U.S. Department of Energy
Building Energy Codes Program

2024 National Energy Codes Conference
May 8, 2024
Sacramento, CA

# Are We There Yet: Defining a Model Energy Code Endpoint

AIA Provider # 1014
AIA Course # 24NECC-D2S3

AIA Approved Continuing Education

ICC PREFERRED EDUCATION PROVIDER

RESNET® RESIDENTIAL ENERGY SERVICES NETWORK

# AIA and ICC Continuing Education Provider

Continuing Education Credits Earned on Completion of this Live Session:

- 1.5 LUs will be reported to AIA CES for AIA members.
- 0.15 ICC CEUs for ICC members must self-report to ICC with the Certificate of Completion.
- Certificates of Completion for self-reporting to your professional organization for non-AIA and non-ICC members are available upon request.

- This course is registered with AIA CES and ICC PP for continuing professional education. As such, it does not include content that may be deemed or construed to be an approval or endorsement by the AIA or ICC of any material of construction or any method or manner of handling, using, distributing, or dealing in any material or product.

---

AIA Approved Continuing Education

ICC PREFERRED EDUCATION PROVIDER

RESNET RESIDENTIAL ENERGY SERVICES NETWORK

# Course Description

Where are we ultimately going with our energy code development work? Zero energy? Zero emissions? Some other standard? How much of that progress should be efficiency, vs. renewables, and is cost-effectiveness the only factor? These questions and more will help pin down our ultimate code target.

# Learning Objectives

Articulate a target performance level for an ultimate energy code, including how cost-effectiveness should be considered.

Understand the optimal balance between system efficiency and renewable energy in setting energy code targets.

Understand the challenges inherent in “zero net energy” and “zero operational carbon” as appropriate targets for individual buildings.

Understand how to minimize stress on the power grid when setting targets for efficiency and renewables.

# Are we there yet?

**National Energy Codes Conference**

**May 2024**

# Disclaimer

This is an “ideas” discussion. Concepts presented here do not represent the policies of the panelists’ agencies or employers.

*Participate & enjoy!*

# It’s 2031:
# Imagine Success…

All our new buildings perform beautifully

- What do they look like?
- What did we do right?
- “What do they got that we ain’t got?”

# Other targets

- ASHRAE 90.1: “Net Zero Operational Carbon” 2031
- IECC & DOE: “Zero Code”
- IECC: “Glide Path” Appendix
- WA: 70% reduced energy 2031
- CA: Carbon neutral 2045

# “That which exists, must be possible”

| Building Type | 2018 Seattle Code (guess) | 2021 Seattle Code target | Best local examples (without solar) | 2030 Target EUI? |
|---|---|---|---|---|
| High-rise office | 38 | 33 | 37 | 25 |
| Mid-rise office | 34 | 31 | **16, 21** | 20 |
| Mid-rise multifamily | 32 | 28 | 16, 17, 19 | 20 |
| Elementary school | 28 | 25 | 16, 18, 20 | 19 |
| Warehouse | 18 | 16 | | 12 |

# Efficiency first. Then, add (less) solar.

- Less stress on grid in winter
- Less stress on grid in summer
- More room on grid to extend EV charging
- More room on grid for building decarbonization
- Smaller loads = smaller solar

# Range of technical tools for getting there

- Reduce thermal loads
  - Insulation, triple glazing, solar shading, air tightness, thermal bridging
- Change comfort criteria
  - Cooler in winter, warmer in summer
  - Mean radiant temperature
- “Design for Off”
  - Systems turn *off* when no one’s there
  - Systems turn *down* under partial load

- Waste heat recovery
  - Exhaust air, drain water, condenser
- Site & trees
  - Cooling & shading
- Solar over roof & pavement
  - Direct connection to vehicle charging?
- Energy Storage
  - Battery, hot water, ice storage, GSHP
- Robust & intuitive controls

Optimize human well-being

Sunlight, views, nature, fresh air, quiet

# Time to argue a few points.

“Shaking hands is nice, but we get stronger by arm wrestling.”

No grandstanding, please!

