DOCKETED	
Docket Number:	22-BSTD-01
Project Title:	2025 Energy Code Pre-Rulemaking
TN #:	251590
Document Title:	Presentation - August 10, 2023 - 2025 Pre-Rulemaking Staff Workshop
Description:	Slides from August 10, 2023, staff pre-rulemaking workshop on proposed 2025 Energy Code requirements for controlled environment horticulture buildings, refrigeration systems, and nonresidential HVAC controls.
Filer:	Javier Perez
Organization:	California Energy Commission
Submitter Role:	Commission Staff
Submission Date:	8/11/2023 8:14:38 AM
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Good morning and thank you for joining us.

The workshop will begin shortly.

Housekeeping Rules

Public Comment Period

Zoom App/Online

- Click “raise hand”

Telephone

- Press *9 to raise hand
- Press *6 to Mute/Unmute

When called upon

- CEC will open your line
- Unmute on your end
- Spell name and state affiliation, if any
- 2 minutes or less per speaker, 1 speaker per entity

Today’s Agenda

	Topics	Presenter
1	Introduction: Authority, Metrics, and Timeline	Javier Perez
2	Controlled Environmental Horticulture Requirements	Thao Chau
3	Refrigeration System Requirements	Haile Bucaneg
4	Nonresidential HVAC Control Requirements	Bach Tsan
5	Adjourn	

2025 Energy Code – Pre-Rulemaking

Energy Code Authority, Drivers and Themes, Metrics, and Timeline

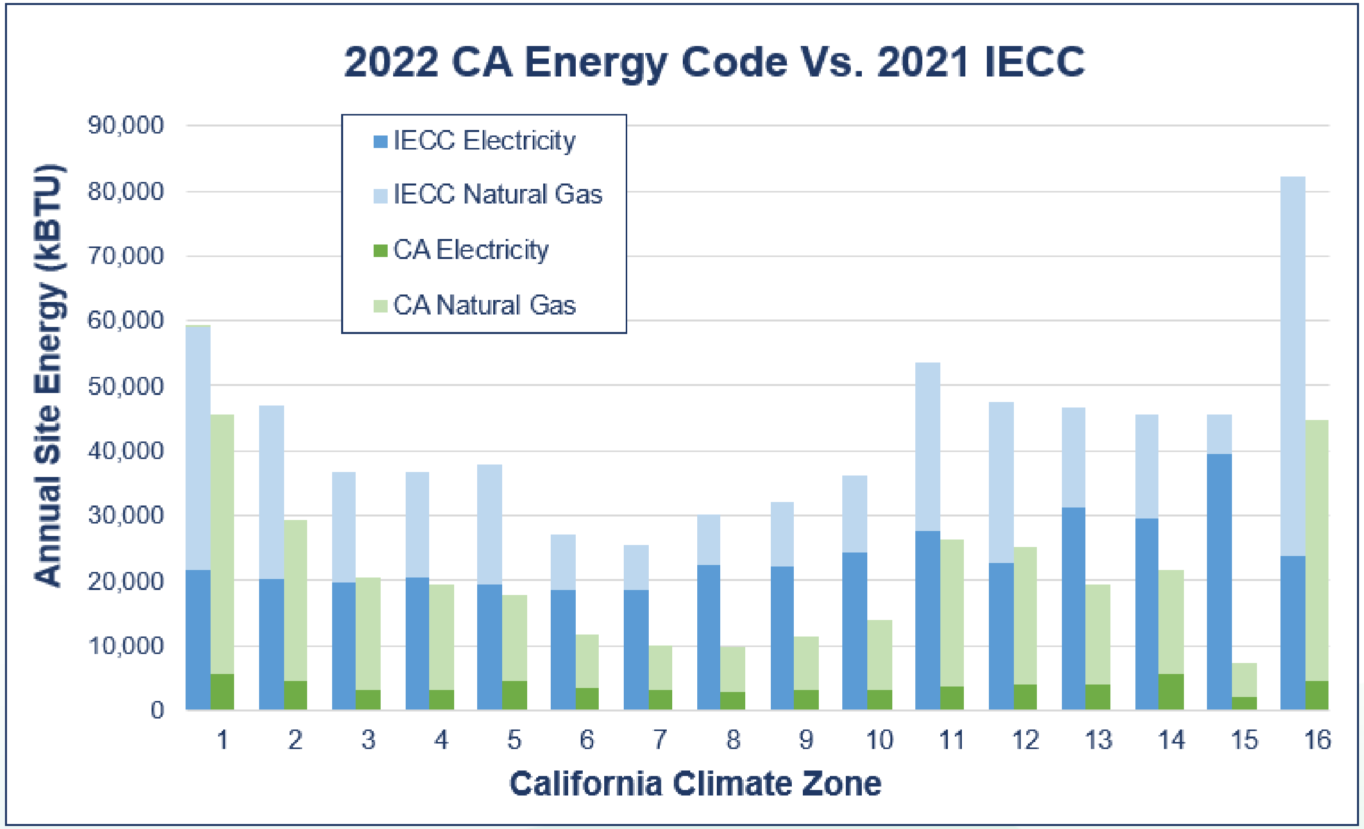
Javier Perez, Energy Commission Specialist III, Building Standards Branch

August 10, 2023

California Energy Commission's Authority and Process

California's Warren Alquist Act Signed into law in 1974

- Reduction of wasteful, uneconomic, inefficient, or unnecessary consumption of energy as it relates to buildings
- Residential Chart Details:
  - Blue bars: Site energy of a single-family building built to 2021 International Energy Conservation Code (IECC)
  - Green bars: Site energy of a single-family building built to 2022 California Energy Code
- For more on how the 2022 Energy Code compares to federal standards, see our 2022 Impact Analysis at: https://www.energy.ca.gov/publications/2023/impact-analysis-2022-update-california-energy-code



2025 Energy Code Drivers and Themes

State Goals

- Increase building energy efficiency cost-effectively
- Contribute to the state's GHG reduction goals

