Washington State Energy Code
2018 Residential

Effective November 1, 2020
(original effective date was July 1, 2020)

Mike Lubliner, Building Science Specialist
WSU Code Support Services

Technical support provided in Washington:

• Training (in person, webinars, video)
• Phone and email inquiry hotline support
• Energy code compliance tools
• Website with educational resources:
  [WSU Energy Code website](#)
WSU Technical Assistance Services

- Delivered 80 WSEC-R 2015 trainings to 2,100 attendees
- Reply to over 2,000 hotline calls and emails annually
- Participate in SBCC Energy & Mechanical TAGs
Energy Code Support in WA State

Residential - Spend an hour on our web page!
• WSU Energy Program
• 360-956-2042
• energycode@energy.wsu.edu
• www.energy.wsu.edu/code
• Mike Lubliner, Melinda Spencer, Carolyn Roos

Non-residential
• Evergreen Technology Consulting
• 360-539-5300
• com.techsupport@waenergycodes.com
• http://waenergycodes.com
• Lisa Rosenow

WSU Energy Program
Building Efficiency

2018 WSEC–R effective date delayed to Nov. 1, 2020 (update: April 2, 2020)
As part of Governor Inslee’s proclamation to delay the implementation of the
Washington State Building Code, the implementation date for the Washington State
Energy Code–Residential has been delayed from July 1, 2020, to November 1,
2020.
Today’s Proclamation by Governor Inslee is available here.

2018 WSEC–R Training (update: March 10, 2020)
Due to the COVID-19 outbreak in the Puget Sound region, the professional meetings
where we planned to deliver WSEC training sessions in March have been cancelled or
re-scheduled by the host organizations at the direction of local public health
authorities.
We recorded the 2018 WSEC-R training presentation this week and will post it on
our Training webpage in the next day or two. We will notify those on our email
distribution list when the training is available.
Email us at energycode@energy.wsu.edu to be added to this list. We appreciate your
understanding.

2018 Washington State Energy Code
(update: Jan. 8, 2020)
Our code experts provide support to those who use the residential sections of
the Washington State Energy Code (WSEC-R). The 2018 code will go into effect July
1, 2020. All residential structures permitted on or after July 1, 2020, must meet the
requirements of the 2018 code. The 2018 WSEC-R is available here.
2018 WSEC-R: Past, Current and Future

45% energy savings
(or 55% of the energy consumption in 2006)

WA Target: 8.75% Savings/cycle over 2006
WA Target: 14% Savings over Previous Cycle

Modeled Energy Use (Compared to 2006)

*Values sourced from the 2012 Washington State Energy Code Legislative Report
Code Chapters

• Chapter 1 - Scope and Administration
• Chapter 2 - Definitions
• Chapter 3 - General Requirements
• Chapter 4 - Residential Energy Efficiency
• Chapter 5 - Existing Buildings
• Chapter 6 - Reference Standards
• Appendix A - Default Heat Loss U-Factors
• Appendix RA/RB - R405 Optional Energy Measures
• Appendix C - Exterior Design Conditions
Chapter 4
Residential Energy Efficiency

- R401 - General
- R402 - Building Envelope
- R403 - Mechanical Systems
- R404 - Electrical Power & Lighting
- R405 - Simulated Performance Alternative
- R406 - Additional Energy Efficiency Credits
- R407 - Certified Passive House
R401- General

401.2 - Compliance Paths

- R402.1 - Prescriptive & R406
- R402.1.4 - UA Alternative & R406
- R405 - Simulated Performance Alternative & R406
- R406 - Energy Credits for SF and low-rise MF (raised #)
- R407 - Certified Passive House (new)

Note: Energy Rating Index (ERI/HERS Index) is not an approved compliance path in Washington. However, ERI may be used by energy raters for IRS $2,000/home builder tax credits.
### TABLE R402.1.1

**INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT**

<table>
<thead>
<tr>
<th>Component</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fenestration U-Factor</td>
<td>0.30</td>
</tr>
<tr>
<td>Skylight U-Factor</td>
<td>0.50</td>
</tr>
<tr>
<td>Ceiling R-Value</td>
<td>49</td>
</tr>
<tr>
<td>Wood Frame Wall R-Value</td>
<td>21 int</td>
</tr>
<tr>
<td>Floor R-Value</td>
<td>30</td>
</tr>
<tr>
<td>Below-Grade Wall R-value</td>
<td>10/15/21 int + 5TB</td>
</tr>
<tr>
<td>Slab R-Value &amp; Depth</td>
<td>10, 2 ft</td>
</tr>
</tbody>
</table>
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.
R406.3 Additional energy efficiency requirements. Each dwelling unit in a residential building shall comply with sufficient options from Table R406.2 so as to achieve the following minimum number of credits:

1. Small Dwelling Unit: ................................................................. 3.0 credits
   Dwelling units less than 1500 square feet in conditioned floor area with less than 300 square feet 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 credits
   All dwelling units that are not included in #1, #3 or #4.

