STATE OF WASHINGTON

# STATE BUILDING CODE COUNCIL

Washington State Energy Code Development

## Standard Energy Code Proposal Form

**21-GP2-073**
Proponent
Correlation submittal
Post-TAG review
Submitted 6/15/22

Code being amended: ☐ Commercial Provisions ☒ Residential Provisions

Code Section # **R405.3, R406, Chapter 6**

Brief Description: **This proposal updates Section R406 and requires additional energy efficiency credits. Revised to address heat pump space and water heating proposals, as passed by the TAG as of 6/10.**

Proposed code change text: (Copy the existing text from the Integrated Draft, linked above, and then use underline for new text and ~~strikeout~~ for text to be deleted.)

**R405.3 Performance-based compliance.** Compliance based on simulated energy performance requires ~~that a proposed residence (*proposed design*) be shown to have an annual energy consumption based on carbon emissions of the fuels and energy use in the proposed building. Carbon emissions for both the standard reference design and the proposed design shall be calculated using Table R405.3. Energy u se derived from simulation analysis shall be expressed in pounds of carbon per square foot of *conditioned floor area* as follows:~~

1. The requirements of the sections indicated within Table R405.2

~~1.2.~~ For structures less than 1,500 square feet of conditioned floor area, the annual carbon emissions shall be less than or equal to ~~73~~ 64 percent of the annual carbon emissions of the *standard reference design*.

~~2.~~3. For structures 1,500 to 5,000 square feet of conditioned floor area, the annual carbon emissions shall be no more than ~~56~~ 47 percent of the *standard reference design*.

~~3.~~4. For structures over 5,000 square feet of conditioned floor area, the annual carbon emissions shall be no more than ~~50~~ 41 percent of the *standard reference design*.

~~4.~~5. For structures serving Group R-2 occupancies, the annual carbon emissions shall be less than or equal to ~~70~~ 61 percent of the annual carbon emissions of the *standard reference design*.

**SECTION R406**

**ADDITIONAL ENERGY EFFICIENCY REQUIREMENTS**

**R406.1 Scope.** This section establishes additional energy efficiency requirements for all new construction covered by this code, including additions subject to Section R502 and change of occupancy or use subject to Section R505 unless specifically exempted in Section R406. Credit from both Sections R406.2 and R406.3 are required.

**R406.2 Carbon emission equalization.** This section establishes a base equalization between fuels used to define the equivalent carbon emissions of the options specified. The permit shall define the base fuel selection to be used and the points specified in Table R406.2 shall be used to modify the requirements in Section R406.3. ~~The sum of credits from Tables R406.2 and R406.3 shall meet the requirements of Section R406.3.~~

**R406.3 Additional energy efficiency requirements.** Each dwelling unit in a residential building shall comply with sufficient options from Table R406.2 and R406.3 so as to achieve the following minimum number of credits:

1. Small Dwelling Unit: ..... ~~3.0~~2.5 credits
   Dwelling units less than 1500 square feet in conditioned floor area with less than 300 square feet of fenestration area. Additions to existing building greater than 500 square feet of heated floor area but less than 1500 square feet.
2. Medium Dwelling Unit: ..... ~~6.0~~5.0 credits
   All dwelling units that are not included in #1, #3 or #4.
3. Large Dwelling Unit: ..... ~~7.0~~6.0 credits
   Dwelling units exceeding 5000 square feet of conditioned floor area.
4. Dwelling units serving R-2 occupancies: ..... 4.5 credits
5. Additions ~~less than or equal to~~ 150 to 500 square feet: ..... ~~1.5~~ 2.0 credits

The drawings included with the building permit application shall identify which options have been selected and the point value of each option, regardless of whether separate mechanical, plumbing, electrical, or other permits are utilized for the project.

**TABLE R406.2**
**FUEL NORMALIZATION CREDITS**

| System Type | Description of Primary Heating Source | Credits | |
|---|---|---|---|
| | | ~~All Other~~ | ~~Group R-2~~ |
| ~~1~~ | ~~Combustion heating equipment meeting minimum federal efficiency standards for the equipment listed in Table C403.3.2(4) or C403.3.2(5)~~ | ~~0~~ | ~~0~~ |
| ~~2~~ | ~~For an initial heating system using a heat pump that meets federal standards for the equipment listed in Table C403.3.2(1)C or C403.3.2(2) or Air to water heat pump units that are configured to provide both heating and cooling and are rated in accordance with AHRI 550/590~~ | ~~1.0~~ | ~~1.0~~ |
| ~~3~~ | ~~For heating system based on electric resistance only (either forced air or Zonal)~~ | ~~-1.0~~ | ~~-1.0~~ |
| ~~4~~ | ~~For heating system based on electric resistance with a ductless mini-split heat pump system in accordance with Section R403.7.1 including the exception~~ | ~~0.5~~ | ~~N/A~~ |
| ~~5~~ | ~~All other heating systems~~ | ~~-1~~ | ~~-0.5~~ |

| System Type | Description of ~~Primary~~ Space Heating Source | Credits | |
|---|---|---|---|
| | | All Other | R-2 |
| 1 | For an initial heating system using a heat pump that meets federal standards for the equipment listed in C403.3.2(2) and a secondary heating provided by a combustion furnace meeting minimum standard listed in Table C403.3.2(4)* | 0 | 0 |
| 2 | For an initial heating system using a heat pump that meets federal standards for the equipment listed in Table C403.3.2(1)C or C403.3.2(2) **or** Air to water heat pump units that are configured to provide both heating and cooling and are rated in accordance with AHRI 550/590 | 1.5 | 2.0 |
| 3 | For heating system based on electric resistance with a ductless mini-split heat pump system in accordance with Section R403.7.1 including the exception | 0.5 | 0 |
| 4 | For heating system based on electric resistance only (either forced air or Zonal) | -1.0 | -0.5 |
| 5 | Combustion heating equipment meeting minimum federal efficiency standards for the equipment listed in Table C403.3.2(4) or C403.3.2(5) | -3 | 0 |

