

DOE Zero Energy Ready Home for Multifamily Dwellings

Draft Program Requirements for Comment – December 2019

Eligibility Requirements

Buildings that are eligible for the DOE Zero Energy Ready Home Multifamily program are the same as those buildings eligible under the ENERGY STAR Multifamily New Construction (ESMFNC) program, with the exception that DOE Zero Energy Ready Home – Multifamily eligible buildings must be 5 stories or less above-grade.ⁱ Eligible building types include multifamily buildings ≤ 5 stories above-grade that are not 2-family dwellings, and may include mixed-use buildings where dwelling units and common space exceed 50% of the building square footage (parking garage square footage is excluded from this calculation).ⁱⁱ Townhouses are also eligible under certain conditions.ⁱⁱⁱ

Note that these specifications do not apply to projects in California, where DOE is considering alternate multifamily specifications.

Partnership and Training Requirements

Builders, developers, and verifiers must register online to become a DOE Zero Energy Ready Home partner here: <https://www5.eere.energy.gov/buildings/residential/register>

Qualification

Dwellings may qualify for DOE Zero Energy Ready Home - Multifamily (ZERH-Multifamily) using either the Prescriptive Path or the ERI compliance pathway. Note that compliance with these guidelines is not intended to imply compliance with all local code requirements that may be applicable.

DOE Zero Energy Ready Home - Multifamily Prescriptive Path

The prescriptive path provides a single set of measures that can be used to construct a ZERH labeled project. This path requires that dwelling units meet or exceed all applicable items in Exhibit 1 (Mandatory Requirements) and Exhibit 2 (ZERH-Multifamily Target Dwelling Design). Common spaces must meet all applicable Mandatory items in Exhibit 1, to the extent that they apply. All dwellings certified through the Prescriptive Path shall be submitted to DOE (email: zero@newportpartnersllc.com).

DOE Zero Energy Ready Home - Multifamily ERI Path

The ERI path requires that dwelling units and common spaces meet all applicable items in Exhibit 1 (Mandatory Requirements). Additionally, each dwelling unit must achieve an ERI score equal to or less than the ERI of the ZERH-Multifamily Target Dwelling Design (Exhibit 2), as demonstrated by energy modeling. Projects must use a software rating tool approved by an EPA-Approved Verification Oversight Organization (VOO) to determine the ERI.

Exhibit 1: Mandatory Requirements

Area of Improvement	Mandatory Requirements	Applicability
1. ENERGY STAR Multifamily New Construction Baseline	<input type="checkbox"/> Certified under ENERGY STAR Multifamily New Construction Program Version 1.0, 1.1, or 1.2 (depending on state) ^{iv} . Common spaces must comply with applicable ESMFNC requirements.	Dwelling Units and Common Spaces

2. Envelope	<input type="checkbox"/> Ceiling, wall, floor, slab, and opaque door insulation for dwelling units shall meet or exceed 2018 Commercial IECC levels (wood frame, Group R) ^v	Dwelling Units
3. Duct System	<input type="checkbox"/> Duct distribution systems for dwelling units and for common spaces are located within the building's thermal and air barrier boundary or an optimized location to achieve comparable performance. ^{vi} <input type="checkbox"/> HVAC air handler is located within the building's thermal and air barrier boundary.	Dwelling Units and Common Spaces
4. Water Efficiency	<input type="checkbox"/> Hot water delivery systems (in-dwelling or central) shall meet efficient design requirements ^{vii} or <input type="checkbox"/> Water heaters and fixtures shall meet efficiency criteria ^{viii}	Dwelling Units
5. Lighting & Appliances	<input type="checkbox"/> All in-dwelling installed refrigerators, dishwashers, clothes washers, and clothes dryers are ENERGY STAR qualified. ^{ix} <input type="checkbox"/> 95% of in-dwelling 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 ^{ix}	Dwelling Units
6. Indoor Air Quality	<input type="checkbox"/> Dwelling Units are Certified under EPA Indoor airPLUS <input type="checkbox"/> Common Spaces, as defined by ESMFNC National Program Requirements , meet Indoor airPLUS Construction Specifications	Dwelling Units and Common Spaces
7. Renewable Ready	<input type="checkbox"/> Multifamily provisions of the DOE Zero Energy Ready Home PV-Ready Checklist are Completed ^x	See End Note

DOE Zero Energy Ready Home Target Dwelling

For the purpose of Partner review, the table below contains additional information to allow Partners to compare the ZERH-Multifamily Target Design specifications to the ESMFNC Reference Dwelling specifications. The table shows the draft DOE ZERH Multifamily Target Dwelling specs (Column 3) as compared to the ENERGY STAR Multifamily Reference Design (Version 1.1) specifications (Column 2). ZERH-Multifamily specifications shown in **green** in Column 3 are more stringent than the ESMFNC Reference Design in Column 2. Additionally, green shading in Column 4 illustrates when the proposed ZERH-Multifamily specs (Column 3) are more stringent than the ESMFNC specs found in Column 2. The darker the shading, the greater the increase in stringency. No shading in Column 4 indicates parity between the ESMFNC Reference Design and the DOE ZERH – Multifamily Target Dwelling.

