



Puget Sound Chapter

October 18th 2023

2021 Seattle and Washington State Energy Codes

**Puget Sound
ASHRAE is a
Volunteer
organization**

Looking for help with:

- 1. Several Committees**
- 2. Upcoming Board Position**

Today's Meeting

2021 Seattle and Washington State: Energy Codes

Speaker: Duane Jonlin



2021 WA & Seattle Energy Codes

Puget Sound ASHRAE

October 2023



Duane Jonlin, FAIA

Seattle Department of Construction and Inspections

Schedule for revised “2021” code

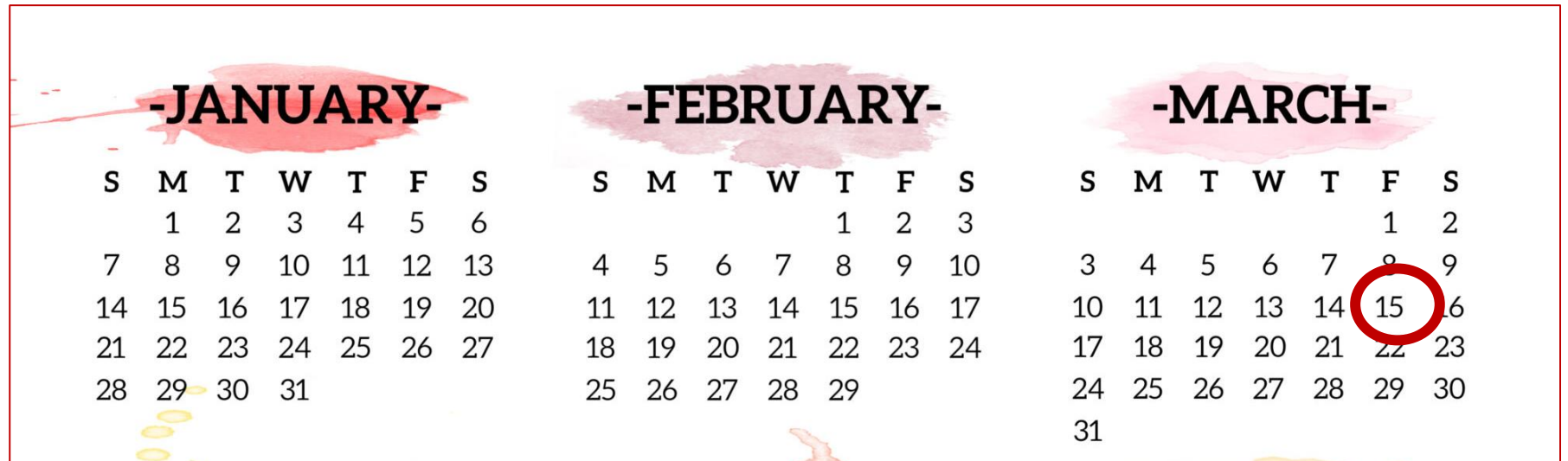
Permit applications starting:

WA 2021 code: March 15, 2024

Seattle 2021 code?

...sometime *after* March 15, 2024

WSEC “Fossil fuel compliance path” amendments out for public comment ~~now~~ soon?



If you have better ideas how to do this, let's hear 'em!



Washington state:
70% less building
energy use by 2030

- And zero-carbon

Washington state:
45% reduction in GHG
emissions by 2030

- 95% by 2050

Seattle: Zero-carbon
building & vehicle
operations by 2050

- New & existing

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

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

Will your new buildings work for zero-carbon 2050, without major surgery?

A great building should *at least* excel at these:

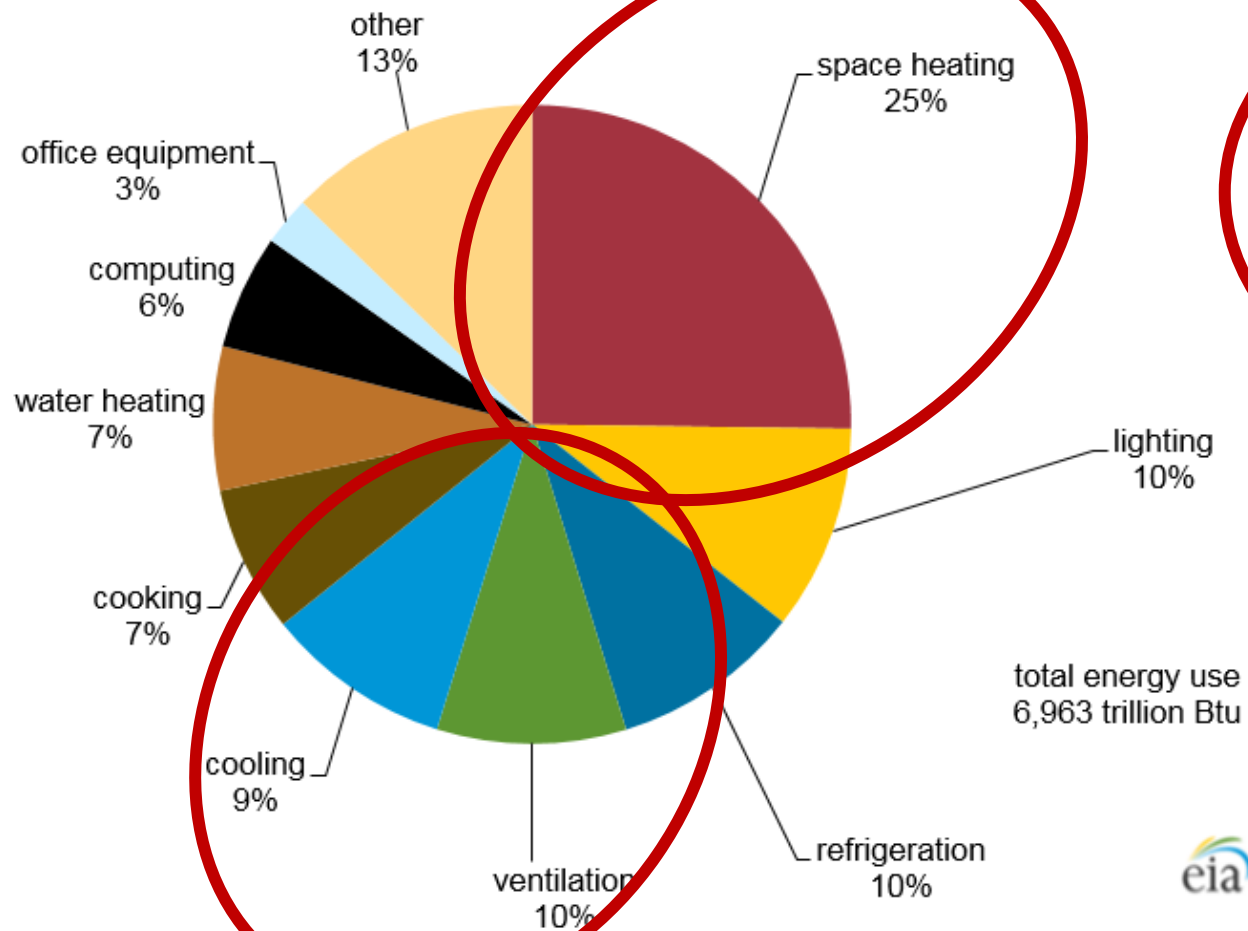
1. Commissioning
2. Metering
3. Heating type
4. TSPR
5. DOAS
6. Economizers
7. Energy Recovery
8. Controls
9. DDC
10. C406 options



+ Special Occupancies

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

Start with the *big* mechanical slices



- **Space heating**
 - System efficiency
 - Heat recovery
 - Envelope UA & air tightness
- **Cooling**
 - System efficiency
 - Ventilation
 - Fenestration size & shading
- Lighting
 - Efficiency
 - Controls
- Water heating
 - System efficiency
- Plug loads



Your HVAC loads are shrinking

But will you believe your own calculations?

- Seattle: 20% (or 35%) of glazing is triple
 - And U-factors are lower for the other 80%
- Seattle & WA: Max air leakage rate is 0.25 cfm/sf
 - And buildings *must* pass
- Cooling for lighting & plug loads is much lower than standard assumptions
- Significant heating from internal loads

...and speaking of envelope...

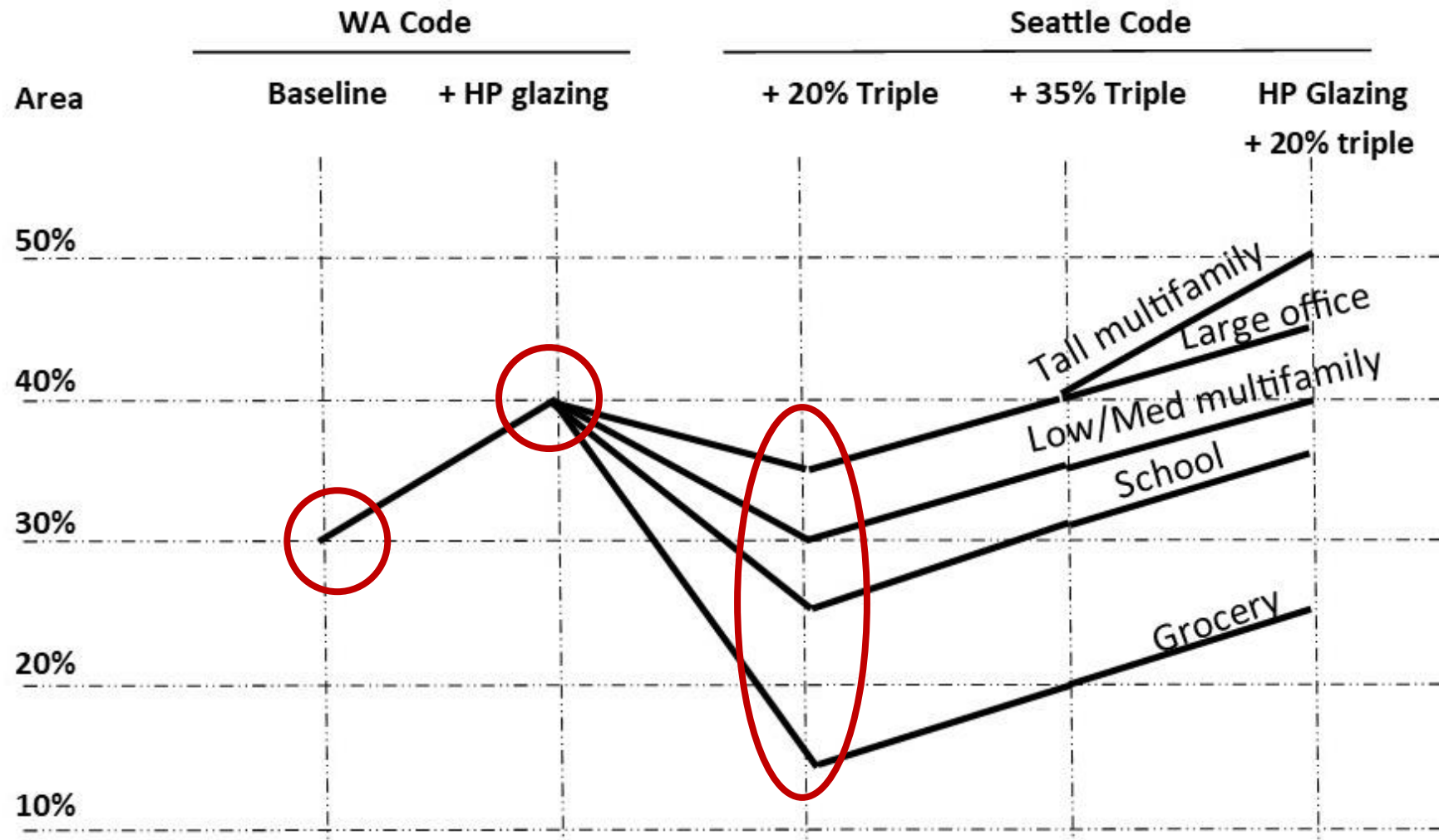
Sea & WA: U-value of PTAC/PTHP units

- Conventional PTAC & PTHP units leak heat & leak air badly
- Through-wall mech units assigned default U-factor of 0.50
 - Unless mfr has tested U-value
 - (This is 10x typ wall heat loss!)
- If over 1% of wall area, you must do UA calc with this U-factor

