Energy Code ASHRAE 90

Awesome. Thank you, Shan. So today we have our third webinar in the Energy Code Webinar Series. We're going to be talking about ASHRAE 90.1-2019. Thank you for everyone joining this call. And if you want to see the webinars that we've already hosted, they'll be posted online on the Energy Code's HUD Exchange page in the coming weeks.

So we started off with a session covering the impact of the HUD USDA final determination for home and housing trust fund projects, and then moved on to an introduction to the 2021 IECC. And in the new year, we're going to be hosting a final session on alternative compliance pathways. And we'll share the date for that once we have it scheduled. Move on to the next slide.

So I am Andrew Poling. I'm a Program Analyst with the US Department of Housing and Urban Development. And then after, I'm going to provide a little bit of background for today's session and talk a little bit about the final determination that was published last spring.

And then once I'm done with that, I'm going to pass it off to Paula Zimin, who's a Senior Research Analyst with Pacific Northwest National Laboratory. And she's going to be talking us through all of the specifics of the ASHRAE code.

You can go to the next slide. And one more. Perfect. So starting off with a little bit of context. The Energy Independence and Security Act of 2007, or EISA, requires HUD and USDA to jointly adopt the most recently published energy standards.

It does require a housing affordability and availability test to ensure that any adopted standards don't adversely impact either of those factors. So previously, HUD and USDA had required the 2009 IECC and ASHRAE 90.1-2007.

However, this past year, our final determination, which was published in the Federal Register on April 26, 2024, brought HUD and USDA back into compliance with EISA by adopting the 2021 IECC and ASHRAE 90.1-2019 standards as the minimum energy standards for new construction.

To get to that final determination, we obviously went through the affordability and availability testing, as well as an extensive public comment period before formally adopting the standards the end of April.

So this notice does only impact new construction. And then the other thing I want to note is that the updated energy code does not apply to FHA-insured or USDA mortgage financing for existing housing or manufactured housing. You can go to the next slide.

And so here we have the two codes that are specified in the statute for single-family and low-rise multifamily. We're talking about 2021 IECC. And then for buildings, multifamily buildings with four or more stories, it's ASHRAE 90.1-2019. Next slide.

So a little bit on the anticipated benefits of this update. First off, the cost savings. So more energy-efficient homes reduce energy bills and costs for homeowners. The ASHRAE 90.1-2019 standard, our analysis showed that the savings annually for each unit are around $225, well, over the 30-year life-cycle of the building, around $6,000 in savings per unit, up to just under $200,000 across a building.

We also have significant health benefits. So improved energy efficiency often translates to better indoor air quality, with homes building to these updated standards being less likely to have moisture issues which can contribute to higher rates of asthma or other respiratory problems.

And that also leads into the enhanced comfort. Better insulation, efficient windows, and improved HVAC systems help homeowners and renters maintain a more consistent indoor air temperature and really lead to greater comfort.

And finally, and particularly with the severity and frequency of extreme weather events over the last few years, resilience, which is a key piece here. So building to higher energy standards can enhance a home's durability against extreme weather events and actually enable greater passive survivability for a home.

And with that, passive survivability is really talking about a home's ability to maintain critical life support conditions in the event of extended loss of power or water. You can go to the next slide.

So here we have the estimated savings for ASHRAE 90.1-2019. So this standard is 22.5% more efficient than the 2007 standard, HUD'S previous requirement. And in aggregate, energy savings are estimated at $1.1 million per year or up to $53 million over the 30-year life cycle. Next slide.

And then this is the list of compliance dates just for multifamily programs. So you can see the program event that triggers compliance. And then also in the final determination

column, we have the date that the compliance date take effect, for FHA-insured multifamily, and then also public housing, so capital fund and project-based vouchers.

This goes into effect 12 months after the effective date or the end of May 2025. Home and housing trust fund actually just went into effect at the end of last month. And then for competitive grant programs, choice neighborhoods, section 202 and 811. It's the next published NOFO after the effective date.

And then the other thing I just want to call attention to here is the exemption for projects in persistent poverty rural areas. So based on USDA's map of persistent poverty rural areas, which you can find online, we've extended the compliance date to 24 months after the effective date or the end of May 2026. Next slide.

And then we're also looking into and going to release a list of alternative compliance pathways to meet this standard. So industry is already building to standards that meet or exceed the 2021 IECC or ASHRAE 90.1-2019.

Programs such as the Low-Income Housing Tax Credit Qualified Allocation Plans often require or incentivize high-performance building standards, and then the IRA tax credits, which are available, reference building and require building to ENERGY STAR program requirements or certifying to Department of Energy's Zero Energy Ready Homes Program.

So, as I mentioned, HUD and USDA will be publishing a list of high-performance building standards that are accepted as alternative compliance pathways. And this may include programs such as ENERGY STAR Certified Homes, Department of Energy Zero Energy Ready Home Program, as well as other high performance building standards that set or incentivize the 2021 IECC or ASHRAE 90.1-2019 as baseline standards or requirements. Next slide.

And then here we have a little bit on the state code adoption and how it relates to the HUD requirements. So codes are adopted at the state or local level. And states often include amendments when adopting codes.

This map here is developed by the Department of Energy and shows the code efficiency category of each state adopted code and takes into account any weakening or strengthening amendments that a state might have included to the unamended standard, so with this map showing which versions of the ASHRAE 90.1-2019 standard that states have adopted, taking into account impacts of weakening or strengthening amendments.

We have 14 states that currently are at the 90.1-2019 version and then also the District of Columbia. And just to walk through an example here, I want to take Ohio, which has adopted the ASHRAE 90.1-2019 standard, however, has done so with some weakening amendments.

