# Commercial Energy Code for Alterations

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Lighting Design Lab
June 6, 2023

# Before we Begin…

## During the Webinar

- Attendees will be muted
- Please use the chat feature in the control panel to submit questions to LDL staff
- The presenter will pause to address questions periodically.
- Please participate in the online polls.

## Following the Webinar

- Please take the short survey
- A recording and the slide deck will be posted on LDL's webpage
- Reach out to LightingDesignLab@seattle.gov with comments or questions.

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# These targets are trickier for existing buildings

Washington state:
45% reduction in GHG emissions by 2030

- 95% by 2050

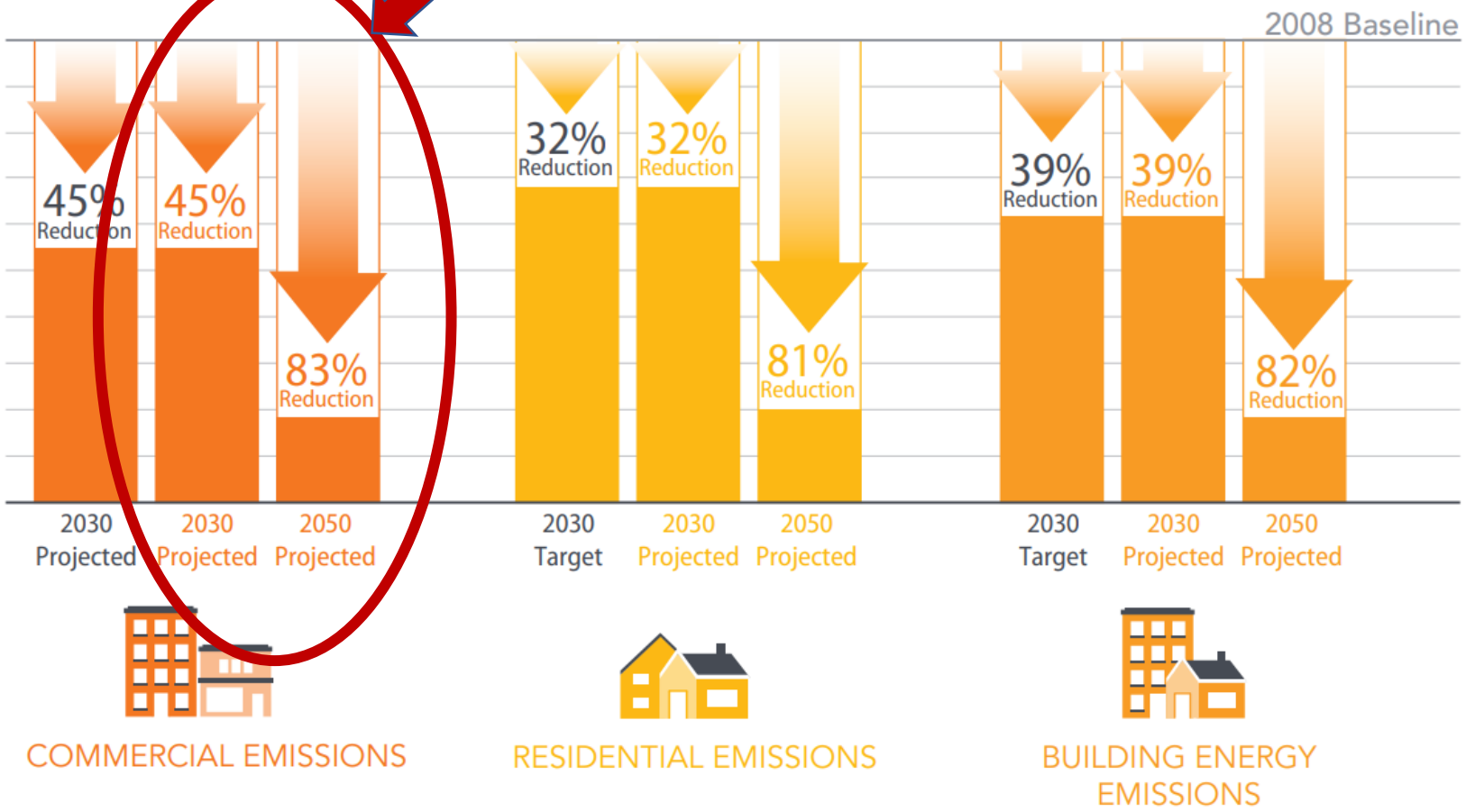
Seattle: Carbon-neutral building & vehicle operations by 2050

- 45% GHG reduction by 2030
- …or sooner with Green New Deal?

# Seattle Climate Action Plan

This is emissions of the *entire building stock*, including all the millions of ft² of new construction

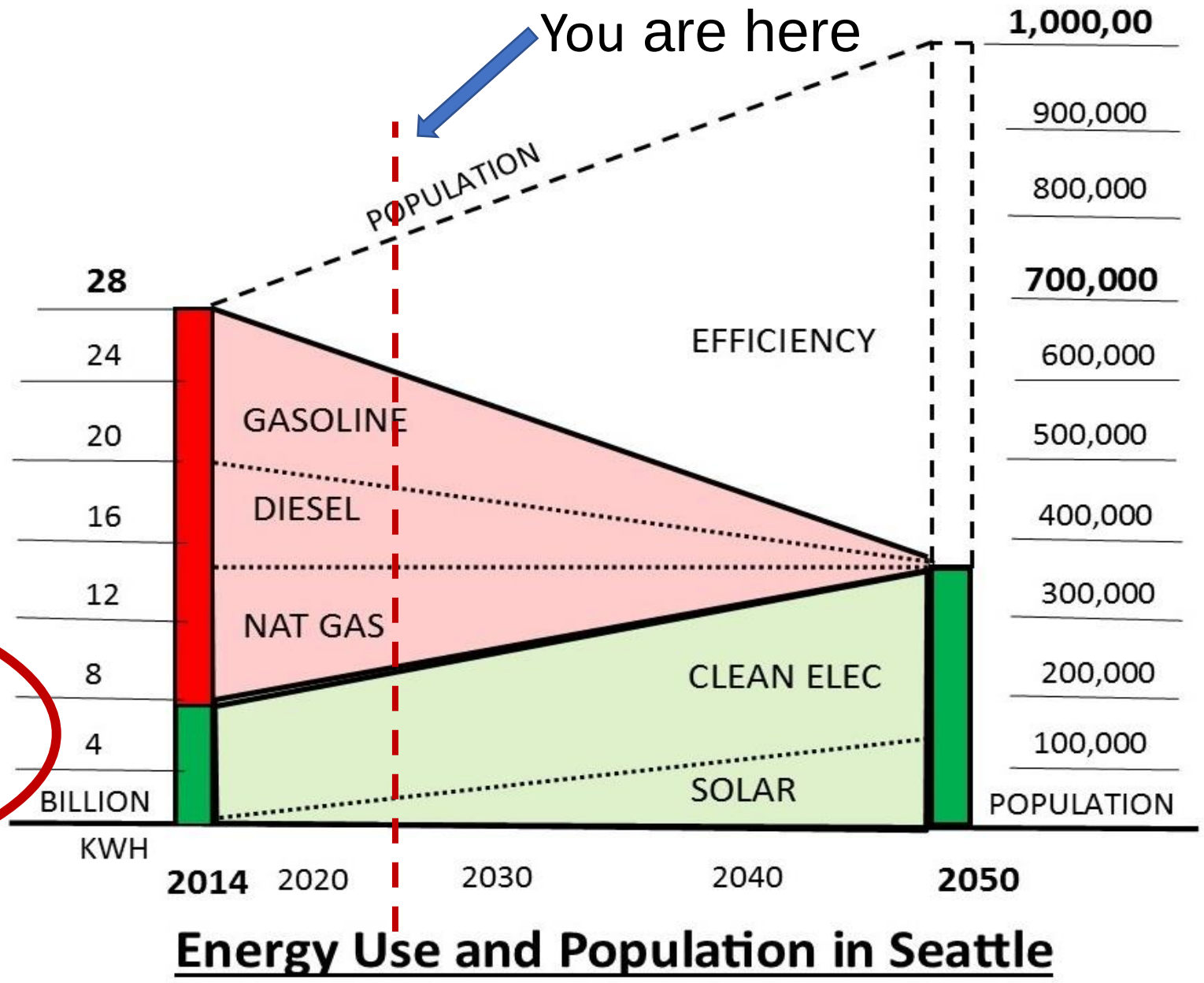
- Seattle GHG emissions *per person* have declined, but building sector emissions went up 8.3% 2016 - 2018
- Seattle CAP 2030 emissions target: 45% below 2008
- Seattle CAP 2030 energy use target: 10% below 2008
- Seattle CAP 2050 emissions target: 83% below 2008



# The big picture

- Shrink fossil fuel use
- Grow renewables
- Absorb population growth
- **Close the gap with efficiency**

Between now & 2030, we might get 10% of progress from new construction, but need 90% from **existing** buildings




