



Zero Fuel Bias Overlay for Residential Low-Rise Buildings v1.0

For use with the 2024 International Energy Conservation Code



Justification and Analysis

*This proposal is intended for jurisdictions considering the adoption of the **2024 International Energy Conservation Code Residential Provisions** (2024 IECC). It adopts Appendix RG, the 2024 IECC Stretch Code, and adjusts all compliance options so that mixed-fuel and heat pump buildings will be required to meet comparable levels of site energy efficiency.*

*The quantification of all newly proposed and re-baselined credits and conservation objectives is to be determined (TBD). Jurisdictions considering adopting the Code Overlays should reach out to the **US Department of Energy's Building Energy Codes Program** (DOE BECP) to request assistance calculating TBD figures that are appropriate for the climate zones and market conditions across the relevant state or locality. DOE BECP, in conjunction with **Pacific Northwest National Laboratory** (PNNL), provides technical assistance to states and local governments who are updating and implementing their energy codes, free of charge, commonly including technical analysis to help inform energy code deliberations and assess code impacts, and based on the same calculation methods and performance targets used for developing the IECC. Alternatively, third-party firms with expertise in energy codes and modeling may be able to provide this service.*

This proposal additionally adopts Appendix RK, Electric-Ready Residential Building Provisions, with amendments to add electric space heating readiness requirements.

Proposed code text is depicted through underlining, and proposed deletions are depicted through ~~strike-through formatting~~. Explanatory text, not intended to be part of the code, is depicted in italics. In the context of code text, italics indicate the use of a term defined in code.

Prescriptive pathway. *It is standard practice for credit values to be determined by calculating the savings from the measure compared to a baseline model building using the same fuel for the relevant end use. The baseline model compares heat pump measures to minimum-efficiency electric resistance space heating, while gas furnace measures are compared to a minimum-efficiency gas furnace. This suggests that a home complying with the prescriptive pathway using a natural gas furnace and gas tank water heater may be less energy efficient than an otherwise identical home using an air source heat pump and heat pump water heater.*

The prescriptive pathway in this proposal would instead compare all efficiency measures against a single site energy use baseline using a minimum-efficiency gas furnace and gas tank water heater. A new measure will award credits based on the energy savings from using an air source heat pump rather than a gas furnace, where the installed and comparison systems each meet and do not exceed federal minimum appliance efficiency standards. A second, analogous new measure will award credits based on the energy savings from using a heat pump water heater rather than a gas tank water heater, where the installed and the comparison appliances each meets and does not exceed federal minimum appliance efficiency standards.

Energy rating index (ERI) pathway. *The ERI metric is a relative rating against a building of the same fuel type complying with the 2006 IECC. A home earning an ERI score of 48 that uses gas for space and water heating may therefore be less efficient than an otherwise similar home with an ERI score of 48 that uses electric equipment for space and water heating. To compensate for this issue and ensure all homes reach the same conservation outcome regardless of fuel type, this proposal's ERI pathway allows a higher maximum*

ERI score if a building does not use purchased energy other than electricity for space or water heating. The amount of the ERI value increase is TBD by PNNL or Home Energy Rating System (HERS) rater analysis and will be calculated such that mixed-fuel and electricity-heated buildings will be required to attain equal site energy use in each climate zone.

Performance pathway. *In lieu of varying the standard reference design and performance threshold by fuel type, this simulated building performance pathway uses natural gas space and water heating products for the standard reference design regardless of the fuels used in the proposed design. This ensures homes of any fuel type must meet the same conservation objective. Notably, this proposal eliminates a provision that allows all-electric buildings to comply while reducing energy cost less than combustion buildings compared to their respective standard reference designs.*

Additionally, performance is quantified in site energy use, rather than energy cost. Site energy use is the performance metric over which the designer has the greatest control. Site energy use can also be estimated with greater confidence than energy cost because the occupant's energy provider or rate will not affect it.

Finally, this option increases the stringency of the envelope backstop to ensure any reduction in efficiency of the standard reference design does not inadvertently allow installation of an outdated envelope.

Proposal

General

Adopt the **2024 IECC**, including **Appendix RG** and **Appendix RK**, with the following language.

