



# DOE Zero Energy Ready Home National Program Requirements Version 1, Revision 9.0

## Building Eligibility Requirements

To qualify as a DOE Zero Energy Ready Home (ZERH), a dwelling unit shall meet the minimum requirements specified below and be verified and field-tested by a Rater working under a DOE-recognized Home Certification Organization (HCO) for ZERH or Multifamily Review Organization for ZERH (MRO for ZERH). Dwelling units must meet the requirements of either the Performance path or the Prescriptive path to qualify for certification.<sup>1</sup> Note that compliance with these requirements does not imply compliance with all local code requirements that may be applicable to the building. In cases where local codes overlap with and/or exceed the ZERH program requirements, these local requirements shall be met.<sup>2</sup>

The following building types are eligible to use the DOE Zero Energy Ready Home National Program Requirements, Version 1, Revision 9.0:

- Multifamily buildings with dwelling units<sup>3</sup> or sleeping units<sup>4</sup> that is NOT a detached dwelling.<sup>5</sup>
- Mixed-use buildings with dwelling units or sleeping units where the dwelling units, sleeping units, and common space exceed 50% of the building square footage (parking garage square footage is excluded from this calculation).<sup>6</sup>

Note that throughout the remainder of this document, the term 'dwelling unit' is implied to also apply to 'sleeping units' unless otherwise stated. The terms 'in-unit' and 'in-dwelling' both reference equipment that is installed within or only serves a single dwelling unit.

Detached dwelling units (e.g., single-family homes); duplexes; and townhomes are not eligible to participate in ZERH Version 1, Revision 9.0. ZERH program versions which apply to these building types are provided on the DOE ZERH Program Requirements webpage.

Note that certification under the ENERGY STAR Multifamily New Construction program (Version 1.1 National, Version 1.2 WA/OR, or Version 1.2 National) and certification under the Indoor airPLUS program are also required for a building to be eligible. See Exhibit 1 below for additional details. To determine the required version and revision of DOE ZERH program requirements to use based on a project's location, building type, and permit date<sup>7</sup>, partners must reference the DOE ZERH implementation timeline information posted on the [DOE ZERH program requirements website](#). Note that these National Program Requirements do not apply to projects located in California, where the ZERH program has state-specific requirements.

Dwelling units in eligible multifamily and mixed-use buildings may only be certified under the ZERH program if the entire building (all dwelling units and covered common spaces) is certified under these program requirements.

## Partnership and Credentialing Requirements

The following requirements must be met by program participants before a multifamily building can be certified:

- The builder or developer must [register as a ZERH partner](#) and sign the ZERH Builder Partner Agreement, available in [Partner Central](#) on the ZERH website.
- Energy Rating Companies (e.g., rater companies and Providers) are required to [register as a ZERH partner](#) and sign a ZERH Partnership Agreement, available in [Partner Central](#) on the ZERH website.
- Raters must be credentialed by a Home Certification Organization for the Zero Energy Ready Home program (HCO for ZERH) or meet the credential requirements of a Multifamily Review Organization for the Zero Energy Ready Home program (MRO for ZERH). Learn more and find a current list of HCOs and MROs for ZERH [here](#).

## DOE Zero Energy Ready Home Prescriptive Path

The Prescriptive path provides a single set of measures that can be used to construct a ZERH project. Modeling is not required, but no tradeoffs are allowed. Follow these steps to use the Prescriptive path:



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1. Assess eligibility by using the number of bedrooms in the dwelling unit to be built to determine the conditioned floor area (CFA) of the Benchmark Dwelling Unit (see Exhibit 3). If the CFA of the dwelling unit to be built exceeds this value, the unit is not eligible for certification under the Prescriptive path and must follow the Performance path, below.
2. Design and build the dwelling unit using the mandatory requirements for all labeled dwelling units (Exhibit 1) and all requirements of the DOE Zero Energy Ready Home Target Dwelling Design (Exhibit 2). The rigor of the specifications in Exhibit 2 shall be met **or** exceeded in all dwelling units. The specifications in Exhibits 1 and 2 apply to dwelling units only, while the ENERGY STAR Multifamily New Construction and Indoor airPLUS requirements apply to dwelling units **and** common spaces.
3. Use a Rater operating under a DOE-recognized MRO for ZERH to verify that all requirements for certification have been met in accordance with the inspection procedures for minimum rated features in ANSI/RESNET/ICC 301, Appendix B.<sup>8</sup> This will require a minimum of two inspections: one at pre-drywall and the other at final. For modular multifamily buildings, a Rater must verify any requirement in the plant not able to be verified on-site because a feature will be concealed prior to shipment.<sup>9</sup>
4. The Rater submits the DOE ZERH National Rater Checklist Version 1, Revision 9.0 for all units in the building to the MRO for ZERH for final certification once verification on all units is complete. The submission must also include all documentation specified by the MRO for ZERH, based on as-built conditions.