As a result, this map shows it as equivalent to the 2016 standard. In that case, the state code would not be seen as an equivalent performance level to the HUD and USDA requirements. So projects need to be building to that unamended ASHRAE 90.1-2019, or at least its equivalent performance level. Next slide.

And then here we have a little bit of information on some of the resources that we've put together to support the implementation of the minimum energy standards. We have a screenshot here from our web page on HUD Exchange.

And this minimum energy standards page offers a variety of resources and training materials to help assist HUD grantees, participating jurisdictions, developers, and builders with information on the requirements of the updated minimum energy standards. So resources such as introductory code materials, some information on compliance tools, such as contract or risktech, some state resources as well, and then, additionally, technical information largely brought and developed by the Department of Energy's Building Energy Codes Program.

We also have some information on additional funding opportunities. And then finally, you'll be able to find the recordings of the webinars, as well as the links to the slide decks on that page as well. And go to the next slide. Yep, and so that is it for me. I'll pass it over to Paula to talk us through the code.

Thanks, Drew. Just going to share my screen now. All right. Can everybody see that and hear me? Thumbs up.

Looks good.

Awesome. Thank you guys. Thank you for having me. Today, as Drew said, I'm going to introduce some high-level changes between ASHRAE standard 90.1 version 2007 to the 2019 version. And again, this is specifically for new construction multifamily housing.

And keep going. A little bit about me first. I wanted to introduce myself. My name is Paula Zimin. I am a senior research analyst at the Pacific Northwest National Lab, or PNNL. I reside in the great state of New Jersey. I went to school for architecture at Virginia Tech.

I am now a registered architect in New Jersey and New York. And I've been specializing in building energy performance for 17 years. I know probably too much about ASHRAE 90.1. And I am a boy-mom. These are my two sons. It's a little bit of an older picture. My older son is about my height now, so that's a little scary. But they're adorable. And other than standards, I love to hang out with them.

OK. So this is what we have in store for you today. I'll start with the background of the DOE's Building Energy Codes Program, and then review what energy codes are and the HUD minimum energy standards. Then we'll dive into the ASHRAE standard itself, comparing the changes in organization, scope, compliance paths, and compliance requirements between the 2007 version and the 2019 version.

And hopefully, the bulk of this session is going to be that high-level review of the key technical updates of energy efficiency requirements within the system sections themselves. I've picked out and highlighted the more significant changes that would impact multifamily buildings or mixed use buildings.

There are many more changes between the two standard versions that would not typically apply to these building typologies. And there are other subtle changes as well. So big disclaimer here is that this presentation is not comprehensive.

Project teams should definitely consult with their design professionals to confirm any design changes needed to comply with the new minimum efficiency standard. The intent is really just to inform you of the larger changes to expect as you move forward with compliance.

Finally, at the end of this presentation, I've included some resources relative to the ASHRAE standard 90.1-2019 and energy efficiency in multifamily buildings, as well as an appendix with some additional comparisons that we won't have time to review in more detail today.

So let's have some fun and dive right in. A little bit of a background of DOE's Building Energy Codes Program, which is the program I primarily support here at PNNL. It is funded by the Department of Energy. And the mission is to support building energy code development, adoption, and implementation to achieve the maximum practical, cost-effective improvements in energy efficiency while providing safe, affordable, and healthy building for occupants.

To achieve this mission, the Building Energy Codes Program directive is to participate in development of energy codes, establish methodologies, and issue determinations to

confirm energy codes result in energy savings, promulgate standards for federal buildings, and provide technical assistance to states and jurisdictions to implement their energy codes.

To learn more about the DOE Building Energy Codes Program, you can visit our website at www.energycodes.gov.

For those of you who don't work with energy codes as much as I do, you may be wondering, what are energy codes? And how do they relate to HUD'S change in minimum energy standards? At their basic level, energy codes set requirements for minimum levels of efficiency for buildings and homes.

Energy codes are adopted by states and/or individual jurisdictions, along with or similar to other building codes. There are two energy codes that are the predominant building energy codes in the US, and Drew had already shown them. It's ASHRAE standard 90.1 and the IECC. Both codes are updated on a three-year cycle.

So energy codes are a bunch of regulations on how buildings and homes use energy. But what does that really look like? How can energy codes impact you? Newer energy codes result in lower energy bills with more stringent performance requirements on various systems and equipment, such as lighting and controls, as well as properly sized mechanical equipment and well-insulated hot water systems.

Newer energy codes also result in more comfortable and healthy indoor environments with increased insulation, improved air sealing to reduce drafts, and higher performance windows that allow healthy daylight but minimize heat flow either from a glaring sun in the summertime on the outside or keeping the warmth inside in the winter.

So the two predominant codes, as we said, are ASHRAE standard 90.1 for multifamily buildings four stories and above and the commercial provisions of the International Energy Conservation Code. In content, the energy requirements of both look very similar. IECC is largely based on ASHRAE 90.1. The IECC is usually published two years after the ASHRAE 90.1 standard. And their partner codes are meant to be equivalent.

So the ASHRAE standard 90.1 version 2007 is the partner code to the 2009 IECC. And the ASHRAE standard 90.1-2007 is the previous minimum energy standard for HUD for multifamily buildings, four stories or more.

The new HUD minimum energy standard is now a standard 90.1-2009 for multifamily buildings, four stories or more. The partner energy code is 2021. And as IECC and as Drew mentioned, HUD will accept the 2021 IECC in place of 90.1-2019 since they're comparable energy codes.

Developers and contractors and states or jurisdictions whose energy code is older than the 2021 IECC or ASHRAE 90.1-2019 will need to become familiar with the differences of their local energy code. And we hope that this overview can help with those larger changes.

