



U.S. DOE Zero Energy Ready Home Multifamily ERI Target Procedure Version 2 (Rev. 1)

National ERI Target Procedure for use with ANSI/RESNET/ICC 301

This document provides detailed instructions for determining the Zero Energy Ready Home (ZERH) ERI Target, the highest ERI value that each rated multifamily dwelling unit, excluding townhouses, may achieve to earn the DOE Zero Energy Ready Home Multifamily Program Version 2 (ZERH MF V2) Certification. In addition to meeting the ZERH MF V2 ERI Target for each unit, units shall also meet all mandatory requirements in Exhibit 1 of the ZERH MF V2 National Program Requirements. While Townhouses are eligible to earn ZERH MF V2 certification by meeting their ZERH ERI Target and also meeting all mandatory requirements in Exhibit 1 of the ZERH MF V2 National Program Requirements, the instructions for determining their ZERH ERI Target is in the ZERH Single Family Homes ERI Target Procedure Version 2 (most recent revision).

A DOE-recognized Home Certification Organization for Zero Energy Ready Home certifications (HCO for ZERH) Approved Software Rating Tool shall automatically determine (i.e., without relying on a user-configured ZERH Multifamily Reference Design) this target for each rated unit. This software is reviewed and approved by DOE. The target is created by configuring the ZERH MF V2 Reference Design in accordance with Exhibit 1 below, the Expanded ZERH Multifamily Reference Design Definition, and calculating its associated ERI value. The 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 implementation schedule defined by the HCO for ZERH that the building is being certified under, with approved exceptions listed [here](#). This ERI value, rounded to the nearest whole number, shall equal the ZERH MF V2 ERI Target.

On-site power generation in the Design Dwelling may not be used to meet the DOE ZERH MF V2 ERI target.

Exhibit 1: Expanded Zero Energy Ready Home Multifamily Reference Design Definition

Expanded ZERH Multifamily Reference Design Definition ¹								
Building Component: Foundations								
Construction Type and Structural Mass: Same as Rated Unit, ² except:								
<ul style="list-style-type: none">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 Unit, except:								
<ul style="list-style-type: none">Crawlspaces shall be modeled as vented with net free vent aperture = 1 ft² per 150 ft² of crawlspace floor area.								
Gross Area: Same as Rated Unit								
Insulation: ^{3, 4} Choose appropriate insulation level below:								
<ul style="list-style-type: none">Basement wall continuous insulation R-value only applies to conditioned basements; if applicable, insulation shall be located on interior side of wallsFloor 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 and crawlspace walls shall be uninsulated.Slab floors with a floor surface less than 24" 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 walls and then vertically below-grade to the slab insulation depth.⁵								
Climate Zone (CZ): ⁶	1	2	3	4	4C, 5	6	7	8
Slab Insulation R-Value:	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



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Building Component: Floors Over Unconditioned Space Volumes, Non-Freezing Space, or outdoor space								
Construction type: Mass Floor if Rated Unit has a Mass Floor; otherwise, Wood frame								
Gross Area: Same as Rated Unit								
Insulation:								
Climate Zone:	1	2	3	4	4C, 5	6	7	8
Wood Framed Floor U-factor:	0.064	0.064	0.047	0.047	0.033	0.033	0.028	0.028
Mass Floor U-Factor:	0.322	0.087	0.074	0.051	0.051	0.051	0.042	0.038
Building Component: Above-Grade Walls, adjacent to Exterior or Garage								
Interior and Exterior Construction Type: Wood frame								
Gross Area: Same as Rated Unit								
Solar Absorptance = 0.75								
Emittance = 0.90								
Insulation:								
Climate Zone:	1	2	3	4	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
Building Component: Thermally Isolated Sunrooms								
None								
Building Component: Doors								
Area: Same as Rated Unit, with door seal properly installed to minimize air leakage between the door and door frame, to avoid the 140 CFM50 addition to measured airflow per ANSI/RESNET/ICC Standard 380.								
Orientation: Same as Rated Unit								
Door Type: ⁷	Opaque	≤ ½-Lite	> ½-Lite CZ 1-3	> ½-Lite CZ 4-8				
Whole Door U-Factor:	0.17	0.25	0.30	0.30				
SHGC:	n/a	0.25	0.25	0.40				
Building Component: Glazing								
Total Area: AG = 0.15 x CFA x FA x F, without exceeding available wall area. ⁸								
Orientation: Same as Rated Unit, by percentage of area								
Interior Shade Coefficient: Same as Energy Rating Reference Home, as defined by ANSI/RESNET/ICC Standard 301								
External Shading: None								
Climate Zone:	1	2	3	4	4C, 5	6	7	8
U-Factor:	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
Class AW Assembly U-Factors (I.e., Structural) Windows								
Climate Zone:	1	2	3	4	4C, 5	6	7	8
Fixed Window U-Factor:	0.48	0.43	0.40	0.34	0.34	0.32	0.28	0.27
Operable Window U-Factor:	0.59	0.57	0.51	0.43	0.43	0.40	0.34	0.30
SHGC:	0.25	0.25	0.25	0.30	0.30	0.30	0.30	0.30
Skylights: None								
Building Component: Ceilings, adjacent to Exterior or Unconditioned Space Volumes								
Construction Type: Wood frame								



