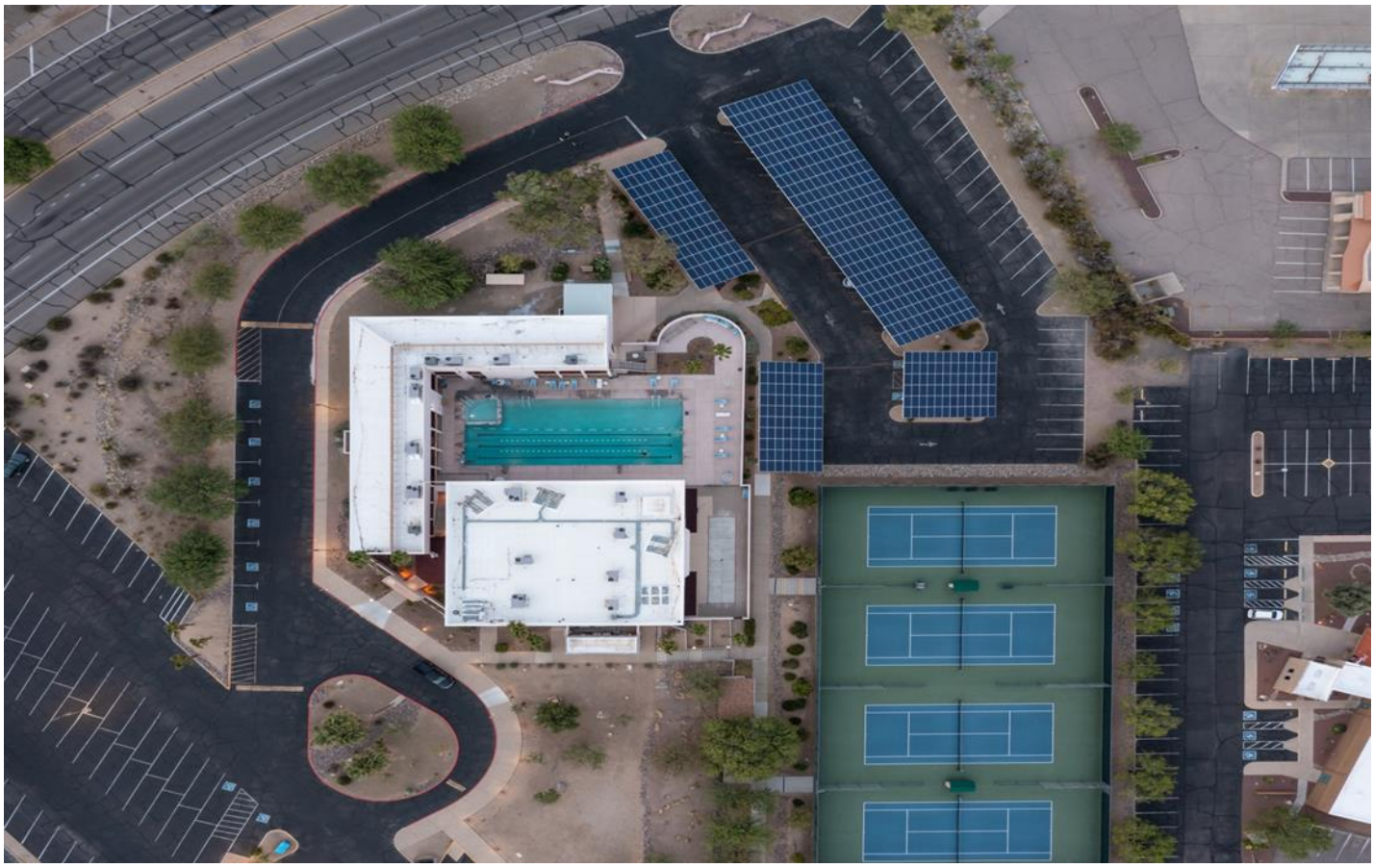
Codes and Standards Enhancement (CASE) Initiative

2028 California Energy Code

Swimming Pool and Spa Heating



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Executive Summary

This proposal presents updates to the current pool heating requirements for nonresidential new construction and certain existing nonresidential pools and spas. The Statewide Codes and Standards Enhancement (CASE) Team developed this proposal for submission to the California Energy Commission (CEC) for potential inclusion in the 2028 update to the California Energy Code. To be adopted, each proposed measure must be both cost effective and technically feasible.

Stakeholder engagement included emails, individual stakeholder meetings, and three public stakeholder workshops held on September 30, 2025, October 29, 2025, and March 17, 2026. The Statewide CASE Team revised the proposal with feedback and expertise from more than 50 entities representing industry associations, manufacturers, installers, solar thermal system designers, swimming pool and related nonprofit groups, construction and trade groups, subject matter experts, state and local governments, and others. Stakeholder feedback led to significant refinements to improve feasibility for retrofit projects. The Team surveyed 32 pools in Los Angeles County to address concerns about upfront cost and available roof area. Based on feedback, the Statewide CASE Team reduced the minimum solar collector sizing requirement from 65 percent to 40 percent, clarified that solar thermal systems are not intended to replace all other heating sources, added a compliance option for 94 percent efficient gas heaters, and used a more conservative 15-year lifetime for cost-effectiveness analysis.

The Statewide CASE Team recognizes ongoing systemic inequities in environmental and social justice (ESJ) communities and is developing code change proposals with careful consideration of potential unintended impacts. The Statewide CASE Team reviewed impacts through the lens of cost, health, resiliency, and comfort for nonresidential building types used by ESJ communities. The proposal includes lower-cost compliance flexibility through a high-efficiency gas heater option and is expected to reduce point-source air emissions from gas pool heating, which can provide health benefits over time for ESJ communities.

Proposed Code Change

The proposed code change would expand existing pool heating requirements from new construction to certain existing nonresidential pools and spas, excluding portable electric spas and pools serving Group R Occupancy or common and public use areas serving that occupancy. The six compliance options would include solar thermal pool and spa heating systems, heat pump pool heaters (HPPHs) meeting sizing and controls requirements, on-site renewable energy, site-recovered energy, gas heaters with a thermal efficiency of 94 percent, or another system approved by the CEC Executive

Director. For the solar thermal compliance option, collector surface area would be at least 40 percent of the surface area of the nonresidential pool served. No requirements were proposed for Climate Zone 1 because the solar thermal option was not cost effective in that zone.

