

Paving the Way to Zero Net-Energy Ready Homes

U.S. DEPARTMENT OF
ENERGY

Energy Efficiency &
Renewable Energy



How to Execute HERS Plan
Evaluation and Field Verification
for DOE Challenge Homes

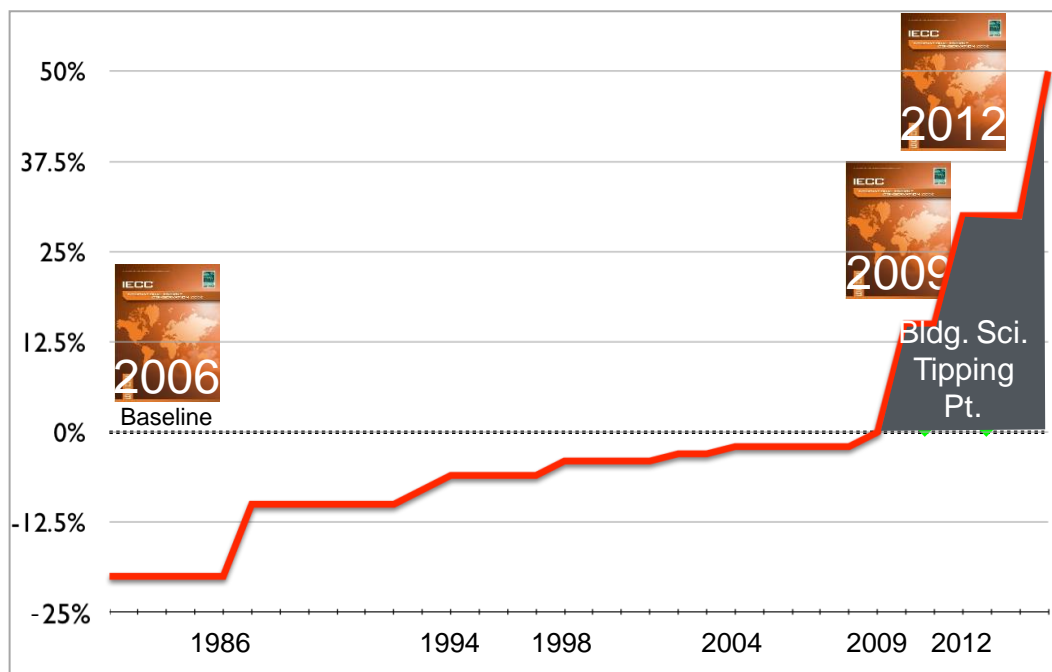
Jamie Lyons, P.E
DOE Challenge Home
&
Dennis Stroer, Calcs-Plus

- **Why** Should Raters Care about DCH?
- DOE Challenge Home Specifications – Overview
- Plan Review for DOE Challenge Home – What to Look For
- Software Tools for Plan Review
- Field Verification
- How to Move Forward

- Today's Builder:
 - Enormous pressure on lowest-first cost model
 - Existing home sales (short sales, foreclosures)
 - Smaller buyer pool
 - Alternate Business Case:
 - **Maximize Value & Innovation** (not minimize cost)
 - Capitalize on “Innovation Premium”
 - Superior Value
 - Better Protection
 - Lower Ownership Cost



- Today's Homes
 - Face a building science tipping point
 - Can't dry out if they get wet
 - Can't assure adequate IAQ
 - Greater combustion safety risks



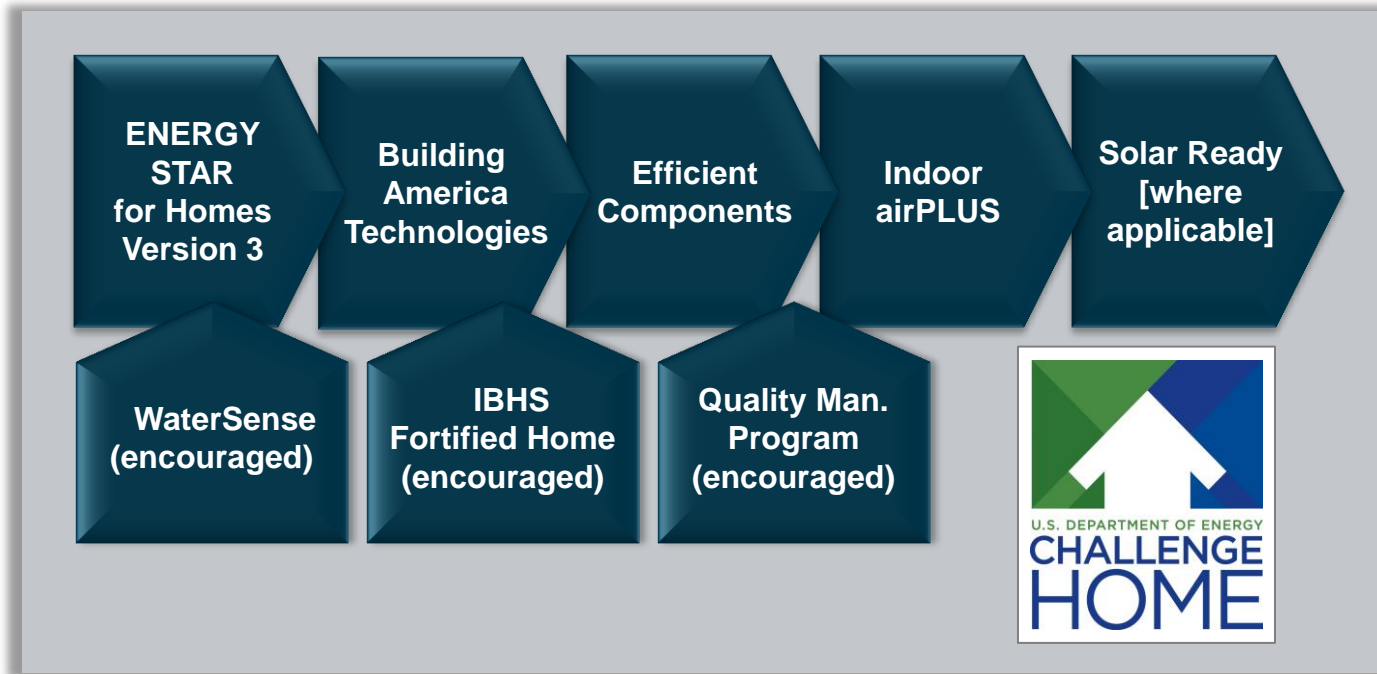
- Today's Raters!
 - National network of energy and building science consultants for builders
 - Navigating a complex web of code compliance, building performance/safety, above-code program compliance, and cost optimization for builder clients
 - Opportunity to add value-add services to builders – when there's value

Why Build Home of the Future?

- Consumers want it, (they just don't know it yet)
- It's readily achievable today
- It's dramatically differentiates your product from low cost competition
- It substantially reduces risk

Zero Net-Energy Ready
Technical Specifications

Specifications flow from the program strategy....



DOE Challenge Home - Framework



DOE Challenge Home National Program Requirements (Rev. 02) July 1, 2012

Exhibit 1: DOE Challenge Home Mandatory Requirements for All Labeled Homes

Area of Improvement	Mandatory Requirements
1. ENERGY STAR for Homes Baseline	<input type="checkbox"/> Certified under ENERGY STAR Qualified Homes Version 3 ⁵
2. Envelope ⁶	<input type="checkbox"/> Fenestration shall meet or exceed latest ENERGY STAR requirements ^{7, 8} <input type="checkbox"/> Ceiling, wall, floor, and slab insulation shall meet or exceed 2012 IECC levels ⁹
3. Duct System	<input type="checkbox"/> Ducts located within the home's thermal and air barrier boundary ¹⁰
4. Water Efficiency	<input type="checkbox"/> Hot water delivery systems shall meet efficient design requirements ¹¹
5. Lighting & Appliances ¹²	<input type="checkbox"/> All installed refrigerators, dishwashers, and clothes washers are ENERGY STAR qualified. <input type="checkbox"/> 80% of lighting fixtures are ENERGY STAR qualified or ENERGY STAR lamps (bulbs) in minimum 80% of sockets <input type="checkbox"/> All installed bathroom ventilation and ceiling fans are ENERGY STAR qualified
6. Indoor Air Quality	<input type="checkbox"/> EPA Indoor airPLUS Verification Checklist and Construction Specifications ¹³
7. Renewable Ready ¹⁴	<input type="checkbox"/> EPA Renewable Energy Ready Home Solar Electric Checklist and Specifications ¹⁵ <input type="checkbox"/> EPA Renewable Energy Ready Home Solar Thermal Checklist and Specifications ¹⁶

DOE Challenge Home Mandatory Reqmnts.

Must Comply

Exhibit 2: DOE Challenge Home Target Home^{3, 17}

HVAC Equipment ¹⁸			
	Hot Climates (2012 IECC Zones 1,2) ¹⁹	Mixed Climates (2012 IECC Zones 3, 4 except Marine)	Cold Climates (2012 IECC Zones 4 Marine 5,6,7,8)
AFUE	80%	90%	94%
SEER	18	15	13
HSPF	8.2	9	10 ²⁰
Geothermal Heat Pump	ENERGY STAR EER and COP Criteria		
ASHRAE 62.2 Whole-House Mechanical Ventilation System	1.4 cfm/W; no heat exchange	1.4 cfm/W; no heat exchange	1.2 cfm/W; heat exchange with 60% SRE
Insulation and Infiltration			
<ul style="list-style-type: none"> Insulation levels shall meet the 2012 IECC and achieve Grade 1 Installation, per RESNET standards. Infiltration²¹ (ACH50): 3 in CZ's 1-2 2.5 in CZ's 3-4 2 in CZ's 5-7 1.5 in CZ 8 			
Windows ^{22, 23, 24}			
	Hot Climates (2012 IECC Zones 1,2,)	Mixed Climates (2012 IECC Zones 3, 4 except Marine)	Cold Climates (2012 IECC Zones 4 Marine 5,6,7,8)
SHGC	0.25	0.27	any
U-Value	0.4	0.3	0.27
Homes qualifying through the Prescriptive Path with a total window-to-floor area greater than 15% shall have adjusted U-values or SHGCs. ²⁵			
Water Heater			
ENERGY STAR minimum; for heating oil water heaters use EF = 0.60			

"Target Home" Design Specs

Flexibility through Trade-offs

Homes larger than the benchmark home size must use the size adjustment factor to determine the target HERS index

Size
Adjustment
Factor

Exhibit 3: Benchmark Home Size²⁸

Bedrooms in Home to be Built	1	2	3	4	5	6	7	8
Conditioned Floor Area <small>Benchmark Home</small>	1,000	1,600	2,200	2,800	3,400	4,000	4,600	5,200

Note: Renewable energy systems may not be used to qualify for the Challenge Home HERS Index Target Score, but may be used for the incremental HERS Index points needed for the Size Adjustment Factor.

