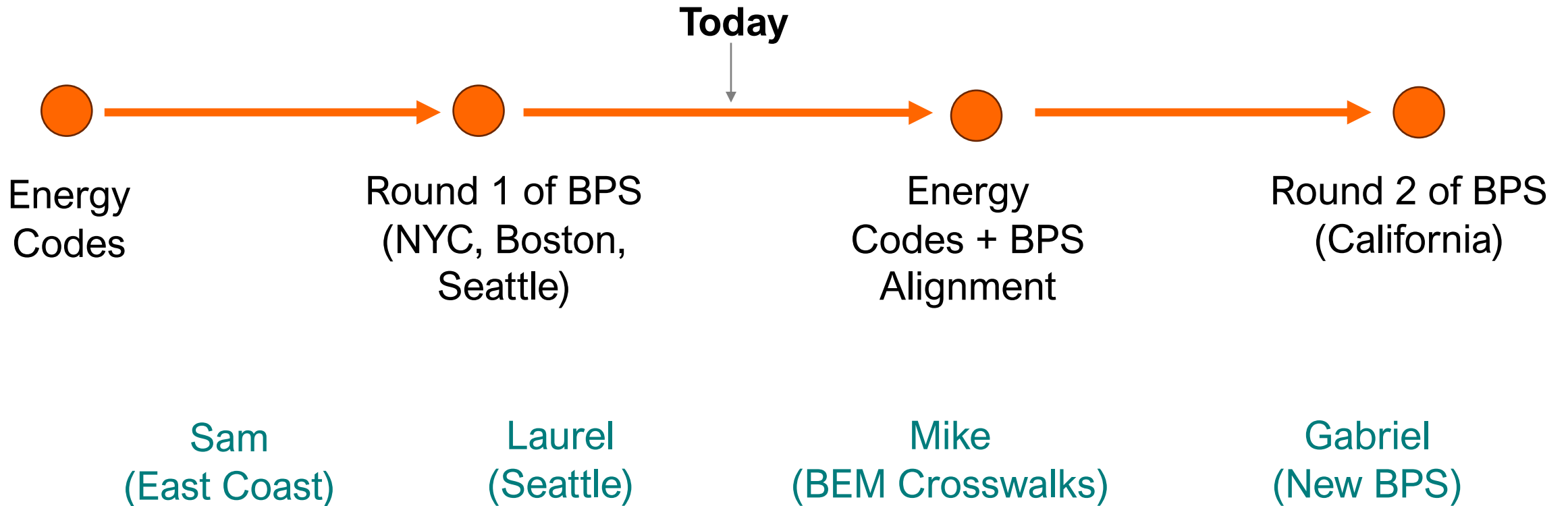


Timescale of BPS



Existing Buildings and Building
Performance Standards
*Challenges and Specific
Contexts in New York*



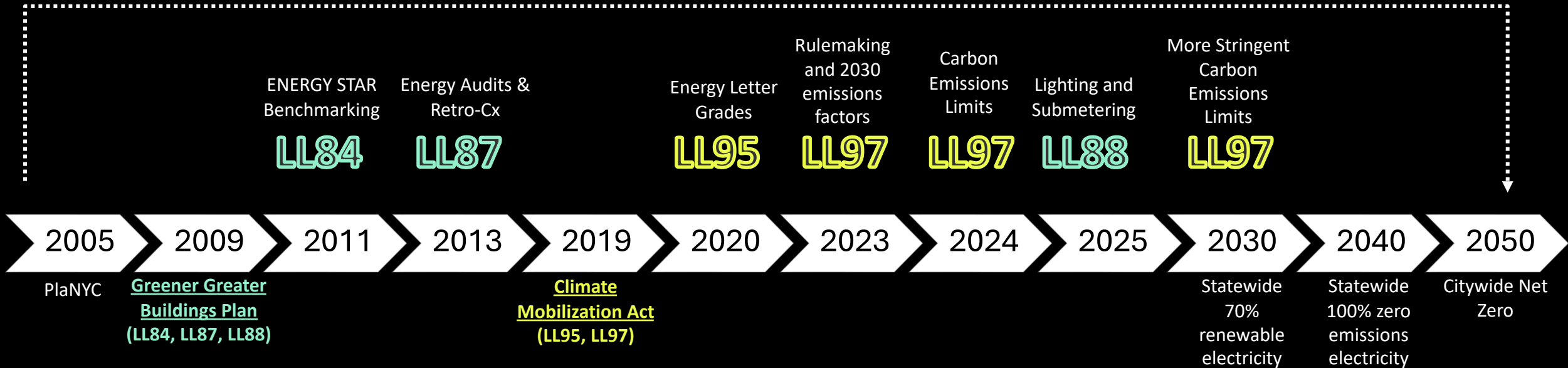
CODE GREEN

Sam Mason

smason@codegreensolutions.com

NYC Building Energy Efficiency Regulations

Citywide Net Zero Carbon Target by 2050



Energy Availability and Other Considerations

New York City

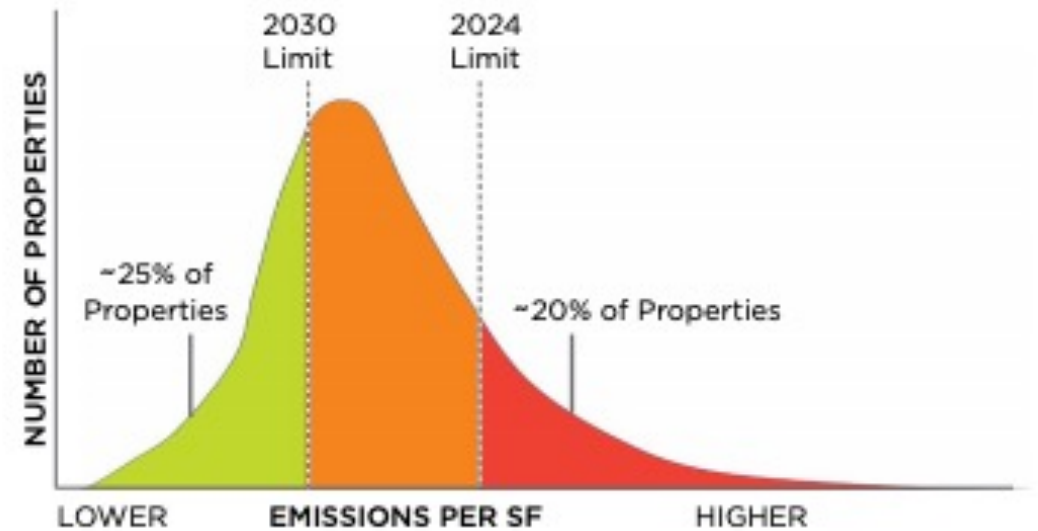
- Limited access to renewable energy
- High cost for electrical peak demand - summer
- High demand for electricity for future decarbonization projects
- District steam available in parts of the city but not all areas
- New natural gas connections prohibited by 2029
- Fuel oil #4 prohibited in 2027
- Planned reduction in grid electricity emissions – NYISO
- Local Laws & Building Performance Standards are driving energy efficiency, decarbonization

Decarbonization in New York

Local Law 97

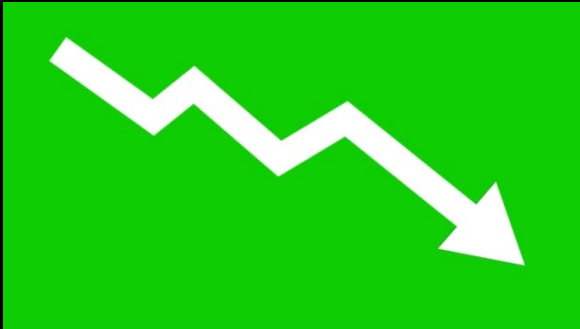
- Fossil fuels that cool, heat and power buildings are responsible for 70% of NYC's carbon emissions
- NYC wants to be carbon neutral by 2050
- Structures over 25k sq ft will need to comply with greenhouse gas emissions and new energy efficiency standards by 2024, standards and penalties will increasingly become harsher in 2030, 2035, and 2040
- Structures will need to emit 40% less carbon by 2030 and 80% by 2050
- Utilizes Energy Star Portfolio Manager to report building data and utilities
- The utility directly reports energy data to the portal

FIGURE 3
Emissions Distribution of Covered Properties



This graph is meant as a conceptual aid and does not represent actual properties or emissions limits.

