U.S. DOE Zero Energy Ready Home
National Program Requirements for Single Family Homes
Version 2.0 ***DRAFT***

The following homes are eligible for qualification under the DOE Zero Energy Ready Home Single Family program: detached dwelling units[1] (e.g., single-family homes); duplexes; and townhomes.[2] These homes may be site-built or modular construction.[3]

To determine the applicable version of DOE Zero Energy Ready Home requirements to use based on a project's location and permit date[4], partners must reference the DOE Zero Energy Ready Home Program Requirements website.

To qualify for the DOE Zero Energy Ready Home Single Family program, an eligible home shall meet the minimum requirements specified below, be verified and field-tested by an approved Rater[5], and meet all applicable codes.[6] Note that compliance with these guidelines does not imply compliance with all local code requirements that may be applicable to the home to be built. The builder of the home and the Rater must both sign a DOE Zero Energy Ready Home partner agreement for the home to be certified.

DOE Zero Energy Ready Home Certification Process

1. Projects must meet the Mandatory requirements listed in Exhibit 1.
2. Projects conduct energy modeling using an approved software rating tool from an EPA-recognized Home Certification Organization (HCO) to establish the home's Energy Rating Index (ERI) value. The home's ERI value must be equal to or lower than the ERI of the DOE Zero Energy Ready Home Target Home as defined in Exhibit 2. The ERI value for the Target Home shall be automatically generated by the HCO's approved software rating tool.[7]
3. Construct the home using the measures specified in the design that result in an ERI value at or below the DOE Zero Energy Ready Home ERI Target, calculated above, ***and*** incorporate the mandatory requirements listed in Exhibit 1. On-site power generation may not be used to meet the Target ERI
4. Use a Rater operating under an HCO certification program to verify that all requirements have been met in accordance with the Mandatory Requirements and with the inspection procedures for minimum rated features in ANSI / RESNET / ICC Standard 301-2019, Appendix B.[8,9] For modular homes, 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. Submit the home to the HCO for final certification and follow the HCO's certification and oversight procedures, including those for quality assurance, recordkeeping, and reporting. The Rater is required to keep electronic or hard copies of completed checklists required for the DOE Zero Energy Ready Home certification, including those required for prerequisite certifications.
5. The submission of qualifying DOE Zero Energy Ready Home projects to DOE occurs through the HCO.

Request for Comments on DOE Zero Energy Ready Home Version 2.0 & ENERGY STAR New Certification Label to Accelerate Construction of the Next Generation of Homes and Apartments

On October 18, 2021, EPA shared a draft[10] for a new companion certification label to the current ENERGY STAR program for residential new construction. This certification will provide additional recognition for the next generation of homes and apartments that incorporate technologies such as heat pumps, heat pump water heaters, induction cooking, and electric vehicle charging capabilities. Details on the draft certification label (open for public comment until November 15, 2021) are available online here. DOE and EPA are committed to continuing to work together to ensure that the Federal certification programs evolve towards zero-emission homes in the future while providing value to both builders and homebuyers in the market.

DOE is interested in comments on the following questions:

1) Should DOE consider requiring the new ENERGY STAR next generation certification for DOE Zero Energy Ready Home V2?

2) Should DOE consider offering two types of DOE Zero Energy Ready Home certification under Version 2 -- a basic version and a "next gen" version that includes the ENERGY STAR next generation certification requirements?

