

Energy Targets in zEPI and Outcome-based Codes

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New Buildings Institute



Hood River Middle School
Photo: Michael Mathers

New Buildings Institute (NBI)

- Nation-wide non-profit
- Board of Directors represent leaders in energy efficiency and green building
- Strategic relationships with leading organizations including AIA, USGBC, NEEA, CPUC etc
- Staff of leading building science technical experts and research managers
- Funding from progressive utilities, foundations and research projects



Agenda

1. Targets and ZNE
2. Outcome-based Codes & Policies
3. zEPI

Not on the Agenda

1. How to set Targets

Why Targets?

Why Whole-Building, Absolute Energy Targets?

(credit to Mike Leach, PNNL, ACEEE Summer Study, 2012)

Definition: target that represents total, as-operated energy use

- Clear goals without room for interpretation
 - No interpretation of codes or standards or assumptions of typical design and use are required
- Directly measureable
 - Encourages and facilitates goal verification
 - Enables contractual inclusion of energy goals
- Capture whole-building energy performance
 - Encourages design team to carefully consider aspects of building performance that may be overlooked by codes or standards
- Place focus on low-energy design
 - Project resources are applied to improving low-energy design
 - Allows for design flexibility and encourages innovative, cost effective, integrated design strategies

Setting Bold Targets

NET ZERO
CARBON
EMISSIONS
BY THE YEAR 2030

JOIN THE 2030 COMMITMENT ▶

ADOPTER





BRITISH
COLUMBIA

WASHINGTON



OREGON

CALIFORNIA



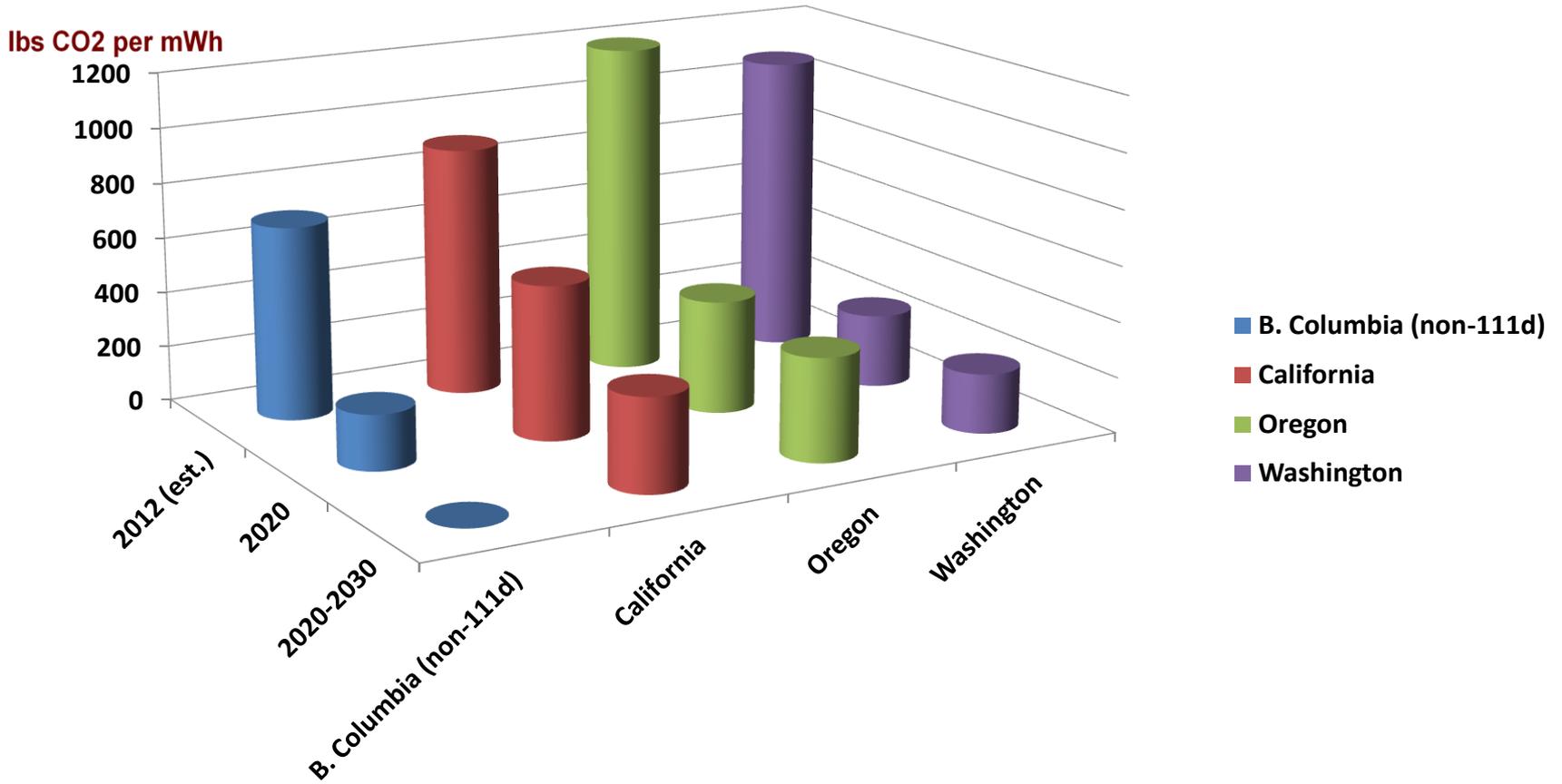
PACIFIC COAST COLLABORATIVE

*“Transform the market for energy efficiency
and lead the way to “net-zero” buildings”*

Section 111(d) of the Clean Air Act
-this is not the target-



Grid Carbon Intensity Targets (111d)



