The Tug-of-War: Decarbonization

Puget Sound ASHRAE & WSPE

Seattle Department of Construction & Inspections

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November, 2021

Decarbonization in WA State Law

- **Cap & Invest**
- **Electricity 100% renewable by 2045**
  - **No coal by 2025**
  - **Carbon neutral by 2030**
- **Reduce carbon intensity of remaining fuel 20%**
- **Limit GHG of insulation blowing agents**
- **Limit GHG of HVAC refrigerants**

The question is *how* we'll reach these targets

Washington state:
70% less building energy use by 2030

- Zero-carbon buildings
- Gov says move faster

Washington state:
45% reduction in GHG emissions by 2030

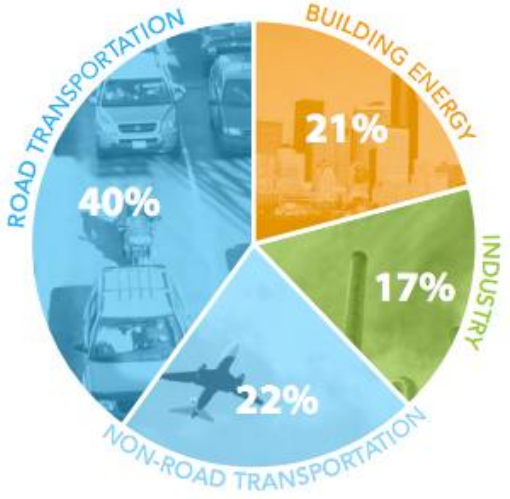
- 95% reduction by 2050

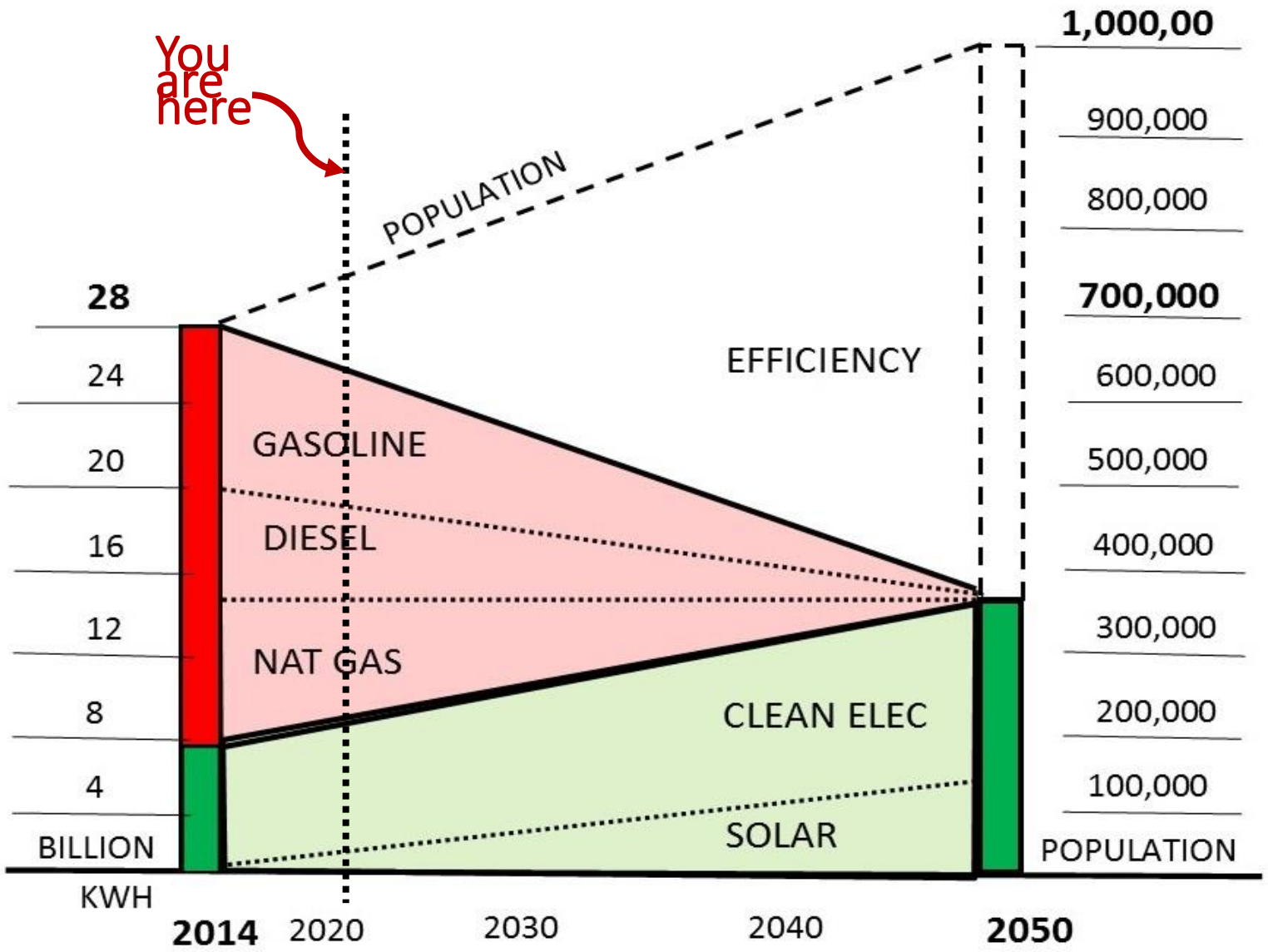
Seattle:
Carbon-neutral buildings & transportation by 2050