Size Modification Factor = $\left[\frac{\text{CFA}_{\text{Benchmark Home}}}{\text{CFA}_{\text{Home to Be Built}}} \right]^{0.25}$,
but Not to Exceed 1.0

Mandatory Requirements

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6. Indoor Air Quality	<input type="checkbox"/> EPA Indoor airPLUS Verification Checklist and Construction Specifications ¹³
7. Renewable Ready¹⁴	<input type="checkbox"/> EPA Renewable Energy Ready Home Solar Electric Checklist and Specifications ¹⁵ <input type="checkbox"/> EPA Renewable Energy Ready Home Solar Thermal Checklist and Specifications ¹⁶

Encouraged:

- Quality Management
- WaterSense Label (indoor and outdoor)
- Disaster Resistance (IBHS Fortified Home)

Target Home Sets the Bar

Exhibit 2: DOE Challenge Home Target Home 3¹⁷

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Water Heater			
ENERGY STAR minimum			
Thermostat ²⁵ & Ductwork			
<ul style="list-style-type: none"> Programmable thermostat (except for zones with radiant heat) 			
Lighting & Appliances			
<ul style="list-style-type: none"> For purposes of calculating the DOE Challenge Home Target Home HERS Index, homes shall be modeled with an ENERGY STAR dishwasher, ENERGY STAR refrigerator, ENERGY STAR ceiling fans, and ENERGY STAR lamps (bulbs) in 80% of sockets or 80% of lighting fixtures are ENERGY STAR Qualified. 			

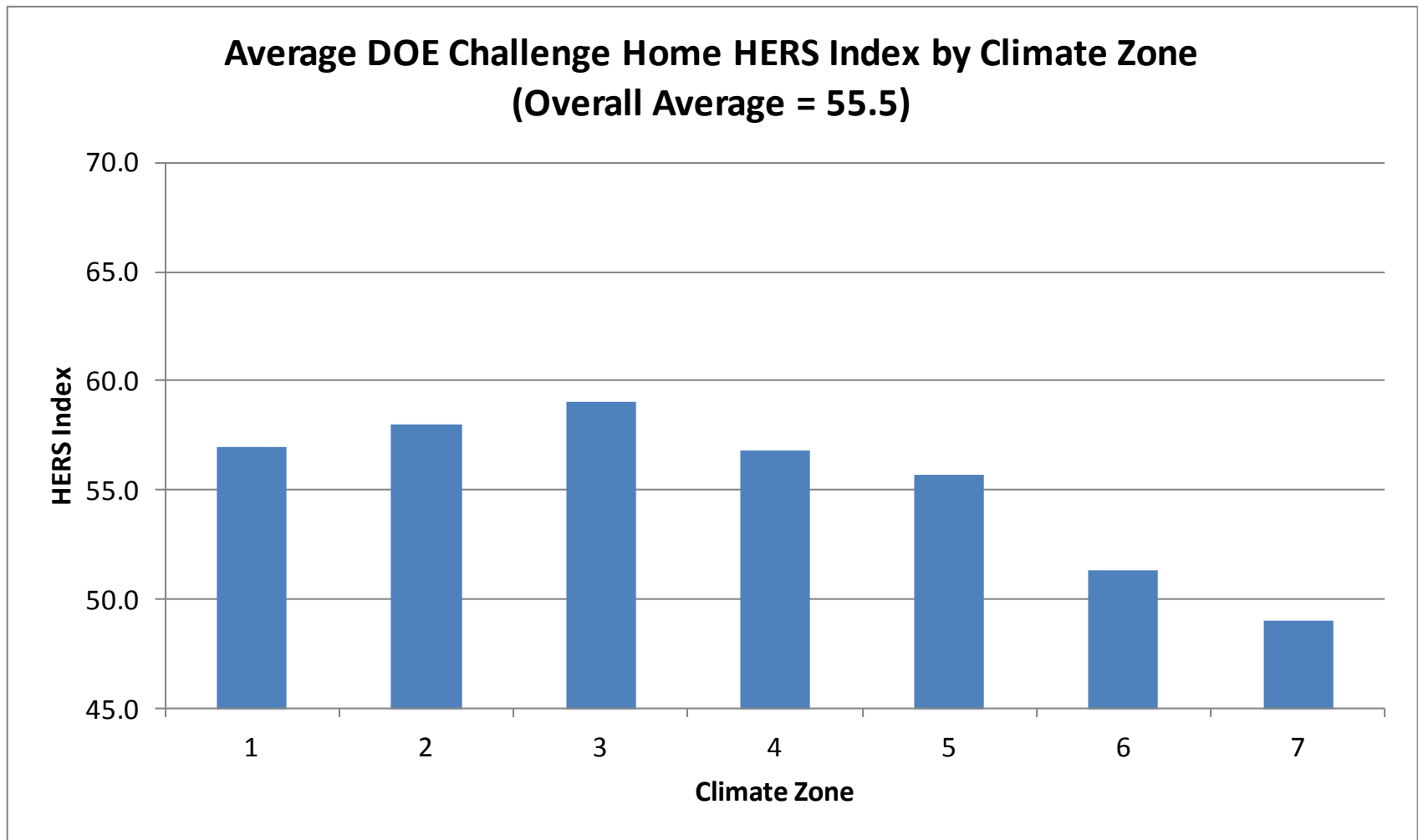
Higher Eff. HVAC Equip.

2012 vs. 2009 IECC Insul.

More Eff. Windows

Half ACH50

ENERGY STAR Water Htg.



Based on 1800, 2400, and 3600 ft² prototypes on climate-appropriate foundations.

Overview of Mandatory Requirements

ENERGY STAR for Homes Baseline - Mandatory

- Alignment: ENERGY STAR V3 as prerequisite
- Systems-based; building-science based
- Required for all qualifying homes (prescriptive & performance)
- Variable versus fixed HERS Index
- Benchmark Home
- Sampling - same policy
- V3 Checklists
 - Thermal Enclosure
 - HVAC – Contractor
 - HVAC – Rater
 - Water Management **or** Indoor airPLUS



2012 IECC Envelope Insulation Levels & ENERGY STAR Qualified Windows - Mandatory

- 2012 IECC Envelope Insulation Levels
 - Assures the home's envelope will meet next generation code
 - Alternative equivalent U-factor or total UA calculation permitted
 - Allowances for ceilings without attic spaces
- ENERGY STAR Windows
 - Assures window performance beyond code and ENERGY STAR V3 levels
 - Fenestration used for passive solar design are exempt from the U-factor and SHGC requirements
 - Area-weighted averages for U, SHGC permitted

ENERGY STAR® Qualified in All 50 States



World's Best Window Co.
Millennium 2000+
Vinyl-Clad Wood Frame
Double Glazing • Argon Fill • Low E
Product Type: Vertical Slider
(per NFRC 100-97)

ENERGY PERFORMANCE RATINGS

U-Factor (U.S./I-P)	Solar Heat Gain Coefficient
0.30	0.27

ADDITIONAL PERFORMANCE RATINGS

Visible Transmittance	Air Leakage (U.S./I-P)
0.51	0.2

Manufacturer stipulates that these ratings conform to applicable NFRC procedures for determining whole product performance. NFRC ratings are determined for a fixed set of environmental conditions and a specific product size. Consult manufacturer's literature for other product performance information.
www.nfrc.org

Ducts located within the home's thermal and air barrier boundary - Mandatory

- “Must Have” for highest performing homes
- Alternatives & Allowances:
 - Up to 10' of total duct length is permitted to be outside of the home's thermal and air barrier boundary.
 - Ducts are located in an unvented attic
 - “BEDS” – buried & encapsulated ducts in an attic
 - Attic jump ducts (sealed and buried)
 - Ducts are located within an unvented crawl space
 - Ducts are located in a basement which is within the home's thermal boundary
 - Ductless HVAC system is used



ENERGY STAR Appliances & Lighting - Mandatory

- Ensure good performance levels from these increasingly important energy end-uses in high performance homes
- ENERGY STAR Appliances: installed refrigerators, dishwashers, clothes washers, bathroom ventilation, and ceiling fans
- ENERGY STAR Lighting: 80% of fixtures or lamps (bulbs)

Built for when water was free and energy was cheap!

Copper L piping:

- 1" = 5.53 ounces/ft
- $\frac{3}{4}$ " = 3.22 ounces/ft
- $\frac{1}{2}$ " = 1.55 ounces/ft

Stored Volume:

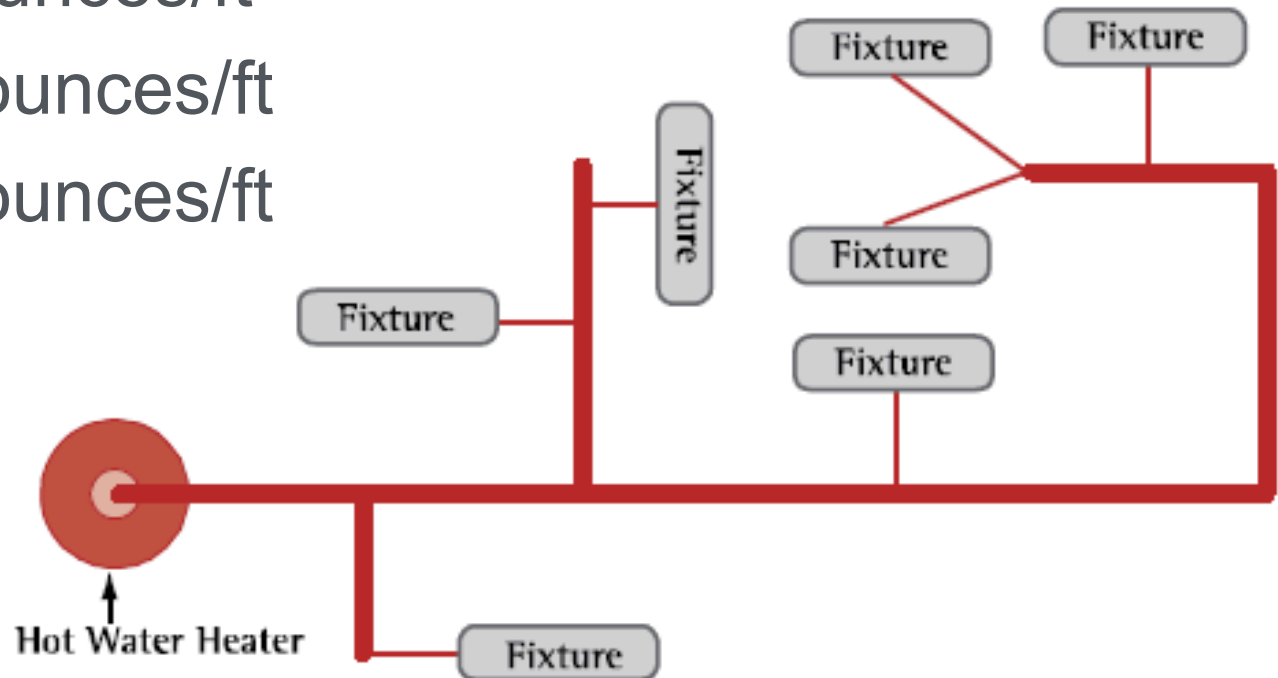
30 gallons

10' branch

Wait Time: 1 – 1.5

minutes

2 GPM Showerhead



Efficiency Hot Water Distribution Systems - Mandatory

- “Must Have” for highest performing homes
- Provision is drawn from EPA WaterSense Single-Family New Home Specifications.
 - hot water distribution system shall store no more than 0.5 gallons (1.9 liters) of water in any piping/manifold between the hot water source and any hot water fixture.
 - To account for the additional water that must be removed from the system before hot water can be delivered, no more than 0.6 gallons (2.3 liters) of water shall be collected from the hot water fixture before hot water is delivered.
 - Timer- and temperature-based recirculating systems shall not be used to meet the criteria.

IAQ – Comply with EPA Indoor airPLUS Verification Checklist and Construction Specs - Mandatory

- Homes this efficient, this well insulated and tight, must adopt a systems-based approach to IAQ
- Exceptions & Allowances:
 - ENERGY STAR for Homes V3 Water Management System Builder Checklist shall be equivalent to compliance Indoor airPLUS “Moisture Control” provisions (Provisions 1.1 through 1.13).
 - Builders shall not be required to provide home buyers with radon test kits (Provision 2.2 of Indoor airPLUS). However, builders are strongly encouraged to include a radon fact sheet in their homeowner materials.
 - For Provision 5.6 of Indoor airPLUS, garage exhaust fans operated by automatic fan controls that activate the fan whenever the garage is occupied and run for at least 10 minutes after the garage has been vacated are deemed acceptable.
 - Builders seeking the Indoor airPLUS label must achieve **full** compliance with the Indoor airPLUS Verification Checklist.

EPA Renewable Energy Ready Home Checklists - Mandatory

- After taking all of the other steps to produce a high performance home –basic, minimal cost steps accommodate a future renewable energy system. E.g.:
 - Document max allowable roof dead/live load ratings
 - Provide conduit between attic and water heater area
 - Reserve & label space in electrical service panel for future PV breaker
- Allowances:
 - Application of RERH Checklists reserved for homes where renewables make the most sense
 - Recognition of high performance water heating systems

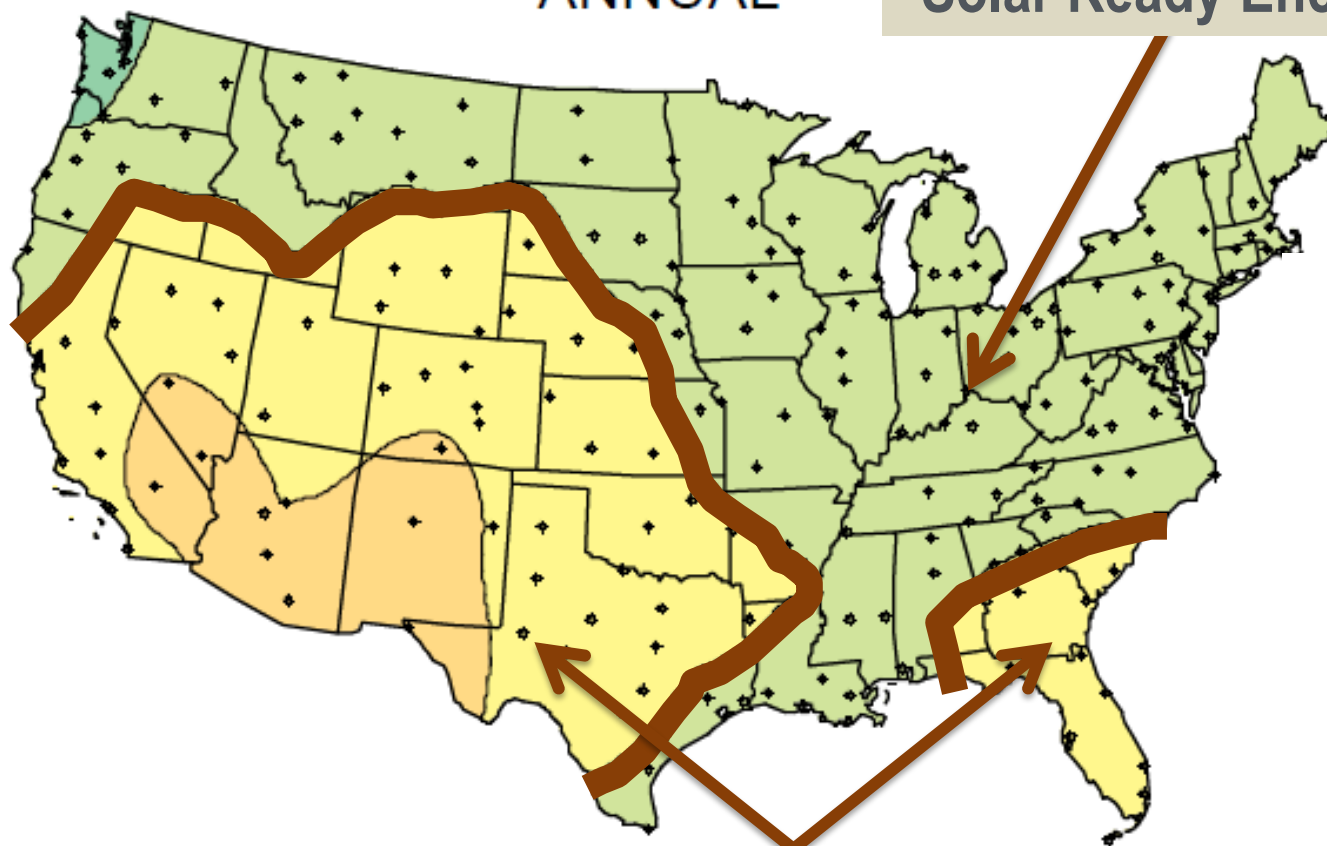


Solar Ready Requirement

Average Daily Solar Radiation Per Month

ANNUAL

Solar Ready Encouraged



kWh/m²/day



Required

Encouraged

Solar Ready Required

Solar Electric Ready Requirements

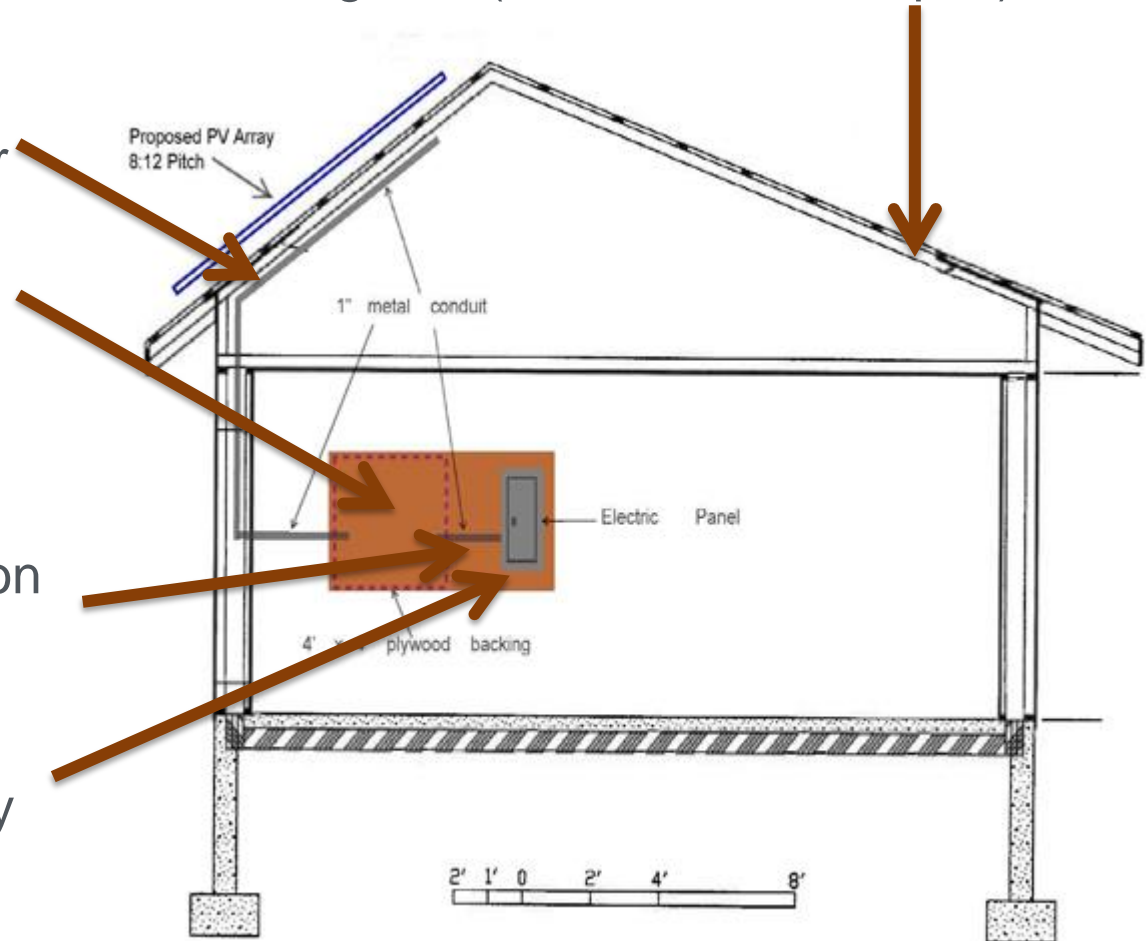
Provide code-compliant documentation of the maximum allowable dead load and live load ratings of the existing roof (Rec DL.: 6 lbs./sq. ft.)