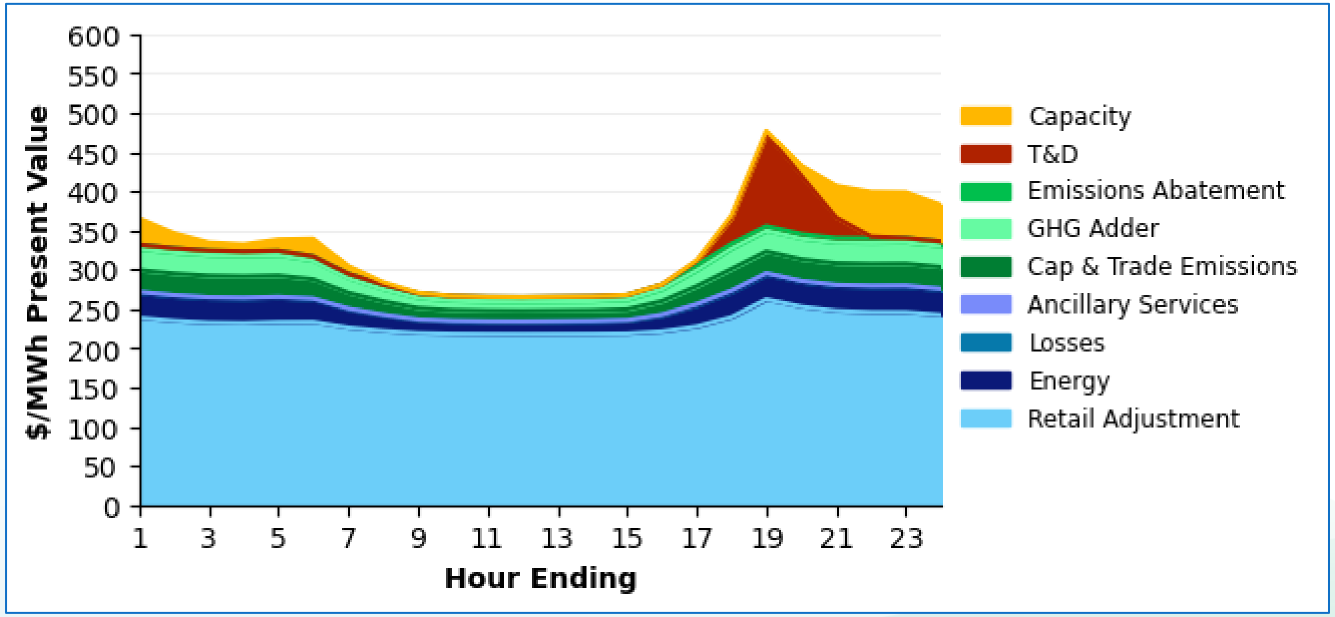
2025 Energy Code Strategies

- Heat pump baselines
- Promote demand flexibility, Solar PV generation and energy storage
- Covered process loads
- Equity & affordable new housing program integration
- Additions, alterations, and smaller homes (e.g., ADUs)
- Electric vehicle readiness support
- Interagency coordination

Long-Term System Cost

Long-term System Cost (LSC) Hourly factors are used to convert predicted site energy use to long-term dollar costs to CA's energy system.

Since the *time* that energy is used is as important as the *amount* of energy used, these factors are generated on an hourly basis for a representative year and created for each of CA's diverse climate zones.



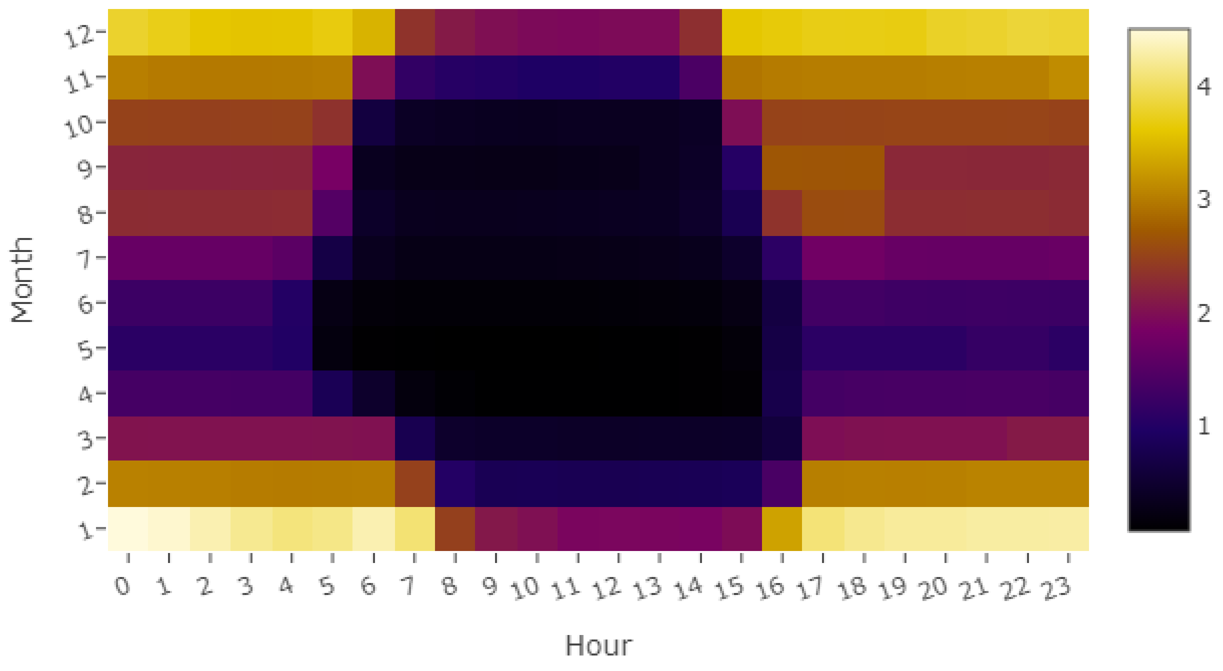
Sample LSC shape by component, average day, levelized 30-year residential, climate zone 12

Source Energy Metric

Long run marginal source energy is defined as the source energy of fossil fuels following the long-term effects of any associated changes in resource procurement.

Source Energy focuses specifically on the amount of fossil fuels that are combusted in association with demand-side energy consumption and assists in aligning our standards with the CA’s environmental goals.

