2018 HVAC Energy Codes

Puget Sound ASHRAE

Seattle Department of Construction & Inspections

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It's not *whether* we're going to do this, it's *how*

Washington state:
70% less building energy use by 2030

- Zero-carbon buildings
- Gov says move faster

Washington state:
45% less GHG emissions by 2030

- 95% reduction by 2050

Seattle: Carbon-neutral building & vehicle operations by 2050

- …or sooner with Green New Deal?

Seattle amendments: 4 Guiding Principles

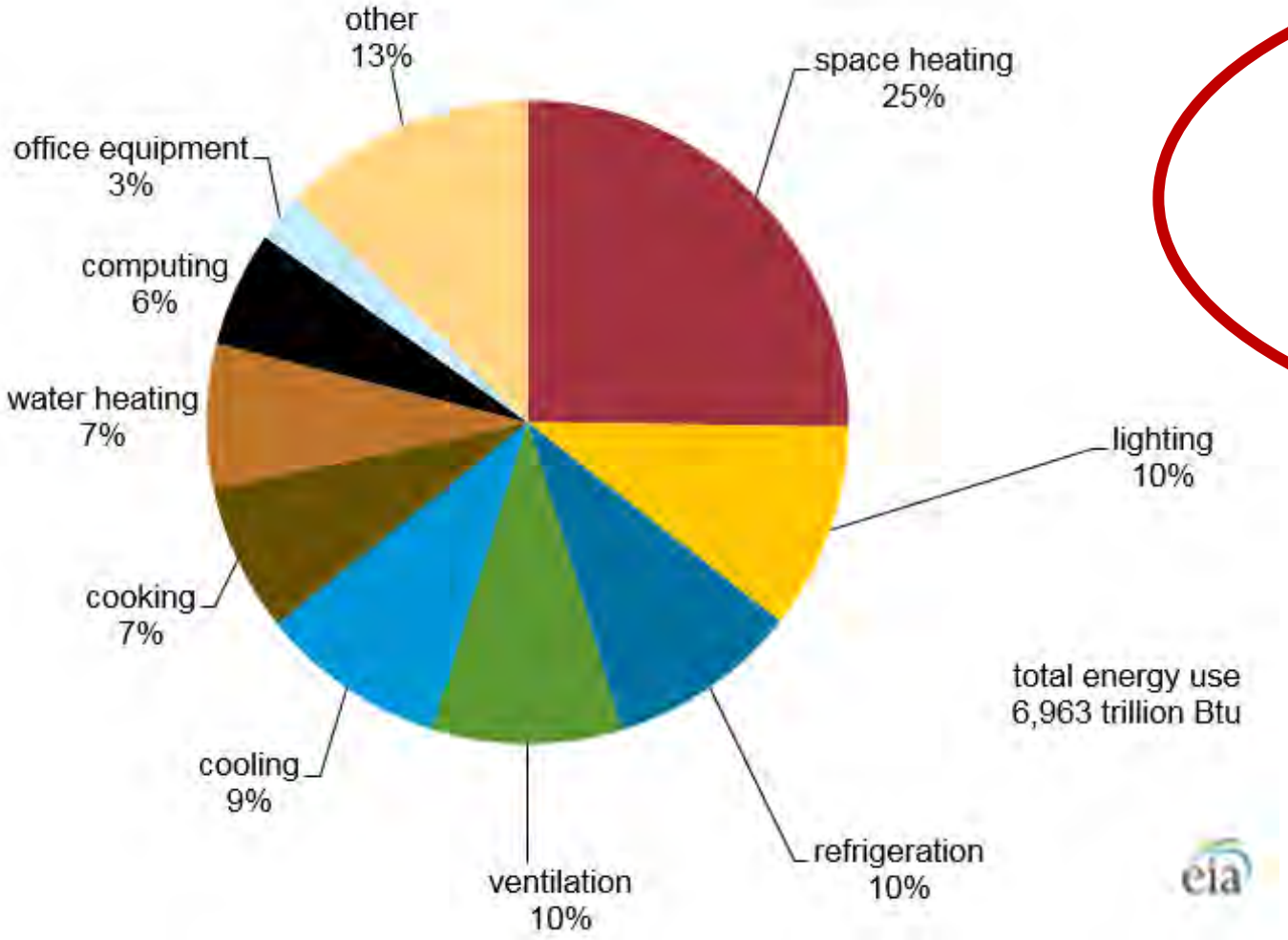
1. Envelopes meet our “2050” standard
   - We have to decide what that 2050 standard is
2. No “internal combustion buildings”
   - Electrical infrastructure for exceptions
3. Efficient use of electricity
   - Typically heat pumps for space heating & water heating
4. Increased on-site renewables
   - Options for off-site purchase
   - Plus “solar readiness” for bigger future system

HVAC

Seattle: “Intent” section now includes “reduction of carbon emissions”

New buildings must be *capable of* meeting Seattle’s 2050 targets.

Start with the big slices



- **Space heating**
  - **System efficiency**
  - **Heat recovery**
  - Envelope UA & air tightness
- **Cooling**
  - **System efficiency**
  - Fenestration size & shading

HVAC

- Lighting
  - Efficiency
  - Controls
- Water heating
  - System efficiency
- Plug loads

How is HVAC section organized? (It's not)

…but rather than trying to cover everything…

C403.1.1 TSPR
C403.1.2 Load calculations
C403.1.3 Data centers
C403.1.4 Fossil fuel and electric resistance restriction (Seattle)
C403.2 System design. (zone isolation, ventilation & exhaust, variable speed drives)
C403.3 Equipment selection & Tables (sizing, performance, chillers, humidification)
C403.3.5 DOAS (occupancy table, energy recovery, decoupled supply air)
C403.3.6 Balanced ventilation for R-2
C403.3.7 Hydronic flow rate

C403.4 HVAC system controls (thermostats, heat pump supplementary heat, deadband, vestibules, door switch tstat control
C403.4.3 Hydronic system controls (hydronic heat pump controls, dead band, heat rejection, isolation valves, part load controls, pump isolation, variable flow controls)
C403.4.9 Multifamily units
C403.4.11 DDC
C403.5 Economizers
C403.6 Multi-zone systems
C403.6.10 High-efficiency VAV systems (alternative to DOAS)
C403.7 Ventilation and exhaust (DCV, occ sensor, loading dock, garage)

C403.7.6 Energy recovery ventilation
C403.7.7 Exhaust systems (kitchen, laboratory)
C403.7.8 Shutoff dampers
C403.8 Fans and fan controls
C403.9 Heat rejection & heat recovery
C403.10 HVAC system construction (ducts, pipes, insulation, sealing)
C403.11 Systems outside thermal envelope (radiant heaters, snow melt, freeze protection)
C403.12 High-efficiency single-zone VAV (alternative to DOAS)
C403.13 Commissioning
C403. 14 Compressed air & vacuum air
C403.15 Commercial food service

What belongs on our HVAC Top 10 list?

