ENERGY STAR Certified Homes

The Year Ahead

October 23, 2017
Consistency

Stability

Refinement
The Numbers
Annual ENERGY STAR Certified Homes Built

<table>
<thead>
<tr>
<th>Year</th>
<th>Homes Reported</th>
</tr>
</thead>
<tbody>
<tr>
<td>2016</td>
<td>93,249</td>
</tr>
<tr>
<td>2015</td>
<td>83,899</td>
</tr>
<tr>
<td>2014</td>
<td>87,813</td>
</tr>
</tbody>
</table>
Checking in on Program Requirements: Version 3.1
Version 3.1: Overview

- Maintains meaningful savings in states that adopt the 2012 IECC or equivalent.

**Performance Target**

- HERS Index Target
  - ~ 55 - 65

**Mandatory Features**

- Exact Same Checklists as v3
Version 3.1: Implementation

- There are now 17 states, plus D.C., for which the v3.1 implementation date has been defined, plus regional v3.1 requirements for CA and FL.
Version 3.1: TX

- Proactive outreach to partners starting in the Spring.
Version 3.1: TX

Sample ENERGY STAR HERS Index Target by Climate Zone

- Gas
- Elec
Version 3.1: TX

- **Furnace Efficiency:**
  - In CZ 3, for v3.1, furnace efficiency reduced to 80 AFUE.

- **Size Adjustment Factor:**
  - In all CZ’s, for National & FL v3.1, Size Adjustment Factor eliminated.

- **Water Heater Tank Size:**
  - In all CZ’s, for both v3 and v3.1, ES Reference Design configured with a 50 gallon 0.59 EF gas tank, when rated home has instant gas water heater.

- **Extended v3.1 implementation timeline for TX from 10/01/17 to 07/01/18.**
Version 3.1: Key Takeaways

- For FL and the 17 national v3.1 states, ENERGY STAR will get a bit easier, particularly in CZ 3.
- We’re reasonable, collaborative, people.
- Don’t hesitate to reach out to us.
Checking in on Program Requirements:
Version 3.2
Version 3.2

• These two states now have the most stringent energy codes in the country.
• In response, we’re developing a brand-new Version 3.2.
• Same concept as Version 3.1 –
  – More aggressive performance target
  – Exact same mandatory features
• Comment period underway for WA v3.2.
• Comment period in early November for CA v3.2.
• Propose to implement both for homes permitting starting July 1, 2018.
Revision 09.

• Since the release of Rev. 08 in July 2015, we’ve only made a handful of small policy adjustments.
• Eventually we’ll want to roll these improvements into the program documents, which will result in the creation of Rev. 09.
• No set timeline yet. It’s not imminent, but will occur before we meet next year.
• In summary, Rev. 09 is shaping up to be a very minor revision.
Builder Recruitment
Builder Recruitment

2012
Builder Recruitment

HERS® Index

Zero Energy Home  Reference Home  Existing Homes

Less Energy  More Energy

85 This Home

ENERGY STAR Qualified Homes Thermal Bypass Inspection Checklist

2012
Builder Recruitment

HERS® Index

Zero Energy Home  Reference Home  Existing Homes

Less Energy  More Energy

65
This Home

2017
Builder Recruitment

What’s Left to Reach ENERGY STAR?

- HVAC Design & Commissioning
- Bedroom pressure balancing

2017
Builder Recruitment

2017
**Builder Recruitment**

- Offer gap analysis.
- Educate about new resources.
- Provide hands-on support.
- Outreach to willing Raters to collaborate and identify potential builders.
HERS Credit for HVAC Quality Design & Installation
Installation defects in HVAC systems are commonplace
Installation defects in HVAC systems are commonplace

- Improper airflow:
  - Average airflow ~20% below target. Blasnik et al. (1995)
  - Average airflow 14% below design. Proctor (1997)
  - Measured airflow ranging from 130 - 510 CFM / ton. Parker (1997)
  - 70% of units had airflow < 350 CFM / ton. Neme et al. (1999)
  - Improper airflow in 44% of systems. Mowris et al. (2004)
Installation defects in HVAC systems are commonplace

