2018 WSEC–R
Updates & Discussions

Michael Lubliner, Senior Building Science Specialist
WSU Energy Program
May 14, 2021
10:00 a.m. to noon (Pacific)

We gratefully acknowledge our funder,
WSEC–R Agenda – 2 hours

Today’s Theme: Challenges & Opportunities (CHOP)

• WSU Energy Program Services & Training Partners
• 2018 WSEC-R Code Change Overview
• 2018 WSEC-R Point Package Scenarios
• 2018 WSEC-R Compliance Tools
• 2018 WSEC-R Interpretations
• Duct Sealing & Testing
• 2018 WSEC-R Benefits
• Follow-up Q&A
• Additional Trainings & Resources

Email us with any questions not covered today: energycode@energy.wsu.edu
WSU Energy Program Services
WSU Energy Program
Code Support Services

Technical support we provide in Washington:

• Training (in-person, webinars, videos)
• Phone and email inquiry hotline support
• Energy code compliance tool development
• WSU website with educational resources: energy.wsu.edu/BuildingEfficiency/EnergyCode.aspx
• Building department site visits
WSUEP Assistance to AHJ & WABO (CYA)

Our WSEC-Residential technical support team is not an affiliate of, nor do we speak for, the Washington State Building Code Council (SBCC). Official opinions of WSEC intent are made only by the SBCC in response to official inquiries submitted to the SBCC by authorities having jurisdiction. While we try to stay aligned with the SBCC, the technical support we provide is advisory only and non-binding on authorities having jurisdiction, builders, designers, and the building trades personnel involved with construction and remodeling of residential structures.
Introduction – 40 years of Building Science “BS”

Nationally recognized for research, development and market transformation:
- Single family homes
- Multifamily homes
- Site built homes
- Manufactured homes (U.S. Dept. of Housing & Urban Development and modular)
- Affordable housing (public housing agency, Habitat for Humanity, etc.)
- HVAC systems
- Energy efficiency
- Indoor air quality

• USDOE Building America & USEPA ENERGY STAR homes
• Super Good Cents Pacific Northwest utility program
• 35-year ASHRAE member (Standards: 62.2, 90.2)
Introduction – 40 years of Building Science “BS” (cont.)

• Member of:
  – ACCA Manual S Committee (sizing)
  – WA Labor & Industries Factory Assembled Structures Advisory Board
  – HUD’s Manufactured Housing Consensus Committee

• Voting member of the Residential Energy Service Network (RESNET)

• Five-time Energy Value Housing Awards Judge for National Association of Home Builders
Energy Code Support in Washington

Residential
WSU Energy Program
360-956-2042
ergycode@energy.wsu.edu
www.energy.wsu.edu/code
Mike Lubliner, Melinda Spencer, Carolyn Roos

Non-residential
Evergreen Technology Consulting
360-539-5202
com.techsupport@waenergycodes.com
http://waenergycodes.com
Lisa Rosenow

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Code Progression in Washington
Design & Construction of High-Performing Energy-Efficient Homes
Design & Construction of High-Performing Energy-Efficient Homes
WSU Energy Program Training Partners
Energy Raters & Certification Programs

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2018 WSEC–R
Code Change Overview
Overview – WSEC-R Changes

Single Family:
R406 additional energy efficiency requirements
- New credit requirements
- Fuel normalization credit

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 R503 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 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 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 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.
## Fuel Normalization Credits

<table>
<thead>
<tr>
<th>System Type</th>
<th>Description of Primary Heating Source</th>
<th>Credits All Other</th>
<th>Credits Group R-2</th>
</tr>
</thead>
<tbody>
<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>
<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>
<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>
<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>
<td>N/A</td>
</tr>
<tr>
<td>5</td>
<td>All other heating systems</td>
<td>-1</td>
<td>-0.5</td>
</tr>
</tbody>
</table>
Fuel Normalization Credit – Challenge

Solar Electricity

89% Price Drop

Wind Electricity

70% Price Drop
## Energy Credits

### TABLE 406.3 ENERGY CREDITS

<table>
<thead>
<tr>
<th>OPTION</th>
<th>DESCRIPTION</th>
<th>CREDIT(S)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>All Other</td>
</tr>
</tbody>
</table>

### 1. EFFICIENT BUILDING ENVELOPE OPTIONS

Only one option from Items 1.1 through 1.3 may be selected in this category.

**Compliance with the conductive UA targets is demonstrated using Section R402.1.4. Total UA alternative, where [1 - (Proposed UA/Target UA)] represents the required %UA reduction.**

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
<th>Credit(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1</td>
<td>Prescriptive compliance is based on Table R402.1.1 with the following modifications:</td>
<td>0.5</td>
</tr>
<tr>
<td></td>
<td>Vertical fenestration U = 0.24.</td>
<td></td>
</tr>
<tr>
<td>1.2</td>
<td>Prescriptive compliance is based on Table R402.1.1 with the following modifications:</td>
<td>1.0</td>
</tr>
<tr>
<td></td>
<td>Vertical fenestration U = 0.20.</td>
<td></td>
</tr>
<tr>
<td>1.3</td>
<td>Prescriptive compliance is based on Table R402.1.1 with the following modifications:</td>
<td>0.5</td>
</tr>
<tr>
<td></td>
<td>Vertical fenestration U = 0.26.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Roof R-38</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Slab on grade R-10 perimeter and under entire slab</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Below grade slab R-10 perimeter and under entire slab</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Compliance based on Section R402.1.4: Reduce the Total conductive UA by 5%.</td>
<td></td>
</tr>
<tr>
<td>1.4</td>
<td>Prescriptive compliance is based on Table R402.1.1 with the following modifications:</td>
<td>1.0</td>
</tr>
<tr>
<td></td>
<td>Vertical fenestration U = 0.26.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Wall R-21 plus R-4 ci</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Floor R-38</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Basement wall R-21 int plus R-5 ci</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Slab on grade R-10 perimeter and under entire slab</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Below grade slab R-10 perimeter and under entire slab</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Compliance based on Section R402.1.4: Reduce the Total conductive UA by 15%.</td>
<td></td>
</tr>
<tr>
<td>1.5</td>
<td>Prescriptive compliance is based on Table R402.1.1 with the following modifications:</td>
<td>2.0</td>
</tr>
<tr>
<td></td>
<td>Vertical fenestration U = 0.22.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ceiling and single-rafter or post-vaulted R-49 advanced</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Wood frame wall R-21 int plus R-12 ci</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Floor R-38</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Basement wall R-21 int plus R-12 ci</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Slab on grade R-10 perimeter and under entire slab</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Below grade slab R-10 perimeter and under entire slab</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Compliance based on Section R402.1.4: Reduce the Total conductive UA by 30%.</td>
<td></td>
</tr>
</tbody>
</table>