1. Commissioning
2. Metering
3. Heating type
4. TSPR
5. DOAS
6. Economizers
7. Energy Recovery
8. Controls
9. DDC
10. C406 options

<u>+ Special Occupancies</u>

- Commercial kitchen
- Data center cooling
- Refrigerated spaces
- Multifamily
- Garage/loading dock
- Outdoor café
- Lab exhaust
- Hotel guest room
- Grocery

#1 Top Ten: Mechanical Commissioning

- Plans: Statement that Cx will be done
- Site: Submit mech portion of Cx Report
  - As proof that commissioning was done
- Code: C408, C403.13
- Benefit: Cx does a lot of detailed “inspection” work that inspectors can’t get to

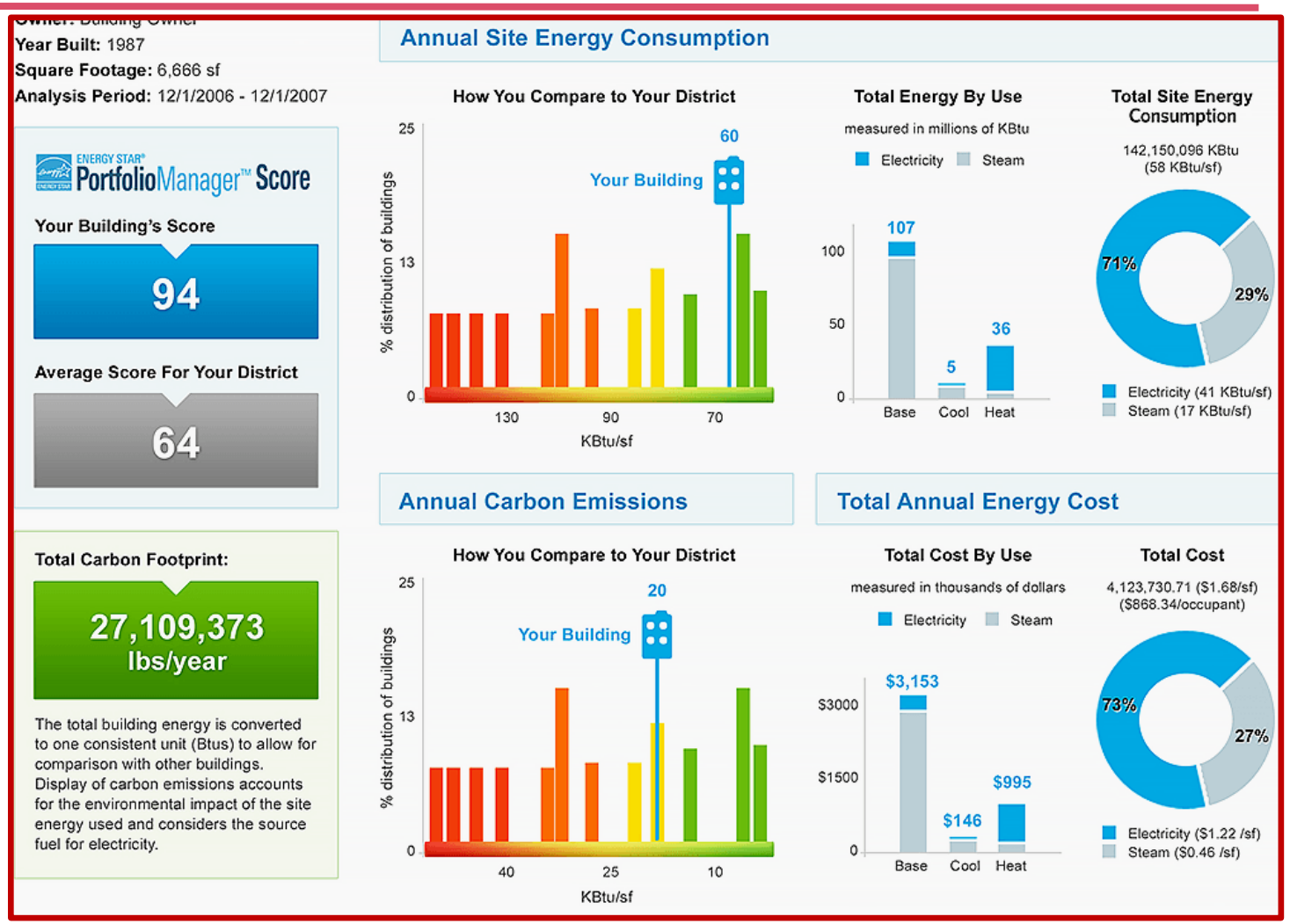
Commissioning of HVAC required, plus…

- Cx professional qualifications
- Conflict of interest statement
- Checklist
- CX plan and Cx report
  - Lighting, controlled receptacles
  - HVAC, water heating
  - Refrigeration
  - Metering
- HVAC Cx thresholds:
  - 240 kBtu/h cooling
  - 300 Kbtu/h heating

Taking HVAC systems all the way to the finish line

#2 Top Ten: Metering

- Plans: Metering system indicated
- Site: Contractor demos metering display working
- Code: C409
- Benefit: Lets building manager know when systems drift out of spec



~~Metering~~ Actionable energy display

- Graphic energy use display for bldgs 20,000+ SF
  - Source meters (usually gas & elec pulse meters)
  - HVAC & water heating sub-meters
  - Lighting, plug load & process load sub-meters
- Also required for replacement HVAC systems
- Planning and load segregation can reduce number of meters

#3 Top Ten: Heating system type

Restricts fossil fuel & electric resistance heating

- Plans: Show heat pumps
  - or meet an exception
- Site: Per plan
- Code: C403.1.4
- Benefit: Reduce EUI & carbon emissions

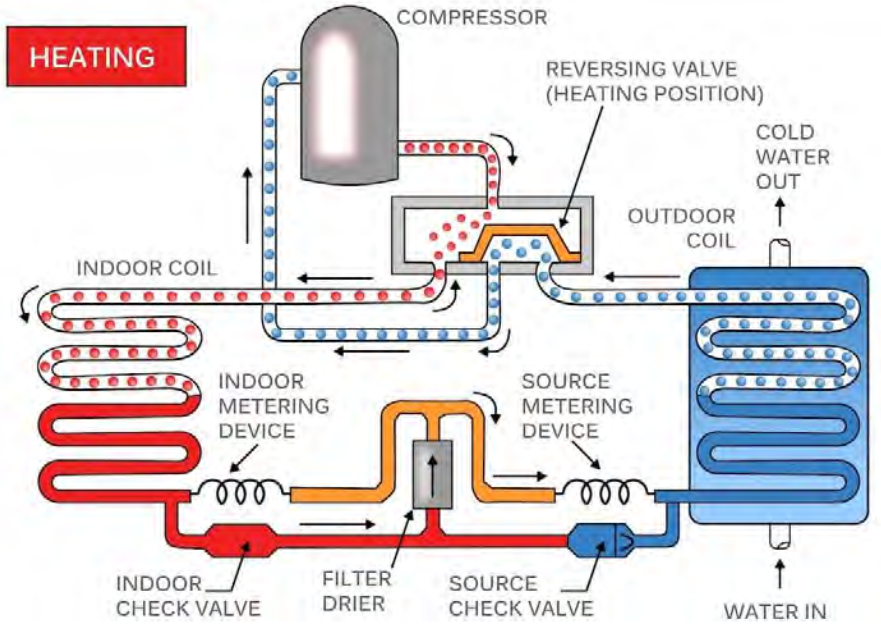
Seattle: Space heating

No electric resistance or fossil fuel combustion for space heating

- Usually means “use heat pumps”

