ENERGY STAR Residential New Construction Program Roadmap

Framework Document for Stakeholder Feedback

October 18, 2021

I. Abstract

EPA is proposing three important initiatives to advance and expand the ENERGY STAR Residential New Construction programs to keep pace with advancing building codes, foster a clean energy economy, and further reduce emissions associated with the residential new construction sector.

First, EPA is proposing to transition all states where ENERGY STAR Single-Family New Homes (SFNH) Version 3.0 is still in effect to Version 3.1. Similarly, this transition will move states currently subject to Multifamily New Construction (MFNC) Version 1.0 to Version 1.1 and advance the baseline ASHRAE code in multifamily to ASHRAE 90.1-2010.

Second, EPA is proposing to introduce new versions of both the Single-Family New Homes and Multifamily New Construction program requirements, called SFNH National Version 3.2 and MFNC National Version 1.2, respectively. These new versions will maintain the same program structure as Version 3.1 and Version 1.1 and are designed to achieve 10 percent savings relative to the 2021 IECC. The new requirements will only become mandatory in states that adopt the 2021 IECC or an equivalently stringent code.

Third, to help set the stage for the economy-wide transition needed to address the challenge of climate change, EPA is proposing to introduce 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. EPA hopes that this new certification will inspire the industry and prospective new home buyers to show that it is possible to build the housing we need for tomorrow, today.

EPA is seeking stakeholder feedback and comment on all three initiatives.

In the future, EPA also anticipates developing a new version of the base ENERGY STAR New Construction program, which we are tentatively referring to as Version 4, for both the Single-Family New Homes and Multifamily New Construction programs. This update would improve (and potentially simplify)

the program's design and introduce new technologies that advance the program's core pillars of energy efficiency, quality, performance, and comfort. EPA expects to begin developing Version 4 over the next 3-5 years and stakeholders will have an opportunity to provide feedback throughout that process.

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II. Background

A. ENERGY STAR Program Success

ENERGY STAR is the government-backed symbol for energy efficiency, providing simple, credible, and unbiased information that consumers and businesses rely on to make well-informed decisions. Thousands of industrial, commercial, utility, state, and local organizations—including nearly 40% of the Fortune 500®—partner with the U.S. Environmental Protection Agency (EPA) to deliver cost-saving energy efficiency solutions that protect the climate while improving air quality and protecting public health.

In 1995, EPA first offered a label for homes to earn ENERGY STAR certification by meeting a rigorous, third-party verified energy efficiency specification. Since that time, over 2.2 million ENERGY STAR certified homes and apartments have been built, including more than 120,000 in 2020 alone. More than three thousand builders, developers, and manufactured housing plants are ENERGY STAR partners, including all of the nation's twenty largest home builders. Last year, the market share for ENERGY STAR certified single-family homes (the predominant type of home certified through the program) was nearly 10 percent.

ENERGY STAR certified homes and apartments are at least 10% more energy efficient than those built to the code that is enforced in each state. Data indicate that, on average, these homes achieve a 20% improvement when compared to code-built homes.

B. History and Purpose of Versions and Revisions

Launched in 1995, the first iteration of the ENERGY STAR program requirements for single-family and low-rise multifamily homes (now referred to as SFNH Version 1) was designed to deliver a 30 percent increase in efficiency compared to the 1992 Model Energy Code (MEC). This was achieved through a basic package of energy-efficiency improvements, such as tighter construction and ducts, higher levels of insulation, high-performance windows, and high-efficiency heating and cooling equipment. A key aspect of the program was the use of independent energy rating companies, who worked with builders to identify the most cost-effective strategies to achieve the program's requirements and provided third-party verification of the measures required by EPA. Although it took a few years to see progress in the market, program growth soon took off, with builder participation and market share increasing rapidly in the early 2000s.

In 2007, EPA introduced SFNH Version 2 of the ENERGY STAR program requirements for single-family and low-rise multifamily homes. The Version 2 requirements were designed to ensure that the program continued to deliver meaningful improvements in energy efficiency compared to code-built homes. Using the 2006 International Energy Conservation Code (IECC) as a baseline, the new program requirements

were designed to achieve 15 percent savings relative to code. With the Version 2 specification, EPA also began to introduce mandatory building-science-based measures through a “Thermal Bypass Checklist” (or TBC). The TBC identified a series of prescriptive improvements to the home envelope to ensure that ENERGY STAR certified homes delivered savings while providing comfort, quality, and durability.

In addition, due to increasing partner interest in certifying taller multifamily buildings, EPA created a complementary ENERGY STAR certification for mid and high-rise multifamily buildings. This program was piloted from 2005-2011 and officially launched at the end of 2011, with program requirements generally aligned with Version 2 of the single-family and low-rise multifamily home program.

Also in 2011, to continue to keep pace with increasing building codes and introduce important new building science improvements, EPA introduced the SFNH Version 3 specification for single-family and low-rise multifamily homes. SFNH Version 3 was designed to provide at least 10% savings compared to the 2009 IECC and expanded the set of mandatory measures for certified homes to earn the label. These included enhanced envelope requirements (through the “Thermal Enclosure System Rater Checklist” (or TEC), durability requirements through the “Water Management System Builder Checklist,” and quality installation of heating and cooling (HVAC) equipment through the “HVAC System Quality Installation Contractor Checklist” and “HVAC System Quality Installation Rater Checklist.”

EPA has maintained the overall SFNH Version 3 program structure since 2011 but has increased the level of rigor of the underlying energy efficiency requirements as newer versions of the IECC have been developed. SFNH Version 3.0 has remained in place for states that have implemented the 2009 IECC (or have a less-rigorous code or no statewide code); and SFNH Version 3.1 is implemented in states that adopt the 2012, 2015, or 2018 versions of the IECC to ensure that the program continues to deliver at least 10 percent savings compared to those more rigorous versions of the code. In certain states and territories where a different type of code is used, or the predominant construction approach differs from the contiguous U.S., EPA has developed specific regional or state-level versions of the program requirements.

In 2018, EPA developed a new multifamily program to cover all multifamily buildings and better align with the SFNH Version 3 program enhancements. This program launched in 2019 with both MFNC Version 1 and MFNC Version 1.1 variants, which were implemented in states according to their code adoption status at that time, as well as state-specific and regional variations where needed. The MFNC program also included the same structure for advancing the program in states in response to the adoption of new codes as is employed in the single-family program.

In addition to the development of new program versions, since the initial release of SFNH Version 3 (and the more recent release of MFNC Version 1), EPA has continued to refine the programs, mainly in response to partner feedback, to clarify and streamline requirements and remove unintended barriers to participation. These revisions were initially more frequent but have slowed to approximately once per year over the past several years.

III. National Transition to SFNH v3.1/MFNC v1.1

EPA is proposing to transition those states that remain at SFNH Version 3.0 and MFNC Version 1.0 of the program requirements to the SFNH Version 3.1 and MFNC Version 1.1 program requirements, respectively. For multifamily, this transition will also advance the baseline ASHRAE code from ASHRAE 90.1-2007 to ASHRAE 90.1-2010.

EPA is proposing an extended timeline for this transition to ensure that builders and developers have ample time to prepare for the change. Additional detail on EPA's analysis is provided below. EPA is seeking stakeholder feedback and comment on the proposal and timeline for this transition.

A. Background on ENERGY STAR Versions Implementation Status

When Version 3 of the ENERGY STAR Residential New Construction national program requirements for single-family homes was first introduced, homes in all states were certified using what is now referred to as the SFNH v3.0 requirements (or an equivalent state-specific version). SFNH Version 3.0 was designed to deliver at least 10 percent energy savings compared to a home built to the Residential 2009 IECC.

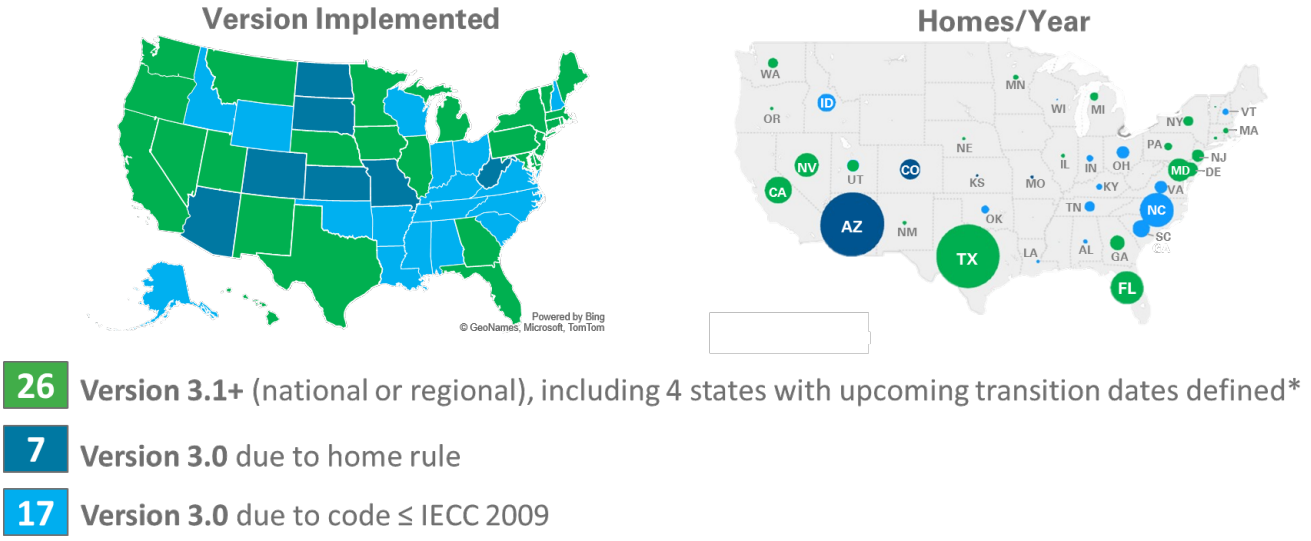
The release of the 2012 IECC marked a significant advancement in code stringency. In response, EPA developed the SFNH Version 3.1 requirements to be implemented in states that adopted the 2012 IECC code. Version 3.1 retained the same program structure as Version 3.0 but increased the required level of energy efficiency to maintain the 10 percent savings threshold compared to the more rigorous code. EPA determined that Version 3.1 also delivered at least 10 percent savings compared to the subsequent 2015 and 2018 editions of the IECC, which brought minimal changes.

Similarly, when the Multifamily New Construction program was developed, the MFNC Version 1.0 program requirements were designed to deliver at least 10 percent energy savings compared to buildings constructed to the Residential and Commercial 2009 IECC; and the MFNC Version 1.1 program requirements were developed to maintain that level of savings in states that adopted the 2012, 2015, and 2018 editions of the Residential and Commercial IECC, or equivalently stringent codes.

There are currently 22 states where the SFNH Version 3.1 and MFNC Version 1.1 [1] (or more rigorous state-specific versions) have already been implemented, with an additional four states scheduled for the transition by October 2022. Of the remaining 24 states where homes can still be certified to the SFNH Version 3.0 and MFNC Version 1.0 requirements, 17 remain at this level because they have yet to adopt a more advanced code than the 2009 IECC. The other seven states (AZ, CO, KS, MO, ND, SD, and WY) are defined as 'home rule' states, meaning that they are statutorily prohibited from adopting a statewide

[1] The MFNC ASHRAE performance target is based on the state commercial code. The commercial energy code adoption is not necessarily aligned with the residential code adoption, and currently 31 states that have a commercial code baseline of ASHRAE 90.1-2010 or higher.

code. However, even in these home rule states, many municipalities have adopted more advanced codes at the local level.