Exhibit 2: DOE Zero Energy Ready Home Target Dwelling Design

1. Building Component	2. ENERGY STAR MFNC Reference Design (based on V1.1 from 10/2019)	3. DOE ZERH - Multifamily Target Dwelling Specification - <i>DRAFT</i>	4. Notes
Building Envelope			
BUILDING ENVELOPE NOTES	Insulation levels based on 2012 IECC insulation levels (Commercial, wood frame)	Insulation levels based on 2018 IECC insulation levels (Commercial, Group R, wood frame) for opaque components	
Insulation Grade	RESNET Grade 1	RESNET Grade 1	
Foundations – Unheated Slabs Insulation R-Value & Depth	CZ 1: 0,0 CZ 2: 0,0 CZ 3: 0,0 CZ 4: R10, 2 ft CZ 5 & 4C: R10, 2 ft CZ 6: R15, 2 ft CZ 7: R15, 2 ft CZ 8: R20, 2 ft	CZ 1: 0,0 CZ 2: 0,0 CZ 3: 0,0 CZ 4: R10, 2 ft CZ 5 & 4C: R10, 2 ft CZ 6: R15, 2 ft CZ 7: R15, 2 ft CZ 8: R20, 2 ft	
Foundations – Basement Wall Continuous Insulation R-Value	CZ 1: R 0 CZ 2: R 0 CZ 3: R 0 CZ 4: R7.5 CZ 5 & 4C: R7.5 CZ 6: R7.5 CZ 7: R10 CZ 8: R12.5	CZ 1: R 0 CZ 2: R 0 CZ 3: R 0 CZ 4: R7.5 CZ 5 & 4C: R7.5 CZ 6: R7.5 CZ 7: R10 CZ 8: R12.5	
Floors over Unconditioned Spaces (U-factor)	CZ 1: U 0.066 CZ 2: U 0.033 CZ 3: U 0.033 CZ 4: U 0.033 CZ 5 & 4C: U 0.033 CZ 6: U 0.033 CZ 7: U 0.033 CZ 8: U 0.033	CZ 1: U 0.066 CZ 2: U 0.033 CZ 3: U 0.033 CZ 4: U 0.033 CZ 5 & 4C: U 0.033 CZ 6: U 0.033 CZ 7: U 0.033 CZ 8: U 0.033	
Wood-Framed Above Grade Walls (U-Factor)	CZ 1: U 0.064 CZ 2: U 0.064 CZ 3: U 0.064 CZ 4: U 0.064 CZ 5 & 4C: U 0.064 CZ 6: U 0.051 CZ 7: U 0.051 CZ 8: U 0.036	CZ 1: U 0.064 CZ 2: U 0.064 CZ 3: U 0.064 CZ 4: U 0.064 CZ 5 & 4C: U 0.064 CZ 6: U 0.051 CZ 7: U 0.051 CZ 8: U 0.036	
Glazing	CZ 1: U 0.4, SHGC 0.25 CZ 2: U 0.4, SHGC 0.25 CZ 3: U 0.30, SHGC 0.25 CZ 4: U 0.30, SHGC 0.40 CZ 5 & 4C: U 0.27, SHGC 0.40 CZ 6: U 0.27, SHGC 0.40 CZ 7: U 0.27, SHGC 0.40 CZ 8: U 0.27, SHGC 0.40	CZ 1: U 0.4, SHGC 0.25 CZ 2: U 0.4, SHGC 0.25 CZ 3: U 0.30, SHGC 0.25 CZ 4: U 0.30, SHGC 0.40 CZ 5 & 4C: U 0.27, SHGC 0.40 CZ 6: U 0.27, SHGC 0.40 CZ 7: U 0.27, SHGC 0.40 CZ 8: U 0.27, SHGC 0.40	
Glazing – Exception for Class AW Windows	FX = Fixed; OP=Operable CZ 1: FX U 0.48, OP U 0.62; SHGC 0.25 CZ 2: FX U 0.48, OP U 0.62; SHGC 0.25	FX = Fixed; OP=Operable CZ 1: FX U 0.48, OP U 0.62; SHGC 0.25 CZ 2: FX U 0.48, OP U 0.62; SHGC 0.25	

