



DOE Challenge Home National Program Requirements (Rev. 02)

July 1, 2012

To qualify as a DOE Challenge Home, a home shall meet the minimum requirements specified below, be verified and field-tested in accordance with HERS Standards by an approved verifier, and meet all applicable codes. Builders may meet the requirements of either the Performance Path or the Prescriptive path to qualify a home.¹

DOE Challenge Home Prescriptive Path

The prescriptive path provides a single set of measures that can be used to construct a DOE Challenge Home labeled home. Modeling is not required, but no tradeoffs are allowed. Follow these steps to use the prescriptive path:

1. Assess eligibility by using the number of bedrooms in the home to be built to determine the conditioned floor area (CFA) of the Benchmark Home, Exhibit 3. If the CFA of the home to be built exceeds this value, the performance path shall be used.
2. If the prescriptive path is eligible for use based on the prior step, build the home using the mandatory requirements for all labeled homes, Exhibit 1, and all requirements of the DOE Challenge Home Target Home, Exhibit 2. The rigor of the specifications in Exhibit 2 shall be met **or** exceeded.
3. Verify that all requirements have been met using an approved verifier.²

All home certified through the Prescriptive Path shall be submitted to DOE (email: doechallengehome@newportpartnersllc.com).

DOE Challenge Home Performance Path

While all mandatory requirements for labeled homes in Exhibit 1 shall be met, the performance path provides flexibility to select a custom combination of measures that meet performance level of the DOE Challenge Home HERS Target Home (Exhibit 2). Modeling is required, but measures can be optimized for each particular home or builder. Follow the steps below to use the performance path with RESNET-accredited Home Energy Rating Software programs:

1. The HERS Index of the DOE Challenge Home Target Home is determined. The DOE Challenge Home Target Home is identical to the home that will be built, except that it is configured with the energy efficiency features of the DOE Challenge Home Target Home as defined in Exhibits 1 and 2. Note, any state energy code requirements that exceed those specified on Exhibit 2 take precedence for purposes of determining the DOE Challenge Home Target Home³. The HERS Index of the Target Home is automatically calculated in accordance with the RESNET Mortgage Industry National Home Energy Rating Standards.
2. A size modification factor is next calculated using the following equation:

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

Where:

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

Since the Size Modification Factor cannot exceed 1.0, it only modifies the HERS Index score for homes larger than the CFA of the Benchmark Home.

3. The HERS Index of the DOE Challenge Home Target Home is calculated next⁴:

$$\text{Challenge Home HERS Target} = \text{HERS Index of Challenge Home Target Home} \times \text{Size Modification Factor}$$

4. Complete HERS software calculations for preferred set of energy measures and verify resulting HERS Index Score at or below DOE Challenge Home Target Home HERS Index Score modified, as required, for house size.
5. Construct the home using measures that result in a HERS Index at or below the DOE Challenge Home HERS Target, calculated above, and the mandatory requirements for all labeled homes, Exhibit 1.
6. Verify that all requirements have been met using an approved verifier.

All homes certified through the Performance Path shall be submitted through the RESNET National Buildings Registry.



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Exhibit 1: DOE Challenge Home Mandatory Requirements for All Labeled Homes

Area of Improvement	Mandatory Requirements
1. ENERGY STAR for Homes Baseline	☐ Certified under ENERGY STAR Qualified Homes Version 3 ⁵
2. Envelope⁶	☐ Fenestration shall meet or exceed latest ENERGY STAR requirements ^{7, 8} ☐ Ceiling, wall, floor, and slab insulation shall meet or exceed 2012 IECC levels ⁹
3. Duct System	☐ Ducts located within the home's thermal and air barrier boundary ¹⁰
4. Water Efficiency	☐ Hot water delivery systems shall meet efficient design requirements ¹¹
5. Lighting & Appliances¹²	☐ All installed refrigerators, dishwashers, and clothes washers are ENERGY STAR qualified. ☐ 80% of lighting fixtures are ENERGY STAR qualified or ENERGY STAR lamps (bulbs) in minimum 80% of sockets ☐ All installed bathroom ventilation and ceiling fans are ENERGY STAR qualified
6. Indoor Air Quality	☐ EPA Indoor airPLUS Verification Checklist and Construction Specifications ¹³
7. Renewable Ready¹⁴	☐ EPA Renewable Energy Ready Home Solar Electric Checklist and Specifications ¹⁵ ☐ EPA Renewable Energy Ready Home Solar Thermal Checklist and Specifications ¹⁶