Install conduit to run DC wire from roof to inverter

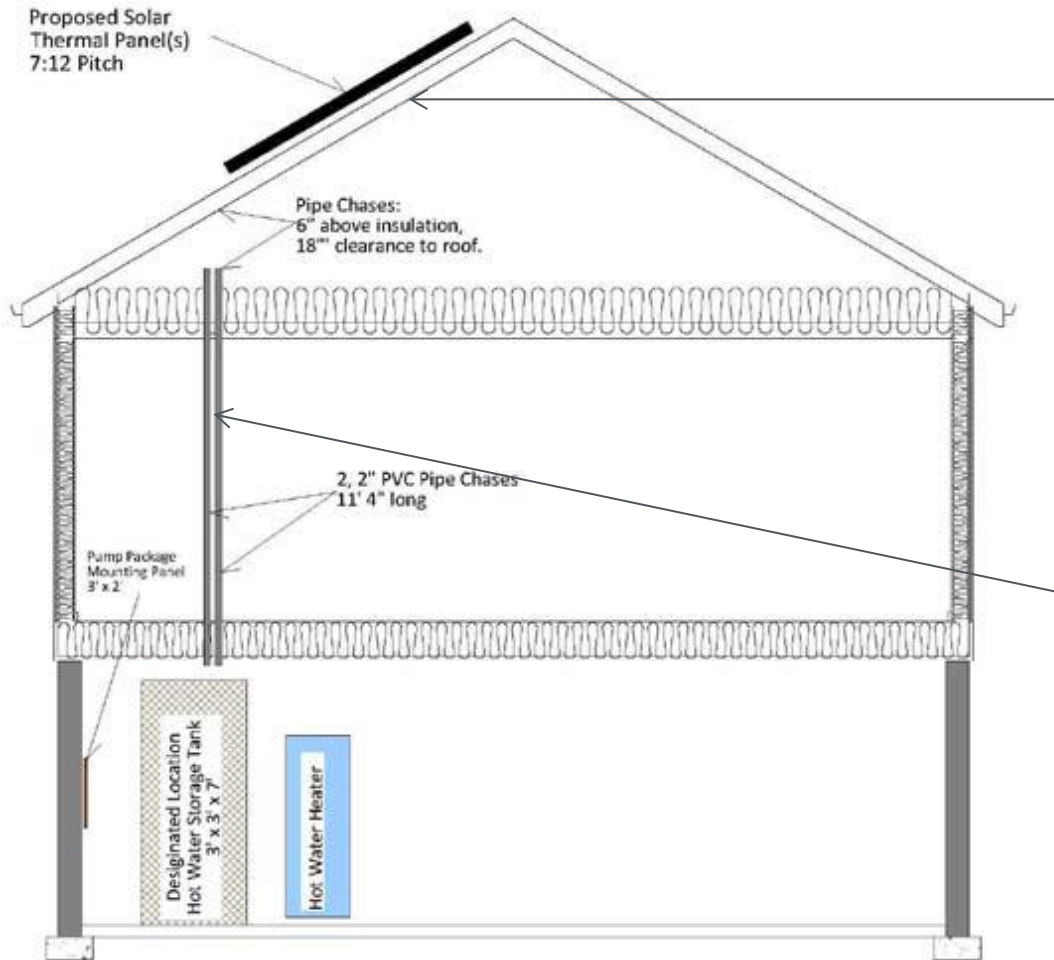
Dedicate area for installing inverter and balance of system

Install conduit to run AC wire from inverter location to electric panel

Designate and install circuit breaker for use by the PV system in the electric panel



Solar Hot Water Ready Requirements



Provide code-compliant documentation of the maximum allowable dead load and live load ratings of the existing roof (Rec DL.: 6 lbs./sq. ft.)

Install a single 4" chase or 2-2" chases from utility room to the attic space below designated array location. Cap and label both ends.

Overview of Target Home

Exhibit 2: DOE Challenge Home Target Home ^{3, 17}

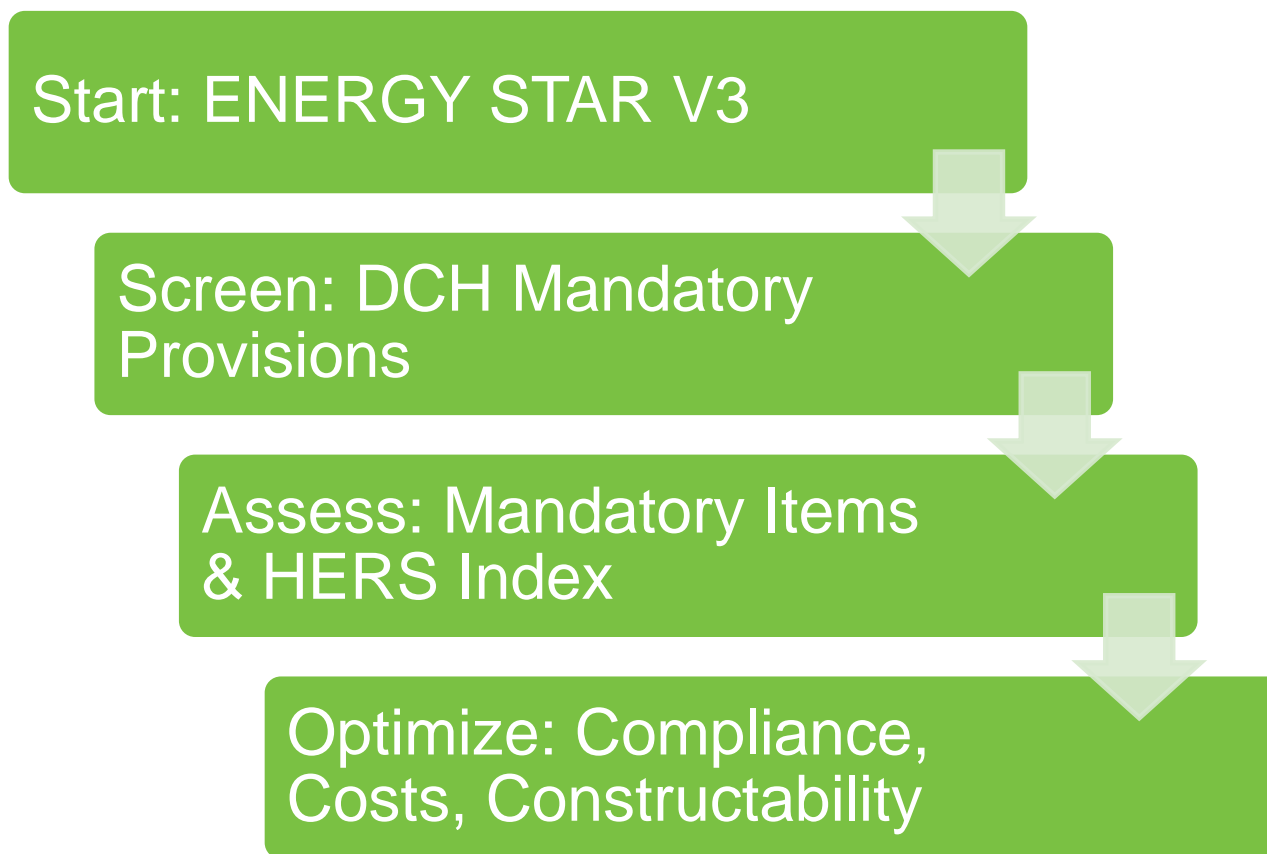
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AFUE	80%	90%	94%
SEER	18	15	13
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ASHRAE 62.2 Whole-House MV System Performance	1.4 cfm/W; no heat exchange	1.4 cfm/W; no heat exchange	1.2 cfm/W; heat exchange with 60% SRE
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Water Heater			
ENERGY STAR minimum			
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Lighting & Appliances			
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Performance Path Example

4 BR, 3500 SF, CZ2 Prototype

Specification	Target Home Spec	Design Home
Mandatory Items: ducts in conditioned space; 2012 IECC insulation; etc.		Meets all mandatory items; uses total UA to meet insulation reqmnt.
Windows	U=0.40; SHGC=0.25	U=0.32; SHGC=0.24
Infiltration	3 ACH50	2.5 ACH50
Duct Leakage	Total ≤ 8 CFM25 per 100 SF of CFA; Leakage to outdoors ≤ 4 CFM25 per 100 SF of CFA	Total leakage ≤ 280 CFM25 Leakage to outdoors ≤ 140 CFM25
Furnace AFUE	80	92
A/C SEER	18	16
Whole-House Mech. Vent.	75 cfm; 1.4 cfm/W;	75 cfm; 5.0 cfm/W
Water Heater	ENERGY STAR	Gas storage 0.67 EF
Target Home HERS Index	55; (52 with SAF)	
HERS Index – Design Home		52 – COMPLIES!

Plan Review



System	Spec
House Type	SF detached, 4 Bedroom
Climate Zone	4
Foundation	Basement
Square Footage	2600 above-grade
Energy Sources	Electric; natural gas
Solar Resources	4.8 kWh/m ² /day
Garage	2 car, attached

- Project must be ENERGY STAR Homes compliant
 - Assures a HERS Index ~ low 70s or better
 - Assures 2009 IECC insulation levels, thermal enclosure checklist, HVAC Contractor and HVAC Rater checklists, Water Management checklist

Start: ENERGY STAR V3

Screen: DCH Mandatory Provisions

Assess: Mandatory Items & HERS Index

Optimize: Compliance, Costs, Constructability

Screen for DCH Mandatory Items

- Identify approach for achieving 2012 IECC insulation levels for ceiling, wall, floor, & slab
- For CZ4:

Start: ENERGY STAR V3

Screen: DCH Mandatory Provisions

Assess: Mandatory Items & HERS Index

Optimize: Compliance, Costs, Constructability

ASSEMBLY	2012 IECC	2009 IECC
Ceiling R-Value	49	38
Wood Wall R-Value	20 or 13+5 ^h	13
Floor R-Value	19	19
Basement Wall R-Value	10 / 13	10 / 13
Slab R-Value, Depth	10, 2 ft	10, 2 ft
Crawlspace Wall R-Value	10 / 13	10 / 13

- Identify strategy for locating ducts within conditioned space

Start: ENERGY STAR V3

Screen: DCH Mandatory Provisions

Assess: Mandatory Items & HERS Index

Optimize: Compliance, Costs, Constructability

Alternative Compliance Paths:

- **Short Duct Run**

up to 10' of total length is permitted to be outside of the home's thermal and air barrier boundary.

