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9/14/21

STATE OF WASHINGTON
STATE BUILDING CODE COUNCIL

2015-2021 Washington State Energy Code Development
Energy Code Proposal Short Form

For editorial **Coordination, Clarifications & Corrections** only,
without substantive energy or cost impacts

Code being amended: **Commercial** Provisions **Residential** Provisions
(A MS Word version of the code is linked to the name)

Code Section # C406 Efficiency Packages, other prescriptive requirements and associated definitions in C202

Brief Description:

Add a definition of a low-carbon district energy exchange system to C202 and modify heating/cooling/service hot water related create a new C406 sections to reward for utilizing low-carbon district energy exchange systems, and allow them to meet the service water heating C406 credits.

9/14 Update: This proposal has been updated per working group follow ups on 8/31 and 9/14 to align with the approved proposal #206. The working group reviewed calculations to establish a set of C406 criteria to justify a >5% emissions reduction target and a >15% emissions reduction target for heating and cooling, and establish C406 credit targets aligning with those goals in the modeling completed for the approved proposal #206 credits.

These revisions are intended to address comments made at the MVE committee regarding the 20% savings cap, as well as give consideration to code officials and simplify the proposal from an enforcement perspective.

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.)

Approved during 8/27 Energy TAG meeting

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C202 GENERAL DEFINITIONS (add the following definitions, which should be consistently defined if any other district energy exchange related code proposals are adopted):

LOW-CARBON DISTRICT ENERGY EXCHANGE SYSTEM. Any system serving multiple buildings providing energy in the form of a circulated fluid that can accept or reject heat from individual buildings. Energy can be indirectly converted to meet building heating or cooling loads by serving as the heat source or sink for heat-pump systems. Examples include, but are not limited to low temperature condenser water, ground source condenser water, or sewer heat recovery.

Low-carbon district energy exchange systems must demonstrate that 25% of the annual district-system-net-load-met (sum of heating and cooling energy provided to attached buildings) comes from heat recovery between connected buildings, waste heat, or renewable energy resources and no more than 25% of the annual heat input to the system comes from fossil fuel or electric-resistance sources.

LOW-CARBON DISTRICT HEATING AND COOLING OR HEATING ONLY SYSTEM. Any system serving multiple buildings providing energy in the form of direct heating and cooling, or heating only to a building. Energy can be directly converted to meet building heating or cooling loads through a heat exchanger. Examples include, but are not limited to steam, hot water, and chilled water.

Low-carbon district system must demonstrate the following:

1. Distribution losses must be accounted for and may not exceed 10% of the annual load delivered to buildings served by the system.
 - 2.1 25% of the annual district-system-net-load-met (sum of heating and cooling energy provided to attached buildings) comes from heat recovery between connected buildings, waste heat, or renewable energy resources and no more than 25% of the annual heat input to the system comes from fossil fuel or electric-resistance sources.
- or
- 2.2 No more than 10% of the system annual heat input to the system comes from fossil fuel or electric-resistance sources.

LOW-CARBON DISTRICT ENERGY EXCHANGE SYSTEM. Any system serving multiple buildings providing energy in the form of a circulated fluid that can accept or reject heat from individual buildings. Energy can be indirectly converted to meet building heating or cooling loads by serving as the heat source or sink for heat-pump systems. Examples include, but are not limited to low temperature condenser water, ground source condenser water, or sewer heat recovery.

~~(ADD DISTRICT ENERGY EXCHANGE TO TSPR EXCEPTIONS, C404 as well)~~C403.1.1 HVAC total system performance ratio (HVAC TSPR). For systems serving office, retail, library and education occupancies and buildings, which are subject to the requirements of Section C403.3.5 without exceptions, the HVAC total system performance ratio (HVAC TSPR) of the proposed design HVAC system shall be more 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 with conditioned floor area less than 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 D601.11.1.
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 system served by heating water plants that include air to water or water to water heat pumps.
7. Underfloor air distribution HVAC systems.
8. Space conditioning systems that do not include mechanical cooling.
9. Alterations to existing buildings that do not substantially replace the entire HVAC system.
10. HVAC systems meeting all the requirements of the standard reference design HVAC system in Table D602.11, Standard Reference Design HVAC Systems.

