



U.S. DOE Zero Energy Ready Home & the Year Ahead

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1. The Year Ahead – 10,000' View
2. DOE ZERH Program Updates
3. Getting Started with DOE ZERH

Who's in the audience today?

- a. Energy raters
- b. Builders
- c. Utilities
- d. Others

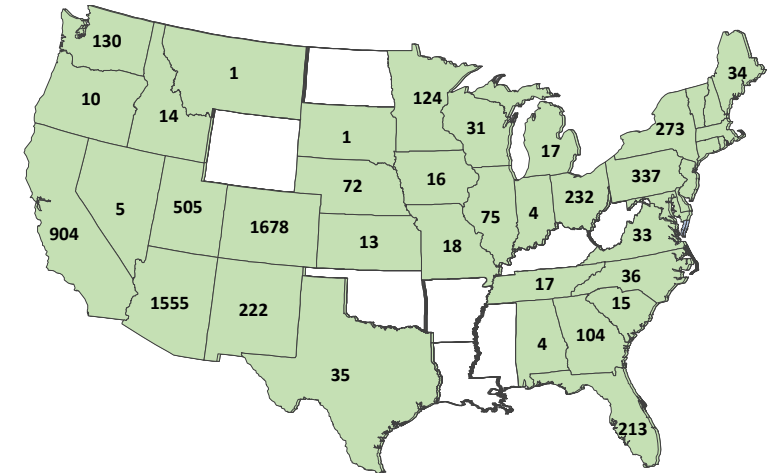


U.S. DOE Zero Energy Ready Home

The Year Ahead - 10,000' View

DOE Zero Energy Ready Home at a Glance

- Leading U.S. homebuilders are invested in DOE ZERH for market recognition and distinction
- 53% annual average growth
- National production builders starting to adopt
- Part of federal recognition system for high-performance, energy-efficient new homes
- Highest energy efficiency of federal labels, targeted performance benefits, and PV readiness



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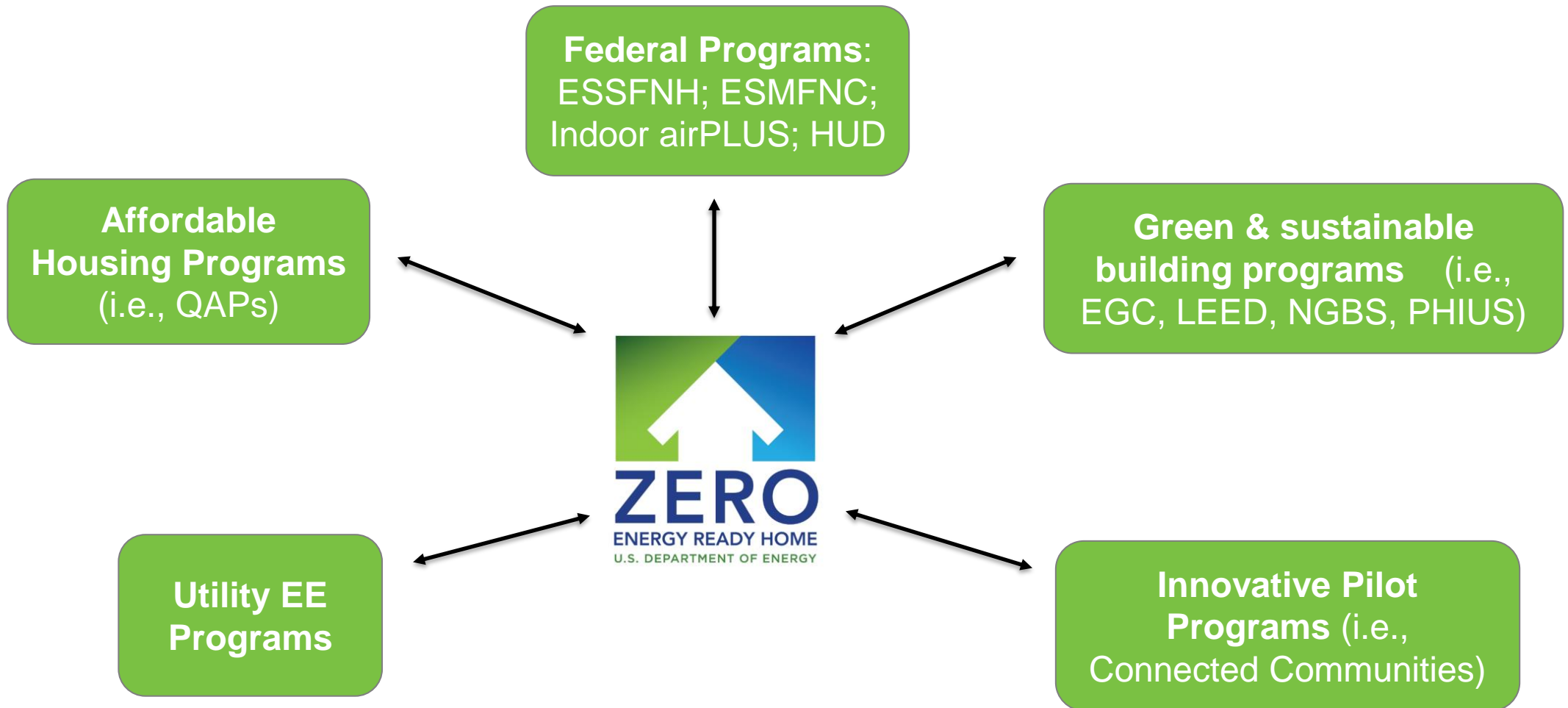