Local Law 97 Carbon Limits



2024

GHG Emissions Limits by Building Space Use				
LL97 Final Rules assign carbon emissions limits by Energy Star Property Types				
Statistic	Carbon Limit (kgCO ₂ e/sf)			
Energy Star Property Type	2024-2029	2030-2034	2035-2039	2040-2049
Data Center	23.81	14.79	11.09	7.4
Hospital	23.81	7.34	4.65	3
Laboratory	23.81	26.03	19.52	13.01
Restaurant	11.81	4.04	3.03	2.02
Hotel	9.87	3.85	2.64	1.47
Entertainment/Public Assembly	9.87	2.96	2.25	1.36
Refrigerated Warehouse	9.87	2.85	2.14	1.43
Financial Office	8.46	3.7	2.77	1.85
Manufacturing/Industrial Plant	7.58	1.42	0.98	0.51
Office	7.58	2.69	1.65	0.58
Retail Store	7.58	2.1	1.22	0.18
Multifamily Housing	6.75	3.35	2.69	2.05
Distribution Center	5.74	0.99	0.55	0.12
Non-Refrigerated Warehouse	4.26	0.88	0.57	0.16

Fines: Annual \$268 per mtCO₂e over the limit

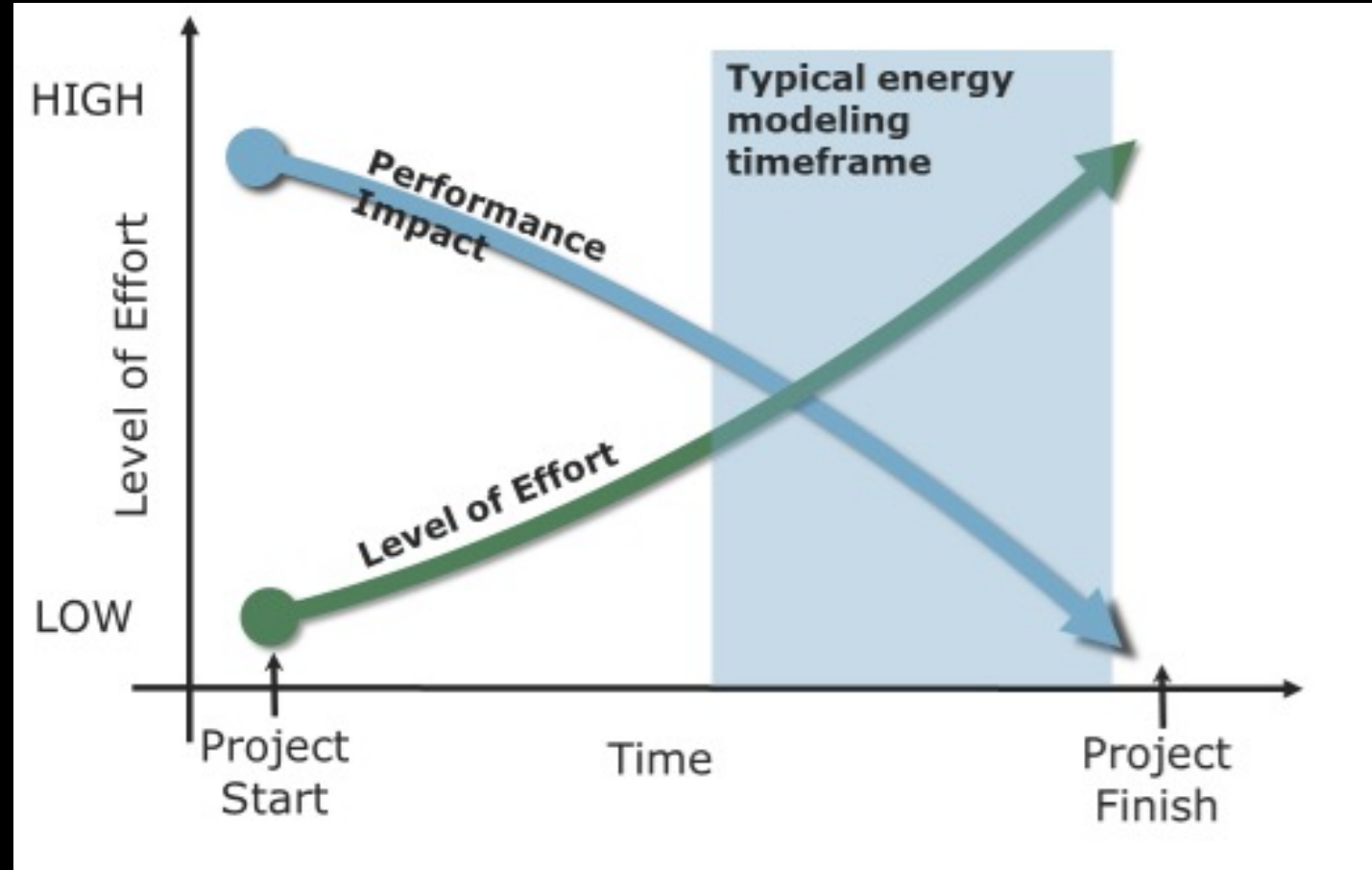
The CodeGreen Strategy: Energy Analysis throughout the Design Process

Starting Modeling early on in pre-schematics and schematic design phase is critical to making impactful changes in the design.

Design changes made early on can drastically change the cost-profile of a new construction project or tenant-fit out, both in terms of:

- Upfront Capital Cost
- Overall Cost of O&M, Materials, and Utility expenses over the lifetime of the equipment in question

As decisions and changes are made later in the design process, the potential impact is lower, the level of effort is higher, and generally the cost is higher

