U.S. DOE Zero Energy Ready Home Program

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

Review of Draft Version 2 National Program Requirements for Single Family Homes

November 16, 2021

Today's Presenters

Eric Werling
Building America and DOE Zero Energy Ready Home
Program Director

Jaime Van Mourik
ORISE Science, Technology, and
Policy Fellow

Jamie Lyons
Newport Partners
Technical Director

Connor Statham
Newport Partners
Account Manager

Today's Topics

1. Why Version 2?
2. DOE & EPA Coordination
3. Review of DOE ZERH Version 2 Draft Updates
4. How to Submit Feedback

Poll #1

Who's in the audience today?

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

slido

Who's in the audience today?

ⓘ Start presenting to display the poll results on this slide.

Poll #2

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

slido

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

ⓘ Start presenting to display the poll results on this slide.

U.S. DOE Zero Energy Ready Home

Why Version 2?

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

U.S. DOE Zero Energy Ready Home

DOE & EPA Coordination

DOE & EPA Coordination

ENERGY STAR

EPA Indoor airPLUS
QUALIFIED HOMES

ZERO
ENERGY READY HOME
U.S. DEPARTMENT OF ENERGY

DOE & EPA Coordination

Federal certification programs work together to provide a recognition system for residential new construction built to higher standards of performance and lead the way to zero emission homes.

- **EPA's ENERGY STAR SFNH**: great starting point for builders on their journey to building above-code, high-performance, energy-efficient homes
- **DOE's Zero Energy Ready Home V2:** step-up program for builders that brings higher levels of energy efficiency and additional specific provisions for improved building envelope performance
- **EPA's new certification (TBD):** program for builders that want to take the next step towards decarbonization / electrification, along with higher levels of energy efficiency
- Certify to **DOE's Zero Energy Ready Home *OR* EPA's new certification *OR BOTH***

DOE & EPA Coordination

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

Federal certification programs work together to provide a recognition system for residential new construction built to higher standards of performance and lead the way to zero emission homes.

- **EPA's ENERGY STAR SFNH**: great starting point for builders on their journey to building above-code, high-performance, energy-efficient homes
  - 10% more energy efficient than adopted state code
- **DOE's Zero Energy Ready Home V2:** step-up program for builders that brings higher levels of energy efficiency and additional specific provisions for improved building envelope performance
  - 20% more energy efficiency than 2021 IECC (nationwide)
  - ENERGY STAR v3.2 and Indoor airPLUS certifications are prerequisites
  - Requires more efficient duct and hot water system designs, a complete package of IAQ protections, and PV readiness
- **EPA's new certification (TBD):** program for builders that want to take the next step towards decarbonization / electrification, along with higher levels of energy efficiency
  - 10% more energy efficient than 2021 IECC (nationwide)
  - ENERGY STAR v3.2 certification is a prerequisite
  - Requires installation of connected heat pumps, connected HPWHs, induction cooking, and electric vehicle charging capabilities
- Certify to DOE's Zero Energy Ready Home or EPA's new certification – or both
  - Neither program is a prerequisite for the other
  - DOE and EPA are committed to continuing to work together to ensure that the Federal certification programs continue to evolve towards zero emission homes into the future

U.S. DOE Zero Energy Ready Home

Draft Program Updates

Eligible Building Types – Looking Ahead

Single-Family Detached

Single-Family Attached

- Performance Compliance
- ESSFNH **Version 3.2** & IAP as prerequisites

DOE ZERH – Version 2

Multifamily (Any Height)

- ERI or Prescriptive Compliance
- ESMFNC & IAP as prerequisites

DOE ZERH – Multifamily V1

DOE ZERH Requirements

Mandatory Provisions

ZERO ENERGY READY HOME

U.S. DOE Zero Energy Ready Home
National Program Requirements for Single Family Homes
Version 2.0
October 2021 Draft

1. ENERGY STAR Single Family New Homes Baseline	☐ Certified under ENERGY STAR Single Family New Homes Version 3.2.[6]
2. Envelope	☐ Ceiling, wall, floor, and slab insulation meet or exceed 2021 IECC levels[9,10] ☐ Above Grade Walls in Mixed and Cold Climates provide thermal breaks[11] ☐ Windows meet high performance requirements based on climate zone[12]
3. Duct System	☐ All ducts and heating and cooling air-handling equipment are located within the thermal and air barrier boundary[13]
4. Water Heating Efficiency	☐ Hot water delivery systems meet efficient design requirements[14] *or* ☐ Water heater and fixtures meet efficiency criteria[15]
5. Lighting & Appliances	☐ All installed refrigerators, dishwashers, clothes washers, and clothes dryers are ENERGY STAR qualified.[16,17] ☐ 95% of builder-installed lighting fixtures are ENERGY STAR qualified or ENERGY STAR lamps (bulbs) in minimum 95% of sockets ☐ All installed bathroom ventilation and ceiling fans are ENERGY STAR qualified
6. Indoor Air Quality	☐ Certified under EPA Indoor airPLUS[18] ☐ MERV 13 (minimum) filter is installed on all ducted heating and cooling systems[19] ☐ Energy efficient balanced ventilation (HRV or ERV) is provided in Climate Zones 6-8[20]
7. Renewable Ready	☐ Provisions of the DOE Zero Energy Ready Home PV-Ready Checklist (Version 2) are Completed[21]
8. Electrification	☐ *Advisory*: Effective in a future version update of the DOE ZERH program, homes will integrate high efficiency electric technologies and measures for grid interactivity.[22]