### 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>Option</th>
<th>Description</th>
<th>Credit(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1</td>
<td>Compliance based on R402.4.1.2:</td>
<td>0.5</td>
</tr>
<tr>
<td></td>
<td>Reduce the tested air leakage to 3.0 air changes per hour maximum at 50 Pascals</td>
<td></td>
</tr>
<tr>
<td></td>
<td>For R-2 Occupancies, optional compliance based on Section R402.4.1.2:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Reduce the tested air leakage to 0.3 cfm/ft² maximum at 50 Pascals</td>
<td></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).</td>
<td></td>
</tr>
<tr>
<td></td>
<td>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>
<td></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>
<td></td>
</tr>
</tbody>
</table>
## Energy Credits

### TABLE 406.3 (continued)

<table>
<thead>
<tr>
<th>OPTION</th>
<th>DESCRIPTION</th>
<th>CREDIT(S)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.2</td>
<td>Compliance based on Section R402.4.1.2: Reduce the tested air leakage to 2.0 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 cfm³ ft maximum at 50 Pascals and All whole house ventilation requirements as determined by Section MI507.3 of the International Residential Code or Section 403.3 of the International Mechanical Code shall be met with a heat recovery ventilation system with minimum sensible heat recovery efficiency of 0.65. 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>1.0 1.5</td>
</tr>
<tr>
<td>2.3</td>
<td>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 cfm³ ft maximum at 50 Pascals and All whole house ventilation requirements as determined by Section MI507.3 of the International Residential Code or Section 403.3 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.</td>
<td>1.5 2.0</td>
</tr>
<tr>
<td>2.4</td>
<td>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 cfm³ ft maximum at 50 Pascals and All whole house ventilation requirements as determined by Section MI507.3 of the International Residential Code or Section 403.3 of the International Mechanical Code shall be met with a heat recovery ventilation system with minimum sensible heat recovery efficiency of 0.90. 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 2.5</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>OPTION</th>
<th>DESCRIPTION</th>
<th>CREDIT(S)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1²</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%. 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.</td>
<td>1.0 1.0</td>
</tr>
<tr>
<td>3.2²</td>
<td>Air-source centrally ducted heat pump with minimum HSPF of 9.5. 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.</td>
<td>1.0 N/A</td>
</tr>
<tr>
<td>3.3²</td>
<td>Closed-loop ground source heat pump with a minimum COP of 3.3 or Covered loop water source heat pump with a maximum heating hydraulic head of 150 feet and minimum COP of 3.6. 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.</td>
<td>1.5 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. 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.</td>
<td>1.5 2.0</td>
</tr>
<tr>
<td>3.5²</td>
<td>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.</td>
<td>1.5 N/A</td>
</tr>
<tr>
<td>3.6²</td>
<td>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 and shall specify the heating equipment type(s), the minimum equipment efficiency, and total installed heat capacity (by equipment type).</td>
<td>2.0 3.0</td>
</tr>
</tbody>
</table>
## Energy Credits

### TABLE 406.3 (continued)

<table>
<thead>
<tr>
<th>OPTION</th>
<th>DESCRIPTION</th>
<th>CREDIT(S)</th>
<th>CREDIT(S)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>All Other</td>
<td>Group R-2</td>
</tr>
</tbody>
</table>

### 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 R403.3.7. 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 metal 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.

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.

Electric resistance heat and ductless heat pumps are not permitted under this option.

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.

### 5. EFFICIENT WATER HEATING OPTIONS

Only one option from Items 5.2 through 5.6 may be selected in this category. Item 5.4 may be combined with any other option.

5.1 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 50% if installed for unequal flow. Such unit(s) shall be rated in accordance with CSA B55.1 or IAPMO IRC 349-2017 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.

5.2 Water heating system shall include one of the following:

Energy Star rated gas or propane water heater with a minimum UEF of 0.69.

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.

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 or Solar water heater supplementing a minimum standard water heater.

Solar water heating will provide a rated minimum savings of 85 therms or 2,000 kWh based on the Solar Rating and Certification Corporation (SRCC) Annual Performance of GS-300 Certified Solar Water Heating System or 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.

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 or 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.

5.5 Water heating system shall include one of the following:

Electric heat pump water heater meeting the standards for Tier II of NEEA's advanced water heating specification or For R-2 Occupancy, electric heat pump water heater(s), meeting the standards for Tier II 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.
### Energy Credits

#### 6. RENEWABLE ELECTRIC ENERGY OPTION

**6.1** For each 1.200 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 "P/WATTS" or approved alternately 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:
  - 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.

#### 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:
- 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 0.2

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 vent caps are not permitted to be installed in the dwelling unit.