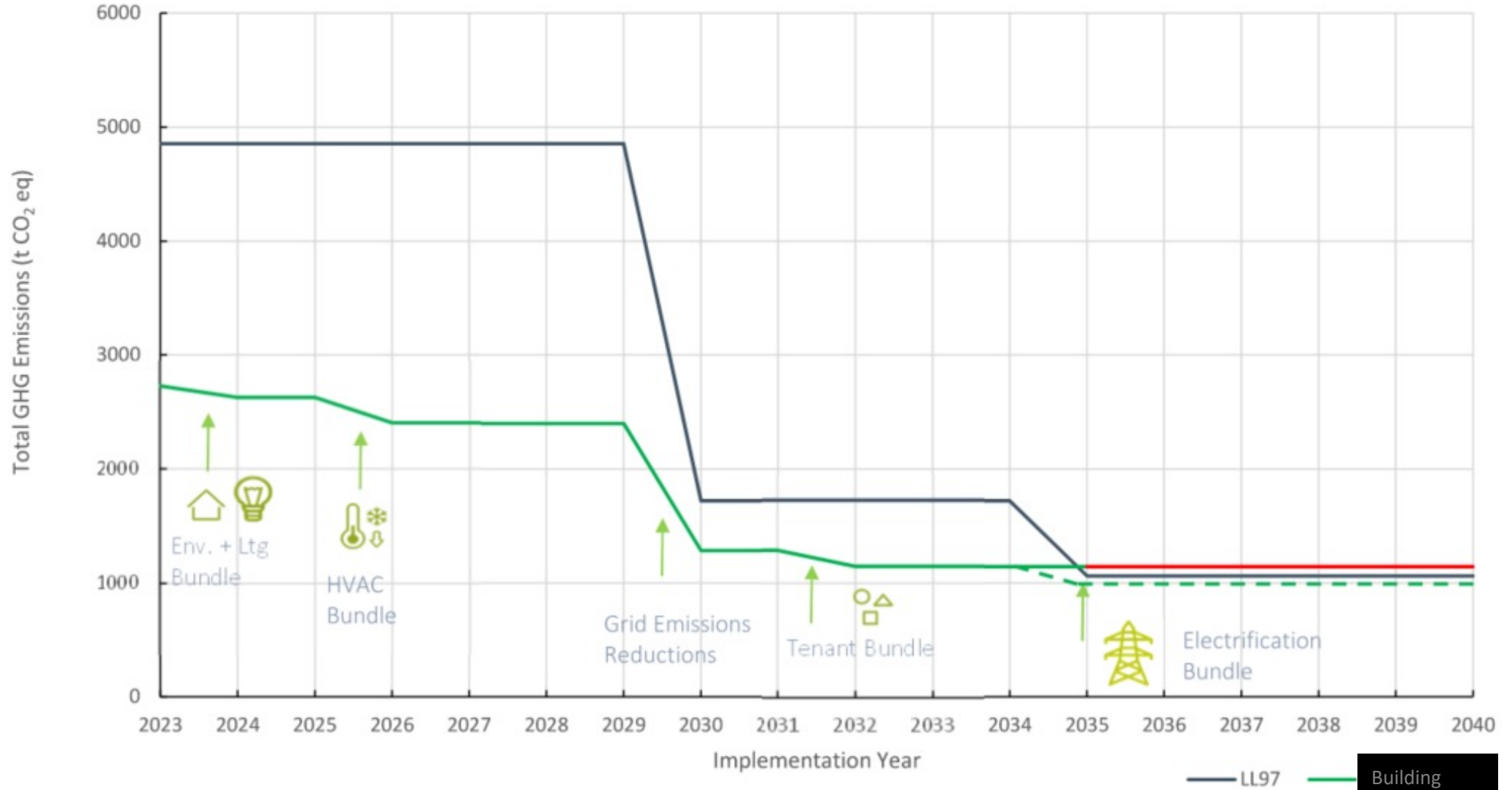


Decarbonization Strategies – New York City

- How do you provide decarbonized heating to buildings in NYC?
- Energy efficiency and reducing loads
- Fuel switching
 - Fuel oil to natural gas
 - Fuel oil to steam
 - All fuels to electricity
- Heat pumps
- Hybrid mixed source heating
- Thermal storage
- Load management



Decarbonization Roadmap



BPS in Washington State: CBPS & BEPS

Laurel Schandelmier, Energy Associate

CalBEM

November 20, 2024



Washington State & City of Seattle Climate Goals

Net Zero Emissions **by 2050**

Washington: buildings are **27%** of total emissions

Seattle: buildings are **21%** of total emissions

Washington & Seattle Overview



Washington State Energy Code (WSEC) and Seattle Energy Code (SEC)

- **New Construction** and Major Renovations
- Focus on energy efficiency, new load management
- Based on IECC, updated every 3 years



Clean Buildings Performance Standard (CBPS)

- Existing Buildings
- Focuses on **energy targets (EUI) over five-year cycles**
- ***Oregon CBPS coming soon!**

Plus: Seattle Benchmarking Ordinance

- Large buildings report energy use to publicly accessible map



Seattle Building Tune-Up

- Existing Building Operation and Maintenance (O&M)
- Focuses on **energy and water efficiency in O&M**
- **Seattle Specific**



Building Emissions Performance Standard (BEPS)

- Existing Buildings
- Focuses on **carbon targets (kBtu/sf) over next 20-30 years**
- **Seattle specific**



Washington Clean Buildings Standard (HB1257)

CBPS sets EUI targets for **existing buildings** by building type and size to propel operational energy efficiency, starting with the largest buildings first and updating targets every 5 years.

Tier 1 Compliance Dates	
>220,001 SF	2026
90,001 to 220,000 SF	2027
50,001 to 90,000 SF	2028
Tier 2 Compliance Dates	
20,001 to 50,000 SF & Multifamily >20,000 SF	2027 (reporting) 2031 (compliance)

Compliance is centered around the Target EUI (kBtu/sf-yr)

CBPS Energy Targets



- Reduce proven operational energy through **EUI Targets** as validated by 12 months utility data
- Target EUI based on building type and operational hours/week
- Recently built buildings have a lower target EUI (-15%)

Target EUI Examples

Building Type	Western WA (Climate 4C)	Central & Eastern WA (Climate 5B)
College / University	102	102
Elementary School	49	50
Laboratory	237	249
Office	66	68
Multifamily	32	33

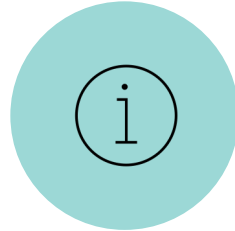
CBPS Covered Buildings



Tier 1 Buildings

Covered Buildings: Non-Residential and Hotel/Motel/Dormitory **greater than 50,000 sf**

