2021 WSEC Commercial

KEY CHANGES TO THE MECHANICAL PROVISIONS

PART 2

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WSEC Commercial Technical Support

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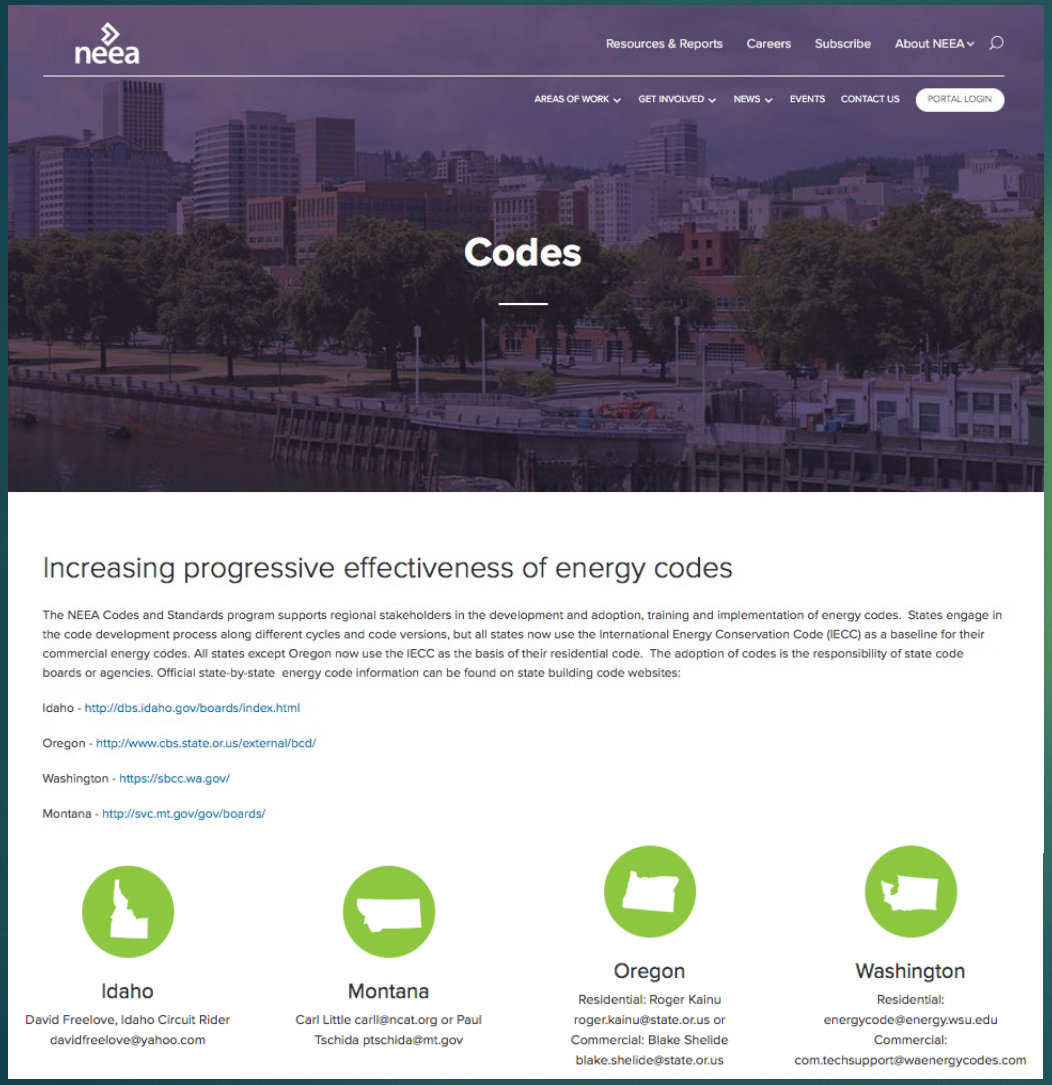

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Today's Presentation

- This presentation represents ETC's ***unofficial*** interpretation of code intent.
- Our technical support team is not an affiliate, nor do we speak for the Washington State Building Code Council (SBCC).
- The WSEC commercial technical support we provide is advisory only and non-binding.