*An alternative heating source sized at a maximum of 0.5 Watts/sq ft (equivalent) of heated floor area or 500 Watts, whichever is bigger, may be installed in this dwelling unit.*
## Energy Credits Summary

<table>
<thead>
<tr>
<th>Category</th>
<th>Credit range SF</th>
<th>Credit range MF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Efficient building envelope</td>
<td>0.5 – 3.0</td>
<td>0.5 – 2.0</td>
</tr>
<tr>
<td>Air leakage control &amp; efficient ventilation</td>
<td>0.5 – 2.0</td>
<td>1.0 – 2.5</td>
</tr>
<tr>
<td>High efficiency HVAC equipment</td>
<td>1.0 – 2.0</td>
<td>1.0 – 3.0</td>
</tr>
<tr>
<td>High efficiency HVAC distribution system</td>
<td>0.5 – 1.0</td>
<td>NA</td>
</tr>
<tr>
<td>Efficient water heating</td>
<td>0.5 – 2.5</td>
<td>0.5 – 3.0</td>
</tr>
<tr>
<td>Renewable electric energy</td>
<td>1.0 – 3.0</td>
<td>1.0 – 3.0</td>
</tr>
<tr>
<td>Appliance package</td>
<td>0.5</td>
<td>1.5</td>
</tr>
</tbody>
</table>

**Note:** For medium and large homes, likely need points from each of the first five categories to comply.
1. Efficient Envelope Options

• Only one option from Items 1.1 through 1.7 may be selected in this category.

• Compliance with the conductive total heat loss targets (represented as a UA) is demonstrated using Section R402.1.4, Total UA Alternative, where:

\[ 1 - \left( \frac{\text{Proposed UA}}{\text{Target UA}} \right) \] > the required % UA reduction
2. **Air Leakage Control & Efficient Ventilation Options**
   - Overall increase in tightness per option (descending air changes per hour (ACH) value, paired with overall increasing efficiency of ventilation (starting with ENERGY STAR fans going to heat recovery ventilators/energy recovery ventilators (HRV/ERVs)).

3. **High-Efficiency HVAC Equipment Options**
   - One gas furnace option, two air source heat pump (ASHP) levels, two ductless heat pump (DHP) levels, one ground source heat pump (GSHP) option.

4. **High-Efficiency HVAC Distribution System Options**
   - Both require equipment inside thermal boundary.
   - Deeply buried ducts still requires testing.
5. Efficient Water Heating Options
   • 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

6. Renewable Electric Energy Option
   • Up to 3 credits = 3kW photovoltaic power = 800-1,200 kWh/year/1kW power

7. Appliance Package Option
   • ENERGY STAR refrigerator, dishwasher & vent-less dryer
How will you do it?

### Efficient Building Envelope Options - Pick One

<table>
<thead>
<tr>
<th>Number</th>
<th>Description</th>
<th>SF Points</th>
<th>MF Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1</td>
<td>0.24 windows</td>
<td>0.5</td>
<td>0.5</td>
</tr>
<tr>
<td>1.2</td>
<td>0.20 windows</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>1.3</td>
<td>UA 5% reduction</td>
<td>0.5</td>
<td>NA</td>
</tr>
<tr>
<td>1.4</td>
<td>UA 15% reduction</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>1.5</td>
<td>UA 30% reduction</td>
<td>2.0</td>
<td>1.5</td>
</tr>
<tr>
<td>1.6</td>
<td>UA 40% reduction</td>
<td>3.0</td>
<td>2.0</td>
</tr>
<tr>
<td>1.7</td>
<td>0.28 + advanced framing</td>
<td>0.5</td>
<td>0.5</td>
</tr>
</tbody>
</table>
### Air Leakage Control & Efficient Ventilation Options

<table>
<thead>
<tr>
<th>Number</th>
<th>Description</th>
<th>SF Points</th>
<th>MF Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1</td>
<td>3 ACH + high-efficiency ventilation</td>
<td>0.5</td>
<td>1.0</td>
</tr>
<tr>
<td>2.2</td>
<td>2 ACH + heat recovery ventilation (HRV)</td>
<td>1.0</td>
<td>1.5</td>
</tr>
<tr>
<td>2.3</td>
<td>1.5 ACH + HRV medium efficiency</td>
<td>1.5</td>
<td>2.0</td>
</tr>
<tr>
<td>2.4</td>
<td>0.6 ACH + HRV high efficiency</td>
<td>2.0</td>
<td>2.5</td>
</tr>
</tbody>
</table>

Image source: https://airtightnesstesting.co.uk/about-us/
### How will you do it?

#### High Efficiency HVAC Equipment Options

<table>
<thead>
<tr>
<th>Number</th>
<th>Description</th>
<th>SF Points</th>
<th>MF Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Annual Fuel Utilization Efficiency (AFUE) 95% gas</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>3.2&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Heating seasonal performance factor (HSPF) 9.5 ASHP</td>
<td>1.0</td>
<td>N/A</td>
</tr>
<tr>
<td>3.3&lt;sup&gt;a&lt;/sup&gt;</td>
<td>GSHP 3.3/3.0 COP</td>
<td>1.5</td>
<td>1.0</td>
</tr>
<tr>
<td>3.4</td>
<td>HSPF 10 DHP</td>
<td>1.5</td>
<td>2.0</td>
</tr>
<tr>
<td>3.5&lt;sup&gt;a&lt;/sup&gt;</td>
<td>HSPF 11 ASHP</td>
<td>1.5</td>
<td>N/A</td>
</tr>
<tr>
<td>3.6&lt;sup&gt;a&lt;/sup&gt;</td>
<td>HSPF 10 DHP no ER</td>
<td>2.0</td>
<td>3.0</td>
</tr>
</tbody>
</table>

<sup>a</sup> = alt heat source maxed at 0.5 Watt/sf or 500 watts, whichever is larger
How will you do it?