- …or sooner with Green New Deal

The big picture

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





Decarbonization Pathway

…from this week's ASHRAE newsletter

State and Local Government Affairs

Seattle Announces New Building Performance Standards to Reach Net-Zero by 2050

Last week, Seattle, Washington Mayor Jenny Durkin signed a new Executive Order aimed at reducing building-related emissions by at least **39% from the 2008 baseline by 2030 and reaching net-zero carbon emissions for buildings by 2050**. The order requires the Office of Sustainability and Environment to develop **carbon-based building performance standards (BPS)** for existing commercial and multifamily buildings **20,000 sq. ft**. or larger by July 2022. The order requires the BPS to transition to net-zero emissions as soon as is feasible, with initial emission reduction targets for the largest cohort of buildings beginning no later than 2026. Other aspects of these requirements are related to equity, affordable housing, and providing clean energy career initiatives. The full Executive Order can be found **here**.

Carbon-neutral Seattle by 2050

1. Build great envelope
   - Dependable energy savings for decades
2. Eliminate combustion
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3. Use electricity wisely
   - Don't waste on electric resistance heat
4. Generate power
   - Plus "solar readiness" for bigger future system

Build today so that no "major surgery" for buildings is required for 2050

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Burning stuff indoors is

Caveman Technology

Coal
1800

Oil
1900

Gas
1950

Gas is popular

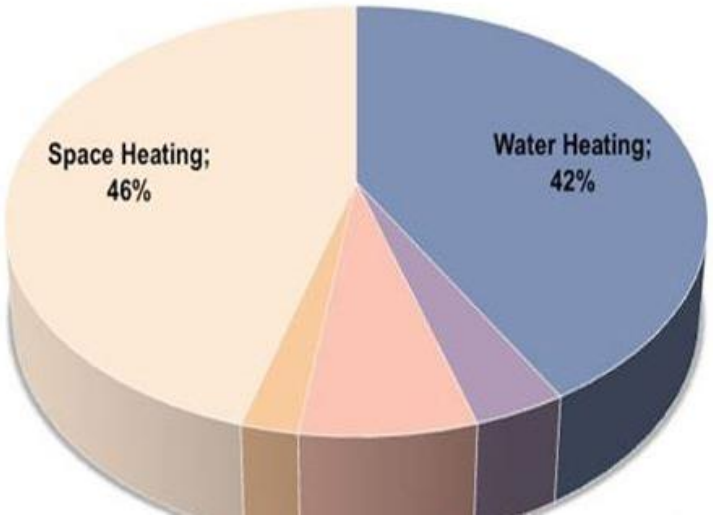
- Gas is cheap (maybe?)
- Equipment is cheap
- Equipment is compact
- Cozy “blue flame” image

Big gas uses:

- Space heating
- Water heating

Little uses:

- Cooking
- Fireplaces



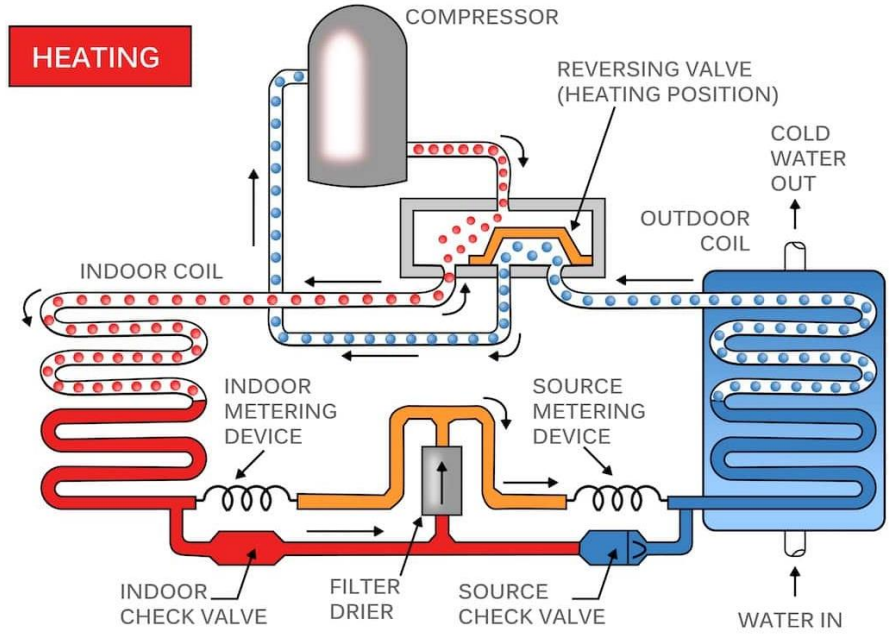
Seattle* No elec resistance or fossil fuel space heating

i.e.: “Use heat pumps”

Exceptions electric resistance OK for:

1. **Dwelling units: Max 750 W** per habitable room (1000 W for corner room)
2. Other space types: Max 2.5 W/sf total installed heating (The “Passive House” rule)
3. Heat pump auxiliary heat in cold weather
4. …etc

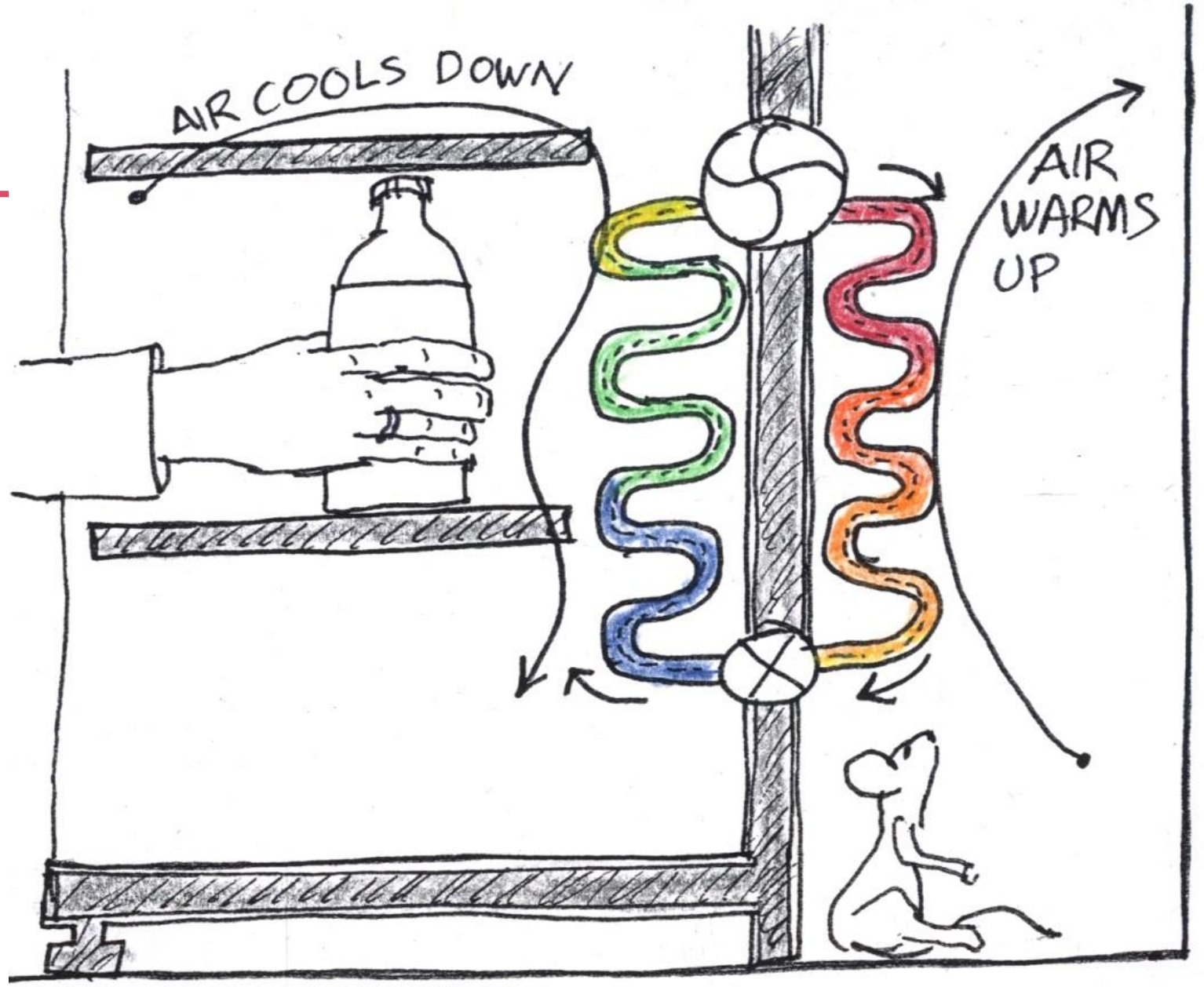
***Similar rules proposed for “2021” WA code**