Benefits of Proposed Change

The measure would reduce dependence on nonrenewable energy sources for heated nonresidential swimming pools and spas, particularly natural gas. By reducing gas heating, the proposal would support California's long-term energy efficiency and greenhouse gas (GHG) reduction goals, and reduce pollutants that contribute to poor air quality, supporting cleaner and healthier environments for people and wildlife. Pool owners would benefit from lower energy consumption and utility bills.

Compliance and Enforcement

The proposed measure represents a substantive change for altered pool heating systems and would require targeted outreach, training, and ongoing support for code users and enforcement officials. Compliance would rely on review of required documentation, including NRCC-PLB-E (Nonresidential Certificate of Compliance – Plumbing) and NRCI-PLB-E (Nonresidential Certificate of Installation-Plumbing) forms. The proposed measure would not require field verification or acceptance testing, but additional guidance would be needed to help industry professionals understand when and how requirements apply to altered pools. The proposal builds on similar pool heating system sizing requirements established by the previous code cycle.

Market Assessment

California has a long history of solar thermal technology use, and the technology and design practices needed for this code change are common and readily available in the California market. Some cities exceed the proposed requirements and have already implemented all-electric aquatic centers, and some municipal and school pools have already implemented solar heating technologies.

There is variability in the layout and design of existing pool facilities that may limit the feasibility of one or more system types. The proposal offers compliance options that provide significant design flexibility, including options to use well-established technologies like condensing gas systems.

The Statewide CASE Team does not anticipate that the proposed changes would lead to the creation of new types of jobs or the elimination of existing types of jobs. The proposed change represents a modest adjustment to requirements for heating source replacements in existing pools, which would not excessively burden or competitively

disadvantage California businesses, nor would it necessarily lead to a competitive advantage.

Cost Effectiveness

One of the six compliance pathways must demonstrate cost effectiveness. The proposed solar thermal heating option is cost effective across all California climate zones except Climate Zone 1. Benefit-to-cost ratios (BCRs)[1] range from 1.2 to 7.7 depending on climate zone and pool prototype, with a conservative 15-year product lifetime basis used for cost-effectiveness analysis. The Statewide CASE Team performed pool heating simulations to calculate energy savings and relied on a detail solar thermal rebate database to estimate incremental costs. The Statewide CASE Team conducted a cost-effectiveness analysis for the condensing gas option, which is cost effective in all pool prototypes and climate zones.

First-Year Statewide Impacts

The proposal would provide significant statewide natural gas savings and associated GHG reductions by using solar heating as the primary heating source, with supplemental gas heating, for nonresidential pools.

Table 1: Summary of Statewide Impacts

Metric [a]	Total Statewide Impacts
Annual Electricity Savings (GWh)	N/A
Peak Demand Reduction (MW)	N/A
Annual Natural Gas Savings (Million Therms)	2.46
Annual Source Energy Savings (Million kBtu)	210.3
30-Year Long-term System Cost Savings (Million 2029 PV$)	$196.70
Annual Avoided GHG (Metric Tons CO2e/yr)	12,800

a. Values represent impacts from buildings permitted during the first year the code is in effect. Positive values indicate savings or reductions.

[1] The benefit-to-cost ratio (BCR) compares benefits or cost savings to costs over the 30-year period of analysis. Proposed code changes with a BCR of 1.0 or greater are cost effective.

Acronyms

Table 2 presents a list of acronyms used in this report. Title24stakeholders.com also maintains a glossary of terms.

Table 2: List of Acronyms

Acronym	Definition
ACM	Alternative Calculation Method
ADA	Americans with Disabilities Act
ANSI	American National Standards Institute
APSP	Association of Pool and Spa Professionals
ASHRAE	American Society of Heating, Refrigeration, and Air-Conditioning Engineers
ATT	Acceptance Test Technician
BCR	Benefit-to-cost Ratio
Btu	British Thermal Units
CALGreen	California Green Building Standards Code
CALSSA	California Solar and Storage Association
CASE	Codes and Standards Enhancement
CBSC	California Building Standards Commission
CBECC	California Building Energy Code Compliance Software
CBO	Community-Based Organization
CCCSH	California Coalition for Children's Safety and Health
CDPH	California Department of Public Health
CEC	California Energy Commission
CEQA	California Environmental Quality Act
CLICC	California Low-Income Consumer Coalition
COP	Coefficient of Performance
CPUC	California Public Utilities Commission
CSI	California Solar Initiative
CZ	Climate Zone
DAC	Disadvantaged Community
DOSH	Division of Occupational Safety and Health
ECC	Energy Code Compliance
ESJ	Environmental and Social Justice
GHG	Greenhouse Gas
GWh	Gigawatt-Hour
HPPH	Heat Pump Pool Heater

Acronym	Definition
ICC	International Code Council
ICC-SRCC	International Code Council - Solar Rating & Certification Corporation
IECC	International Energy Conservation Code
IOU	Investor-Owned Utility
ISO	International Organization for Standardization
ISPSC	International Swimming Pool and Spa Code
kBtu	Kilo-British Thermal Units
kBtu/year	Kilo-British Thermal Units Per Year
kWh	Kilowatt-Hour
kWh/year	Kilowatt-Hour Per Year
LMI	Low- and Moderate-Income
LSC	Long-term System Cost
MeasureSET	CASE Measure Savings Estimation Template
MG	Million Gallons of Water
MW	Megawatt
NPDI	Net Private Domestic Investment
NRCC	Nonresidential Certificate of Compliance
NRCI	Nonresidential Certificate of Installation
PEP	Public Engagement Plan
PHTA	Pool and Hot Tub Alliance
PV	Present Value
QCEW	Quarterly Census of Employment and Wages
SARA	Solar Access Roof Area
SME	Subject Matter Expert
SRCC	Solar Rating & Certification Corporation
USSSA	U.S. Swim School Association
W	Watt

1. Introduction

1.1 Report Context

California has one of the largest concentrations of commercial pools in the country (P.K. Data, Inc. 2023). Because many of these facilities are heated year-round, solar thermal systems offer substantial cumulative potential to offset a large portion of the natural gas used for pool water heating.

Currently, Title 24, Part 6 efficiency requirements apply only to new construction, such as when a new pool is installed with a new heating system or when an existing pool adds a heater for the first time. The current code provides flexibility for compliance, with options, including high-efficiency systems, such as solar thermal, heat pump pool heaters, on-site renewable energy, combinations of these systems, or other approaches approved by the California Energy Commission (CEC).