High Efficiency HVAC Distribution System Options

<table>
<thead>
<tr>
<th>Number</th>
<th>Description</th>
<th>SF Points</th>
<th>MF Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.1&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Deeply buried ducts</td>
<td>0.5</td>
<td>0.5</td>
</tr>
<tr>
<td>4.2&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Ducts inside</td>
<td>1.0</td>
<td>N/A</td>
</tr>
</tbody>
</table>

<sup>a</sup> = Duct leakage must be reduced to 3 cfm/100 sf  
<sup>b</sup> = Cannot claim with DHP  

Image source: https://www.insulation4less.com
### Efficient Water Heating Options

<table>
<thead>
<tr>
<th>Number</th>
<th>Description</th>
<th>SF Points</th>
<th>MF Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.1(^a)</td>
<td>DWHR 40% eff</td>
<td>0.5</td>
<td>0.5</td>
</tr>
<tr>
<td>5.2(^b)</td>
<td>UEF 0.80 gas</td>
<td>0.5</td>
<td>0.5</td>
</tr>
<tr>
<td>5.3(^b)</td>
<td>UEF 0.91 gas (^c)</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>5.4</td>
<td>Tier I HPWH</td>
<td>1.5</td>
<td>2.0</td>
</tr>
<tr>
<td>5.5</td>
<td>Tier III HPWH</td>
<td>2.0</td>
<td>2.5</td>
</tr>
<tr>
<td>5.6</td>
<td>Split HPWH</td>
<td>2.5</td>
<td>3.0</td>
</tr>
</tbody>
</table>

\(^a\) = can be combined with other water heating options  
\(^b\) = must be ENERGY STAR rated  
\(^c\) = or solar water heater or ground source water heater

Image source: https://www.mitsubishicomfort.com/Heating
How will you do it?

Renewable Electric Energy Option

<table>
<thead>
<tr>
<th>Number</th>
<th>Description</th>
<th>SF Points</th>
<th>MF Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.1</td>
<td>1,200 kWh solar PV</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td></td>
<td>2,400 kWh solar PV</td>
<td>2.0</td>
<td>2.0</td>
</tr>
<tr>
<td></td>
<td>3,600 kWh solar PV</td>
<td>3.0</td>
<td>3.0</td>
</tr>
</tbody>
</table>
How will you do it?

## Appliance Package Option

<table>
<thead>
<tr>
<th>Number</th>
<th>Must include</th>
<th>SF Points</th>
<th>MF Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.1</td>
<td>Dishwasher</td>
<td>0.5</td>
<td>0.5</td>
</tr>
<tr>
<td></td>
<td>Refrigerator (^a)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Washing machine</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Dryer – CEF 5.2</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\(^a\) = only if provided  
All equipment must be ENERGY STAR rated  
Dryer must be ventless model
2018 WSEC–R
Point Package Scenarios
## Single Family – Scenario 1: Electric space heat, electric water heat

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.3</td>
<td>UA 5% reduction or R-38 floor (R-10 slab) and U 0.28 window average</td>
<td>0.5</td>
</tr>
<tr>
<td>2.1</td>
<td>3.0 ACH$_{50}$ (0.3 cfm/sf for MF) + ENERGY STAR – 0.35 watt/cfm exhaust</td>
<td>0.5</td>
</tr>
<tr>
<td>3.2$^a$</td>
<td>Central ASHP at 9.5 HSPF</td>
<td>1.0</td>
</tr>
<tr>
<td>4.2</td>
<td>HVAC equipment and ductwork inside thermal envelope (does not apply to DHP)</td>
<td>1.0</td>
</tr>
<tr>
<td>5.5</td>
<td>NEEA Tier III HPWH</td>
<td>2.0</td>
</tr>
<tr>
<td>Fuel Norm</td>
<td>Heat pump credit</td>
<td>1.0</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>6.0</strong></td>
</tr>
</tbody>
</table>

$^a$ = An alternative heating source sized at a maximum of 0.5 Watts/sf (equivalent) of heated floor area or 500 Watts, whichever is bigger, may be installed in the dwelling unit.
Single Family – Scenarios 1 & 2: Electric space heat, electric water heat

1 credit + 1 credit (fuel norm.)

0.5 credit

1 credit

0.5 credit

2 credits
## Single Family – Scenario 2: Electric space heat, electric water heat

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.3</td>
<td>UA 5% reduction or R-38 floor (R-10 slab) and U 0.28 window average</td>
<td>0.5</td>
</tr>
<tr>
<td>2.1</td>
<td>3.0 ACH\textsubscript{50} (0.3 cfm/sf for MF) + \textit{ENERGY STAR} – 0.35 Watt/cfm exhaust</td>
<td>0.5</td>
</tr>
<tr>
<td>3.2\textsuperscript{a}</td>
<td>Central ASHP at 9.5 HSPF</td>
<td>1.0</td>
</tr>
<tr>
<td>4.1</td>
<td>HVAC equipment inside and ductwork deeply buried (does not apply to DHP)</td>
<td>0.5</td>
</tr>
<tr>
<td>5.1</td>
<td>Drain water heat recovery unit</td>
<td>0.5</td>
</tr>
<tr>
<td>5.5</td>
<td>NEEA Tier III HPWH</td>
<td>2.0</td>
</tr>
<tr>
<td>Fuel Norm</td>
<td>Heat pump credit</td>
<td>1.0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>6.0</strong></td>
</tr>
</tbody>
</table>

\textsuperscript{a} An alternative heating source sized at a maximum of 0.5 Watts/sf (equivalent) of heated floor area or 500 Watts, whichever is bigger, may be installed in the dwelling unit.
Single Family – Scenarios 1 & 2: Electric space heat, electric water heat

1 credit + 1 credit (fuel norm.)