Exhibit 2: DOE Challenge Home Target Home ^{3, 17}

HVAC Equipment ¹⁸			
	Hot Climates (2012 IECC Zones 1,2) ¹⁹	Mixed Climates (2012 IECC Zones 3, 4 except Marine)	Cold Climates (2012 IECC Zones 4 Marine 5,6,7,8)
AFUE	80%	90%	94%
SEER	18	15	13
HSPF	8.2	9	10 ²⁰
Geothermal Heat Pump	ENERGY STAR EER and COP Criteria		
ASHRAE 62.2 Whole-House Mechanical Ventilation System	1.4 cfm/W; no heat exchange	1.4 cfm/W; no heat exchange	1.2 cfm/W; heat exchange with 60% SRE
Insulation and Infiltration			
- Insulation levels shall meet the 2012 IECC and achieve Grade 1 installation, per RESNET standards. - Infiltration²¹ (ACH50): 3 in CZ's 1-2 2.5 in CZ's 3-4 2 in CZ's 5-7 1.5 in CZ 8			
Windows ^{22, 23, 24}			
	Hot Climates (2012 IECC Zones 1,2,)	Mixed Climates (2012 IECC Zones 3, 4 except Marine)	Cold Climates (2012 IECC Zones 4 Marine 5,6,7,8)
SHGC	0.25	0.27	any
U-Value	0.4	0.3	0.27
Homes qualifying through the Prescriptive Path with a total window-to-floor area greater than 15% shall have adjusted U-values or SHGCs. ²⁵			
Water Heater			
ENERGY STAR minimum; for heating oil water heaters use EF = 0.60			



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Thermostat²⁶
Programmable thermostat (except for zones with radiant heat)
Lighting & Appliances
For purposes of calculating the DOE Challenge Home Target Home HERS Index, homes 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 ENERGY STAR Qualified.

Exhibit 3: Benchmark Home Size²⁷

Bedrooms in Home to be Built	1	2	3	4	5	6	7	8
Conditioned Floor Area Benchmark Home	1,000	1,600	2,200	2,800	3,400	4,000	4,600	5,200

Footnotes:

¹ 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. If the Provider also cannot make this determination, then the Rater or Provider shall report the issue to DOE prior to project completion at: builderschallenge@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 after 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.

² The term 'Rater' refers to the person completing the third-party inspections required for qualification. This party may be a certified Home Energy Rater, Rating Field Inspector, BOP Inspector, or an equivalent designation as determined by a Verification Oversight Organization such as RESNET.

³ State energy code specifications that exceed the DOE Challenge Home National Program Requirements always take precedence and shall be used instead of DOE Challenge Home specifications to determine DOE Challenge Home compliance. In states where the residential provisions of the 2012 International Energy Conservation Code (IECC) have been adopted, the Target Home specifications (Exhibit 2) will be updated to reflect the specifications of the 2015 IECC within 6 months of the 2015 IECC publication date. DOE will maintain a list of state-specific compliance requirements and timelines on the DOE Challenge Home website.

⁴ On-site power generation may not be used to qualify a home for the DOE Challenge Home Target Home requirements, but can be used to achieve additional HERS Index Score reductions needed for homes larger than the Benchmark Home.

⁵ Consistent with the ENERGY STAR for Homes V3 allowance for sampling, the Thermal Enclosure System Rater Checklist and the HVAC System Quality Installation Rater Checklist shall be permitted to be completed for a batch of homes using a RESNET-approved sampling protocol. The Indoor airPLUS Verification Checklist may also be completed using a RESNET-approved sampling protocol. Sampling shall not be permitted to complete the HVAC System Quality Installation Contractor Checklist.