Heat pumps squeeze warmth out of cold air

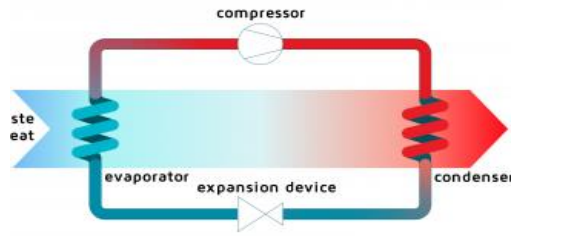
The heat pump

(simplified)



Heat pumps run on

Renewable Energy



Heat pump separates out heat

Seattle**: Multifamily Heat Pump Water Heating

Effective <u>January 2022:</u>

Only for hotel & multifamily buildings* with central domestic water heating:

- No electric resistance or fossil fuel water heating equipment for central systems
- **Use heat pump water heating**

Also, effective April or May, 2022?

- **Add commercial buildings**

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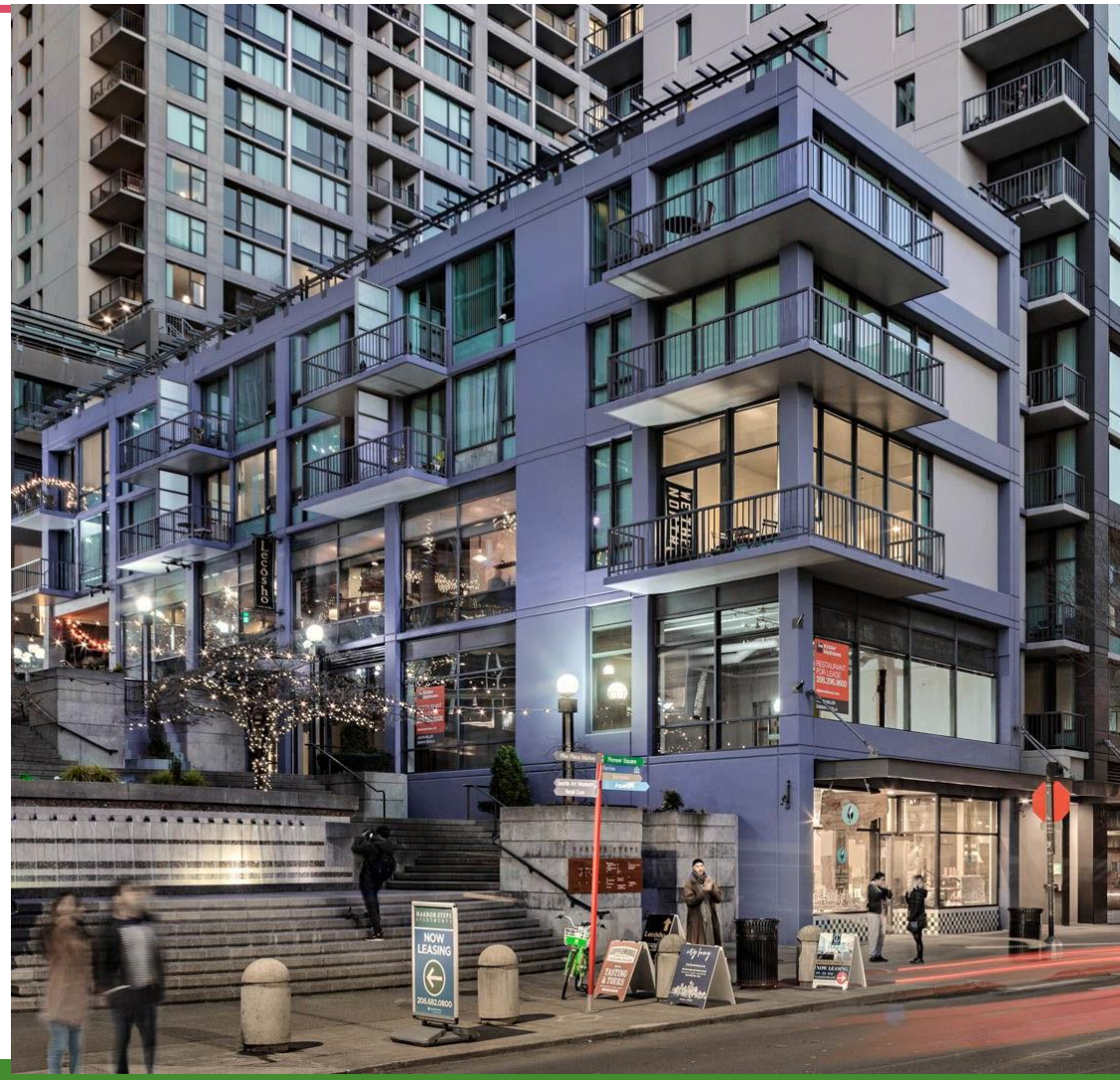

