STATE OF WASHINGTON

STATE BUILDING CODE COUNCIL

Washington State Energy Code Development

Standard Energy Code Proposal Form

Jan 2022

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Code being amended: ☒ Commercial Provisions ☐ Residential Provisions

Code Section # C202, C403, Appendix D

Brief Description:

This proposed change provides multiple revisions to Appendix D: Calculation of HVAC Total System Performance Ratio, including:

1. Change in calculation metric from carbon emissions to site energy.
2. Change in Table D601.10.1 to include air to water heat pumps in the list of proposed building HVAC systems supported by HVAC TSPR simulation software.
3. Updates to the rated efficiencies of energy recovery in the Standard Reference Design, to meet the minimum prescriptive requirements.
4. Change in the Standard Reference Design for multifamily use types, to remove economizer control.
5. Change to clarify that the efficiency requirements required to meet the Standard Reference Design exception are those in the prescriptive requirements.
6. Updates to the VRF system heating and cooling efficiency inputs to account for the new AHRI test procedure.
7. Modifications to the modeling approach for GSHPs, for more accurate simulation of the ground water loop.
8. Allowing more detailed thermal zoning as an option.
9. If heating, cooling equipment efficiencies, fan power, ERV efficiencies etc. are updated during the code cycle, those would need to rolled into this proposal.

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

SECTION C202
GENERAL DEFINITIONS

HVAC TOTAL SYSTEM PERFORMANCE RATIO (HVAC TSPR). The ratio of the sum of a building's annual heating and cooling load in thousands of Btus to the sum of annual ~~carbon emissions in pounds from~~ site energy consumption of the building HVAC systems in thousands of Btus. ~~Carbon emissions shall be calculated by multiplying site energy consumption by the carbon emission factors from Table C407.1.~~

STANDARD REFERENCE DESIGN. A version of the *proposed design* that meets the minimum requirements of this code and is used to determine the maximum annual energy use requirement ~~and carbon emissions~~ from energy consumption for compliance based on total simulated building performance and *HVAC total system performance ratio*.

SECTION C403

MECHANICAL SYSTEMS

C403.1.1 HVAC total system performance ratio (*HVAC TSPR*). For systems serving office (including medical office), retail, library and education occupancies and buildings, which are subject to the requirements of Section C403.3.5 without exceptions, and the dwelling units and residential common areas within Group R-2 multi-family buildings, the *HVAC total system performance ratio* (*HVAC TSPR*) of the *proposed design* HVAC system shall be greater than or equal to the *HVAC TSPR* of the *standard reference design* as calculated according to Appendix D, Calculation of HVAC Total System Performance Ratio.

Exceptions:

1. Buildings where the sum of the *conditioned floor area* of office, retail, education, library, and multifamily spaces is less than 5,000 square feet. Areas that are eligible for any of the exceptions below do not count towards the 5,000 square feet.
2. HVAC systems using district heating water, chilled water or steam.
3. HVAC systems connected to a *low-carbon district energy exchange system*.
4. HVAC systems not included in Table D601.10.1.
5. HVAC systems with chilled water supplied by absorption chillers, heat recovery chillers, water to water heat pumps, air to water heat pumps, or a combination of air and water cooled chillers on the same chilled water loop.
6. HVAC systems included in Table D601.10.1 with parameters in Table D601.10.2 not identified as applicable to that HVAC system type.
7. HVAC system served by heating water plants that include air to water or water to water heat pumps.
8. Underfloor air distribution and displacement ventilation HVAC systems.
9. Space conditioning systems that do not include *mechanical cooling*.
10. Alterations to existing buildings that do not substantially replace the entire HVAC system and are not serving initial build-out construction.
11. ~~HVAC systems meeting all the requirements of the *standard reference design* HVAC system in Table D602.11, Standard Reference Design HVAC Systems.~~ HVAC systems meeting all the requirements of the standard reference design HVAC system in Table D602.11, Standard Reference Design HVAC Systems. Heating and cooling efficiency shall meet the requirements from Tables C403.3.2(2) and C403.3.2(14) instead of the COPnf listed in Table D602.11
12. Buildings or areas of medical office buildings that comply fully with ASHRAE Standard 170 including, but not limited to, surgical centers, or that are required by other applicable codes or standards to provide 24/7 air handling unit operation.
13. HVAC systems serving the following areas and spaces:
    - 13.1. Laundry rooms.
    - 13.2. Elevator machine rooms.
    - 13.3. Mechanical and electrical rooms.
    - 13.4. *Data centers* and *computer rooms*.
    - 13.5. Laboratories with fume hoods.
    - 13.6. Locker rooms with more than two showers.