1. Building Component	2. ENERGY STAR MFNC Reference Design (based on V1.1 from 10/2019)	3. DOE ZERH - Multifamily Target Dwelling Specification - DRAFT	4. Notes
	CZ 3: FX U 0.44, OP U 0.57; SHGC 0.25 CZ 4: FX U 0.36, OP U 0.43; SHGC 0.40 CZ 4C/5: FX U 0.36, OP U 0.43; SHGC 0.40 CZ 6: FX U 0.34, OP U 0.41; SHGC 0.40 CZ 7: FX U 0.28, OP U 0.35; SHGC ANY CZ 8: FX U 0.28, OP U 0.35; SHGC ANY	CZ 3: FX U 0.44, OP U 0.57; SHGC 0.25 CZ 4: FX U 0.36, OP U 0.43; SHGC 0.40 CZ 4C/5: FX U 0.36, OP U 0.43; SHGC 0.40 CZ 6: FX U 0.34, OP U 0.41; SHGC 0.40 CZ 7: FX U 0.28, OP U 0.35; SHGC ANY CZ 8: FX U 0.28, OP U 0.35; SHGC ANY	
Opaque Door U-factor	CZ 1: U 0.17 CZ 2: U 0.17 CZ 3: U 0.17 CZ 4: U 0.17 CZ 5 & 4C: U 0.17 CZ 6: U 0.17 CZ 7: U 0.17 CZ 8: U 0.17	CZ 1: U 0.17 CZ 2: U 0.17 CZ 3: U 0.17 CZ 4: U 0.17 CZ 5 & 4C: U 0.17 CZ 6: U 0.17 CZ 7: U 0.17 CZ 8: U 0.17	
Glazing Area	AG = 0.15*floor area* (AG wall/ .5 * BG wall) * (total wall/ (AG wall + total wall))	AG = 0.15*floor area* (AG wall/ .5 * BG wall) * (total wall/ (AG wall + total wall))	
Skylights	Assumes none are present	Assumes none are present	
Ceilings	CZ 1: U = 0.027 CZ 2: U = 0.027 CZ 3: U = 0.027 CZ 4: U = 0.027 CZ 4C & 5: U = 0.021 CZ 6: U = 0.021 CZ 7: U = 0.021 CZ 8: U = 0.021	CZ 1: U = 0.027 CZ 2: U = 0.027 CZ 3: U = 0.027 CZ 4: U = 0.027 CZ 4C & 5: U = 0.021 CZ 6: U = 0.021 CZ 7: U = 0.021 CZ 8: U = 0.021	
Attics	Vented, 1sq ft per 300sq ft ceiling area Radiant barrier in CZ 1-3 if more than 10 ft ductwork in attic	Vented, 1sq ft per 300sq ft ceiling area Radiant barrier in CZ 1-3 if more than 10 ft ductwork in attic	
Roofs	Composition shingle on wood Solar Absorptance = 0.92 Emittance = 0.90	Composition shingle on wood Solar Absorptance = 0.92 Emittance = 0.90	
Heating Systems			
AFUE – Gas Furnace	CZ 1: 80 AFUE CZ 2: 80 AFUE CZ 3: 80 AFUE CZ 4: 95 AFUE E* CZ 5 & 4C: 95 AFUE E* CZ 6: 95 AFUE E* CZ 7: 95 AFUE E* CZ 8: 95 AFUE E*	CZ 1: 80 AFUE CZ 2: 80 AFUE CZ 3: 90 AFUE CZ 4: 95 AFUE CZ 5 & 4C: 95 AFUE CZ 6: 95 AFUE CZ 7: 95 AFUE CZ 8: 95 AFUE	ZERH-Multifamily adds stringency in CZ 3, otherwise is aligned.
AFUE - Gas Boiler	CZ 1: 80 AFUE CZ 2: 80 AFUE CZ 3: 80 AFUE	CZ 1: 80 AFUE CZ 2: 80 AFUE CZ 3: 90 AFUE	ZERH-Multifamily adds stringency in CZ 3 and CZs 5-8.