C402.1.4.3

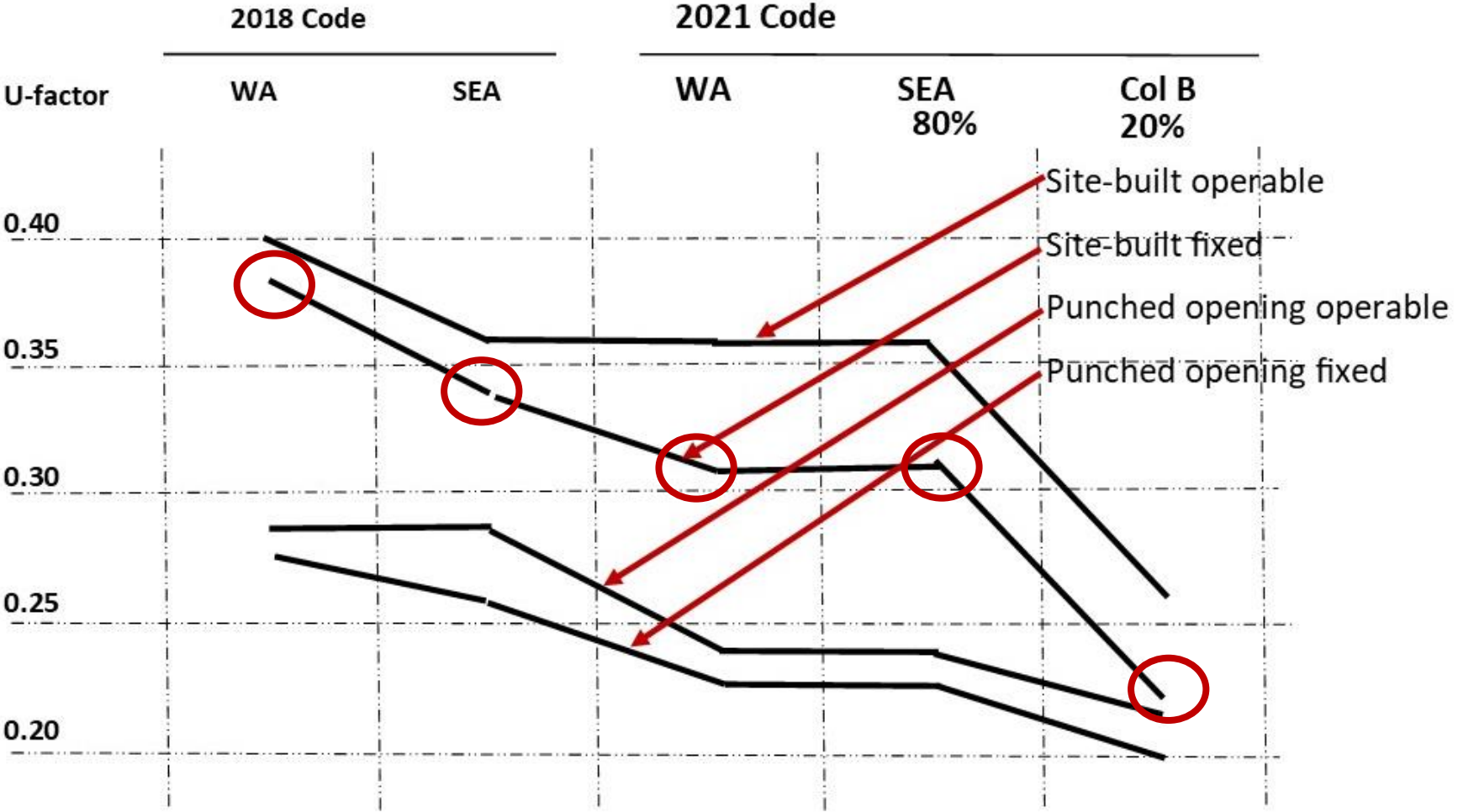


Allowable fenestration area

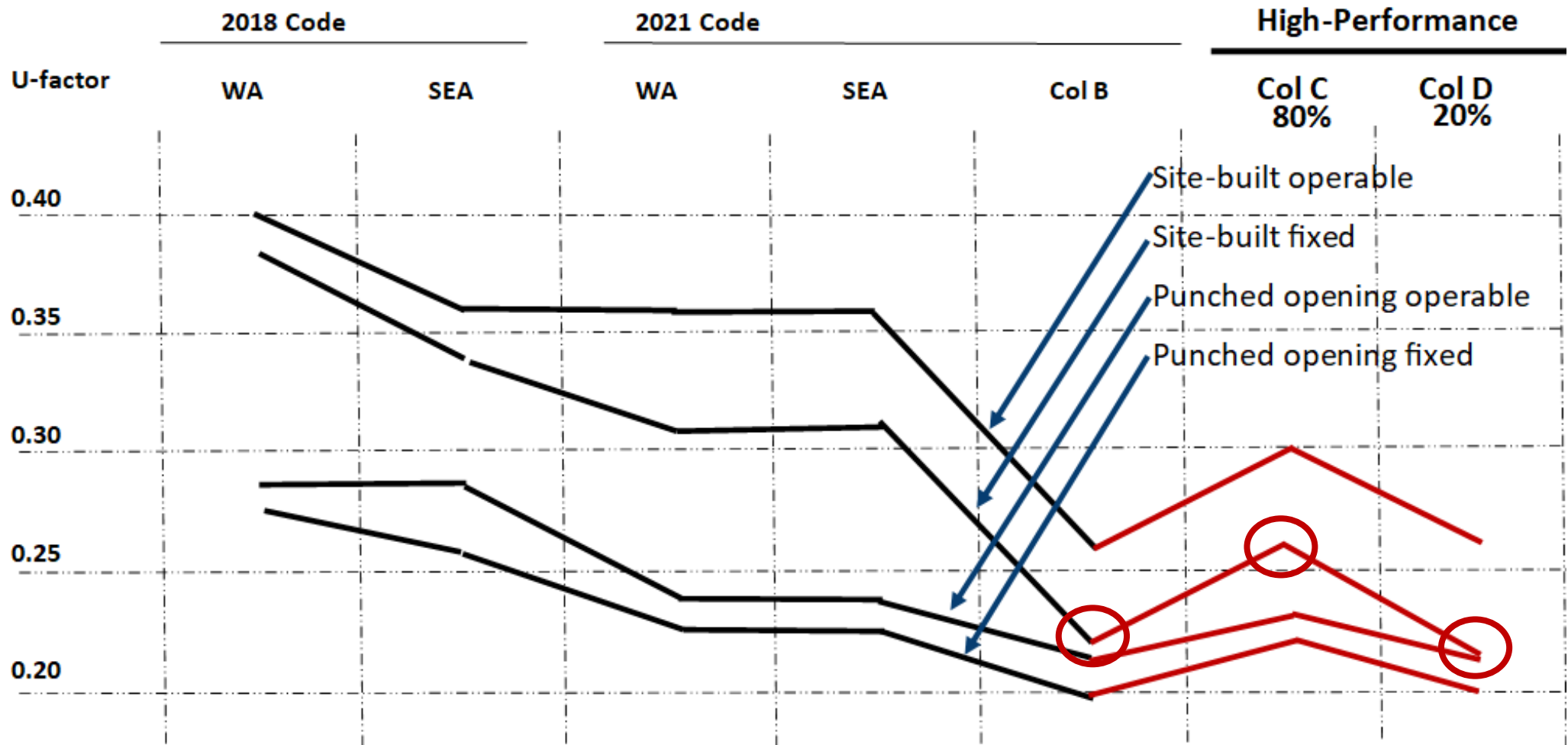


For UxA calculations, these are the baseline allowable areas

Fenestration U-factors



High-Performance U-Factors



WA & Seattle Air Barrier Testing

Test standard 0.25 cfm/sf of envelope



Passing test now mandatory

...at 0.25 cfm/sf

Q: Do your HVAC design calcs account for reduced leakage?

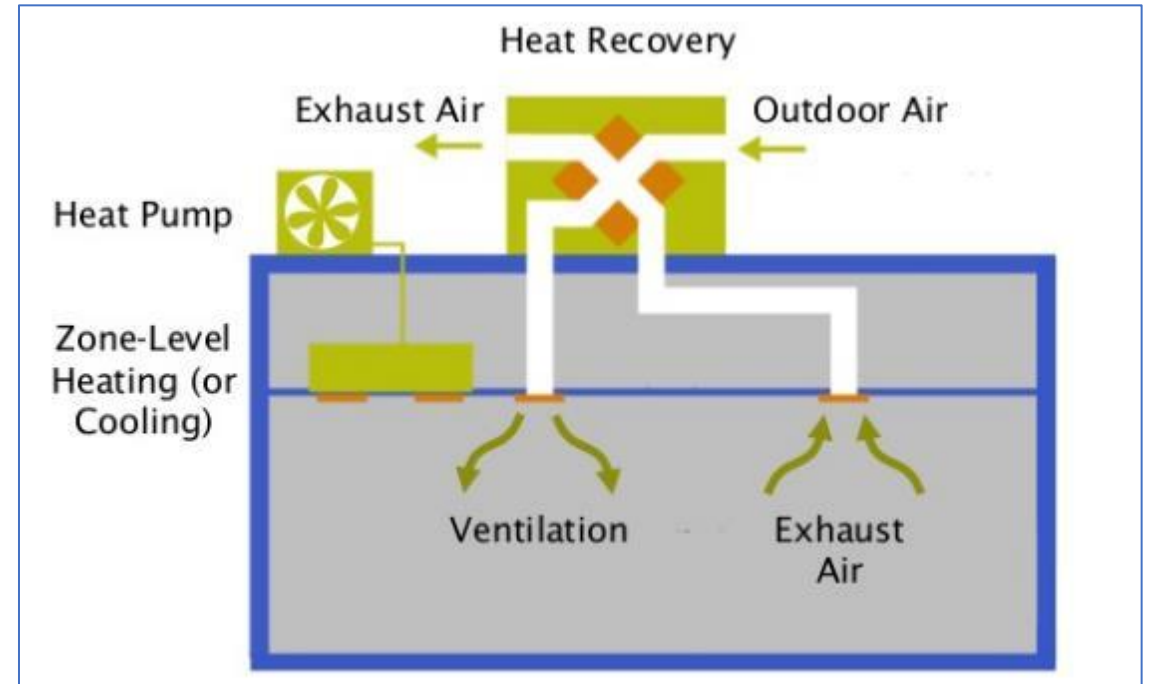
Data Center Cooling Efficiency C403.1.3

- WA & Seattle: ASHRAE 90.4 **2022 edition**, Sections 6 & 8
- No WA modifications



DOAS scope (details next slide)

- Office, education, retail, library, assembly
- Seattle: add “Dwelling & Sleeping Units,” served by central system
- Seattle: add Group R corridors and other common areas
- “Accessory Occupancies” exempt
- Seattle: DOAS fan power 0.8 W/cfm
- Seattle: DOAS can “temper” air up to 55°F, or cool for dehumidification



Dedicated Outdoor Air System:
Ventilation “decoupled” from heating & cooling, with energy recovery

DOAS Clarification:

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
R	<p>Group R dwelling and sleeping units served by energy recovery ventilation systems that each serve two or more dwelling or sleeping units for which energy recovery ventilation is required in accordance with Section C403.7.6.</p> <p>Group R spaces other than dwelling and sleeping units, including corridors and other common use areas.</p>	<p>Groups R-1 and R-3 dwelling or sleeping units for which energy recovery ventilation is not required in accordance with Section C403.7.6.</p> <p>Group R dwelling and sleeping units served by energy recovery ventilation systems that each serves only one dwelling or sleeping unit.</p>
E, M	All occupancies included	

DOAS & Economizers

- Economizer *required* for DOAS if cooling equipment is outdoors or in a space adjacent to an exterior wall or roof.
 - So, exception only applies if chiller is buried in some interior mechanical room with no access to outside air

C403.5 Economizers. *Air economizers* 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.