California Code Cycles to ZNE

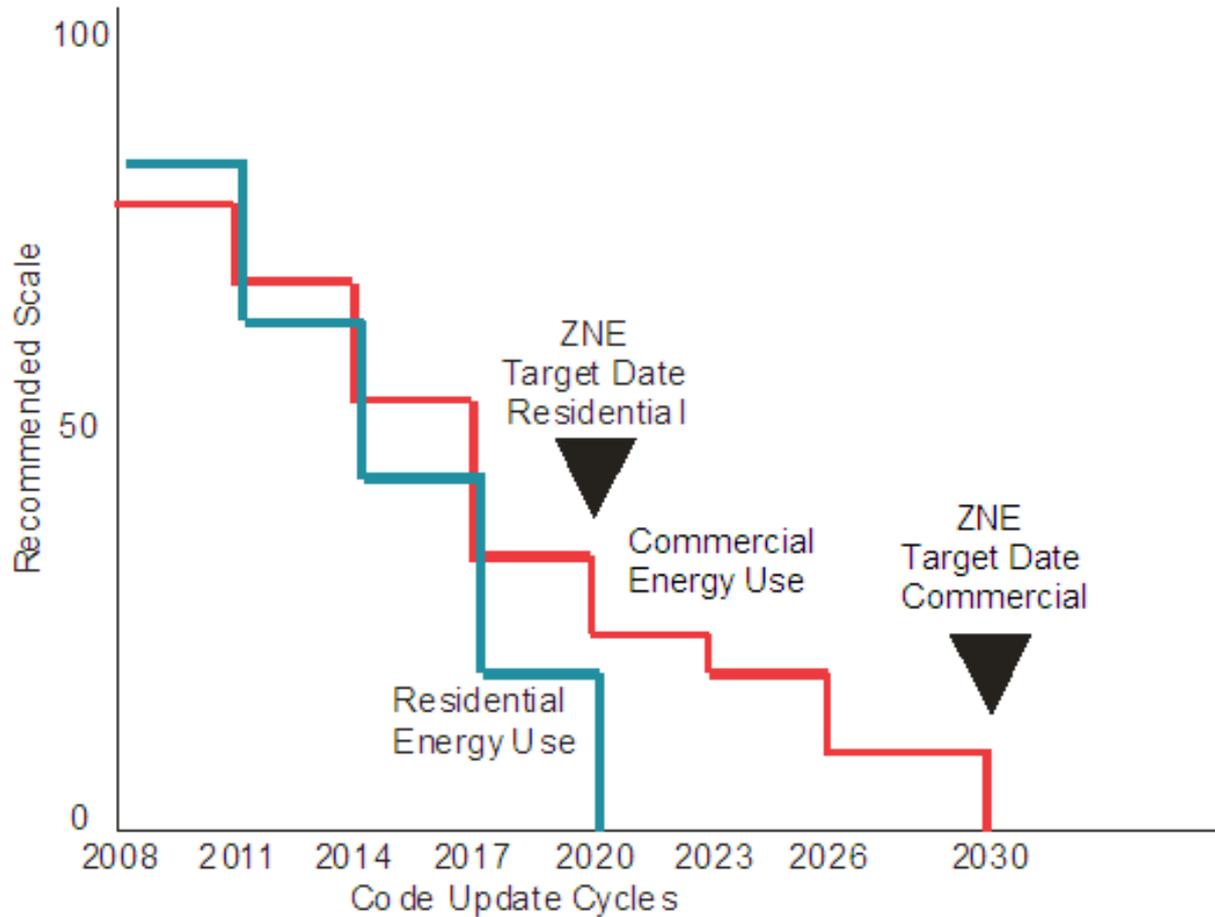
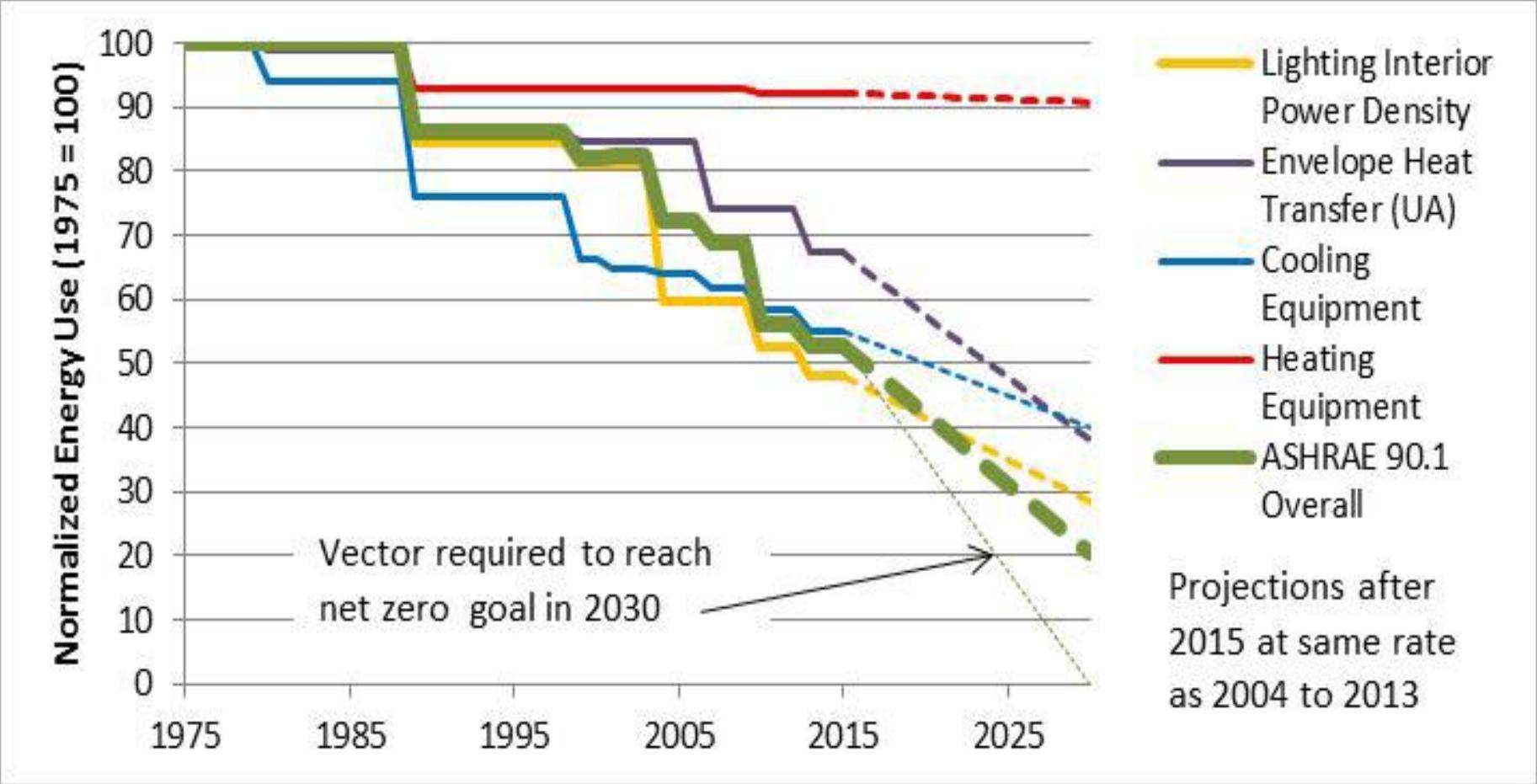