3. Large Dwelling Unit: ............................................................... 7.0 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 500 square feet: .......................... 1.5 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.
Dwelling or Sleeping Unit
Energy Credits

- Small (<1,500 sf)
  - 1.5 credits in 2015 (3.0 starting Nov. 1, 2020)

- Medium (1,500 – 5,000 sf)
  - 3.5 credits in 2015 (6.0 starting Nov. 1, 2020)

- Large (>5,000 sf)
  - 4.5 credits in 2015 (7.0 starting Nov. 1, 2020)
Dwelling or Sleeping Unit Energy Credits (cont.)

- Low-rise multifamily (all sizes)
  – 1.5 credits in 2015 (4.5 starting Nov. 1, 2020)

- Additions less than 500 sf
  – 0.5 credit in 2015 (1.5 starting Nov. 1, 2020)
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.
<table>
<thead>
<tr>
<th>System Type</th>
<th>Description of Primary Heating Source</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>All Other</td>
</tr>
<tr>
<td>1</td>
<td>Combustion heating equipment meeting minimum federal efficiency standards for the equipment listed in Table C403.3.2(4) or C403.3.2(5)</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>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</td>
<td>1.0</td>
</tr>
<tr>
<td>3</td>
<td>For heating system based on electric resistance only (either forced air or Zonal)</td>
<td>-1.0</td>
</tr>
<tr>
<td>4</td>
<td>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</td>
<td>0.5</td>
</tr>
<tr>
<td>5</td>
<td>All other heating systems</td>
<td>-1</td>
</tr>
</tbody>
</table>
### Envelope Credits

<table>
<thead>
<tr>
<th>OPTION</th>
<th>DESCRIPTION</th>
<th>CREDIT(S)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. EFFICIENT BUILDING ENVELOPE OPTIONS</strong></td>
<td>Only one option from Items 1.1 through 1.7 may be selected in this category. Compliance with the conductive UA targets is demonstrated using Section R402.1.4. Total UA alternative, where (1-[\text{Proposed UA}/\text{Target UA}]) &gt; the required %UA reduction</td>
<td>All Other</td>
</tr>
<tr>
<td>1.1</td>
<td>Prescriptive compliance is based on Table R402.1.1 with the following modifications: Vertical fenestration (U = 0.24)</td>
<td>0.5</td>
</tr>
<tr>
<td>1.2</td>
<td>Prescriptive compliance is based on Table R402.1.1 with the following modifications: Vertical fenestration (U = 0.20)</td>
<td>1.0</td>
</tr>
<tr>
<td>1.3</td>
<td>Prescriptive compliance is based on Table R402.1.1 with the following modifications: Vertical fenestration (U = 0.28) Floor R-38 Slab on grade R-10 perimeter and under entire slab Below grade slab R-10 perimeter and under entire slab or Compliance based on Section R402.1.4: Reduce the Total conductive UA by 5%</td>
<td>0.5</td>
</tr>
<tr>
<td>1.4</td>
<td>Prescriptive compliance is based on Table R402.1.1 with the following modifications: Vertical fenestration (U = 0.25) Wall R-21 plus R-4 ci Floor R-38 Basement wall R-21 int plus R-3 ci Slab on grade R-10 perimeter and under entire slab Below grade slab R-10 perimeter and under entire slab or Compliance based on Section R402.1.4: Reduce the Total conductive UA by 15%</td>
<td>1.0</td>
</tr>
<tr>
<td>1.5</td>
<td>Prescriptive compliance is based on Table R402.1.1 with the following modifications: Vertical fenestration (U = 0.22) Ceiling and single-rafter or joist-vaulted R-49 advanced Wood frame wall R-21 int plus R-12 ci Floor R-38 Basement wall R-21 int plus R-12 ci Slab on grade R-10 perimeter and under entire slab Below grade slab R-10 perimeter and under entire slab or Compliance based on Section R402.1.4: Reduce the Total conductive UA by 30%</td>
<td>2.0</td>
</tr>
</tbody>
</table>
## (1) Envelope Credits (cont.)

<table>
<thead>
<tr>
<th>OPTION</th>
<th>DESCRIPTION</th>
<th>CREDIT(S)</th>
<th>All Other</th>
<th>Group R-2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.6</td>
<td>Prescriptive compliance is based on Table R402.1.1 with the following modifications: Vertical fenestration $U = 0.18$ Ceiling and single-rafter or joist-vaulted R-80 advanced Wood frame wall R-21 int plus R-16 ci Floor R-48 Basement wall R-21 int plus R-16 ci Slab on grade R-20 perimeter and under entire slab Below grade slab R-20 perimeter and under entire slab or Compliance based on Section R402.1.4: Reduce the Total conductive UA by 40%.</td>
<td>3.0</td>
<td>2.0</td>
<td></td>
</tr>
<tr>
<td>1.7</td>
<td>Advanced framing and raised heel trusses or rafters Vertical Glazing $U=0.28$ R-49 Advanced (U-0.020) as listed in Section A102.2.1, Ceilings below a vented attic and R-49 vaulted ceilings with full height of uncompressed insulation extending over the wall top plate at the eaves.</td>
<td>0.5</td>
<td>0.5</td>
<td></td>
</tr>
</tbody>
</table>
(2) Air Leakage Control & Ventilation System Effectiveness Credits

| 2. AIR LEAKAGE CONTROL AND EFFICIENT VENTILATION OPTIONS | | |
|----------------------------------------------------------|----------------------|
| Only one option from Items 2.1 through 2.4 may be selected in this category. | |