Exceptions...

DCV Required c403.7.1.1

- Single-zone systems with economizer
- Spaces over 500 sf with 15 occ's per 1000 sf need DCV
 - Includes retail
 - Exempts several small occupancy types
- Exception for “total system design outdoor airflow” less than 750 cfm (or 1500 cfm with 60% effective ERV)
- Exception for multi-zone system with “design occupant component outdoor airflow” less than 100 cfm (or 200 cfm with 60% effective ERV)





$$\text{TSPR} = \frac{\text{Heating + Cooling Loads}}{\text{Carbon Emissions}}$$

(annual)

TSPR: Total System Performance Ratio
Office, Medical office, Retail,
Library, Education, Multifamily



TSPR evaluates HVAC efficiency by comparing:

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

Free online calculation tool from PNNL

Seattle TSPR clarifying table: What's in, what's out

Table C403.1.1
Occupancy Classifications Requiring TSPR

Occupancy Classification	Inclusions	Excluded
A	Library	All other Group A uses
B	Office, medical office	All other Group B uses
E	All occupancies included	
M	All occupancies included	
R	Dwelling units and common areas within Group R-2 areas of buildings	Groups R-1 and R-3 occupancies. Sleeping units and associated residential common areas in Group R-2
F, H, I, S, U		All occupancies

Lots more info in [SDCI Tip #425](#)—HVAC Total System Performance Ratio

“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 with bathroom exhaust doesn’t work anymore
- Heat recovery required
 - w/ 67% sensible heat recovery effectiveness (68% in WA code)
 - “Informative note” about how to determine sensible heat recovery effectiveness from HVI publication

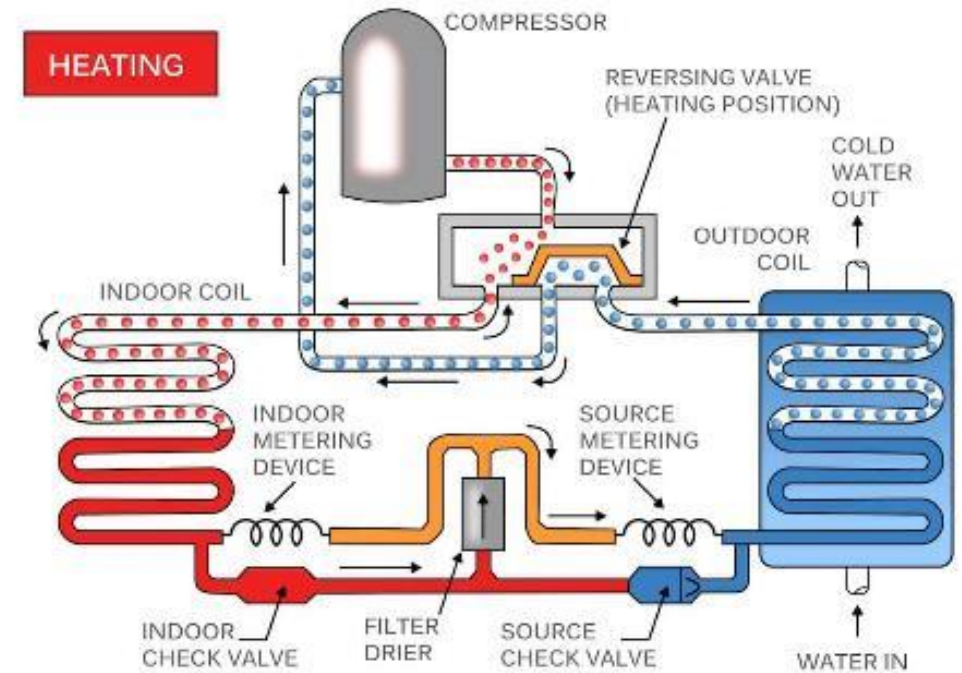


Seattle & WA: Heat pump space heating

No electric resistance or fossil fuel combustion for space heating

Exceptions allow electric resistance heat for:

1. “Passive House” rule: Max 2.5 W/sf total installed heating
2. Dwelling & sleeping units: Max **750 W** per habitable room
 - **1000 W** for corner room
 - **250 W** for room at exterior wall, with no window
 - Seattle: averaging within apartment OK
 - (More in CZ-5: 1000 W & 1300 W)
3. Buildings smaller than 2,500 sf
4. Heat pump defrost



Heat pumps squeeze warmth out of cold air

C403.1.4 (space heating) More Exceptions

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 heat pump
 1. All sizes
 2. Auxiliary heat locked out down to 36°F
 1. Fossil fuel auxiliary OK in CZ 5 only
 3. Compressor is first stage of heat down to lowest design temp
 4. Capacity at 17°F is min 75% of cap at 29°F
7. Ground-source HP
8. Small systems
9. Specific conditions (if *approved*)
10. Kitchen make-up air
11. District energy
12. Heat tape
13. Temporary systems
14. Pasteurization cycle
15. Freeze protection
16. DOAS ERV auxiliary heat
17. Low-carbon district energy
18. Essential facilities
19. Standby heating equipment
20. Emergency generators
21. Wastewater heat recovery pumps

Simultaneous heating/cooling

C403.4.1

- In “thermostatic control” section
- You can’t have heating in the perimeter zone with cooling in the interior zone of the same space at the same time.
 - Duh-oh!
 - You *can* have one zone in heating or cooling while the other is neutral
 - Permanent opening between areas bigger than 10% of either floor area constitutes a single space for this requirement



Seattle: Occupied standby controls

“Occupied standby” ventilation & temp control

Shuts down ventilation & tweaks temp while space is unoccupied

- Ventilation fan does not run while space temp is in the expanded deadband

C403.8.7 Occupied standby controls.

Occupied standby controls in compliance with C403.8.7.1 and C403.8.7.2 are required for zones and systems serving zones where no less than 90 percent of the floor area of the zone consists of use types including those listed below and other space types with similar functions, and none of the spaces within the zone are required by the International Mechanical Code to have ventilation airflow greater than zero when unoccupied.

1. Classroom/lecture/training rooms
2. Conference/meeting/multipurpose rooms
3. Lounges and breakrooms
4. Enclosed offices/open office/reception/lobbies
5. Assembly areas
6. Library stacks

Heat Recovery C403.9.2

- **Heat recovery required** to provide water heating in buildings (like hospitals) with minimum:
 - 24/7 operations
 - 1.5 MBTU/H total heat capacity of water-cooled systems
 - 250 KBTU/H service water heating load
- **Steam: condensate** water recovery required
 - Or condensate *heat recovery* for off-site steam with no return
- **Refrigeration condenser** heat recovery (like groceries)
 - 500 kBTUH remote refrigeration condensers
 - Use heat for service water, space heating, or dehumidification
- and...



Heat recovery for space heating C403.9.2.4

- Water-source condenser heat recovery system required if:
 - Operating hours over 70 hours per week
 - Heat rejection equip capacity over 1.5 MBTU/H
 - Min 0.45 cfm/sf airflow in zones with reheat
 - EXCEPTION: DOAS – dedicated outdoor air systems
- 90% of heating from heat recovery chiller or water-to-water heat pump, rejecting heat from cooling loop to heating loop as first stage of heating
- Heat recovery from 90% of exhaust airflow
 - Leaving exhaust air temp max 55F in full heat recovery mode
- Process heat recovery (like data center or computer room) over 5 W/sf
 - Cooling loops must be served by water-cooled equip & heat recovery
 - Economizer override required

Heating the great outdoors c403.11

- Outdoor heat must be “radiant”
- Seattle adds “...or in unheated spaces” (repair garage, desk at warehouse...)
- Auto-off by timer or occ sensor
- Seattle adds “...in the area heated by each individual device for a period not to exceed 20 minutes.”
- Freeze protection (like heat trace) shut off above 40°F



C406 credit system Pick several “above-code” options

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)) <u>59</u>	((41)) <u>45</u>	((42)) <u>46</u>	((48)) <u>53</u>	((74)) <u>61</u>	((49)) <u>54</u>
Building additions energy efficiency credit requirement	C406.2	((27)) <u>30</u>	((20)) <u>22</u>	((21)) <u>23</u>	((23)) <u>25</u>	((36)) <u>30</u>	((21)) <u>23</u>
New building load management credit requirement	C406.3	12	15	27	15	13	26

Table C406.2

List all your HVAC-related efficiency credits & load mgmt. credits on HVAC set cover page

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)) 8	((2)) 5	((3)) 10	((4)) 10	((3)) 8	((2)) 8
4. Improve heating efficiency	C406.2.2.3	((2)) 1	((3)) 1	((3)) 1	((10)) 1	((16)) 2	((7)) 1
5. Improved low-carbon district energy system (10% better)	C406.2.2.4	3	3	4	11	17	8
6. Improved low-carbon district energy system (20% better) ^b	C406.2.2.5	9	10	12	33	52	24
7. High performance DOAS	C406.2.2.6	31	31	21	39	40	21/ (Group A: 40) ^c
8. Fault detection & diagnostics (FDD)	C406.2.2.7	2	2	2	6	9	4

C406 “load management” credits

New building load management credit requirement	C406.3	12	15	27	15	13	26
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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

C406 credit: Improved TSPR C406.2.2.1

- TSPR 5% higher than code min
- Can be prorated up to 20% higher TSPR



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 ... **Tenant spaces qualify for the credits assigned to the occupancy type of the tenant space in accordance with Table C406.2 if the tenant space includes the distribution system and equipment that the central HVAC systems or service water heating systems were designed to support.**

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

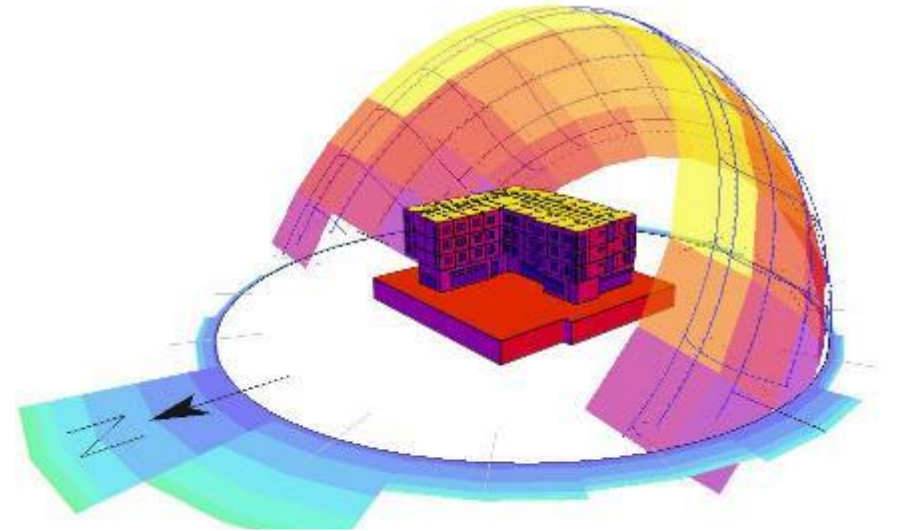
Seattle: No C406 credits for fossil fuel equipment

- **C406.2.2.6 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 as specified by the International Mechanical Code, shall be served by DOAS installed in accordance with Section C403.3.5 with the following adjustments:
 - ...
 - ... **No HVAC systems incorporating fossil fuel-fired equipment, or heat from district energy systems that are primarily heated by fossil fuel combustion, are permitted to utilize this credit.**
 - **Same** for C406.2.6 Service water heating

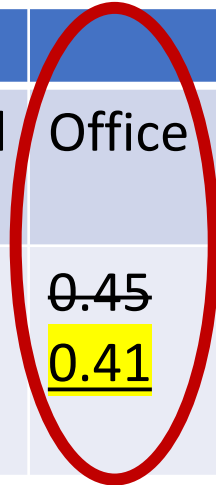
Energy Modeling – emissions based

...plus EUI cap

- **Carbon emissions** compared with 2004 ASHRAE 90.1 standard
- Seattle BPF **10% below** WA code
 - To align models with more stringent Seattle Energy Code requirements



SEATTLE 10% lower									
Building Area Type	Multi family	53	Hotel	Office	Rest.	Retail	School	Ware house	Others
Building Performance Factor	0.55 <u>0.50</u>	0.71 <u>0.64</u>	0.53 <u>0.48</u>	0.45 <u>0.41</u>	0.35 <u>0.32</u>	0.41 <u>0.37</u>	0.36 <u>0.32</u>	0.19 <u>0.17</u>	0.44 <u>0.40</u>



So, what's a BPF?