0.5 credit

0.5 credit

0.5 credit

2 credits
Single Family – Scenarios 1 & 2: Electric space heat, electric water heat

Challenges
• HVAC equipment inside thermal envelope for either package
• Builders not accustomed to DWHR units
• Fear that ASHPs will not deliver useful heat in winter

Opportunities
• Option 2 likely lowest cost electric option
• Option 1 likely lowest consumer utility bills
**Single Family – Scenario 3: Electric space heat, gas water heat**

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.4</td>
<td>UA 15% Reduction <strong>or</strong> R-38 floor (R-10 slab), R-4 continuous insulation, U-0.25 windows</td>
<td>1.0</td>
</tr>
<tr>
<td>2.1</td>
<td>$3.0 \text{ACH}_{50}$ (0.3 cfm/ft² for MF) + ENERGY STAR – 0.35 Watt/cfm exhaust</td>
<td>0.5</td>
</tr>
<tr>
<td>3.5&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Central ASHP at 11 HSPF</td>
<td>1.5</td>
</tr>
<tr>
<td>4.2</td>
<td>HVAC equipment and ductwork inside thermal envelope</td>
<td>1.0</td>
</tr>
<tr>
<td>5.3</td>
<td>ENERGY STAR gas/propane tankless UEF 0.91</td>
<td>1.0</td>
</tr>
<tr>
<td><strong>Fuel Norm</strong></td>
<td>Heat pump credit</td>
<td>1.0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>6.0</strong></td>
</tr>
</tbody>
</table>

<sup>a</sup> An alternative heating source sized at a maximum of 0.5 Watts/sf (equivalent) of heated floor area or 500 Watts, whichever is bigger, may be installed in the dwelling unit.
Single Family – Scenario 3: Electric space heat, gas water heat

- 1.5 credit + 1 credit (fuel norm.)
- 1 credit
- 0.5 credit

1 credit
1 credit
1 credit
Single Family – Scenario 3: Electric space heat, gas water heat

Challenges
• HVAC equipment inside thermal envelope for either package
• Ducts inside can be a design and install challenge
• Fear that ASHPs will not deliver useful heat in winter

Opportunities
• Sales teams love tankless water heaters
  – No risk running out of hot water
  – More room in garage/utility closet
Single Family – Scenario 4: Gas space heat, electric water heat

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.4</td>
<td>UA 15% reduction or R-38 floor (R-10 slab), R-4 continuous insulation, U-0.25 windows</td>
<td>1.0</td>
</tr>
<tr>
<td>2.1</td>
<td>3.0 ACH50 (0.3 cfm/ft² for MF) + ENERGY STAR – 0.35 Watt/CFM exhaust</td>
<td>0.5</td>
</tr>
<tr>
<td>3.1</td>
<td>ENERGY STAR gas/propane furnace AFUE 95%</td>
<td>1.0</td>
</tr>
<tr>
<td>4.2</td>
<td>HVAC equipment and ductwork inside thermal envelope</td>
<td>1.0</td>
</tr>
<tr>
<td>5.1</td>
<td>Drain water heat recovery unit</td>
<td>0.5</td>
</tr>
<tr>
<td>5.5</td>
<td>NEEA Tier III HPWH</td>
<td>2.0</td>
</tr>
<tr>
<td>Fuel Norm</td>
<td>Heat pump credit</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>6.0</strong></td>
</tr>
</tbody>
</table>
Single Family – Scenario 4: Gas space heat, electric water heat

1 credit

1 credit

0.5 credit

2 credits
Challenges

- HVAC equipment inside thermal envelope for any package
- Ducts inside can be a design and install challenge
- Builders not accustomed to DWHR units

Opportunities

- Sales teams love gas furnaces
- Likely 2nd lowest overall first cost
# Multifamily Low-Rise R2 – Scenario 1: DHP + Electric Heat

<table>
<thead>
<tr>
<th>Opt</th>
<th>Description – Feb. 1, 2021</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\textsubscript{50}) + 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>
Multifamily Low–Rise R2 – Scenario 2: HSPF 10 VRF–HP

<table>
<thead>
<tr>
<th>Opt</th>
<th>Description – Feb. 1, 2021</th>
<th>Pts</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Fuel normalization – 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 cfm 50/sf unit sf (or 2 ACH(_{50})) + 65% HRV/ERV – tested!!!</td>
<td>1.5</td>
</tr>
</tbody>
</table>

**Total** 5.5
Multifamily Low–Rise R2 – Unit HVAC/DHW

Challenges to Opportunities:
- Selling ductless heat pump vs. PTAC/HP - $$$
- Selling electric resistance w/high-performance envelope? (TBD)
- Selling HRV/ERV and better indoor air quality
- New equipment design, install & commissioned
- “Build tight ventilation right” workforce skill sets
- Triple-pane - $$$$$
2018 WSEC–R Compliance Tools
Prescriptive Checklist for 2018 WSEC–R

- Chapter 51-11R WAC
- New checklist and other tools, links and useful information available on the WSU WSEC-R website: www.energycode.wsu.edu
Welcome to the WSU Code Compliance Calculator

This worksheet is designed to document the qualification of building designs by the (1) R402.1.1 prescriptive path, including the R406.3 UA percent trade off for Option 1 envelope measures, and (2) R402.1.4 Total UA Alternative (component performance). These are both based on the requirements of the 2015 and the 2018 editions of the Washington State Energy Code (WSEC). This tool can also calculate Efficient Building Envelope Options 1.3 – 1.6 for 2018 and Options 1a to 1c for 2015.

We appreciate your feedback! Send us your suggestions, comments and bug reports to the email above.

