Marshall Fire Incentives

Department of Energy:
Zero Energy Ready Homes v2
Agenda

• Introductions
• Program Participation Process
• DOE Zero Energy Ready Homes v2
• Q&A
• Survey
Introductions

• Rob Buchanan
• Michael Resech
• Erik Straite
• Robby Schwarz
Builder Incentives

- Baselined to 2018 IECC

### COMBO HOMES – 2012 IECC OR HIGHER AND PERCENT BTC

<table>
<thead>
<tr>
<th>Percent BTC</th>
<th>Rebate</th>
</tr>
</thead>
<tbody>
<tr>
<td>10% – 14.999%</td>
<td>$250</td>
</tr>
<tr>
<td>15% – 19.999%</td>
<td>$400</td>
</tr>
<tr>
<td>20% – 24.999%</td>
<td>$600</td>
</tr>
<tr>
<td>25% – 29.999%</td>
<td>$900</td>
</tr>
<tr>
<td>30% – 34.999%</td>
<td>$1,300</td>
</tr>
<tr>
<td>35% – 39.999%</td>
<td>$2,000</td>
</tr>
<tr>
<td>40% and higher</td>
<td>$2,550</td>
</tr>
</tbody>
</table>

### ELECTRIC ONLY HOMES – REBATE LEVELS – 2012 IECC OR HIGHER AND PERCENT BTC

<table>
<thead>
<tr>
<th>Percent BTC</th>
<th>Rebate</th>
</tr>
</thead>
<tbody>
<tr>
<td>10% – 14.999%</td>
<td>$500</td>
</tr>
<tr>
<td>15% – 19.999%</td>
<td>$800</td>
</tr>
<tr>
<td>20% – 24.999%</td>
<td>$1,200</td>
</tr>
<tr>
<td>25% – 29.999%</td>
<td>$2,800</td>
</tr>
<tr>
<td>30% – 34.999%</td>
<td>$3,900</td>
</tr>
<tr>
<td>35% – 39.999%</td>
<td>$5,200</td>
</tr>
<tr>
<td>40% and higher</td>
<td>$6,700</td>
</tr>
</tbody>
</table>
## MARSHALL FIRE REBUILDING REBATES

Xcel Energy is offering one-time incentives for homes impacted by the Marshall Fires. Consider one of the 5 tiers below:

- Energy savings are based on saving estimate over 2018 IECC
- Cost savings are based on comparison existing homes (1980 and newer)
- Homes that meet multiple performance tiers are only eligible for the highest incentivized tier achieved.

### Xcel Energy Incentives

<table>
<thead>
<tr>
<th>Tier</th>
<th>Rebuilds: $7500</th>
<th>New Residents: $0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Savings</td>
<td>8.5% energy savings</td>
<td>28% utility bill cost savings</td>
</tr>
<tr>
<td>Key Elements</td>
<td>High efficiency heating and cooling</td>
<td>Advanced air sealing, insulation, windows improve indoor air quality</td>
</tr>
</tbody>
</table>

### 2021 IECC

<table>
<thead>
<tr>
<th>Tier</th>
<th>Rebuilds: $10,000</th>
<th>New Residents: $1,250</th>
</tr>
</thead>
<tbody>
<tr>
<td>Savings</td>
<td>18% energy savings</td>
<td>32% utility bill cost savings</td>
</tr>
<tr>
<td>Key Elements</td>
<td>ENERGY STAR requirements plus advanced technologies</td>
<td></td>
</tr>
</tbody>
</table>

### ENERGY STAR® v3.2

<table>
<thead>
<tr>
<th>Tier</th>
<th>Rebuilds: $12,500</th>
<th>New Residents: $2,500</th>
</tr>
</thead>
<tbody>
<tr>
<td>Savings</td>
<td>27% energy savings</td>
<td>33% utility bill cost savings</td>
</tr>
<tr>
<td>Key Elements</td>
<td>All electric heating &amp; cooking</td>
<td>EV charging</td>
</tr>
</tbody>
</table>

### 2018 IECC

<table>
<thead>
<tr>
<th>Tier</th>
<th>Rebuilds: $37,500</th>
<th>New Residents: $15,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Savings</td>
<td>50% energy savings</td>
<td>60-80% utility bill cost savings</td>
</tr>
<tr>
<td>Key Elements</td>
<td>LOWEST energy consumption</td>
<td>Ultra efficient insulation, air sealing &amp; windows</td>
</tr>
</tbody>
</table>

### Passive House

- DOE Zero Energy Ready
  - Xcel Energy Incentives
    - Rebuilds: $17,500
    - New Residents: $5,000
  - Savings
    - 18% energy savings
    - 9% utility bill cost savings
  - Key Elements
    - All electric heating & cooking
    - EV charging

### MARSHALL FIRE REBUILDING REBATES

- **Xcel Energy Incentives**
  - **Rebuilds**: $7,500
  - **New Residents**: $0
  - **Savings**
    - 8.5% energy savings
    - 28% utility bill cost savings
  - **Key Elements**
    - High efficiency heating and cooling
    - Advanced air sealing, insulation, windows improve indoor air quality
    - Protection against moisture damage

### ENERGY STAR® v3.2

- **Xcel Energy Incentives**
  - **Rebuilds**: $12,500
  - **New Residents**: $2,500
  - **Savings**
    - 27% energy savings
    - 33% utility bill cost savings
  - **Key Elements**
    - ENERGY STAR requirements plus advanced technologies
    - Improved indoor air quality and ventilation
    - Small rooftop solar system can offset electric use