Commented [SG1]: Corrected table numbers.

13.7. Natatoriums and rooms with saunas.
13.8. Restaurants and commercial kitchens with total cooking capacity greater than 100,000 Btu/h.
13.9. Areas of buildings with commercial refrigeration equipment exceeding 100 kW of power input.
13.10. Cafeterias and dining rooms.

APPENDIX D

CALCULATION OF HVAC TOTAL SYSTEM PERFORMANCE RATIO

D201 Compliance. Compliance based on *HVAC total system performance ratio* requires that the provisions of Section C403.3 are met and the *HVAC total system performance ratio* of the *proposed design* is more than or equal to the *HVAC total system performance ratio* of the *standard reference design*. The *HVAC TSPR* is calculated according to the following formula:

HVAC TSPR = annual heating and cooling load / annual ~~carbon emissions from~~ site energy consumption of the building HVAC systemsWhere:

Annual ~~carbon emissions from~~ site energy consumption of the building HVAC systems	= sum of the annual site energy ~~carbon emissions in pounds~~ for heating, cooling, fans, energy recovery, pumps, and heat rejection in thousands of Btus ~~calculated by multiplying site energy consumption by the carbon emission factors from Table D201~~
Annual heating and cooling load	= sum of the annual heating and cooling loads met by the building HVAC system in thousands of Btus.

~~**TABLE D201**~~
~~**CARBON EMISSIONS FACTORS**~~

~~Type~~	~~CO2e (lb/unit)~~	~~Unit~~
~~Electricity~~	~~0.44~~	~~kWh~~
~~Natural gas~~	~~11.70~~	~~Therm~~
~~Oil~~	~~19.2~~	~~Gallon~~
~~Propane~~	~~10.5~~	~~Gallon~~
~~Other[a]~~	~~195.00~~	~~mmBtu~~
~~On-site renewable energy[b]~~	~~0.00~~	

~~a. District energy systems may use alternative emissions factors supported by calculations approved by the *code official*.~~
~~b. Not applicable to TSPR calculation in Appendix D~~

D601.1.1 Number of blocks. One or more *blocks* may be required per building based on the following restrictions:

1. Each *block* can have only one occupancy type (multifamily *dwelling unit*, multifamily common area, office, library, education, or retail). Therefore, at least one single *block* shall be created for each unique use type.
2. Each *block* can be served by only one type of HVAC system. Therefore, a single *block* shall be created for each unique HVAC system and use type combination. Multiple HVAC units of the same type may be represented in one *block*. Section D601.10.2 provides directions for combining multiple HVAC units or components of the same type into a single *block*. When

Commented [SG2]: Modified to clarify thermal block requirements.

multifamily-dwelling units include portions which are directly and indirectly conditioned, only portions of the multifamily-dwelling units directly heated and cooled as well as portions of the dwelling unit that are permanently open to the directly heated and cooled space shall be modeled.

Informative Note: multifamily-dwelling units are permitted to be zoned vertically as blocks for dwelling units with the same floor plan, when served by the same HVAC system type.

3. Each *block* can have a single definition of floor to floor or floor to ceiling heights. Where floor heights differ by more than two feet, unique *blocks* should be created for the floors with varying heights.
4. Each *block* can include either above grade or below grade floors. For buildings with both above grade and below grade floors, separate *blocks* should be created for each. For buildings with floors partially above grade and partially below grade, if the total wall area of the floor(s) in consideration is greater than or equal to 50 percent above grade, then it should be simulated as a completely above grade *block*, otherwise it should be simulated as a below grade *block*.
5. Each wall on a façade of a *block* shall have similar vertical fenestration. The product of the proposed design U-factor times the area of windows (UA) on each façade of a given floor cannot differ by more than 15 percent of the average UA for that façade in each *block*. The product of the proposed design SHGC times the area of windows (SHGCA) on each façade of a given floor cannot differ by more than 15 percent of the average SHGCA for that façade in each *block*. If either of these conditions are not met, additional *blocks* shall be created consisting of floors with similar fenestration.
6. For a building model with multiple *blocks*, the *blocks* should be configured together to have the same adjacencies as the actual building design.