C404.2.1 High input-rated service water heating systems for other than Group R-1 and R-2 occupancies. In new buildings where the combined input rating of the water-heating equipment installed in a building is equal to or greater than 1,000,000 Btu/h (293 kW), the combined input-capacity-weighted-average efficiency of water-heating equipment shall be no less than the following for each water heating fuel source:

1. Electric: A rated COP of not less than 2.0. For air-source heat pump equipment, the COP rating will be reported at the design leaving heat pump water temperature with an entering air temperature of 60°F(15.6°C) or less.
2. Fossil Fuel: A rated Et of not less than 90-92 percent as determined by the applicable test procedures in Table C404.2.

Exceptions:

1. Where not less than 25 percent of the annual service water-heating requirement is provided from any of the following sources:
 - 1.1. Renewable energy generated on site that is not being used to satisfy another requirement of this code;

or

- 1.2. Site recovered energy that is not being used to satisfy other requirements of this code.
2. Redundant equipment intended to only operate during equipment failure or periods of extended maintenance.
3. Electric resistance heated systems installed as part of an alteration where the water heating equipment is installed at the grade level in a building with a height of four stories or greater.
4. Hot water heat exchangers used to provide service water heating from a district utility (steam, heating hot water).
5. Water heaters provided as an integral part of equipment intended to only heat or boost the heat of water used by that equipment.
6. For electric heat systems, supplemental water heaters not meeting this criteria that function as auxiliary heating only when the outdoor temperature is below 32°F (0°C) or when a defrost cycle is required are not required to have a rated COP of 2.0. Such systems shall be sized and configured to lock out electric resistance or fossil fuel heating from operation when the outdoor temperature is above 32°F (0°C) unless the system is in defrost operation.
7. Systems connected to a low-carbon district energy exchange system.

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C404.2.2 High input-rated service water heating system for Group R-1 and R-2 occupancies. In new buildings with over 1,000,000 Btu/h installed service water heating capacity serving Group R-1 and R-2 occupancies, at least 25 percent of annual water heating energy shall be provided from any combination of the following water heating sources:

1. Renewable energy generated on site that is not being used to satisfy other requirements of this code;
- or
2. Site-recovered energy that is not being used to satisfy other requirements of this code.

Exception: Compliance with this section is not required if the combined input-capacity-weighted average equipment rating for each service water heating fuel source type is not less than the following:

1. Electric Resistance: An electric resistance water heater water with a rating of 105% of the rated efficiency of Table C404.2.
2. Electric Heat Pump (10 CFR Part 430): A heat pump water heater rated in accordance with 10 CFR Part 430 with a rating of 105% of the rated efficiency of Table C404.2.
3. Electric Heat Pump (not listed in accordance with 10 CFR Part 430): A heat pump water heater not rated in accordance with 10 CFR Part 430 shall have a COP of not less than 2.0. For air-source heat pump equipment the COP rating will be reported at the design leaving heat pump water temperature with an entering air temperature of 60°F (15.6°C) or less. Supplemental water heaters not meeting the above criteria that function as auxiliary heating only when the outdoor temperature is below 32°F (0°) or when a defrost cycle is required are not required to have a rated COP of 2.0. Such systems shall be sized and configured to lock out electric resistance or fossil fuel heating from operation when the outdoor temperature is above 32°F (0°C) unless the system is in defrost operation.
4. Fossil Fuels: A rated Et of not less than 90% as determined by the applicable test procedures in Table C404.2.
5. Hot water heat exchangers used to provide service water heating from a district utility (steam, heating hot water).

6. Systems connected to a low-carbon district energy exchange system.

Base language is approved Proposal 206. Proposed additions in **ORANGE** to incorporate feedback from 8/27 Energy TAG meeting, and ~~and~~ 8/31 and 9/13 working group sessions. All other black text and blue/yellow highlights are from approved proposal text.