*The gas back-up furnace will operate as fan-only when the heat pump is operating. The heat pump shall operate at all temperatures above 38F (or lower). Below that "changeover" temperature the heat pump would not operate to provide space heating. The gas furnace provides heating below 38F (or lower).
†Additional points for this HVAC system are included in Table R406.3

**TABLE R406.3**
**ENERGY CREDITS**

| OPTION | DESCRIPTION | CREDIT(S) | |
|---|---|---|---|
| | **1. EFFICIENT BUILDING ENVELOPE OPTIONS**<br>Only one option from Items 1.1 through ~~1.7~~1.4 may be selected in this category. Compliance with the conductive UA targets is demonstrated using Section ~~R402.1.4~~ R402.1.5, Total UA alternative, where [1-(Proposed UA/Target UA)] > the required %UA reduction | | |
| 1.1 | Prescriptive compliance is based on ~~Table R402.1.1~~ R402.1.3 with the following modifications:<br>Vertical fenestration ~~U = 0.24~~. U-0.22 | 0.5 | 0.5 |
| ~~1.2~~ | ~~Prescriptive compliance is based on Table R402.1.1 with the following modifications:~~<br>~~Vertical fenestration U = 0.20~~ | ~~1.0~~ | ~~1.0~~ |
| ~~1.3~~ | ~~Prescriptive compliance is based on Table R402.1.1 with the following modifications:~~<br>~~Vertical fenestration U = 0.28~~<br>~~Floor R-38~~<br>~~Slab on grade R-10 perimeter and under entire slab~~<br>~~Below grade slab R-10 perimeter and under entire slab~~<br>~~**or**~~<br>~~Compliance based on Section R402.1.4: Reduce the Total conductive UA by 5%.~~ | ~~0.5~~ | ~~N/A~~ |
| ~~1.4~~ 1.2 | Prescriptive compliance is based on Table ~~R402.1.1~~R402.1.3 with the following modifications:<br>Vertical fenestration U = 0.25<br>~~Wall R-21 plus R-4 ci~~<br>Floor R-38<br>Basement wall R-21 int plus R-5 ci<br>Ceiling and single-rafter or joist-vaulted R-60 advanced<br>Slab on grade R-10 perimeter and under entire slab<br>Below grade slab R-10 perimeter and under entire slab<br>**or**<br>Compliance based on Section ~~R402.1.4~~R402.1.5: Reduce the Total conductive UA by 15%. | ~~1.0~~ 0.5 | 1.0 |
| ~~1.5~~ 1.3 | Prescriptive compliance is based on Table ~~R402.1.1~~R402.1.3 with the following modifications:<br>Vertical fenestration U = ~~0.22~~0.18<br>Ceiling and single-rafter or joist-vaulted R-~~49~~60 advanced<br>~~Wood frame wall R-21 int plus R-12 ci~~<br>Floor R-38<br>Basement wall R-21 int plus R-12 ci<br>Slab on grade R-10 perimeter and under entire slab<br>Below grade slab R-10 perimeter and under entire slab<br>**or**<br>Compliance based on Section ~~R402.1.4~~R402.1.5: Reduce the Total conductive UA by ~~30%~~22.5%. | ~~2.0~~ 1.0 | 1.5 |

**TABLE R406.3 (continued)**
**ENERGY CREDITS**

| OPTION | DESCRIPTION | CREDIT(S) | |
|---|---|---|---|
| | | All Other | Group R-2 |
| ~~1.6~~ 1.4 | Prescriptive compliance is based on Table ~~R402.1.1~~R402.1.3 with the following modifications:<br>Vertical fenestration U = 0.18<br>Ceiling and single-rafter or joist-vaulted R-60 advanced<br>Wood frame wall R-21 int plus R-16 ci<br>Floor R-48<br>Basement wall R-21 int plus R-16 ci<br>Slab on grade R-20 perimeter and under entire slab<br>Below grade slab R-20 perimeter and under entire slab<br>**or**<br>Compliance based on Section ~~R402.1.4~~R402.1.5: Reduce the Total conductive UA by ~~40%~~30%. | ~~3.0~~ 1.5 | 2.0 |
| ~~1.7~~ | ~~Advanced framing and raised heel trusses or rafters~~<br>~~Vertical Glazing U-0.28~~<br>~~R-49 Advanced (U-0.020) as listed in Section A102.2.1, Ceilings below a vented attic~~<br>~~**and**~~<br>~~R-49 vaulted ceilings with full height of uncompressed insulation extending over the wall top plate at the eaves.~~ | ~~0.5~~ | ~~0.5~~ |
| | **2. AIR LEAKAGE CONTROL AND EFFICIENT VENTILATION OPTIONS**<br>Only one option from Items 2.1 through 2.4 may be selected in this category. | | |
| ~~2.1~~ | ~~Compliance based on Section R402.4.1.2:~~<br>~~Reduce the tested air leakage to 3.0 air changes per hour maximum at 50 Pascals~~<br>~~**or**~~<br>~~For R-2 Occupancies, optional compliance based on Section R402.4.1.2: Reduce the tested air leakage to 0.3 cfm/ft2 maximum at 50 Pascals~~<br>~~**and**~~<br>~~All whole house ventilation requirements as determined by Section M1505.3 of the *International Residential Code* or Section 403.8 of the *International Mechanical Code* shall be met with a high efficiency fan(s) (maximum 0.35 watts/cfm), not interlocked with the furnace fan (if present). Ventilation systems using a furnace including an ECM motor are allowed, provided that they are controlled to operate at low speed in ventilation only mode.~~<br><br>~~To qualify to claim this credit, the building permit drawings shall specify the option being selected, the maximum tested building air leakage, and shall show the qualifying ventilation system and its control sequence of operation.~~ | ~~0.5~~ | ~~1.0~~ |

