2028 California Energy Code

Measure Proposal to the

California Energy Commission

Measure Name

Measure Category. Use one of these options: Residential Envelope, Residential HVAC, Residential Water Heating, Residential Lighting, Multifamily Envelope, Multifamily HVAC, Multifamily Water Heating, Multifamily Lighting, Nonresidential Envelope, Nonresidential HVAC, Nonresidential Water Heating, Nonresidential Lighting, or Process Loads

Prepared by: Name of organization Month Year

 Additional names of authors

Template Instructions

This template is intended to help authors write and structure an Energy Code measure proposal for consideration by the California Energy Commission (CEC). Highlighted text should be replaced with content specific to your proposal. Highlighted text also offers additional guidance and examples from the CEC to assist the author. Before submitting your proposal, delete all unneeded yellow highlighted text.

All documents referenced in the proposal must be submitted electronically or provided via a link to the CEC, except for textbooks, handbooks, or other published materials that have an International Standard Book Number (ISBN). References must include the volume, edition, and page number. Ensure all acronyms used in the proposal are listed in the Acronyms Table following the Executive Summary.

Authors should ensure proposals are formatted according to this template.

* Use pre-defined styles for headings, content, and table formatting.
* Do not modify Styles (e.g., do not modify “Normal” font).
* Do not add an extra space between paragraphs or before a heading.
* Use one space (not two) after each period.
* Use “Table Title,” “Table left,” and “Table right” styles for content in tables.
* Use “Caption” Style for table and figure captions. Table captions go above the table. Figure captions go below the figure.
* Assign alternative text (alt text) to all images and tables. Do not insert images of text or add tables in place of text.
* Adhere to the Department of Rehabilitation’s accessibility guidelines, as described on their website at <https://www.dor.ca.gov/Home/HowToCreateAccessibleContent>.

In an effort to keep nomenclature consistent across proposals, please use:

* Terms defined in the Energy Code, or the California Building Standards Code, where applicable (e.g. “historical” instead of “historic”)
* Title 24 – not “T24” or “Title24” – when referring to the entirety of the California Building Standards Code
* Title 24, Part 6 – not Title 24 – when referring to the California Energy Code.
* Nonresidential – not “non-residential” or “nonres” or “NR.”
* Newly constructed building measure – not “new construction measure” (new construction can occur in existing buildings)

Table of Contents

[1. Introduction 1](#_Toc130559677)

[2. Measure Description 3](#_Toc130559678)

[2.1 Measure Modifications to Energy Code Documents 3](#_Toc130559679)

[2.1.1 Energy Code Change Summary 3](#_Toc130559680)

[2.1.2 Reference Appendices Change Summary 4](#_Toc130559681)

[2.1.3 Compliance Manuals Change Summary 4](#_Toc130559682)

[2.1.4 ACM Reference Manuals Change Summary 4](#_Toc130559683)

[2.1.5 Compliance Forms Change Summary 5](#_Toc130559684)

[2.2 Measure Context 5](#_Toc130559685)

[2.2.1 Comparable Model Code or Standard 5](#_Toc130559686)

[2.2.2 Conflicts with Other Regulations or Certifications 5](#_Toc130559687)

[2.3 Compliance and Enforcement 5](#_Toc130559688)

[3. Market and Economic Analysis 6](#_Toc130559689)

[3.1 Market Structure and Availability 6](#_Toc130559690)

[3.2 Design and Construction Practices 6](#_Toc130559691)

[3.3 Impacts on Market Actors 6](#_Toc130559692)

[3.4 Impacts on Jobs and Businesses 6](#_Toc130559693)

[3.5 Economic and Fiscal Impacts 7](#_Toc130559694)

[3.6 Cost of Compliance and Enforcement 7](#_Toc130559695)

[4. Cost-effectiveness 8](#_Toc130559696)

[4.1 Energy Savings Methodology 8](#_Toc130559697)

[4.2 Energy Savings Results 9](#_Toc130559698)

[4.3 Incremental First Cost 11](#_Toc130559699)

[4.4 Incremental Maintenance Costs 11](#_Toc130559700)

[4.5 Cost Effectiveness 12](#_Toc130559701)

[5. Statewide Energy Impacts 14](#_Toc130559702)

[5.1 Statewide Energy and Energy Cost Savings 14](#_Toc130559703)

[5.2 Statewide Greenhouse Gas Emissions Savings 14](#_Toc130559704)

[5.3 Statewide Water Savings 15](#_Toc130559705)

[5.4 Other Non-Energy Impacts 15](#_Toc130559706)

[6. Proposed Code Language 15](#_Toc130559707)

[6.1 Energy Code (Title 24, Part 6) 16](#_Toc130559708)

[6.2 Reference Appendices 16](#_Toc130559709)

[6.3 Compliance Manuals 16](#_Toc130559710)

[6.4 ACM Reference Manuals 16](#_Toc130559711)

[6.5 Compliance Forms 16](#_Toc130559712)

[7. References 17](#_Toc130559713)

[7.1 Reference List 19](#_Toc130559714)

[7.1.1 Works by the Same Author 19](#_Toc130559715)

[7.1.2 Italics 20](#_Toc130559716)

[7.1.3 Page Numbers 20](#_Toc130559717)

[7.1.4 Abbreviations of Names of States 20](#_Toc130559718)

[7.1.5 Reference List Examples 20](#_Toc130559719)

[7.1.6 Books 20](#_Toc130559720)

[7.1.7 Journal Articles 20](#_Toc130559721)

[7.1.8 Newspapers 21](#_Toc130559722)

[7.1.9 Published Reports 21](#_Toc130559723)

[7.1.10 Unpublished Papers Presented at a Meeting 21](#_Toc130559724)

[7.1.11 Personal Communications 21](#_Toc130559725)

[7.1.12 Printed Proceedings 21](#_Toc130559726)

[7.1.13 Web sites 21](#_Toc130559727)

[Appendices 23](#_Toc130559728)

[Appendix A: Statewide Savings Methodology 23](#_Toc130559729)

[Appendix B: Embedded Electricity in Water Methodology 35](#_Toc130559730)

[Appendix C: Environmental Impacts Methodology 37](#_Toc130559731)

[Appendix D: CBECC Software Specification 39](#_Toc130559732)

List of Tables and Figures

[Table 1: Code Change Scope of Work ix](#_Toc201042207)

[Table 2: Cost-effectiveness Summary x](#_Toc201042208)

[Table 3: Estimated Statewide Energy Savings xi](#_Toc201042209)

[Table 4: Estimated Statewide Greenhouse Gas Emission Savings xi](#_Toc201042210)

[Table 5: Prototype(s) Used for Energy, Cost, and Environmental Analysis 10](#_Toc201042211)

[Table 6: LSC Savings Over 30-Year Period of Analysis 11](#_Toc201042212)

[Table 7: Cost-effectiveness Summary 14](#_Toc201042213)

[Table 8: Estimated Statewide Energy Savings 15](#_Toc201042214)

[Table 9: Estimated Statewide Greenhouse Gas Emissions Savings 16](#_Toc201042215)

[Table 10: Estimated Statewide Water Savings 16](#_Toc201042216)

[Table xx: Estimated Statewide Materials Impacts 17](#_Toc201042217)

[Table 11: FCZ to BCZ Conversion Factors (Table to be updated by CEC) 26](#_Toc201042218)

[**Table 12: Statewide Residential Units (2029) (Table to be updated by CEC)** 28](#_Toc201042219)

[**Table 13: Statewide Residential New Construction (2029) (Table to be updated by CEC)** 29](#_Toc201042220)

[Table 14: Statewide Nonresidential New Construction Building Types 30](#_Toc201042221)

[Table 15: Statewide Nonresidential New Construction Distribution 32](#_Toc201042222)

[Table 16: Statewide Nonresidential New Construction (2029 in Million ft²) (Table to be updated by CEC) 33](#_Toc201042223)

[Table 17: Statewide Nonresidential Construction (2029 in Million ft²) (Table to be updated by CEC) 35](#_Toc201042224)

[Table 18: Statewide First-Year Projected Installation Totals 36](#_Toc201042225)

Document Information

Keywords: Energy Code, Building Energy Efficiency Standards, Statewide Codes and Standards, Title 24, Part 6, 2028, efficiency add key words associated with the proposed measure.

Executive Summary

Introduction

Name of organization authored this proposal. This proposal describes specific energy efficiency code changes (referred to as “measures”) aimed at reducing wasteful, uneconomic, inefficient, or unnecessary consumption of energy in California. The energy efficiency measures described in this proposal are submitted to the California Energy Commission (CEC) for consideration and potential inclusion in California’s Energy Code (Title 24, Part 6). The Energy Code sets statewide energy efficiency requirements for newly constructed buildings, and additions and alterations to existing buildings. The measures in this proposal may also be considered and included in CALGreen (Title 24, Part 11) as voluntarily energy efficiency standards that would only take effect if adopted by a local government seeking to exceed the minimum requirements of the Energy Code. Measures submitted to the CEC will be reviewed, may be modified, and may be incorporated into a broader regulatory package proposed and adopted by the CEC. To be included in the Energy Code, proposed measures must be both cost-effective and technically feasible.

Code Change Description

1-3 sentences summarizing the proposed measure**.**

Scope of Work

Short summary of *Section 2 Measure Description*. Describe how a project can comply with the specifications of this energy efficiency measure. Explain how this will modify specific Energy Code sections, reference appendices and supporting documents. Use Table1 to provide specific sections that will need to be modified in order to accommodate the proposed measure. In the “Regulation Type(s)” column of Table 1 use “M” to indicate if the proposed measures are mandatory requirements, “Ps” to indicate prescriptive requirements, or “Pm” to indicate requirements in the performance modeling approach. List multiple if applicable. In the remaining columns, place any anticipated modifications needed to accommodate the proposed measure in the Energy Code Reference Appendices, Energy Code Modeling Tools (e.g., CBECC), Energy Code Forms by form number, or other Energy Code Supporting Documents (e.g., Compliance Manuals or Alternative Calculation Methods Reference Manal). Insert “N/A” if the proposed code change will not result in a modification. Use bullets and be as brief as possible.