Pushback: Change is threatening

- Gas industry & labor (lost revenue)
- Developers (construction cost)
- Manufacturers (market readiness)

Stated objections:

1. Equip suppliers not ready
2. Grid can’t handle the extra load
3. What about renewable natural gas?
4. Takes away choice
5. Violates federal preemption law
6. Power outage scenario

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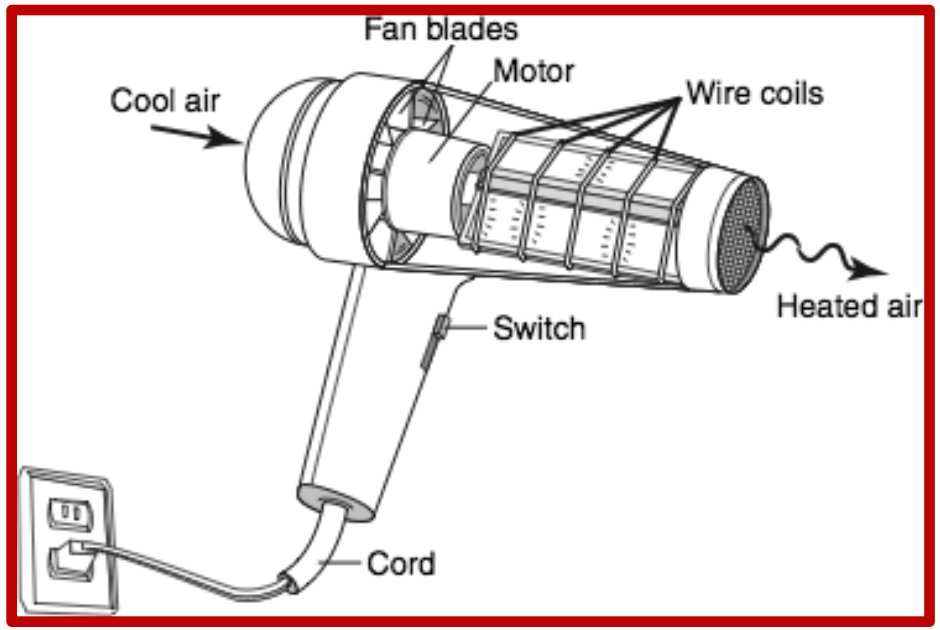
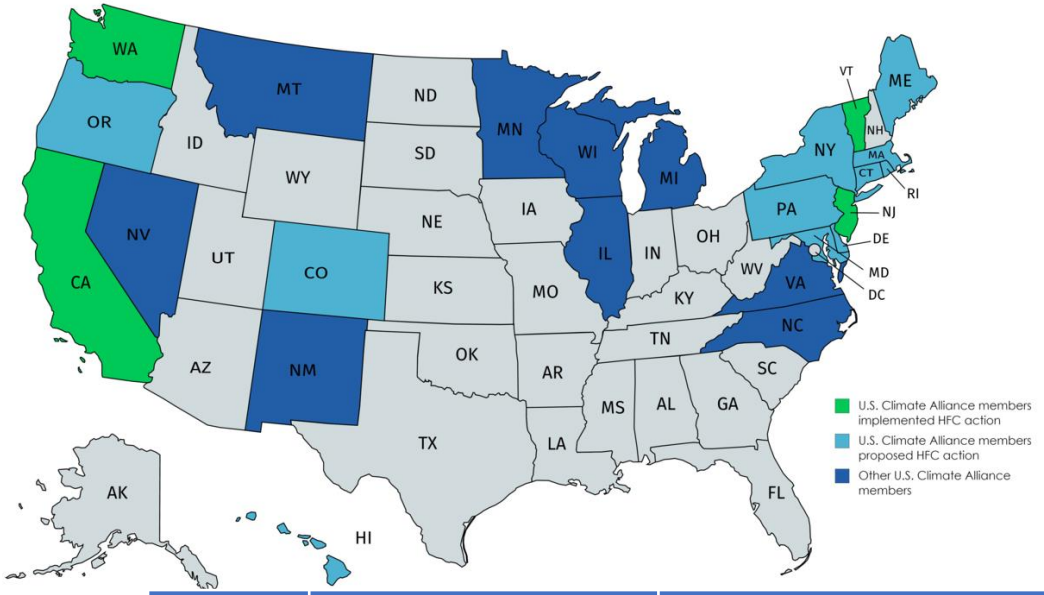
Electric resistance