**TABLE R406.3 (continued)**
**ENERGY CREDITS**

| OPTION | DESCRIPTION | CREDIT(S) | |
|---|---|---|---|
| | | All Other | Group R-2 |
| 2.~~2~~1 | Compliance based on Section R402.4.1.2:<br>Reduce the tested air leakage to 2.0 air changes per hour maximum at 50 Pascals<br>**or**<br>For R-2 Occupancies, optional compliance based on Section R402.4.1.2:<br>Reduce the tested air leakage to 0.25 cfm/ft2 maximum at 50 Pascals<br>**and**<br>All whole house ventilation requirements as determined by Section M1507.3 of the *International Residential Code* or Section 403.8 of the *International Mechanical Code* shall be met with a heat recovery ventilation system with minimum sensible heat recovery efficiency of 0.65.<br><br>To qualify to claim this credit, the building permit drawings shall specify the option being selected and shall specify the maximum tested building air leakage and shall show the heat recovery ventilation system. | ~~1.0~~ 0.5 | ~~1.5~~ 1.0 |
| 2.~~3~~2 | Compliance based on Section R402.4.1.2:<br>Reduce the tested air leakage to 1.5 air changes per hour maximum at 50 Pascals<br>**or**<br>For R-2 Occupancies, optional compliance based on Section R402.4.1.2:<br>Reduce the tested air leakage to 0.20 cfm/ft2 maximum at 50 Pascals<br>**and**<br>All whole house ventilation requirements as determined by Section M1507.3 of the *International Residential Code* or Section 403.8 of the *International Mechanical Code* shall be met with a heat recovery ventilation system with minimum sensible heat recovery efficiency of 0.75.<br><br>To qualify to claim this credit, the building permit drawings shall specify the option being selected and shall specify the maximum tested building air leakage and shall show the heat recovery ventilation system. | ~~1.5~~ 1.0 | ~~2.0~~ 1.5 |
| 2.~~4~~3 | Compliance based on Section R402.4.1.2:<br>Reduce the tested air leakage to 0.6 air changes per hour maximum at 50 Pascals<br>**or**<br>For R-2 Occupancies, optional compliance based on Section R402.4.1.2:<br>Reduce the tested air leakage to 0.15 cfm/ft2 maximum at 50 Pascals<br>**and**<br>All whole house ventilation requirements as determined by Section M1507.3 of the *International Residential Code* or Section 403.8 of the *International Mechanical Code* shall be met with a heat recovery ventilation system with minimum sensible heat recovery efficiency of 0.80. Duct installation shall comply with Section R403.3.7.<br><br>To qualify to claim this credit, the building permit drawings shall specify the option being selected and shall specify the maximum tested building air leakage and shall show the heat recovery ventilation system. | ~~2.0~~ 1.5 | ~~2.5~~ 2.0 |

**TABLE R406.3 (continued)**
**ENERGY CREDITS**

| OPTION | DESCRIPTION | CREDIT(S) | |
|---|---|---|---|
| | | All Other | Group R-2 |
| **3. HIGH EFFICIENCY HVAC EQUIPMENT OPTIONS**<br>Only one option from Items 3.1 through 3.6 may be selected in this category. | | | |
| 3.1[a] | For secondary heating system serving System Type 1 in Table R406.2:<br>Energy Star rated (U.S. North) Gas or propane furnace with minimum AFUE of 95%<br>**or**<br>Energy Star rated (U.S. North) Gas or propane boiler with minimum AFUE of 90%.<br><br>To qualify to claim this credit, the building permit drawings shall specify the option being selected and shall specify the heating equipment type and the minimum equipment efficiency. | ~~1.0~~ 0.5 | ~~1.0~~ 0.5 |
| 3.2[a] | For a System Type 5 in Table R406.2:<br>Energy Star rated (U.S. North) Gas or propane furnace with minimum AFUE of 95%<br>**or**<br>Energy Star rated (U.S. North) Gas or propane boiler with minimum AFUE of 90%.<br><br>To qualify to claim this credit, the building permit drawings shall specify the option being selected and shall specify the heating equipment type and the minimum equipment efficiency. | 1.0 | 1.0 |
| ~~3.2[a]~~<br>3.3[a,b] | Air-source centrally ducted heat pump with minimum HSPF of 9.5.<br>To qualify to claim this credit, the building permit drawings shall specify the option being selected and shall specify the heating equipment type and the minimum equipment efficiency. | ~~1.0~~ 0.5 | N/A |
| ~~3.3[a]~~<br>3.4[a,b] | Closed-loop ground source heat pump; with a minimum COP of 3.3<br>**or**<br>Open loop water source heat pump with a maximum pumping hydraulic head of 150 feet and minimum COP of 3.6.<br><br>To qualify to claim this credit, the building permit drawings shall specify the option being selected and shall specify the heating equipment type and the minimum equipment efficiency. | 1.5 | 1.0 |
| ~~3.4~~ 3.5[b] | Ductless mini-split heat pump system, zonal control: In homes where the primary space heating system is zonal electric heating, a ductless mini-split heat pump system with a minimum HSPF of 10.0 shall be installed and provide heating to the largest zone of the housing unit.<br><br>To qualify to claim this credit, the building permit drawings shall specify the option being selected and shall specify the heating equipment type and the minimum equipment efficiency. | 1.5 | 2.0 |
| ~~3.5[a]~~<br>3.6[a,b] | Air-source, centrally ducted heat pump with minimum HSPF of 11.0.<br><br>To qualify to claim this credit, the building permit drawings shall specify the option being selected and shall specify the heating equipment type and the minimum equipment efficiency. | ~~1.5~~ 1.0 | N/A |
| ~~3.6[a]~~<br>3.7[a,b] | Ductless split system heat pumps with no electric resistance heating in the primary living areas. A ductless heat pump system with a minimum HSPF of 10 shall be sized and installed to provide heat to entire dwelling unit at the design outdoor air temperature. | 2.0 | 3.0 |