# 1. ZNE is a blunt instrument & not the right target

1. Massive solar needed for heavy process load buildings (grocery, hospital, Thai food)
   - And high-rise buildings
2. Use of space not always known
   - And keeps changing anyway
3. Off-site renewables not always available
4. Allows low-performance low-rise buildings
5. Summer surplus/winter deficit

Maybe European “Nearly Zero Energy Building” only counting HVAC, water heating, & lighting?

Maybe just “Efficiency + On-Site Solar”?


Vote 1. The target should be:

a. ZNE

b. Zero Net Operational Carbon

c. Passive House

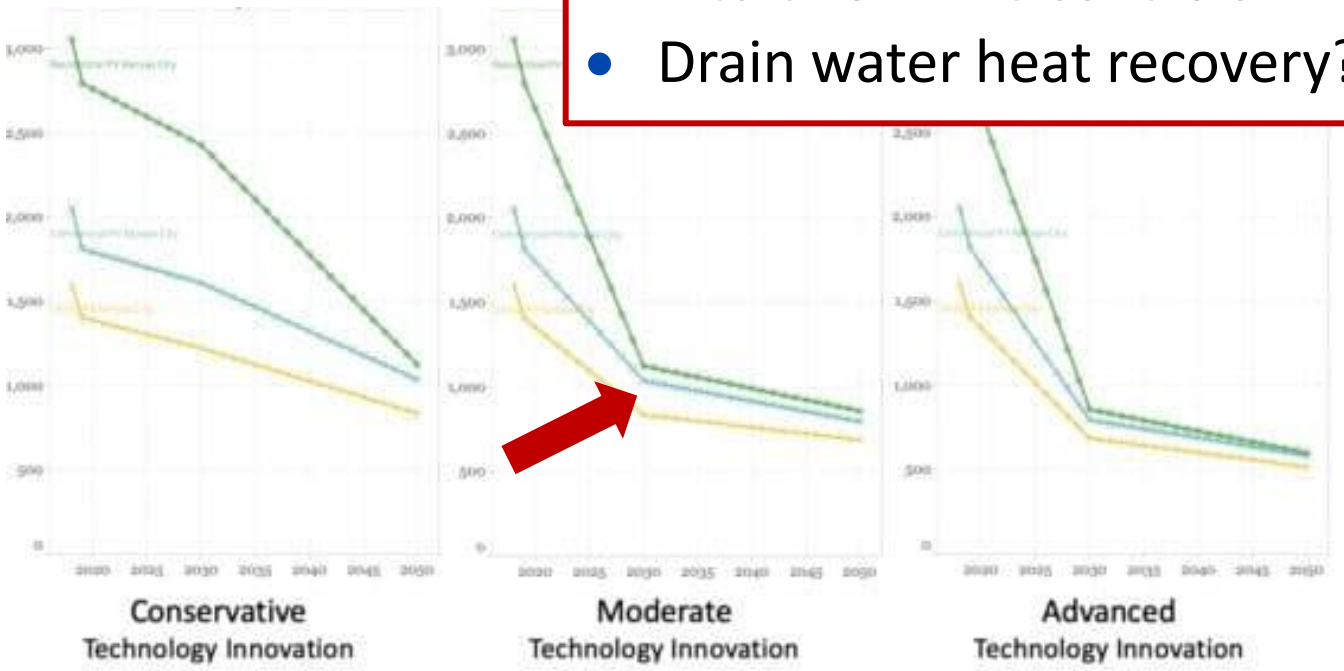
d. EUI of 20 for all conditioned space
(not counting process loads)

e. European “Nearly zero energy”

# 2. Another option:
## Base tomorrow's performance target on today's champions

- Best 2024 Buildings = Code-minimum 2030 Buildings
- Future tech advances will facilitate reaching current stretch goals

- Better glass?
- Better plug load controls?
- Automated solar shading?
- Intuitive HVAC controls?
- Drain water heat recovery?



Vote 2: Even better?
Base ultimate target on 2024’s best-performing buildings.
a. Yes
b. No

# 3. *Don't* make it a Performance-based code
## (Apologies to NYC)

**Modeling is just a happy fantasy**

- Energy models *significantly* underpredict actual energy use
- You'll think you've hit the target, while you're still 30% behind
  - Why isn't anyone studying the gap between modeled & actual efficiency?