Taking a step back, the Department of Energy's building energy code program tracks the normalized net energy use of each energy code update. This chart identifies the net average energy use reduction of both residential and commercial construction based on their respective energy codes on an energy index scale of 0 to 100.

100 represents the start of energy codes back in 1975 with ASHRAE standard 90. And 0 represents a net zero energy code. The blue dots identify the normalized net energy use of the residential energy code, as written in the MEC back in 1980, through the development of the IECC in the 2000s. The green dots identify the normalized energy code of the commercial energy code or ASHRAE standard 90.1 over each version from 1975 to 2022.

The previous HUD minimum energy standard for midrise and taller multifamily buildings was ASHRAE standard 90.1-2007. The net average energy use reduction across all commercial construction, not just multifamily, was 69.

And then the new HUD minimum energy standard for midrise and taller multifamily buildings is ASHRAE standard 90.1-2019. The net average energy use reduction across all commercial construction is approximately 47. So across all commercial construction, this is approximately a 30% reduction between the two standards.

Drew showed this map earlier. This is the building energy code program efficiency equivalency mapping. If a state adopts a model code with no amendments which impact energy use, the code efficiency category will reflect the adopted energy code.

If a state includes weakening amendments which reduce energy efficiency, the code efficiency category will align with an older model energy code with a closer efficiency equivalence. This map reflects the efficiency equivalency of the state codes. States that are white do not have a statewide code. An equivalency has not been calculated.

Dark green states, as Drew mentioned, have adopted ASHRAE 90.1-2019 or an equivalent efficiency code. Lighter green states will find a few changes will need to be made in their designs to comply with ASHRAE standard 90.1-2019 requirements. States in yellow and orange will need to make more significant changes to comply with the new HUD minimum energy efficiency requirements.

All right. Now we're going to focus more in on ASHRAE standard 90.1-2019 specifically and changes specific to section or organization appendices, scope application, compliance paths, and compliance requirements.

I did put together this little key to help identify where the changes are. Blue text highlights slight changes that should be noted, although the general intent of the code requirements remains unchanged.

Requirements in orange text are notable changes between the 2019 and 2007 standard. But the code intent changes or expands. And then anything in an orange box or with a star New Requirement in the upper left-hand corner are all new code sections, so we can follow along in that way.

The organization of the main sections of ASHRAE 90.1 have not changed between the two versions, sections 1 through 12. Each section is maintained. And there's no significant changes, although I'll get into more detail about the system section changes relative to building envelope, heating, ventilation, and air conditioning, service water heating, power, lighting, and other equipment.

Although the main sections haven't changed the standard-- of the standard, the appendices have been rearranged a little bit. Appendices have been-- sorry, appendices B and D previously discussed building envelope, climate criteria, as well as climate data, which is often referenced. And we'll reference that information in a little bit.

But starting with the 2019-- sorry, the 2016 standard, ASHRAE replaced these appendices and started referencing an annex, which references ASHRAE standard 169, which is the climate standard for ASHRAE.

All right. What else? Excuse me. Appendix F in the 2007 standard was updated and shifted to Appendix I in the 2019 standard, which just includes the detailed list of changes between the 2016 version and the 2019 version. Pardon me.

I'm speaking too fast. All right. And then there's two new appendices, appendix F, which lists DOE's minimum efficiency requirements, and appendix H, which provides-- oopsie,

sorry-- additional guidance for verification, testing, and commissioning, which we'll talk about also in a little bit, and new requirements.

One important thing to note before we go any further is what ASHRAE 90.1 does not cover. ASHRAE 90.1 is a commercial building standard. It covers all buildings, including residential buildings, except for residential buildings that are single family, multifamily, three stories or less, or manufactured housing.

So when I refer to residential buildings today or multifamily buildings, I am not referring to any of these building types. When I refer to residential buildings or multifamily buildings today, I'm referring to any of these building typologies, four stories or more, multifamily, mixed-use multifamily, four stories or more, and the more obvious, mid or high-rise multifamily buildings.

So for compliance with the standard, the structure hasn't really changed. But there are two key additions that we should highlight. First, all projects must comply as prescribed at the system level at step one, and all projects must comply with mandatory provisions defined for each system.

This is the same as the 2007 standard. The first key change is that appendix G, which is the performance rating method and is broadly used for above code programs such as utility incentive programs or ENERGY STAR, can now be used to show performance compliance with ASHRAE 90.1.

The second significant change in the compliance summary is a new requirement for verification, testing, and commissioning, which is an expanded concept from the 2007 standard but now applies to each and every system regulated by the standard.

A little bit more about the updates to appendix G. Appendix G is not a new appendix. And it has been used by above code program since the early 2000. However, Appendix G has gone through a reorganization itself since 2007. And there are now new ways to claim additional energy credit.

Some examples of additional credit that can be claimed relate to optimized orientation, rightsizing of HVAC equipment, optimized use of thermal mass, optimized fenestration and daylighting design, new-- sorry, natural ventilation and other passive conditioning strategies, reduced fan power, and optimized selection of HVAC and service water heating system types. In previous versions of ASHRAE 90.1, credit for these conditions was limited.

Related to the new section, requiring verification, testing, and commissioning across all system types. This is a new compliance section further detailed in each building system section. Each building system section defines specific requirements for ventilation, testing, and commissioning and are required regardless of the compliance path chosen, such as the performance path or one of the two-- the prescriptive path or one of the two performance path options.

The verification and testing provider must be identified in a permit application. This third party should have been involved during design to do a design review of the drawings prior to permitting.

Finally, a verification and testing report as well as functional performance testing results, which is related to commissioning work, must be provided to either the owner or the owner's representative.

Finally, and related to compliance, there is also an expanded documentation requirement related to operation and maintenance manuals. In previous versions of the standard, operation and maintenance manuals were only required for HVAC systems and power systems.