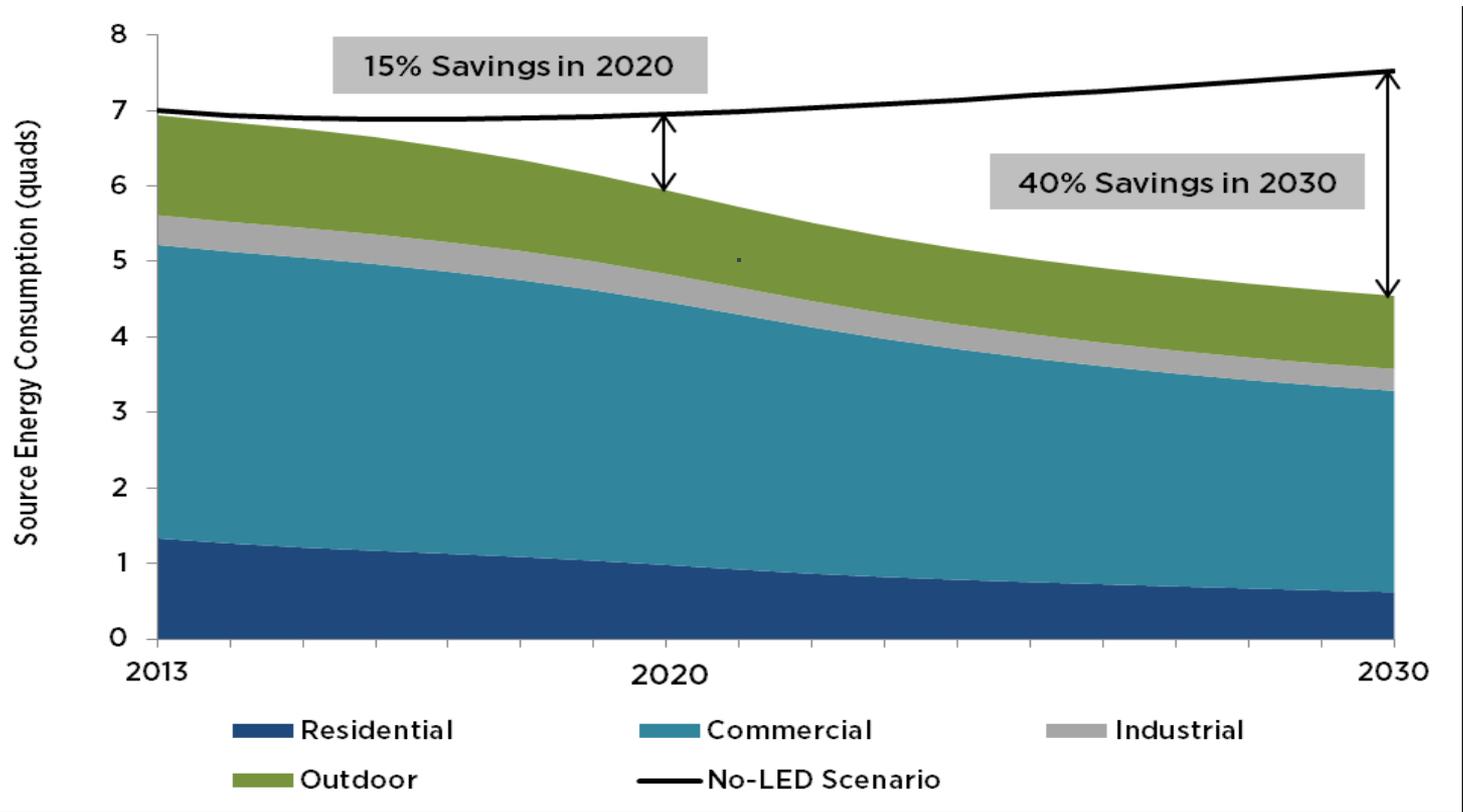
Figure 2. Code Cycles to ZNE, Source: SCE & AEC, 2009

End Use Efficiency Progression



DOE – Lighting savings to 2030

Energy Savings Forecast of
Solid-State Lighting in General
Illumination Applications
August, 2014