ENABLE MACROS: Macros must be enabled for this tool to function properly.
Office 365 Users: Save this file to your LOCAL drive.

Calculator tabs will open when macros are enabled.

If the tool does not open:

- Have you enabled editing? Have you enabled macros? Have you saved to your hard drive?
- See the text box “Excel Start Up Tips” to the right
- If you missed clicking "Enable Macros" just below the Excel ribbon, close this file and open again.

www.energy.wsu.edu/BuildingEfficiency/EnergyCode.aspx

How-to video: Using C3 to print PDF forms:
http://www.energy.wsu.edu/videos/wsec-using_c3_to_print_pdf_forms/
Demo of 2018 Prescriptive Path Worksheets

2015 Prescriptive Worksheet

2018 Prescriptive Worksheets (SF & MF)

www.energy.wsu.edu/BuildingEfficiency/EnergyCode.aspx

Demo of New WSEC–R Compliance Certificate

2015 Compliance Certificate

2018 Compliance Certificate & Instructions


www.energy.wsu.edu/BuildingEfficiency/EnergyCode.aspx
Recommended Practice: Ventilation Stickers

Lawrence Berkeley National Lab - Equipment Labels

Home Ventilating Institute (HVI) - Fresh Air Systems: Installer Guidance


https://www.hvi.org/resources/publications/fresh-air-system/installer-guidance/
Passive House Compliance

Need to know:

- During permitting, need to have list of compliance features
- Most likely also Pre-Cert letter or plan for certification
- Concern: Can you get a project cert before occupancy?
2018 WSEC–R Interpretations
STATE BUILDING CODE OPINION NO. 20-11

SECTION: Table R406.2, Fuel Normalization Credits

QUESTION 1: Does fuel normalization credit system type 2 apply for a PTAC HP that meets minimum federal standards?
ANSWER 1: No. PTAC units would be considered system type 5, Other, since they are not listed in the equipment efficiency tables [C403.3.2(1)C: C403.3.2(2)] cited by system type 2. To be considered system type 2, through the wall heat pumps would need to meet all requirements in the referenced tables C403.3.2(1)C and C403.3.2(2), including HSPF rating and listing per AHRI 210/240.

QUESTION 2: Does fuel normalization credit system type 2 apply to central ducted residential heat pumps that meet minimum federal standards when used with supplemental gas heating meeting the requirements of Section R403.1.2?
ANSWER 2: Yes, when installed per Section R403.1.2 with controls that prevent supplemental heater operation above 40°F. At final inspection the auxiliary heat lock out control shall be set to 35°F or less.

QUESTION 3: What fuel normalization credit is taken if the electric resistance heat does not exceed 2 kW per dwelling?
ANSWER 3: For single-family, duplex and townhouse dwellings, system type 4, as it references those systems meeting Section R403.7.1 including the exception for total installed electric resistance heating not exceeding 2 kW per dwelling, would apply. For R-2 dwellings, it would be system type 3.

SUPERSEDES: None
REQUESTED BY: Kitsap County
WSEC–R SBCC 20–11 Interpretations

- Gas furnace on HP is OK for HP fuel credits (type 2) IF the gas furnace back-up is locked out above 35° F, per R403.1.2 Supplemental Heat.
  - To field verify lockout, you need access to the thermostat settings set by the HVAC contractor.

- PTHP w/o HSPF test uses fuel type 4 (other).
  - AHJ to verify HSPF test provided with AHRI directory or equal.
  - IR thermal bridge and air leakage issues – FYI (Clark County experience).
Programmable T–Stats

- Primary space conditioning systems in each dwelling unit require a programmable thermostat
- Heat pumps with supplemental electric resistance heaters shall have strip heat lockout controls
  - Max. setting of 40° F
  - Set to 35° F or less at final inspection
STATE BUILDING CODE OPINION NO. 20-12

SECTION: Table R406.3, Energy Credits

QUESTION: Can the appliance credit 7.1 be taken for each residential multi-family unit if there is a central laundry facility in the building? If so, how would one determine compliance with CEF testing or equivalent energy efficiency metric to determine compliance with CEF testing?

ANSWER: No. All appliances must be installed in the dwelling unit to qualify for the credit. However, per Section R102, code officials may approve alternate means or design methods that are equivalent and meet the intent of the code. This could be applied to central laundry facilities with equivalent energy savings.

SUPERSEDES: None
REQUESTED BY: Kitsap County
AHJ may approve central laundry for Energy Credit 7, if equivalent saving to vent-less dryer (CEF 5.2) in each unit.

- WSUEP is working on this research to determine equivalency and solutions: central laundry ENERGY STAR washer?
  - Central laundry ENERGY STAR dryer equal to CEF 5.2?
  - Waste water heat recovery per energy credit 5.1
  - Balanced heat recovery with HRV using energy credit options 2 - Air Leakage and Efficient Ventilation: 2.2 (65%), 2.3 (75%), 2.4 (80%) sensible heat recovery efficiencies
WSEC–R SBCC #20–13 Interpretations

Washington State Building Code Council

Improving the built environment by promoting health, safety and welfare

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(360) 407-9277 • e-mail sbcc@des.wa.gov • www.sbcc.wa.gov

STATE BUILDING CODE OPINION NO. 20-13

SECTION: R402.4.1.2
Table R406.3, Energy Credits

QUESTION: Does the Authority Having Jurisdiction have the authority to allow sampling to determine compliance with envelope tightness of R-2 low rise multifamily?

ANSWER: The local jurisdiction is the enforcement authority. It is up to them to set their own policies and acceptance criteria.