Exhibit 2: DOE Zero Energy Ready Home Target Home [23]

HVAC Equipment[24]			
	Very Hot & Hot Climates (2021 IECC Climate Zones 1,2)	Warm & Mixed Climates (2021 IECC Climate Zones 3, 4 except Marine)	Cold & Very Cold Climates (2021 IECC Climate Zones 4 Marine 5,6,7,8)
Furnace AFUE	80%	CZ3: 92%; CZ4: 95%	95%
SEER	18	16	16 (ASHP) 14 (A/C)
HSPF	9.2	9.2	9.5
Geothermal Heat Pump	ENERGY STAR EER and COP Criteria		
Boiler AFUE	80%	CZ3: 92%; CZ4: 95%	95%
Whole-House Mechanical Ventilation System Efficiency	2.9 cfm/W no heat exchange	2.9 cfm/W no heat exchange	1.2 cfm/W; balanced with heat exchange, 65% ASRE
HVAC Grading			

Target Home Sets the ERI

Building Envelope Updates

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

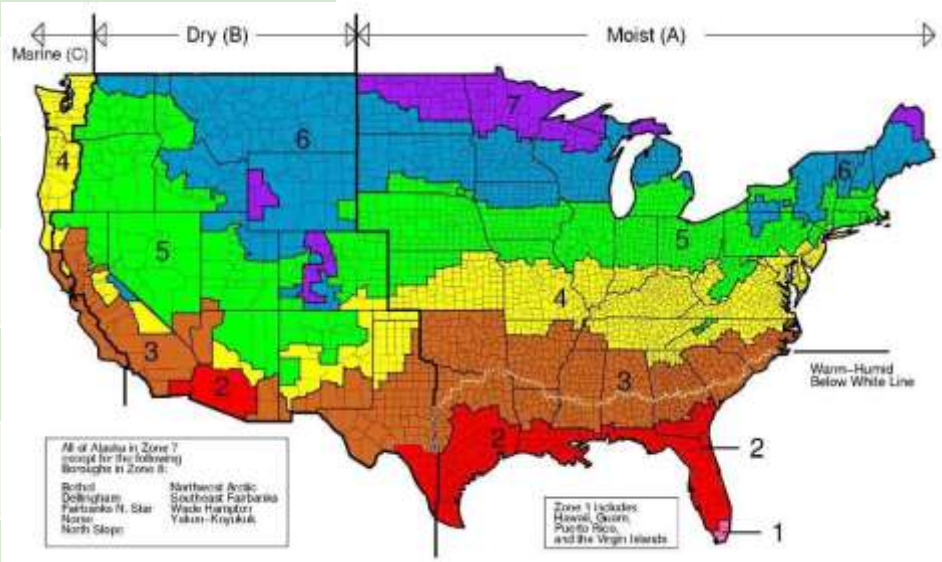
Program Component	ZERH Version 1	ZERH Version 2.0 Proposed	Rationale
Building Envelope Insulation Levels	2015 IECC insulation levels for opaque areas	2021 IECC insulation levels for opaque areas. Thermal breaks in walls in CZs 4-8.	Deliver most robust code-based building envelope with an additional,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

2021 IECC Insulation Values

CZ	Ceiling	Wood-framed Wall	Mass Wall	Floor	Basement	Slab	Crawl Space Wall
1	30	13 or 0+10	3/4	13	0	0	0
2	49	13 or 0+10	4/6	13	0	0	0
3	49	20 or 13+5 or 0+15	8/13	19	5/13	10, 2ft	5/13
4	60	20+5 or 13+10 or 0+15	8/13	19	10/13	10, 4ft	10/13
5	60	20+5 or 13+10 or 0+15	13/17	30	15/19 or 13+5	10, 4ft	15/19 or 13+5
6	60	20+5 or 13+10 or 0+20	15/20	30	15/19 or 13+5	10, 4ft	15/19 or 13+5
7/8	60	20+5 or 13+10 or 0+20	19/21	38	15/19 or 13+5	10, 4ft	15/19 or 13+5

Envelope Efficiency Improvements

Climate Zone	2021 IECC UA Stringency Compared to DOE ZERH V1 UA Requirements [A]
1	+ 0%
2	+ 5%
3	+16%
4	+8%
5	+8%
6	+1%
7	+1%



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)

UA Tradeoffs Offer Flexibility

Climate Zone 3

Two-Story, 2400 SF Home on Slab

	Slab Edge Insulation*	Above-Grade Walls	Window U / SHGC Factor	Ceilings	UA Tradeoff Complies?
2021 IECC Prescriptive Requirement	R-10, 2’	R-20	0.30 / 0.25	R-49	
UA Tradeoff Model	R-10, 2’	R-20	**0.28** / 0.25	**R-38**	***YES***

* R-10 slab edge insulation is difficult to trade off

Thermal Breaks in Walls in CZs 4-8

- In Mixed & Cold Climates: provide thermal break for the studs in AGWs

Staggered Stud

Exterior Insulation

ICF

SIP

Double Stud

HVAC Design Updates

Program Component	ZERH Version 1	ZERH Version 2.0 Proposed	Rationale
HVAC and Duct Location	Requires ducts & HVAC equipment to be located in an optimized location	Same as V1. Clarification: only applies to equipment & ducts serving heating/cooling systems.	Improve HVAC efficiency, reduce demand, and improve comfort.