Area threshold by conditioned gross floor area, exclude parking garages

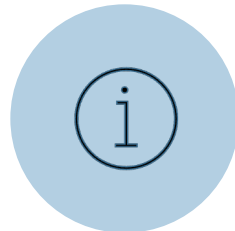


Tier 2 Buildings

Covered Buildings with gross floor area **20,000 - 50,000 sf**

Multifamily Residential greater than 20,000 sf

Area threshold by conditioned gross floor area, exclude parking garages

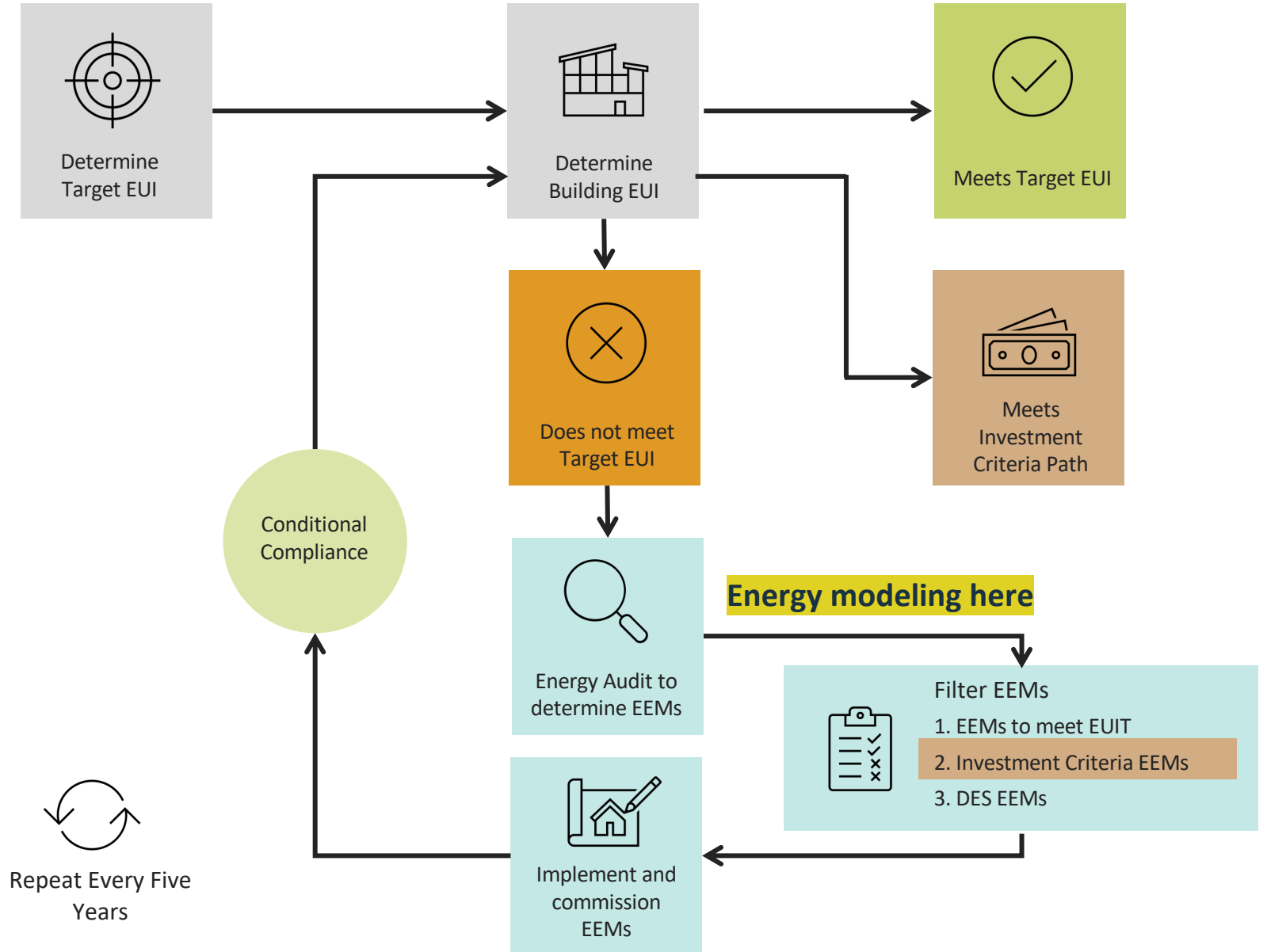


State Campus District Energy System

- Provides heating and/or cooling to **five or more** buildings totaling at least 100,000 sf combined conditioned space
- DES and all buildings are **owned by the state of WA** or by a public-private partnership

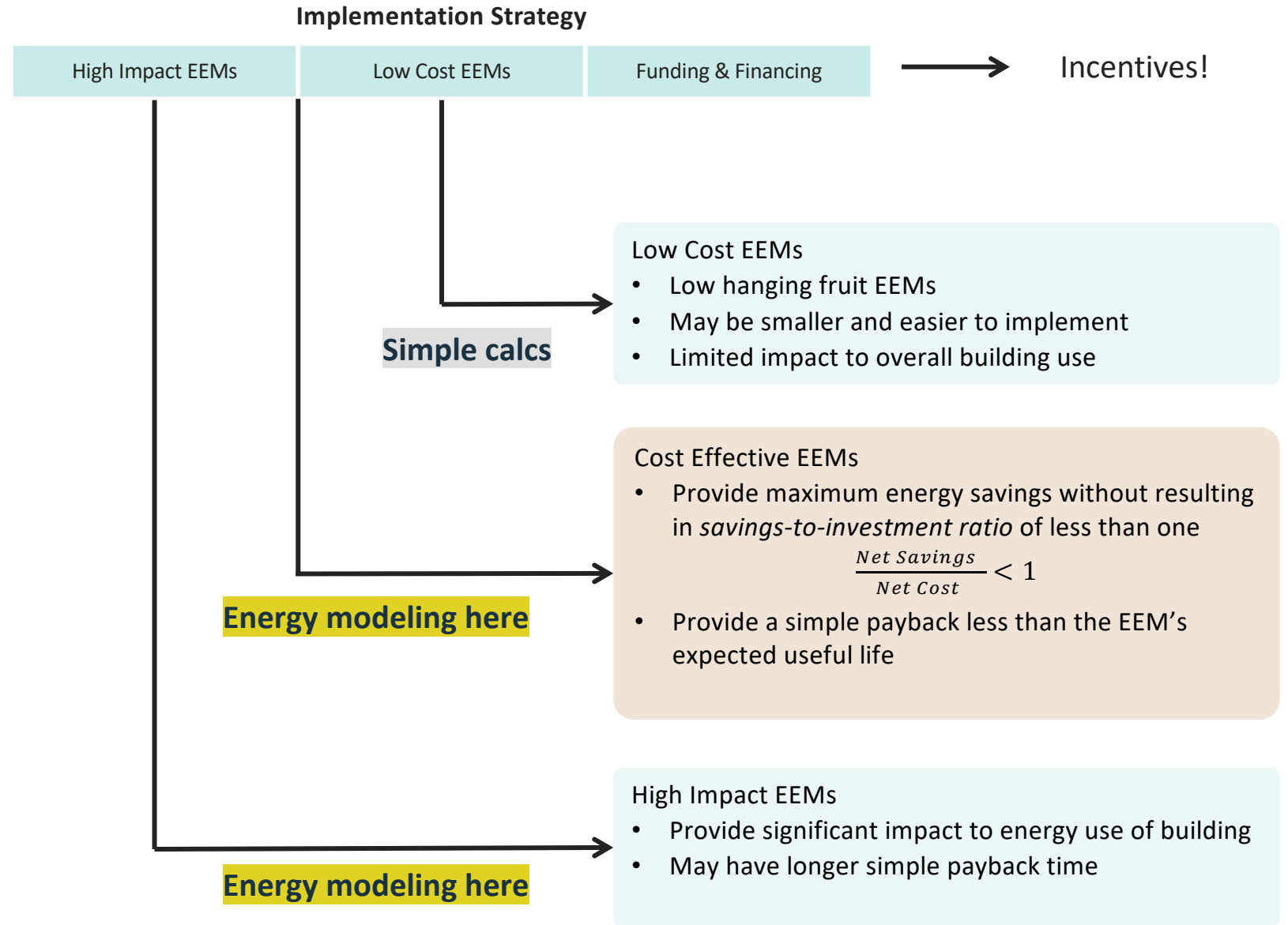
Compliance Pathway available but not required for Campus District Energy Systems owned by a single entity, public-private partnership, or two private entities

CBPS Compliance Pathway



EEMs = Energy Efficiency Measures

CBPS Selecting EEMs

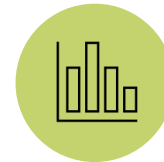


EEMs must achieve 75% of modeled savings



Seattle BEPS

BEPS covers existing nonresidential & multifamily buildings greater than 20,000 square feet, excluding parking, and will require the following to hit net-zero emissions by 2050:



Verification of emissions data



Documentation of current emissions performance and develop plan and start actions to hit greenhouse gas intensity (GHGI) targets



Demonstrate meeting GHGI targets

Compliance is centered around Target Emissions (kg CO₂e/sf-yr)

BEPS Greenhouse Gas Emissions Factors

Table B for 22.925.070: Greenhouse gas emissions factor

Energy source	Emissions factors (kgCO ₂ e/kBtu)	
	For baseline GHGI (2019-2028)	For compliance GHGI (2031-2035) (Provisional)
Seattle City Light electricity	0.0058	0.0029
Puget Sound Energy natural gas	0.053	0.053
CenTrio district thermal energy	0.081	0.081

Other fossil fuels: Emission factors for fuels such as heating oil, propane, etc. will reference the US EPA.