**Energy Use and Population in Seattle**

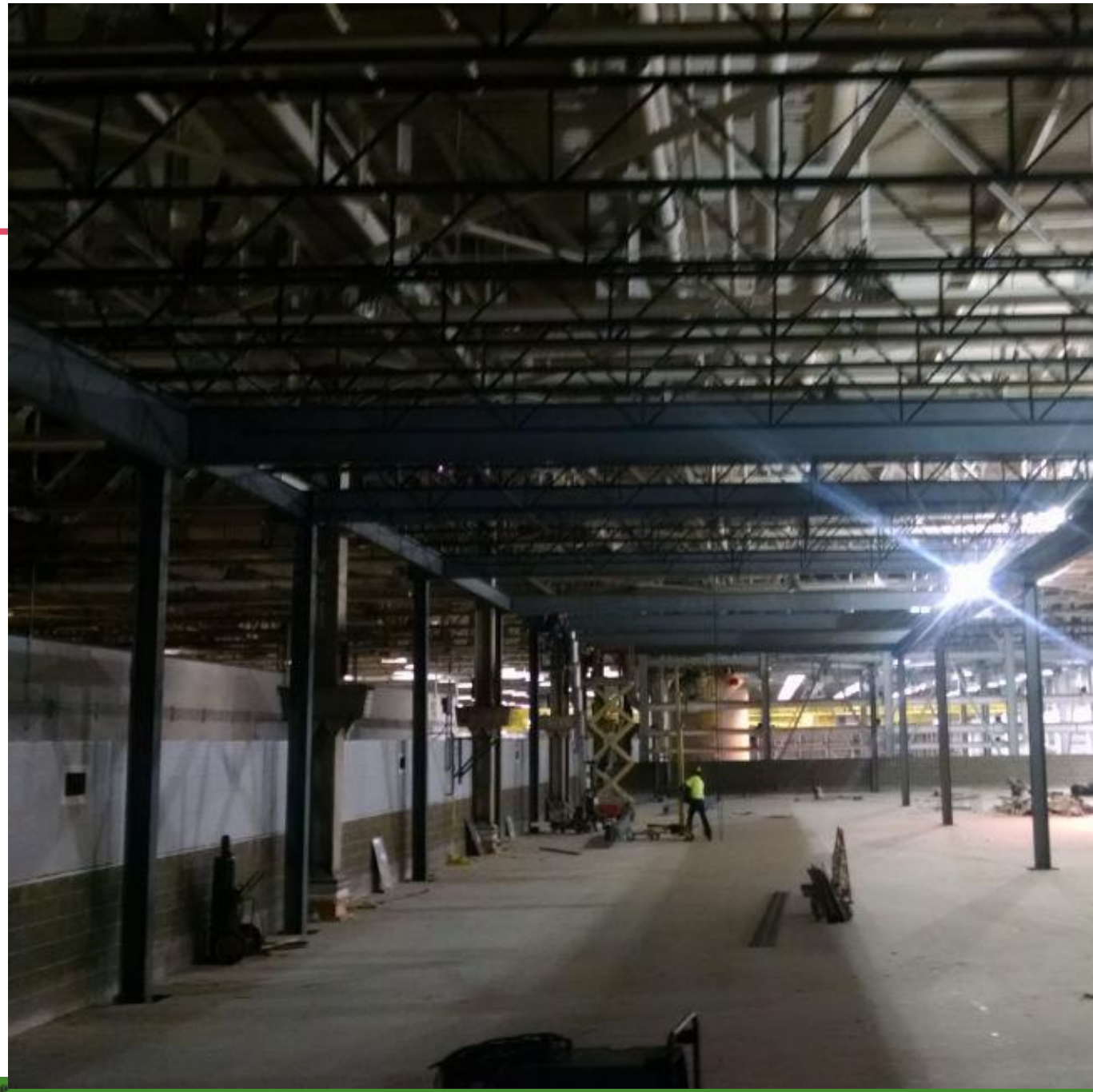
# Additions C502

- The addition alone can comply with code
- or (existing + addition) complies
- Prescriptive projects comply with C502.2
  - Fenestration area, skylight area, etc.
- Includes C406 options
  - Except additions under 500 sf

# Alterations C503

## General principles:

- Existing can remain as-is
- Service and repairs OK
- But, any *new* equipment and new systems must meet code
- Don’t harm any feature protected by Landmarks
- Code official discretion if full compliance is physically or economically “impractical”
  - …so come talk with us
  - …but bring alternate ideas!



# Bring the *whole building* up to code for:

1. **Change of space conditioning** (C505.2)
   - *From:* low-energy building (C402.1.1.1)
   - *To:* conditioned space
   - *From (Seattle only):* heated only
   - *To:* heated and cooled
2. **Change of occupancy** (C505.3)
   - *from*: S – storage, F – factory, or U – utility
   - *to:* Anything else
   - *From:* not a dwelling unit
   - *To:* dwelling unit
   - *From:* pre-2009 code dwelling unit
   - *To:* not a dwelling unit
3. Seattle only: "**Substantial Alterations**"

- Envelope UxA can be **10% higher** than for new code
  - For change of space conditioning or change of occupancy
- Envelope UxA can be **15% higher** than for new code
  - For substantial alteration

or…

- C407 carbon emissions can be **10% higher** than for new code

# Minimum Energy Performance for "Substantial Alterations" C503.9

- Once in a generation "deep green" retrofit
- For major alterations (like complete gut-and-remodel) nearly full compliance required
- ***"…substantially extends the useful physical or economic life of the building"***
  - Or, vacant for more than 24 months
  - Or, major flood/fire damage repair
- "Impracticality" clause
- Also seismic & life safety

# Substantial Alterations: Exceptions & Options C503.9

- Exceptions
  - Building features protected by Landmarks
  - URM (only) projects
  - Fairly new, but vacant, buildings
  - “Impractical” (building official call)
- Options
  1. Full prescriptive code compliance
  2. UxA 15% higher than code
  3. TBP 10% more $CO^2$ emissions than code
  4. Target Performance Path option

<u>Sub Alt determination:</u>

Significant alterations to 2 of 3:

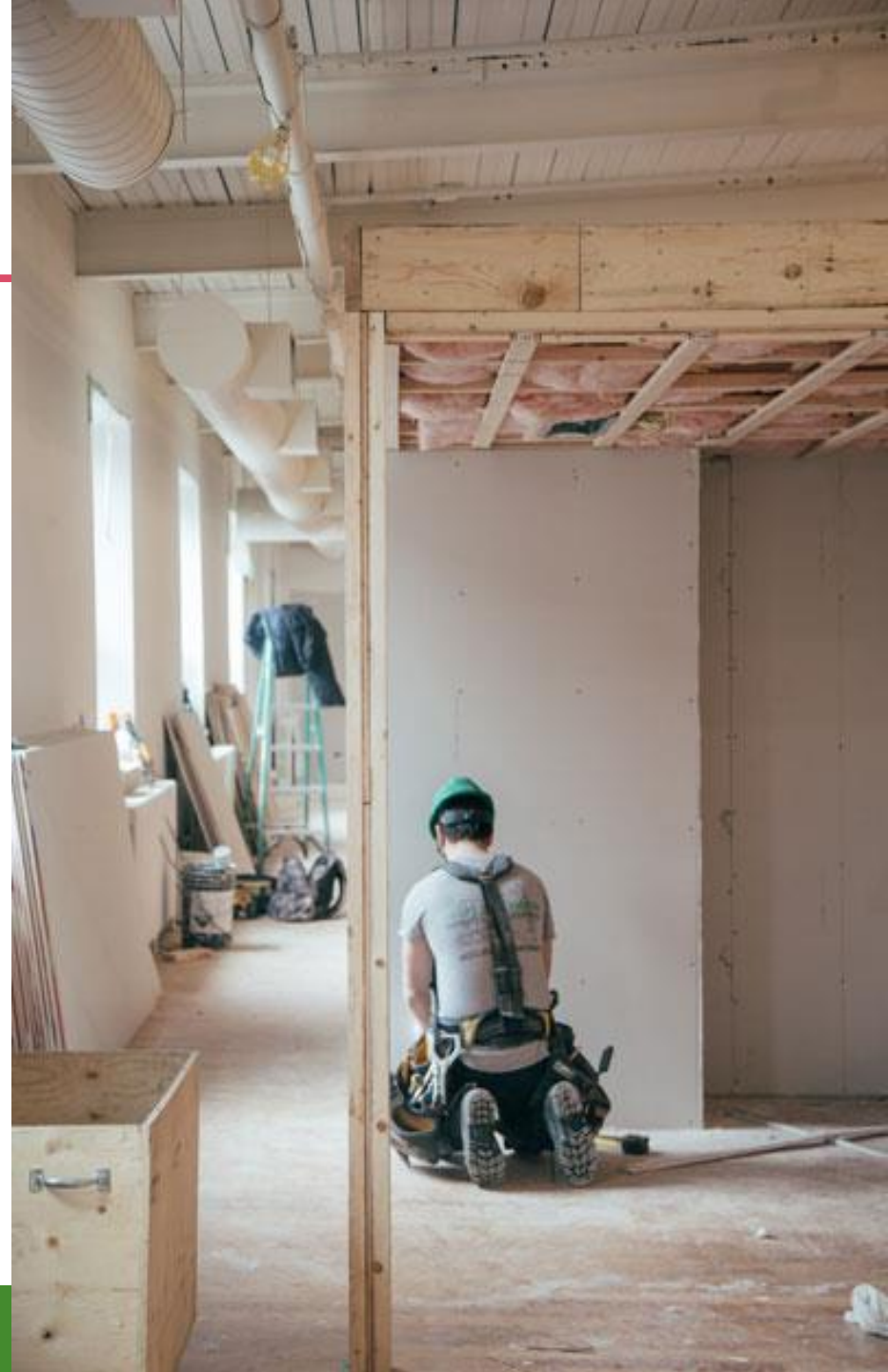
- Envelope
- Mechanical
- Electrical

<u>Possible exception</u>:

- HVAC change from gas or resistance to heat pump, plus required electric & structural upgrades
- Ask your SDCI reviewers

# Tenant Improvements

- First construction of new TI space **within 18 months of C of O** can use same code edition as shell & core
- C406 credits from shell & core HVAC system can apply to TI space
  - If TI is extension of central system
- Substantial alterations not triggered by “typical tenant improvements”



# Seattle Heat Pump Exception:
## Upgrade to “heated and cooled”

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

1. A change in space conditioning does not require full compliance with this code if the existing heated but not cooled space is altered to become both heated and cooled solely **by replacement of the existing heating-only HVAC system with an electric heat pump HVAC system**, provided that there is no change in the use or occupancy classification of the area served by the HVAC system that would increase the cooling load, and the new system includes a DOAS with energy recovery in compliance with Section C403.3.5.