**Modeling: slow market transformation**

- Want real "market transformation"? Put it in the prescriptive code!
- **Use prescriptive code + efficiency options, not performance code**

"Energy modeling, when used for code compliance, *always* harms performance"

Vote 3: The ultimate code should be prescriptive, not performance, with flexibility provided through additional efficiency options.

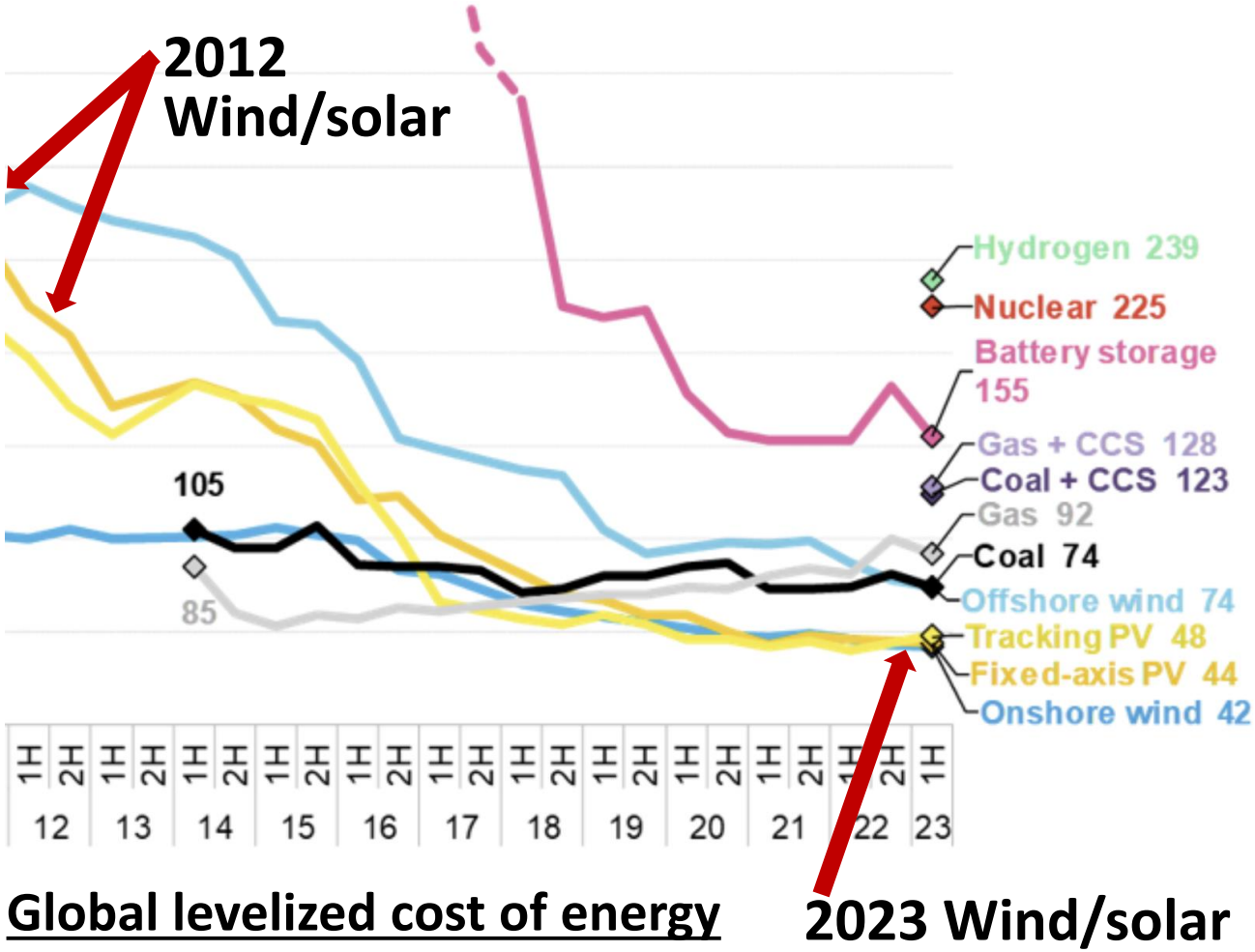
a. Yes

b. No

c. Other?