Exhibit 1: DOE Zero Energy Ready Home Mandatory Requirements

Area of Improvement	Mandatory Requirements
1. ENERGY STAR Single Family New Homes Baseline	☐ Certified under ENERGY STAR Single Family New Homes Version 3.2 [11]
2. Envelope	☐ Ceiling, wall, floor, & slab insulation meet or exceed 2021 IECC R, U, or UA levels [12,13] ☐ Above Grade Walls in Mixed and Cold Climates provide thermal breaks [14] ☐ Windows meet high performance requirements based on climate zone [15] *Advisory*: DOE is monitoring the development of the planned update to the ENERGY STAR product specifications for residential windows (V7.0), and plans to adopt these in a future program update [16]
3. Duct System	☐ All ducts and heating and cooling air-handling equipment are located within the thermal and air barrier boundary [17]
4. Water Heating Efficiency	☐ Hot water delivery systems meet efficient design requirements [18] ***or*** ☐ Water heater and fixtures meet efficiency criteria[19]
5. Lighting & Appliances	☐ All installed refrigerators, dishwashers, clothes washers, and clothes dryers are ENERGY STAR qualified [20, 21] ☐ 95% of builder-installed lighting fixtures are ENERGY STAR qualified or ENERGY STAR lamps (bulbs) in minimum 95% of sockets ☐ All installed bathroom ventilation and ceiling fans are ENERGY STAR qualified
6. Indoor Air Quality	☐ Certified under EPA Indoor airPLUS [22] ☐ MERV 13 (minimum) filter is installed on all ducted heating and cooling systems and accounted for in system design [23] ☐ Energy efficient balanced ventilation (HRV or ERV) is provided in Climate Zones 6-8 [24]
7. Renewable Ready	☐ Provisions of the DOE Zero Energy Ready Home PV-Ready Checklist Version 2 are Completed [25]

Exhibit 2: DOE Zero Energy Ready Home Target Home [26]

HVAC Equipment[27]			
	Very Hot & Hot Climates (2021 IECC Climate Zones 1,2)	**Warm & Mixed Climates** (2021 IECC Climate Zones 3, 4 except Marine)	**Cold & Very Cold Climates** (2021 IECC Climate Zones 4 Marine 5,6,7,8)
Furnace AFUE	80%	CZ3: 92%; CZ4: 95%	95%
SEER	18	16	16 (ASHP); 14 (A/C)
HSPF	9.2	9.2	9.5
Boiler AFUE	80%	CZ3: 92%; CZ4: 95%	95%

Whole-House Mechanical Ventilation System Efficiency	2.9 cfm/W no heat exchange	2.9 cfm/W no heat exchange	1.2 cfm/W; balanced with heat exchange, 65% ASRE

HVAC Grading

• **Airflow Deviation:** Grade I, -7.5%	• **Watt Draw Efficiency**: Grade I, 0.45 cfm/W	• **Refrigerant Grade** (as applicable): Grade III

Insulation and Infiltration

- Insulation levels modeled to 2021 IECC Prescriptive values and achieve Grade 1 installation, per ANSI / RESNET / ICC Standard 301
- Infiltration – SF Detached Dwellings[28] (ACH50): CZs 1-2: 2.75 | CZ 3-4: 2.25 | CZs 5-7: 2.0 | CZ 8: 1.5
- Infiltration – SF Attached Dwellings (ACH50): 3.0 (all Climate Zones)

Windows

	2021 IECC Climate Zones				
	1 – 2	3	4 (except Marine)	4 Marine and 5	6 – 8
U-Value	0.40	0.30	0.30	0.27	0.25
SHGC	0.23	0.25	0.40	Any	Any

Doors

	Door Type	Opaque	≤ ½-Lite	> ½-Lite	
	Climate Zone	All	All	1 – 3	4 - 8
	Door U-Value	0.17	0.25	0.30	0.30
	Door SHGC	Any	0.25	0.25	0.40

Water Heater

DHW equipment modeled at the following applicable efficiency levels based on Energy Factor (EF):

- Electric Systems: EF = 2.5
- Gas / Propane Systems: EF = 0.95

Ducts and Thermostat[29]

- All ducts and air handlers modeled within conditioned space, uninsulated, with no leakage to the outside
- Programmable thermostat (except for zones with radiant heat)

Lighting & Appliances

- For purposes of calculating the DOE Zero Energy Ready Home Target Home HERS Index, homes shall be modeled with an ENERGY STAR dishwasher, ENERGY STAR refrigerator; ENERGY STAR ceiling fans (if used), and ENERGY STAR lamps (bulbs) or fixtures in 100% of Qualify Light Fixture Locations as defined by ANSI / RESNET / ICC Standard 301-2019.