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Gross Area: Same as Rated Unit								
Insulation:								
Climate Zone:	1	2	3	4	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
Building Component: Attics								
Construction Type: Vented with aperture = 1 ft ² per 300 ft ² ceiling area ⁹								
Radiant Barrier: None								
Building Component: Roofs								
Construction Type: Composition shingle on wood sheathing								
Gross Area: Same as Rated Unit								
Solar Absorptance = 0.92								
Emittance = 0.90								
Building Component: Internal Mass								
Same as Energy Rating Reference Home, as defined by ANSI/RESNET/ICC Standard 301.								
Additional mass specifically designed as a Thermal Storage Element for the Rated Unit shall be excluded								
Building Component: Lighting, Appliances, Fixtures, and Internal Gains								
Lighting: Fraction of qualifying Tier II fixtures to all fixtures in qualifying light fixture locations 100% for interior; 100% for exterior and garage								
Refrigerator: 450 kWh per year								
Dishwasher: Capacity: Same as Rated Unit, or Standard capacity if no dishwasher in installed in Rated Unit 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 Unit per ANSI/RESNET/ICC 301, either 0 or Number of bedrooms + 1								
Clothes Washer: If clothes washer present in the Rated Unit, efficiency equal to "Std 2018-Present" Standard Clothes Washer Model; otherwise, same as Energy Rating Reference Home, as defined by ANSI/RESNET/IOCC Standard 301								
Clothes Dryer: Same as Energy Rating Reference Home, as defined by ANSI/RESNET/ICC Standard 301								
Water fixtures: all showers and faucets ≤ 2.0 gpm.								
Internal Gains: Same as Energy Rating Reference Home, as defined by ANSI/RESNET/ICC Standard 301, except for adjustments for the lighting, refrigerator, dishwasher, clothes washer, and ceiling fans specified in this section								
Building Component: Heating Systems								
Heating capacity shall be selected in accordance with ACCA Manual S based on loads calculated for the Reference Design 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. Where heat from a central boiler is distributed by water-loop heat pumps within the Rated Unit, in accordance with the methodology for the Rated Home in ANSI/RESNET/ICC Standard 301, the Reference Design shall be configured such that the heating load is assigned to two separate heating systems: 1) a heat pump with a capacity that is equal to the Reference Design heating load divided by 4.5 COP and 2) a boiler with the balance of the capacity of (1-1/4.5) or 77.78%								



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Fuel Type: ¹⁰ Same as Rated Unit, except Reference Design shall be configured with gas where Rated Unit has non-electric equipment								
Installation Quality: For forced-air HVAC systems, Grade I total duct leakage ¹¹ , Grade I (-7.5%) blower fan airflow deviation, Grade I (0.45 W/CFM) blower fan efficiency, and for air-source heat pumps, Grade III refrigerant undercharge								
System Type: Same as Rated Unit, except Reference Design shall be configured with air-source heat pump where Rated Unit has electric strip heat or electric baseboard heat; efficiency selected from below: ¹²								
Climate Zone:	1	2	3	4	4c, 5	6	7	8
Gas Furnace AFUE:	90	90	90	95	95	95	95	95
Gas Boiler AFUE:	90	90	90	95	95	95	95	95
Central Boiler, ≥ 300 KBtu/h E_t :	80	80	80	86	95	95	95	95
Central Boiler w/WLHP, ≥ 300 KBtu/h E_t :	80	80	80	89	90	90	90	90
Air-Source Heat Pump HSPF:	9.2	9.2	9.2	9.2	9.5	9.5	9.5	9.5
Air-Source Heat Pump Backup:	Electric							
Ground-Source Heat Pump COP:	2.7	2.7	2.7	2.7	2.8	2.8	2.8	2.8
For non-electric warm air furnaces and non-electric boilers, serving the Rated Unit and no other units, the Electric Auxiliary Energy shall be determined in accordance with the methodology for the Energy Rating Reference Home in ANSI/RESNET/ICC Standard 301. For non-electric boilers and GSHPs, serving the Rated Unit and other units through a shared circulation loop, the Electric Auxiliary Energy shall be determined in accordance with the methodology for the Rated Home in the ANSI/RESNET/ICC Standard 301, using the same Shared Pump Power (SP_{kw}) OR using 0.85 for motor efficiency and using the same HP as the pump serving the Rated Unit								
Building Component: Cooling Systems ¹³								
Cooling capacity shall be selected in accordance with ACCA Manual S based on loads calculated for the Reference Design 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 Grade III install shall be accounted for using same methodology applied to Energy Rating Reference Home								
Fuel Type: Same as Rated Unit, except Reference Design shall be configured with gas where Rated Unit has non-electric equipment								
Installation Quality: For forced-air HVAC systems, Grade I total duct leakage ¹¹ , Grade I (-7.5%) blower fan airflow deviation, Grade I (0.45 W/CFM) blower fan efficiency and, for A/Cs and air-source heat pumps, Grade III refrigerant undercharge								
System Type: Same as Rated Unit, except Reference Design shall be configured with air-source heat pump where Rated Unit has electric strip heat, or electric baseboard heat; applicable efficiency selected from below:								
Climate Zone:	1	2	3	4	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
Ground-Source Heat Pump EER:	16	16	14	14	14	14	14	14
Where system type is a chiller or cooling tower with water-loop heat pumps, Reference Design $SEER_{eq}$ shall be determined in accordance with the methodology for the Rated Home in ANSI/RESNET/ICC Standard 301, using the same pumping and fan power OR using 0.85 for motor efficiency and using the same HP as the pumps and fans serving the Rated Unit. For chillers, Reference Design $SEER_{eq}$ shall be determined using 0.75 kW/ton. For water-loop heat pumps, Reference Design $SEER_{eq}$ shall be determined using 15 EER								