Exceptions allow <u>electric resistance heat</u> for:

1. <u>Permits applied for prior to 1/1/2022</u>
2. **<u>Dwelling units</u>**: Max **750 W** per room
   - **<u>1000 W</u>** for corner room
3. <u>Other space types</u>: Max 2.5 W/sf total installed heating (The “Passive House” rule)
4. Heat pump <u>auxiliary heat</u> in cold weather
5. etc.…



Heat pumps squeeze warmth out of cold air

C403.1.4 (space heating) more exceptions
(for small loads and low temp supplementary heat)

5. Air-to-air heat pumps
    1. Compressor is first stage of heat down to 17°F , capacity is 2X elec resistance
6. Air-to-water HP <2,000 MBH
    1. Compressor is first stage of heat down to 17°F , capacity is **2X** elec resistance
7. Air-to-water HP <3,000 MBH
    1. Compressor is first stage of heat down to 17°F , capacity is **1.75** X elec resistance
8. Air-to-water HP >3,000 MBH
    1. Compressor is first stage of heat down to 17°F , capacity is **1.5** X elec resistance
9. Ground-source HP
10. Small systems
11. Specific conditions
12. Kitchen exhaust
13. District energy
14. Heat tape
15. Temporary systems
16. Emergency generators
17. Pasteurization cycle

HFC refrigerant phaseout – HB 1112 & HB 1050

- Cutoff dates for equipment using HFCs:
  - (HVAC equipment manufacture date, not permit date)
  - Supermarket & warehouse 2020
  - Chillers 2024
  - Heat pumps 2025
  - VRF 2026

- Permit app late 2023
- Permit issued 2024
- Foundation, structure
- It's already 2025!

- R-410, R134…going, going, gone!
- R-32 approved, but no equipment yet

Refrigerant line piping insulation – commercial

Official Seattle "interpretation"

C403.10.4 Insulation of refrigerant piping. Refrigerant piping, other than piping factory installed in HVAC equipment, shall have minimum ((~~1/2-inch insulation within conditioned spaces and 1-inch insulation outside of conditioned spaces, at~~)) insulation that has a conductivity rating of 0.21 to 0.26 Btu x in/(h x ft^2 x °F) with a mean temperature rating of 75°F, and with thickness in compliance with the following:

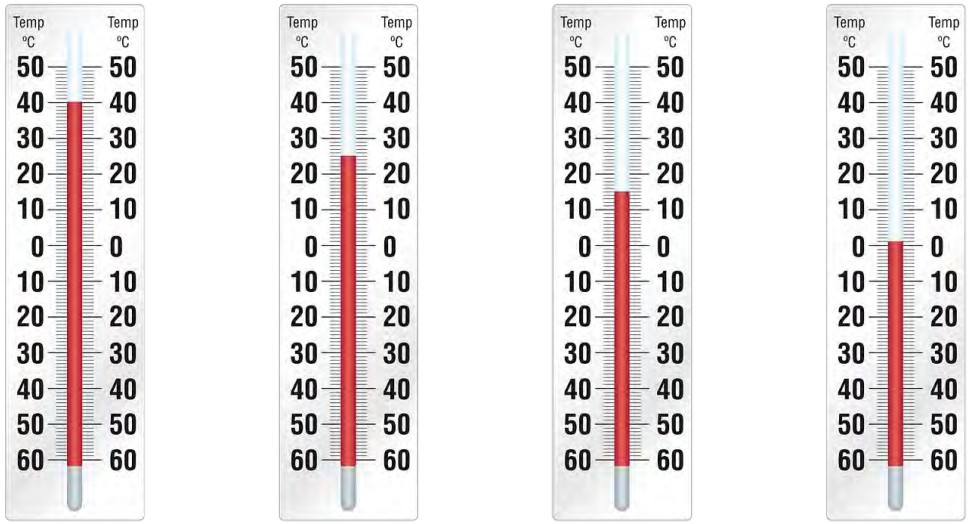
1. For lines that convey **hot gas**:
   a. Minimum **1-inch** insulation on piping **outside** the building thermal envelope
   b. Minimum **1/2-inch** insulation on piping **within** the building thermal envelope
2. For **liquid lines**:
   a. Minimum **1/2-inch insulation for mini-split systems** and for other systems where the manufacturer requires insulation, or where the metering device is located in the outdoor unit.
   b. No insulation is required for other heat pump types or for cooling-only units, unless required by the manufacturer.

Commercial building HP system options

Heat Pump System	Building types	Cost	Pros	Cons
Split systems, Mini Split	Simple low rise	$	Low cost, good efficiency, high flexibility	Only works with DOAS for most building types, no economizer
Packaged Rooftop HP, VAV or single zone	Simple low and midrise if DOAS not required	$	Low Cost, moderate efficiency, medium flexibility, economizer	Can't easily use for office, education, assembly, retail.
VRF (w/ DOAS)	Low and Midrise, existing buildings, DOAS systems	$$	High flexibility	High refrigerant volume is problematic for sleeping or non-ambulatory occ's
2-Pipe hydronic w HP chiller	Facilities with uniform usage	$$	Good flexibility, lower cost, good energy performance	Changeover problematic in spring/fall for multi-zone buildings
4-Pipe Hydronic w/ HP chiller, or centrifugal chiller	Large and tall facilities	$$$	Moderate flexibility, good performance, heat recovery from process loads possible	High Cost, system complexity, Centrifugal requires backup boiler, may be electric
Water Source w/ heat recovery chiller loop	Large & medium facilities, highrise residential	$$$	High flexibility, tried and true systems, can be high performance.	Distributed compressors with distributed noise
Ground source water to water 2 or 4-pipe	Large & medium facilities with enough land	$$$$	High efficiency, good in cold weather. Water side heat recovery OK.	Highly complex systems, specialty maintenance, High cost

Heat pump low OSA operating temp

- **40° - 45°** PTHP/VTHP
- **20° - 25°** Single speed compressors
  - Before steep drop in capacity & COP
- **5° - 15°** Modern variable speed compressors
  - Before steep drop in capacity & COP
- **-10° to -15°** *Some* variable speed compressors
  - Before needing backup electric heat



- **Q:** Why do so many engineers still think heat pumps don't work below 45°?
- (I'm talkin' to you, PS ASHRAE!)