1. **D601.2 Thermal zoning.** Each floor in a *block* shall be modeled as a single thermal zone or as five thermal zones consisting of four perimeter zones and a core zone. Below grade floors shall be modeled as a single thermal *block*. If any façade in the *block* is less than 45 feet in length, there shall only be a single thermal zone per floor. Otherwise, each floor shall be modeled with five thermal zones. A perimeter zone shall be created extending from each façade to a depth of 15 feet. Where facades intersect, the zone boundary shall be formed by a 45 degree angle with the two facades. The remaining area or each floor shall be modeled as a core zone with no exterior walls. Thermal zoning as per the design documents shall be allowed provided that the rules specified in Sections D601.1 and D601.10.2 are followed.

TABLE D601.10.1
PROPOSED BUILDING HVAC SYSTEMS SUPPORTED BY HVAC TSPR SIMULATION SOFTWARE

System No.	System Name	System Abbreviation
1	Packaged Terminal Air Conditioner	PTAC
2	Packaged Terminal Air Heat Pump	PTHP
3	Packaged Single Zone Gas Furnace (includes split system)	PSZGF
4	Packaged Single Zone Heat Pump (air to air only) (includes split system)	PSZHP
5	Variable Refrigerant Flow (air cooled only)	VRF
6	Four Pipe Fan Coil	FPFC
7	Water Source Heat Pump	WSHP
8	Ground Source Heat Pump	GSHP
9	Packaged Variable Air Volume (DX cooling)	PVAV
10	Variable Air Volume (hydronic cooling)	VAV
11	Variable Air Volume with Fan Powered Terminal Units	VAVFPTU
12	Dedicated Outdoor Air System (in conjunction with systems 1-8)	DOAS
13	Air to water heat pumps[1] (hot-water loops only)	AWHP

Commented [SG3]: Clarifying that these are AWHPs with HW loops only.

[1] The

XD601.10.2 Proposed building HVAC system simulation. The HVAC systems shall be modeled as in the proposed design with clarifications and simplifications as described in Table D601.10.2. System parameters not described in the following sections shall be simulated to meet the minimum requirements of Section C403. All zones within a *block* shall be served by the same HVAC system type as described in Section D601.1.1 item 2. Where multiple system components serve a *block*, average values weighed by the appropriate metric as described in this section shall be used. Heat loss from ducts and pipes shall not be modeled.

1. Where multiple fan systems serve a single block, fan power shall be based on weighted average using the design supply air cfm.
2. Where multiple cooling systems serve a single block, COP shall be based on a weighted average using cooling capacity. DX coils shall be entered as multi-stage if more than 50% of coil capacity serving the block is multi-stage with staged controls.
3. Where multiple heating systems serve a single block, thermal efficiency or heating COP shall be based on a weighted average using heating capacity.
4. Where multiple boilers or chillers serve a heating water or chilled water loop, efficiency shall be based on a weighted average for using heating or cooling capacity.
5. When multiple cooling towers serving a condenser water loop are combined, the cooling tower efficiency, cooling tower design approach and design range are based on a weighted average of the design water flow rate through each cooling tower.
6. Where multiple pumps serve a heating water, chilled water or condenser water loop, pump power shall be based on a weighted average for using design water flow rate.
7. When multiple system types with and without economizers are combined, the economizer maximum outside air fraction of the combined system shall be based on weighted average of 100% supply air for systems with economizers and design outdoor air for systems without economizers.
8. Multiple systems with and without ERVs cannot be combined.
9. ERVs with the same bypass SAT setpoint are permitted to be combined. When multiple systems with ERVs are combined, the ERV sensible and latent effectiveness of the combined system shall be calculated as a design supply flow weighted average value.
10. Systems with and without supply air temperature reset cannot be combined.
11. Systems with different fan control (constant volume, multi-speed or VAV) for supply fans cannot be combined.
12. Demand Controlled Ventilation (DCV) shall be modeled using a simplified approach that adjusts the design outdoor supply air flow rate based on the area of the building that is covered by DCV.

Commented [SG4]: Additional guidance for combining systems with ERVs.