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Topics we'll discuss today ~

1. Economizer exceptions
2. Demand control ventilation (DCV)
3. HVAC door interlock controls
4. Demand responsive controls
5. Hydronic system design requirements
6. Mechanical additional energy efficiency measures
7. Mechanical load management measures
8. Q&A

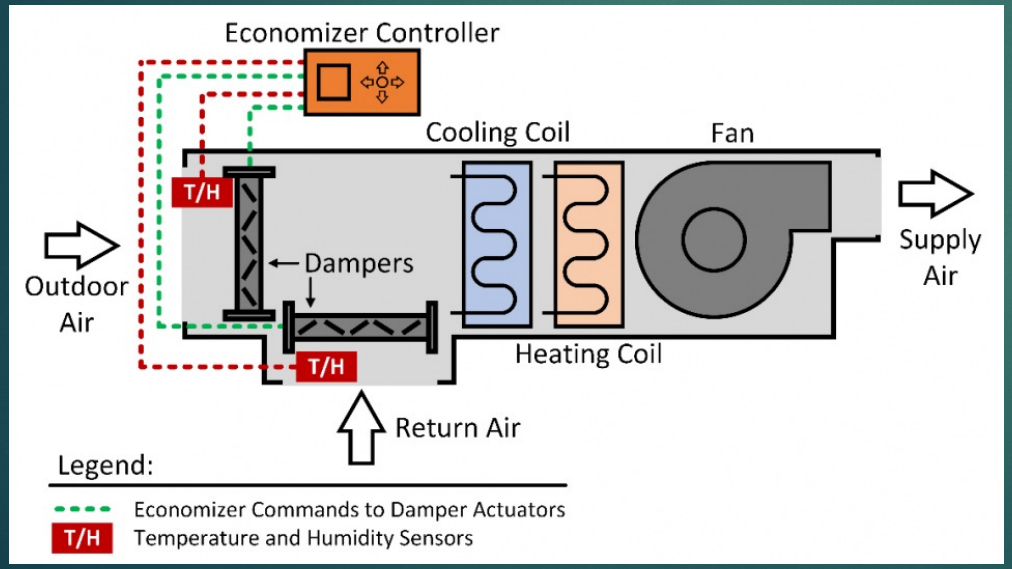
Current Status of the 2021 WSEC-C

- **Effective date of the 2021 WSEC has been delayed until October 29th, 2023**
- The Energy Code Technical Advisory Group (TAG) is being reconvened to address legal uncertainty stemming from the decision in California Restaurant Association v. City of Berkeley recently issued by the Ninth Circuit Court of Appeals.
- This presentation covers changes between the 2018 and 2021 WSEC-C that are not likely to be affected by this process.
- Follow the Washington State Building Council **https://www.sbcc.wa.gov/** for the latest news or to participate in the code development process.

Economizer Exceptions

Economizer Requirement

- **C403.5 Air economizers** – Required on all new cooling systems including those serving computer server rooms, electronic equipment, radio equipment and telephone switchgear



- Economizer shall be the first stage of cooling when available
- Sized to provide 100% outside air supply
- Relief air system sized for 100% outside air

C403.5

Location of Cooling System Supply Fan

There are two locations that define cooling equipment eligibility for Economizer Exceptions 1a, 1b and 5:

- Cooling systems where the supply fan **IS NOT** installed outside the building thermal envelope nor in a mechanical room adjacent to the outdoors
- Cooling systems where the supply fan **IS** installed outside the thermal envelope or within a mechanical room adjacent to outdoors

Cooling Systems Paired with DOAS

Economizer Exception 1a – Cooling systems serving spaces **other than Group R2 occupancy**

- Economizer requirements do not apply to a cooling system that complies with **ALL** of the following:
  1. Cooling systems where the supply fan **IS NOT** installed outside the building thermal envelope nor in a mechanical room adjacent to the outdoors
  2. Ventilation air is delivered to the spaces served by a dedicated outdoor air system (DOAS) that complies with Section C403.3.5
  3. Spaces served by the cooling system have year-round cooling loads from lights and equipment of less than 5 watts per square foot

C403.5 Exception 1a

Cooling Systems Paired with DOAS

Cooling system types that are eligible for **Exception 1a** include:

- Ductless heat pumps and AC units
- Ducted split system heat pumps and AC units not installed in a mechanical room adjacent to the outdoors
- Package terminal heat pumps and AC units (PTHP/PTAC)
- Single packaged vertical heat pumps and AC units (SPVHP/SPVAC)
- Water source heat pumps installed above the ceiling or in a mechanical room that is not adjacent to the outdoors
- Chilled water fan coils