1. Building Component	2. ENERGY STAR MFNC Reference Design (based on V1.1 from 10/2019)	3. DOE ZERH - Multifamily Target Dwelling Specification - DRAFT	4. Notes
	CZ 4: 90 AFUE E* CZ 5 & 4C: 90 AFUE E* CZ 6: 90 AFUE E* CZ 7: 90 AFUE E* CZ 8: 90 AFUE E*	CZ 4: 90 AFUE CZ 5 & 4C: 94 AFUE CZ 6: 94 AFUE CZ 7: 94 AFUE CZ 8: 94 AFUE	
AFUE - Oil Furnace	CZ 1: 80 AFUE CZ 2: 80 AFUE CZ 3: 80 AFUE CZ 4: 85 AFUE E* CZ 5 & 4C: 85 AFUE E* CZ 6: 85 AFUE E* CZ 7: 85 AFUE E* CZ 8: 85 AFUE E*	CZ 1: 80 AFUE CZ 2: 80 AFUE CZ 3: 86 AFUE CZ 4: 86 AFUE CZ 5 & 4C: 86 AFUE CZ 6: 86 AFUE CZ 7: 86 AFUE CZ 8: 86 AFUE	ZERH-Multifamily adds stringency in CZs 3-8.
AFUE – Oil Boiler	CZ 1: 80 AFUE CZ 2: 80 AFUE CZ 3: 80 AFUE CZ 4: 86 AFUE E* CZ 5 & 4C: 86 AFUE E* CZ 6: 86 AFUE E* CZ 7: 86 AFUE E* CZ 8: 86 AFUE E*	CZ 1: 80 AFUE CZ 2: 80 AFUE CZ 3: 86 AFUE CZ 4: 86 AFUE CZ 5 & 4C: 87 AFUE CZ 6: 87 AFUE CZ 7: 87 AFUE CZ 8: 87 AFUE	ZERH-Multifamily adds stringency in most climate zones except 1, 2, and 4.
ASHP HSPF CZ 1-6	CZ 1: 8.2 HSPF CZ 2: 8.2 HSPF CZ 3: 8.2 HSPF CZ 4: 8.5 HSPF CZ 5 & 4C: 9.25 HSPF CZ 6: 9.5 HSPF CZ 7: COP of 3.6 CZ 8: COP of 3.6	CZ 1: 8.2 HSPF CZ 2: 8.2 HSPF CZ 3: 9.0 HSPF CZ 4: 9.0 HSPF CZ 5 & 4C: 10.0 HSPF CZ 6: 10.0 HSPF CZ 7: COP of 3.6 CZ 8: COP of 3.6	ZERH-Multifamily adds stringency in CZs 3 – 6. Note: When ASHPs are used in CZs 7 or 8, the Target Dwelling (ZERH) and the Reference Dwelling (ESMFNC) both assume the use of a GSHP at the noted COP.
Geothermal heat pump	For CZs 1-6, Reference Design modeled with an ASHP as noted in prior row. CZ 7: COP of 3.6 CZ 8: COP of 3.6	For CZs 1-6, Reference Design modeled with an ASHP as noted in prior row. CZ 7: COP of 3.6 CZ 8: COP of 3.6	
Cooling Systems			
A/C SEER	CZ 1: 15 SEER 12EER CZ 2: 15 SEER 12EER CZ 3: 15 SEER 12EER CZ 4: 13 SEER CZ 5: 13 SEER CZ 6: 13 SEER CZ 7: 13 SEER CZ 8: 13 SEER	CZ 1: 18 SEER CZ 2: 18 SEER CZ 3: 16 SEER CZ 4: 15 SEER CZ 5 & 4C: 14 SEER CZ 6: 13 SEER CZ 7: 13 SEER CZ 8: 13 SEER	ZERH-Multifamily adds stringency in CZs 1-5.
ASHP SEER	CZ 1: 15 SEER 12EER CZ 2: 15 SEER 12EER CZ 3: 15 SEER 12EER CZ 4: 15 SEER 12EER CZ 5: 15 SEER 12EER CZ 6: 15 SEER 12EER CZ 7&8 Switch to GSHP, min 3.6 COP	CZ 1: 18 SEER 12EER CZ 2: 18 SEER 12EER CZ 3: 16 SEER 12EER CZ 4: 15 SEER 12EER CZ 5: 15 SEER 12EER CZ 6: 15 SEER 12EER CZ 7&8 Switch to GSHP, min 3.6 COP	ZERH-Multifamily adds stringency in CZs 1-3.