## DOE Zero Energy Ready Home Performance Path

Like the Prescriptive path, the Performance path requires all items in Exhibit 1, Mandatory Requirements for Labeled Dwelling Units. However, the Performance path provides flexibility to select a custom combination of measures that meet the performance level of the DOE Zero Energy Ready Home Energy Rating Index (ERI) as established by the Target Dwelling in Exhibit 2. Modeling is required, but measures can be optimized for each particular dwelling unit. The following process applies:

1. The ERI of the DOE ZERH Target Dwelling is determined. The DOE ZERH Target Dwelling is identical to the dwelling unit that will be built, except that it is configured with the energy efficiency features of the DOE ZERH Target Dwelling as defined in Exhibits 1 and 2. The ERI of the Target Dwelling is automatically calculated in accordance with ANSI/RESNET/ICC Standard 301, using a DOE-recognized HCO for ZERH's Approved Software Rating Tool.<sup>10</sup>

2. Calculate the size modification factor using the following equation:

$$\text{Size Modification Factor} = [\text{CFA}_{\text{Benchmark Dwelling Unit}} / \text{CFA}_{\text{Dwelling Unit to be Built}}]^{0.25}, \text{ but not to exceed } 1.0$$

Where:

$\text{CFA}_{\text{Benchmark Dwelling Unit}}$  = Conditioned Floor Area of the Benchmark Dwelling Unit, using Exhibit 3  
 $\text{CFA}_{\text{Dwelling Unit to be Built}}$  = Conditioned Floor Area of the Dwelling Unit to be Built

Since the Size Modification Factor cannot exceed 1.0, it only modifies the ERI score for dwelling units larger than the CFA of the Benchmark Dwelling Unit.

3. Calculate the DOE ZERH Target Dwelling ERI using the following equation:

$$\text{DOE ZERH Target Dwelling ERI (with Size Modification Factor)} = \text{DOE ZERH Target Dwelling ERI} \times \text{Size Modification Factor}$$

4. Complete ERI software calculations for preferred set of energy efficiency measures and verify that the resulting ERI is at or below the DOE ZERH Target Dwelling ERI (with Size Modification Factor).<sup>11</sup>
5. Construct the dwelling unit using the preferred set of energy efficiency measures determined in Step 4 and the Mandatory Requirements for Labeled Dwelling Units (Exhibit 1). These specifications apply to



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dwelling units only, while the ENERGY STAR Multifamily New Construction and Indoor airPLUS requirements apply to the whole building (including common spaces).

6. Use a Rater operating under a DOE-recognized HCO for ZERH to verify that all requirements for certification have been met in accordance with the inspection procedures for minimum rated features in ANSI/RESNET/ICC 301, Appendix B.<sup>8</sup> This will require a minimum of two inspections: one at pre-drywall and the other at final. For modular multifamily buildings, a Rater must verify any requirement in the plant not able to be verified on-site because a feature will be concealed prior to shipment.<sup>12</sup>
7. The Rater submits the DOE ZERH National Rater Checklist Version 1, Revision 9.0 for all units in the building to the HCO for ZERH for final certification once verification on all units is complete.<sup>13</sup> The submission must also include all documentation specified by the HCO for ZERH, based on as-built conditions.