### DOE Zero Energy Ready

- **Xcel Energy Incentives**
  - **Rebuilds**: $17,500
  - **New Residents**: $5,000
  - **Savings**
    - 18% energy savings
    - 9% utility bill cost savings
  - **Key Elements**
    - All electric heating & cooking
    - EV charging

### Passive House

- **Xcel Energy Incentives**
  - **Rebuilds**: $37,500
  - **New Residents**: $15,000
  - **Savings**
    - 50% energy savings
    - 60-80% utility bill cost savings
  - **Key Elements**
    - Lowest energy consumption
    - Ultra efficient insulation, air sealing & windows
    - Solar ready

---

**Notes**:
- Marsh energy incentives are based on saving estimate over 2018 IECC.
- Cost savings are based on comparison existing homes (1980 and newer).
- Homes that meet multiple performance tiers are only eligible for the highest incentivized tier achieved.

**References**:
- DOE Zero Energy Ready
- ENERGY STAR® v3.2
- 2018 IECC
- 2021 IECC
Prequalification*

ENERGY STAR v3.2, New Certification Program, DOE ZER v2, Passive House

• Prequalification form

• ENERGY STAR v3.2 National Rater Design Review Checklist** (draft version prior finalization)

*Optional, but strongly encouraged, Requirements subject to change

**Most recent draft version if prior to program finalization
Submission

Department of Energy Zero Energy Ready Homes v2:

• Homeowner claim form
• ENERGY STAR v3.2 National Rater Field Checklist*
• Zero Energy Ready Homes v2 National Program Requirements Checklist*
• Zero Energy Ready Homes v2 PV-Ready Checklist*
• Blower door test file**
• Energy modeling file**

* Most recent draft version if prior to program finalization
**Also part of builder rebate submission requirements
Requirements – Zero Energy Ready v2

• ERI w/o PV <= 50 (for homes permitted prior to rating software support for ENERGY STAR v3.2 or Zero Energy Ready v2)

• Meet the requirements of the draft or finalized version at the time home was permitted
DOE Zero Energy Ready Homes Version 2 Overview

Presented By Robby Schwarz

Thinking ZERO to 360°
Question

Who’s in the audience today?

a. Builder
b. Designer
c. Energy Rater / Consultant
d. Utility or EE Program
e. Other
Question

To what extent have you been involved with DOE Zero Energy Ready Home projects?

a. No experience
b. No experience, but considering ZERH for an upcoming project
c. Involved with ZERH on a few projects
d. Involved with ZERH on many projects
U.S. DOE Zero Energy Ready Home

Why Version 2?
Ten people building a balloon frame house in 1877 Nebraska

300 people building a modern-day house in 2020 (NAHBResearch)
5 strategies to retain construction workers in a competitive labor market
Times and Expectations Have Changed

1900’s housing vs. 2019 housing
Why Version 2? Why Now?

- New residential construction matters
- 2021 IECC & ENERGY STAR Homes
- HERS score trend towards greater efficiency
- Technology innovations and ZERH Cost Effectiveness
- ZERHs pave the way to the clean energy economy
- Increasing demand for ZERH in programs, policies, and incentives
HERS Trends - Lower Scores & More Ratings

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U.S. Residential Buildings

- 95% of U.S. buildings
- 50% of peak demand on electricity grids
- 20% of greenhouse gas emissions in the U.S.

- 70% of U.S. building stock square footage
- 21% of U.S. energy use
- 6% Increase in electricity use associated with COVID pandemic

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BUILD Tank, Inc.
The Apocalypse is Coming!

ZERH Base Building Envelope Insulation Levels

The Apocalypse is Coming - Again
Risk #1: Moisture Damage

- Colder Surface
  - More Efficient Enclosure
  - Cold Side
  - Thermal/Air Flow

- Warm Side
  - Less Efficient Enclosure
  - Thermal/Air Flow

More Wetting, Less Drying

Less Wetting, More Drying
What does ZERH Mean?

Technical Strategy

**Step One:**
- Optimize Efficiency
  - Energy Efficient Enclosure
  - Energy Efficient Components
  - Systems Thinking: Applied Building Science

**Step Two:**
- Do No Harm
  - Comprehensive Water Protection
  - Ensured Comfort System
  - Comprehensive Indoor Air Quality

**Step Three:**
- Ensure Future Ready
  - Solar Ready Construction

What does ZERH Mean? Technical Strategy

©2022 BUILDtank, Inc.
“A high-performance home which is so energy efficient, that a renewable energy system can offset all or most of its annual energy consumption.”
What does the ZERH Definition Mean?

- A pathway to achieve Zero Energy

- At a minimum every home is "future proofed" to be able to achieve zero net energy as technology advances

- For example, we see PV panel generation and efficiency improve
  - Therefore, we know that in the future, small roof areas will be able to generate more power to achieve this goal
Zero Energy Ready Home Spec

- Optimized Enclosure System
- Optimized Comfort System
- Water Protection System
- Complete IAQ System
- Efficient Comps System
- Solar Ready System
ZERH is the Home of the Future Available Now

- Future Ready - Optimized Thermal Protection that meets and exceeds code
- Moisture Ready - Whole-House Water Protection
- Comfort Ready - High-Performance Heating and Cooling Systems
- Tech Ready - High-Efficiency Components
- Health Ready - Comprehensive Indoor Air using EPA Indoor airPLUS
- Zero Ready - Solar Ready Construction minimizes the cost of adding it in the future
Zero Ready vs. Zero

