U.S. DOE Zero Energy Ready Home
Single Family Homes ERI Target Procedure
Version 2 (Rev. 2)

This document provides detailed instructions for determining the DOE Zero Energy Ready Home Version 2 Energy Rating Index (ERI) Target, the highest ERI value that a home can achieve and qualify under the Zero Energy Ready Home program. Note, however, that regardless of the measures selected, the Mandatory Requirements in Exhibit 1 of the DOE Zero Energy Ready Home Version 2 National Program Requirements shall be met.

A DOE-recognized Home Certification Organization for Zero Energy Ready Home certifications (HCO for ZERH) approved software rating tool shall automatically determine the ZERH Version 2 - ERI Target for each rated home (referred to as the "ZERH V2 ERI Target" within this document). This shall be done by configuring the DOE ZERH Target Home Design in accordance with the building characteristics defined in Exhibit 1. The approved software rating tool shall not rely on a user-configured DOE ZERH Target Home Design. The approved software rating tool shall calculate the ERI value of the DOE ZERH Target Home Design. This ERI value shall be calculated using ANSI / RESNET / ICC Standard 301 including all Addenda and Normative Appendices, with new versions and Addenda implemented according to the schedule defined by the HCO for ZERH that the home is being certified under, with approved exceptions listed here. This value, rounded to the nearest whole number, shall equal the ZERH V2 ERI Target. The software rating tool ***must not include*** the contribution of PV generation when determining whether a Rated Home complies with the ZERH V2 ERI Target.

Exhibit 1: Expanded DOE Zero Energy Ready Home Single Family Homes Version 2 (Rev. 2) Target Home Design Definition [1]

Building Component	Target Specification								
Foundations	Construction Type & Structural Mass: Same as Rated Home, except: • For masonry floor slabs, modeled with 80% of floor area covered by carpet and 20% of floor directly exposed to room air								
	Conditioning Type: Same as Rated Home, except: • Crawlspaces shall be modeled as vented, with uninsulated walls, with net free vent aperture = 1sq. ft. per 150 sq. ft. of crawlspace floor area. This vented crawl shall be insulated at the floor level at a U value based on the section "Floors over Unconditioned Spaces" below.								
	Gross Area: Same as Rated Home								
	Insulation [2, 3]: Choose appropriate insulation level below: • Basement Wall Assembly U-factor only applies to conditioned basements; if applicable, insulation shall be located on interior side of walls • Floor assemblies above crawlspace foundations shall be configured to meet the applicable floor assembly U-factor listed in the building component section for Floors Over Unconditioned Spaces • Slab floors with a floor surface less than 12" below grade shall be insulated to the Slab Insulation R-value. The insulation shall extend downward from the top of the slab on the outside of the foundation wall and then vertically below-grade to the Slab Insulation Depth								
	2021 IECC Climate Zone [4]	1	2	3	4A, 4B	4C, 5	6	7	8
	Slab Insulation R-Value [5]	0	0	10	10	10	10	10	10
	Slab Insulation Depth (ft)	0	0	2	4	4	4	4	4
	Basement Wall Assembly U-Factor	0.360	0.360	0.091	0.059	0.050	0.050	0.050	0.050
Floors Over Unconditioned Spaces	Construction Type: Wood frame								
	Gross Area: Same as Rated Home								
	Insulation:								
	2021 IECC Climate Zone	1	2	3	4A, 4B	4C, 5	6	7	8

	Floor Assembly U-Factor	0.064	0.064	0.047	0.047	0.033	0.033	0.028	0.028
Above-Grade Walls	Interior & Exterior Construction Type: Wood frame								
	Gross Area: Same as Rated Home								
	Solar Absorptance = 0.75								
	Emittance = 0.90								
	Insulation:								
	2021 IECC Climate Zone	1	2	3	4A, 4B	4C, 5	6	7	8
	Wall Assembly U-Factor	0.084	0.084	0.060	0.045	0.045	0.045	0.045	0.045
Thermally Isolated Sunrooms	None								
Doors[6]	Area: same as Rated home								
	Orientation: same as Rated home								
	U-Values and SHGCs, as defined below:								
	Door Type	Opaque		≤1/2-Lite		>1/2-Lite, CZ 1-3		>1/2-Lite, CZ 4-8	
	U-Value	0.17		0.25		0.30		0.30	
	SHGC	N/A		0.25		0.25		0.40	
Glazing	Total Area: (except in homes with conditioned basements and attached homes[7]) • Same as Rated Home, where Rated Home glazing area is less than 15% of conditioned floor area; OR • 15% of the conditioned floor area, where the Rated Home glazing area is 15% or more of the conditioned floor area								
	Orientation: Equally distributed to North, East, South, and West								
	Interior Shade Coefficient: Same as Energy Rating Reference Home, as defined by ANSI / RESNET / ICC Std. 301								
	External Shading: none								
	U-Values and SHGCs, as defined below:								
	2021 IECC Climate Zone	1	2	3	4A, 4B	4C, 5	6	7	8
	U-Value	0.40	0.40	0.30	0.30	0.27	0.25	0.25	0.25
	SHGC	0.23	0.23	0.25	0.30	0.30	0.30	0.30	0.30
Skylights	None								
Ceilings	Construction Type: Wood frame								
	Gross Area: Same as Rated Home								
	Insulation:								
	2021 IECC Climate Zone	1	2	3	4A, 4B	4C, 5	6	7	8
	Ceiling Assembly U-Factor	0.035	0.026	0.026	0.024	0.024	0.024	0.024	0.024
Attics	Construction Type: Vented with aperture = 1sq. ft. per 300 sq. ft. ceiling area								
	Radiant Barrier: none								
Roofs	Construction Type: Composition shingle on wood sheathing								
	Gross Area: Same as Rated Home								
	Solar Absorptance = 0.92								
	Emittance = 0.90								