Now operation and maintenance manuals are required for all other systems, including the building envelope, service water heating, lighting, and other systems regulated in section 10. Operation and maintenance manuals are invaluable to building operations and facility managers, particularly with turnover of staff and succession. And we want to keep track of required operation and maintenance processes and a clear list of replacement details for ongoing, efficient operation of the building.

All right. We are about to dive into each individual systems section, sections through 10. This is a list of the key changes included in this webinar, with the most significant ones in bold text. I'm going to read through them quickly to provide-- and then provide more detail as we go through each system.

In section 5, which is for building envelope, there's a new requirement for a continuous air barrier as well as leakage testing, along with updates to vestibule requirements and a prescriptive R-value and U-value updates.

In section 6 for HVAC, there are updated ventilation design requirements and expanded requirements for energy recovery ventilation which will impact multifamily construction. There are also new limits on vestibule heating and cooling, updates to parking garage ventilation, insulation of ducts and piping, load calculation, pumps and fans and motor

sizing, oh my, and general efficiency updates on individual heating and/or cooling equipment.

Section 7 is for service water heating. There are expanded pipe insulation requirements and updated equipment efficiencies. Section 8 is power and has new energy monitoring and reporting requirements.

Section 9 now explicitly regulates dwelling unit lighting, reduces lighting power densities for common areas, and adds lighting control requirements. And now there is a new exterior lighting power framework.

And finally in section 10, which covers all other miscellaneous equipment. They add regulations on elevator lighting and ventilation, controls for water pressure booster pumps, and electric motors.

All right, let's dive in. So we'll start with the technical updates in section 5. So the building envelope defines building envelope performance requirements for insulation of walls, roofs, and floors, and thermal and solar performance of windows. It also defines weather protection requirements and air-sealing and air-leakage requirements in the envelope system.

There are three notable changes that exist in the 2019 standard in comparison to the 2007 standard. One is related to the envelope air leakage requirements. One is related to vestibule requirements. And lastly, some updates on insulation requirements.

OK, so the first two updates exist in the mandatory provisions of section 5. A key subsection that has changed pretty significantly is the air leakage section. The previous building envelope sealing subsection has been renamed continuous air barrier. Loading dock weatherseal requirements are largely the same. But there is an update to the vestibule requirements, so let's take a look at that.

First, the new continuous air barrier subsection greatly expands the brief building envelope sealing section from 90.1-2007. In the 2007 standard, building envelope sealing was prescriptive, specific to sealing at joints and junctions and other building envelope penetrations.

The new continuous air barrier subsection specifically requires an air barrier component within each of the building envelope assemblies as well as continuous transition at openings and intersections. Further, there must be an overlap where the air barrier

material changes. And the air barrier must resist all building pressures, either from the exterior or interior. In this way, no one material can be relied upon to be the air barrier.

One way a design team can design a continuous air barrier is to draw a continuous line around a building section representing the air barrier system, as shown with the green line in this building section.

At each intersection of different components, such as at building overhangs, window openings, or roof transitions, the details in these locations should show what components make up the air barrier and how they will overlap to maintain continuity.

The 2019 standard maintains the majority of the 2007 standards prescriptive sealing requirements at joints and junctions in the continuous air barrier design and installation section. The requirements are slightly modified to better integrate with the continuous air barrier requirement.

There are several available resources online to help understand multifamily whole building air sealing at the component level, as well as translating this to a continuous air barrier system. This example was prepared by an energy consulting firm, Steven Winter Associates.

They have prepared air sealing guides for three different multifamily construction types, masonry steel and wood construction, which cover common air sealing details found in the multifamily building typology. This link and other air sealing guides will be provided in a consolidated resource page at the end of this presentation.

The new continuous air barrier subsection also requires testing of the system to confirm the installation achieves the intended performance. This is essentially one step in commissioning the continuous air barrier system.

Testing of the continuous air barrier system is required in all climate zones. Testing is conducted with a whole building pressurization test using blower door equipment. In buildings larger than 50,000 square feet, partial building testing, such as floor by floor, is permitted.

HUD also accepts compartmentalization testing in accordance with ENERGY STAR multifamily guidelines. The design and installation of the air barrier must be inspected and tested by an independent third party.

Air leakage testing with blower door equipment can be conducted by envelope and/or energy consultants. Look for certifications, such as HERS Energy Raters, or training by a nationally recognized organization, such as the Air Barrier Association of America.

The images on the right are examples of blower door testing equipment. The upper photo is set up in a dwelling unit. This testing is considered unit by unit or compartmentalization testing. The lower photo is a setup in the entrance to a building and is testing the air leakage of the whole building.

All right. Vestibules. The vestibule section has been updated to include revolving doors. The fundamental requirement has not changed. It's just that ASHRAE 90.1 recognizes that revolving doors achieve the same energy or equivalent energy savings as a vestibule.

Vestibules and/or revolving doors should be used at all building entrances. Building entrances include any main access point ordinarily used by regular occupants or visitors to access a building.

The key change for a multifamily building is that vestibules or revolving doors are now required in all climate zones, no exceptions. Building entrances can include the main entry door from a street, potentially a back entrance from a parking garage or courtyard area, and entrances from a parking garage, perhaps to an elevator lobby.

All right. We're going to go into some installation updates in a second. But before we do that, I wanted to share this map, which is, as previously referenced, from ASHRAE Standard 169, which identifies climate zones by county.

If you do not know your climate zone, look for it here. Climate zones are determined on a scale from one to eight, with one being more tropical and cooling-dominated found in Florida and Hawaii, for example, up to zone eight, which only, I think, exists here in Alaska. That's a heating-dominated climate.