A Symbol of Excellence

<table>
<thead>
<tr>
<th>HEALTHFUL ENVIRONMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>COMFORT PLUS</td>
</tr>
<tr>
<td>ADVANCED TECHNOLOGY</td>
</tr>
<tr>
<td>ULTRA EFFICIENT</td>
</tr>
<tr>
<td>QUALITY BUILT</td>
</tr>
<tr>
<td>DURABILITY</td>
</tr>
</tbody>
</table>

KEY
- DOE Zero Energy Ready Home
- ENERGY STAR Certified Home
- Existing Home

Features of a net-zero home

https://www.24hplans.com/cost-to-build-a-net-zero-energy-home/
## ZERH Cost Effectiveness

### ZER Incremental Cost

<table>
<thead>
<tr>
<th>Source: ‘The Economics of Zero Energy Homes: Single Family Insights,’ Rocky Mountain Institute, 10/18</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>ZER Incremental Cost</th>
<th>Houston (C22)</th>
<th>Atlanta (C23)</th>
<th>Baltimore (C24)</th>
<th>Chicago (C25)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mortgage Threshold (30 Years)</td>
<td>$2,083</td>
<td>$6,094</td>
<td>$5,998</td>
<td>$3,568</td>
</tr>
<tr>
<td>Resale Threshold (12 Years)</td>
<td>$10,980</td>
<td>$13,563</td>
<td>$23,503</td>
<td>$20,619</td>
</tr>
<tr>
<td>Consumer WTP (4%)</td>
<td>$5,576</td>
<td>$7,903</td>
<td>$11,835</td>
<td>$10,472</td>
</tr>
<tr>
<td>First Cost Threshold (0%)</td>
<td>$9,139</td>
<td>$8,690</td>
<td>$10,130</td>
<td>$15,874</td>
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</tbody>
</table>

### ZE Incremental Cost

<table>
<thead>
<tr>
<th>ZE Incremental Cost</th>
<th>Houston (C22)</th>
<th>Atlanta (C23)</th>
<th>Baltimore (C24)</th>
<th>Chicago (C25)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mortgage Threshold (30 Years)</td>
<td>$15,488</td>
<td>$20,089</td>
<td>$18,674</td>
<td>$23,125</td>
</tr>
<tr>
<td>Resale Threshold (12 Years)</td>
<td>$26,715</td>
<td>$35,927</td>
<td>$49,118</td>
<td>$54,414</td>
</tr>
<tr>
<td>Consumer WTP (4%)</td>
<td>$13,567</td>
<td>$18,245</td>
<td>$24,945</td>
<td>$23,065</td>
</tr>
<tr>
<td>First Cost Threshold (0%)</td>
<td>$9,139</td>
<td>$9,890</td>
<td>$10,130</td>
<td>$13,874</td>
</tr>
</tbody>
</table>

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Market-Ready Innovations

- Aerosol envelope sealing for new construction
- "Plug-n-Play" Air Delivery Systems
- Testing and validation of smart ventilation controls
- Validation and application guidance for High-R wall systems
- Heat Pump Water Heater field testing and application guidance
## Increasing Demand for ZERHs in Programs, Policies, and Incentive Programs

<table>
<thead>
<tr>
<th>Affordable Housing</th>
<th>State &amp; Utility Rebates</th>
<th>Codes</th>
<th>Green Financing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colorado</td>
<td>CenterPoint (TX)</td>
<td>Many CO jurisdictions going to the 2021</td>
<td>Fannie Mae</td>
</tr>
<tr>
<td>Connecticut</td>
<td>Dominion Energy (UT)</td>
<td>Oregon 2023</td>
<td>Federal Home Loan Bank of NY</td>
</tr>
<tr>
<td>Delaware</td>
<td>Eversource (CT)</td>
<td>RI Stretch Code</td>
<td></td>
</tr>
<tr>
<td>Maryland</td>
<td>NJ (statewide)</td>
<td>Summit County, CO</td>
<td></td>
</tr>
<tr>
<td>Minnesota</td>
<td>Oncor (TX)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>New Jersey</td>
<td>Rhode Island (statewide)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pennsylvania</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Virginia</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Washington D.C.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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Integrated Design Process

https://www.youtube.com/watch?v=5eYVNK37k
Integrated Design Process

- Change is hard / Change is good
- Start Early
- Opportunity Costs
- What does integration mean?
  - Applied Building Science
  - Systems Thinking
    - Air control
    - Thermal Control
    - Moisture Control
  - Program Requirements

https://caddispc.com/our-integrated-design-process/

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Integrated Design Process

Define the project

- Zero Energy Ready Home
  - Integration of four programs
- Share responsibility
  - Bring the right team together
  - Architect, Builder, Trade Partners, Energy Rater
- Viewing things Holistically at one time
- Information sharing
  - Research materials, building practices
- Integration
  - Structure, Systems, Enclosure, Climate, Occupant
ZEROH Program resources

https://www.energy.gov/eere/buildings/doe-zero-energy-ready-home-resources

Getting Enclosures Right,
Joe Lstiburek, Building Science Corp.