The ZNE Equation

Annual Energy Use = Annual Energy Production

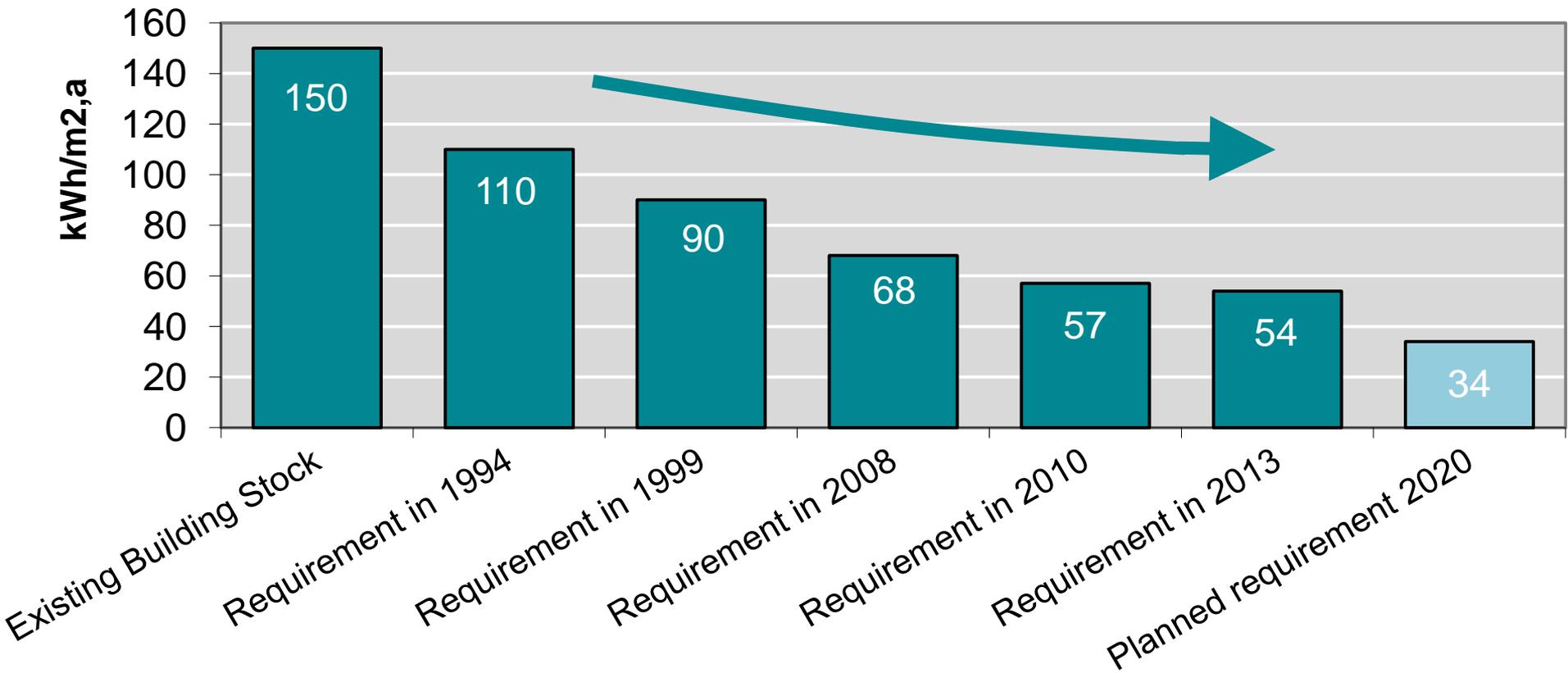


Solar Costs Will Fall Another 40% In 2 Years.

Here's Why.

January 29th, 2015 by [Giles Parkinson](#)

Upper Austria Energy performance indicators as the basis for building energy codes (ex.: 1family homes)



Why Outcome-based Codes and/or Policies?

(NIBS and NBI paper this month)

Basic Mechanism of Code: Regulating Design Components

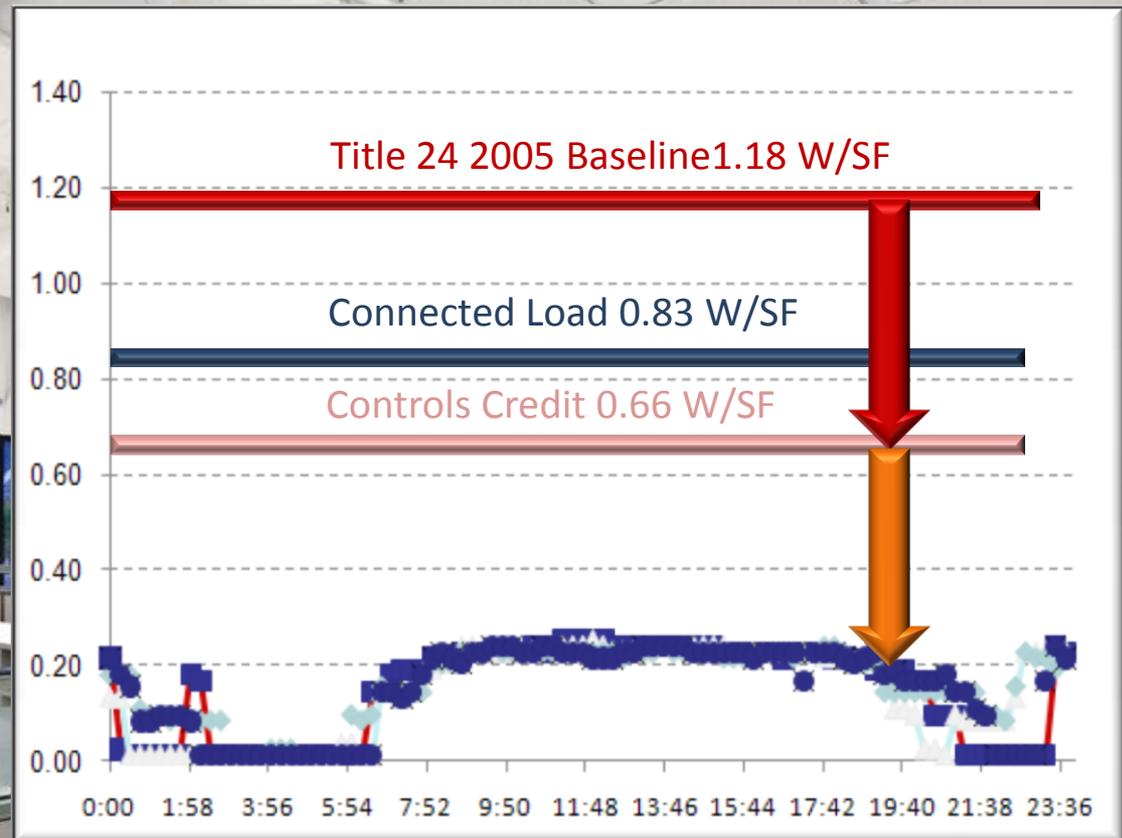


Redding School for the Arts, CA
Courtesy: Trilogy Architecture & Steve Whittaker Photography



Office of the Future Program

- Single-Fixture Task-ambient (task light provides ambient)
- All building lighting on occupancy sensors
- Private offices 50% auto-on with occupancy sensors, all lights auto-off



The ZNE Equation (*DOE proposed*)

Actual Annual Energy Use = Actual Annual Energy Production

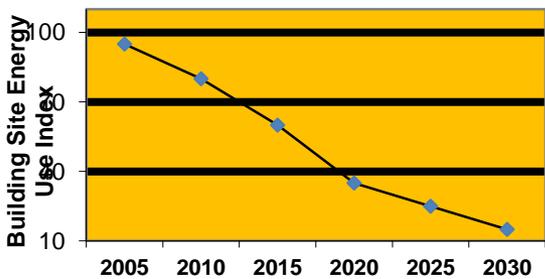
Why zEPI?

- ZNE as a policy target necessitates a top-down approach: it is where we are going, it is not “where we’ve been” nor “percentage better than the last code.”
- Different individual buildings, energy code baselines, and even building portfolios can all be compared on the same scale.