TABLE D601.10.2
PROPOSED BUILDING SYSTEM PARAMETERS

Category	Parameter	Fixed or User Defined	Required	Applicable Systems
HVAC System Type	System Type	User Defined	Selected from Table D601.10.1	All
System Sizing	Design Day Information	Fixed	99.6% heating design and 1% dry-bulb and 1% wet-bulb cooling design	All
	Zone Coil Capacity	Fixed	Sizing factors used are 1.25 for heating equipment and 1.15 for cooling equipment	All
	Supply Airflow	Fixed	Based on a supply-air-to-room-air temperature *set-point* difference of 20°F	1-11
		Fixed	Equal to required outdoor air ventilation	12

Outdoor Ventilation Air	Portion of Supply Air with Proposed Filter ≥ MERV 13	User Defined	Percentage of supply air flow subject to higher filtration (adjusts baseline fan power higher. Prorated)	All
	Outdoor Ventilation Air Flow Rate	Fixed	As specified in ASHRAE Standard 90.1 Normative Appendix C, adjusted for proposed DCV control	All
	Outdoor Ventilation Supply Air Flow Rate Adjustments	Fixed	Based on ASHRAE Standard 62.1 Section 6.2.4.3 system ventilation efficiency (E_VS) is 0.75	9-11
		Fixed	System ventilation efficiency (E_VS) is 1.0	1-8, 12
		Fixed	Base is 1.0 zone air distribution effectiveness	All
System Operation	Space temperature Set points	Fixed	As specified in ASHRAE Standard 90.1 Normative Appendix C, except multifamily which shall use 68°F heating and 76°F cooling setpoints	1-11
	Fan Operation – Occupied	User Defined	Runs continuously during occupied hours or cycled to meet load. Multispeed fans reduce airflow related to thermal loads	1-11
	Fan Operation – Occupied	Fixed	Fan runs continuously during occupied hours	12
	Fan Operation - Night Cycle	Fixed	Fan cycles on to meet setback temperatures	1-11
Packaged Equipment Efficiency	DX Cooling Efficiency	User Defined	Cooling COP without fan energy calculated in accordance with ASHRAE Standard 90.1 Section ~~11~~12.5.2c.[b] When DX cooling efficiency is specified as SEER2, SEER is calculated as specified in 10 CFR Part 431, Table III-1[2].	1, 2, 3, 4, ~~5,~~ 7, 8, 9, 11, 12
	DX Cooling Efficiency (only System 5)		Cooling COP without fan energy calculated in accordance with ASHRAE Standard 90.1 Section 12.5.2c.[b] When VRF equipment test procedure is specified as AHRI 1230-2023, the rated efficiency (specified as EER) will be converted to a simulation tool input using the equation specified below. This value will be converted to a COP value without fan energy as described above. $EER_{sim} = EER_{2023rated} \times VRF_{2023Factor}$ $VRF_{2023Factor} = [(-2.60926 \times 10^{-7}) \times \text{Rated Net Cooling Capacity (Btu/h)}] + 1.14394$	5
	DX Coil Number of Stages	User Defined	Single state or multistage	3, 4, 9, 10, 11, 12
	Heat Pump Efficiency	User Defined	Heating COP without fan energy calculated in accordance with ASHRAE Standard 90.1 Section ~~11~~12.5.2c.[C] When heat pump efficiency is specified as HSPF2, HSPF is calculated as specified in 10 CFR Part 431, Table III-1.	2, 4, 5, 7, 8
	Furnace Efficiency	User Defined	Furnace thermal efficiency[c]	3, 9, 11, 12

Commented [SG5]: Reference to CFR added in footnote below.

[2] 10 CFR Part 431: https://www.federalregister.gov/documents/2023/06/02/2023-10181/energy-conservation-program-energy-conservation-standards-for-air-cooled-three-phase-small