1. Building Component	2. ENERGY STAR MFNC Reference Design (based on V1.1 from 10/2019)	3. DOE ZERH - Multifamily Target Dwelling Specification - DRAFT	4. Notes
Service Water Heating Systems/ Water Heater			
Gas ≤ 55gal	EF = 0.67 (UEF=.66)	EF = 0.70 (UEF= .69)	ZERH-Multifamily is more stringent
Gas > 55gal	EF = 0.77 (UEF= .77)	EF = 0.77 (UEF= .77)	
Electric	≤ 55gal = 0.95 EF > 55 gal = 2.00 EF	≤ 55gal = 1.5 EF >55 gal = 2.0 EF	ZERH-Multifamily is more stringent for the smaller size electric water heaters, which will be more common.
Oil	30 gal = 0.64 EF 40 gal = 0.62 EF 50 gal = 0.60 EF 60 gal = 0.58 EF 70 gal = 0.56 EF 80 gal = 0.54 EF	30 gal = 0.64 EF 40 gal = 0.62 EF 50 gal = 0.60 EF 60 gal = 0.58 EF 70 gal = 0.56 EF 80 gal = 0.54 EF	
DHW System Efficiency	WaterSense bathroom faucets, bathroom aerators, and showerheads.	Requires either on-demand recirculation, shorter hot water piping layouts, or the use of very efficient water heater plus low-flow fixtures (see Mandatory provision #4 in Exhibit 1).	Depending on the compliance path for ZERH-Multifamily Mandatory Item #4, ZERH will result in higher water heater efficiency or more efficient hot water distribution.
Thermal Distribution Systems (ducts)			
Duct Location & Leakage	Ducts all in conditioned space	Ducts all in conditioned space	
Duct Leakage	Duct leakage to outdoors: 4 cfm25/100 SF of CFA	Duct leakage to outdoors: 4 cfm25/100 SF of CFA	
Thermostat			
Programmable thermostat	Temperature Setpoints: Same as Energy Rating Reference Dwelling, but with offsets for a programmable thermostat, as defined by ANSI / RESNET / ICC Std. 301	Temperature Setpoints: Same as Energy Rating Reference Dwelling, but with offsets for a programmable thermostat, as defined by ANSI / RESNET / ICC Std. 301	
Infiltration & Mechanical Ventilation			
Infiltration (attached dwellings)	0.30 CFM50/sq. ft of enclosure	0.30 CFM50/sq. ft of enclosure	
Whole Dwelling Ventilation Rates	Dwelling Unit mechanical ventilation rate meets ASHRAE 62.2-2010	Dwelling Unit mechanical ventilation rate meets ASHRAE 62.2-2010	
Ventilation Efficacy (cfm/W)	All units CFM/W CZ 1: 2.8 supply CZ 2: 2.8 supply CZ 3: 2.8 supply CZ 4: 2.8 supply CZ 4C & 5: 2.8 exhaust CZ 5: 2.8 exhaust CZ 6: 2.8 exhaust CZ 7: 2.8 exhaust CZ 8: 2.8 exhaust	All units CFM/W CZ 1: 2.8 supply CZ 2: 2.8 supply CZ 3: 2.8 supply CZ 4: 2.8 supply CZ 4C & 5: 1.2 balanced with 60% SRE CZ6-8: 1.2 balanced with 60% SRE	ZERH-Multifamily adds stringency in CZs 1-4. ZERH-Multifamily Target system is balanced ventilation in CZs 5-8 whereas ESMFNC reference dwelling uses exhaust-based ventilation.