- **Jump Ducts**

which do not directly deliver conditioned air from the HVAC unit may be located in attics if all joints, including boot-to-drywall, are fully air sealed with mastic

- **Ductless HVAC system**

- Identify strategy for locating ducts within conditioned space

Location Options:

- **Conditioned Floor Space** within the thermal boundary (**basement in this case**)
- **Unvented Attic** regardless of whether conditioned with a supply register
- **Unvented Crawl Space/Basement** which is within the home's thermal boundary
- **Vented Attic** equivalent option where other locations in conditioned space are impractical, expensive, don't work well in specific climates, or increase envelope loads

Start: ENERGY STAR V3

Screen: DCH Mandatory Provisions

Assess: Mandatory Items & HERS Index

Optimize: Compliance, Costs, Constructability



- **ENERGY STAR Qualified Windows**

- $U \leq 0.32$ in CZ 4
- $SHGC \leq 0.40$ in CZ 4
- Allowances for passive solar design
- Note that Target Home windows are more stringent (but not Mandatory)

- **Efficient Hot Water Distribution**

- Meeting 0.5 gallon stored volume limit will require central plumbing layouts or hot water recirculation system based on occupant-controlled switch or occupant sensor; look for:
 - Core plumbing layouts
 - Manifold systems
 - Demand systems based on occupant controls (motion, push button)

Start: ENERGY STAR V3

Screen: DCH Mandatory Provisions

Assess: Mandatory Items & HERS Index

Optimize: Compliance, Costs, Constructability

- **ENERGY STAR Lights & Appliances**

- All installed refrigerators, dishwashers, and clothes washers
- 80% of lighting fixtures or bulbs
- All installed bathroom ventilation and ceiling fans

- **Indoor airPLUS**

- Significant overlap with ENERGY STAR V3 in terms of water-managed building assemblies, mechanical ventilation, HVAC design, and combustion safety
- New/different include :
 - radon-resistant construction (Radon Zone 1)
 - MERV 8 on central AHUs
 - Additional dehumidification (Warm-humid climates)
 - Garage exhaust ventilation
 - Low –formaldehyde pressed wood materials
 - Low-VOC or no VOC interior paints & finishes

Start: ENERGY STAR V3

Screen: DCH Mandatory Provisions

Assess: Mandatory Items & HERS Index

Optimize: Compliance, Costs, Constructability

- **Renewable Energy Ready Checklists**

- Determine applicability by zip code
- <http://gisatnrel.nrel.gov/PVWatts Viewer/index.html>
- In this Mid-Atlantic example, solar resources = 4.8 kWh/m²/day

Start: ENERGY STAR V3

Screen: DCH Mandatory Provisions

Assess: Mandatory Items & HERS Index

Optimize: Compliance, Costs, Constructability



- How can the plan integrate any significant building system modifications?
 - Duct system
 - Envelope modifications
- Does the revised plan achieve the Target Home HERS Index?
- What other performance incentives are gained along the way?
 - Utility incentives
 - Federal tax credit

Start: ENERGY STAR V3

Screen: DCH Mandatory Provisions

Assess: Mandatory Items & HERS Index

Optimize: Compliance, Costs, Constructability

Rating Software*	Currently Includes DOE Challenge Home Compliance Reporting?
REM/Rate	Yes – V14.2 (released FEB 2013)
EnergyGauge	PENDING

* DOE has developed the “DOE Challenge Home HERS Index Target Procedure” which establishes how rating software generates the Target Home and assesses compliance for rated homes.

- Automatically programs the Target Home and compares to Design Home
- Mandatory Requirements
- Optional Home Builder Commitments

REM/Rate v 14.1 - DCH Target Home Design - CZ4 2 story bsmnt.blg

File Building View Extras Libraries Reports Tools Help

Marking any given checkbox certifies that the home complies with all mandatory requirements referenced by that checkbox. Needed for showing compliance on various reports.

IECC - Mandatory Requirements

<input checked="" type="checkbox"/> 2004 IECC	<input checked="" type="checkbox"/> 2009 IECC	<input type="checkbox"/> 2010 NY IECC
<input checked="" type="checkbox"/> 2006 IECC	<input checked="" type="checkbox"/> 2012 IECC	

ENERGY STAR Version 2

<input type="checkbox"/> Thermal Bypass Checklist	<input type="checkbox"/> ENERGY STAR Products
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ENERGY STAR Version 2.5 and 3.0

<input checked="" type="checkbox"/> Thermal Enclosure	<input checked="" type="checkbox"/> # Refrigerators	1
<input checked="" type="checkbox"/> HVAC System Quality Installation Contractor	<input type="checkbox"/> # Ceiling Fans	0
<input checked="" type="checkbox"/> HVAC System Quality Installation Rater	<input checked="" type="checkbox"/> # Exhaust Fans	2
<input checked="" type="checkbox"/> Water Management System Builder	<input type="checkbox"/> # Dishwashers	0
<input checked="" type="checkbox"/> Indoor airPlus Verification		

Conditioned Basement Exclusion

<input checked="" type="checkbox"/> Basement Qualifies for SAF exclusion?	Basement Conditioned Floor Area:	1600
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- Home Builder ID#
(from DOE)
- Mandatory Requirements
- Optional Home Builder Commitments

REM/Rate v 14.1 - DCH Target Home Design - CZ4 2 story bsmnt.blg

File Building View Extras Libraries Reports Tools Help

Marking any given checkbox certifies that the home complies with all mandatory requirements referenced by that checkbox.

DOE Challenge Home

Home Builder ID#: 12345

Mandatory Requirements

<input checked="" type="checkbox"/> Fenestration	<input checked="" type="checkbox"/> Appliance	<input checked="" type="checkbox"/> Indoor Air Quality
<input checked="" type="checkbox"/> Insulation	<input checked="" type="checkbox"/> Lighting	<input checked="" type="checkbox"/> Fan Efficiency
<input checked="" type="checkbox"/> Renewable Energy Ready Solar Electric	<input checked="" type="checkbox"/> Duct Location	
<input checked="" type="checkbox"/> Renewable Energy Ready Solar Hot Water		

Optional Home Builder Commitments for Recognition

Yes	Certified under the EPA Indoor airPlus Program*
Yes	Certified under the EPA WaterSense for New Homes Program
No	Certified under the IBHS fortified for Safer Living Program
No	Followed the DOE Challenge Home Quality Management Guidelines
No	The buyer of this home signed a waiver giving DOE Challenge Home access to utility bill data for one year.

*Certification under the DOE Challenge Home permits limited exceptions to full compliance with Indoor airPLUS. Builders seeking the Indoor airPLUS label must achieve full compliance with the Indoor airPLUS Verification Checklist.

REM/Rate V14.2 & DOE Challenge Home Compliance Reporting

- DOE Challenge Home Compliance on “Compliance” tab
- Also note “Tax Credit” which passes in Most/All cases

The screenshot displays the REM/Rate v14.1 software interface for a 'DCH Target Home Design - CZ4 2 story bsmnt.blg'. The main window is divided into several sections:

- Compliance Settings:**
 - IECC - Mandatory Requirements:** 2004 IECC, 2006 IECC, 2009 IECC, and 2012 IECC are checked. 2010 NY IECC is unchecked.
 - ENERGY STAR Version 2:** Thermal Bypass Checklist and ENERGY STAR Products are unchecked.
 - ENERGY STAR Version 2.5 and 3.0:**
 - Checklists Fully Enforced for 3.0:** Thermal Enclosure, HVAC System Quality Installation Contractor, HVAC System Quality Installation Rater, Water Management System Builder, and Indoor airPlus Verification are checked.
 - ENERGY STAR Product Count:** # Refrigerators (1), # Exhaust Fans (1), # Ceiling Fans (0), and # Dishwashers (0) are entered.
 - Conditioned Basement Exclusion:** Basement Qualifies for SAF exclusion? is checked. Basement Conditioned Floor Area is 1600.
- Analysis Panel (Right):** A table showing compliance results for various programs and codes. A red box highlights the 'Programs' section.

Programs	Result
V2.0 ENER...	Fails
V2.5 ENER...	Passes
V3.0 ENER...	Passes
Tax Credit	Passes
DOE Chall...	Passes
HERS Index	52
NY HERS ...	N/A
- Code Panel (Right):** A list of codes with their compliance status.

Code	Result
IECC 2012 ...	Passes
IECC 2009 ...	Passes
IECC 2006 ...	Passes
IECC 2004 ...	Passes
IECC 2003 ...	Passes
IECC 2001 ...	Passes
IECC 2000 ...	Passes
IECC 1998 ...	Passes
ECCCNYS-	Fails
ECC of Sou...	Passes
MEC 1995 ...	Passes
MEC 1993 ...	Passes
MEC 1992 ...	Passes
ASHRAE 9...	Passes
- Errors/Warnings Panel (Bottom):** No errors or warnings exist.
- Spreadsheet Panel (Bottom Right):** A small spreadsheet grid is visible.

REM/Rate V14.2 & DOE Challenge Home Compliance Reporting

- Viewing the Target Home HERS Score
- Reports/DOE Challenge Home Verification Summary

Report - C:\Users\Public\Architectural Energy Corporation\REM Rate 12\Reports\DOEChal

Viewing: DOE Challenge Home Verification Summary (1) << Report Report >>

1 of 2 80% 1:1

DOE Challenge Home Verification

Projected Rating: Based on Plans - Field Confirmation Required.