## Exhibit 1: DOE Zero Energy Ready Home Mandatory Requirements for Labeled Dwelling Units

Component	Mandatory Requirements
<b>1. National Rater Checklist</b>	1.1 Rater completes the DOE ZERH National Rater Checklist Version 1, Revision 9.0
<b>2. ENERGY STAR Multifamily New Construction Baseline</b>	2.1 Certified under one of the following ENERGY STAR Multifamily New Construction Program Versions <sup>14</sup> : <ul style="list-style-type: none"> <li>▪ Version 1.1 National or Version 1.2 National for projects in all states except Washington and Oregon.</li> <li>▪ Version 1.2 Washington/Oregon or Version 1.2 National for projects in WA and OR</li> </ul> <i>Note that projects in California are not eligible under DOE ZERH Version 1, Revision 9.0 (see Building Eligibility Requirements, above).</i>
<b>3. Envelope</b>	3.1 Dwelling unit windows meet high performance requirements based on climate zone. <sup>15</sup> 3.2 Dwelling unit ceiling, wall, floor, and slab insulation meets or exceeds 2015 IECC levels. <sup>16, 17</sup>
<b>4. Duct System</b>	4.1 All in-unit heating and cooling system distribution ducts are located within the dwelling unit's thermal and air barrier boundary. <sup>18</sup> 4.2 All in-unit heating and cooling system air-handling equipment is located within the dwelling unit's thermal and air barrier boundary.
<b>5. Water Efficiency</b>	5.1 Hot water delivery systems meet efficient design requirements. <sup>19</sup> <i>or</i> 5.2 Water heaters and fixtures meet efficiency criteria. <sup>20</sup>
<b>6. Lighting &amp; Appliances</b>	6.1 All builder-installed, in-unit refrigerators, dishwashers, and clothes washers are ENERGY STAR certified. <sup>21</sup> 6.2 80% of builder-installed, in-unit lighting fixtures are LEDs or LED lamps (bulbs) in minimum 80% of sockets. 6.3 All builder-installed in-unit bathroom ventilation fans are ENERGY STAR certified. <sup>22</sup>
<b>7. Indoor Air Quality</b>	7.1 Certified under EPA Indoor airPLUS Version 1. <sup>23</sup>
<b>8. Renewable Ready</b>	8.1 Provisions of the DOE Zero Energy Ready Home PV-Ready Checklist Version 1, Revision 9.0 are completed. <sup>24</sup>



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## Exhibit 2: DOE Zero Energy Ready Home Target Dwelling Design <sup>25</sup>

<b>HVAC Equipment</b> <sup>26, 27</sup> (for central systems using prescriptive compliance path, see endnote) <sup>28</sup>			
	<b>Hot Climates</b> (2015 IECC Zones 1,2) <sup>29</sup>	<b>Mixed Climates</b> (2015 IECC Zones 3, 4 except Marine)	<b>Cold Climates</b> (2015 IECC Zones 4 Marine 5,6,7,8)
AFUE	80%	90%	94%
SEER	18	15	13
HSPF	8.2	9.0	10.0
Geothermal Heat Pump	ENERGY STAR EER and COP Criteria		
ASHRAE 62.2 Whole-House Mechanical Ventilation System	2.8 cfm/W no heat exchange	2.8 cfm/W no heat exchange	1.2 cfm/W; heat exchange with 60% SRE
<b>Insulation and Infiltration</b>			
<ul style="list-style-type: none"> <li>Insulation levels shall meet the 2015 IECC and achieve Grade 1 installation, per ANSI/RESNET/ICC 301.</li> <li>Infiltration (ACH50): 3.0 (all Climate Zones)</li> </ul>			
<b>Windows</b> <sup>30</sup>			
	<b>Hot Climates</b> (2015 IECC Zones 1,2)	<b>Mixed Climates</b> (2015 IECC Zones 3, 4 except Marine)	<b>Cold Climates</b> (2015 IECC Zones 4 Marine, 5,6,7,8)
SHGC	0.25	0.25	any
U-Value	0.4	0.3	0.27
<b>Water Heater</b> (for central systems using prescriptive compliance path, see endnote) <sup>31</sup>			
Efficiency levels for system Energy Factor (EF), as follows: <ul style="list-style-type: none"> <li>Gas/propane systems of ≤ 55 gallons, EF = 0.67</li> <li>Gas/propane systems of &gt; 55 gallons, EF = 0.77</li> <li>Electric systems, EF = 1.50</li> </ul>			
<b>Thermostat</b> <sup>32</sup>			
<ul style="list-style-type: none"> <li>Programmable thermostat (except for zones with radiant heat)</li> </ul>			
<b>Lighting &amp; Appliances</b>			
<ul style="list-style-type: none"> <li>For purposes of calculating the DOE Zero Energy Ready Home Target Dwelling ERI, dwelling units shall be modeled with an ENERGY STAR dishwasher, ENERGY STAR refrigerator, ENERGY STAR ceiling fans, and ENERGY STAR lamps (bulbs) in 80% of sockets or 80% of lighting fixtures are LEDs.</li> </ul>			

