S-tile roof (RWB)

• White flat tile roof (RWF)

• White metal 5-vee roof (RWM)

• Standard dark shingles with R-19 sprayed insulation on roof decking and unvented attic (RSL)

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Cool Roof Results

Case Description	Cooling Savings		Peak Demand Reduction	
	kWh	Percent	kW	Percent
RGS (Control)	0	0%	0	0%
RWS (White Shingle)	300	4%	0.48	17%
RSL (Sealed Attic)	620	9%	0.13	5%
RTB (Terra Cotta Tile)	180	3%	0.36	13%
RWB (White S-Tile)	1,380	20%	0.92	32%
RWF (White Flat Tile)	1,200	17%	0.98	34%
RWM (White Metal)	1,610	23%	0.79	28%

* Percentages relative to typical values for average sized detached S. FL homes

Florida Green Building Coalition, Inc.

"To provide a Florida green building designation resulting in environmental and economic benefits."

fgbc

www.floridagreenbuilding.org

Florida Green Home Standard Checklist

Schedule A

NEW HOME REQUIREMENTS: Select measures to obtain the minimum number of points listed for each category. The sum of the minimums totals 160 points. Accumulate at least an additional 40 points of your choice to qualify for the program. If any category minimums cannot be achieved, point deficiencies may be made up by adding the deficiency to the total minimum score of 200. (Example: Applicant elects to achieve only 10 points from a category with a minimum of 15. Applicant may still qualify if total points equal or exceed 200 + [15-10] = 205.) Note that category maximums cannot be exceeded at any time.

EXISTING HOME REQUIREMENTS: Same as for **NEW HOME** except no minimum point requirement in the Materials and Site categories.

PREREQUISITES: If home site borders a natural water body and/or has a swimming pool or spa, at least one measure from the following Waterfront Considerations and/or Swimming Pool/Spa Prerequisite lists must be incorporated.

Prerequisite 1: Swimming Pool / Spa (Ref.)

- ❑ Sanitation system that reduces/eliminates chlorine use (salt water, ionization, etc.)
- ❑ Retractable pool cover
- ❑ Solar pool heating system
- ❑ Efficient pool pumping
- ❑ Swimming pool/spa free house

Prerequisite 2: Waterfront Considerations (Ref.)

- ❑ Use of native aquatic vegetation in shoreline area
- ❑ Low maintenance plants placed between lawn and shoreline; no turf adjacent to water
- ❑ Use of terraces, swales, or berms to slow storm water movement into water body
- ❑ Home site does not border natural water body

Category 1: Energy (Building Envelope/Systems)

Points Achieved	Points Possible	Criteria
		Code/Ratings
100	100	Meet Florida Energy Code
	5-50	Confirmed Florida HERS Rating (attach)
		5 pts for every HERS pt above 80
		For complete explanation of HERS Rating, see Ref. Guide
		Homes are given credit for features including:
		Efficient a/c and heat — *Solar or efficient water heating*
		Proper orientation — *Ducts sealed or in cond. space*
		Efficient windows — *Insulation quantity and type*
		Radiant barrier — *Envelope sealing*
		Design
	1	Cross vent and ceiling fans code credits
	1	Min 100ft^2 roofed porch min 3 sides open
	1	Passive solar space heat system
	1	Passive solar day-lighting
	1	House shaded on east and west by trees
	1	Washer and dryer outside of cond space
	1	Light colored roof
	1	Light colored exterior walls
	1	South roof area for future solar use
	1	Earth sheltered design
	1	Pre-plumb for solar hot water
	1	Centrally locate hot water heater
	1	Efficient envelope volume:surface area ratio
	1	Dwelling unit attached, zero lot-line, row house
		Total points for Category 1 (100 min/150 max)

Category 2: Energy (Appliances, Lights, Amenities)

Points Achieved	Points Possible	Criteria
		Energy-efficient appliances/amenities
	3	Energy Star® refrigerator
	3	Energy Star® dishwasher
	3	Energy Star® clothes washer
	3	Energy-efficient clothes dryer
	3	Energy-efficient oven/range
	1	Buyer given info if none installed
	2	Efficient well pumping
		Energy-efficient lighting
	2	Recessed, sealed IC fixtures
	1	Indoor lights are compact fluorescent
	2	Max installed lighting wattage < 0.5 W/ft^2
	2	Light colored interior walls, ceilings, carpet/ floors
	1	Single light in bathroom
	2	Outdoor lights are fluorescent/elec ballast, pv, low voltage, or have motion detector
		Total points for Category 2 (10 min/25 max)