Internal Mass	Same as Energy Rating Reference Home, as defined by ANSI / RESNET / ICC Std. 301 Additional mass specifically designed as a Thermal Storage Element for the Rated Home shall be excluded.
On-site Energy Storage Systems	None.
On-site Power Production	None.
Lighting, Appliances, & Internal Gains	Lighting: Fraction of qualifying Tier II fixtures to all fixtures in qualifying light fixture locations: 100% for interior, exterior, and garage. If this mandatory requirement is configured with a pass/fail compliance check, DOE will accept either a check for 95% LEDs across all locations combined or 95% LEDs in each location separately. Note that software is not required to implement compliance checks on mandatory program requirements (Exhibit 1 of the National Program Requirements).
	Refrigerator: 450 kWh per year
	Dishwasher: Capacity Same as Rated Home, or Standard capacity if no dishwasher in the Rated Home For Standard capacity: LER = 270, GHWC = $22.23, Elec$ = $0.12, Gas$ = $1.09, LCY = 208 For Compact capacity: LER = 203, GHWC = $14.20, Elec$ = $0.12, Gas$ = $1.09, LCY = 208
	Ceiling Fan: 122 CFM per Watt; Quantity = Same as Rated Home per ANSI/RESNET/ICC 301, either 0 or Number of bedrooms + 1
	Clothes Washer: Efficiency equal to “Std 2018-Present” Standard Clothes Washer Model if clothes washer present in the Rated Home; otherwise, same as Energy Rating Reference Home, as defined by ANSI / RESNET / ICC Std. 301.
	Clothes Dryer: Same as Energy Rating Reference Home, as defined by ANSI / RESNET / ICC Std. 301.
	Internal Gains: Same as Energy Rating Reference Home, as defined by ANSI / RESNET / ICC Std. 301, except for adjustments for the lighting, refrigerator, dishwasher, and ceiling fans specified in this Section.
Heating Systems	Heating capacity shall be selected in accordance with ACCA Manual S based on building heating and cooling loads calculated in accordance with ACCA Manual J, Eighth Edition, ASHRAE Handbook of Fundamentals, or an equivalent computation procedure. For forced-air HVAC systems, degraded capacity from other than Grade I installation shall be accounted for using same methodology applied to Energy Rating Reference Home.
	Fuel Type: Same as Rated Home, except Target Home Design shall be configured with gas where Rated Home has non-electric equipment [8]
	Installation Quality: For forced-air HVAC systems, Grade I total duct leakage[9], Grade I (-7.5%) blower fan airflow deviation; Grade I (0.45 Watts/CFM) blower fan watt draw efficiency; and for air-source heat pumps, Grade III refrigerant undercharge.
	System Type: Same as Rated Home, except Target Home Design shall be configured with air-source heat pump where Rated Home has air-source or ground-source heat pump, electric strip heat, or electric baseboard heat; efficiency selected from below [10]

2021 IECC Climate Zone	1	2	3	4A, 4B	4C, 5	6	7	8
Gas Furnace AFUE	80	80	92	95	95	95	95	95
Gas Boiler, AFUE	80	80	92	95	95	95	95	95
Air-Source HP, HSPF	9.2	9.2	9.2	9.2	9.5	9.5	9.5	9.5
ASHP Backup	electric	electric	electric	electric	electric	electric	electric	electric

	For non-electric warm furnaces and non-electric boilers, the Electric Auxiliary Energy shall be determined in accordance with the methodology for the Energy Rating Reference Home in ANSI / RESNET / ICC Std. 301.
Cooling Systems	Cooling capacity shall be selected in accordance with ACCA Manual S based on building heating and cooling loads calculated in accordance with ACCA Manual J, Eighth Edition, ASHRAE Handbook of Fundamentals, or an equivalent computation procedure. For forced-air HVAC systems, degraded capacity from other-than-Grade I installation shall be accounted for using same methodology applied to Energy Rating Reference Home.