Table 1: Code Change Scope of Work

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Energy Code Section(s) | Regulation Type(s): M, Ps, or Pm | Reference Appendices | ModelingTools | Forms | Other Supporting Documents |
| Section XXX.XX |  |  |  |  |  |

An (M) indicates mandatory requirements, (Ps) Prescriptive, (Pm) Performance.

Compliance and Enforcement

Short summary of *Section 2.4 Compliance and Enforcement*.

Market Assessment

Short summary of *Section 3. Market and* Economic Analysis*.*

Cost-effectiveness

Short summary of *Section 4. Cost-effectiveness.* Table 2 summarizes the estimated benefits, costs and resulting Benefit-Cost Ratios (BCR) by California climate zone for the proposed measures.

Table 2: Cost-effectiveness Summary

|  |  |  |  |
| --- | --- | --- | --- |
| Climate Zone | Benefit: Total Incremental LSC Savings and Other Savings(PV$) | Cost: Total Incremental First Costs and Maintenance Costs(PV$) | Benefit-Cost Ratio (BCR) |
| Climate Zone 1 | $ | $ | 1.0 |
| Climate Zone 2 | $ | $ | 1.0 |
| Climate Zone 3 | $ | $ | 1.0 |
| Climate Zone 4 | $ | $ | 1.0 |
| Climate Zone 5 | $ | $ | 1.0 |
| Climate Zone 6 | $ | $ | 1.0 |
| Climate Zone 7 | $ | $ | 1.0 |
| Climate Zone 8 | $ | $ | 1.0 |
| Climate Zone 9 | $ | $ | 1.0 |
| Climate Zone 10 | $ | $ | 1.0 |
| Climate Zone 11 | $ | $ | 1.0 |
| Climate Zone 12 | $ | $ | 1.0 |
| Climate Zone 13 | $ | $ | 1.0 |
| Climate Zone 14 | $ | $ | 1.0 |
| Climate Zone 15 | $ | $ | 1.0 |
| Climate Zone 16 | $ | $ | 1.0 |

Statewide Energy Impacts

Short summary of *Section 5. Statewide Energy Impacts.*Tables 3 and 4 summarize the estimated statewide energy and greenhouse gas (GHG) emissions savings for the first year that the proposed measure is implemented.

Table 3: Estimated Statewide Energy Savings

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | First Year StatewideElectricity Savings(GWh) | First Year Statewide Power Demand Reduction(MW) | First Year Statewide Natural Gas Savings(Million Therms) | First Year StatewideElectricity LSC Savings(PV$) | First Year StatewideNatural Gas LSC Savings(PV$) |
| Sub-measure 1 | # | # | # | $ | $ |
| Sub-measure 2  | # | # | # | $ | $ |
| **TOTAL** | **#** | **#** | **#** | **$** | **$** |

Table 4: Estimated Statewide Greenhouse Gas Emission Savings

|  |  |  |
| --- | --- | --- |
|  | First Year StatewideGHG Emission Savings(MT CO2e/year) | First Year StatewideGHG Emissions Savings(PV$) |
| Sub-measure 1 | # | $ |
| Sub-measure 2  | # | $ |
| **TOTAL** | **#** | **$** |

Acronyms

|  |  |
| --- | --- |
| Acronym | Definition |
| ACM | Alternate Calculation Method |
| BCR | Benefit-Cost Ratio |
| BCZ | Building Climate Zone |
| BEM | Building Energy Modeling |
| BTU | British Thermal Units |
| Cal/OSHA | California Division of Occupational Safety and Health |
| CARB | California Air Resources Board |
| CBSC | California Building Standards Commission |
| CBECC | California Building Energy Code Compliance software |
| CBECC-Res | California Building Energy Code Compliance software for single-family buildings |
| CEC | California Energy Commission |
| CEQA | California Environmental Quality Act |
| CPUC | California Public Utilities Commission |
| CZ | California Climate Zone |
| DGS | California Department of General Services |
| EIR | Environmental Impact Report |
| GHG | Greenhouse Gas |
| GWh | Gigawatt-Hour |
| HVAC | Heating, Ventilation and Air Conditioning |
| IECC | International Energy Conservation Code |
| ISBN | International Standard Book Number |
| IOU | Investor Owned Utility |
| KBTU | Thousands of British Thermal Units |
| kWh | Kilowatt-Hour |
| kWh/year | Kilowatt-Hour Per Year |
| MG | Million Gallons of Water |
| MMT CO2e | Million Metric Tons of Carbon Dioxide Equivalent |
| MTCO2e | Metric Tons of Carbon Dioxide Equivalent |
| MW | Megawatt |
| PV$ | Present Value Dollars |
| RPS | Renewable Portfolio Standard |
| SDD | Standards Data Dictionary |
| SOC | Standard Occupational Classification |
| Solar PV | Solar Photovoltaic |
| LSC | Long-term System Cost (30-year $) |
| Insert your acronyms | Define your acronyms |

Delete acronyms from this table if they are not used in the measure proposal.

# Introduction

This proposal describes specific energy efficiency code changes (referred to as “measures”) aimed at reducing wasteful, uneconomic, inefficient, or unnecessary consumption of energy in California. The energy efficiency measures described in this proposal are submitted to the California Energy Commission (CEC) for consideration and potential inclusion in California’s Energy Code (Title 24, Part 6). The Energy Code sets statewide energy efficiency requirements for newly constructed buildings, and additions and alterations to existing buildings. The measures in this proposal may also be considered and included in CALGreen (Title 24, Part 11) as voluntarily energy efficiency standards that would only take effect if adopted by a local government seeking to exceed the minimum requirements of the Energy Code. Measures submitted to the CEC will be reviewed, may be modified, and may be incorporated into a broader regulatory package proposed and adopted by the CEC. To be included in the Energy Code, proposed measures must be both cost-effective and technically feasible.

Consistent with California Law (Public Resources Code 25000), an energy efficiency measure is cost-effective if the Benefit-Cost Ratio (BCR) is 1.0 or greater, when amortized over the economic life of the structure. BCR is calculated by dividing the total dollar benefit of the measure by the total dollar cost of the measure, over a period of analysis of 30 years.

To calculate benefit, Long-term System Cost (LSC) is used to determine the dollar value of energy efficiency measures in the Energy Code. LSC hourly factors help the state account for long-term benefits associated with policies needed to meet the statewide climate actions goals – such as 100% renewable generation, proliferation of electric transportation, and drastic reductions in fossil fuel combustion occurring in buildings. Today’s energy costs do not adequately account for these long-term values to California’s energy system. LSC hourly factors weigh the long-term value of each hour differently, where times of peak demand are more valuable, and times off-peak demand are less valuable. LSC hourly factors are not utility rates or energy rate forecasts. LSC is not a predicted utility bill.

LSC hourly conversion factors are developed and published by the CEC for each code cycle. These LSC hourly factors are used to convert predicted site energy use – an output common to building energy modeling (BEM) software – to 30-year present value to California’s energy system.

Energy savings for proposed measures are estimated using both LSC hourly factors and CEC-established model prototypes. Large sets of survey data are used to create prototypes that act as averaged representations of common building types in California. These prototypes are created for use in BEM software to provide accuracy and consistency amongst energy models that are used to determine energy savings for the state. CEC-developed prototypes and LSC hourly factors are published by the CEC ahead of each code cycle integral to research versions of CEC’s reference Energy Code compliance software (CBECC-Res and CBECC). For this reason, CBECC-Res and CBECC are the CEC-recommended BEM software tool when assessing energy savings of proposed measures.

To calculate cost, first costs and ongoing maintenance costs must be assessed for proposed measures and accounted for over a period of analysis of 30 years. In the BCR, both the benefits and the costs are assessed incrementally, meaning in comparison to the latest adopted version of the Energy Code.

Similar to LSC hourly factors, the CEC develops and publishes conversion factors for Source Energy, and for GHG Emissions for each code cycle. These three sets of hourly factors are published on CEC’s website and formatted to be accessible and usable in combination with broadly available BEM tools.

# Measure Description

Describe the proposed measure or change and how it applies to buildings regulated by the Energy Code. Explain if this is a modification to existing regulations or an entirely new measure. If the proposed measure is a modification to existing regulations, identify which section(s) of the Energy Code will be impacted. Explain how the measure achieves energy efficiency or reduces energy consumption and explain how the measure allows the installation of federally covered products. Describe the building types or systems where the change/measure would most likely apply. Describe where the measure is most appropriate geographically. If the proposed measure impacts or takes content from other buildings standards (e.g., ASHRAE 90.1 or IECC), please describe how. Provide any other important details.

## Measure Modifications to Energy Code Documents

This section provides descriptions of how the proposed measure will affect each Energy Code document. See *Section 7. Proposed Code Language* for detailed revisions to code language.

### Energy Code Change Summary

Identify the section(s) of the Energy Code that will be affected by the proposed measure(s). Briefly describe the change. If the proposed measure will not modify Energy Code language, please explain why.

**Examples**

**SECTION 150.0 – MANDATORY FEATURES AND DEVICES**

**Subsection 150.0(a):** The proposed regulations add insulation requirements for attic access doors to minimize the heat transfer between the unconditioned attic and the conditioned house. This reduces the energy use of residential buildings. This requirement cost-effectively increases the stringency of the Energy Code, thereby minimizing the energy use of residential buildings, which in turn improves the state’s economic and environmental health.

**Subsection 150.0(c):** The proposed regulations add an exception to the wall insulation requirements for existing walls that are already adequately insulated.

**Subsection 150.0(f):** The proposed regulations remove the language for air retarder wraps because it is duplicative with the revised subsection (150.0(g)) for vapor retarders.

**Subsection 150.1(a):** The proposed regulations change the basis of all climate zones from metes and bounds to postal zip codes. Using a zip code basis rather than the metes and bounds used in previous version of the Energy Code will make it easier for building owners and energy consultants to comply with, and for building officials to enforce, the Energy Code.

**Subsection 150.1(b):** The proposed regulations delete existing language that is extraneous and simplify the explanations of the energy budgets used in the performance approach.

### Reference Appendices Change Summary

Identify the section(s) of the Energy Code Reference Appendices that will be affected by the proposed measure(s). Briefly describe the change. If the proposed measure will not modify Energy Code Reference Appendices, please explain why.