R101.2 Scope. This code applies to the design and construction of detached one- and two-family dwellings and multiple single-family dwellings (townhouses) and Group R-2, R-3 and R-4 buildings three stories or less in height above *grade plane*.

R101.2.1 Appendices. Provisions in the appendices shall not apply unless specifically adopted and referenced as a requirement of a compliance option. **Appendix RG** and **Appendix RK** are adopted as requirements for compliance paths as specified in **Section R401.2**.

Amend as follows.

R401.2 Application. Residential buildings shall comply with **Appendix RK** and one of **Sections R401.2.1, R401.2.2, R401.2.3** or **R401.2.4**.

Exception: *Additions, alterations, repairs and changes of occupancy to existing buildings* complying with **Chapter 5**.

R401.2.1 Prescriptive Compliance Option. The Prescriptive Compliance Option requires compliance with **Sections R401** through **R404** and **R408**, as amended by **Appendix RG Section RG101.3**.

R401.2.2 Simulated building Performance Option. The Simulated building Performance Option requires compliance with **Section R405** as amended by **Appendix RG Section RG101.1**.

R401.2.3 Energy Rating Index Option. The *Energy Rating Index* (ERI) Option requires compliance with **Section R406** as amended by **Appendix RG Section RG101.2**.

ERI Compliance

Amend as follows. The TBD ERI values in the new **Table RG101.2** columns shall be calculated such that they result in equivalent site energy outcomes for a building that uses natural gas for space and water heating and attains the ERI indicated in the model code's **Table RG101.2** and a building that meets the enumerated requirements and attains the increased, electric-heat-building ERI.

RG101.2 (R406.5) ERI-based compliance. Compliance based on an *Energy Rating Index* (ERI) analysis requires that the *rated design* and each confirmed as-built *dwelling unit* be shown to have an ERI less than or equal to the applicable value indicated in **Table RG101.2** where compared to the ERI reference design as follows:

1. Where the building uses purchased energy that is not electricity for space conditioning or service water heating and on-site renewables are not installed, the maximum ENERGY RATING INDEX NOT INCLUDING OPP, MIXED-FUEL BUILDING applies.
2. Where the building does not use purchased energy that is not electricity for space conditioning or service water heating and on-site renewables are not installed, the maximum ENERGY RATING INDEX NOT INCLUDING OPP, ELECTRIC HEAT BUILDING applies.
- ~~2.~~ 3. Where the building uses purchased energy that is not electricity for space conditioning or service water heating and on-site renewables are installed, the maximum ENERGY RATING INDEX WITH OPP, MIXED-FUEL BUILDING applies.
4. Where the building does not use purchased energy that is not electricity for space conditioning or service water heating and on-site renewables are installed, the maximum ENERGY RATING INDEX WITH OPP, ELECTRIC HEAT BUILDING applies.

Amend table as follows. Highlighted “TBD” placeholders must be replaced with ERI values during code development.

**TABLE RG101.2
MAXIMUM ENERGY RATING INDEX**

CLIMATE ZONE	ENERGY RATING INDEX NOT INCLUDING OPP		ENERGY RATING INDEX WITH OPP	
	<u>MIXED-FUEL BUILDING</u>	<u>ELECTRIC HEAT BUILDING</u>	<u>MIXED-FUEL BUILDING</u>	<u>ELECTRIC HEAT BUILDING</u>
0 and 1	46	<u>TBD</u>	27	<u>TBD</u>
2	46	<u>TBD</u>	26	<u>TBD</u>
3	45	<u>TBD</u>	24	<u>TBD</u>
4	48	<u>TBD</u>	32	<u>TBD</u>
5	49	<u>TBD</u>	37	<u>TBD</u>
6	48	<u>TBD</u>	39	<u>TBD</u>
7	47	<u>TBD</u>	43	<u>TBD</u>
8	47	<u>TBD</u>	43	<u>TBD</u>

Prescriptive Compliance

Amend **Table R408.2** so that all credit values are “TBD.” Credit values for existing measures shall be recalculated to reflect site energy improvements compared to a standard reference design that uses a natural gas furnace and natural gas tank water heater, neither of which may exceed the US Department of Energy’s currently effective minimum efficiency standard for those products.