| | | | |
|---|---|---|---|
| | To qualify to claim this credit, the building permit drawings shall specify the option being selected, the heated floor area calculation, the heating equipment type(s), the minimum equipment efficiency, and total installed heat capacity (by equipment type). | | |

**TABLE R406.3 (continued)**
**ENERGY CREDITS**

| OPTION | DESCRIPTION | CREDIT(S) | |
|---|---|---|---|
| | | All Other | Group R-2 |
| | **4. HIGH EFFICIENCY HVAC DISTRIBUTION SYSTEM OPTIONS** | | |
| ~~4.1~~ | ~~All supply and return ducts located in an unconditioned attic shall be deeply buried in ceiling insulation in accordance with Section R403.3.6~~3~~.~~<br><br>~~For mechanical equipment located outside the conditioned space, a maximum of 10 linear feet of return duct and 5 linear feet of supply duct connections to the equipment may be outside the deeply buried insulation. All metallic ducts located outside the conditioned space must have both transverse and longitudinal joints sealed with mastic. If flex ducts are used, they cannot contain splices.~~<br><br>~~Duct leakage shall be limited to 3 cfm per 100 square feet of conditioned floor area.~~<br><br>~~Air handler(s) shall be located within the conditioned space.~~ | ~~0.5~~ | ~~0.5~~ |
| ~~4.2~~ 4.1 | HVAC equipment and associated duct system(s) installation shall comply with the requirements of Section R403.3.~~7~~2.<br><br>~~Locating system components in conditioned crawl spaces is not permitted under this option.~~<br><br>Electric resistance heat, hydronic heating, and ductless heat pumps are not permitted under this option.<br><br>~~Direct combustion heating equipment with AFUE less than 80% is not permitted under this option.~~<br><br>To qualify to claim this credit, the building permit drawings shall specify the option being selected and shall specify the heating equipment type and shall show the location of the heating and cooling equipment and all the ductwork. | ~~1.0~~ 0.5 | N/A |
| **OPTION** | **DESCRIPTION** | **CREDIT(S)** | |
| | | **All Other** | **Group R-2** |
| | **5. EFFICIENT WATER HEATING OPTIONS**<br>Only one option from Items 5.2 through 5.~~6~~4 may be selected in this category. Item 5.1 may be combined with any option. | | |
| 5.1 | A drain water heat recovery unit(s) shall be installed, which captures waste water heat from at least two showers, including shower/tub combinations. It is acceptable, but not required, for sink water to be connected. Unit shall have~~all and only the showers, and has~~ a minimum efficiency of 40% if installed for equal flow or a minimum efficiency of 54% if installed for unequal flow. Such units shall be rated in accordance with CSA B55.1 or IAPMO IGC 346-2017 and be so labeled.<br><br>To qualify to claim this credit, the building permit drawings shall include a plumbing diagram that specifies the drain water heat recovery units and the plumbing layout needed to install it. Labels or other documentation shall be provided that demonstrates that the unit complies with the standard. | 0.5 | 0.5 |