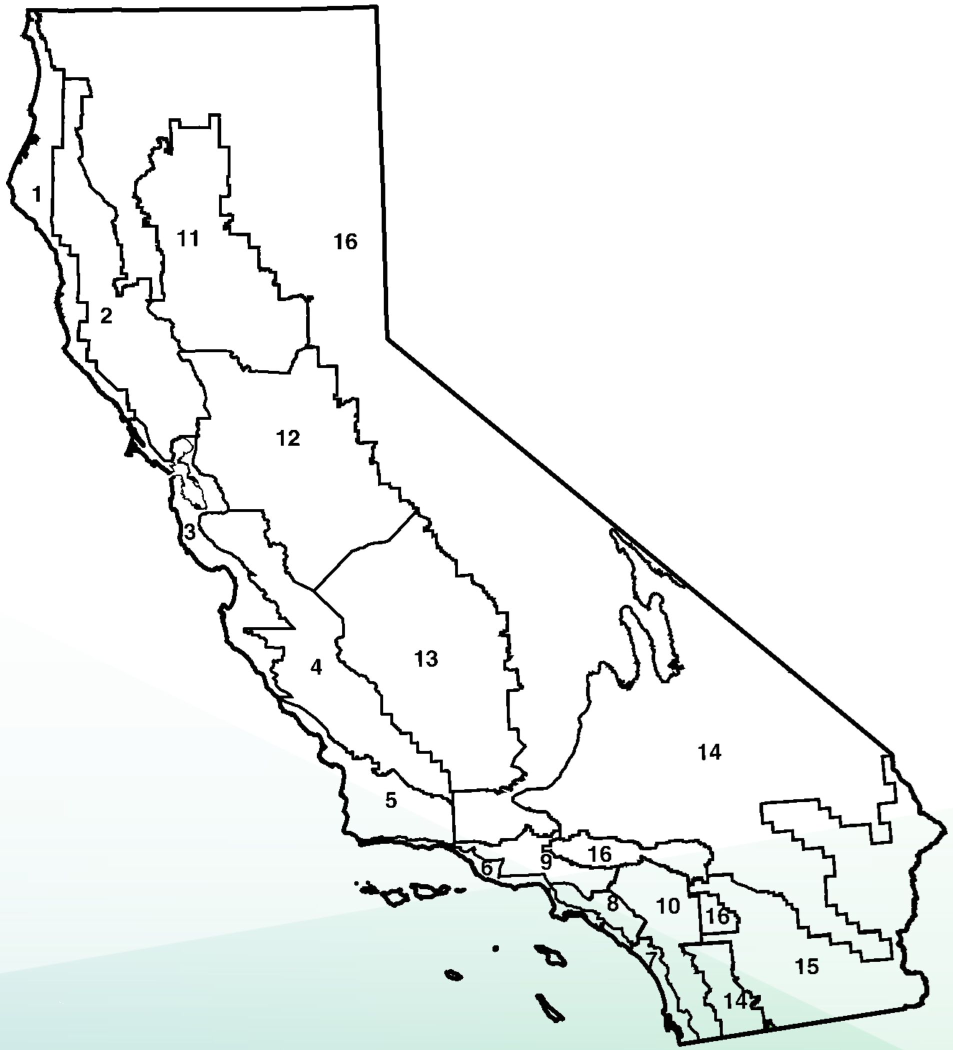
5-Month Average of electricity long run marginal source energy for 2025 Energy Code



California Climate Zones

California has 16 climate zones

- Climate Zones allow software to more accurately simulate variances weather, and as a result, energy consumption of buildings
- A measure's cost effectiveness can vary as a result of weather differences
- Energy Code requirements vary by climate zone as a result



More on 2025 Energy Accounting Metrics

For more on the 2025 Energy Code metrics:

- July 18th, 2022, workshop page, including slides and recording
  - https://www.energy.ca.gov/event/workshop/2022-07/staff-workshop-energy-accounting-2025-building-energy-efficiency-standards
- November 10th, 2022, workshop page, including slides and recording
  - https://www.energy.ca.gov/event/workshop/2022-11/final-staff-workshop-energy-accounting-2025-building-energy-efficiency

2025 Energy Code Work To Date

Milestones	Timelines
Codes & Standards Enhancement (CASE) Team Requested & Received 2025 Measure Proposal Ideas	June 2021 – May 2022
CEC Updated Weather Data, LSC, and Source Energy Metrics	March - November 2022
CASE Team Held Welcome Webinars on 2025 Measures & Work To Come	October 2022
CASE Team Held Stakeholder Workshops on 2025 Proposals	January – May 2023
Energy Commission Worked Feverishly on 2025 Heat Pump and PV System Measures	November 2022 - Now
CASE Team Published Draft Measure Proposal Reports* + Comment Period	May – July 2023

*To view CASE team draft measure proposal reports, and upcoming final reports, visit https://title24stakeholders.com/2025-cycle-case-reports/

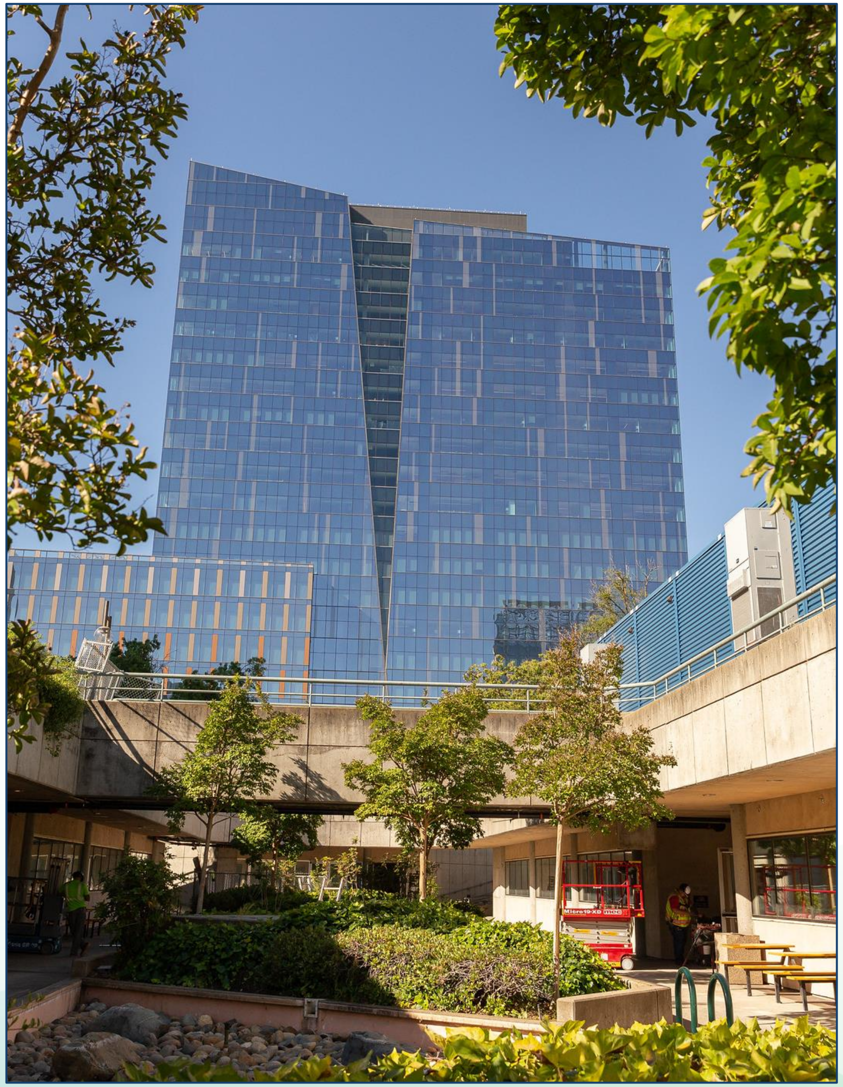
2025 Energy Code Work To Come

Milestones	Timelines
CASE Team Publishes Final Measure Proposal Reports	July – August 2023
CEC 2025 Prerulemaking Workshops*	July – August 2023
CEC Publishes 2025 Energy Code Draft Updates (Draft Express Terms)	October 2023
CEC Rulemaking for 2025 Energy Code	January 2023 – June 2024
2025 Energy Code Business Meeting Adoption	June 2024
Building Standards Commission Approval of 2025 Energy Code	December 2024
2025 Energy Code Effective Date	January 2026

