STATE OF WASHINGTON

STATE BUILDING CODE COUNCIL

Washington State Energy Code Development

Standard Energy Code Proposal Form

Jan 2022

Log No. 24-RE-010 Revised 6/12/25

Code being amended: ☐ Commercial Provisions ☒ **Residential Provisions:**

Code Section # New Section R402.6,

Brief Description:

This section adds mandatory residential cool low sloped roof requirements. There are no requirements in the 2024 IECC related to solar reflectance and albedo for residential buildings, neither in the prescriptive nor in the mandatory section. These requirements closely mirror those in the IECC-C for Climate Zones 0-3.

Proposed code change text:

SECTION R402.6 SOLAR REFLECTANCE AND THERMAL EMITTANCE

Add Sections(s) as follows:

R402.6 Solar Reflectance and Thermal Emittance.

This section establishes additional requirements applicable to all compliance approaches to achieve additional energy efficiency.

R402.6.1. Roof Solar Reflectance and Thermal Emittance. Roofs having a slope less than 2 units vertical in 12 units horizontal in *Climate Zones* 0 through 5 shall comply with one or more of the options in Table R402.6.1.

Exceptions: The following roofs and portions of roofs are exempt from the requirements of Table R402.6.1:

1. Portions of the roof that include or are covered by the following:

    1.1. Photovoltaic systems or components.

    1.2. Solar air or water-heating systems or components.

    1.3. Vegetative roofs or landscaped roofs.

    1.4. Above-roof decks or walkways.

    1.5. Skylights.

    1.6. HVAC systems and components, and other opaque objects mounted above the roof.

2. Portions of roofs that are ballasted with a minimum stone ballast of 17 pounds per square foot (74 kg/m2) or 23 pounds per square foot (117 kg/m2) pavers.

3. Roofs where not less than 75 percent of the roof area complies with one or more of the exceptions to this section.

TABLE R402.6.1 MINIMUM ROOF REFLECTANCE AND EMITTANCE OPTIONS [a, b, c, d]

Option 1	Three-year-aged solar reflectance of 0.55 and 3-year aged thermal emittance of 0.75
Option 2	Three-year-aged solar reflectance index of 64

a. The use of area-weighted averages to comply with these requirements shall be permitted. Materials lacking 3-year-aged tested values for either solar reflectance or thermal emittance shall be assigned both a 3-year-aged solar reflectance in accordance with Section R401.2.6.1 and a 3-year-aged thermal emittance of 0.90.

b. Aged solar reflectance tested in accordance with ASTM C1549, ASTM E903 or ASTM E1918 or CRRC-S100.

c. Aged thermal emittance tested in accordance with ASTM C1371 or ASTM E408 or CRRCS100.

d. Solar reflectance index (SRI) shall be determined in accordance with ASTM E1980 using a convection coefficient of 2.1 Btu/h × ft2 × °F (12 W/m2 × K). Calculation of aged SRI shall be based on aged tested values of solar reflectance and thermal emittance . C402.4.1 Aged roof solar reflectance. Where an aged solar reflectance required by Section C402.4 is not available, it shall be determined in accordance with Equation 4-2.

$$R_{aged} = [0.2 + 0.7(R_{initial} - 0.2)] \qquad \text{(Equation 4-2)}$$

where

R_{aged} = The aged solar reflectance.

$R_{initial}$ = The initial solar reflectance determined in accordance with CRRC-S100.

Purpose of code change:

In the U.S., heat is the most fatal climate event, over four times more fatal than cold temperatures.[1] Extreme heat exacerbates existing health vulnerabilities and is especially dangerous to those with chronic conditions, outdoor workers, and low-income residents. Heat increases the prevalence of low-level ozone, or smog, which means that heat is correlated with an increase in respiratory problems. Extreme heat can lead to heat stress and heat stroke, where the body is severely dehydrated and not able to cool itself down to a safe level. High heat can also impact mental health, as extreme heat has been linked to reduced concentration and increased anxiety, depression, and violence. Further, high temperatures can make some common medications less effective. While, and some medications reduce the body's ability to cool down, putting people at increased risk for heat illness.