Low Load HVAC,
Greg Cobb, Energy Inspectors

Lazy Air Conditioning: HVAC & Humidity Control,
Ken Gehring, Therma-Stor

Best Practices for Ventilation,
Paul Raymer, ICF

Indoor airPLUS Revision 4 Updates,
Nick Hurst, EPA
3rd Party Verification

- Provide third-party verification that homes meet DOE Zero Energy Ready Home National Program Requirements

- Program requirement

- Adds value to the process and legitimacy to the label
  - Independence
  - Government back label / Proof of compliance
Verification by approved agency

- Verification of compliance with Energy Code may be completed by an approved third party
- Often this party is also a RESNET Energy Rater
- Partnered with the DOE Zero Energy Ready Home Program
3rd Party Services

- Consulting and participation in Intergrade Design Process
  - Knowledgeable about:
    - Program requirements
    - Applied building science
    - Assemblies and materials
    - Construction Schedule impacts
- Proposed and Confirmed Energy Modeling
- Field Inspection
  - Verification
  - Quality Assurance
- Trade Partner recommendation
- Possible other services
  - HVAC Design or consulting
  - Control layer management
  - Material specification recommendations

https://homesmsp.com/2019/01/should-home-inspectors-trample-insulation-no.html
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RESNET Quality Assurance

- Quality of standard creation and maintenance
- Rating Providers employ Q.A.D.’s to perform QA on their certified raters
  - 10% of all building software file inputs review
  - 1% of each certified Raters’ homes are recreated and reviewed for accuracy
- RESNET performs QA on Rating Providers
  - Annual quality assurance report and review
  - RESNET enhanced quality assurance
    - 50% of all rating providers each year receive either online reviews and/or in-field site visits
- Tracking QA reviews in real time in the RESNET Registry

https://www.resnet.us
DOE Zero Energy Ready Home Partner Locator

 Builders across the United States are building DOE Zero Energy Ready Homes. The interactive map below highlights the number of partners in each state. You can search for partners using the text box or find partners by state and type using the drop down menus below.

Ready to Take the Zero Energy Ready Challenge?

Builders interested in learning more about DOE Zero Energy Ready Home can view the requirements or start the sign up process.

Search Partners:

Search

Or Filter By:

State:

Partner Type:

See Results
Certified RESNET HERS Raters

Enter a rater's first and/or last name to look up his/her certification information:

Rater Name *

Certified RESNET HERS RFIs

Rating Field Inspector (RFI)
A Field Inspector is the entry level of Rater certification. A Field Inspector under the direct supervision of a certified home energy Rater may conduct the inspections and necessary basic performance tests (blower door & duct blaster) to produce a home energy rating. This category requires the ability to identify and quantify building components and systems.

Enter an RFI's first and/or last name to look up his/her certification information:

RFI Name *

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The public can now access the following information on rated homes:
- Address of Home Rated
- Rating Company Name That Rated the Homes
- Date That Rating was Completed
- HERS Index Score of Home
Looking for a HERS Rated Home?

Homes with HERS Index scores are more energy efficient, resulting in lower energy bills and higher home comfort.

To find out if a home has been HERS-rated, enter its full address in fields below.

Enter an Address

Find a HERS Rated Home

https://www.resnet.us
Moving to Sunset the Prescriptive Compliance Option

- Least use and least flexible compliance option
Eligible Building Types – Looking Ahead

Single-Family
Detached

Single-Family Attached

Multifamily
(Any Height)

- Performance Compliance
- ESSFNH Version 3.2 & IAP as prerequisites

- ERI or Prescriptive Compliance
- ESMFNC & IAP as prerequisites

DOE ZERH – Version 2

DOE ZERH – Multifamily V1
Step 1 demonstrate projected compliance

WHAT is HERS?
HERS = Home energy rating system

HERS is the most well known and nationally recognized energy rating system for residential construction builders. It was established in 2006 by Residential Energy Services Network (RESNET).

How it works

- A rating of 100 is referred to as the HERS Reference Home baseline and is based on the 2006 International Energy Conservation Code (IECC).
- The lower the score the more efficient the home.
- A home with a HERS Index of 70 uses 30% less energy than a code-minimum home of the same size and shape.
- A certified RESNET Home Energy Rater determines a home energy rating.

http://www.resnet.us
http://www.volunteerweekly.org/the-first-step/
ENERGY STAR & DOE ZERH

- Same rater network
- Same modeling software (at least 3 different options)
- Same plan review & site inspection protocol
**IECC & Energy Star used as foundation**

<table>
<thead>
<tr>
<th>IECC 2015 Enclosure</th>
<th>IECC 2009 Enclosure</th>
<th>IECC 2021 Enclosure</th>
<th>IECC 2021 Enclosure +</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>HERS</strong> 70-80</td>
<td><strong>HERS</strong> 65-75</td>
<td><strong>HERS</strong> 55-65</td>
<td><strong>HERS</strong> 40-55</td>
</tr>
<tr>
<td><strong>IECC 2015</strong></td>
<td><strong>ENERGY STAR v3</strong></td>
<td><strong>ENERGY STAR v3.2</strong></td>
<td><strong>ZERH</strong></td>
</tr>
</tbody>
</table>

**Features:**
- **Solar Ready**
- **Eff. Comps. & H₂O Distrib.**
- **EPA Indoor Air Package**
- **Optimized Duct Location**
- Water Management
- HVAC QI with WHV
- Independent Verification
- **EPA Indoor Air Package**
- **Optimized Duct Location**
- **EPA Indoor Air Package**
- **Optimized Duct Location**
- Water Management
- HVAC QI with WHV
- Independent Verification
Version 1 ZERH ERI Target Home specifications

- Energy Rating Index (ERI) scores to qualify for ZERH in the 50s

- V2 ZERH Target Home achieves increased energy savings

- Resulting ERI Targets to qualify for ZERH in the 40s
1. Colorado will transition to version 3.2

