

The *Retrofit Challenge*:
Master Specifications for
Affordable Housing
Renovation Programs

Hot Humid Climate – Zones 1, 2, and 3

Janet McIlvaine

Florida Solar Energy Center

Research Institute of the University of Central Florida

Building America

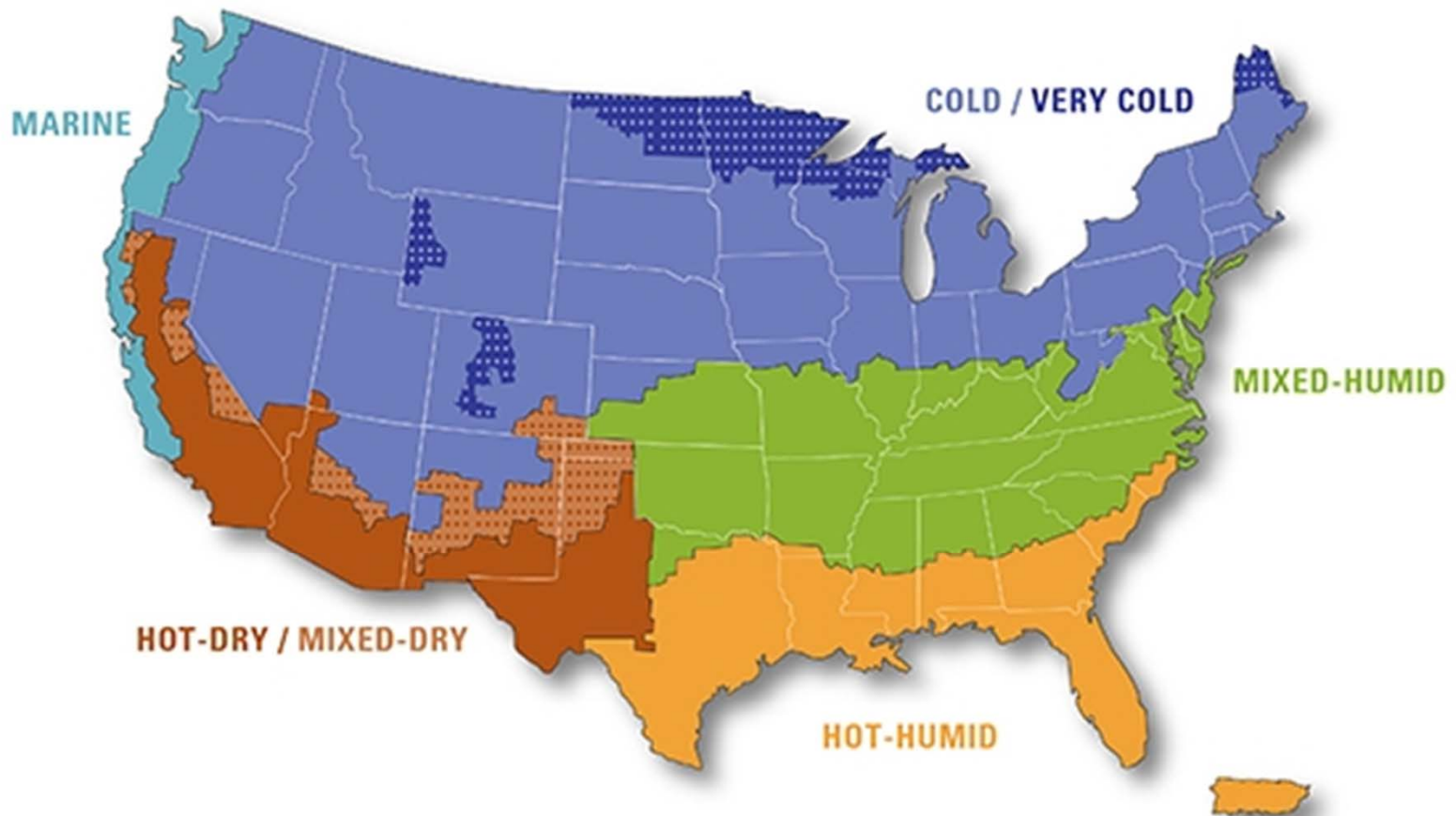
Partnership for Improved Residential Construction

Context

Building America Partnership for Improved Residential Construction

Hot-Humid Climate Zone Existing Homes Research

Take the *Retrofit Challenge!* www.ba-pirc.org/retrofit



Context

- 2009 – BA-PIRC expanded to include existing homes
- 2010 – Building America sets goal for existing homes
 - Identify current best practices for 15% savings by 2011
 - Identify paths for 30% savings by 2013
- How can we apply **systems engineering** to existing homes?
- Can we develop **standardized guidance** for existing homes?
- Challenges
 - Existing homes are not standardized
 - Renovation industry very competitive - \$500 might lose a job
 - **No one is doing energy focused home improvement in Florida**
 - **Where can we find partners?**

Context

Sarasota County with HUD funding.
Purchase and renovate foreclosed homes.
Sell in affordable housing sector.

Tell us what to do.
Give us “the list”.

Let’s figure out
together.



Technical Approach – Field Study

1. Develop scope of work for each house prior to purchase.

2. Pre-retrofit Audit & Analysis
Recommendations for 30% Improvement

3. Partner - Finalizes Scope of Work &
Conducts Renovation

4. BA-PIRC – Post-retrofit Audit & Analysis

HERS Index Score
Improvement

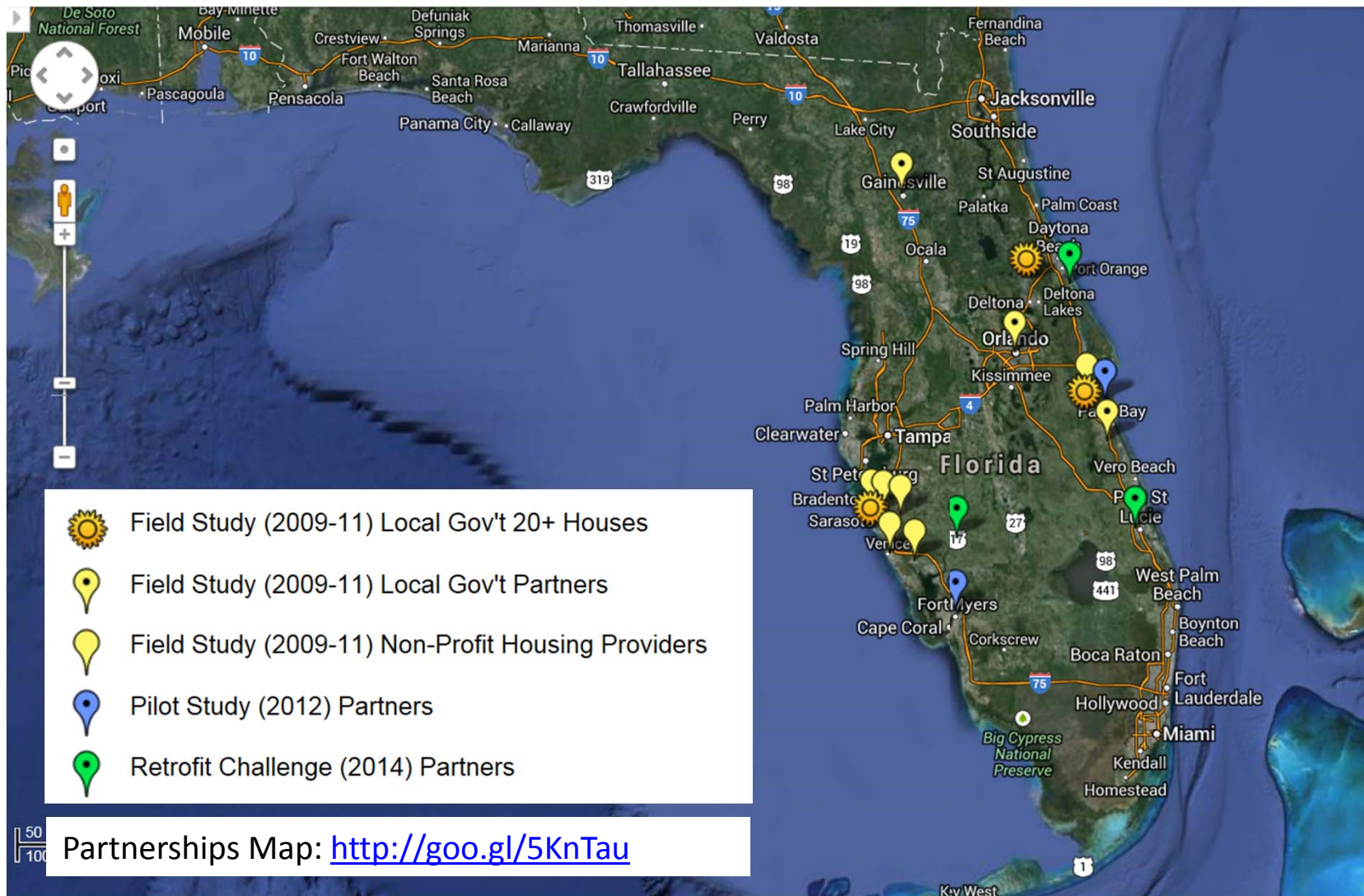
Projected Annual
Energy Use & Cost
Savings