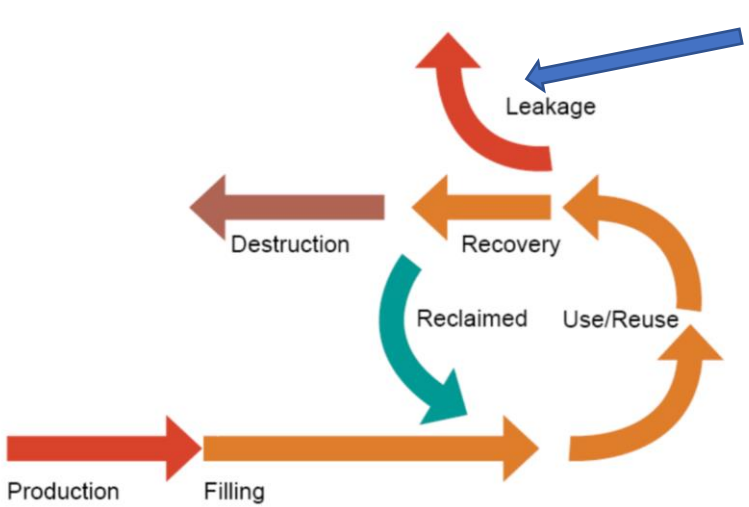
- Wasteful use of electricity
  - Even though 100% efficient
  - But, not as good as 270% efficient
- Traditional for VAV systems



HVAC refrigerant restrictions:

Max GWP 750 if manufactured after Jan 1, 2025 (2026 for VRF)





50% Leakage

GWP	Refrigerant	Manufacturers	COP	Low Temp	Water Temp
1	R-744 (CO2)	Sanden, Mitsubishi	3.2	(-25)	190
1450	R-134a	Colmac, Rheem	2.7	35	160
2088	R-410a	LG, GREE	2.5	(-5)	120
677	R-32 (+ new?)	Daiken	2.8		