<table>
<thead>
<tr>
<th>2.1</th>
<th>Compliance based on R402.4.1.2:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Reduce the tested air leakage to 3.0 air changes per hour maximum at 50 Pascals or</td>
</tr>
<tr>
<td></td>
<td>For R-2 Occupancies, optional compliance based on Section R402.4.1.2:</td>
</tr>
<tr>
<td></td>
<td>Reduce the tested air leakage to 0.3 cfm/ft² maximum at 50 Pascals and</td>
</tr>
<tr>
<td></td>
<td>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 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.</td>
</tr>
<tr>
<td></td>
<td>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.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2.2</th>
<th>Compliance based on Section R402.4.1.2:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Reduce the tested air leakage to 2.0 air changes per hour maximum at 50 Pascals or</td>
</tr>
<tr>
<td></td>
<td>For R-2 Occupancies, optional compliance based on Section R402.4.1.2:</td>
</tr>
<tr>
<td></td>
<td>Reduce the tested air leakage to 0.25 cfm/ft² maximum at 50 Pascals and</td>
</tr>
<tr>
<td></td>
<td>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.</td>
</tr>
<tr>
<td></td>
<td>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.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>0.5</th>
<th>1.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.2</td>
<td>1.0</td>
<td>1.5</td>
</tr>
</tbody>
</table>
2.3 Compliance based on Section R402.4.1.2:
Reduce the tested air leakage to **1.5 air changes per hour** maximum at 50 Pascals
or
For R-2 Occupancies, optional compliance based on Section R402.4.1.2:
Reduce the tested air leakage to **0.25 cfm/ft²** maximum at 50 Pascals
and
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**.

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.

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</tr>
</thead>
<tbody>
<tr>
<td>2.3</td>
<td>Compliance based on Section R402.4.1.2: Reduce the tested air leakage to <strong>1.5 air changes per hour</strong> maximum at 50 Pascals or For R-2 Occupancies, optional compliance based on Section R402.4.1.2: Reduce the tested air leakage to <strong>0.25 cfm/ft²</strong> maximum at 50 Pascals and All whole house ventilation requirements as determined by Section M1507.3 of the <em>International Residential Code</em> or Section 403.8 of the <em>International Mechanical Code</em> shall be met with a heat recovery ventilation system with minimum sensible heat recovery efficiency of <strong>0.75</strong>. 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.</td>
<td>1.5</td>
</tr>
</tbody>
</table>

2.4 Compliance based on Section R402.4.1.2:
Reduce the tested air leakage to **0.6 air changes per hour** maximum at 50 Pascals
or
For R-2 Occupancies, optional compliance based on Section R402.4.1.2:
Reduce the tested air leakage to **0.15 cfm/ft²** maximum at 50 Pascals
and
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.

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.

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<table>
<thead>
<tr>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>2.4</td>
<td>Compliance based on Section R402.4.1.2: Reduce the tested air leakage to <strong>0.6 air changes per hour</strong> maximum at 50 Pascals or For R-2 Occupancies, optional compliance based on Section R402.4.1.2: Reduce the tested air leakage to <strong>0.15 cfm/ft²</strong> maximum at 50 Pascals and All whole house ventilation requirements as determined by Section M1507.3 of the <em>International Residential Code</em> or Section 403.8 of the <em>International Mechanical Code</em> shall be met with a heat recovery ventilation system with minimum sensible heat recovery efficiency of <strong>0.80</strong>. Duct installation shall comply with Section R403.3.7. 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.</td>
<td>2.0</td>
</tr>
</tbody>
</table>
3. HIGH EFFICIENCY HVAC EQUIPMENT OPTIONS

Only one option from Items 3.1 through 3.6 may be selected in this category.