Healthy House

- Participating in development of ALA national technical standards and program

- Upcoming demonstration project in Orlando on healthy remodeling

Highlights from the UCF Constructability Lab

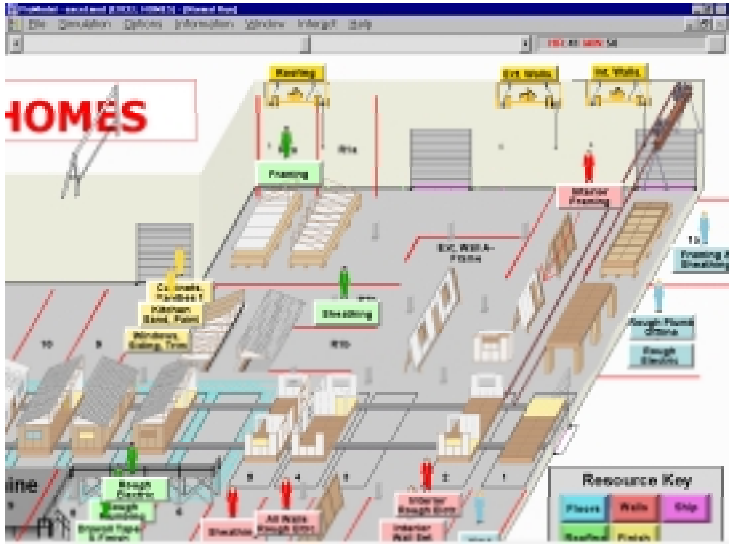
April 10, 2001

Housing Constructability Lab

University of Central Florida

Innovations in Modular Manufacturing

Used Simulation Modeling to Make 2 New Modular Manufacturing Plants More Lean & Agile

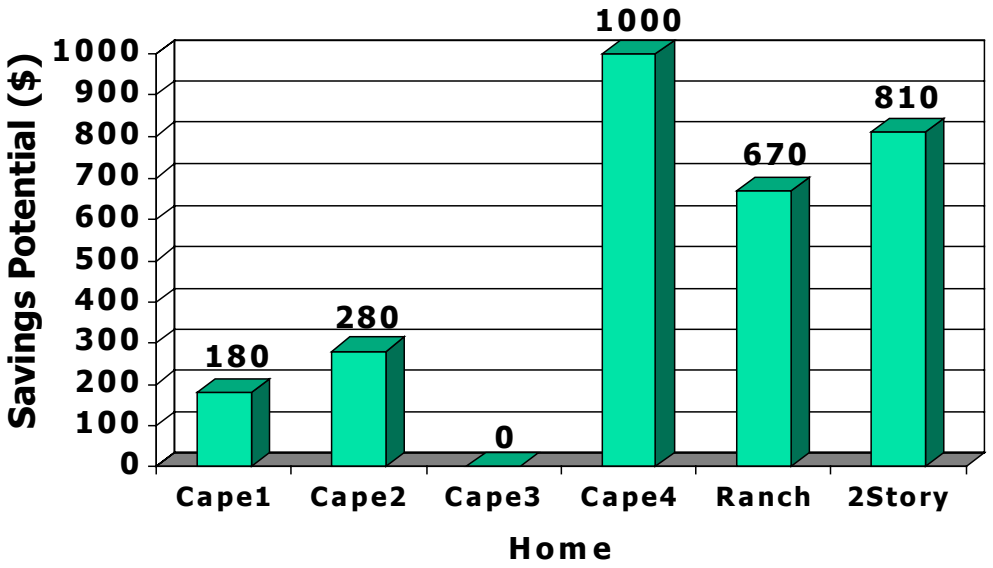


Housing Constructability Lab

University of Central Florida

Innovations in Module Set

Identified Numerous Opportunities for Improving the Module Set Process



Housing Constructability Lab

University of Central Florida

Current Research Efforts

- Support Continued Innovation in Modular Home Manufacturing
  - Improve Quality Systems
  - Move Technology to Shop Floor
  - Become More Lean & Agile
- Support Modular Classroom Manufacturers
  - Integrate Energy Saving Innovations into Production Process

Portable Classrooms

Goal

- To research innovative technologies that enhance the energy efficiency, indoor air quality, and the learning environment in portable classrooms.
- Foster the adoption of appropriate technologies through extensive collaborations and partnerships

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Portable Classrooms (Cont.)