**Examples**

**JA4 - U-factor, C-factor, and Thermal Mass Data:** The proposed regulations add, modify, and delete data to reflect the updated Energy Code language. JA4 is no longer used by either the residential or nonresidential compliance software so many of the existing entries are eliminated. Only the heat transfer data for assemblies relevant to the prescriptive compliance approach are now included in this appendix.

**JA5 – Reference Design for Upgradeable Setback Thermostats:** The proposed regulations would add this appendix to support the new mandatory requirements for thermostats.

**JA6 – HVAC Fault Detection and Diagnostic Technology:** The proposed regulations expand this appendix to include both charge indicator display and saturation pressure measurement sensor specifications. The new title of this appendix reflects this scope expansion. The specifications for the Saturation Pressure Measurement Sensors (SPMS) are provided as a substitution for the existing refrigerant pressure diagnostic technology, such that a non-intrusive procedure for a rater to access the refrigerant pressure measurements during the refrigerant charge verification procedure is available.

### Compliance Manuals Change Summary

Identify the section(s) of the Energy Code Compliance Manuals that will be affected by the proposed measure(s). Briefly describe the change. If the proposed measure will not modify Compliance Manuals, please explain why.

### ACM Reference Manuals Change Summary

Identify the section(s) of the Alternative Calculation Methods (ACM) Reference Manuals that will be affected by the proposed measure(s). Briefly describe the change. If the proposed measure will not modify ACM Reference Manuals, please explain why.

### Compliance Forms Change Summary

Identify the specific Energy Code Compliance Documents (forms) that will be affected by the proposed measure(s). Briefly describe the change. If the proposed measure will not modify compliance forms, please explain why.

## Measure Context

### Comparable Model Code or Standard

Explain if the proposed measure is already included in other similar model building codes or technical standards (e.g., ASHRAE 62.2, ASHRAE 90.1, ASHRAE 189.1, IECC).

### Conflicts with Other Regulations or Certifications

Explain if there are any known federal, state, or local regulatory requirements that address the same topic as the proposed change. For example, please call out any conflicts with California Fire Code requirements in the wildland urban interface. Specify how the proposed measure is not duplicative of, and not in conflict with, applicable federal, state, or local regulations. Explain if there are any other known codes, standards or certification programs that are in conflict with the proposed measure.

## Compliance and Enforcement

Discuss the feasibility of compliance and enforcement for the proposed measure. Specify if field verification or diagnostic testing is required to ensure success of the proposed measure. If known, explain if the proposed measure will increase or decrease burden on those responsible for ensuring compliance with the building code. If known, explain if the proposed measure will result in increased or decreased compliance transactions costs.

# Market and Economic Analysis

For the proposed measure, this section provides the author’s assessment of product availability, incremental cost, potential market size, and potential economic and fiscal impacts to the state – including potential impacts on the creation or elimination of jobs in the state.

## Market Structure and Availability

Describe the manufacturers, suppliers and installers of the appliance or building systems used in the proposed measure. Specify if the appliance and or building systems can be manufactured, supplied, and installed by more than one party. Comment on the current ability of the market to supply the proposed measure in response to the possible Energy Code change and the potential for the market to ramp up to meet demand associated with the possible Energy Code change. If the measure needs further development and refinement in response to possible Energy Code changes, comment on if the measure will be available from several manufacturers by the effective date of the Energy Code. Identify competing products or possible patent restrictions.

Describe the expected adoption rate absent of any regulation requiring the measure. Ensure that this assumption is discounted from the statewide impacts.

## Design and Construction Practices

Describe the current best practices for designing and constructing the proposed measure. If known, explain if the proposed measure impacts current design and construction best practices, such as impacts to physical space, electrical service needs, aesthetics, and occupant comfort. If known, explain if workforce training is likely to be needed to ensure that the proposed measure is effectively designed and installed. If known, also explain any potential impacts to health and safety, such as impacts to structural and seismic design, indoor air quality, moisture management, fire-resistance ratings, or other.

## Impacts on Market Actors

Explain how the proposed measure will affect builders, developers, building designers, building owners and occupants. Identify if this proposed measure will have a disproportionate impact on low-income communities, disadvantaged communities, or tribal communities. If negative impacts are anticipated, explain how these impacts might be mitigated.

## Impacts on Jobs and Businesses

Discuss the effect on employment within the State of California. Include a reasonable estimate of short-term and long-term jobs created and eliminated that reflects the uncertainty of the estimate. Specifically, round all job estimates to the nearest 10 (e.g., if job estimate is 516, round this to 520). Job creation and elimination outside of California should be described but does not need to be quantified. Include regional and industry specific effects and effects on small businesses. To the extent possible, separate these estimates by job classification using the 2010 Standard Occupational Classification (SOC) system from the Bureau of Labor Statistic (<http://www.bls.gov/soc/#materials>). When assessing the creation or elimination of businesses in California, there are many factors to consider. Consider capital costs, maintenance costs, taxes, access to capital, labor supply, and any other relevant factors. Include the North American Industry Classification System (NAICS) code where possible for each type or specific business(es) assessed. (<http://www.census.gov/eos/www/naics/>). Discuss the proposed measure’s likely effect on businesses within California in comparison to competing businesses in other states and across the globe where this measure would not be imposed. Again, include the NAICS where possible.

## Economic and Fiscal Impacts

Discuss specific economic impacts – costs and benefits – as a direct or indirect result of implementing the proposed measure. An economic assessment should evaluate economic impacts for individual projects, and for the State of California as a whole. A quantitative evaluation that reflects the uncertainty of the estimate is highly preferred. Specifically, round all economic impacts to the nearest $500 thousand (e.g., if statewide cost is estimated at $5.85 million, round to $6 million). If no quantitative information is available, we recommend a thorough qualitative description of the mechanics of the potential impacts with a bounding estimate of the likely impacts.

For the 2022 Energy Code update, the CEC commissioned an analysis of the economic impacts of the proposed 2022 Energy Code measures. That analysis can serve as an example and provides a detailed description of parameters and methodologies important to estimating economic and fiscal impacts to the state of California. The analysis is available here: <https://efiling.energy.ca.gov/GetDocument.aspx?tn=237722&DocumentContentId=70943>.

## Cost of Compliance and Enforcement

Assume state and local government staffing is unavailable. Discuss the likely cost to the state to ensure compliance with the measures and enforce the proposed measures in the field, including any additional person years or new programs that must be developed. Discuss the likely costs to deliver training to enforcement officials to enable them to adequately enforce the proposed measure. If workforce training is likely to be needed for the construction industry to ensure that the proposed measure is effectively designed and installed, as discussed under the *Design and Construction Practices* section, estimate those costs.

# Cost-effectiveness

This section provides a summary of energy savings estimates, costs, and overall cost-effectiveness analysis for the proposed measure. Energy savings, costs, and cost effectiveness of proposed measures are assessed incrementally, meaning in comparison to the latest adopted version of the Energy Code. Best available data is used and references to those data sources are provided to clearly substantiate energy savings, costs, and cost effectiveness. Details required to reproduce the cost-effectiveness analysis are included in Appendix X.

## Energy Savings Methodology

Consistent with California Law (Public Resources Code 25000), an energy efficiency measure is cost-effective if the Benefit-Cost Ratio (BCR) is 1.0 or greater, when amortized over the economic life of the structure. BCR is calculated by dividing the total dollar benefit of the measure by the total dollar cost of the measure, over a period of analysis of 30 years.

To calculate benefit, Long-term System Cost (LSC) is used to determine the dollar value of energy efficiency measures in the Energy Code. LSC hourly factors help the state account for long-term benefits associated with policies needed to meet the statewide climate actions goals – such as 100% renewable generation, proliferation of electric transportation, and drastic reductions in fossil fuel combustion occurring in buildings. Today’s energy costs do not adequately account for these long-term values to California’s energy system. LSC hourly factors weigh the long-term value of each hour differently, where times of peak demand are more valuable, and times off-peak demand are less valuable. LSC hourly factors are not utility rates or energy rate forecasts. LSC is not a predicted utility bill.

LSC hourly conversion factors are developed and published by the CEC for each code cycle. These LSC hourly factors are used to convert predicted site energy use – an output common to building energy modeling (BEM) software – to 30-year present value to California’s energy system.

Energy savings for proposed measures are estimated using both LSC hourly factors and CEC-established model prototypes. Large sets of survey data are used to create prototypes that act as averaged representations of common building types in California. These prototypes are created for use in BEM software to provide accuracy and consistency amongst energy models that are used to determine energy savings for the state. CEC-developed prototypes and LSC hourly factors are published by the CEC ahead of each code cycle integral to research versions of CEC’s reference Energy Code compliance software (CBECC-Res and CBECC). For this reason, CBECC-Res and CBECC are the CEC-recommended BEM software tool when assessing energy savings of proposed measures.

To calculate cost, first costs and ongoing maintenance costs must be assessed for proposed measures and accounted for over a period of analysis of 30 years. In the BCR, both the benefits and the costs are assessed incrementally, meaning in comparison to the latest adopted version of the Energy Code.

Similar to LSC hourly factors, the CEC develops and publishes conversion factors for Source Energy, and for GHG Emissions for each code cycle. These three sets of hourly factors are published on CEC’s website and formatted to be accessible and usable in combination with broadly available BEM tools.

## Energy Savings Results

List and describe the BEM tools you used to quantify energy savings results for the proposed measure. See Appendix X for additional detail on the BEM analysis. Explain what hourly factors were used to convert predicted site energy to LSC. Provide any additional detail explaining how the proposed measure conformed to the CEC’s written methodology for energy cost savings.

Summarize the prototypes that were used as the basis for predicting energy savings of the proposed measure, similar to Table 5. Single-family residential energy savings are calculated using three prototypes (500 ft2, 2,100 ft² and 2,700 ft²) which are available in CBECC-Res. Single-family residential results are weighted 2% for the 500 ft2 prototype, 42% for the 2,100 ft² prototype and 56% for the 2,700 ft² prototype. Multifamily savings are calculated based on multifamily prototypes in CBECC. Multifamily results are weighted Low-Rise Garden (4%), Loaded Corridor (33%), Mid-Rise Mixed Use (58%) and High-Rise Mixed Use (5%). Those weights are based on newly constructed building activity square footage. If a per-building weighting is more appropriate based on the proposed measure, then results should be weighted Low-Rise Garden (27%), Loaded Corridor (44%), Mid-Rise Mixed Use (27%) and High-Rise Mixed Use (2%).