Projected First Year
Cash Flow with
Actual Costs

Multi-faceted decision
making process.
Priorities, cost,
availability, market
expectations, etc.

Technical Approach – Field Study

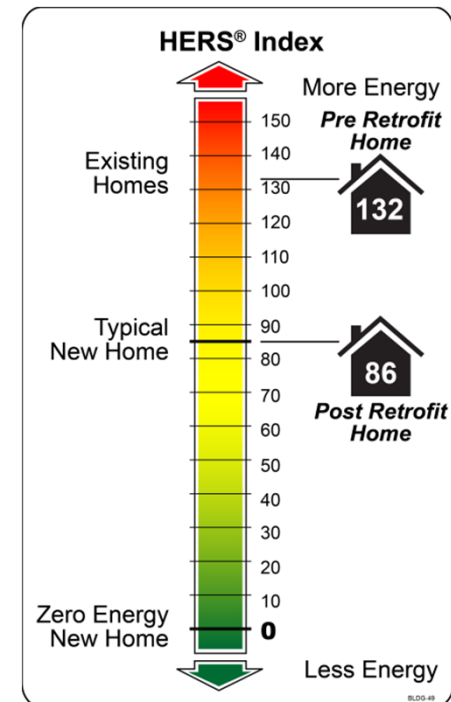
70 house field study resulted in detailed best practices.



Technical Approach – Field Study

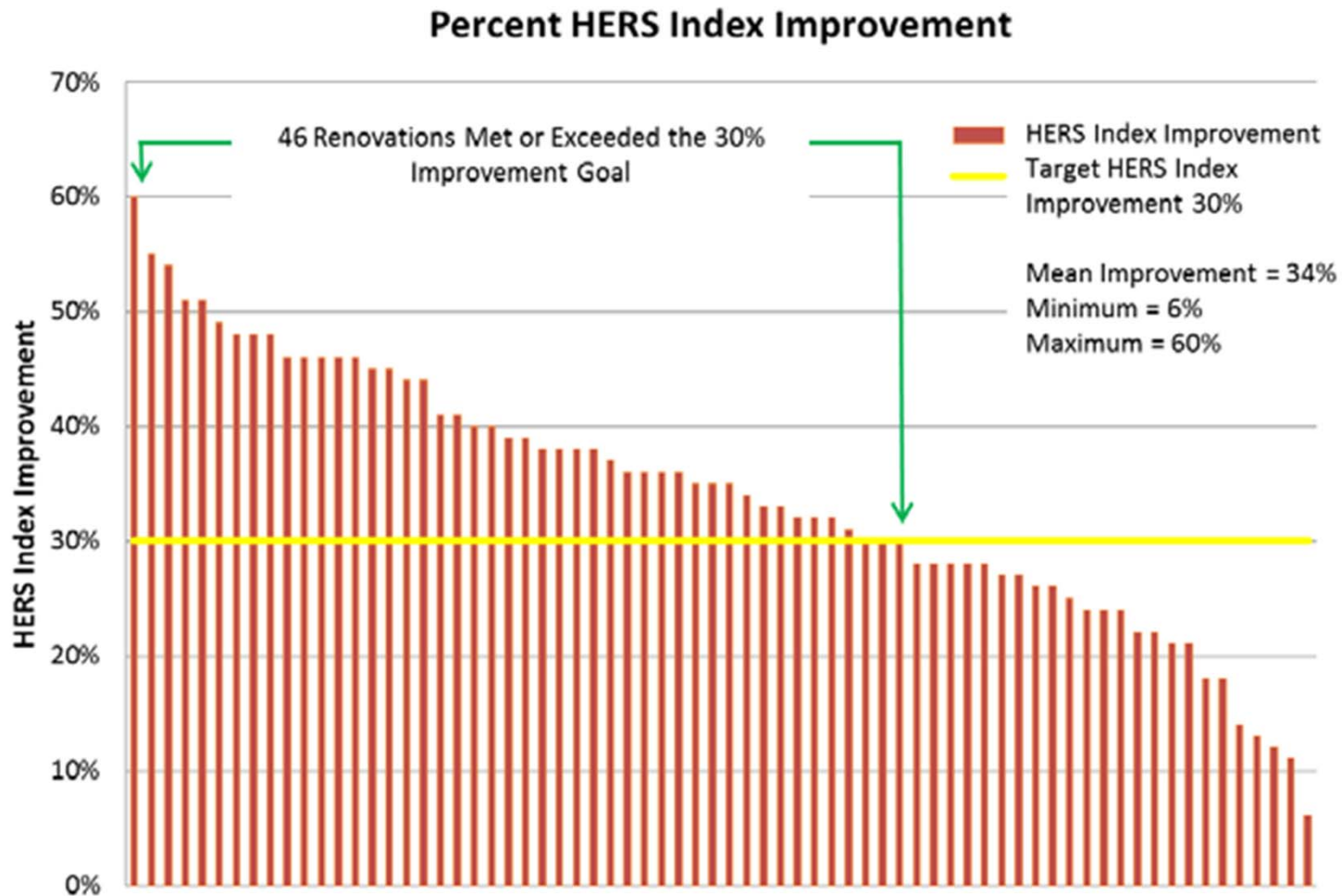
70 homes of 1950's – 2000's vintage.

HERS Index range from 95 to 184.