C403.5 Exception 1a

Group R-2 Cooling Systems Paired with DOAS

VENTILATION BASELINE – C403.3.6 Ventilation for Group R-2 Multi-family

- Balanced ventilation system with heat recovery that provides outdoor air to all habitable spaces
- ERV/HRV shall have at minimum **60%** sensible recovery effectiveness

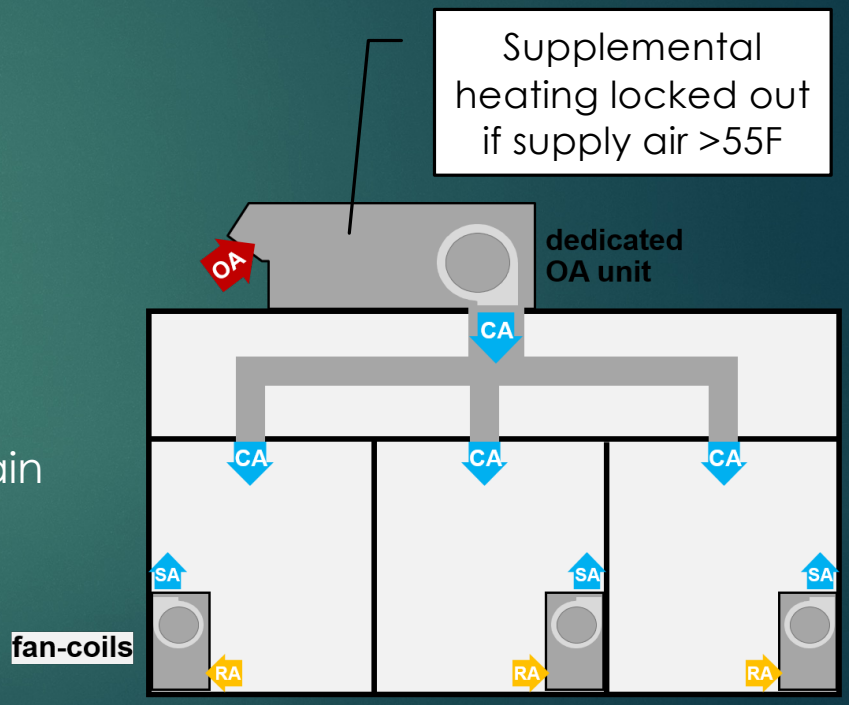
C403.3.5 Dedicated outside air systems (DOAS)

- Energy recovery device shall have at minimum **68%** sensible recovery effectiveness (per Equation 4-9) or 60% enthalpy recovery ratio (per C403.7.6)
- Comply with DOAS fan power limits – 1 watt/cfm or comply with C403.8.1
- Comply with DOAS supplemental heating & cooling limitations (per C403.7.3)

C403.3.6, C403.3.5

DOAS Supplemental Heating or Cooling

- Supplemental heating shall not warm ventilation supply air to greater than 55°F
- Supplemental cooling is permitted for dehumidification only
- Cooling coil shall be sized to meet peak dehumidification requirement at design outdoor temperatures, and no larger
- Cooling coil shall be controlled to maintain supply air RH or zone RH



C403.7.3

Group R-2 Cooling Systems Paired with DOAS

Economizer Exception 1b – Cooling systems serving **Multi-family**

- Economizer requirements do not apply to a cooling system that complies with **ALL** of the following:
  1. Cooling systems where the supply fan **IS NOT** installed outside the building thermal envelope nor in a mechanical room adjacent to the outdoors
  2. Ventilation air is delivered to the spaces served via an ERV/HRV that has at minimum 68% sensible recovery or 60% enthalpy recovery heating effectiveness and complies with Section C403.3.5 DOAS
  3. Spaces served by the cooling system have year-round cooling loads from lights and equipment of less than 5 watts per square foot