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⁶ Building envelope assemblies, including exterior walls and unvented attic assemblies (where used), shall comply with the relevant vapor retarder provisions of the 2012 International Residential Code.

⁷ Windows shall meet the ENERGY STAR Window Product Criteria which are in force at the time of the final rating inspection. See [www.energystar.gov/windows for current ENERGY STAR Window Product Criteria](http://www.energystar.gov/windows_for_current_ENERGY_STAR_Window_Product_Criteria).

⁸ Fenestration shall meet the applicable ENERGY STAR Window Product Criteria for U and SHGC, with the following exceptions:

- 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 $\geq 50\%$ 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 $> 20 \text{ btu} / \text{ft}^3 \times \text{F}$ 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.

⁹ Insulation levels in a home shall meet or exceed the component insulation requirements in the 2012 International Energy Conservation Code (IECC) - Table R402.1.1. The following exceptions apply:

- a. Steel-frame ceilings, walls, and floors shall meet the insulation requirements of the 2012 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 or less than specified in 2012 IECC Table 402.1.3 complies. A total building thermal envelope UA that is less than or equal to the total UA resulting from the U-factors in Table 402.1.3 also complies. The insulation levels of all non-fenestration components (i.e., ceilings, walls, floors, and slabs) can be traded off using the UA approach under both the Prescriptive and the Performance Path. Note that fenestration products (i.e., windows, skylights, doors) shall not be included in this calculation. Also, note that while ceiling and slab insulation can be included in trade-off calculations, Items 4.1 through 4.3 of the ENERGY STAR for Homes V3 Thermal Enclosure System Rater Checklist shall 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.

¹⁰ Exceptions to locating 100% of forced-air ducts in home's thermal and air barrier boundary are:

- a. Up to 10' of total duct length is permitted to be outside of the home'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



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- c. Ducts are located in a vented attic with all of the following characteristics: minimum R-8 duct insulation with an additional minimum 1.5" of closed-cell spray foam insulation encapsulating the ducts; total duct leakage ≤ 3 CFM25 per 100 ft² of conditioned floor area; and ductwork buried under at least 2" of blown-in insulation
- d. 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.
- e. Ducts are located within an unvented crawl space
- f. Ducts are located in a basement which is within the home's thermal boundary
- g. Ductless HVAC system is used

¹¹ Hot water delivery systems shall meet efficiency requirements found in Section 3.3 of the EPA WaterSense Single-Family New Home Specification. Under the DOE Challenge Home program, the approved verifier may also confirm compliance with these requirements. These requirements are stated below:

Hot Water Delivery System – 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. To account for the additional water that must be removed from the system before hot water can be delivered, no more than 0.6 gallons (2.3 liters) of water shall be collected from the hot water fixture before hot water is delivered. Timer- and temperature-based recirculating systems shall not be used to meet the criteria.

¹² Further efficiency and savings can be achieved by installing ENERGY STAR qualified products in addition to those required.

¹³ The following exceptions apply to the mandatory requirement to meet the EPA Indoor airPLUS Verification Checklist and Construction Specifications:

- a. Compliance with the ENERGY STAR for Homes V3 Water Management System Builder Checklist shall be equivalent to compliance with the EPA Indoor airPLUS Verification Checklist "Moisture Control" provisions (Provisions 1.1 through 1.13).
- b. Builders shall not be required to provide home buyers with radon test kits (Provision 2.2 of Indoor airPLUS). However, builders are strongly encouraged to include a radon fact sheet in their homeowner materials.
- c. For Provision 5.6 of Indoor airPLUS, garage exhaust fans operated by automatic fan controls that activate the fan whenever the garage is occupied and run for at least 10 minutes after the garage has been vacated are deemed acceptable.

Homes utilizing any of these exceptions will not qualify for the Indoor airPLUS label. Builders seeking the Indoor airPLUS label must achieve full compliance with the Indoor airPLUS Verification Checklist.