Joe Nebbia
Newport Partners
*Operations
Director*



Connor Statham
Newport Partners
*Account
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DOE ZERH Program Participation is Growing



DOE ZERH is Leveraged by Affordable Housing, Utility, State, & Green Financing Programs

Affordable Housing	State & Utility Rebates	Codes	Green Financing
Colorado	CenterPoint (TX)	Boulder, CO	Fannie Mae
Connecticut	Dominion Energy (UT)	Oregon 2023	Federal Home Loan Bank of NY
Delaware	Eversource (CT)	RI Stretch Code	
Maryland	NJ (statewide)	Summit County, CO	
Minnesota	Oncor (TX)		
New Jersey	Rhode Island (statewide)		
Pennsylvania			
Virginia			
Washington D.C.			

Plus Federal 45L Tax Credit for Energy Efficiency New Homes:

DOE ZERH has been proposed as an upper tier, \$5k tax credit for 45L starting in 2022

ZERH Technical Foundation & Efficiency Increases in Version 2 Update





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**

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**

Buildings Share of Total U.S. Energy Use: **40%**

Buildings Share of Total U.S. Electricity Use: **75%**

Fossil Fuel Share of Total U.S. Electricity: **60%**

U.S. Share of Global Population: **4%**

U.S. Share of Global CO2 Emissions: **14% (3.5X)**

Single-Family Detached



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

Single-Family Attached



Multifamily (Any Height)



- ERI or Prescriptive Compliance
- ESMFNC & IAP as prerequisites

DOE ZERH – Version 2

DOE ZERH – Multifamily V1

Mandatory Provisions


 <div>U.S. DOE Zero Energy Ready Home National Program Requirements for Single Family Homes Version 2.0 October 2021 Draft</div>	
1. ENERGY STAR Single Family New Homes Baseline	<input type="checkbox"/> Certified under ENERGY STAR Single Family New Homes Version 3.2. ⁸
2. Envelope	<input type="checkbox"/> Ceiling, wall, floor, and slab insulation meet or exceed 2021 IECC levels ^{9,10} <input type="checkbox"/> Above Grade Walls in Mixed and Cold Climates provide thermal breaks ¹¹ <input type="checkbox"/> Windows meet high performance requirements based on climate zone ¹²
3. Duct System	<input type="checkbox"/> All ducts and heating and cooling air-handling equipment are located within the thermal and air barrier boundary ¹³
4. Water Heating Efficiency	<input type="checkbox"/> Hot water delivery systems meet efficient design requirements ¹⁴ or <input type="checkbox"/> Water heater and fixtures meet efficiency criteria ¹⁵
5. Lighting & Appliances	<input type="checkbox"/> All installed refrigerators, dishwashers, clothes washers, and clothes dryers are ENERGY STAR qualified. ^{16,17} <input type="checkbox"/> 95% of builder-installed lighting fixtures are ENERGY STAR qualified or ENERGY STAR lamps (bulbs) in minimum 95% of sockets <input type="checkbox"/> All installed bathroom ventilation and ceiling fans are ENERGY STAR qualified
6. Indoor Air Quality	<input type="checkbox"/> Certified under EPA Indoor airPLUS ¹⁸ <input type="checkbox"/> MERV 13 (minimum) filter is installed on all ducted heating and cooling systems ¹⁹ <input type="checkbox"/> Energy efficient balanced ventilation (HRV or ERV) is provided in Climate Zones 6-8. ²⁰
7. Renewable Ready	<input type="checkbox"/> Provisions of the DOE Zero Energy Ready Home PV-Ready Checklist (Version 2) are Completed. ²¹
8. Electrification	<input type="checkbox"/> 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