1. Building Component	2. ENERGY STAR MFNC Reference Design (based on V1.1 from 10/2019)	3. DOE ZERH - Multifamily Target Dwelling Specification - DRAFT	4. Notes
Lighting, Appliances, Fixtures, & Internal Gains			
Lighting	ENERGY STAR bulbs or fixtures in 90% of qualifying locations	ENERGY STAR bulbs or fixtures in 95% of qualifying locations	ZERH-Multifamily is more stringent than ESMFNC
Refrigerator	ENERGY STAR Qualified (423 kWh/yr.)	ENERGY STAR Qualified (423 kWh/yr.)	
Dishwasher	ENERGY STAR Qualified (.66 EF) Standard ≤ 270 kWh/yr., ≤ 3.5 gallons/ cycle Compact < 203 kWh/yr. ≤ 3.1 gallons/ cycle	ENERGY STAR Qualified (.66 EF) Standard ≤ 270 kWh/yr., ≤ 3.5 gallons/ cycle Compact < 203 kWh/yr. ≤ 3.1 gallons/ cycle	
Clothes Washer	ENERGY STAR Qualified Front loading Residential washer IMEF ≥ 2.76, IWF ≤ 3.2 Top Loading Residential washer IMEF ≥ 2.06, IWF ≤ 4.3 Compact Residential Washer IMEF ≥ 2.07, IWF ≤ 4.2 Front Loading Commercial washer IMEF ≥ 2.20, IWF ≤ 4.0	ENERGY STAR Qualified Front loading Residential washer IMEF ≥ 2.76, IWF ≤ 3.2 Top Loading Residential washer IMEF ≥ 2.06, IWF ≤ 4.3 Compact Residential Washer IMEF ≥ 2.07, IWF ≤ 4.2 Front Loading Commercial washer IMEF ≥ 2.20, IWF ≤ 4.0	
Clothes Dryer	Energy Star Qualified Field Use Factor is 1.04 and CEF is 3.93 for electric and 3.43 for gas, even if no clothes dryer is installed. Unless the installed clothes dryer is not available as ENERGY STAR certified (e.g., commercial clothes dryers, Combination All-In One Washer-Dryers), then model the same as the Rated Unit clothes dryer	Energy Star Qualified Field Use Factor is 1.04 and CEF is 3.93 for electric and 3.43 for gas, even if no clothes dryer is installed. Unless the installed clothes dryer is not available as ENERGY STAR certified (e.g., commercial clothes dryers, Combination All-In One Washer-Dryers), then model the same as the Rated Unit clothes dryer	
Ceiling Fan(s)	ENERGY STAR Qualified (122 cfm/W)	ENERGY STAR Qualified (122 cfm/W)	
Water Fixtures	WaterSense bathroom faucets, aerators, showerheads	WaterSense bathroom faucets, aerators, showerheads	
Bath Exhaust Fans	No requirement unless used as part of dwelling unit's mechanical ventilation system	ENERGY STAR Qualified	ZERH-Multifamily adds stringency
Internal Mass			
	Same as Energy Rating Reference Home, as defined by ANSI / RESNET / ICC Std. 301. Additional mass specifically	Same as Energy Rating Reference Home, as defined by ANSI / RESNET / ICC Std. 301. Additional mass specifically	

1. Building Component	2. ENERGY STAR MFNC Reference Design (based on V1.1 from 10/2019)	3. DOE ZERH - Multifamily Target Dwelling Specification - DRAFT	4. Notes
	designed as a Thermal Storage Element for the Rated Unit shall be excluded	designed as a Thermal Storage Element for the Rated Unit shall be excluded	

ⁱ Any above-grade story with 20% or more occupiable space, including commercial space, shall be counted towards the total number of stories for the purpose of determining eligibility to participate in the program. The definition of an ‘above-grade story’ is one for which more than half of the gross surface area of the exterior walls is above-grade. All below-grade stories, regardless of type, shall not be included when evaluating eligibility. Per ASHRAE 62.2-2010, occupiable space is any enclosed space inside the pressure boundary and intended for human activities or continual human occupancy, including, but not limited to, areas used for living, sleeping, dining, and cooking, toilets, closets, halls, storage and utility areas, and laundry areas.

ⁱⁱ “Common space” is defined in the same terms as it is for the ESMFNC program: any spaces in the building being certified that serve a function in support of the residential part of the building that is not part of a dwelling or sleeping unit. This includes spaces used by residents, such as corridors, stairs, lobbies, laundry rooms, exercise rooms, residential recreation rooms, and dining halls, as well as offices and other spaces used by building management, administration or maintenance in support of the residents.

ⁱⁱⁱ The term ‘townhouse’ refers to a single-family dwelling unit constructed in a group of three or more attached units in which each unit extends from the foundation to roof and with open space on at least two sides. Townhouses under the DOE Zero Energy Ready Home – Multifamily program must use the ERI Path for compliance, and must be modeled to Exhibit 2 of the [DOE Zero Energy Ready Home program requirements](#). Townhouses are also eligible to use the DOE Zero Energy Ready Homes program instead.

^{iv} The version of ESMFNC to be used shall be determined based on ENERGY STAR program requirements and implementation timelines. See https://www.energystar.gov/newhomes/homes_prog_reqs/multifamily_national_page#site-built.

^v Insulation levels in a dwelling unit shall meet or exceed the opaque thermal envelope insulation Group R requirements in the 2018 International Energy Conservation Code (IECC) – Commercial section. The opaque portions of the dwelling unit’s thermal envelope must comply with either the R-value based method (C402.1.3); the U-, C- and F-factor based method (C402.1.4); or the component performance alternative (C402.1.5).