**TABLE R406.3 (continued)**
**ENERGY CREDITS**

| OPTION | DESCRIPTION | CREDIT(S) | |
|---|---|---|---|
| | | All Other | Group R-2 |
| ~~5.2~~ | ~~Water heating system shall include one of the following:~~<br>~~Energy Star rated gas or propane water heater with a minimum UEF of 0.80.~~<br><br>~~To qualify to claim this credit, the building permit drawings shall specify the option being selected and shall specify the water heater equipment type and the minimum equipment efficiency.~~ | ~~0.5~~ | ~~0.5~~ |
| ~~5.3~~ 5.2 | ~~Water heating system shall include one of the following:~~<br>~~Energy Star rated gas or propane water heater with a minimum UEF of 0.91~~<br>~~or~~<br>Solar water heating supplementing a minimum standard water heater. Solar water heating will provide a rated minimum savings of 85 therms or 2000 kWh based on the Solar Rating and Certification Corporation (SRCC) Annual Performance of OG-300 Certified Solar Water Heating Systems<br>**or**<br>Water heater heated by ground source heat pump meeting the requirements of Option 3.3.<br><br>To qualify to claim this credit, the building permit drawings shall specify the option being selected and shall specify the water heater equipment type and the minimum equipment efficiency and, for solar water heating systems, the calculation of the minimum energy savings. | 1.0 | 1.0 |
| ~~5.4~~ | ~~Water heating system shall include one of the following:~~<br>~~Electric heat pump water heater meeting the standards for Tier I of NEEA's advanced water heating specification~~<br>~~or~~<br>~~For R-2 Occupancy, electric heat pump water heater(s), meeting the standards for Tier I of NEEA's advanced water heating specification, shall supply domestic hot water to all units. If one water heater is serving more than one dwelling unit, all hot water supply and recirculation piping shall be insulated with R-8 minimum pipe insulation.~~<br><br>~~To qualify to claim this credit, the building permit drawings shall specify the option being selected and shall specify the water heater equipment type and the minimum equipment efficiency.~~ | ~~1.5~~ | ~~2.0~~ |
| 5.~~5~~3 | Water heating system shall include one of the following:<br>Electric heat pump water heater meeting the standards for Tier III of NEEA's advanced water heating specification<br>**or**<br>For R-2 Occupancy, electric heat pump water heater(s), meeting the standards for Tier III of NEEA's advanced water heating specification, shall supply domestic hot water to all units. If one water heater is serving more than one dwelling unit, all hot water supply and recirculation piping shall be insulated with R-8 minimum pipe insulation.<br><br>To qualify to claim this credit, the building permit drawings shall specify the option being selected and shall specify the water heater equipment type and the minimum equipment efficiency. | 2.0 | 2.5 |

**TABLE R406.3 (continued)**
**ENERGY CREDITS**

| OPTION | DESCRIPTION | CREDIT(S) | |
|---|---|---|---|
| | | All Other | Group R-2 |
| 5.~~6~~4 | Water heating system shall include one of the following:<br>Electric heat pump water heater with a minimum UEF of 2.9 and utilizing a split system configuration with the air-to-refrigerant heat exchanger located outdoors. Equipment shall meet Section 4, requirements for all units, of the NEEA standard Advanced Water Heating Specification with the UEF noted above<br>**or**<br>For R-2 Occupancy, electric heat pump water heater(s), meeting the standards for Tier III of NEEA's advanced water heating specification and utilizing a split system configuration with the air-to-refrigerant heat exchanger located outdoors, shall supply domestic hot water to all units. If one water heater is serving more than one dwelling unit, all hot water supply and recirculation piping shall be insulated with R-8 minimum pipe insulation.<br><br>To qualify to claim this credit, the building permit drawings shall specify the option being selected and shall specify the water heater equipment type and the minimum equipment efficiency. | 2.5 | 3.0 |
| **6. RENEWABLE ELECTRIC ENERGY OPTION** | | | |
| 6.1 | For each ~~12~~600 kWh of electrical generation per housing unit provided annually by on-site wind or solar equipment ~~a 1.0~~0.5 credit shall be allowed, up to ~~3~~ 4.5 credits. Generation shall be calculated as follows:<br>For solar electric systems, the design shall be demonstrated to meet this requirement using the National Renewable Energy Laboratory calculator PVWATTs or approved alternate by the code official.<br><br>Documentation noting solar access shall be included on the plans.<br><br>For wind generation projects designs shall document annual power generation based on the following factors:<br>The wind turbine power curve; average annual wind speed at the site; frequency distribution of the wind speed at the site and height of the tower.<br><br>To qualify to claim this credit, the building permit drawings shall specify the option being selected and shall show the photovoltaic or wind turbine equipment type, provide documentation of solar and wind access, and include a calculation of the minimum annual energy power production. | ~~1.0~~0.5-4.5 | ~~1.0~~0.5-4.5 |
| **7. APPLIANCE PACKAGE OPTION** | | | |
| 7.1 | All of the following appliances shall be new and installed in the dwelling unit and shall meet the following standards:<br>1. Dishwasher, Standard – Energy Star rated~~,~~ Most Efficient 2021<br>**or**<br>Dishwasher, Compact – Energy Star rated ~~(~~Version 6.0~~)~~<br>2. Refrigerator (if provided) – Energy Star rated ~~(~~Version 5.1~~)~~<br>3. Washing machine (Residential ~~or Commercial~~) – Energy Star rated ~~(~~Version 8.1~~)~~<br>**Exception:** For Group R-2, a new Commercial Clothes Washer rated to Energy Star Version 8.1 and installed in the same *building* as the dwelling unit shall be an acceptable compliance alternative for this requirement.<br>4. Dryer – Energy Star rated~~,~~ Most Efficient 2022~~ventless dryer with a minimum CEF rating of 5.2~~.<br><br>To qualify to claim this credit, the building permit drawings shall specify the option being selected and shall show the appliance type and provide documentation of Energy Star compliance. At the time of inspection, all appliances shall be installed and connected to utilities. Dryer ducts and exterior dryer vent caps are not permitted to be installed in the dwelling unit. | 0.5 | 1.5 |

a. An alternative heating source sized at a maximum of 0.5 Watts/ft$^2$ (equivalent) of heated floor area or 500 Watts, whichever is bigger, may be installed in the dwelling unit.
b. May only be claimed if serving System Type 2 or 3 from Table R406.2.

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

- ☐ Addresses a critical life/safety need.
- ☐ The amendment clarifies the intent or application of the code.
- ☒ Addresses a specific state policy or statute. (Note that energy conservation is a state policy)
- ☒ Consistency with state or federal regulations.
- ☐ Addresses a unique character of the state.
- ☐ Corrects errors and omissions.