C403.5 Exception 1b

Group R with High Efficiency Cooling Systems

Economizer Exception 5 – Cooling systems serving **Group R**

- Applies to Group R-1 hotel/motel and Group R-2 multi-family
- Exception eligibility capacity thresholds:
  - Max capacity < 20,000 Btu/h – Cooling equipment where the supply fan **IS NOT** installed outside the building thermal envelope nor in a mechanical room adjacent to the outdoors
  - Max capacity < 54,000 Btu/h – All other cooling equipment, including those where the supply fan **IS** installed outside the thermal envelope or within a mechanical room adjacent to outdoors
  - For split systems, compliance is based on the cooling capacity of individual fan coil units

C403.5 Exception 5

Group R-2 Cooling Systems Paired with DOAS

Economizer Exception 5 – Cooling systems serving **Group R**

- Economizer requirements do not apply to the following cooling systems that qualify per the exception eligibility capacity thresholds:
  - High-efficiency cooling equipment with IEER, CEER, SEER, and EER values that are **>15%** better than code minimum efficiencies
  - Includes unitary heat pumps & AC units, ducted & ductless split system heat pumps & AC units, PTHP/PTAC, SPVHP/SPVAC, room AC units, VRF systems
  - High-efficiency chillers & heat recovery chillers with IPLV.IP values that are **>15%** better than code minimum efficiency, serving chilled water systems

C403.5 Exception 5

Demand Control Ventilation

Demand Control Ventilation

DEMAND CONTROL VENTILATION (DCV). *A ventilation system capability that provides for the automatic reduction of outdoor air intake below design rates when the actual occupancy of spaces served by the system is less than design occupancy.*

DCV is required in the following cases:

- Spaces with ventilation provided by a single-zone system that is required to have air economizer
- Spaces with an occupant load ≥ (~~25~~) **15** people per 1,000 SF or **occupant outdoor airflow rate of ≥ 15 cfm/person**
- Applies to **ALL** sized spaces, no longer limited to just spaces > 500 SF

C403.7.1

Exceptions to DCV

- Spaces where > 75% of the design outdoor airflow is transfer air required for an adjacent commercial kitchen make-up air (dining rooms, cafeterias, etc)
- Correctional cells, educational laboratories, barbers, beauty and nail salons, bowling alley seating areas
- Dormitory sleeping areas with fewer than five occupants
- Spaces served by a multiple zone system where:
  - *Design occupant component outdoor airflow* (as calculated per IMC) is less than 100 cfm, or 200 cfm if the system includes energy recovery with minimum 60% sensible effectiveness
  - Total system design outdoor airflow is less than 750 cfm, or 1,500 cfm if the system includes energy recovery with minimum 60% sensible effectiveness

C403.7.1

DCV Controls

NEW – DCV Design Criteria

- Requires CO2 sensors to monitor indoor air quality
- Controls shall automatically adjust quantity of outdoor supply air based on measured CO2
- Requires variable speed fan control
- Other means of adjusting outdoor air is allowed for:
  - Single zone systems designed to recirculate return air
  - Systems with total system supply air < 1,500 cfm

C403.7.1.2

HVAC Door Interlock Controls

Interlock Operable Openings With HVAC System Controls

Operable openings requiring interlock controls

- Openings **larger than 48 SF** that open to the outdoors from a conditioned space
- Examples – Garage style doors in restaurants, large sliding glass doors from gathering space and living areas, retail entries (Costco), etc
- Does not apply to:
  - Warehouses that utilize overhead doors for the function of the occupancy (i.e. loading docks), where approved by code official
  - Kitchens and food prep spaces with appliances that contribute to the HVAC loads of a restaurant or similar type of occupancy (make-up air, etc)
  - Operable openings from spaces served by hydronic radiant heating and cooling systems due to slow response time of this system type
  - Building entrances with a vestibule
  - Building alterations

C402.5.11

Interlock Operable Openings With HVAC System Controls

Operable opening switches for HVAC system thermostatic control

- Activate HVAC interlock controls once doors have been **open for five (5) minutes**
- Disable mechanical heating to the zone or reset space heating temperature setpoint to 55°F
- Disable mechanical cooling to the zone or reset space cooling temperature setpoint to 85°F