## Exhibit 3: Benchmark Dwelling Unit Size <sup>33</sup>

<b>Bedrooms in Dwelling Unit to be Built</b>	0	1	2	3	4	5	6	7
Conditioned Floor Area Benchmark Dwelling Unit (ft <sup>2</sup> )	1,000	1,000	1,600	2,200	2,800	3,400	4,000	4,600



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## Endnotes

<sup>1</sup> If a Rater determines that a program requirement has not been met, the building cannot earn ZERH certification until the item is corrected. If correction of the item is not possible, the building cannot earn ZERH certification and individual units in the multifamily building also cannot be certified. If mandatory requirements (in Exhibit 1) cannot be inspected by the Rater, the building as well as individual dwelling units cannot earn ZERH certification.

<sup>2</sup> While certification will result in compliance with many code requirements, a Rater is not responsible for ensuring that all code requirements have been met prior to certification. In the event that a code requirement, a manufacturer's installation instruction, or an engineering document conflicts with a requirement of the ZERH program, then the conflicting requirement within these program requirements shall not be met. Certification shall only be allowed if the Rater has determined that no equivalent option is available that could meet the conflicting requirement. Note that a dwelling unit must still meet its energy performance target. Therefore, other efficiency measures may be needed to compensate for the omission of the conflicting requirement.

<sup>3</sup> A dwelling unit, as defined by ANSI/RESNET/ICC 301, is a single unit that provides complete independent living facilities for one or more persons, including permanent provisions for living, sleeping, eating, cooking, and sanitation.

<sup>4</sup> A sleeping unit, as defined by ANSI/RESNET/ICC 301, is a room or space in which people sleep that can also include permanent provisions for living, eating, and either sanitation or kitchen facilities, but not both. Such rooms and spaces that are part of a dwelling unit are not considered sleeping units, but rather part of the dwelling unit.

<sup>5</sup> A dwelling, as defined by ANSI/RESNET/ICC 301, is any building that contains one or two dwelling units used, intended, or designed to be built, used, rented, leased, let, or hired out to be occupied, or that are occupied for living purposes.

<sup>6</sup> The term 'common space' refers to 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.

<sup>7</sup> The 'permit date' is the date on which the permit authorizing construction of the building was issued. Alternatively, the date of the Rater's first site visit is allowed to be used as the 'permit date.' The permit application date is not allowed to be used.

<sup>8</sup> The Rater must review all mandatory items for every dwelling unit in the building to verify that each inspection checklist item has been met within program-defined tolerances.

If a Rater determines that a program requirement has not been met, the building cannot earn ZERH certification until the item is corrected. If correction of the item is not possible, the building cannot earn ZERH certification and individual units in the multifamily building also cannot be certified. If an item cannot be inspected by the Rater, the building as well as individual dwelling units also cannot earn ZERH certification.

If a Rater is not able to determine whether a program requirement has been met, (e.g., an alternative method of meeting a checklist requirement has been proposed), then the Rater shall consult their Provider (e.g., rating company) or MRO for ZERH. If the Provider or MRO for ZERH also cannot make this determination, then the Rater, MRO for ZERH, or Provider shall report the issue to DOE prior to building completion at [zerh@doe.gov](mailto:zerh@doe.gov) and will typically receive an initial response within 10 business days. If DOE believes the current program requirements are sufficiently clear to determine whether the item in question has been met, then this guidance will be provided to the partner and enforced beginning with the building in question. However, if DOE believes the program requirements need revisions to make the intent clear, then this guidance will be provided to the partner but only enforced for buildings permitted after a specified transition period following the release of the revised requirements, typically 60 days in length. This process will allow DOE to make formal policy decisions as partner questions arise and to disseminate these policy decisions through the Policy Record (see ZERH website) and periodic release of revised program documents to ensure consistent application of the program guidelines.

<sup>9</sup> A modular building is a prefabricated building that is made of multiple modules or sections that are manufactured and substantially assembled in a manufacturing plant. These pre-built sections are transported to the building site and constructed by a builder to meet all applicable building codes for site-built buildings.



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<sup>10</sup> The software program shall automatically determine (i.e., without relying on a user-configured ZERH Target Dwelling Design) the ERI target for each rated unit by following the DOE Zero Energy Ready Home Version 1 ERI Target Procedure for National Program Requirements.