2. Same program structure designed to achieve 10% savings over 2021 IECC

3. EnergyStar companion labels
   - Electrification Technologies
   - Technologies that are impactful today and tomorrow
## Efficiency Target Updates

<table>
<thead>
<tr>
<th>Program Component</th>
<th>ZERH Version 1</th>
<th>ZERH Version 2.0 Proposed</th>
<th>Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum Required Energy Efficiency Threshold</td>
<td>Based on the Version 1 ZERH ERI Target Home specifications - circa 2013. <strong>ERI scores in the 50s.</strong></td>
<td>Updated ZERH Target Home achieves increased energy savings of 20% beyond 2021 IECC. <strong>Resulting ERI Targets in the 40s.</strong></td>
<td>Reflect recent innovations in the ZERH efficiency threshold.</td>
</tr>
</tbody>
</table>
Size Adjustment Factor (SAF) / Removed

- SAF will sunset
- EnergyStar v3.1 has eliminated SAF
- EnergyStar v3.2 will not include SAF
- Homes built under ZERH v2 will be efficient regardless of SAF
- Removing SAF simplifies program requirements
- Homes under ZERH V2 will be very efficient regardless of SAF.

Exhibit 3: Benchmark Home Size

<table>
<thead>
<tr>
<th>Bedrooms in Home to be Built</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conditioned Floor Area</td>
<td>1,000</td>
<td>1,000</td>
<td>1,600</td>
<td>2,200</td>
<td>2,800</td>
<td>3,400</td>
<td>4,000</td>
<td>4,600</td>
</tr>
</tbody>
</table>
Doe ZERH V2

Energy Star v3.2 Revision
- ANSI 310

Indoor airPLUS v1 revision 4
- Moving to v2 maybe in 2022
- ZERH will phase it
  - Balanced ventilation in cold climates (6-8)
  - MERV 13 filtration

1. It clarifies
2. It simplifies
3. It improves
Mandatory Requirements

ZERH v1 rev7

<table>
<thead>
<tr>
<th>Area of Improvement</th>
<th>Mandatory Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. ENERGY STAR for Homes Baseline</td>
<td>□ Certified under ENERGY STAR Qualified Homes Program Version 3, 3.1, or 3.2 (depending on state), or under ENERGY STAR Multifamily New Construction program Version 1.0 or 1.1 (depending on state) 1, 2, 8, 10</td>
</tr>
<tr>
<td>2. Envelope</td>
<td>□ Fenestration shall meet or exceed ENERGY STAR requirements. See End Note for specific U, SHGC values, and exceptions. 11</td>
</tr>
<tr>
<td>3. Duct System</td>
<td>□ Duct distribution systems located within the home’s thermal and air barrier boundary or an optimized location to achieve comparable performance. 14</td>
</tr>
<tr>
<td>4. Water Efficiency</td>
<td>□ HVAC air handler is located within the home’s thermal and air barrier boundary.</td>
</tr>
<tr>
<td>5. Lighting &amp; Appliances</td>
<td>□ Hot water delivery systems (distributed and central) shall meet efficient design requirements or Water heaters and fixtures shall meet efficiency criteria 16</td>
</tr>
<tr>
<td>6. Indoor Air Quality</td>
<td>□ All installed refrigerators, dishwashers, and clothes washers are ENERGY STAR qualified. 17</td>
</tr>
<tr>
<td>7. Renewable Ready</td>
<td>□ 80% of lighting fixtures are ENERGY STAR qualified or ENERGY STAR lamps (bulbs) in minimum 80% of sockets</td>
</tr>
<tr>
<td>8. Indoor Air Quality</td>
<td>□ All installed bathroom ventilation and ceiling fans are ENERGY STAR qualified</td>
</tr>
<tr>
<td>9. Certified under EPA Indoor airPLUS 16</td>
<td></td>
</tr>
</tbody>
</table>

ZERH v2

<table>
<thead>
<tr>
<th>Area of Improvement</th>
<th>Mandatory Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Envelope</td>
<td>□ Ceiling, wall, floor, &amp; slab insulation meet or exceed 2021 IECC R, U, or Ua levels 12, 13</td>
</tr>
<tr>
<td>3. Duct System</td>
<td>□ Above Grade Walls in Mixed and Cold Climates provide thermal breaks 14</td>
</tr>
<tr>
<td>4. Water Heating Efficiency</td>
<td>□ Windows meet high performance requirements based on climate zone 15</td>
</tr>
<tr>
<td>5. Lighting &amp; Appliances</td>
<td>□ Advisory: DOE is monitoring the development of the planned update to the ENERGY STAR product specifications for residential windows (V7.0), and plans to adopt these in a future program update 16</td>
</tr>
<tr>
<td>6. Indoor Air Quality</td>
<td>□ All ducts and heating and cooling air-handling equipment are located within the thermal and air barrier boundary 17</td>
</tr>
<tr>
<td>7. Water Heating Efficiency</td>
<td>□ Hot water delivery systems meet efficient design requirements or Water heater and fixtures meet efficiency criteria 18</td>
</tr>
<tr>
<td>8. Lighting &amp; Appliances</td>
<td>□ All installed refrigerators, dishwashers, clothes washers, and clothes dryers are ENERGY STAR qualified 19, 20</td>
</tr>
<tr>
<td>9. Indoor Air Quality</td>
<td>□ 65% of builder-installed lighting fixtures are ENERGY STAR qualified or ENERGY STAR lamps (bulbs) in minimum 65% of sockets 21</td>
</tr>
<tr>
<td>10. Certified under EPA Indoor airPLUS 22</td>
<td></td>
</tr>
</tbody>
</table>
1. Building Envelope Updates