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Credits 1.0</th>
<th>Credits 1.5</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1a</td>
<td>Energy Star rated (U.S. North) Gas or propane furnace with minimum AFUE of 95% or Energy Star rated (U.S. North) Gas or propane boiler with minimum AFUE of 90%</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>3.2a</td>
<td>Air-source centrally ducted heat pump with minimum HSPF of 9.5.</td>
<td>1.0</td>
<td>N/A</td>
</tr>
<tr>
<td>3.3a</td>
<td>Closed-loop ground source heat pump; with a minimum COP of 3.3 or Open loop water source heat pump with a maximum pumping hydraulic head of 150 feet and minimum COP of 3.6.</td>
<td>1.5</td>
<td>1.0</td>
</tr>
<tr>
<td>3.4</td>
<td>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.</td>
<td>1.5</td>
<td>2.0</td>
</tr>
</tbody>
</table>
| 3.5<sup>a</sup> | Air-source, **centrally ducted heat pump with minimum HSPF of 11.0**.  
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 | N/A |
|-----------------|-------------------------------------------------------------------------------------------------|-----|-----|
| 3.6<sup>a</sup> | **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.  
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). | 2.0 | 3.0 |

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a. An alternative heating source sized at a maximum of 0.5 Watts/ft<sup>2</sup> (equivalent) of heated floor area or 500 Watts, whichever is bigger, may be installed in the dwelling unit.
### 4. HIGH EFFICIENCY HVAC DISTRIBUTION SYSTEM OPTIONS

<table>
<thead>
<tr>
<th>4.1 All supply and return ducts located in an unconditioned attic shall be deeply buried in ceiling insulation in accordance with Section R403.3.7. 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. Duct leakage shall be limited to 3 cfm per 100 square feet of conditioned floor area. Air handler(s) shall be located within the conditioned space.</th>
<th>0.5</th>
<th>0.5</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.2 HVAC equipment and associated duct system(s) installation shall comply with the requirements of Section R403.3.7. Locating system components in conditioned crawl spaces is not permitted under this option. <strong>Electric resistance heat and ductless heat pumps are not permitted under this option.</strong> Direct combustion heating equipment with AFUE less than 80% is not permitted under this option. 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.</td>
<td>1.0</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
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</tr>
<tr>
<td>---</td>
<td>---</td>
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</tr>
<tr>
<td><strong>5. EFFICIENT WATER HEATING OPTIONS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Only one option from Items 5.2 through 5.6 may be selected in this category. Item 5.1 may be combined with any option.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>5.1</strong></td>
<td>A drain water heat recovery unit(s) shall be installed, which captures waste water heat from 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. 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.</td>
<td>0.5</td>
</tr>
<tr>
<td><strong>5.2</strong></td>
<td>Water heating system shall include one of the following: Energy Star rated gas or propane water heater with a minimum UEF of 0.80. 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.</td>
<td>0.5</td>
</tr>
</tbody>
</table>
### DHW Credits (cont.)

<table>
<thead>
<tr>
<th>OPTION</th>
<th>DESCRIPTION</th>
<th>All Other</th>
<th>Group R-2</th>
</tr>
</thead>
</table>
| 5.3    | Water heating system shall include one of the following:  
Energy Star rated gas or propane water heater with a minimum UEF of 0.91  
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 O-300 Certified Solar Water Heating Systems  
Water heater heated by ground source heat pump meeting the requirements of Option 3.3.  
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:  
Electric heat pump water heater meeting the standards for Tier I of NEEA’s advanced water heating specification  
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.  
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    | Water heating system shall include one of the following:  
Electric heat pump water heater meeting the standards for Tier III of NEEA’s advanced water heating specification  
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.  
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>
<thead>
<tr>
<th>OPTION</th>
<th>DESCRIPTION</th>
<th>CREDIT(S)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.6</td>
<td>Water heating system shall include one of the following: 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 or 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. 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.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>All Other</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2.5</td>
</tr>
</tbody>
</table>
### 6. RENEWABLE ELECTRIC ENERGY OPTION

| 6.1 | For each **1200 kWh** of electrical generation per housing unit provided annually by on-site wind or solar equipment a **1.0 credit** shall be allowed, up to **3 credits**. Generation shall be calculated as follows:

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.

Documentation noting solar access shall be included on the plans.

For wind generation projects designs shall document annual power generation based on the following factors:

- 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.

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. |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>1.0</td>
<td></td>
</tr>
</tbody>
</table>
(7) Appliance Credits

<table>
<thead>
<tr>
<th>7. APPLIANCE PACKAGE OPTION</th>
</tr>
</thead>
</table>
| 7.1 | All of the following appliances shall be new and installed in the dwelling unit and shall meet the following standards:  
Dishwasher – Energy Star rated  
Refrigerator (if provided) – Energy Star rated  
Washing machine – Energy Star rated  
Dryer – Energy Star rated, ventless dryer with a minimum CEF rating of 5.2.  
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 |
## All Electric Heat Pump
1,500 to 5,000 sf homes (6.0 credits)