	Fuel Type: Same as Rated Home, except Target Home Design shall be configured with gas where Rated Home has non-electric equipment [8]								
	Installation Quality: For forced-air HVAC systems, Grade I total duct leakage[9], Grade I (-7.5%) blower fan airflow deviation; Grade I (0.45 Watts/CFM) Watt draw efficiency; and for AC's and air-source heat pumps, Grade III refrigerant undercharge.								
	System Type: Same as Rated Home, except Target Home Design shall be configured with air-source heat pump where Rated Home has air-source or ground-source heat pump; efficiency selected from below [11]								
	2021 IECC Climate Zone	1	2	3	4A, 4B	4C, 5	6	7	8
	AC SEER	18	18	16	16	14	14	14	14
	Air-Source Heat Pump SEER	18	18	16	16	16	16	16	16
Service Water Heating Systems	Use (Gallons per Day): Same as Energy Rating Reference Home, as defined by ANSI / RESNET / ICC Std. 301, except for reduced usage resulting from the dishwasher specified in the Lighting, Appliances, & Internal Gains Section.[12]								
	Tank Temperature: Same as Energy Rating Reference Home, as defined by ANSI / RESNET / ICC Std. 301.								
	Fuel Type: Same as Rated Home, except Reference Design shall be configured with gas where Rated Home has non-electric equipment [8]								
	System Type: Where Rated Home has non-electric water heater, Target Home Design shall be configured with a tankless gas water heater with **0.95 Uniform Energy Factor** (UEF) with no solar heating. Where Rated Home has electric water heater, Target Home Design shall be configured with an electric heat pump water heater with **2.57 UEF** with no solar heating, tank size shall be equal to the Rated Home or 60-gallon tank size if Rated Home uses tankless electric water heater, and first hour rating (FHR) shall be equal to the Rated Home or 63 if the Rated Home does not specify FHR.								
Thermal Distribution Systems	Duct Leakage to Outside: 0 CFM25 per 100 sq. ft. of conditioned floor area								
	Duct Insulation: None								
	Duct Surface Area: Same as Rated Home								
	Supply and Return Duct Locations shall be 100% in conditioned space.								
Thermostat	Type: Programmable								
	Temperature Setpoints: Same as Energy Rating Reference Home, but with offsets for a programmable thermostat, as defined by ANSI / RESNET / ICC Std. 301								
Dehumidifiers	Type, capacity, efficacy, and dehumidistat setpoint same as Energy Rating Reference Home, as defined by ANSI/RESNT/ECC 301, when dehumidification system is present in Rated home; otherwise none.								
Infiltration	**Infiltration Rates (ACH50)**								
	2021 IECC Climate Zone	1	2	3	4A, 4B	4C, 5	6	7	8
	Single Family Detached	2.75	2.75	2.25	2.25	2.0	2.0	2.0	1.5
	Single Family Attached	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Whole-House Mechanical Ventilation	Rate: CFM = 0.01 * CFA + 7.5 * (Nbr + 1), where CFA = Conditioned Floor Area and Nbr = Number of Bedrooms; Runtime: 24 Hours / Day								
	Fan Watts: determined by dividing the airflow rate (cfm) as calculated based on prior row, by the fan efficacy values (cfm/Watt) shown below								
	System Type: determined from table entries below								
	Climate Zone	1	2	3	4	4C, 5	6	7	8
	System Type[13]	supply	supply	supply	supply	balanced	balanced	balanced	balanced
	Fan Efficacy (cfm/W)	2.9	2.9	2.9	2.9	1.2	1.2	1.2	1.2
	Heat Exchange	No	No	No	No	Yes; 65% ASRE	Yes; 65% ASRE	Yes; 65% ASRE	Yes; 65% ASRE

Endnotes:

[1] Any parameter not specified in this exhibit shall be identical to the value entered for the Rated Home.

[2] Slab insulation R-values represent nominal insulation levels; and assembly U-factors for foundations, floors, walls, and ceilings represent the overall assembly, inclusive of sheathing materials, cavity insulation, installation quality, framing, and interior finishes.

[3] If software allows the user to specify the thermal boundary location independent of the conditioned space boundary in the basement of the rated home, then the thermal boundary of the ZERH Target Home Design shall be aligned with this boundary. For example, if the thermal boundary is located at the walls, then the wall insulation shall be configured as if it was a conditioned basement. If the thermal boundary is located at the floor above the basement, then the floor insulation shall be configured as if it was a floor over an unconditioned space.

[4] Climate Zones as defined by the 2021 IECC may be viewed online: https://codes.iccsafe.org/content/IECC2021P1/chapter-3-re-general-requirements. Note that some locations have shifted to a different climate zone in the 2021 IECC as compared to prior versions of the IECC. Compliance with DOE ZERH program requirements is based on climate zones as defined in the 2021 IECC.