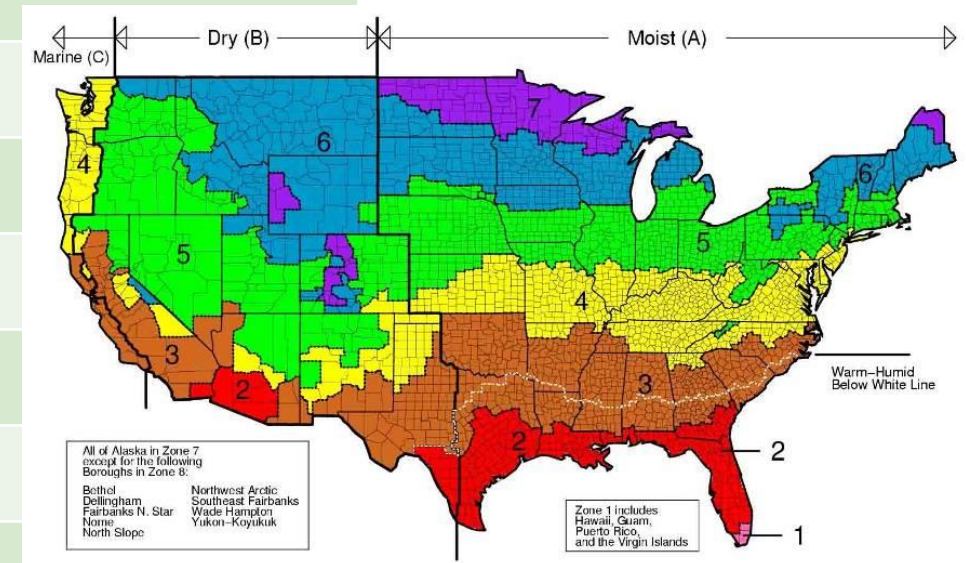
Program Component	ZERH Version 1	ZERH Version 2.0 Proposed	Rationale
Building Envelope Insulation Levels	2015 IECC insulation levels for opaque areas	2021 IECC insulation levels for opaque areas. Thermal breaks in walls in CZs 4-8.	Deliver most robust code-based building envelope with an additional, 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	8/13	19	10/13	10, 4ft	10/13
5	60	20+5 or 13+10	13/17	30	15/19 or 13+5	10, 4ft	15/19 or 13+5
6	60	30 or 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	30 or 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)

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

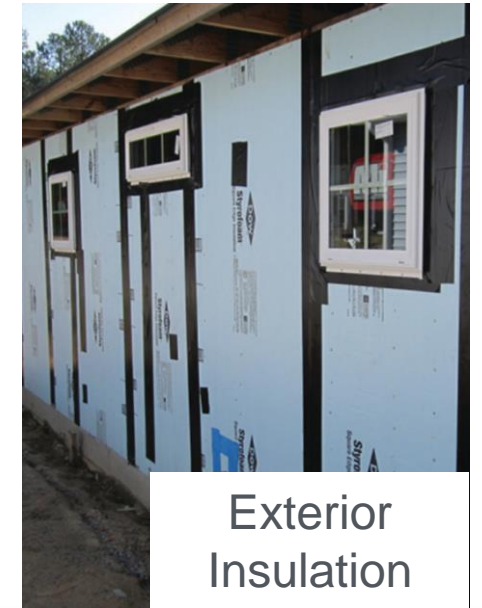
* R-10 slab edge insulation is difficult to trade off

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

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. Provision only applies to equipment & ducts serving heating/cooling systems.	Improve HVAC efficiency and comfort.

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.

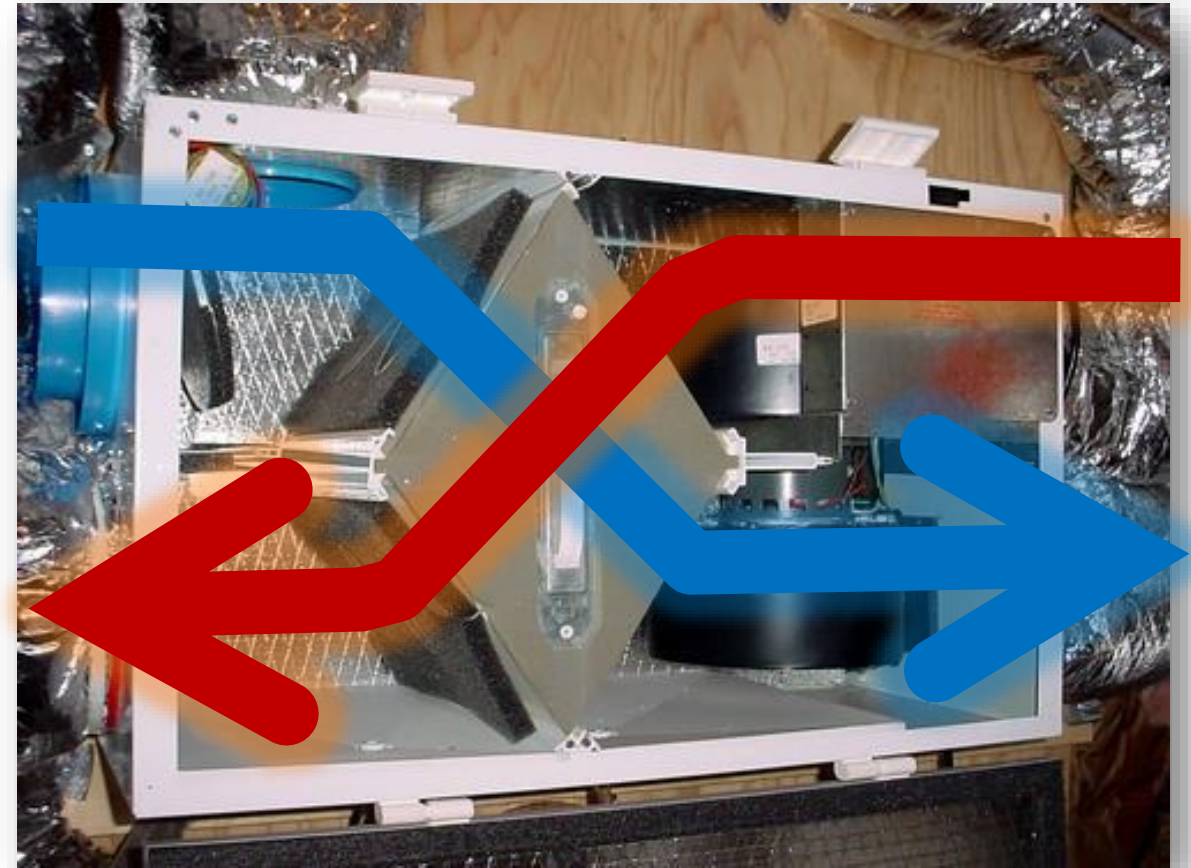
IECC CZ 1-2		IECC CZ 3-4 except Marine		IECC CZ 5 and 4 Marine		IECC CZ 6-8	
U-Value	SHGC	U-value	SHGC	U-Value	SHGC	U-Value	SHGC
0.40	0.25	[CZ 3] 0.30 [CZ 4] 0.30	[CZ 3] 0.25 [CZ 4] 0.40	≤ 0.27	Any	≤ 0.25	Any