[renumber credits as required for added district energy credit]

Measure Title	Applicable Section	Group R-1	Group R-2	Group B	Group E	Group M	All Other
1. Dwelling unit HVAC control	C406.2.1	NA	7	NA	NA	NA	NA
2. Improved HVAC TSPR ^a	C406.2.2.1	NA	8	11	17	22	NA
3. Improve cooling and fan efficiency	C406.2.2.2	2	1	2	2	3	2
4. Improve heating efficiency	C406.2.2.3	2	3	3	10	16	7
X. Improved Low Carbon District Energy Systems	C406.2.2.X	NA³	83	114	1711	2217	NA⁸
X. Improved Low Carbon District Energy Systems	C406.2.2.Y	9	10	12	33	52	24
5. High performance DOAS	C406.2.2.4	31	31	21	39	40	21 / (A) 40 ^b
6. Fault detection & diagnostics (FDD)	C406.2.2.5	2	2	2	6	9	4
7. 10% reduced lighting power	C406.2.3.1	7	4	18	16	20	15
8. 20% reduced lighting power ^c	C406.2.3.2	13	8	36	32	40	29
9. Lamp Efficacy Improvement	C406.2.3.3	5	6	NA	NA	NA	NA
10. Residential lighting control	C406.2.4.1	NA	8	NA	NA	NA	NA
11. Enhanced lighting control	C406.2.4.2	1	1	6	6	11	6
12. Onsite renewable energy	C406.2.5	7	12	13	13	10	11
13. Shower drain heat recovery	C406.2.6.1	9	30	NA	3	NA	NA
14. Service water heat recovery	C406.2.6.2	35	111	13	14	(Grocery) 41 ^d	NA
15. Heat Pump water heating	C406.2.6.3	NA	NA	17	33	(Grocery) 95 ^d	(A-2) 95 ^e
If proposal 21-GP1-136 is not included in the final WSEC, then replace the row above with the following:							
15. Heat Pump water heating	C406.2.6.3	81	261	17	33	(Grocery) 95 ^d	(A-2) 95 ^e
16. Heat trace system	C406.2.7.1	6	13	4	1	NA	26 6
17. Point of use water heater	C406.2.7.2	NA	NA	56 19	45 5	NA	NA
18. Service Hot Water Distribution Right Sizing	C406.2.8	13	42	NA	NA	NA	NA
19. Enhanced envelope performance ^f	C406.2.9	24	20	13	5	19	14
20. Base Reduced air infiltration ^f	C406.2.10.2	29	24	6	3	9	11
21. Enhanced Reduced air infiltration ^f	C406.2.10.2	53	44	11	5	16	20
22. Enhanced commercial kitchen equipment	C406.2.11	NA	NA	NA	NA	NA	(A-2) 31 ^e
23. Enhanced residential kitchen equipment	C406.2.12	12	19	NA	NA	NA	NA

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24. Enhanced residential laundry equipment	C406.2.13	NA	6	NA	NA	NA	NA
25. Efficient elevator equipment	C406.2.14	3	5	5	5	4	4

- a. Projects using ~~this option~~ Item 2 shall not use Items 3 through 5 2.
- b. For C406.2.2.4 occupancy Group A achieves 40 credits while other occupancy groups within the "all other" category achieve 21 credits.
- c. Projects using C406.2.3.2 shall not use C406.2.3.1.
- d. Service water heat recovery and heat pump water heating are available in Group M only for grocery stores larger than 10,000 square feet. Large mixed retail with full grocery and butcher sections shall achieve half the credits.
- e. Heat pump water heating and kitchen equipment efficiency credits are available in the "all other" category only for Group A-2.
- f. Buildings or building areas that are exempt from thermal envelope requirements in accordance with Sections C402.1.1 and C402.1.2 do not qualify for ~~this~~ these package measures.

C406.2.2 More efficient HVAC System Performance. All heating and cooling systems shall meet the minimum requirements of Section C403 and efficiency improvements shall be referenced to minimum efficiencies listed in Tables referenced by Section C403.3.2. Where multiple efficiency requirements are listed, equipment shall meet the seasonal efficiencies including SEER, EER/IEER, IPLV, or AFUE. Equipment that is larger than the maximum capacity range indicated in Tables referenced by Section C403.3.2 shall utilize the values listed for the largest capacity equipment for the associated equipment type shown in the table. Where multiple individual heating or cooling systems serve the project, the improvement shall be the weighted average improvement based on individual system capacity.

For occupancies and systems required to comply with Section C403.1.1, credits are permitted to be achieved by meeting the requirements of C406.2.2.1. Other systems are permitted to achieve credits by meeting the requirements of either:

1. C406.2.2.2 More efficient HVAC equipment cooling and fan performance
2. C406.2.2.3 More efficient HVAC equipment heating performance
3. C406.2.2.4 High performance dedicated outdoor air system (DOAS)
4. Any combination of C406.2.2.2, C406.2.2.3, and C406.2.2.4

In addition, energy credits are permitted to be achieved for C406.2.2.5 fault detection and diagnostics (FDD) where not otherwise required by Sections C403.2.3 or C403.6.10(15).