#4 Top Ten: TSPR

HVAC Total System Performance Ratio

- Office, retail, library, education
- (Seattle) medical office, multifamily
- Plans: Show calc: ratio > 1.0
- Site: Nada
- Code: C403.1.1
- Benefit: Ensures that overall HVAC efficiency is at least “pretty good”

Exceptions:

- < 5000 sf conditioned floor area
- Buildings with district heating
- Several kinds of chilled water supply
- Air to water or water to water HP
- Underfloor air distribution
- No mechanical cooling
- Most alterations
- (Seattle) laundry, elevator, mech, elec rooms, data center, kitchen
- Surgery centers (ASHRAE 170)

Seattle Department of Construction & Inspections

Pacific Northwest NATIONAL LABORATORY
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TSPR = $\frac{\text{Heating + Cooling Loads}}{\text{Carbon Emissions}}$ (annual)

TSPR: Total System Performance Ratio

Office, Retail, Library, Education

Seattle adds multifamily and medical office

TSPR evaluates HVAC efficiency by comparing:

- required annual heating & cooling to
- carbon emissions due to heating & cooling

Free online calculation tool from PNNL

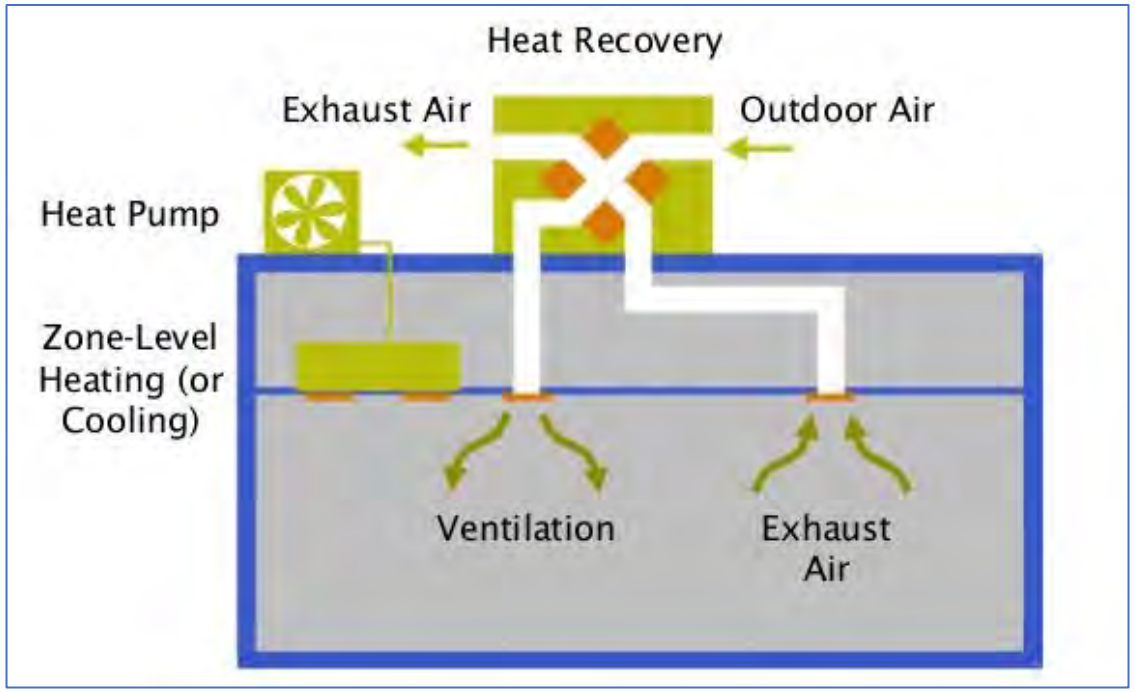
#5 Top Ten: DOAS

- Dedicated Outdoor Air System
  - OSA flow decoupled from heat/cool fans
  - Office, education, retail, library, assembly
- Plans: DOAS w/ energy recovery
- Site: Equip & controls per plan
  - Demonstrate controls
- Code: C403.3.5
- Benefit: Much more efficient than traditional VAV or RTU

- Office
- Retail
- Education
- Library
- Fire Station
- Assembly

DOAS scope

- Office, education, retail, library
- **Now required for "assembly" (auditorium, conference, etc.)**
- Removed some exceptions:
  - No double-dipping with C406
  - Don't get extra glazing area
  - Limited economizer exemption
- Seattle: "Accessory Occupancies" exempted
  - Like a little office in a warehouse



Dedicated Outdoor Air System: Ventilation is "decoupled" from heating & cooling, includes energy recovery

OCCUPANCY CLASSIFICATIONS REQUIRING DOAS

TABLE C403.3.5

Occupancy Classification[a]	Inclusions	Exempted
A-1	All occupancies not specifically exempted	Television and radio studios
A-2	Casinos (gaming area)	All other A-2 occupancies
A-3	Lecture halls, community halls, exhibition halls, gymnasiums, courtrooms, libraries, places of religious worship	All other A-3 occupancies
A-4, A-5		All occupancies excluded
B	All occupancies not specifically exempted	Food processing establishments including commercial kitchens, restaurants, cafeterias; laboratories for testing and research; data processing facilities and telephone exchanges; air traffic control towers; animal hospitals, kennels, pounds; ambulatory care facilities.
F, H, I, R, S, U		All occupancies excluded
E, M	All occupancies included	

Special Assembly Occupancies

Large Concert Halls

Small Lecture Rooms

Gymnasiums

Religious Sanctuaries

Consider using fan wall, to handle dramatic load variation

DOAS & Economizers

Economizer now *required* for DOAS if cooling equipment is outdoors or in a space next to an exterior wall or roof.

- Exception only applies if chiller is buried in an interior room

C403.5 Economizers. *Air economizer*s shall be provided on all new cooling systems including those serving computer server rooms, electronic equipment, radio equipment, and telephone switchgear. Economizers shall comply with Sections C403.5.1 through C403.5.5.

Exception: Economizers are not required for the systems listed below:

1. Cooling systems not installed outdoors nor in a mechanical room adjacent to outdoors and installed in conjunction with DOAS complying with Section C403.3.5 and serving only spaces with year-round cooling loads from lights and equipment of less than 5 watts per square foot.

DOAS & DCV & Energy Recovery

- WA: *No* spaces with both DOAS and DCV need energy recovery
- Seattle: Spaces over 650 sf with DOAS & DCV *do* need energy recovery
- Seattle: Spaces over 500 sf with at least 15 occ's per 1000 sf need DCV
  - Mostly just adds retail
  - Exempts dorms
- Seattle: 60% ERV effectiveness

60% air-to-air heat recovery effectiveness

C403.7.6 Energy recovery ventilation systems. Any system with minimum outside air requirements at design conditions greater than 5,000 cfm or any system where the system's supply airflow rate exceeds the value listed in Tables C403.7.6(1) and C403.7.6(2), based on the climate zone and percentage of outdoor airflow rate at design conditions, shall include an energy recovery system. Table C403.7.6(1) shall be used for all ventilation systems that operate less than 8,000 hours per year, and Table C403.7.6(2) shall be used for all ventilation systems that operate 8,000 hours or more per year. The energy recovery system shall have the capability to provide a change in the enthalpy of the outdoor air supply of not less than **((~~50~~)) 60 percent** of the difference between the outdoor air and return air enthalpies, at design conditions…

Exception: The energy recovery systems for occupancy type **I-2 hospitals**, and buildings that primarily consist of technical **laboratory** spaces, are permitted to provide a change of enthalpy of the outdoor air and return air of not less than 50 percent of the difference between the outdoor air and return air enthalpies, at design conditions.