# 4. Only require as much solar as fits on roof (& over parking)

- A decade ago, off-site renewables needed a financial boost to be viable
  - We don't need new construction to get it built any longer
- Why use construction to finance utility-scale renewables?
  - How could you prove "additionality"?
- Off-site renewables don't mitigate peak grid stress or provide resilience



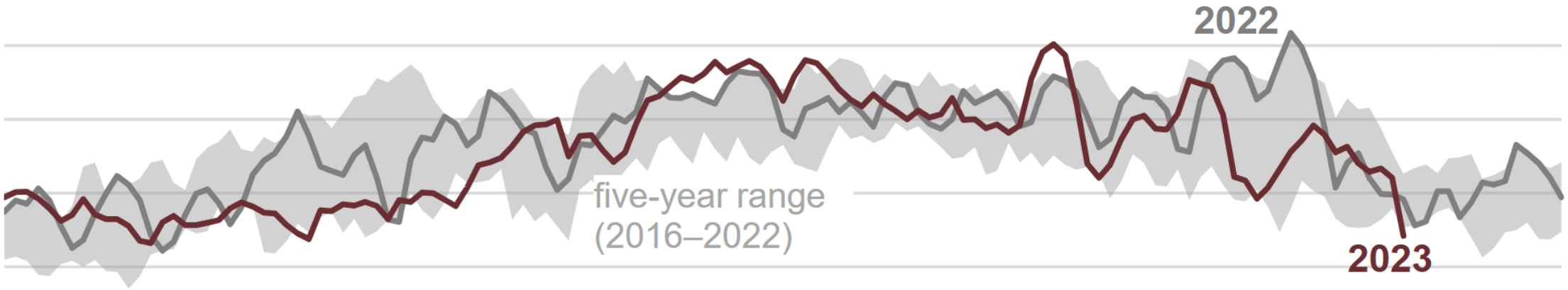
Vote 4: Require only as much renewable energy as fits over roof & parking. (No off-site renewables required.)

a. Yes

b. No

c. Other

# 5. Code should mitigate peak grid loading




- Summer: Solar control
- Winter: Fenestration, heat recovery
- Year-round: Equipment efficiency & controls
- Demand controls: Lighting & thermostat
- Load timing: EV charging, water heating
- Battery storage: Discharge during peak hour
- Thermal storage: Phase change materials

Vote 5: Include reduction of grid impacts in energy code purpose & scope.