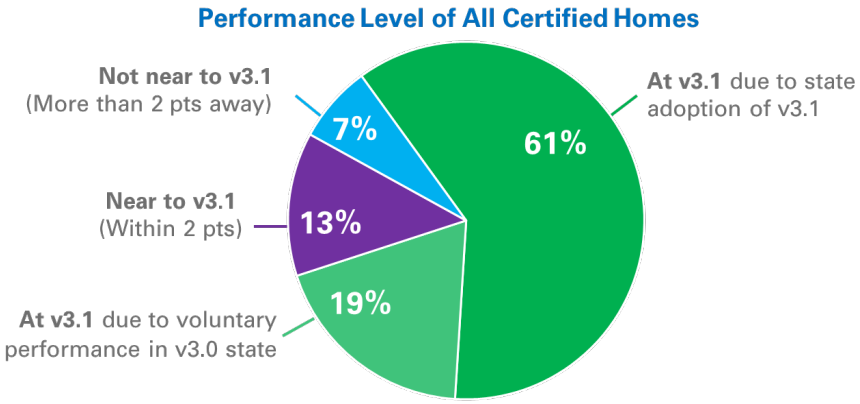


B. Rationale for National Transition to SFNH v3.1 and MFNC v1.1

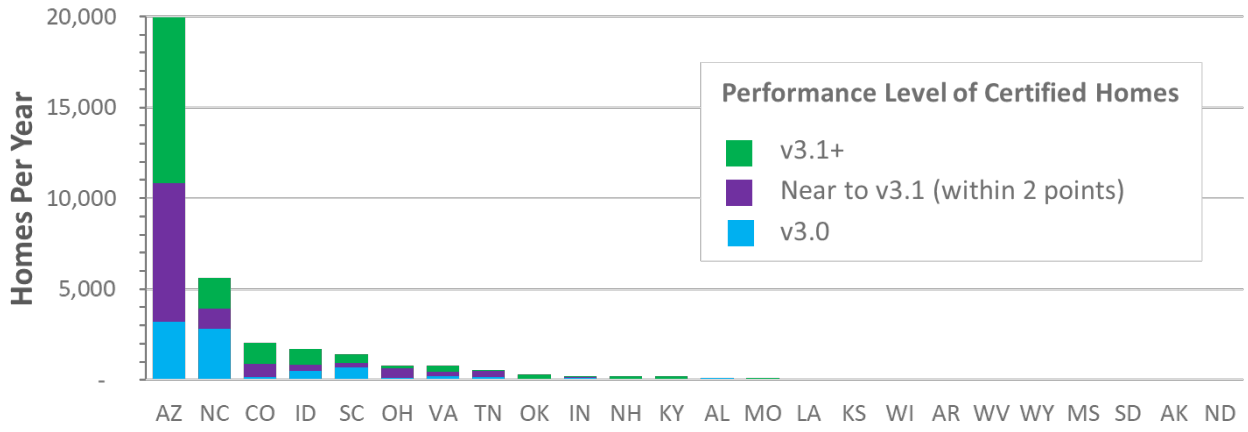
Transitioning all remaining states to SFNH Version 3.1 and MFNC Version 1.1, and moving the MFNC ASHRAE Path baseline to ASHRAE 90.1-2010, could help homeowners save over 800 million additional kilowatt-hours of electricity, avoid $150 million in energy costs, and achieve nearly 1 million metric tons of greenhouse gas reductions over the next five years. EPA's analysis indicates that the great majority of ENERGY STAR partners are ready to build and be recognized at this level of performance.

Over the last ten years, national model codes have advanced significantly, and available data indicate that builders' construction practices and performance have also continued to rise, even in states where the more stringent codes have not been adopted. According to data from RESNET, between 2014 and 2020, the average ERI score among all rated homes (not just ENERGY STAR certified homes) decreased 5 points, from 63 to 58.

Over the period from August 2019 to August 2020, EPA found that 93% of ENERGY STAR certified single-family homes were already meeting or approaching (within 2 ERI points) the required SFNH Version 3.1 efficiency levels. Specifically, 61% of certified homes were built in states where Version 3.1 is already in effect; an additional 19% met or exceeded the v3.1 ERI target, despite only v3.0 being required in the state; and another 13% of homes were within 2 points of the v3.1 ERI target. The remaining 7% of certified homes were found to be more than 2 points from meeting the Version 3.1 ERI target.



Focusing specifically on the states where Version 3.0 is still in effect, Arizona reported the most single-family homes, followed by North Carolina, Colorado, Idaho, and South Carolina. In these states, and in all states reporting at least 100 homes per year, at least half of the homes certified as ENERGY STAR during the period analyzed were already performing at or near (within 2 points) of Version 3.1, as shown in the figure below. While some markets have better average performance than others, these data indicate a significant track record of building homes at the v3.1 level in every region of the country.



Transitioning all remaining states to SFNH Version 3.1 and MFNC Version 1.1 has the added benefit of advancing home rule states to the more rigorous program requirements. This is particularly important in Arizona and Colorado, where the largest municipalities in those states have already adopted the 2012 IECC or more rigorous codes, which would normally trigger a transition to SFNH Version 3.1 and MFNC Version 1.1 if the code were adopted at the state level. Transitioning these states to SFNH Version 3.1

and MFNC Version 1.1 will help to ensure that ENERGY STAR maintains a performance premium for homebuyers compared to what is actually being built to code in those states' major metro areas.

C. Key Differences Between SFNH v3.0 vs. 3.1 (MFNC v1.0 vs. 1.1)

Versions 3.0 and 3.1 of Single-Family New Homes program requirements share the same program structure, mandatory measures, and checklists. The same is true of Versions 1.0 and 1.1 of Multifamily New Construction program requirements. The only difference in SFNH v3.1 and MFNC v1.1 is a higher-performance reference design to maintain at least 10% savings relative to the 2012-2018 IECC generation of codes. This results in an SFNH Version 3.1/MFNC Version 1.1 ENERGY STAR ERI target that is approximately 10 points more stringent than the SFNH v3.0/MFNC v1.0 target.

To address a common misconception, the Reference Design defines the ENERGY STAR ERI Target, but individual elements of the Reference Design are not mandatory [2]. For example, the SFNH v3.1 Reference Design includes ducts in conditioned space and tighter benchmark infiltration rates, but neither of these items are required to be included in any given home that is certified to the SFNH v3.1 program requirements, and builders have the flexibility to trade-off these measures to meet the ENERGY STAR ERI Target. The target may be achieved using any combination of measures including, but not limited to, lower infiltration rates, more insulation, better windows and doors, more efficient heating and cooling systems, and tankless or heat pump water heaters.

D. Proposed Timeline for Transition

EPA is proposing that all homes and multifamily projects permitted on or after January 1, 2023, will be required to meet the ENERGY STAR Single-Family New Homes National Version 3.1 or ENERGY STAR Multifamily New Construction National Version 1.1 program requirements (unless subject to a state-specific variant, such as in California). Similarly, EPA is proposing that all MFNC projects using the ASHRAE Path permitted on or after January 1, 2023, will be subject to a performance target of ASHRAE 90.1-2010 or later. Please refer to the National Program Requirements for a detailed definition of "permit date" for each program.

Barring significant concerns expressed during the stakeholder feedback period, EPA hopes to announce a determination on the national transition to SFNH Version 3.1 and MFNC Version 1.1 by the end of 2021 to provide partners with an extended transition period throughout 2022.

[2] For Multifamily projects that choose to use the Prescriptive Path, the individual elements of the ENERGY STAR Multifamily Reference Design are effectively mandatory due to the prescriptive nature of this compliance path.

E. Questions

1) Are there any available data or analyses to indicate that a national transition to SFNH Version 3.1 and MFNC Version 1.1 is not warranted at this time?

2) Will the proposed date of January 1, 2023 (based on permit date) provide partners with sufficient time to prepare for the transition to SFNH Version 3.1 and MFNC Version 1.1?

IV. Introduction of National SFNH Version 3.2 and MFNC Version 1.2 Program Requirements

After a period of relatively slower increases in code requirements from 2012 to 2018, the 2021 IECC has significantly raised the bar for energy efficiency requirements. As a result, EPA must again develop more rigorous program requirements for ENERGY STAR certification for homes and apartments that are constructed in states that adopt the 2021 version of the code. EPA is proposing to maintain the same general program structure as the current national program requirements of the SFNH and MFNC programs but increase the underlying efficiency requirements to deliver at least 10 percent savings relative to the 2021 IECC. Other aspects of the program requirements (e.g., program checklists and mandatory measures) are proposed to remain unchanged, with the exception of establishing a new thermal backstop. The new versions, called National Program Requirements, Version 3.2 for the SFNH program (SFNH Version 3.2) and National Program Requirements, Version 1.2 for the MFNC program (MFNC Version 1.2), will only be implemented in states that adopt the 2021 IECC or an equivalently stringent code.

EPA also intends to replace the existing state-specific program requirements in Oregon with these new national versions. For Washington, which has recently adopted a new code that exceeds the stringency of the 2021 IECC, EPA intends to propose a state-specific variation of these new national versions through a separate public comment process. For California, EPA will continue to maintain a state-specific version of the program requirements, with a new version proposed through a separate public comment process.

Additional details on the proposed SFNH Version 3.2 and MFNC Version 1.2 are provided below. EPA is seeking stakeholder feedback and comment on the proposed new program requirements.

A. Overview of 2021 IECC and Rationale for the Development of New Versions

DOE has determined that the latest edition of the model code, the 2021 IECC, will improve energy cost savings by approximately 9% relative to the prior edition. As a result, the SFNH National Version 3.1 program requirements and the MFNC National Version 1.1 program requirements will no longer achieve meaningful savings in certified homes and apartments relative to those built to this latest model code. Therefore, EPA is proposing to define a new version of the program requirements for single-family homes (SFNH Version 3.2) and for multifamily construction (MFNC Version 1.2).

Using the same process that EPA has employed when developing prior new national versions, a new ENERGY STAR Reference Design has been defined for the SFNH and MFNC programs, with additional efficiency features that will result in a more stringent Energy Rating Index (ERI) target.

The mandatory features introduced in the SFNH National Version 3.0 program requirements and MFNC National Version 1.0 program requirements (i.e., the inspection checklists) are intended to ensure that efficiency is not achieved by compromising other attributes like indoor air quality, comfort, and durability. Unlike the more rigorous performance targets proposed in the new versions, these mandatory features will remain unchanged, with a few exceptions, such as introducing a new thermal backstop and several MFNC-specific updates to the Prescriptive Path requirements in the Rater Field Checklist.

The methodology, resulting ENERGY STAR Reference Design Home, ENERGY STAR Multifamily Reference Design, new thermal backstop, additional mechanical efficiencies for MFNC, and implementation timeline are described in the following sections, followed by questions for stakeholders.

B. Methodology

Single-Family New Homes Program Methodology

To develop the proposed SFNH Version 3.2 ENERGY STAR Reference Design Home, EPA first evaluated sixteen typical homes across hot, mixed, and cold climates.

The architectural characteristics for each home were determined using the 2015 edition of DOE's Methodology for Evaluating Cost-Effectiveness of Residential Energy Code Changes. Exhibit 1 shows the house parameters that were modeled consistently across all Climate Zones.