<table>
<thead>
<tr>
<th>Opt</th>
<th>Description – Nov. 1, 2020</th>
<th>Pts</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.2 (a)</td>
<td>HSPF 9.5 centrally ducted heat pump</td>
<td>1.0</td>
</tr>
<tr>
<td>4.2</td>
<td>All ducts and furnace inside the conditioned space</td>
<td>1.0</td>
</tr>
<tr>
<td>2.1</td>
<td>3 ACH$_{50}$, Energy Star 0.3 cfm/sf</td>
<td>0.5</td>
</tr>
<tr>
<td>1.3</td>
<td>R-38 floors (R10 under slab) and U-0.28 windows and door average</td>
<td>0.5</td>
</tr>
<tr>
<td>5.5</td>
<td>Heat pump water heater NEEA Tier III</td>
<td>2.0</td>
</tr>
<tr>
<td>Heat HP</td>
<td>Fuel equalization heat pump credit</td>
<td>1.0</td>
</tr>
</tbody>
</table>

**Total** 6.0
# Heat Pump & Gas DHW

1,500 to 5,000 sf homes (6.0 credits)

<table>
<thead>
<tr>
<th>Opt</th>
<th>Description – Nov. 1, 2020</th>
<th>Pts</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.5a</td>
<td>11.0 HSPF centrally ducted heat pump</td>
<td>1.5</td>
</tr>
<tr>
<td>4.2</td>
<td>All ducts and furnace inside conditioned space</td>
<td>1.0</td>
</tr>
<tr>
<td>2.1</td>
<td>$3 \text{ ACH}_{50}$, Energy Star 0.3 cfm/sf</td>
<td>0.5</td>
</tr>
<tr>
<td>1.4</td>
<td>U-0.25 windows, R38 crawl/R10 under slab, R21 with R4 CI on exterior walls</td>
<td>1.0</td>
</tr>
<tr>
<td>5b</td>
<td>Gas water heater $\geq 0.91$ UEF</td>
<td>1.0</td>
</tr>
<tr>
<td><strong>Heat HP</strong></td>
<td>Fuel equalization heat pump credit</td>
<td>1.0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>6.0</strong></td>
<td></td>
</tr>
</tbody>
</table>
## Gas Heat + HPWH

1,500 to 5,000 sf homes (6.0 credits)

<table>
<thead>
<tr>
<th>Opt</th>
<th>Description – Nov. 1, 2020</th>
<th>Pts</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1a</td>
<td>95% AFUE gas furnace</td>
<td>1.0</td>
</tr>
<tr>
<td>4.2</td>
<td>All ducts and furnace inside conditioned space</td>
<td>1.0</td>
</tr>
<tr>
<td>2.1</td>
<td>3 ACH(_{50}), Energy Star 0.3 cfm/sf</td>
<td>0.5</td>
</tr>
<tr>
<td>1.4</td>
<td>U-0.25 windows, R38 crawl/R10 under slab, R21 with R4 CI exterior walls</td>
<td>1.0</td>
</tr>
<tr>
<td>7.1</td>
<td>Appliance Credit: Energy Star dishwasher, washer, refrigerator (if provided) and vent-less dryer (CEF 5.2)</td>
<td>0.5</td>
</tr>
<tr>
<td>5b</td>
<td>Heat pump water heater NEEA Tier III</td>
<td>2.0</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>6.0</strong></td>
</tr>
</tbody>
</table>
# DHP + Electric Heat

Multifamily - Low-rise R2

<table>
<thead>
<tr>
<th>Opt</th>
<th>Description – Nov. 1, 2020</th>
<th>Pts</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.4</td>
<td>DHP with electric resistance</td>
<td>2.0</td>
</tr>
<tr>
<td>1.2</td>
<td>Triple pane window U=0.22</td>
<td>1.0</td>
</tr>
<tr>
<td>2.1</td>
<td>0.25 cfm50/sf unit sf (or 2 ACH&lt;sub&gt;50&lt;/sub&gt;) + 65% HRV/ERV – tested!!!</td>
<td>1.5</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>4.5</strong></td>
</tr>
</tbody>
</table>
## HSPF 10 VRF-HP
### Multifamily - low-rise R2

<table>
<thead>
<tr>
<th>Opt</th>
<th>Description – Nov. 1, 2020</th>
<th>Pts</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Fuel equalization – HP</td>
<td>1.0</td>
</tr>
<tr>
<td>3.6</td>
<td>All HSPF 10 (ducted cassette)</td>
<td>3.0</td>
</tr>
<tr>
<td>2.2</td>
<td>0.25 cfm50/sf unit sf (or 2 ACH\textsubscript{50}) + 65% HRV/ERV – tested!!!</td>
<td>1.5</td>
</tr>
</tbody>
</table>

**Total** 5.5
• Total UA Alternative is typically used when prescriptive path assembly is not a viable option.

• Default U-factors - typical assemblies are in Appendix A.