¹⁴ The Renewable Energy Ready Home (RERH) checklists only apply under the following conditions:

- a. If a solar photovoltaic or solar hot water system is already included with the home, then compliance with the solar photovoltaic or solar hot water RERH checklist, respectively, is not required.
- b. Location has at least 5 kWh/m²/day average daily solar radiation based on annual solar insolation (<http://www.energysavers.gov/pdfs/208.pdf>).
- c. Location does not have significant natural shading (e.g., trees, tall buildings) on the south-facing roof.
- d. Home as designed has adequate free roof area within +/- 45° of true south as noted in the table below. Note that in some cases a house may have insufficient roof area for the Solar Electric RERH checklist, but it may still have the minimum roof area for the Solar Thermal RERH checklist, and would therefore have to comply with the Solar Thermal RERH checklist. In other cases, the home may only have adequate south facing roof for the Solar Electric or Solar Thermal RERH checklist, but not both. In that case, the builder can decide which one of those two checklists to apply.



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Conditioned Floor Area of House (ft ²)	Minimum Roof Area for Solar Electric RERH Checklist (ft ²)	Minimum Roof Area for Solar Thermal RERH Checklist (ft ²)
≤ 2000	110	40
≤ 4000	220	60
≤ 6000	330	80
>6000	440	100

¹⁵ For those building sites where the EPA Renewable Energy Ready Home Solar Electric Checklist does apply, the following exceptions are permitted:

- A permanent roof anchor fall safety system (Provision 2.2) is recommended, but not required.
- A shading study (Provision 1.4) is not required, given that the checklist is already limited to viable sites.
- Blocking is permitted to be used as an alternative to the 4' x 4' wood panel area called for in Provision 3.1. The area designated for the future panel to mount PV components shall be clearly noted in the system documentation.
- As an alternative to installing a 70 Amp double-pole breaker in the electrical service panel for use by the future PV system (Provision 3.4), a labeled slot for a double-pole breaker in the electrical service may be provided.
- As an alternative to providing architectural drawings of a future solar PV system (Provisions 3.5 and 4.1), builders may provide home buyers with the following information: list of renewable-ready features, available free roof area within +/- 45° of true south, location of panel or blocking for future mounting of PV components, location of riser, location of breaker or slot for future breaker in electrical service panel, code-compliant documentation of maximum allowable dead load and live load ratings of the roof, copy of RERH Solar PV Checklist, and copy of RERH Specification Guide.

¹⁶ For those building sites where the EPA Renewable Energy Ready Home Solar Water Heating Checklist does apply, the following exceptions are permitted:

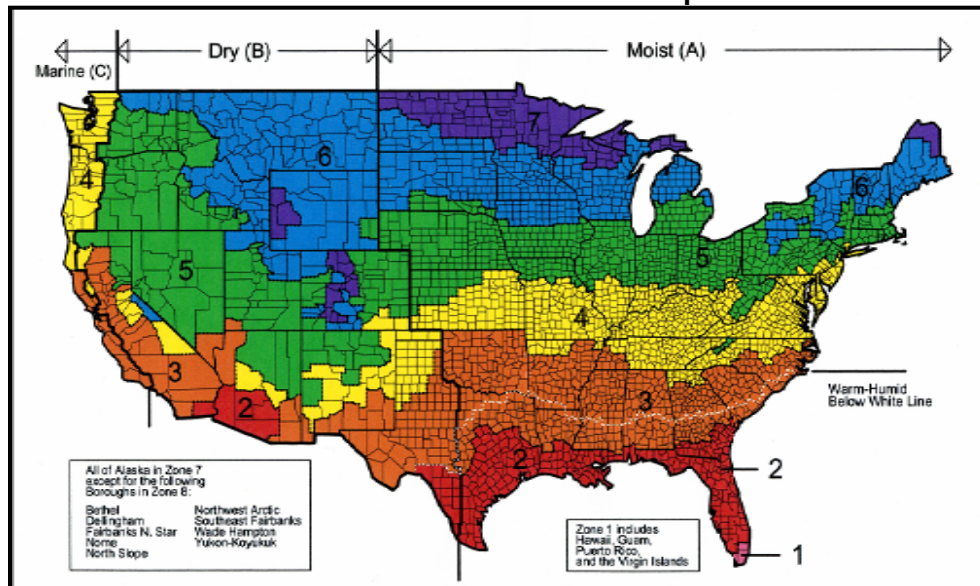
- A permanent roof anchor fall safety system (Provision 2.3) is recommended, but not required.
- A shading study (Provision 1.4) is not required, given that the checklist is already limited to viable sites.
- Blocking is permitted to be used as an alternative to the 3' x 2' wood panel area called for in Provision 3.2. The area designated for the future panel to mount solar HW components shall be clearly noted in the system documentation.
- Homes equipped with an ENERGY STAR qualified whole home gas tankless water heater or an ENERGY STAR qualified heat pump water heater are exempt from Provisions 3.1, 3.2, 3.3, 3.4.
- As an alternative to providing architectural drawings of a future solar HW system (Provisions 3.6 and 4.1), builders may provide home buyers with the following information: list of renewable-ready features, available free roof area within +/- 45° of true south, location of panel or blocking for future mounting of solar hot water system components, location of riser, code-compliant documentation of maximum allowable dead load and live load ratings of the roof, copy of RERH Solar Hot Water Checklist, and copy of RERH Specification Guide.