*For details on the 2022 Intervening Code Cycle efforts of the Building Standards Commission, and their workshops scheduled for August 1st – 3rd, visit https://www.dgs.ca.gov/BSC/Rulemaking/2022-Intervening-Cycle/Commission-Mtgs-List-v2/2023-08-01-CommMtg

2025 Energy Code Senior Staff Contacts

- **Javier Perez** – Project Manager
- **Payam Bozorgchami** – Technical Lead, Envelope, Additions and Alterations, ADUs
- **Haile Bucaneg** – Covered Process, Demand Response, Nonresidential and Residential ACM
- **Muhammad Saeed** – Solar Photovoltaic and Energy Storage Systems
- **Bach Tsan** – HVAC Systems, Refrigeration
- **Email Convention at the Energy Commission:** firstname.lastname@energy.ca.gov



2025 Pre-rulemaking Workshop

Controlled Environment Horticulture

Thao Chau, P.E.

August 10, 2023

Existing Mandatory Horticultural Lighting Requirements

- **Section 120.6(h)2** – Indoor Growing, Horticultural Lighting
- **Section 120.6(h)6** – Greenhouses, Horticultural Lighting
- Photosynthetic Photon Efficacy (PPE) in accordance with ANSI/ASABE S640, 400-700 nm wavelength
- 40kW aggregated horticultural lighting load threshold
- Multi-level lighting controls
- Time-switch controls
- PPE minimum efficacy for lamps (if serviceable) or luminaires (if integrated) are 1.9 μmol/J for indoor grows and 1.7 μmol/J for greenhouses

2025 Proposed Requirements

- **New Constructions:** Increase the minimum horticultural lighting PPE to 2.3 μmol/J for both indoor grows and greenhouses.
- **Alterations and Additions:** No proposed change. The same 10% threshold for adding or altering the existing lighting systems applies.

Software Used & Prototypes

- Six prototypes used:
  - Cannabis, greens, tomatoes/flowers
  - Indoor and greenhouse models for each crop group
- 8760 weather sensitive analysis
- HVAC interaction included
- Assume equivalent Photosynthetic Photon Flux Density (PPFD) for baseline and proposed measures

Key Assumptions – Indoor Growing

Parameter	Cannabis - Flower	Cannabis - Vegetative	Cannabis - Clone	Leafy Greens	Tomatoes
Canopy Area per Luminaire (ft^2)	20	24	10	58	56
Photoperiod (hours per day)	12	18	24	18	12
PPFD (μMol/m^2/s)	1,000	600	200	200	350
Baseline PPE (μMol/J)	1.9	1.9	1.9	1.9	1.9
Proposed PPE (μMol/J)	2.3	2.3	2.3	2.3	2.3
Baseline Mounting Height Above Canopy	36 in	36 in	36 in	36 in	36 in
Proposed Mounting Height Above Canopy	24 in	24 in	24 in	24 in	24 in

Key Assumptions – Greenhouses

Parameter	Cannabis - Flower	Cannabis - Vegetative	Cannabis - Clone	Leafy Greens	Tomato es / Flowers
Canopy Area per Luminaire (ft^2)	20	24	10	58	56
Photoperiod (hours per day)	12	18	24	18	12
PPFD ($\mu Mol/m^2/s$)	600	400	200	200	350
Baseline PPE (µMol/J)	1.7	1.7	1.7	1.7	1.7
Proposed PPE (µMol/J)	2.3	2.3	2.3	2.3	2.3
Baseline Mounting Height Above Canopy	36 in	36 in	36 in	36 in	36 in
Proposed Mounting Height Above Canopy	24 in	24 in	24 in	24 in	24 in

Key Assumptions – Statewide Impacts

Building Type	New Construction Impacted (Percent ft^2)	Existing Building Stock (Alterations) Impacted (Percent ft^2)
Indoor Cannabis	20.61	2.44
Indoor Greens	1.12	0.13
Indoor Tomatoes	0.67	0.08
Greenhouse Cannabis	14.28	1.69
Greenhouse Greens	14.28	1.69
Greenhouse Tomatoes	19.04	2.26

Climate Zone	New Construction Impacted (Percent ft^2)	Existing Building Stock (Alterations) Impacted (Percent ft^2)
1	16.4	0.1
2	2.2	0.0
3	1.5	0.0
4	0.3	0.0
5	11.8	0.3
6	1.6	0.1
7	0.0	0.0
8	0.1	0.0
9	0.1	0.0
10	2.3	0.0
11	10.0	0.1
12	1.9	0.0
13	1.7	0.1
14	0.4	0.0
15	2.6	0.0
16	0.5	0.0

First-Year Energy Impacts

Construction Type	First-Year Electricity Savings (GWh)	First-Year Peak Electrical Demand Reduction (MW)	First -Year Natural Gas Savings (Million Therms)	First-Year Source Energy Savings (Million kBtu)	30-Year Present Valued Energy Cost Savings (PV$ Million)
Cannabis - New Construction & Additions	28.38	1.54	0.00	35.06	142.47
Cannabis Alterations	65.05	3.52	0.00	80.32	326.96
Greens - New Construction & Additions	3.86	0.43	0.00	6.53	21.74
Greens - Alterations	8.82	0.99	0.00	14.91	49.65
Tomatoes - New Construction & Additions	1.78	0.17	0.00	3.63	10.30
Tomatoes - Alterations	3.82	0.38	0.00	7.81	22.10
Total	**111.71**	**7.03**	**0.00**	**148.26**	**573.22**

