DEVELOPING A POLICY FRAMEWORK FOR AN OUTCOME-BASED ENERGY CODE IN CALIFORNIA

by
Joshua Dean, C.E.M., LEED AP O+M

A capstone submitted to Johns Hopkins University in conformity with the requirements for the degree of Master of Science in Energy Policy & Climate.

Baltimore, Maryland
May 2020

Acknowledgements

The author would like to acknowledge and thank their Capstone Advisor Kelly Seeger, MSc, LC, IES, LEED AP, Global Project Leader – Standards and Regulations for Signify North America Corporation. An additional thanks goes to the California Energy Alliance administrative team of John Martin, Cori Jackson, and Doug Avery for their foundational support of this Outcome-based Energy Code initiative.

Table of Contents

Acknowledgements ii
Executive Summary 1
Introduction 2
Methods 7
Literature Review 8
Identifying Energy Policy Pathways in California 10
Policy Vehicles and Products 10
Stakeholder Interviews and Survey 11
Results 12
Potential Policy Levers 13
Roadmap of Current Energy Policy in California 17
Relationship Between Policy Vehicles and Outcomes 20
Stakeholder Insights 23
Discussion 29
Recommendations 32
Conclusion 37
References 39
Appendix A 42

Executive Summary

Taking a deep dive into California energy policy related to the building sector requires a general understanding of climate goals, regulatory bodies in the state, and the processes and components of nonresidential construction. This capstone project allowed me to combine my professional work as an Executive Director of the San Diego Green Building Council with knowledge gained throughout the Energy Policy and Climate program by researching legislative and regulatory pathways in California for implementing a new energy code compliance pathway based on performance outcomes.

By identifying an adoption pathway for an outcome-based approach to energy code, this project helps create a paradigm shift in the way new nonresidential buildings receive their certificate of occupancy and verify compliance. This approach requires technical analysis of current and new energy metrics to align modeled building energy usage with measured energy usage after occupancy. Throughout this process, an understanding of all stakeholders and decision-making organizations were identified which lead to uncovering the web of interconnections in the energy policy framework.

This report creates a solid foundation for carrying out the next phase of analysis which is identifying proper energy metrics and creating a pilot study of projects wanting to pursue and outcome-based approach. Through the findings from the legislative review and identification of key climate related goals for the state, this report constructs a legislative and regulatory framework to allow for an outcome-based energy code to change the future landscape of energy usage in California.

Introduction

Often referred to as a leader in energy policy, California has put aggressive goals and legislation in place to reduce greenhouse gas (GHG) emissions from the building, transportation, industrial, and electric power sectors. A few of these such targets are: reducing GHG emissions to 1990 levels by 2020, reduce 40% below 1990 levels by 2030, and reduce 80% below 1990 levels by 2050 as codified by Assembly Bill 32[1], Senate Bill 32[2], and ordered by Executive Order S-3-05[3] respectively; zero net energy (ZNE) for new residential construction by 2020 and nonresidential construction by 2030 as set out in the California Long Term Energy Efficiency Strategic Plan[4]; the doubling of energy efficiency savings by 2030 through Senate Bill 350[5] and achieving economy-wide carbon neutrality by 2045 as ordered by Executive Order B-55-18.[6]

The California Energy Commission (CEC) is of one of the leading agencies tasked with helping reach these goals. One of the CEC's roles is to develop efficiency standards and programs for new and existing buildings. Through development of the Building Energy Efficiency Standards, the CEC seeks to "reduce wasteful, uneconomic, inefficient or unnecessary consumption of energy, and enhance indoor and outdoor environmental quality" [7]. As buildings make up about 36% of California's energy end use, there is still a need to enhance the codes governing the new buildings and align strategies to decarbonize the built environment.[8]

---

[1] *Assembly Bill 32: California Global Warming Solutions Act* (2006)
[2] *Senate Bill 32: California Global Warming Solutions Act: Emissions Limit* (2016)
[3] Executive order S-3-05, (2005).
[4] Kenney, Michael, Heather Bird, and Heriberto Rosales. 2019. *2019 California Energy Efficiency Action Plan*. Publication Number: CEC- 400-2019-010-CMF.
[5] *Senate Bill 350: Clean Energy and Pollution Reduction Act* (2015)
[6] Executive order B-55-18 (2018).
[7] *Warren-Alquist Act,* Public Resources Code. Section 25000 (2020)
[8] "Profile Overview." U.S. Energy Information Agency (EIA)., accessed April 4, 2020, https://www.eia.gov/state/?sid=CA#tabs-2.

The purpose of this paper is to identify legislative and regulatory pathways in California which allow nonresidential building energy codes to establish compliance and enforcement mechanisms extending past a building's design, construction, and issuance of certificate of occupancy phases. This paradigm shift in building energy standards and code compliance verification would be the creation of an outcome-based energy code (OBC). The California Energy Alliance (CEA) defines OBC as an energy code that "relies on measured energy post-occupancy to determine compliance with energy codes instead of estimates based on expected connected load or modeling". In addition, an OBC "seeks to capture whole building energy use including process loads and other miscellaneous electric loads (MELs), which often go unaddressed by performance or prescriptive energy code compliance approaches"[9].

The objectives for this research project are to identify existing processes governing energy policy development, identify regulatory barriers to adopting an OBC, and create actionable recommendations to establish the legal grounds and mechanisms for OBC compliance, incentivization, and enforcement in nonresidential buildings across the State of California. Ultimately, a redefined energy policy framework would be developed incorporating OBC methodologies along with a new set of standards and procedures for meeting energy code compliance. Woven into this policy framework would be the key industry stakeholders, how these relationships interconnect, and actionable steps to achieving the state's long-term GHG emissions reduction goals.

Since California has set aggressive energy and GHG emissions reduction targets for the building sector, there is a clear need for the energy usage in buildings to better align with those

[9] "Outcome-Based Energy Code." California Energy Alliance. Accessed March 7, 2020. https://caenergyalliance.org/outcomebased-energy-code.

targets and move towards decarbonization[10]. This means the building energy code will need to rely on improved energy performance targets during the permit phase, additional interval meters covering all end uses, and enhanced grid harmonization[11]. A compliance pathway will need to hold building owners and managers accountable for energy usage after occupancy has occurred. To align the pre and post occupancy energy consumption targets, legislative and regulatory amendments are needed to allow code compliance verification to occur past the Certificate of Occupancy.

First adopted and put into effect in 1978, the Building Energy Efficiency Standards (Energy Standards) are incorporated in Part 6 - California Energy Code of Title 24 Building Standards Code of the California Code of Regulations[12]. Since 1978, the CEC has consistently updated the Energy Standards every three years in order to increase energy efficiency in buildings. These Standards have allowed California to establish itself as a leader in energy efficiency in the buildings sector and put itself on a pathway to meeting the previously stated energy goals. However, as more stringent requirements are stacked onto the code with each iteration, the experience of building industry professionals is that compliance pathways are unnecessarily complex and prevent innovative approaches to design[13]. Additionally, the current energy code relies on anticipated energy performance rather than actual, measured energy outcomes in buildings. While the current compliance pathways of prescriptive requirements and

[10] Kenney, Michael, Heather Bird, and Heriberto Rosales. 2019. *2019 California Energy Efficiency Action Plan*. Publication Number: CEC- 400-2019-010-CMF.
[11] California Energy Commission staff. 2019. Final 2019 Integrated Energy Policy Report. California Energy Commission. Publication Number: CEC-100-2019-001-CMD.
[12] "California Building Standards Code." Building Standards Commission., accessed March, 7, 2020, https://www.dgs.ca.gov/BSC/Codes.
[13] "Outcome-based Energy Code Survey". Google Forms survey. April 2020. https://forms.gle/qhZwsa6JAGAdoKEm9.

comparative performance modeling can be good indicators of energy usage in some buildings, in others there can be gaps in actual energy usage versus the predicted due to assumptions made by the design team and the energy modelers. For California to ultimately hit targets of ZNE and reduction of GHG emissions in buildings, a new methodology for building energy efficiency metrics and approaches to compliance with the Energy Standards should be implemented.

An OBC is not a new idea or strategy for energy code compliance. This compliance pathway is being integrated into several codes across the United States including Seattle, WA, Boulder, CO, and the International Green Construction Code (IgCC). In addition, outcome-based approaches can be found in building codes around the world such as in Sweden and Singapore[14]. Outcome-based strategies are based on a defined set of parameters that establish an annual energy use intensity (EUI) budget to which the building must comply. GHG emissions limits may also be considered as part of an outcome-based approach. Additionally, it gives building owners and operators the tools to meet energy efficiency through enhanced meter data from end uses, benchmark for comparison to the market, and identify future energy efficiency improvements. Through many stakeholder workshops and interactions, the CEA has found that an OBC also entails "mechanisms to value and incorporate on and off-site renewable energy, mechanisms to set building energy performance targets and demonstrate achievement, the ability to adjust targets based on reasonable variation in environmental and market conditions during operation, and compliance demonstrated with actual energy use documentation at a point during building operation"[15].

[14] "Outcome-Based Energy Code." California Energy Alliance. Accessed March 7, 2020, https://caenergyalliance.org/outcomebased-energy-code.
[15] Seeger, Kelly. "Outcome-Based Code Initiative Update". CEA Member Meeting, February 2020.

However, key elements for implementing such a compliance strategy do not exist in the current California energy codes. Current building energy code enforcement culminates in the attainment of a certificate of occupancy. Once a building owner has received the certificate of occupancy, there are no mechanisms in place to follow up on how well, in regard to energy consumption, a building is performing. Buildings today can have many complex energy using systems that require proper installation, acceptance testing, commissioning, and ongoing operations and maintenance. With these complex systems and ever-changing building codes, there is a growing concern of the difficulty in meeting compliance with the Energy Standards[16]. Highlighted in the 2019 California Energy Efficiency Action Plan are the following findings from the Bay Area Regional Energy Network (BayREN) regarding compliance concerns:

> "Within its territory that only 16 percent of permits are error-free, and more than half of reviewed projects had errors that would result in worse energy performance than expected. BayREN found that installed measures were often less efficient than the documented measures, and designs were often changed during construction without updating the energy efficiency portion of the design to match. To make matters worse, building departments have noted that soon most of their officials will retire, and departments lack knowledgeable staff to replace them or acquire their institutional knowledge. Several parties noted that the frequency of changes to the residential and nonresidential code, and the lack of enforcement capabilities, leads to lower compliance"[17].

[16] "Outcome-based Energy Code Survey". Google Forms survey. April 2020. https://forms.gle/qhZwsa6JAGAdoKEm9

[17] Kenney, Michael, Heather Bird, and Heriberto Rosales. 2019. *2019 California Energy Efficiency Action Plan*. Publication Number: CEC- 400-2019-010-CMF.

In order to adopt an OBC in California, research and analysis is needed to identify the various barriers, opposition hurdles, benefits, and legislative changes needed to make it possible and future proof. This approach to energy code compliance is focused on results rather than mechanisms along with the idea that a building's energy consumption should monitored throughout its useful life. All recommendations and policy framework should be looked at through an energy equity, environmental justice, and cost-effectiveness lens to align with the state's values[18]. Overall, there has been extensive analysis and reporting on the benefits and motivations for moving energy code compliance away from prescriptive measures and modeling of anticipated loads and towards actual energy outcomes. However, much of this research was conducted at local municipal levels and was completed prior to advances in energy efficiency technologies, drastic reductions in renewable energy costs, and new GHG emissions reduction targets. With these aforementioned considerations in mind, this research project developed an energy policy framework to set California on a pathway to implementing an OBC.

Methods

This paper is designed to support policy changes, which may require modification of both existing legislation and regulations. Both qualitative and quantitative analyses are required to build the framework for such far-reaching changes. In order to create a new energy policy framework, there was a need for:

- reviewing extensive literature related to this topic,

[18] Kenney, Michael, Heather Bird, and Heriberto Rosales. 2019. *2019 California Energy Efficiency Action Plan*. Publication Number: CEC- 400-2019-010-CMF.

- analyzing interviews with individuals currently involved in OBC efforts,
- analyzing outcome-based compliance pathways in their codes, and
- analyzing survey feedback from industry stakeholders of what has and hasn't worked in an effort to identify the regulatory and legislative pathways that can connect this effort from start to finish.