SUPERSEDES: None
REQUESTED BY: Kitsap County
WSEC-R SBCC 20–13 Interpretations

- Corridor loaded: test whole building at once (ACH$_{50}$ PA)
- Non-corridor “garden”: test each unit separately (cfm/sf SA)
- R2 low-rise residential dwellings require testing of each unit or building
- Working with AABA certification training for air barrier installer and air barrier air leakage testing companies. We hope to have AABA training available in mid-2021 (TBD)
- It is up to the AHJ to decide if sampling is acceptable
- If they fail, what do they do? Need FAQ: “What do we do if we fail the blower door test?”
WSEC–R SBCC 20–13 Interpretations

• Root cause failure analysis and fix items identified before CO
• Root cause analysis and fix items identified on next unit/building
• Repair using Aero Barrier™ or other sealing systems to pass. Note: $0.75 to $1.75/sf is typical steady state range (prices decreasing in some regions)
• Look at systems engineering approach: CI and air barrier details, window operator types, minimum envelope penetrations, HRV in conditioned space, etc.
WSEC–R Gray Area – Option 4

- Can HVAC location credits 4.1 & 4.2 apply to central ducted or hydronic heating only. (Yes)
  Energy savings credit for non-centrally ducted HVAC is already assumed to be contributing to the credits 3.4 DHP in primary or 3.6 DHP (or equal) in each zone. (Intent of energy credits)

- Can HVAC location energy credits option 4.1 and 4.2 can be used with energy credit 3.1, 3.2, 3.3, 3.5. (Yes)
Gray Areas &/or Interpretations

• Definitions of "primary" for a space heating system when zonal electric. It is the largest load? (Yes?)

• Does energy credit Option 4 require that the HRV/ERV be located within conditioned space? (Yes?)

• Does a non-ducted or ducted cassette heat pump need to be located in conditioned space for energy credit Option 4? (Yes?)
Gray Areas &/or Interpretations

- Do energy credits apply to conditioned den, shop, garage, ADU? – Chapter 5 Simulation R405
  (WSUEP recommendation: check with AHJ)

- Is any software currently available that meets rulesets in R405? (WSUEP recommendation: check with AHJ)

- Can software that does not meet ruleset be used for Chapter 5 compliance? (WSUEP recommendation: check with AHJ)

- Waste Water Heat Recovery (WWHX):
  - Can only one primary shower be connected to get the energy credit? (WSUEP recommendation: TBD)
  - Can non-shower fixture drains (sink or toilet water) be connected to get the credit (WSUEP recommendation: YES)
Duct Sealing & Testing
WSU HVAC Air Leakage Training & Certification

- Required per RS-33
- See list of certified testers
- AHJs taking the test also!
- New 0.5 option for buried ducts
- Check out WSUEP's HVAC training webinars
- Links to TEC and RETROTEC for specific equipment training

www.energy.wsu.edu/EventsTrainings.aspx
Technical Assistance and Testing Resources

Duct Testers

This list of duct testers includes individuals who attended the one-day duct testing training offered by the WSU Energy Program or completed the online training, and meet the minimum requirements to test ducts for the WSEC.

Technicians who can verify that they have successfully completed duct testing training provided by the Northwest ENERGY STAR Program or Performance Tested Comfort Systems (PTCS) may also be qualified to test ducts under the WSEC.

Database of PTCS Technicians

PTCS Training

Home Energy Raters (HERS)

For information about Home Energy Raters, please see the Building Efficiency webpage.
Building with Ducts Inside Conditioned Spaces

- On-demand online (2 hrs)
- Explore 6 different strategies
  - Open web floor trusses
  - Insulated attic trusses
  - Conditioned attics
  - Inverted soffits
  - Dropped soffits
  - Conditioned basements
- Access resources (CAD drawings, case studies, trade guidelines, and more)

betterbuiltnw.com/events/online-training-ducts-inside
Now that you understand the testing approaches and requirements for WSEC-R, it is important to learn how to use the equipment and become proficient using it.

Spend 1-3 hours on these websites learning how to use the equipment:

- https://retrotec.com/training.html
- https://store.energyconservatory.com/training
Duct Testing Equipment

- Duct tester
- Manometer
- Register blocks or “mask”
Duct Leakage to the Exterior

Yields duct leakage CFM to the exterior
Duct Testing Affidavit

Duct Leakage Affidavit (New Construction)

Test Result Calculator

Duct Testing Calculator (New Construction)

<table>
<thead>
<tr>
<th>House address or lot #:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conditioned Floor Area:</td>
</tr>
<tr>
<td>Duct tester location:</td>
</tr>
<tr>
<td>Pressure tap location:</td>
</tr>
<tr>
<td>Ring (if applicable):</td>
</tr>
</tbody>
</table>

At Rough-In or Post Construction

<table>
<thead>
<tr>
<th>Test Method</th>
<th>Standard¹</th>
<th>Calculated Target</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air Handler Present (Leakage to Exterior or Total Leakage)</td>
<td>≤ 4 CFM₃₂₅ per 100 sf of CFA</td>
<td></td>
</tr>
<tr>
<td>Air Handler not Present (Leakage to Exterior or Total Leakage)</td>
<td>≤ 3 CFM₃₂₅ per 100 sf of CFA</td>
<td></td>
</tr>
</tbody>
</table>

1. Test CFM₃₂₅ must be equal to or less than the calculated target.

Air Leakage Testing Calculator (Blower Door Test)

<table>
<thead>
<tr>
<th>Conditioned Floor Area:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ceiling Height (ft)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Standard</th>
<th>Tested CFM₃₂₀</th>
<th>Calculated Test Result (ACH₅₀)</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤0.0 ACH₅₀</td>
<td>(CFM₃₂₀ X 50 + conditioned volume)</td>
<td></td>
</tr>
</tbody>
</table>

Glossary

Rough-In: After installation of the complete air distribution system but before installation of insulation and sheet 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 systems 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