- Building Performance Factor
- From ASHRAE 90.1 Appendix G
- Ratio of:
 - Regulated carbon emissions from *proposed* building, to;
 - Regulated emissions from ASHRAE 90.1-2004 *baseline* building
- So, 0.51 BPF = 51% of the emissions from 2004 ASHRAE building
- See Tip 423
 - New and revised Tips will be posted with 2021 code

- “Regulated” uses include:
 - HVAC, Water heating
 - Lighting, refrigeration
- Unregulated uses include:
 - Computers, printers
 - Appliances, misc plug loads
- Emissions factors:

Type	CO2e (lb/unit)	Unit
Electricity	0.44 (0.70)	kWh
Natural gas	11.7	Therm
Oil	19.2	Gallon
Propane	10.5	Gallon
Other ^a	195.00	mmBtu
On-site renewables	0.00	

Commissioning of HVAC required, plus...

- Cx qualifications, checklist
- Conflict of interest statement
- CX plan and Cx report
 - Lighting, controlled receptacles
 - HVAC, water heating
 - Refrigeration, Metering
- HVAC Cx thresholds:
 - 240 kBtu/h cooling
 - 300 Kbtu/h heating
- Write Cx requirement in mech permit docs, including MEP sets



Also see C408.1.4.1.1 for Post-Occ Cx reqs!

Seattle: Approved unregulated loads C407.3.4.1

- You *might* get C407 “credit” for unregulated but high-performing systems
- Demonstrate that proposed equipment is significantly better than what is typically being installed in Seattle
 - It’s a pretty high bar
- Any approved credits will be publicly listed so everyone else can use them
- A few residential appliances pre-approved

Like, maybe:

- FDD
- Heat trace?
- Point of use water heater

~~Metering~~ Actionable energy display

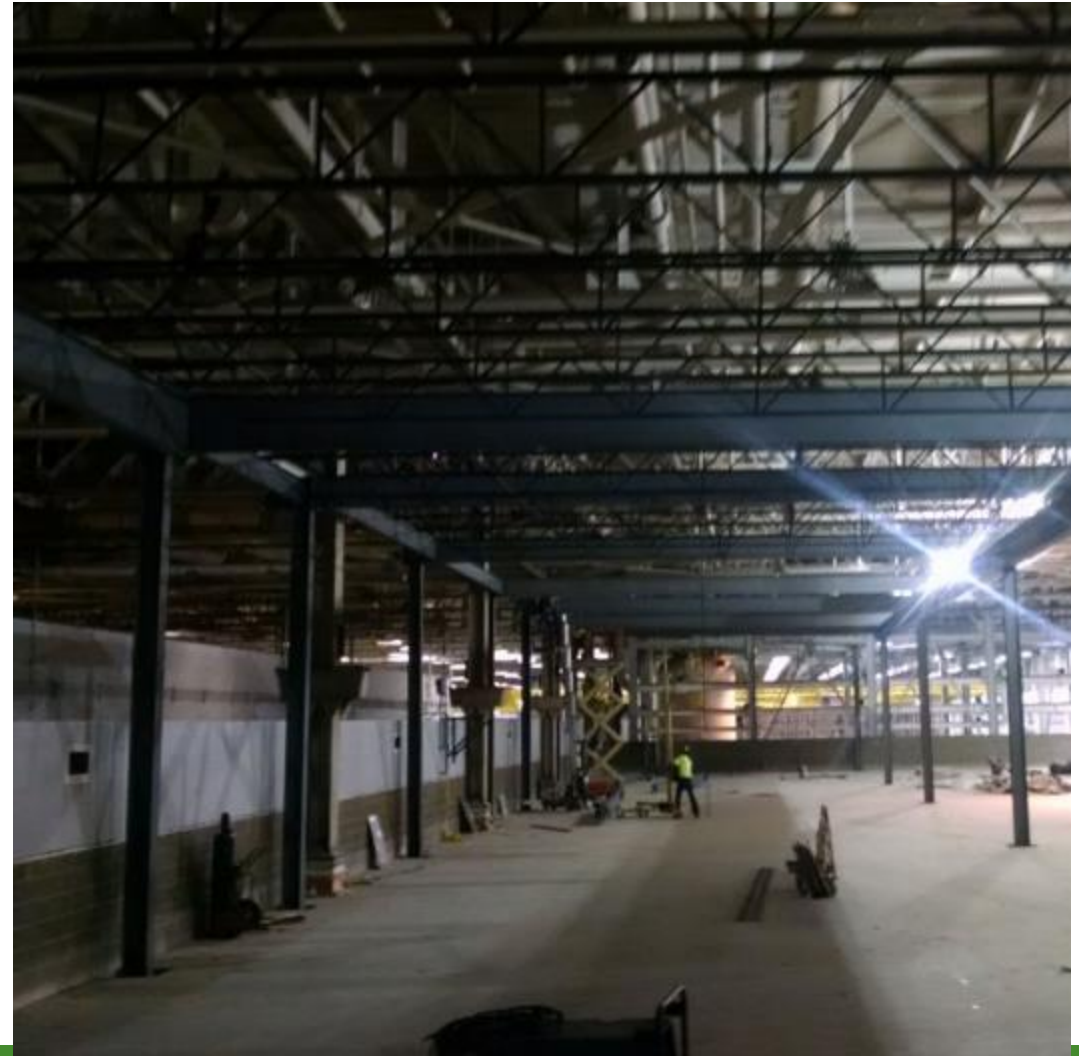
- Graphic energy use display for bldgs. 20,000+ SF
 - Source meters (usually gas & elec pulse meters)
 - HVAC & water heating sub-meters
 - Lighting, plug load & process load sub-meters
- Also required for replacement HVAC systems
- Planning can reduce number of meters



Alterations C503, C505

General principles:

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



Seattle Energy Code: Replacement of existing gas equipment

- **Most economical time to upgrade**
- **Current (2018) Code.** Replacement heating and water heating equipment must be heat pump system
 - Exception like-for-like replacement of “failing” equipment
- **New (2021) Code.** More options to postpone full conversion
 - But, no exception to “do nothing and keep burning gas forever”



Building Performance Standards

Getting real about good intentions

- Should existing buildings stay low-performing forever?
 - Precedents in nightclubs, high-rise stairs
- BPS is departure from tradition
- Technical challenges
 - AKA “Business development opportunity” for engineers



OK, so where will you put the heat pumps?

BPS: WA State *plus*

BEPS: Seattle

Energy

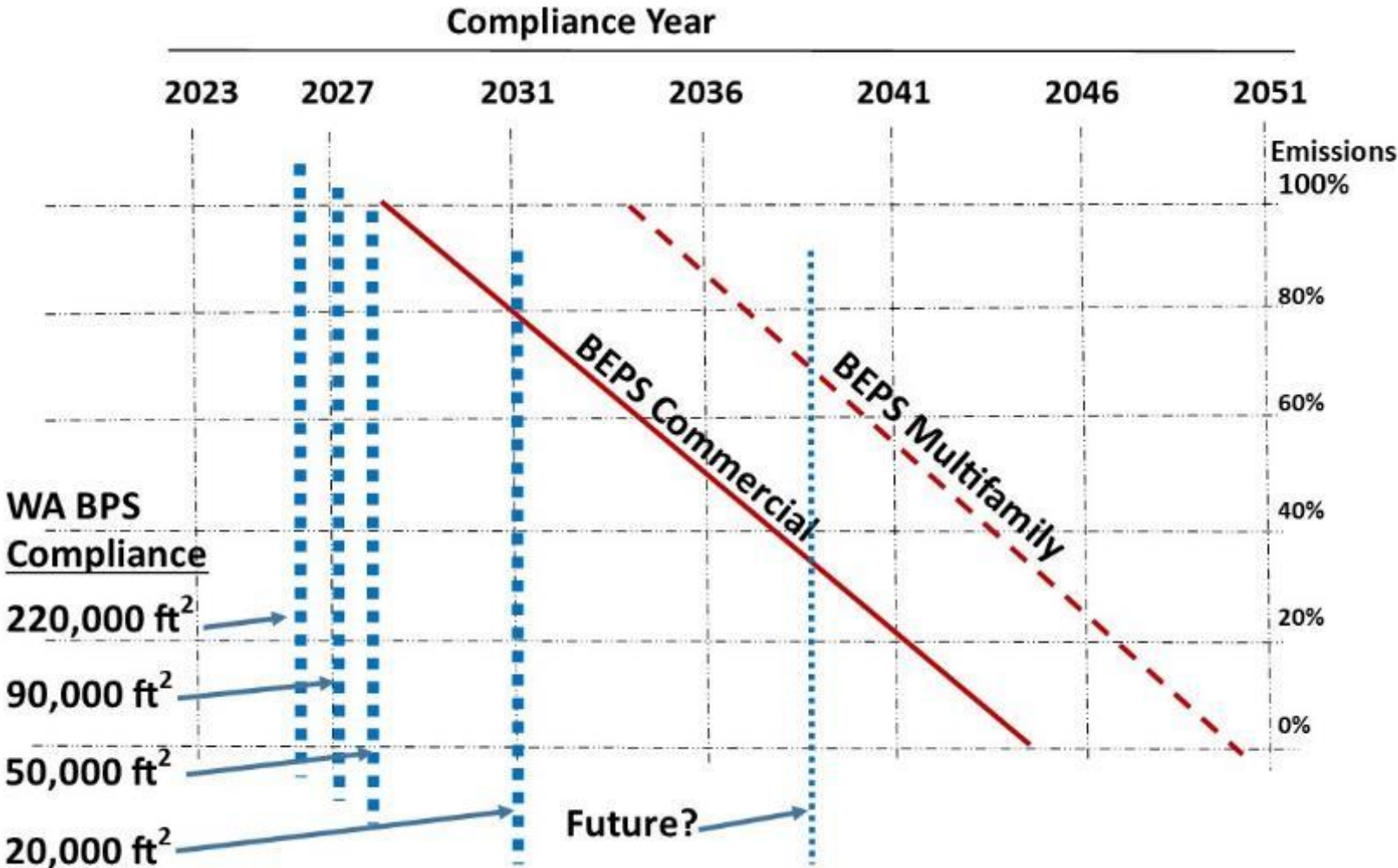
- Most building types
- **EUI targets** set at state “average” for each building type
- Lower EUIs in future?
- 50,000 ft²: Starts 2026
- 20,000 ft²: Starts 2031