In addition, climate zones are assigned a letter based on humidity. Higher humidity climates are assigned the letter A. This would include Omaha, Nebraska, or Oklahoma City, and extends east to Maine and Florida. The drier parts of the country are assigned the letter B and include Eastern Washington, Oregon, and California and extend over the Rockies and includes all of Montana, Wyoming, and Colorado.

A sliver of the western states along the Pacific Coast are considered marine and are assigned the letter C. Take note now of which climate zone you may be doing your work in to follow along with updates on installation.

So some changes in thermal requirements for fenestration or window performance. There was a fundamental shift in categorizing windows first, whereas in the 2007 standard, there were different performance requirements based on the material of the window frame. The 2019 standard ignores framing material but offers a higher U-factor allowance for operable windows versus fixed windows.

Climate zones one through three see the greatest reduction in maximum U-factor performance, with moderate decreases in maximum U-factor performance from climate zones four through eight within about a tenth reduction.

Section 5.5.4.5 is a new section and puts limits on fenestration or window area of east and west-oriented fenestration or windows. For prescriptive compliance, the east and west facades cannot have a fenestration area that exceeds 25% of the gross exterior wall area of that specific orientation.

There are adjustments that can be made to this area restriction with improved solar heat gain coefficients or shading. This restriction may be the most impactful to urban infill projects, which may have little option around orientation of windows.

This photo is of an urban infill building and chosen an east-facing facade that exceeds 25%. To meet the new requirement, the solar heat gain coefficient will need to be reduced or shading provided to the windows to minimize heat gain from low sun angles that occur in the morning and the evening.

Here is updates to attic insulation. These are the prescriptive requirements. There have been no changes in climate zones one to three. Those remain at an R-38 insulation level. Climate zones four to six have increased from R-38 to R-49. And climate zone seven increased from R-38 to R-60. And climate zone eight increased from R-49 to 60 as well.

Across the board for insulation entirely above the roof deck. So this will be a flat or structurally sloped roofs. The 2007 standard across the board had our 20 continuous insulation as the minimum insulation value. And standard 90.1-2019 increases from R-25 in zones 1 to 3, R-30 in zones 4 to 6, and R-35 in climate zones 6, 7, and 8.

For wood-framed walls, prescriptive insulation requirements increase slightly in climate zones 3, which increased standalone cavity insulation to R-20, in climate zone 8, which increases continuous insulation from R-15.6 to R-18.8.

Climate zones 3 through 7 also include two prescriptive compliance options. In climate zones 3 and 4, a project can be compliant either with standalone cavity insulation of R-20 or a combination of insulation with R-13 cavity insulation and R-3.8 continuous insulation. Climate zones 5, 6, and 7 also have two compliance options, but both options require both cavity insulation and continuous insulation.

Our last highlight of insulation requirement changes are with mass floors, which are often seen in multifamily construction when there's a parking garage. Insulation requirements for mass floors have increased across the board from zones 3 through 8.

In climate zone 3, required continuous insulation increased from R-8.3 to R-10. And in climate zone 8, required continuous insulation increased from R-16.7 to R-23.

All right. On to the technical updates for HVAC systems and equipment. This section covers mechanical systems serving heating, vent cooling, ventilation, and refrigeration services.

There are several updates in this category. And due to time limitations, I'm going to highlight four of them. There is updated requirements and ventilation design, energy recovery ventilation, vestibule heating and cooling, and minimum system efficiencies.

Some of the other notable updates that we don't have time for today are related to parking garage ventilation, insulation on ductwork and piping, load calculation and pump requirements, and efficiency requirements for fans and motors. Some information regarding these updates can be provided in an appendix when this presentation is shared later.

All right. So in the ASHRAE 90.1-2019 standard, sections 6.5.3 is a new section-- oh, it's not a new section. It outlines provisions for air system design and control. Some parts of the section relate to fan system power and efficiency and various fan controls.

A new part within this section is a ventilation design for a building. Specifically, this new section requires compliance with ASHRAE 62.1, which is ASHRAE's ventilation standard for commercial buildings.

For all common area, spaces, or commercial spaces in a mixed-use building, ASHRAE 62.1 is the appropriate ventilation standard. However, for dwelling unit ventilation,

design teams should reference standard 62.2, which defines ventilation requirements for residential or dwelling unit spaces regardless of the height of the building.

As shown in this diagram from the ASHRAE 62.2 user manual, ASHRAE 62.1 should be used for any commercial spaces of a building or shared common areas, such as common laundry rooms, meeting rooms, or hallways that connect stairwells and elevators and apartments.

62.2 regulates ventilation requirements in unit-only spaces. So those areas outlined in the dashed blue line would be for 62.2.

Also in ASHRAE 62.2, the 2019 standard has a different definition for natural ventilation than the 62.2-2007 standard. Natural ventilation, as previously defined, is no longer a realistic compliance pathway for ventilation of a dwelling unit. Mechanical ventilation is required in all dwelling units.

Mechanical ventilation, while critical for occupant health, will necessarily increase energy usage. To minimize the impact of the increase in energy, this section includes additional requirements to either recover heat energy through energy recovery system or include additional air regulation controls to maintain the set outdoor air rate or design the system so that it does not provide excessive outdoor air.

These three options are applicable to all ventilation systems, either residential or common area, so the options might also change based on each system and other requirements within the standard.

Based on the required ventilation design error, ASHRAE has also defined energy recovery requirements for nontransient dwelling units or long-term renters or owners who, by definition, occupy a unit for more than 30 days.

All dwelling units across all climate zones are required to have energy recovery ventilation, except for climate zone 3C, which is the Central California Coast, and units smaller than 500 square feet in climate zones 1, 2, 3A and 3B, 4C, and 5C.