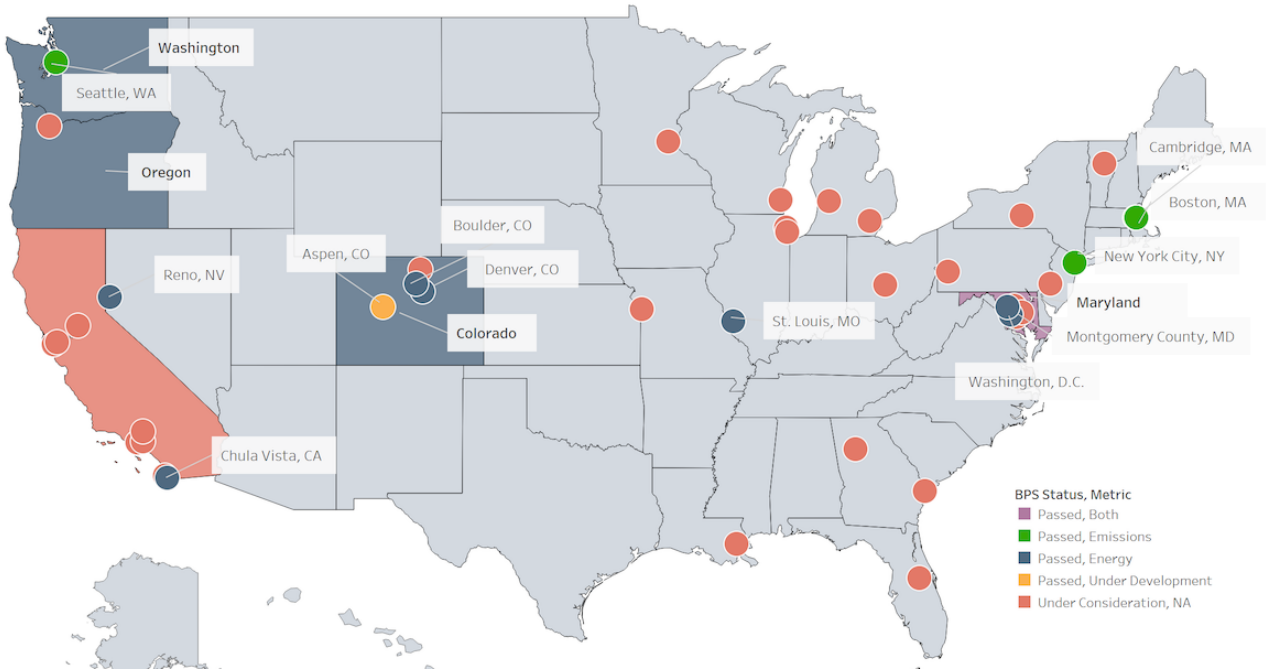
a. Yes

b. No

# 6. BPS doesn't work as an OBC

- OBC – Outcome-Based Code – regulates new building energy use into future
- Almost nobody can make an OBC work

- BPS is an "ankle-breaker" to upgrade low performers
- But *new* buildings are mostly best 5%
- Building use will change anyway




**Use "building tune-up" process to ensure optimal future performance**

- Periodically inspect all energy systems
- Fix all the easy and obvious stuff

Vote 6: Tune-up. Require 3rd party inspection and optimization of systems for first three years.

a. Yes

b. No

# 7. Elephant in the Room: Embodied Carbon

- For new buildings, *embodied* carbon (EC) now similar in magnitude to *operational* carbon
- Should we place EC restrictions in the building code ?

- Set EC limits for steel & concrete
  - Higher EC allowed, with more solar or other efficiency credits
- Should we consider all remaining EC to be a shared societal burden?
  - Like we treat transportation infrastructure
  - We all need and use buildings

<u>Focus on what can be improved</u>:

- Only regulate materials with:
  - Large proportion of total EC
  - Available low-carbon options
  - Easy to inspect/confirm

Vote 7: Embodied carbon.

a. Status quo: Nothing in code

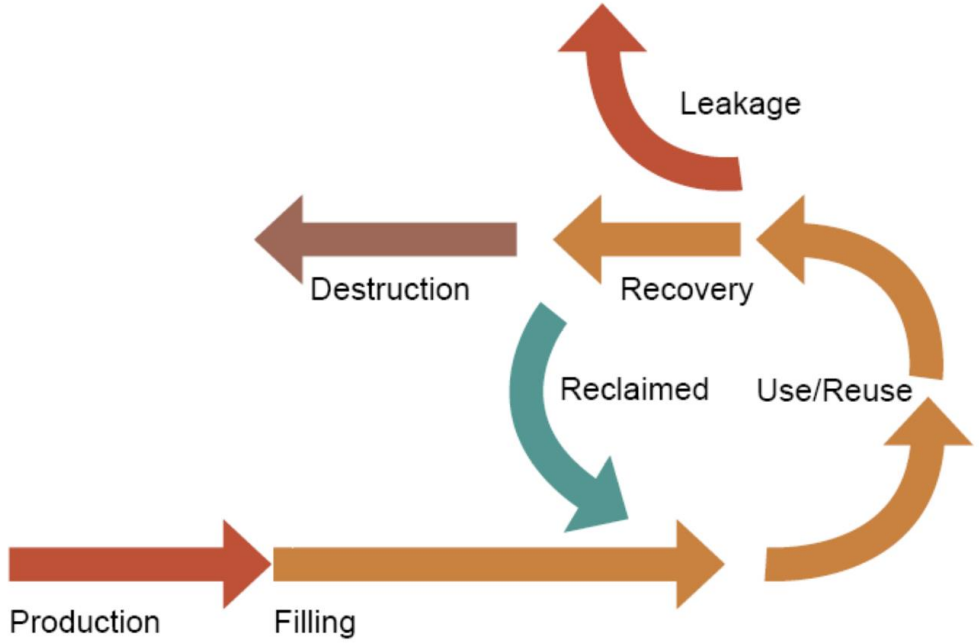
b. Pay SCC ($185/ton) for *all* EC in building

or build equivalent renewables

c. Pay SCC for EC *above a defined limit* for steel & concrete only

# 8. Hippo in the Room: Refrigerant leakage

- Main problem is field connections
  - Grocery refrigeration
  - VRF
  - Mini-splits
- State laws, not code, limits GWP
- Can code reduce leakage?
- Can code restrict connection type?