CFM₃₂₀: Cubic feet per minute of air leakage at 25 pascals of pressure

CFM₅₀: Cubic feet per minute of air leakage at 50 pascals of pressure

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

ACH₅₀: Air changes per hour at 50 pascals of pressure
Duct Tape

Duct Tape is NOT the solution to EVERY problem!
All Joints Must Be Sealed
“I’ve Got Some Duct Tape”
System Deficiencies

Hole at dovetail connection
Large Hole

Unsealed Dovetail Connections
Large hole where down drafting furnace connects to supply plenum
Mechanical Fastening

Mechanically fastened joint using “the right tool for the job” per UL flex duct listing using approved Panduit strapping gun!
“Currently Unattached”
Duct Testing Standards

Exception
Duct tightness test is not required if:

• The air handler and all ducts are located within conditioned space

• 10 ft of return ducts and 5 ft of supply ducts are allowed to be outside the conditioned space
A Better Way: Move the Ducts Inside!

- Habitat for Humanity
- First WA ENERGY STAR
- All ducts Inside
- 1,000 sf
- All electric < $40/month
Ducts in dropped ceiling in hall
After drywall
Air handler inside

Supply register in wall
Dropped soffit with duct in bathroom
Duct System Supply Leakage

105° - 140°
Where is the Air Coming From?

Other soil gas

Radon
Duct System Return Leakage in Heating Season

40°

68°-72°

105° - 140°

68°-72°

68°-72°

68°-72°

68°-72°
Ducts between floors

High-efficiency furnace inside the structure
2018 WSEC–R Benefits: Durability, Liability & Indoor Air Quality
Cautionary Case Studies: Damage in Northwest Multifamily Housing Walls With Vinyl Siding

George Tsongas, Ph.D., P.E.
Consulting Engineer and Building Scientist
Professor Emeritus of Mechanical Engineering
Portland State University
Avoid Mold and Rot!

“VAPOR MIGRATION” is the migration of water vapor through walls by a combination of vapor diffusion and air movement that carries water vapor in the air with it.

- When indoor temperatures are warmer than outdoor conditions, vapor drive is on balance from indoors (warmer) to outdoors (colder).
Avoid Mold and Rot!

Vapor drive is occurring in all walls

- It is a normal mechanism for removal from housing of moisture generated by occupants and their activities
- A family of 3-4 persons generates about 3 gallons per day of water vapor as a result of breathing, perspiration & indoor activities
  - All this moisture has to be removed from the indoor spaces
    - Mostly by air leakage
Avoid Mold and Rot!

If during cold weather the inside surface of sheathing is below the dew point temperature of the indoor air and its water vapor that is migrating through the wall cavity, then the water vapor will “condense” on the sheathing (which is the first cold condensing surface), be absorbed into the wood and raise its moisture content.
Wintertime vapor movement in walls

- Vapor diffusion
- Air movement (leakage)

Air moves through the walls and there are two types of movement: vapor diffusion and air movement (leakage).
Avoid Mold and Rot!

Most of the vapor drive in walls is by air leakage

- Especially for walls with an interior vapor retarder such as asphalt-impregnated kraft paper backing on fiberglass insulation or a poly vapor barrier
- Greatly reduces the amount of vapor diffusion
Breezeway wall construction observation

- **Units 302 & 303**: Insulation and vapor barrier were missing at the intersection of the exterior wall cavity and the interior demising walls and closet walls (observed from breezeway)

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**WINTER CONDITION**

- Air leakage
- Increased moisture accumulation area
- Uninsulated cavity at interface IV interior, closet (and bedroom) walls
- Vapor barrier

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**CLOSET**
Results of the Perfect Storm

Worse damage on inside face of OSB
Results of the Perfect Storm

Damage to gypsum sheathing & TJL decay behind vinyl siding

Between 2nd & 3rd stories of 3-story apartment

Very wet TJL

Gypsum sheathing
(Water stained & moldy)

Colville, Washington multifamily housing
Building Science
Top 10 Best Practices to Avoid Mold

1. Vapor retarders limit moisture condensation
2. Warm surfaces limit moisture condensation
3. R4-6 Pipe and R8-10 HVAC duct insulation limits moisture condensation
4. Water Resistive Barriers (WRB) limit wind and rain
5. “Build Tight & Ventilate Right” in modern homes – Why?
Building Science
Top 10 Best Practices to Avoid Mold (cont.)

6. Use a blower door to reduce envelope leakage
7. Locate ducts and HVAC within conditioned space
8. Use a duct blaster to reduce duct leakage
9. Design, install, commission and O&M to ventilate right
10. Use a systems approach for moisture management
Additional Trainings & Resources
BetterBuiltNW Training

Chasing Opportunities in the WSEC-R

• On-demand videos (1 hr each)
• Deep dive into the requirements for:
  - Efficient Building Envelope Options
  - Build Tight & Ventilate Right
  - H/AC System Inside Options
• Watch the videos anytime on BetterBuiltNW’s Youtube Channel.

betterbuiltnw.com/events/chasing-opportunities-in-the-washington-energy-code
BetterBuiltNW Training

Top 10 Best Practices for Today’s Homebuilder

• On-demand training (3 hrs)
• Covers Top 10 "Good, Better & Best" approaches to:

betterbuiltnw.com/events/now-online-top-10-best-practices-for-todays-homebuilder
Top 10 Best Practices for Today’s Homebuilder

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Wrap Up & Next Steps
Takeaways & Next Steps

1. Get to know WSUEP website resources and documents
2. Review point package scenarios
3. Discuss with relevant subcontractors and designers
4. Take additional training offered by WSUEP and BBNW
Thank You!

Send questions and comments to:

Michael Lubliner
360-956-2042

Join our update list:
energycode@energy.wsu.edu