Through the CEA and through industry connections, interviews and a survey were conducted with individuals from local governments, universities, architecture firms, engineering firms, construction firms, and research institutions. Additionally, this research involved analysis of which enforcement and incentive mechanisms would or could lead to greater utilization of an OBC. The methodology section includes four sections: literature review, roadmap development for current energy policy in California, independent and dependent variables, and stakeholder interviews and survey.

Literature Review

First, I conducted a literature review to establish a baseline of information related to current and past energy legislation, overarching climate policies, building and energy code compliance, state and national energy standards, and industry reports related to outcome-based approaches. This research provided a foundation for past and current efforts around OBCs and building energy performance standards. This literature review focused on the nonresidential sector and included the following key documents:

- California Statutes – Public Resources Code, Public Utilities Code, Health and Safety Code

    - Assembly Bill 32, Senate Bill 32, Assembly Bill 1575, Assembly Bill 758, Senate Bill 350, Assembly Bill 802, Assembly Bill 3232, Executive Orders
- California Code of Regulations – Title 20 Public Utilities and Energy, Division 2 and Title 24 Building Standards Code including Part 6 and Part 11
- California Agencies and Reports – California Energy Commission, California Public Utilities Commission, California Building Standards Commission, California Air Resources Board, Department of General Services, California Energy Efficiency Action Plans, Integrated Energy Policy Reports, Doubling Energy Efficiency Savings by 2030 Report
- California Municipal Codes and Ordinances – City of San Diego, City of San Francisco, City of Los Angeles, Bay Area Regional Energy Network
- Leading local building energy codes and green codes across the U.S. – City of Boulder, Colorado; City of Seattle, Washington; City of New York, New York; International Green Construction Code (IgCC)
- Reports and studies from building industry stakeholders – New Buildings Institute, California Energy Alliance, Rocky Mountain Institute, Institute for Market Transformation, Natural Resources Defense Council, Pacific Northwest National Laboratory, American Council for Energy Efficient Economy, California Investor-Owned Utilities, industry studies, and peer-reviewed articles

Next, energy studies and reports were reviewed for applicability to code approaches focused on energy performance targets and verification after occupancy. There has been quite a bit of research related to outcome-based approaches in energy codes. However, most of the reports found analyzed the implementation of outcome-based approaches at the municipal level.

There is, however, some precedent for an OBC at higher government levels than local municipalities. This includes Sweden, which adopted their code in 2006[19], and Singapore, which adopted their code in 2012[20].

Identifying Energy Policy Pathways in California

In order to understand pathways for current and future energy code adoption, a roadmap was developed to graphically show the various agencies, departments, timeframes, and stakeholders involved. This figure illustrates a pathway starting from the California Constitution through State Legislature and down to regulatory bodies and local governments. This framework will be further detailed in the Discussion section of this report to highlight pathways for an OBC for nonresidential buildings in California and identify ways stakeholders are involved at each level. In addition to an energy policy roadmap, a current timeline of design, construction, and code compliance was evaluated to understand the stages at which an OBC can align with current energy benchmarking disclosure laws.

Policy Vehicles and Products

To evaluate an OBC from a state level perspective, a number of conditions on the current policy vehicles were analyzed. Knowing that enforcement of building energy efficiency stops at certificate of occupancy, this research looked at existing legislative and regulatory vehicles which need to be amended in order to align verification of actual energy performance to modeled

[19] Feng, Wei, Xiwang Li, Carolyn Szum, Nan Zhou, Michael Bendewald, Zihe Meng, and Yani Zeng. "From Prescriptive to Outcome-Based — The Evolution of Building Energy Codes and Standards in China." ECEEE Summer Study 2017. Presqu'ile de Giens, Hyeres, France, 2017.
[20] *Building Control Act,* Republic of Singapore. (2019)

energy targets at the design and permitting phase. Moreover, the overarching climate goals and energy efficiency savings for California were evaluated to determine the positive and negative correlations between these variables. The experimental design in this project involved:

a. Legislative and Regulatory Vehicles – Warren Alquist Act; California Code of Regulations: Title 20, Division 2, Chapter 4, Article 9; California Code of Regulations: Title 24, Part 6 and Part 11
b. Policy Products – certificate of occupancy, building energy usage, enforcement, compliance liability

Amendments to these existing legislative and regulatory vehicles will affect the identified policy products which will be discussed in the Results section. The intent of evaluating these relationships is to characterize what changes, if any, will occur to the products and if this will establish mechanisms for an outcome-based approach.

Stakeholder Interviews and Survey

This portion of the research was conducted through analysis of previous interviews completed by the CEA, conducting new interviews with stakeholders currently engaged in OBC efforts, and sharing an OBC survey to industry stakeholders to gain feedback on possible barriers, hurdles, and benefits of an OBC.

The prior interviews conducted by the CEA were studied and included stakeholders from the City of Seattle, Pacific Northwest National Laboratory, and the International Code Council. New interviews were conducted with representatives from the City of Boulder, BayREN, and industry design stakeholders such as lighting designers and energy consultants. Many of the questions asked related to the representatives' involvement with OBC efforts, what energy

metrics should be utilized, enforcement processes, decisions for pursuing an OBC, and difficulties in implementing this code framework.

To add to the anecdotal insights from industry stakeholders, an additional survey was developed and circulated to a broad cross section of professionals working in the building industry, ranging from local government representatives to architects and energy consultants. The survey questions, which can be found in Appendix A, asked about barriers, benefits, educational needs, familiarity with OBCs and energy codes, incentives, and enforcement mechanisms. This feedback allowed for individuals with all levels of understanding regarding an OBC to weigh in on possible pathways of adoption.

Results

In conducting research into the literature review of OBCs, current legislative pathways, and interviews and surveys with industry stakeholders, there were a number of key findings, of which two stand out:

- There is a need to identify a logical and simple pathway for connecting predicted energy targets to actual energy usage in buildings
- Clear energy metrics, and enforcement mechanisms will need to be defined in order for an OBC to be successfully implemented

Results from the four research areas are detailed below.

Potential Policy Levers

The shape of California's energy policy landscape emerges from statutes, building codes, action plans, policy reports, and industry studies related to OBC. These documents also help us understand the interconnections among current pathways that would allow for an energy code requiring compliance after certificate of occupancy. Highlights of this literature analysis are in Table 1 below with the key opportunities for enabling an OBC.

Table 1: Potential Policy Levers

Literature Reviewed	About	Goals / Outcomes	Opportunities for OBC
Assembly Bill 1575 / Warren-Alquist Act[21] (Has been amended multiple times over the years with new and revised Sections. Many of the documents reviewed below are incorporated into this Act.)	Adopted in 1974 and established the Energy Resources Conservation and Development Commission, also known as the California Energy Commission (CEC). This was established in response to the energy crisis, and it "requires the CEC to reduce wasteful, inefficient, and unnecessary consumption of energy". The Warren-Alquist Act (WAA) is amended by the state Legislature to incorporate emerging energy needs and issues.	- Outlines criteria for development of a Prescriptive and Performance energy efficiency standard. - Requires assessments of energy forecasts, trends, and policy recommendations as well as setting annual targets for energy efficiency savings. - Lays out the framework for public disclosures of annual building energy consumption	- Needs to be amended to align pre and post occupancy energy metrics. - Chapter 5, Section 25401 (f) states "comparisons in the efficiencies of alternative methods of energy utilization". Opportunity to press the CEC on studying and collecting data on an OBC per this section. - Chapter 10.8, Section 25943 (a) align this energy savings program for existing buildings with the building standards in Section 25402.
Assembly Bill 32 [22]**/ Senate Bill 32**[23]	Key legislation from 2006 and 2016 respectively that put California on a pathway to reducing GHG emissions and towards a low-carbon future. This legislation required the California Air Resources Board (CARB) to develop a scoping plan on how to meet these reductions as	- AB 32: reduce GHG emissions to 1990 levels by 2020; requires CARB to direct state efforts on GHG reductions through a Climate Action Team made up of multiple state agencies; gave CARB authority to establish regulations for a market-based program to reduce	- The Climate Action Team includes the CEC and CA Public Utilities Commission (CPUC) which can align overall goals of GHG reductions with energy efficient design and ongoing energy performance in buildings. - This gives a pathway to align GHG emissions from the

[21] *Warren-Alquist Act,* Public Resources Code. Section 25000 (2020)
[22] *Assembly Bill 32: California Global Warming Solutions Act* (2006)
[23] *Senate Bill 32: California Global Warming Solutions Act: Emissions Limit* (2016)

	well as spurring future legislation and regulations to meet these reductions through energy efficiency savings[24].	GHG emissions (e.g. cap-and-trade).[25] - SB 32: reduce GHG emissions to 40% below 1990 level by 2030; codifies the 2030 targets in the Health & Safety Code	building sector to 2030 goals through the Health and Safety Code. Shifting current energy code compliance (entails predicted GHG emissions) to actual energy consumption in buildings (true GHG emissions) allows CARB to account for future emissions targets in the building sector.
Assembly Bill 758[26]	This bill, passed in 2009, added to the biennial reporting requirements of the CEC. Specifically, it required the CEC to establish regulations for a comprehensive energy savings program focused on the existing building stock in California. This bill also required the CPUC to amend its public benefit programs to incorporate the CEC developed comprehensive program discussed above.	- Enabled the Long Term Energy Efficiency Action Plan - Spurred future legislation and regulations around energy benchmarking and disclosure	- The comprehensive program is really just an action plan for opportunities and savings pertaining to energy efficiency in buildings. - There is opportunity in the WAA – Section 25943 (a)(2) to develop an "energy rating" program that aligns existing building energy efficiency to the state's GHG emissions reduction goals[27]. - This section language also creates an opportunity for a building energy performance standard to be established through as a part of the comprehensive program.
Senate Bill 350[28]	This bill, passed in 2015, updated the state's Renewable Portfolio Standards to increase eligible renewable energy resources to 50% by 2030. This bill also required the CEC to establish annual targets for energy efficiency savings and demand reduction that will achieve a doubling of energy efficiency by 2030.	- These annual energy efficiency savings targets are now incorporated into the CEC's Energy Efficiency Action Plans and Integrated Energy Policy Reports. - The CEC shall report the energy efficiency savings and demand reductions through metered data for achieving annual targets.	- For the CEC to report annual energy efficiency savings, an OBC approach incorporates metering whole building energy usage including unregulated loads to give a proper energy profile of a building. This data would be shared through the compliance protocols of an OBC and with ongoing programs, such as benchmarking disclosure, as a way to align with annual reporting mechanisms in SB 350.
Assembly Bill 802 / Title 20, Division 2,	This bill, passed in 2015, amended a previous	- Covered buildings in excess of 50,000 square feet are	- A disconnect lies between this benchmarking program

[24] "Assembly Bill 32 Overview." California Air Resources Board., accessed April 4, 2020, https://ww3.arb.ca.gov/cc/ab32/ab32.htm.
[25] "Assembly Bill 32 Overview." California Air Resources Board., accessed April 4, 2020, https://ww3.arb.ca.gov/cc/ab32/ab32.htm.
[26] *Assembly Bill 758: Energy: energy audit*. (2009)
[27] Crowe, Eliot, Kristine Falletta, Martha Brook, Justin Regnier, Dimitri Contoyannis. "California's Commercial Building Energy Asset Rating System (BEARS): Technical Approach and Design Considerations". ACEEE Summer Study. 2012.
[28] *Senate Bill 350: Clean Energy and Pollution Reduction Act* (2015)