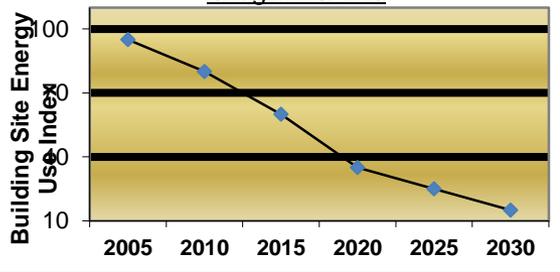
New IgCC Definition

- **ZERO ENERGY PERFORMANCE INDEX (zEPI).** A scalar representing the ratio of the energy performance of a proposed design or an existing building compared to the mean energy performance of the building stock from the benchmark year of 2000

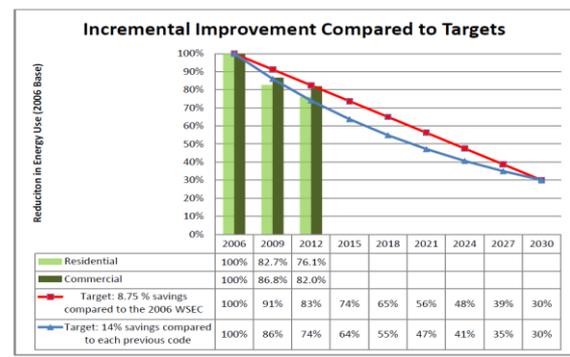
ZERO NET ENERGY PATH- COMM. California - Big Bold Goals



ZERO NET ENERGY PATH Oregon -SB 79

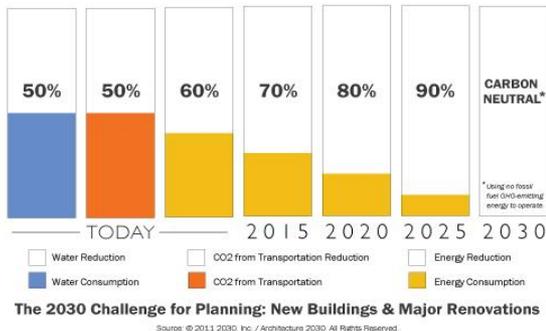


Incremental Improvement Compared to Targets



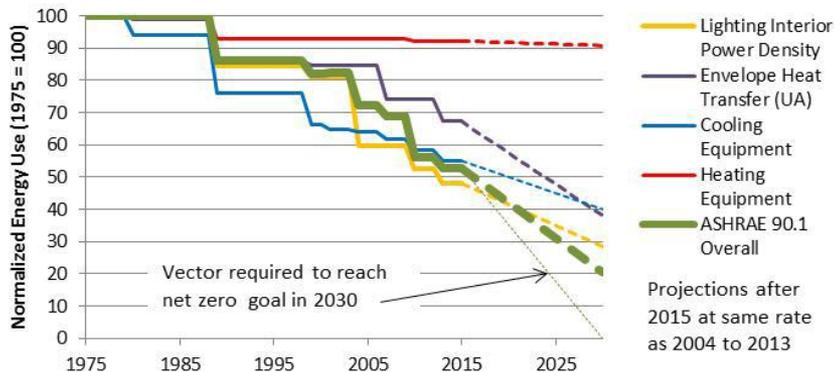
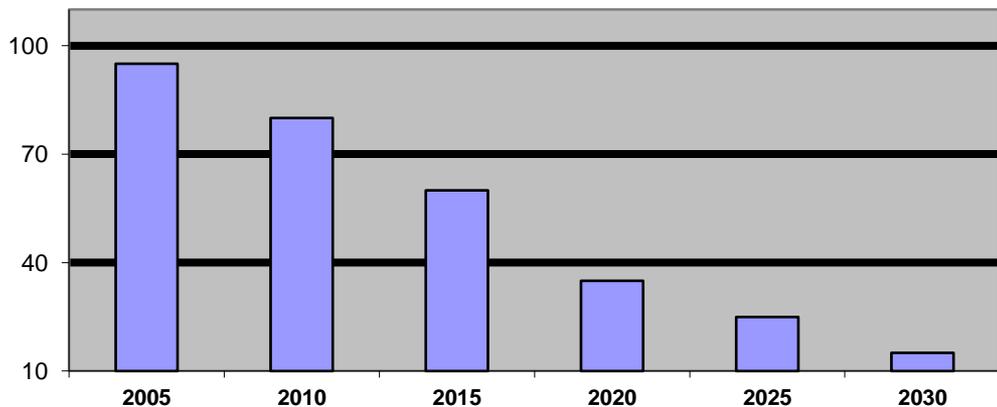
Carbon Metrics

Seattle EcoDistrict and Architecture 2030
Carbon to Site EUI = 1.23 lbs CO2 per BTU