^{vi} Exceptions and alternative compliance paths to locating 100% of forced-air ducts in the dwelling unit’s thermal and air barrier boundary are:

- a. Up to 5% of total duct length is permitted to be outside of the dwelling unit’s thermal and air barrier boundary.
- b. Ducts are located in an unvented attic, regardless of whether this space is conditioned with a supply register
- c. Ducts are located in a vented attic with all of the following characteristics:
 - i. In Moist climates (Zones 1A, 2A, 3A, 4A, 5A, 6A and 7A per 2015 IECC Figure R301.1) and Marine climates (all “C” Zones per 2015 IECC Figure R301.1), minimum R-8 duct insulation with an additional minimum 1.5” of closed-cell spray foam insulation encapsulating the ducts; duct leakage to outdoors ≤ 3 CFM25 per 100 ft² of conditioned floor area (in addition to meeting *total* duct leakage requirements from

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- Section 4.1 of the ENERGY STAR HVAC Rater checklist); and ductwork buried under at least 2" of blown-in insulation.
 - ii. In Dry climates (all "B" Zones per 2015 IECC Figure R301.1), minimum R-8 duct insulation; duct leakage to outdoors ≤ 3 CFM25 per 100 ft² of conditioned floor area (in addition to meeting *total* duct leakage requirements from Section 4.1 of the ENERGY STAR HVAC Rater checklist); and ductwork buried under at least 3.5" of blown-in insulation.
 - d. Systems which meet the criteria for "Ducts Located in Conditioned Space" as defined by the 2018 IECC Section R403.3.7
 - e. Jump ducts which do not directly deliver conditioned air from the HVAC unit may be located in attics if all joints, including boot-to-drywall, are fully air sealed with mastic or foam, and the jump duct is fully buried under the attic insulation.
 - f. Ducts are located within an unvented crawl space
 - g. Ducts are located in a basement which is within the thermal boundary
 - h. Ductless HVAC system is used

vii **In-dwelling domestic hot water delivery systems** meet the following efficiency requirements:

To minimize water wasted while waiting for hot water, the hot water distribution system shall store no more than 0.5 gallons (1.9 liters) of water in any piping/manifold between the hot water source and any hot water fixture. In the case of on-demand recirculation systems, the 0.5 gallon (1.9 liter) storage limit shall be measured from the point where the branch feeding the fixture branches off the recirculation loop, to the fixture itself. To verify that the system stores no more than 0.5 gallons (1.9 liters), verifiers shall calculate the stored volume using the piping or tubing inside diameter and the length of the piping/tubing. System options include manifold-fed systems; structured plumbing systems; core plumbing layouts, and on-demand recirculation systems. The following requirements apply to recirculation systems:

- a. Recirculation systems must be based on an occupant-controlled switch or an occupancy sensor, installed in each bathroom which is located beyond a 0.5 gallon stored-volume range from the water heater.
- b. Recirculation systems which operate based on "adaptive" scheduling, meaning that they "learn" the hot water demand profile in the dwelling unit and adapt their operation to anticipate this profile, are permitted at this time, and do not require the use of occupant-controlled switches or occupancy sensors.
- c. Recirculation systems that are activated based **solely** on a timer and/or temperature sensor are not eligible.

No more than 0.6 gallons (2.3 liters) of water shall be collected from the hot water fixture before hot water is delivered. Only the fixture with the greatest stored volume between the fixture and the hot water source (or recirculation loop) needs to be tested. To field verify that the system meets the 0.6 gallon (2.3 liter) limit, verifiers shall first initiate operation of on-demand recirculation systems, if present, and let such systems run for at least 40 seconds. If an Adaptive Scheduling system cannot be "forced" into recirculation mode, contact DOE for further guidance. Next, a bucket or flow measuring bag (pre-marked for 0.6 gallons) shall be placed under the hot water fixture. The hot water shall be turned on completely and a digital temperature sensor used to record the initial temperature of the water flow. Once the water reaches the pre-marked line at 0.6 gallons (approximately 24 seconds for a lavatory faucet), the water shall be turned off and the ending temperature of the water flow (not the collection bucket) shall be recorded. The temperature of the water flow must increase by ≥ 10 °F. Under the DOE Zero Energy Ready Home program, the approved verifier may confirm compliance with these requirements.

Central hot water delivery systems in multifamily buildings must include on-demand recirculation which operates based on both a demand indicator and the loop water temperature. For qualifying central systems, verifiers must confirm that the pump is installed with flow in the correct direction and that the system's temperature sensors are installed.