Chapter 4, Article 9[29]	building energy benchmarking disclosure law (AB 1103 from 2007) to support greater access to utility data and reporting of energy benchmarking to the CEC on an annual basis for covered buildings. Regulations established by the CEC have been codified in the Title 20 CA Code of Regulations.	required to disclose the building's energy usage to the CEC through the Energy Star Portfolio Manager platform. - Additionally, building owners with multiple tenants can now receive aggregated whole building data that was previously difficult to obtain without individual tenant authorization.	and Title 24, Part 6 energy metrics as the two do not report a comparative energy number. - As a mechanism already in place statewide, this benchmarking program can be a conduit to align new energy consumption targets (ones that can be compared with metered energy) at the permitting phase with annual energy reporting practices to the CEC.
CA Building Standards Code - Title 24, Part 6[30]	The California Energy Code makes up Part 6 of the Title 24 Building Standards Code. This code incorporates the Building Energy Efficiency Standards, which the CEC is tasked with updated on a 3-year cycle. These Standards apply to residential and nonresidential buildings.	- The CEC develops the Standards to increase the efficiency in energy and water use in buildings. - There are predominantly (2) code compliance pathways including Prescriptive and Performance. - The Standards have to be cost-effective per WAA Section 25402.	- The Title 24, Part 6 in large part leave out some plug loads. To align existing building energy usage with these Standards, the target energy metric would need to be amended. - Compliance with the Energy Code ends at certificate of occupancy, creating a hurdle for an OBC. - Alternative Compliance Pathways are allowed which could be an avenue for an outcome-based approach.
CA Building Standards Code - Title 24, Part 11[31]	The California Green Building Standards code (CALGreen) as introduced into Title 24 in 2007. These standards created the first green building code in the nation. The standards use "building concepts that have a reduced negative impact or positive environmental impact and encourage sustainable construction practices".	- CALGreen has a set of Mandatory Measures, and then Voluntary Measures which can achieve increasing stringency through Tier 1 and Tier 2 requirements. - CALGreen Mandatory Measures require a building to meet Title 24, Part 6 energy standards. But Tier 1and Tier 2 levels require a building to be 10% and 15%, respectively, better than the energy code.	- Since CALGreen has Voluntary Tiers, there is an opportunity to amend Tier 1 and/or Tier 2 to incorporate outcome-based compliance pathways instead of a percentage better than code. - Incorporating an OBC in CALGreen Tier 1 or Tier 2 would also allow for the Energy Standards of Title 24, Part 6 to act as a backstop for minimum energy efficiency in a building.
2019 Energy Efficiency Action Plan[32]	This Plan is produced by the CEC and fulfills the requirements set out by the WAA Section	- The 2019 Plan highlights the state is expected to fall about 20% short of the 2030	- Pg. 70 says "a paradigm shift is needed that targets energy savings and demand flexibility during specific hours of the

[29] *Assembly Bill 802: Energy efficiency.* (2015)
[30] California Energy Commission staff. 2018. 2019 Building Energy Efficiency Standards for Residential and Nonresidential Buildings – Title 24, Part 6. California Energy Commission. Publication Number: CEC-400-2018-020-CMF.
[31] California Building Standards Commission. 2018. 2019 California Green Building Standards Code (CALGreen) – Title 24, Part 11. Accessed April 12, 2020. https://codes.iccsafe.org/content/CAGBSC2019/cover.
[32] Kenney, Michael, Heather Bird, and Heriberto Rosales. 2019. *2019 California Energy Efficiency Action Plan*. Publication Number: CEC- 400-2019-010-CMF.

	25310(c) and 25943(f). The document incorporates aspects of legislation previously discussed including AB 758 and SB 350.	doubling of energy efficiency savings goals. - Recommendations in the plan include: a need for meter-based data with hourly energy efficiency savings profiles, integrated demand flexibility, establish a low- to zero-emission building policy, provide a pathway to building decarbonization in the building codes and standards, and electrification can be a viable and least-cost path to zero-emission buildings. - The report also highlights future energy code updates will aim to improve GHG-based metrics, and that there is an ongoing concern of code compliance.	day when GHG emissions are highest". An OBC which incorporates all building energy end uses and sub-metering can help achieve these targets. - Recommendations and highlights of what the CEC sees as opportunities align with the strategies in an outcome-based approach.
City of San Diego Municipal Code, Chapter 15, Article 6, Division 3[33]	This division of the City of San Diego Municipal Code "establishes land use regulations and design and development criteria to implement the Downtown Community Plan". This division provides development incentives should projects meet green building requirements.	- One way a Floor Area Ratio bonus can be earned is if projects achieve performance path requirements that meet either CALGreen Tier 2 or LEED Silver and higher. - The LEED Certification pathway requires a financial surety, deposit, or other suitable guarantee by the project team to ensure the development meets LEED Silver or higher. The applicant has 180 days after certificate of occupancy to demonstrate achievement of LEED Silver or higher. If they fail to show compliance, then they forfeit all or a portion of the financial guarantee. If certification is achieved, then the entire guarantee is returned.	- This LEED Certification Performance Guarantee provides a local pathway to an OBC. The code language is in place for a project to provide a future "target" due to an incentive, and then enforcement mechanisms are in place to verify compliance after certificate of occupancy. - The City of San Diego was the only local municipality researched for green building incentive programs, but they do exist in many other jurisdictions throughout the state.
City of Seattle[34] **and City of Boulder Energy Codes**[35]	The cities of Seattle and Boulder have taken aggressive steps to create outcome-based paths in	- Both energy codes are requiring set energy targets during the permitting phase to be verified through	- California can identify steps taken by both cities to adopt an OBC. They should also be analyzed for unintended

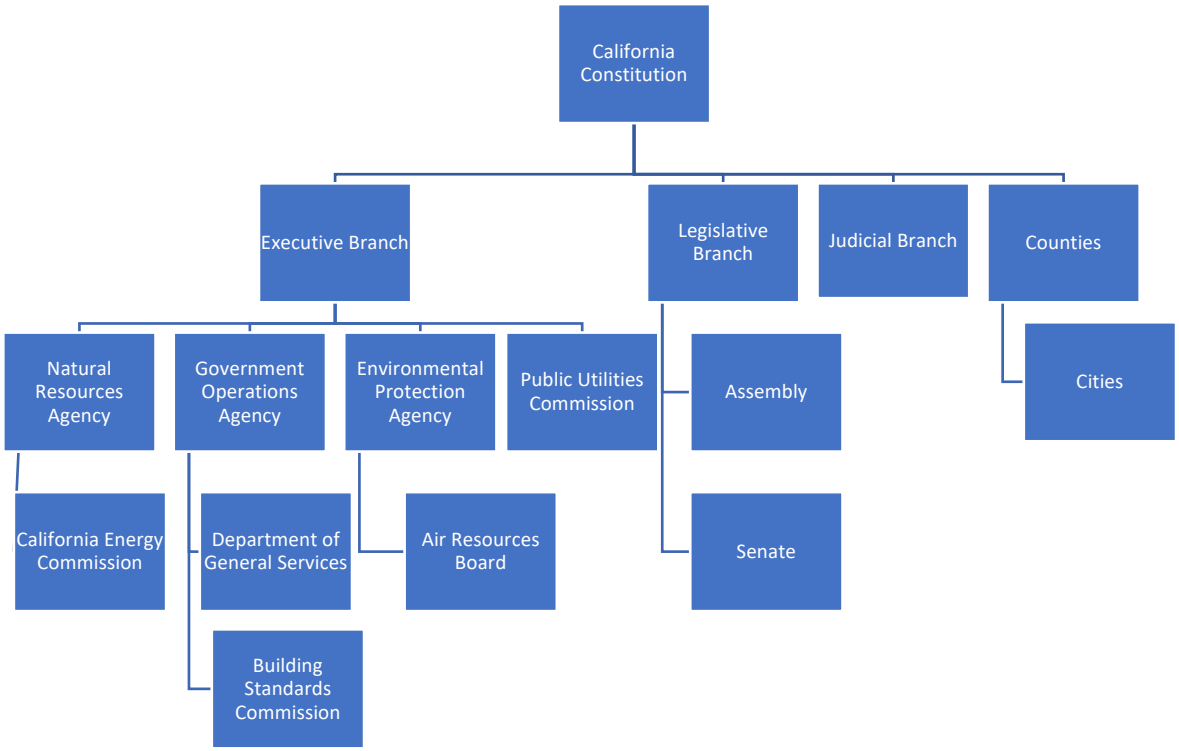
[33] San Diego Municipal Code §156.0309. (2020).
[34] Seattle Department of Construction and Inspections. 2018. Energy Compliance Through the Target Performance or Total Building Performance Paths. Accessed March 27, 2020. http://www.seattle.gov/sdci.
[35] City of Boulder. 2020. Energy Conservation Code. Accessed April 4, 2020. https://bouldercolorado.gov/plan-develop/energy-conservation-codes

	their energy code. Seattle created this as a pathway in their 2015 Energy Code, and Boulder provided this pathway to certain building types in the 2020 Energy Conservation Code.	metered energy use after occupancy. - There are mandatory measures in places to provide energy efficiency backstops.	consequences, technical improvements, and impacts on the building code enforcement departments.

Roadmap of Current Energy Policy in California

In developing a roadmap of the current energy policy framework in California, it was found that multiple state agencies, building stakeholder groups, utilities, and local governments are involved[36]. Figure 1 below shows the framework which implements current energy codes in California.

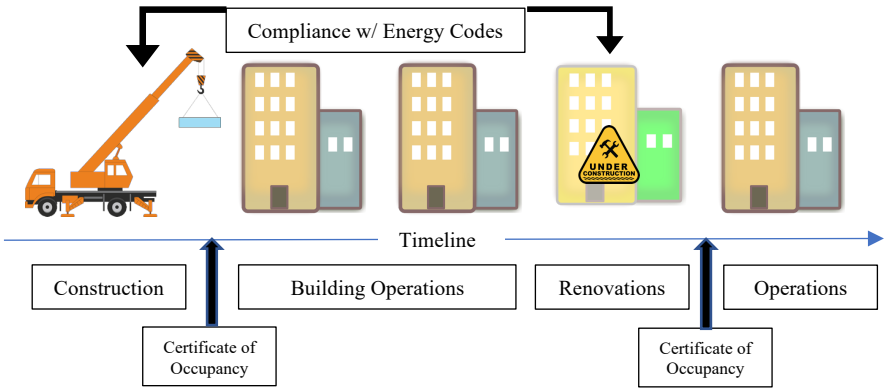
Figure 1: California Organizational Chart for Energy Policy



[36] "Governor's Office Organizational Chart". Office of Governor Gavin Newsom. Accessed May 2, 2020. https://www.gov.ca.gov/orgchart/.

After determining the organization flowchart for energy code development and enforcement in California, this research also highlighted the processes by which buildings are designed, permitted, constructed, reach compliance, and move into operations. Figure 2 showcases this timeline as well as when existing building energy codes intervene. This current code compliance timeline will also be relevant to highlight at what stages a future OBC will interact with the design, construction, and operations timeline.

Figure 2: Current Code Compliance Timeline

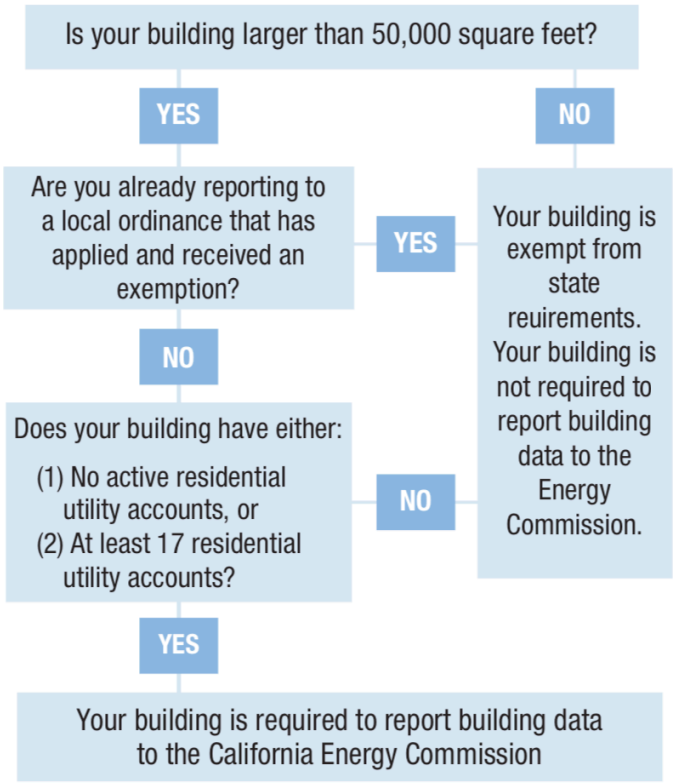


Currently, energy code compliance ends at certificate of occupancy unless a renovation occurs which requires intervention of the building code department[37]. There is one area of current California law requiring existing buildings over a certain square footage to disclose energy consumption through the passage of Assembly Bill 802 in 2015[38]. The roadmap in Figure 3 highlights which buildings are required to comply using the Energy Star Portfolio Manager portal. A number of local jurisdictions have passed their own benchmarking and disclosure laws as well, they are exempt from this reporting pathway due to buildings in their area reporting

[37] Meres, Ryan, Jayson Antonoff. March 2014. "Linking Building Energy Codes with Benchmarking and Disclosure Policies". Institute for Market Transformation. Accessed April 14, 2020. https://www.imt.org/resources/linking-building-energy-codes-with-benchmarking-and-disclosure-policies/.
[38] *Assembly Bill 802: Energy efficiency.* (2015)

directly to the municipality[39]. This building energy performance disclosure law will be imperative to aligning future energy code targets with actual energy consumption.