Require both energy recovery and demand control from high-occupancy spaces with DOAS

C403.3.5.1 Energy recovery ventilation with DOAS. The DOAS shall include *energy recovery ventilation*. The energy recovery system shall have a ((~~60 percent minimum sensible recovery effectiveness or have~~ ~~50~~)) 60 percent enthalpy recovery effectiveness in accordance with Section C403.7.6. For DOAS having a total fan system motor nameplate hp less than 5 hp, total combined fan power shall not exceed 1 W/cfm of outdoor air…

Exceptions

1. Occupied spaces with all of the following characteristics:
   - Complying with Section C403.7.6 (ERV systems)
   - Occupant load minimum 15 (not 25)per 1000 sf
   - Fans max 5000 cfm
   - Smaller than 650 square feet

Threshold for DCV (Demand Control Ventilation)

C403.7.1 Demand control ventilation. Demand control ventilation (DCV) shall be provided for all single-zone systems required to comply with Sections C403.5 through C403.5.3 and spaces larger than 500 square feet (46.5 m) and with an average occupant load of **((~~25~~))** **15** people or greater per 1,000 square feet (93 m) of floor area, as established in Table 403.3.1.1 of the International Mechanical Code, and served by systems with one or more of the following:

1. Air-side economizer.

2. Automatic modulating control of the outdoor air damper.

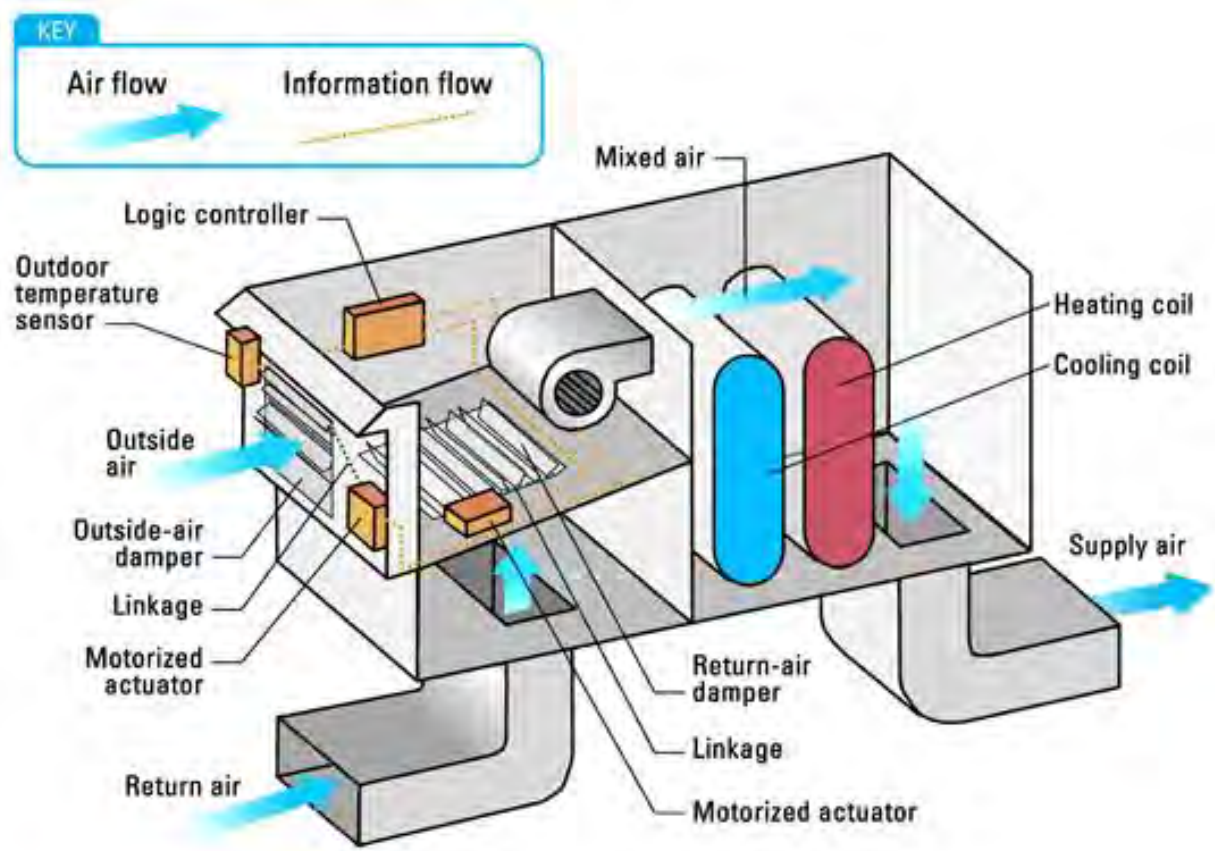
3. Design outdoor airflow greater than 3,000 cfm

(several exceptions)

#6 Top Ten: Economizers

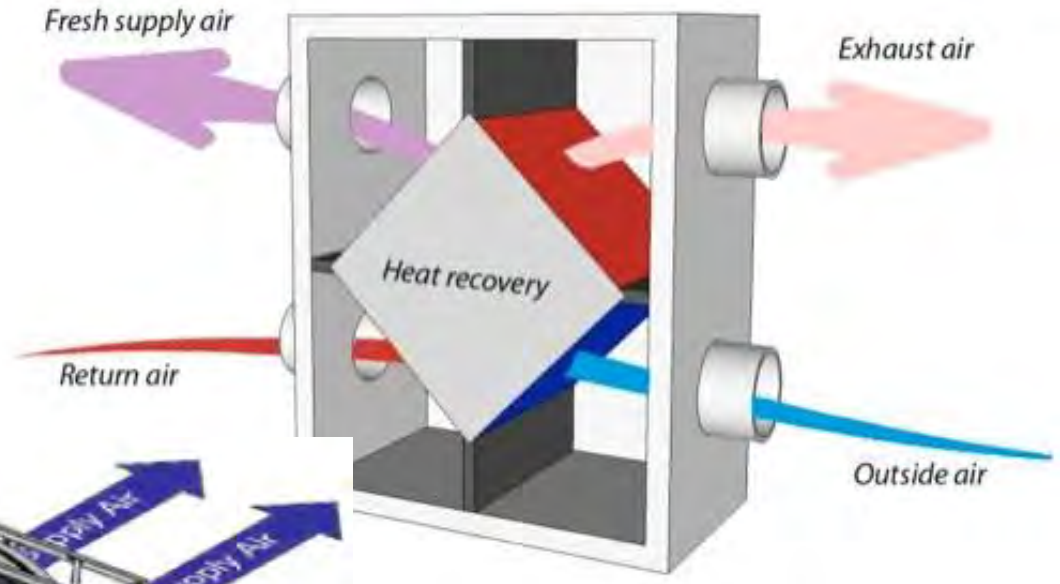
(Not exciting, but important)

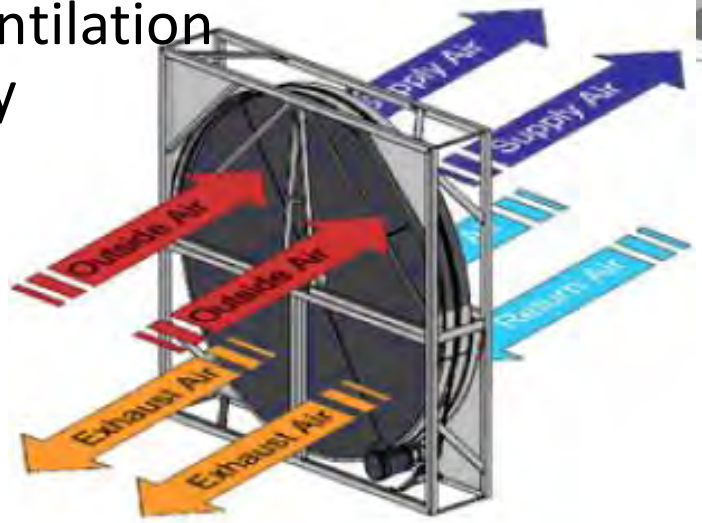
- Plans: Economizer, or meet exception
  - FDD for economizer
- Site: Per plan
- Code: C403.5. 403.5.5
- Benefit: Take advantage of “free cooling” when OSA temp is right