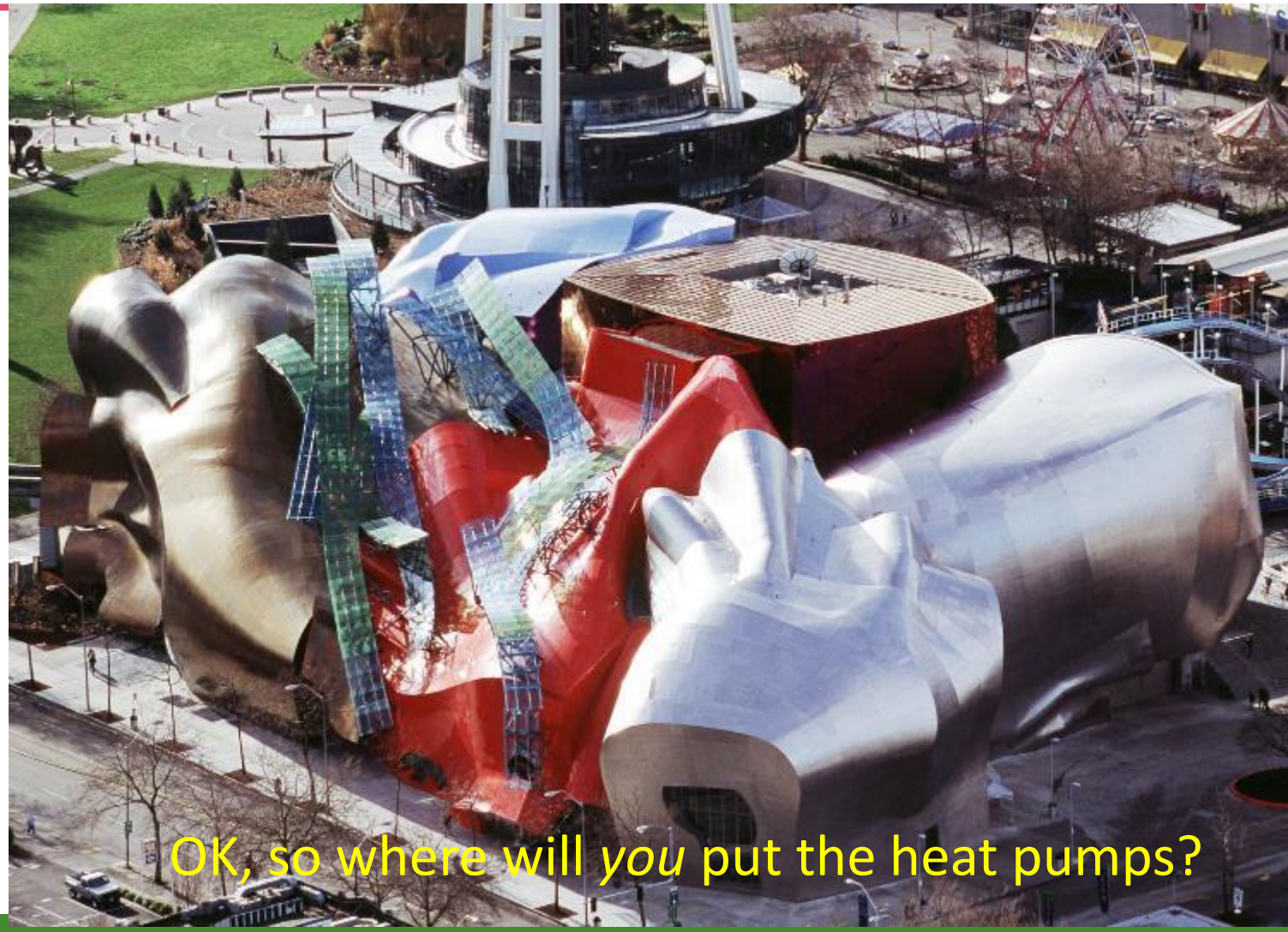
# 2021 WA code: HVAC heat pumps in alterations
## (There's almost always an exception)

- Heat pump only required if replacing heating equip
- Exceptions to heat pump alterations:
  - If electrical service upgrade would be required
  - Terminal units
  - Air handling units with hydronic coils
  - 100% OSA, but not subject to DOAS
  - Oil-fired boilers, steam boilers
- "Alternate mechanical designs" OK if constraints in:
  - Available mechanical space
  - Limitations of existing structure
  - Too close to existing air intakes or exhausts
  - (The alternate should include some energy savings)

# Upgrading existing buildings
# Getting real about our good intentions

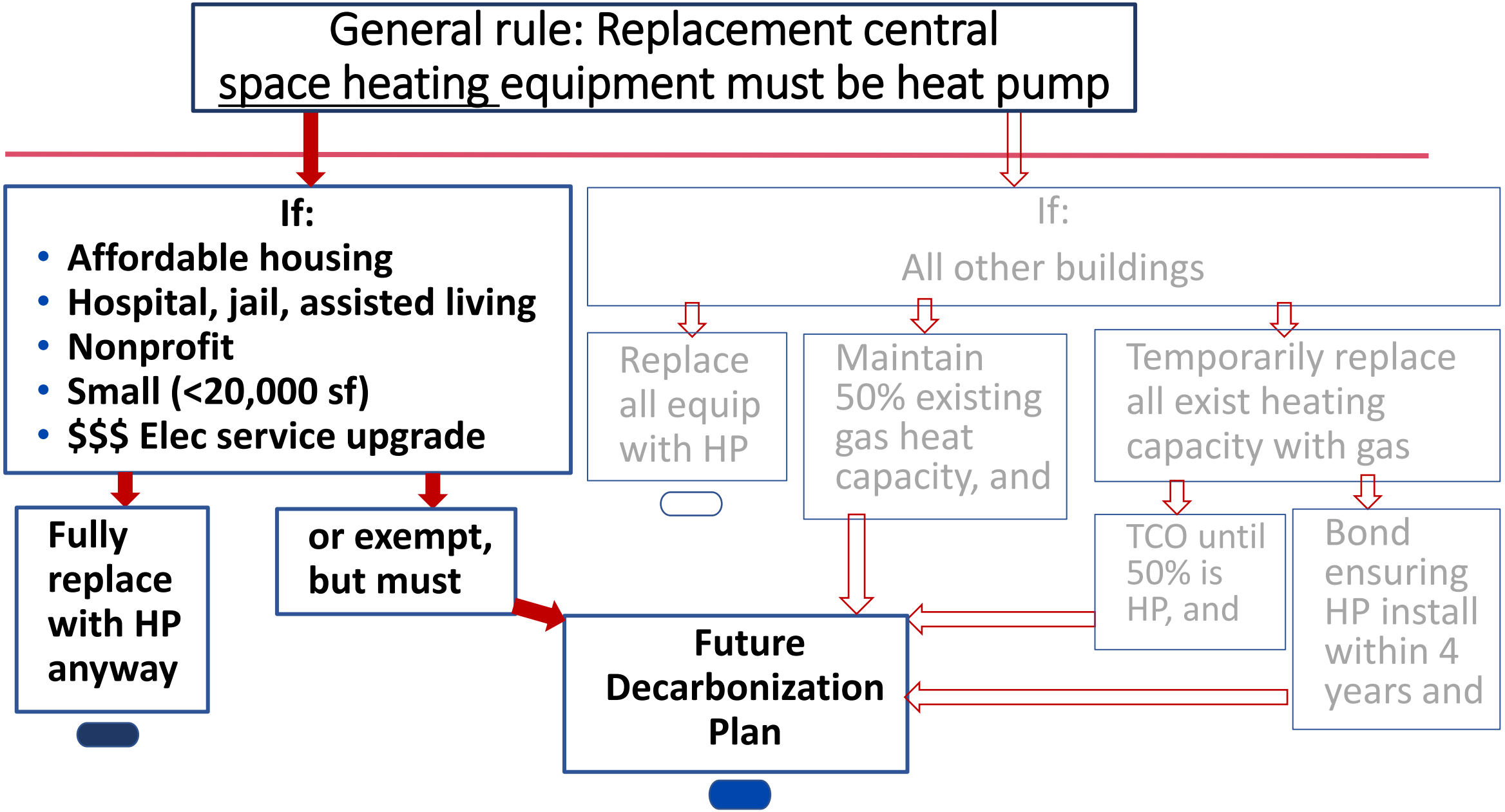
- Can existing buildings remain funky forever?
  - Precedents with nightclubs, high-rise stairs
- BPS is a major departure from tradition
- Are we serious enough about climate commitments to mandate major upgrades?

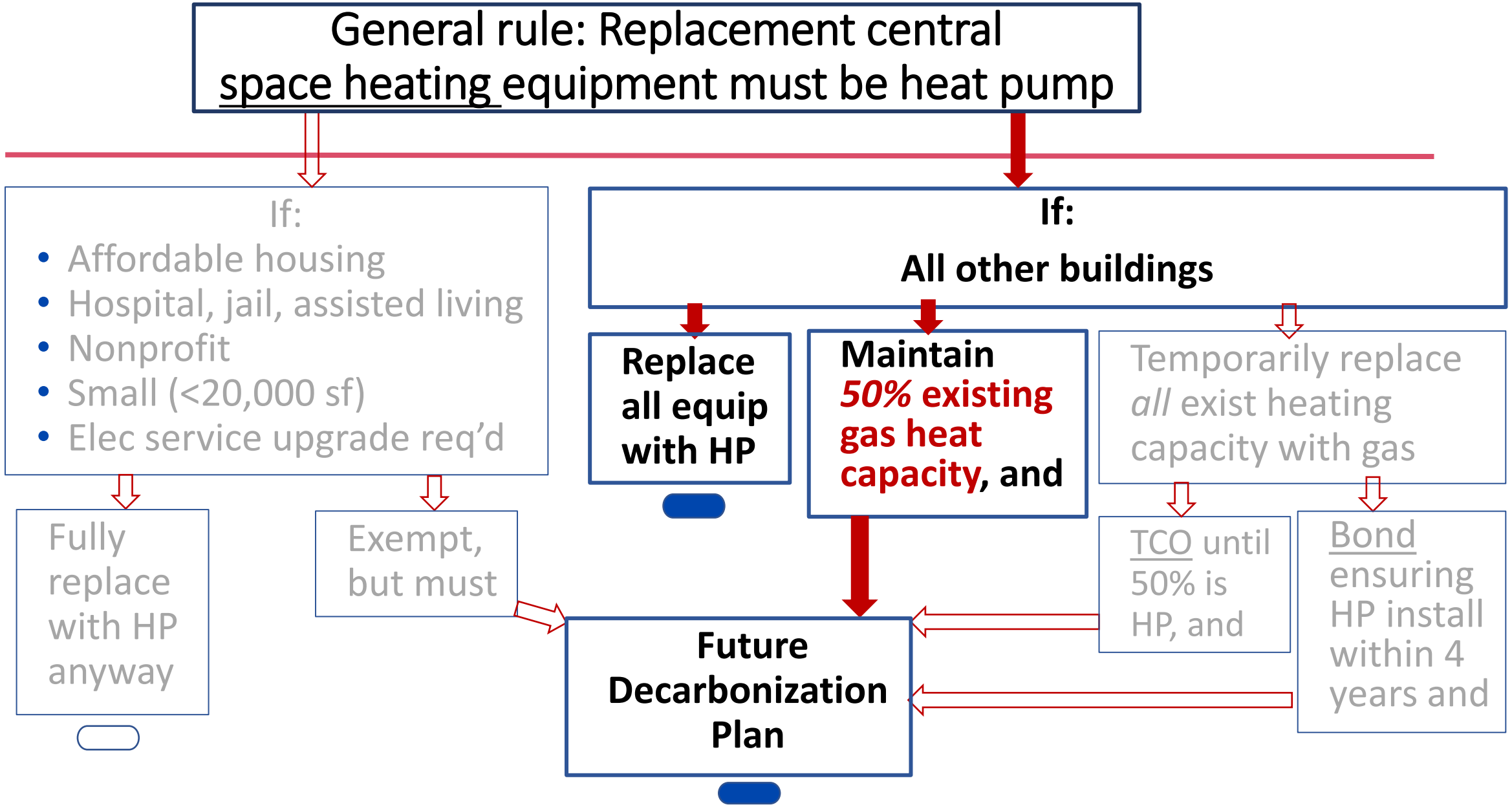
- It's not popular!