Category	Parameter	Fixed or User Defined	Required	Applicable Systems
Heat Pump Supplemental Heat	Control	Fixed	Supplemental electric heat locked out above 40°F. Runs In conjunction with compressor between 40°F and 0°F.	2, 4
System Fan Power and Controls	Part-Load Fan Controls	User Defined	Constant volume or two speed	1-8
	Part-Load Fan Controls[a]	User Defined	Constant volume or variable air volume	12
	Part-Load Fan Controls[a]	Fixed	Variable air volume. VFD with static pressure reset.	9-11
	Design Fan Power (W/cfm)	User Defined	Input electric power for all fans in required to operate at *fan system design conditions* divided by the supply airflow rate	All
	Low-Speed Fan Power	User Defined	Low speed input electric power for all fans required to operate at low speed conditions divided by the low speed supply airflow rate. This is a "wire to air" value including all drive, motor efficiency and other losses.	1-8
Variable Air Volume Systems	Supply Air Temperature (SAT) Controls	User defined	If not SAT reset constant at 55°F. Options for reset based on outdoor air temperature (OAT) or warmest zone. If warmest zone, then the user can specify the minimum and maximum temperatures. If OAT reset, SAT is reset higher to 60°F at outdoor low of 50°F. SAT is 55°F at outdoor high of 70°F.	9, 10, 11
	Minimum Terminal Unit airflow percentage	User Defined	Average minimum terminal unit airflow percentage for *block* weighted by cfm	9, 10, 11
	Terminal Unit Heating Source	User Defined	Electric or hydronic	9, 10, 11
	Dual Set Point Minimum VAV Damper Position	User Defined	Heating maximum airflow fractions	9, 10
	Fan Powered Terminal Unit (FPTU) Type	User Defined	Series or parallel FPTU	11
	Parallel FPTU Fan	Fixed	Sized for 50% peak primary air at 0.35 W/cfm	11
	Series FPTU Fan	Fixed	Sized for 50% peak primary air at 0.35 W/cfm	11
Economizer	Economizer Presence	User Defined	Yes or No	3, 4, 9, 10, 11
	Economizer Control Type	Fixed	Differential dry-bulb	3, 4, 9, 10, 11

TABLE D601.11.2 (continued) PROPOSED BUILDING SYSTEM PARAMETERS

Category	Parameter	Fixed or User Defined	Required	Applicable Systems
Energy Recovery	Sensible Effectiveness	User Defined	Heat exchanger sensible effectiveness at design heating and cooling conditions	3, 4, 9, 10, 11, 12
	Latent Effectiveness	User Defined	Heat exchanger latent effectiveness at design heating and cooling conditions	3, 4, 9, 10, 11, 12
	Economizer Bypass	User Defined	If ERV is bypassed during economizer conditions	3, 4, 9, 10, 11, 12
	Bypass SAT Setpoint	User Defined	If bypass, target supply air temperature	3, 4, 9, 10, 11, 12
	Fan Power Reduction during Bypass (W/cfm)	User Defined	If ERV system include bypass, static pressure set point and variable speed fan, fan power can be reduced during economizer conditions	3, 4, 9, 10, 11, 12
Demand Controlled Ventilation	DCV Application	User Defined	Percent of block floor area under DCV control	3, 4, 9, 10, 11, 12
DOAS	DOAS Fan Power W/cfm	User Defined	Fan electrical input power in W/cfm of supply airflow	12
	DOAS Supplemental Heating and Cooling	User Defined	Heating source, cooling source	12
	Minimum SAT Setpoint (Cooling)	User Defined	SAT setpoint if DOAS includes supplemental cooling	12
	Minimum SAT Setpoint (Heating)	User Defined	SAT setpoint if DOAS includes supplemental heating	12
Heating Plant	Boiler Efficiency	User Defined	Boiler thermal efficiency	1, 6, 7, 9, 10, 11, 12
	Heating Water Loop Configuration[a]	User Defined	Constant flow primary only; variable flow primary only; constant flow primary-variable flow secondary; variable flow primary and secondary	1, 6, 7, 9, 10, 11, 12
	Heating Water Primary Pump Power (W/gpm)	User Defined	Heating water primary pump input W/gpm heating water flow	1, 6, 7, 9, 10, 11, 12
	Heating Water Secondary Pump Power (W/gpm)	User Defined	Heating water secondary pump input W/gpm heating water flow (if primary/ secondary)	1, 6, 7, 9, 10, 11, 12
	Heating Water Loop Temperature	User Defined	Heating water supply and return temperatures	1, 6, 9, 10, 11, 12
	Heating Water Loop Supply Temperature Reset Included	User Defined	Yes/No	1, 6, 9, 10, 11, 12
	Heating Water Loop Supply Reset Temperature	Fixed	Reset HWS by 27.3 percent of design delta-T (HWS - 70°F (21.1°C) space heating temperature set point) between 20°F (-6.7°C) and 50°F (10°C) OAT	1, 6, 9, 10, 11, 12
	Boiler Type	Fixed	Noncondensing boiler where input thermal efficiency is less than 86 percent; condensing boiler otherwise	1, 6, 7, 9, 10, 11, 12