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Building Component: Service Water Heating Systems
Domestic hot water service piping insulation: Hot water distribution piping that serves multiple dwelling units (including all central systems) insulated to R-3. Hot water distribution piping associated with water heaters serving only one dwelling unit insulated to R-0.
Use (Gallons per Day): Same as Energy Rating Reference Home, as defined by ANSI/RESNET/ICC Standard 301, except for reduced usage resulting from the dishwasher, low-flow fixtures, and clothes washer as specified in the Lighting, Appliances, Fixtures, and Internal Gains Section
Tank Temperature: Same as Energy Rating Reference Home, as defined by ANSI/RESNET/ICC Standard 301
Recirculation Pump Energy (for pumps serving the Rated Unit and no other units): 0 kWh per year Recirculation Pump Energy (for pumps serving the Rated Unit and other units): as defined by ANSI/RESNET/ICC Standard 301, using the same Shared HW Pump Power (SHWP _{kw}) OR using 0.85 for motor efficiency and using the same HP as the pump serving the Rated Unit
Fuel Type: Same as Rated Unit except Reference Design shall be configured with gas where Rated Unit has non-electric equipment
System Type (when Rated Unit is served by a commercial system): Same as system serving the Rated Unit, with no solar heating. For fossil-fuel boilers or water heaters, use 95% E _t . For electric boilers or water heaters, use 1.6 COP. System Type (when Rated Unit is served by residential systems): Conventional storage water heater with no solar heating. Where Rated Unit has non-electric water heater, Reference Design shall be configured with a tankless gas water heater with 0.95 UEF. Where Rated Unit has electric water heater, Reference Design shall be configured with an electric heat pump water heater with 1.95 UEF and tank size equal to that of Rated Unit, or 60 gallon tank size if Rated Unit 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.
Building Component: Thermal Distribution Systems
Duct Leakage to Outside: 0 CFM25 per 100 ft ² of conditioned floor area
Duct Insulation: None
Duct Surface Area: Same as Rated Unit
Supply and Return Duct Locations shall be 100% in conditioned space
Building Component: Dehumidifiers
Type, capacity, and dehumidistat setpoint same as Energy Rating Reference Home, as defined by ANSI/RESNET/ICC 301, when dehumidification system is present in Rated Unit; otherwise, none.
Building Component: On-site Power Production
None.
Building Component: On-site Energy Storage Systems
None.
Building Component: Thermostat
Type: Programmable
Temperature Setpoints: Same as Energy Rating Reference Home, but with offsets for a programmable thermostat, as defined by ANSI/RESNET/ICC Standard 301
Building Component: Infiltration and Mechanical Ventilation