The ERV system can be a unitary system or a centralized system. Energy recovery ventilation transfers the heat from one air stream to another. The two streams are the exhaust air from the inside of a building and the fresh outdoor ventilation air.

In colder climates, the heat from warmer inside air can be transferred to colder incoming air to help temper that air. Similarly, in warmer climates, warmer outdoor ventilation air can be cooled down through heat transfer with cooler exhaust air from inside of the

building. This heat transfer can reduce the heating or cooling load inherent to introducing outdoor air to a dwelling unit or building.

If a project is required to provide energy recovery ventilation, this can be achieved with a centralized system that is ducted throughout a building, or from within each dwelling unit, they can have a dedicated ventilator.

There are pros and cons for each option. Key factors to be considered are impacts to floor area, electricity costs and who pays for what, and maintenance costs and schedule. I've included in the resources section a link to an article prepared by an energy consulting firm, Steven Winter Associates, discussing this comparison in more detail, which could help project teams figure out which one would be better for their project.

Another new requirement in section 6 includes thermostat set point limitations for heating and cooling in vestibules. There is now a maximum set point of 60 degrees Fahrenheit in heating for vestibules. But that heat can only come on when it is below 45 degrees Fahrenheit outdoor air temperature.

In cooling, you cannot set your thermostat in vestibules lower than 85 degrees Fahrenheit. There is an exception to the above. Heating or cooling that is provided by site-recovered energy or transfer air that would otherwise be exhausted can be used for conditioning vestibules.

All right, the last bit to the HVAC section is across all systems there have been updates to efficiency requirements. HVAC efficiency minimums cannot be traded off. All equipment must meet or exceed minimum efficiency requirements identified.

Here are some examples of some common HVAC systems found in multifamily buildings, both unitary or systems that are within individual units, and central systems which serve either multiple apartments or a whole building.

We have a split system, air conditioner, and furnace. The furnace at AFUE you requirement has increased slightly to 80%. Thermal efficiency stays the same at 80%. Sorry. And for the cooling efficiency, the 2007 standard had 13.0 SEER.

The 2019 standard has an updated SEER 2 rating of 13.4 required. They're going to be hard to compare because there's a different testing procedure between the two. But there's generally an increase in efficiency.

In a split system heat pump, there's a similar increase on the cooling side, an increase of 14.3 SEER on the split system heat pump for cooling and heating. It looks like a reduction of efficiency. But again, the efficiency rating is based on a new testing procedure, so there should be an a general increase in efficiency in the 2019 standard for heating and a heat pump.

On the central system design, the boiler efficiency has remained the same between 2007 and 2019, with a caveat that very large boilers, over 1 million BTUH, would need to achieve a 90% thermal efficiency. But that's not good. That's not very common. It would a very large building that would have that big of a boiler.

On the cooling side, for a PTAC, the efficiency ranges depend on the capacity of the PTAC. So the range in 2007 was a 9.3 EER to 11 EER. And that has increased slightly to 9.5 to 11.9 EER.

On the water source heat pump side, the boiler remains the same at 80% thermal efficiency, whereas the heat pump itself, that would be within a dwelling unit, increases slightly on the cooling side from 11.2 to 12 EER to 12.2 to 13 EER in the 2019 standard. And then the COP, again, the efficiency rating testing procedure has changed between 2007 and 2019, so we're comparing a 4.2 COP to a 3.5 ISCOP.

All right, moving on to section seven which covers service water heating systems. In multifamily buildings, this system is actually more commonly identified as the domestic hot water system, providing hot water to faucets, showers, and clothes washers. There are minimal updates in this section, really focused on pipe insulation and equipment efficiencies.

Because there are less changes, I can walk you through how 90.1 changed through the years. There were no changes in this section in 2010-- in the 2010 standard.

In the 2017 standard, there was an introduction of the high capacity service water heating systems that I just mentioned that also exist in the heating HVAC section. This would apply to centralized domestic hot water systems with a very large capacity of 1 million BTUH or more. Again, it's not common but, hey, may happen.

In the 2016 code, there is a new requirement for insulation of the first 8 feet of branch piping. We're going to get into that a little bit. In the next slide, I have a detail that we can follow. And then in 2019, there were some updates to minimum performance requirements for the efficiencies. And the efficiencies, that was really done just to align with the federal minimum standards.

So the new insulation requirement for branch piping relates to recirculation system. So this is a central system. In multifamily buildings, the heater, which is most commonly a boiler, sends hot water to a storage tank. And then a recirculation loop snakes through the building to service the dwelling units.

Insulation has been required from the boiler to the storage tank as well as on the recirculation loop in the 27-- sorry, 2007 standard. What is new since the 2016 standard is that the branch piping, which is the piping that branches off of the recirculation loop piping, must also be insulated for the first 8 feet of the branch pipe. The branch piping in this diagram is located within that dashed orange box. So that's a new requirement to insulate the first 8 feet of that branch piping.

All right. There are a handful of updates in section 8 for power that could be applied to multifamily buildings. First, there are new performance requirements for dry transformers. If this is interest to anybody out there, put in something in the chat. And we could talk about that a little bit further.

There's also a new modification to voltage drop in the 2007 standard. Feeder conductors were limited to a 2% drop. And branch circuits were limited to 3%. By 2019, the standard recognized that electrical engineers could combine that limit as 5% total and no longer put limits on the individual parts of the distribution system.

In this diagram on the right, we show a schematic of the electrical distribution system. The feeders are the primary distribution lines coming up from the meter. The branch circuits branch off of that primary line to each floor. So that's where the voltage drop would need to be calculated and limited.