<table>
<thead>
<tr>
<th>Program Component</th>
<th>ZERH Version 1</th>
<th>ZERH Version 2.0 Proposed</th>
<th>Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building Envelope Insulation Levels</td>
<td>2015 IECC insulation levels for opaque areas</td>
<td><strong>2021 IECC insulation levels</strong> for opaque areas. Thermal breaks in walls in CZs 4-8.</td>
<td>Deliver most robust code-based building envelope with an additional, targeted provision for Above Grade Walls.</td>
</tr>
</tbody>
</table>
Mandatory - Envelope

Optimized Enclosure System

2021 IECC Envelope Insulation + Tighter Construction = High Performance Windows

https://www.finehomebuilding.com/2012/09/06/two-ways-to-insulate-attic-kneewalls
## 2021 IECC Insulation Values

<table>
<thead>
<tr>
<th>CZ</th>
<th>Ceiling</th>
<th>Wood-framed Wall</th>
<th>Mass Wall</th>
<th>Floor</th>
<th>Basement</th>
<th>Slab</th>
<th>Crawl Space Wall</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>30</td>
<td>13 or 0+10</td>
<td>3/4</td>
<td>13</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>49</td>
<td>13 or 0+10</td>
<td>4/6</td>
<td>13</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>49</td>
<td>20 or 13+5 or 0+15</td>
<td>8/13</td>
<td>19</td>
<td>5/13</td>
<td>10, 2ft</td>
<td>5/13</td>
</tr>
<tr>
<td>4</td>
<td>60</td>
<td>20+5 or 13+10 or 0+15</td>
<td>8/13</td>
<td>19</td>
<td>10/13</td>
<td>10, 4ft</td>
<td>10/13</td>
</tr>
<tr>
<td>5</td>
<td>60</td>
<td>30 or 20+5 or 13+10 or 0+15</td>
<td>13/17</td>
<td>30</td>
<td>15/19 or 13+5</td>
<td>10, 4ft</td>
<td>15/19 or 13+5</td>
</tr>
<tr>
<td>6</td>
<td>60</td>
<td>20+5 or 13+10 or 0+20</td>
<td>15/20</td>
<td>30</td>
<td>15/19 or 13+5</td>
<td>10, 4ft</td>
<td>15/19 or 13+5</td>
</tr>
<tr>
<td>7/8</td>
<td>60</td>
<td>20+5 or 13+10 or 0+20</td>
<td>19/21</td>
<td>38</td>
<td>15/19 or 13+5</td>
<td>10, 4ft</td>
<td>15/19 or 13+5</td>
</tr>
</tbody>
</table>
### Envelope Efficiency Improvements

#### 2021 IECC UA Stringency Compared to DOE ZERH V1 UA Requirements

<table>
<thead>
<tr>
<th>Climate Zone</th>
<th>2021 IECC UA Stringency Compared to DOE ZERH V1 UA Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>+ 0%</td>
</tr>
<tr>
<td>2</td>
<td>+ 5%</td>
</tr>
<tr>
<td>3</td>
<td>+16%</td>
</tr>
<tr>
<td>4</td>
<td>+8%</td>
</tr>
<tr>
<td>5</td>
<td>+8%</td>
</tr>
<tr>
<td>6</td>
<td>+1%</td>
</tr>
<tr>
<td>7</td>
<td>+1%</td>
</tr>
</tbody>
</table>

**A.** Based on 4 prototype models per Climate Zone: 1-story slab (CZ 1-3) or basement (CZ4+) foundation; 1-story crawlspace; 2-story slab or basement foundation (depending on CZ); 2-story interior TH unit on slab or basement foundation (depending on CZ)
Thermal Breaks

Above Grade Walls
Climate Zones 4-8
Must provide thermal breaks
Windows meet high performance requirements based on climate

- Based on ENERGY STAR v6.0 specs
- Advisory: DOE is monitoring the development of the planned update to the ENERGY STAR product specifications for residential windows (v7.0), and plans to adopt these in a future program update

<table>
<thead>
<tr>
<th>Windows</th>
<th>2021 IECC Climate Zones</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 – 2</td>
</tr>
<tr>
<td>U-Value</td>
<td>0.40</td>
</tr>
<tr>
<td>SHGC</td>
<td>0.23</td>
</tr>
</tbody>
</table>
## Window Updates

<table>
<thead>
<tr>
<th>Program Component</th>
<th>ZERH Version 1</th>
<th>ZERH Version 2.0 Proposed</th>
<th>Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Window U/SHGC Values</td>
<td>Based on ENERGY STAR V5.0 or V6.0 specs</td>
<td>Based on ENERGY STAR V6.0 specs; Very Cold Climates (6-8) more rigorous at U 0.25</td>
<td>Updates minimum window requirements. Higher performance windows will likely be used as part of UA tradeoff strategies.</td>
</tr>
</tbody>
</table>
UA Tradeoffs Offer Flexibility

- ZERH allows the use of a UA tradeoff
A trade off refers to putting something **more in one** assembly so you can put something **less in another**

HOWEVER, **in the IECC’s case** the energy performance scale remains balanced.

You can tradeoff R-values, U-values, air tightness, duct leakage, etc. depending on the compliance path you are using.