C406.2.2.1 Improved HVAC TSPR. For systems required to comply with Section C403.1.1, HVAC total system performance ratio, the TSPR shall exceed the minimum requirement by 5 percent. If improvement is greater, credits in Table C406.2 are permitted to be prorated up to a 20 percent improvement.

C406.2.2.2 More efficient HVAC equipment cooling and fan performance. No less than 90 percent of the total HVAC capacity serving the total conditioned floor area of the entire building, or tenant space in accordance with Section C406.1.1, shall comply with Sections C406.2.2.2.1 through C406.2.2.2.3. Where individual equipment efficiencies vary, weight them based on capacity. For systems required to comply with Section C403.1.1, HVAC total system performance ratio, exceed the minimum requirement by 10 percent.

Exception: In low energy spaces complying with Section C402.1.1 and semi-heated spaces complying with Section C402.1.1.2, no less than 90 percent of the installed heating capacity is provided by electric infrared or gas-fired radiant heating equipment for localized heating applications. Stand-alone supply, return and exhaust fans shall comply with Section C406.2.3.

C406.2.2.1 HVAC system selection. Equipment installed shall be types that are listed in Tables referenced by Section C403.3.2. (1) through C403.3.2(12) or a combination thereof. Electric resistance heating does not meet this requirement.

Exception: Allowed equipment not listed in Tables C403.3.2(1) through C403.3.2(13):

1. ~~Air-to-water heat pumps.~~
2. ~~Heat recovery chillers.~~

C406.2.2.2.2 Minimum e Cooling Equipment efficiency. Equipment shall exceed the minimum cooling efficiency requirements listed in Tables referenced by Section C403.3.2(1) through C403.3.2(12) by at least 15 percent, in addition to the requirements of Section C403. Where multiple performance requirements are provided, the equipment shall exceed all the requirements by 15 percent. Where equipment exceeds the minimum annual cooling efficiency and heat rejection efficiency requirements by more than 5 percent, energy efficiency credits for cooling shall be determined using Equation 4-C406.2.2.2, rounded to the nearest whole number.

$$EE_{CHEC} = EEC_5 \times [1 + ((CEI - 5 \text{ percent}) \div 5 \text{ percent})] \quad (\text{Equation 4-C406.2.2.2})$$

Where:

EE_{CHEC} = energy efficiency credits for cooling efficiency improvement

EEC_5 = C406.2.2.2 credits from Tables C406.2

CEI = the lesser of: the improvement above minimum cooling efficiency requirements, minimum heat rejection efficiency requirements, or 20 percent. Where cooling efficiency varies by system, use the capacity weighted average efficiency improvement for all cooling equipment combined. Where cooling rating reduces as efficiency increases, base the efficiency improvement on the inverse of the rating.

Exceptions:

1. Equipment that is larger than the maximum capacity range indicated in Tables referenced by Section C403.3.2(1) through C403.3.2(12) shall utilize the values listed for the largest capacity equipment for the associated equipment type shown in the table.
2. Equipment complying with the exception to Section C406.2.1 is not required to comply with the minimum equipment efficiency requirement.
3. Compliance may be demonstrated by calculating a total weighted average percentage for all heating and cooling equipment combined. All equipment shall have efficiency that is no less than 5 percent better than the minimum required efficiency in Tables C403.3.2(1) through C403.3.2(12), and the resulting weighted average percentage for all equipment performance requirements shall exceed 15 percent. Calculation shall include heating and cooling capacities for all equipment, percentage better or worse than minimum required efficiency per Tables C403.3.2(1) through C403.3.2(12) for each performance requirement (SEER, EER/IEER, COP, HSPF, Et, Ec and AFUE), and the total weighted average efficiency percentage.
4. Hot water boilers with input capacity greater than 2,500,000 Btu/h shall be considered to comply with this section with a minimum thermal efficiency of 95 percent E_t per the test procedure in 10 CFR Part 434.