- Incorrect refrigerant charge:
  - In 57% of systems. Downey/Proctor (2002)
  - In 62% of systems. Proctor (2004)
  - In 72% of systems. Mowris et al. (2004)
  - In 82% of systems. Proctor (1997)
Installation defects in HVAC systems are commonplace

<table>
<thead>
<tr>
<th>Study Author</th>
<th>State</th>
<th>New/Existing Home?</th>
<th>Sample Size</th>
<th>Average Airflow &lt;350 cfm</th>
<th>Airflow w/in 10% of 400 cfm</th>
<th>Energy Savings</th>
<th>Potential Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blasnik et al. 1995a</td>
<td>NV</td>
<td>New</td>
<td>30</td>
<td>345</td>
<td>50%</td>
<td>8%</td>
<td>Est @ 33% combined charge/air flow correction benefits</td>
</tr>
<tr>
<td>Blasnik et al. 1995b</td>
<td>CA</td>
<td>New</td>
<td>10</td>
<td>319</td>
<td>90%</td>
<td>8%</td>
<td>Est @ 33% combined charge/air flow correction benefits</td>
</tr>
<tr>
<td>Blasnik et al. 1996</td>
<td>AZ</td>
<td>New</td>
<td>22</td>
<td>344</td>
<td>64%</td>
<td>29%</td>
<td>Est @ 33% combined charge/air flow correction benefits</td>
</tr>
<tr>
<td>Hammarlund et al. 1992</td>
<td>CA</td>
<td>New</td>
<td>12</td>
<td></td>
<td></td>
<td>10%</td>
<td>Est @ 33% combined charge/air flow correction benefits</td>
</tr>
<tr>
<td>Hammarlund et al. 1992</td>
<td>CA</td>
<td>New</td>
<td>66</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neme et al. 1997</td>
<td>MD</td>
<td>New</td>
<td>25</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Palani et al. 1992</td>
<td>n.a.</td>
<td>n.a.</td>
<td>n.a.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parker et al. 1997</td>
<td>FL</td>
<td>Both</td>
<td>27</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Proctor &amp; Pernick 1992</td>
<td>CA</td>
<td>Existing</td>
<td>175</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Proctor 1991</td>
<td>CA</td>
<td>Existing</td>
<td>15</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Proctor et al. 1995a</td>
<td>CA</td>
<td>Existing</td>
<td>30</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rodriguez et al. 1995</td>
<td>n.a.</td>
<td>n.a.</td>
<td>n.a.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rodriguez et al. 1995</td>
<td>n.a.</td>
<td>n.a.</td>
<td>n.a.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VEIC/PEG 1997</td>
<td>NJ</td>
<td>New</td>
<td>52</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Average**