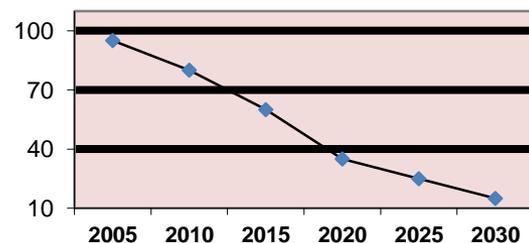


ZERO NET ENERGY PATH 2012-2030 PACIFIC COAST COLLABORATIVE

Building Site Energy Use Index



ZERO NET EMISSIONS PATH (draft) Vancouver, British Columbia



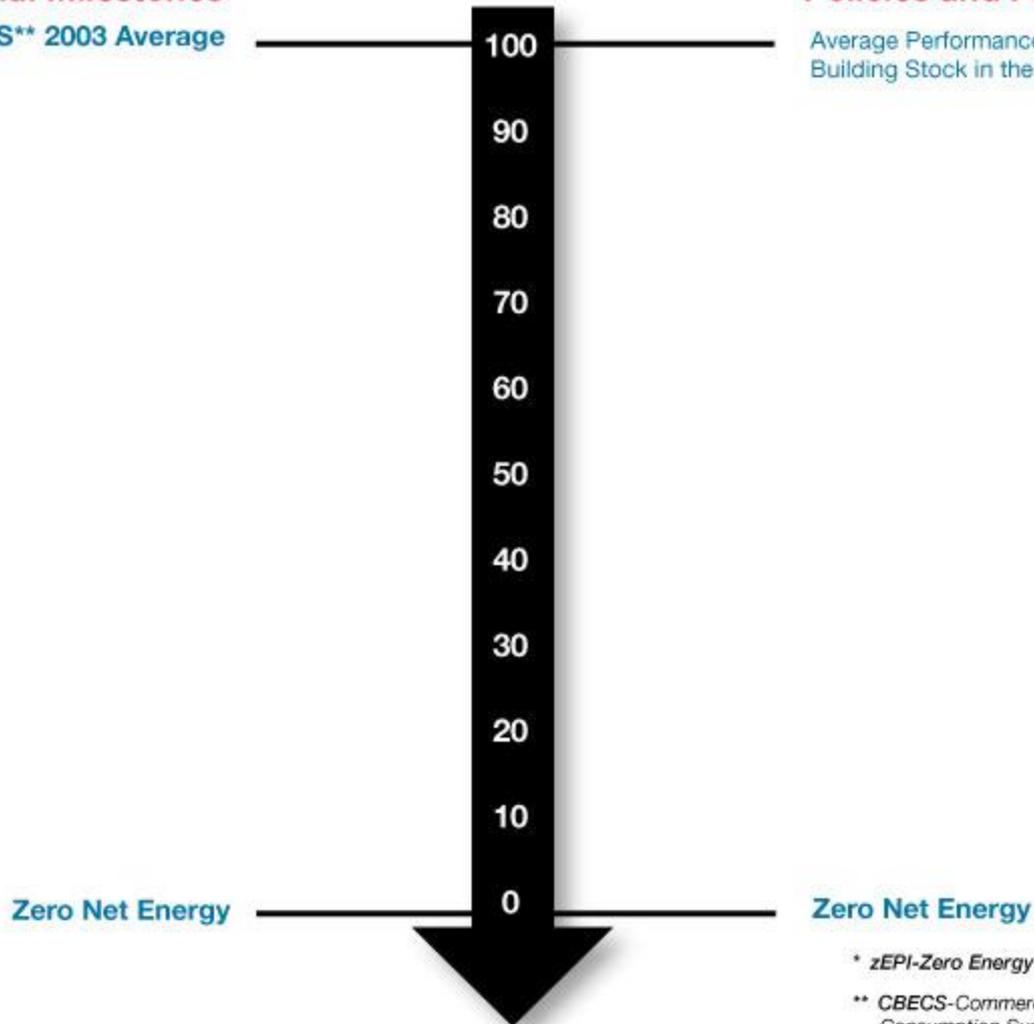
zEPI* Scale to ZNE

National Milestones

CBECS** 2003 Average

Policies and Projects

Average Performance of United States's Building Stock in the Year 2000