First-Year GHG Emissions Impacts

Measure	Electricity Savings (GWh/yr)	Reduced GHG Emissions from Electricity Savings (Metric Tons CO2e)	Natural Gas Savings (Million Therms/yr)	Reduced GHG Emissions from Natural Gas Savings (Metric Tons CO2e)	Total Reduced GHG Emissions (Metric Ton CO2e)	Total Monetary Value of Reduced GHG Emissions ($)
Indoor Cannabis	87.56	5,635.89	0.00	0.00	5,635.89	694,046
Indoor Greens	0.29	26.08	0.00	0.00	26.08	3,211
Indoor Tomatoes	0.68	60.66	0.00	0.00	60.66	7,470
Greenhouse Cannabis	5.87	468.88	0.00	0.00	468.88	57,742
Greenhouse Greens	12.39	1,108.24	0.00	0.00	1,108.24	136,477
Greenhouse Tomatoes	4.92	544.81	0.00	0.00	544.81	67,093
TOTAL	**111.71**	**7,844.57**	**0.00**	**0.00**	**7,844.57**	**966,039**

30-Year LSC Electricity Savings per Square Foot (2026 PV $)

Climate Zone	Indoor Tomatoes	Indoor Greens	Indoor Cannabis	Greenhouse Tomatoes	Greenhouse Greens	Greenhouse Cannabis
1	81.54	69.89	305.80	33.97	69.89	38.07
2	82.42	82.42	311.37	27.38	82.42	33.17
3	82.33	70.60	307.21	25.68	70.60	32.90
4	82.56	70.44	308.72	23.42	70.44	31.08
5	82.18	70.44	309.47	18.48	70.44	31.10
6	83.26	71.36	311.90	17.49	71.36	31.73
7	82.55	70.76	318.93	15.80	70.76	32.41
8	83.39	71.48	312.64	18.03	71.48	30.85
9	83.44	71.52	312.57	18.03	71.52	30.06
10	83.46	71.53	313.23	17.29	71.53	29.82
11	83.24	71.35	310.60	26.91	71.35	31.48
12	82.89	71.05	309.69	26.92	71.05	31.59
13	83.34	71.43	311.24	25.99	71.43	31.14
14	83.31	71.40	311.64	13.42	71.40	27.15
15	85.27	73.09	318.93	13.74	73.09	28.14
16	81.91	70.21	305.71	23.68	70.21	30.78

Total Incremental Cost

Assumptions:

- 30-year evaluation period
- Luminaire replacement every 10 years
- Lamp replacement once a year for indoor baseline
- Lamp replacement every other year for greenhouse baseline
- No lamp replacement for proposed measures
- 3% discount rate for present value of maintenance and equipment costs

Incremental Costs

30-Year Incremental Cost per Square Foot of Canopy

Building Type	Incremental Equipment Cost	Incremental Maintenance Cost
Indoor Cannabis	$34.88	-$37.76
Indoor Greens	$27.55	-$32.65
Indoor Tomatoes	$34.88	-$35.32
Greenhouse Cannabis	$13.13	-$35.32
Greenhouse Greens	$27.55	-$32.65
Greenhouse Tomatoes	$34.88	-$14.28

Average Cost per Luminaire

Technologies	Average Cost per Luminaire	Average Cost per Lamp
CMH	$429.67	$74.51
HPS	$322.33	$67.02
LED	$906.22	$0.00

Cost Effectiveness (Benefit-to-Cost Ratios) – New Construction & Additions

Climate Zone	Indoor Tomatoes	Indoor Greens	Indoor Cannabis	Greenhouse Tomatoes	Greenhouse Greens	Greenhouse Cannabis
1	3.42	3.72	9.85	3.67	3.72	2.17
2	3.45	4.18	10.01	3.17	4.18	2.03
3	3.44	3.75	9.89	3.04	3.75	2.03
4	3.45	3.74	9.93	2.87	3.74	1.97
5	3.44	3.74	9.96	2.49	3.74	1.97
6	3.47	3.78	10.03	2.42	3.78	1.99
7	3.45	3.75	10.23	2.29	3.75	2.01
8	3.47	3.78	10.05	2.46	3.78	1.97
9	3.47	3.78	10.04	2.46	3.78	1.94
10	3.48	3.78	10.06	2.40	3.78	1.94
11	3.47	3.78	9.99	3.14	3.78	1.99
12	3.46	3.76	9.96	3.14	3.76	1.99
13	3.47	3.78	10.01	3.07	3.78	1.98
14	3.47	3.78	10.02	2.11	3.78	1.86
15	3.53	3.84	10.23	2.13	3.84	1.89
16	3.43	3.73	9.85	2.89	3.73	1.97

Cost Effectiveness (Benefit-to-Cost Ratios) – Alterations

Climate Zone	Indoor Tomatoes	Indoor Greens	Indoor Cannabis	Greenhouse Tomatoes	Greenhouse Greens	Greenhouse Cannabis
1	3.42	6.30	9.85	2.42	6.74	2.17
2	3.45	7.39	10.01	2.18	7.82	2.03
3	3.44	6.36	9.89	2.12	6.80	2.03
4	3.45	6.35	9.93	2.04	6.78	1.97
5	3.44	6.35	9.96	1.86	6.78	1.97
6	3.47	6.43	10.03	1.82	6.86	1.99
7	3.45	6.38	10.23	1.76	6.81	2.01
8	3.47	6.44	10.05	1.84	6.87	1.97
9	3.47	6.44	10.04	1.84	6.88	1.94
10	3.48	6.44	10.06	1.81	6.88	1.94
11	3.47	6.43	9.99	2.16	6.86	1.99
12	3.46	6.40	9.96	2.16	6.84	1.99
13	3.47	6.44	10.01	2.13	6.87	1.98
14	3.47	6.43	10.02	1.67	6.87	1.86
15	3.53	6.58	10.23	1.68	7.01	1.89
16	3.43	6.33	9.85	2.04	6.76	1.97

Thank You!

2025 Pre-rulemaking Workshop

Refrigerated Warehouses, Evaporator Specific Efficiency

Haile Bucaneg, Senior Mechanical Engineer

August 10, 2023

Refrigerated Warehouses, Evaporator Specific Efficiency

Refrigerated Warehouses, Evaporators Specific Efficiency

1. Existing code requirements
2. What's being proposed
3. Energy savings methodology
4. Energy impact results
5. Incremental costs
6. Conclusion

Existing 2022 Code Requirements for Refrigerated Warehouses, Evaporators

- Section 120.6(a)3 – Mandatory requirements for refrigerated warehouses, evaporators.
- Apply to refrigerated warehouses and refrigerated spaces of 3,000 square feet or more.
- Requirements for fans serving evaporators are based on fan motor size and system configuration:
  - Minimum motor efficiency
  - Variable speed fan
  - Reduce airflow

2025 Proposed Requirements

- Add evaporator specific efficiency requirements:
  - Gross total refrigeration capacity (Btu/h) divided by electrical input power at 100 percent fan speed.
  - Specific efficiency requirements varies based on evaporator type.