Table 5: Prototype(s) Used for Energy, Cost, and Environmental Analysis

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Prototype ID | Occupancy Type(Residential, Retail, Office, etc.) | Floor Area(ft²) | Number of Stories | Statewide Floor Area(Million ft²) |
| Prototype 1 |  |  |  |  |
| Prototype 2 |  |  |  |  |
| Prototype 3 |  |  |  |  |
| Prototype 4 |  |  |  |  |
| Prototype 5 |  |  |  |  |

Summarize and discuss the LSC savings attributed to the proposed measure using a table similar to Table 6. If the proposed measure impacts more than one building prototype, fill out the table below for each prototype. If prototypes established by the CEC are not adequate for assessing proposed measures, state the reasons why and describe the alternate building prototype to assess the impacts. If the measure impacts more than one occupancy such as retail and office, provide information about each prototype used in the analysis.

Describe the expected adoption rate absent of any regulation requiring the measure. Ensure that this assumption is discounted from the 30-year savings.

Table 6: LSC Savings Over 30-Year Period of Analysis

|  |  |  |  |
| --- | --- | --- | --- |
| Climate Zone | 30-Year Electricity LSC Savings(PV$) | 30-Year Natural Gas LSC Savings(PV$) | 30-Year Total Energy LSC Savings(PV$) |
| 1 |  |  |  |
| 2 |  |  |  |
| 3 |  |  |  |
| 4 |  |  |  |
| 5 |  |  |  |
| 6 |  |  |  |
| 7 |  |  |  |
| 8 |  |  |  |
| 9 |  |  |  |
| 10 |  |  |  |
| 11 |  |  |  |
| 12 |  |  |  |
| 13 |  |  |  |
| 14 |  |  |  |
| 15 |  |  |  |
| 16 |  |  |  |

## Incremental First Cost

Explain in brief how you determined the incremental cost of the proposed measure. Describe the interviews, cost databases, quotes, etc. used to develop the incremental cost estimate. If interviews were used, indicate how many people were contacted. Clearly state the source(s) you used for each assumption. If an interview script was used insert the script as one of the appendices to this proposal. You might also summarize the minimum, maximum, and average values. This information will help readers interpret your results. The incremental construction cost represents the incremental cost of the measure in comparison to the latest adopted version of the Energy Code. Design costs are not included in the incremental first cost. If incremental first costs are based on per square foot estimates, state the square footage range where these estimates are valid. See Appendix X for additional detail on development of the incremental cost.

## Incremental Maintenance Costs

Explain how you determined the incremental maintenance cost of the proposed measure. The incremental maintenance cost is the incremental cost of replacing the equipment or parts of the equipment, as well as periodic maintenance required to keep the equipment operating relative to current practices over the period of analysis of 30 years. The present value of equipment and maintenance costs or savings is calculated using the following equation:

$$Present Value of Maintenance Cost=Maintenance Cost ×\left⌊\frac{1}{1+d}\right⌋^{n}$$

Where:
d = the discount rate of 3%
n = the number of periods of 30 years

Describe the effective useful life, frequency of replacement, and maintenance procedures related to the measure relative to the maintenance requirements for the baseline using reference publications, interviews, or other methods of documenting these values. Specify how long energy savings from the proposed measure will persist and if persistence will be improved with verification, proper maintenance and/or commissioning.

Identify the period between maintenance activities, including equipment replacements. Please provide referenceable data sources when specifying effective useful life of equipment. For federally regulated equipment, consider aligning the effective useful life assumption with the assumption used by the Department of Energy. If an effective useful life is used that is different than the assumption used by the Department of Energy, explain the reason. See Appendix X for additional detail on development of the incremental maintenance cost.

If there is a net increase in the maintenance cost relative to existing conditions, then treat the incremental 30-year maintenance costs as incremental costs. If there is a net decrease in maintenance costs, then treat the 30-year maintenance cost savings as a benefit in the Benefit-Cost Ratio (BCR) analysis.

## Cost Effectiveness

Cost-effectiveness analysis is required to determine the economic impact of proposed measures over a 30-year period of analysis. This analysis must consider and include incremental energy savings for all impacted energy sources (electricity and natural gas), incremental first costs, and incremental maintenance costs over a 30-year period of analysis. Design costs and incremental costs associated with code compliance are not included in this analysis.

For purposes of the California Energy Code, a measure is cost-effective if the Benefit-Cost Ratio (BCR) is equal to or greater than 1.0. BCR is calculated by dividing the total present value cost benefits by the total present value costs.

Summarize cost-effectiveness results per unit and by applicable prototype in tables similar to Table 7. Describe the summary results and explicitly state whether we found the measure to be cost-effective in every climate zone or only is specific climate zones or specific applications.

If the measure does not propose mandatory or prescriptive requirements replace the previous paragraphs with, “This measure does not propose mandatory or prescriptive requirements. A cost-effectiveness analysis is not necessary because the measure is not proposed to be part of the baseline level of stringency.”

Table 7: Cost-effectiveness Summary

|  |  |  |  |
| --- | --- | --- | --- |
| Climate Zone | Benefit: Total Incremental LSC Savings and Other Savings(PV$) | Cost: Total Incremental First Costs and Maintenance Costs(PV$) | Benefit-Cost Ratio (BCR) |
| CZ 1 |  |  |  |
| CZ 2 |  |  |  |
| CZ 3 |  |  |  |
| CZ 4 |  |  |  |
| CZ 5 |  |  |  |
| CZ 6 |  |  |  |
| CZ 7 |  |  |  |
| CZ 8 |  |  |  |
| CZ 9 |  |  |  |
| CZ 10 |  |  |  |
| CZ 11 |  |  |  |
| CZ 12 |  |  |  |
| CZ 13 |  |  |  |
| CZ 14 |  |  |  |
| CZ 15 |  |  |  |
| CZ 16 |  |  |  |

# Statewide Impacts

This section provides the first year statewide savings of the proposed measure. This analysis is to help determine the overall value of the proposed measure to the State of California and is not used to determine cost effectiveness of the proposed measure. To assist with this analysis a statewide new construction forecast was developed by the CEC for 2029, which is presented in more detail in *Appendix A: Statewide Savings Methodology*. The first year energy impacts represent the first year annual savings from all buildings forecasted to be completed in 2029. This section also provides statewide greenhouse gas emissions savings, water use impacts, materials impacts and environmental impacts.

Describe the expected adoption rate absent of any regulation requiring the measure. Ensure that this assumption is discounted from the statewide impacts.

## Statewide Energy and Energy Cost Savings

Summarize the estimated statewide energy savings in a table similar to Table 8.

Table 8: Estimated Statewide Energy Savings

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | First Year Statewide Electricity Savings(GWh) | First Year Statewide Power Demand Reduction(MW) | First Year Statewide Natural Gas Savings(Million Therms) | First Year Statewide Electricity LSC Savings(PV$) | First Year Statewide Natural Gas LSC Savings(PV$) |
| Sub-measure 1 |  |  |  |  |  |
| Sub-measure 2  |  |  |  |  |  |
| **TOTAL** |  |  |  |  |  |

## Statewide Greenhouse Gas Emissions Savings

Using the appropriate hourly GHG Emissions factors published by the CEC, summarize the estimated statewide greenhouse gas emissions savings in a table similar to Table 9.

Table 9: Estimated Statewide Greenhouse Gas Emissions Savings

|  |  |  |
| --- | --- | --- |
|  | First Year StatewideGHG Emission Savings(MT CO2e/year) | First Year StatewideGHG Emissions Savings(PV$) |
| Sub-measure 1 |  |  |
| Sub-measure 2  |  |  |
| **TOTAL** |  |  |

## Statewide Water Savings

If the proposed measure results in increased or decreased water use in the state, summarize the estimated water savings in a table similar to Table 10 and include any detailed assumptions used to support the analysis. Specify if the increased or decreased water use occurs indoors or outdoors. The following conversion factors can be used to determine embedded electricity savings from reduced or increased water use: 4,848 kWh/million gallons (indoor water use, and 3,565 kWh/million gallons (outdoor water use. See *Appendix B: Embedded Electricity in Water Methodology* for additional information on the embedded electricity savings estimates.

Table 10: Estimated Statewide Water Savings

|  |  |  |  |
| --- | --- | --- | --- |
|  | First Year Statewide Indoor Water Savings(gallons/year) | First Year Statewide Outdoor Water Savings (gallons/year) | First Year Statewide Embedded Electricity Savings(kWh/year) |
| Sub-measure 1 |  |  |  |
| Sub-measure 2 |  |  |  |

## Statewide Material Impacts

Summarize any statewide impacts of the proposed measure on materials use. Include mercury, lead, copper, steel, plastic, silicon, gold, lithium, aluminum, fiberglass, glass, and wood. Delete any rows for materials that are not impacted by the proposed measure. Also, summarize any anticipated change in refrigerant type, global warming potential, charge and / or volume.

Table xx: Estimated Statewide Materials Impacts

|  |  |  |  |
| --- | --- | --- | --- |
| Material | Impact | Per Unit Impacts (pounds per square foot) | First Year Statewide Impacts (pounds) |
| Mercury | No change / Increase / Decrease |  |  |
| Lead |  |  |  |
| Copper |  |  |  |
| Steel |  |  |  |
| Plastic |  |  |  |
| Silicon |  |  |  |
| Gold |  |  |  |
| Lithium |  |  |  |
| Aluminum |  |  |  |
| Fiberglass |  |  |  |
| Glass |  |  |  |
| Wood |  |  |  |

## Environmental Impacts

Summarize any potential significant environmental benefits and/or adverse environmental effects resulting from the proposed measure. Include direct and indirect impacts, possible mitigation measures and, reasonable alternatives to the proposed measure that achieve the purpose of the proposal with less environmental effect. In brief, provide any rationale as to why these reasonable alternatives should or should not be taken.

## Other Impacts

Identify any other non-energy impacts such as impacts on criteria pollutants, human productivity, increased property valuation, or any other impacts not previously described in this proposal.