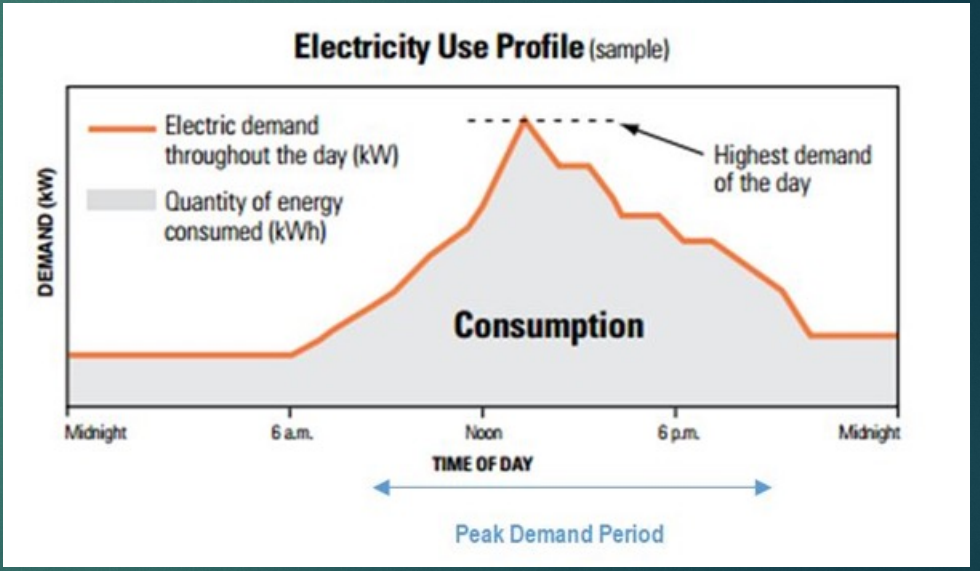
C403.4.1.6

Demand Responsive Controls

Demand Responsive Controls

DEMAND RESPONSIVE CONTROL. *A control capable of receiving and automatically responding to a demand response signal.*

DEMAND RESPONSE SIGNAL. *A signal that indicates a price or a request to modify electricity consumption for a limited time period.*



Demand Responsive Controls

NEW – Setpoint Adjustment based on a *Demand Response Signal*

- Thermostatic controls for all heating & cooling systems shall include *demand responsive control* capable of increasing the cooling setpoint and decreasing the heating setpoint by no less than 4°F
- Multiple zone systems with DDC control of individual zones shall be capable of remotely adjusting the heating/cooling setpoints for each zone
- Thermostatic controls shall be capable of performing all other functions when a *demand response signal* is not detected
- Health care & assisted living facilities are exempt from this requirement

C403.4.1.7

Hydronic System Design Requirements

Chilled & Condenser Water Piping Flow Rates

- **NEW** – Defines design flow rate based on pipe size and design annual hours of operation
- **Purpose** – Reduce pumping energy by sizing pipes large enough to minimize flow resistance

TABLE C403.3.7
PIPING SYSTEM DESIGN MAXIMUM FLOW RATE IN GPM[a]

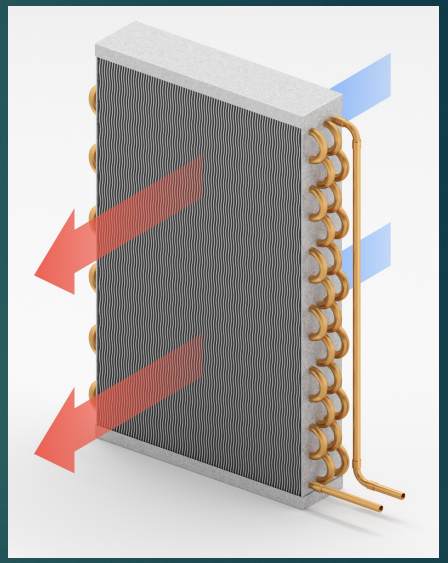
Pipe Size (in)	≤ 2000 hours/yr		>2000 and ≤ 4400 hours/year		> 4400 hours/year	
	Other	Variable Flow/ Variable Speed	Other	Variable Flow/ Variable Speed	Other	Variable Flow/ Variable Speed
2 1/2	120	180	85	130	68	110
3	180	270	140	210	110	170
4	350	530	260	400	210	320
5	410	620	310	470	250	370
6	740	1100	570	860	440	680
8	1200	1800	900	1400	700	1100
10	1800	2700	1300	2000	1000	1600
12	2500	3800	1900	2900	1500	2300
Maximum velocity for pipes over 14 to 24 in. in size	8.5 ft/s	13.0 ft/s	6.5 ft/s	9.5 ft/s	5.0 ft/s	7.5 ft/s

a. There are no requirements for pipe sizes smaller than the minimum size or larger than the maximum size shown in the table.