GHG Emissions

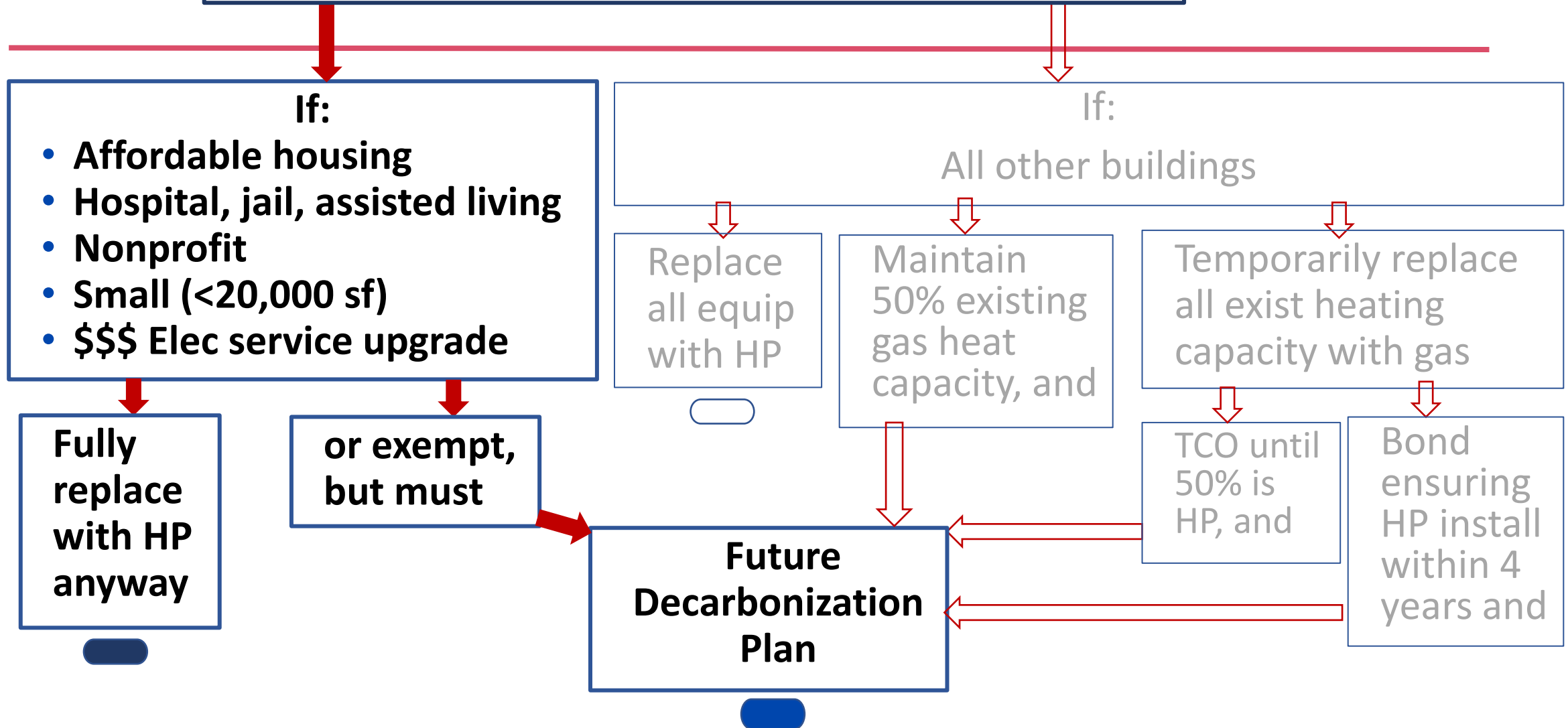
- Meet BEPS *in addition to* WA BPS
- **Maximum allowable emissions** drop every 5 years...
- ...to zero carbon in the 2040s
- 50,000 ft²: Starts 2028

BPS + BEPS

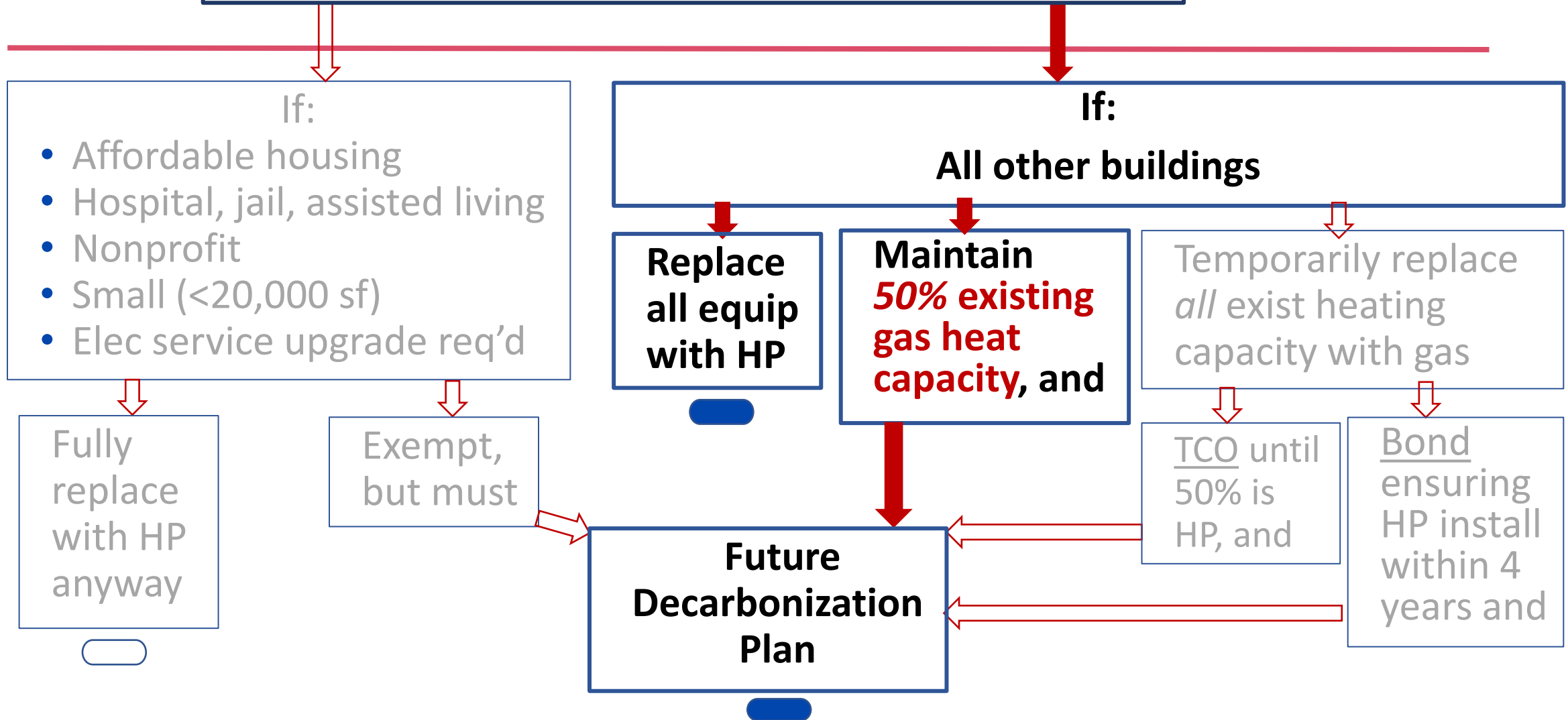
- **2-fer Bonus Prize:** Heat pumps tackle both energy *and* emissions



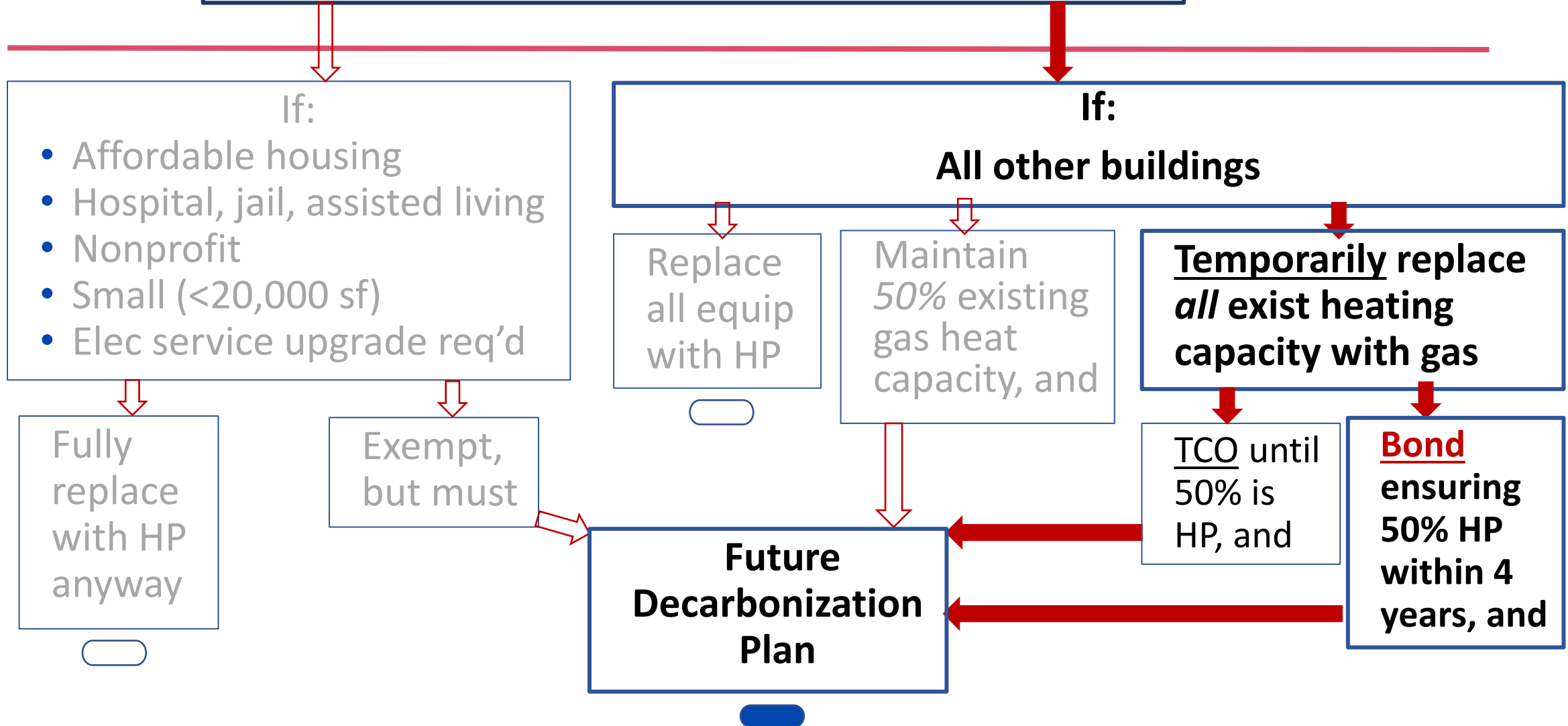
General rule: Replacement central space heating equipment must be heat pump