Energy Performance	
House Type	DOE Challenge Home Builder Partner ID#
Single-family detached	12345
Year built	Square footage of Conditioned Space including Basement
2013	3968.0
Number of Bedrooms	Square footage of Conditioned Space without Basement
4	2368.0
Site address (if not available, list the site Lot #)	Registered Builder
555 Main Street	Certified Rater
Rockville	
MD, 20853	
HERS Index without On-site Generation	Date of Rating
52	
HERS Index with On-site Generation	Rating Software
52	REM/Rate - v14.1
HERS Index of the Target Home using size adjustment factor	Estimated annual energy costs(\$)
53	1399
Estimated annual energy use	Estimated annual energy savings
Electric: 14690 kWh \ Natural Gas: 177 Therms	Electric: 10731 kWh \ Natural Gas: 34 Therms
Energy cost rates	Estimated annual emissions reductions
Electric: 0.08 \$/kWh \ Natural Gas: 0.90 \$/Therms	CO2: 7.3 tons / SO2: 117.4 lbs / NOx: 26.9 lbs

DOE Challenge Home Certification

As the certified Rater for this house, I certify this house meets/complies with all mandatory requirements of the DOE Challenge home guidelines, including the following:

<input checked="" type="checkbox"/>	Compliance with all ENERGY STAR Qualified Homes Version 3 requirements and checklists
<input checked="" type="checkbox"/>	Compliance with Mandatory Fenestration Requirements
<input checked="" type="checkbox"/>	Compliance with Mandatory Insulation Requirements
<input checked="" type="checkbox"/>	Compliance with Mandatory Duct Location Requirements
<input checked="" type="checkbox"/>	Compliance with Mandatory Appliance Requirements
<input checked="" type="checkbox"/>	Compliance with Mandatory Lighting Requirements
<input checked="" type="checkbox"/>	Compliance with Mandatory Fan Efficiency Requirements
<input checked="" type="checkbox"/>	Compliance with Mandatory Indoor Air Quality Requirements
<input checked="" type="checkbox"/>	Compliance with Mandatory Renewable Energy Ready Solar Electric Requirements
<input checked="" type="checkbox"/>	Compliance with Mandatory Renewable Energy Ready Solar Hot Water Requirements
<input checked="" type="checkbox"/>	This home was qualified via sampling in lieu of testing, in accordance with allowable sampling provisions as stated in the DOE Challenge Home National Program Requirements

Optional Compliance for Builder Recognition

I further certify that the following also apply to this house:

YES	NO	DON'T KNOW	Optional Home Builder Commitments for Recognition
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Certified under the EPA Indoor airPLUS Program*

*Certification under the DOE Challenge Home permits limited exceptions to full compliance with Indoor airPLUS. Builders seeking the Indoor airPLUS label must achieve full compliance with the Indoor airPLUS Verification Checklist.

REM/Rate - Residential Energy Analysis and Rating Software v14.1

- Plan Review Feedback
- Common Issues
 - Design HERS > Target Home HERS
 - Failure to Check Mandatory Boxes
 - 2012 IECC UA Not Low Enough
 - Unvented attics can be tricky
 - Duct not in conditioned space

DOE Challenge Home Verification

Projected Rating: Based on Plans - Field Confirmation Required.

The building DOES NOT meet DOE CHALLENGE for the following reasons:

The Design Home HERS Index is larger than the DOE Challenge HERS Index Target.
 - HERS Index w/o PV is 56
 - HERS Index with PV is 56
 - DOE Challenge HERS Index Target w/o SAF is 53
 - DOE Challenge HERS Index Target w/SAF is 53
 The HERS Index w/o PV must be lower than the DOE Challenge HERS Index Target w/o SAF AND the HERS Index with PV must be lower than the DOE Challenge HERS Index Target with SAF.

Energy Performance

House Type	DOE Challenge Home Builder Partner ID#
Single-family detached	12345
Year built	Square footage of Conditioned Space including Basement
2013	3968.0
Number of Bedrooms	Square footage of Conditioned Space without Basement
4	2368.0
Site address (if not available, list the site Lot #)	Registered Builder
555 Main Street	
Rockville	Certified Rater
MD, 20853	
HERS Index without On-site Generation	Date of Rating
56	
HERS Index with On-site Generation	Rating Software
56	REM/Rate - v14.1
HERS Index of the Target Home using size adjustment factor	Estimated annual energy costs(\$)
53	1428
Estimated annual energy use	Estimated annual energy savings
Electric: 14986 kWh \ Natural Gas: 220 Therms	Electric: 10648 kWh \ Natural gas: -9 Therms
Energy cost rates	Estimated annual emissions reductions
Electric: 0.08 \$/kWh \ Natural Gas: 0.50 \$/Therms	CO2: 7.0 tons / SO2: 116.5 lbs / NOx: 26.1 lbs

DOE Challenge Home Certification

As the certified Rater for this house, I certify this house meets/complies with all mandatory requirements of the DOE Challenge home guidelines, including the following:

	Compliance with all ENERGY STAR Qualified Homes Version 3 requirements and checklists
X	Compliance with Mandatory Fenestration Requirements

Ceiling, wall, floor, and slab insulation shall meet or exceed 2012 IECC levels [Table R402.1.1}.

The following [4] exceptions apply:

- d) An alternate equivalent U-factor or total UA calculation:
- **U-factor** equal or less than Table 402.1.3.
 - Total building **thermal envelope UA** \leq to the total UA from U-factors in Table 402.1.3.
 - ~~Fenestration products (i.e., windows, skylights, doors) not included in this calculation.~~
 - Attic eave, slab edge, and attic platform insulation reqts. (4.1 through 4.3 of the ES for Homes V3 TES) shall be met.
 - The UA calculation method consistent with ASHRAE HOF and include thermal bridging effects: ASHRAE zone method or equivalent, and not a series-parallel path calculation method.

- REM/Rate V14.1 models this UA Calculation approach automatically
- Non-compliance messages will show up if envelope doesn't meet 2012 IECC UA
- Use “2012 IECC Building UA Compliance” for diagnosing issues
 - Don't include fenestration

Report - C:\Users\Public\Architectural Energy Corporation\REM Rate 12\Reports\IECCUA12.ll

Viewing: IECC 2012 UA Compliance (1) << Report Report >> Print All Reports...

1 of 1 100% 1:1

2012 IECC Building UA Compliance

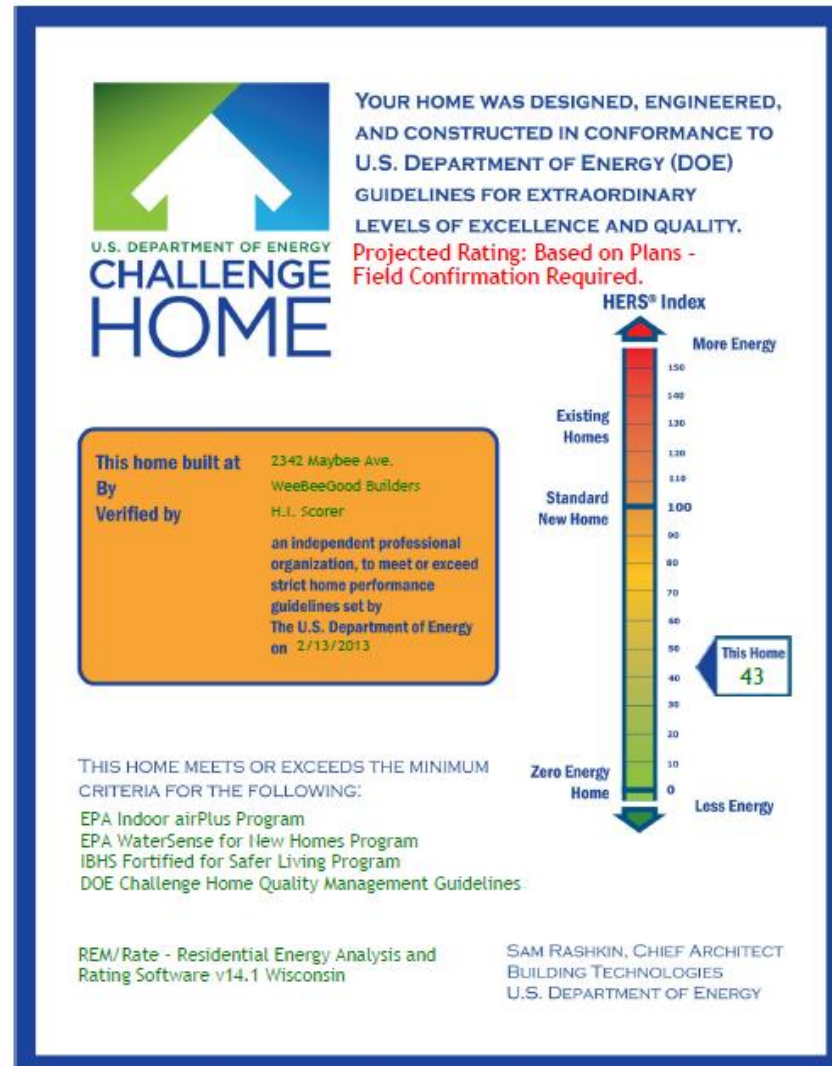
Property: Howard Homeowner, 555 Main Street, Rockville, MD 20853
Organization: Newport
HERS Rater ID:
Builder:

Weather: Baltimore, MD
DOE Challenge Home - Target CZ4
DCH Target Home Design - CZ4.2

Elements	Insulation Levels	
	2012 IECC	As Designed
Shell UA Check		
Ceilings:	34.9	34.9
Above-Grade Walls:	132.2	128.4
Windows and Doors:	115.2	91.9
Basement Walls:	69.2	67.7
Overall UA (Design must be equal or lower):	351.5	322.9
Window U-Factor Check (Section 402.5)		
Window U-Factor (Design must be equal or lower):	0.480	0.300

This home MEETS the overall thermal performance requirements and verifications of the International Energy Conservation Code based on a climate zone of 4A. (Section 402, International Energy Conservation Code, 2012 edition.) In fact, this home

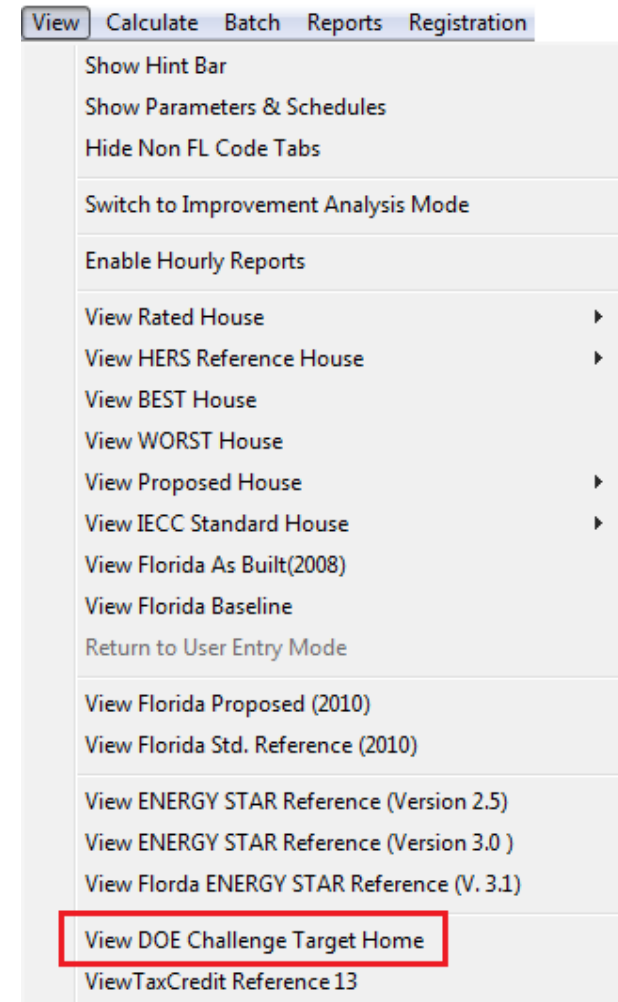
- Within REM/Rate, located under Reports/DOE Challenge Home Certificate





This feature is available under the reports menu item and automatically creates the DOE Challenge Target Home following the DOE Challenge Home requirements based on the rated home. The DOE Challenge Target Home building component and equipment are display on each screen.