This proposal builds on that framework by expanding the scope of pool heating system sizing requirement from new construction to certain include existing commercial buildings. This scope expansion would not apply to hotel or motel pools, multifamily or residential pools.

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. These measures are submitted to the CEC for consideration and potential inclusion in California's Energy Code (Title 24, Part 6), which sets statewide energy efficiency requirements for newly constructed buildings and for additions and alterations to existing buildings. Measures may also be considered for inclusion in CALGreen (Title 24, Part 11) as voluntary energy efficiency standards, which would take effect only if adopted by a local jurisdiction 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.

1.2 Proposal Sponsors

Three California Investor-Owned Utilities (IOUs)—Pacific Gas & Electric Company, San Diego Gas & Electric, and Southern California Edison jointly sponsored this effort. Where the term "Statewide CASE Team" is used in this report, it refers to the authors and State Building Codes Advocacy activities supported through the Codes and Standards program

1.3 Stakeholder Engagement to Inform Proposal

This 2028 code change proposal builds upon the Statewide CASE Team's work in the previous code cycle's development of the "2025 Swimming Pool and Spa Heating CASE Report" proposal. The Statewide CASE Team values feedback from stakeholders, including data for energy modeling and cost-effectiveness assumptions. The Statewide CASE Team conducted extensive stakeholder outreach via emails, individual stakeholder meetings, and three public stakeholder workshops held on September 30, 2025, (Statewide CASE Team, (a) 2025), October 29, 2025 (Statewide CASE Team, (b) 2025), and March 17, 2026 (Statewide CASE Team, (c) 2026).

During these meetings, the Statewide CASE Team received valuable input from many stakeholders. Martin Aquatic Design and Engineering, Aquatherm Industries, and Counsilman-Hunsaker commented on the potential impacts of the proposed code change, market share of alterations, cost assumptions, the share of pools that would qualify for the Solar Access Roof Area (SARA) exception due to lack of roof area, and which pools to model to better represent the statewide stock in nonresidential applications. Technical input provided by the Pool and Hot Tub Association (PHTA), California Solar and Storage Association (CALSSA), Aquatherm Industries, Inc., and Hot Sun Industries, Inc. informed the Statewide Case Team's additional outreach efforts and the incremental cost assumptions for retrofits. PHTA helped the Statewide CASE Team better understand the impact of the proposed code change and clarified questions on the triggers and exceptions modified in Section 801.5.2.1.3. WaterWorks Swim Schools and U.S. Swim School Association (USSSA), California Coalition for Children's Safety and Health (CCCSH), Stop Drowning Now, and Drowning Prevention Foundation provided insights on the proposed code change's potential effects on swim schools as well as technical barriers and proposal costs.

This feedback prompted the Statewide CASE Team to conduct a survey of pools in LA County to determine available roof space near existing pools. The survey led the Statewide CASE Team to amend the proposal to improve its feasibility. The research also revealed more information on the market share of heated pools vs. unheated pools and common pool temperatures. In addition, prompted by feedback regarding the perceived impact of this measure on public schools and ESJ communities, the Statewide CASE Team investigated the feasibility of additional energy-efficient technology that would provide similar climate benefits to California, with a lower first incremental cost to pool owners.

The Statewide CASE Team considered significant feedback and expertise from more than 50 distinct entities representing industry associations, manufacturers, installers, solar thermal system designers, swimming pool and related non-profit groups, construction/trade groups, and individual subject matter experts (SMEs) including architects, engineers, permitting specialists, compliance and enforcement professionals,

state and local governments, and others. The Statewide CASE Team appreciates the many contributions that helped refine cost assumptions; provide data for modeling additional pools; and resulted in proposal revisions. Key revisions include:

- Reducing the requirement for the solar collector area from 65% to 40%, while allowing gas "supplemental" heating from a minimum efficiency gas pool heater to serve as backup heating when replacing an existing pool or spa heater.
- Adding the use of gas heaters with a thermal efficiency of 94% or greater as another compliance option,

The Statewide CASE Team determined that while these revisions reduce some energy savings, they allow more pools the ability to meet the requirement and help lower upfront costs while maintaining cost-effectiveness, directly addressing the cost concerns of some stakeholders. See Appendix E for additional details on the Statewide CASE Team's stakeholder engagement.

1.4 Addressing Energy Equity and Environmental Justice

The Statewide CASE Team recognizes, acknowledges, and accounts for a history of prejudice and inequality in environmental and social justice (ESJ) communities.[2] These issues persist today. To minimize the risk of perpetuating inequity, code change proposals were developed with intentional consideration of the unintended consequences on ESJ communities.

When analyzing impacts for nonresidential buildings, the Statewide CASE Team reviewed each nonresidential building type through the lens of the four criteria: cost, health, resiliency, and comfort. The Statewide CASE Team examined which building types are used by ESJ communities most frequently and evaluated the allocation of impacts related to the following areas among all populations. Some building types have unique environmental justice concerns due to their common uses, location, or other factors.

[2] The CPUC refers to ESJ communities as "low-income or communities of color that have been underrepresented in the policy setting or decision-making process, are subject to a disproportionate impact from one or more environmental hazards, and likely to experience disparate implementation of environmental regulations and socio-economic investments in their communities" (CPUC 2022). ESJ communities also include the CPUC definition for Disadvantaged Communities, which comprises "(1) Census tracts receiving the highest 25 percent of overall scores in CalEnviroScreen 4.0 (1,984 tracts); (2) Census tracts lacking overall scores in CalEnviroScreen 4.0 due to data gaps, but receiving the highest 5 percent of CalEnviroScreen 4.0 cumulative pollution burden scores (19 tracts); (3) Census tracts identified in the 2017 DAC designation as disadvantaged, regardless of their scores in CalEnviroScreen 4.0 (307 tracts); and (4) Lands under the control of federally recognized Tribes (OEHHA 2022).

The Statewide CASE Team will continue to build relationships with CBOs and other stakeholders to improve the identification of potential impacts for future code cycles and is open to additional resources that can contribute to this effort.

2. Measure Description

2.1 Proposed Code Change

The proposed code change would require existing indoor and outdoor pools, other than those serving group R occupancy and common or public areas serving group R occupancy, to meet pool heating system sizing requirements when replacing an existing pool heating system. The pools replacing their heating system would be required to comply with one of the following pathways: solar thermal pool or spa heating, electric heat pump pool heaters (HPPH), gas pool heaters with a thermal efficiency of 94 percent or higher as the only heating system, or on-site renewable or site-recovered energy. Section 7 of this report provides more information on the proposed code language, including sizing requirements for the different compliance pathways. Supplemental gas pool heaters would be allowed after meeting one of the proposed compliance requirements. Supplemental, minimally compliant gas pool heaters would not be allowed for the 94 percent efficiency gas heater option.