Exhibit 1: House Parameters Consistent Across Climate Zones

Parameter	Value
Number of stories	Two
Conditioned floor area per floor (sq. ft.)	1,188
Total conditioned floor area (sq. ft.)	2,376
Perimeter (ft.)	54 x 22
Ceiling height (ft.)	8.5
Bedrooms	3
Window area (% of floor area) & distribution	15%, Evenly distributed
Exterior door quantity & total area	2 doors, 42 sq. ft.

Exhibit 2 shows the parameters that were modeled with variations across Climate Zones. One home in each zone was configured with an electric heat pump and electric water heater (named 'Configuration A'). A second home was configured with a gas furnace, electric air conditioner, and gas water heater (named 'Configuration B').

Exhibit 2: House Parameters Varied Across Climate Zones

Parameter		CZ 1	CZ 2	CZ 3	CZ 4	CZ 4C & 5	CZ 6	CZ 7	CZ 8
Location		Miami FL	Tampa FL	Fort Worth TX	St. Louis MO	Indianapolis IN	Burlington VT	Duluth MN	Fairbanks AK
Foundation type		Slab				Unconditioned basement			
Space heating, cooling, &	Cfg. A	Electric air-source heat pump & electric DHW							
	Cfg. B	Gas furnace, AC, & gas DHW							

The energy efficiency features of the baseline homes were aligned with the 2021 IECC prescriptive path, except for the window and door performance in Climate Zone 1 and the glazed fenestration performance in Climate Zones 4 Marine through 8. In Climate Zone 1, the prescriptive path of code defines a U-factor of 0.50 and an SHGC of 0.25. Given the relatively stringent SHGC, a corresponding U-factor of 0.40 was assumed in lieu of the code value of 0.50. In Climate Zones 4 Marine through 8, the prescriptive path of code does not define an SHGC requirement. However, in Section 405, the total building performance compliance option, Table R405.4.2(1) specifies that the SHGC of the Standard Reference Design shall be configured as specified in Table R402.1.2 except for climate zones without an SHGC requirement, in which case the SHGC shall be equal to 0.40. Therefore, a value of 0.40 was used for these locations.

In addition, because no insulation installation grade is defined or required by code, all zones were modeled with Grade II insulation installation in walls and floors and Grade I insulation installation in ceilings. This was based upon the predominant insulation grade, by assembly type, identified for single-family residential buildings for homes not indicated as 'above-code,' using data from DOE's energy efficiency field studies.

Further, because no HVAC installation quality grade is defined or required by code, all zones were modeled with the default Grade III blower fan volumetric airflow, blower fan watt draw, and refrigerant charge defined within ANSI / RESNET / ACCA 310-2020.

Finally, the prescriptive path of the 2021 IECC requires builders to select one additional efficiency package from among a list of five options. EPA selected the measure believed to be the most likely for builders to incorporate into their homes, which is the option to reduce energy use in service water-heating. This option requires that the home include a 0.82 EF fossil fuel service, 2.0 EF electric service, or 0.4 solar fraction solar water-heating system. Because of these efficiencies, this option effectively requires the use of an instantaneous water heater, heat pump water heater, or solar water-heating system. The Residential Energy Services Network (RESNET) has reported that approximately a third of

all homes that received an energy rating and were registered in 2020 already used such technology. EPA believes the other four options available for complying with the 2021 IECC are less likely to be used throughout the country for a variety of reasons: the enhanced envelope performance option requires changes to the thermal enclosure system; the improved air sealing and efficient ventilation system option requires the use of less commonly employed ERV/HRV technologies [3]; the more efficient duct thermal distribution system option requires design practices that are currently only commonly used in homes without slab-on-grade foundations; and the more efficient HVAC equipment performance option requires equipment efficiencies that are not climate-specific (e.g., 95 AFUE furnaces in the south and 16 SEER AC in the north).

The energy efficiency features of the baseline homes are summarized in Exhibit 3.

[3] Approximately 3% of all homes that received an energy rating and were registered with RESNET in 2020 used balanced ventilation, indicative of HRV/ERV technology.

Exhibit 3: Key efficiency features of 2021 IECC baseline for Version 3.2 Analysis

Climate Zone	1	2	3	4	4C & 5	6	7	8
Thermal Enclosure								
Ceiling Insulation	R-30	R-49		R-60				
Ceiling Insulation Grade	I							
Wall Insulation: Cavity	R-13		R-20					
Wall Insulation: Continuous	None			R-5				
Wall Insulation Grade	II							
Door U-factor	0.40		0.30					
Frame Floor Insulation	Not present			R-19	R-30		R-38	
Floor Insulation Grade	Not present			II				
Slab Insulation & Depth	Uninsulated		R-10 2 ft	Not present				
Window U-factor	0.40		0.30					
Window SHGC	0.25			0.40				
Infiltration and Mechanical Ventilation								
Infiltration (ACH50)	5		3					
Mech. Vent. Type & Efficiency (CFM / W)	Supply Fan / 2.9				Exhaust Fan / 2.8			
HVAC								
Furnace & AC Efficiency (AFUE / SEER)	80 / 15				80 / 14			
Heat Pump Efficiency (HSPF / SEER)	8.8 / 15							
HVAC Grade - Airflow Deviation	-25%							
HVAC Grading - Watt Draw Efficiency (W / CFM)	0.58							
HVAC Grading - Refrigerant Grade	III							
Thermostat Type	Programmable							
Duct Leakage to Outside (CFA) & Insulation	4 CFA / R-8							
Duct Location	75% Attic / 25% Cond.			50% Attic / 50% Basement				
DHW								
Gas - Efficiency & Capacity (EF / Gal.)	0.82 / 0 (Instantaneous)							
Electric - Efficiency & Capacity (EF / Gal.)	2.00 / 60							
Lighting & Appliances								
Lighting	100% Tier 1, Per ANSI / RESNET / ICC 301							
Refrigerator (kWh/yr)	491							
Dishwasher	NAECA Minimum Defaults, Per ANSI / RESNET / ICC 301							

The energy efficiency features proposed for SFNH Version 3.2 were selected through an iterative process. Key features include a thermal enclosure system with insulation levels aligned with the 2021 IECC prescriptive compliance option, achieving Grade I insulation installation; windows and doors aligned with the latest ENERGY STAR Windows, Doors, and Skylights specification (Version 6.0); infiltration of 3 ACH50 in all locations; heat pump efficiency in all climates and air conditioner efficiency in warm and mixed climates aligned with the latest ENERGY STAR Central Air Conditioner and Heat Pump specification (Version 6.0); furnaces in mixed and cold climates generally aligned with the latest ENERGY STAR Furnace specification (Version 4.1), with all HVAC systems achieving Grade I for total duct leakage

and Grade II installation for blower fan airflow and blower fan watt draw, per ANSI / RESNET / ACCA 310; 100% of ducts located in conditioned space; water heaters meeting or exceeding the minimum requirements for gas-fired instantaneous equipment and electric equipment defined in the latest ENERGY STAR Residential Water Heater specification (Version 4.0); a refrigerator meeting the requirements of the latest ENERGY STAR Consumer Refrigeration Products specification (Version 5.1); a dishwasher aligned with the ENERGY STAR defaults defined in ANSI / RESNET / ICC 301; and 100% Tier 2 lighting, as defined by ANSI / RESNET / ICC 301. These features are summarized in Exhibit 4 below, with improved features relative to the baseline homes shaded green.

Exhibit 4: Key efficiency features of National SFNH Version 3.2 ENERGY STAR Reference Design

Climate Zone	1	2	3	4	4C & 5	6	7	8
Thermal Enclosure								
Ceiling Insulation	R-30	R-49		R-60				
Ceiling Insulation Grade	I							
Wall Insulation: Cavity	R-13		R-20					
Wall Insulation: Continuous	None			R-5				
Wall Insulation Grade	I							
Door U-factor	0.17							
Frame Floor Insulation	Not present			R-19	R-30		R-38	
Floor Insulation Grade	Not present			I				
Slab Insulation & Depth	Uninsulated		R-10 2 ft	Not present				
Window U-factor	0.40		0.30		0.27			
Window SHGC	0.25			0.40				
Infiltration and Mechanical Ventilation								
Infiltration (ACH50)	3		3					
Mech. Vent. Type & Efficiency (CFM / W)	Supply Fan / 2.9				Exhaust Fan / 2.8			
HVAC								
Furnace & AC Efficiency (AFUE / SEER)	80 / 16			90 / 16	95 / 14			
Heat Pump Efficiency (HSPF / SEER)	9.2 / 16							
HVAC Grade - Airflow Deviation	-20%							
HVAC Grading - Watt Draw Efficiency (W / CFM)	0.52							
HVAC Grading - Refrigerant Grade	III							
Thermostat Type	Programmable							
Duct Leakage to Outside (CFA) & Insulation	0 CFA / Not Present							
Duct Location	100% Conditioned Space							
DHW								
Gas - Efficiency & Capacity (EF / Gal.)	0.90 / 0 (Instantaneous)							
Electric - Efficiency & Capacity (EF / Gal.)	2.06 / 60							
Lighting & Appliances								
Lighting	100% Tier 2, Per ANSI / RESNET / ICC 301							
Refrigerator (kWh/yr)	450							
Dishwasher	ENERGY STAR Defaults, Per ANSI / RESNET / ICC 301							

To estimate energy savings, the baseline and ENERGY STAR home configurations were first modeled in Ekotrope Version 4.0.0. Energy consumption was determined from the resulting Fuel Summary report.

The resulting energy consumption for the baseline homes and ENERGY STAR certified homes were then converted to purchased energy costs using a national average rate of $0.13 / kWh and $1.084 / therm. Electricity rates were referenced from the Energy Information Administration's average retail price of electricity to residential customers for 2019. Natural gas rates were referenced from the Energy Information Administration's annual natural gas residential prices for 2020. Finally, the purchased energy costs for the ENERGY STAR certified homes were subtracted from those of the baseline homes to determine savings.

The incremental cost of the energy efficiency features for each ENERGY STAR certified home was then estimated. This included both the measures described above that were used to meet the ENERGY STAR ERI target required by the program, as well as the mandatory measures required within the ENERGY STAR National Rater Design Review Checklist, National Rater Field Checklist, and National Water Management System Builder Requirements.

While this analysis provides illustrative incremental costs and savings, these values will vary for any specific certified home, depending on variables such as baseline construction practices, geographic location, house design, and vendor relationships. For example, builders are likely to experience lower incremental costs than stated in this document if they are able to procure equipment or materials below retail rates or if they already build above code-minimum requirements. In addition, many partners achieve decreasing costs over time as they gain experience and develop more cost-effective strategies to meet the program requirements. Therefore, these estimates are only illustrative and are likely to represent the higher end of the cost spectrum.

New Thermal Backstop for Single-Family New Homes

In Version 3.0 and 3.1 of the Single-Family New Homes program, a thermal backstop is included in the National Rater Design Review Checklist that is aligned with the 2009 IECC, with an alternative compliance option included for homes with low infiltration. While a home can 'trade off' between ceiling, wall, and foundation insulation; windows; and doors, it cannot have an enclosure worse than this thermal backstop regardless of the ERI achieved.

The 2021 IECC has better fenestration and/or higher insulation levels than the 2009 IECC in all locations, as shown in the Exhibit 5.