Window Updates

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

DOE ZERH V2 Window Requirements

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

IECC CZ 1-2		IECC CZ 3-4 except Marine		IECC CZ 5 and 4 Marine		IECC CZ 6-8	
U-Value	SHGC	U-value	SHGC	U-Value	SHGC	U-Value	SHGC
0.40	0.23	[CZ 3] 0.30 [CZ 4] 0.30	[CZ 3] 0.25 [CZ 4] 0.40	≤ 0.27	Any	≤ 0.25	Any

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

Lighting Updates

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

Program Component	ZERH Version 1	ZERH Version 2.0 Proposed	Rationale
High Efficiency Lighting	80% requirement	**95% requirement**	Recognize cost-effectiveness of LEDs and increase ZERH efficiency, while providing a little flexibility. Note that the Target Home assumes 100% high efficiency lighting.

Appliance Updates

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

Program Component	ZERH Version 1	ZERH Version 2.0 Proposed	Rationale
Energy Efficient Appliances	All builder-installed refrigerators, dishwashers, and clothes washers are ENERGY STAR qualified	All builder-installed refrigerators, dishwashers, clothes washers, **and clothes dryers** are ENERGY STAR qualified	Recognize ENERGY STAR labeling of clothes dryers and increase ZERH efficiency

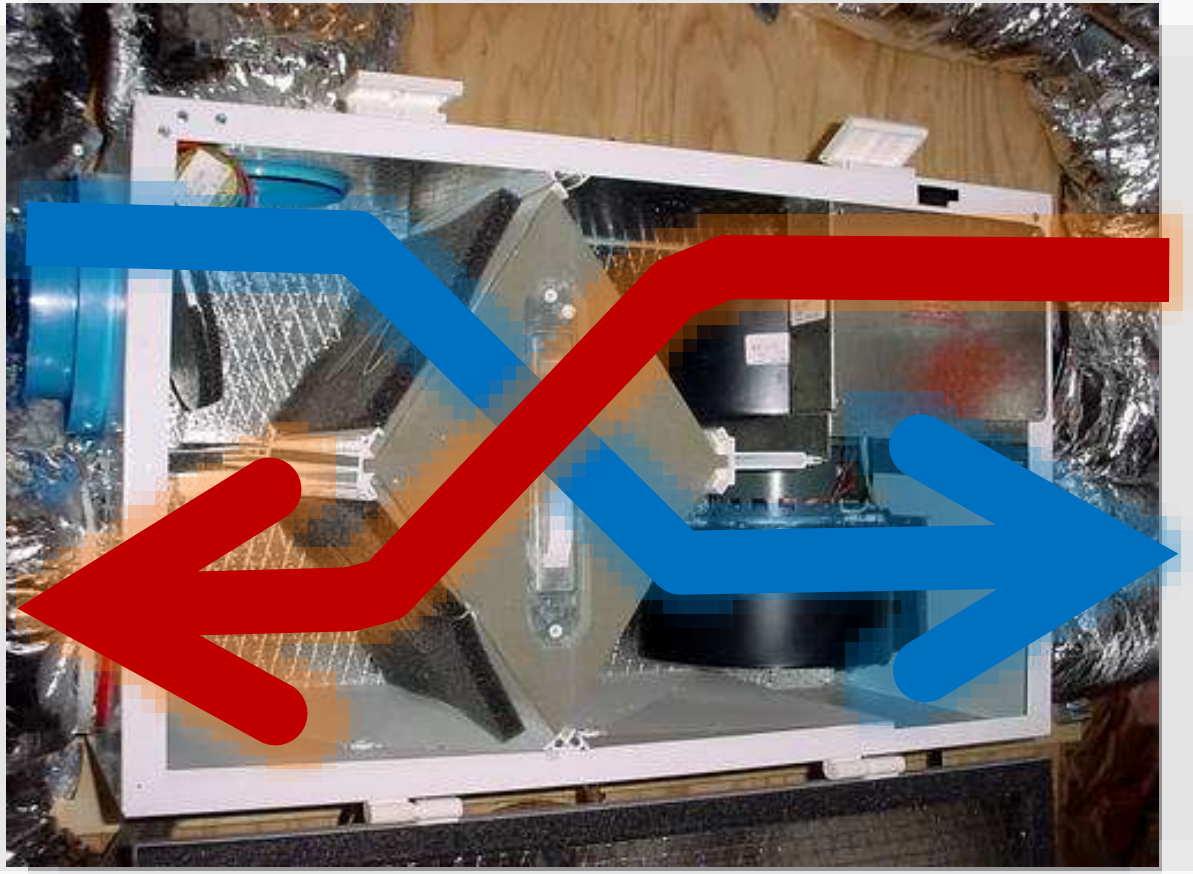
Indoor Air Quality Updates

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

Program Component	ZERH Version 1	ZERH Version 2.0 Proposed	Rationale
Indoor Air Quality	Certify under Indoor airPLUS (IAP) V1	Phase in certification under an updated IAP version over time. IAP Version 1 will be allowed through 2022. H/ERVs in Very Cold Climates (6-8) MERV 13 (minimum) filter installed on ducted heating and cooling systems	Maintain requirement to certify under the federal government's residential IAQ label for new homes. Accelerate the MERV 13 filter requirement (likely to appear in the updated IAP specs)