# Proposed Code Language

If possible, provide complete language change recommendations for the Energy Code, the Reference Appendices, and any other impacted supporting document. This section should have specific recommended language and contain enough detail to develop draft documents in the next phase of work. Use the language from the restructured 2025 Energy Code document(s) and use underline (new language) and ~~strikethrough~~ (deletions) to show edits to code language. The restructured 2025 Energy Code will be available by August 1, 2025, on the 2028 Energy Standards website, at <https://www.energy.ca.gov/programs-and-topics/programs/building-energy-efficiency-standards/2028-building-energy-efficiency>.

In developing code language, when using terms defined in the Energy Code, or the California Building Code, use the defined term. Consider readability in structuring the language. For example, whenever possible, break up sentences containing multiple requirements into lists of separate requirements.

## Energy Code (Title 24, Part 6)

Include marked up language for all relevant sections of the Energy Code, including the definitions section. If there are no proposed changes state “There are no proposed changes to the Energy Code.”

## Reference Appendices

Include marked up language for all relevant sections of the Energy Code Reference Appendices, including the glossary. If there are no proposed changes state “There are no proposed changes to the Reference Appendices.”

## Compliance Manuals

Include marked up language for all relevant sections of the Energy Code Compliance Manuals. The proposed language should describe how the proposed changes improve design suggestions to assist persons in conforming to the Energy Code. Ensure that proposed language remains within the scope of the measure (or existing code language). If there are no proposed changes, state “There are no proposed changes to the Compliance Manuals."

## ACM Reference Manuals

Include marked up language for all relevant sections of the ACM Reference Manual. The proposed language should describe how the software should treat the proposed design and the standard design and reference the required field verification protocols developed in the Reference Appendices. If there are no proposed changes state “There are no proposed changes to the ACM Reference Manuals."

## Compliance Forms

Include marked up language for specific Energy Code Compliance Documents (forms). The proposed language should describe how the proposed changes improve compliance verification for enforcement agencies. If there are no proposed changes state “There are no proposed changes to the compliance forms."

# References

List and describe each of the research studies, reports, and personal communications that provide background for this proposal. Identify all resources that have been pursued to further this measure. Identify all “experts” that were involved in further developing the change, all research and analysis reports and documents that were reviewed, and all industry standards that were consulted (e.g., ASTM, UL, ASHRAE test procedures, etc.). Include research that is underway that addresses the measure/change. Indicate if data or information will be produced in time to be used in this update of the Energy Code.

[CA DWR] California Department of Water Resources. 2016. “California Counties by Hydrologic Regions”. <http://www.water.ca.gov/landwateruse/images/maps/California-County.pdf>. Accessed April 3, 2016.

[CPUC] California Public Utilities Commission. 2015a. “Water/Energy Cost-Effectiveness Analysis: Revised Final Report.” Prepared by Navigant Consulting, Inc. <http://www.cpuc.ca.gov/WorkArea/DownloadAsset.aspx?id=5360>.

[CPUC] California Public Utilities Commission. 2015b. “Water/Energy Cost-Effectiveness Analysis: Errata to the Revised Final Report.” Prepared by Navigant Consulting, Inc. <http://www.cpuc.ca.gov/WorkArea/DownloadAsset.aspx?id=5350>

[CARB] California Air Resources Board. 2010. “Proposed Regulation for a California Renewable Electricity Standard Staff Report: Initial Statement of Reasons Appendix D.” <http://www.arb.ca.gov/regact/2010/res2010/res10d.pdf>. Accessed November 12, 2013.

U.S. Census Bureau. 2014. Population Division. “Annual Estimates of the Resident Population: April 1, 2010 to July 1, 2014.” <http://factfinder2.census.gov/bkmk/table/1.0/en/PEP/2014/PEPANNRES/0400000US06.05000>.

[U.S. EPA] United States Environmental Protection Agency. 2011. “Emission Factors for Greenhouse Gas Inventories.” <http://www.epa.gov/climateleadership/documents/emission-factors.pdf>. Accessed December 2, 2013.

[CPUC] California Public Utilities Commission Energy Division. 2022. “Water-Energy Calculator 2.0 Project Report.” Prepared by SBW Consulting, Inc. <https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/documents/water-energy-nexus/we-calc20-project-report.pdf>.

Delete this reference if they do not apply to the proposal.

[U.S. EPA] United States Environmental Protection Agency. 2011. “Emission Factors for Greenhouse Gas Inventories.” <http://www.epa.gov/climateleadership/documents/emission-factors.pdf>. Accessed December 2, 2013.

Reference Citations

The full reference citation should be provided in the reference list at the end of this proposal.

* When a reference is cited in the the body of the measure proposal, the acronym of the authoring organization or the author’s last name and publication date should be cited. :
	+ (EIA 1992) for EIA Energy Information Administration. 1992.
* For three authors or less, all authors’ names should be cited in the text. If there are more than three authors, cite first author’s name, followed by et al.:
	+ (Smith, Jones & Clark 1992) Note “&” and no comma before date.
	+ (Jones et al. 1991) Note no italics for “et al.” and period after “al.”
* Multiple cites should be cited in alphabetical (not chronological) order:
	+ (Smith 1989; Tenenbaum 1992) Note semicolons between cites of different authors.
* Multiple cites for the same author should be listed chronologically, earliest first. If there is more than one citation for same year, use “a,” “b,” etc. after the year according to the alphabetical order of the titles:
	+ (Kelley 1986a, 1986b, 1990) Note commas between multiple items of the same author.
* Statistics, quotations, and other specific information should be cited with a specific page number:
	+ (Smith 1990, 125–26) Note no “p.” for page number, en dash used between page numbers, and only last two digits given for page numbers over 100.
	+ (Kelley 1986a, 10; 1986b, 13–23; 1987) Note use of semicolons between cites if page numbers are used.

## Reference List

List all references for text, tables, and figures alphabetically by author(s) at the end of this proposal, per style shown below.Single-space citations. The first line of each citation should be indented at the same level as Normal Text (0.13’) flush left with the margin. Indent following lines with paragraph indent. Do not number. Skip one line between citations.

Each citation should include full bibliographical information: author(s)’ first and last name(s) (initials may be used instead of first names); year published; title of journal article or chapter in book; title of journal, book, or monograph; book editor(s); and place of publication and publisher (with the exception of journals).

Follow examples below for style, including capitalization, use of italics and quotes, information cited, and spacing.

### Works by the Same Author

* Cite all works by the author alone first: chronologically, earliest first. If there is more than one citation for the same year, use “a,” “b,” etc., with the date, according to the alphabetical order of the titles.
* For author plus one or more other authors: cite alphabetically according to the names of the second authors (and chronologically as above if authors are the same for more than one work). If there is more than one citation for the same year for the same set of authors, use “a,” “b,” etc. as with a single author, above.
* Do not use “et al.” in this reference list. List all authors with each citation.

### Italics

Use italics for titles of books, journals, and published monographs. Italics should be used for titles of articles that can “stand alone” as a published work.

### Page Numbers

Specific page numbers for statistics, quotations, and other specific information should be included with the reference citation in the text, not in the reference list. Inclusive page numbers for journal articles and book chapters should be cited in the reference list. Note that the word “page” or the abbreviation “p.” is not used with page numbers.

### Abbreviations of Names of States

Use *Chicago Manual of Style* abbreviations (not postal service abbreviations). For example, use Mont. instead of MT; Tenn. instead of TN; Calif. instead of CA.

### Reference List Examples

Carefully note the position of authors’ last names; placement of date; punctuation; spacing; capitalization; use of italics and quotation marks; citation of journal volumes, numbers, and pages; and type of information given in citation.

### Books

Bleviss, D. 1988. The New Oil Crisis and Fuel Economy Technologies: Preparing the Light Transportation Industry for the 1990s, Volume I. New York, N.Y.: Quorum Press.

Burwell, D.G., K. Bartholomew & D. Gordon. 1990. “Energy and Environmental Research Needs.” In Transportation, Urban Form, and the Environment. Special Report 231. Washington, D.C.: Transportation Research Board.

Rashid, M., ed. 1989. The Complete Guide to D.C.’s Native American Restaurants. Berkeley, Conn.: Island Press.

### Journal Articles

Abraham, D.L. 1990. “An Analysis of the Effects of Introducing M&M’s to a D.C. Office.” *Washington Gossip* 11 (3): 37–57.

Buchnew, H. & R. Povel. 1982. “The Daimler-Benz Hydride Vehicle Project.” *International Journal of Hydrogen Energy* 7: 259–66.

Murphy, L. 1993. “Life at ACEEE: Myth vs. Reality.” *New Yorker* (spring): 119–175.

Note: for the first example, 11=volume, 3=issue number, and 37–57=page numbers. For the third, spring=issue and 119–175=page numbers.

### Newspapers

Stone, B. 1991. “Snow: How It Affects D.C. Drivers’ Brains.” *Washington Post Health Magazine*. February 29.

### Published Reports

Davis, S. & P. Hu. 1991. *Transportation Energy Date Book (Draft)*. 11th ed. ORNL-6649. Oak Ridge, Tenn.: Oak Ridge National Laboratory.

### Unpublished Papers Presented at a Meeting

DeRissicio, J. 1991. “How I Spend My Mornings.” Paper presented at the Socioeconomic Energy Research and Analysis Conference, Baltimore, Md., June 27–28.

### Personal Communications

Sweirenga, John (National Association of Associations). 1991. Personal communication. August 12.

### Printed Proceedings

Berkowitz, P. & P. Newman. 1988. “Reinventing the WHEEL: An Integrated Approach to Energy Efficiency in the Rental Housing Sector.” In *Proceedings of the ACEEE 1988 Summer Study on Energy Efficiency in Buildings*, 5:28–32. Washington, D.C.: American Council for an Energy-Efficient Economy.

### Web sites

BoC U.S. Bureau of the Census. 1999. "Refrigeration, Air Conditioning, and Warm Air Heating Equipment, 1998." Current Industrial Reports. <http://census.gov/ftp/pub/> industry/1/ma35m98.pdf. Washington, D.C.: U.S. Bureau of the Census.

BOMA Building Owners and Managers Association. 2000. http://www.boma.org/index.htm. Washington, D.C.: Building Owners and Managers Association.

CAISO California Independent System Operator. 2000. http://www.caiso.com/clientserv/load. Folsom, Calif.: California Independent System Operator.