• Unlike the prescriptive path, which allows unlimited fenestration (e.g., windows), the UA Alternative and the simulated performance path use 15% in the target home.
UA Alternative Example
Building Envelope Trade-Off

<table>
<thead>
<tr>
<th>Component</th>
<th>Code Target Values</th>
<th>Proposed Design</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Area</td>
<td>UA</td>
</tr>
<tr>
<td>Doors U = 0.300</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Overhead Glazing U = 0.500</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Vertical Glazing U = 0.300</td>
<td>345</td>
<td>104</td>
</tr>
<tr>
<td>Flat/Vaulted Ceilings U = 0.026</td>
<td>1,628</td>
<td>42</td>
</tr>
<tr>
<td>Wall (above grade) U = 0.056</td>
<td>1,815</td>
<td>102</td>
</tr>
<tr>
<td>Floors U = 0.029</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Slab on Grade F = 0.540</td>
<td>222</td>
<td>120</td>
</tr>
<tr>
<td>Below Grade Wall U = 0.042</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Below Grade Slab F = 0.570</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Target UA Total: 367

Target Credits from Table 406.2: 3.5

Proposed UA Total: 398

Proposed Credits from Table 406.2: 3.0
R405 –
Simulated Performance Alternative

R405.1 Scope. This section establishes criteria for compliance using simulated energy performance analysis. Such analysis shall include heating, cooling, mechanical ventilation and service water heating energy only.

- 15% target home also used for standard reference home, just like UA tradeoff compliance. This makes it harder to comply when building over 15%.
- WSU is not aware of software that currently meets the requirements of Table 405.5.2(1).
- We may see this for Energy Raters working with builders who desire IRS tax credits in 2020.
R401.3 Certificate

• A permanent certificate shall be completed by the builder or other approved party
• Post on a wall in the space where the furnace is located, utility room or an approved location inside
• The certificate shall list the R-values of insulation: ceiling/roof, walls, foundation (slab, below-grade wall, and/or floor), and ducts outside conditioned spaces
• U-factors for fenestration (see glazing worksheet)
R401.3 Certificate (cont.)

• Types and efficiencies:
  – HVAC
  – DHW service water heating
  – Appliances
  – Renewables

• Test results & documentation:
  – Ductwork air leakage by certified tester (per RS-33)
  – Envelope air leakage
  – Ventilation flow rate testing & commissioning
Code official may require that test documentation include an electronic record of the time, date and location of the test, using a date-stamped smart phone photo or air leakage testing software.
### R401.3 Certificate (new HVAC tests)

<table>
<thead>
<tr>
<th><strong>HVAC System “duct” Leakage Testing</strong> <em>(R403.3.3)</em></th>
</tr>
</thead>
<tbody>
<tr>
<td>All ductwork &amp; Air Handler in conditioned space: Y or N (circle one)</td>
</tr>
<tr>
<td>All ductwork &amp; Air Handler outside conditioned space insulated to minimum R8? Y or N (circle one)</td>
</tr>
<tr>
<td>Air Handler Present at duct leakage test? Y or N (circle one)</td>
</tr>
<tr>
<td>HVAC System Leakage Test Calculated Design Target: __________ cfm @ 25PA</td>
</tr>
<tr>
<td>HVAC System Leakage Test Measured Results: __________ cfm @ 25PA</td>
</tr>
<tr>
<td>Do HVAC Leakage Tests include GPS &amp; Time Stamp Verification? Y or N (circle)</td>
</tr>
</tbody>
</table>

### Building Leakage Testing *(R402.4.1.2)*

| Building Leakage Test Calculated Design Target: __________ cfm @ 50PA |
| Building Leakage Test Measured: __________ cfm @ 50PA |
| Do Building Leakage Tests include GPS & Time Stamp Verification? Y or N (circle) |

### Whole House Ventilation System Measured Flow Rates *(M1505.4 IRC-WA)*

The Whole House Ventilation (WHV) system operation and maintenance (O&M) instructions were provided to the building owner? Y or N (circle one)

Provided to: __________________________ on ______________________ (date)

Are the system controls correctly labelled? Y or N (circle one)

WHV System Type: (circle one)

1. Whole House Exhaust Fan Operating Continuous
2. Whole House Exhaust Fan Operating Intermittently
   - Specify run-time: ________ hours/day
3. Balance Heat Recovery Ventilator Operating Continuous
4. Balance Heat Recovery Ventilator Operating Intermittently
   - Specify run-time: ________ hours/day
5. Supply or HRV WHV integral to the air handler. Describe system control sequence of operations: __________________________

WHV Calculated Design Minimum Flow Rate: __________ cfm
WHV Measured Minimum Flow Rate: __________ cfm
WHV Measured High Speed Flow Rate: __________ cfm

Do Measured Flow Rate Test Results include GPS & Time Stamp Verification? Y or N (circle one)
Testing Affidavits & Resources

Duct Testing (new & existing)

Duct Leakage Affidavit (New Construction)

Duct Testing Calculator (New Construction)

Duct Testing Calculator (Blower Door Test)

Glossary

Rough-In: After installation of the complete air distribution system but before installation of insulation and sheath rock. Allows for access to all duct seams and connections for re-evaluation of seal integrity if standard is not met in initial test.