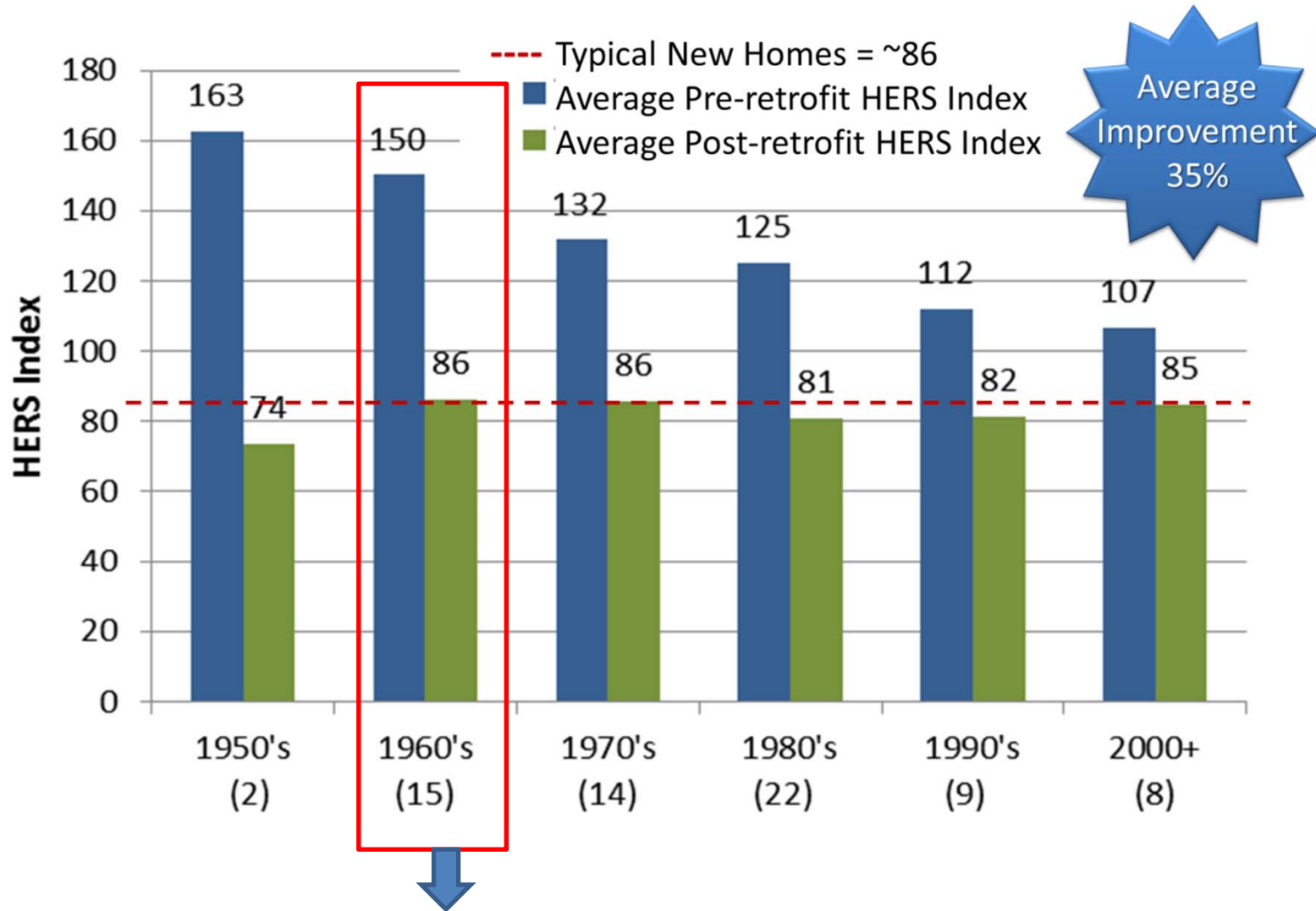
Technical Approach – Field Study

46 out of 70 Renovations achieved
30%+ HERS Index score improvement – **HOW?**



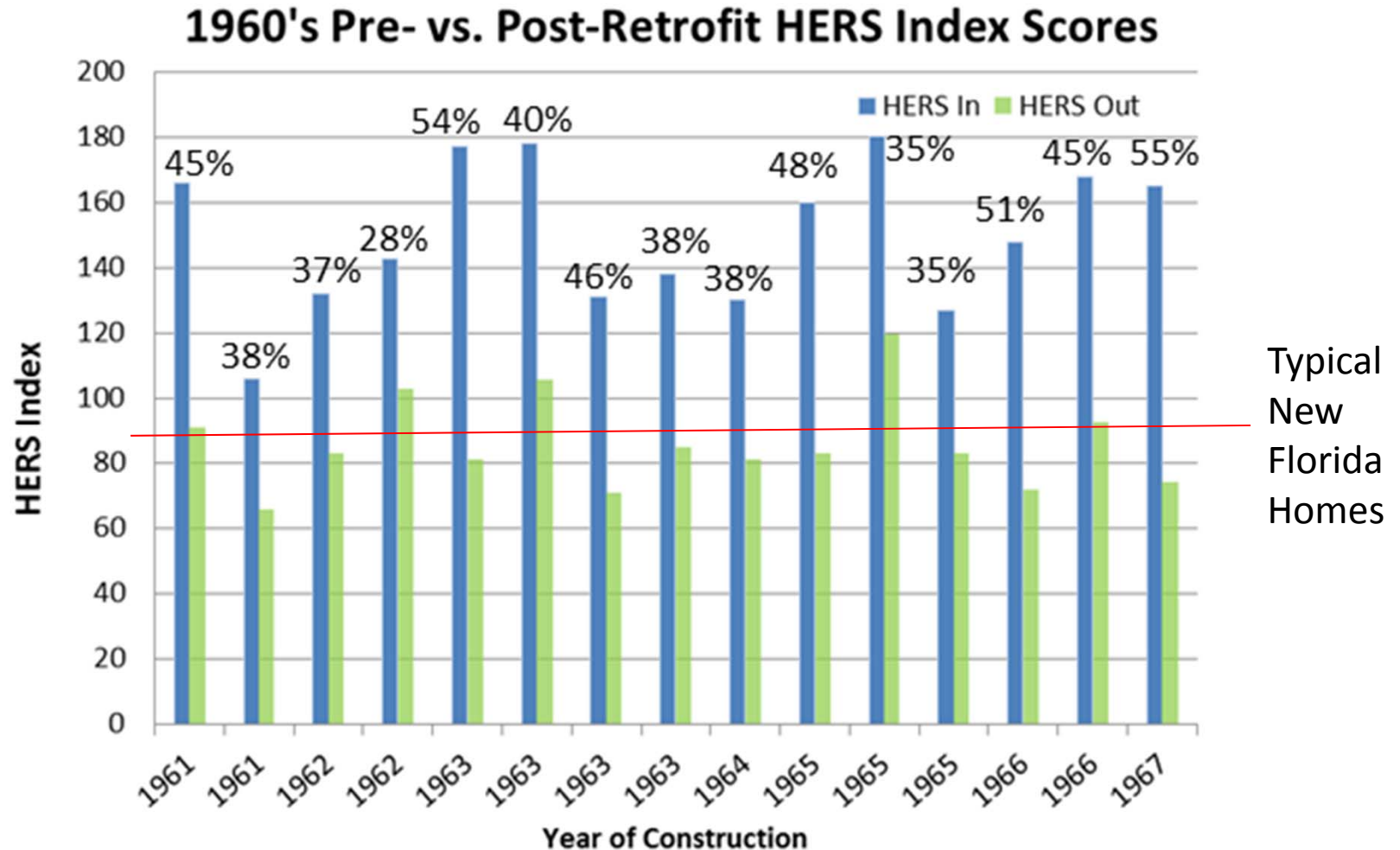
Technical Approach – Field Study

How? Trend in Average HERS Index and Vintage.