Installing cool roofs is a low- to no-cost add and a cost-effective energy conservation measure to passively reduce cooling loads and annual cooling demand in hot and mixed climate zones throughout the USA. Cool surfaces reflect sunlight and efficiently radiate heat away from the roof. Installing a cool roof reduces the conduction of heat into the building, reducing the need for air-conditioning in conditioned spaces, and improving thermal comfort in buildings without active cooling systems.

Reductions in the surface temperature of roofing materials also reduce the urban heat island; the phenomena of urban areas seeing increased air and radiative temperatures for longer periods of time.[2] This increased temperature contributes to increased localized air temperatures, resulting in decreased equipment operating efficiencies, and increased runtime of active cooling systems. Minimizing the need for and demand of active air conditioning saves energy, contributes to energy affordability, and helps to moderate peak grid demand during heat waves and very hot summer afternoons, reducing the risk of power outages.

Recognizing that a changing climate has increased the need for indoor cooling across the U.S., and that the climate burden is disproportionately placed on low-income households, it is critical that the residential provisions in Washington's Energy Code recognize passive cooling, reduced urban heat islands, and improved reduced cooling energy use as a basic requirement for health and safety in all new housing. These

[1] National Oceanic and Atmospheric Administration, "Weather Related Fatality and Injury Statistics: National Weather Service," [Online]. Available: http://tinyurl.com/242m5xfd [Accessed 25 February 2024].
[2] https://www.epa.gov/heatislands/using-cool-roofs-reduce-heat-islands

requirements are appropriate for the current and future conditions that the buildings and roofs will operate in.

Your amendment must meet one of the following criteria. Select at least one:

☒ **Addresses a critical life/safety need. X**

☐ The amendment clarifies the intent or application of the code.

☐ **Addresses a specific state policy or statute. X** (Note that energy conservation is a state policy)

☐ Consistency with state or federal regulations.

☐ **Addresses a unique character of the state. X**

☐ Corrects errors and omissions.

Check the building types that would be impacted by your code change:

☒ **Single family/duplex/townhome** ☐ Multi-family 4 + stories ☐ Institutional

☒ Multi-family 1 – 3 stories ☐ Commercial / Retail ☐ Industrial

Your name	Kathleen Petrie	Email address	kpetrie@kingcounty.gov
Your organization	King County	Phone number	(206) 477-2482

Other contact name Tristan Grant, New Buildings Institute; tristan@newbuildings.org

Economic Impact Data Sheet

Is there an economic impact: ☒ **Yes** ☐ No

Briefly summarize your proposal's primary economic impacts and benefits to building owners, tenants, and businesses. If you answered "No" above, explain your reasoning.

The economic impact to building owners, tenants, and businesses is summarized below in the construction cost and NPV analysis. While the modeled energy savings directly attributable to the cool roof requirement are negligible – they provide a significant passive benefit to tenants in non-cooled buildings, and to the surrounding local environment. Both of these are not fully reflected in traditional modeling where weather files do not account for elevated temperatures due to the urban heat island effect.

Provide your best estimate of the construction cost (or cost savings) of your code change proposal? (See OFM Life Cycle Cost Analysis tool and Instructions; use these Inputs. Webinars on the tool can be found Here and Here)

$.23/square foot (For residential projects, also provide $.23/ dwelling unit)

Show calculations here, and list sources for costs/savings, or attach backup data pages

The Delivering Urban Resilience report studying cool roof implementation in 3 major cities in the US found cool roof applications to low-slop residential roofs to cost $0.23/SF of roof application, and to yield lifecycle cost savings when considering a number of variables, and lifecycle cost savings when considering energy only. The most transferable cities studied were Washington, DC, and Philadelphia, PA – both Climate Zone 4A.