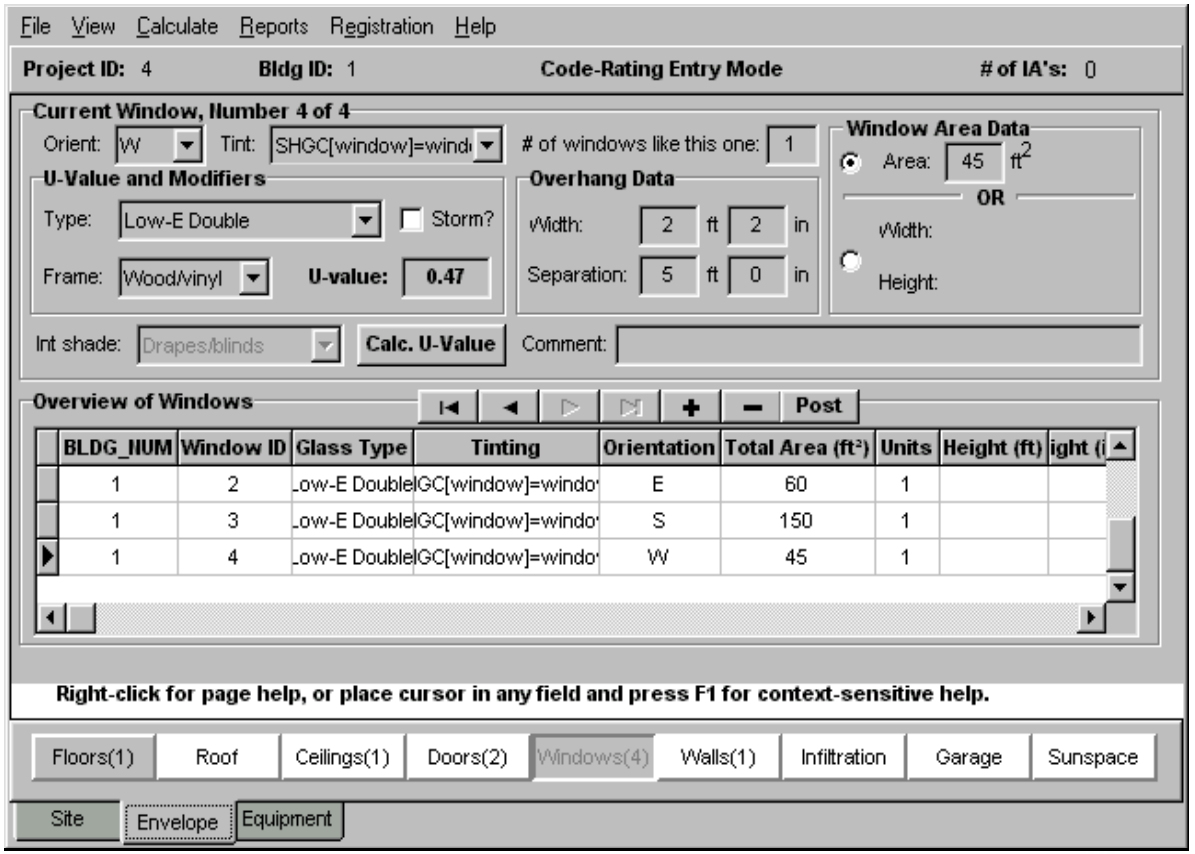
- New activity in partnership with the northwest states (Washington, Oregon, Idaho)
- PNNL instrumented 1 classroom in Idaho, 2 in Washington. Data available at www.infomonitors.com
- FSEC to monitor portable in Southern California in partnership with SCE
- Extensive collaboration with sister DOE activities, manufacturing, school boards, and the states.

EnergyGauge USA

- Software for accurate predictions of energy use and ratings
- Based on DOE2.1E with FSEC enhancement
- Passed BESTEST
- When compared to monitored field data, average error ~4% in predicting energy cooling use

Available now! See http://energygauge.com

EnergyGauge USA



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