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

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, <u>and clothes dryers</u> are ENERGY STAR qualified	Recognize ENERGY STAR labeling of clothes dryers and increase ZERH efficiency

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

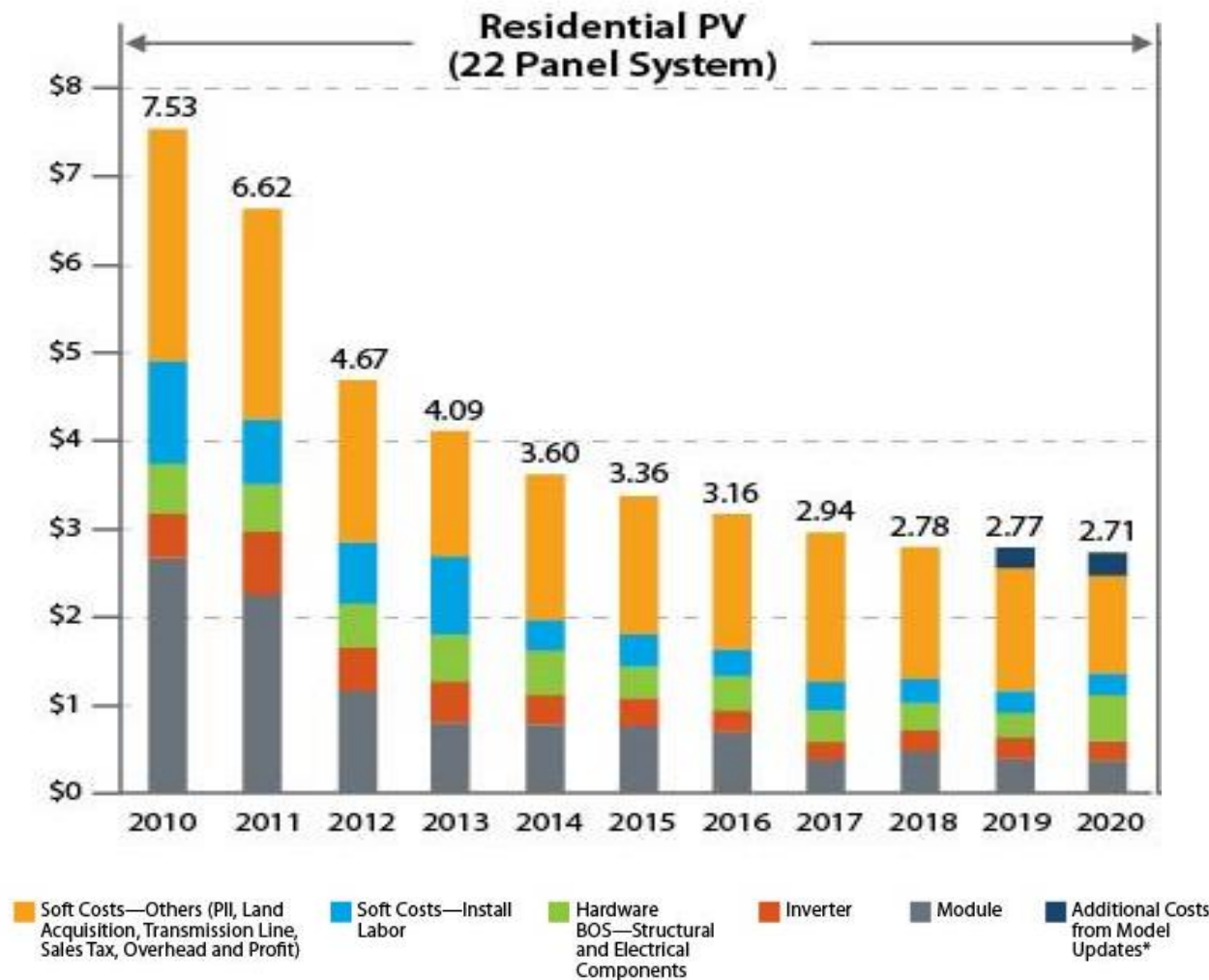
- Required in Very Cold Climates Zones 6 – 8
- Provide whole-house ventilation while reducing impact on heating load
- Numerous technology options available