Figure 3: Benchmarking and Disclosure Program Compliance Path



(Source: CEC Building Energy Benchmarking Program[40])

[39] "Exempted Local Benchmarking Ordinances." California Energy Commission. Accessed April 28, 2020, https://www.energy.ca.gov/programs-and-topics/programs/building-energy-benchmarking-program/exempted-local-benchmarking.

[40] California Energy Commission. May 2018. Benchmarking and Public Disclosure (AB 802). Accessed May 1, 2020. https://www.energy.ca.gov/programs-and-topics/programs/building-energy-benchmarking-program.

Relationship Between Policy Vehicles and Outcomes

The available policy vehicles were analyzed for currently available pathways to adopt an OBC as well as linkages among different governing regulations. The following policy vehicles were evaluated with the potential amendments in order to incorporate OBC strategies.

- Warren-Alquist State Energy Resources Conservation and Development Act – As this statute created and gives authority to the CEC to develop the Energy Standards, amendments are needed to Section 25402 to add language regarding comparative analysis between the prescriptive and performance design standards with post-occupancy energy consumption performance. Additionally, an amendment is needed in Section 25943 to further expand the existing building comprehensive program to align its requirements to design standards in Section 25402[41].
- New legislation is needed to extend building compliance verification past certificate of occupancy. This can be similar to the authority given to fire code officials through the Health and Safety Code, Division 12[42]. Should authority be given to building code officials in the same manner, then energy code compliance can be regularly checked like fire prevention systems.
- California Code of Regulations: Title 20, Division 2, Chapter 4, Article 9 – These regulations relate to energy benchmarking disclosure and energy data access. These regulations should be amended to align the energy use intensity metrics disclosed with predicted energy targets during the design and permitting phase.

[41] *Warren-Alquist Act,* Public Resources Code. Section 25000 (2020)
[42] "Health and Safety Code, Division 12, Part 2. Fire Protection". California Legislative Information. Accessed April 6, 2020. https://leginfo.legislature.ca.gov/faces/codes_displayexpandedbranch.xhtml?tocCode=HSC

Additionally, there is a need to determine which buildings and of what square footage to include since current regulations only require buildings 50,000 square feet and above to report energy data[43].

- California Code of Regulations: Title 24 Building Standards Code, Part 6 – California Energy Code - The Energy Standards should be amended to house energy performance metrics that are aligned with measurable energy metrics during occupancy.[44] Current metrics are tied to a Time Dependent Valuation (TDV) energy metric which does not align with actual energy consumption metrics.
- California Code of Regulations: Title 24 Building Standards Code, Part 11 - California Green Building Standards Code (CALGreen) – There are opportunities to amend Voluntary Measures in CALGreen Tier 1 and Tier 2 compliance levels. These changes should move from a percentage better than the Energy Standards performance pathway to a model that requires verification of actual energy performance post occupancy.[45] The CALGreen Tier 1 or Tier 2 would have to incorporate an energy metric that aligns with the Energy Standards as noted above.

As amendments are made to the above policy vehicles to incorporate OBC strategies, the key policy outcomes are affected. With energy code compliance taking place after construction

[43] California Code of Regulations §1680. (2020).
[44] California Energy Commission staff. 2018. 2019 Building Energy Efficiency Standards for Residential and Nonresidential Buildings – Title 24, Part 6. California Energy Commission. Publication Number: CEC-400-2018-020-CMF.
[45] California Building Standards Commission. 2018. 2019 California Green Building Standards Code (CALGreen) – Title 24, Part 11. Accessed April 12, 2020. https://codes.iccsafe.org/content/CAGBSC2019/cover

and occupancy under an OBC, the liability of delivering on energy performance shifts to a future date for architects, engineers, contractors, and owners. Furthermore, enforcement and penalties for non-compliance shifts to a temporary certificate of occupancy, monetary fines, and loss of performance bonds. The policy outcomes would be affected in the following manner:

- Certificate of Occupancy: This would be implemented in various ways depending on OBC strategies pursued, but this research looked at Temporary or Initial Certificate of Occupancy and Certificate of Occupancy after verified energy performance.
- Building energy usage: OBCs require a comparison of predicted energy targets with measured energy consumption after occupancy. This means energy consumption metrics need to be aligned with pre and post occupancy.
- Enforcement: Local building code officials would need to implement new processes to verify an OBC. Inspectors would need to be educated on new energy performance compliance metrics. These processes may be less burdensome as the inspector will be verifying energy data reported from the building against a permitted EUI target.
- Compliance liability: The burden of liability for the energy performance of the building typically stops at certificate of occupancy for the design team. Project documents and legal contracts would need to be adjusted depending on which entity carries the liability of compliance until energy performance is verified.

Stakeholder Insights

This research lead to a number of interviews and survey analysis. The surveys were conducted with industry stakeholders already involved in or pursuing an OBC. There were many overlapping comments regarding the implementation of an OBC. This included everything from a need for an agreed upon energy metric to current energy code iterations will not help California achieve long-term GHG emissions reduction goals. Additionally, it was noted that incentives are a critical component to have projects participate in this code compliance pathway and that reliable energy data will be needed to sustain an OBC.[46]

The results from the survey of industry stakeholders garnered much of the same feedback as the interviews. A few extra questions, such as familiarity with Energy Standards and OBC initiatives, were addressed due to the nature of not knowing who would complete the survey. The survey was shared through an online form to 127 industry stakeholders with 24 people responding. Highlights of the feedback from the survey include:

- Over 60% of the respondent's clients are asking for projects to have measurable performance outcomes beyond the building code – Figure 4.
- 25% of respondents said that future updates to Title 24, Part 6 can help the State meet 2030 GHG emissions reductions goals, while 42% said Maybe these updates will help achieve the 2030 goals – Figure 5.
- 76% of the respondents said the OBC benefit of "Supporting Building to Grid Harmonization" is "moderately important and most important/essential" – Figure 6.

[46] "Outcome-based Energy Code Survey". Google Forms survey. April 2020. https://forms.gle/qhZwsa6JAGAdoKEm9

The following pie charts show these highlights, and all of the survey questions with a breakdown of answers can be found in Appendix A.

Figure 4

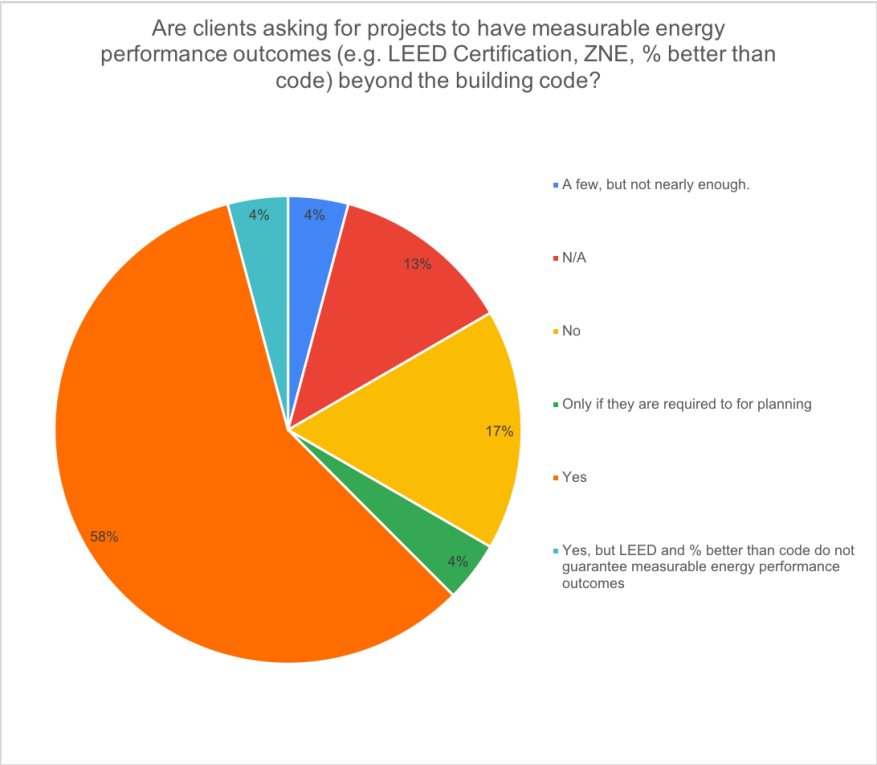


Figure 5

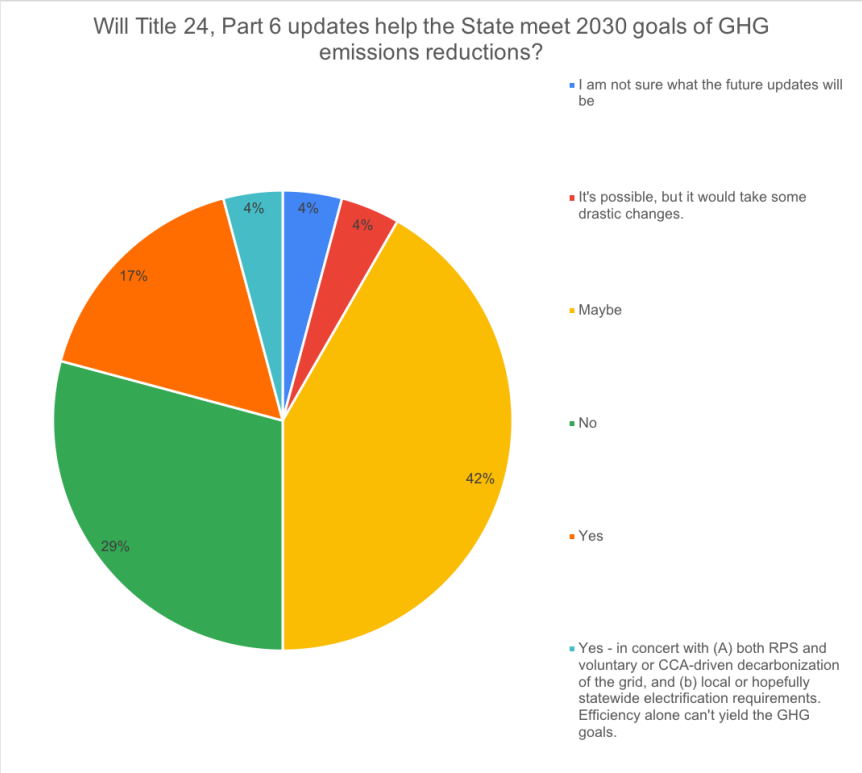
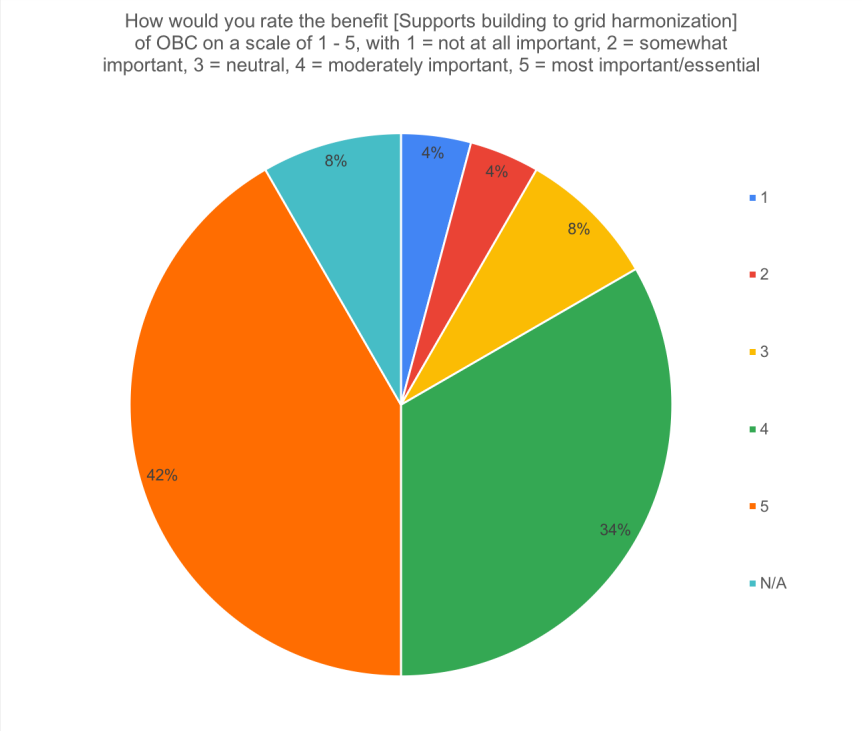