General rule: Replacement central space heating equipment must be heat pump

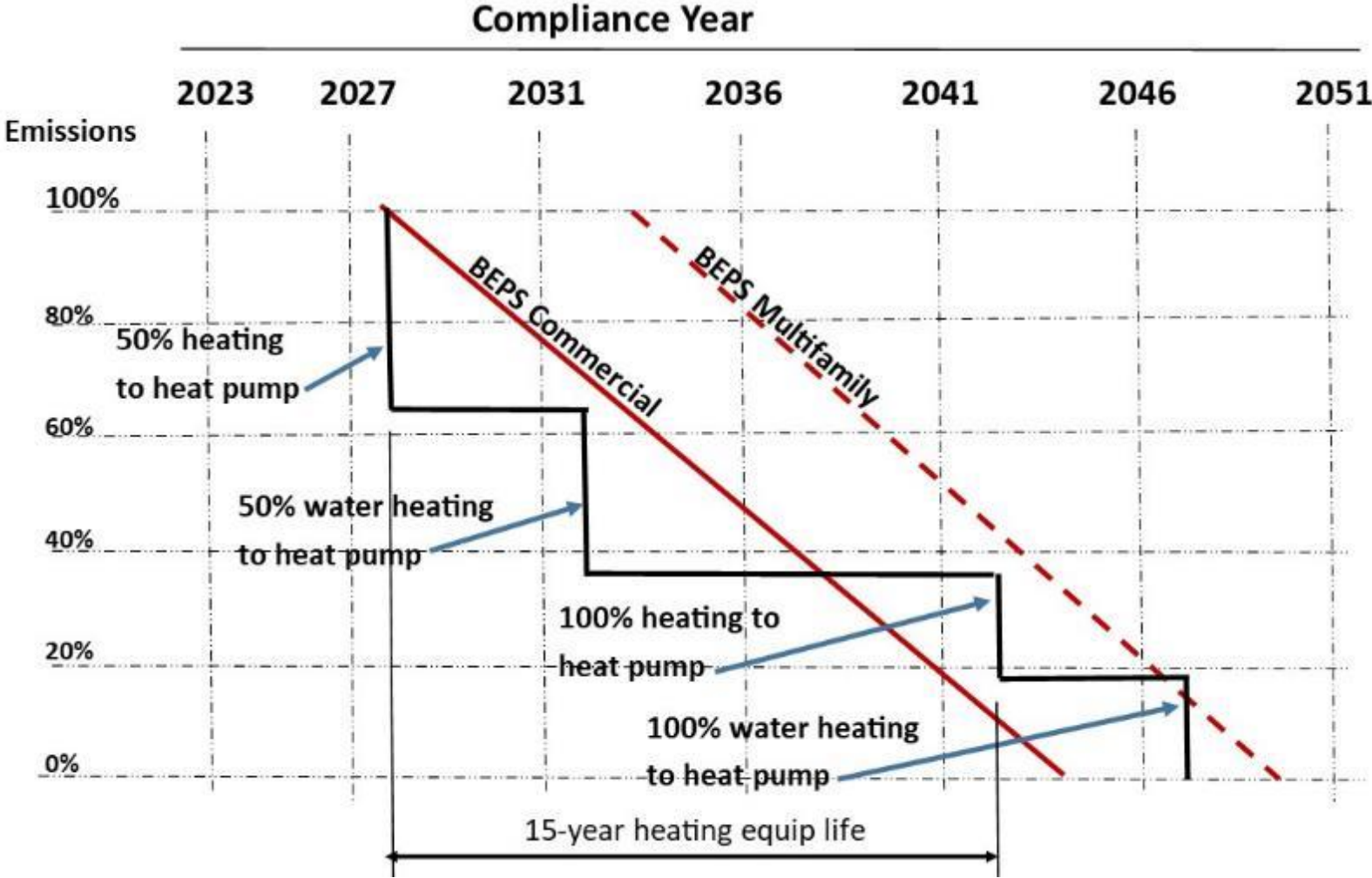


General rule: Replacement central space heating equipment must be heat pump



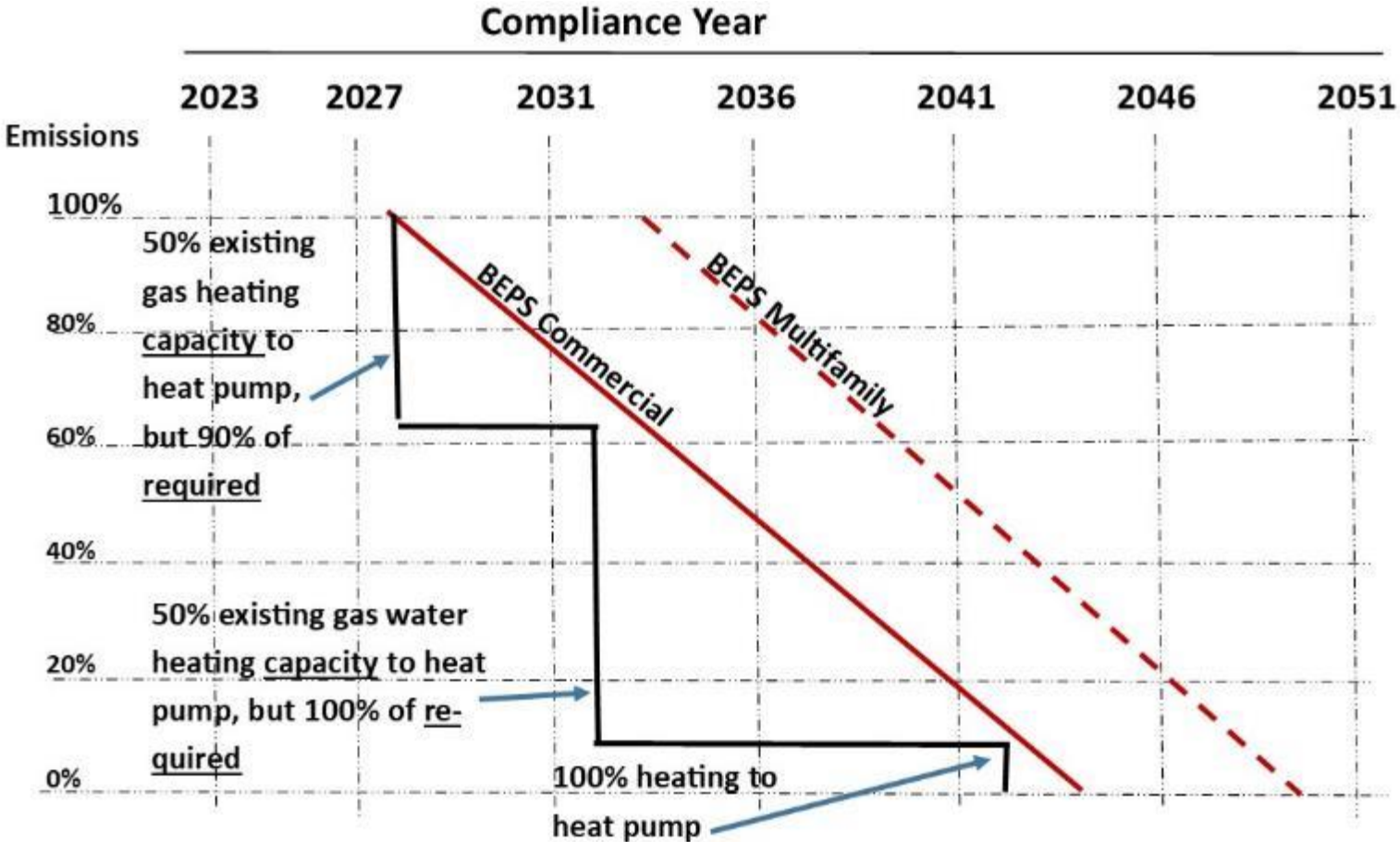
BEPS + SEC

- Seattle **BEPS**: emissions
- Seattle **Energy Code**: heat pump upgrade



BEPS + SEC – Take Two

- Seattle **BEPS**: emissions
- Seattle **Energy Code**: heat pump upgrade
- **Quiz**: By what factor are mech systems oversized?
- 10%, 20%, 50%, 100%?