#7 Top Ten: Energy Recovery

- Plans: Heat recovery on exhaust air
  - Min 60% efficient
- Site: Show that controls are working
- Code: C403.7.6
- Benefit: Allows generous ventilation with minimal heating energy

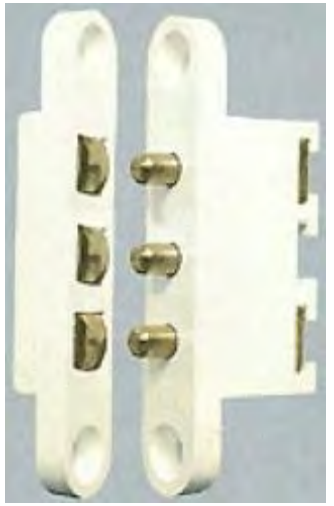




#8 Top Ten: Controls

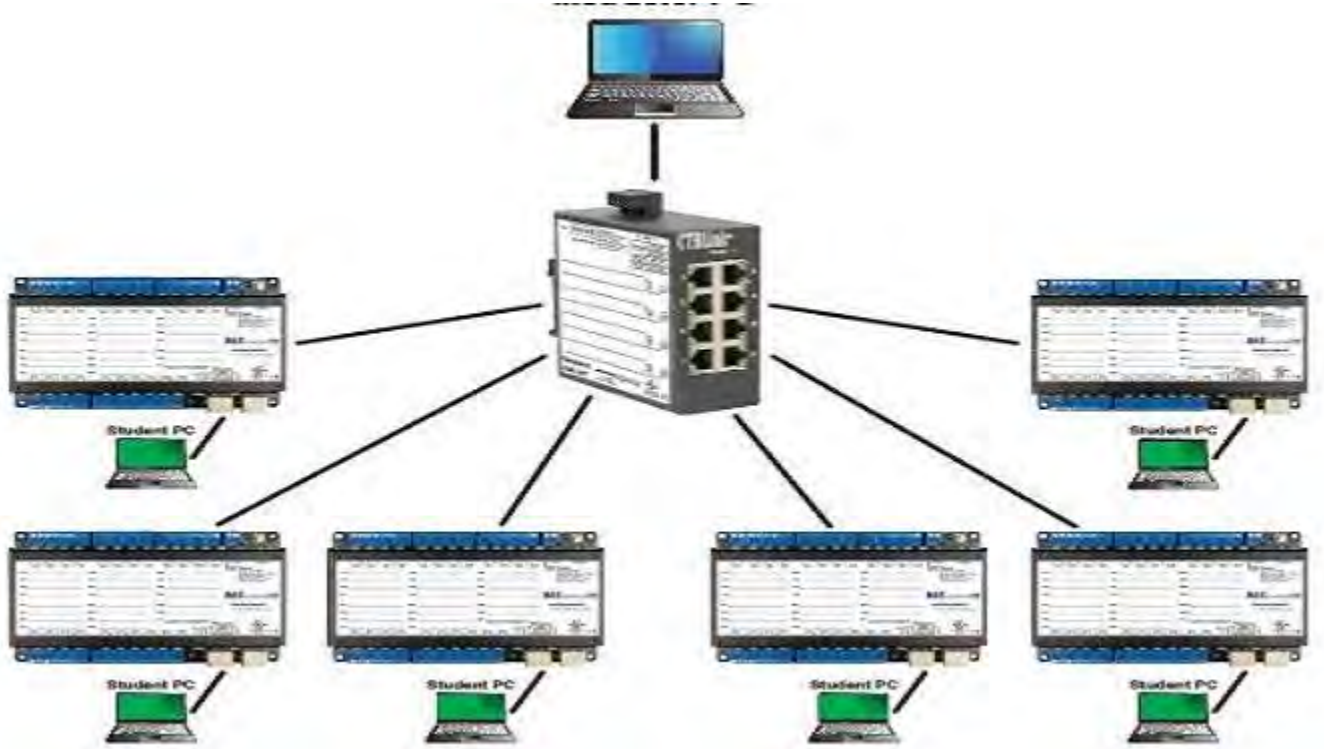
- Plans: Controls shown per code
- Site: Spot check a few controls
  - Cx will do a more in-depth check
- Code: C403.4, C403.4.1.6
- Benefit: Systems slow down or shut off when not needed

- Thermostats
- Heat pump supplementary heat
- Deadband
- Door switches



#9 Top Ten: DDC

- Direct Digital Control
- Plans: DDC shown
  - If above thresholds
- Site: Demonstrate DDC settings
- Code: C403.4.11.1
- Benefit: Maintain comfortable temperature and humidity in each zone, without wasting energy



#10 Top Ten: C406 efficiency credits

- 6 credits in WA, 8 credits in Seattle
- Plans: Identify selected credits
  - And show in documents
- Site: Check that selected elements were installed
- Code: C406
- Benefit: Provides designer choice and gives credit for high-performance equipment while reducing carbon impact

(** credit not available in Seattle)

1. High-efficiency HVAC
2. 10% LPA reduction
3. 20% LPA reduction
4. Enhanced lighting controls
5. Renewables
6. DOAS
7. High-performance DOAS
8. **HPWH
9. Low-GHG HPWH
10. Envelope UA
11. Air infiltration
12. **Comm kitchen appliances

C406 Efficiency Package Credits

- **WA: Now a "points-based" table**
  - 2 (old) credits = 6 (new) credits
- **WA: 6 credits required**
  - 3 credits for low-energy occupancies
- **Seattle: Require 8 credits**
  - Instead of 6
- Seattle: Gas equip doesn't qualify
- Integrated design team advised!

	R1	R2	B	E	M	Other
1. More efficient HVAC performance in accordance with Section C406.2	**2.0**	**3.0**	**3.0**	**2.0**	**1.0**	**2.0**
2. Reduced lighting power: Option 1 in accordance with Section C406.3.1	**1.0**	**1.0**	**2.0**	**2.0**	**3.0**	**2.0**
3. Reduced lighting power: Option 2 in accordance with Section C406.3.2[a]	**2.0**	**3.0**	**4.0**	**4.0**	**6.0**	**4.0**

HVAC C406 credit for tenant spaces C406.1.1.2

Where shell & core permit includes C406.2 (HVAC) credit, tenant spaces also qualify if they connect to building HVAC system.

- Tenant space can also qualify for HVAC credit independently

C406.1.1.2 Applicable HVAC and service water heating credits. Where HVAC and service water heating systems and services are installed and comply with Section C406.2 or C406.8 under an initial tenant improvement permit, those systems and services shall be considered a part of the tenant space. **Tenant spaces qualify for the credits assigned to the occupancy type of the tenant space in accordance with Table C406.1 if the tenant space includes the distribution system and equipment that the central HVAC systems or service water heating systems were designed to support.**

> **Exception:** Previously occupied tenant spaces in existing buildings that comply with this code in accordance with Section C501.