Since the Draft CASE Report, the Statewide CASE Team has introduced a new compliance pathway that would allow the use of a gas pool heater with a minimum thermal efficiency of approximately 94 percent. In addition, the required solar sizing for existing nonresidential pool heaters would be reduced to 40 percent of pool surface area, compared to the 65 percent of pool surface area requirement for nonresidential new construction.

The proposed requirements would likely apply to nonresidential pools and spas located at municipal facilities, medical centers, water parks, schools, sports clubs, and other membership-based facilities when an existing heating system is replaced.

Pools and spas in Group R occupancy buildings, including single family residential pools, multifamily pools, and pools at hotels or motels with an existing pool heater, would remain outside the scope of these proposed changes. These pools may replace their heating system with a new unit of the same technological type (e.g., gas-for-gas) without triggering these new proposed requirements, provided the new unit meets all applicable federal and state appliance standards.

The proposal mirrors the existing exceptions for new construction. These exceptions would include portable electric spas, permanent spas in buildings with existing natural gas service, pools or spas heated solely by solar, and permanent spas with inadequate SARA.

Gas pool heaters meeting the minimum federal appliance standards where applicable would remain a permissible supplemental heating source for any of the primary compliance pathways, except the 94 percent efficient gas heating option which is

required to be installed as the sole heating system. Gas pool heaters meeting the minimum federal appliance standards may also serve as a primary heat source if an exception applies.

The Statewide CASE Team would propose no new requirements for existing pools in Climate Zone 1. This region has very mild climate, with some of it within the coastal fog belt, offering shorter periods of sunlight. The Statewide CASE Team found that, due to these geographic conditions, solar thermal pool heating would not serve as a cost-effective option for Climate Zone 1.

The Statewide CASE Team proposes to remove the voluntary pool heater sizing requirements from Title 24, Part 11.

Table 3: Scope of Proposed Code Change

A ☑ indicates the proposed code change is relevant.

Building Type(s)	Construction Type(s)	Type of Change
☐ Single Family	☐ New Construction	☑ Mandatory
☐ Multifamily	☐ Additions	☐ Prescriptive
☑ Nonresidential (Not Occupancy R)	☑ Alterations	☐ Performance

Application Climate Zones	Energy Code Sections	Compliance Forms	Sections of ACM Reference Manuals
Climate Zones 2-16	Part 6, Section 800.3 Part 6, Section 801.1 Part 6, Section 801.5.2.1.3	NRCC-PLB-E NRCI-PLB-E	N/A

Third Party Verification)	Updates to Compliance Software
☑ No changes to third party verification	☑ No updates
☐ Update existing verification requirements	☐ Update existing feature
☐ Add new verification requirements	☐ Add new feature

2.2 Benefits of Proposed Change

The proposal for solar heating of existing pools represents a readily available and highly effective strategy for reducing reliance on conventional gas heating by preheating pool water when weather conditions are favorable. Some key benefits include:

- The proposed systems can reduce fossil fuel consumption which reduces air pollution and improves air quality, thereby reducing negative health impacts associated with asthma and related health concerns.
- Harnessing abundant solar energy can significantly reduce operating costs and is cost effective in all climate zones proposed.

- The reduction in natural gas consumption leads to a large reduction in greenhouse gas emissions, which aligns with the State of California's policy goals.
- The proposed code change can achieve benefits that include job creation in the solar industry such as in the design and installation of solar thermal collectors.
- This proposal is similar to work being done to update the International Energy Conservation Code (IECC) and ASHRAE 90.1.
- The proposed code change would more closely align the requirements for new and existing pools in the State of California. Having similar requirements for both retrofit and new construction and aligning them as much as possible with other national standards provides a more consistent baseline for market actors.

2.3 Background Information

2.3.1 Origin of Solar Pool Heating

Solar thermal collectors are a renewable energy technology that harnesses the sun's energy to generate heat. Solar thermal water heating has a long history in the United States, dating back to the early 1900s. Interest in the technology surged during the 1970s energy crisis, in part due to the support of the U.S. Department of Energy and research programs that helped modernize collector designs, improve controls, and establish testing and certification standards. Since the 2000s, this technology has become a mature and well-understood technology, mostly applied for domestic hot water and high load purposes, such as pool heating. While photovoltaic systems have captured more market attention, solar thermal heating remains one of the most efficient ways to convert sunlight into useable hot water.

2.3.2 Solar Pool Heating Operation

Solar thermal pool heating works only when heat from the sun is available. When solar collectors are warmer than pool water, pool water is pumped through collectors, as shown in Figure 1.

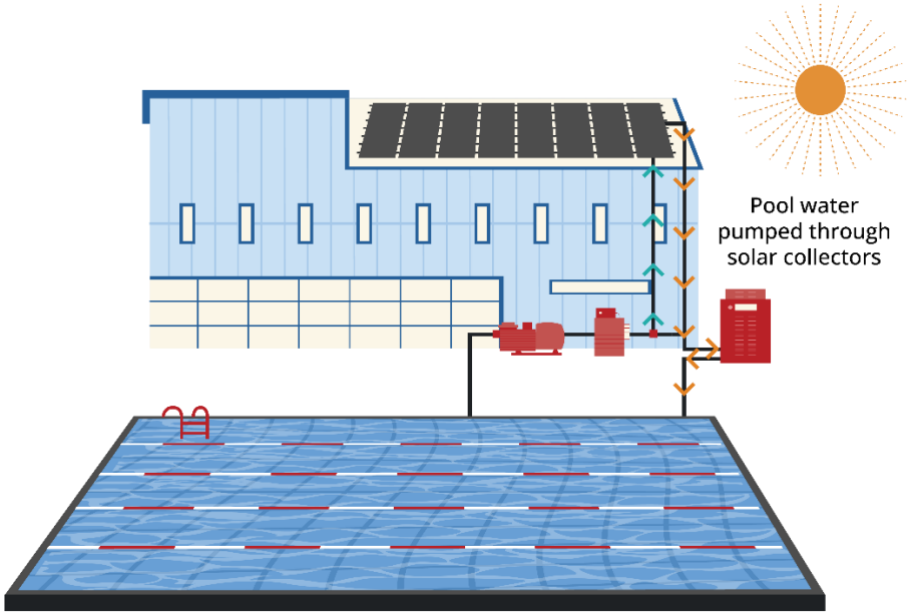

Figure 1: When collectors are warmer than pool water, the solar thermal operates.