<table>
<thead>
<tr>
<th>Study Author</th>
<th>State</th>
<th>New/Existing Home?</th>
<th>Sample Size</th>
<th>Charge correct to mfg spec</th>
<th>% over</th>
<th>% under</th>
<th>Energy Savings</th>
<th>Potential Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blasnik et al. 1995a</td>
<td>NV</td>
<td>New</td>
<td>30</td>
<td>85%</td>
<td>5%</td>
<td>59%</td>
<td>17%</td>
<td>Est @ 67% combined charge/air flow correction benefits</td>
</tr>
<tr>
<td>Blasnik et al. 1995b</td>
<td>CA</td>
<td>New</td>
<td>10</td>
<td>8%</td>
<td>4%</td>
<td>72%</td>
<td>21%</td>
<td>Est @ 67% combined charge/air flow correction benefits</td>
</tr>
<tr>
<td>Blasnik et al. 1996</td>
<td>AZ</td>
<td>New</td>
<td>22</td>
<td>18%</td>
<td>4%</td>
<td>78%</td>
<td>21%</td>
<td>Est @ 67% combined charge/air flow correction benefits</td>
</tr>
<tr>
<td>Farzad &amp; O'Neal 1993</td>
<td>n.a.</td>
<td>n.a.</td>
<td>n.a.</td>
<td>5%</td>
<td>0%</td>
<td>75%</td>
<td>17%</td>
<td>Lab test of TXV; 5% loss @ 20% overch &amp; 2% loss @ 20% underch</td>
</tr>
<tr>
<td>Farzad &amp; O'Neal 1993</td>
<td>n.a.</td>
<td>n.a.</td>
<td>n.a.</td>
<td>12%</td>
<td>3%</td>
<td>71%</td>
<td>17%</td>
<td>Lab test of Orifice; 13% loss @ 20% overch &amp; 21% loss @ 20% underch</td>
</tr>
<tr>
<td>Hammarlund et al. 1992</td>
<td>CA</td>
<td>New</td>
<td>12</td>
<td>31%</td>
<td>61%</td>
<td>8%</td>
<td>13%</td>
<td>Single family results</td>
</tr>
<tr>
<td>Hammarlund et al. 1992</td>
<td>CA</td>
<td>New</td>
<td>66</td>
<td>31%</td>
<td>61%</td>
<td>8%</td>
<td>12%</td>
<td>Multi-family results</td>
</tr>
<tr>
<td>Katz 1997</td>
<td>NC/SC</td>
<td>New</td>
<td>22</td>
<td>4%</td>
<td>64%</td>
<td>23%</td>
<td>12%</td>
<td>Charge measured in 22 systems in 13 homes</td>
</tr>
<tr>
<td>Proctor &amp; Pernick 1992</td>
<td>CA</td>
<td>Existing</td>
<td>175</td>
<td>44%</td>
<td>33%</td>
<td>23%</td>
<td>12%</td>
<td>Results from PG&amp;E Model Energy Communities Program</td>
</tr>
<tr>
<td>Proctor 1991</td>
<td>CA</td>
<td>Existing</td>
<td>15</td>
<td>44%</td>
<td>33%</td>
<td>23%</td>
<td></td>
<td>Fresno homes</td>
</tr>
<tr>
<td>Proctor et al. 1995a</td>
<td>CA</td>
<td>Existing</td>
<td>30</td>
<td>11%</td>
<td>33%</td>
<td>56%</td>
<td>13%</td>
<td>Est @ 67% combined charge/air flow correction benefits</td>
</tr>
<tr>
<td>Proctor et al. 1997a</td>
<td>NJ</td>
<td>New</td>
<td>52</td>
<td>3%</td>
<td>33%</td>
<td>33%</td>
<td>15%</td>
<td>Lab test of Orifice EER; 7% loss @ 20% overch &amp; 22% loss @ 20% underch</td>
</tr>
<tr>
<td>Rodriguez et al. 1995</td>
<td>n.a.</td>
<td>n.a.</td>
<td>n.a.</td>
<td>5%</td>
<td>33%</td>
<td>33%</td>
<td></td>
<td>Lab test of TXV EER; 5% loss at both 20% overch &amp; 20% underch</td>
</tr>
<tr>
<td>Rodriguez et al. 1995</td>
<td>n.a.</td>
<td>n.a.</td>
<td>n.a.</td>
<td>15%</td>
<td>33%</td>
<td>33%</td>
<td></td>
<td>Lab test of Orifice EER; 7% loss @ 20% overch &amp; 22% loss @ 20% underch</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>28%</td>
<td>33%</td>
<td>41%</td>
<td>12%</td>
</tr>
</tbody>
</table>
Overview of Grading Concept
Guiding Principles

• Take a ‘carrot’ rather than a ‘stick’ approach.
• Reward incremental improvement by HVAC professionals and Raters.
• Rely upon procedures that:
  – Can be performed by both HVAC professionals and Raters.
  – Favor consistency over breadth.
  – Provide value in and of themselves.
Grading Concept

• Follow the insulation quality-installation model:

  • **Grade III**: The default. No QI is done. No penalty and no credit.

  • **Grade II**: Rater reviews key design parameters for accuracy and takes accurate measurements of key installation parameters. The resulting values indicate that the system is not great, but not terrible.