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

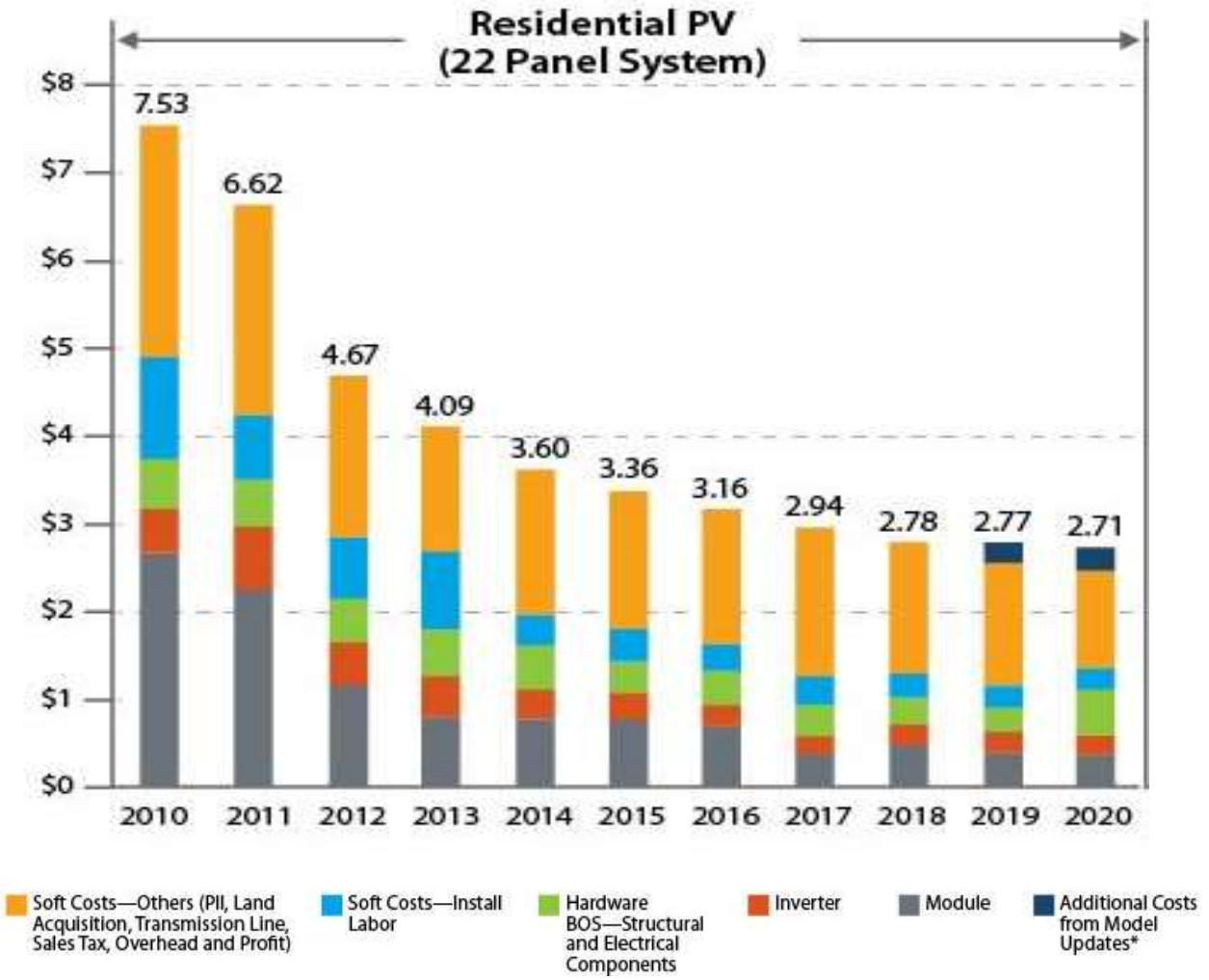


ERV or HRV

PV Ready Updates

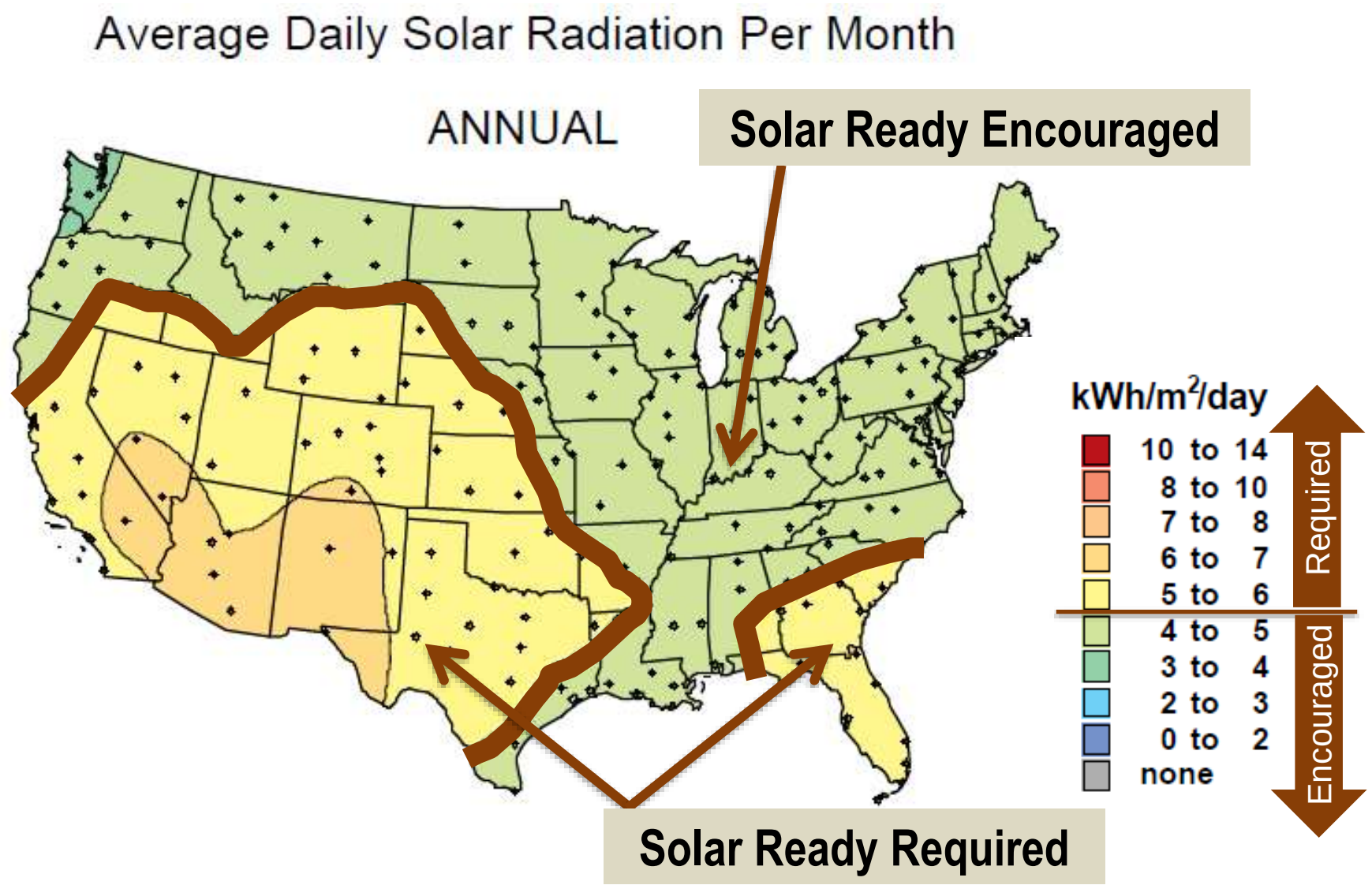
Program Component	ZERH Version 1	ZERH Version 2.0 Proposed	Rationale
Photovoltaic (PV) Readiness	Implement the ZERH PV-Ready Checklist	Same as V1, but eliminates the exception for sites with lower annual solar resources. Also updates provisions based on current technologies.	Increase PV Readiness in ZERH homes and recognize the steady increases in PV cost effectiveness.