- Seattle: Initial TI permit can use S&C permit code edition for 18 months after C/O

#1 Special occupancy: Commercial Kitchen

- Plans: Exhaust fan speed controls, (Seattle) Energy Star appliances
- Site: Contractor demo the fan, equipment Energy Star labels
- Code: C403.7.7, C403.15
- Benefit: No sense running the exhaust fan full speed with just one burger on the grill

#2 Special occupancy: Data Center Cooling

- Plans: Show that cooling system meets ASHRAE 90.4 (2019) MLC values
- Site: Match system on plans
- Code: C403.1.3
- Benefit: Cooling energy use optimized via system layout & controls
    - ASHRAE 90.4 – **2019**, with no modifications
    - 2019 version is much better than 2016 – separate values for large and small data centers

90.4: Data Center vs. Computer Room

(20 W/sf threshold)

DATA CENTER. A room or series of rooms that share *Data Center Systems* whose primary function is to house equipment for the processing and storage of electronic data, which has a design total *information technology equipment (ITE)* equipment power density exceeding 20 watts per square foot of conditioned area and a total design ITE equipment load greater than 10 kW.

COMPUTER ROOM. A room whose primary function is to house equipment for the processing and storage of electronic data and that has a design total *information technology equipment (ITE)* equipment less than or equal to 20 watts per square foot of conditioned area or a design *ITE* equipment load less than or equal to 10 kW.

#3 Special occupancy: Refrigerated spaces

Walk-in refrigerators & freezers, refrigerated & frozen warehouses

- Plans: Check walk-in specs for insulation, lighting, mechanical
- Site: Equipment same as shown on plan, insulation for warehouses
- Code: C410
- Benefit: Minimize refrigeration system energy use

#4 Special occupancy: Multifamily units

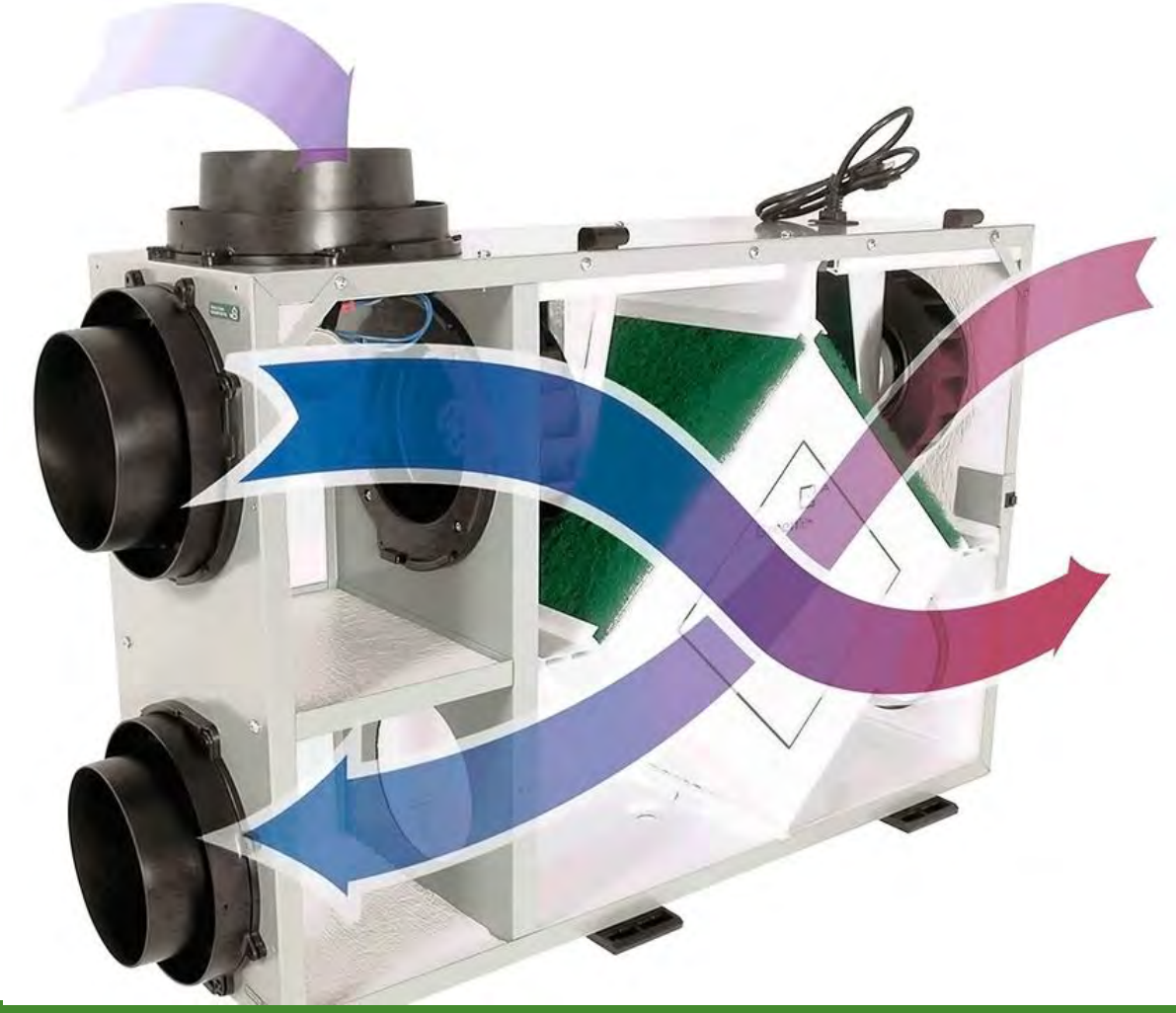
Balanced ventilation with heat recovery

- Plans: Mech air supply & exhaust for each unit, with exhaust air heat recovery
- Site: Match plans – spot check units
- Code: C403.3.6, C403.8.4
- Benefit: Way better ventilation than the old trickle vent systems, filtration for wildfire smoke days

“Balanced ventilation” for R-2 dwelling units

R-2 dwelling & sleeping units

- Deliver ventilation air directly to each “habitable space”
  - Living room, bedrooms
  - Trickle vents & bathroom exhaust doesn’t work anymore
- Heat recovery required
  - w/ 60% sensible heat recovery effectiveness
  - “Informative note” about how to determine sensible heat recovery effectiveness from HVI publication



#5 Special occupancy: Garage/loading dock

Ventilation triggered by air monitoring

- Plans: Show sensors & controls
- Site: Demo system operation
- Code: C403.7.5
- Benefit: Protect occupants from hazardous environment

#6 Special occupancy: Outdoor café

Built-in gas or electric radiant heaters

- Plans: Show occ sensor or timer switch
  - Seattle: 20-min max shutoff time
  - Seattle: also applies to unheated spaces
- Site: Spot check occ sensors
- Code: C403.11
- Benefit: Why waste gas and heat up the great outdoors if nobody's sitting there to appreciate it?