Conectiv Power Delivery. 2000a. <http://www.smartstartbuildings.com/> main/pdf/pres\_lite.pdf. Wilmington, Del.: Conectiv Power Delivery.

\_\_\_. 2000b. http://www.smartstartbuildings.com/main/pdf/perf\_lite.pdf. Wilmington, Del.: Conectiv Power Delivery.

\_\_\_. 2000c. http://www.smartstartbuildings.com/main/pdf/chillers.pd. Wilmington, Del.: Conectiv Power Delivery.

LRC Lighting Research Center, Rensselaer Polytechnic Institute. 2000. “Alternatives to Halogen Torchieres.” *Lighting Answers*, 5 (1). http://.lrc.rpi.edu/nlpip/online/la-torch/quest\_two.html.

Meier, A. & W. Huber. 2000. *Results from the Investigations on Leaking Electricity in the U.S.A.* http://[.eetd.lbl.gov/EA/reports/40909](http://eetd.lbl.gov/EA/reports/40909). Berkeley, Calif.: Lawrence Berkeley National Laboratory.

# Appendices

## Appendix A: Statewide Savings Methodology

Estimated statewide energy savings for the first year that the Energy Code becomes in effect (2029) can be generated by multiplying the proposed measure’s per unit savings by the provided statewide construction forecasts in this appendix.

The CEC has provided residential and nonresidential new construction forecasts for 2029, broken out by building type and forecast climate zones (FCZ). This data can be converted from FCZ to building climate zones (BCZ) using the weighting factors presented in Table 11. The CEC provided prototypes for all forecasted building types except for Controlled Environmental Horticulture, Grocery, Refrigerated Warehouse, Vehicle Service, Manufacturing and Miscellaneous. The Enclosed Parking Garage is included in the multifamily prototypes. Additionally, Table 14 provides more complete definitions of the various space types used in the forecast.

Updates to Appendix A, including updates to building start data, will be located on the 2028 Energy Code Pre-Rulemaking Docket 25-BSTD-03, <https://efiling.energy.ca.gov/Lists/DocketLog.aspx?docketnumber=25-BSTD-03>.

For table 18, estimate the first-year statewide expected installations of the given submeasure(s)/component(s) of the proposal by climate zone.

Table 11: FCZ to BCZ Conversion Factors (Table to be updated by CEC)

Forecast zones (FCZ) along X-axis, building climate zones (BCZ) along Y-axis

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Climate Zone | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** |
| **1** | 17.90% | 0.00% | 13.51% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| **2** | 0.00% | 0.00% | 80.20% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| **3** | 0.00% | 52.43% | 6.28% | 0.00% | 3.64% | 0.00% | 52.26% | 0.00% | 0.00% | 0.00% | 0.00% |
| **4** | 0.00% | 30.39% | 0.00% | 0.00% | 0.00% | 0.00% | 15.39% | 0.00% | 0.00% | 0.00% | 0.00% |
| **5** | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 32.33% | 0.00% | 0.18% | 0.00% | 0.00% |
| **6** | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.01% | 18.89% | 61.19% | 0.00% | 0.00% |
| **7** | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| **8** | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 43.99% | 0.00% | 0.00% | 0.00% |
| **9** | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 32.29% | 37.22% | 0.00% | 0.00% |
| **10** | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 71.19% |
| **11** | 0.42% | 0.00% | 0.00% | 84.77% | 22.07% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| **12** | 0.00% | 17.18% | 0.00% | 0.00% | 72.61% | 4.55% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| **13** | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 94.81% | 0.00% | 0.00% | 0.00% | 78.49% | 0.00% |
| **14** | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 4.51% | 0.00% | 12.10% | 24.17% |
| **15** | 3.18% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.10% |
| **16** | 78.50% | 0.00% | 0.01% | 15.23% | 1.68% | 0.64% | 0.00% | 0.33% | 1.41% | 9.41% | 4.55% |
| **Total** | **100.00%** | **100.00%** | **100.00%** | **100.00%** | **100.00%** | **100.00%** | **100.00%** | **100.00%** | **100.00%** | **100.00%** | **100.00%** |

**Table 11 (continued) (Table to be updated by CEC)**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Climate Zone | **11** | **12** | **13** | **14** | **15** | **16** | **17** | **18** | **19** | **20** |
| **1** | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| **2** | 0.00% | 0.00% | 0.00% | 0.00% | 0.19% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| **3** | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| **4** | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| **5** | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| **6** | 0.00% | 6.60% | 0.00% | 0.00% | 0.00% | 17.18% | 0.00% | 0.00% | 0.00% | 0.00% |
| **7** | 0.00% | 62.81% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| **8** | 0.00% | 1.94% | 0.00% | 0.00% | 0.00% | 27.90% | 0.00% | 0.00% | 0.00% | 0.00% |
| **9** | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 54.92% | 99.35% | 100.00% | 0.00% | 0.00% |
| **10** | 86.11% | 27.88% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| **11** | 0.00% | 0.00% | 0.42% | 0.00% | 44.55% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| **12** | 0.00% | 0.00% | 99.58% | 100.00% | 52.65% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| **13** | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| **14** | 0.00% | 0.66% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.02% | 0.00% |
| **15** | 13.33% | 0.12% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 99.98% | 0.00% |
| **16** | 0.56% | 0.00% | 0.00% | 0.00% | 2.61% | 0.00% | 0.65% | 0.00% | 0.00% | 100.00% |
| **Total** | **100.00%** | **100.00%** | **100.00%** | **100.00%** | **100.00%** | **100.00%** | **100.00%** | **100.00%** | **100.00%** | **100.00%** |

**Table 12: Statewide Residential Units (2029) (Table to be updated by CEC)**

| **Climate Zone** | **Single-Family Units** | **Multifamily Units** |
| --- | --- | --- |
| 1 | 44,875 | 17,558 |
| 2 | 265,807 | 105,894 |
| 3 | 972,513 | 553,186 |
| 4 | 497,321 | 288,786 |
| 5 | 97,271 | 45,671 |
| 6 | 594,544 | 322,513 |
| 7 | 494,355 | 307,272 |
| 8 | 926,278 | 515,137 |
| 9 | 1,250,479 | 1,117,605 |
| 10 | 1,067,399 | 329,302 |
| 11 | 335,468 | 85,339 |
| 12 | 1,318,779 | 471,876 |
| 13 | 634,709 | 157,075 |
| 14 | 247,852 | 83,480 |
| 15 | 177,670 | 41,152 |
| 16 | 97,937 | 28,066 |
| Total | 9,023,257 | 4,469,912 |

**Table 13: Statewide Residential New Construction (2029) (Table to be updated by CEC)**

|  |  |  |
| --- | --- | --- |
| **Climate Zone** | **Single-Family Units** | **Multifamily Units** |
| 1 | 359 | 144 |
| 2 | 1,861 | 1,391 |
| 3 | 3,035 | 7,699 |
| 4 | 2,689 | 3,417 |
| 5 | 616 | 285 |
| 6 | 1,719 | 2,243 |
| 7 | 1,869 | 5,156 |
| 8 | 4,163 | 8,600 |
| 9 | 4,286 | 10,302 |
| 10 | 7,950 | 4,306 |
| 11 | 5,840 | 1,173 |
| 12 | 14,542 | 5,537 |
| 13 | 7,257 | 1,009 |
| 14 | 3,739 | 1,446 |
| 15 | 3,160 | 373 |
| 16 | 1,937 | 187 |
| Total | 65,022 | 53,268 |

Table 14: Statewide Nonresidential New Construction Building Types

|  |  |  |  |
| --- | --- | --- | --- |
| **Forecast Building Types** | **Uses** | **Number of Stories** | **Floor Area (sf)** |
| Assembly | Gatherings including, but not limited to: Arenas, Coliseums, Auditoriums, Transportation Terminals, Clubs and Lodges, Exhibition Halls, Funeral or Internment Facilities, Religious Buildings, Libraries, Museums, Theaters, Recreational and Exercise Facilities. | Any | Any |
| Controlled-environment Horticulture | Buildings with indoor conditioned spaces used for agriculture. | Any | Any |
| Hospital | Hospitals, Clinics, and Nursing Convalescent Facilities | Any | Any |
| Hotel | Hotels and Motels | Any | Any |
| Laboratory | Laboratories | Any | Any |
| Large Office | Offices, Banks and Financial Institutions, Government Services Buildings, Post Offices | ≥ 5 | Any |
| Medium Office | Offices, Banks and Financial Institutions, Government Services Buildings, Post Offices | 2 - 4 | Any |
| Small Office | Offices, Banks and Financial Institutions, Government Services Buildings, Post Offices | 1 | Any |
| Restaurant | Food and/or Beverage Service | Any | Any |
| Large Retail | Stores and Other Mercantile Buildings | Any | ≥ 50k |
| Medium Retail | Stores and Other Mercantile Buildings | Any | < 50k |
| Grocery | Stores and Other Mercantile Buildings used for the sale of food items | Any | Any |
| Strip Mall Retail | Shopping Centers | Any | Any |
| Large School | Schools and Educational Facilities | Any | ≥ 50k |
| Small School | Schools and Educational Facilities | Any | < 50k |
| Warehouse | Warehouses and Freight Terminals | Any | Any |
| **Forecast Building Types** | **Uses** | **Number of Stories** | **Floor Area (sf)** |
| Refrigerated Warehouse | Refrigerated Warehouses | Any | Any |
| Vehicle Service | Auto, Aircraft, Bus, Truck, Railroad, Boat, or any other Vehicle Servicing Facility | Any | Any |
| Manufacturing | Manufacturing Facilities | Any | Any |
| Enclosed Parking Garage | Parking Garages enclosed by walls and a roof with rooftop parking. | Any | Any |
| Open Parking Garage | Parking Garages that are open to the ambient environment. Parking lots with canopies are not considered Parking Garages. | Any | Any |
| Miscellaneous | Miscellaneous Non-Residential Buildings.  | Any | Any |