When collectors are not warmer than the pool water, solar is bypassed and supplemental gas or HPPH is used, as shown in Figure 2.

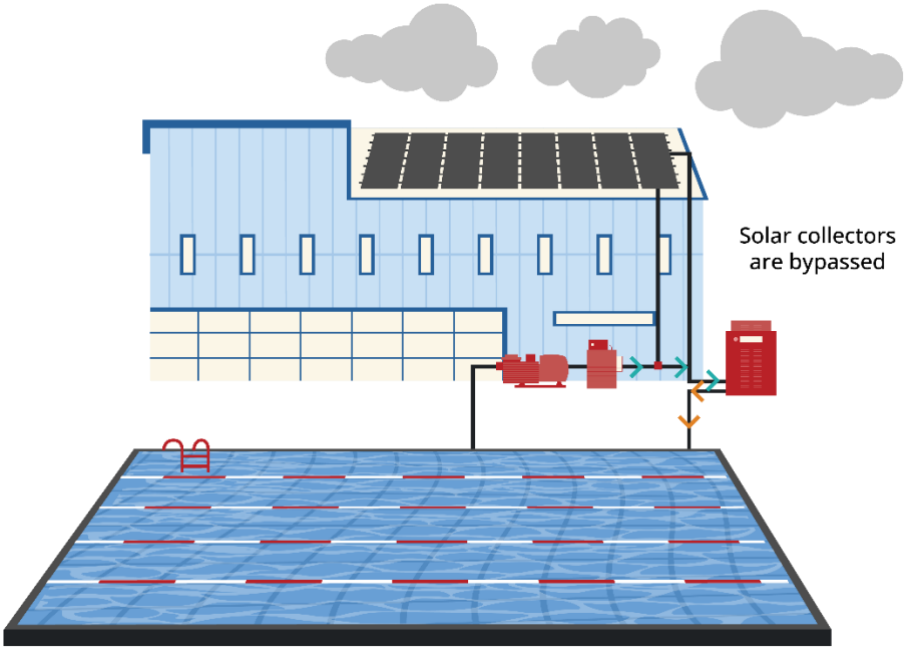

Figure 2: Collectors are bypassed when unable to capture heat to warm the pool.

In colder climates, the favorable operating conditions are shorter for collecting solar heat. In winter, the sun warms panels for fewer hours each day. See Figure 3 for an example comparison of swim schools in Pasadena and San Francisco where pool

temperatures are expected to be 90 degrees Fahrenheit. In Pasadena – Climate Zone 9, there are more hours available for solar thermal collectors to offset gas use than in San Francisco – Climate Zone 3, where more supplemental gas would be required to heat the swimming pools.

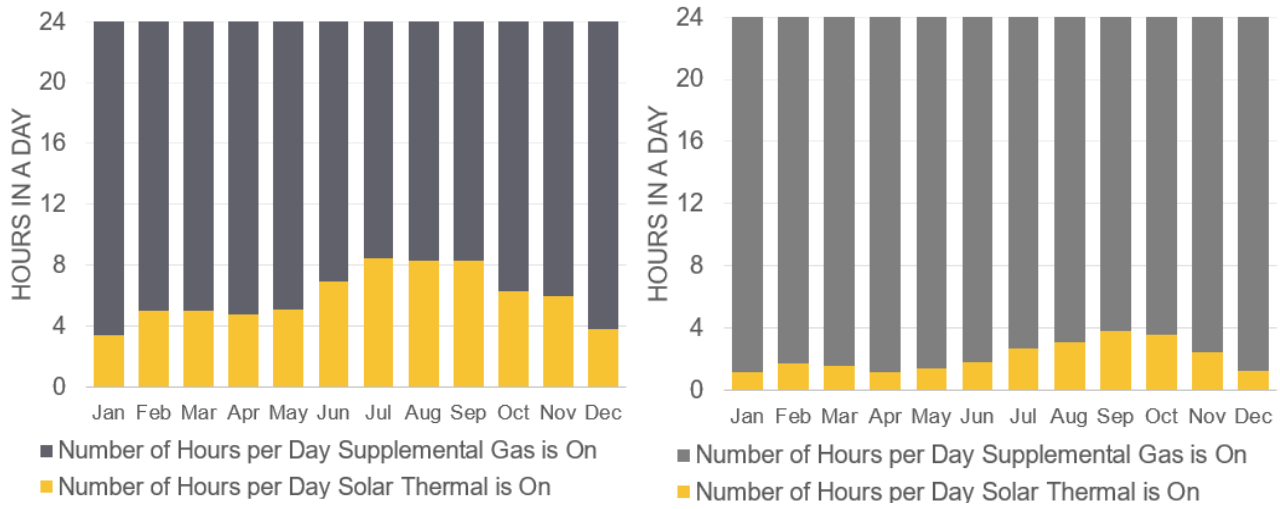

Figure 3: Daily heating hours available for swim schools in Climate Zone 9 (Pasadena, left graph) as compared to Climate Zone 3 (San Francisco, right graph).

2.3.3 Solar Pool Heating Technologies

There are several types of collectors that can be used for solar thermal systems; however, for swimming pool heating, unglazed collectors are often used due to their efficiency and affordability. Unglazed solar collectors operate at relatively low water temperatures (95°F-100°F) and are among the simplest and least expensive forms of solar thermal technology. These collectors are described as “unglazed” because they do not have a glass covering or “glazing” on the collector surface to trap heat. Unglazed technologies often use black plastic tubular panels mounted on a roof or other support structure to absorb sunlight. Using a pump, pool water is run directly through the tubular panels to transfer energy to the water, which is then returned to the pool at a higher temperature. This allows a building with a swimming pool to use a gas heater that meets minimum federal requirements as a secondary or supplemental heating source, only during times of the year when solar thermal cannot meet the temperature requirements. This offset of gas consumption for heating results in significant energy and bill savings, as well as reduced greenhouse gas emissions. For information on current market practices in California, see Section 4.1 of this report.

