STATE OF WASHINGTON

STATE BUILDING CODE COUNCIL

Log No. 121-C
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Revised 8/26/21
Low Carbon District Energy Exchange System++

Washington State Energy Code Development

Standard Energy Code Proposal Form

Code being amended: ☒ Commercial Provisions ☐ Residential Provisions

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 create a ne low-carbon district energy exchange systems for HVAC space heating and service water heati

Update to same definition as Proposal 122A

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.)

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.

Documentation for the low-carbon district energy exchange system must be available to 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.

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 l imps.
7. Underfloor air distribution
8. Space conditioning syster

Add the following match language of Proposal 122A: 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.

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 bereported 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*.

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. ements of this code.

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fo be is not less than the

Add the following match language of Proposal 122A: 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.

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
3. Electric Heat Pump (not listed in accordan not rated in accordance with 10 CFR Part source heat pump equipment the COP rati water temperature with an entering air tem water heaters not meeting the above criter 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*.

Add the following match language of Proposal 122A: 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.XX Low Carbon district energy exchange system for HVAC equipment performance. No less than 90 percent of the total HVAC capacity serving the total conditioned floor area of the entire building, or tenant space shall connect to a *low-carbon district energy exchange system*.

C406.XY Reduced energy use in service water heating. Buildings with service hot water heating equipment that serves the whole building, building addition or tenant space shall comply with Sections C406.XY.1 and C406.XY.2.

C406.XY.1 Building type. Not less than 90 percent of the *conditioned floor area* of the whole building, building addition or tenant space shall be of the following types:

1. Group R-1: Boarding houses, hotels or motels.
2. Group I-2: Hospitals, psychiatric hospitals and nursing homes.
3. Group A-2: Restaurants and banquet halls or buildings containing food preparation areas.
4. Group F: Laundries.
5. Group R-2.
6. Group A-3: Health clubs and spas.
7. Buildings with a service hot water load of 10 percent or more of total building energy loads, as shown with an energy analysis as described in Section C407 or as shown through alternate service hot water load calculations showing a minimum service water energy use of 15 k/Btu per square foot per year, as approved by the building official.

C406.XY.2 Load fraction. Not less than 60 percent of the annual service hot water heating energy use, or not less than 100 percent of the annual service hot water heating energy use in buildings with water-cooled systems subject to the requirements of Section C403.9.5 or qualifying for one of its exceptions, shall be provided by a low-carbon district energy exchange system.

C406.XZ 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 sourced from a *low-carbon district energy exchange system*. This efficiency package is allowed be taken in addition to Section C406.XY.2.

TABLE C4(

Add the following match language of Proposal 122A: 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.

Code Section	Commercial Building Occupancy					
	Group R-1	Group R-2	Group B	Group E	Group M	All Other
	Additional Efficiency Credits					
Low carbon district energy exchange system for HVAC equipment performance in accordance with C406.XX	2.0	3.0	3.0	2.0	1.0	2.0
High-efficiency service water heating in accordance with Sections C406.XY.1 and C406.XY.2	4.0	5.0	NA	NA	NA	8.0
High performance service water heating in multi-family buildings in accordance with Section C406.XZ	7.0	8.0	NA	NA	NA	NA

Purpose of code change:

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 a new C406 credit option 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.

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	Clarence Clipper	Email address	clarence.clipper@centrioenergy.com
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Other contact name	Click here to enter text.		

Economic Impact Data Sheet

Briefly summarize your proposal's primary economic impacts and benefits to building owners, tenants and businesses.

A significant economic benefit of this proposal is that it introduces more options for energy code compliance for projects which invest in systems that provide long-term lower carbon operation.

Depending on the specifics, the on-site equipment is likely less expensive than a stand alone plant (if heat pump provisions are adopted). Buildings that primarily "add" heat to a district energy exchange system largely benefit in freeing up roof space and capital cost that would be required for heat rejection equipment, as well as eliminating potential cooling tower plume concerns at the site. Buildings that "pull" heat from the district energy system will likely utilize equipment to extract the heat from the condenser water loop (often Water-to-Water Heat Pumps (WWHP)) which is likely less expensive than an all-on-site plant which may include Air-to-Water Heat Pumps and backup electric boilers and associated electrical service increase.

This proposal creates a viable energy code compliance path to enable projects with diverse/complimentary load profiles to exchange energy beyond the footprint of their sites on a utility scale instead of requiring owner-to-owner negotiations.

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**)

$0.50-$2.00 ROM Capital Cost savings/square foot, Operating costs may be similar

(For residential projects, also provide $Minimal cost impact in units – capital cost impacts for central equipment / dwelling unit)

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

Buildings that primarily "add" heat to a district energy exchange system largely benefit in freeing up roof space and capital cost that would be required for heat rejection equipment.

Buildings that "pull" heat from the district energy system will likely utilize equipment to extract the heat from the condenser water loop (often Water-to-Water Heat Pumps (WWHP)) which is likely less expensive than an all-on-site plant which may include Air-to-Water Heat Pumps and backup electric boilers and associated electrical service increase.

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

See energy discussion below - Highly dependent upon connected building loads) KWH/ square foot (or) KBTU/ square foot

(For residential projects, also provide KWH/KBTU / dwelling unit)

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

Energy modeling of projects that have both office and residential towers on immediately adjacent sites (and thus can implement direct energy exchange between the cooling dominated offices and heating dominated residences), shows that there is a significant increase in heat recovery potential when the projects can exchange energy compared to any heat recovery available within each individual project. For example, a stand-alone residential tower might be able to meet ~10-15% of its gross annual heating load (space heating, DHW, pool etc) from on-site recovered heat (cooling). However, when connected to an equivalent sized office tower, with year-round heat-rejection needs, 40-60% of the gross heating load can be met by heat-recovery equipment.

Given a source of heat, such as district energy exchange systems, water-to-water-heat-pumping can operate significantly more efficiently than air-to-water-heat-pumping (COPs of 5-7 instead of COPs of 2-3). Thus there is a big site energy "win" for heating dominated buildings to use heat recovery options as the first stage of heating before utilizing even AWHPs.

The exact energy savings that can be expected vary significantly based on the exact project type and balance of loads on a given energy exchange system, and there may be times when heat must be added by district equipment to maintain a minimum loop temperature. That is why this proposal introduces language to define a "low carbon district energy system" with minimum % of heat that must come from heat-recovery and maximum % of heat that can come from fossil fuels or electric resistance (values that can be modified by the TAG or in future code cycles). This would ensure that the energy code is only encouraging the most efficient district energy recovery schemes while still allowing projects to gain the design flexibility introduced by connecting to such systems. The minimal allowance for fossil fuel or electric resistance inputs gives some flexibility for these large-scale systems to ramp up to full operation (year-one load balance might not be significantly different than the established system operation).

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

Allowing a straight forward path for prescriptive compliance (and achieving adequate C406 credits) for a project connecting to a low carbon district energy system should allow for LESS review time for an individual project, though the district system provider will have to work with code officials to initially establish that their system meets the low carbon designation, thus opening the door for projects to connect and take advantage of the proposed code language.

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