Alternate possibility, accounting for gross oversizing of existing systems

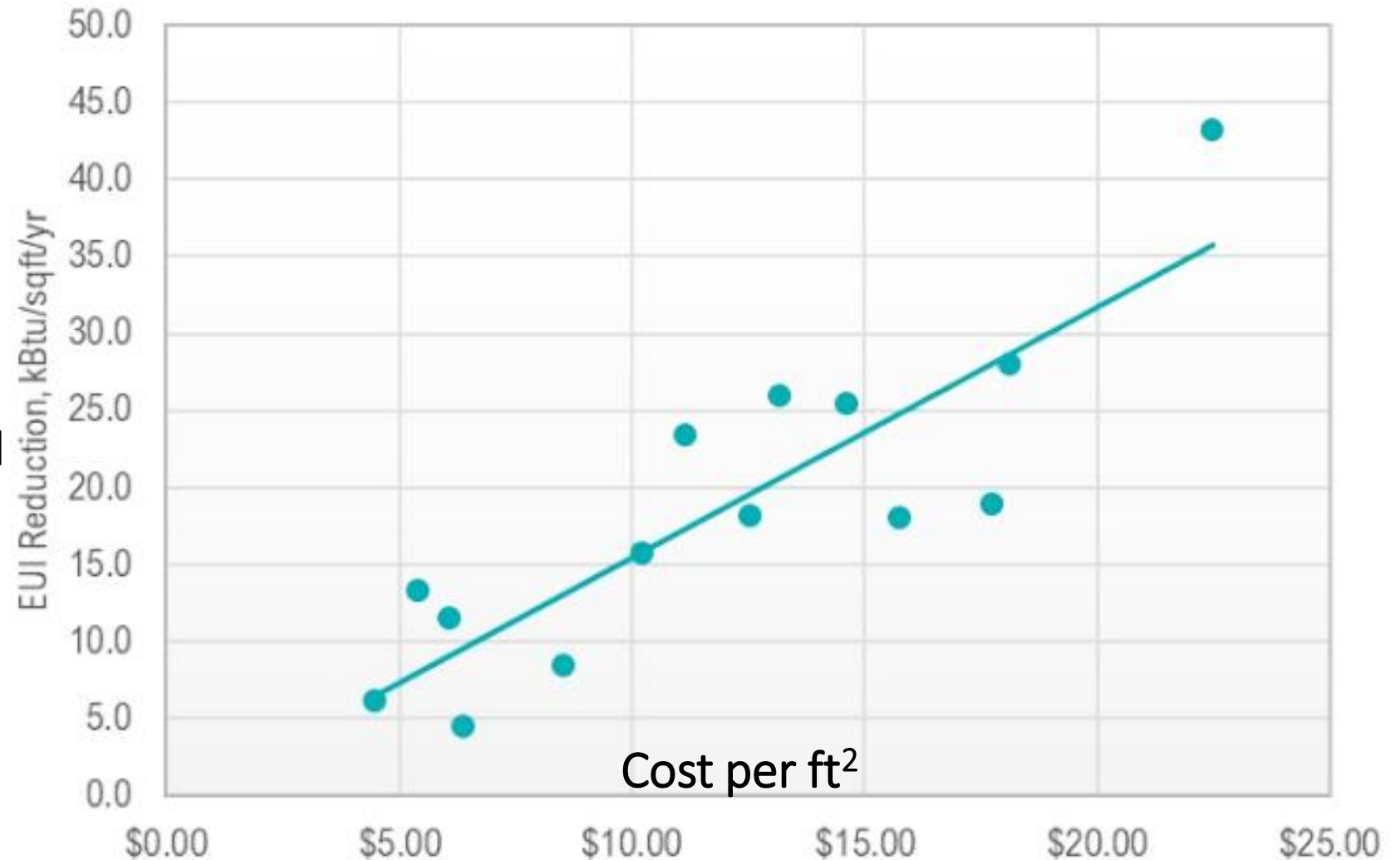
Costs

- These are *not* trivial.
- Real-world study of 16 local buildings

Required EUI reduction

Study courtesy of MacDonald Miller, Seattle, 2023

Project Cost per Square Foot Comparison



Potential Cost Reductions

Problems

1. Replacement heat pump system is big & expensive
2. Needs new electric service

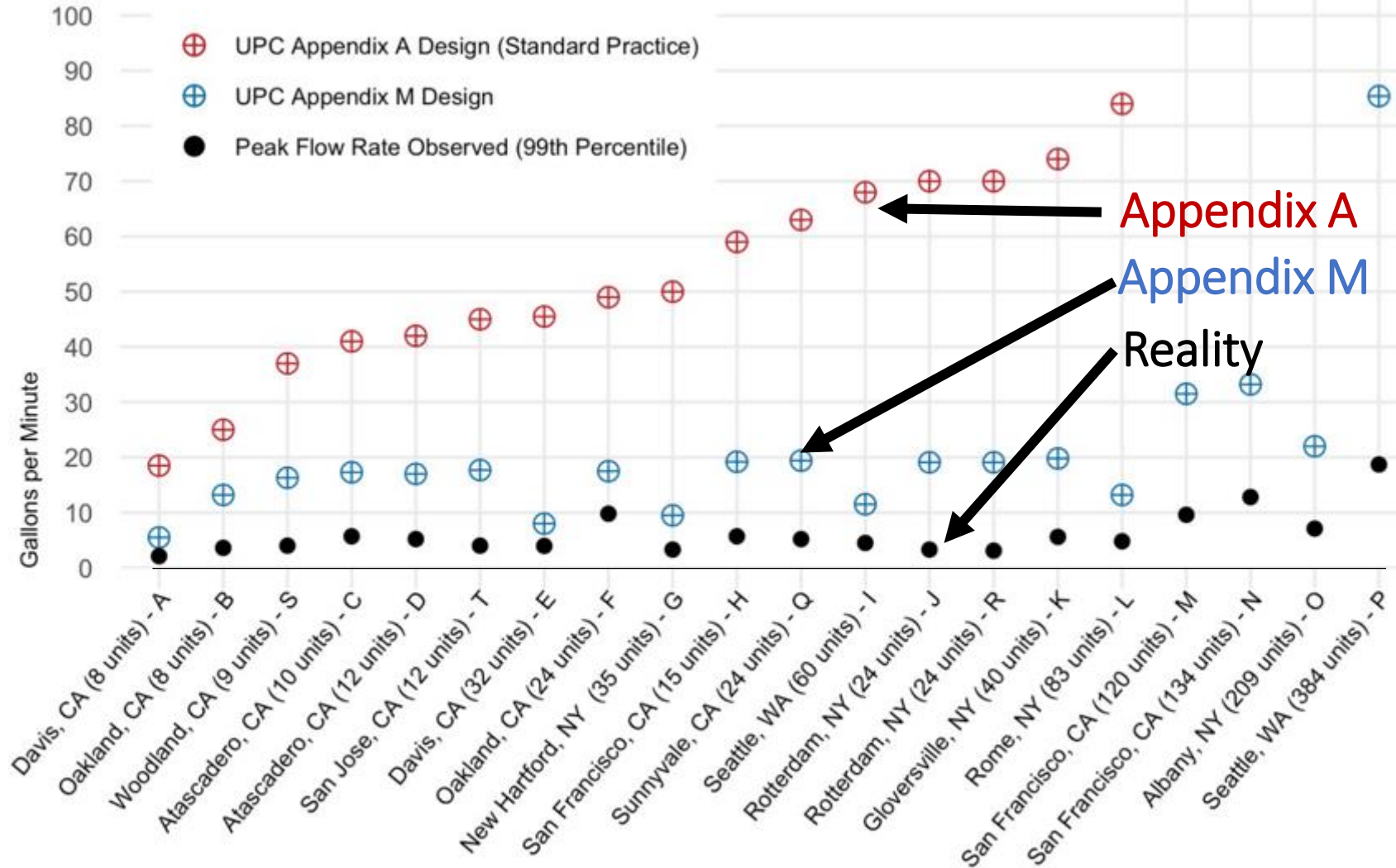
Solutions

1. Do you really need that much heating capacity? Are existing systems oversized?
2. Is metered building electric use as high as the default code assumption?
 - Electrical code allows metered peak + 25%

Image: Ecotope, Seattle 2023

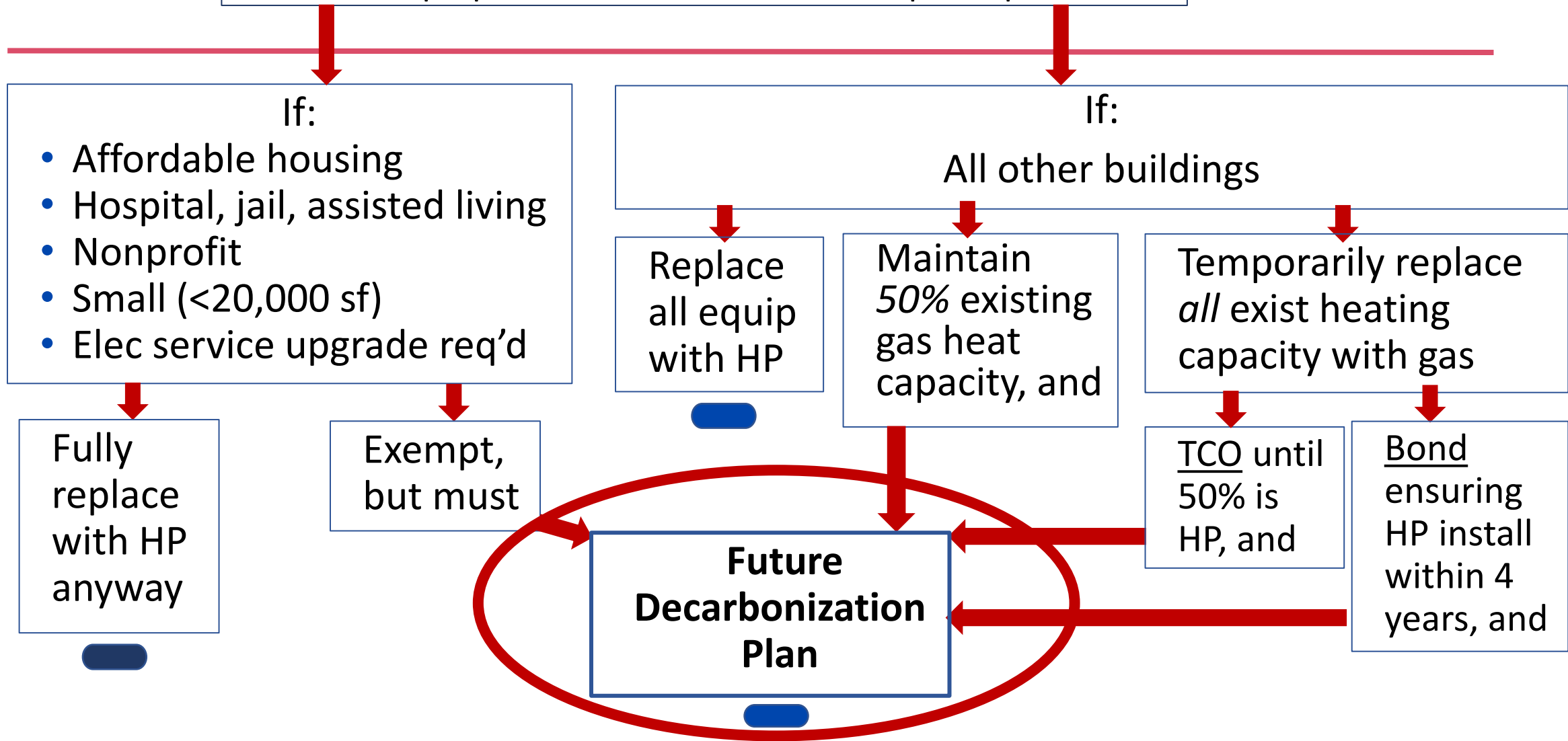
Comparing Design Predictions to Actual Peak Flow Rates

Peak Hot Water Flow Rates in Multifamily Buildings



Many thanks to the Association for Energy Affordability, Ecotope, Frontier Energy, Peter Skinner, and the UC Davis Western Cooling Efficiency Center for providing data.

Replacement central space heating equipment must be heat pump



Future Decarbonization Plan

Full engineered schematic design & cost estimate

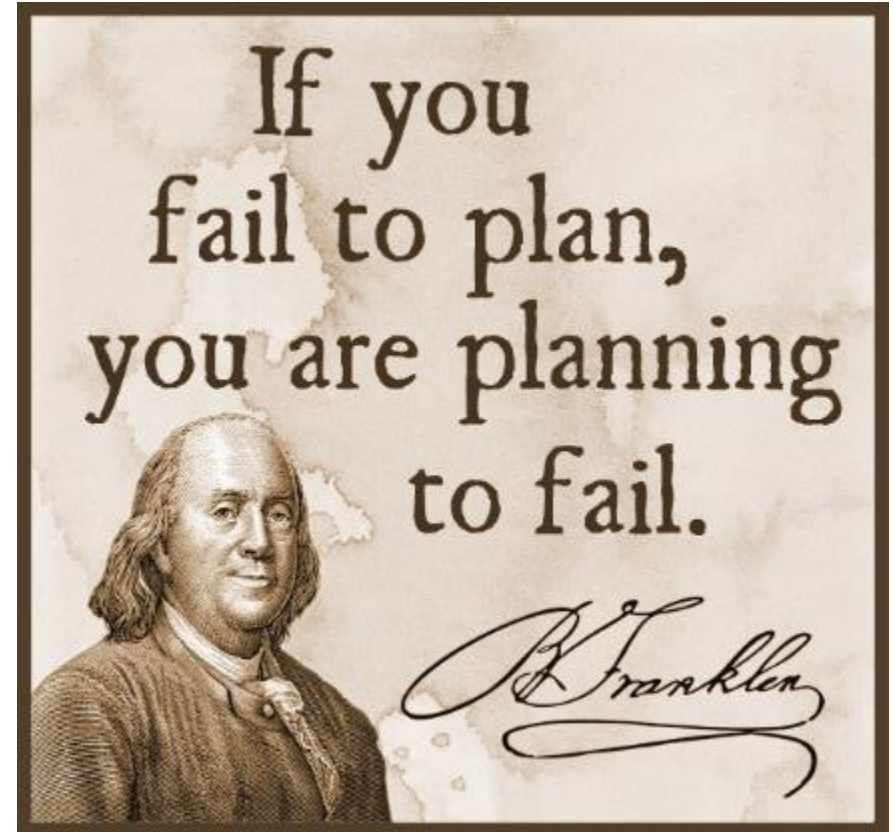
- a. One-line system diagrams
- b. Equipment laid out to scale.
- c. Louvers, ducts, & air handling equipment
- d. Structural modifications
- e. Partitions & doors
- f. Electrical infrastructure
- g. Allowable roof coverage area & height
- h. Decarbonization planning form
- i. Schematic cost estimate
- j. Compliance dates for WA & Seattle Building Performance Standards

Decarbonization Planning Form
Jonlin Jan 17, 2023 version

Requirement	Project Information
Prof Engineer name & firm name	
Project address	
Mechanical permit no. and date	
Electrical permit no. and date	
Building permit no. and date	
Submittal date of this form	
Conditioned floor area of building	
Number of stories above grade plane	
Existing building electrical service capacity	
For projects replacing existing central space heating equipment:	
Existing fossil fuel central space heating capacity	
Required primary heat pump system capacity to comply with C403.1.4	
Estimated full cost to owner for full electrification of space heating	
Location of primary heating appliances in building (basement, roof, etc.)	
Required electrical service capacity for full electrification of space heating	
For projects replacing existing central service water heating equipment:	
Existing fossil fuel central service water heating capacity	
Required primary HPWH capacity to comply with C404.2.1	

BEPS & Code: Two paths, same destination

- BEPS sets date certain for decarbonization
- Energy code requires heat pump as systems are replaced
 - with options to postpone
- Postpone, or not, based upon:
 - Construction cost: Pay now
 - Years until BPS or BEPS would mandate upgrade anyway: Pay later



Cooling system alterations C505.2

- When adding cooling to an “uncool” space, must provide either DOAS or economizer, both at the individual equipment level and the total system level
- Alteration or replacement of cooling system: Table C503.4 - Economizers

Table C503.4.3

Economizer Compliance Options for Mechanical Alterations

	Option A	Option B (alternate to A)	Option C (alternate to A)	Option D (alternate to A)
Unit Type	Any alteration with new or replacement equipment	Replacement unit of the same type with the same or smaller output capacity	Replacement unit of the same type with a larger output capacity	New equipment added to existing system or replacement unit of a different type
1. Packaged Units	Efficiency: min. ^a Economizer: C403.5 ^b	Efficiency: min. ^a Economizer: C403.5 ^b	Efficiency: min. ^a Economizer: C403.5 ^b	Efficiency: min. ^a Economizer: C403.5 ^b
2. Split Systems	Efficiency: min. ^a Economizer: C403.5 ^b	For units ≤ 60,000 Btuh, comply with two of two measures: 1. Efficiency: + 10% ^e 2. Economizer: shall not decrease existing economizer capability	For units ≤ 60,000 Btuh replacing unit installed prior to 1991 comply with at least one of two measures: 1. Efficiency: + 10% ^e 2. Economizer: 50% ^f	Efficiency: min. ^a Economizer: C403.5 ^b
		For all other capacities: Efficiency: min. ^a Economizer: C403.5 ^b	For all other capacities: Efficiency: min. ^a Economizer: C403.5 ^b	

Important Exception:

If you upgrade from gas to heat pump, even though you're adding cooling, it will not constitute a “change in space conditioning”
C505.2, Exception 1

Seattle: Air cooled chiller replacement

Must replace *air-cooled chiller* with heat pump system serving as first stage of heating.