Advisories:

- On-demand central systems in multifamily buildings do not currently have a stored volume limit. DOE encourages partners to design central hot water distribution systems in multifamily buildings to limit the stored volume between the recirculation loop and the furthest fixture to 1.0 gallons.
- Piping for central system recirculation loops in multifamily buildings should be insulated per the local code requirements. DOE encourages the use of R-4 pipe insulation on recirculation loop piping.
- DOE encourages that the recirculation pump for central systems be set to operate at a temperature which is at least 5°F less than the water heater set point temperature.

DOE will evaluate the possibility of making these recommendations into requirements in future updates to these specifications.

^{viii} Water heaters and fixtures in multifamily dwellings with their own independent water heater meet the following efficiency criteria:

- a. Gas water heaters, if present, shall have an Energy Factor ≥ 0.90 or a Uniform Energy Factor ≥ 0.87
- b. Electric water heaters, if present, shall have an Energy Factor ≥ 2.2 or a Uniform Energy Factor ≥ 2.2
- c. All showerheads and bathroom sink faucets shall be WaterSense labeled.
- d. The hot water distribution system shall store no more than 1.2 gallons between the hot water source and the furthest fixture. This shall be verified by either 1) a calculation using the piping or tubing interior diameter and the system length based on plans, or 2) by a field verification test, using the protocol described in Endnote 15, which demonstrates a minimum temperature rise of 10 °F by the time 1.4 gallons of water is delivered to the furthest hot water fixture.

These provisions do not apply to multifamily buildings with central hot water delivery systems. These project types must instead satisfy the Efficient Hot Water Distribution provision (see prior Endnote).

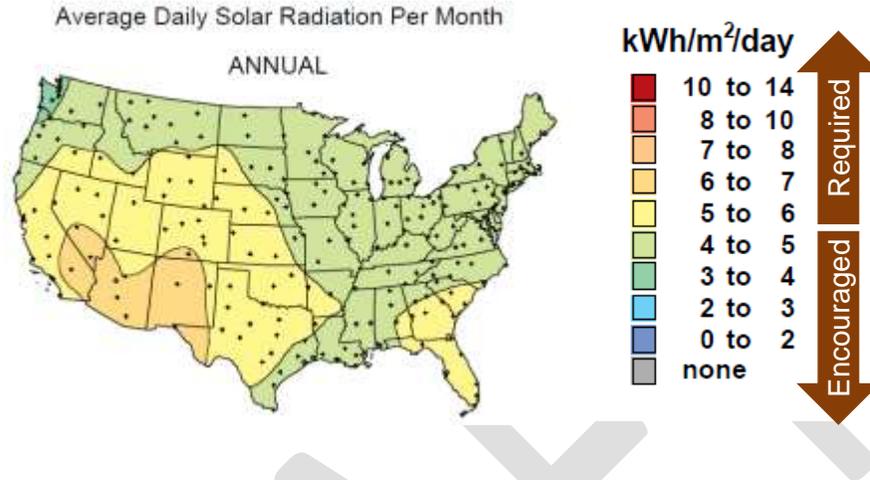
^{ix} For products in categories which are not covered by ENERGY STAR product criteria, such as combination all-in-one clothes washer-dryers, these products are exempt.

^x DOE ZERH-Multifamily requires that the provisions of the PV-Ready Checklist are completed based on the requirements and allowances in this end note. For multifamily buildings, the PV-Ready provisions may be applied to the electric service for the building's common space instead of being applied to each dwelling unit.

The PV-Ready Checklist only applies when all of the following conditions a through c below are satisfied. Projects for which the PV-Ready Checklist does not apply based on these criteria may still qualify for DOE ZERH-Multifamily if all other program requirements are satisfied. Projects that utilize renewable energy from utilities or third parties on a contractual basis may also be exempt from the PV-Ready Checklist – contact DOE for further guidance.

- a. The building does not already include a PV system. This includes installed community solar systems which contribute some amount of offset to the building's electrical usage.

- b. Location, based on zip code, has at least 5 kWh/m²/day average daily solar radiation based on annual solar insolation using this online tool: <http://pvwatts.nrel.gov/pvwatts>. Users should enter the project location zip code, use the System Info default settings, and then proceed to the “Results” tab on the tool to see the Average Annual Solar Radiation value in kWh/m²/day.



- c. Location does not have significant natural shading (e.g., trees, tall buildings on the south-facing roof).