- Static pressure drop for evaporator shall not exceed 0.5 in. water.

- Exception to specific efficiency requirement for quick chilling/freezing equipment.

2025 Proposed Requirements – Specific Efficiency

Evaporator Type	Specific Efficiency Btuh/Watt
DX Ammonia Refrigerant Cooler/Dock	35
DX Ammonia Refrigerant Freezer	25
Liquid Overfeed Ammonia Refrigerant Cooler/Dock	50
Liquid Overfeed Ammonia Refrigerant Freezer	45
DX CO2 Refrigerant Cooler/Dock	35
DX CO2 Refrigerant Freezer	25
Liquid Overfeed CO2 Refrigerant Cooler/Dock	50
Liquid Overfeed CO2 Refrigerant Freezer	45
DX Halocarbon Refrigerant Cooler/Dock	45
DX Halocarbon Refrigerant Freezer	40

Key Assumptions

Description	Standard Design Specific Efficiency (Btuh/Watt)	Proposed Design Specific Efficiency (Btuh/Watt)
Ammonia liquid overfeed for coolers and docks	34	50
Ammonia liquid overfeed for freezers	34	45
Ammonia DX for coolers and docks	20	35
Ammonia DX for freezers	20	25
HFC DX for coolers and docks	34	45
HFC DX for freezers	34	40

Software Used & Prototypes

DOE-2.2 R energy simulation software

Prototype	Number of Stories	Floor Area (ft^2)	Description
Large Refrigerated Warehouse	1	52,000	Ammonia liquid overfeed for coolers and docks
Large Refrigerated Warehouse	1	40,000	Ammonia liquid overfeed for freezers
Small Refrigerated Warehouse	1	16,000	Ammonia DX for coolers and docks
Small Refrigerated Warehouse	1	10,000	Ammonia DX for freezers
Small Refrigerated Warehouse	1	16,000	HFC DX for coolers and docks
Small Refrigerated Warehouse	1	10,000	HFC DX for freezers

First Year Savings Summary – New Construction and Additions

Climate Zone	First Year Electricity Savings (kWh)	First Year Peak Electricity Demand Reductions (kW)	First Year Natural Gas Savings (Million Therms)	First Year Source Energy Savings (Million kBtu)
1	N/A	N/A	N/A	N/A
2	N/A	N/A	N/A	N/A
3	52.471	5.316	N/A	0.085
4	46.10.9	4.485	N/A	0.074
5	12.230	1.226	N/A	0.020
6	19.920	1.980	N/A	0.032
7	N/A	N/A	N/A	N/A
8	6.477	0.636	N/A	0.010
9	12.396	1.211	N/A	0.020
10	37.357	3.622	N/A	0.059
11	N/A	N/A	N/A	N/A
12	64.343	6.339	N/A	0.102
13	113.354	10.985	N/A	0.180
14	7.108	0.692	N/A	0.011
15	8.193	0.790	N/A	0.013
16	4.295	0.429	N/A	0.007

* No new construction refrigerated warehouse projects or addition projects to existing refrigerated warehouses are forecast in climate zones 1, 2, 7, or 11.

First Year Savings Summary - Alterations

Climate Zone	First Year Electricity Savings (kWh)	First Year Peak Electricity Demand Reductions (kW)	First Year Natural Gas Savings (Million Therms)	First Year Source Energy Savings (Million kBtu)
1	0.17	0.017	N/A	0.000
2	19.43	1.927	N/A	0.031
3	36.64	3.705	N/A	0.059
4	9.02	0.879	N/A	0.014
5	15.46	1.548	N/A	0.025
6	19.30	1.920	N/A	0.031
7	0.98	0.097	N/A	0.002
8	18.64	1.830	N/A	0.030
9	34.42	3.368	N/A	0.055
10	29.34	2.852	N/A	0.047
11	11.59	1.136	N/A	0.018
12	94.22	9.299	N/A	0.150
13	175.16	17.029	N/A	0.279
14	8.01	0.782	N/A	0.013
15	9.39	0.907	N/A	0.015
16	5.61	0.560	N/A	0.009

Incremental Costs

Assumed increased evaporator surface area of evaporator coil needed to meet proposed specific efficiencies.

Description	Assumed % Evaporator Incremental Cost (%)	Evaporator Incremental Cost ($/ft^2)
Ammonia liquid overfeed for coolers and docks	18	0.48
Ammonia liquid overfeed for freezers	13	0.33
Ammonia DX for coolers and docks	24	1.85
Ammonia DX for freezers	11	0.58
HFC DX for coolers and docks	13	0.69
HFC DX for freezers	8	0.30

Long Term System Cost (LSC) Savings - Statewide

Climate Zone	30 Year Long Term System Cost (LSC) Savings – New Construction and Additions (Million $)	30 Year Long Term System Cost (LSC) Savings – Alterations (Million $)
1	N/A	0.00
2	N/A	0.11
3	0.29	0.20
4	0.25	0.05
5	0.07	0.08
6	0.11	0.11
7	N/A	0.01
8	0.04	0.10
9	0.07	0.19
10	0.20	0.16
11	N/A	0.06
12	0.35	0.51
13	0.62	0.096
14	0.04	0.04
15	0.04	0.05
16	0.02	0.03

* No new construction refrigerated warehouse projects or addition projects to existing refrigerated warehouses are forecast in climate zones 1, 2, 7, or 11.