  • **Grade I**: Rater duplicates the tasks in Grade II, but the resulting values indicate that the system falls within tolerance of ACCA’s QI Std.
Potential Workflow:
**Step 1: Collection of HVAC Design Documents**

- Rater collects standardized HVAC design documentation.
- While this makes the workflow more complex, it’s absolutely necessary.
- Without knowing the design intent, not enough information is available to properly assess the installation.
**Potential Workflow:**
**Step 2: Review of HVAC Design Documents**

- Rater reviews HVAC design documentation to ensure that:
  - It reflects the rated home.
  - Meets minimum requirements.
Potential Workflow:
**Step 3: Completion of Diagnostic Tests in the Field**

- Rater completes diagnostic tests on the installed equipment in the following areas:
  - Total airflow of HVAC system
  - Refrigerant charge of HVAC system
  - Wattage of HVAC fan
Potential Workflow:

Step 4: Rater Enters Field Results in HERS Software

- Rater enters field data into HERS software, which:
  - Uses the field data to apply an installation adjustment factor to the HVAC equipment.
  - Generates the HERS index with this factor applied.
  - Assigns an installation grade to the system.
Diagnostic Tests Under Consideration
Total HVAC Airflow

- Five test procedures under consideration.
- All but #5 have been incorporated into CA code:
  1. Fan flowmeter / Pressure Matching
  2. Flow grid
  3 & 4. Powered or Passive Flow Capture Hood
  5. Static pressure + fan-speed setting
Refrigerant Charge

• Working on one test procedure that uses refrigerant line temperatures as a proxy for refrigerant charge.
• Raters would not need to connect gauges directly to the refrigerant system.
• Would avoid needing EPA training for refrigerant handling.
Fan Wattage

• Three procedures are under consideration:
  1. Watt meter for direct measurement
  2 & 3. Reading digital whole-house utility meter or clocking analog whole-house utility meter
Diagnostic Tests Converted to Credit
Potential HERS Impact

• Potential for HERS points will depend on efficiency of house as well as climate.

• Current analysis suggests, for an ENERGY STAR Home:
  • CZ 2: ~ 3 points
  • CZ 4: ~ 2 points
  • CZ 6: ~ 1 point
Alternative Compliance Paths
Possible Alternative Compliance Paths

- On-board diagnostics
- Third-party oversight organization
Summary & Next Steps
Summary

• A major step towards unifying ENERGY STAR and HERS ratings.

• For Raters - provide additional value during site visits.

• For ENERGY STAR builders - earn HERS points for things they’re basically already already investing in.

• For utilities – quantify savings from proper HVAC design and installation.

• Overall, will help slowly transform HVAC design and installation.
Next Steps

• Q1 18: Finish drafting standard.
• Q2 18 – Q1 19: Public comment process. Develop training and certification. HERS software modifications.
• Q2/Q3 19: Begin using standard?
ENERGY STAR Certified Homes
RaterPRO App
Goal of RaterPRO

- Provide a tool that facilitates the collection of high-quality field data during the pre-drywall and final inspections.
- This helps increase the value, and reduce the cost, of a high-quality third-party rating.
- Promote increased adoption of high-quality ratings across the industry.
What key features will be included in the app?

- Ability to verify both ENERGY STAR and HERS homes.
- Cloud-based, but with the ability to work offline.
- Able to import proposed ratings from HERS software.
- Able to export confirmed ratings back to HERS software.
- Capable of capturing robust data.
- Voluntary and freely available.
When will you get your hands on RaterPRO?

- Core functionality is almost complete.
- Additional features being added every two weeks.
- Aiming to release a public beta the first half of 2018.
- We’ll drop the ‘beta’ label after gaining experience and completing jobs.
Status of Automated HVAC Design Report

- Wrightsoft – 03 / 2016
- Energy Gauge USA – In progress
- Elite RHVAC – In progress
Overhaul of ENERGY STAR Technical Website

Version 2.5 and 3 Training Resources

Training Presentations
- **Webinars** — ENERGY STAR offers free webinars to help you get the most out of your partnership and prepare for Version 3.
- **How to Measure Whole-House Ventilation Airflow** — Watch these four short videos to see how to measure whole-house ventilation airflow — one critical commissioning task for ENERGY STAR certified homes.