ERV or HRV

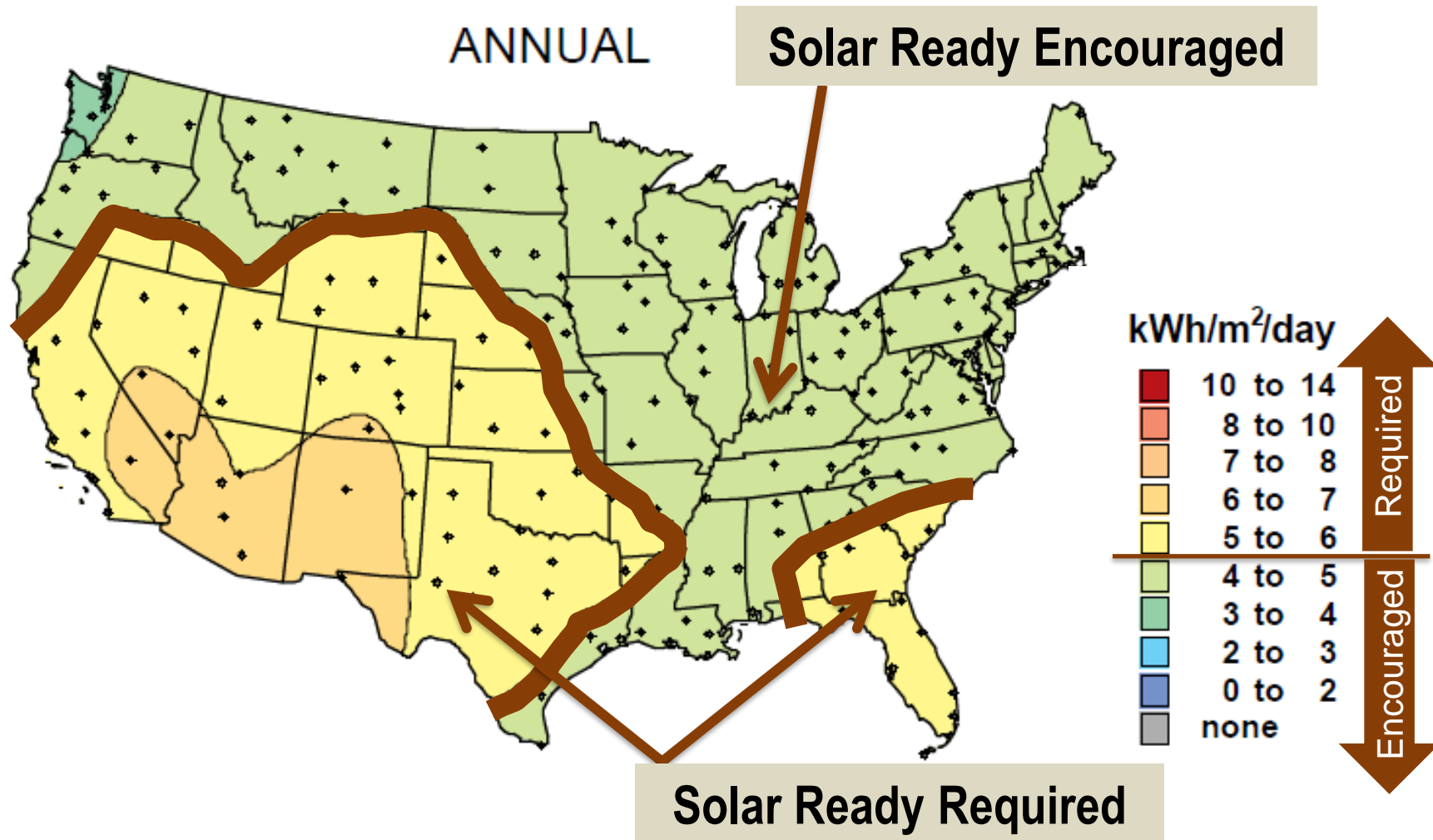
Program Component	ZERH Version 1	ZERH Version 2.0 Proposed	Rationale
Photovoltaic (PV) Readiness	Implement the ZERH PV-Ready Checklist	Same as V1, but eliminates the exception for sites with lower annual solar resources. Also updates provisions based on current technologies.	Increase PV Readiness in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