# Seattle Energy Code: Replacement of existing gas equipment

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


General rule: Replacement central space heating equipment must be heat pump
If:
Affordable housing
Hospital, jail, assisted living
Nonprofit
Small (<20,000 sf)
$$$ Elec service upgrade
Fully replace with HP anyway
or exempt, but must
If:
All other buildings
Replace all equip with HP
Maintain 50% existing gas heat capacity, and
Temporarily replace all exist heating capacity with gas
TCO until 50% is HP, and
Bond ensuring HP install within 4 years and
Future Decarbonization Plan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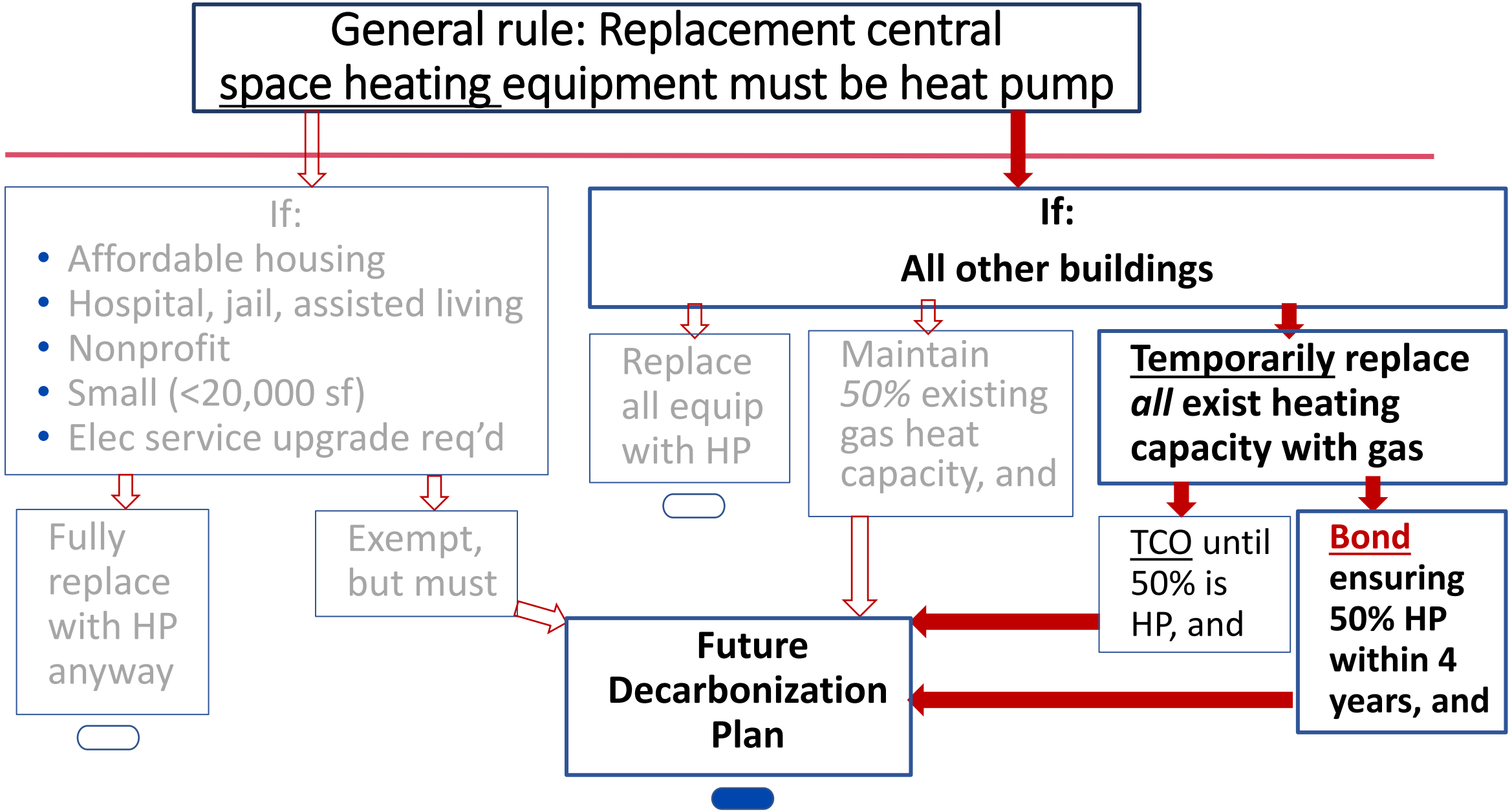
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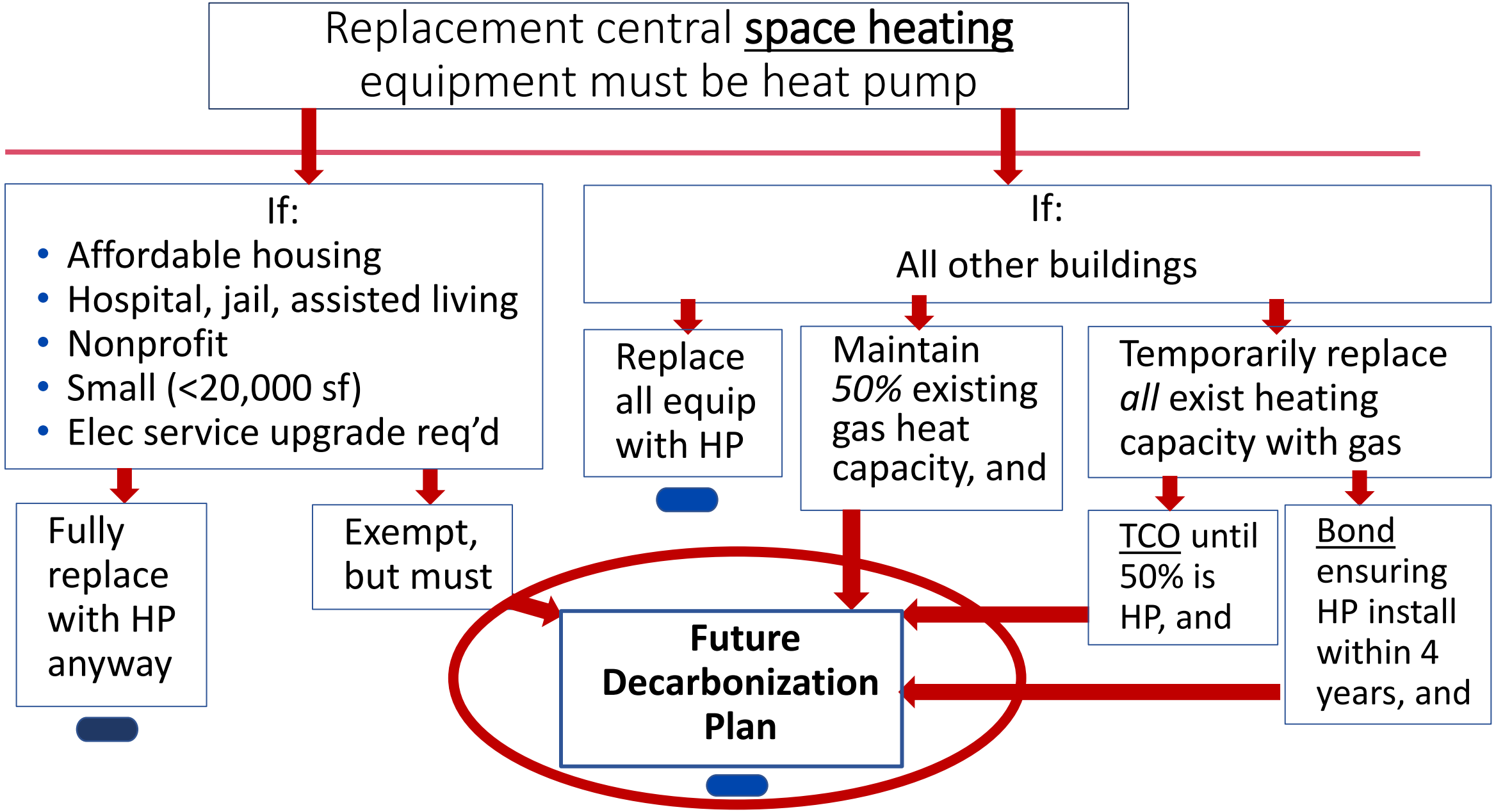
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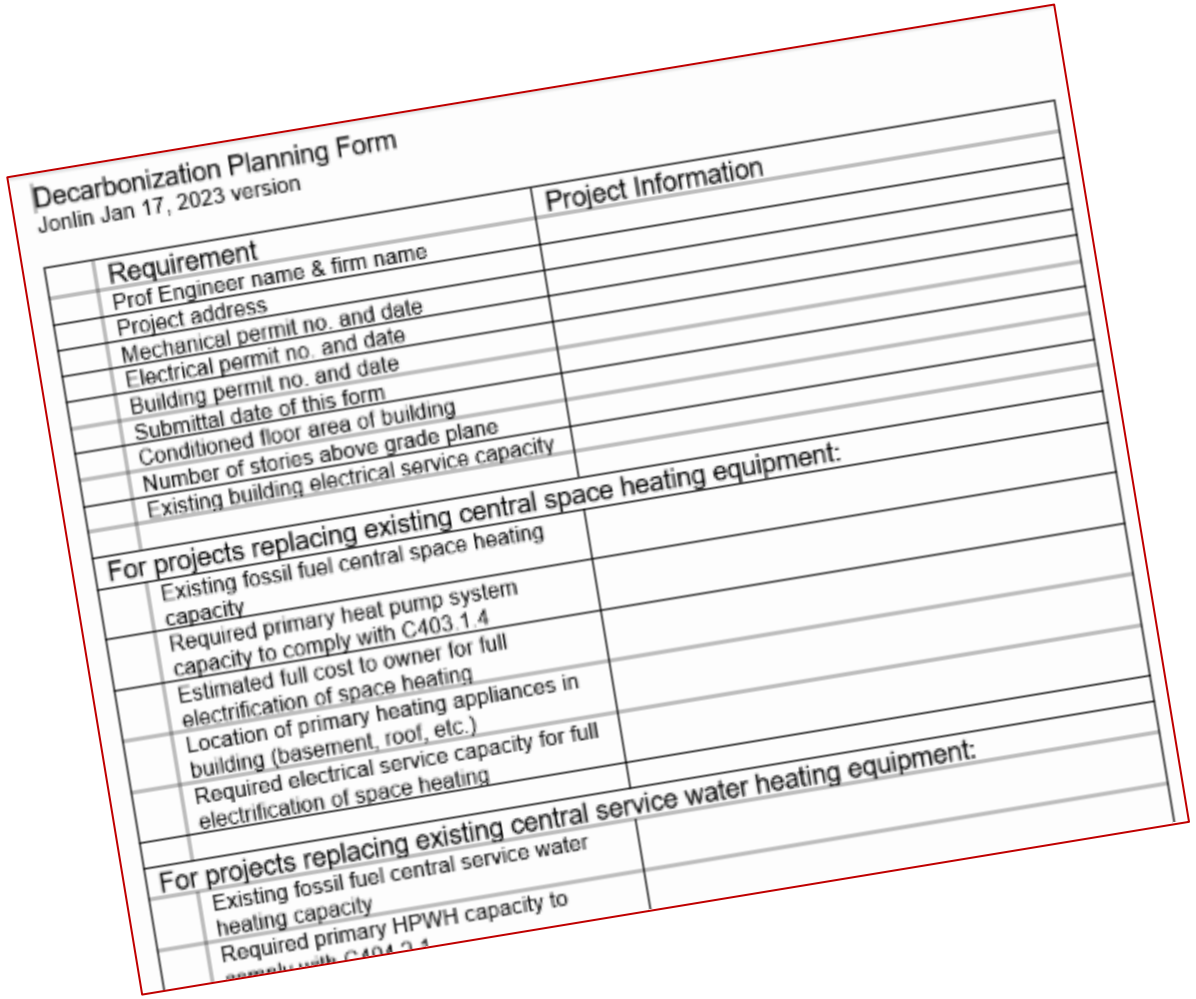
Future Decarbonization Plan