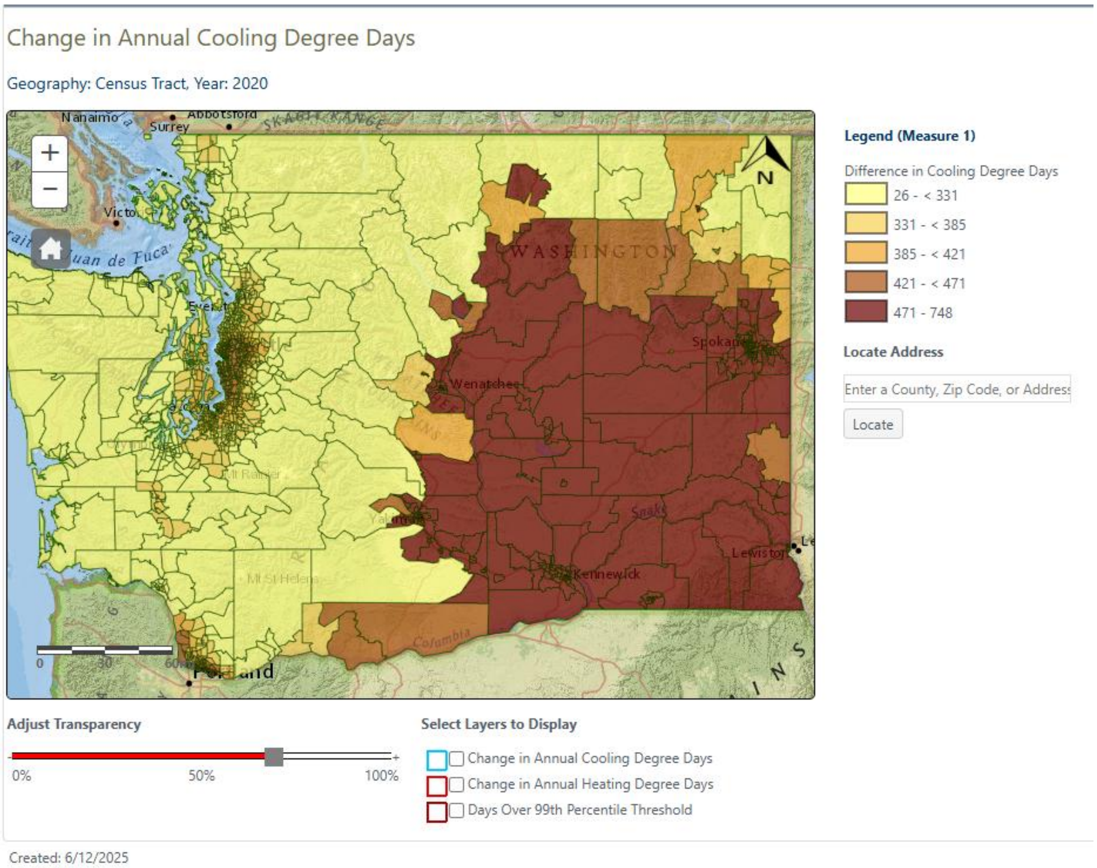
Washington, DC: Residential Cool Roof Cost ($/SF)	Climate Zone	Roof Type	First Cost ($/SF)	NPV ($/SF)
	4A	Low Slope	0.23	3.52
Philadelphia, PA Residential Cool Roof Cost ($/SF)	4A	Low Slope	0.23	3.41

The majority of the population and associated residential development in Washington State is located in climate zone 4C.

Climate Zone	Statewide Residential SF	Percent SF in Climate Zone
4C	3,902,356,763	79%
5B	944,381,433	19%
6B	90,713,036	2%
Total	4,937,451,232	100%

While Washington State and Climate Zone 4C is not perfectly analogous to Climate Zone 4A and the cities studies in the Delivering Urban Resilience report, the code requirement is impacting roofing products that will typically have estimated useful lifetimes of 20+ years, so we must consider the future climate conditions as well. While Climate Zone 4C has fewer Cooling Degree Days than Climate Zone 4A, Cooling Degree Days have been increasing over the recent past and are projected to increase significantly through the next century.