Residential PV System Costs Down 64%

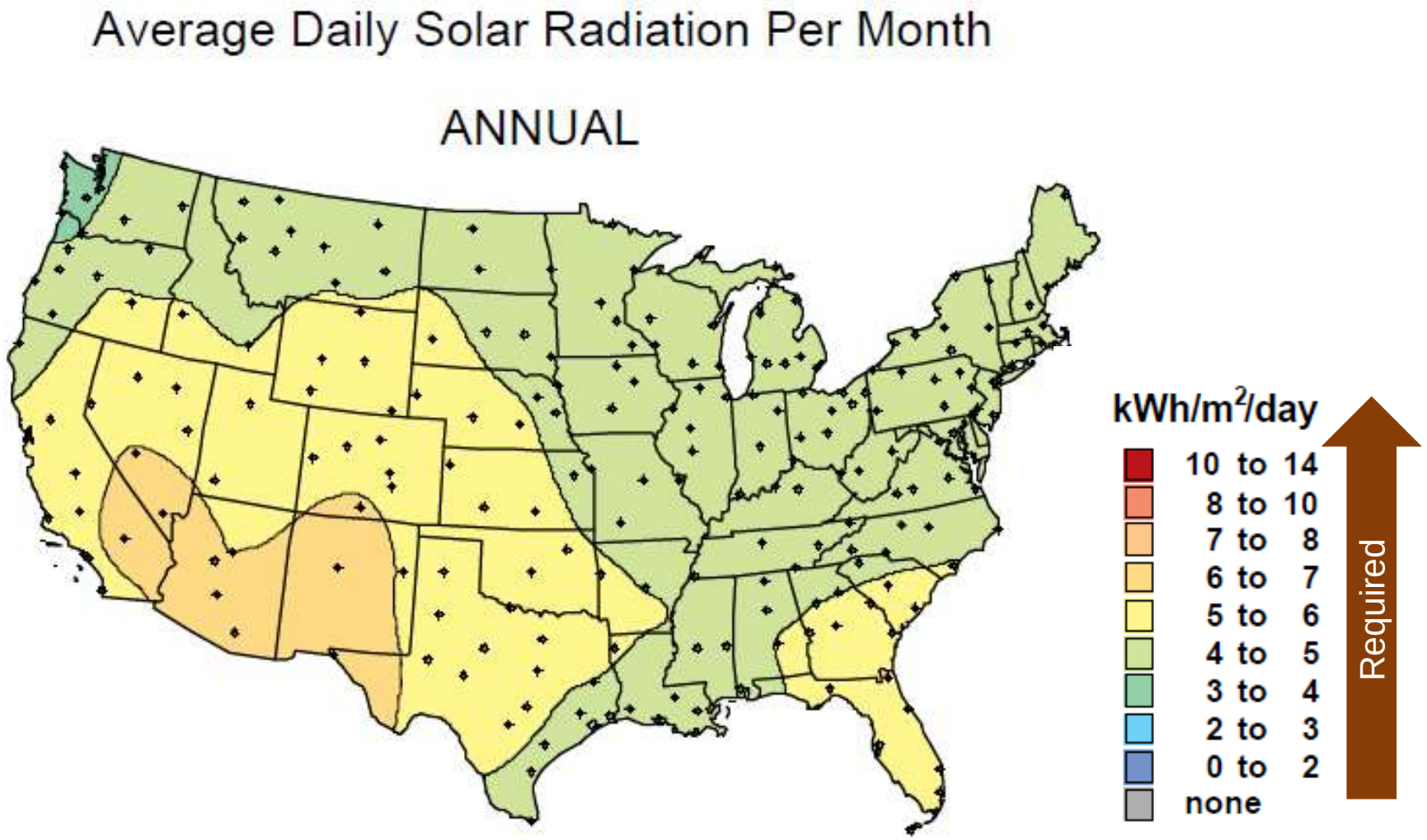


Source: [NREL Documenting a Decade of Cost Decline for PV Systems](), 2021.

Expand PV-Readiness



Expand PV-Readiness



Update PV Ready Requirements

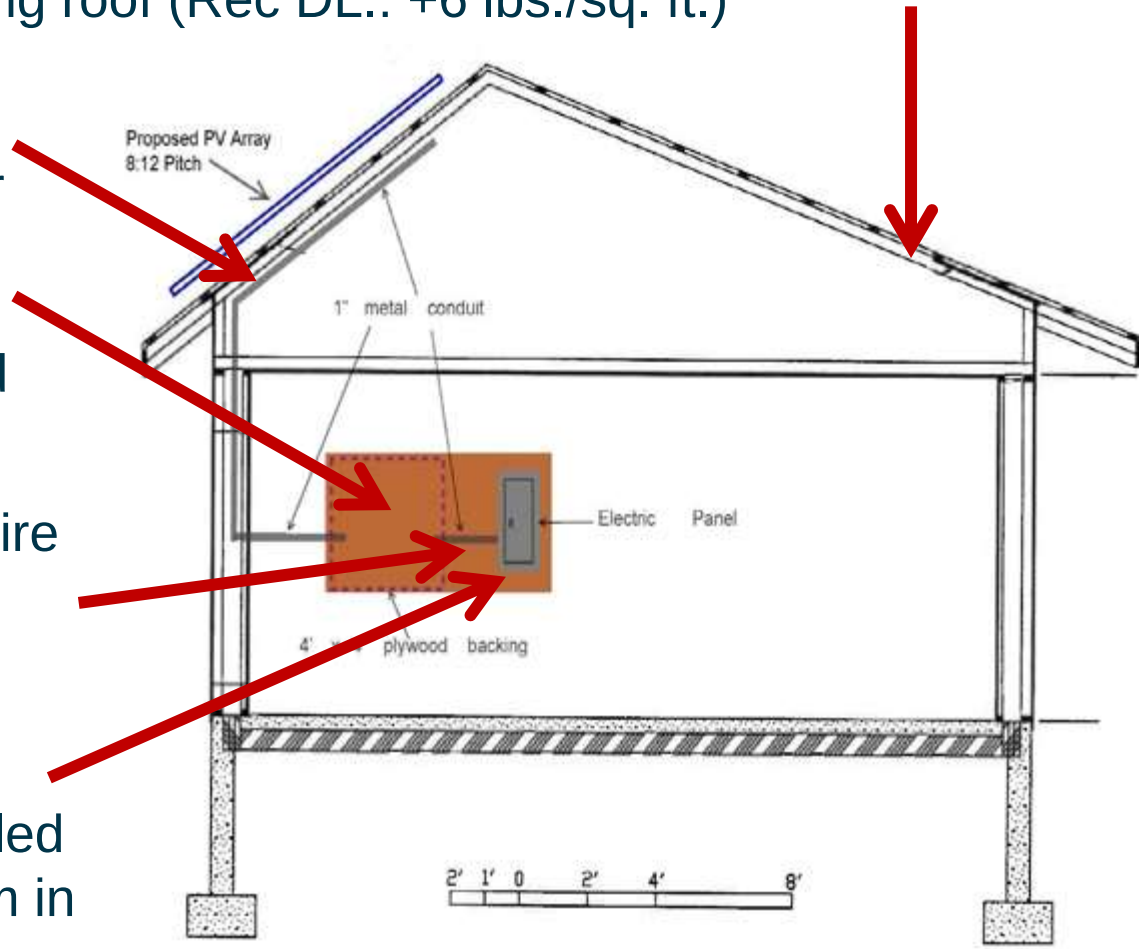
Documentation of the maximum allowable dead load and live load ratings of the existing roof (Rec DL.: +6 lbs./sq. ft.)