C406.2.2.2.3 Minimum fan efficiency. Where fan energy is not included in packaged equipment rating or it is and the fan size has been increased from the as-rated equipment condition, fan power or horsepower shall be less than 95 percent of the allowed fan power in Section C403.8.1, Allowable fan motor horsepower. Stand-alone supply, return and exhaust fans designed for operating with motors over 750 watts (1 hp) shall have a fan efficiency grade of not less than FEG 71 as defined in AMCA 205. The total efficiency of the fan at the design point of operation shall be within 10 percentage points of either the maximum total efficiency of the fan or the static efficiency of the fan.

C406.2.2.3 More efficient HVAC equipment heating performance. No less than 90 percent of the total HVAC capacity serving the total conditioned floor area of the entire building, or tenant space in accordance with Section C406.1.1, shall comply with Sections C406.2.2.3.1 through C406.2.2.3.2

C406.2.2.3.1 HVAC system selection. Equipment installed shall be types that are listed in Tables referenced by Section C403.3.2. Electric resistance heating shall be limited to 20 percent of system capacity, with the exception of heat pump supplemental heating.

C406.2.2.3.2 Heating equipment efficiency. Equipment shall exceed the minimum heating efficiency requirements listed in Tables referenced by Section C403.3.2 by at least 5 percent. Where equipment exceeds the minimum annual heating efficiency requirements by more than 5 percent, energy efficiency credits for heating shall be determined using Equation 4-C406.2.2.3 rounded to the nearest whole number.

$$EE_{CHEH} = EEC_5 \times [1 + ((CEI - 5 \text{ percent}) \div 5 \text{ percent})] \quad (\text{Equation 4-C406.2.2.3})$$

Where:

EE_{CHEH} = energy efficiency credits for heating efficiency improvement

EEC_5 = C406.2.2.3 credits from Tables C406.2

CEI = the lesser of: the improvement above minimum heating efficiency requirements, or 20 percent. Where heating efficiency varies by system, use the capacity weighted average percentage for all heating equipment combined.

Exception to C406.2.2.3.2: In low energy spaces complying with Section C402.1.1 and semi-heated spaces complying with Section C402.1.1.2, no less than 90 percent of the installed heating capacity is provided by electric infrared or gas-fired radiant heating equipment for localized heating applications. Such spaces shall achieve credits for EECs.

C406.2.2.X Improved Low Carbon District Energy Systems. Not less than 90 percent of the annual service hot water and space heating load, or not less than 90 percent of the annual service hot water, space heating, and space cooling load shall meet the criteria of C406.2.2.X.1 or C406.2.2.X.2.

Documentation for the low-carbon district system that is operational prior to the final inspection shall be provided to demonstrate that the definition of low-carbon district energy exchange system is satisfied.

C406.2.2.X.1 Low-carbon District Energy Exchange Systems. Low-carbon district energy exchange systems must demonstrate the following:

1.1 45% of the annual district-system-net-load-met (sum of heating and cooling energy provided to attached buildings) comes from heat recovery between connected buildings, waste heat, or renewable energy resources and no more than 25% of the annual heat input to the system comes from fossil fuel or electric-resistance sources.

~~1.2~~ or

1 **C406.2.2.X.2 Low-carbon District Energy Heating and Cooling or Heating only Systems.** Distribution losses must be accounted for and may not exceed 5% of the annual load delivered to buildings served by the system. Low-carbon district energy heating and cooling or heating only systems must demonstrate the following:

2.1 45% of the annual district-system-net-load-met (sum of heating and cooling energy provided to attached buildings) comes from heat recovery between connected buildings, waste heat, or renewable energy resources and no more than 25% of the annual heat input to the system comes from fossil fuel or electric-resistance sources.

or

2.2 No more than 10% of the system annual heat input to the system comes from fossil fuels or electric-resistance sources. The remaining annual heat input must be provided using heat pump technology with a minimum annual operating COP of 3.0.

~~2.2~~

~~2.2~~ or

service hot water and space heating load, or not less than 90 percent of the annual service hot water, space heating, and space cooling load shall meet the criteria of C406.2.2.Y.1 or C406.2.2.Y.2.

Documentation for the low-carbon district system that is operational prior to the final inspection shall be provided to demonstrate that the definition of low-carbon district energy exchange system is satisfied.