Endnotes:

[1] A dwelling unit, as defined by the 2021 IECC, 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.

[2] A townhome is defined as 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. Townhomes may

instead choose to use the DOE Zero Energy Ready Home Multifamily program, in which case they must use the ERI Path and DOE Zero Energy Ready Home program Target Home.

[3] A modular home is a prefabricated home that is made of 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 homes.

[4] The Rater may define the 'permit date' as either the date that the permit was issued or the date of the contract on the home. In cases where permit or contract dates are not available, Providers have discretion to estimate permit dates based on other construction schedule factors. These assumptions should be both defensible and documented.

[5] The Rater is defined as the person(s) completing the third-party verification required for certification. The person(s) shall: a) be a Certified Rater or Approved Inspector, as defined by ANSI / RESNET / ICC Standard 301, or an equivalent designation as determined by an EPA-recognized Home Certification Organization (HCO). All Raters for DOE Zero Home Single Family projects must attend and complete a DOE Zero Home training class (www.buildings.energy.gov/zero under Resources). The person(s) shall also have a signed partnership agreement in place with the DOE Zero Home program.

[6] Where requirements of the local codes, covenants, manufacturers' installation instructions, or engineering documents overlap with the requirements of these guidelines, DOE offers the following guidance:

a. In cases where the overlapping requirements exceed the DOE Zero Home Single Family guidelines, these overlapping requirements shall be met;
b. In cases where overlapping requirements conflict with a requirement of these DOE Zero Home Single Family guidelines, then the home is exempt from conflicting requirement within these guidelines. However, certification shall only be allowed if the Rater has determined that no equivalent option is available that could meet the intent of the conflicting requirement of these guidelines. Note that a home must still meet the Target Home HERS Index Target. Therefore, other efficiency measures may be needed to compensate for the omission of the conflicting requirement.

[7] The software program shall automatically determine, without relying on a user-configured Target Home, the ERI target for each rated home by following the DOE Zero Energy Ready Home Target Home Procedure, Version 2.0, Rev01.

[8] In the event that a Rater is not able to determine whether an item is consistent with the intent of a provision, (e.g., an alternative method of meeting a checklist requirement has been proposed), then the Rater shall consult their Provider. The term 'Provider' refers to an Approved Rating Provider, as defined by ANSI / RESNET / ICC Standard 301-2019, that is approved by an EPA-recognized HCO. If the Provider also cannot make this determination, then the Rater or Provider shall report the issue to DOE prior to project completion at: zero@newportpartnersllc.com and will typically receive an initial response within 5 business days. If DOE believes the current program guidelines are sufficiently clear to determine whether the intent has been met, then this guidance will be provided to the Partner and enforced beginning with the house in question. However, if DOE believes the program guidelines require revisions to make the intent clear, then this guidance will be provided to the Partner but only enforced for homes permitted after a specified transition period following the release of the revised guidelines, 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 periodic release of revised program documents to ensure consistent application of the program guidelines.

[9] Sampling of those requirements for ESSFNH and Indoor airPLUS qualification is allowed to the extent permitted by their respective program requirements and allowances for sampling. Rater-only sampling of features specific to the DOE Zero Home Single Family Home qualification may be conducted in accordance with an HCO-approved Sampling Protocol.

[10] More information on EPA's new certification label can be found here. This draft certification is currently under development and open for public comment from October 18, 2021 to November 15, 2021.

[11] In some states, an earlier version of ENERGY STAR Single Family New Homes such as Version 3.1 may be required by the program. However, compliance with DOE Zero Energy Ready Home V2.0 requires compliance with ESSFNH V3.2.

[12] Building envelope assemblies, including exterior walls and unvented attic assemblies (where used), shall comply with the relevant vapor retarder provisions of the 2021 International Residential Code (IRC).