Add rows to **Table R408.2** as follows. The TBD credit values for these new measures shall be calculated to reflect site energy improvements compared to a standard reference design that uses a natural gas furnace and a natural gas tank water heater, neither of which may exceed the US Department of Energy’s currently effective minimum efficiency standard for those products.

MEASURE NUMBER	MEASURE DESCRIPTION	CREDIT VALUE			
		Climate Zone 4	Climate Zone 5	Climate Zone 6	Climate Zone 7
<u>R408.2.2(15)</u>	<u>Federal Minimum-Efficiency Heat Pump</u>	<u>TBD</u>	<u>TBD</u>	<u>TBD</u>	<u>TBD</u>
<u>R408.2.3(8)</u>	<u>Federal Minimum-Efficiency Heat Pump Water Heater</u>	<u>TBD</u>	<u>TBD</u>	<u>TBD</u>	<u>TBD</u>

Add option under **R408.2.2** as follows:

15. Federal Minimum-Efficiency Heat Pump: Air source heat pump having an efficiency rating equal to or exceeding the minimum required by federal law for the geographic location where the equipment is installed.

Add a row in **Table R408.2.3** as follows:

MEASURE NUMBER	WATER HEATER	SIZE AND DRAW PATTERN	TYPE	EFFICIENCY
<u>R408.2.3(8)</u>	<u>Federal Minimum-Efficiency Heat Pump Water Heater</u>	<u>Any</u>	<u>HPWH with or without hybrid electric resistance element</u>	<u>Any efficiency equal to or exceeding currently effective US Department of Energy minimum energy efficiency standards</u>

Simulated Building Performance Compliance

Amend **Section R202** as follows:

SITE ENERGY USE. The metric indicating the total amount of energy consumed by a *building* in 1 year.

Amend as follows:

RG101.1 (R405.2) Simulated building performance compliance. Compliance based on *simulated building performance* requires that a *building* comply with the following:

1. The requirements of the sections indicated within **Table R405.2**.
2. The proposed total *building thermal envelope* thermal conductance, TC, shall be less than or equal to the *building thermal envelope* TC using the prescriptive U-factors and F-factors from **Table R402.1.2** multiplied by ~~1.08~~ 1.05 in Climate Zones 0, 1 and 2, and ~~1.15~~ in Climate Zones 3 through 8 in accordance with **Equation 4-2** and **Section R402.1.5**. The area-weighted maximum fenestration SHGC permitted in Climate Zones 0 through 3 shall be 0.30.
3. ~~For each dwelling unit with one or more fuel-burning appliances for space heating, water heating, or both, the~~ The annual energy cost site energy use of the each dwelling unit shall be less than or equal to 70 percent of the annual energy cost site energy use of the standard reference design. For all other dwelling units, the annual energy cost of the dwelling unit shall be less than or equal to 75 percent of the annual energy cost of the standard reference design. For each *dwelling unit* with greater than 5,000 square feet (465 m²) of *living space* located above *grade plane*, the annual energy cost site energy use of the *dwelling unit* shall be reduced by an additional 5 percent of annual energy cost site energy use of the *standard reference design*. ~~Energy prices shall be taken from an approved source, such as the US Energy Information Administration's state energy data system prices and expenditures reports. Code officials shall be permitted to require time-of-use pricing in energy cost calculations.~~

Exceptions:

1. ~~The energy use based on source energy expressed in Btu or Btu per square foot of conditioned floor area shall be permitted to be substituted for the energy cost. The source energy multiplier for electricity shall be 2.51. The source energy multiplier for fuels other than electricity shall be 1.09.~~
2. ~~The energy use based on site energy expressed in Btu or Btu per square foot of conditioned floor area shall be permitted to be substituted for the energy cost.~~

Amend **Table R405.4.2(1)** to require a standard reference design that uses minimum-efficiency natural gas equipment for space and water heating as follows. Rows not depicted, including sub-rows, are unchanged.