According to the Washington Tracking Network, A Source for Environmental Public Health Data, all areas of Washington State are anticipated to see significant increases in Annual Cooling Degree Days through 2064, with the most significant deviations in the Seattle metropolitan area and the southeastern portion of the state. Cool Roofs are one of the lowest hanging fruit and most cost-effective resilience measures that can address extreme heat, and are especially important in mild states that have historically not installed active cooling in all residential buildings, and where extreme heat poses a direct life-safety risk during heat waves. As an example, the annual Cooling Degree Days in King County over the 2036-2065 future period is anticipated to increase by an average of 418 from the historical 1976-2005 period. It is imperative that construction built today is adequately designed and constructed for the range of environmental conditions it will endure.



According to the Cool Roof Rating Council product directory, there are:

- At least 1042 products that meet the requirement of this code section including:
  - 54 Asphaltic Membrane products with a 3y-aged SRI value of 64 or greater
  - 647 coating products
  - 36 liquid applied roofing products
  - 197 single ply products

Provide your best estimate of the **annual energy savings** (or additional energy use) for your code change proposal?

Click here to enter text.**KWH/ square foot (or)** Click here to enter text.**KBTU/ square foot**

(For residential projects, also provide 2-13KWH / dwelling unit)

Show calculations here, and list sources for energy savings estimates, or attach backup data pages

The 2019 Study "Potential benefits of cool walls on residential and commercial buildings across California and the United States: conserving energy, saving money, and reducing emission of greenhouse gases and air pollutants." found that modeling of Seattle in USCZs 4C yielded minor HVAC source energy savings from some surfaces, including the roof, with the installation of cool products. The savings ranged depending on the age of the roof, with older roofs yielding increased savings, but new roofs still showed a positive energy and cost savings.

Instructions: Send this form as an email attachment, along with any other documentation available, to: sbcc@des.wa.gov. For further information, call the State Building Code Council at 360-407-9255.

All questions must be answered to be considered complete. Incomplete proposals will not be accepted.

Table 9. Annual HVAC energy cost savings intensity ($\$/m^2$) by U.S. climate zone (1A - 8), building vintage (new, older, oldest), and surface(s) modified (R = roof; N = north wall; E = east wall; S = south wall; W = west wall; N E S W = all four walls), tabulated for (a) single-family home, (b) medium office, and (c) retail standalone buildings. Results are mean of values for N-S and E-W orientations of the building's long axis.

(a) Single-family home annual HVAC energy cost savings intensity ($\$/m^2$).