Hydronic coil selection

NEW – Chilled-water and Hot-water Coil Selection Criteria

- **Purpose** – Define optimal temperature differences for hydronic coils to increase pump efficiency and primary equipment efficiency
- Criteria based upon ASHRAE 90.1-2019 Section 6.5.4.7
- Chilled-water cooling coil selection:
  - 15°F or higher temperature difference between leaving and entering water
  - 57°F min leaving water temperature at design conditions
- Hot-water heating coils selection:
  - 20°F or lower temperature difference between leaving and entering water
  - 118°F max leaving water temperature at design conditions



Refer to C403.3.8 for exceptions

Additional Energy Efficiency and Load Management

Additional Energy Efficiency & Load Management Measures

- In addition to complying with all applicable mandatory and prescriptive provisions, a project is also required to comply with a minimum number of additional energy efficiency and load management measures
- **Number of available additional energy efficiency measures has substantially expanded**
- **NEW – Load management measures**
- Number of required credits varies by occupancy group
- Credit value of each measure is based on modeled energy efficiency potential by occupancy group

C406.2

Which project types are required to comply with additional energy efficiency measures?

- New buildings, including shell & core
- First occupancy build-out of a tenant space (initial TI)
- Building additions
- Existing building retrofits that require full compliance with 2021 WSEC-C are treated the same as a new building
- All levels of space conditioning – unconditioned, low energy, equipment buildings, semi-heated, fully conditioned, refrigerated warehouse coolers and freezers

C406.1, C406.1.1

Which project types are required to comply with load management credit measures?

- **New buildings greater than 5,000 SF**
- Does not apply to:
  - First occupancy build-out of a tenant space (initial TI)
  - Building additions
  - Unconditioned and low energy spaces
  - Equipment buildings
  - Open and enclosed parking garages
  - Warehouses

C406.1, C406.1.1

Number of Required Credits

Table C406.1 Energy Measure Credit Requirements

Required Credits for Projects	Section	Occupancy Group					
		Group R-1	Group R-2	Group B	Group E	Group M	All Other
New building energy efficiency credit requirement	C406.2	54	41	42	48	74	49
Building additions energy efficiency credit requirement	C406.2	27	20	21	23	36	21
New building load management credit requirement	C406.3	12	15	27	15	13	26

Number of required credits is based upon the project scope and the occupancy group

Number of Required Credits

- **Table C406.1 Exceptions** – Allows 50% of the minimum required number of additional energy efficiency credits in the following spaces:
  - Unconditioned spaces including open parking garages
  - Low energy spaces
  - Enclosed parking garages
  - Equipment buildings
  - Building additions less than 1,000 SF of conditioned floor area

Mechanical Additional Energy Efficiency Measures

Table C406.2 Efficiency Measure Credits

Measure Title	Applicable Section	Occupancy Group					
		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	2	3	4	3	2
4. Improve heating efficiency	C406.2.2.3	2	3	3	10	16	7
5. Improve low-carbon district energy system (10% better)	C406.2.2.4	3	3	4	11	17	8
6. Improve low-carbon district energy system (20% better)	C406.2.2.5	9	10	12	33	52	24
7. High performance DOAS	C406.2.2.6	31	31	21	39	40	21/ (A) 40[c]
8. Fault detection & diagnostics (FDD)	C406.2.2.7	2	2	2	6	9	4

Dwelling Unit HVAC Control

- In dwelling & sleeping units, install automatic controls configured to adjust heating & cooling setpoint by at least 5°F during occupied sleep periods
- Unoccupied setback mode shall be configured to operate in conjunction with one of the following enhancements:
  - Manual main control device at main entrance that initiates setback of all HVAC units in the dwelling unit
  - Occupancy sensors in each room combined with a door switch to initiate setback mode
  - Advanced learning thermostat
  - Automated sensing control linked to occupant cell phone

C406.2.1

Improved TSPR Score

For systems serving project areas that are required to comply with the TSPR provision:

- Proposed project TSPR ratio (score) shall be at least **5% better** than the TSPR standard reference design score
- If proposed project score is more than 5% better, credits may be pro-rated up to a maximum 20% better score