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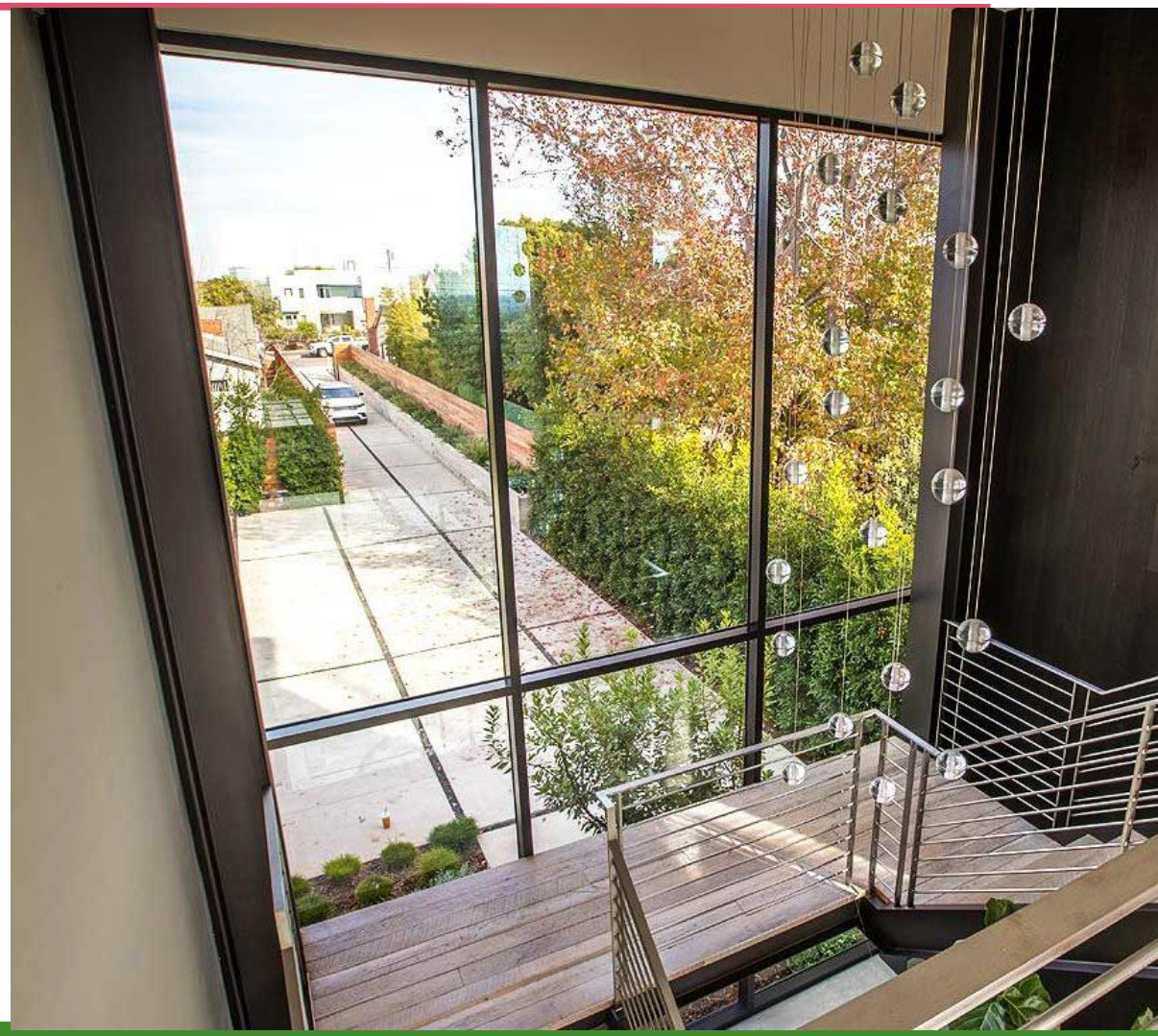
Air Barrier Testing

- Test standard reduced to 0.25 cfm/sf of envelope

- Passing test now mandatory
  - …at the old std: 0.40 cfm/sf
  - between 0.25 & 0.40 cfm, just fix what leaks you can

Fenestration U-values

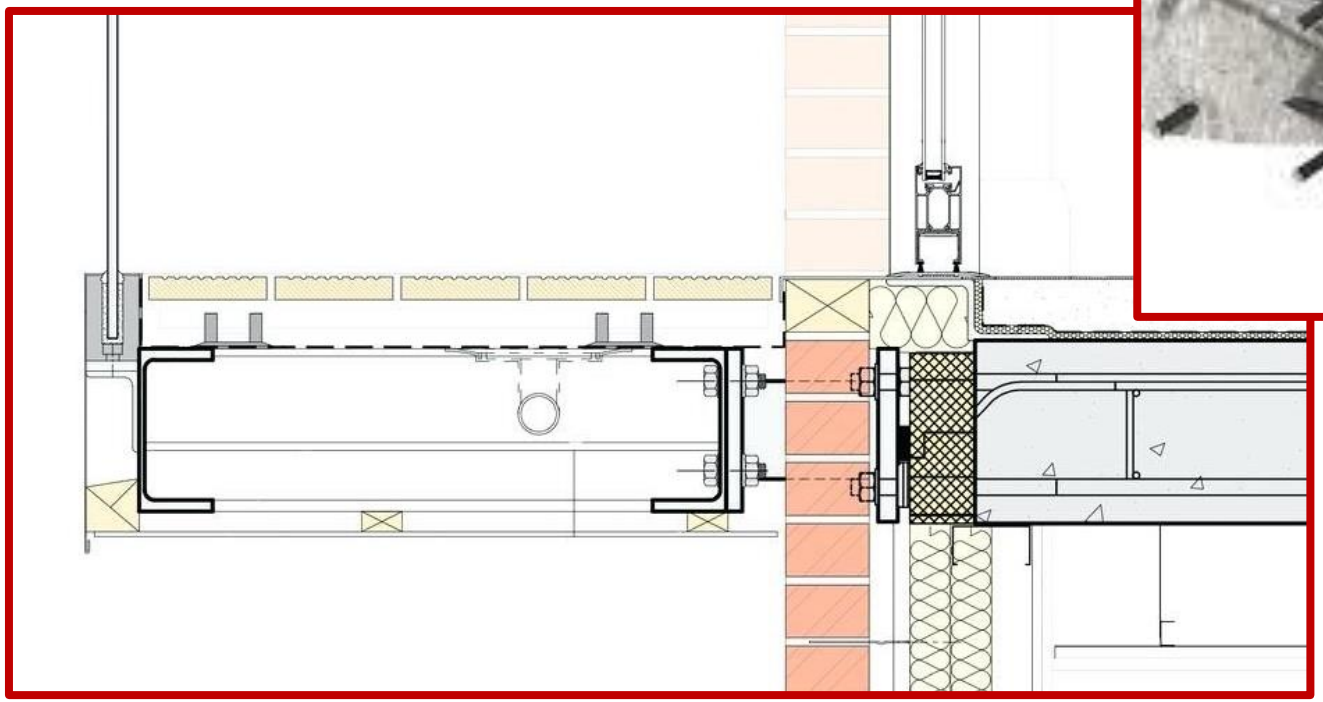
- All frame materials use same values
  - WA: U-0.38 for curtain wall, storefront, Class AW windows
  - WA: U-0.30 for “all other”
    - Includes most typical windows
- **Lower U-values in Seattle**
  - Sea: U-0.34 (vs. 0.38) for curtain wall, storefront, Class AW windows
  - Sea: **U-0.26** (vs. 0.30) for “all other”
    - Includes most typical windows
  - Sea: **U-0.28** for operable windows