Post Construction: At or near final inspection. The home must be complete enough to pressurize the home to 25 pa.

Total Leakage: Aggregation of the entire system's duct leakage in a duct test.

Leakage to Exterior: Aggregation of all duct system leaks to the exterior of the CFA in a duct test.

Pascal (pa): Unit of pressure

CFA: Conditioned Floor Area in square feet

CFM: Cubic feet per minute of air leakage at 25 and 50 pascals of pressure

Conditioned Volume: Volume of conditioned space (CFA x ceiling height)

ACH: Air changes per hour at 50 pascals of pressure
Why Do We Seal Ducts?

• Health & safety
• Comfort
• Energy savings
• Building durability
Duct Testing Standards

- Total leakage ≤ 4 cfm per 100 sf of conditioned floor area @ 25 Pa for a complete system at rough-in
- Total leakage ≤ 3 cfm per 100 sf of conditioned floor area @ 25 Pa if air handler has not been installed
- Total leakage test: ≤ 4 cfm per 100 sf of conditioned floor area @ 25 Pa at post construction
- Leakage to exterior test: ≤ 4 cfm per 100 sf of conditioned floor area @ 25 Pa - duct tester & blower door used together to eliminate leakage of ducts “inside” at post construction
Duct Sealants

All joints, seams and connections shall be fastened and sealed

- See IMC 603.9 or IRC M1601.3 for details
- Closure systems must be installed according to the manufacturer’s listing
- Unlisted duct tape is not permitted as a sealant on any metal ducts
Necessary Equipment

• Duct tester
• Manometer
• Register blocks or “mask”
Duct Testing (R403.3.3)

- Duct testing not required when ducts & air handlers are located entirely within the building’s thermal envelope
- A maximum of 10 linear feet of return ducts and 5 linear feet of supply ducts may be located outside
- Buried ducts shall be tested to 3% of conditioned floor area (new for 2018)
R403.3.6 “Buried” Ducts

**R403.3.6 Ducts buried within ceiling insulation.** Where supply and return air ducts are partially or completely buried in ceiling insulation, such ducts shall comply with all of the following:

1. The supply and return ducts shall have an insulation R-value not less than R-8.
2. At all points along each duct, the sum of the ceiling insulation R-value against and above the top of the duct, and against and below the bottom of the duct, shall be not less than R-19, excluding the R-value of the duct insulation.

**Exception:** Sections of the supply duct that are less than 3 feet (914 mm) from the supply outlet shall not be required to comply with these requirements.

**R403.3.6.1 Effective R-value of deeply buried ducts.** Where using a simulated energy performance analysis, sections of ducts that are: installed in accordance with Section R403.3.6; located directly on, or within 5.5 inches (140 mm) of the ceiling; surrounded with blown-in attic insulation having an R-value of R-30 or greater and located such that the top of the duct is not less than 3.5 inches (89 mm) below the top of the insulation, shall be considered as having an effective duct insulation R-value of R-25.

HVAC in the Conditioned Space “Change”

• Moves HVAC into conditioned space & NOT crawlspace, garage or attic

• By far the most cost-effective measure and largely avoided until 2020

• Requires design planning between builder, HVAC sub and floor plan designer

• Don’t drive an expensive box “on flat tires.” Just do it!
R403.3.7 Locating Ducts in Conditioned Space

R403.3.7 Ducts located in conditioned space. For ducts to be considered as inside a conditioned space, such ducts shall comply with either of the following:

1. All duct systems shall be located completely within the continuous air barrier and within the building thermal envelope.

2. All heating, cooling and ventilation system components shall be installed inside the conditioned space including, but not limited to, forced air ducts, hydronic piping, hydronic floor heating loops, convectors and radiators. Combustion equipment shall be direct vent or sealed combustion.

3. For forced air ducts, a maximum of 10 linear feet of return ducts and 5 linear feet of supply ducts is permitted to be located outside the conditioned space, provided they are insulated to a minimum of R-8.
   3.1. Metallic ducts located outside the conditioned space must have both transverse and longitudinal joints sealed with mastic.
   3.2. If flex ducts are used, they cannot contain splices. Flex duct connections must be made with nylon straps and installed using a plastic strapping tensioning tool.
Why HVAC in the Conditioned Space

HVAC in conditioned space, NOT crawlspace, garage or attic

- Fewer, smaller “right-sized” ducts & S/R registers
- Install conducive to good installation & QA
- Fewer comfort issues from cold air blasts
- Download and review article from Energy Program web page

Moving Ducts Inside: Big Builders, Scientists Find Common Ground

Michael Lubliner, Washington State University Extension Energy Program
Ryan Kerr, ConSol/BIRA
Andy Gordon, Washington State University Extension Energy Program
Chuck Murray, Washington State Dept. of Community Trade and Economic Development

"Hot Topic" Archives
How to Move Ducts Inside -
Just do it, or spend more $
HVAC Inside Ideas – Habitat for Humanity

Figure 1. Habitat for Humanity, Moses Lake - Duct Chase Pre- and Post-Drywall
HVAC Inside Ideas - Quadrant

Figure 6. Quadrant Homes – 2nd Floor Mechanical Room, Code (Left), Energy Star/Tax Credit (Right)

Source: Quadrant Homes
HVAC Inside Ideas – New Tradition Homes

Figure 3. New Tradition Homes – Ducts Between Floors, Pre- and Post-Drywall

Figure 5. New Tradition Homes – Air Handler in Conditioned Space, under Stairwell
Air Barriers and Energy Code R402.4

What does the Energy Code require?