Exhibit 5: 2009 and 2021 IECC fenestration and insulation levels

CZ	Code	Windows	Ceiling	Wall: Cavity + Cont	Frame Floor	Basement Wall	Crawlspace Wall	Slab
1	2009 IECC	1.20	30	13	13	0	0	0
	2021 IECC	0.50	30	13	13	0	0	0
2	2009 IECC	0.65	30	13	13	0	0	0
	2021 IECC	0.40	49	13	13	0	0	0
3	2009 IECC	0.50	30	13	19	13	13	0
	2021 IECC	0.30	49	20	19	13	13	10, 2ft
4	2009 IECC	0.35	38	13	19	13	13	10, 2ft
	2021 IECC	0.30	60	20 + 5	19	13	13	10, 4ft
4C & 5	2009 IECC	0.35	38	20	30	13	13	10, 2ft
	2021 IECC	0.30	60	20 + 5	30	19	19	10, 4ft
6	2009 IECC	0.35	49	20	30	19	13	10, 4ft
	2021 IECC	0.30	60	20 + 5	30	19	19	10, 4ft
7 & 8	2009 IECC	0.35	49	21	38	19	13	10, 4ft
	2021 IECC	0.30	60	20 + 5	38	19	19	10, 4ft

For SFNH Version 3.2, a more stringent primary thermal backstop that is aligned with the 2021 IECC is being proposed. Specifically, homes will be required to meet the fenestration requirements specified in 2021 IECC Table 402.1.2. In addition, they will be required to use the ceiling, wall, floor, and slab insulation levels specified in 2021 IECC Table 402.1.3 or achieve a total building thermal envelope UA that is less than or equal to the total UA resulting from the U-factors in 2021 IECC Table 402.1.2.

EPA is also proposing to retain an alternative compliance option for homes with low infiltration, with the infiltration limits identical to what is defined in Item 3.1.2 of the National Rater Design Review Checklist, Version 3 / 3.1 (Rev. 11). For this compliance option in SFNH v3.2, EPA is proposing to require that a home achieve a total building thermal envelope UA that is ≤ 115% of the total UA resulting from the U-factors in 2021 IECC Table 402.1.2. EPA believes this alternative compliance option is used relatively rarely, primarily for homes with ducts located in an unvented attic. Several questions are included at the end of this section requesting stakeholder feedback on the alternative compliance option.

To evaluate the feasibility of achieving the more stringent primary thermal backstop that is aligned with the 2021 IECC, a variety of thermal enclosure configurations were modeled for a 2,400 square foot, two-story home, with a 15% window to floor area ratio in Climate Zone 2 through 5. The resulting total envelope UA was calculated for each configuration and compared to the 2021 IECC total UA as reported in the 'beta' version of the "IECC 2021 Building UA Compliance" report in Ekotrope v4.0.0. The results of this analysis are shown in the exhibits below.

Note that the insulation requirements have remained essentially unchanged since the 2009 IECC in Climate Zone 1 and that the 2021 IECC insulation requirements are nearly identical in Climate Zones 5-8, making the analysis in Climate Zone 5 representative of those four zones.

Exhibit 6: UA Analysis - CZ 2 - Slab Home

Scenario Name	2021 IECC	Config. 1
Ceiling Insulation	49	30
Wall Insulation: Cavity	13	13
Wall Insulation: Continuous	None	None
Window U-factor	0.40	0.30
Door U-factor	0.40	0.17
Frame Floor Insulation	n/a	n/a
Basement Wall Insulation	n/a	n/a
Crawlspace Wall Insulation	n/a	n/a
Slab Insulation & Depth	None	None
Total UA for Home	449.9	412.0
% better than 2021 IECC	0.6%	9.0%

Exhibit 7: UA Analysis - CZ 3 - Slab Home

Scenario Name	2021 IECC	Config. 1	Config. 2	Config. 3
Ceiling Insulation	49	49	49	49
Wall Insulation: Cavity	20	15	15	15
Wall Insulation: Continuous	None	3	5	3
Window U-factor	0.30	0.28	0.28	0.24
Door U-factor	0.30	0.17	0.17	0.17
Frame Floor Insulation	n/a	n/a	n/a	n/a
Basement Wall Insulation	n/a	n/a	n/a	n/a
Crawlspace Wall Insulation	n/a	n/a	n/a	n/a
Slab Insulation & Depth	10, 2ft	R5, 2ft	None	None
Total UA for Home	341.7	337.6	338.8	338.9
% better than 2021 IECC	0.5%	1.7%	1.3%	1.3%

Exhibit 8: UA Analysis - CZ 4 – Slab Home

Scenario Name	2021 IECC	Config. 1	Config. 2
Ceiling Insulation	60	60	49
Wall Insulation: Cavity	20	23	21
Wall Insulation: Continuous	5	None	None
Window U-factor	0.30	0.27	0.24
Door U-factor	0.30	0.17	0.17
Frame Floor Insulation	n/a	n/a	n/a
Basement Wall Insulation	n/a	n/a	n/a
Crawlspace Wall Insulation	n/a	n/a	n/a
Slab Insulation & Depth	10, 4ft	10, 4ft	10, 4ft
Total UA for Home	300.5	300.3	299.9
% better than 2021 IECC	0.9%	1.0%	1.1%

Exhibit 9: UA Analysis - CZ 4 - Conditioned Basement Home

Scenario Name	2021 IECC	Config. 1	Config. 2	Config. 3
Ceiling Insulation	60	49	49	49
Wall Insulation: Cavity	20	21	23	21
Wall Insulation: Continuous	5	None	None	None
Window U-factor	0.30	0.27	0.27	0.24
Door U-factor	0.30	0.17	0.17	0.17
Frame Floor Insulation	n/a	n/a	n/a	n/a
Basement Wall Insulation	13	21	15	13
Crawlspace Wall Insulation	n/a	n/a	n/a	n/a
Slab Insulation & Depth	None	None	None	None
Total UA for Home	384.4	383.1	382.6	373.8
% better than 2021 IECC	1.5%	1.8%	2.0%	4.2%

Exhibit 10: UA Analysis - CZ 5 - Conditioned Basement Home

Scenario Name	2021 IECC	Config. 1	Config. 2	Config. 3
Ceiling Insulation	60	60	49	49
Wall Insulation: Cavity	20	21	23	21
Wall Insulation: Continuous	5	None	None	None
Window U-factor	0.30	0.27	0.27	0.24
Door U-factor	0.30	0.17	0.17	0.17
Frame Floor Insulation	n/a	n/a	n/a	n/a
Basement Wall Insulation	19	21	19	13
Crawlspace Wall Insulation	n/a	n/a	n/a	n/a
Slab Insulation & Depth	None	None	None	None
Total UA for Home	379.2	378.4	378.7	373.8
% better than 2021 IECC	0.5%	0.7%	0.7%	1.9%

While the revised backstop is more stringent in most climate zones, particularly in Climate Zone 3 and 4, this analysis suggests that there are a variety of pathways available for homes to comply with it. This will be particularly true as more efficient double-pane windows become common, which are capable of achieving the 0.24 U-factor modeled in some configurations.

Furthermore, recent versions of the program have been implemented for more than ten years, and the same extended timeline is anticipated for SFNH v3.2. Therefore, EPA believes it is important to define a thermal backstop that is appropriate not just for homes certified starting in the next few years but well into the future. Considering that the thermal enclosure system is costly to upgrade after the time of construction and that it is integral to comfort, efficiency, and future-looking features such as being grid-responsive, EPA believes this proposed backstop is warranted.

Multifamily New Construction Program Methodology

To develop the proposed MFNC Version 1.2 ENERGY STAR Multifamily Reference Design, EPA followed a similar methodology as it used to define the Single-Family New Homes Version 3.2 ENERGY STAR Reference Design. Because multifamily buildings may be subject to the Residential or Commercial provisions of the IECC, EPA analyzed both scenarios.

2021 IECC – Residential Chapter Analysis

To assess the savings over the 2021 IECC Residential chapter, EPA evaluated fourteen typical low-rise buildings across hot, mixed, and cold climates. The architectural characteristics for each building were determined using the U.S. Department of Energy's Methodology for Evaluating Cost-Effectiveness of Residential Energy Code Changes. Exhibit 11 shows the building and unit parameters that were modeled consistently across all Climate Zones.

Exhibit 11: Building and Unit Parameters Consistent Across Climate Zones

Parameter	Value
Number of Stories in Unit	One
Conditioned Floor Area per Unit (ft²)	1,200
Number of Stories in Building	Three
Number of Units in Building	18
Unit Perimeter (ft)	30 x 40
Ceiling Height (ft)	8.5
Bedrooms	2
Window Area & Distribution	23% of exterior wall (not including breezeway)
Exterior Door Quantity & Total Area (ft^2)	1 Doors, 21 ft^2
Framing	Wood
Foundation Type	Slab

Exhibit 12 shows the different locations modeled, as well as the heating, cooling, and DHW configurations. In Climate Zones 1 through 7, one building in each zone was configured with an electric heat pump and electric water heater (named 'Configuration A'); and a second building was configured with a gas furnace, electric air conditioner, and gas water heater (named 'Configuration B').

Exhibit 12: Building Heating, Cooling, and DHW Parameters

Parameter		CZ 1	CZ 2	CZ 3	CZ 4	CZ 5	CZ 6	CZ 7
Location		Miami, FL	Tampa, FL	Fort Worth, TX	St. Louis, MO	Indianapolis, IN	Burlington, VT	Duluth, MN
Space Heating, Cooling, & DHW	Config. A	Electric Air-Source Heat Pump & Electric DHW						
	Config. B	Gas Furnace, Electric AC, & Gas DHW						

The energy efficiency features of the baseline buildings were aligned with the same characteristics as the baseline homes used in the single-family analysis, with several exceptions. For multifamily, EPA selected the more efficient duct thermal distribution system option as the additional efficiency package, which requires ducts in conditioned space. EPA believes that this is the most likely compliance option for multifamily because, for architectural reasons, many of the units will already have ducts in conditioned space. In addition, the infiltration requirement was converted to a compartmentalization metric, with each code apartment assumed to have 0.3 cfm50 of leakage per SF of enclosure area (for Climate Zones 3-7, where 3 ACH50 was required) and 0.5 cfm50 of leakage per SF of enclosure area (for Climate Zones 1-2, where 5 ACH50 was required). The enclosure area includes all surfaces surrounding the apartment (exterior and party walls, floors, and ceilings).

The energy efficiency features of the baseline units are summarized in Exhibit 13.