[5] Rating software incorporating DOE ZERH Version 2 compliance should include an input that indicates if a code official in the project's jurisdiction has designated the jurisdiction as having a Very Heavy Termite infestation. If this input is selected, then for the purpose of an envelope UA analysis, the code reference home's slab edge insulation level shall be set to the same R-value and depth as the Rated Home. The intent is that the Rated Home would not be penalized (in terms of envelope UA compliance) if it is unable to install slab edge insulation due to termite-related risks. However, for the determination of the ZERH V2 ERI Target value, the slab edge insulation R-value and depth shall be as listed in Exhibit 1, regardless of whether the input for Very Heavy Termite infestation is selected.

[6] Note that the U-factor requirement applies to the whole door while the SHGC only applies to the glazed portion.

ZERH has adopted the following definitions for door types (from the ENERGY STAR eligibility criteria in the Version 6.0 Product Specification for Residential Windows, Doors, and Skylights):

i) Opaque: A Door or Sidelite with no glazing (per NFRC 100).
ii) ≤ ½-Lite: A Door with ≤ 900 in^2 (6.25 ft^2, 0.581 m^2) of glazing or a Sidelite ≤ 281 in^2 (1.95 ft^2, 0.181m^2) of glazing (per NFRC 100). Includes ¼- and ½-lite Doors and Sidelites.
iii) > ½-Lite: A Door with > 900 in^2 (6.25 ft^2, 0.581 m^2) of glazing or a Sidelite with > 281 in^2 (1.95 ft^2, 0.181m^2) of glazing (per NFRC 100). Includes ¾-lite and fully glazed Doors and Sidelites.

[7] When determining the ZERH ERI Target for homes with conditioned basements and for attached homes, the following formula shall be used to determine total window area of the ZERH Target Design:

$$AG = 0.15 \times CFA \times FA \times F$$

Where:

- AG = Total glazing area
- CFA = Total conditioned floor area
- FA = (Gross above-grade thermal boundary wall area) / (Gross above-grade thermal boundary wall area + 0.5 x Gross below-grade thermal boundary wall area)

- F = 1 - 0.44 x (Gross common wall area) / (Gross above-grade thermal boundary wall area + Gross common wall area)

And where:

- Thermal boundary wall is any wall that separates Conditioned Space from Unconditioned Space, outdoor environment, or the surrounding soil;
- Above-grade thermal boundary wall is any portion of a thermal boundary wall not in contact with soil;
- Below-grade thermal boundary wall is any portion of a thermal boundary wall in soil contact; and
- Common wall is the total wall area of walls adjacent to another conditioned living unit, not including foundation walls.

[8] Fuel type(s) shall be same as Rated Home, including any dual-fuel equipment where applicable. For a Rated Home with multiple heating, cooling, or water heating systems using different fuel types, the applicable system capacities and fuel types shall be weighted in accordance with the loads distribution (as calculated by accepted engineering practice for that equipment and fuel type) of the multiple systems.

[9] The Target Home's duct leakage shall be configured as the maximum allowable total duct leakage to comply with the ENERGY STAR Single-Family New Homes National Rater Field Checklist Version 3.2, item 6.4. These values correspond to the limits to achieve Grade I per Standard 310, section 5.4.1, Table 2a (shown below):

Time of Test	Number of Returns	Leakage Limit (CFM at 25 Pa)
Rough-In	< 3	The greater of ≤ 4 per 100 ft^2 of CFA or ≤ 40
Rough-In	≥ 3	The greater of ≤ 6 per 100 ft^2 of CFA or ≤ 60
Final	< 3	The greater of ≤ 8 per 100 ft^2 of CFA or ≤ 80
Final	≥ 3	The greater of ≤ 12 per 100 ft^2 of CFA or ≤ 120

[10] For a Rated Home without a heating system, the ZERH Target Home Design shall be configured with a 78% AFUE gas furnace system, unless the Rated home has no access to natural gas or fossil fuel delivery. In such cases, the ZERH Target Home Design shall be configured with a 7.7 HSPF air-source heat pump.

[11] For a Rated Home without a cooling system, the ZERH Target Home Design shall be configured with a 13 SEER electric air conditioner.

[12] ZERH Target Home Design should reflect standard-flow plumbing fixtures, reference or "Std 2018-Present" Standard Clothes Washer Model gallons per day, standard distribution system water use effectiveness, a hot water piping ratio of 1.0, no pipe insulation, and no drain water heater recovery.

[13] Ventilation Type is identified here for clarity in programming the Target Home Design only. Numerous factors such as energy performance, induced sensible and latent loads, IAQ, and moisture management should be considered in selecting an appropriate ventilation system type.