Table 15: Statewide Nonresidential New Construction Distribution

|  |  |  |  |
| --- | --- | --- | --- |
| Type of Nonresidential Space | Sub-measure 1 | Sub-measure 2 | Sub-measure 3 |
| Assembly | 20% | 80% | 80% |
| Controlled-environment Horticulture | 20% | 80% | 80% |
| Hospital | 20% | 80% | 80% |
| Hotel | 20% | 80% | 80% |
| Laboratory | 20% | 80% | 80% |
| Large Office | N/A | N/A | N/A |
| Medium Office | 20% | 80% | 80% |
| Small Office | 20% | 80% | 80% |
| Restaurant | N/A | N/A | N/A |
| Large Retail | 20% | 80% | 80% |
| Medium Retail | 20% | 80% | 80% |
| Grocery | 20% | 80% | 80% |
| Strip Mall Retail | 20% | 80% | 80% |
| Large School | 20% | 80% | 80% |
| Small School | 20% | 80% | 80% |
| Warehouse | 20% | 80% | 80% |
| Refrigerated Warehouse | 20% | 80% | 80% |
| Vehicle Service | N/A | N/A | N/A |
| Manufacturing | 20% | 80% | 80% |
| Enclosed Parking Garage | 20% | 80% | 80% |
| Open Parking Garage | N/A | N/A | N/A |
| Miscellaneous | 20% | 80% | 80% |

Table 16: Statewide Nonresidential New Construction (2029 in Million ft²) (Table to be updated by CEC)

Source: CEC

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Space Type** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** | **15** | **16** |
| Large Office | 0 | 0 | 3.234 | 1.578 | 0 | 1.422 | 0.825 | 2.288 | 4.152 | 0.3916 | 0.1088 | 0.5747 | 0 | 0.2002 | 0.01303 | 0.04995 |
| Medium Office | 0.1302 | 0.4761 | 1.372 | 0.7442 | 0.3705 | 1.201 | 0.8046 | 1.646 | 3.184 | 1.174 | 0.2685 | 2.799 | 0.5859 | 0.3482 | 0.2629 | 0.102 |
| Small Office | 0.01306 | 0.4369 | 0.1869 | 0.02019 | 0.06423 | 0.1481 | 0.2339 | 0.1594 | 0.36 | 0.4167 | 0.0933 | 0.5443 | 0.3852 | 0.04404 | 0.1051 | 0.03313 |
| Large Retail | 0 | 0 | 1.097 | 0.5497 | 0.1491 | 0.6978 | 0.3746 | 0.8316 | 1.664 | 0.6327 | 0.2997 | 1.303 | 0.3564 | 0.1442 | 0.1803 | 0.05547 |
| Medium Retail | 0.08421 | 0.348 | 0.7947 | 0.4459 | 0.08574 | 0.6027 | 0.2856 | 0.8641 | 1.424 | 0.8224 | 0.142 | 0.6274 | 0.379 | 0.18 | 0.1242 | 0.08122 |
| Strip Mall | 0.001146 | 0.1543 | 0.504 | 0.2256 | 0.007439 | 0.5629 | 0.4878 | 0.9855 | 1.065 | 1.345 | 0.07164 | 0.5928 | 0.3253 | 0.3206 | 0.1001 | 0.0602 |
| Mixed-use Retail | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Large School | 0.006476 | 0.1273 | 0.8761 | 0.4418 | 0.03636 | 0.5941 | 0.6084 | 0.9052 | 1.421 | 0.8535 | 0.3545 | 1.152 | 0.6149 | 0.1661 | 0.08573 | 0.0681 |
| Small School | 0.0665 | 0.2698 | 0.4566 | 0.2294 | 0.1395 | 0.3155 | 0.2944 | 0.3516 | 0.6581 | 0.3481 | 0.09881 | 0.7763 | 0.3025 | 0.107 | 0.03728 | 0.04489 |
| Non-refrigerated Warehouse | 0.06177 | 0.3672 | 2.16 | 1.118 | 0.1776 | 1.363 | 0.7108 | 1.948 | 3.01 | 1.36 | 0.6315 | 2.844 | 0.8203 | 0.3618 | 0.3673 | 0.1381 |
| Hotel | 0.03627 | 0.2154 | 1.033 | 0.5306 | 0.1095 | 0.5527 | 0.4822 | 0.7835 | 1.183 | 0.5716 | 0.1534 | 0.8029 | 0.2557 | 0.1375 | 0.1248 | 0.04395 |
| Assembly | 0.01028 | 0.3935 | 1.583 | 0.5574 | 0.05869 | 0.7868 | 0.7991 | 1.431 | 1.824 | 1.144 | 0.1669 | 1.414 | 0.3043 | 0.2453 | 0.118 | 0.08429 |
| Hospital | 0.02939 | 0.1746 | 0.8416 | 0.4358 | 0.07972 | 0.3285 | 0.549 | 0.4412 | 0.7894 | 0.8128 | 0.1459 | 0.8253 | 0.2729 | 0.1417 | 0.115 | 0.04813 |
| Laboratory | 0.000819 | 0.0531 | 0.6313 | 0.3632 | 0.02078 | 0.07327 | 0.05265 | 0.1017 | 0.1214 | 0.06227 | 0.008372 | 0.04996 | 0.009723 | 0.01063 | 0.006101 | 0.003518 |
| Restaurant | 0.0139 | 0.08256 | 0.3269 | 0.1667 | 0.03403 | 0.3365 | 0.2036 | 0.4933 | 0.8189 | 0.4129 | 0.07099 | 0.3135 | 0.1414 | 0.1015 | 0.04739 | 0.0296 |
| Enclosed Parking Garage | 0.000176 | 0.009137 | 1.83 | 1.245 | 0.004558 | 2.585 | 0.7059 | 2.265 | 1.527 | 0.05053 | 0.001585 | 0.04116 | 0.002972 | 0.0152 | 0.003691 | 0.007247 |
| Open Parking Garage | 0.002272 | 0.1182 | 2.474 | 1.682 | 0.05894 | 3.648 | 1.201 | 3.197 | 2.155 | 0.6535 | 0.0205 | 0.5323 | 0.03843 | 0.1965 | 0.04773 | 0.09372 |

**Table 16: (Continued, Non-Prototype Building Types) (Table to be updated by CEC)**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Building Type** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** | **15** | **16** |
| Grocery | 0.006871 | 0.04512 | 0.1048 | 0.06175 | 0.01187 | 0.04649 | 0.01716 | 0.0519 | 0.09145 | 0.0494 | 0.00891 | 0.03876 | 0.02276 | 0.01081 | 0.007629 | 0.006042 |
| Refrigerated Warehouse | 0 | 0 | 0.06098 | 0.05067 | 0.01431 | 0.02204 | 0 | 0.00683 | 0.01322 | 0.03874 | 0 | 0.06849 | 0.1181 | 0.007633 | 0.007893 | 0.00517 |
| Controlled-environment Horticulture | 0.09265 | 0.07749 | 0.3197 | 0.03986 | 0.2021 | 0.2578 | 0.001464 | 0.02342 | 0.02606 | 0.278 | 0.3027 | 0.3053 | 0.09011 | 0.01079 | 0.04796 | 0.004662 |
| Vehicle Service | 0.001921 | 0.07746 | 0.5473 | 0.3582 | 0.02914 | 0.5513 | 0.3416 | 0.7989 | 1.809 | 0.5735 | 0.02149 | 0.3892 | 0.2476 | 0.1954 | 0.05667 | 0.04908 |
| Manufacturing | 0.00564 | 0.1329 | 0.4035 | 0.1914 | 0.05985 | 0.1284 | 0.08885 | 0.1075 | 0.095 | 0.1144 | 0.06035 | 0.1555 | 0.02059 | 0.02453 | 0.01736 | 0.01262 |
| Miscellaneous | 0 | 0 | 0.000253 | 0.4212 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.000774 | 0 | 0 | 0 | 0 |

Table 17: Statewide Nonresidential Construction (2029 in Million ft²) (Table to be updated by CEC)

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Space Type** | **1** | **2** | **3** |  | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** | **15** | **16** |
| Large Office | 0.1275 | 3.102 | 139.8 | 72.35 | 1.832 | 99.54 | 72.71 | 162.6 | 303.1 | 58.48 | 2.608 | 78.61 | 9.264 | 20.27 | 4.434 | 4.663 | 3.102 |
| Medium Office | 3.379 | 30.99 | 78.79 | 42.28 | 13.32 | 47.81 | 43.87 | 59.11 | 86.34 | 66.69 | 16.94 | 101.7 | 25.18 | 13.33 | 10.25 | 4.063 | 30.99 |
| Small Office | 4.178 | 12.75 | 22.19 | 11.33 | 7.504 | 13.22 | 8.516 | 13.28 | 20.88 | 24.43 | 10.6 | 43.94 | 21.47 | 4.987 | 6.181 | 2.676 | 12.75 |
| Large Retail | 1.002 | 8.665 | 58.68 | 26.9 | 4.2 | 31.96 | 25.34 | 43.46 | 66.53 | 53.31 | 11.4 | 58.16 | 22.51 | 10.91 | 9.402 | 3.207 | 8.665 |
| Medium Retail | 1.176 | 13.11 | 44.52 | 25.74 | 5.433 | 44.27 | 34.66 | 66.72 | 108.2 | 66.89 | 10.37 | 60.5 | 24.15 | 15.53 | 8.769 | 5.17 | 13.11 |
| Strip Mall | 3.336 | 9.842 | 37.42 | 18.43 | 5.095 | 40.23 | 28.29 | 55.76 | 83.7 | 66.92 | 12.25 | 48.37 | 24.18 | 15.27 | 8.696 | 4.591 | 9.842 |
| Mixed-use Retail | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Large School | 0.7589 | 8.02 | 34.83 | 13.95 | 2.071 | 28.37 | 22.54 | 42.91 | 73.58 | 56.01 | 10.13 | 53.38 | 26.41 | 12.06 | 7.621 | 3.589 | 8.02 |
| Small School | 2.23 | 11.13 | 25.57 | 9.979 | 6.06 | 25.69 | 14.96 | 34.44 | 54.31 | 33.03 | 13.5 | 42.08 | 23.44 | 8.72 | 4.251 | 3.645 | 11.13 |
| Non-refrigerated Warehouse | 3.33 | 20.22 | 108.3 | 53.43 | 9.802 | 89.98 | 51.48 | 128.4 | 207.3 | 182.7 | 33.73 | 148.3 | 51.08 | 38.87 | 29.05 | 11.63 | 20.22 |
| Hotel | 1.771 | 10.52 | 48.1 | 24.73 | 5.011 | 30.49 | 32.66 | 41.97 | 66.01 | 37.09 | 7.218 | 40.53 | 13.08 | 8.006 | 5.876 | 2.439 | 10.52 |
| Assembly | 4.328 | 18.18 | 91.34 | 45.06 | 6.594 | 57.25 | 40.9 | 89.14 | 120.2 | 91.75 | 16.35 | 69.72 | 30.13 | 18.95 | 11.83 | 6.439 | 18.18 |
| Hospital | 1.866 | 11.09 | 48.33 | 24.67 | 5.055 | 28.25 | 27.15 | 40.77 | 69.88 | 39.6 | 11.11 | 53.18 | 22.49 | 8.802 | 5.034 | 3.234 | 11.09 |
| Laboratory | 0.1782 | 4.01 | 36.93 | 28.06 | 1.531 | 12.21 | 17.19 | 15.61 | 19.31 | 10.81 | 0.679 | 12.14 | 4.396 | 1.723 | 0.387 | 0.5716 | 4.01 |
| Restaurant | 0.6087 | 3.616 | 14.72 | 7.494 | 1.546 | 16.46 | 10.73 | 23.78 | 40 | 32.41 | 3.515 | 16.95 | 7.742 | 6.859 | 3.453 | 1.897 | 3.616 |
| Enclosed Parking Garage | 0.01696 | 0.5432 | 40.71 | 30.94 | 0.2988 | 29.15 | 20.67 | 58.41 | 72.53 | 2.673 | 0.345 | 3.09 | 0.4883 | 0.8543 | 0.1666 | 0.4343 | 0.5432 |
| Open Parking Garage | 0.2193 | 7.024 | 55.03 | 41.82 | 3.864 | 41.14 | 35.17 | 82.44 | 102.4 | 34.57 | 4.461 | 39.96 | 6.314 | 11.05 | 2.155 | 5.616 | 7.024 |