Residential PV System Costs Down 64%



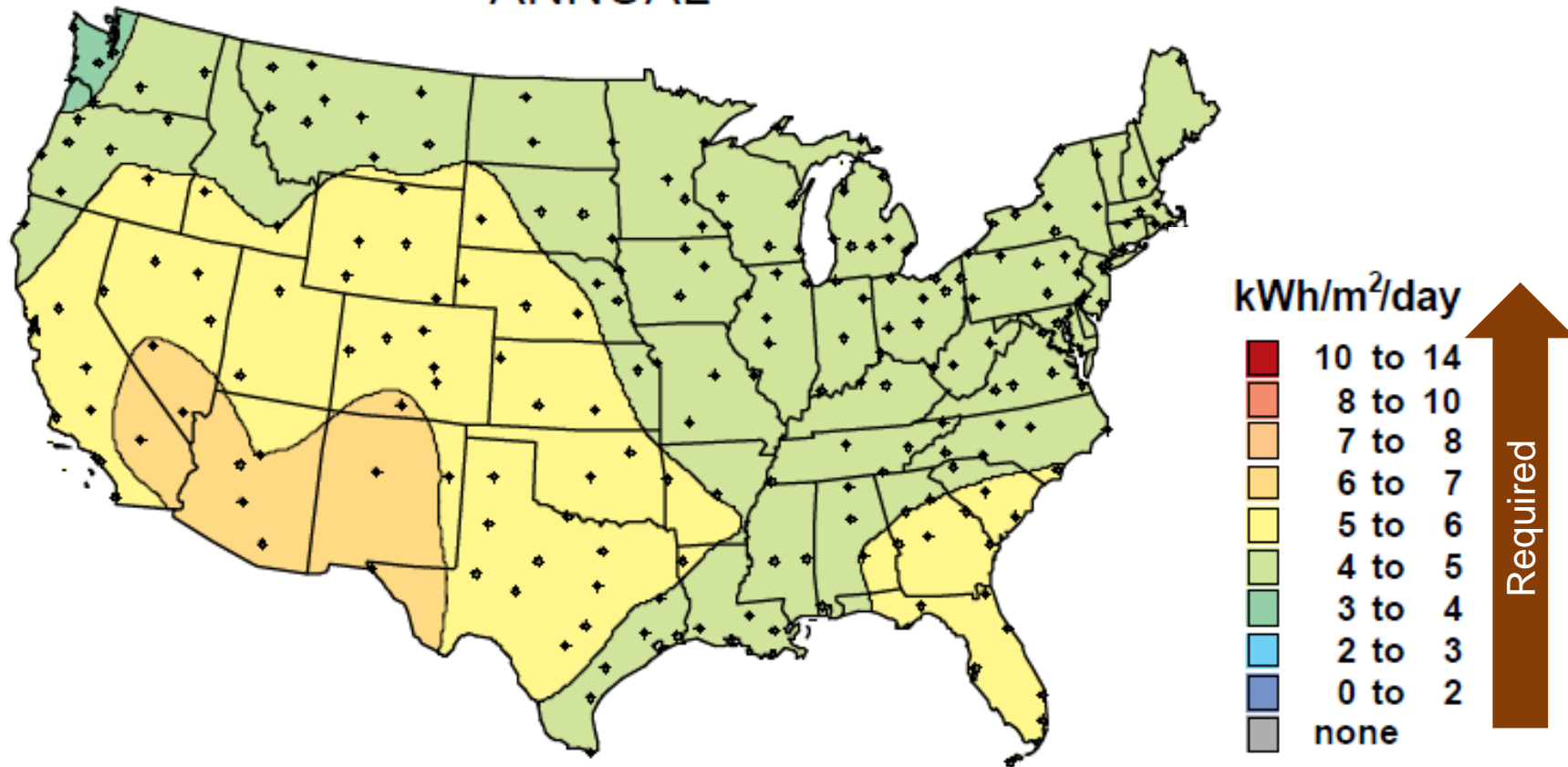
Source: [NREL Documenting a Decade of Cost Decline for PV Systems, 2021.](#)

Average Daily Solar Radiation Per Month



Average Daily Solar Radiation Per Month

ANNUAL



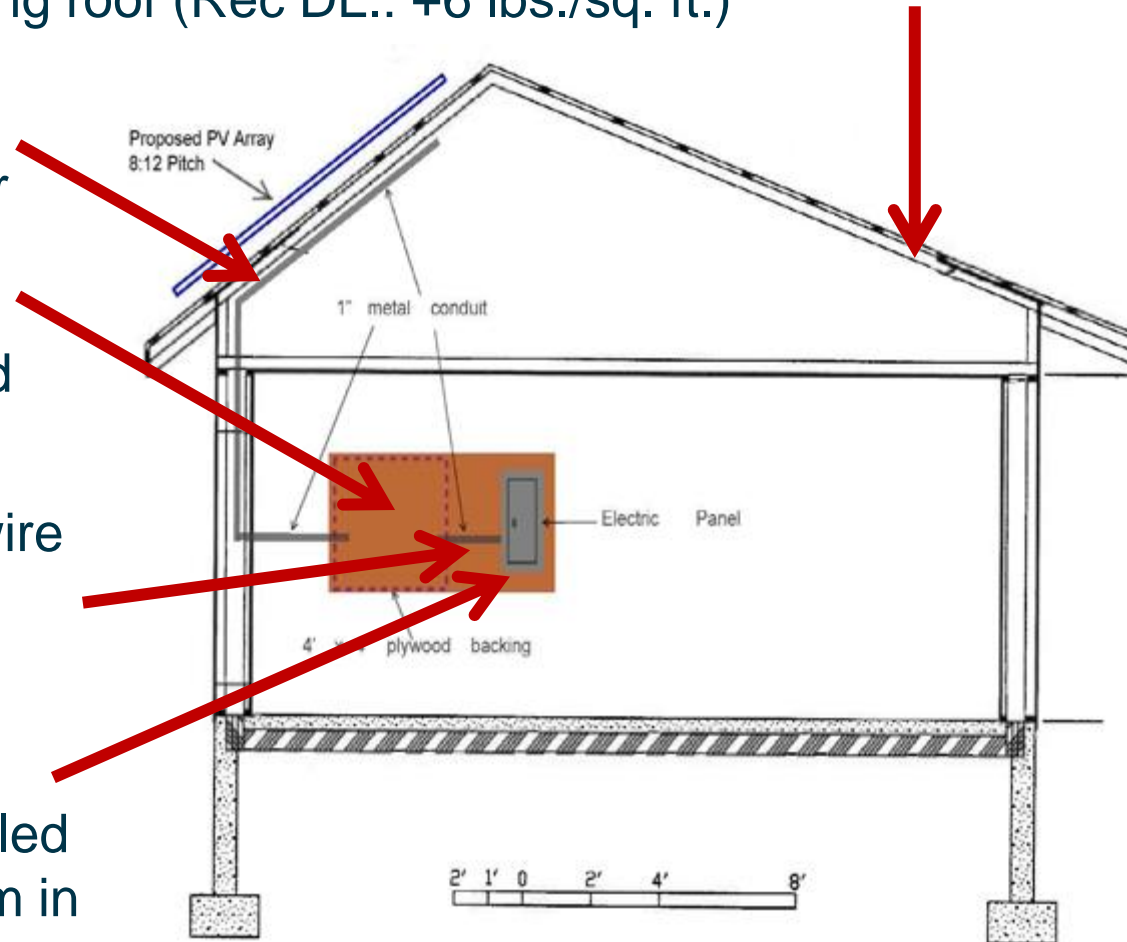
Documentation of the maximum allowable dead load and live load ratings of the existing roof (Rec DL.: +6 lbs./sq. ft.)