C406.2.2.Y.1 Low-carbon District Energy Exchange Systems. Low-carbon district energy exchange systems must demonstrate the following:

1.1 50% of the annual district-system-net-load-met (sum of heating and cooling energy provided to attached buildings) comes from heat recovery between connected buildings, waste heat, or renewable energy resources and no more than 10% of the annual heat input to the system comes from fossil fuel or electric-resistance sources.

C406.2.2.Y.2 Low-carbon District Energy Heating and Cooling or Heating only Systems. Distribution losses must be accounted for and may not exceed 5% of the annual load delivered to buildings served by the system. Low-carbon district energy heating and cooling or heating only systems must demonstrate the following:

2.1 50% of the annual district-system-net-load-met (sum of heating and cooling energy provided to attached buildings) comes from heat recovery between connected buildings, waste heat, or

renewable energy resources and no more than 10% of the annual heat input to the system comes from fossil fuel or electric-resistance sources.

or

2.2 No more than 10% of the system annual heat input to the system comes from fossil fuels or electric-resistance sources. The remaining annual heat input must be provided using heat pump technology with a minimum annual operating COP of 4.0.

C406.2.2.4 High performance dedicated outdoor air system (DOAS). No less than 90 percent of the total conditioned floor area of the whole project, excluding floor area of unoccupied spaces that do not require ventilation per the *International Mechanical Code*, shall be served by DOAS installed in accordance with Section C403.3.5 with the following adjustments:

1. Minimum heat recovery sensible effectiveness of 80 percent, calculated in accordance with Section C403.3.5.1.
2. Where design outdoor airflow is greater than 500 cfm (250 L/s), the DOAS shall be equipped with an economizer bypass, damper control, or wheel speed control that is active between 55°F (12°C) and 75°F (24°C) and minimizes energy recovery or maintains an appropriate DOAS leaving air temperature when the building is generally in cooling, based either on outdoor air temperature or a DDC zone-based cooling system reset.
3. DOAS total combined fan power shall be less than either:
 - 3.1. 0.769 W/cfm (1.55 W/L/s) when calculated in accordance with Section C403.3.5.2, or
 - 3.2. 80% of fan power allowance for a constant volume system when calculated in accordance with Section 403.8.1

C406.2.2.5 Fault detection and diagnostics system.

A project not required to comply with C403.2.3 or C403.6.10(15) shall achieve energy credits for installing a fault detection and diagnostics system to monitor the HVAC system's performance and automatically identify faults. The installed system shall comply with items 1 through 6 in Section C403.2.3.

C406.82.6.2 Load fraction Service Water Heating Energy Recovery. Not less than ~~60~~ 30 percent of the annual service hot water heating energy use, or not less than ~~400~~ 70 percent of the annual service hot water heating energy use in buildings with water-cooled chiller systems subject to the requirements of Section ~~C403.9.5~~ C403.9.2.1 or qualifying for one of its exceptions, shall be provided by one or more of the following:

Service hot water system delivering heating requirements using heat pump technology with a minimum COP of 3.0. For air source equipment, the COP rating will be reported at the design leaving heat pump water temperature with an entering air temperature of 60°F (15.6°C) or lower. For water source equipment, the COP rating will be reported at the design leaving load water temperature with an entering water temperature of 74°F (23.3°C) or lower.

1. 2 Waste heat recovery from service hot water, heat recovery chillers, building equipment, process equipment, or other approved system. Qualifying heat recovery must be above and beyond heat recovery required by other sections of this code.
2. 3 On site renewable energy water-heating systems where not used to meet other requirements or to obtain other energy credits.

C406.9 High performance service water heating in multifamily buildings. For a whole building, building addition, or tenant space with not less than 90 percent of the conditioned floor area being Group R-2 occupancy, not less than 90 percent of the annual building service hot water energy use shall be provided by a heat pump system with a minimum COP of 3.0. This efficiency package measure is allowed be taken in addition to Section C406.2.8.2.

C406.2.6.3 Heat Pump Service Water Heating

Projects shall achieve credits through compliance with C406.2.6.3.1 **or** C406.2.6.3.2.

If proposal 21-GP1-136 is not included in the final WSEC, add the "or" language above.