BEPS Greenhouse Gas Intensity Targets (GHGITS)

BEPS Greenhouse Gas Intensity Targets (GHGITS)

Table A for 22.925.070: Building activity type greenhouse gas intensity targets (GHGITS)

Building Activity Type	GHGITS (KGC02e/SF/YR) by compliance interval			
	2031-2035	2036-2040 ¹	2041-2045 ^{1,2}	2046-2050 ^{1,3}
College/University	2.69	1.57	0	0
Entertainment/Public Assembly	1.18	0.69	0	0
Fire/Police Station	2.23	1.3	0	0
Hospital	4.68	2.73	0	0
Hotel	2.06	1.2	0	0
K-12 School	0.95	0.56	0	0
Laboratory	6.3	3.68	0	0
Multifamily Housing	0.89	0.63	0.37	0
Non-Refrigerated Warehouse	0.77	0.45	0	0
Office	0.81	0.47	0	0
Other	2.48	1.45	0	0
Recreation	3.22	1.88	0	0
Refrigerated Warehouse	0.98	0.57	0	0
Residence Hall/Dormitory	1.16	0.68	0	0
Restaurant	5.73	3.34	0	0
Retail Store	1.03	0.6	0	0
Self-Storage Facility	0.31	0.18	0	0
Senior Living Community	2.11	1.23	0	0
Services	1.36	0.79	0	0
Supermarket/Grocery Store	3.42	2	0	0
Worship Facility	1.2	0.7	0	0

1 — Targets may be revised by future rule, per subsection 925.070.A.

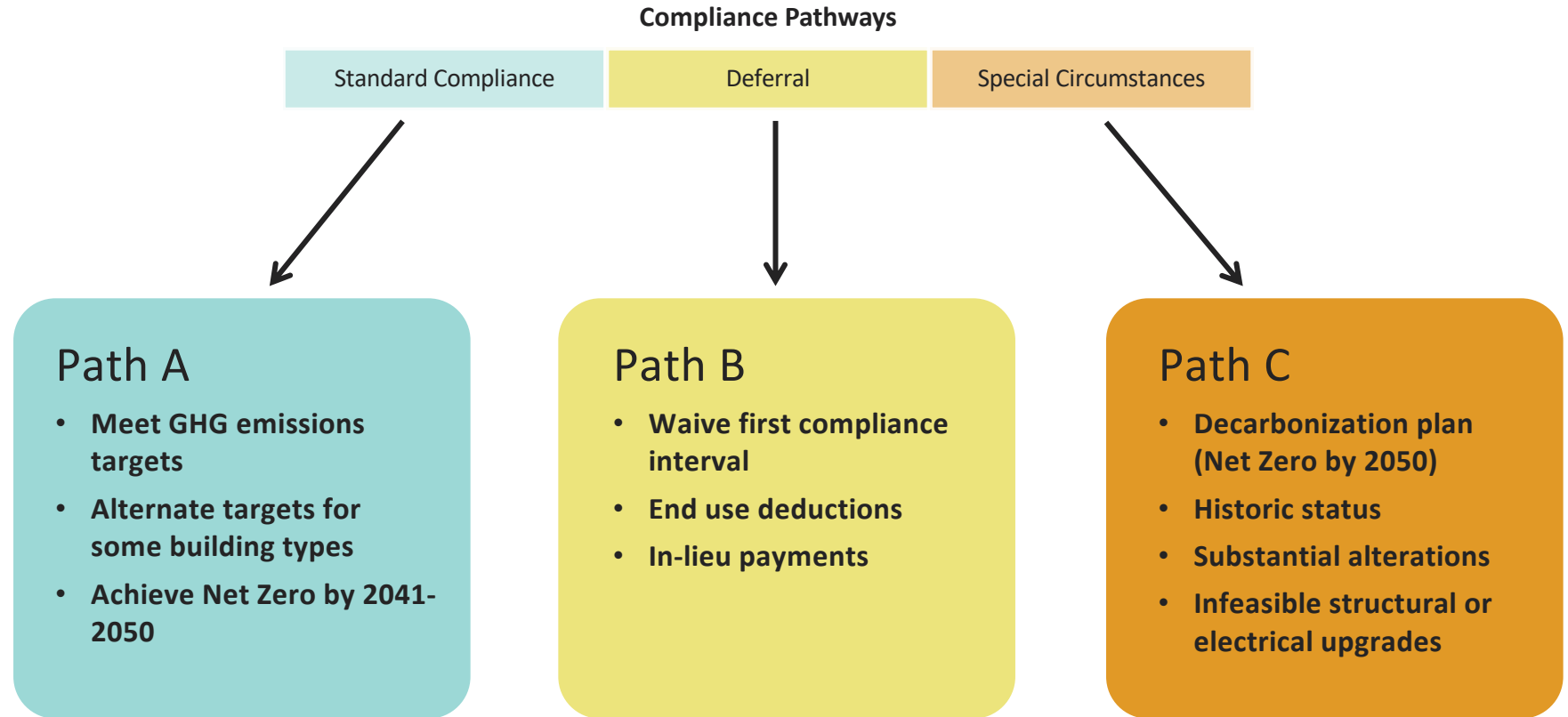
2 — Net-zero emissions by 2041-2045 for nonresidential.

3 — Net-zero emissions by 2046-2050 for multifamily housing.

4 — Pursuant to Section 22.925.110, owners Of low-income housing, human service use, and low-rent housing may receive an extension from meeting the GHGITS in 2031-2035 but Still must meet benchmarking verification and all other reporting obligations for 2031-2035.

BEPS Compliance Paths

All Fully Electric buildings are deemed to comply



Energy modeling may be needed for electrification scenario planning

Energy Modeling Tools

Tools depend on level of analysis required

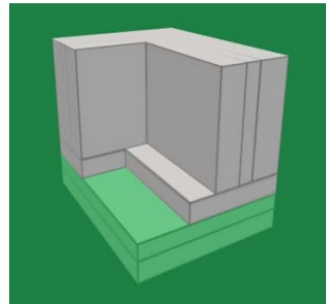
Humid Rat After ERV	Enthalpy after HR	Approx. WB after HR	Heating or Cooling Mode?	Wet or Dry Cooling Coil?	Cooling Load BTUs	Cool-Cap: FEM/ &OAT	Operating Ctg Cap.	Cooling PIR	DX-Cool EIR: FEWB &OAT	DX-Cool EIR: FPIR	EIR at Operating Conditions	Cooling Energy (kWh)
0.0119	33.59	68.9	Cooling	Wet	454,254	0.957	769,164	59%	1.156	0.632	0.223	50.3
0.0121	33.40	68.6	Cooling	Wet	444,438	0.977	785,398	57%	1.100	0.607	0.203	46.8
0.0124	33.37	68.6	Cooling	Wet	444,432	1.001	804,886	55%	1.044	0.590	0.188	44.3
0.0124	33.05	68.3	Cooling	Wet	430,276	1.021	820,769	52%	0.992	0.559	0.169	40.7
0.0124	32.70	67.9	Cooling	Wet	416,517	1.040	836,169	50%	0.943	0.529	0.152	37.3
0.0124	32.27	67.4	Cooling	Wet	395,505	1.058	850,542	47%	0.895	0.496	0.135	33.8
0.0122	31.69	66.7	Cooling	Wet	369,412	1.072	862,345	43%	0.850	0.458	0.119	30.0
0.0118	30.89	65.4	Cooling	Wet	334,135	1.076	865,525	39%	0.807	0.415	0.102	25.9
0.0099	27.58	61.1	Cooling	Wet	186,613	1.032	830,238	22%	0.762	0.280	0.065	15.8
0.0075	23.82	55.4	Cooling	Dry	108,000	1.016	816,878	13%	0.762	0.194	0.045	10.8
0.0063	21.27	51.3	Cooling	Dry	54,000	1.016	816,878	7%	0.762	0.097	0.023	5.4
0.0058	19.48	48.3	Cooling	Dry	0	-	0	0%	-	-	-	0.0