2.3.4 HPPH Technology

HPPHs use electricity to transfer heat from the surrounding air to the pool water through a heat exchanger. HPPHs will be required to meet federal appliance standards in 2028

with a coefficient of performance (COP), the ratio of the energy used to the energy provided, of nearly 6 to 1. The high COP provides significant energy savings. The Statewide CASE Team found that many municipal pools are choosing to install a combination of HPPHs and solar thermal systems (Mamuyac and Singh 2026), especially with all-electric designs. Appendix H of the 2025 Swimming Pool and Spa Heating CASE Report provides estimates of energy savings (Statewide CASE Team 2023).

2.3.5 Heat Recovery Technology

Pool heating systems may use on-site heat recovery to heat pool water using heat that would otherwise be rejected to the environment. Common sources include on-site heating ventilation and air conditioning (HVAC) loads, where waste heat generated during cooling can be used to heat pool water. Another common heat-recovery option is to use heat from indoor pool dehumidification as a source for pool water heating (Desert Aire 2019).

2.3.6 Condensing Gas Pool Heater Technology

A condensing gas pool heater is a high-efficiency heater that captures heat that would normally be lost in the exhaust of a traditional (non-condensing) gas pool heater. It works by cooling the exhaust gases enough to condense the water vapor back into liquid, allowing the heater to recover additional heat and use that extra energy to warm the pool water. This process makes condensing heaters more efficient—often exceeding 90 percent—compared to the typical 82–84 percent efficiency of minimally compliant gas heaters.

Because the condensate produced during this process is acidic, condensing heaters are built with corrosion-resistant materials and require a condensate drain line, and in some cases a neutralizer, to safely remove the condensate. Overall, these heaters deliver more heat per unit of fuel, reducing operating costs with only minor differences in installation and maintenance requirements relative to traditional gas pool heaters.

2.4 Modifications to Energy Code Documents

This section provides descriptions of how the proposed code change will affect each Energy Code document. See Section 7 of this report for detailed revisions to code language.

2.4.1 Energy Code Change Summary

SECTION 800 – MANDATORY REQUIREMENTS FOR ALL OCCUPANCIES (NEWLY CONSTRUCTED, ADDITIIONS, ALTERATIONS)

Exception 2 to Subsection 800.3 The proposed measure modifies the exception for alterations to existing swimming pools and/or spas to only group R occupancy buildings and common or public use areas serving that occupancy.

SECTION 801– NONRESIDENTIAL AND HOTEL/MOTEL OCCUPANCIES (NEWLY CONSTRUCTED, ADDITIONS, ALTERATIONS)

Section 801.1

Section 801.2 The proposed section clarifies that existing T24 requirements apply for non-residential newly constructed pools.

Section 801.3: Reserved section for prescriptive requirements for newly constructed pools.

Section 801.4: Reserved section for performance requirements for newly constructed pools.

Section 801.5.1: The proposed section clarifies that existing Title 24 requirements apply to alterations to non-residential pools.

Section 801.5.1.1.1: The proposed measure would add mandatory heating source requirements for nonresidential pool and spa alterations in climate zones 2 through 16. Compliance options include solar thermal systems, heat pump pool heaters, systems using at least 60 percent on-site renewable or recovered energy, or condensing gas pool heaters with a minimum 94 percent thermal efficiency. Combination solar and heat pump systems and alternative systems approved by the CEC Executive Director are also permitted.

Exception 1 to Section 801.5.1.1.1: The proposed measure would not apply to portable electric spas. Portable electric spas are plumbed separately from in-ground pools and are typically sold as manufactured units with basin, plumbing, and heating system integrated. Energy efficiency is mandated by an existing Title 20 appliance efficiency standard.

Exception 2 to Section 801.5.1.1.1: The proposed measure would not apply to pools that are heated by only solar pool heaters. In this situation, the pool owner would size the solar pool heater to meet their heating needs without supplemental heating.

Exception 3 to Section 801.5.1.1.1: The proposed measure would not apply to permanent spas in existing buildings with existing natural gas availability. Spa heating is intermittent, and the heating load is much smaller due to the much smaller water volume compared to a pool.

Exception 4 to Section 801.5.1.1.1: The proposed measure would not apply to heating systems used exclusively for permanent spas.

Exception 5 to Section 801.5.1.1.1: The proposed measure would not apply to existing pools located in buildings with Group R Occupancy or Public Use Areas serving that Occupancy.

2.4.2 CALGreen Change Summary

A5.204.1.1 Altered pool and/or spa heating for existing buildings.

The proposed code change would remove the CALGreen voluntary requirements for pool heater system sizing.

2.4.3 Reference Appendices Change Summary

The proposed code change would not modify the Reference Appendices.

2.4.4 Compliance Manuals Change Summary

Chapter 4 of the Nonresidential Compliance Manual, which outlines the mandatory requirements for pools and spas, would be updated. The manual would need to incorporate the proposed mandatory requirements for existing pools and spas that are replacing their pool heaters.

There are no requirements for hotel or motel pools and spas to replace their existing pool heater.

2.4.5 Alternative Calculation Method Reference Manual Change Summary

The proposed code change would not modify the ACM Reference Manual, as it requires no associated software updates.

2.4.6 Compliance Forms Change Summary

The existing Nonresidential Certificate of Compliance, NRCC-PLB-E, compliance form would be updated to reflect the proposed change. Any changes to the NRCC-PLB-E form must be supported in all applicable Nonresidential Certificate of Installation (NRCI) forms. The Certificate of Compliance form would also document any applicable exceptions.

2.5 Measure Context

2.5.1 Comparable Model Codes or Standards

Since the 2025 Title 24 code cycle and adoption of the pool heating system sizing requirements, several national code committees have considered similar measures for incorporation.

Section 7.4.5.1 of ASHRAE Standard 90.1-2025 requires that pool heaters be equipped with readily accessible on/off switches. Pool heaters fired by natural gas shall not have continuously burning pilot lights. Section 800.2.4 of Title 24, Part 6, currently requires an on/off switch, while Section 800.5 requires natural gas-burning pool heaters to not have continuously burning pilot lights.

Section 7.4.5.2 of ASHRAE Standard 90.1-2025 prescribes a pool cover requirement for outdoor heated pools. Section 800.2.3 of Title 24, Part 6, currently requires a cover for only outdoor pools or outdoor spas that have a heat pump or gas pool heater.

The ICC expects to publish an updated IECC standard on December 31, 2026. The updated standard will include primary pool heating system requirements similar to the Title 24 proposal, although exceptions differ, providing no requirements for outdoor pools in IECC Climate Zones 3 through 8. There is also an exception for pools with surface areas over 15,000 sq. ft. Another exception is for pools with a power safety cover, defined as a pool cover placed over the water and opened and closed by a motorized mechanism.