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Infiltration rate modeled at ≤ 0.25 CFM50/ft ² of enclosure area with A_{ext} applied to calculate Infiltration Rate, in accordance with ANSI / RESNET / ICC 301									
Mechanical ventilation system:									
Rate: CFM = $0.01 \times CFA + 7.5 \times (Nbr + 1)$, where CFA = Conditioned Floor Area and Nbr = Number of Bedrooms; Runtime: 24 Hours/Day									
Fan Watts: Watts = CFM Rate/Ventilation Efficacy, where CFM Rate is determined above and Ventilation Efficacy is determined below									
Climate Zone:	1	2	3	4	4c, 5	6	7	8	
Ventilation Efficacy (cfm/W):	2.9	2.9	2.9	2.9	1.2	1.2	1.2	1.2	
Ventilation Type & Heat Recovery:	Supply				Balanced, 65% ASRE				

Endnotes

¹ Any parameter not specified in this exhibit shall be identical to the value entered for the Rated Unit. Where envelope building components do not exist in the Rated Unit, such as a foundation or slab, they should not be modeled in the ZERH Multifamily Reference Design, unless explicitly stated, such as vented attics where unvented attics are present in the Rated Unit. Where the envelope component is adiabatic in the Rated Unit, it shall also be adiabatic in the Multifamily Reference Design. Where the envelope component is not adiabatic but is adjacent to a space other than those specified in the Building Component column of Exhibit 1, model as uninsulated in the Reference Design.

² "Same as Rated Unit" indicates that the parameter shall be identical to the value entered for the Rated Unit.

³ 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.

⁴ If software allows the user to specify the thermal boundary location independent of the conditioned space boundary in the basement of the Rated Unit, then the thermal boundary of the ZERH Multifamily Reference 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.

⁵ Note that, for the purposes of the ZERH Reference Design, the slab insulation R-value and depth shall be modeled even in jurisdictions designated by a code official as having Very Heavy Termite Infestation for the purpose of determining the ZERH ERI Target.

⁶ 2021 IECC Climate Zone designations, as defined and illustrated in Section R301 of the code, shall be used to configure the ZERH Reference Design. Note that some locations have shifted to a different Climate Zone in the 2021 IECC compared to prior editions.

⁷ 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):



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i) Opaque: A Door or Sidelite with no glazing (per NFRC 100).

ii) $\leq \frac{1}{2}$ -Lite: A Door with ≤ 900 in² (6.25 ft², 0.581 m²) of glazing or a Sidelite ≤ 281 in² (1.95 ft², 0.181m²) of glazing (per NFRC 100). Includes $\frac{1}{4}$ - and $\frac{1}{2}$ -lite Doors and Sidelites.

iii) $> \frac{1}{2}$ -Lite: A Door with > 900 in² (6.25 ft², 0.581 m²) of glazing or a Sidelite with > 281 in² (1.95 ft², 0.181m²) of glazing (per NFRC 100). Includes $\frac{3}{4}$ -lite and fully glazed Doors and Sidelites.

⁸ When determining the ZERH ERI Target, the following formula shall be used to determine total window area of the ZERH Multifamily Reference Design: $AG = 0.15 \times CFA \times FA \times F$

Where:

- AG = Total glazing area
- CFA = Total conditioned area
- FA = (Gross above-ground thermal boundary wall area) / (Gross above-grade boundary wall area + 0.5 x Gross below-grade thermal boundary wall area)
- F = $1 - 0.44$ (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 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 other conditioned space, not including foundation walls.

⁹ A vented unconditioned attic shall only be modeled in the Multifamily Reference Design where attics (of any type) exist in the Rated Unit or when specified as the Duct Location in the Thermal Distribution systems section of this Exhibit. Where the Rated Unit has more than one ceiling type, the ceiling area used to calculate the vent aperture area shall be the area of the ceiling that is exposed to exterior, under attics, and/or under other unconditioned common spaces. Where the Rated Unit is entirely located beneath another dwelling unit or unrated conditioned space, no attic is modeled in the Reference Design.

¹⁰ Fuel type(s) shall be same as Rated Unit, including any dual-fuel equipment where applicable. For a Rated Unit 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, unless otherwise specified by ANSI/RESNET/ICC Standard 301.

¹¹ The Target Home's duct leakage shall be configured as the maximum allowable total duct leakage 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



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¹² For a Rated Unit without a heating system, the ZERH Multifamily Reference Design shall be configured with a 78% AFUE gas furnace system, unless the Rated Unit has no access to natural gas or fossil fuel delivery. In such cases, the ZERH Reference Multifamily Design shall be configured with a 7.7 HSPF air-source heat pump.

Where a furnace or boiler is the heating system for the Rated Unit and is rated in combustion efficiency (E_c), the thermal efficiency (E_t) shall be modeled as $E_c - 2\%$. Where thermal efficiency (E_t) is modeled, it shall be converted to AFUE using the following equation: $E_t = 0.875 \times \text{AFUE} + 10.5\%$.

¹³ For a Rated Unit without a cooling system, the ZERH Multifamily Reference Design shall be configured with a 13 SEER electric air conditioner.