There is also a requirement for automatic receptacle controls, which will likely only apply to a central office or business center in a multifamily complex. This requires a 50% of nonessential outlets to have a central control switch to automatically turn off either with a vacancy sensor or during nonbusiness hours, so not as common in multifamily, but it could pop up.

And finally and most importantly, there is a new requirement for electrical energy use monitoring and recording. So this is what I will discuss next.

So in a typical multifamily building, individual electric meters are usually provided for each dwelling unit. This isn't anything new. In addition to being separately metered, common areas greater than 10,000 square feet must also separately meter major

building systems, including HVAC systems, interior lighting, exterior lighting, and receptacle circuits. So those all have to be metered separately from each other.

Also, in those common areas that are larger than 10,000 square feet, energy use must be recorded in 15 minute intervals and able to be reported in hourly, daily, monthly, and annual summaries.

In a mixed use building with commercial tenant spaces greater than 10,000 square feet, these energy use reports must also be provided to the tenants. In multifamily buildings with digital control systems, such as a building automation system, the common area energy use data must be able to be graphically displayed. The building energy use data also must be maintained for at least 36 months.

All right, two more technical sections to go. Section 9 covers interior and exterior lighting. Specific updates to this section relate to new dwelling lighting requirements, updates to lighting power densities in common areas and expanded control requirements, and a new framework regulating exterior lighting.

All right, first up is interior lighting. ASHRAE 90.1 version 2019 now explicitly regulates hardwired lighting in dwelling units. At least 75% of permanently installed lighting fixtures in units must have either high efficacy lamps, which is defined as greater than 55 lumens per watt, or have a total luminaire efficacy of greater than 45 lumens per Watt.

In general, but not universally, LED lamps and LED fixtures will achieve the efficacy requirements here. Additional updates have been made to lighting power density allowances, or LPD by space type of at least about a 20% reduction.

Committing to LED fixtures here will also help to achieve these lower lighting power densities. More significantly, there are additional control requirements in these common multifamily space types. Corridors, lobbies, and stairs require some level of bi-level control with occupancy or vacancy sensors for partial off operation.

There are similar bi-level control requirements in parking garages. There may be some exceptions that are allowed based on population, such as for senior housing.

Moving on to the exterior lighting, there is a new framework of an allowance-- of exterior lighting allowance between the 2007 standard and the 2019 standard. The new framework identifies a base site wattage allowance connected to a lighting zone, which

is from 0 to 5. I've given each zone my own personal alias here to help understand them better.

Lighting zone 0 should be considered like a dark sky location. Zero light pollution allowance. Definitely in national parks, state parks, there's no light allowed on the site at all. Zone 1 is for rural spaces or developed areas on parks and national or state forests and otherwise rural lands.

I call zone 2 the default zone, probably the most commonly used zone, particularly for residential construction. Zone 3 is a brighter version of zone 2. So this could be in a downtown area and generally urban in nature.

Zone 4 is like zone 0, and it should be a very uncommon. This would be appropriate for a project, for example, located in the middle of Times Square or on the Vegas Strip. Similar to the old framework, there are tradable lighting areas, such as uncovered parking, buildings, grounds, and entryways, and nontradable surfaces, including building facades. The standard does not want to encourage excessive lighting of building facades.

The last key change relative to exterior lighting is a new power reduction control requirements, so like bilevel lighting for pole-mounted parking lot lighting that exceeds 78 watts per fixture and with mounting height shorter than 24 feet. All right.

On to our last system section, which is system 10. It covers miscellaneous equipment, such as elevators, water pressure booster pumps, and electric motors.

There are updates to each equipment category as follows. For elevators, ASHRAE 90.1-2019 now regulates controls for elevator cab lighting and ventilation systems. Both systems must de-energize when in standby mode.

For water pressure booster pumps, the pumps have new control requirements to achieve the best efficiency point during operations. And finally, electric motor efficiency requirements have been updated to reference DOE efficiency standards and no longer NEMA. This mostly impacts larger central ventilation fans or pumps.

All right, we did it. Did I lose you? Are you all still there? So in summary, ASHRAE 90.1-2019 is the new HUD minimum energy standard. Everybody got that? Check. There are three compliance pathways. There previously were two. One is prescriptive, and two, performance pathways.

Each compliance pathway also now requires operation and maintenance manuals for all of those technical system sections, as well as testing, verification, and commissioning of each building system.

And then the key updates that we reviewed today are primarily bolded. Continuous air barrier requirement as well as leakage testing, air leakage testing. The vestibules, they're now required in every building at those main entrances.

There are some updates to our value requirements as well in the building envelope. For HVAC, there's now an updated ventilation design requirements, requirements for energy recovery ventilation in many climate zones and most climate zones, as well as vestibule heating and cooling limits.

For surface water heating, we've got those branch insulation requirements as well as some equipment efficiency updates. For power, for common areas greater than 10,000 square feet, we need to monitor that common area energy use by system type and be able to report out on it.

In lighting, we have dwelling unit lighting is explicitly regulated with some efficacy requirements on the fixtures. Interior lighting and lighting controls have gotten more regulatory. And exterior lighting power allowance has this new structure.

And finally, another equipment. Elevators have to have a de-energizing ability on the lighting and ventilation system and some updates on the water pressure booster pumps and electric motors.

And again, in the appendix, just because we're running out of time, I will have some notes on the parking garage ventilation, updated insulation for ducts and piping, some notes on load calculations, pumps, fans, and motor sizing and equipment efficiency updates within that HVAC section.

And I'll also leave you with some resources. When this presentation gets published, you'll have access to these links relative to additional resources to help you get updated on ASHRAE 90.1-2019 and the concepts, the new concepts that are within it. And then that is it. I'm going to turn it back over to Kathryn.

Thanks so much. This is Dana--

Dana, great.