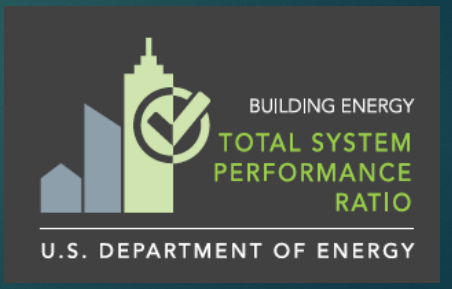
Whole Building Total System Performance Ratio

Proposed Building TSPR:	16.9
Baseline Building TSPR:	12

Exceed Baseline by at least 5%

The Total System Performance Ratio complies with the 2018 Washington State Energy Code.

Total System Performance Ratio (TSPR) is the ratio of the sum of a building's annual heating and cooling load in thousands of BTUs to the sum of the annual carbon emissions in pounds from energy consumption of the building HVAC systems.



C406.2.2.1

Improved Cooling & Fan Efficiency

- Cooling equipment efficiency
  - No less than 90% of the total HVAC cooling capacity serving the project area shall have **5% better than code efficiency**
  - Calculate the weighted average of all cooling equipment efficiency when different equipment efficiency requirements exist
  - Where weighted average better than code cooling efficiency exceeds 5%, additional credits are awarded proportionately up to a maximum of a 20% improvement
- Fan Efficiency
  - Applies to fans not included in packaged equipment efficiency rating
  - Proposed fan power shall be **≤ 95%** of allowed fan power per C403.8.1

C406.2.2.2

Improved Heating Efficiency

- Heating equipment efficiency
  - No less than 90% of the total HVAC heating capacity serving the project area shall have **5% better than code efficiency**
  - **Electric resistance primary heating is limited to 20% of total capacity**
  - Same weighted average efficiency criteria and additional credits for up to 20% improvement as the Improved Cooling Efficiency measure

C406.2.2.3

Improved Low Carbon District Energy System

- **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. (Refer to complete definition)
- **10% More Efficient System**
  - 45% of the annual district energy net-load-met (sum of heating & cooling energy provided to attached buildings) comes from heat recovery between connected buildings, waste heat or renewable energy resources **AND,**
  - Not more than 25% of the annual heat input to the system comes from fossil fuel or electric-resistance sources
- **20% More Efficient System**
  - 50% of the annual district energy net-load-met
  - Not more than 10% comes from fossil fuel or electric-resistance sources

C406.2.2.4, C406.2.2.5

Other Mechanical Energy Efficiency Measures

- Fault detection and diagnostics (FDD)
  - Include FDD in the controls package for all HVAC systems serving the project area that are not otherwise required to have this level of performance and fault identification monitoring
- High performance DOAS
  - **80%** or higher sensible heat recovery effectiveness;
  - Reduced fan power – **0.769** watts/CFM or not more than **80%** of code minimum fan power allowance
  - Efficient DOAS supply air temperature control during cooling mode