¹⁷ The following Map is shown to depict climate zone boundaries. It is for illustrative purposes only and is based on the 2012 IECC.



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2012 IECC Climate Zone Map



¹⁸ HVAC System Type for the Target Home shall be the same as the Rated Home, with the following exceptions. The Target Home shall be configured with an air-source heat pump in Climate Zones 1-6 when the Rated Home is modeled with a ground-source heat pump, electric strip or baseboard heat; and the Target Home shall be configured with ground-source heat pump in Climate Zones 7 & 8 when the Rated Home is modeled with an air-source or ground-source heat pump, electric strip or baseboard heat. Applicable efficiency levels shall be selected from Exhibit 2.

¹⁹ 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.

²⁰ Air source heat pumps with electric resistance backup cannot be used in homes qualified in Climate Zones 7 & 8 using the Prescriptive Path.

²¹ Envelope leakage shall be determined by an approved verifier using a RESNET-approved testing protocol.

²² All decorative glass and skylight window areas count toward the total window area to above-grade conditioned floor area (WFA) ratio.

²³ DOE strongly encourages all DOE Challenge Home partners to consider using R-5 windows in cold climates in anticipation of them becoming the state-of-the-art window choice in the near future. Visit the DOE web site (<http://www1.eere.energy.gov/buildings/windowsvolumepurchase/>) for more details and sources of these windows.

²⁴ For homes using Exhibit 2 for Prescriptive compliance with the DOE Challenge Home, the following exceptions to the U-Value and SHGC requirements in Exhibit 2 apply:

- An area-weighted average of fenestration products shall be permitted to satisfy the U-factor requirements;
- An area-weighted average of fenestration products $\geq 50\%$ glazed shall be permitted to satisfy the SHGC requirements;
- 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;



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- 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 / ft³ x °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.

²⁵ *For Prescriptive Path:* All decorative glass and skylight window areas count toward the total window area to above-grade conditioned floor area (WFA) ratio. For homes using the Prescriptive Path that have a WFA ratio > 15%, the following additional requirements apply:

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

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

Where the ENERGY STAR SHGC is the maximum allowable SHGC in Exhibit 1, ENERGY STAR Reference Design, for the Climate Zone where the home will be built.

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

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

Where the ENERGY STAR U-Value is the maximum allowable U-Value in Exhibit 1, ENERGY STAR Reference Design, for the Climate Zone where the home will be built.

²⁶ In homes with heat pumps, programmable thermostats shall have "Adaptive Recovery" technology to prevent the excessive use of electric back-up heating.

²⁷ The average-size home for a specific number of bedrooms is termed "Benchmark Home". The conditioned floor area for a Benchmark Home (CFA Benchmark Home) is determined by selecting the appropriate value from Exhibit 3. For homes with more than 8 bedrooms, the CFA Benchmark Home shall be determined by multiplying 600 sq. ft. times the total number of bedrooms and adding 400 sq. ft.

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