LSC Savings - Prototype

Description	LSC Savings – New Construction and Additions ($/ft^2)	LSC Savings – Alterations ($/ft^2)
Ammonia liquid overfeed for coolers and docks	4.07	4.12
Ammonia liquid overfeed for freezers	2.62	2.62
Ammonia DX for coolers and docks	13.45	13.59
Ammonia DX for freezers	4.80	4.79
HFC DX for coolers and docks	4.12	4.16
HFC DX for freezers	2.18	2.19

Cost Effectiveness – Benefit to Cost Ratio

Description	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Ammonia Overfeed Cooler	7.1	8.2	7.8	8.2	7.8	8.4	8.4	8.7	8.6	9.0	8.8	8.7	8.9	8.5	9.6	7.5
Ammonia Overfeed Freezer	7.6	8.1	8.1	8.1	8.1	8.2	8.0	8.2	8.2	8.2	8.1	8.1	8.1	8.1	8.3	7.8
Ammonia DX Cooler	5.9	7.3	6.7	7.1	6.6	7.1	7.1	7.6	7.4	7.7	7.4	7.4	7.6	7.3	8.4	6.5
Ammonia DX Freezer	8.0	8.3	8.1	8.7	7.8	8.1	8.5	8.5	8.6	8.6	8.3	8.1	8.3	8.6	8.8	8.0
HFC DX Cooler	5.0	5.8	5.5	5.8	5.5	5.9	5.8	6.1	6.0	6.2	6.1	6.1	6.2	6.0	6.9	5.2
HFC DX Freezer	6.7	7.3	7.2	7.4	7.2	7.3	7.5	7.4	7.4	7.5	7.4	7.4	7.5	7.6	7.7	7.4

Questions

1. Are the gross total refrigeration capacity and the electrical input power at 100 percent fan speed readily available to builders?
2. Should specific efficiency be based on evaporator type or should a single specific efficiency value be used for all evaporators?

Thank You!

15-minute Break

We will resume at 10:00

2025 Pre-Rulemaking Workshop

Nonresidential HVAC Controls/Guideline 36

Bach Tsan, P.E.; Senior Mechanical Engineer

Date: August 10, 2023

Agenda

- Brief Overview of Guideline 36
- Existing code requirements
- What's being proposed
- Energy savings methodology
- Energy impact – 1st year savings
- 30-year energy savings results
- Incremental costs
- Conclusion

Guideline 36 Overview

- 2018 - ASHRAE Guideline 36 Committee established high-performance sequences based on a survey of existing logic that has been vetted and improved over decades through a consensus process
- Collection of best practice HVAC control sequences
  - Uniform sequences of operation for heating, ventilation, and air conditioning (HVAC) systems that are intended:
    - to maximize energy efficiency and performance, and
    - provide control stability, and
    - allow for real-time fault detection and diagnostics
- Proposal focuses on Air-Side HVAC Systems
  - Variable Air Volume (VAV) Terminal Units
    - Single Duct, Dual Duct, Fan Powered
  - VAV Air Handling Units
    - Single Zone and Multizone

Existing 2022 Code Requirements

- Existing prescriptive HVAC control requirements in the energy standard for direct digital control (DDC) systems
  - §140.2(c)2 – VAV system static pressure setpoint reset control
  - §140.4(d)2 – Space-conditioning zone controls for systems with direct digital controls (DDC)
  - §140.4(e)2.D – Economizer setpoints and sensors
  - §140.4(f) – Supply temperature reset controls
- Mandatory Requirements
  - §120.1(d)4 – Demand control ventilation requirements
  - §120.1(f) – Outside air control requirements
  - §120.2(j) – Requirements for Direct Digital Controls

2025 Proposed Requirements

- Add prescriptive requirements for the use of control sequences from ASHRAE Guideline 36 for new heating, ventilation, and air conditioning (HVAC) systems
- Prescriptive requirement that controls programming for DDC systems using control logic based on certification requirements in the new joint appendix
- The proposal would include updated acceptance tests, which provide compliance credits for projects that use certified Guideline 36 programming libraries
- Applies to all nonresidential buildings, including new and replacement systems or alterations
- Exception of health care occupancies that rely on airside VAV HVAC systems
- New/Replacement components of VAV systems not covered

Energy Impacts Analysis Key Assumptions

	Base Case: Current Practice	Proposed Design: ASHRAE G36
Terminal unit logic	Single max VAV logic; Zone min airflow = 30%	Zone min airflow = ventilation; Separate heating max airflow setpoint
Duct static pressure reset	"Good" DSP reset fan curve	"Perfect" DSP reset fan curve
Supply air temperature reset	Reset based on cooling demand of warmest zone by increasing flow first, then temperature	Reset based on cooling demand of warmest zone by increasing temperature, with maximum supply air flow rate
Zone groups	1 floor has one hour longer schedule than remaining floors. HVAC system runs to serve whole building on extended schedule.	1 floor has one hour longer schedule than remaining floors. HVAC system only serves active floor.

First Year Savings – New Construction and Additions

Climate Zone	First Year Electricity Savings (GWh)	First Year Peak Electricity Demand Reductions (MW)	First Year Natural Gas Savings (Million Therms)	First Year Source Energy Savings (Million kBtu)
1	0.01	0.01	0.00	0.01
2	0.06	0.10	0.00	0.07
3	0.83	1.29	0.02	0.81
4	0.72	0.75	0.01	0.63
5	0.04	0.08	0.00	0.05
6	0.72	0.63	0.01	0.62
7	0.38	0.28	0.01	0.34
8	1.35	1.04	0.02	1.07
9	2.39	1.85	0.03	1.89
10	0.44	0.41	0.01	0.32
11	0.09	0.09	0.00	0.07
12	0.58	0.68	0.01	0.58
13	0.09	0.11	0.00	0.06
14	0.18	0.17	0.00	0.14
15	0.06	0.09	0.00	0.03
16	0.03	0.04	0.00	0.03

First Year Savings – Alterations

Climate Zone	First Year Electricity Savings (GWh)	First Year Peak Electricity Demand Reductions (MW)	First Year Natural Gas Savings (Million Therms)	First Year Source Energy Savings (Million kBtu)
1	0.02	0.03	0.00	0.03
2	0.33	0.50	0.01	0.36
3	2.73	4.28	0.08	2.70
4	2.51	2.64	0.05	2.19
5	0.13	0.24	0.00	0.14
6	3.20	2.71	0.05	2.71
7	2.17	1.57	0.03	1.90
8	6.22	4.38	0.08	4.88
9	10.77	7.36	0.13	8.47
10	3.11	2.41	0.04	2.28
11	0.26	0.31	0.01	0.20
12	2.96	3.01	0.06	2.74
13	0.59	0.52	0.01	0.43
14	0.95	0.74	0.01	0.69
15	0.37	0.31	0.01	0.20
16	0.15	0.15	0.00	0.15

First-Year Water Savings

Impact	On-site Outdoor Water Savings (gallons/year)	Embedded Electricity Savings[a] (kWh/year)
Average Per Square Foot Impacts	0.72	0.0024
First-Year[b] Statewide Impacts for New Construction and Additions	7,630,722	25,029
First-Year[b] Statewide Impacts for Alterations	42,728,171	140,148
First-Year[b] Total Statewide Impacts	50,358,892	165,177

a. Assumes embedded energy factor of 3,280 kWh per million gallons of water for outdoor water use (SBW Consulting, Inc. 2022).
b. First-year savings from all buildings completed statewide in 2026.