Technical Guidance Documents
- **Slab Edge Insulation Exemption Details** — This document provides explanations and illustrations of slab edge insulation exemptions.
- **Kitchen Exhaust Guidance** — This document provides guidance on alternative compliance options for meeting the kitchen mechanical exhaust requirements.
- **Attic Hatch Details** — This document provides explanations and illustrations of insulation details for attic entrances.
- **HVAC Design Temperatures** — This document lists the 1% and 99% ACCA Manual J outdoor design conditions that HVAC designers are required to use and lists are required to verify per the Version 3 guidelines.
- **ENERGY STAR Version 3 HERS Index Target Procedures** — This document provides detailed instructions for manually determining the ENERGY STAR HERS Index Target.

Inspection Checklist Technical Guides
Technical guides for the ENERGY STAR Inspection Checklists are available at the [Building America Solutions Center](https://www.energy.gov/building/buildingamericasolutionscenter), created by the U.S. Department of Energy. These free guides replace EPA’s Inspection Checklist Field Guidebooks and provide a wealth of building science and energy-efficiency information. They are intended to be aligned with, and used as a supplemental resource to, the [Version 3 guidelines](https://www.energy.gov/building/buildingamericasolutionscenter) and do not represent the official policy of the ENERGY STAR Certified Homes Program. Where questions arise, please contact energystarhomes@energy.gov.
Overhaul of ENERGY STAR Technical Website

ENERGY STAR CERTIFIED HOMES PROGRAM REQUIREMENTS

PROGRAM VERSIONS AT A GLANCE

PROGRAM REQUIREMENTS

- Version 3 (PDF, 182 KB)
- Version 3.1 (PDF, 195 KB)
- Tropics Version 3 (PDF, 151 KB)
- California Version 3.1 (PDF, 129 KB)
- Florida Version 3.1 (PDF, 144 KB)
- Rater Design Review & Rater Field Checklist (PDF, 634 KB)
- Rater Design Review & Rater Field Checklist (Tropics) (PDF, 474 KB)
- HVAC Design Report (PDF, 339 KB)
- HVAC Commissioning Checklist (PDF, 184 KB)
- Water Management System Builder Requirements (PDF, 121 KB)

ADDITIONAL RESOURCES

- ENERGY STAR Policy Record
- ENERGY STAR Training & Education
- Building America Solutions Center
- Version 3 Cost & Savings Document (PDF, 2.2 MB)
- Version 3 ENERGY STAR Reference Design (PDF, 221 KB)
Overhaul of ENERGY STAR Technical Website

ENERGY STAR CERTIFIED HOMES PROGRAM REQUIREMENTS

TEXAS AT A GLANCE

Select a County

PROGRAM REQUIREMENTS

- National Program Requirements Version 3.1 (PDF, 195 KB)
- Rater Design Review & Rater Field Checklist (PDF, 634 KB)
- HVAC Design Report (PDF, 339 KB)
- HVAC Commissioning Checklist (PDF, 184 KB)
- Water Management System Builder Requirements (PDF, 121 KB)

ADDITIONAL RESOURCES

- ENERGY STAR Policy Record
- ENERGY STAR Training & Education
- Building America Solutions Center
- Version 3.1 Cost & Savings Document (PDF, 2.0 MB)
- Version 3.1 ENERGY STAR Reference Design (PDF, 166 KB)

IMPLEMENTATION TIMELINE

Homes in Texas must be certified using the National Program Requirements Version 3 (PDF, 182 KB) if permitted on or after 01/01/2012 but before 07/01/2018. Homes in TX must be certified using the National...
Overhaul of ENERGY STAR Technical Website

COUNTY-LEVEL DESIGN TEMPERATURE LIMITS

Below are the heating and cooling design temperature limits for the selected state and country. These limits generally must not be exceeded in the HVAC design for a home that will be certified in this location. See the Design Temperature Limit Reference Guide for exceptions and details.