C406.2.6.3.1 Heat Pump Water Heater. Credits shall be achieved where service hot water system capacity is 82,000 Btu/h (24 kW) or less and is served using air-source heat pump technology with a minimum COP of 3.0 no more than 4.5 kW of resistance supplemental heating and meets one of the following:

1. The COP rating will be with a minimum COP of 3.0 and reported at the design leaving heat pump water temperature with an entering air temperature of 60°F (15.6°C) or lower. For water-source equipment, the COP rating will be reported at the design leaving load water temperature with an entering water temperature of 74°F (23.3°C) or lower.
2. The Uniform Energy Factor (UEF) shall be a minimum of 3.40 rated based on U.S. Department of energy requirements.

The following credit shall be included if proposal 21-GP1-136 is not included in the WSEC as a prescriptive measure:

C406.2.6.3.2. Central Heat Pump Service Water Heating.

Energy credits shall be achieved by . . .

[include the heat pump water heater requirements in proposal 136, Sections C402.2.1 through C402.1.5 (without exceptions and with required definitions) here with necessary renumbering]

[verify section C404.2.1 incorporates exceptions allowing low-carbon district energy systems to comply]

C406.2.7 Improved Service Hot Water Temperature Maintenance

For buildings with gross floor area greater than 10,000 square feet, credits shall be achieved when hot water temperature maintenance is installed in accordance with one of the following:

C406.2.7.1 Self-regulated heat trace system. The credit achieved shall be from Table C406.2. This system shall include self-regulating electric heat cables, connection kits, and electronic controls. The cable shall be installed directly on the hot water supply pipes underneath the insulation to replace standby losses.

C406.2.7.2 Point of Use Water Heater. The credit achieved shall be from Table C406.2 where any fixtures requiring hot water shall be supplied from a localized electric source of hot water with no recirculation or heat trace and limited to 2kW and 6 gallons of storage. The supply pipe length from the point of use water heater to the termination of the fixture supply pipe shall be no more than 20 feet.

C406.2.8 Service Hot Water Distribution Right Sizing

To achieve this credit, where Group R-1 and R-2 occupancies are served by a central service hot water system, the distribution system serving dwelling units and guest rooms shall be sized using IAPMO/ANSI *Uniform Plumbing Code UPC 1-2018*, Appendix M.

Note: Consider including the following informative note or commentary to clarify the requirements of C406.2.8

Informative Note: *Where the distribution sizing protocol is applied to other than multi-family residential buildings, a variance to the plumbing code may be needed. Note that UPC Appendix M is based on IAPMO/ANSI WE•Stand – 2017 Water Efficiency and Sanitation Standard for the Built Environment].*

More efficient HVAC equipment and fan performance. *No less than 90 percent of the total HVAC capacity serving the total conditioned floor area of the entire building, or tenant space in accordance with Section*

Commented [ALB2]: Do we need to define an efficiency for the WWHP on site? Submitting without to try to keep this open, may be a TAG comment

C406.1.4.1 compliance with C406.2.2.2 for systems that comply with C406.1.1 HVAC systems for commercial buildings, 10 credit

District energy systems which utilize low-carbon fuel sources and that enable cross-project heat recovery or energy sharing should be encouraged as a method for achieving the state’s targeted carbon emission reductions. Proposed language adds more a new C406 credit options for projects that utilize a low-carbon district energy exchange system to achieve prescriptive code compliance in section C406.

Language is intended to be flexible enough not to force a single method (ie- water-to-water-heat-pump) for buildings to interact with energy exchange loop, preserving creative design decisions while still requiring the ultimate source of heating to be from a high-efficiency system.

A parallel proposal has been submitted to modify existing C406 credits for district energy exchange systems instead of proposing new C406 credits if that is deemed to be the more reasonable approach.

Definition could be tweaked in future code cycles to reduce the portion of district energy coming from non-renewable or fossil fuel sources.

- Commented [NM3]:** Do we need to add in requirements for the WWHP or WSHP equip efficiency requirements, or just attachment to the system ok?
- Commented [ALB4]:** Do we need to define an efficiency for the WWHP on site? Submitting without to try to keep this open, may be a TAG comment
- Commented [NM5]:** Want to discuss how a district energy exchange system would work with these. Do we need any additions?

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Update 9/14: The added credits for C406.2.2.X and C406.2.2.Y are based on analysis establishing a % reduction in carbon emissions per BTU delivered, assuming a similar baseline hydronic plant complying with the Proposal #103 for C403.1.4. The analysis assumed a lowest possible efficiency plant complying with the criteria stated with the credits.