[13] Insulation levels in a home shall meet or exceed the component insulation requirements in the 2021 International Energy Conservation Code (IECC) – Table R402.1.3. The following exceptions apply:

a. Steel-frame ceilings, walls, & floors shall meet the insulation requirements of 2021 IECC, Table 402.2.6.
b. For ceilings with attic spaces, R-30 shall satisfy the requirement for R-38; R-38 shall satisfy the requirement for R-49; and R-49 shall satisfy the requirement for R-60, only if 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 402.1.2 of the 2021 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 402.1.2 also complies. The performance of all components (i.e., fenestration, ceilings, walls, floors, slabs) can be traded off using the UA approach. However, note that the DOE ZERH Mandatory window provisions (Exhibit 1) and Items 3.1 through 3.3 of the ESSFNH Rater Field Checklist must be met regardless of the UA tradeoffs calculated. 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.

[14] In Climate Zones 4-8, above-grade walls must use of one the following: continuous insulation exterior to the framing; a framing technique that prevents wall studs from creating a continuous thermal bridge from the wall's interior surface to the wall's exterior cladding (e.g., double stud walls; staggered stud walls); SIPs; ICFs; or another construction method that provides a continuous thermal break in the wall stud framing.

[15] Windows shall meet the criteria which are based on ENERGY STAR Window Product Criteria Version 6 for Climate Zones 1 – 5.

Window Specs Required for DOE Zero Energy Ready Home Projects	**IECC CZ 1-2**		**IECC CZ 3-4 except Marine**		**IECC CZ 5 and 4 Marine**		**IECC CZ 6-8**	
	U-Value	SHGC	U-value	SHGC	U-Value	SHGC	U-Value	SHGC
	0.40	0.25	[CZ 3] 0.30 [CZ 4] 0.30	[CZ 3] 0.25 [CZ 4] 0.40	≤ 0.27 0.28 0.29 0.30	Any ≥0.32 ≥0.37 ≥0.42	≤ 0.25	Any

The following exceptions apply:

a. An area-weighted average of fenestration products shall be permitted to satisfy the U-factor requirements;
b. An area-weighted average of fenestration products ≥ 50% glazed shall be permitted to satisfy the SHGC requirements;
c. 15 square feet of glazed fenestration 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. One side-hinged opaque door assembly up to 24 square feet in area shall be exempt from the U-factor requirements and shall be excluded from area-weighted averages calculated using a) and b), above;
e. Fenestration 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^3x°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.

[16] More information on the ENERGY STAR V7.0 residential window specification may be found here: https://www.energystar.gov/products/building_products/residential_windows_doors_and_skylights/partners?qt-partners_product_tab=1#qt-partners_product_tab. DOE may consider early phase in of the ENERGY STAR V7.0 window specifications prioritizing Climate Zones 7 and 8, due to the significant benefit of advanced windows in these very cold climate zones. The *draft* ENERGY STAR V7.0 window specifications for Climate Zones 7 and 8 are U-Value ≤ 0.22 and SHGC ≥ 0.17.

[17] Exceptions:
a. Up to 10 ft. of total duct length is permitted to be outside of the home/unit's thermal and air barrier boundary.
b. Ducts (but not air handlers) may be located in a vented attic if minimum R-8 duct insulation is used, duct leakage to outdoors is measured ≤ 3 CFM25 per 100ft2 of conditioned floor area, and:
    - In Moist (A) climate zones (per 2018 IECC Figure R301.1), an additional 1.5 in. (min.) of closed-cell spray foam encapsulates the ducts and ductwork is buried under 2 in. (min.) of blown-in insulation; OR
    - In Dry (B) and Marine (C) climate zones (per 2018 IECC Figure R301.1), ductwork is buried under at least 3.5 in. of blown-in insulation.
c. 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.
d. Jump ducts which do not directly deliver conditioned air from the heating/cooling equipment may be located in attics if all joints, including boot-to-drywall, are air sealed and the jump duct is fully buried under the attic insulation
e. Ducts and air-handling equipment may be located within an uninsulated and unvented crawl space or basement when the applicable dehumidification requirements of the Indoor airPLUS program are met
f. Ducts and air-handling equipment associated with rooftop make-up air units or dedicated outdoor air systems (DOAS) that provide ventilation, but also provide supplemental heating and cooling, are permitted to be outside of the building's thermal and air barrier boundary.