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

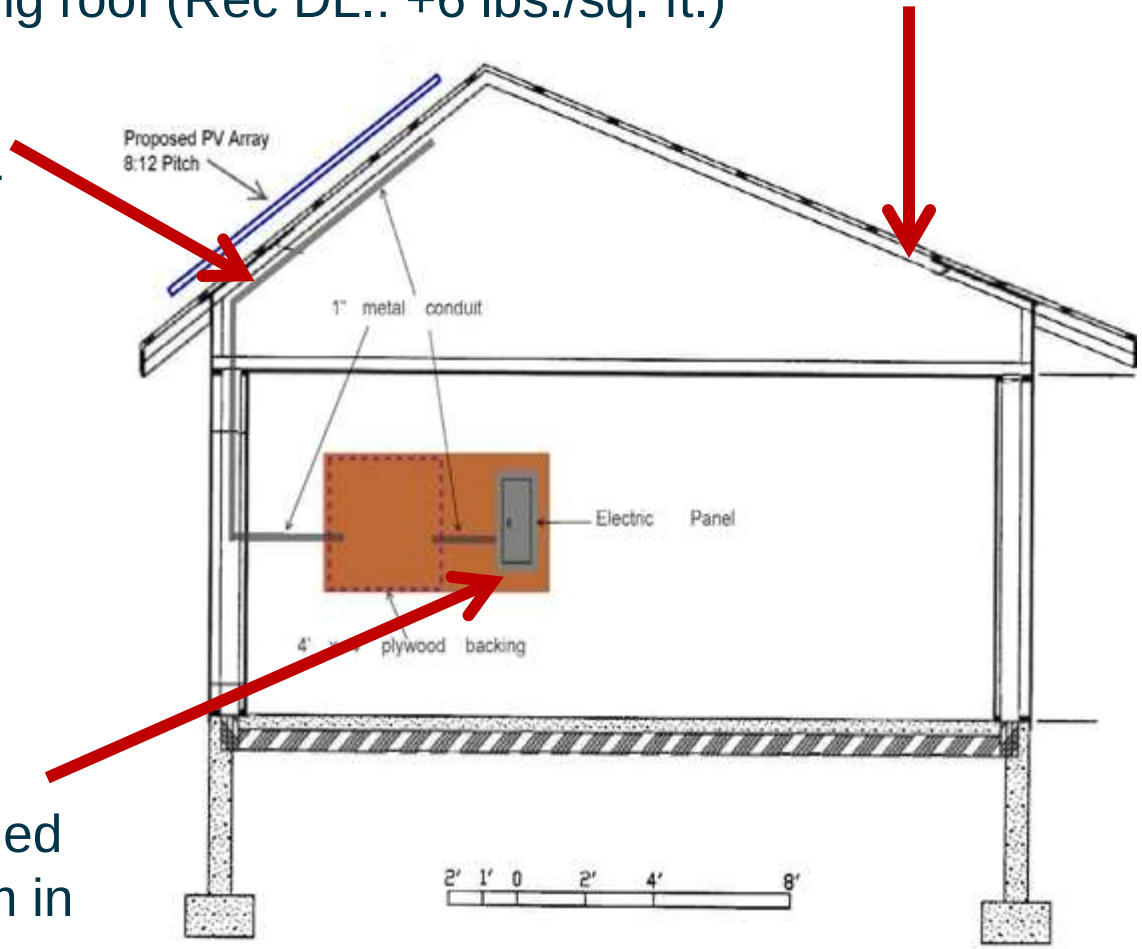
Circuit Breaker designated and/or installed for use by the PV system in the electric panel



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



Circuit Breaker designated and/or installed for use by the PV system in the electric panel

ZERH Efficiency Target - Background

- Target Home is a replica of the Design Home
- Target Home exists in the rating software
- Target Home establishes the max ERI for the Design Home to meet the ZERH's efficiency requirements
- Example: Target Home specs are:
  - 2.0 ACH50
  - HSPF 9.0
- And ERI = 48