<sup>11</sup> On-site power generation may not be used to qualify a dwelling unit for the DOE Zero Energy Ready Home Target Dwelling ERI requirements but can be used to achieve additional ERI score reductions needed for dwelling units larger than the Benchmark Dwelling Unit.

<sup>12</sup> A modular building is a prefabricated building that is made of multiple modules or sections that are manufactured and substantially assembled in a manufacturing plant. These pre-built sections are transported to the building site and constructed by a builder to meet all applicable building codes for site-built buildings.

<sup>13</sup> Generally, buildings must be submitted for certification after verification on all units and common spaces is complete. Alternatively, at the discretion of the Provider, individual dwelling units that are part of ERI path projects may be conditionally certified prior to the building completion if the following process is observed:

- a. The Provider must generate a Conditional ZERH Certification Disclosure letter to be included with the label and certificate for the homebuyer of each conditionally certified unit.
- b. Once verification on all dwelling units and common spaces is complete and the whole building is certified, the Provider must generate a ZERH Certification Confirmation letter for the building to deliver to the applicable homebuyers.

If any dwelling unit or common space in the building is ultimately unable to be verified, the building will not be able to earn certification, the Provider must decertify any conditionally certified units, and the builder must notify the applicable homebuyers.

<sup>14</sup> Sampling of those requirements for ENERGY STAR Multifamily New Construction (ESMFNC) and Indoor airPLUS certification is only allowed to the extent permitted by their respective program requirements and allowances for sampling. Sampling of these ZERH program requirements may be allowed if the Multifamily Review Organization (MRO) for ZERH or Home Certification Organization (HCO) for ZERH overseeing the project's certification has a sampling protocol approved by DOE as part of the MRO/HCO for ZERH approval process.

<sup>15</sup> Windows shall meet the product criteria listed in this table.

Window Specs Required for DOE Zero Energy Ready Home Projects	Hot Climates IECC CZ 1-2		Mixed Climates IECC CZ 3-4 except Marine		Cold Climates IECC CZ 5-8 and 4 Marine	
	U-factor	SHGC	U-factor	SHGC	U-factor	SHGC
	≤ 0.40	≤ 0.25	[CZ 3] ≤ 0.30 [CZ 4] ≤ 0.30	[CZ 3] ≤ 0.25 [CZ 4] ≤ 0.40	≤ 0.30 = 0.31 = 0.32	Any ≥ 0.35 ≥ 0.40

The following exceptions apply:

- a. An area-weighted average of windows shall be permitted to satisfy the U-factor requirements.
- b. An area-weighted average of windows ≥ 50% glazed shall be permitted to satisfy the SHGC requirements.
- c. 15 square feet of windows per dwelling unit shall be exempt from the U-factor and SHGC requirements and shall be excluded from area-weighted averages calculated using a) and b), above.
- d. Windows utilized as part of a passive solar design shall be exempt from the U-factor and SHGC requirements and shall be excluded from area-weighted averages calculated using a) and b), above. Exempt windows shall be facing within 45 degrees of true South and directly coupled to thermal storage mass that has a heat capacity > 20 btu / ft<sup>3</sup>·°F and provided in a ratio of at least 3 sq. ft. per sq. ft. of South facing fenestration. Generally, thermal mass materials will be at least 2 in. thick.

<sup>16</sup> Building envelope assemblies, including exterior walls and unvented attic assemblies (where used), shall comply with the relevant vapor retarder provisions of the 2015 International Residential Code (IRC).





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<sup>17</sup> Insulation levels in a dwelling unit shall meet or exceed the component insulation requirements in the 2015 International Energy Conservation Code (IECC) – Table R402.1.2. The following exceptions apply:

- a. Steel-frame ceilings, walls, and floors shall meet the insulation requirements of the 2015 IECC – Table 402.2.6.
- b. For ceilings with attic spaces, R-30 shall satisfy the requirement for R-38 and R-38 shall satisfy the requirement for R-49 wherever the full height of uncompressed insulation at the lower R-value extends over the wall top plate at the eaves. This exemption shall not apply if the alternative calculations in d) are used.
- c. For ceilings without attic spaces, R-30 shall satisfy the requirement for any required value above R-30 if the design of the roof / ceiling assembly does not provide sufficient space for the required insulation value. This exemption shall be limited to 500 sq. ft. or 20% of the total insulated ceiling area, whichever is less. This exemption shall not apply if the alternative calculations in d) are used.
- d. An alternative equivalent U-factor or total UA calculation may also be used to demonstrate compliance, as follows: An assembly with a U-factor equal to or less than specified in Table 402.1.4 of the 2015 IECC complies. A total building thermal envelope UA that is less than or equal to the total UA resulting from the U-factors in Table 402.1.4 also complies. The insulation levels of a dwelling unit's fenestration, ceilings, walls, floors, and slabs can be traded off using the UA approach under both the Prescriptive and Performance paths. The UA calculation shall be done using a method consistent with the ASHRAE Handbook of Fundamentals and shall include the thermal bridging effects of framing materials. The calculation for a steel-frame envelope assembly shall use the ASHRAE zone method or a method providing equivalent results, and not a series-parallel path calculation method.

<sup>18</sup> Exceptions and alternative compliance paths to locating 100% of forced-air distribution ducts for in-dwelling heating/cooling systems within dwelling unit's thermal and air barrier boundary are:

- a. Up to 10' 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  $\leq$  3 CFM25 per 100 ft<sup>2</sup> of conditioned floor area (in addition to meeting *total* duct leakage requirements from the ENERGY STAR HVAC Report/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  $\leq$  3 CFM25 per 100 ft<sup>2</sup> of conditioned floor area (in addition to meeting *total* duct leakage requirements from the ENERGY STAR HVAC Report/Checklist); and ductwork buried under at least 3.5" of blown-in insulation. Note that in either of these designs the HVAC equipment must still be located within the home's thermal and air barrier boundary.
- d. Systems which meet the criteria for "Ducts Located in Conditioned Space" as defined by the 2018 IECC Section R403.3.7 or 2021 IECC Section R403.3.2.
- 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 home's thermal boundary.
- h. Ductless HVAC system is used.

This provision does not apply to equipment or ductwork that only provides ventilation.

<sup>19</sup> Hot water delivery systems for a water heater serving an individual dwelling unit 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 1) calculate the stored volume using the piping or tubing inside diameter and the length of the piping/tubing, or 2) perform the field verification described below. System options include manifold-fed systems; structured plumbing systems; core plumbing layouts, and on-demand recirculation systems. The following requirements apply to recirculation systems:



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- 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.

Field Verification: 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. 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  $\geq 10$  °F. Under the DOE Zero Energy Ready Home program, the approved verifier may confirm compliance with these requirements.

These provisions do not apply to buildings with central hot water delivery systems. These project types must instead satisfy the applicable efficiency criteria for domestic hot water systems in the next endnote (parts b and c).

<sup>20</sup> Systems meet the following requirements:

- a. Individual (in-unit) water heaters serving a single dwelling unit meet the following efficiency criteria:
  - i. Gas water heaters, if present, shall have an Energy Factor  $\geq 0.90$  or a Uniform Energy Factor  $\geq 0.87$
  - ii. Electric water heaters, if present, shall have an Energy Factor  $\geq 2.2$  or a Uniform Energy Factor  $\geq 2.2$
  - iii. Solar water heating systems, if present, shall have a minimum solar fraction, as follows:

2021 IECC Climate Zone	1, 2	3, 4A, 4B	4C, 5, 6	7, 8
Minimum Solar Fraction (SF)	0.80	0.64	0.47	0.28

- The solar water heating system’s Solar Fraction (SF) must be documented by an OG-300 certification. Alternatively, projects may find an equivalent system in the [OG-300 directory](#) which contains the same OG-100 elements as the chosen system and meets or exceeds the minimum required solar fraction. In this situation, documentation of the OG-100 elements and the comparable OG-300 system must be provided. All systems must be made up of OG-100 tested components.
    - When a solar water heating system meeting these specifications is used, gas and electric water heaters used for backup are exempt from the Uniform Energy Factor (in the two prior sub-items) requirements of 0.87 and 2.2, respectively.
- b. All in-unit showerheads and bathroom sink faucets shall be WaterSense labeled. WaterSense labelling of products may be verified in one of two ways:
  - i. A cut sheet for the installed product indicates that it is WaterSense labeled and field verification shows that the installed product is the one described on the cut sheet.
  - ii. The installed product can be found in the most recent WaterSense Product Search tool (<https://lookforwatersense.epa.gov/products/>) and field verification shows that the installed product matches the product described in the search tool.
- c. The hot water distribution system shall store no more than 1.8 gallons between the hot water source and the furthest fixture. The hot water source is either the water heater or the point where the branch feeding the furthest fixture branches off the recirculation loop, if present. This shall be verified by either:
  - i. A calculation using the piping or tubing interior diameter and the system length based on plans, or
  - ii. A field verification test, using the protocol described in the previous endnote, which demonstrates a minimum temperature rise of 10 °F by the time 2.0 gallons of water is delivered to the furthest hot water fixture.