* zEPI-Zero Energy Performance Index

** CBECS-Commercial Buildings Energy Consumption Survey-U.S. Department of Energy

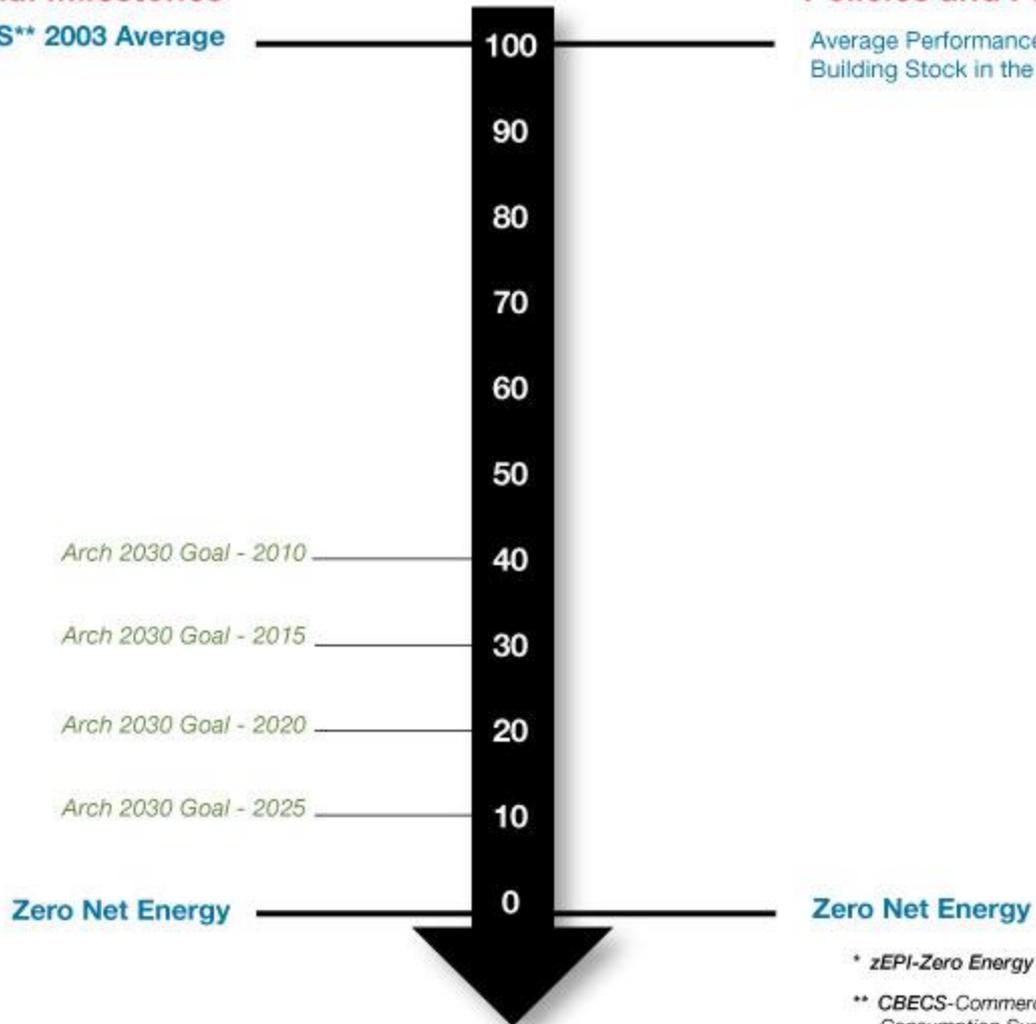
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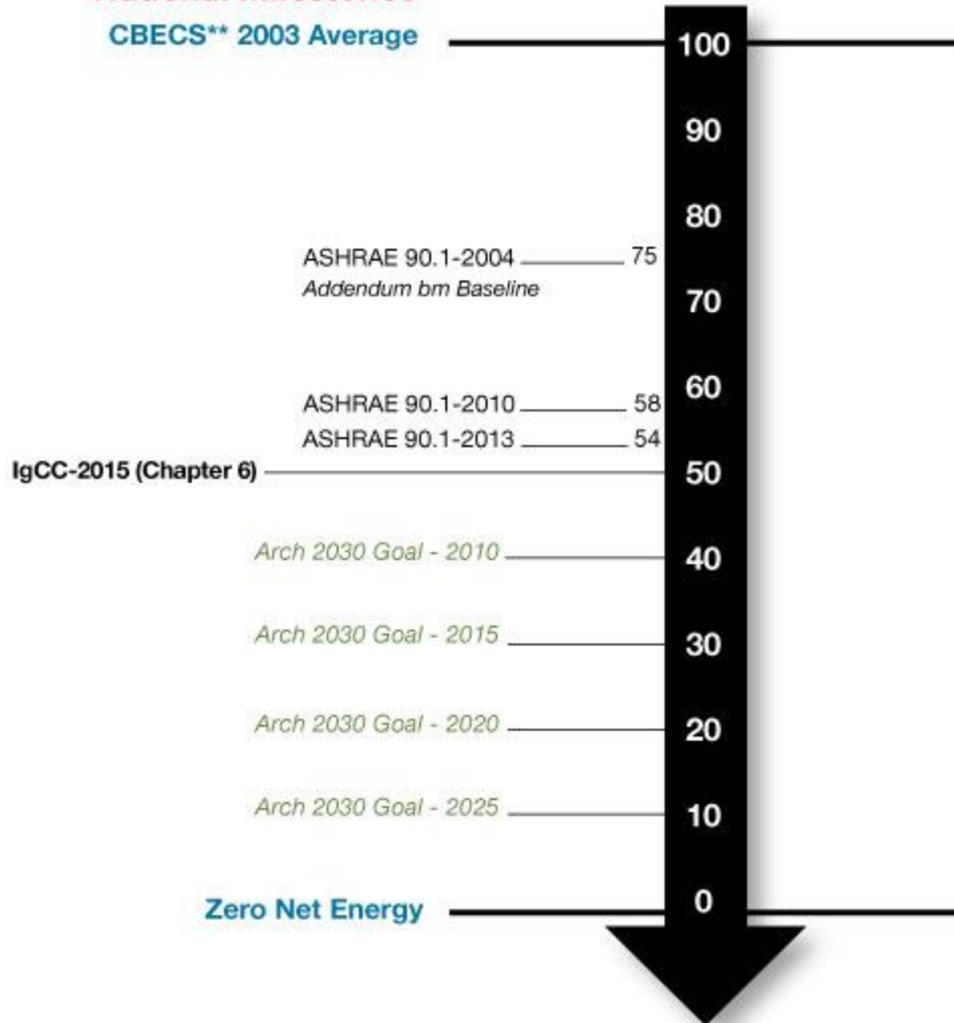
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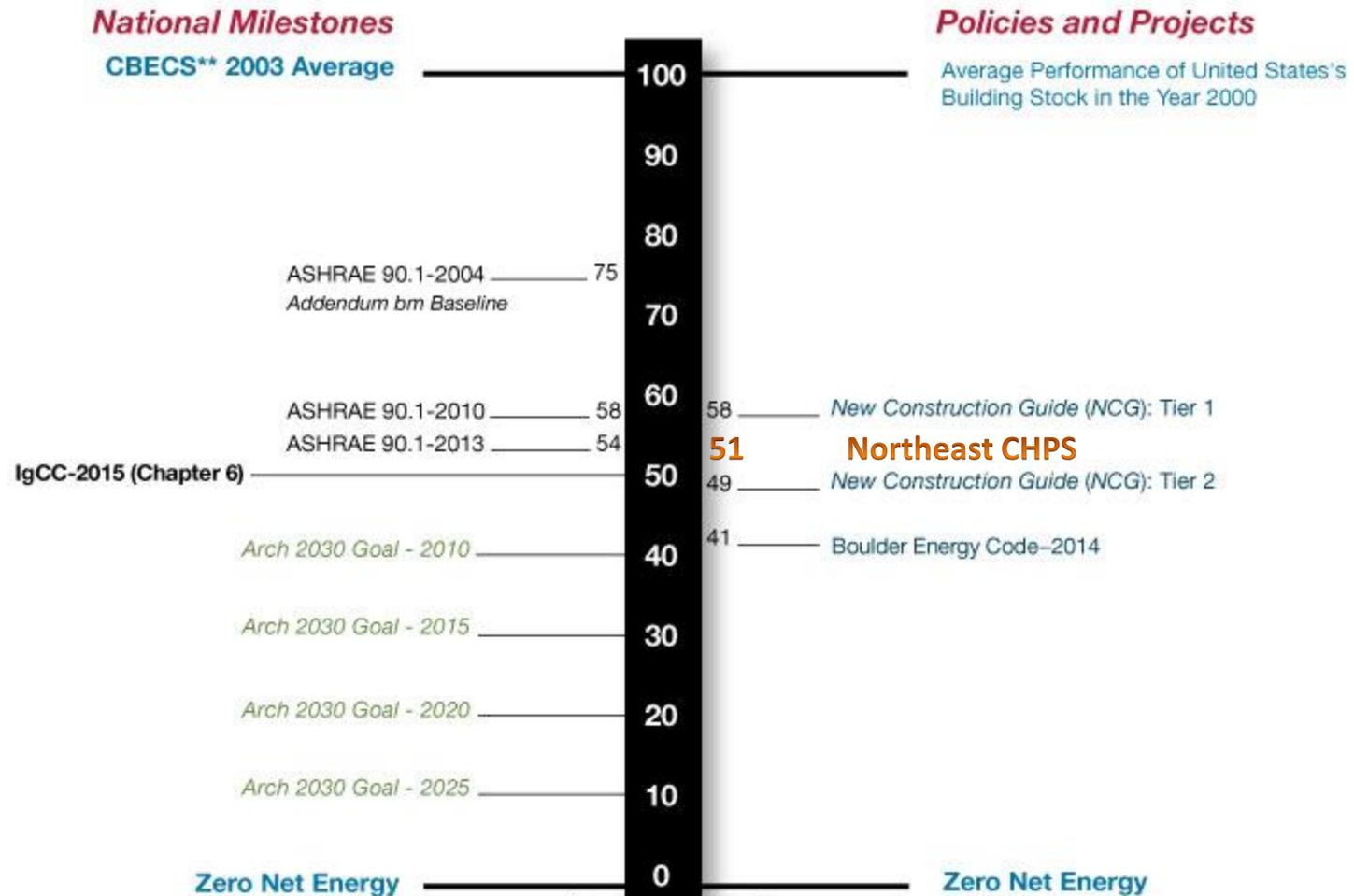