Spreadsheet calculations

Bin calcs

8760 calcs

Simple replacements, rules of thumb, high-level estimates

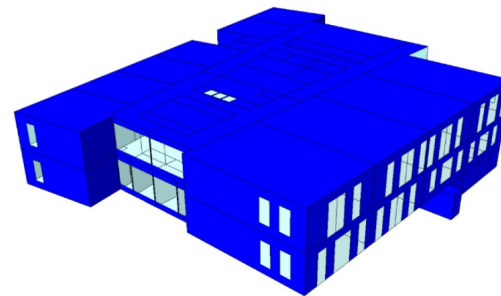


Basic energy modeling

Repurpose pre-built models

Online tools (ie Asset Score)

Moderately complex EEMs



Detailed energy modeling

Full building simulation

Calibrate to existing utility data

Complex EEMs with interactive effects, HVAC systems and controls

Building Performance Standard and Energy Code Alignment

November 20th, 2024

Michael Tillou, PE
Senior Technical Advisor

PNNL is operated by Battelle for the U.S. Department of Energy



BPS / Energy Code Misalignment

What we hope will happen, often doesn't.

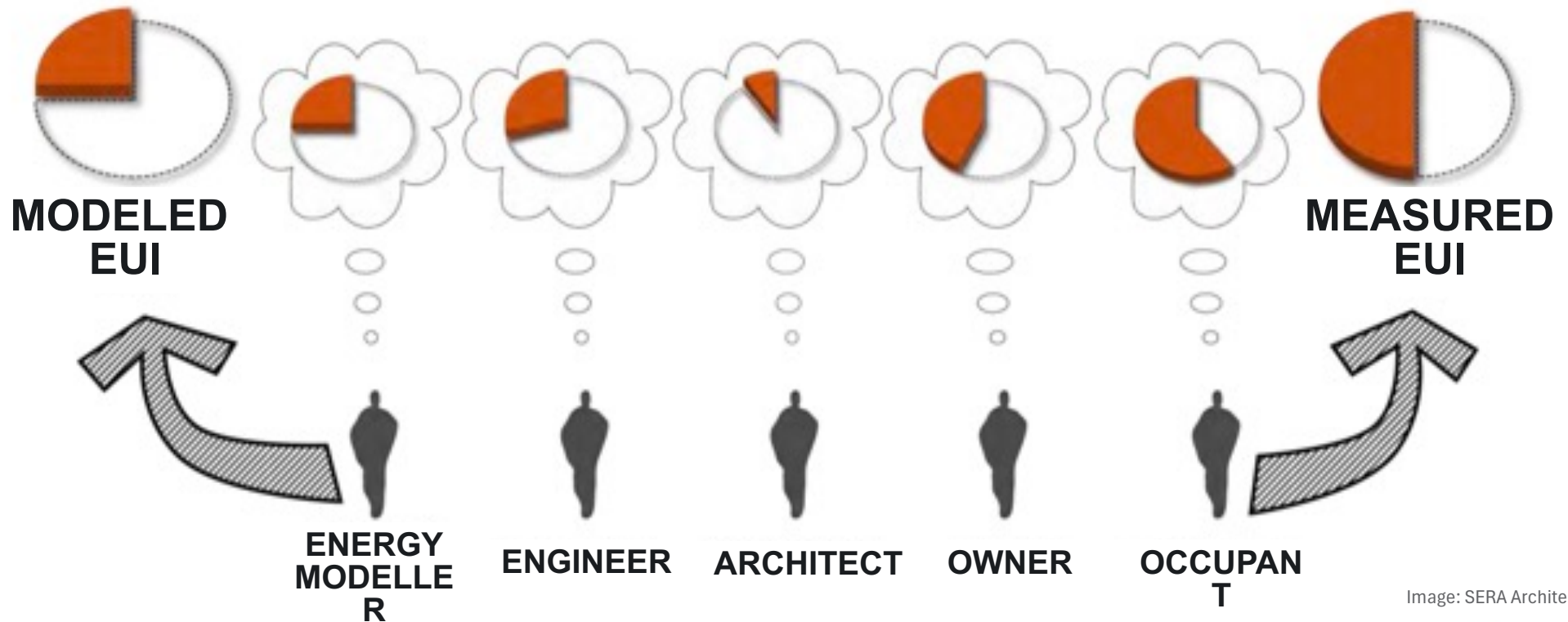


Image: SERA Architects, Inc 2013

“The best way to predict the future is to create it.” - Peter Drucker

BPS / Energy Code Alignment Technical Brief

PNNL has published a Technical Brief with additional code language for ASHRAE 90.1-2022 to help improve the alignment between code outcomes and Building Performance Standards.

Available on the Stretch Code page at EnergyCodes.gov

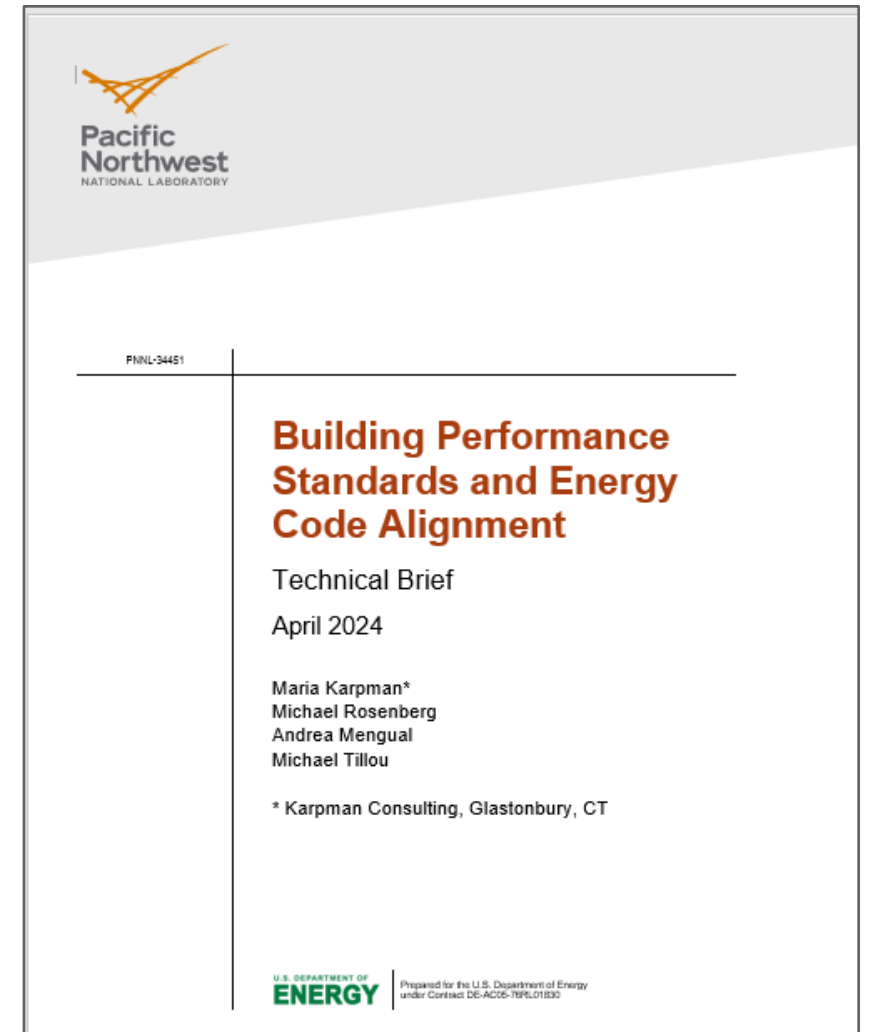
Project Team:

Andrea Mengual, PNNL

Maria Karpman, Karpman Consulting

Michael Tillou, PNNL

Michael Rosenberg, PNNL



Factors Causing Misalignment between Modeled and Measured Energy Use

Factor	Mitigation Strategy
Differences between Assumed and Actual Operation	<ul style="list-style-type: none">• Require enhanced commissioning, metering, and better O&M documentation.• Make models more predictive, per CSA/ANSI Z5020:23 Section 6.2.
Occupant Behavior, Weather, and Occupant-installed Equipment	<ul style="list-style-type: none">• Make models more predictive, per CSA/ANSI Z5020:23 Section 6.2.• Enhanced metering.
Limitations of Building Energy Modeling (BEM) Tools	<ul style="list-style-type: none">• Enhanced simulation program testing and acceptance criteria.• Enhanced qualifications for energy modelers.
Inconsistencies in Modeler Expertise and Results	<ul style="list-style-type: none">• Enhanced qualifications for energy modelers.• Make models more predictive, per CSA/ANSI Z5020:23 Section 6.2.

Proposed Mitigation Strategies

The Tech Brief addresses the following alignment issues:

- Code compliance and BPS metrics.
- Requirements for
 - energy metering
 - commissioning
 - operation and maintenance
- Energy performance documentation
- Predictive modeling to assess future BPS compliance.
- Adoption of PRM as the only allowed path of energy code compliance.



Aligning Compliance Metrics

Standard 90.1-2022, for the first time, includes guidance for using metrics other than energy cost.

- **Informative Appendix I:** Using Other Metrics in Conjunction with Appendix G Performance Rating Method
- **Normative Appendix L (TSPR):** Informative Tables L5-2 through L5-5, optional values for alternate energy input metrics including site energy, source energy and GHG emissions.



Using different metrics for energy code and BPS compliance may send a conflicting signal about appropriate design options. Whenever possible the same compliance metrics should be used.

- For example, if the BPS is based on GHG emissions with prescribed site energy to GHG emissions conversion factors, then the same metric and conversion factors should be used for establishing performance-based compliance in the energy code.

Enhanced Energy Metering

Energy use monitoring, recording, and reporting play an important role in identifying building performance issues and informing future retrofits.

Standard 90.1-2022 includes requirements for submetering important end uses (i.e. HVAC, lighting, receptacles) recording, reporting and storage of energy data.



Aligning metering requirements with a local BPS should also consider metering of:

- On-site renewable energy systems
- End use loads that are exempt from BPS requirements
- Electric Vehicle charging loads

Enhanced Commissioning

Commissioning (Cx) ensures that buildings systems and components are properly controlled and configured to operate as intended in design documents. Standard 90.1-2022 includes mandatory verification, testing and commissioning requirements while Informativ Appendix H provides additional guidance on Cx best practices.



To better align with BPS goals, energy code Cx requirements should be expanded to also address:

- Better conformity with the requirements of ASHRAE Standard 202
- Required use of an independent third party Cx Agent
- Staff training on new systems and equipment
- Single point of responsibility for delivery of Cx documentation including the O&M manuals.

Enhanced Operation and Maintenance

O&M documentation helps ensure that building systems realize their performance potential.

Standard 90.1-2022 requires an O&M manual but lacks specific details. Informative Appendix E lists more than 50 references to various standards, guidelines, and research projects with no clear direction on what to provide.



O&M should rely on a consistent set of requirements across all projects.

Adds compliance with the Operations and Maintenance requirements in ASHRAE Standard 100-2024, Energy Efficiency in Existing Buildings will provide :

- requirements for the establishment and implementation of an O&M program to ensure building energy-using systems achieve intended efficiency throughout their service life.
- the necessary details about the required scope of the O&M plan,
- specific O&M requirements for building systems and elements.

Energy Performance Documentation

Requires submission of an Energy Performance Report documenting the results of an energy model relative to the BPS performance targets, including the following:



- Determination of whether the project are expected to comply with future BPS requirements.
- Energy reported by end use and source allowing a direct comparison to future metered data.
- Anticipated on-site renewable energy generation including any exported energy.
- Future BPS performance targets and timelines that a project will be required to meet.
- The whole building performance expressed using the BPS metric and calculated to align with BPS requirements (ie: excluded energy loads and treatment of renewable energy align with BPS)

Predictive Modeling

By refocusing aspects of the code compliance (PRM) energy modeling process towards a more predictive approach it may be possible to demonstrate code compliance while better estimating a building's post-occupancy performance relative to a BPS.



Requires developing a predictive model for projects subject to BPS requirements.

- Adds reporting requirements to isolate end uses that are exempt from BPS.
- Adds modeler qualifications.
- Updates BEM software testing requirements.
- Provides appropriate modeling rules for the predictive model.

Thank you

Michael Tillou, PE

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California Energy Commission

Building Energy Performance Strategy Report & Recommendations

Gabriel D. Taylor, P.E.

November 20, 2024



Presentation Outline

1. BPS Strategy,
Recommendations, & Analysis
2. Potential Metrics
3. Value Intensity of Energy





Strategy & Recommendations



Building Energy Performance Strategy Report

- ✓ Senate Bill 48 (October 2023) – PRC § 25402.16
- ✓ CEC Must Adopt Report before July 1, 2026
- ✓ Submit to Legislature before August 1, 2026

“...develop a strategy for using benchmarking data to track and manage the energy usage and emissions of greenhouse gases of covered buildings in order to achieve the state’s goals, targets, and standards...”



Required Analysis



Public Resources Code § 25402.16(c)