- Exempt buildings
- Exempt system types

C503.4.3.1 Addition of new or replacement of existing air-cooled chiller systems. Where one or more air-cooled chillers are added or replaced, and the existing HVAC heating equipment is included in one of the categories listed below and is fossil fuel-fired or electric resistance, the replacement cooling appliance shall be an electric heat pump system in compliance with Section C403.1.4, integrated with the existing HVAC heating system and configured to serve as the first stage of heating when conditions permit use of the fluid temperatures produced by the heat pump system, with the existing fossil fuel-fired or electric resistance HVAC heating equipment serving as supplemental heat. Additions, alterations, or replacements shall not be made to an existing HVAC heating system that will cause the system to become out of compliance.

Exceptions .

1. Exempt buildings and occupancies. The new heat pump is not required to serve as the first stage of heating if it serves any of the following building categories and the requirements of Section C503.4.6.2 are met.

- Affordable housing*
- Group I-1, I-2, and I-3 occupancies
- Buildings with more than 50 percent of conditioned floor area occupied by organizations recognized as nonprofit by the State of Washington or by federal tax law
- Buildings with no more than 20,000 square feet of conditioned floor area

2. Exempt systems. The new heat pump is not required to serve as the first stage of heating if it serves any of the following system types, and the requirements of Section C503.4.6.2 are met.

- Steam heating systems, including replacement of existing steam boilers with steam distribution piping to terminal units and replacement of the existing associated boiler feed equipment.
- Terminal unit equipment including but not limited to electric resistance VAV boxes, electric duct heaters, electric resistance fan coils, or electric resistance heaters.
- Dedicated chillers serving only spaces that have no heating loads and are not served by heating equipment, including but not limited to data centers.**



New & replacement heating systems Seattle

Must replace existing *heating* with heat pump system serving as first stage of heating.

- Exempt buildings
- ...

C503.4.6 Addition or replacement of HVAC heating appliances. New HVAC heating systems shall comply with Section C403.1.4. Where one or more HVAC mechanical heating appliances are added or replaced, the added or replaced appliances shall comply with Section C403.1.4 or with an alternate compliance option in Table C503.4.6. When complying with the alternate compliance option in Table C503.4.6, added or replaced HVAC heating appliances must select HVAC heating appliances from one of the Proposed Heating Type Options and the applicable Heating Efficiency Tables. Additions, alterations, or replacements shall not be made to an existing HVAC heating system that will cause the existing system to become out of compliance.

1. Exempt buildings and occupancies. Replacement heating equipment serving any of the following building categories is permitted to use the same fuel type as the existing equipment, provided the replacement equipment complies with the minimum efficiency in Table C503.4.6 and the same or lower capacity than the existing, and that the requirements of Section C503.4.6.2 are met.

1. *Affordable housing*
2. *Group I-1, I-2, and I-3 occupancies*
3. *Buildings with more than 50 percent of conditioned floor area occupied by organizations recognized as nonprofit by the State of Washington or by federal tax law*
4. *Buildings with no more than 20,000 square feet of conditioned floor area*

New heating system, cont.

- ...
- 50% gas replacement
- 100% gas replacement (50% temp)

2. Retention of portion of existing system capacity. For buildings not exempted by Exception 1 above, a maximum of 50 percent of the existing fossil fuel or electric resistance heating capacity is permitted to be retained or replaced to serve as supplemental heat for the new heat pump heating system, provided that the supplemental heat is controlled to be used only when the heat pump system capacity is insufficient to meet the load, in compliance with the applicable Exception 5, 6, or 7 to Section C403.1.4, and that the requirements of Section C503.4.6.2 are met. **Where an alteration replaces less than 50 percent of the existing fossil fuel or electric resistance heating capacity, the remaining heating appliances are permitted to be retained.** Where the alteration project decreases the peak heating load, the fossil fuel or electric resistance heating capacity shall be limited to 50 percent of the calculated peak heating load. The replacement equipment shall comply with the minimum efficiency in Table C503.4.6.

3. Temporary replacement of failing equipment. Temporary like-for-like replacement of one or more heating appliances, in excess of the 50 percent capacity permitted by Exception 2 above, is permitted where those appliances require immediate replacement, and where no other work on the HVAC system is planned. When using this exception, it is acceptable to replace a single appliance with two or more smaller appliances, provided the total capacity is not greater than that of the original appliance. In addition, the requirements of Section C503.4.6.2 shall be met, and the applicant shall ensure completion of the required heat pump system in compliance with one of the following options.

- a. SDCI will issue a temporary certificate of occupancy (TCO), which will remain in force until the heat pump heating system is installed and the final inspection of the system has been completed.
- b. Applicant shall post a performance bond in the amount of the full estimated cost of installation of the required heat pump system, to ensure completion of the heat pump system within 48 months.

New heating system, cont.

- ...
- Exception for expensive electrical service upgrades
- Terminal units, air handlers, steam systems

4. Utility service upgrade. Compliance with Section C403.1.4 is not required where the requirements of Section C503.4.6.2 are met, and where such compliance would trigger an unplanned utility electrical service upgrade, based on the Seattle Electrical Code Section 220.87 method for determining existing loads, where one or more of the following is required:

- a. A new utility transformer vault located in the existing building or on the site, or an enlargement of the floor area of such a vault.
- b. Trenching across the vehicle lanes of a public way.
- c. The estimated construction cost for the required electrical service enlargement exceeds 50 percent of the project valuation for the remainder of the work, as determined in accordance with the *fee subtitle*. Construction cost shall be documented by an AACE **Class 3** or equivalent cost estimate, including required demolition, construction, site work, and utility fees.

The replacement equipment shall comply with the minimum efficiency in Table C503.4.6.

5. Exempt equipment. Alterations to the following equipment types are not required to comply with this section.

- a. Terminal unit equipment including but not limited to hydronic VAV terminal units, electric resistance VAV boxes, electric duct heaters, water source heat pumps, fan coils, or VRF indoor units, except such modifications to terminal equipment with hydronic heating coils as are required to accommodate lower-temperature fluids circulated from new central heat pump systems in accordance with Section C403.3.8.2.
- b. Air handling equipment with hydronic heating coils, except such modifications to the air handling equipment as are required to accommodate lower-temperature fluids circulated from central heat pump systems in accordance with Section C403.3.8.2.
- c. Replacement of existing steam boilers with steam distribution piping to terminal units and replacement of the existing associated boiler feed equipment.

HFC refrigerant phaseout – HB 1112 & HB 1050

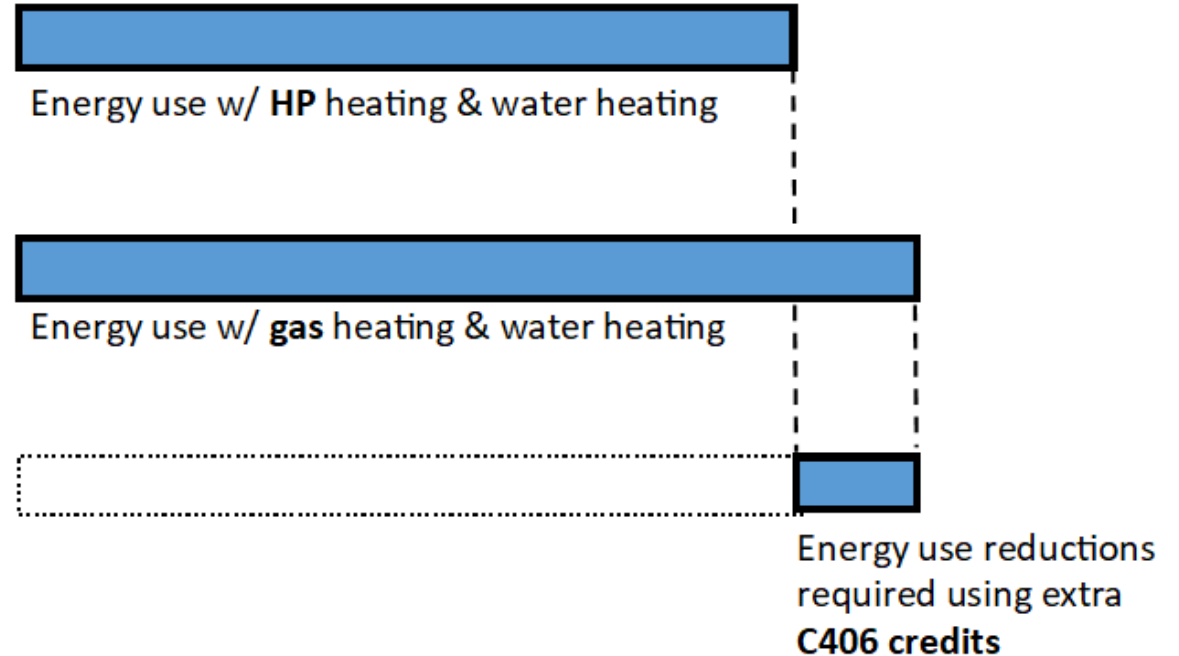
- Cutoff dates for equipment using HFCs
 - Supermarket & warehouse refrigeration 2020
 - Chillers 2024, Heat pumps 2025, VRF 2026
 - Equipment manufacture date, not permit date
- R-410, R134...going, going, gone!
- R-32 approved, but not much equipment yet



New! The Fossil Fuel Compliance Path

Compliance path explicitly permitting gas heating & water heating, while maintaining same overall energy efficiency as heat pump buildings.

1. Calculate difference in annual energy use between buildings using gas & using heat pumps
2. Require sufficient additional C406 credits from buildings with gas equipment to equalize annual energy use.



Takes a lot of credits to compensate

**Table C401.3.3
Additional Credits Required**

Occupancy group	R-1	R-2	B	E	M	All other
HVAC heating	7	24	101	38	111	56
Service water heating	198	212	27	17	79	107
Total credits	205	236	177	55	190	163

Mitigation Formula: $CR = A - (A \times B/C)$

$$\text{Adjusted Credits} = \text{Credits required by Table} - \left(\text{Credits required by Table} \times \frac{\text{heating capacity complying with an exception}}{\text{Total building heating capacity}} \right)$$

When does this become official?

- “Duane” & “Jonny” options out for public comment (?)
 - Technically almost identical
- Duane option puts it all together in one place
 - With a few instructions to change wording in code
- Jonny option spreads requirements around in code
- SBCC will vote on option in November (?)

C401.3.1 Modification of code requirements. For use of this compliance path only, the following changes shall be made to this code:

1. **Section C403.1.4 – space heating.** Strike the phrase “...or fossil fuel combustion...” from the first sentence of Section C403.1.4.
2. **Section C404.2.1 – service water heating.** Revise the first sentence of Section C404.2.1 to read: “Service hot water shall be provided by fossil fuel appliances or an electric air-source heat pump water heating (HPWH) system meeting the requirements of this section or any combination of the two.”
3. **Section C406.2.5 – renewable energy.** When determining renewable energy credits in Equation 4-17 of Section C406.2.5, strike the phrase “...limited to 50 percent of the required credits in Section C406.1” in the definition of the factor AEC_{RRa} .
4. **Table C406.2 – Efficiency Measure Credits.** Use Table C406.2(FF) credit values in place of Table C406.2 credit values.

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