# 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 | |

# BPS: WA State *plus* BEPS: Seattle

Building Performance Standard

Building *Emissions* Performance Standard

<u>Energy</u>

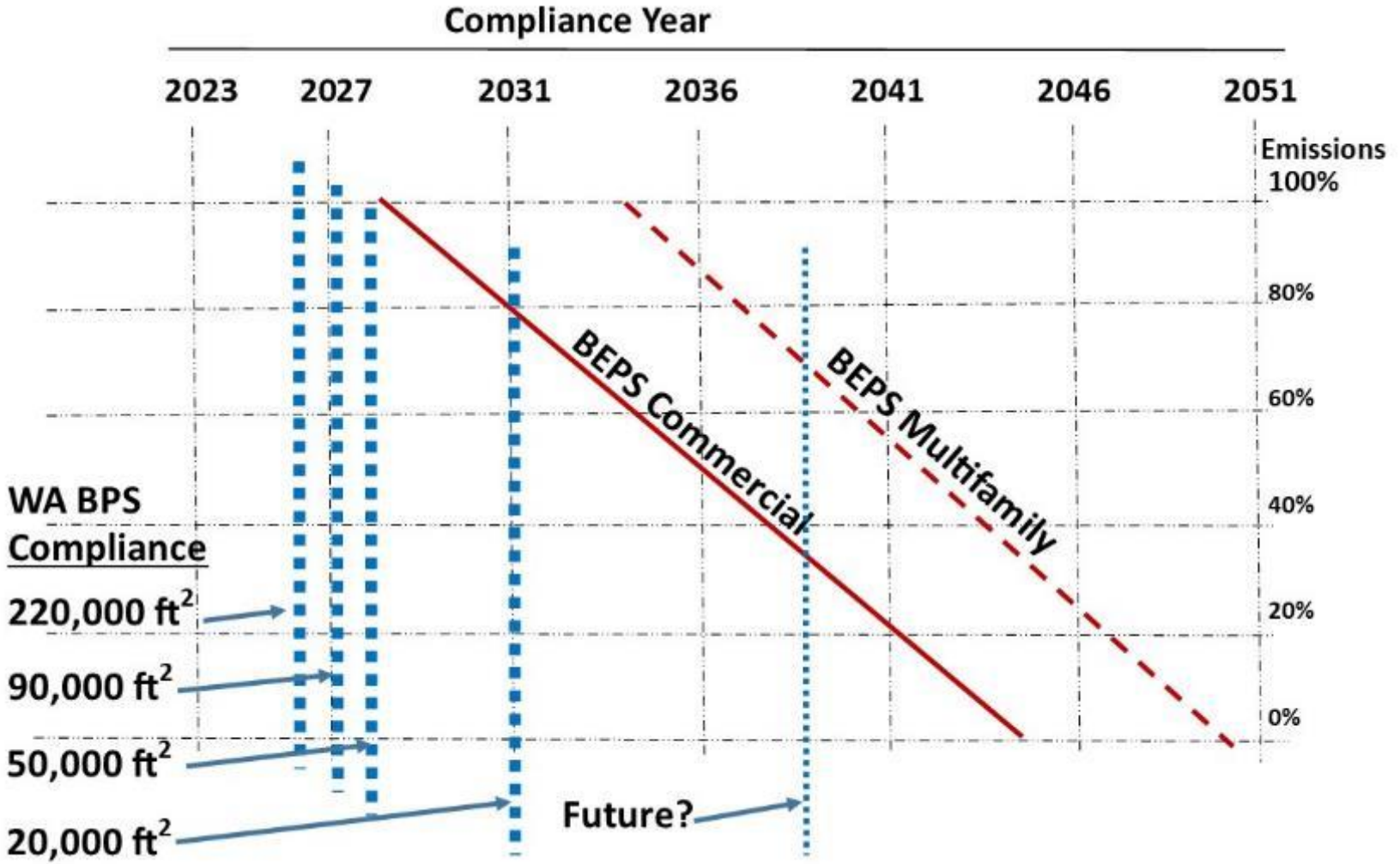
- Most building types
- **EUI targets** set at state "average" for each building type
- Lower EUIs in future?
- 50,000 $ft^2$: Starts 2026
- 20,000 $ft^2$: Starts 2031

<u>GHG Emissions</u>

- *In addition to* State BPS
- **Emissions targets** shrink every 5 years…
- …to zero carbon in the 2040s
- 50,000 $ft^2$: Starts 2028