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

- ☒ Single family/duplex/townhome
- ☒ Multi-family 1 – 3 stories
- ☐ Multi-family 4 + stories
- ☐ Commercial / Retail
- ☐ Institutional
- ☐ Industrial


| | | | |
|---|---|---|---|
| Your name | Henry Odum, PE | Email address | henry@ecotope.com |
| Your organization | Ecotope, Inc. | Phone number | (206) 596-4715 |

Other contact name Click here to enter text.


## 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.

This is a amended R406 proposal intended to reflect the heat pump water and space heating proposals, as accepted by the tag. Also incorporatess various proposals regarding envelope upgrades.

**Energy Savings Estimates**

The energy savings estimates will be included in final draft. They are being developed using 6 single family and one multi-family prototype. For each building prototype, each predominant HVAC system (gas furnace, gas furnace with AC, central heat pump and Ductless heat pumps with zonal electric) is modeled and located in various weather climates within the state. The energy savings attributed to each option are then weighted to consolidate energy savings estimates for the 4 primary categories of homes in Section R406.3 (small, medium, large, and R-2 dwelling units). Large homes (greater than 5000sf) only compromise 2% of the total building stock – therefore energy savings estimates used for the Life Cycle Cost Analysis will be omitted from this economic analysis.

Provide your best estimate of the **construction cost** (or cost savings) of your code change proposal?

**Table 1: Total Measure Costs by Single Family Prototypes**

| | | | | Prototypes Weight % by Floor Area | | | |
|---|---|---|---|---|---|---|---|
| | | | | 1344 | 2200 | 2688 | 5000 |
| Option-Description | Gas Credit Value | HP Credit Value | **Weighted Measure Cost** | 15% | 72% | 11% | 2% |
| 1.1 - U-.24 Glaze | 0.5 | 0.5 | **$ 1,730** | $ 991 | $ 1,790 | $ 1,987 | $ 3,688 |
| 1.2 - U-.20 Glaze | 1 | 1 | **$ 2,537** | $ 1,454 | $ 2,625 | $ 2,914 | $ 5,409 |
| 1.3 - 5% UA reduc | 0.5 | 0.5 | **$ 1,261** | $ 955 | $ 1,270 | $ 1,762 | $ 476 |
| 1.4 - 15% UA reduc | 1 | 1 | **$ 3,263** | $ 1,925 | $ 3,255 | $ 4,676 | $ 5,802 |
| 1.5 - 22.5% UA reduc | 2 | 1.5 | **$ 4,721** | $ 2,938 | $ 4,850 | $ 5,735 | $ 7,852 |
| 1.6 - 30% UA reduc | 3 | 2.5 | **$ 11,235** | $ 6,819 | $ 12,095 | $ 10,587 | $ 16,991 |
| 2.1 - 2 ACH, HRV | 1 | 0.5 | **$ 2,264** | $ 1,395 | $ 2,284 | $ 2,790 | $ 5,190 |
| 2.2 - 1.5 ACH, HRV | 1.5 | 1 | **$ 5,411** | $ 3,334 | $ 5,457 | $ 6,667 | $ 12,402 |
| 2.3 - 0.6 ACH, HRV | 2 | 1.5 | **$ 6,988** | $ 4,306 | $ 7,048 | $ 8,612 | $ 16,019 |
| 3.1a - Furnace | 1 | 1 | **$ 252** | $ 252 | $ 252 | $ 252 | $ 252 |
| 3.2a - 9.5 HSPF HP | 0.5 | 0.5 | **$ 1,388** | $ 1,388 | $ 1,388 | $ 1,388 | $ 1,388 |
| 3.3a - GSHP | 1.5 | 1.5 | **$ 11,034** | $ 10,900 | $ 10,900 | $ 10,900 | $ 17,600 |
| 3.4 - DHP | 1.5 | 1.5 | **$ 1,530** | $ 1,530 | $ 1,530 | $ 1,530 | $ 1,530 |
| 3.5a - 11.0 HSPF HP | 1 | 1 | **$ 1,530** | $ 1,530 | $ 1,530 | $ 1,530 | $ 1,530 |
| 3.6a - DHP (15% elec) | 2 | 2 | **$ 5,901** | $ 5,901 | $ 5,901 | $ 5,901 | $ 5,901 |
| 4.1 - Deeply buried | 1 | 0.5 | **$ -** | $ - | $ - | $ - | $ - |
| 4.2 - HVAC inside | 1.5 | 1 | **$ 328** | $ 328 | $ 328 | $ 328 | $ 328 |
| 5.1 - DWR | 0.5 | 0.5 | **$ 437** | $ 437 | $ 437 | $ 437 | $ 437 |
| 5.2 - 0.80 gas DHW | 0.5 | 0.5 | **$ 640** | $ 640 | $ 640 | $ 640 | $ 640 |
| 5.3 - 0.91 gas DHW, GSHP | 1 | 1 | **$ 1,009** | $ 1,009 | $ 1,009 | $ 1,009 | $ 1,009 |
| 5.4 - Tier III HPWH | 2 | 2 | **$ 955** | $ 955 | $ 955 | $ 955 | $ 955 |
| 5.5 - CO2 HPWH | 2.5 | 2.5 | **$ 3,824** | $ 3,824 | $ 3,824 | $ 3,824 | $ 3,824 |
| 6.1 - Solar pV | 1 | 1 | **$ 5,040** | $ 5,040 | $ 5,040 | $ 5,040 | $ 5,040 |
| 7.1 - ES Appl+ventless Dryer | 0.5 | 0.5 | **$ 505** | $ 505 | $ 505 | $ 505 | $ 505 |