Long-Term System Cost Savings – New Construction and Additions

Climate Zone	Statewide New Construction and Additions (ft^2)	30 Year Long Term System Cost (LSC) Savings (per square foot)
1	63,798	$1.35
2	233,289	$1.94
3	2,093,720	$2.91
4	1,058,236	$4.54
5	181,545	$1.81
6	1,213,502	$3.64
7	756,866	$3.07
8	1,812,185	$4.45
9	3,385,089	$4.21
10	747,380	$3.56
11	179,386	$3.05
12	1,624,108	$2.44
13	287,091	$2.01
14	258,612	$4.47
15	134,548	$2.85
16	71,935	$3.14

Long-Term System Cost Savings - Alterations

Climate Zone	Statewide New Construction and Additions (Square Feet)	30 Year Long Term System Cost (LSC) Savings (per square foot)
1	114,546	$1.41
2	1,113,672	$2.14
3	7,140,607	$2.78
4	3,744,580	$4.40
5	494,965	$2.09
6	4,813,433	$3.99
7	3,808,280	$3.39
8	7,242,527	$4.96
9	12,721,707	$4.87
10	4,088,887	$4.37
11	638,568	$2.47
12	5,890,127	$3.22
13	1,125,171	$3.19
14	1,097,600	$5.15
15	479,677	$4.39
16	285,049	$3.39

Cost Effectiveness

- Incremental Cost assumed to be $0
- Benefit to Cost Ratio is Infinite in all Climate Zones
- IOU Stakeholder meeting survey responses reflect no increased cost

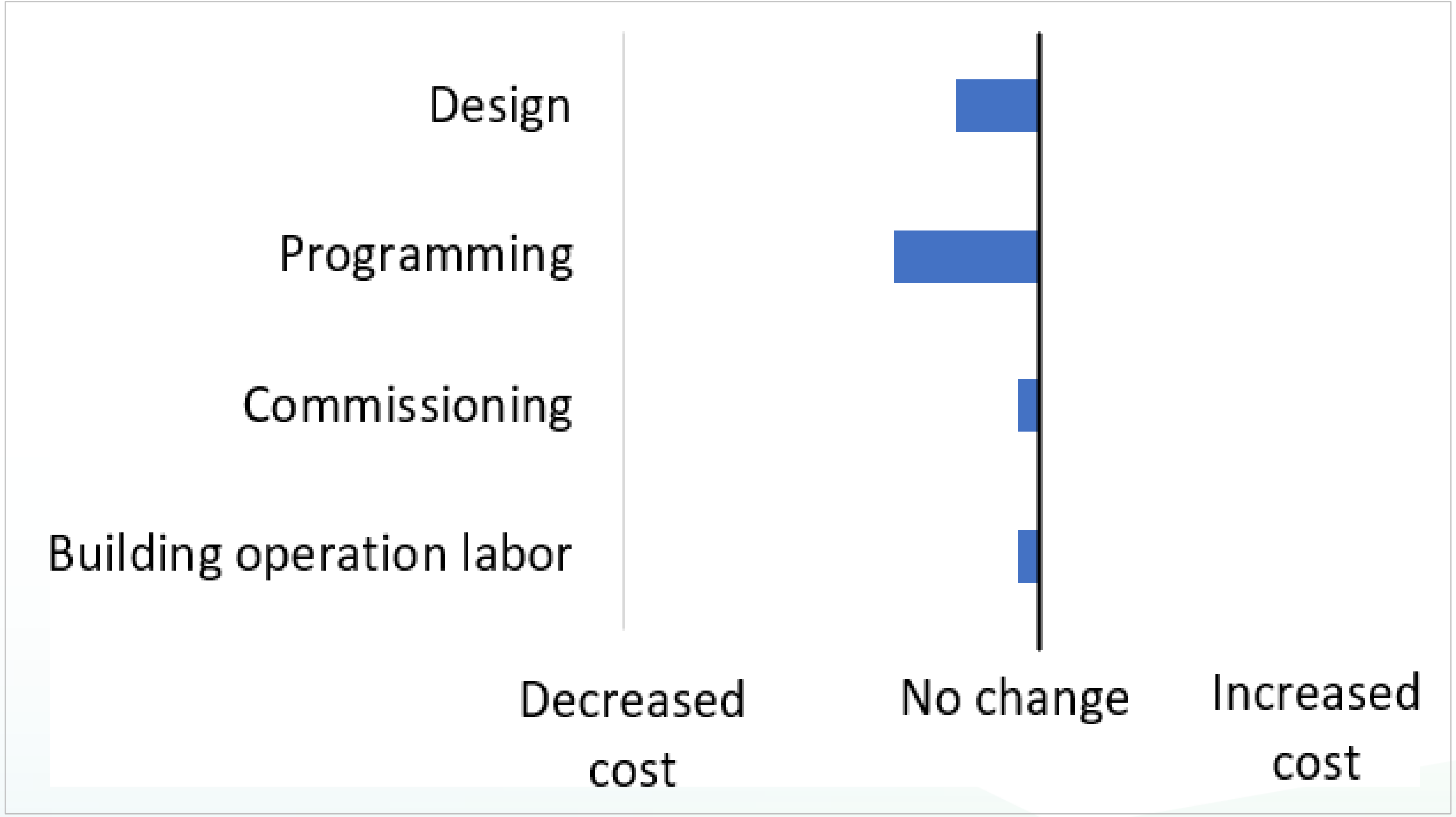


Figure 13: Stakeholder meeting poll response to 'How would the project costs be impacted with comprehensive and robust application libraries developed around Guideline 36 sequence of operation.'

Questions

- Seeking cost data from designers, controls manufacturers, and controls implementers

Thank You!

Today's Workshop & Comments

- **A recording of today's workshop will be posted at** https://www.energy.ca.gov/event/workshop/2023-08/staff-workshop-2025-energy-code-nonresidential-hvac-refrigeration-and

- **Comments on Todays Workshop**
- **Due Date: August 24, 2023, by 5:00 PM**

- **Comments to be submitted to:** https://efiling.energy.ca.gov/Ecomment/Ecomment.aspx?docketnumber=22-BSTD-01

- Thank you for participating!

Next Workshop

Our next workshop is scheduled for Thursday, August 17th, from 9am – 3pm

- Topics covered will include:
  - Single-family envelopes
  - Single-family HVAC buried ducts
  - Multifamily indoor air quality
  - Multifamily envelopes
  - Multifamily restructuring

Draft and final Codes and Standards Enhancement (CASE) reports can be found at https://title24stakeholders.com/2025-cycle-case-reports/

Thank you for participating in today's workshop!