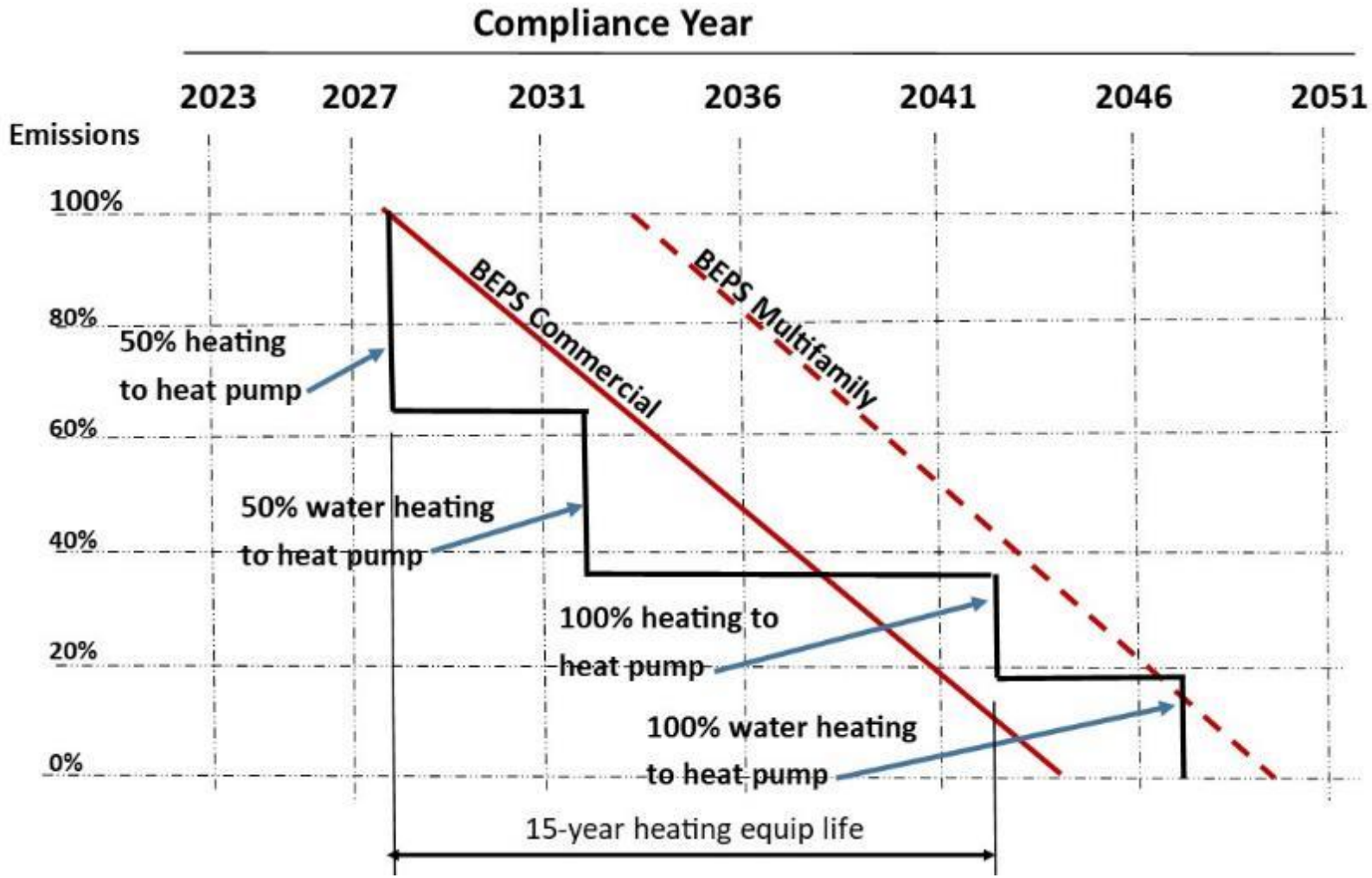
# WA BPS + Seattle BEPS

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



# BEPS + SEC

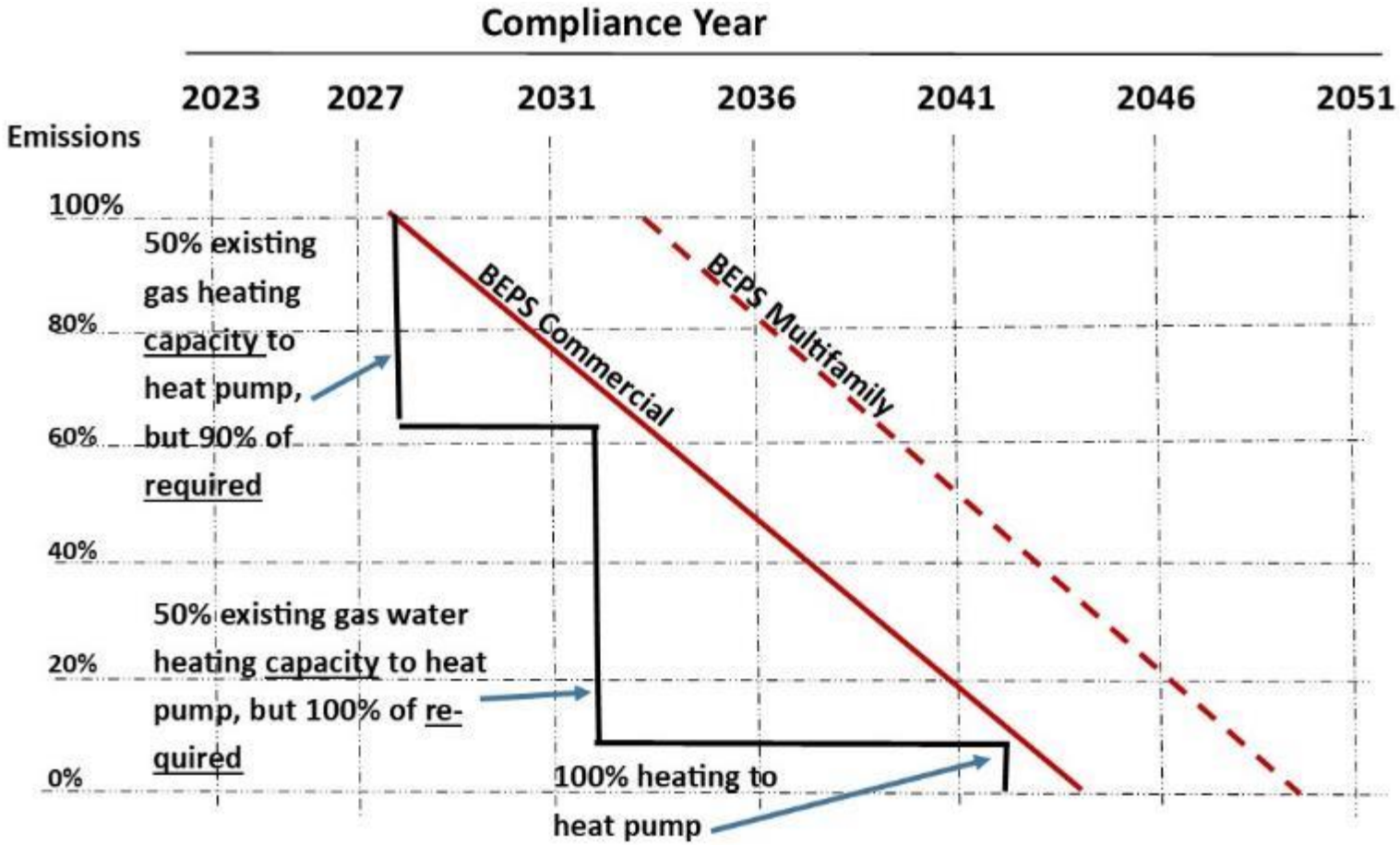
- Seattle **BEPS**: **emissions**
- Seattle **Energy Code**: **heat pump upgrade**



# 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%?



# Really, how else will Seattle get to carbon-neutral?

We recognize that upgrade to heat pumps is expensive & disruptive.

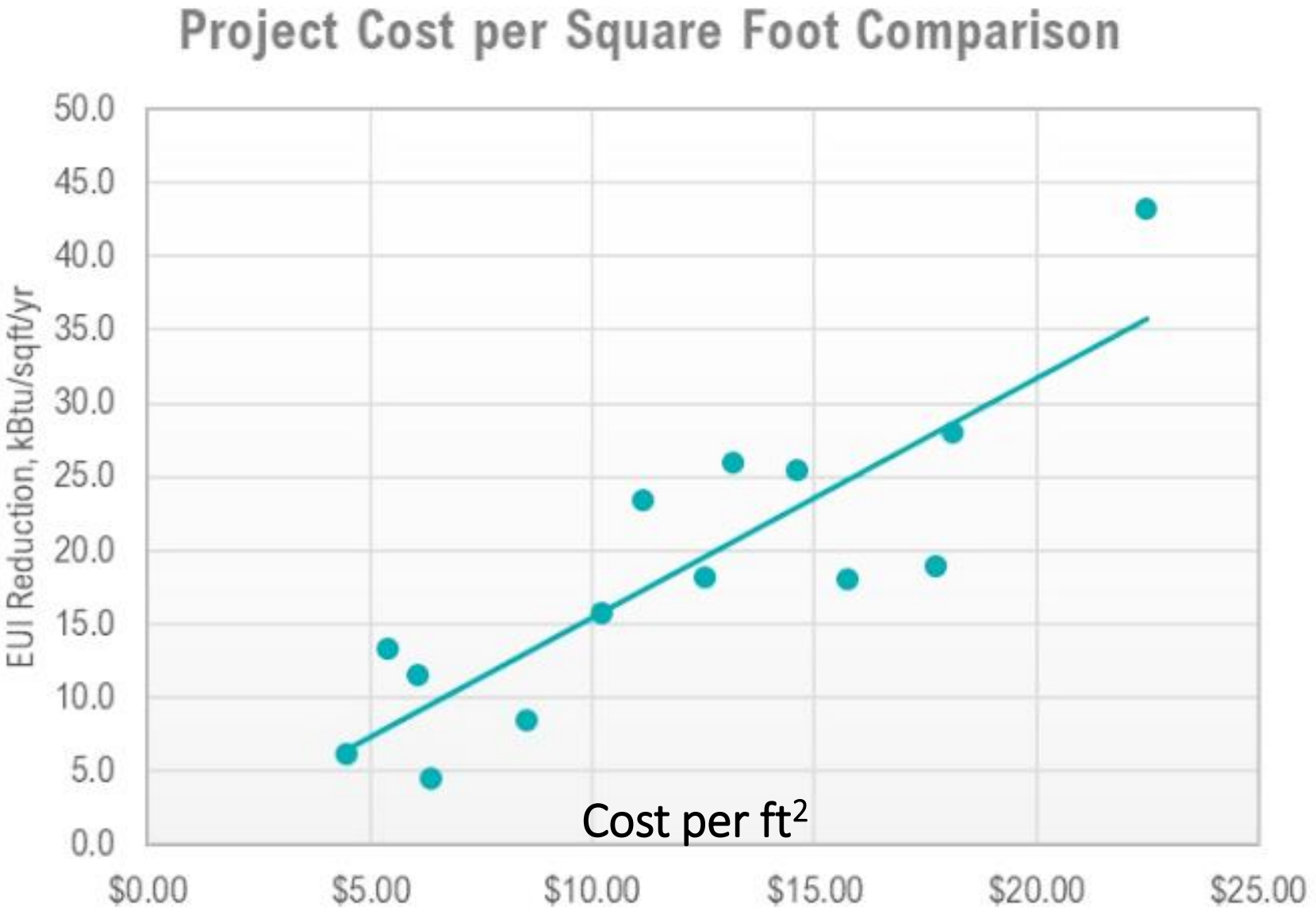
- The most economical timing is at equipment replacement
  - Could be time of sale instead?
  - Future date certain deadline?
- PACE financing now available in King County & others
  - Only for $250,000+ loans
- Gas cost increase may improve heat pump cost-effectiveness