Technical Approach – Field Study

Diverse as-found conditions. **No one-size-fits all package.**
However, a *similar treatment produced similar end results.*



Technical Approach – Field Study

46 deep retrofits - 4 categories of improvements

Affordable, Practical, “Off The Shelf” Best Practices

Low- and No-Cost Measures & Quality Assurance

- Easy-to-do measures for most houses

Health, Safety, and Durability Measures (Risk Reduction)

- Combustion safety
- Whole house pressure balance

Moderately higher performance replacements

- Heating & cooling system (SEER 15 heat pump)
- Windows (low-E)
- Water heating (EF 0.92)
- Energy Star lighting, appliances, and ceiling fans
- Light or white exterior finishes
- Meet new construction code for heating and cooling

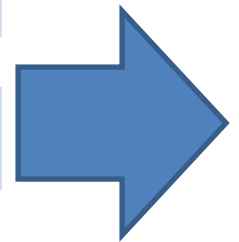
Efficiency Enhancements

- Substantially leak free duct system
- R-38 attic insulation
- Window film
- Air sealing at plumbing and fixtures openings

Technical Approach – Field Study

This is “**how**” the deep retrofits were achieved.
Same strategies also included in non-deep retrofits!

13 Key Efficiency Strategies in Order of Prevalence	Deep Retrofits (n = 46)	Non-Deep Retrofits (n = 24)	All Houses (n = 70)
1. Higher HVAC efficiency at replacement	96%	71%	87%
2. Additional ceiling insulation	93%	63%	83%
3. Whole-house air sealing (Reduced ACH50)	92%	77%	88%
4. Air distribution system sealing (reduced Qn,out)	86%	68%	80%
5. Lower solar heat gain coefficient (SHGC) window windows 6. at replacement or applied film	80%	46%	67%
7. ENERGY STAR® refrigerator at replacement	76%	71%	74%
8. Slightly higher efficiency water heater at replacement (electric EF=0.92)	70%	38%	59%
9. 30% more fluorescent fixtures/bulbs at replacement	52%	42%	49%
10. Programmable thermostat at replacement	48%	42%	46%
11. R-6 ducts at replacement	39%	13%	30%
12. Higher reflectivity exterior wall color at replacement	30%	8%	23%
13. Higher reflectivity roof shingles at replacement	30%	13%	24%
14. Higher efficiency ceiling fan(s) at replacement	15%	13%	14%



Technical Approach – Field Study

More replacements = higher cost-effective improvement.

13 Key Efficiency Strategies in Order of Prevalence	Recommended Best Practices for 30%+ Improvement
1. Higher HVAC efficiency at replacement	Energy Star Heat Pump (Energy Star AC in CZ 1)
2. Additional ceiling insulation	R-38
3. Whole-house air sealing (Reduced ACH50)	ACH50 = 6.0
4. Air distribution system sealing (reduced Q _{n,out})	Q _{n,out} ≤ 0.06
5. Lower solar heat gain coefficient (SHGC) window windows 6. at replacement or applied film	Energy Star Windows
7. ENERGY STAR [®] refrigerator at replacement	Energy Star Refrigerator
8. Slightly higher efficiency water heater at replacement (electric EF=0.92)	0.92+ EF Elec Water Heater Tankless Gas Water Heater
9. 30% more fluorescent fixtures/bulbs at replacement	100% CFLs
10. Programmable thermostat at replacement	Programmable thermostat
11. R-6 ducts at replacement	R-6 ducts
12. Higher reflectivity exterior wall color at replacement	White exterior pain
13. Higher reflectivity roof shingles at replacement	White or light shingles
14. Higher efficiency ceiling fan(s) at replacement	Energy Star Ceiling Fans

Technical Approach – Field Study

Incremental Cost of 30%+ Improvement

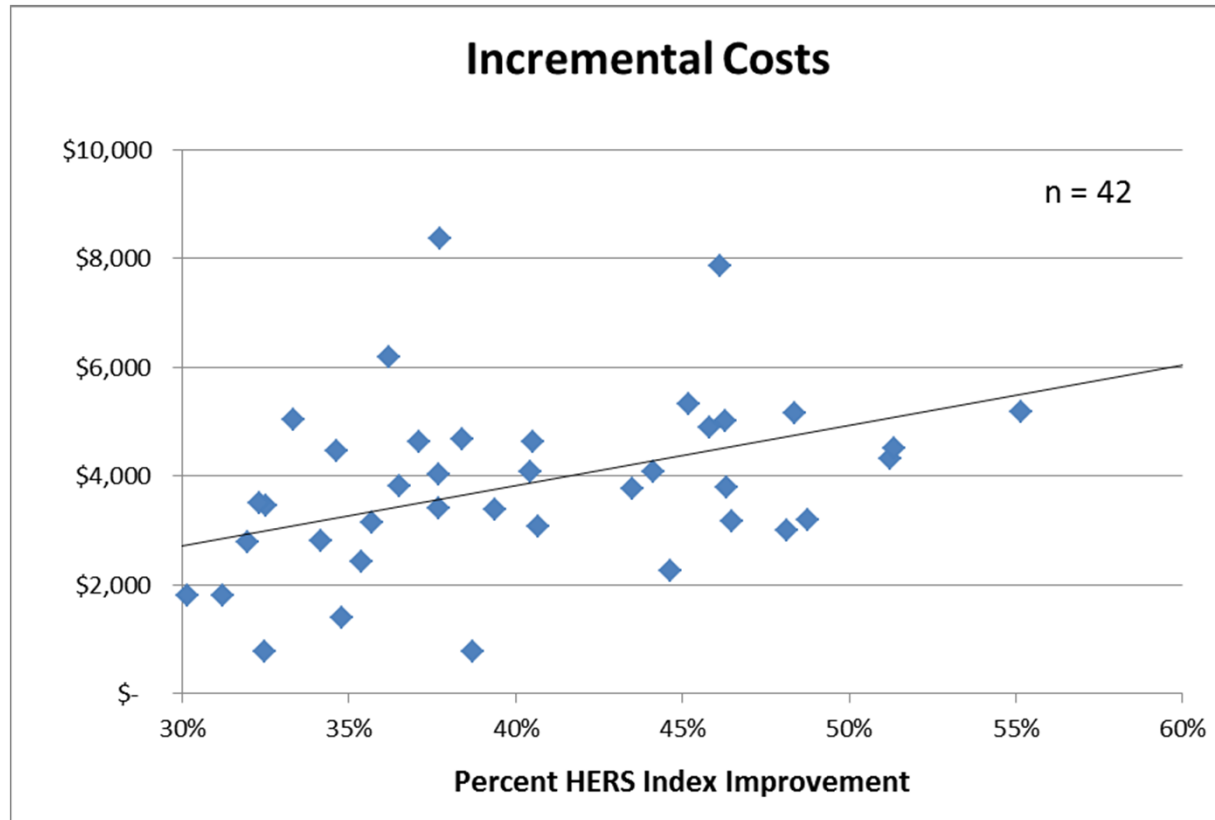



Figure 38. Incremental costs by percent HERS Index improvement for 42 deep retrofits with cost data

Technical Approach – Field Study

Best Practices for replacements, non-replacements, & all houses.
Not “one-size-fits all” but “standard treatment of each element”.
(Not a substitute for audit and analysis of individual houses.)