<sup>21</sup> For products in categories which are not covered by ENERGY STAR product criteria these products are exempt.

<sup>22</sup> ENERGY STAR product certification must be verified with a visual confirmation that installed product is listed in the online ENERGY STAR product registry.





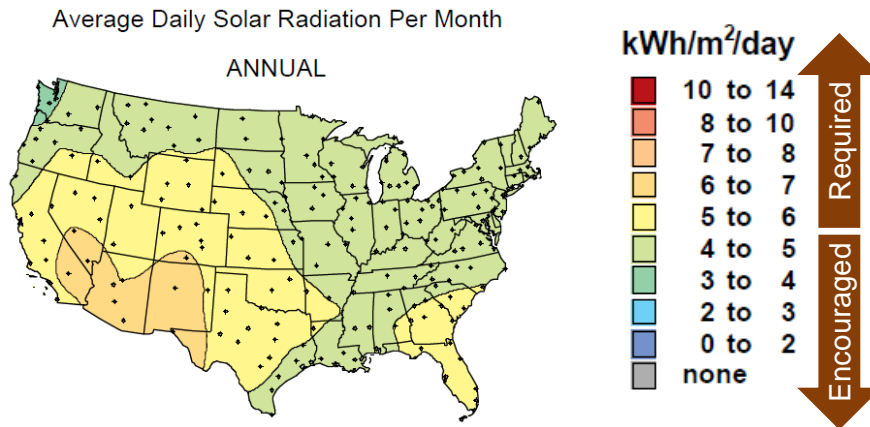
# DOE Zero Energy Ready Home National Program Requirements Version 1, Revision 9.0

<sup>23</sup> Buildings permitted on or before 12/31/2024 must certify under the Indoor airPLUS Version 1 program requirements. For buildings permitted after 12/31/2024, DOE will consider a revision to these program requirements that specifies if an updated version of Indoor airPLUS must be used. See the Indoor airPLUS program site for information on program updates: <https://www.epa.gov/indoorairplus/indoor-airplus-program-documents>

<sup>24</sup> DOE Zero Energy Ready Home requires that the provisions of the Version 1 Rev 9.0 PV-Ready Checklist are completed based on the requirements and allowances in this endnote. 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 dwelling units.

The PV-Ready Checklist only applies when all of the following conditions (a through d) below are satisfied. Dwelling units or buildings for which the PV-Ready Checklist does not apply based on these criteria may still qualify for DOE Zero Energy Ready Home certification if all other program requirements are satisfied.

- a. The building does not already include a PV system. This could include installed community solar systems which contribute some amount of offset to the building's electrical usage. In order for a community solar system to be recognized as providing renewable energy to the building there must be a legally binding agreement in place for the provision of this energy to the building with a duration  $\geq 15$  years and written to survive a full or partial transfer of ownership of the property. Documentation of this agreement must be retained by the rater.
- b. Location, based on zip code, has at least 5 kWh/m<sup>2</sup>/day average daily solar radiation based on annual solar insolation using this online tool: <https://pvwatts.nrel.gov/>. 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/m<sup>2</sup>/day.



- c. Location does not have significant natural shading (e.g., trees, tall buildings on the south-facing roof).
- d. Building as designed has the minimum free roof area within +/- 45° of true south as noted in the table below.

Conditioned Floor Area of Dwelling Unit (ft <sup>2</sup> )	Minimum Roof Area within +/- 45° of True South for PV-Ready Checklist to Apply (ft <sup>2</sup> )
≤ 2000	110
≤ 4000	220
≤ 6000	330
>6000	440

<sup>25</sup> The 2015 IECC Climate Zone Map can be found at the following link: [https://codes.iccsafe.org/content/IECC2015/chapter-3-re-general-requirements#IECC2015\\_Pt02\\_Ch03\\_SecR301](https://codes.iccsafe.org/content/IECC2015/chapter-3-re-general-requirements#IECC2015_Pt02_Ch03_SecR301)

- <sup>26</sup> HVAC System Type for the Target Dwelling shall be the same as the Rated Dwelling, with the following exceptions.
  - The Target Dwelling is configured with an air-source heat pump in Climate Zones 1-6 when the Rated Dwelling is modeled with a ground-source heat pump or electric strip (baseboard) heat.