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

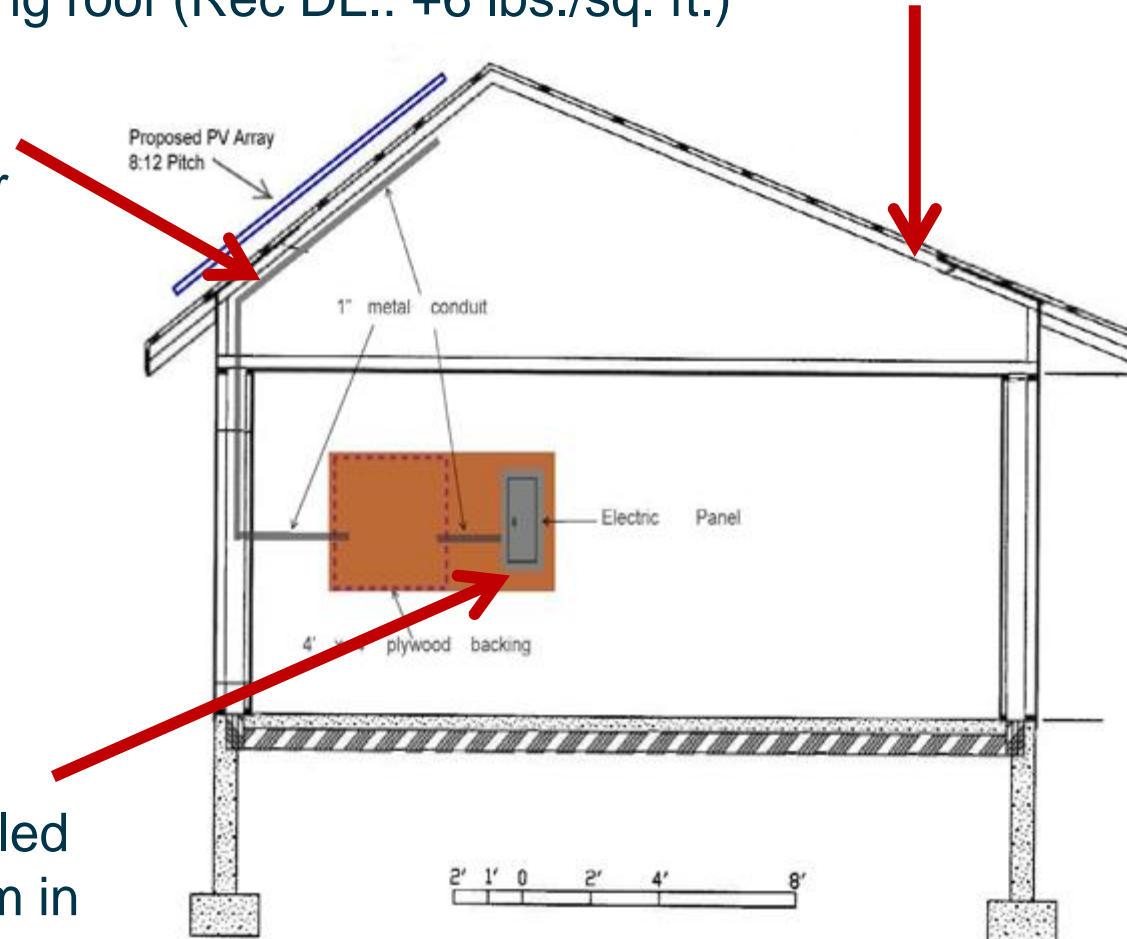
Circuit Breaker designated and/or installed for use by the PV system in the electric panel