Zero Net Energy

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PERFORMANCE PATH 2015 IgCC: *A simple division and multiplication*

- $zEPI = 52 \times \frac{\text{Proposed building performance}}{\text{Baseline building from 90.1-2013}}$

where:

- 52= A fixed value representing the performance of a baseline building designed to comply with ASHRAE Standard 90.1-2013.
- The zEPI must be 50 or lower – or approximately 5% below 90.1-2013.

OUTCOME PATH 2015 IgCC:

A simple division and multiplication

- $zEPI = 100 (EUI_a / EUI_r)$

Where:

- EUI_a = the **Actual** Annual Energy Use Index for the *building* and *building site*
 - EUI_r = the **Reference** Annual Energy Use Index for the *building* use and occupancy in Table 612.1 (*i.e. a table of CBECS values for 9 building types across 14 climate zones*)
- **The zEPI must be 51 or lower – or 49% below CBECS-2003.**

Targets in the 2015 IgCC - based on CBECS

| Climate Zone ^a | 1A | 2A | 2B | 3A | 3B | 3B | 3C | 4A | 4B | 4C | 5A | 5B | 6A | 6B | 7 | 8 |
|--------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Use and Occupancy^b | | | | | | | | | | | | | | | | |
| Reference EUIr skBtu/sf/yr | | | | | | | | | | | | | | | | |
| Business (B) | | | | | | | | | | | | | | | | |
| Office | 154 | 159 | 154 | 151 | 124 | 140 | 137 | 167 | 144 | 152 | 179 | 155 | 190 | 176 | 208 | 282 |
| Bank | 154 | 159 | 154 | 151 | 124 | 140 | 137 | 167 | 144 | 152 | 179 | 155 | 190 | 176 | 208 | 282 |
| Medical Office (non diagnostic) | 115 | 119 | 115 | 113 | 93 | 104 | 102 | 125 | 108 | 114 | 134 | 116 | 148 | 131 | 156 | 210 |
| Storage (S-2) | | | | | | | | | | | | | | | | |
| Distribution/Shipping Center | 105 | 67 | 69 | 66 | 52 | 64 | 55 | 75 | 70 | 66 | 87 | 81 | 104 | 95 | 119 | 186 |
| Mercantile (M) | | | | | | | | | | | | | | | | |
| Grocery/Food Store | 448 | 476 | 452 | 484 | 434 | 450 | 473 | 522 | 479 | 514 | 554 | 511 | 592 | 561 | 633 | 758 |
| Assembly (A) | | | | | | | | | | | | | | | | |
| Library (A-3) | 234 | 232 | 224 | 230 | 193 | 217 | 209 | 254 | 228 | 235 | 275 | 246 | 304 | 277 | 327 | 434 |
| Educational (E) | | | | | | | | | | | | | | | | |
| Elementary/middle school | 140 | 139 | 134 | 134 | 111 | 128 | 124 | 149 | 132 | 132 | 160 | 141 | 182 | 161 | 193 | 274 |
| Institutional (I-2) | | | | | | | | | | | | | | | | |
| Hospital/Inpatient health | 417 | 422 | 397 | 408 | 394 | 388 | 407 | 425 | 366 | 398 | 425 | 374 | 439 | 394 | 446 | 532 |

The Red Line for Energy Codes

Design, Build, Commission.....



CERTIFICATE OF OCCUPANCY



Occupancy

Enforcement Mechanisms

- Conditional Occupancy or Permit – IgCC
- Performance/Surety Bond - Seattle
- Tax or Utility Rate Structures
- Licensing - Boulder
- Public Pillory/Accolades
- Periodic RetroCx – New York City
- Litigation

IMPLEMENTATION OF THE OUTCOME-BASED PATHWAY IN THE 2015 IgCC

- **One New Pathway Application.** Buildings and their associated building sites shall comply with Section 601.3.1, Section 601.3.2 or 601.3.3.
- **Based on actual energy data Reporting of energy use and CO₂e emissions.** Within 36 months of issuance of the temporary certificate of occupancy, the building owner shall provide the *code official* with documentation, in a form acceptable to the code official and certified by a *registered design professional*
- **Option #1 while energy data is collected 612.3.1 Issuance of temporary certificate of occupancy**
- **Option #2 while energy data is collected Exception:** Where the code official has issued a *post occupancy verification permit* in accordance with Section 612.3.3, the code official shall issue a Certificate of Occupancy..
- **New Definition POST OCCUPANCY VERIFICATION PERMIT.** A permit issued before a certificate of occupancy requirements of this code that occur post occupancy.

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Building Code Policy in 2030?

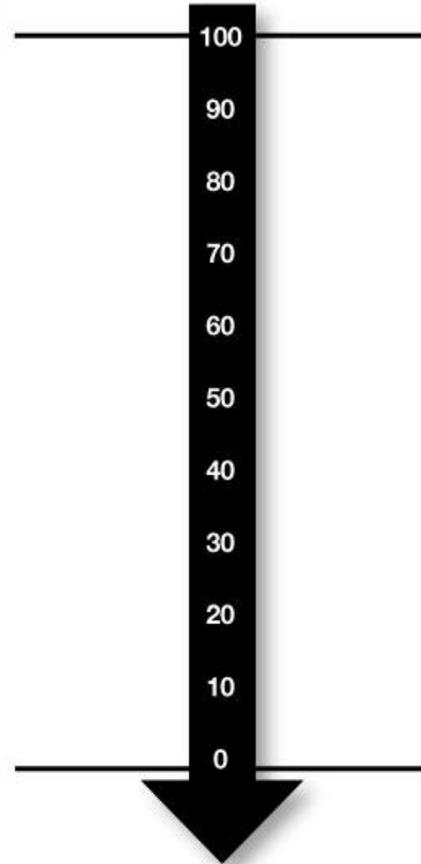


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Questions?