Figure 6

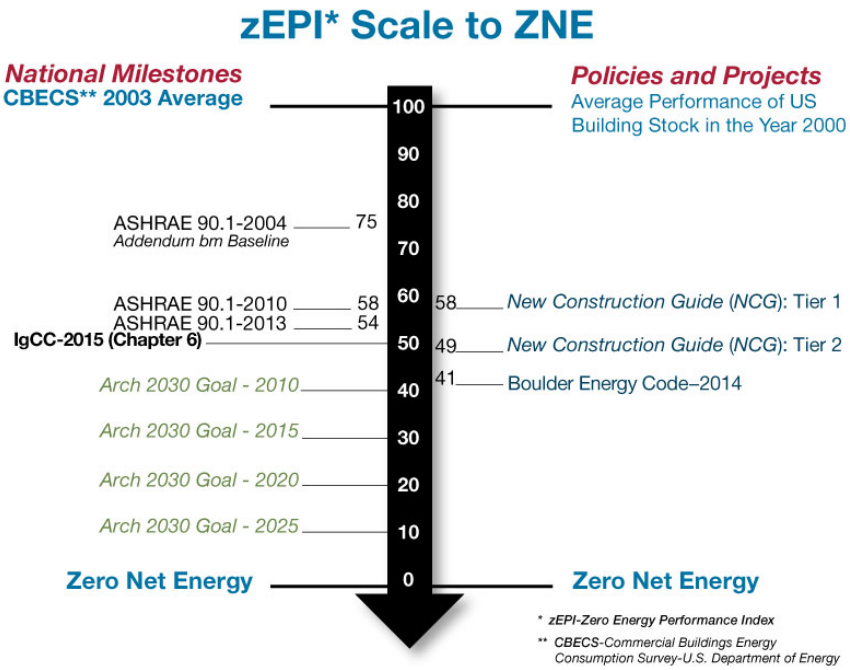


Additional key findings included the need for the right energy metrics because without agreed upon and proven metrics it will be difficult to enforce the code if energy units do not match. Currently, everything is using a different "currency" for energy metrics. While the Energy Standards utilize the TDV metric, benchmarking disclosure laws require different energy metrics known as energy use intensity (EUI) and green building rating systems rely on a number of energy metrics ranging from percent better than code to metrics with operational carbon emissions integrated.[47] The respondents recognized a need for an energy metric that can compare predicted energy use and actual energy usage during occupancy while aligning with state climate goals. This choice of an energy metric also affects the choice of the verification method and the data relied upon for verification[48]. As many questions remain about which energy metric to use, TRC found in a ZNE Verification Methodologies report a few potential options. These include "focusing on avoided carbon, valuing carbon based on the emissions of the source energy generation, developing a system of time-dependent carbon or time-dependent source values, or establishing a dollar value of carbon, potentially in alignment with the state's cap and trade program"[49]. It should be noted that many of these energy metrics align towards ZNE or zero carbon buildings. While the Energy Standards are not currently at this phase, they are moving in this direction with future iterations of code updates. The next code cycle in 2022 is expected to start incorporating carbon as a metric[50].

[47] "LEED v4.1 All in- one building, one space, at a time". U.S. Green Building Council. Accessed May 1, 2020. https://www.usgbc.org/leed/v41.
[48] Pande, Abhijeet. 2018. *ZNE Verification Methodologies Phase 2*. TRC.
[49] Pande, Abhijeet. 2018. *ZNE Verification Methodologies Phase 2*. TRC.
[50] California Energy Commission staff. 2019. Final 2019 Integrated Energy Policy Report. California Energy Commission. Publication Number: CEC-100-2019-001-CMD.

As this paper did not analyze which OBC energy metrics should be utilized, this section below highlights how a proper metric can connect building design to building operations. One such energy metric that can be utilized to connect predicted energy usage at design with actual energy usage during occupancy is the Zero Energy Performance Index (zEPI). "zEPI sets a constant goal of zero and shifts the conversation from percent better than code to percent from zero, which is the kind of market shift that is required for buildings to achieve wide-scale net zero and exemplary energy performance"[51].

Figure 7: zEPI Scale



(Source: New Buildings Institute[52])

Another comparative metric could be the Environmental Protection Agency's (EPA) Energy Star program. This program offers the ability to create an expected building energy performance target through the Target Finder tool, and then track energy usage in Energy Star

[51] "ZEPI". New Buildings Institute. Accessed April 30, 2020. https://newbuildings.org/code_policy/zepi/.
[52] "ZEPI". New Buildings Institute. Accessed April 30, 2020. https://newbuildings.org/code_policy/zepi/.

Portfolio Manager after occupancy which accounts for utility bill data[53]. For new construction, this could connect the initial design to benchmarking ordinances already in place.

One other option for an energy metric is the Zero Code for California from Architecture 2030[54]. "The developers of the Zero Code believe the time dependent source (TDS) metric will encourage building designers to maximize both energy efficiency and load shifting toward periods with lower TDS values, which will in turn promote grid harmonization"[55]. The Zero Code in California does align with the Energy Standards on regulated loads which means certain plug loads are not included[56]. However, it is noted that the Warren-Alquist Act requires all efficiency measures to be cost effective[57]. So, there may be a disconnect between efficiency measures that save on carbon emissions but are not cost effective. To that end, the CEC is working with stakeholders to consider new metrics for use in the building energy efficiency standards. TRC notes, that any viable and sustainable new metric would have to support all the following requirements:[58]

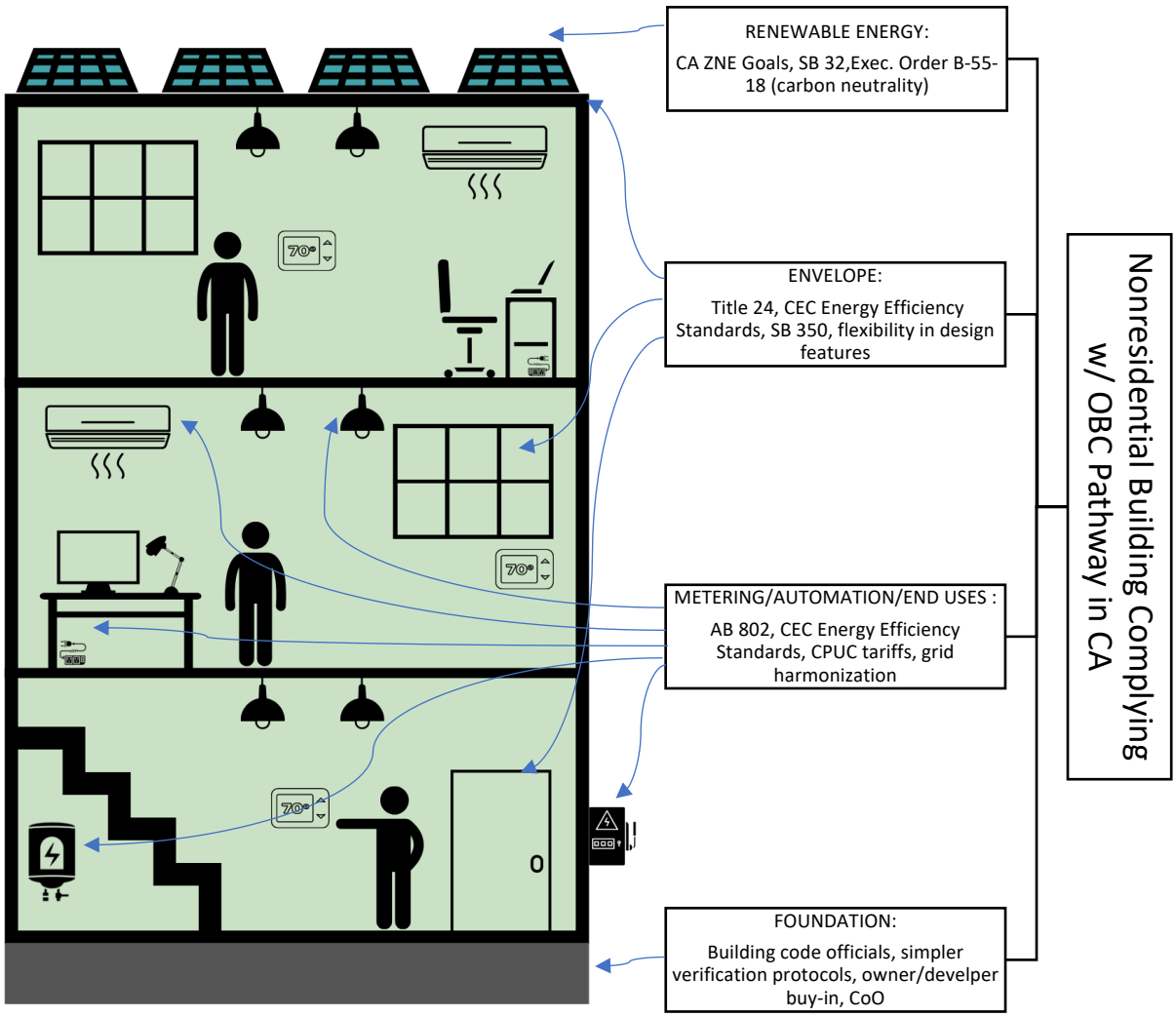
- Meet the state's decarbonization goals
- Preserve grid harmonization signals
- Protect envelope efficiency measures
- Not increase operating and energy costs for buildings
- Minimize confusion and potential for 'gaming'

[53] "An overview of the Energy Star lifecycle". Environmental Protection Agency – Energy Star. Accessed April 30, 2020. https://www.energystar.gov/buildings/facility-owners-and-managers/new-construction/why-design-earn-energy-star/overview-energy.
[54] Pande, Abhijeet. 2018. *ZNE Verification Methodologies Phase 2*. TRC.
[55] Pande, Abhijeet. 2018. *ZNE Verification Methodologies Phase 2*. TRC.
[56] Eley, Charles. August 2018. Zero Code for California. Architecture 2030.
[57] *Warren-Alquist Act,* Public Resources Code. Section 25000 (2020)
[58] Pande, Abhijeet. 2018. *ZNE Verification Methodologies Phase 2*. TRC.

Discussion

In order to develop a policy framework that creates a pathway for an OBC in California, there are logical steps and clear relationships between various state agencies, the legislature, local building departments, industry stakeholders, and emerging technologies. The graphic below was developed to show an illustrative relationship between local jurisdictions, the building community, emerging technologies, building standards and regulatory bodies, and overarching state climate action goals for compliance of an OBC.

Figure 8: OBC Policy Framework



(Graphic Design: Bridget Rickman and Josh Dean[59])

The OBC Policy Framework shown in Figure 8 is used to demonstrate how the components of a nonresidential building can correlate to the state climate goals all the way to local enforcement of building codes. Also, woven throughout this building framework are legislative and regulatory vehicles that provide a pathway for an OBC to be implemented in California. For example: the "Foundation" represents the local code enforcement department and officials; there is a need to identify proper protols to carry out enforcement; and logical energy metrics to compare predicted vs actual usage to verify compliance. Additionally, this framework represents the need for all components to work collectively to achieve the state's GHG emissions reduction goals. Removing one of the layers will disrupt the system.