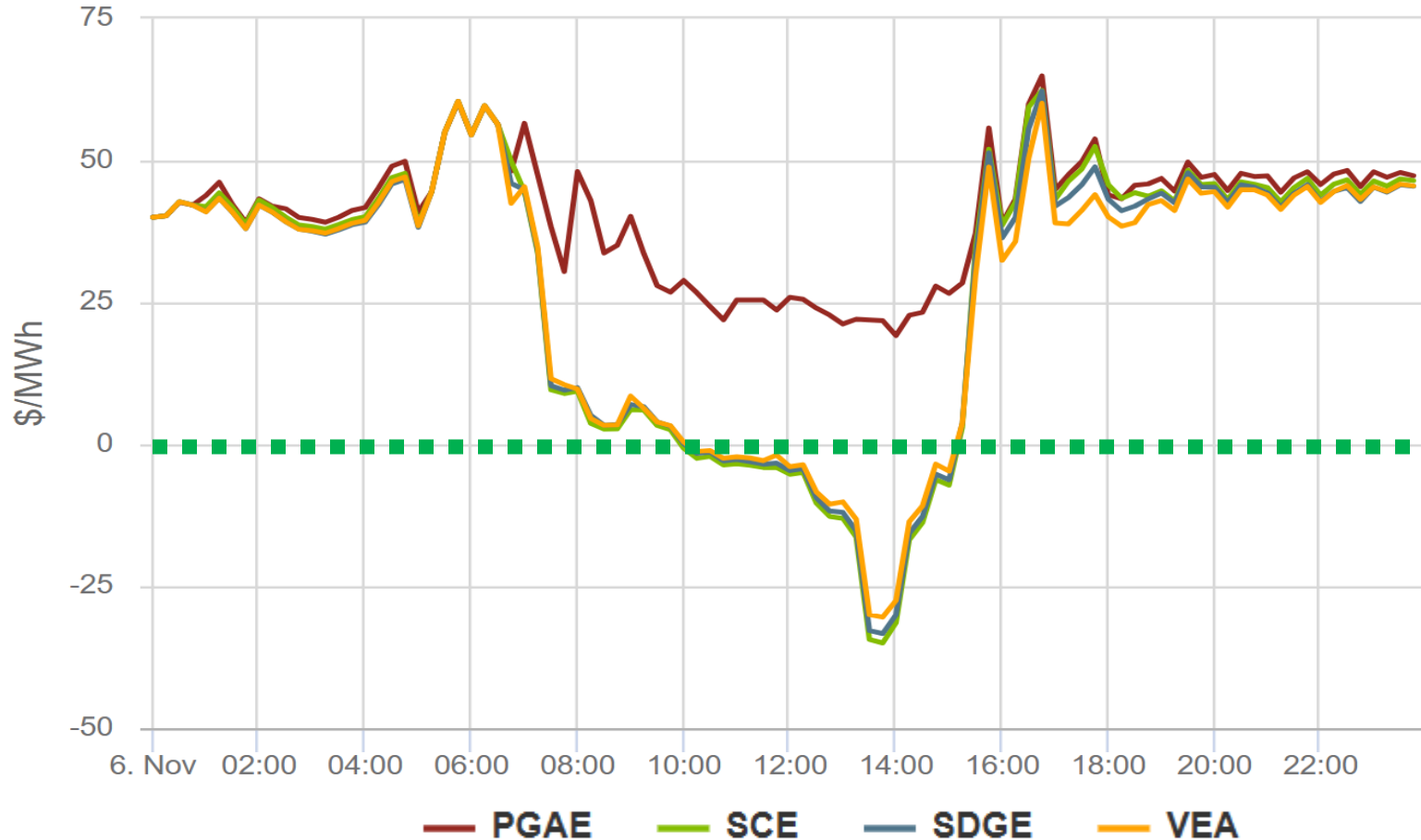
- 1) Avoid increasing utility and rental costs, including:
 - A) Protect renters during renovations
 - B) Prohibit rent increases caused by required renovations
- 2) Feasibility and cost-effectiveness
- 3) Compliance flexibility
- 4) Equitable access to jobs and other economic opportunities
- 5) Reductions in fuel-related emissions
- 6) Tenant benefits
- 7) Process for alternative compliance
- 8) Process to authorize local jurisdictions to exceed the state strategy



Potential CA BPS Metrics

- Energy Use Intensity
- Site GHG Emissions
- Non-Energy Benefits
 - ✓ Cooling Services
 - ✓ Indoor Air Quality
- Marginal & Time of Use Energy Value

California 15-Minute Market Price (Nov. 6, 2024)



Source: California ISO Real-Time Daily Market Watch Report (November 6, 2024)
<https://www.caiso.com/documents/real-time-daily-market-watch-nov-06-2024.html>



Value Intensity of Energy

- Time of Use Rates
- Hourly Marginal Cost-Based Rates (*day or week ahead*)
- Real Time Pricing
- Grid Congestion Costs
- Greenhouse Gas

Marginal GHG Emissions Intensity by Month-Hour for 2023 (MT/MWh)

Hr.	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
0	0.24	0.23	0.18	0.12	0.12	0.14	0.20	0.24	0.25	0.25	0.23	0.24
1	0.24	0.24	0.19	0.12	0.12	0.15	0.21	0.25	0.25	0.25	0.24	0.25
2	0.24	0.24	0.20	0.13	0.13	0.16	0.21	0.26	0.26	0.25	0.24	0.25
3	0.24	0.23	0.19	0.13	0.13	0.16	0.22	0.26	0.26	0.26	0.24	0.25
4	0.24	0.23	0.19	0.12	0.13	0.15	0.22	0.26	0.26	0.25	0.24	0.25
5	0.23	0.23	0.17	0.12	0.12	0.15	0.21	0.25	0.25	0.23	0.23	0.24
6	0.21	0.21	0.17	0.12	0.12	0.14	0.20	0.24	0.25	0.23	0.21	0.23
7	0.21	0.19	0.14	0.10	0.09	0.11	0.16	0.19	0.20	0.20	0.21	0.22
8	0.18	0.16	0.10	0.07	0.08	0.10	0.15	0.16	0.16	0.15	0.15	0.19
9	0.15	0.12	0.09	0.07	0.07	0.09	0.14	0.15	0.15	0.13	0.13	0.15
10	0.14	0.11	0.08	0.06	0.06	0.08	0.13	0.15	0.14	0.12	0.12	0.14
11	0.13	0.10	0.08	0.06	0.06	0.08	0.13	0.15	0.14	0.12	0.11	0.13
12	0.13	0.10	0.08	0.06	0.06	0.08	0.13	0.15	0.14	0.12	0.12	0.13
13	0.13	0.10	0.08	0.06	0.07	0.07	0.13	0.15	0.15	0.13	0.12	0.14
14	0.15	0.12	0.09	0.07	0.07	0.08	0.14	0.16	0.16	0.15	0.14	0.16
15	0.19	0.15	0.12	0.08	0.08	0.08	0.13	0.15	0.17	0.18	0.19	0.21
16	0.21	0.20	0.15	0.09	0.08	0.08	0.13	0.15	0.17	0.18	0.19	0.22
17	0.19	0.18	0.15	0.09	0.08	0.09	0.13	0.15	0.17	0.18	0.17	0.19
18	0.18	0.17	0.14	0.09	0.09	0.10	0.14	0.16	0.18	0.17	0.17	0.19
19	0.18	0.17	0.14	0.09	0.10	0.12	0.15	0.17	0.18	0.18	0.18	0.19
20	0.18	0.18	0.14	0.09	0.09	0.12	0.16	0.19	0.20	0.19	0.18	0.19
21	0.19	0.18	0.15	0.09	0.09	0.12	0.17	0.20	0.21	0.21	0.19	0.20
22	0.21	0.20	0.16	0.10	0.10	0.12	0.18	0.21	0.22	0.23	0.21	0.22
23	0.23	0.22	0.17	0.11	0.11	0.13	0.19	0.23	0.24	0.24	0.22	0.24



CEC BPS Website, Docket, etc.

Project Website

- Building Energy Performance Strategy Report
- <https://www.energy.ca.gov/data-reports/reports/california-building-energy-performance-strategy-report>

Submit Comments to Docket 24-BPS-01

- Building Energy Performance Strategy Report
- <https://efiling.energy.ca.gov/EComment/EComment.aspx?docketnumber=24-BPS-01>

Subscribe for Updates:

- Efficiency Topics – Building Performance Standards
- <https://public.govdelivery.com/accounts/CNRA/signup/31895>

Submit Questions to Staff Here:

- BPS@energy.ca.gov