FLORIDA SOLAR ENERGY CENTER
Creating Energy Independence


Current Best Practices for Performance, Deep Energy Retrofits, and Energy Efficient Florida Affordable Housing

FSEC-RR-444-13
September 2013
Version 2

Authors
Janet McIlvaine
Karen Sutherland
David Beal

Florida Solar Energy Center

1679 Clearlake Road
Cocoa, Florida 32922, USA
(321) 638-1000
www.floridaenergycenter.org



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3.1 Heating, Ventilation, Cooling, and Air Conditioning (HVAC) Distribution Systems

Caution: Reference the Combustion Safety section (3.11) if a gas furnace exists or is planned.

3.1.1 Existing HVAC Equipment Not Being Replaced

- Hire a heating, ventilation, and air conditioning (HVAC) contractor to evaluate, and service if needed, refrigerant charge, inside and outside coil condition, condensate drain lines, and gas furnace components including exhaust flues, combustion air supply, gas lines, and other major equipment components.
- Implement all items in “All Homes Regardless of System Replacement” below.

3.1.2 Full or Partial HVAC System Replacement

- Install, at minimum, an ENERGY STAR heat pump (seasonal energy efficiency ratio (SEER) 14.5 or greater). In south Florida, an ENERGY STAR air conditioner is acceptable.
- Equipment Sizing: Perform ACCA Manual J calculations (now required for replacements by the Florida Energy Code). Use projected home characteristics provided by house supervisor.
- Supply and Return Ducts: Seal accessible (30” clearance) ducts left in place with code-approved sealant (required at equipment change out by Florida Energy Code), including the return plenum air barrier (drywall, duct board, etc). Provide air barrier if not present.
- Air Handler (AHU) Closet at AHU Replacement: Modify AHU closets to create a dedicated, sealed return plenum with a correctly-sized wall or ceiling-mounted return air grille.
- Duct Replacement: Install new ducts with R-value ≥ 6 .
- Implement all items in “All Homes Regardless of System Replacement” below.
- AHU Location: When equipment and ducts are replaced, relocate AHU into conditioned space.
- Perform ACCA Manual S equipment selection.
- Perform ACCA Manual D duct sizing.
- Produce a schematic duct design for field crew showing sizes for each component and conduct rough-in inspection to ensure installation meets design intent.

3.1.3 All Homes Regardless of HVAC System Replacement

- Duct Sealing: Hire an HVAC contractor to seal all duct connections with UL181-rated materials, preferably fiberglass mesh embedded mastic, including joints and edges in supply and return runs, return plenum, and connections to AHU. **Important note:** Contractor will revisit site to conduct additional sealing for all duct systems (new and existing) that do not pass the post-renovation leakage test. Maximum acceptable test result is six cubic feet of air per minute (cfm) per 100 square feet of conditioned area at the test pressure of 25 pascals ($Q_{n,out} \leq 0.06$).
- Duct Airtightness Testing: Have a certified home energy rater conduct a duct airtightness test as outlined in the Duct Testing section (4.1).

AHU Closet: Eliminate louvered doors that serve as returns. Eliminate metal AHU stands. Where the return plenum is formed by open framing and a plywood platform, install and seal an air barrier (drywall or duct board) to separate return from adjacent wall

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Technical Approach – Pilot Study

City of Ft Myers and City of Melbourne use “Current Best Practices” to develop program-level **master specifications**.



FLORIDA SOLAR ENERGY CENTER
Creating Energy Independence


Current Best Practices for High Performance, Deep Energy Retrofits in Florida Affordable Housing

FSEC-RR-444-13
September 2013
Version 2

Authors
Janet McIlvaine
Karen Sutherland
David Beal

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1679 Clearlake Road
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City of Ft Myers




EXHIBIT B
MANDATORY IMPROVEMENTS
Contractor Specifications/Cost Estimate Sheet

Owners Name _____
Address _____
Fort Myers, FL _____

Contractors Name: _____
Date Proposal Received: _____ Prop _____

MATERIALS & PRODUCTS TO BE MANUFACTURED IN THE U.S.A. WITH THE EXCEPTION OF LOCAL AREA VENDORS. *CUT OFF DATE TO BE PROVIDED TO THE PROJECT MANAGER*


INFORMATION
All work to be done shall be in compliance with the Florida Building Code Residential Construction standard within the jurisdiction. Contractor is responsible for failure to comply with all applicable law at the contractor's responsibility.

The housing programs aim to provide a safe, efficient, and healthy environment. Homes as green homes therefore the contractor materials used for the rehabilitation are based on previous training and specific materials during construction must be disapproved.

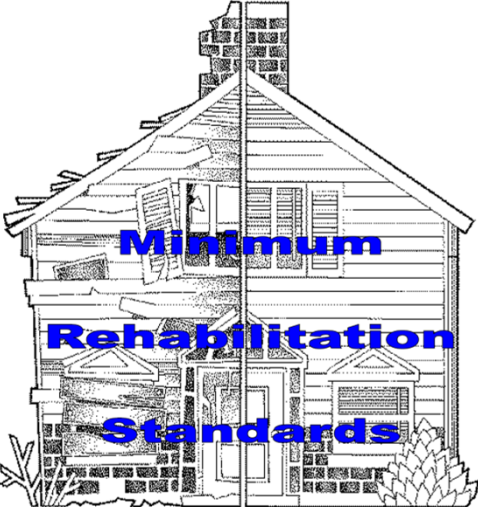
A. All mechanical equipment, plumbing fixtures, electrical appliance, salvageable and unusable contractor, shall be removed by the contractor. Pre-Construction meeting to minimize waste recycling practices. All debris within City of Fort Myers Solid Waste Department contracted through them in compliance with City of Fort Myers municipal code and Florida Statute.

B. Where equipment, material, or articles are required, "equal to", "approved alternate", "the

City of Fort Myers - Office of Sustainability



City of
Melbourne
The Harbor City



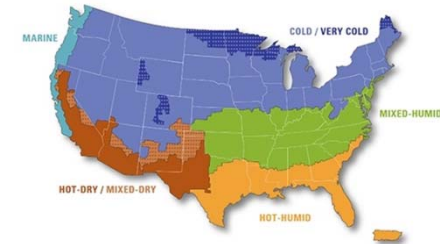
Minimum
Rehabilitation
Standards

Exhibit A – Minimum Rehab Standards Page A-2 Effective Date 6/24/2013

Technical Approach – Moving Forward

Accelerate adoption of Best Practices issuing the *Retrofit Challenge*

www.ba-pirc.org/retrofit



Retrofit Challenge “Pledge”

A screenshot of a web browser displaying the BA-PIRC website. The browser's address bar shows 'http://www.ba-pirc.org/retrofit/index.htm'. The website header features the 'Building AMERICA' logo with the U.S. Department of Energy and the 'Partnership for Improved Residential Construction' logo with the BA-PIRC logo. Below the header are navigation tabs for 'Case Studies', 'Measured Data', 'Partners', 'Presentations', 'Publications', and 'Researchers'. The main content area is titled 'HOME / THE RETROFIT CHALLENGE' and 'The Retrofit Challenge'. The text describes a four-year study with 10 affordable housing entities who completed 70 comprehensive renovations. It states that when the set of best practices are fully implemented, they are predicted to reduce the homes' whole house energy consumption by 25-35%. Measures include moderately higher performance specifications at equipment replacement (HVAC, appliances, water heating, etc.), efficiency enhancements (e.g. ceiling insulation), and building science measures that address construction safety, durability, and moisture management. After a 2012 pilot with the City of Melbourne, researchers invite the remodeling, renovation, and affordable housing sectors to take the Retrofit Challenge by adopting the best practices as master specifications in 2014. Master specifications create a standard treatment across multiple projects and reduce energy consumption. A red circle highlights a graphic that says 'Take the Retrofit Challenge' with a house icon and a list of links: 'Start Here! Take the Pledge', 'Retrofit Challenge Checklist', 'Full Best Practices Report', 'Energy Retrofit Field Study', 'Applying Best Practices Report', and 'Fact Sheet'.