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

[18] 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. 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 home 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.

To verify that the system stores no more than 0.5 gallons (1.9 liters), verifiers shall either using the Calculation method or the Field Verification method. In the Calculation method, the verifier shall calculate the stored volume between the hot water source and the furthest fixture using the piping or tubing inside diameter and the length of the piping/tubing. 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 furthest fixture branches off the recirculation loop, to the fixture itself. An Excel-based tool is available on the DOE ZERH website for this calculation.

Using the Field Verification method, 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 ≥ 10 °F in comparing the final to the initial temperature reading. Under the DOE Zero Home Single Family program, the approved verifier may confirm compliance with these requirements.

For production builders with house plans that offer an optional bathroom that does not include a shower or tub, the hot water distribution to this bathroom, when included, is not required to be evaluated under this requirement.

[19] Water heaters and fixtures 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. In the case of on-demand recirculation systems, the hot water source is considered as the point at which the branch feeding the fixture branches off the recirculation loop. This storage limit 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 the prior endnote, 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.

Projects using this compliance option are not permitted to use hot water recirculation systems which operate continuously or operate based solely on a timer or temperature sensor.

[20] 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.

[21] Due to industry supply chain challenges, DOE is temporarily allowing the use of non-ENERGY STAR certified refrigerators. Any project utilizing this temporary alternative must account for the non-ENERGY STAR certified refrigerator in the energy model and achieve an ERI value equal to or lower than the ERI of the DOE Zero Energy Ready Home Target Home. DOE advises partners that this alternative may be rescinded in a future program update.

[22] Homes permitted on or before 12/31/2022 must certify under the Indoor airPLUS Version 1 program requirements. For homes permitted after 12/31/2022, 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

[23] A MERV 13 filter (or higher), rated per ASHRAE 52.2-2017, is required for all ducted heating and cooling systems. The pressure drop associated with the filter must be accounted for in the HVAC design, per the ENERGY STAR Single-Family New Homes National HVAC Design Report.

[24] An HRV or ERV is required for homes in Climate Zones 6 – 8 and must meet or exceed the following specifications: ≥ 65% SRE (@ 32 °F) and ≥ 1.2 CFM/Watt.

[25] The DOE Zero Energy Ready Home Single Family program requires that the provisions of the PV-Ready Checklist are completed, unless one or more of the exceptions below applies in which case the PV-Ready features in the Checklist are not required. The exceptions are:

a. The home already includes an on-site PV system.
b. The home receives renewable energy from a community solar system, and there is a legally binding agreement in place for the provision of this energy to the home with a duration ≥ 15 years and written to survive a full or partial transfer of ownership of the property.
c. The location has significant natural shading (e.g., trees, tall buildings on the south-facing roof).
d. The home as designed does not have the minimum free roof area within +/- 45° of true south as noted in the table below.

Conditioned Floor Area of House (ft^2)	Minimum Roof Area within +/- 45° of True South for PV-Ready Checklist to Apply (ft^2)
≤ 2,000	110
>2,000 and ≤ 4,000	220
>4,000 and ≤ 6,000	330
>6,000	440

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

[27] HVAC System Type for the Target Home shall be the same as the Rated Home, with the following exceptions. The Target Home is configured with an air-source heat pump when the Rated Home has an air-source or ground-source heat pump, electric strip heat, or baseboard heat. Applicable efficiency levels are based on Exhibit 2.

[28] Envelope leakage shall be determined by using Standard ANSI/RESNET/ICC 380-2019.

[29] In homes with heat pumps with electric resistance back-up heating, programmable thermostats shall have "Adaptive Recovery" technology to prevent the excessive use of electric back-up heating.