The point totals are equal to the sum of half of the C406.2.2.2 credits and the full C406.2.2.3 allocations, which are also a 5% reduction from PNNL’s prototype modeling analysis completed for the approved #206 proposal. The C406.2.2.2 points are reduced by half to account for the cooling savings only, since this proposal does not account for impact of on-site fans and is based on heating and cooling only. This is the approach discussed in the 8/31 and 9/13 working group sessions, which included the proponent of the approved 206 proposal who completed the modeling analysis for those credits.

The full analysis and calculations are available for review with interested parties. Clips of the calculated baseline vs. district energy scenarios is shown below. The credits are in two tiers - ~5% reduction in emissions and ~15% emissions reductions.

Heating and Cooling Baseline emissions target:

	Effective Energy COP	Renewable (Biogas)	% of Annual Load	COP	Fuel Source	Emissions Factor	Units	Energy input	GHG Emissions
Heating and Cooling Plant (Baseline with Heat Pumps)	3.5	Heat Recovery	0%	8	Electricity	0.44	lb/kWh	0.000	0.00
	Effective Emissions COP (lb/MBtu)	Chiller	50%	7.03	Electricity	0.44	lb/kWh	0.071	0.01
		AWHP	48%	2.5	Electricity	0.44	lb/kWh	0.190	0.02
	36.9	Fossil Fuel	0%	0.95	Natural Gas	11.7	lb/therm	0.000	0.00
		Electric Resistance	3%	1	Electricity	0.44	lb/kWh	0.025	0.00
		Pumping	0%	1	Electricity	0.44	lb/kWh	0.000	0.00
		Distribution Losses	0%	4.7	n/a	0	lb/kBtu	0.000	0.00
		Total	100%					0.286	0.037

Heating and Cooling >5% reduction emissions target:

	Effective Energy COP	Renewable (Biogas)	% of Annual Load	COP	Fuel Source	Emissions Factor	Units	Energy input	GHG Emissions
Heating and Cooling Tighter Criteria (5% reduction): 41% Heat Recovery 25% Fossil Fuel Limit 5% Distribution Losses	3.6	Heat Recovery	38%	9	Electricity	0.44	lb/kWh	0.047	0.0061
	Effective Emissions COP (lb/MBtu)	Chiller	27%	7.03	Electricity	0.44	lb/kWh	0.039	0.0050
		WWHP	0%	4	Electricity	0.44	lb/kWh	0.000	0.0000
	34.9	AWHP	20%	2.5	Electricity	0.44	lb/kWh	0.081	0.0105
		Fossil Fuel	7%	0.95	Natural Gas	11.7	lb/therm	0.071	0.0084
		Electric Resistance	0%	1	Electricity	0.44	lb/kWh	0.000	0.0000
		Pumping	3%	1	Electricity	0.44	lb/kWh	0.030	0.0039
		Distribution Losses	5%	5.5			lb/kBtu	0.009	0.0011
	Total	100%					0.278	0.035	

Heating and Cooling >15% reduction emissions target:

		% of Annual Load	COP	Fuel Source	Emissions Factor	Units	Energy input	GHG Emissions
Heating and Cooling Tighter Criteria: 50% Heat Recovery/Renewable 10% Fossil Fuel Limit 5% Distribution Losses	Effective Energy COP	Renewable (Biogas)	0%	0.95	On-Site Renewable	0	0	0.000
	4.2	Heat Recovery	46%	8	Electricity	0.44	lb/kWh	0.058
	Effective Emissions COP (lb/MBtu)	Chiller	23%	7.03	Electricity	0.44	lb/kWh	0.033
	30.1	WWHP	0%	4	Electricity	0.44	lb/kWh	0.000
	18.5%	AWHP	21%	2.5	Electricity	0.44	lb/kWh	0.083
		Fossil Fuel	2%	0.95	Natural Gas	11.7	lb/therm	0.024
		Electric Resistance	0%	1	Electricity	0.44	lb/kWh	0.000
		Pumping	3%	1	Electricity	0.44	lb/kWh	0.030
		Distribution Losses	5%	5.8			lb/kBtu	0.009
		Total	100%					0.236

Your name Clarence Clipper Email address clarence.clipper@centrioenergy.com
 Your organization Centrio Phone number
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