Exhibit 13: Key efficiency features of 2021 IECC baseline for Version 1.2 Analysis

Climate Zone	1	2	3	4	4C & 5	6	7	8
Thermal Enclosure								
Ceiling Insulation U-Factor	U-0.035	U-0.026		U-0.024				
Ceiling Insulation	R-30	R-49		R-60				
Ceiling Insulation Grade	I							
Wall U-factor	U-0.084		U-0.060	U-0.045				
Wall Insulation: Cavity	R-13		R-20					
Wall Insulation: Continuous	None			R-5				
Wall Insulation Grade	II							
Door U-factor	0.40		0.30					
Slab Insulation & Depth	Uninsulated		R-10 2 ft	R-10, 4ft				
Window U-factor	0.40		0.30					
Window SHGC	0.25			0.40				
Infiltration and Mechanical Ventilation								
Infiltration (Compartmentalization)	0.5 cfm50/ft2		0.3 cfm50/ft2					
Mech. Vent. Type & Efficiency (CFM / W)	Supply Fan / 2.9				Exhaust Fan / 2.8			
HVAC								
Furnace & AC Efficiency (AFUE / SEER)	80 / 15				80 / 14			
Heat Pump Efficiency (AFUE / SEER)	8.8 / 15							
HVAC Grade - Airflow Deviation	-25%							
HVAC Grading - Watt Draw Efficiency (W / CFM)	0.58							
HVAC Grading - Refrigerant Grade	III							
Thermostat Type	Programmable							
Duct Leakage to Outside (CFA) & Insulation	0 CFA / Not Present							
Duct Location - Top Floor Units	100% Conditioned Space							
Duct Location - Ground/Middle Floor Units	100% Conditioned Space							
DHW								
Gas - Efficiency & Capacity (EF / Gal.)	0.62 / 40							
Electric - Efficiency & Capacity (EF / Gal.)	0.95 / 40							
WH Insulation	None							
Low flow fixtures	None							
Lighting & Appliances								
Lighting	100% Tier 1, Per ANSI / RESNET / ICC 301							
Refrigerator (kWh/yr)	491							
Dishwasher	NAECA Minimum							

The energy efficiency features of the ENERGY STAR Multifamily New Construction building were selected using a similar iterative process as was used for the Single-Family New Homes program described above. Many of the same features were used in the multifamily design, but several aspects were adjusted. First, similar to the baseline units, the infiltration level was set using a compartmentalization metric. In addition, because the hot water heating load can often exceed the space

heating or cooling loads in multifamily buildings, to drive savings in this end-use, WaterSense fixtures were included, gas water heating was set to 0.90 EF, and the electric water heater efficiency was set at 1.2 EF. While electric water heating equipment does not exist at this modeled efficiency, it is used in the Reference Design to allow flexibility when choosing designs to meet the ERI Target. With these efficiency levels, each modeled unit achieved at least 10% savings in all Climate Zones, and the savings for each unit were comparable for electric and natural gas fuels. These features are summarized in Exhibit 14 below, with improved features relative to the baseline building shaded green.

Exhibit 14: Key efficiency features of National MFNC Version 1.2 ENERGY STAR Reference Design

Climate Zone	1	2	3	4	4C & 5	6	7	8
Thermal Enclosure								
Ceiling Insulation U-Factor	U-0.035	U-0.026		U-0.024				
Ceiling Insulation	R-30	R-49		R-60				
Ceiling Insulation Grade	I							
Wall U-factor	U-0.084		U-0.060	U-0.045				
Wall Insulation: Cavity	R-13		R-20					
Wall Insulation: Continuous	None			R-5				
Wall Insulation Grade	I							
Door U-factor	0.17							
Slab Insulation & Depth	Uninsulated		R-10 2 ft	R-10, 4ft				
Window U-factor	0.40		0.30		0.27			
Window SHGC	0.25			0.40				
Infiltration and Mechanical Ventilation								
Infiltration (Compartmentalization)	0.3 cfm50/ft2		0.3 cfm50/ft2					
Mech. Vent. Type & Efficiency (CFM / W)	Supply Fan / 2.9				Exhaust Fan / 2.8			
HVAC								
Furnace & AC Efficiency (AFUE / SEER)	80 / 16			90 / 16	95 / 14			
Heat Pump Efficiency (AFUE / SEER)	9.2 / 16							
HVAC Grade - Airflow Deviation	-20%							
HVAC Grading - Watt Draw Efficiency (W / CFM)	0.52							
HVAC Grading - Refrigerant Grade	III							
Thermostat Type	Programmable							
Duct Leakage to Outside (CFA) & Insulation	0 CFA / Not Present							
Duct Location - Top Floor Units	100% Conditioned Space							
Duct Location - Ground/Middle Floor Units	100% Conditioned Space							
DHW								
Gas - Efficiency & Capacity (EF / Gal.)	0.90 / 0 (Instantaneous)							
Electric - Efficiency & Capacity (EF / Gal.)	1.2 / 60							
WH Insulation	None							
Low flow fixtures	WaterSense							
Lighting & Appliances								
Lighting	100% Tier 2, Per ANSI / RESNET / ICC 301							
Refrigerator (kWh/yr)	450							
Dishwasher	ENERGY STAR							

2021 IECC – Commercial Chapter Analysis

Because the ENERGY STAR Multifamily Reference Design is the same for all multifamily buildings regardless of height, it was necessary to perform a similar evaluation to confirm that modeled units achieved similar savings above the commercial code. The architectural characteristics for each building were determined using DOE's midrise apartment commercial reference building. Similar to the Residential chapter analysis, for the Commercial chapter, EPA selected the prescriptive compliance path that is expected to be the most common pathway for developers of mid- and high-rise multifamily buildings, which is the ASHRAE 90.1-2019 prescriptive compliance path. Under this option, one of the main differences compared to the residential analysis is that an additional efficiency measure package does not need to be selected for the project to comply with the ASHRAE 90.1-2019 prescriptive requirements. Therefore, in contrast to the units modeled to meet the residential IECC, in the commercial baseline models, the ducts are modeled to be in unconditioned space for top floor units. Another key difference is the change in framing, from wood to steel, which better reflects construction practices for mid- and high-rise buildings. The energy efficiency features of the commercial baseline units are presented in Exhibit 15 below. Based on EPA's analysis, the Reference Design achieved more than 10% savings compared to the ASHARE 90.1-2019 prescriptive compliance path, and savings were generally higher than the savings compared to the IECC Residential Chapter.

Exhibit 15: Key efficiency features of ASHRAE 90.1 baseline

Climate Zone	1	2	3	4	4C & 5	6	7	8
Thermal Enclosure								
Ceiling Insulation U-Factor (Roof Deck)	U-0.039			U-0.032			U-0.028	
Ceiling Insulation Grade	I							
Wall U-factor (Steel)	U-0.124	U-0.064			U-0.055	U-0.049	U-0.042	U-0.037
Wall Insulation Grade	II							
Door U-factor (Swinging)	0.37							
Slab Insulation & Depth	Uninsulated		R-10 2 ft	R-15, 2ft	R-20, 2ft	R-20, 4ft		R-25, 4ft
Window U-factor (Operable)	0.62	0.60	0.54	0.45		0.42	0.36	0.32
Window SHGC (Operable)	0.21	0.23		0.33		0.34	0.36	
Infiltration and Mechanical Ventilation								
Infiltration (Compartmentalization)	0.3 cfm50/ft2							
Mech. Vent. Type & Efficiency (CFM / W)	Supply Fan / 2.9				Exhaust Fan / 2.8			
HVAC								
Furnace & AC Efficiency (AFUE / SEER)	80 / 15				80 / 14			
Heat Pump Efficiency (AFUE / SEER)	8.8 / 15							
HVAC Grade - Airflow Deviation	-25%							
HVAC Grading - Watt Draw Efficiency (W / CFM)	0.58							
HVAC Grading - Refrigerant Grade	III							
Thermostat Type	Programmable							
Duct Leakage to Outside (CFA) & Insulation	12 CFA / R-8							
Duct Location - Top Floor Units	75% Attic / 25% Conditioned Space							
Duct Location - Ground/Middle Floor Units	100% Conditioned Space							
DHW								
Gas - Efficiency & Capacity (EF / Gal.)	0.62 / 40							
Electric - Efficiency & Capacity (EF / Gal.)	0.95 / 40							
WH Insulation	Yes							
Low flow fixtures	None							
Lighting & Appliances								
Lighting	75% Tier 2, Per ANSI / RESNET / ICC 301							
Refrigerator (kWh/yr)	491							
Dishwasher	NAECA Minimum							

Prescriptive Efficiency Measures for the Prescriptive and ERI Paths

Most of the efficiency requirements for the Prescriptive and ERI Paths are contained within the ENERGY STAR Multifamily Reference Design. However, for common spaces for both paths and for dwelling units in the Prescriptive Path, there are additional prescriptive efficiency requirements within the Rater Field Checklist. While these requirements did not adjust between Version 1 and 1.1, for Version 1.2, some efficiency measures will become more stringent, aligning with the increased stringency of the ENERGY STAR Version 1.2 Multifamily Reference Design and federal standards. The following updates are proposed:

1) In the Rater Field Checklist (Items 11.1 and 11.2): For gas water heaters rated in thermal efficiency, the minimum efficiency increases from 85% Et to 90% Et. For electric water heaters

serving dwelling units in the Prescriptive Path, rather than a minimum thermal efficiency of 95%, the minimum efficiency becomes 2.0 COP.

2) In the Rater Field Checklist (Exhibit X): Efficiencies will be updated as shown below. For equipment types not listed below, minimum efficiencies shall be based on 10% improvement over those listed in ASHRAE 90.1-2019.

Equipment Type	CZ 1-4	CZ 5-8
Room AC (window, through-wall)	ENERGY STAR certified	
Air conditioners, air cooled (Split system & single package)		
Air conditioners, air cooled (<65 kBtu/h)	See Reference Design	
Air conditioners, air cooled (≥65 and <135 kBtu/h)	CZ 1-4: 15.7 IEER	CZ 5-8: 14.6 IEER
Air conditioners, air cooled (≥135 and <240 kBtu/h)	CZ 1-4: 15.1 IEER	CZ 5-8: 14.0 IEER
Air conditioners, air cooled (≥240 and < 760 kBtu/h)	CZ 1-4: 14.1 IEER	CZ 5-8: 13.0 IEER
Electric resistance space heating	• Not permitted in any dwelling unit using the Prescriptive Path • Electric resistance heating specified in common spaces has a total heating capacity ≤ 12 kBtu/h (3.5 kW) per enclosed space and has automatic thermostatic controls	
Warm-Air Furnace (<225 kBtu/h, common spaces)	See Reference Design	CZ 5-8 90% AFUE
Warm-Air Furnace (≥225 kBtu/h, common spaces)	80% Et	81% Et
Warm-Air Furnace (dwelling units)	See Reference Design	
Packaged Terminal Air Conditioner (PTAC), w/gas-fired heat (dwelling units)	80% Et in CZ 1-4;	82% Et in CZ 5-8, AND 0.25 cfm50/ft2 avg per unit
PTAC (dwelling units)	12.5 EER	11.9 EER
PTAC (common spaces)	<7 kBtu/h: 12.5 EER	<7 kBtu/h: 11.9 EER
	≥7 and ≤15 kBtu/h: 14.7 - (0.320 X Cap/1000) EER	≥7 and ≤15 kBtu/h: 14.0 - (0.300 X Cap/1000) EER
	>15 kBtu/h: 10.0 EER	>15 kBtu/h: 9.5 EER
Packaged Terminal Heat Pump (PTHP) (Cooling)	<7 kBtu/h: 12.5 EER	<7 kBtu/h: 11.9 EER
PTHP (dwelling units, cooling)	≥7 and ≤ 10 kBtu/h: 14.7 - (0.320 X Cap/1000) EER	≥7 and ≤ 15 kBtu/h: 14.0 - (0.300 X Cap/1000) EER
	> 10 kBtu/h: 11.5 EER	> 15 kBtu/h: 9.5 EER
PTHP (common spaces, cooling)	≥7 and ≤ 15 kBtu/h: 14.7 - (0.320 X Cap/1000) EER	≥7 and ≤ 15 kBtu/h: 14.0 - (0.300 X Cap/1000) EER
	>15 kBtu/h: 10.0 EER	>15 kBtu/h: 9.5 EER
PTHP (dwelling units, heating)	< 8 kBtu/h: 3.3 COP ≥ 8 kBtu: 3.7– (0.052 X Cap/1000)	3.4 COP
PTHP (common spaces, heating)	<7 kBtu/h: 3.3 COP	<10.5 kBtu/h: 3.4 COP
	≥7 and ≤15 kBtu/h: 3.7– (0.052 X Cap/1000) COP	≥10.5 and ≤12 kBtu/h: 3.3 COP
	> 15 kBtu/h: 2.9 COP	> 12 kBtu/h: 3.2 COP
Air cooled heat pump (Split system and single package)		
Air cooled heat pump (<65 kBtu/h)	See Reference Design	
Air cooled heat pump (≥65 and <135 kBtu/h)	15.1 IEER, 3.5 COP	
Air cooled heat pump (≥135 and <240 kBtu/h)	14.4 IEER, 3.4 COP	
VRF Air Conditioners and Heat Pumps	16.2 IEER, 3.3 COP	
Water-loop heat pump (WLHP) (<135 kBtu/h)	15.0 EER, 4.5 COP	
Boilers, hot water (<300,000 Btu/h)	See Reference Design	
Boilers, hot water (≥300,000 Btu/h)	CZ 1-3 80% Et CZ 4 86% Et (89% Et with WLHP)	95% Et (90% Et with WLHP)