The research methods were used to identify gaps in current legislation and building codes, identify successful implementation of an OBC, applicable reporting processes, and applicable stakeholders. Through this research, it was found that there is enormous complexity to ensuring an OBC is implemented correctly. However, there is evidence that aligning building design standards with a reportable and targeted energy consumption metric at the permitting phase with a verification process after occupancy and on an ongoing basis can help the state achieve its long-term GHG emissions reduction in goals.

Additionally, there is evidence that incentives and enforcement need to be in place for this compliance strategy to remain effective. Results from interviews and the survey show that creating expedited permitting processes, reduction in permitting fees, and an increase in floor

[59] Rickman, Bridget, Josh Dean. *OBC Policy Framework.* May 2020.

area ratio can be the possible avenues to incentivize building owners and developers to pursue an outcome-based compliance pathway.[60]

The other key area for further research and analysis is the energy metric target for both predicted and actual energy usage. The reason for identifying a new energy target metric is to align the predicted energy usage with actual energy usage from utility bills. As with most energy codes, Title 24, Part 6 does not regulate all loads (e.g. certain plug loads). This automatically creates a disconnect between how buildings are expected to operate into the future versus how they will actually operate. These largely unregulated loads are becoming a greater portion of energy end use in nonresidential buildings[61]. If they are left out of regulations, the CEC will have further difficulty measuring energy efficiency savings each year to align with its cumulative doubling of energy efficiency savings by 2030[62].

This issue of ongoing measurement of actual energy efficiency savings has been identified in the CEC's own energy efficiency action plan[63]. After establishing the problem (predicted energy usage versus actual energy usage), there are a few policy tools that can be used to achieve the desired result of implementing an OBC statewide. These tools are policy instruments to be used to implement an OBC at different paces.

1. Do nothing – Let the market decide by moving towards energy performance rating systems and desired outcomes due to market demand.

[60] "Outcome-based Energy Code Survey". Google Forms survey. April 2020. https://forms.gle/qhZwsa6JAGAdoKEm9.
[61] Pande, Abhijeet. 2018. *ZNE Verification Methodologies Phase 2*. TRC.
[62] *Senate Bill 350: Clean Energy and Pollution Reduction Act* (2015)
[63] Kenney, Michael, Heather Bird, and Heriberto Rosales. 2019. *2019 California Energy Efficiency Action Plan*. Publication Number: CEC- 400-2019-010-CMF.

2. Influence based – Utilizing energy benchmarking disclosures to the State and to general public (AB 802) can incentivize building owners to implement efficiency measures to remain relevant in the market.
3. Incentive based – Local and State governments can work with land use planning departments to offer greater floor area ratio, expedited permitting, or work with the CPUC to develop favorable energy tariffs for buildings performing at certain efficiency levels. Stakeholders, such as owners, developers, and lenders, should be a part of this process in order to determine which incentives are most promising.
4. Regulations – This would be a paradigm shift in code compliance. The CEC would create a new pathway for energy code compliance in Title 24, Part 6 to require predicted energy use to be verified after occupancy is in place for a 12-month period. The current "prescriptive pathway" could be simplified and remain in place to provide a backstop for minimal energy performance of simple buildings.

Recommendations

This section will highlight various OBC implementation strategies, topics to be explored further, possible legislative amendments to pursue, and respective code updates. The purpose of this paper was to uncover legislative and regulatory pathways to implement an OBC, and while this will need to be a phased effort, it is feasible and can have significant impacts on saving energy in nonresidential buildings and helping California meet its future GHG emissions

reductions targets of 40% below 1990 levels by 2030[64]. Topics to explore further and possible pathways to open the door to an OBC in California are discussed below:

1. Ensure compliance before certificate of occupancy is awarded. As noted in the 2019 California Energy Efficiency Action Plan, many projects are receiving certificate of occupancy with errors in the reports. Construction modifications happen between design and final as-builts. There should be an added enforcement layer to require energy models to be revised after construction and before certificate of occupancy.
2. There needs to be focus on existing building energy performance in the short term. This can be an amendment to the Warren-Alquist Act, Section 25943 to develop a statewide building energy performance standard and couple with the CEC's Building Energy Benchmarking Program. This performance standard would help meet statewide GHG emissions goals by creating an emissions threshold that can be lowered annually to align with future reduction targets.
3. Leverage the Voluntary Measures in the Title 24, Part 11 - CALGreen Code. Instead of requiring a percentage better than current energy code in Tier 1 and Tier 2, the energy performance requirements could be amended to require verification of the designed energy target to actual measured energy. A comparative energy metric would need to be defined in the energy code to allow for verification by local building inspectors. Additionally, this would allow for the Title 24 building code to act as a backstop for minimal energy efficiency in design.
    a. Since this wouldn't be a mandatory pathway as Tier 1 and Tier 2 or voluntary, local jurisdictions could adopt a reach code that requires Tier 1 or Tier 2.

[64] *Senate Bill 32: California Global Warming Solutions Act: Emissions Limit* (2016)

4. OBC pathway phased in the California Energy Code triennial updates. The CEA has identified a glide path for phasing an OBC into the energy code. This requires including OBC language in the Exceptional Design section of Title 24 in 2022 updates, introducing an OBC as an "alternative" pathway in code compliance versus just prescriptive or performance in the 2025 update, and then universal adoption in the 2028 code. This approach also aligns with state ZNE goals for nonresidential new construction and GHG emissions reductions in 2030.
    a. As shown throughout this paper, legislation will need to be amended and regulatory pathways do exist along with the need being identified in CEC reports for an outcome-based approach to energy efficiency savings in buildings.
5. A disconnect lies in the regulation of plug loads within a nonresidential building. As plug loads are increasing in share of energy end use, relying on current Title 24, Part 6 TDV energy metrics will create a difficulty in understanding energy consumption in buildings in the future[65]. Further analysis should be completed to identify the best energy metrics for comparing pre and post occupancy energy performance. A number of stakeholders, such as CalTrack, are working to identify methods to standardize measurement and reporting of meter-based data[66].
6. Provide additional educational opportunities to local jurisdictions and their building enforcement departments regarding the Building Energy Benchmarking Program at the state level or local ordinance level. Any "covered building" applying for a permit

[65] Kenney, Michael, Heather Bird, and Heriberto Rosales. 2019. *2019 California Energy Efficiency Action Plan*. Publication Number: CEC- 400-2019-010-CMF.
[66] CalTRACK Methods. 2020. CALTRACK. Accessed May 1, 2020. https://www.caltrack.org/

and being constructed in California over the respective benchmarking program square footage threshold should be informed of reporting protocols after 12 months of occupancy. This can help flag and inform the building owners of energy benchmarking reporting practices to ensure higher utilization of the program.

7. If an OBC were added as a compliance pathway in the energy code, one way to phase this in could be through starting at buildings over a certain square footage (e.g. 50,000 sf and above). Then, local jurisdictions can leverage their benchmarking ordinances or rely on the state's benchmarking program to comply with the OBC pathway energy performance disclosure.
8. Current language in municipal codes that could be amended to incorporate an outcome-based approach and have enforcement mechanisms extending past certificate of occupancy are through "green building incentive programs". The City of San Diego was discussed earlier as one municipality that had a similar approach in place. Should projects pursue a floor area ratio bonus, then they could be required to put forward a guarantee instrument that is held until verification of energy performance after occupancy. See the OBC opportunities in Table 1 of the Potential Policy Levers section.

The above is not an exhaustive list, but it lays the groundwork for further research and analysis into the possible pathways of implementing an OBC in California. However, one of the fundamental recommendations is to focus on the "Foundation" of the policy framework no matter which OBC strategy is pursued. If code compliance is already weak and a cost burden to many local building departments, adding more compliance layers will only inundate them more. Additionally, if there is a large transition of "seasoned" inspectors and code officials retiring,

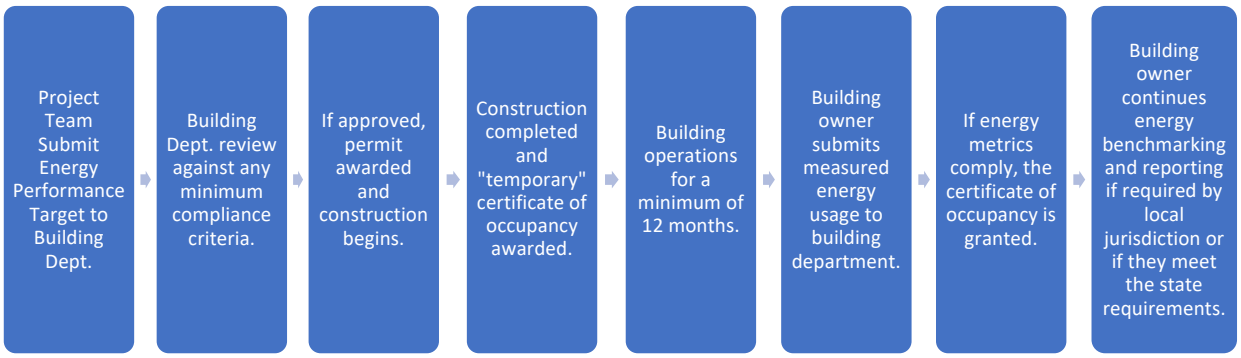
how will the next generation help or how long will it take them to catch up to current practices? A focus should be on education and incentives to building departments for enforcing compliance and ensuring that buildings actually meet the current and future codes.

Furthermore, energy codes need to be considered just as important as health and safety due to societal impacts of GHG emissions[67]. Possibly local governments can look at "third-party energy code enforcement as a way to increase compliance and reduce financial burden on local jurisdictions, whose officials may not have enough time, or needed expertise, to focus on the energy code"[68]. In addition, simplifying code compliance by requiring the project team to submit one energy metric as a target performance during permitting phase that can then be compared against a 12-month period after occupancy holds the owner and project team accountable for ongoing energy performance. A simplified version of this compliance pathway can be found in Figure 9 below. Finally, if plug loads remain to be largely unregulated in Title 24, Part 6, then the TDS metric should be explored more as a possible metric to align pre and post occupancy energy consumption.

[67] Vine, Edward, Alison Williams, and Sarah Price. 2017. "The Cost of Enforcing Building Energy Codes: An Examination of Traditional and Alternative Enforcement Processes." *Energy Efficiency (1570646X)*10 (3): 717–28. doi:10.1007/s12053-016-9483-2.

[68] Vine, Edward, Alison Williams, and Sarah Price. 2017. "The Cost of Enforcing Building Energy Codes: An Examination of Traditional and Alternative Enforcement Processes." *Energy Efficiency (1570646X)*10 (3): 717–28. doi:10.1007/s12053-016-9483-2.

Figure 9: Simplified OBC Compliance Pathway



Conclusion

With climate goals for 2030 and 2045 quickly approaching, a paradigm shift is needed in the building energy efficiency standards. The code has done an excellent job of reducing consumption in the main building systems, but without a focus on unregulated loads it will remain difficult for the state to close the gap on its energy efficiency savings goals. This paper has recommended a few pathways industry stakeholders can take to continue phasing in an OBC into the current building standards. There should be further engagement with local jurisdictions, the building community, and regulators to identify and clear all hurdles for future proofing an OBC. Without industry stakeholders and project owner buy in, choosing an OBC as a compliance pathway will be limited. However, the market can be incentivized through various avenues to choose this pathway and will help the state meet climate goals.

Additional analysis should be completed to compare buildings reporting to the state's energy benchmarking disclosure portal to their Title 24, Part 6 energy model predicted energy usage. This analysis can pull buildings constructed in the past three to five years or last two code cycles and determine any disparity between modeled predicted energy use and actual building

performance from a 12-month period. While comparing the most recently constructed buildings to the operational energy usage, analysis should be conducted to determine a proper energy target metric to report during the permitting phase that aligns with state GHG emission reduction goals.

References

"An overview of the Energy Star lifecycle". Environmental Protection Agency – Energy Star. Accessed April 30, 2020. https://www.energystar.gov/buildings/facility-owners-and-managers/new-construction/why-design-earn-energy-star/overview-energy.

Assembly Bill 32: California Global Warming Solutions Act, (2006)

"Assembly Bill 32 Overview." California Air Resources Board. Accessed April 4, 2020, https://ww3.arb.ca.gov/cc/ab32/ab32.htm.