- The **blue ball** is attic insulation R38
- The prescriptive R-value path says it must be R60 in CZ5
- The **3 silver balls** balanced the energy equation because they represent better windows, air tightness, and reduced duct leakage than is required by the IECC
- Therefore, I traded off less attic R-value for better windows, air tightness and duct leakage
3. HVAC

Optimized Comfort System

- Optimized Duct Location
- RH Control In Hot/Humid Climates

https://www.kriegermechanical.com/residential.php

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Duct Systems – no significant change

All ducts and heating and cooling air-handling equipment are located within the thermal and air barrier boundary

- Some exceptions apply

https://www.greenbuildingadvisor.com/article/how-to-get-your-ducts-inside-the-building-enclosure

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## HVAC Design Updates

<table>
<thead>
<tr>
<th>Program Component</th>
<th>ZERH Version 1</th>
<th>ZERH Version 2.0 Proposed</th>
<th>Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>HVAC and Duct Location</td>
<td>Requires ducts &amp; HVAC equipment to be located in an optimized location</td>
<td>Same as V1.</td>
<td>Improve HVAC efficiency, reduce demand, and improve comfort.</td>
</tr>
<tr>
<td></td>
<td>Clarification: only applies to equipment &amp; ducts serving heating/cooling systems.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
4. Water Efficiency - no significant change

Hot water delivery systems meet efficient design requirements

or

Water heater and fixtures meet efficiency criteria
Water Efficiency Mandatory

Hot water circulation systems requirements

- Based on EPA WaterSense Specifications:
  - ≤ 0.5 gallons of water in any piping/manifold between hot water source and any hot water fixture

- Tested:
  - By the time the flow at the furthest fixture has + 10F temp increase, no more than 0.6 gallons of water has been delivered

OR

- Water heaters and fixtures shall meet efficiency criteria
  - Gas water heaters - Energy Factor ≥ 0.90 or a Uniform Energy Factor ≥ 0.87
  - Electric water heaters - Energy Factor ≥ 2.2 or a Uniform Energy Factor ≥ 2.2
  - All Water fixtures shall be WaterSense labeled
  - The hot water distribution system shall store no more than 1.2 gallons between the hot water source and the furthest fixture
Demand Pumping System

Sensor or Controls

Demand Pump

Dedicated Return
Verifying Efficient Hot Water Distribution

Prime loop (if applicable)
Start flow
Take $T_{\text{init}}$ (of flow)

Stop at 0.6 gallons
Take $T_{\text{fin}}$ (of flow)

$T_{\text{fin}} - T_{\text{init}}$ must be at least 10 F
5. Lights and Appliances

Efficient Comps

ENERGY STAR:
- Appliances
- Exhaust Fans
- Ceiling Fans
- Water Heating*

Efficient:
- Lighting
- Hot Water Distribution
- Equipment*

https://www.retrofoamofmichigan.com/blog/energy-star-appliances
Efficient Components

- Zero Energy Ready Home requires:
  - ENERGY STAR Certified Appliances:*
    refrigerators, dishwashers, clothes washers & Dryers
  - ENERGY STAR Certified Fans*:
    bathroom ventilation, ceiling fans
  - ENERGY STAR Certified Lighting:
    Min. 95% of fixtures or lamps (CFL or LED)
    - 2015 IECC requires 75%
    - 2018 IECC requires 90%
    - 2021 IECC requires 100%

*Only when installed by builder
## Lighting Updates

<table>
<thead>
<tr>
<th>Program Component</th>
<th>ZERH Version 1</th>
<th>ZERH Version 2.0 Proposed</th>
<th>Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Efficiency Lighting</td>
<td>80% requirement</td>
<td>95% requirement</td>
<td>Recognize cost-effectiveness of LEDs and increase ZERH efficiency, while providing a little flexibility. Note that the Target Home assumes 100% high efficiency lighting.</td>
</tr>
</tbody>
</table>
## Appliance Updates

<table>
<thead>
<tr>
<th>Program Component</th>
<th>ZERH Version 1</th>
<th>ZERH Version 2.0 Proposed</th>
<th>Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy Efficient Appliances</td>
<td>All builder-installed refrigerators, dishwashers, and clothes washers are ENERGY STAR qualified</td>
<td>All builder-installed refrigerators, dishwashers, clothes washers, <strong>and clothes dryers</strong> are ENERGY STAR qualified</td>
<td>Recognize ENERGY STAR labeling of clothes dryers and increase ZERH efficiency</td>
</tr>
</tbody>
</table>
6. Indoor Air Plus

Indoor Air Quality

- Radon Resistant
- Low Emission Materials
- Combustion Safe
- High MERV Filter

EPA Indoor airPLUS QUALIFIED HOMES

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## Indoor Air Quality Updates

<table>
<thead>
<tr>
<th>Program Component</th>
<th>ZERH Version 1</th>
<th>ZERH Version 2.0 Proposed</th>
<th>Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indoor Air Quality</td>
<td>Certify under Indoor airPLUS (IAP) V1</td>
<td>Phase in certification under an updated IAP version over time. IAP Version 1 will be allowed through 2022.</td>
<td>Maintain requirement to certify under the federal government’s residential IAQ label for new homes.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>H/ERVs in Very Cold Climates (6-8)</td>
<td>Accelerate the MERV 13 filter requirement (likely to appear in the updated IAP specs)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>MERV 13 (minimum) filter installed on ducted heating and cooling systems</td>
<td></td>
</tr>
</tbody>
</table>
ZERH v2 eliminates the exception for sites with lower annual solar resources