C402.2.9 Concrete balconies

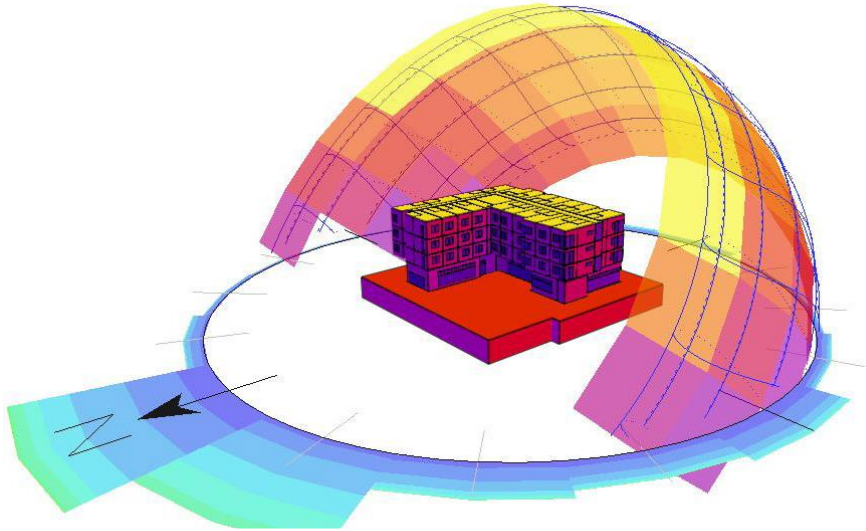
Concrete decks and balconies:

- **R-10 thermal break**
- Or use the **default U-factors** ***(U-0.741)***



Energy Modeling – now CO_2 emissions based

- **ASHRAE Appendix G method**
- **Carbon emissions,** compared with emissions under 2004 ASHRAE 90.1
- Seattle 10% *lower* than WA code
  - To align models with more stringent Seattle Energy Code requirements



SEATTLE 10% lower									
Building Area Type	Multi family	Health care	Hotel	Office	Rest.	Retail	School	Ware house	Others
Building Performance Factor	~~0.56~~ 0.50	~~0.54~~ 0.49	~~0.64~~ 0.58	~~0.54~~ 0.49	~~0.73~~ 0.66	~~0.47~~ 0.42	~~0.36~~ 0.32	~~0.48~~ 0.43	~~0.54~~ 0.49

Limits on sub-standard envelope

- WA: Modeled envelope heat loss cannot be more than **20%** **worse** than prescriptive
- **Seattle: Modeled envelope heat loss cannot be more than *10%* worse than prescriptive**
- So, if you can't use modeling to make a worse envelope anymore, what's it good for?

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Renewable energy

- **0.25 W/sf** of conditioned floor area
- Affordable housing exempted
- Option: Gift to affordable housing

Building Stories	Roof Area Required
1	1.8%
2	3.6%
4	7.2%
6	10.9%
8	14.5%
10	18.1%
12	21.7%
14	25.4%
16	29.0%
18	32.6%
20	36.2%

Utility Issues

- **Seattle City Light wrapping up EPRI study of decarbonization impacts**
  - **Conclusion: Yes, the grid can handle complete decarbonization**
  - **And: We will need to build in some load-shifting and other mitigation to shave extreme winter peaks**
- **Gas: From profitable regulated monopoly to pariah in a single decade?**

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Leaders lead.

everyone else can catch up later