A form titled 'The Retrofit Challenge Pledge' for the 'Hot-Humid Climate'. The form is from the Florida Solar Energy Center, with the tagline 'Creating Energy Independence'. The form includes fields for 'Organization', 'Organization Type' (with checkboxes for Local Government, Non-profit Housing, Market Rate General Remodeling Contractor, Trade Contractor, Home Energy Rating, and Other), 'Approximate number of renovations anticipated in next 12-18 months', 'Location of project', and 'Primary Contact for The Retrofit Challenge (or attach business card)'. The contact information fields include Name, Title, Email, Phone, Address, City, State, Zip, and County. There is also a section for 'Person Completing this Form (if different)' with Name and Phone fields. A paragraph of text explains the purpose of the pledge: 'In the interest of enhancing and preserving our existing housing stock for the benefit of future generations, we are joining others in rising to the Retrofit Challenge. After a detailed review of the Retrofit Challenge guidelines, we will integrate occupant health and safety, building durability, energy efficiency, and comfort best practices into our master renovation specifications.' The form concludes with 'Signature:' and 'Date:' fields, and another 'Name:' and 'Title:' field. At the bottom, there is a logo for 'Building AMERICA' and contact information: 'Return to Janet McIvaine, BA-PIRC, Florida Solar Energy Center, 1679 Clearlake Road, Cocoa, Florida 32922. Email: janet@fsec.ucf.edu (include "Retrofit Challenge" in subject) Phone: 321-638-1434 Fax: 321-638-1439'. A small note at the very bottom says 'A Research Institute of the University of Central Florida'.

Recommended Guidance for Programs

Case studies are examples but also provide contacts.

U.S. DEPARTMENT OF ENERGY Energy Efficiency & Renewable Energy BUILDING TECHNOLOGIES PROGRAM

Building America Efficient Solutions for Existing Homes

Case Study: Habitat for Humanity of Palm Beach County

Lake Worth, Florida

39%

PROJECT INFORMATION
 Construction: Retrofit
 Type: Single-family
 Builder: Habitat for Humanity of Palm Beach County
<http://www.habitatpbc.org/>
 Size: 1,573 sq ft
 Date completed: October 2011 (originally built in 1996)
 Climate Zone: Hot-Humid

PERFORMANCE DATA
 HERS Index: Home as found = 120; case study after retrofit = 73
 Projected annual energy cost savings: \$572
 Total cost of energy-efficiency measures: \$ 5,401
 Incremental annual mortgage: \$435
 Payback period: 6 years
 Billing data: Available in FY12



Project Description

Habitat for Humanity of Palm Beach County, working with Building America researchers from Pacific Northwest National Laboratory and the Florida Solar Energy Center, upgraded this previously unoccupied

Building America Efficient Solutions for New Homes Case Study: Habitat for Humanity, Palm Beach County, FL

KEY ENERGY-EFFICIENCY MEASURES

- HVAC:**
- SEER 14.5 forced air, central air conditioner with integral electric resistance heater (title heating load in south Florida)
 - Programmable thermostat
 - Pre-retrofit duct leakage = 0.10 cfm flow to out (Qn out)
 - Post-retrofit duct leakage = 0.065 cfm (Qn out)
- Envelope:**
- R-38 blown fiberglass insulation in attic
 - Pre-retrofit ACH50 = 15.05
 - Post-retrofit ACH50 = 6.15

Lighting, Appliances, and Water Heating:

- 80% CFL
- ENERGY STAR® refrigerator
- Coefficient of Performance (COP) 2.35, 50-gal hybrid heat pump/electric tankless water heater

For more information, please visit: www.buildings.energy.gov



Left: This SEER 10 window unit was replaced with a SEER 14.5 central air conditioner, which will save an estimated \$109 each year. Right: The new air handler required additional effort to fit into the existing air handler closet space.

Lessons Learned

- Air handlers and other ventilation equipment may be installed in confined spaces, making them difficult to replace or reposition that holes be created to accommodate the new equipment. Verify that any holes created during installation are properly sealed once the installation is complete.
- Most homes do not have central outside air ventilation systems, and the design or dimensions of existing air handler closets may eliminate the possibility of adding one. When the mechanical systems is being replaced, consider modifying the closet to accommodate an outside air ventilation strategy.
- Certain efficiency measures may require unacceptable changes to the home's appearance. In this case, efforts to incorporate outside air were ultimately abandoned when it was determined that doing so would have an unacceptable impact on the aesthetics of the house.
- Inadequate quality assurance from the retrofit contractor can leave avoidable gaps and leakages in the duct system. In this instance workers failed to seal the plenums seams with mastic.

"The biggest change was upgrading to the heat pump water heaters. This had the largest bang for the buck of all the upgrades. The water heater was twice the cost but the energy savings will pay for itself within a five year period."

— Don Kula, Director of Construction, Habitat for Humanity of Palm Beach County



EERE Information Center
 1-877-EERE-INFO (1-877-337-3463)
eere.energy.gov/informationcenter
 PNNL-SA-86824 3/30/2012

For information on Building America visit buildingamerica.gov. The website contains expanded case studies, technical reports, and best practices guides.

U.S. DEPARTMENT OF ENERGY Energy Efficiency & Renewable Energy BUILDING TECHNOLOGIES PROGRAM

Building America Efficient Solutions for Existing Homes

Case Study: Historic Home in Eastern Washington

Dayton, Washington

50%

PROJECT INFORMATION

Construction: Retrofit

Project Description

Built in 1915, this two-story, three-bedroom home with an un-basement and 2,600 ft² of living space is typical of many older found in Eastern Washington. Building America researchers from Pacific Northwest National Laboratory, along with local energy Energy Incentives Inc. assisted the home owners in cost-effectively reducing their energy use by over 50%. Researchers used Energy USA simulation software to model retrofit packages and predict most cost-effective retrofit measures within the home owner's

The presence of asbestos insulation on the boiler made it more effective to pursue efficiency measures that left the boiler in place to avoid the additional costs of disposal. Major energy and cost were achieved by installing a multi-headed ductless heat pump complement the existing hydronic heating system and offset its fuel needs, leaving the boiler to provide supplemental heating in times of exceptional cold weather, if needed. The homeowners considering further improving energy efficiency and thermal envelope insulating and air sealing the building envelope.