1% Cooling Limit: 99°F
99% Heating Limit: 26°F

EFFICIENCY FEATURES AT A GLANCE

2009 IECC Climate Zone 3

Below is the set of efficiency features modeled to determine the ENERGY STAR HERS Index Target for homes in Climate Zone 3. While the features are not mandatory, if they are not used then other measures will be needed to achieve the target. See National Program Requirements v3.1 (PDF, 195 KB) for complete details.

<table>
<thead>
<tr>
<th>Envelope, Windows, &amp; Doors</th>
<th>Water Heating Equipment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radiant Barrier?</td>
<td>n/a</td>
</tr>
<tr>
<td>Insulation Install. Quality</td>
<td>Grade 1</td>
</tr>
<tr>
<td>Ceiling Insulation</td>
<td>R-30</td>
</tr>
<tr>
<td>Wall Insulation</td>
<td>R-20 cavity or R-13 cavity + 5 cont.</td>
</tr>
<tr>
<td>Masonry Wall Insulation</td>
<td>R-9 ext. or R-12 int</td>
</tr>
<tr>
<td>Floor Insulation</td>
<td>R-19</td>
</tr>
<tr>
<td>Basement Wall Insulation</td>
<td>R-5 cont. or R-13 cavity</td>
</tr>
<tr>
<td>Crawlspace Wall Insulation</td>
<td>R-5 cont. or R-13 cavity</td>
</tr>
<tr>
<td>Slab Insulation</td>
<td>0</td>
</tr>
<tr>
<td>Infiltration Rate</td>
<td>3 ACH50</td>
</tr>
<tr>
<td>Windows</td>
<td>U-factor 0.30 / SHGC: 0.25</td>
</tr>
<tr>
<td>Door Opacity</td>
<td>U-factor 0.17 / SHGC: Any</td>
</tr>
<tr>
<td>Efficiency varied by tank size. Common sizes shown below.</td>
<td></td>
</tr>
<tr>
<td>Gas Water Heater</td>
<td>40 gal: 0.01 EF, 60 gal: 0.07 EF</td>
</tr>
<tr>
<td>Electric Water Heater</td>
<td>40 gal: 0.03 EF, 60 gal: 0.01 EF</td>
</tr>
<tr>
<td>Oil Water Heaters</td>
<td>40 gal: 0.53 EF, 60 gal: 0.46 EF</td>
</tr>
<tr>
<td>Solar water heater</td>
<td>n/a</td>
</tr>
</tbody>
</table>

Thermostats & Ductwork

<table>
<thead>
<tr>
<th>Thermostat Type</th>
<th>Duct Insulation for Ducts in Unconditioned Space</th>
</tr>
</thead>
<tbody>
<tr>
<td>Programmable</td>
<td>All within conditioned space</td>
</tr>
<tr>
<td>Location of Ducts and Air Handlers</td>
<td>All within conditioned space</td>
</tr>
<tr>
<td>Duct Insulation for Ducts in Unconditioned Space</td>
<td>n/a</td>
</tr>
</tbody>
</table>
Trends
Trends

• Better whole-house ventilation, particularly in CZ 1-3.
  – In-line fans.
  – In-line fans with built-in dehumidification.
  – Builder-grade ERV’s
• Centralized HVAC Designs
  – More consistent results
  – Allows for strategic improvements
• Instant gas water heaters
• LED lighting
• Smart thermostats
ENERGY STAR Certified Homes

Web & Email:
Main: www.energystar.gov/newhomespartners
Technical: www.energystar.gov/newhomesguidelines
Training: www.energystar.gov/newhomestraining
HVAC: www.energystar.gov/newhomesHVAC
Email: energystarhomes@energystar.gov

Social Media:
@energystarhomes
facebook.com/energystar

Contacts:
Dean Gamble
EPA
Technical Manager
ENERGY STAR Certified Homes
gamble.dean@epa.gov