	new						older						oldest					
	R	N	E	S	W	N E S W	R	N	E	S	W	N E S W	R	N	E	S	W	N E S W
USCZ_1A	0.40	0.28	0.48	0.49	0.52	0.44	0.49	0.35	0.60	0.61	0.64	0.55	1.14	0.56	0.94	0.99	1.07	0.89
USCZ_2A	0.26	0.22	0.37	0.33	0.36	0.31	0.39	0.28	0.47	0.42	0.45	0.40	0.80	0.47	0.78	0.78	0.81	0.70
USCZ_2B	0.58	0.33	0.76	0.76	0.65	0.61	0.54	0.31	0.71	0.71	0.60	0.57	1.33	0.57	1.27	1.39	1.21	1.10
USCZ_3A	0.28	0.19	0.35	0.27	0.31	0.28	0.29	0.20	0.36	0.28	0.31	0.28	0.62	0.34	0.62	0.57	0.60	0.52
USCZ_3B	0.30	0.14	0.33	0.23	0.23	0.22	0.44	0.26	0.57	0.47	0.45	0.42	0.99	0.48	1.03	1.01	0.91	0.84
USCZ_3C	0.21	0.07	0.25	0.17	0.09	0.13	0.31	0.11	0.41	0.33	0.12	0.21	1.07	0.31	0.90	1.01	0.53	0.65
USCZ_4A	0.13	0.09	0.17	0.05	0.11	0.10	0.25	0.16	0.30	0.16	0.25	0.21	0.70	0.30	0.56	0.42	0.51	0.43
USCZ_4B	0.24	0.17	0.40	0.26	0.26	0.26	0.35	0.20	0.47	0.31	0.30	0.31	1.01	0.42	0.97	0.91	0.75	0.73
USCZ_4C	0.03	0.00	0.05	0.00	0.00	0.01	0.04	0.01	0.07	0.03	0.03	0.02	0.18	0.06	0.20	0.20	0.14	0.13
USCZ_5A	0.13	0.08	0.17	0.08	0.12	0.11	0.19	0.15	0.27	0.17	0.24	0.20	0.47	0.28	0.52	0.44	0.52	0.42
USCZ_5B	0.11	0.03	0.13	0.04	0.04	0.05	0.17	0.09	0.24	0.16	0.15	0.15	0.52	0.19	0.51	0.47	0.39	0.37
USCZ_6A	0.08	0.03	0.07	-0.06	0.01	0.01	0.09	0.05	0.10	-0.07	0.03	0.02	0.24	0.21	0.32	0.19	0.36	0.24
USCZ_6B	0.04	0.02	0.07	-0.04	-0.01	-0.01	0.11	0.05	0.16	0.05	0.07	0.05	0.39	0.14	0.36	0.27	0.26	0.24
USCZ_7	0.02	0.01	0.02	-0.08	-0.02	-0.03	0.02	-0.00	0.01	-0.10	-0.05	-0.04	0.14	0.06	0.12	-0.04	0.06	0.03
USCZ_8	0.06	0.07	0.13	0.01	0.03	0.05	0.09	0.11	0.20	0.09	0.09	0.10	0.28	0.21	0.42	0.31	0.26	0.27

List any **code enforcement** time for additional plan review or inspections that your proposal will require, in hours per permit application:

- These requirements are verifiable at time of plan review by checking for comments or product data relating to SRI And emittance, and through visual inspection at time of final or progress inspection. This requirement would not add significant time.

Small Business Impact. Describe economic impacts to small businesses:

- n/a residential code

Housing Affordability. Describe economic impacts on housing affordability:

- There are readily available products on the market at cost parity to conventional roofing products. It is anticipated that this is a low-to-no cost add that increases energy affordability and improves broader health and safety outcomes for affordable housing residents.

Other. Describe other qualitative cost and benefits to owners, to occupants, to the public, to the environment, and to other stakeholders that have not yet been discussed:

- Urban heat island impacts contribute to significantly elevated local temperature conditions. This can contribute to decreased cooling equipment operational efficiency through elevated air temperatures, increased cooling energy cost, and adverse public health impacts due to extreme localized heat. The energy performance penalties of urban heat islands are not appropriately captured in typical energy modeling protocols, which use the nearest weather station, often drawing from isolated airport weather and climate data. Increased localized temperatures result in elevated intake air temperature for air cooled systems, resulting in decreased system performance efficiencies and increased energy use and costs associated with active cooling systems. Urban heat islands also result in elevated temperatures for longer periods of time in urban centers causing cooling systems to run longer into the evening to maintain comfortable interior conditions.

- Urban heat islands contribute to decreased worker productivity, lost wages, and deaths during severe heatwaves. Low- and moderate-income communities face the greatest risk from extreme heat and urban heat islands and suffer the consequences of extreme heat impacts. This was clearly seen during the 2021 heat wave which resulted in the deaths of 400 people in Washington State. The report, In The Hot Seat, details the role that building codes have in creating a climate conscious and adaptive built environment that can mitigate the worst impacts of increasing temperatures. The Washington State Department of Health Seasonal Hazard Tracker shows the impact of extreme summer temperatures on emergency department visits throughout the state and the strain that extreme heat can cause to critical life-safety services. The WA Department of Health also indicates that sensitive populations are the most at-risk of extreme heat and associated poor air quality. This includes older adults, pregnant people, young children, people with chronic illness, and those experiencing homelessness.

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