Select View DOE Challenge Target Home



Target Home Screen

EnergyGauge USA - DOE Challenge - Basement Unconditioned

File View Calculate Batch Reports Registration Support Help Tools

Project ID: 25 View DOE Challenge Target

Project Info

Title: DOE Challenge - Basement Unconditioned
Owner: OWNER
Builder: BUILDER
Rater: TEST RATER
Comment: HERS BESTEST insulated basement case

Permit Office:
Permit Date: // Permit #:
Jurisdiction:
Final Inspection Date: //
Rater ID: 000000

Building Info

Status: New (From Plans)
Year of Construction:
Rotate Building: 0
Number of Bathrooms:
Total Number of Stories:
Total Number of Bedrooms: 4
Total Conditioned Area: 1539 sq. ft.

Worst Case
 Yes No

Occupancy
 Single Family
 Multi Family

Single-family detached
 Regain

Post Project
Energy Star
 Yes No

Property Location

Address Type
 Street Address Lot Information

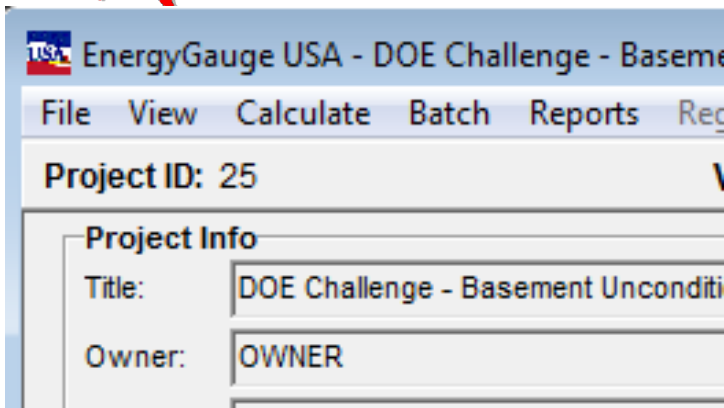
Street: 111 Anywhere Lane
City: Jacksonville State: FL
County: Duval Zip: -
Florida Climate Zone: North

Rating only Info

Development:
Model:

Project Climate Utility Rates Surroundings

DOE Challenge Target Home Input Summary Report



In View DOE Challenge Target mode, simply select **Input Summary** to generate the complete inputs of the generated DOE Challenge Home.

Building Input Summary Report

PROJECT												
Title:	DOE Challenge Home	Bedrooms:	3	AddressType:	StreetAddress							
Building Type:	DOECH2012	Bathrooms:	2	Lot#								
Owner:	OWNER	Conditioned Area:	1152 sq.ft.	Block/SubDivision:								
# of Units:	1	Total Stories:	1	PlatBook:								
Builder Name:	BUILDER	WorstCase:	No	Street:	Main Street							
Permit Office:		Rotate Angle:	0	County:	Orange							
Jurisdiction:		Cross Ventilation:	No	City, State, Zip:	Orlando, FL, 32801-							
Family Type:	Single-family	Whole House Fan:	No									
New/Existing:	New (From Plans)	Terrain:	Suburban									
Year Construct:		Shielding:	Suburban									
Comment:												
CLIMATE												
Design Location	Tmy Site	Design Temp	97.5%	2.5%	Int Design Temp	Winter	Summer	Heating Degree Days	Design Moisture	Daily Temp Range		
FL, Orlando	FL_ORLANDO_INTL_ARPT	41	91	70	75	526	44	Medium				
UTILITY RATES												
Fuel	Unit	Utility Name	Monthly Fixed Cost				\$/Unit					
Electricity	kWh	Florida Average	0				0.1151					
Natural Gas	Therm	Florida Average	0				1.82					
Fuel Oil	Gallon	Florida Default	0				1.1					
Propane	Gallon	Central FI Propane March 2006	0				1.4					
SURROUNDINGS												
Ornt	Type	Shade Trees			Exist	Adjacent Buildings						
		Height	Width	Distance		Height	Width	Distance				
N	None	0 ft	0 ft	0 ft		0 ft	0 ft	0 ft				
NE	None	0 ft	0 ft	0 ft		0 ft	0 ft	0 ft				
E	None	0 ft	0 ft	0 ft		0 ft	0 ft	0 ft				
SE	None	0 ft	0 ft	0 ft		0 ft	0 ft	0 ft				
S	None	0 ft	0 ft	0 ft		0 ft	0 ft	0 ft				
SW	None	0 ft	0 ft	0 ft		0 ft	0 ft	0 ft				
W	None	0 ft	0 ft	0 ft		0 ft	0 ft	0 ft				
NW	None	0 ft	0 ft	0 ft		0 ft	0 ft	0 ft				
BLOCKS												
Number	Name	Area	Volume									
1	Block1	1152	9561.6									
SPACES												
Number	Name	Area	Volume	Kitchen	Occupants	Bedrooms	Finished	Cooled	Heated			
1	RoomsInBlock1	1152	9561.6	Yes	3	3	Yes	Yes	Yes			
FLOORS												
#	Floor Type	Space	Perimeter	R-Value	Area	Tile				Wood	Carpet	
1	Slab-On-Grade Edge Insulation	RoomsInBlock1	152 ft	0	1152 ft²	---				0.2	0	0.8

Two DOE Challenge Home calculations



File View Calculate Batch Reports Registration

- Annual Simulation
- Building America ▶
- BESTEST Loads
- Florida Code Compliance 2010 ▶
- Fannie Mae
- Rating... ▶
- Tax Credit ▶
- ManualJ8 System Sizing
- ENERGY STAR ▶
- DOE Challenge ▶
 - DOE Challenge 2012
 - DOE Challenge IECC 2012 Thermal Envelope

Calculate the DOE Challenge Home HERS Index



The DOE Challenge calculation menu item calculates the DOE Challenge Home HERS Target Index, the SMF (Size Modification Factor), DOE Challenge Home HERS Index (which includes the SMF) and HERS Index of the rated home.

Upon completion of the calculation the DOE Challenge Summary displays the results and a PASS/FAIL status. The IECC 2012 Prescriptive Envelope Requirements are also checked and a PASS/FAIL status is displayed.

DOE Challenge Summary

State:	FL
Building Type:	Single-family detached
Conditioned Area Non-Basement (sq. ft.):	1152
Bedrooms Non-Basement:	3
Conditioned Area Benchmark	2200
Size Modification Factor:	1.00

DOE Challenge Home Target HERS Index :	59
DOE Challenge Home HERS Index:	59

HERS Index (without PV) :	59
HERS Index (with PV) :	N/A

DOE Challenge Home HERS Index Status: PASS

IECC Prescriptive Envelope Requirements: PASS



DOE Challenge Home Report

Close


DOE Challenge Information



Required information for
DOE Challenge Report
generation.

House Type <input checked="" type="radio"/> Single-family Detached <input type="radio"/> Attached <input type="radio"/> Duplex <input type="radio"/> Low-rise Multifamily <input type="radio"/> Other	Third Party Verifier Company: <input type="text" value="Rater Company Name"/> Contact: <input type="text" value="Rater"/> Phone: <input type="text" value="(321)555-1212"/> Email: <input type="text" value="Rater@rater.com"/> Website: <input type="text" value="www.rater.com"/> Rating Date: <input type="text" value="02/22/2013"/>
Year Built (Homes completed in 2007 or later may qualify if they meet the energy threshold and a third-party verifier can verify the Quality Criteria) <input type="text" value="2013"/>	Identification Number (RESNET ID, Professional license #, etc) <input type="text" value="3000"/>
Building Plan Number <input type="text" value="15000"/>	Developer (if known) Company: <input type="text" value="Developer Name"/> Contact: <input type="text" value="Jim Brown"/> Phone: <input type="text" value="(777)555-1212"/> Email: <input type="text" value="Jim@developer.com"/>
Registered Builder Company: <input type="text" value="Builder Company"/> Contact: <input type="text" value="John Smith"/> Phone: <input type="text" value="(321)444-1212"/> Email: <input type="text" value="John@builder.com"/>	

Information **Requirements**

[View DOE Challenge Home Report](#)  Close



Required checklist items for DOE Challenge Report generation

Quality Criteria Checklist

As the Third-Party Verifier for this house, I certify that the house complies with all of the "Required" Builders Challenge Quality Criteria, as defined by the Builders Challenge Quality Criteria Checklist.