#7 Special occupancy: Labs

Lab exhaust: provide heat recovery or meet one of the exceptions

- Plans: Show heat recovery or controls to meet exception
- Site: Match plans
- Code: C403.7.7.2
- Benefit: Labs are huge energy hogs, mostly due to fume hood exhaust

#8 Special occupancy: Hotel guestrooms

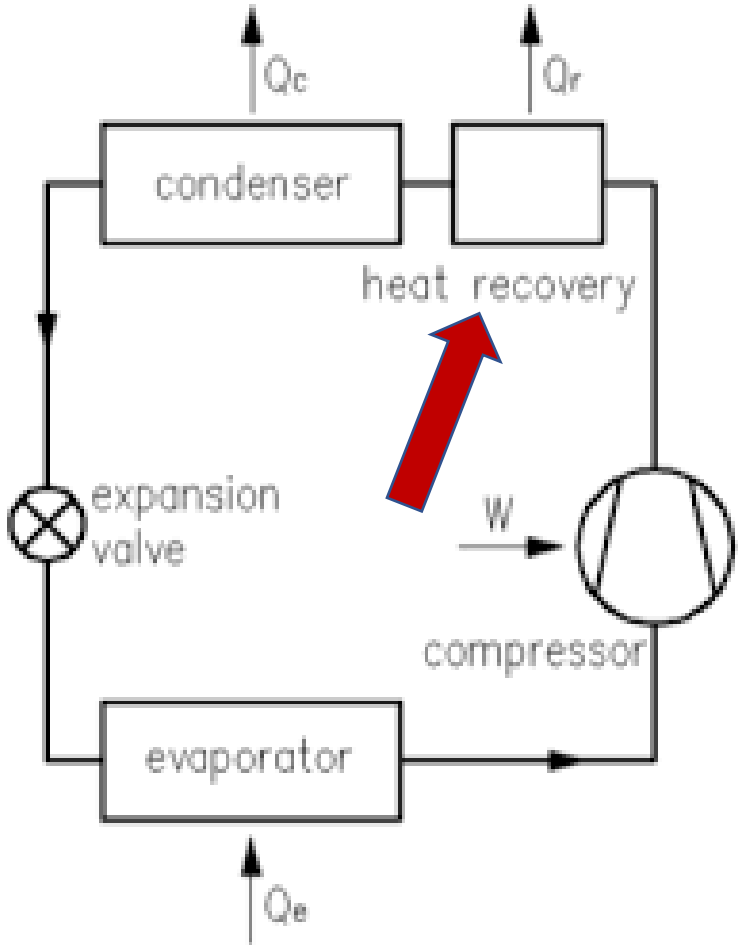
Guestroom HVAC setback controls

- Plans: Show control system
- Site: Demo control system
- Code: C403.7.4
- Benefit: Back off heating/cooling energy when no one's there to appreciate it

#9 Special occupancy: Grocery

Condenser heat from refrigeration recaptured for space heating or water heating

- Plans: Show heat recovery
- Site: See system installed on site
- Code: C403.9.2
- Benefit: Saves both the energy required to remove heat from the building and energy required to heat water



Heat Recovery C403.9.2

- **Refrigeration condenser** heat recovery (like in grocery)
  - 500 kBTUH remote refrigeration condensers
  - Use heat for service water, space heating, or dehumidification
  - 500 kBTUH is a medium or large grocery, not a corner store
- **Condenser heat recovery required** for heating service water in buildings (like hospitals) with:
  - 24/7 operations
  - 1.5 MBTUH total heat capacity of water-cooled systems
  - 250 kBTUH service water heating load
- **Steam condensate** water recovery required
  - Or condensate *heat recovery* for off-site steam with no return

WA – Modeling: Appendix G & carbon metric

- Switched to ASHRAE Appendix G method
  - Allowable emissions compared to a 2004 ASHRAE baseline
  - See table below
- Switched from “site energy” to “carbon” metric
  - Advantages heat pump, disadvantages electric resistance
  - Carbon content of electricity = 0.70#/kwh
    - 0.80#/kwh for low-rise “residential buildings”

Building Area Type	Multi family	Health care	Hotel	Office	Rest.	Retail	School	Ware house	Others
BPF – Building Performance Factor	0.56	0.54	0.64	0.54	0.70	0.47	0.36	0.48	0.54

Emissions factors & BPFs (WA & Seattle)

TABLE C407.3(1)
CARBON EMISSIONS FACTORS

	CO2e (lb/unit)	Unit
Electricity	0.70	kWh
Natural Gas	11.7	Therm
Oil	19.2	Gallon
Propane	10.5	Gallon
Other [a]	195.00	mmBtu
On-site renewable[b]	0.00	

a. District energy systems may use alternative emission factors supported by calculations approved by the code official.

b. The TSPR calculation does not separately account for the use of renewable energy.

TABLE C407.3(2)
BUILDING PERFORMANCE FACTORS (BPF) TO BE USED FOR COMPLIANCE WITH SECTION C407.3

Building Area Type	Building Performance Factor
Multifamily	((~~0.58~~)) 0.52
Healthcare/hospital	((~~0.54~~)) 0.49
Hotel/motel	((~~0.64~~)) 0.58
Office	((~~0.56~~)) 0.51
Restaurant	((~~0.70~~)) 0.63
Retail	((~~0.47~~)) 0.43
School	((~~0.36~~)) 0.32
Warehouse	((~~0.48~~)) 0.43
All Others	((~~0.54~~)) 0.49

WA

SEA

Alterations C503

General principles:

- Existing (untouched) can remain as-is
- Service and repairs OK
- New equipment and new systems must meet code
- "Substantial Alterations" Whole *building* meets code
  - With a small break for UA *or* BPF
- … same with change of occupancy, change of space conditioning

Replacement heating equipment

- New HVAC work must comply with all of Section C403
- **New central heating must be heat pump**
- Distributed fan coils not affected
- **Exception**: One (only) failing boiler or furnace can be replaced like for like. **Not** for planned replacements or as part of a larger project

How else can Seattle get to carbon-neutral?

- Recognized that upgrade to heat pumps is expensive & disruptive.
- Time of equipment replacement is the most economical option.
- Time of sale?
- Future date certain deadline?
- PACE financing now available in King County
- Gas cost increase may change cost-effectiveness equation

- Larger equipment space
- Structural support for heavy equipment and tanks
- Potential new electrical service and main panel
- Pathway for substantial supply and exhaust of outside air
- Noise and vibration control
- For hospital and other critical facilities, backup heat source for power outages

Interpretation: Upgrade to “heated and cooled”

Where triggered by SEC 503.2, a full energy code upgrade of the rest of the building is not required under these conditions:

1. The existing heated but not cooled space is altered to become both heated and cooled by replacement of the existing heating-only HVAC system with an electric heat pump HVAC system; and
2. The annual carbon emissions from heating and cooling of the new HVAC system is less than the annual heating-only carbon emissions of the existing HVAC system. SDCI will accept energy modeling complying with SEC Section C407 or another calculation method approved by the code official to demonstrate the reduced annual carbon emissions.

WA law 2019: Building performance standards

WA "below-average" buildings:

- 50.000 sf threshold
- Meet **EUI** target, or
- Pay: $1.00/sf/year penalty
- Starting 2026 – 2028

Conversion to heat pumps reduces both EUI *and* carbon emissions

Seattle building CO_2 emissions:

20,000 sf threshold

2030: 39% below 2008 baseline

2050: Zero carbon emissions

“That which exists, must be possible.”

Mark Frankel

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