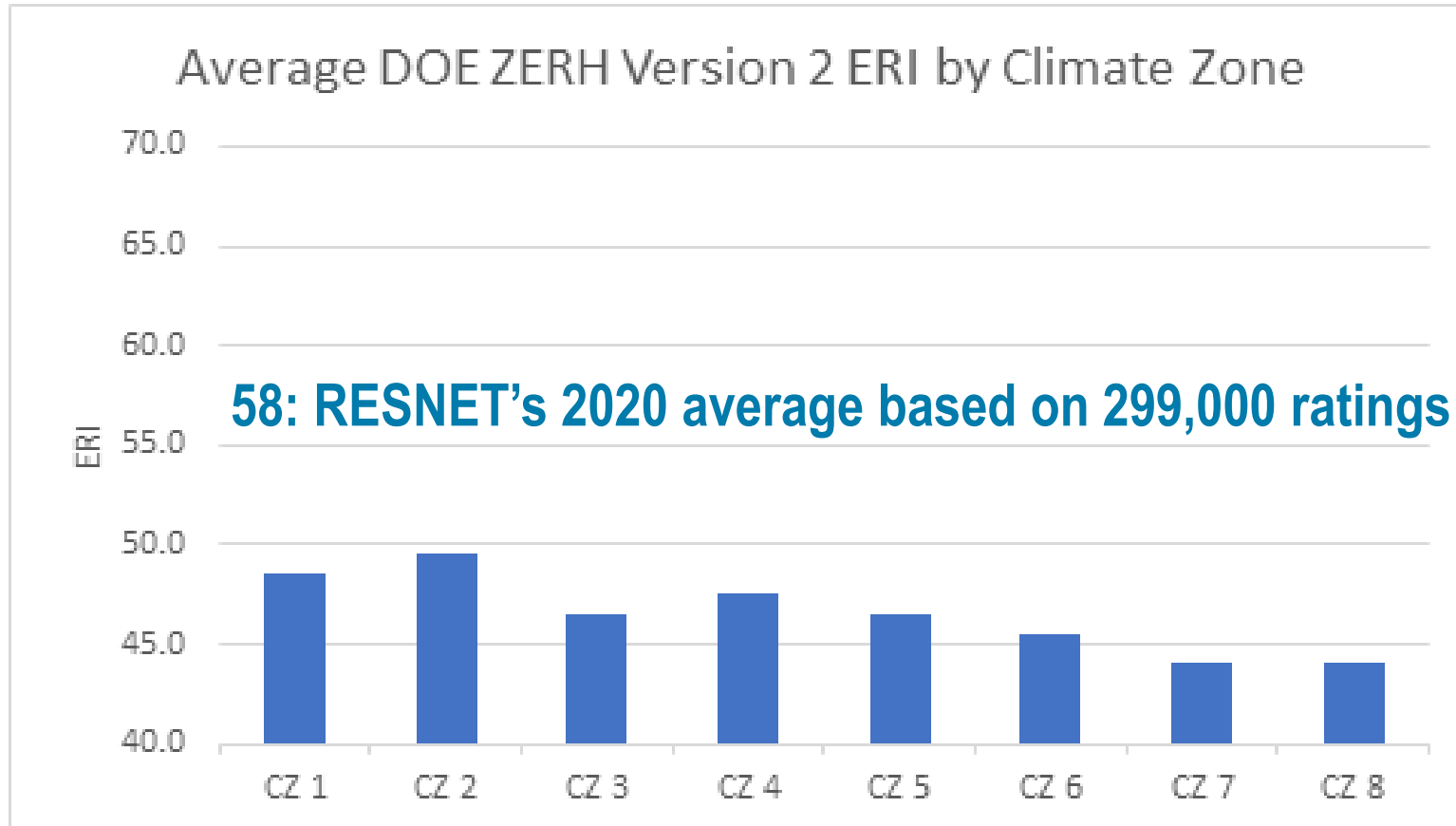
Documentation of the maximum allowable dead load and live load ratings of the existing roof (Rec DL.: +6 lbs./sq. ft.)

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



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. Resulting ERI Targets in the 40s.	Reflect recent innovations in the ZERH efficiency threshold.



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

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.

Which of the proposed DOE ZERH Version 2 updates looks the most challenging?

- a. Increased envelope insulation levels
- b. Lower ERI Values
- c. Wider application of PV Ready measures
- d. Increased lighting and appliance requirements

- 2021 Q4: ZERH V2 available for 30-day stakeholder comment period
- Early 2022: ZERH V2 finalized & integrated into rating software
- 2022 Q1: ZERH – Multifamily draft made available for stakeholder comment



U.S. DOE Zero Energy Ready Home

Getting Started with ZERH

- Same rater network
- Same modeling software
(at least 3 different options)
- Same plan review &
site inspection protocol



- 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

www.buildings.energy.gov/zero/

- Review & Comment on Draft Version 2 Program Specs (soon)
- DOE Tour of Zero (~300 homes)
- 24+ Recorded Webinars
- Marketing Tool Kit

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