Vote 8: Refrigerants.

a. Nothing in code

b. Restrictions on pipe fitting types

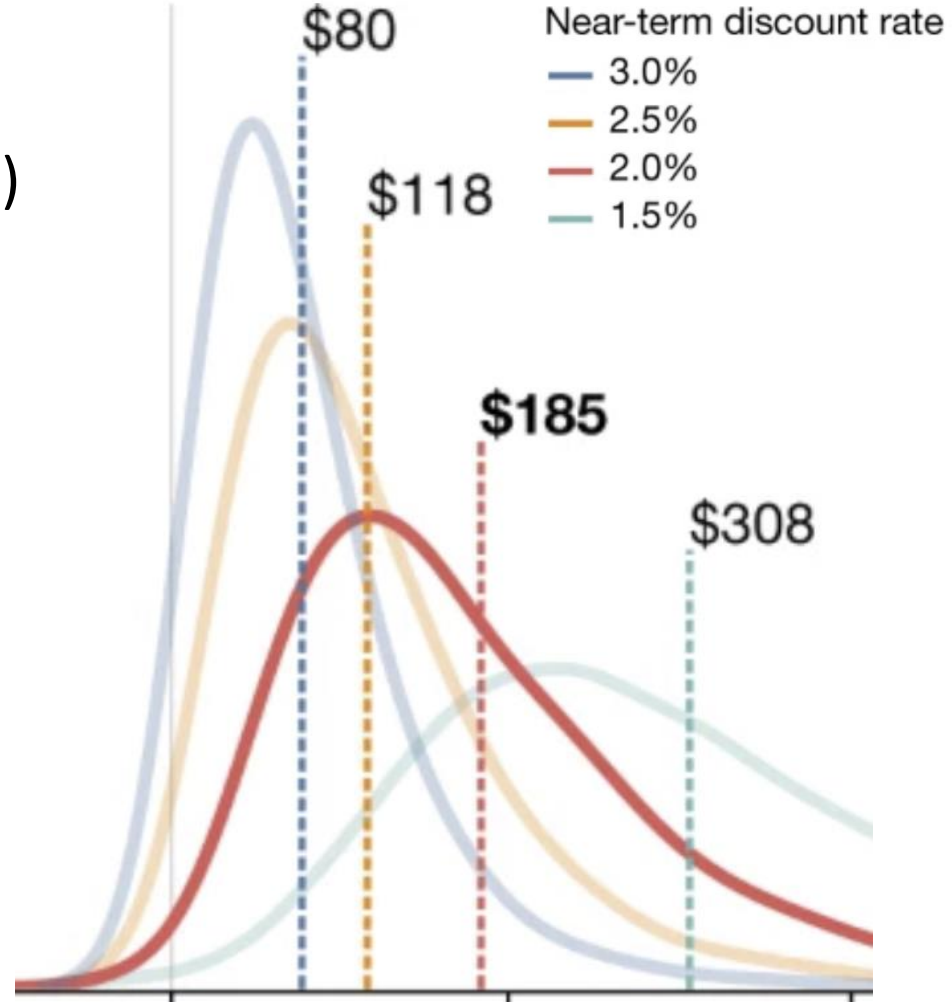
c. “Credit” for GWP below state limits

d. Surcharge on all refrigerant recharge

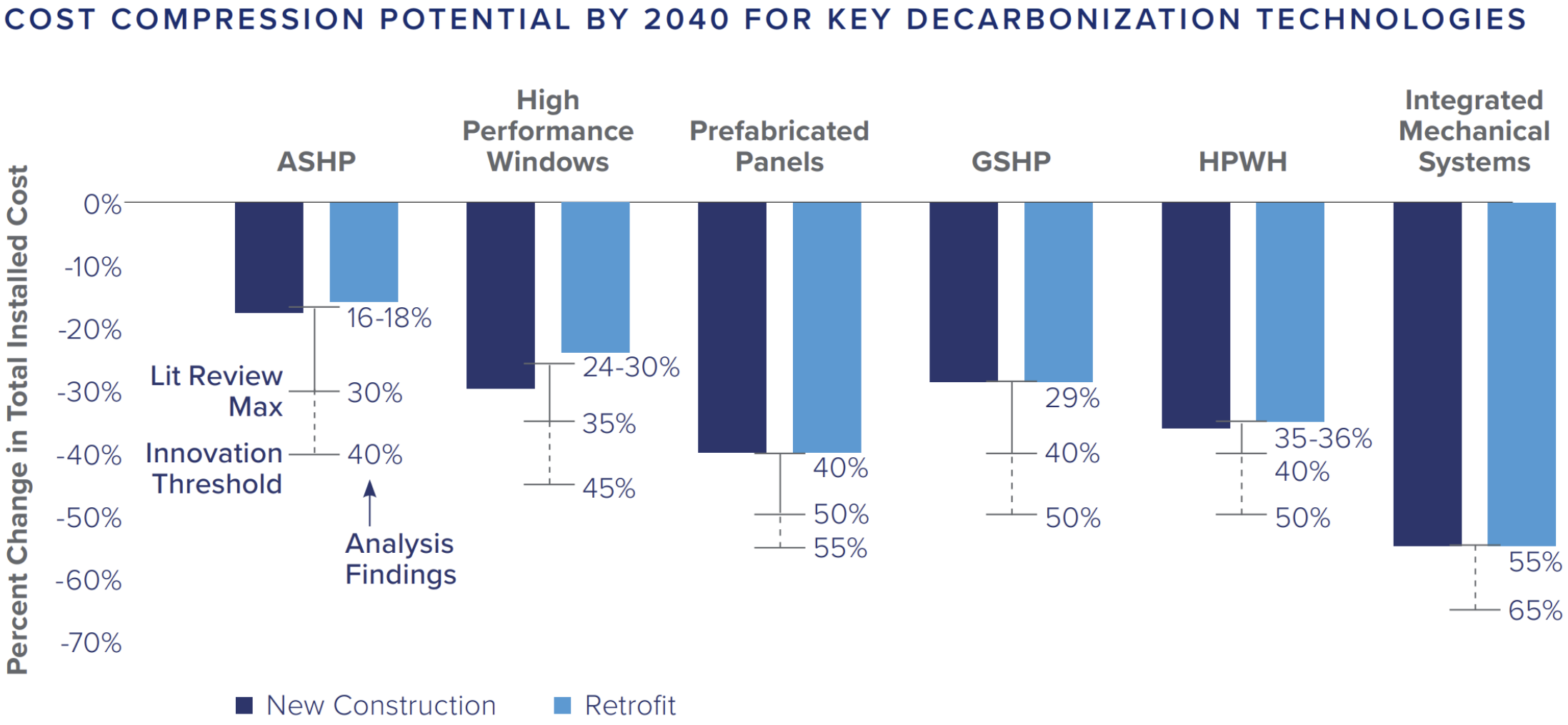
# 9. Cost-effectiveness: Use “expanded” test

- Require decarbonization upfront
- Add “social cost of carbon” to energy cost (+15%?)
- Subtract “learning curve” from construction cost: Marginal costs fall after new code provisions become “business as usual” (-15%?)
  - More realistic cost

- Then, select *most cost-effective path* to target, from all available options



# NY says cost premium has room to fall



Vote 9: Cost-effectiveness determinations: include $185 SCC & assume “learning curve” cost reductions.

a. Yes

b. No

c. Just pick the “most cost-effective” option that meets energy reduction target

# What time is it?

- Buildings last a long, long time
- 5 – 10 years from code writing to occupied buildings
- **So your 2030 goal is *now*.**
  - 2050 goals don't have this urgency
- Politically difficult to make a huge jump in any one code cycle
- Hard to find new big-impact ideas

**Duane Jonlin**
**duane.jonlin@seattle.gov**

**Gypsy Achong**
**Gypsy.Achong@energy.ca.gov**

**Remember, we're just discussing *ideas* here, not our agencies' policies**

***Please continue discussing (arguing?) over lunch!***