Assembly Bill 758: Energy: energy audit. (2009)

Assembly Bill 802: Energy efficiency. (2015)

Building Control Act, Republic of Singapore. (2019)

California Building Standards Commission. 2018. 2019 California Green Building Standards Code (CALGreen) – Title 24, Part 11. Accessed April 12, 2020. https://codes.iccsafe.org/content/CAGBSC2019/cover

"California Buildings Standards Code." Building Standards Commission. Accessed March 7, 2020, https://www.dgs.ca.gov/BSC/Codes.

California Code of Regulations §1680. (2020).

California Energy Commission. May 2018. Benchmarking and Public Disclosure (AB 802). Accessed May 1, 2020. https://www.energy.ca.gov/programs-and-topics/programs/building-energy-benchmarking-program.

California Energy Commission staff. 2018. 2019 Building Energy Efficiency Standards for Residential and Nonresidential Buildings – Title 24, Part 6. California Energy Commission. Publication Number: CEC-400-2018-020-CMF.

California Energy Commission staff. 2019. Final 2019 Integrated Energy Policy Report. California Energy Commission. Publication Number: CEC-100-2019-001-CMD.

CalTRACK Methods. 2020. CALTRACK. Accessed May 1, 2020. https://www.caltrack.org/

City of Boulder. 2020. Energy Conservation Code. Accessed April 4, 2020. https://bouldercolorado.gov/plan-develop/energy-conservation-codes

Crowe, Eliot, Kristine Falletta, Martha Brook, Justin Regnier, Dimitri Contoyannis. "California's Commercial Building Energy Asset Rating System (BEARS): Technical Approach and Design Considerations". ACEEE Summer Study. 2012.

Eley, Charles. August 2018. Zero Code for California. Architecture 2030.

Executive Order B 55 18. (2018)

Executive Order S-3-05. (2005)

"Exempted Local Benchmarking Ordinances." California Energy Commission. Accessed April 28, 2020, https://www.energy.ca.gov/programs-and-topics/programs/building-energy-benchmarking-program/exempted-local-benchmarking.

Feng, Wei, Xiwang Li, Carolyn Szum, Nan Zhou, Michael Bendewald, Zihe Meng, and Yani Zeng. "From Prescriptive to Outcome-Based — The Evolution of Building Energy Codes and Standards in China." ECEEE Summer Study 2017. Presqu'ile de Giens, Hyeres, France, 2017.

"Governor's Office Organizational Chart". Office of Governor Gavin Newsom. Accessed May 2, 2020. https://www.gov.ca.gov/orgchart/.

Kenney, Michael, Heather Bird, and Heriberto Rosales. 2019. *2019 California Energy Efficiency Action Plan*. Publication Number: CEC- 400-2019-010-CMF.

"LEED v4.1 All in- one building, one space, at a time". U.S. Green Building Council. Accessed May 1, 2020. https://www.usgbc.org/leed/v41.

Meres, Ryan, Jayson Antonoff. March 2014. "Linking Building Energy Codes with Benchmarking and Disclosure Policies". Institute for Market Transformation. Accessed April 14, 2020. https://www.imt.org/resources/linking-building-energy-codes-with-benchmarking-and-disclosure-policies/.

"Outcome-Based Energy Code". California Energy Alliance. Accessed March 7, 2020, https://caenergyalliance.org/outcomebased-energy-code.

"Outcome-based Energy Code Survey". Google Forms survey. April 2020. https://forms.gle/qhZwsa6JAGAdoKEm9.

Pande, Abhijeet. 2018. *ZNE Verification Methodologies Phase 2*.

"Part 2. Fire Protection – Health and Safety Code." California Legislative Information. Accessed April 6, 2020. https://leginfo.legislature.ca.gov/faces/codes_displayexpandedbranch.xhtml?tocCode=HSC

"Profile Overview." U.S. Energy Information Agency (EIA)., accessed April 4, 2020, https://www.eia.gov/state/?sid=CA#tabs-2.

Rickman, Bridget, Josh Dean. *OBC Policy Framework.* May 2020.

San Diego Municipal Code §156.0309. (2020).

Seattle Department of Construction and Inspections. 2018. Energy Compliance Through the Target Performance or Total Building Performance Paths. Accessed March 27, 2020. http://www.seattle.gov/sdci.

Seeger, Kelly. “Outcome-Based Code Initiative Update”. CEA Member Meeting, February 2020.

Senate Bill 32: California Global Warming Solutions Act: Emissions Limit. (2016)

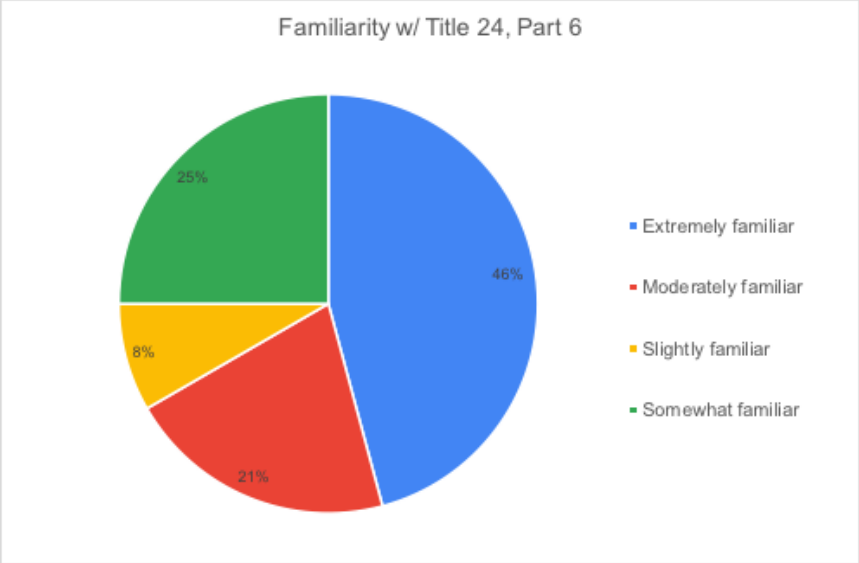
Senate Bill 350: Clean Energy and Pollution Reduction Act. (2015)

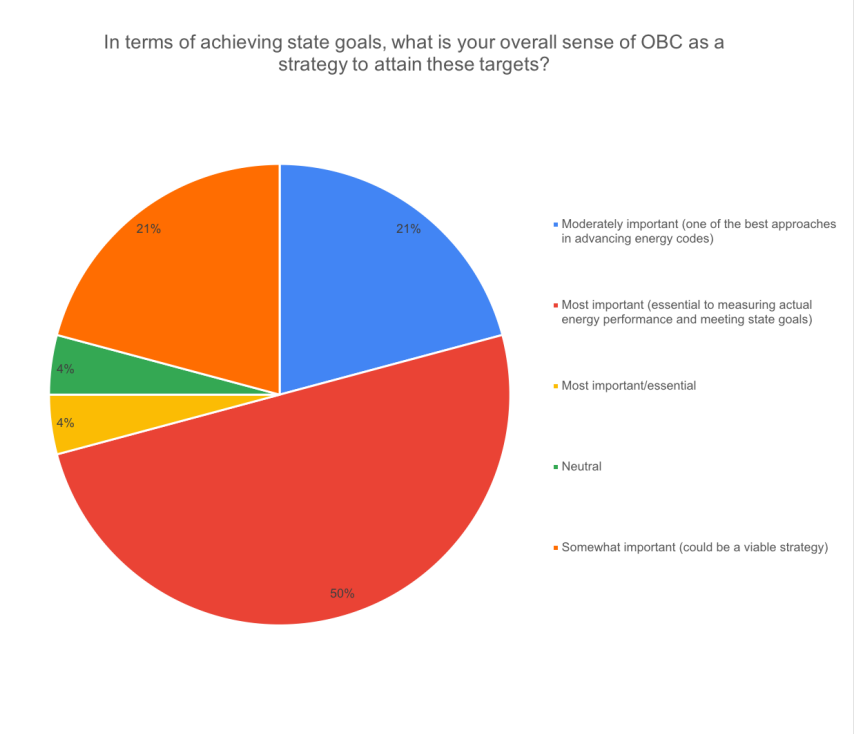
Warren-Alquist Act, Public Resources Code. Section 25000. (2020)

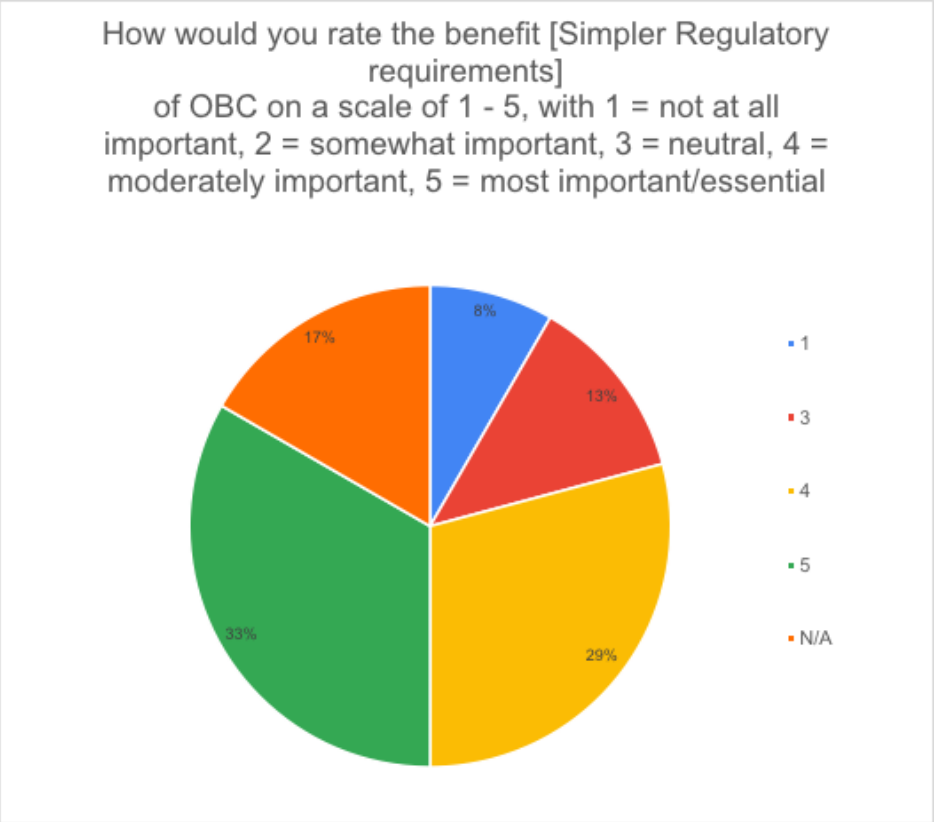
“ZEPI”. New Buildings Institute. Accessed April 30, 2020. https://newbuildings.org/code_policy/zepi/.