PHTA has developed several standards in partnership with the International Code Council (ICC) on swimming pools, spas, and hot tubs for residential and commercial applications.[3] The International Swimming Pool and Spa Code (ISPSC) 2021, ANSI/APSP/ICC-15 2021, and ICC 902/APSP 902/SRCC 400 are some codes and standards relevant to the measures in this Final CASE Report.

The Solar Rating & Certification Corporation (ICC-SRCC), an ISO/IEC 17065-accredited third-party certification body and standard developer, addresses the certification and performance rating of solar heating and cooling products.

ISPSC is currently adopted in several local jurisdictions in California, including Costa Mesa, Indian Wells, Pleasanton, Benicia, San Bernardino, Palo Alto, Newport Beach, and Mission Viejo. Section 303 addresses energy consumption of residential and commercial swimming pools and spas and prescribes the following provisions for pool heaters: switch, continuously burning ignition pilots, time switches, and pool covers.

Section 5.4.3 of the 2021 ANSI/APSP/ICC-15 Standard for Residential Swimming Pool & Spa Efficiency prescribes that at least 18 inches of horizontal or vertical pipe shall be installed between the filter and the heater or dedicated suction and return lines, or built-in or built-up connections shall be installed to allow for the future addition of solar heating equipment.

At least 11 of the 16 California climate zones have outdoor temperature fractional bin hours that are considered to be freezing conditions. The standard for Solar Pool and

[3] PHTA Standards available here: https://www.phta.org/standards-and-codes/phta-standards/industry-codes-and-standards/

Spa Heating Systems, specifically 2020 ICC 902/PHTA 902/SRCC 400, requires freeze protection as outlined in Section 302.12.3. The 2020 ICC 901/SRCC 100, a Solar Thermal Collector Standard, mandates in Section 301.2.2 that where a collector is designated as "freeze tolerant," it shall be designed to withstand freezing conditions without damaging the collector or reducing the design life of the collector while ensuring that verification is performed using a freeze-resistance test. The proposed revisions to Title 24, Part 6, seek to ensure they do not conflict with the freeze protection and freeze tolerance provisions prescribed in these standards.

2.5.2 Interactions with Other Regulations

The California Department of Public Health (CDPH) does not have requirements for pool heater efficiency. There is no inconsistency between pool sanitation requirements by the CDPH and this proposal.

This proposal is not relevant to other parts of the California Building Standards Code, and thus changes outside of Title 24, Part 6, are not needed.

The proposal is not intended to conflict with any existing state or local laws and regulations. There are local regulations that are relevant to this proposal. As an example, in the City of Santa Monica building code per Section 8.106.080, *Non-residential, high-rise residential, hotel and motel solar and pool heating requirements*[4]*,* Section 5.201 of the 2019 California Green Building Standards Code is amended to read as follows:

> *5.201.3 Pool Heating—Non-Residential, High-Rise Residential, and Hotel and Motel Buildings.*
>
> *(a) For new pool construction, if the pool is to be heated, an electric heat pump water heater or a solar thermal system shall be used for such heating.*

This was adopted in 2019.[5] Several additional local communities in California are considering adopting similar electric pool heating requirements.

California Code, Government Code - GOV § 65850.5 provides requirements for the permitting of solar energy systems including solar pool heaters by local code officials.

The Governor's Office of Planning and Research provides a solar permitting handbook. This handbook discusses Government Code 65850.5(b-c).

[4] Code language is available at: https://library.qcode.us/lib/santa_monica_ca/pub/municipal_code/item/article_8-chapter_8_106?view=all#article_8-chapter_8_106-8_106_080

[5] Record of adoption is available here: https://perma.cc/J42K-F4D5

3. Compliance and Enforcement

3.1 Compliance Considerations

When developing the previous 2025 code cycle solar pool heating proposal, the Statewide CASE Team considered methods to streamline the compliance and enforcement process and to mitigate or reduce impacts on market actors involved in the process. The Statewide CASE Team recognizes that the proposed measure represents a substantive change for altered pool heating systems and would require additional effort to ensure consistent application. While the Statewide CASE Team believes that compliance and enforcement of the proposed measure is feasible, successful implementation would depend on targeted outreach, training, and ongoing support for both code users and enforcement officials. The 2028 Title 24, Part 6 solar heating proposal maintains an identical compliance and enforcement approach.

The proposed measure would not require field verification or acceptance testing. Compliance would be determined upon review of plans and other documentation submitted for permit review. The NRCC-PLB-E would demonstrate that the documents submitted for the permit application comply with the energy code, and the NRCI-PLB-E would capture the installed features as meeting the design requirements. Based on the building inspector's discretion, a field visit to verify that the solar collectors were installed as designed may be included. The Statewide CASE Team is not recommending field verification, particularly not to the level of measuring the area of installed solar panels.

3.2 Impact on Market Actors

Table 4 summarizes impacts on market actors and suggests outreach and education that might be helpful to support market actors as they prepare for the effective date of the requirements.

Table 4: Impacts on Market Actors and Suggested Training and Education Opportunities

Market Actor	Impact(s)	Suggested Outreach and Education
Design Professional [a]	Designers will need to be aware of new solar thermal requirements, the condensing gas option, and all other compliance pathways permitted for pool heating alterations, and must design compliant systems. Designers are also responsible for communicating the available options and requirements to the building owner.	Provide outreach and training on new triggers and requirements through pool and spa events, conferences, or online training (Energy Code Ace).
Construction Team [b]	• Document compliance of the new requirements in revised form NRCC-PLB-E and NRCI-PLB-E worksheets for solar pool and spa heating system. • The installer of the pool and spa heating system would be responsible for obtaining the permit from the local building department. Plans may be reviewed by the building department along with field inspections performed by a building inspector. • Perform the above listed tasks if a pool heating system is scheduled to be installed at the same time as a new swimming pool; or • Coordinate pool heating system installation with a swimming pool and spa heating equipment contractor.	EnergyCodeAce to provide outreach and training on new triggers and requirement thresholds.
Building Department [c]	Plan examiners will need to be aware of the triggers for the proposed requirements and how to confirm compliance based on the design pathway selected. They will trigger a plan inspection to review new or revised compliance forms prior to permit approval.	Provide outreach through building official associations and conferences and provide training (online and in-person). EnergyCodeAce to develop education and training outlining new requirements and compliant design solutions.
Manufacturers and Distributors	Manufacturers and distributors need to ensure that they have readily available products that meet the proposed requirements.	Awareness of new requirements and preparedness for client questions.

a. Design professionals include architects, engineers (mechanical, electrical, plumbing, structural), specification writers, cost estimators, commissioning agents, lighting designers, and energy consultants.
b. Construction team includes general contractors, design-build contractors, installation contractors (e.g., HVAC, plumbing, electrical), commissioning agents, and tradespeople.
c. Building departments include plans reviewers, building inspectors, specialty inspectors, permit counter technicians and third-party plan review and inspection.