ASHRAE Path Performance Target for Multifamily

The ASHRAE Path allows whole-building energy modeling that includes both dwelling units and common spaces to be used to meet a Performance Target. Currently, ENERGY STAR MFNC requires 15% whole-

building energy cost or source energy savings compared to the relevant ASHRAE 90.1 version, following the modeling protocols described in Appendix G. While low-rise multifamily buildings remain outside the scope of ASHRAE 90.1-2019, in Version 1.2, ENERGY STAR will continue to allow low-rise multifamily buildings to choose this path. To ensure that the dwelling units in low-rise buildings still achieve 10% savings over the 2021 IECC Residential code when not following the ERI or Prescriptive Path based on the Multifamily Reference Design, EPA compared ASHRAE 90.1-2019 efficiency levels to the 2021 IECC Residential Chapter. Given that ASHRAE is up to 5% less efficient than efficiency levels in the 2021 IECC Residential Chapter [4], rather than a 10% savings target, EPA is proposing to maintain the 15% savings target over ASHRAE 90.1-2019 for states that adopt the 2021 IECC or ASHRAE 90.1-2019. While the units in the residential analysis showed 10% savings above code, a 10% Performance Target using ASHRAE 90.1 Appendix G modeling protocols would potentially yield lower performance compared to low-rise multifamily buildings. EPA will continue to monitor feedback on this Performance Target.

New Thermal Backstop for Multifamily New Construction

Similar to the SFNH program, Multifamily New Construction Versions 1.0 and 1.1 have a thermal backstop aligned with the 2009 IECC. Initially, this backstop was based only on the Commercial chapter. However, EPA recently updated this policy to allow project teams to choose to have the backstop based on either the Residential or the Commercial chapter of the 2009 IECC.

For MFNC Version 1.2, in alignment with the SFNH program, EPA is proposing to update the thermal backstop to the 2021 IECC. EPA is also proposing to retain the choice to use either the Residential or the Commercial chapter for MFNC v1.2. Note that in MFNC, there is currently no alternative compliance option for buildings with lower infiltration, and EPA is not proposing to add this option for MFNC v1.2.

C. Results and Discussion

Exhibit 16 summarizes the annual purchased energy costs for each baseline and ENERGY STAR certified home. In addition, it includes the ERI achieved by each home, summarizes the annual purchased energy savings and the total upgrade cost for each ENERGY STAR certified home, and the resulting monthly purchased energy savings, monthly mortgage upgrade cost, and net cash flow. The monthly mortgage upgrade cost was calculated assuming a 30-year fixed mortgage with a 5.0% interest rate.

[4] This analysis was based on the features of a building following the requirements of the ENERGY STAR MFNC ASHRAE Path, including modeling to ASHRAE 90.1-2019 Appendix G and meeting the mandatory ENERGY STAR requirements.

Exhibit 16: ENERGY STAR National v3.2 Single-Family New Home vs. 2021 IECC Home, Illustrative Cost & Savings Summary

					2021 IECC		ENERGY STAR Version 3.2						
#	CZ	Location	Found.	HVAC Equipment Type	Annual Purchased Energy Costs	ERI Score	Annual Purchased Energy Costs	ERI Score	Annual Purchased Energy Savings		Total Upgrade Cost	Monthly Purchased Energy Savings	Monthly Mortgage Upgrade Cost	Net Cash Flow
1	1	Miami, FL	Slab	Elec. Air-Source HP	$1,488	62	$1,288	52	$200	13%	$1,259	$17	$7	$10
2	1	Miami, FL	Slab	Gas Furnace / Elec. AC	$1,430	63	$1,226	52	$204	14%	$1,425	$17	$8	$9
3	2	Tampa, FL	Slab	Elec. Air-Source HP	$1,464	66	$1,252	54	$211	14%	$1,511	$18	$8	$10
4	2	Tampa, FL	Slab	Gas Furnace / Elec. AC	$1,365	66	$1,169	55	$195	14%	$1,677	$16	$9	$7
5	3	Fort Worth, TX	Slab	Elec. Air-Source HP	$1,765	59	$1,493	48	$272	15%	$810	$23	$4	$18
6	3	Fort Worth, TX	Slab	Gas Furnace / Elec. AC	$1,489	61	$1,282	50	$207	14%	$1,228	$17	$7	$11
7	4	St. Louis, MO	Bsmt.	Elec. Air-Source HP	$1,879	62	$1,552	49	$327	17%	$1,492	$27	$8	$19
8	4	St. Louis, MO	Bsmt.	Gas Furnace / Elec. AC	$1,484	63	$1,249	49	$234	16%	$1,793	$20	$10	$10
9	5	Indianapolis , IN	Bsmt.	Elec. Air-Source HP	$2,239	68	$1,800	53	$440	20%	$1,528	$37	$8	$28
10	5	Indianapolis , IN	Bsmt.	Gas Furnace / Elec. AC	$1,659	70	$1,328	50	$331	20%	$2,424	$28	$13	$15
11	6	Burlington, VT	Bsmt.	Elec. Air-Source HP	$2,447	70	$1,932	53	$514	21%	$1,528	$43	$8	$35
12	6	Burlington, VT	Bsmt.	Gas Furnace / Elec. AC	$1,765	74	$1,357	50	$408	23%	$2,676	$34	$14	$20
13	7	Duluth, MN	Bsmt.	Elec. Air-Source HP	$3,233	71	$2,467	54	$766	24%	$1,528	$64	$8	$56
14	7	Duluth, MN	Bsmt.	Gas Furnace / Elec. AC	$2,087	75	$1,527	48	$560	27%	$2,676	$47	$14	$32
15	8	Fairbanks, AK	Bsmt.	Elec. Air-Source HP	$5,174	75	$3,891	57	$1,283	25%	$1,276	$107	$7	$100
16	8	Fairbanks, AK	Bsmt.	Gas Furnace / Elec. AC	$2,632	73	$1,926	47	$705	27%	$2,612	$59	$14	$45

Similarly, for MFNC National v1.2, Exhibit 17 summarizes the same key attributes. All values reflect building-level results, inclusive of all units, except ERI scores, which are a weighted average of the individual unit scores.

Exhibit 17: ENERGY STAR National v1.2 Multifamily New Construction vs. 2021 IECC Building Illustrative Cost & Savings Summary

					2021 IECC		ENERGY STAR Version 1.2						
#	CZ	Location	Found.	HVAC Equipment Type	Annual Purchased Energy Costs	ERI Score	Annual Purchased Energy Costs	ERI Score	Annual Purchased Energy Savings		Total Upgrade Cost	Monthly Purchased Energy Savings	Monthly Mortgage Upgrade Cost	Net Cash Flow
1	1	Miami, FL	Slab	Elec. Air-Source HP	$16,077	53	$14,274	46	$1,803	11%	$17,659	$150	$95	$55
2	1	Miami, FL	Slab	Gas Furnace / Elec. AC	$14,945	54	$12,628	45	$2,317	16%	$24,849	$193	$133	$60
3	2	Tampa, FL	Slab	Elec. Air-Source HP	$15,921	56	$14,051	49	$1,870	12%	$17,659	$156	$95	$61
4	2	Tampa, FL	Slab	Gas Furnace / Elec. AC	$14,200	58	$12,118	47	$2,081	15%	$24,849	$173	$133	$40
5	3	Fort Worth, TX	Slab	Elec. Air-Source HP	$17,852	50	$15,921	45	$1,931	11%	$14,471	$161	$78	$83
6	3	Fort Worth, TX	Slab	Gas Furnace / Elec. AC	$14,258	52	$12,799	44	$1,459	10%	$21,661	$122	$116	$5
7	4	St. Louis, MO	Bsmt.	Elec. Air-Source HP	$19,933	53	$17,787	48	$2,145	11%	$14,371	$179	$77	$102
8	4	St. Louis, MO	Bsmt.	Gas Furnace / Elec. AC	$14,886	54	$13,341	45	$1,545	10%	$23,751	$129	$128	$1
9	5	Indianapolis , IN	Bsmt.	Elec. Air-Source HP	$22,408	57	$19,848	51	$2,559	11%	$16,060	$213	$86	$127
10	5	Indianapolis , IN	Bsmt.	Gas Furnace / Elec. AC	$15,774	59	$13,988	47	$1,786	11%	$27,152	$149	$146	$3
11	6	Burlington, VT	Bsmt.	Elec. Air-Source HP	$23,701	57	$20,974	52	$2,728	12%	$16,060	$227	$86	$141
12	6	Burlington, VT	Bsmt.	Gas Furnace / Elec. AC	$16,070	59	$14,248	47	$1,822	11%	$27,152	$152	$146	$6
13	7	Duluth, MN	Bsmt.	Elec. Air-Source HP	$29,241	57	$26,161	51	$3,080	11%	$16,060	$257	$86	$170
14	7	Duluth, MN	Bsmt.	Gas Furnace / Elec. AC	$18,104	58	$15,980	46	$2,125	12%	$27,152	$177	$146	$31

EPA's analysis illustrates that the proposed reference designs for SFNH National v3.2 and MFNC v1.2 are cost-effective and achieve at least 10% savings relative to the baseline homes and apartments. Partners can refer to the ENERGY STAR Single-Family New Homes National ERI Target Procedure,

Version 3.2, and the ENERGY STAR Multifamily New Construction National ERI Target Procedure, Version 1.2, documents for the complete reference design specification.

As noted above, the purpose of the ENERGY STAR Reference Design is to determine the ERI target that must be achieved for each home and apartment to be certified. Therefore, while a home that includes all the measures in the ENERGY STAR Reference Design is very likely to meet the ERI target for that home, there is no requirement to use any of these individual features[5]. Instead, a partner is permitted to mix and match measures until they achieve comparable performance as the ENERGY STAR Reference Design, as defined by the ERI target. For example, a home that does not have ducts in conditioned space may still be certified, as long as other measures are selected to achieve the ERI target for that home. As SFNH Version 3.2 and MFNC Version 1.2 are implemented, EPA will develop climate-specific training to illustrate different pathways that might be used to achieve the ERI target.

D. Implementation Timeline

EPA's approach to implementing the SFNH National Version 3.1 and MFNC National Version 1.1 program requirements in states that have adopted the 2012, 2015, and 2018 editions of the IECC (or an equivalently stringent code) has been to require that the new version be used to certify homes and apartments permitted one year after the date of implementation of the state's new code. To prepare builders for the coming change, EPA provides ample notification in advance of the transition, with email announcements, periodic reminders, and training webinars to ensure that partners are well-positioned for success with the newly introduced program requirements.