**Table 17: (Continued, Non-Prototype Building Types) (Table to be updated by CEC)**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Building Type** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** | **15** | **16** |
| Grocery | **0.09598** | **1.7** | **5.869** | **3.564** | **0.7523** | **3.415** | **2.082** | **4.008** | **6.951** | **4.018** | **0.6502** | **3.737** | **1.45** | **0.9323** | **0.5386** | **0.3846** |
| Refrigerated Warehouse | **0.004721** | **0.4556** | **0.9104** | **0.2123** | **0.3863** | **0.4566** | **0.02334** | **0.4213** | **0.7865** | **0.6521** | **0.2629** | **2.146** | **3.907** | **0.1842** | **0.1939** | **0.1444** |
| Controlled-environment Horticulture | **0.6988** | **0.4569** | **2.62** | **1.072** | **6.327** | **8.264** | **1.072** | **0.7413** | **1.599** | **3.609** | **2.513** | **4.533** | **5.36** | **0.4681** | **0.6443** | **0.2349** |
| Vehicle Service | **0.9073** | **6.184** | **33.65** | **15.98** | **2.971** | **33.73** | **23.08** | **49.52** | **81.78** | **56.54** | **6.296** | **38.32** | **18.24** | **15.09** | **6.18** | **3.543** |
| Manufacturing | **4.105** | **16.89** | **61.93** | **79.55** | **5.59** | **73.33** | **33.27** | **122.7** | **168.1** | **49.58** | **12.86** | **57.01** | **25.97** | **16.98** | **5.146** | **9.273** |
| Miscellaneous | **0.3582** | **6.575** | **9.025** | **6.318** | **0.2196** | **2.575** | **0.7716** | **3.778** | **7.868** | **2.551** | **3.367** | **14.35** | **2.935** | **0.7699** | **0.4029** | **1.026** |

Table 18: Statewide First-Year Projected Installation Totals

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** | **15** | **16** |
| Submeasure 1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Submeasure 2 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

## Appendix B: Embedded Electricity in Water Methodology

Delete this appendix if there are no on-site water savings associated with the proposed measure.

Embedded electricity use for indoor water use includes electricity used for water extraction, conveyance, treatment to potable quality, water distribution, wastewater collection, and wastewater treatment. Embedded electricity for outdoor water use includes all energy uses upstream of the customer; it does not include wastewater collection or wastewater treatment. The embedded electricity values do not include on-site energy uses for water, such as water heating and on-site pumping. On-site energy impacts are accounted for in the energy savings estimates presented in *Section 4 Energy Savings*.

Embedded electricity in water shall be determined according to the Water-Energy Calculator 2.0 Project Report, found at <https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/documents/water-energy-nexus/we-calc20-project-report.pdf>.

## Appendix C: Environmental Impacts Methodology

Greenhouse Gas Emissions Impacts Methodology

GHG emissions are calculated assuming the latest applicable GHG Emissions hourly factors published by the CEC and used by the CEC’s reference code compliance software (CBECC-Res and CBECC).

Water Use and Water Quality Impacts Methodology

State any assumptions used to estimate impacts on water use and water quality, separate from using the embedded energy in water values specified in Appendix B to derive electricity costs or savings.

Potential Significant Environmental Effect of Proposal

The CEC is the lead agency under the California Environmental Quality Act (CEQA) for the 2028 Energy Code and must evaluate any potential significant environmental effects resulting from the proposed Energy Code. A “significant effect on the environment” is “a substantial adverse change in the physical conditions which exist in the area affected by the proposed project.” (Cal. Code Regs., tit. 14, § 15002(g).)

If a proposed project will not have significant effect on the environment, the lead agency may publish a negative declaration. If a proposed project may have significant effect on the environment, but that effect can be sufficiently mitigated, the lead agency can publish a mitigated negative declaration. However substantial evidence of a “significant effect on the environment” will result in the development of an Environmental Impact Report (EIR), consistent with California Code of Regulations, Title 14, Article 7, section 15080, et seq.

Additionally, the CEC may determine that a categorical exemption from CEQA is appropriate because the proposal has a positive impact on the environment. The CEC may make such a determination if the proposal is, among other things, taken to “assure the maintenance, restoration, enhancement of a natural resource” or the environment. (Cal. Code Regs., tit. 14, § 15307 and 15308.)

Direct Environmental Impacts

**Direct Environmental Benefits**

Please include any studies, data, or other information that demonstrates the direct environmental benefits of the proposed measure.

**Direct Adverse Environmental Impacts**

Please include any studies, data, or other information that demonstrates the direct adverse environmental impacts of the proposed measure. Please also include in Section 7.4 potential mitigation measures, as described below.

Indirect Environmental Impacts

**Indirect Environmental Benefits**

Please include any studies, data, or other information that demonstrates the indirect environmental benefits of the proposed measure.

**Direct Adverse Environmental Impacts**

Please include any studies, data, or other information that demonstrates the indirect adverse environmental impacts of the proposed measure. Please also include potential mitigation measures.

Mitigation Measures

If a proposal will result in a significant effect on the environment, CEQA authorizes lead agencies to include mitigation measures to reduce the environmental impact of the project. (Cal. Code Regs. Tit. 14, § 15041.)

Consider, and if possible, provide opportunities to minimize the environmental impact of the proposed measure, including an evaluation of “specific economic, environmental, legal, social, and technological factors.” (Cal. Code Regs., tit. 14, § 15021.)

Reasonable Alternatives to Proposal

If an EIR is developed, CEQA requires a lead agency to evaluate reasonable alternatives to proposals that would have a significant adverse effect on the environment, including a “no project” alternative. (Cal. Code Regs. Tit. 14, §§ 15002(h)(4) and 15126.6.)

Consider, and if possible, provide reasonable alternatives to the proposed measure that achieves the purpose of the proposal with less environmental effect. Provide any rationale as to why these reasonable alternatives should or should not be taken.

## Appendix D: CBECC Software Specification

Create a software specification for the proposed measure describing how the compliance software shall be written to accurately reflect the measure. The specification should describe the information needed by the CBECC development team to implement changes to the compliance software. This specification should include but may not be limited to:

* Description and mockup of CBECC user inputs – including identification of the range limits and tooltip descriptions.
* Determination of the simulation engine inputs and outputs.
* Identification of report variables (for debugging purposes).
* At least two simulation engine models with the proposed measure and a comparison case that demonstrates the recommended modeling approach.
* List of compliance report variables, what ECC-Rater flags are needed, and subsequent details needed for field verification, and a mockup of the PRF-01 tables to document the modeling of the feature.
* Additional terms to be added to the Standards Data Dictionary (SDD) for all the needed variables.
* Development of the logic to be implemented in the compliance software ruleset to collect and check user inputs.
* Any new schedules, and any additional data needed to calculate or otherwise generate values needed for simulation.
* For nonresidential measures, explanation of EnergyPlus input file changes based on user inputs or rule calculated values.
* Discussion of how the proposed measure could be affected by various building model combinations (space-type, system type, number of stories, mixed use, etc.).
* Description of what building or space types should be included or excluded.

## Appendix X: Key assumptions, modeling approaches used in Cost-effectiveness analysis

Note: This Appendix is only necessary for cost-effectiveness analyses that are sufficiently complex that the description provided in Chapter 4 is insufficient for a stakeholder to reproduce the analysis.

This Appendix details key assumptions and modeling approaches used to develop energy savings estimates and costs used in the overall cost-effectiveness analysis for the proposed measure, which is summarized in Chapter 4.

**Modeling Approach**

Provide details on any novel modeling approaches used to develop the energy savings estimates needed to reproduce the analysis. For example, if an object that is not currently available in the compliance software was used to model a piece of equipment, provide sufficient detail on that object to allow evaluation by stakeholders.

**Incremental First Cost**

Include sufficient detail on development of the incremental first cost to allow a stakeholder to reproduce the analysis. For example, if in developing an incremental first cost for a commercial HVAC system, number of units was based on an average number of units per square foot, describe the approach and list the metric used. If incremental first costs are based on per square foot estimates, state the square footage range where these estimates are valid.

**Incremental Maintenance Cost**

Include sufficient detail on development of the incremental maintenance cost to allow a stakeholder to reproduce the analysis. For example, if incremental maintenance cost for a commercial HVAC system was based on an average incremental maintenance cost per number of indoor units installed, please describe the approach and list the metrics used.