DOE Challenge Home Additions to Mandatory Requirements Checklist page

DOE Challenge Home Builder ID#:

DOE Challenge Home report to be uploaded to RESNET National HERS Registry

Compliance with all ENERGY STAR Qualified Homes version 3 requirements and checklists

Compliance with Mandatory Fenestration Requirements

Compliance with Mandatory Insulation Requirements

Compliance with Mandatory Duct Location Requirements

Compliance with Mandatory Appliance Requirements

Compliance with Mandatory Lighting Requirements

Compliance with Mandatory Fan Efficiency Requirements

Compliance with Mandatory Indoor Air Quality Requirements

Compliance with Mandatory Renewable Energy Ready Solar Electric Requirements

Compliance with Mandatory Renewable Energy Ready Solar hot Water Requirements

This home was qualified via sampling in lieu of testing, in accordance with allowable sampling provisions as stated in the DOE Challenge Home National Program Requirements

DOE Challenge Home Additional Optional Programs:

Certified under the EPA Indoor airPLUS Program	<input checked="" type="radio"/> Yes <input type="radio"/> No <input type="radio"/> Don't Know
Certified under the EPA WaterSense for New Homes Program*	<input checked="" type="radio"/> Yes <input type="radio"/> No <input type="radio"/> Don't Know
Certified under the IBHS Fortified for Safer Living Program	<input checked="" type="radio"/> Yes <input type="radio"/> No <input type="radio"/> Don't Know
Followed the DOE Challenge Home Quality Management Guidelines	<input checked="" type="radio"/> Yes <input type="radio"/> No <input type="radio"/> Don't Know
The buyer of this home signed a waiver giving DOE Challenge Home access to utility bill data for one year.	<input checked="" type="radio"/> Yes <input type="radio"/> No <input type="radio"/> Don't Know

Information Requirements

DOE Challenge Compliance Status Report

U.S. DEPARTMENT OF
ENERGY

Energy Efficiency &
Renewable Energy



DOE Challenge Home Report

Date: 02/25/2013
Site Address: Main Street, Orlando FL
Builders Name: BUILDER
DOE Challenge Home Builder ID#:

Certified Rater: Joe Smith
Date of Rating: 02/25/2013
Rating Software: EnergyGauge

Estimated annual energy use:

Electric (kWh): 7631
Natural Gas (therms): 0
Oil (gallons): 0
Propane (gallons): 0

Estimated annual energy savings

Electric (kWh): 3627
Natural Gas (therms): 0
Oil (gallons): 0
Propane (gallons): 0

Energy cost rates:

\$0.115/kWh \$ 1.82/therm
\$1.10/gallons oil \$1.40/gallons propane

Estimated annual emissions reductions

CO2 (tons): 2.45 NOX (lbs): 8.46
SO2 (lbs): 14.40

HERS Index without On-site Generation: 59
HERS Index with On-site Generation (if applicable): NA
HERS Index of Target Home using size adjustment factor: 59
Estimated annual energy costs: \$ 878

House Type: Single-family Detached
Year Built: 2013
of Bedrooms: 3
Conditioned Space including Basement: 1152 sq.ft.
Conditioned space without Basement: 1152 sq.ft.

Building complies with: [mandatory items checked during entry]

- All ENERGY STAR Qualified Homes Version 3 requirements and checklists
- Mandatory Fenestration Requirements
- Mandatory Insulation Requirements
- Mandatory Duct Location Requirements
- Mandatory Appliance Requirements
- Mandatory Lighting Requirements



Report Indicating Ceiling Insulation Failure

- Mandatory Fan Efficiency Requirements
- Mandatory Indoor Air Quality Requirements
- Mandatory Renewable Energy Ready Solar Electric Requirements
- Mandatory Renewable Energy Ready Solar hot Water Requirements

Building complies with the following optional additional programs:
None

*Certification under the DOE Challenge Home permits limited exceptions to full compliance with Indoor airPLUS. Builders seeking the Indoor airPLUS label must achieve full compliance with the Indoor airPLUS Verification Checklist.

The Design Home fails to meet DOE Challenge Home due to the following reasons

Minimum Ceiling Insulation must be ≥ 38

This home does not meet the energy efficiency and mandatory requirements for designation as a DOE Challenge Home.



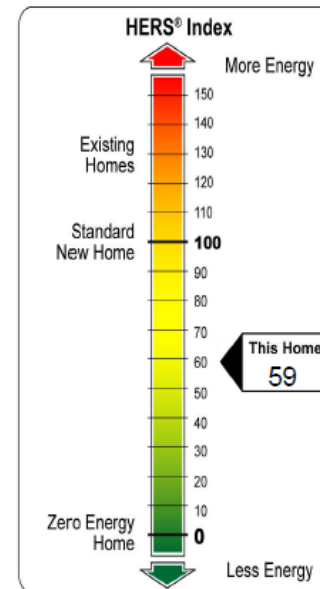
The DOE Challenge Home Certificate is generated upon successful HERS registration and registration with RESNET. The report is available for download from the raters EnergyGauge HERS webpage.

U.S. DEPARTMENT OF ENERGY

CHALLENGE HOME

The symbol of Excellence for Peak Performance

Your home was designed, engineered, and constructed in conformance to U.S. Department of Energy (DOE) guidelines for extraordinary levels of excellence and quality.



Not Registered

This home built at

**Main Street
Orlando, FL**

by BUILDER

has been verified by

Joe Smith

an independent professional or organization to meet or exceed strict energy efficiency guidelines set by the U.S. Department of Energy on 2/25/2013

This home meets or exceeds the minimum criteria for the following:

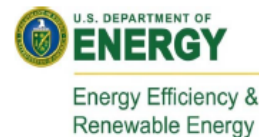
DOE Challenge Home
EPA ENERGY STAR Version 3 Home
EPA Indoor AirPLUS
EPA WaterSense

IBHS Fortified for Safer Living
DOE Challenge Home Quality Program

EnergyGauge®

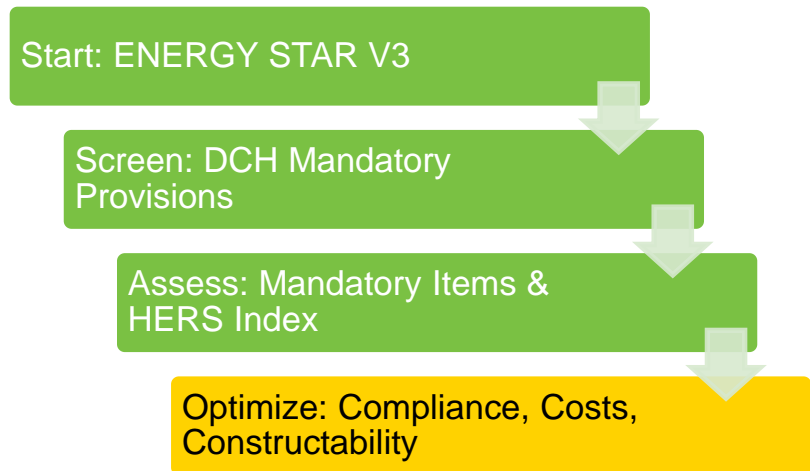
www.eere.energy.gov/buildings/challenge

Comes from Provider



Sam Rashkin, Chief Architect
Building Technologies
U.S. Department of Energy

- Beating the Target Home
- Manage Cost Impacts



- Maximize high efficiency lighting
 - 80% up to 100% worth can gain 1 or more HERS points
- High efficiency water heating
 - For gas systems, Target Home System @ 0.67 EF
- WHMV Fan Efficiency
 - For an example home of 4 BR and 2500 SF:
 - $Q_{fan} = 0.01A_{floor} + 7.5(N_{br} + 1)$
 - $= 0.01*(2500) + 7.5*(5) = 63 \text{ cfm}$

CZ 1-2	CZ 3, 4 (except Marine)	CZ 4 Marine, 5-8
1.4 cfm/W	1.4 cfm/W	1.2 cfm/W
No heat exchange	No heat exchange	HX with 60% SRE

- $63 \text{ cfm} / (1.4 \text{ cfm/W}) = 45 \text{ Watts}$
- More efficient WHMV systems can use lower Watts, gain HERS

- Lower Infiltration....

	ACH50 Requirements/Targets			
Climate Zones	DOE Challenge Home	ENERGY STAR V3	2012 IECC	Passive House
1-2	3.0	6.0	5.0	0.6
3-4	2.5	5.0	3.0	0.6
5-7	2.0	4.0	3.0	0.6
8	1.5	3.0	3.0	0.6

Beating the Target Home

- Higher Insulation Values.....

Climate Zone	Mass Wall R-Value ⁱ	Floor R-Value	Basement ^c Wall R-Value	Slab ^d R-Value, Depth	Crawl Space ^c Wall R-Value
1	3/4	13	0	0	0
2	4/6	13	0	0	0
3	8/13	19	5/13 ^f	0	5/13
4 except Marine	8/13	19	10 /13	10, 2 ft	10/13
5 & Marine 4	13/17	30 ^g	15/19	10, 2 ft	15/19
6	15/20	30 ^g	15/19	10, 4 ft	15/19
7 & 8	19/21	38 ^g	15/19	10, 4 ft	15/19

Prescriptive Requirements *(cont.)*

Climate Zone	Fenestration	Skylight U-Factor	Glazed Fenestration SHGC	Ceiling R-Value	Wood Frame Wall R-Value
1	NR	0.75	0.25	30	13
2	0.40	0.65	0.25	38	13
3	0.35	0.55	0.25	38	20 or 13+5 ^h
4 except Marine	0.35	0.55	0.40	49	20 or 13+5 ^h
5 & Marine 4	0.32	0.55	NR	49	20 or 13+5 ^h
6	0.32	0.55	NR	49	20+5 or 13+10 ^h
7 & 8	0.32	0.55	NR	49	20+5 or 13+10 ^h

- Leverage “Innovation Premium”
- Design
 - Integrate code compliance, constructability, and high performance features
- Credits & Incentives
 - Federal Energy Efficiency Credit (builders)
 - Utility High Performance Home incentives
- Learning Curve
 - Many aspects of DOE Challenge Home are 1 step ahead of codes

- Same: ENERGY STAR Homes framework
- New:
 - Indoor airPLUS Checklist;
 - Renewable Energy Ready Home Checklists (where applicable)
 - Hot Water Distribution test
- Submissions:
 - Send “DOE Challenge Home Verification Summary” electronically to doechallengehome@newportpartnersllc.com
 - Otherwise builders will not receive “credit” on DCH website
 - Considering RESNET National Homes Registry for future

- Indoor airPLUS Checklist;
 - 1-page checklist
 - Builder or Rater may verify
 - Permissible methods:
 - Visual verification on site during construction
 - Reviewing photos taken during construction
 - Checking documentation
 - Equivalent methods as appropriate
 - Sampling permitted per RESNET-approved protocol

- Renewable Ready Checklists;
 - Follow checklists in RERH documents, ***but apply DOE Challenge Home exceptions***
 - Revised checklist under development
- Hot Water Distribution
 - Measurement of stored water volume (0.6 gallon limit)
 - For recirculation systems, the “start” point is the branch off the loop to the fixture
 - To measure, DCH specs describe a field process to run the system, measure volume until $10F_{\Delta}$ reached;
 - Only measured on fixture with greatest stored volume
 - See Specs Footnote 12

Thank You

Questions?

For More Information:

www.buildings.energy.gov/challenge

e-mail Contact:

doechallengehome@newportpartnersllc.com