Consistent with its past approach, EPA intends to require that homes and apartments be certified to the SFNH Version 3.2 and MFNC Version 1.2 program requirements when permitted one year after the implementation date of the 2021 IECC in the state (or an equivalently stringent code). Please refer to the National Program Requirements for a detailed definition of "permit date" for each program. Prior versions of the program requirements will continue to be implemented in states that have not adopted such a code.

E. Questions

1) Are there any available data or analyses to indicate that EPA's proposed SFNH Version 3.2 and MFNC Version 1.2 program requirements are not warranted or that the proposed efficiency levels are not achievable or cost-effective?

[5] For Multifamily projects where the Prescriptive Path is used, the individual elements of the ENERGY STAR Multifamily Reference Design are effectively mandatory due to the prescriptive nature of this compliance path.

2) Is the proposed more stringent thermal backstop for SFNH Version 3.2 and MFNC Version 1.2, aligned with the 2021 IECC, appropriate and achievable?

3) For SFNH Version 3.2, is the proposed more stringent alternative backstop for homes with low infiltration, defined as ≤ 115% of the total UA resulting from the U-factors in the 2021 IECC, appropriate and achievable? Should this alternative backstop be restructured to better target the types of homes most likely to use it (e.g., homes with ducts in an unvented attic)?

4) Should EPA maintain its previous policy of requiring that the new version of the program be used to certify homes and apartments permitted one year after the date of implementation of the state's new code for the proposed SFNH Version 3.2 and MFNC Version 1.2 program requirements?

5) In the new MFNC Reference Design, EPA is proposing to include a 1.2 EF water heater. This efficiency level falls between what is available for electric tank products and heat pump products and was selected to require apartments with electric water heating to install heat pump water heaters when using the Prescriptive Path, while not making it prohibitively difficult to achieve the ERI target for those using the ERI Path. Is this an appropriate level of water heater efficiency for EPA to include in the proposed new MFNC Reference Design?

V. Introduction of New Certification Label to Accelerate Construction of the Next Generation of Homes and Apartments

Addressing the challenge of climate change will require commitment and action from every level of government and every sector of the economy. In the residential new construction sector, this will include efforts to expand beyond simply increasing energy efficiency to making more significant strides in decarbonizing the operation of homes. EPA believes that the ENERGY STAR Residential New Construction program can play an important role in enabling this transition while also ensuring that the program continues to deliver the associated benefits that partners and consumers have come to expect, such as comfort, durability, and improved indoor air quality.

While improving residential new construction alone will not be enough to meet the nation's climate goals, it is an important component to success. New construction represents a 100-year opportunity to build in critical features and technologies today, with many being difficult and costly to retrofit later. Further, the ability to make a significant impact through new construction is surprisingly high. EPA estimates that more than 20 percent of the housing that will be in the ground in 2050 has not yet been built.

EPA is proposing to introduce a new certification, above and beyond the existing ENERGY STAR New Construction programs for single-family and multifamily homes, that will provide additional recognition for next-generation homes and apartments and the builders that construct them. EPA hopes that this certification will inspire the industry and new home buyers to demonstrate that it is possible to build the housing that we need for tomorrow, today.

A. A New Level of Recognition from EPA's ENERGY STAR Residential New Construction Program

EPA is proposing a new certification label that will provide an additional level of recognition for homes and apartments that include key next-generation features. The new certification will rely on the same energy efficiency levels specified in the proposed SFNH National Version 3.2 and MFNC National Version 1.2 program requirements (or the new California SFNH v3.3 and MFNH v1.3 requirements in that state), plus a set of achievable and market-ready prescriptive requirements for connected space-conditioning heat pumps, connected heat pump water heaters, electric cooking, and EV charging capability.

EPA believes that this new certification is an opportunity to define the major elements and technologies necessary in new homes and apartments to support operational decarbonization by:

- Recognizing builders and developers for incorporating these measures into their homes and apartments with a government-backed label, marketing, and awards;

- Creating a national platform for training, tools, and support to help the industry achieve success;
- Providing state and local policymakers with a national standard that could be used as a model for the development of future policies;
- Providing a basis for incentives as utilities begin to develop more sophisticated residential demand response programs to meet their commitments to reduce carbon emissions; and
- Offering a new opportunity for builders to demonstrate progress towards their environmental, social, and governance (ESG) goals.

EPA's proposed new certification is not intended to replace the existing ENERGY STAR Residential New Construction program, nor the U.S. Department of Energy's Zero Energy Ready Homes program. Rather, it will work in conjunction with these established programs to provide an additional level of recognition for those builders that choose to pursue it.

Note that EPA is still in the process of evaluating options for how the new certification will be branded, but EPA believes that it is important to begin seeking stakeholder feedback and comment on the underlying program requirements now to allow for an accelerated timeline to bring the new certification to market. Stakeholders can expect additional information about branding and consumer positioning in the coming months.

B. Proposed Measures and Technologies for the New Certification

To earn the new certification, EPA is proposing that a home or apartment must be independently verified to meet all the following requirements:

- Highly energy-efficient construction;
- A multi-stage ENERGY STAR certified connected heat pump installed;
- An ENERGY STAR certified connected heat pump water heater installed;
- An induction cooktop and electric oven provided; and
- Electric vehicle charging capability included.

EPA believes that all of these elements can be easily verified by the same energy rating companies that perform the inspections and testing required for the existing ENERGY STAR Residential New Construction programs under the oversight of their Home Certification Organization (HCO) or Multifamily Review Organization (MRO). EPA anticipates that these new requirements can be documented by a rater using a single 1-page checklist. A more detailed discussion of each of the proposed required elements is provided below.

While stakeholders are encouraged to provide comments on all elements of the proposed new certification, EPA has also called out several specific questions that it is seeking feedback on.

1. Energy Efficiency Prerequisite

To be eligible for the new certification, EPA is proposing that homes and apartments must first meet ENERGY STAR's SFNH National Version 3.2 or MFNC National Version 1.2 program requirements for energy efficiency, even if these more rigorous specifications are not implemented in the state for the base ENERGY STAR program. In California, the energy efficiency requirement is proposed to be aligned with the CA SFNH Version 3.3 or CA MFNC Version 1.3 specification.

Initially, the proposed certification will not be available in certain areas (e.g., the Caribbean or Pacific Islands) where EPA has already defined specialized program requirements for the ENERGY STAR certification. EPA will re-evaluate the applicability of, and demand for, a customized version of the new certification for these areas at a later date.

Questions

1) Are EPA's proposed energy efficiency requirements at an appropriate level for the new certification?

2. ENERGY STAR Certified Connected Heat Pumps

Traditionally, heat pumps have been employed in the southern parts of the U.S., with gas heating dominating in the north. However, advances in heat pump technology have made their use an appropriate option in cold climates as well. ENERGY STAR certified heat pumps have higher ratings for seasonal energy efficiency ratio (SEER), energy efficiency ratio (EER), and heating seasonal performance factor (HSPF) while using about 5% percent less energy than conventional new models.

EPA is proposing that to earn the new certification, homes and dwelling units must be equipped with a properly sized two-speed or variable-speed ENERGY STAR certified air- or ground-source heat pump that meets EPA's 'connected' criteria (or includes an ENERGY STAR certified smart thermostat); and in Climate Zones 5-8, the installed heat pumps must meet additional efficiency and capacity requirements.

Additional information about ENERGY STAR certified heat pumps, EPA's connected criteria, and smart thermostats can be found on the ENERGY STAR website.

Multi-Speed Requirements

For the new certification, EPA is proposing that all installed heat pumps be two-speed or variable-speed and ENERGY STAR certified. With multiple speeds, heating and cooling systems can meet the design loads on the hottest and coldest days by operating on high. But for the majority of their operation, they can run at partial speeds to satisfy heating and cooling demand. Running at a lower speed is quieter,

improves indoor humidity levels, and reduces short cycling of the equipment.

Cold-Climate Heat Pump Requirements

In Climate Zones 5-8, EPA is proposing that installed air-source heat pumps must also meet the ENERGY STAR cold climate requirements specified in the ENERGY STAR Version 6 Product Specification for Air Source Heat Pump and Central Air Conditioner Equipment. These additional requirements are designed to ensure that heat pumps perform well and remain efficient at low ambient temperatures.

Sizing and Installation Requirements

EPA understands that proper sizing and installation are essential for a heat pump to operate properly, and the base ENERGY STAR Residential New Construction program requirements already contain equipment sizing and selection requirements in the SFNH National HVAC Design Report, MFNC National HVAC Design Report, and National HVAC Design Supplement. Over the next year, EPA will be developing additional sizing and selection guidance for multi-speed and cold climate heat pumps for partners.

For the new certification, EPA is proposing that homes must be certified using the rater-based HVAC Grading Track and may not use the alternative HVAC Credential Track, which is permitted in the base ENERGY STAR program. Heat pumps are particularly sensitive to proper installation, and because this technology is a mandatory feature in the proposed new certification, EPA believes that it is critical to have 3rd party verification through direct testing of installation quality by a trained and certified rater. The HVAC Grading Track makes use of ANSI / RESNET / ACCA 310, which was released in 2020 for raters to independently assess the installation quality of HVAC systems.

The HVAC Grading standard is comprised of five key tasks: a design review; a measurement of total duct leakage, blower fan airflow, and blower fan watt draw; and an assessment of refrigerant charge. The base ENERGY STAR program allows a home to be certified while achieving either Grade I or II for airflow and watt draw and, in some cases, the default Grade III for the refrigerant charge. For the new certification, EPA is proposing that Grade I must be achieved for all elements to ensure that only homes and apartments with the highest installation quality of HVAC systems are eligible to receive certification.

Connected Requirements

Electric grid efficiency is improved when electricity demand aligns with electricity production. Buildings can help the grid to operate more reliably, cleanly, and affordably if they use electricity at optimal times. In housing, one significant opportunity to support this load shifting is through connected, demand-response capable heat pumps.

EPA is proposing that each installed heating and cooling system must meet EPA's 'connected' criteria (or be controlled by an ENERGY STAR certified smart thermostat). These connected criteria identify products that provide energy reporting, remote consumer access, and grid services through connection to other systems inside and outside the home. ENERGY STAR certified connected equipment and ENERGY STAR smart thermostats are designed to be compatible with electric utilities' demand response programs.

Multifamily Building Common Space Requirements

For multifamily buildings, the installation of connected, multi-stage ENERGY STAR heat pumps is only proposed to be required in the building's dwelling units. EPA is proposing that common spaces will not be subject to these requirements, although the efficiency requirements of MFNC v1.2 still govern them.

Questions

1) EPA is proposing that all installed heat pumps must use the HVAC Grading Track and achieve Grade I for all elements. Is mandatory HVAC grading and achieving Grade I in homes an appropriate requirement for the new certification?

2) EPA is proposing that all installed heat pumps must meet EPA's 'connected' criteria or use an ENERGY STAR smart thermostat. Are these connected options appropriate requirements?

3) EPA is not proposing to include space conditioning or connected requirements for non-dwelling unit spaces in multifamily buildings. Is this an appropriate and advisable exemption?

4) EPA is proposing that cold climate heat pumps be required in Climate Zones 5-8. Are these the most appropriate areas for requiring these systems? Should any Climate Zones be added or any eliminated?