TABLE R405.4.2(1)
SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Heating systems ^{d, e, j, k}	Fuel type/capacity: <u>natural gas, with capacity the same as proposed design.</u>	As proposed.
	Product class: <u>if the proposed design uses only natural gas heating systems, same as proposed design. For any proposed heating systems that do not use natural gas, the standard reference design shall include a heating system of a product class that uses natural gas. For proposed designs with forced air or electric resistance radiative heating systems, substitute a furnace. For proposed designs with hydronic heating systems, substitute a boiler.</u>	As proposed.
	Efficiencies:	
	Heat pump: complying with 10 CFR §430.32.	As proposed.
	Fuel gas and liquid fuel furnaces: <u>complying with and having efficiency ratings equal to the minimum requirements of 10 CFR §430.32.</u>	Forced air and electric resistance heating systems as proposed.
	Fuel gas and liquid fuel boilers: <u>complying with and having efficiency ratings equal to the minimum requirements of 10 CFR §430.32.</u>	Hydronic heating systems as proposed.
Service water heating ^{d, g, k}	Fuel type and product class: same as proposed design <u>natural gas tank water heater complying with and having efficiency ratings equal to the minimum requirements of 10 CFR §430.32.</u>	As proposed.
Thermal distribution systems	Duct insulation: in accordance with Section R403.3.3.	Duct insulation: as proposed. ^{mk}
	Duct location:	Duct location: as proposed. ^{lj}

SI unit information and footnotes a, b, and c are unchanged. Amend footnote d as follows:

d. For a proposed design with multiple heating, cooling or water heating systems using different ~~fuel types-product classes~~, the applicable standard reference design system capacities and ~~fuel types-product classes~~ shall be weighted in accordance with their respective loads as calculated by accepted engineering practice for each ~~equipment and fuel type-product class~~ present.

Footnotes e and f are unchanged. Amend footnote g as follows:

g. For a proposed design without a proposed water heater, the following assumptions shall be made for ~~both the proposed design and the standard reference design. For a proposed design with a heat pump water heater, the following assumptions shall be made for the standard reference design, except the fuel type shall be electric.~~

Fuel type: for the standard reference design, natural gas. For the proposed design, the same as the predominant heating fuel type in the proposed design.

Rated storage volume: 40 gallons

Draw pattern: medium

Efficiency: Uniform Energy Factor complying with and not exceeding the minimum efficiency requirements of 10 CFR § 430.32

Footnotes h and i are unchanged. Delete footnotes j and k. Renumber footnote l as footnote j. Renumber footnote m as footnote k.

Electric Readiness Including Space Heating

Amend as follows.

RK101.1 Electric readiness. Water heaters, household clothes dryers, and cooking appliances, and space heating systems that use fuel gas or liquid fuel shall comply with Sections RK101.1.1 through ~~RK101.1.4~~RK101.1.5.

Amend as follows.

RK101.1.4 Space heating systems. Where a building has combustion equipment for space heating, the building shall be provided with a designated exterior location(s) in accordance with the following:

1. Natural drainage for condensate or a condensate drain location located within 3 feet (914 mm), and
2. A dedicated branch circuit in compliance with **IRC Section E3702.11** based on heat pump space heating equipment sized in accordance with **Section R403.7** and terminating within 3 feet (914 mm) of the location with no obstructions.

~~**RK101.1.4**~~**RK101.1.5 Electrification-ready circuits.** The unused conductors required by Sections **RK101.1.1** through ~~**RK101.1.3**~~**RK101.1.4** shall be labeled with the word “spare.” Space shall be reserved in the electrical panel in which the branch circuit originates for the installation of an overcurrent device. Capacity for the circuits required by **Sections RK101.1.1** through ~~**RK101.1.3**~~**RK101.1.4** shall be included in the load calculations of the original installation.

Erin Sherman, Daniel Carpenter-Gold, Jonny Kocher, and Jamie Long, *The Energy Code Safe Harbor: How to Adopt Ambitious Building Energy Codes That Boost Efficiency, Reduce Pollution, and Comply with Federal Law*, RMI, 2024, <https://rmi.org/insight/the-energy-code-safe-harbor>.

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