- 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

# Costs

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

Required EUI reduction




Study courtesy of MacDonald Miller, Seattle, 2023

# Potential Cost Reductions

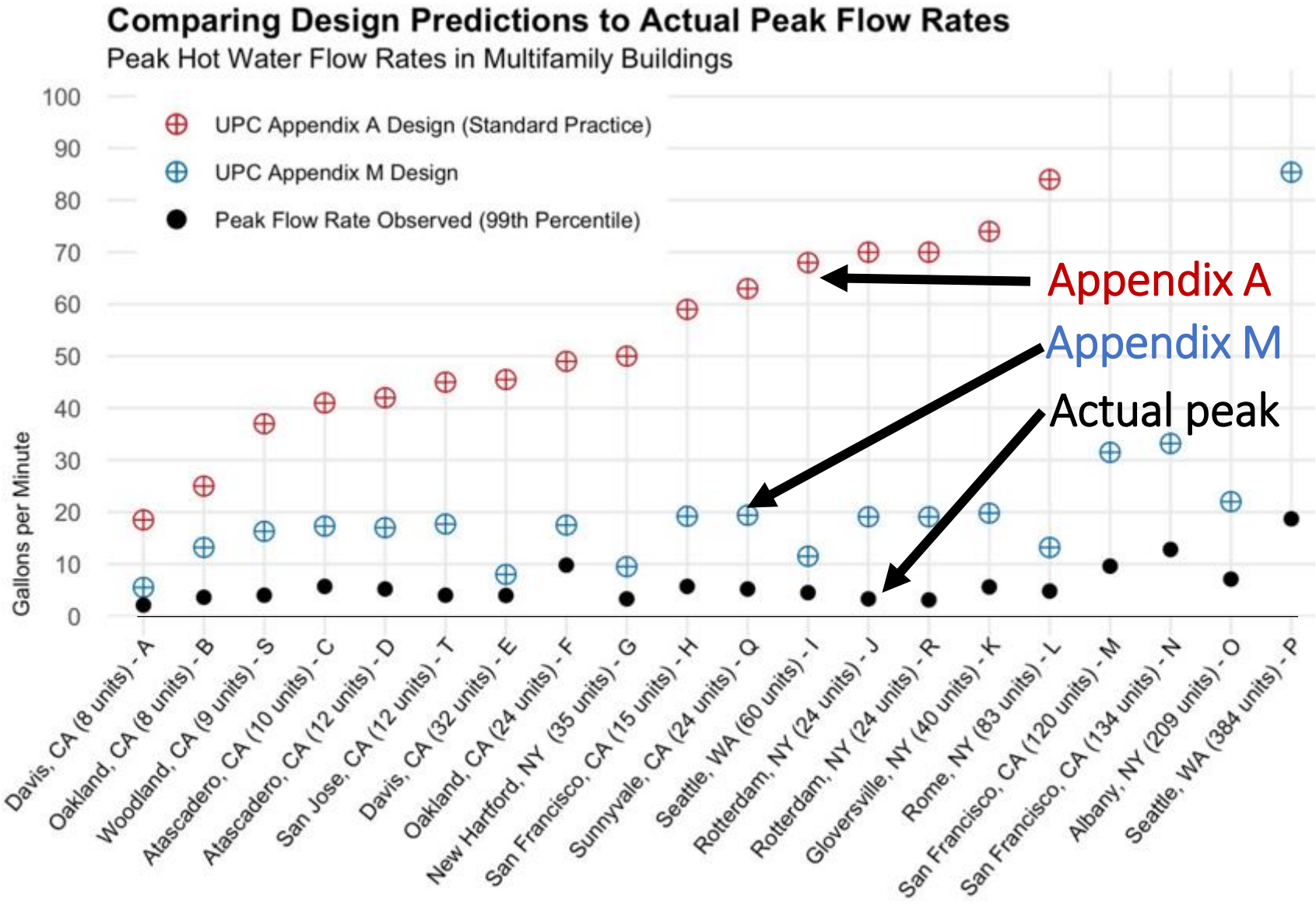
**Problems**

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

**Solutions**

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

Image: Ecotope, Seattle 2023



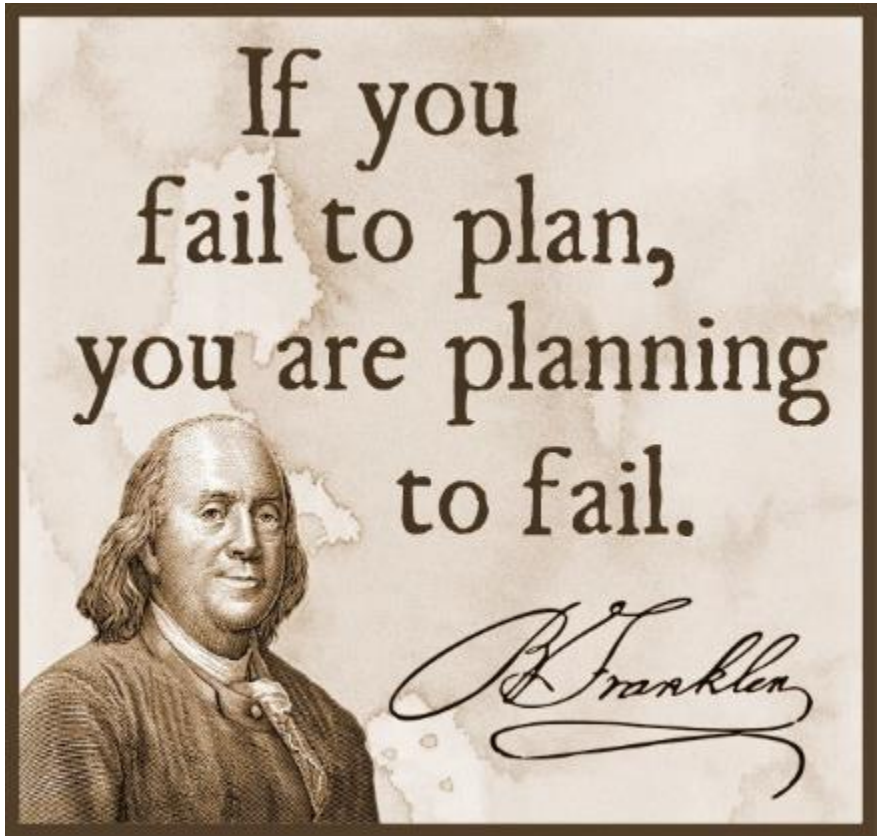

*Many thanks to the Association for Energy Affordability, Ecotope, Frontier Energy, Peter Skinner, and the UC Davis Western Cooling Efficiency Center for providing data.*

# BPS collision with code? Not really.

| Building Type | 2018 SEC EUI (guess) | 12% lower (2021 SEC target) | Best local examples | 2030 Target EUI | WA BPS target |
|---|---|---|---|---|---|
| High-rise office | 38 | 33 | 37 | 28 | 63-69 |
| Mid-rise office | 34 | 30 | **16, 21** | 22 | 63-69 |
| Mid-rise multifamily | 32 | 28 | 17, 19 | 20 | -- |
| Elementary school | 28 | 25 | 16, 18 - 20 | 19 | 49 |
| Warehouse, conditioned | 18 | 16 | | 12 | 36 |

# 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 me now
  - Years until BPS or BEPS would mandate upgrade anyway: Pay me later



# Cooling system alterations C503.4.1

- 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]<br>Economizer: C403.5[b] | Efficiency: min. [a]<br>Economizer: C403.5[b] | Efficiency: min. [a]<br>Economizer: C403.5[b] | Efficiency: min. [a]<br>Economizer: C403.5[b] |
| 2. Split Systems | Efficiency: min. [a]<br>Economizer: C403.5[b] | For units ≤ 60,000 Btuh, comply with two of two measures:<br>1. Efficiency: + 10%[e]<br>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:<br>1. Efficiency: + 10%[e]<br>2. Economizer: 50% [f] | Efficiency: min. [a]<br>Economizer: C403.5[b] |
| | | For all other capacities:<br>Efficiency: min.[a]<br>Economizer: C403.5[b] | For all other capacities:<br>Efficiency: min.[a]<br>Economizer: C403.5[b] | |

**Seattle exception:**

If you upgrade from gas to heat pump, even though it’s adding cooling, it will not constitute a “change in space conditioning”

# 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 – chillers - exempt buildings & systems

**1. Exempt buildings and occupancies.**
**(Same as for heating system replacement)**
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.

a. Affordable housing
b. Group I-1, I-2, and I-3 occupancies
c. 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
d. 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.

a. **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.
b. **Terminal unit** equipment including but not limited to electric resistance VAV boxes, electric duct heaters, electric resistance fan coils, or electric resistance heaters.
c. **Dedicated chillers** serving only spaces that have **no heating loads** and are not served by heating equipment, including but not limited to data centers.

# Existing Buildings: Water heating

**C503.5 New Service water heating equipment.** All new service water heating systems shall comply with Section C404.

**C503.5.1 Addition or replacement of service water heating equipment.** All existing service hot water systems, equipment, and components of existing systems that are altered or replaced shall comply with Section C404, C408.3, C506.1, and C501.6. Additions or alterations shall not be made to an existing service water heating system that will cause the existing system to become out of compliance.

Seattle:

Splits charging paragraph into "new" and "addition or replacement"

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# Seattle: Exception for $$ electrical upgrades

**1.** ((~~Reserved~~.)) **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 Level 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.

# Seattle: Exempt systems & building types

2. **Exempt Systems.** Replacement of any of the following water heater appliances is not required to comply with this section or with Section C404.2.1:

2.1. Electric water heaters with an input of ((~~12~~)) 24 kW or less.

2.2. Gas storage water heaters with an input of 75,000 Btu/h or less.

2.2. Gas storage water heaters with an input of 75,000 Btu/h or less.

**4. Exempt buildings and occupancies.**
**(Same as for heating system replacement)**

# Seattle: 50% replacement rule

## same as for space heating

**5. Retention of portion of existing system capacity**. A **maximum of 50 percent of the existing central fossil fuel or electric resistance water heating capacity is permitted to be provided as supplemental heat** for the new heat pump water 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 Section C404.2.1.4, 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 service water heating capacity, the remaining service water heating appliances are permitted to be retained. Where the alteration project decreases the peak service water heating load, the fossil fuel or electric resistance heating capacity shall be limited to 50 percent of the calculated peak heating load.

# Seattle: Temp replacement, 4-year window

**6. Temporary replacement of failing equipment.** Temporary like-for-like replacement of one or more service water heating appliances, in excess of the 50 percent capacity permitted by Exception 5 above, is permitted where those appliances require immediate replacement, and where no other work on the service water heating 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 water heating 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 water 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 water heating system, to ensure completion of the system within **48 months**.