--for Q&A. So just a reminder to participants. If you have a question, go ahead and put that in the Q&A box. We have a couple that have come in so far. And we did get an excellent presentation, so thank you again, Paula. Thank you, Drew, for that.

So the first question that we have in the chat is, if California has adopted ASHRAE 90.1-2019, does it also apply to properties that are less than four units?

And so I can jump in just to reiterate standards. And then, Paula, I don't know if you want to talk a little bit more about that relationship with ASHRAE and IECC that you mentioned a bit at the top of your presentation.

But just to reiterate, so for today's session, talking about ASHRAE 90.1-2019, that's dealing with four or more stories. But the 2021 IECC is the standard that you're looking at for single-family or low-rise multifamily.

And specifically the residential provisions of the 2021 IECC would be appropriate for multifamily three stories and less. Yeah. And less than four-- less than four units. It's irregardless of the number of units. It's the stories. Just want to clarify that too.

OK, great. Thank you. And this next question, Paula, is also probably for you. Can an air curtain be provided in lieu of a vestibule, especially when there are space constraints?

Yes, air curtains can be used. I did exclude that mostly because I haven't, in my experience, seen air curtains commonly in multifamily. But yes, the answer is yes. It is an allowable alternative.

Great. Thank you. So those are the questions that we have so far. Again, I'm going to hold it open for just a minute. If you guys have questions and you want them answered, go ahead and put them in the Q&A box.

All right. I'm not seeing any additional questions come in, so I think that we can go ahead and end a little bit early. Paula, Drew, thank you guys again. Thank you, everyone, for attending.

Oh, Dana, we have one more question.

Oh, we do. Great. OK. The question is, when do we anticipate the next code update?

I'll just chime in really quickly. As I mentioned very early on in my presentation, the model codes are updated on a three-year cycle. So we anticipate ASHRAE 90.1 to be

updated in 2025. And the next version of IECC will be in 2027. What I can answer is from a HUD perspective of when HUD might anticipate an update.

Yeah, and I guess just to answer that quickly, so from a HUD and USDA perspective, we're right now obviously focused on implementation of the current final determination. As part of the acceptable alternative compliance pathways, we would accept future versions of the IECC or ASHRAE standards if they meet or exceed the efficiency of the standards that we've adopted.

So, for instance, if the 2024 IECC is more efficient and Department of Energy is in the process of issuing that determination, we would accept it as an alternative compliance pathway. And, Paula, correct me if I'm wrong here, but I believe the analysis has already been done on the ASHRAE 90.1-2022 standard. So that would already be something we would see as meeting or actually exceeding the baseline set by the 2019 standards. So that would be acceptable.

Thank you. And I do see one question also in the chat. In a high-rise building, are there requirements for where the mechanicals need to be located? Do they need to be in the basement, or should they be elevated above flood levels? Anything in the code on that?

Not in the energy codes and not in the minimum energy standards. I would look to zoning requirements. And I'm not familiar enough with HUD or USDA to know if there's guidelines there, that you guys have guidelines.

Certainly from a resiliency perspective, keeping mechanical equipment up away from a floodplain, et cetera, is best practice. But I don't know if HUD has a specific requirement.

Yeah, so we do have our separate FFRMS rule that dictates the elevation requirements. Let's say that's not an issue that is one I work on regularly. So I would defer to the FFRMS resources that my colleagues have put together.

A couple more, too. Thanks, everyone. And as a reminder, keep them coming. We have a little bit of time. So if you have questions and want them answered, we are happy to do that live. So next question is just about compliance. So how does someone confirm compliance to these standards when they're working on a HUD or USDA-assisted project?

So for compliance, we've largely-- I mean, we haven't changed the compliance requirements from the previous energy code requirements for HUD and USDA to the current final determination.

Largely, it's going to be a self-certification form from builders, developers, though there are some specific programs that have their own requirements as well, the home and housing trust fund, which you can see a little bit more detail on their specific compliance requirements, have some programmatic requirements beyond what we're generally asking for with this update. So I'd suggest looking at that webinar in slide deck once it's posted in the coming weeks for more information there.

And one final question, can we review the compliance deadlines for these programs? I know you mentioned it earlier. Maybe we can just go back to that slide for a second. And then the second part of the question is just, if adopted by HUD, will this affect 221(d)(4) programs?

Yeah, so here we have the compliance dates with which it goes into effect. So we have implemented this with a flexible implementation plan depending on the program. Home and housing trust fund, it went into effect at the end of November. So already requirement for those programs.

And then for FHA-insured multifamily and also our public housing programs, capital fund, project-based vouchers, it goes into effect. So it is a year after the effective date or May 28, 2025. And then we also have our competitive grants choice neighborhood section 202 and section 811.

And there it's going to be for the next published NOFO after the effective date. And then, as I mentioned before, the one exemption we have is for projects in persistent poverty rural areas. So across all impacted programs.

Projects that fall into those regions of the country have a implementation that's actually 24 months after the effective date. So that's not going to go into effect there until May 28, 2026. And you can find those areas on USDA's website on their persistent poverty's rural areas map. And then I don't believe 221 is a covered program.

OK, great. And how about project based vouchers? Is that a covered-- is that covered by the minimum energy standards?

Yes, so that's one of the programs covered that impacts public housing. So we've got capital fund and then also project-based vouchers. And as mentioned, that's going to be

a compliance date of May 28, 2025. And so we are working with all of the program offices to make sure we issue program-specific guidance where necessary.

Great. Thank you. OK. I'm not seeing any additional questions come in, so I will thank our panelists again. Thank you everyone for joining this afternoon. The slides and recording to this webinar will be available on the HUD Exchange Minimum Energy Standards webpage and Trainings page shortly. So thanks, everyone.