-continued-

TABLE D601.11.2 (continued) PROPOSED BUILDING SYSTEM PARAMETERS

Category	Parameter	Fixed or User Defined	Required	Applicable Systems
Chilled Water Plant	Chiller Compressor Type	User Defined	Screw/Scroll, Centrifugal or Reciprocating	6,1 0, 11, 12
	Chiller Condenser Type	User Defined	Air cooled or water cooled	6, 10, 11, 12
	Chiller Full Load Efficiency	User Defined	Chiller COP	6, 10, 11, 12
	Chilled Water Loop Configuration[a]	User Defined	Variable flow primary only, constant flow primary – variable flow secondary, variable flow primary and secondary	6, 10, 11, 12
	Chilled Water Primary Pump Power (W/gpm)	User Defined	Primary pump input W/gpm chilled water flow (if primary/secondary)	6, 10, 11, 12
	Chilled Water Secondary Pump Power (W/gpm)	User Defined	Secondary pump input W/gpm chilled water flow	6, 10, 11, 12
	Chilled Water Temperature Reset Included	User Defined	Yes/No	6, 10, 11, 12
	Chilled Water Temperature Reset Schedule (if included)	Fixed	Outdoor air reset: CHW supply temperature of 44°F at 80°F outdoor air dry bulb and above, CHW supply temperature of 54°F at 60°F outdoor air dry bulb temperature and below, ramped linearly between	6, 10, 11, 12
	Condenser Water Pump Power (W/gpm)	User Defined	Pump input W/gpm condenser water flow	6, 7, 8, 10, 11, 12
	Condenser Water Pump Control	User Defined	Constant speed or variable speed	6, 7, 8, 10, 11, 12
	Cooling Tower Efficiency	User Defined	gpm/hp tower fan	6, 7, 10, 11, 12
	Cooling Tower Fan Control	User Defined	Constant or variable speed	6, 7, 10, 11, 12
	Cooling Tower Approach and Range	User Defined	Design cooling tower approach and range temperature	6, 7, 10, 11, 12
Air to Water Heat Pump	Backup Heat Source	Fixed	~~Hot Water Plant~~ Boiler	13
	Leaving Water Temperature (LWT)	User Defined	Heat Pump Leaving Water Temperature (LWT)	13
	Heat Pump Efficiency	User Defined	COP at the specified LWT and 47F outside air dry-bulb temperature	13
Heat Pump Loop Flow Control	Loop flow and Heat Pump Control Valve	Fixed	Two position Valve with VFD on Pump. Loop flow at 3 gpm/ton	7, 8
Heat Pump Loop Temperature Control		User Defined	Restrict to minimum 20°F and maximum 40°F temperature difference	7

Commented [SG6]: Changed from 'Hot Water Plant' to 'Boiler' based on comment from TAG.

GLHP Well Field- Ground Temperature Profile		Fixed	Ground water loop temperature profiles specified in Table D601.10.4 shall be used for simulating GSHPs. ~~Bore depth = 250'~~ ~~Bore length 200'/ton for greater of cooling or heating load~~ ~~Bore spacing = 15'; Bore diameter = 5"~~ ~~¾" Polyethylene pipe~~ ~~Ground and grout conductivity = 4.8 Btu-in/h-ft²-°F~~	8

TABLE D601.10.4
GROUND WATER LOOP TEMPERATURE PROFILES (°F)

Climate Zone	January	February	March	April	May	June	July	August	September	October	November	December
~~4C and 5B~~	50.22	48	50.22	56.25	64.51	72.75	78.78	81	78.78	72.75	64.51	56.25