# Commissioning for existing buildings

## Building inspectors now serious about this

- Cx required when addition/alteration to a system exceeds “new construction” thresholds:
  - HVAC if:
    - System has economizer, or
    - Heating >600 kBTU/H, or
    - Cooling >480 kBTU/H
  - Water heating - 200 BTUH
  - Lighting and controlled outlets, if
    - 20 kW total new + altered, or
    - 10 kW on occ sensors or daylight sensors
- Applies to added/altered portion of the system, plus any other portions *impacted*
- Must be PE or qualified Cx
- Conflict of interest disclosure if commissioning your own stuff

# WA law 2019: Building performance standards

**WA "below-average" buildings:**

- 50,000 sf threshold (later, 20,000 sf)
- 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**

# Seattle: Periodic "Building Tune-ups"

## Q: Is your economizer working?

Seattle Building Tune-up Ordinance:

- Every 5 years
  - Or demonstrate alternate compliance
- Required "tune-up" of energy systems
  - You *must* fix the easy and obvious stuff
  - Listing of more expensive stuff
- Dwelling units excluded
- Will phase out as BEPS takes effect

# Lighting Alterations C503.7

- Bring buildings closer to current code, one project at a time.
- Proportionate to scale of work

## Stage 1: Fixture Replacement only

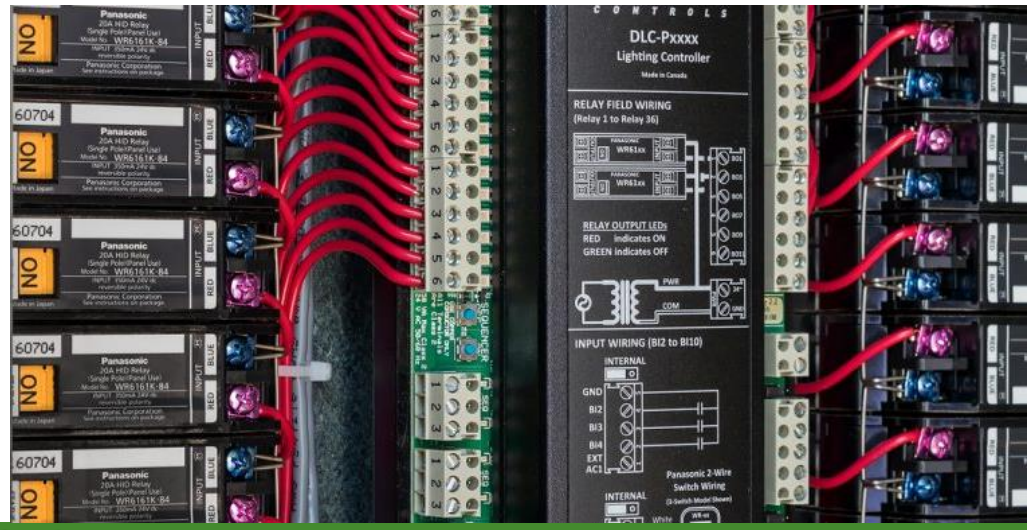
- If you replace 20% of the light fixtures* in any space or on the building exterior, meet the LPA or exterior lighting allowance
  - *or just the lamps and ballasts in existing fixtures

# Stage 2: New Fixtures or Re-Circuiting Existing

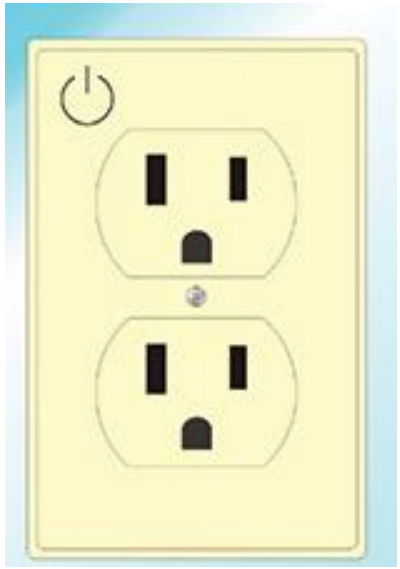
- If new fixtures are wired or existing fixtures are being re-circuited, controls must have:
  - Manual controls (usually switches)
  - Light reduction controls (50% switching)
  - Automatic daylight zone controls
  - Specific application controls (display lights, under-counter lights, stairwell lights, etc.)
  - Occupancy sensors wherever required by C405.2.2.2

# Stage 3: New or Relocated Panel

- A new or moved lighting panel, with new raceway and wiring to the fixtures, must conform to the rest of C405.2.2. Therefore:
  - Automatic time switch for rooms that don't have occupancy sensors, with manual override



# Controlled Receptacles C503.7.7



- Office, classroom, break room, etc:
- Control 50% of <u>new</u> outlets with time clock or occupancy sensor, <u>except</u>:
  - Alterations smaller than **5000 sf**
  - Systems furniture or office cubicle partitions reconfigured or relocated within the same area
  - Existing outlets in existing walls
  - Outlets for safety, security, maint, 24-hour

# Metering for major HVAC alterations

- For <u>full HVAC replacement</u> (or more than half of heating & cooling capacity):
  - Meter incoming gas & electric
  - Sub-meter HVAC
  - Data acquisition & display


# Metering for HVAC equip replacement

- "Local" meter required for:
  - Branch circuit over 50 kVA serving new HVAC equipment
  - New HVAC equipment on variable speed drive
- Gas metering required for new gas connection over 1,000 kBTU

## Metering for complete new electrical system

- Provide complete metering

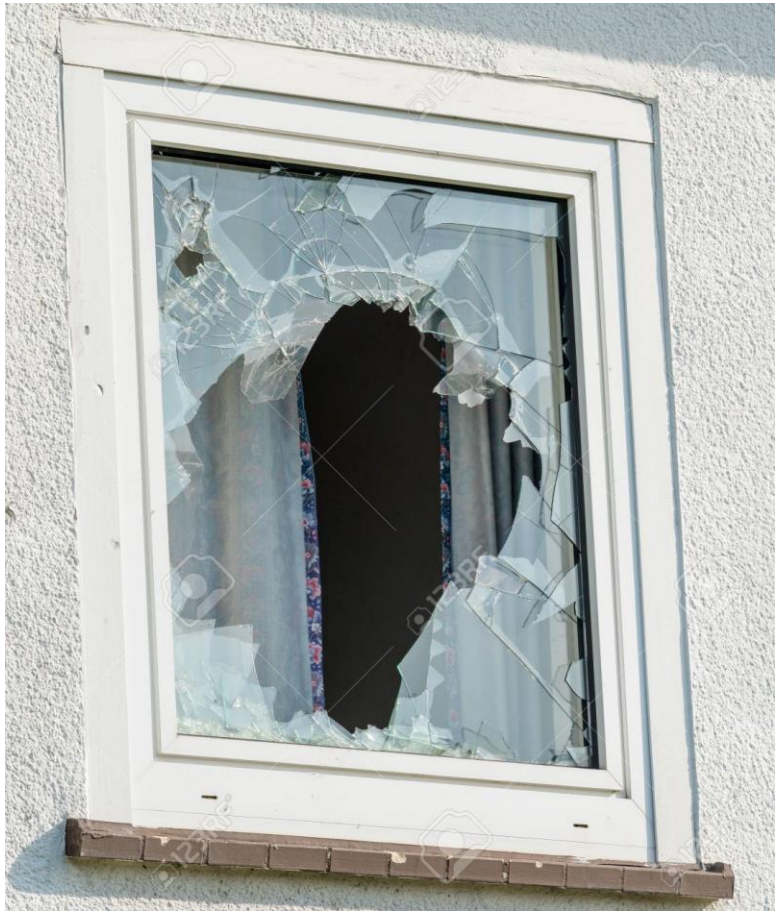
# The envelope, please! C503

- **New envelope assemblies** comply with code
- **Altered opaque envelope** can't be worse than existing
- **Air leakage testing** not required for alterations
  - Except Sub Alt, Change of Occupancy, Change of Conditioning
- **Fenestration**: if new area exceeds Table C404, pick one:
  - Meet high-performance glazing: C402.4.1.1
  - Component performance (Target UA) can be 110%
  - Total Building Performance (C407) can be 110%
  - Or, (Seattle only) the alteration doesn't increase fenestration area

# Envelope exceptions to alteration rules

These don’t have to comply with code:
(…although basically everything else does)

- Storm windows, replacement glass
- Cavities exposed (just fill with insulation)
- Cavities not exposed
- Simple door replacement: vestibule not required
- Air leakage testing not required unless
  - substantial alteration
  - Change of use
  - Change of space conditioning



# You do need a permit for reroofing…

## (Seattle used to allow a blanket exemption)

Except:

1. Single family, duplex & townhouse
2. If less than 500 sf sheathing or insulation exposed

# Roof insulation? Depends

| Existing Conditions | Sheathing or Insulation Exposed | | Sheathing and insulation NOT exposed |
|---|---|---|---|
| | Existing insulation in attic or cavity | No existing insulation in attic or cavity | |
| Framing cavity exposed during demolition or construction | Fill framing cavity with insulation | Full code-required insulation, above or below sheathing | Fill framing cavity with insulation |
| Framing cavity NOT exposed during demolition or construction | No additional insulation required | Full code-required insulation, above or below sheathing | No additional insulation required |

# Air Barrier Testing

- *Not* typically required for alterations, except:
  - Change of occupancy
  - Change of space conditioning
  - Seattle: Substantial alterations

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# (But wait, there's more!)

# Upcoming Lighting Design Lab Events

| Webinar Topic | Delivery Date | Time |
|---|---|---|
| Lighting, Electric & Solar | June 13 | 10:00 - Noon |

Today's slide deck and video recording can be found on
www.lightingdesignlab.com

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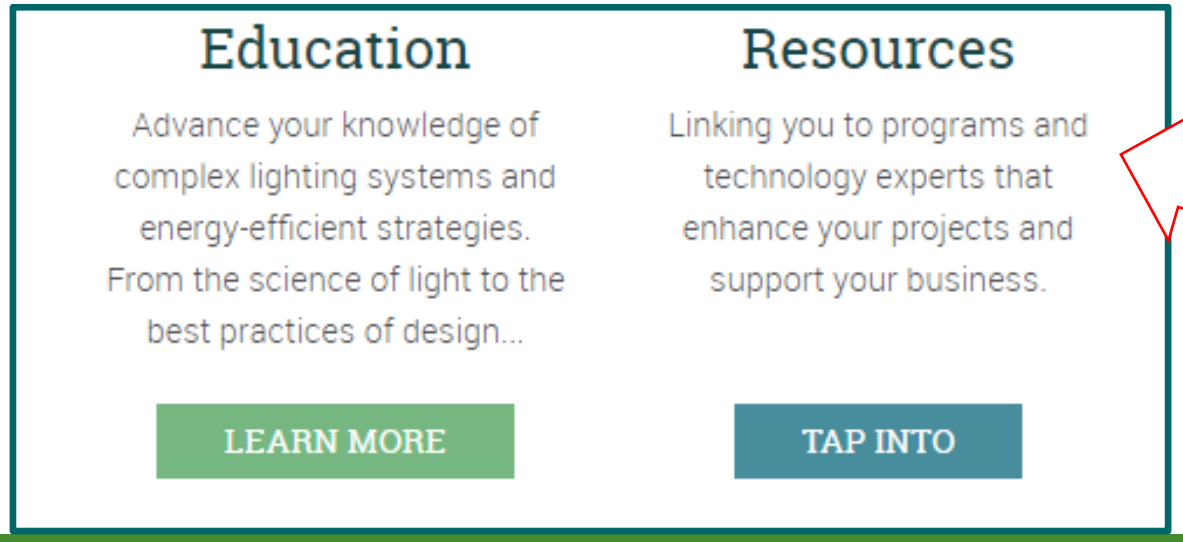


OR

## Email Us

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Todays slide deck will be posted here!


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We'll *SEE* you on the next call… ☺