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**Table 2: Total Measure Costs for Multifamily prototype**

| Option-Description | Credit Value | | Measure Cost |
|---|---|---|---|
| 1.1 - U-.24 Glaze | 0.5 | | --- |
| 1.2 - U-.20 Glaze | 1 | | $ 887 |
| 1.3 - 5% UA reduc | --- | | $ 173 |
| 1.4 - 15% UA reduc | 1 | | $ 947 |
| 1.5 - 22.5% UA reduc | 1.5 | | $ 1,383 |
| 1.6 - 30% UA reduc | 2 | | $ 3,779 |
| 2.1 - 2 ACH, HRV | 0.5 | | $ 851 |
| 2.2 - 1.5 ACH, HRV | 1 | | $ 2,034 |
| 2.3 - 0.6 ACH, HRV | 1.5 | | $ 2,627 |
| 3.1a - Furnace | 1 | | $ 252 |
| 3.2a - 9.5 HSPF HP | --- | | --- |
| 3.3a - GSHP | 1 | | --- |
| 3.4 - DHP | 2 | | $ 3,060 |
| 3.5a - 11.0 HSPF HP | --- | | $ - |
| 3.6a - DHP (15% elec) | 3 | | $ 5,245 |
| 4.1 - Deeply buried | 0.5 | | $ - |
| 4.2 - HVAC inside | --- | | --- |
| 5.1 - DWR | --- | | $ 505 |
| 5.2 - 0.80 gas DHW | 0.5 | | --- |
| 5.3 - 0.91 gas DHW, GSHP | 1 | | --- |
| 5.4 - Tier III HPWH | 2.5 | | $ 318 |
| 5.5 - CO2 HPWH | 3 | | $ 1,275 |
| 6.1 - Solar pV | 1 | | $ 5,040 |
| 7.1 - ES Appl+ventless Dryer | 1.5 | | $ 505 |

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

**See Table 3 for kWh/dwelling unit or therm/dwelling unit savings (savings values are positive)**

**Energy Savings Estimates**

The energy savings estimates below have been developed using 6 single family and two multi-family prototypes. For each building prototype, each predominant HVAC system (gas furnace, gas furnace with AC, central heat pump and Ductless heat pumps with zonal electric) was modeled and located in various weather climates within the state. The energy savings attributed to each option listed in Table 406.3 were then weighted to consolidate energy savings estimates for the 4 primary categories of homes in Section R406.3 (small, medium, large, and R-2 dwelling units). As shown in Table 1, large homes (greater than 5000sf) only compromise 2% of the total building stock – therefore energy savings estimates used for the Life Cycle Cost Analysis have been omitted from this economic analysis.

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## Table 3: Savings All Climates, All Systems

| | S | | | | M | | | | MF |
|---|---|---|---|---|---|---|---|---|---|
| | gfac | gfac | ashp | zonl | gfac | gfac | ashp | zonl | zonl |
| **Options Table 2021** | kWh | Therm | kWh | kWh | kWh | Therm | kWh | kWh | kWh |
| mandatory req's | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| windows U=0.24 | 114 | 5 | 1143 | 173 | 292 | 5 | 302 | 348 | 132 |
| windows U=0.2 | 160 | 12 | 1192 | 291 | 369 | 18 | 492 | 597 | 263 |
| envelope 3 - 5% UA | 18 | 0 | 1101 | 94 | -70 | -2 | 59 | 122 | -34 |
| envelope 4 - 15% UA | 151 | 24 | 1243 | 406 | 288 | 28 | 528 | 648 | 223 |
| envelope 5 - 22.5% UA | 303 | 33 | 1315 | 581 | 577 | 41 | 817 | 1015 | 420 |
| envelope 6 - 30%UA | 348 | 55 | 1430 | 821 | 887 | 69 | 1158 | 1456 | 555 |
| air leakage 1 hrv | -116 | 3 | 1059 | -10 | -271 | 19 | 105 | 111 | 329 |
| air leakage 2 hrv | 4 | 45 | 283 | 344 | 87 | 67 | 504 | 664 | 642 |
| air leakage 3 hrv | 91 | 54 | 414 | 487 | 530 | 78 | 762 | 997 | 934 |
| AFUE .95 | -84 | 34 | - | - | 55 | 51 | - | - | |
| HSPF 9.5 | - | - | 248 | - | - | - | 328 | - | |
| DHP HSPF 10(zonal only) | - | - | - | 689 | - | - | - | 1129 | -41 |
| HSPF 11 | - | - | 371 | - | - | - | 980 | - | |
| DHP HSPF 10 whole house (zonal only) | - | - | - | 1154 | - | - | - | 2185 | 740 |
| ducts inside | 356 | 32 | 385 | - | 781 | 38 | 666 | - | |
| drain water heat recovery | 76 | 23 | 260 | 247 | -55 | 33 | 282 | 318 | 182 |
| dwh gas UEF 0.80 | 18 | 27 | - | - | 3 | 34 | - | - | |
| dwh gas UEF 0.91 | -28 | 39 | - | - | 12 | 48 | - | - | |
| hpwh Tier III | -930 | 121 | 1407 | 1395 | -1167 | 153 | 1761 | 1790 | 973 |
| UEF 2.9 | -813 | 121 | 1536 | 1512 | -1099 | 156 | 1916 | 1941 | 1055 |
| Energy Star appliances | 722 | | 824 | 784 | 625 | | 750 | 776 | 629 |