• Prescriptive air sealing
• Testing of the air barrier
• Maximum leakage targets
  o 2015 WSEC maximum = 5 $\text{ACH}_{50}$ New/Additions
  o 2018 may need 0.5 credit for 3 $\text{ACH}_{50}$
  o 2018 may want 2.0 $\text{ACH}_{50}$ w/HRV or ERV 2020 for 1.5 - 2.0 credits
Table R402.4.1.1
Air Barrier and Thermal Barrier

✓ Building envelope must have continuous air barrier
✓ Breaks or joints are sealed
✓ Air-permeable insulation is not an air barrier
QA Tools for New Construction

Maximum Leakage = 5 ACH_{50}

AR SEaling
Seal air leaks and save energy!

WHAT IS AIR LEAKAGE?
Ventilation is fresh air that enters a house in a controlled manner to exhaust excess moisture and reduce odors and odors. Air leakage, on the other hand, is outside air that enters a house uncontrollably through cracks and openings. It is nearly impossible to keep an air leakage at zero ventilation. During cold or windy weather, too much air may enter the house and, during warm or calm weather, too little. A leaky house that allows mold, dusty crawlspaces or attic air to enter is not healthy.

The recommended strategy in both new and old homes is to reduce air leakage as much as possible to provide controlled ventilation as needed. For single house structures, effective ventilation, such as kitchen and bath fans that exhaust to the outside, may be adequate. For more complex houses or zones in colder climates, whole-home ventilation systems may be appropriate. Such systems may incorporate heat recovery, moisture control, or air filtering.

WHAT ARE THE BENEFITS OF AIR SEALING?
Air infiltration can account for 30 percent or more of a home’s heating and cooling costs and cause leaks to problems with moisture, dust, and the entry of pollutants, insects, and odors. Reducing infiltration can significantly cut annual heating and cooling costs, improve building durability, and create a healthier indoor environment. The size of heating and cooling equipment can also be decreased, which saves additional dollars. Reducing air leakage in new homes, as required by the IWS Model Energy Code (see page 1) typically costs less than $200 for the average home and does not require specialized labor.

WALLS

Seal cracks, gaps, and seams in walls and floor/ceiling assemblies.

DOORS

Seal cracks, gaps, and seams in doors.

FENESTRA TION

Seal cracks, gaps, and seams in windows.

LEAKY ATTIC OR ROOF

Seal cracks, gaps, and seams in the attic or roof.

ROOF TRAYS

Seal cracks, gaps, and seams in the roof trays.

KITCHEN

Seal cracks, gaps, and seams in the kitchen.

BATH

Seal cracks, gaps, and seams in the bathroom.
Sealing HVAC system ducts is a cost-effective energy efficiency action that also improves indoor air quality. Building professionals and homeowners will learn how ducts move air, where common leaks are, and how to fix leaks.
Air Leakage in Homes: The Invisible Thief

http://www.energy.wsu.edu/videos/air-leakage-in-homes_part-01/

(presented in 7 chapters)
Fresh Air for a Healthier Home
The consumer’s guide to ventilation systems
Part 1: Why Ventilate?
R402.4.2.1 Gas Fireplace Efficiency
50% FE for Heaters (new)

R402.4.2.1 Gas fireplace efficiency. All gas fireplace heaters rated to ANSI Z21.88 shall be listed and labeled with a fireplace efficiency (FE) rating of 50 percent or greater in accordance with CSA P.4.1. Vented gas fireplaces (decorative appliances) certified to ANSI Z21.50 shall be listed and labeled, including their FE ratings, in accordance with CSA P.4.1.
R403.7.1 Electric Resistance Zone Heated Units – since 2015

All detached one- and two-family dwellings and multiple single-family dwellings (townhouses) up to three stories in height above grade plane using electric zonal heating as the primary heat source shall install an inverter-driven ductless mini-split heat pump in the largest zone in the dwelling.*

* Does not apply to R-2 construction

1.5 - 2.0 credits allowed from options package 3.6 for single family and multifamily, respectively (increase credits from 2015)
Join our email update list at energycode@energy.wsu.edu

Send questions, comments and suggestions to:

Michael Lubliner
360-956-2042
energycode@energy.wsu.edu

Thank You!