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- The Target Dwelling is configured with a ground-source heat pump in Climate Zones 7 & 8 when the Rated Dwelling is modeled with an air-source or ground-source heat pump, electric resistance or baseboard heat. Applicable efficiency levels shall be selected from Exhibit 2.

<sup>27</sup> Where equipment is rated in SEER2, the following table shall be used to determine the required efficiency specification. The first row shows the efficiency listed in Exhibit 2, and below are rows for the converted metric by equipment type.

Efficiency as listed in Exhibit 2	SEER		
	13.0	15.0	18.0
Equipment Type	SEER2		
Ductless System	13.0	15.0	18.0
Ducted Split System	12.4	14.3	17.1
Ducted Single Packaged System	12.4	14.3	17.1

Where equipment is rated in HSPF2, the following table shall be used to determine the required efficiency specification. The first row shows the efficiency listed in Exhibit 2, and below are rows for the converted metric by equipment type.

Efficiency as listed in Exhibit 2	HSPF		
	8.2	9.0	10.0
Equipment Type	HSPF2		
Ductless System	7.3	8.0	8.9
Ducted Split System	6.9	7.6	8.4
Ducted Single Packaged System	6.8	7.5	8.3

<sup>28</sup> Prescriptive path: For dwelling units served by central systems, the central system must meet the applicable requirements of ESMFNC Version 1.1’s Exhibit X (see ESMFNC Rater Field Checklist). Exceptions:

- Hot water boilers  $\geq 300,000$  Btu/h efficiency must be  $\geq 90\% E_t$
- Where Exhibit X lists the Minimum Efficiency as “See Reference Design,” the project must instead meet applicable efficiency specification found in ZERH V1 Rev 9.0 Exhibit 2.

<sup>29</sup> DOE recommends, but does not require, that cooling systems in hot/humid climates utilize controls for immediate blower shutoff after condenser shutoff, to prevent re-evaporation of moisture off the wet coil.

<sup>30</sup> All decorative glass and skylight window areas count toward the dwelling unit’s total window area to above-grade conditioned floor area (WFA) ratio. Dwelling units following the Prescriptive path may apply the same exceptions available for compliance with the mandatory window requirements to the requirements stated here.

For homes using the Prescriptive path that have a WFA ratio  $> 15\%$ , the following additional requirements apply:

- In Climate Zones 1, 2, and 3, an improved window SHGC is required and is determined by:

$$\text{Improved SHGC} = [0.15 / \text{WFA}] \times [\text{TARGET SHGC}]$$

Where the TARGET SHGC is the maximum allowable SHGC in Exhibit 2 for the Climate Zone where the dwelling unit will be built.

- In Climate Zones 4, 5, 6, 7, and 8, an improved window U-Value is required and is determined by:

$$\text{Improved U-Value} = [0.15 / \text{WFA}] \times [\text{TARGET U-Value}]$$

Where the Target U-Value is the maximum allowable U-Value in Exhibit 2 for the Climate Zone where the dwelling unit will be built.

<sup>31</sup> Prescriptive path: For dwelling units served by central systems, the central system must meet the applicable requirements of ESMFNC Version 1.1 as found in the ESMFNC Rater Field Checklist Item 11.1.

<sup>32</sup> In homes with heat pumps with electric resistance back-up heating, programmable thermostats shall incorporate controls to prevent the excessive use of electric back-up heating. This functionality may be described as adaptive recovery, recovery mode, or similar terms.



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<sup>33</sup> The average-size dwelling unit for a specific number of bedrooms is termed "Benchmark Dwelling Unit." The conditioned floor area for a Benchmark Dwelling Unit (CFA Benchmark Dwelling Unit) is determined by selecting the appropriate value from Exhibit 3. For dwelling units with more than 8 bedrooms, the CFA Benchmark Dwelling Unit shall be determined by multiplying 600 sq. ft. times the total number of bedrooms and adding 400 sq. ft.

Example 10-Bedroom Dwelling Unit: Benchmark Dwelling Unit = (600 sq. ft. x 10) + 400 sq. ft. = 6,400 sq. ft.