Also updates provisions based on current technologies

- Increases PV Readiness in ZERH homes
- Recognizes the major increases in PV cost effectiveness
<table>
<thead>
<tr>
<th>Program Component</th>
<th>ZERH Version 1</th>
<th>ZERH Version 2.0 Proposed</th>
<th>Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Photovoltaic (PV) Readiness</td>
<td>Implement the ZERH PV-Ready Checklist</td>
<td>Same as V1, but eliminates the exception for sites with lower annual solar resources. Also updates provisions based on current technologies.</td>
<td>Increase PV Readiness in ZERH homes and recognize the steady increases in PV cost effectiveness.</td>
</tr>
</tbody>
</table>
Residential PV System Costs Down 64%
Expand PV-Readiness

Average Daily Solar Radiation Per Month

Solar Ready Encouraged

Solar Ready Required

kWh/m²/day

- 10 to 14
- 8 to 10
- 7 to 8
- 6 to 7
- 5 to 6
- 4 to 5
- 3 to 4
- 2 to 3
- 0 to 2
- none

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**Update PV Ready Requirements**

**Documentation** of the maximum allowable dead load and live load ratings of the existing roof (Rec DL.: +6 lbs./sq. ft.)

**Conduit** to run DC wire from roof to inverter

**Dedicated Area** for installing inverter and balance of system

**Conduit** to run AC wire from inverter location to electric panel

**Circuit Breaker** designated and/or installed for use by the PV system in the electric panel
The ZERH program is committed to working with the EPA to ensure that all home and equipment certification programs continue to evolve towards zero-emission.

They are committed to providing value to both builders and homebuyers in the market.
H/ERVs in Cold Climates

- Required in Very Cold Climates Zones 6 – 8
- Provide whole-house ventilation while reducing impact on heating load
- Numerous technology options available

ERV or HRV
# ZERH Multifamily Certification

## ZERH v1
- Like EnergyStar multifamily 5 stories and less may be certified/labeled

## ZERH v2
- **Multifamily buildings will migrate to a new ZERH Multifamily spec**
  - Currently under development to be more efficient than ESMFNC
  - When released it will be phased in
  - Anticipated to be used for any size multifamily project
  - Anticipated to release same time as single family v2.
WHAT'S YOUR NEXT STEP?
Possible 45L changes

- The current credit expired on December 31, 2020

- The 45L Credit allowed Builders to claim a $2,000 tax credit for each newly constructed residence that was 50% more efficient than the 2006 IECC

- It applies to single family homes, apartments, condominiums, assisted living homes, student housing, and other types of residences
Possible 45L changes

- Extend the credit from December 31, 2020, to December 31, 2025
- Changes the benchmark from 50% more efficient than the 2006 IECC to 15% more efficient than the 2018 IECC
- Increases the credit from $2,000 to $2,500

Single family and manufactured homes.
- Single-family homes could demonstrate that they meet the most recent EnergyStar Single-Family New Homes Program requirements
- Manufactured homes could demonstrate they meet the most recent EnergyStar Manufactured Home National Program requirements
Possible 45L changes (DOE ZERH)

- This provision would provide a higher tier credit of $5,000
- For eligible single-family and manufactured new homes certified as zero-energy ready under the Department of Energy Zero Energy Ready Home Program
Multifamily homes eligible to participate in the ENERGY STAR Multifamily New Construction Program could receive a base credit of $500 and a bonus credit of $2,500 for multifamily units that meet:

- The most recent EnergyStar multifamily New Construction Program

- DOE ZERH higher tier:
  - Base credit of $1,000 or a bonus credit of $5,000 for eligible multifamily units certified as a zero-energy ready under the U.S. Department of Energy Zero Energy Ready Home Program

[Image of a building with Energy Star and DOE ZERH logos]
How to Communicate Zero?

Marketing benefits
Leverage ZERH ‘Brand’

is partnering with the U.S. Department of Energy to bring homes of the future to families today.

Take the zero energy ready home tour.

energy.gov/zero-energy-home-tour
Customize Marketing Resources

Homes to the Power of ZERO

A Symbol of Excellence

HEALTHFUL ENVIRONMENT
COMFORT PLUS
ADVANCED TECHNOLOGY
ULTRA EFFICIENT
QUALITY BUILT
DURABILITY

What is the DOE Zero Energy Ready Home™ Label?
It is a Symbol of Excellence for energy savings, comfort, health, quality, and durability met by a select group of leading builders meeting U.S. Department of Energy Guidelines.

What is a Zero Energy Ready Home?
It is a high-performance home as energy efficient as, or in most annual energy consumption can be offset with renewable energy. In other words, it is the Home of the Future.

Learn more at: buildings.energy.gov/zero

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DOE Zero Energy Ready Home Partner
(262) 926-3432
http://www.timobrienhomes.com

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Only a select group of the top builders in the country meet the extraordinary levels of excellence and quality specified by the U.S. Department of Energy guidelines.

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BuildTank Inc.
ZERH Partner Process

- Become a partner online (builder/developer or rater)
- Identify potential verifier partners at ZERH website
- No pre-registration of projects
- No program certification fees
- Recommend integrated design process (MEPs)
- Rater: plan review & site inspections
- Project Certification – generated by the Rater’s modeling report, once it is uploaded to the RESNET Registry
- Builder credited with certified home on DOE website
Thank You

For further information visit: www.buildings.energy.gov/zero

- Draft Version 2 Program Requirements
- “Tour of Zero” – 100s of award-winning ZERH profiles
- Become a partner
- Find builders, verifiers

Email: zero@newportpartnersllc.com