Commented [SG7]: Updated to be in F

TABLE D602.11
STANDARD REFERENCE DESIGN HVAC SYSTEMS

Parameter	Building Type				
	Large Office[a]	**Small Office and Libraries[a]**	**Retail**	**School**	**Multifamily**
System Type	**Water-source Heat Pump**	**Packaged air-source Heat Pump**	**Packaged air-source Heat Pump**	**Packaged air-source Heat Pump**	**Packaged air-source Heat Pump**
Fan control[b]	Cycle on load	Cycle on load	Cycle on load	Cycle on load	Cycles on load
Space condition fan power (W/cfm) Proposed < MERV 13	0.528	0.528	0.522	0.528	0.528
Space Condition Fan Power (W/cfm) Proposed ≥ MERV 13	0.634	0.634	0.634	0.634	0.634
Heating/Cooling sizing factor[c]	1.25/1.15	1.25/1.15	1.25/1.15	1.25/1.15	1.25/1.15
Supplemental heating availability	NA	<40°F	<40°F	<40°F	<40°F
Modeled cooling COP (Net of fan) [d]	4.46	3.83	4.25	3.83	3.83
Modeled heating COP (Net of fan) [d]	4.61	3.81	3.57	3.81	3.86
Cooling Source	DX (heat pump)	DX (heat pump)	DX (heat pump)	DX (heat pump)	DX (Heat Pump)
Heat source	Heat Pump	Heat Pump	Heat Pump	Heat Pump	Heat Pump
Number of Stages of Cooling	Single	Single	Two	Single	Single
OSA Economizer[e]	No	No	Yes	Yes	~~Yes~~ No
Occupied ventilation source[f]	DOAS	DOAS	DOAS	DOAS	DOAS
DOAS Fan Power (W/cfm of outside air)	0.819	0.819	0.730	0.742	0.780
DOAS Fan Power (W/cfm) Proposed ≥ MERV 13	1.042	1.042	0.928	0.944	0.944

DOAS temperature control [g, h]	Bypass	Wild	Bypass	Bypass	Wild
ERV efficiency (sensible only)	~~70%~~ As specified in C403.3.5.1	~~70%~~ As specified in C403.3.5.1	~~70%~~ As specified in C403.3.5.1	~~70%~~ As specified in C403.3.5.1	~~70 percent~~ As specified in C403.3.6
WSHP Loop Heat Rejection	Cooling Tower[i]	NA	NA	NA	NA
WSHP Loop Heat Source	Gas Boiler [j]	NA	NA	NA	NA
WSHP Loop Temperature Control[k]	50°F to 70°F	NA	NA	NA	NA
WSHP circulation Pump W/gpm[l]	16	NA	NA	NA	NA
WSHP Loop Pumping Control[m]	HP Valves & pump VSD	NA	NA	NA	NA

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Purpose of code change:

- Increased coverage of TSPR by supporting additional proposed system types
- Update the standard reference design to align with the prescriptive code.
- Update the calculation procedure to accommodate new HVAC metrics and test conditions.
- Address updates to HVAC equipment performance metrics and test procedures
- Stakeholders have expressed a desire to align the TSPR metric with the C407 metric which was changed from emissions to site energy during the last code cycle.

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

☐ Addresses a critical life/safety need.

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

☒ Addresses a specific state policy or statute.
(Note that energy conservation is a state policy)

☐ Consistency with state or federal regulations.

☐ Addresses a unique character of the state.

☐ Corrects errors and omissions.

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

☐ Single family/duplex/townhome

☐ Multi-family 1 – 3 stories

☒ Multi-family 4 + stories

☒ Commercial / Retail

☒ Institutional

☐ Industrial

Your name	Supriya Goel	Other contact name	Click here to enter text.
Your organization	Pacific Northwest National Laboratory	Email address	supriya.goel@pnnl.gov
		Phone number	(513) 417-7554

Economic Impact Data Sheet

Is there an economic impact: ☐ Yes ☒ No

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

- There will be no change in economic impact due to the switch from emissions to site energy as the same Standard Reference Designs will still comply with the new metric.

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

$Click here to enter text./square foot (For residential projects, also provide $Click here to enter text./ dwelling unit)

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

There is no expected impact on construction costs.

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

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

(For residential projects, also provide Click here to enter text.KWH/KBTU / dwelling unit)

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

There is no expected impact on energy savings

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

No additional enforcement time is anticipated.

Small Business Impact. Describe economic impacts to small businesses:

No economic impact on small businesses is expected.

Housing Affordability. Describe economic impacts on housing affordability:

There may be a decrease in construction cost for multifamily buildings as the standard reference design will have a lower sensible recovery effectiveness (from 70% to 60%) to match the prescriptive requirements and will no longer include an economizer.

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

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

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