ZERH Target Home

Design Home

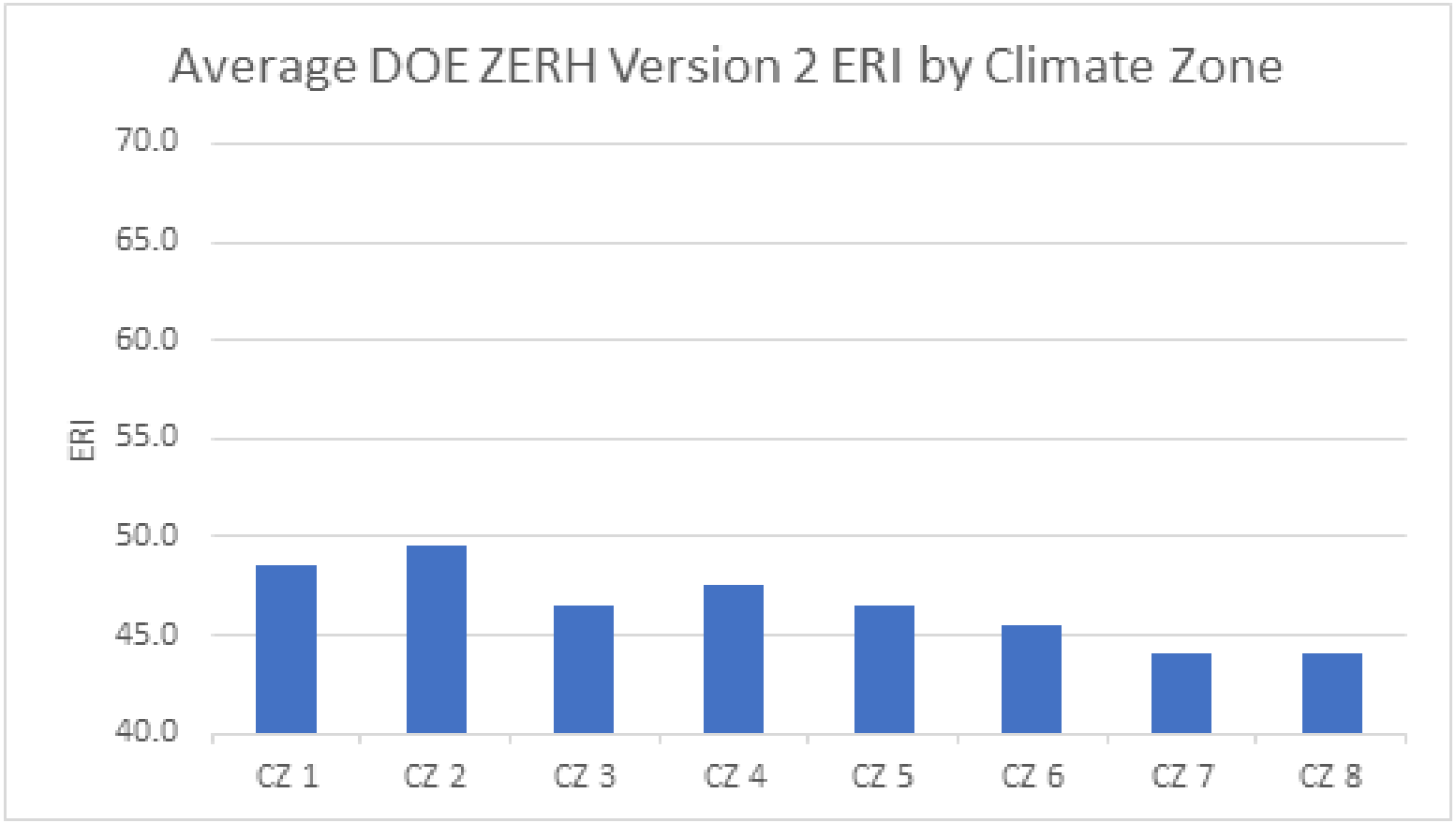
- Design Home is the actual home being ZERH certified
- Design Home still must meet the **Mandatory** ZERH requirements
- Design Home can use different tradeoffs to meet the Target Home's ERI
- Example: Design Home specs:
  - 2.5 ACH50
  - HSPF 9.5
- **ERI = 47. Meets ZERH**

Efficiency Target Updates

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

Program Component	ZERH Version 1	ZERH Version 2.0 Proposed	Rationale
Minimum Required Energy Efficiency Threshold	Based on the Version 1 ZERH ERI Target Home specifications - circa 2013. **ERI scores in the 50s.**	Updated ZERH Target Home achieves increased energy savings of 20% beyond 2021 IECC. **Resulting ERI Targets in the 40s.**	Reflect recent innovations in the ZERH efficiency threshold.

ZERH V2 ERI Target Values



Example ZERH V2 ERI Targets based on draft V2 specifications. Based on energy modeling of 2,400 SF home.

Size Adjustment Factor Updates

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

Program Component	ZERH Version 1	ZERH Version 2.0 Proposed	Rationale
Size Adjustment Factor (SAF)	SAF makes the ERI Target lower for homes larger than the benchmark.	SAF is sunset, consistent with ENERGY STAR Single Family New Homes program.	Homes under ZERH V2 will be very efficient regardless of SAF.

Poll

Which one of these statements is not true?

a. ZERH V2 (draft) aligns with the 2021 IECC insulation values
b. ZERH V2 (draft) requires the use of on-site renewables
c. ZERH V2 (draft) has a lower ERI target compared to V1
d. ZERH V2 (draft) only applies to single-family homes

slido

Which one of these statements is not true?

ⓘ Start presenting to display the poll results on this slide.

Implementation Timeframe

- 2021 Q4: ZERH V2 available for 30-day stakeholder comment period
- Early 2022: ZERH V2 finalized & integrated into rating software (depending on feedback)
- DOE will provide a transition period for V1 to V2 of at least 9 months
- 2022 Q1: ZERH – Multifamily draft made available for stakeholder comment

U.S. DOE Zero Energy Ready Home

Providing Feedback on V2 Draft

How to Provide Stakeholder Feedback

- Visit the U.S. DOE Zero Energy Ready Home Version 2 Website
  - https://www.energy.gov/eere/buildings/us-doe-zero-energy-ready-home-national-program-requirements-single-family-homes
- Review V2
  - Summary of Program Updates (2 pages)
  - Draft V2 National Program Requirements
  - Draft V2 PV Ready Checklist
  - Stakeholder Feedback Form
- Complete and Submit Version 2 Feedback Form by December 2, 2021

Email Contact: zero@newportpartnersllc.com

Thank You