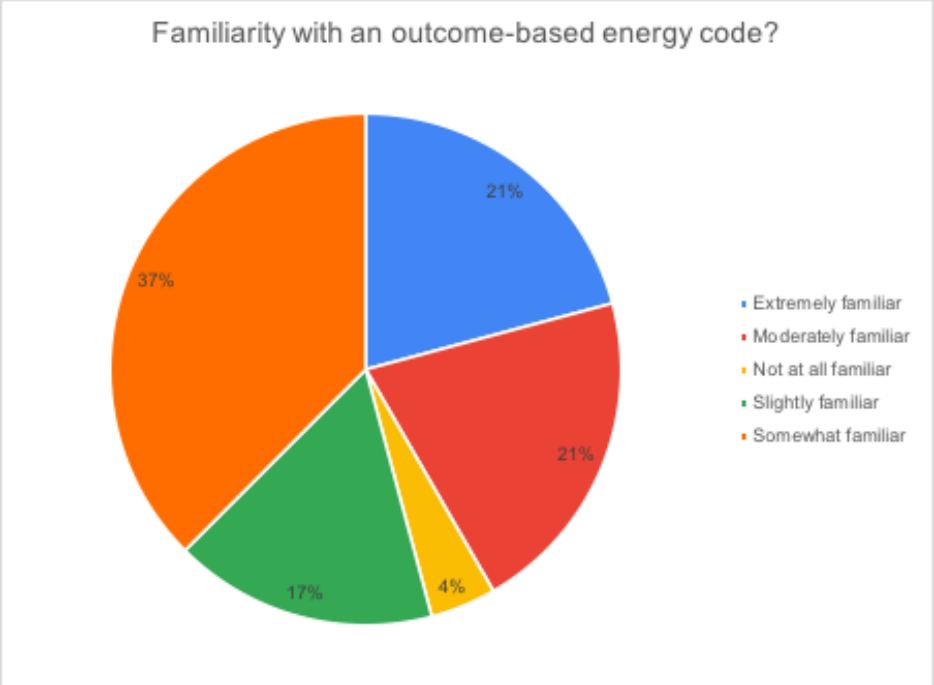
Appendix A

Outcome-based Energy Code Survey – Questions and Feedback






How would you rate the benefit [Simpler Regulatory requirements]
of OBC on a scale of 1 - 5, with 1 = not at all important, 2 = somewhat important, 3 = neutral, 4 = moderately important, 5 = most important/essential
8%
13%
29%
33%
17%
1
3
4
5
N/A


Familiarity with an outcome-based energy code?
21%
21%
4%
17%
37%
Extremely familiar
Moderately familiar
Not at all familiar
Slightly familiar
Somewhat familiar

Outcome-Based Energy Code Survey

The California Energy Alliance (CEA) is the leading advocacy organization for California's energy stakeholders. CEA unites representatives from a broad range of organizations committed to smart, sustainable energy use within the built environment. The CEA actively participates in the development and implementation of pragmatic, environmentally and economically sound building energy standards and other initiatives.

CEA continues to seek out opportunities to drive meaningful, innovative policy improvements that support California's strategic energy and environmental goals including grid integration and decarbonization. The CEA believes that development and implementation of an outcome-based energy code (OBC) represents one such opportunity for the "nonresidential market".

OBC incorporates compliance strategies which measure the actual energy usage of a building over a period of time. The term "outcome-based" refers to the fact that compliance is linked with the actual energy outcomes for a building, and energy usage must be measured post-occupancy for a period of time. This alternative compliance pathway for "nonresidential" is additionally summed up in the Figure 1 below which is compared to the current Title 24, Part 6 compliance pathways - Prescriptive and Performance.

Figure 1: Comparison of Energy Code Compliance Pathways (Source: National Institute of Building Sciences and New Buildings Institute - "Implementing an Outcome-Based Compliance Path in Energy Codes: Guidance for Cities")

Prescriptive	Performance	Outcome
• Sets minimum characteristics for individual components • Easy to use/enforce • Slow to incorporate new technologies • Depends on increasing efficiencies in individual components • Do not reward efficient design decisions • No assurance or requirement to measure results are met	• Set desired end-state—often based on anticipated results from prescriptive code • Flexibility for the design team (but more difficult for code officials) • Technology neutral • Based on building energy models • No assurance or requirement to measure results are met	• Establish a target energy use level and measurement and reporting to assure performance at established level • Includes all energy uses • Flexibility for design team • Assure actual results • Can recognize diversity across building types, even existing and historic buildings

Next

Outcome-Based Energy Code Survey

Why investigate an alternative energy compliance path for "nonresidential buildings" now?

As we put increasing performance demands on our buildings - such as incorporating more connectivity, internet of things, battery storage, on-site generation, frequent changes in space utilization, and other contemporaneous trends - there is a need to better understand buildings as integrated systems. Additionally, CEA believes that there are at least five market trends driving the desire and need for an outcome-based energy code in California.

These trends are:

- California's ambition for carbon neutrality & electrification
- Complexity, inaccuracies in current code pathways
- Persistent gap between energy savings claims and actual outcomes
- Connected building systems innovation
- Increase awareness and importance of health & wellness of occupants

As the building code and energy landscape changes across California, the CEA understands that we cannot continue making deeper energy efficiency gains without considering actual building performance. To this extent, the CEA has started a comprehensive review of adoption pathways, compliance and enforcement needs, and exploration of the necessary steps to enable a practical, statewide OBC program. One important next step is to reach out to industry stakeholders working across the state to gain their feedback on this alternative approach to energy code compliance. Our goal is to reach a wide audience consisting of building owners, architects, engineers, contractors, energy consultants, facility managers, regulatory officials, building code officials, etc. working on nonresidential buildings.

The survey should take between 10-15 minutes to complete depending on your level of knowledge of an OBC.

*This survey is also being conducted as part of a Capstone Research Project for a Master of Science in Energy Policy and Climate program at Johns Hopkins University. All personal information gathered from this survey will remain confidential in the final report unless survey responders choose to disclose their information. If you have any questions regarding the publishing of the survey results or confidentially, please reach out to Josh Dean at josh@sd-gbc.org or 619-786-0979.

Back Next

Page 2 of 5

Outcome-Based Energy Code Survey

* Required

Background Questions

*Survey responder name and organization to remain confidential unless permission is granted.

First Name *

Your answer

Last Name *

Your answer

Email Address *

Your answer

Organization / Company / Government Agency Name *

Your answer

Can we share your name and organization in the survey report? *

- ◯ Yes
- ◯ No
- ◯ Maybe - please contact me first

Position / Title *

Your answer

Sector / Primary Business Focus *

- [ ] Developer
- [ ] Architecture / Designer
- [ ] Construction
- [ ] Engineering - Mechanical
- [ ] Engineering - Electrical
- [ ] Engineering - Other
- [ ] Energy Consultant / Modeler
- [ ] Facility Manager
- [ ] Subcontractor / Trades
- [ ] Building Code Official / Inspector
- [ ] Regulatory Official
- [ ] Local Government
- [ ] Utility
- [ ] Advocate
- [ ] Nonprofit
- [ ] Education
- [ ] Other:

Professional Credentials *

- [ ] PE
- [ ] AIA
- [ ] CEM
- [ ] CEA
- [ ] LEED GA / AP
- [ ] WELL
- [ ] CMVP
- [ ] CBCP
- [ ] EBCP
- [ ] CLEP
- [ ] BEMP
- [ ] N/A
- [ ] Other:

Have you participated on a project with sustainability goals or energy performance outcomes? *

- [ ] CALGreen Tier 1 or Tier 2
- [ ] LEED
- [ ] Energy Star Certification
- [ ] Living Building Challenge
- [ ] Green Globes
- [ ] Zero Net Energy
- [ ] Zero Net Carbon
- [ ] Not sure
- [ ] No
- [ ] Other:

Have you participated on a project(s) that took advantage of a sustainable development or green building incentive program? *

- ◯ Yes
- ◯ No
- ◯ Not sure

If you answered yes to the previous question, please list the program(s) utilized.

Your answer

How familiar are you with the Title 24, Part 6 Nonresidential energy compliance pathways - Prescriptive and Performance? *

- ◯ Not at all familiar
- ◯ Slightly familiar
- ◯ Somewhat familiar
- ◯ Moderately familiar
- ◯ Extremely familiar

Before this survey, how familiar were you with Outcome-based Energy Codes? *

- ○ Not at all familiar
- ○ Slightly familiar
- ○ Somewhat familiar
- ○ Moderately familiar
- ○ Extremely familiar

Back Next

Page 3 of 5

Outcome-Based Energy Code Survey

* Required

OBC Feedback

The following survey questions will seek to gain your feedback on the potential benefits, barriers, liability concerns, educational needs, and enforcement methods of an Outcome-based Energy Code in California.

For more information about outcome-based codes please visit:
CEA website: https://caenergyalliance.org/outcomebased-energy-code
New Buildings Institute: https://newbuildings.org/code_policy/outcome-based-energy-codes/
National Institute of Building Sciences: https://www.nibs.org/page/outcomebasedpathways?&hhsearchterms=%22outcome+and+based+and+code%22

In terms of achieving state goals - (1) all new commercial construction will be Zero Net Energy by 2030, (2) a cumulative doubling of statewide energy efficiency savings in electricity and natural gas final end uses by 2030, and (3) reduce the emissions of greenhouse gases from the state's building stock by at least 40% below 1990 levels by 2030 - what is your overall sense of OBC as a strategy to attain these targets? *

- ◯ Not at all important (not needed to achieve ZNE or Zero Net Carbon)
- ◯ Somewhat important (could be a viable strategy)
- ◯ Neutral
- ◯ Moderately important (one of the best approaches in advancing energy codes)
- ◯ Most important (essential to measuring actual energy performance and meeting state goals)
- ◯ Not sure

How would you rate the difficulty of compliance for the current California Title 24, Part 6 Nonresidential code? *

- ◯ Very difficult
- ◯ Difficult
- ◯ Neutral
- ◯ Easy
- ◯ Very easy
- ◯ Not sure

In your opinion, does the current Title 24, Part 6 Nonresidential energy code provide flexibility in adopting new technologies and solutions? *

- ◯ Yes
- ◯ No
- ◯ Maybe
- ◯ Not Sure
- ◯ Other:

In your opinion, do you think that future energy efficiency updates to Title 24, Part 6 will allow the state to achieve GHG emission reduction goals by 2030 and beyond?

- ◯ Yes
- ◯ No
- ◯ Maybe
- ◯ Other:

Are clients asking for projects to have measurable energy performance outcomes (e.g. LEED Certification, ZNE, % better than code) beyond the building code? *

- ◯ Yes
- ◯ No
- ◯ N/A
- ◯ Other:

How would you rate these benefits of OBC on a scale of 1 - 5, with 1 = not at all important, 2 = somewhat important, 3 = neutral, 4 = moderately important, 5 = most important/essential *

	1	2	3	4	5	N/A
Simpler regulatory requirements	○	○	○	○	○	○
Minimizes prescriptive requirements and complex modeling	○	○	○	○	○	○
Actual energy use is compared to predicted energy target	○	○	○	○	○	○
Supports building to grid harmonization	○	○	○	○	○	○
Offers flexibility for adoption of new technologies	○	○	○	○	○	○
Reduce/eliminate burden on building inspectors to certify energy code compliance	○	○	○	○	○	○
Supports decarbonization and building electrification goals	○	○	○	○	○	○

What are the barriers to adoption of OBC that have to be overcome in your opinion? *

- [ ] Enforcement mechanism after Certificate of Occupancy
- [ ] Liability for non-compliance
- [ ] Financial incentives
- [ ] Extended code compliance timeline
- [ ] Skills and knowledge of building professionals
- [ ] Integration of technology systems
- [ ] Measurement and Verification
- [ ] Energy data disclosure
- [ ] Regulatory pathways
- [ ] No barriers
- [ ] Not sure
- [ ] Other:

Please expand on any barriers to the adoption of OBC.

Your answer

If an OBC were adopted, actual building energy usage compared to predicted energy usage should be verified by... *

- ( ) local building code officials (Authority Having Jurisdiction)
- ( ) the California Energy Commission
- ( ) an approved 3rd Party
- ( ) not sure
- ( ) Other:

If an OBC were adopted, how should the responsibility of energy performance be distributed? *

- [ ] Design Team (architects, engineers, energy modelers, etc.)
- [ ] Contractor/Subcontractors
- [ ] Owner/Developer
- [ ] Tenants/Occupants
- [ ] All of the above
- [ ] None of the above
- [ ] Other:

What would incentivize a project team to pursue OBC as an alternative compliance pathway?

- [ ] Increased floor area ratio
- [ ] Expedited permitting process
- [ ] Favorable utility rates
- [ ] Reduced permitting fees
- [ ] Not sure
- [ ] Other:

Should all building types (e.g. office, restaurant, libraries, retail, high rise, etc.) be included in OBC? *

- ◯ Yes
- ◯ No
- ◯ Maybe
- ◯ Other:

If you answered no to the previous question, what building types should be exempt?

Your answer

Outcome-Based Energy Code Survey

* Required

Final Thoughts

Do you think the building industry is ready for an energy code that focuses on actual energy usage versus prescriptive or comparative building energy modeling? *

- ◯ Yes
- ◯ No
- ◯ Maybe
- ◯ Not sure
- ◯ Other:

If you answered "No" to the previous question, please expand on the area(s) that still need improvement.

Your answer

What other benefits, barriers, liability concerns, or educational needs are there for an OBC?

Your answer

What role should the market play in OBC?

Your answer

Please share any other thoughts or ideas you have about an OBC?

Your answer

Back Submit

Page 5 of 5