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**Table 4:** Measure cost estimates ($/component area, SF or housing unit)

| Component | Base Level | Measures Beyond Base Level | Cost (2021) $s $/ft2 or $/unit | Source |
|---|---|---|---|---|
| **Envelope** | | | | |
| Ceiling | R-60 | R-60 RH Ceiling Insulation | $ 0.22 | CERF |
| Ceiling | R-60 | R-49 Advanced | $ 0.25 | CERF |
| Wall | R-13 int Wall + R10 Foam Sheathing | R-21 int Wall + R12 Foam Sheathing | $ 1.05 | 6th plan |
| Wall | R-13 int Wall + R10 Foam Sheathing | R-21 int Wall + R-4 Foam Sheathing | $ 2.46 | 6th plan |
| Wall | R-13 int Wall + R10 Foam Sheathing | R-21 int Wall + R16 Foam Sheathing | $ 3.28 | 6th plan |
| Floor | R-30 | R-38 Floor | $ 0.42 | RTF-ResNCMTHouseID_v_3_0 .xlsm April 4, 2018; ShellCosts tab |
| Slab | R-10 4' perim | Slab R-15 4' perim | $ 0.99 | 6th Plan Appendix G |
| Slab | R-10 4' perim | Slab R-10 Full | $ 0.99 | 6th Plan Appendix G |
| Slab | R-10 4' perim | Slab R-20 Full | $ 1.33 | 6th Plan Appendix G |
| Window | U-0.30 | Window U-0.25 | $ 4.92 | NPCC Standard workbook |
| Window | U-0.30 | Window U-0.24 | $ 4.92 | NPCC Standard workbook |
| Window | U-0.30 | Window U-0.22 | $ 7.21 | NPCC Standard workbook |
| Window | U-0.30 | Window U-0.20 | $ 7.21 | NPCC Standard workbook |
| Window | U-0.30 | Window U-0.18 | $ 9.83 | MF bids (tripleglaze-BidPrices.xl) Costs from ecowindows bids are about 26.50/sf or 8.50 incremental with contractor mark-up |
| **Air Sealing & Ventilation** | | | | |
| ACH | Tested Infiltration at 3 ACH 50 | Tested Infiltration to 2 ACH50 | $ 0.22 | RTF Workbook. ResWXSF_FY10v2_1.xls, at $.18/ft^2 per 1ACH50 reduction.<br>Dan W |
| ACH | Tested Infiltration at 3 ACH 50 | Tested Infiltration to 1.5 ACH50 | $ 0.30 | |
| ACH | Tested Infiltration at 3 ACH 50 | Tested Infiltration to 0.6 ACH50 | $ 0.47 | |
| Exhaust Fan | Pt Source Exhaust Fan =0.75W/cfm | Pt Source Exhaust Fan <0.35W/cfm | $ 88.12 | navigant 2013 |
| ERV | No ERV | ERV with SHR>= 0.65 | $ 0.82 | $400 for WhisperComfort and $400 for ducting |
| ERV | No ERV | ERV with SHR>= 0.75 | $ 2.19 | renewaire or lifebreath |
| ERV | No ERV | ERV with SHR>= 0.80 | $ 2.73 | high efficiency HRV with ducting (venmar, zhender) |
| **HVAC System** | | | | |
| Ducts | Code level is sealed | Ducts Inside | $ 327.81 | NPCC Sixth Power Plan, Support documentation |
| Furnace | 0.8 | Furnace Upgrade to 94AFUE | $ 251.59 | Navigant Sept 2011 Report for NEEP |
| Heat Pump | 8.2 HSPF | 9.5 HSPF | $ 1,387.73 | SIW, linear regression from 9 HSPF pricing |
| DHP | Zonal Resistance | 1-ton single zone DHP | $ 3,059.56 | Ecotope analysis of NEEA DHP pilot program database |
| 11.0 DHP | 8.2 DHP | 1-ton single zone DHP | $ 1,529.78 | Ecotope analysis of NEEA DHP pilot program database |
| Heat Pump | 8.2 HSPF | 11 HSPF | $ 5,900.58 | 3 ton unit. ResSFExistingHVAC |
| multizone 11.0 DHP | 8.2 HSPF | 10 HSPF efficiency with no electric resistance. Reduction in elec heat but higher tonnage | $ 5,900.58 | Ecotope analysis of NEEA DHP pilot program database |
| **Domestic Hot Water** | | | | |
| Water Htr | 0.59 EF | Gas Water Heater >=0.80 EF | $ 640.32 | NREL, 2013 |
| Water Htr | 0.59 EF | Gas Water Heater >=0.91 EF | $ 1,008.56 | NREL, 2013 |
| Water Htr | 0.95 EF | Heat Pump Water Heater 2 EF | $ 955.02 | RTF ResHPWH.xls |
| DWHR | none | Drain water heat recovery pipe | $ 437.08 | RTF RESDHWDrainWaste.xls |
| Water Htr | 0.95 EF | Tier 3 Water Heater 3 EF | $ 955.02 | RTF ResHPWH.xls |
| Water Htr | 0.95 EF | CO2 Water Heater 4 EF | $ 3,824.45 | RTF ResHPWH.xls |
| **Appliances** | | | | |
| Dryers, refr, dishwasher | Fed pre-empted | Heat pump dryers, ES appliances | $ 504.83 | RTF-ResClothesDryers, ResRef, HD.com $420 for HP dryer, +$40 for Cloth washer, +$90 for refr |

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