(Left) The original diesel boiler was encapsulated in asbestos, in place to eliminate remediation cost as provide a robust backup heating source in extreme weather. (Right) The new HSPF 9.4, four-head ductless pump system will drastically reduce fuel costs and energy consumption.

The estimated annual energy savings, added mortgage costs, and anticipated positive cash flow associated with the whole package of improvements are presented in Table 4.

Table 4. Annual Energy Savings Analysis

	Full Cost & Full Savings	Incremental Cost & Incremental Savings
HERS Index Improvement (%)	23%	23%
Annual Energy Cost Savings (\$)	\$431	\$431
Annual Energy Cost Savings (%)	20%	20%
Improvement Costs	\$3,248*	\$3,248*
Monthly Mortgage	\$22	\$15
Monthly Energy Cost Savings	\$36	\$36
Monthly Cash Flow	\$14	\$21
Simple Payback (years)	6	5

*Retrofit choices compared to minimum efficiency choices considering only the incremental increases in cost and savings.

26%

configuration implemented in this house has been accepted. An insect screen however was provided at the intake. Figures 3-5 show images of this installation.



Figures 3-5. Pre-retrofit return plenum (left), outside air ducted into the post-retrofit return plenum (middle), soffit retrofit for the air intake (right).

The attached, unconditioned storage room measuring 7' x 8' x 9', was large enough to house a heat pump water heater. The installation of the hybrid water heater with heat pump (Figures 6-7) in this location has the added benefit of dehumidifying and cooling this storage area and the attic, which the room is open to.



Figures 6-7. Pre-retrofit electric tank water heater, EF = 0.88 (left), hybrid heat pump water heater, COP = 2.35 (right).

The existing ceiling insulation was comprised of R-19 fiberglass batts laid on top of the ceiling drywall. Blown-in fiberglass insulation was added to the existing batt, yielding R-38 total. Figures 8-9 illustrate the pre- and post-retrofit ceiling insulation.



Figures 8-9. Pre-retrofit (left) and post-retrofit (right) ceiling insulation.

The installation of other penetrations may also produce handler is running will not occur minimized with Although auditors if not adhere well to return system were pressurized to use. This results the mechanical linkage to the al increased from tion installation.

it, however, there return system were pressurized to use. This results the mechanical linkage to the al increased from tion installation.

Recommended Guidance for Programs

Learn about what works in YOUR climate.

www.buildingamerica.gov or

<http://www1.eere.energy.gov/library/>

The Building America Solution Center:

<https://basc.pnnl.gov/building-components>

<https://basc.pnnl.gov/resource-guides>

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Building America Solution Center

EERE » BTO » Building America » Solution Center

Building Components

Click on the component images for a list of components and subcategories. Select one subcategory to display a list of related Guides.

CASE STUDIES

ROOF CEILING WALLS/OPENINGS FOUNDATION HVAC PLUMBING/ELECTRICAL DESIGN STRATEGIES

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Building America Solution Center

EERE » BTO » Building America » Solution Center

Guides A-Z

Items per page: 50

Apply

Above Deck Rigid Foam Insulation for Existing Roofs

All Other Ceilings

Attic Access Panels/Doors/Stairs

Attic Eave Minimum Insulation

Attic Knee Walls

Back-Draft Dampers at Shared Common Exhaust Duct

Bathroom and Kitchen Exhaust Fans

Bathroom Exhaust

Bathroom Fan Ratings

Building Cavities Not Used as Supply or Return Ducts

CURRENT SEARCH

112 Guides

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- Thermal Enclosure (50)
- Heating, Ventilation and Air Conditioning (HVAC) Quality Installation (30)
- Water Management (21)
- Design Strategies (3)
- Above Deck Rigid Foam Insulation for Existing Roofs (4)

FILTER BY CLIMATE ZONE:

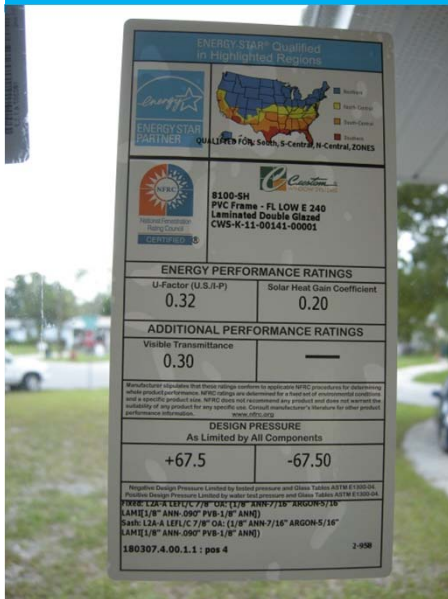
- All Climate Zones (107)
- Zone 5 (3)
- Zone 6 (3)
- Zone 7 (3)
- Zone 8 (3)
- Zone 4 (2)
- Zone 1 (1)
- Zone 2 (1)

Recommended Guidance for Programs

Replacement triggers. If “XYZ”, then we will “ABC”.

ABC = equipment and component specifications

Energy Star
Windows



Energy Star
Refrigerator



R-38 Ceiling
Insulation



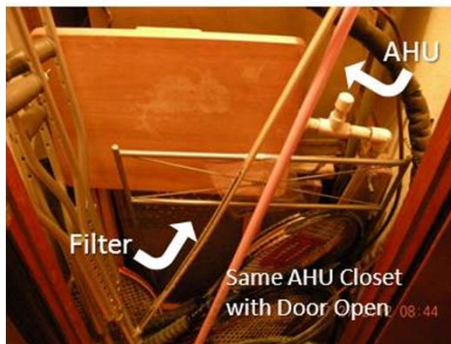
Energy Star HVAC
Equipment



Recommended Guidance for Programs

Define standard detailing for air flow control & moisture mng't

Return Air Plenums and Air Handler Closets



Air Sealing Checklist



Recommended Guidance for Programs

Draft Official Master Specifications.

Build Consensus among decision makers and stakeholders.



Management



Local Experts

Program
Master
Specifications

2014



Contractors



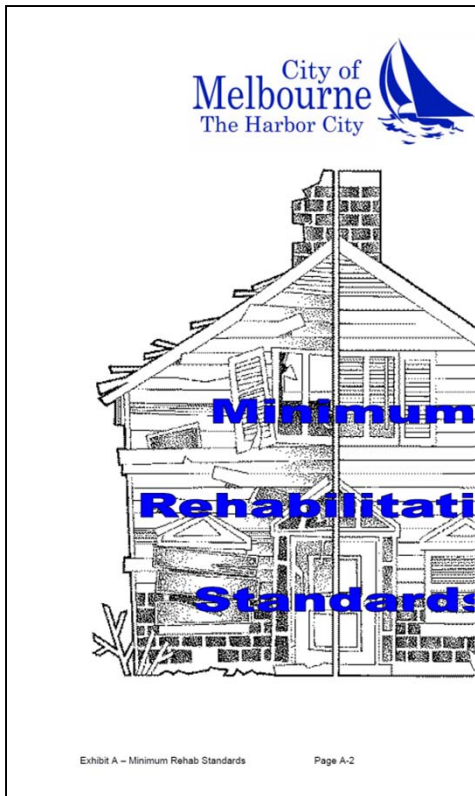
Code Enforcement



Enthusiasm!

Recommended Guidance for Programs

Integrate master specifications with bid documents, work write-ups, and contractor scopes of work.