3. ENERGY STAR Certified Heat Pump Water Heaters

ENERGY STAR certified heat pump water heaters (HPWHs), also commonly referred to as hybrid electric water heaters, are more than twice as efficient as the most efficient gas water heaters and use 70% less electricity to make the same hot water as a standard electric model. Additional information about ENERGY STAR certified heat pump water heaters can be found on the ENERGY STAR website.

EPA is proposing that to earn the new certification, a home or dwelling unit must be equipped with a properly sized ENERGY STAR certified heat pump water heater that also meets EPA's 'connected'

criteria.

Connected Requirements

As noted above, products that meet EPA's connected criteria are able to provide energy reporting, remote consumer access, and grid services through connection to other systems inside and outside the home. Water heating is also an ideal demand response opportunity because connected water heaters can shift up to 1 kW per demand response event through pre-heating and have the communication ability to load shift and respond to demand response events.

Sizing Requirements

HPWHs may heat water more slowly than other technologies, making proper sizing a critical factor in their performance. For the new certification, EPA is proposing to include the following minimum tank sizing requirements for heat pump water heaters to help ensure sufficient hot water to meet occupant demand without requiring excessive use of an electric resistance backup coil, as shown below.

Bedrooms:	1	2	3	4+
Minimum Tank Capacity	40	50	65	80

Sound Rating Requirement

Because some HPWHs make more noise when operating than gas or conventional electric water heaters, EPA is proposing to include a sone rating limit of ≤55 dBA for HPWHs installed within a dwelling unit's occupiable space. This requirement is intended to preclude louder units from being installed in locations where occupants would frequently hear them.

Voltage Requirement

EPA is proposing that only 240V HPWHs be installed in homes and apartments that earn the new certification. Although the ENERGY STAR specification for HPWHs allows 120V models, the 240V models heat water more quickly, and EPA believes they are more appropriate for new construction.

Challenges for Multifamily Buildings

EPA recognizes that there are unique challenges to heat pump water heating in multifamily buildings. There are several efforts underway to research and develop new technologies and solutions, such as split systems and central heat pumps. In late 2020, EPA formed an ENERGY STAR Heat Pump Water Heater

Manufacturers Action Council and recently joined the Advanced Water Heating Initiative to help expedite these solutions.

Questions

1) EPA is proposing minimum tank size requirements to help ensure that the heat pump is used as the primary water heating source, rather than the electric resistance backup coil. Is this advisable, and are the proposed tank sizes appropriate?

2) EPA is proposing that heat pumps installed in occupiable space have a sone rating of ≤55 dBA. Is this an appropriate threshold?

3) EPA is proposing that heat pump water heaters will be mandatory to earn the new certification for all types of new construction, including multifamily. Should EPA consider allowing conventional electric water heaters while the market develops new heat pump water heater solutions?

4. Induction/Electric Cooking

Conventional residential cooktops typically employ gas or resistance heating elements to convey heat, with efficiencies of approximately 32% and 75-80%, respectively. In contrast, induction cooktops use an electromagnetic coil that warms compatible cookware internally, transferring heat energy with approximately 85% efficiency. Induction cooktops are about 5-10% more efficient than conventional electric resistance units and three times more efficient than gas burners.

Induction cooking also offers a number of important consumer benefits. For example, because the source of heat is the cookware itself, cookware reaches desired temperatures more quickly and provides for faster cook times. In addition, the cooktop surface remains cool to the touch, and less heat is lost to the surrounding air. This provides an additional energy efficiency benefit by reducing the workload for the home's HVAC equipment. A cooler cooktop surface also makes induction cooktops safer to work with than other types of cooktops and emits fewer airborne pollutants.

To earn certification through the new program, EPA is proposing that kitchens (including kitchens in common spaces of multifamily buildings) be equipped with cooktops and range elements or burners that use induction technology and ovens that are electric.

Consideration for Affordable Housing Projects

EPA recognizes that induction ranges currently carry a price premium compared to conventional electric ranges and that specific cookware is required. Based on these considerations, EPA is proposing to allow

homes constructed with a government subsidy to use traditional electric cooktops as an alternative to induction to avoid deterring participation by affordable housing project developers.

Questions

1) EPA is proposing an exemption from the certification requirement for induction cooktops and ranges in government-subsidized affordable housing projects, where conventional electric cooktops will be allowed as an alternative. Is this allowance appropriate and advisable for affordable housing?

2) Should EPA also consider allowing conventional electric cooktops in market-rate housing as an alternative to induction?

5. Electric Vehicle Charging Capability

With the predicted growth in the electric vehicle (EV) market and a majority of EV charging expected to occur at home, EPA believes that the inclusion of EV charging capability is a critical component of the proposed certification. EPA is proposing that to earn the new certification, a home or multifamily development must include EV charging capability, as specified below:

- **Single-family homes and two-unit dwellings** (where private automobile parking is provided) must be equipped with at least one 'EV-Ready' parking space to allow residents to plug in a "mobile" Level 2 charger or easily install a permanently-mounted Level 2 charging station.

  EPA defines EV-Ready as the installation of a powered 208/240 receptacle in a private garage or within three feet of a driveway or parking space. The electric service panel must also include a 40-amp breaker, and the panel directory must identify the branch circuit as for "Electric vehicle charging."

- **Multifamily buildings**, as well as single-family units without private parking, must be equipped with one EV-Ready space for each dwelling unit as described above; OR have an ENERGY STAR certified EV charger installed for at least 10% of parking spaces (up to five chargers) AND have an additional 20% of spaces be 'EV-Capable.'

  EPA is proposing that where EV chargers are installed to meet the program requirements, they must be ENERGY STAR certified and meet EPA's 'connected' criteria. ENERGY STAR certified EV chargers that meet EPA's 'connected' criteria minimize standby losses, have a Minimum Active Charging Efficiency of 93%, and are equipped with advanced energy management

capabilities, coupled with an open grid communication platform, to allow them to load shift and respond to demand response events. ENERGY STAR certified EV chargers use 40 percent less energy than standard chargers while in standby mode (i.e., not actively charging a vehicle).

EPA defines EV-Capable as the installation of conduit that runs continuously from the electrical panel to a junction box that terminates within three feet of a parking space. Multifamily projects with common area electrical rooms may have the conduit terminate anywhere within the electrical room. Those parking spots in a covered garage are deemed EV-Capable if the conduit terminates anywhere within the garage on that parking level.

When calculating the number of EV chargers and EV-Capable spaces required, all parking spaces in the development must be included, except for those associated with one and two-family dwellings' private driveways or garages (which must meet the EV-Ready requirements). For this purpose, the "development" includes the combined areas covered by the project's site permit and zoning permit. The number of required compliant spaces shall be rounded up to the nearest whole number. Note that an EV-Ready parking space also meets the criteria for an EV-Capable space.

- **Projects with no provided parking** are not required to install EV charging infrastructure.

Partial Exemption for Service Upgrade

Some stakeholders have cited costs of $3,000 to $10,000 to upgrade a new home's service from 200- to 400-amps. However, a recent report from Home Innovation Research Labs indicates that this electric service upgrade is not likely to be typical in single-family homes where EV charging capability is added. As a result, EPA is proposing a partial exemption in cases where installing a 40-amp breaker to meet the EV-Ready requirement for a dwelling unit would require a service upgrade from 200- to 400-amps. Specifically, EPA is proposing that if the addition of the 40-amp electric vehicle charging branch circuit increases the electrical service from 200-amp to 400-amp service, connecting the circuit to the electrical panel is not required.

Questions

1) Are EPA's proposed requirements for private EV-Ready spaces and/or installed EV chargers and EV-Capable parking spaces appropriate?
2) EPA is proposing to cap the number of required EV-chargers for a development at five (5). Is this an advisable limit?

3) Some concern has been expressed that the addition of an EV charging circuit would require a costly upgrade to 400-amp service. EPA believes this will be a relatively rare occurrence (and may become even rarer with emerging tech solutions that could eliminate the need for upgrades). Is EPA underestimating the frequency with which this might occur, and if so, should the requirement be changed?

4) EPA is not proposing to relax the EV-Ready or EV-Charging requirements for government-subsidized affordable housing. Should EPA consider setting alternative EV charging infrastructure requirements (or have no EV requirements) for affordable housing?

C. Relationship to DOE's Zero Energy Ready Homes Program and New Certification Program Branding

The U.S. Department of Energy (DOE) and U.S. EPA certification programs work together to provide a recognition system for residential new construction built to higher standards of performance. EPA's ENERGY STAR remains a great starting point for builders on their journey to building above-code, high-performance, energy-efficient homes. DOE's Zero Energy Ready Homes (ZERH) is a step-up program for builders that brings higher levels of energy efficiency, indoor air quality (via required EPA Indoor airPLUS certification), PV readiness, and additional provisions for improved building envelope performance.

DOE is currently developing Version 2 of its ZERH program, which is designed to be 20% more stringent than 2021 IECC, compared to 10% for ENERGY STAR v3.2. ZERH v2 proposed changes - relative to ZERH v1 - include certification to ENERGY STAR v3.2 (instead of v3.0 or v3.1), higher envelope insulation and window requirements, increased provisions for energy-efficient lighting and appliances, broader requirements for PV Readiness, and lower Energy Rating Index (ERI) scores in the 40s. After first achieving ENERGY STAR v3.2 certification, builders can choose to pursue DOE's Zero Energy Ready certification, or EPA's new certification, or both. Neither program is proposed to be a prerequisite for the other, and both require certification to ENERGY STAR v3.2.

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.

EPA is currently evaluating options for how its new certification program will be branded. EPA believes that stakeholders would value the new certification leveraging the brand recognition and trust of the ENERGY STAR program. At the same time, EPA appreciates the new certification's potential to undermine consumers' valuing of those homes and apartments that will continue to be certified through the base ENERGY STAR program. EPA is taking all of these factors into consideration and will share additional information with program stakeholders in the coming months.

D. Program Development

After finalizing the specification, EPA will work towards developing branding and messaging to support the new certification, as well as the program's infrastructure, supplemental guidance materials, marketing collateral and labels, and training, webinars, and other educational materials. EPA staff will also closely monitor developments in the industry that may lead to additional decarbonization opportunities in the residential new construction sector.

EPA anticipates that the requirements for the new certification will be modified more frequently than those of the base ENERGY STAR program. As new tools and metrics are released, and new technologies come to market that are viable for national use, EPA will look for opportunities to incorporate them into future versions of the new certification program requirements.

Areas where EPA staff are actively monitoring market developments include, but are not limited to:

- Methodologies that quantify hourly carbon emissions which reward the load shifting benefits of technologies, such as RESNET's time-of-use carbon metric;
- Efforts to quantify the passive survivability benefits of highly efficient buildings, including an "Hours of Safety" methodology;
- The installed costs and market readiness of battery storage, bi-directional EV charging, and other efficient technologies that provide emergency power generation;
- Tracking infrastructure for rooftop or community solar Renewable Energy Credits (RECs);
- Industry efforts to quantify embodied carbon in building materials; and
- Low- and no-GWP refrigerants for heat pumps and blowing agents for foam insulation products.

VI. Stakeholder Feedback Period

EPA values the feedback of our partners and other program stakeholders regarding these important proposed initiatives. Please submit written comments on any aspect of the proposals described in this document to energystarhomes@energystar.gov **no later than November 15, 2021**. Please note that all submitted comments will be posted on the ENERGY STAR website.