C406.2.2.6, C406.2.2.7

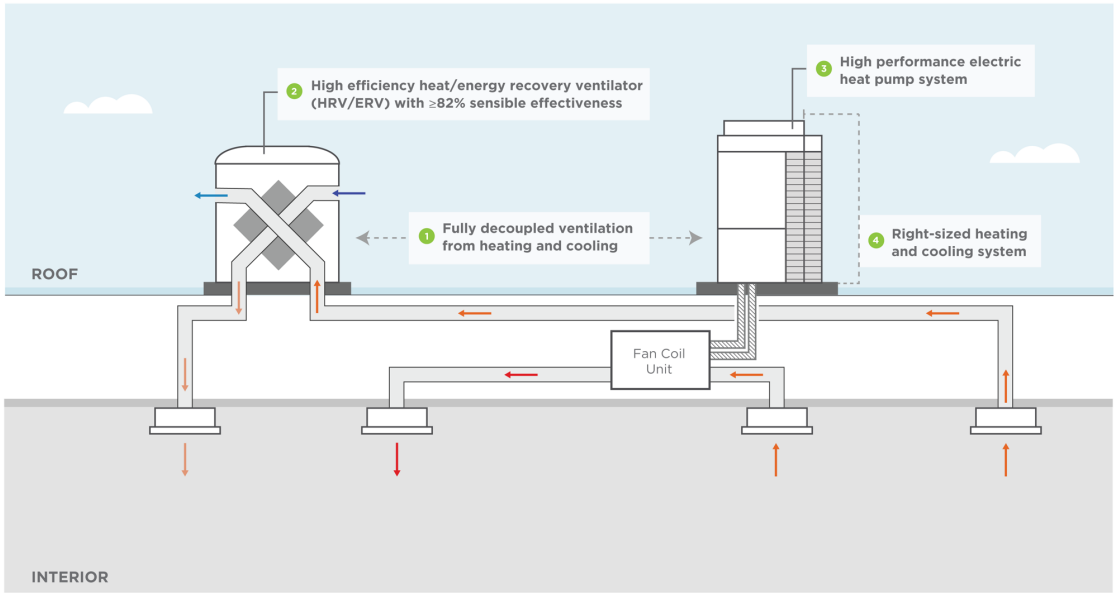
Very High Efficiency DOAS

What is it?

A DOAS approach that maximizes system performance by pairing a high-performance equipment with key design elements, including:

- Fully decoupling ventilation from primary heating and cooling
- High-performance heat/energy recovery ventilator (≥ 82% SRE, etc)
- High-performance inverter driven heating equipment
- Right-sizing heating/cooling equipment

How it Works



Learn more:

For additional information, demonstration project results, case studies, system requirements and compliant E/HRVs, visit: ***betterbricks.com/solutions/hvac***.

Mechanical Load Management Measures

Table C406.3 Load Management Measure Credits

Measure Title	Applicable Section	Occupancy Group					
		Group R-1	Group R-2	Group B	Group E	Group M	All Other
1. Lighting load management	C406.3.1	12	15	27	15	NA	NA
2. HVAC load management	C406.3.2	29	24	42	23	13	26
3. Automated shading	C406.3.3	NA	7	12	16	NA	NA
4. Electric energy storage	C406.3.4	41	50	126	72	37	65
5. Cooling energy storage	C406.3.5	13	10	14	19	NA	14
6. Service hot water energy storage	C406.3.6	31	248	59	8	5	70
7. Building thermal mass	C406.3.7	NA	NA	50	95	96	80

Credit value of each load management measure is based on modeled energy efficiency potential by occupancy group

Load Management Measure Controls and Sequences

- Each measure shall have automatic controls activated by either:
  - Utility demand response
  - Utility price response signal
  - Peak price period time control
  - Local building demand monitoring
- Load management measures include required sequences of operation
  - Controls shall be configured to provide the required load management sequences
  - All equipment associated with required load management sequences shall have controls connected to a central DDC system

C406.3

Mechanical Load Management Measures

- HVAC load management
  - For electric cooling & heating systems, configure automatic HVAC controls to gradually increase the cooling setpoint by at least 3°F during summer peak demand periods and reduce the heating setpoint by at least 3°F during winter peak demand periods.
- Cooling energy storage capacity and controls
  - Automatic controls shall be capable of activating ice or chilled water storage to reduce peak period electric demand
  - The number of load management measure credits are prorated based on installed cooling energy storage capacity between 0.5 and 3.5 tons per design day ton of cooling load

C406.3.2, C406.3.5

Training Topics Review

- DOAS exception for economizers is limited by cooling equipment type and location of cooling supply fan
- Group R economizer exception requires either DOAS or high efficiency cooling equipment
- DOAS supplemental heating is limited to 55F supply air and DOAS supplemental cooling shall be sized for dehumidification load only
- Demand control ventilation is required for single-zone systems where economizer is required & installed, and in spaces with high occupant density
- Entry doors larger than 48 SF require HVAC interlock controls with exceptions
- Thermostatic controls for heating & cooling systems now also require *demand responsive control* capability

Training Topics Review

- There are new hydronic systems design criteria for chilled & condenser water piping flow rates and chilled-water & hot-water coil selection
- List of additional energy efficiency measures has been substantially expanded
- New requirement for load management measures
- Credit value of each measure is based on modeled energy efficiency potential by occupancy group
- Mechanical additional energy efficiency measures include: Group R-2 HVAC setback controls; better than code cooling, heating & fan equipment efficiency; improved TSPR score; fault detection & diagnostics; high performance DOAS and higher efficiency low-carbon district energy exchange systems
- Mechanical load management measures include HVAC load management and cooling energy storage

Q & A

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