Mechanical Ventilation and Air Conditioning:

Existing Systems: Existing systems and mechanical ventilation may continue in use if of adequate capacity, or they may be supplemented or replaced with a new system as required to meet the applicable section of the Florida Building Code as well as local codes and must be in proper working condition. Specify that, where feasible, a duct board plenum is retrofitted into platform returns, louvered doors on air handler closets are replaced with a correctly sized central return grille mounted in the wall (if adjacent to a living space) or in a solid door, and air handler stands are replaced with a ducted return plenum.

New Systems: New mechanical ventilation and air-conditioning equipment and systems shall be designed and installed in accordance with the requirements of the mechanical code or other applicable section of the Florida Building Code as well as local code or ordinance. Specify ENERGY STAR (min. SEER 14.5) qualified air conditioner with heat pump. Ensure a ducted return.

Existing Duct Work: Ensure duct work is strapped to trusses to achieve clearance over anticipated ceiling insulation with hanger supports no more than 5 feet apart. Ideal location is midway between roof deck and top of insulation.

New Duct Work: Ensure duct work is strapped to trusses to achieve clearance over anticipated ceiling insulation with hanger supports no more than 5 feet apart. Ideal location is midway between roof deck and top insulation. Ensure duct sizes specified on design are installed and

Exhibit A – Minimum Rehab Standards Page A-11 Effective Date 06/24/2013

that flex duct collars are fully insulated. Specify joints and edges in supply ducts, return plenum, and connections to air handler to all be sealed, preferably with mesh and mastic. Ensure ducts insulated to R-Value ≥ 6 or higher.

All Systems: HVAC Duct System Air Tightness Test: A post-test is required to verify that duct leakage to unconditioned space does not exceed 6 cubic feet per minute per 100 ft² of conditioned space at test pressure of negative 25 pascals ($Q_{n,out} = 0.06$, commonly referred to as "6%"). If measured leakage exceeds 6% ($Q_{n,out} \geq 0.06$), leakage points to be identified and sealed to reduce measured leakage to 6% threshold or below. Include testing, and retesting as necessary, in the mechanical contractor scope of work.

Testing is required to ensure pressure difference between main body of the house and each bedroom of ≤ 2.5 pascals when air handler is operating at maximum capacity and with all interior doors closed. If in excess of 2.5 pascals, passive air pathways must be provided from pressurized bedroom to main body of home via "jump ducts" of "high-low" passive returns to achieve balanced return air. For size guidelines reference to Florida Mechanical Code section 601.4.

Spec #	Spec	Quantity	Units	Unit Price	Total Price
Trade: 19 Painting					
5561	PREP & PAINT ROOM—SEMI-GLOSS Remove/cover all hardware, fixtures not to be painted. Remove any wallpaper. Fill all holes/tracks, make any necessary repairs to damaged drywall. Paint two coats with BERH WITH PRIMER or similar semi-gloss latex enamel paint (walls, closets & ceiling). Color choice by owner. (One (1) base color & One (1) trim color). Include doors (semi-gloss). *Note - Home owner to get one color choice with this color to be used in all areas of the house requiring semi-gloss paint on walls.	1.00	RM		
Trade: 21 HVAC					
5932	CENTRAL HVAC SYSTEM 15 SEER Remove existing heating and/or cooling equipment. Install new central A/C heat pump system with a minimum SEER of 15.0, Goodman or equal. Unit to have heat strips for emergency heating. Indoor/ outdoor coil match-up must be ARI listed. Install new foil covered ducts, rated R-6 or higher, to all rooms with white supply/return air grills and apply mastic where box penetrates through the ceiling to prevent leakage. Include new thermostat, compressor pad & all necessary connections including properly sized circuit breakers for each unit. Unit shall be sized to efficiently heat and cool residence. Include GFI outlet as required by code. Line inside of return air box with new duct board. Seal all gaps and penetrations with mastic to insure that intake air flow goes through the air filter as designed. (1) Frame a stand for the air handler and install a minimum 5/8" deck. The return register is to be installed into a wall. The door is to be cut to fit to the top of the stand and the wall built under it even with the walls to each side for the return register. (2) Install a 2" thin wall pvc or 3" to 4" flex fresh air duct with a run time damper as well as a manual damper for fresh air to be brought in from a screened grill in the gable end or soffit and filtered as it enters into the return air plenum. (3) Take extra care that the ceiling is sealed to the supply plenum to prevent attic air intrusion. (4) Have a duct leakage test done and passing report (not more than 6% loss) sent to Melbourne Housing & Community Development Dept. (5) Call Housing Rehab Specialist (674-5734) to inform when test is scheduled. Install new A/C in hall closet on the right side of the bathroom door.	1.00	EA		
Trade: 23 Electric					
7735	LIGHT FIXTURE GLOBE Install a new glass light fixture with globe on ceiling fixture. **Use Energy Efficient Bulbs.	1.00	EA		
7810	SMOKE ALARM—HARD WIRED Install a UL approved, ceiling mounted smoke and heat detector permanently wired into a receptacle box with battery back up. All smoke alarms are to be linked together in accordance with	1.00	EA		

Master specifications



Software library for ready access and use in bid docs, work write-ups, and scopes of work.

Recommended Guidance for Programs

Develop Feedback Loop that allows program staff to confirm performance targets have been met.

(2) Install a 2" thin wall pvc or 3" to 4" flex fresh air duct with a run time damper as well as a manual damper for fresh air to be brought in from a screened grill in the gable end or soffit and filtered as it enters into the return air plenum.

(3) Take extra care that the ceiling is sealed to the supply plenum to prevent attic air intrusion.

(4) Have a duct leakage test done and passing report (not more than 6% loss) sent to Melbourne Housing & Community Development Dept.

(5) Call Housing Rehab Specialist (674-5734) to inform when test is scheduled.

Install new A/C in hall closet on the right side of the bathroom door.



Value

Meets stakeholder need originally expressed in field study.

What should do
for our projects?

Check out our best
practices and
develop master
specifications.



Application in Market Place

Goal: generate activity in as many of these communities as possible

Source	Primary Recipient	Total Funding	Secondary Recipients
HUD Home Investment Partnerships (HOME)*	32 local gov't entities	\$45.1 million	Local non-profits & contractors
HUD Community Development Block Grant (CDBG)**	State of Florida	24.2 million	Multiple programs, small cities
HUD Community Development Block Grant (CDBG)**	78 Local gov't entities (directly)	\$105.4 million	Local non-profits & contractors
Florida Legislature, Mortgage Settlement Funds*	Florida Habitat for Humanity to ~20 local affiliates	\$20 million	Florida HFH affiliates; 2 Retrofit Challenge partners
HUD Neighborhood Stabilization Program Residual funding *	Local gov't entities	Residual \$ NSP home sales	Local non-profits & contractors
Total	~130	\$194.7 million	

* Renovation a primary or major funded activity. ** Renovation an allowed activity.

Pros and Cons

- **Cons:**
- Not a substitute for evaluation of individual houses.
- The generality may miss unique opportunities.
- Leaves out conditions not in field study (e.g. frame floors)

- **Pros:**
- **Establish consistent treatment** across varying homes.
- Proven, off-the-shelf measures are **very low risk**.
- **Raise awareness of air, heat, and moisture flow dynamics.**
- **Draws attention to potential risks and mitigation measures.**