The 2028 CASE Methodology Report presents a quantitative assessment of how changes to the California building code impact builders, building designers and energy consultants, and building owners and occupants. While the analysis in the methodology report is not specific to the code change(s) presented in this report, this measure focuses on building occupants and manufacturers, since these market actors are expected to experience the most direct impacts from changes to nonresidential pool heating requirements for alterations. The following provides a qualitative description of how this specific code change affects various market actors and additional quantitative analyses of its potential impacts on building industry subsectors.

Design Professionals. Adjusting design practices to comply with changing building codes is within the normal practices of building designers. Since building codes (including Title 24, Part 6) are typically updated on a three-year revision cycle, building designers and energy consultants engage in continuing education and training to remain compliant with changes to design practices and building codes.

Construction Team. The proposed change would likely affect commercial builders; however, it would likely not impact firms focused on the construction or retrofitting of industrial buildings, utility systems, public infrastructure, or other heavy construction. The proposed change would not affect all firms and workers in the commercial building industries equally; instead, it would primarily affect specific subsectors within the industry. Table 5 lists the commercial building subsectors the Statewide CASE Team expects will be impacted by the changes proposed in this report.

Table 5: Specific Subsectors of the California Commercial and Industrial Building Industry Impacted by Proposed Change to Code/Standard by Subsector in 2025 (Estimated)

Construction Subsector	Establishments*	Employment	Annual Payroll (Billions $)
Commercial Building Construction	5,491	87,450	$10.6
Nonresidential Structural Steel Contractors	365	11,899	$1.1
Nonresidential Framing Contractors	137	3,037	$0.2
Nonresidential Roofing Contractors	385	11,413	$1.0
Nonresidential Siding Contractors	32	735	$0.1
Other Nonresidential Exterior Contractors	234	2,259	$0.1
Nonresidential Electrical Contractors	3,245	72,794	$7.8
Nonresidential Plumbing & HVAC Contractors	2,270	55,182	$5.8
Other Nonresidential Equipment Contractors	580	9,749	$1.1
Nonresidential Site Preparation Contractors	1,147	19,273	$1.9
All Other Nonresidential Trade Contractors	948	17,084	$1.7
Industrial Building Construction	278	4,095	$0.5
Water and Sewer System Construction	1,007	22,926	$2.3
Oil and Gas Pipeline Construction	218	10,047	$1.1

Source: Analysis by the Title 24 CASE Team of QCEW data from the California Employment Development Department
https://labormarketinfo.edd.ca.gov/cgi/dataanalysis/areaselection.asp?tablename=industry

*An establishment is single economic unit, typically at one physical location, that engages in one, or predominantly one, type of economic activity for which a single industrial classification may be applied. Many businesses are composed of multiple establishments. US Bureau of Labor Statistics, Handbook of Methods.
https://www.bls.gov/opub/hom/cew/concepts.htm

Building occupants (owners and tenants). The proposed code change would have incremental costs and would reduce building owners' utility bills throughout the measure's lifetime. See the 2028 CASE Methodology Report for a description of how LSC savings relate to occupant utility bill savings.

Retailers. The Statewide CASE Team anticipates that the proposed measure would increase sales of HPPHs and solar thermal systems while reducing sales of gas-fired pool heaters.

Manufacturers. Manufacturers SunEarth,Inc., Suntrek Industries, and Hot Sun Industries Inc. are based in California and manufacture the solar thermal pool heating technology proposed. These manufacturers already operate in a significant portion of the California market and would need to be aware of the changing requirements to

assist nonresidential clients. Refer to Section 4.4 for more information on the impact on California jobs.

3.3 Compliance Software Updates

There are no recommended revisions to the compliance software because of this code change proposal.

3.4 Cost of Enforcement

The Statewide CASE Team acknowledges that changes to the code will impact enforcement costs. This report evaluates specific measures and the collective impact of all proposed changes to the 2028 Title 24, Part 6, which may increase training and/or workload for enforcement personnel.

The proposed measure would not require field verification or acceptance testing. The plan review function would consist of reviewing the NRCC-PLB-E certificate of compliance to ensure that it meets the new code requirements and is consistent with the drawings and specifications.

Inspection review would consist of reviewing the NRCI-PLB-E certificate of installation and ensuring that the information on the forms is consistent with the approved NRCC-PLB-E certificate of compliance form and the installed equipment.

4. Market and Economic Analysis

4.1 Market Structure and Availability

4.1.1 Current Market Structure and Availability

Currently, the main market actors for nonresidential swimming pool solar thermal water heating include system designers, architects, solar thermal contractors, distributors, manufacturers, and commissioning agents.

The Statewide CASE Team performed a market analysis to identify current technology availability, current product availability, and market trends. It then considered how the proposed standard may impact the market in general as well as individual market actors. The Statewide CASE Team gathered information about the incremental cost of complying with the proposed measure. It also identified estimates of market size and measure applicability through research and outreach with stakeholders including utility program staff, CEC staff, and a wide range of industry actors. In addition to conducting personalized outreach, the Statewide CASE Team discussed the current market structure and potential market barriers during three public stakeholder meetings that the Statewide CASE Team held on September 30, 2025, October 29, 2025, and March 17, 2026. Notes are available for both stakeholder meetings in the bibliography.

The technology to implement this code change is readily available in the California market. California has a long history of using solar thermal technology as a clean energy source, with numerous companies operating in the state for over 40 years. The two biggest manufacturers of solar thermal technologies are Aquatherm and Magen eco-Energy US (Heliocol). Others include Techno-Solis, Hot Sun Industries, Inc., Enerworks (Canada), Consolidated Manufacturers (CMI), Inc., SunEarth Inc., and Suntrek Industries.

Through market research and consultation with industry players, such as Aquatherm and ELS Architecture and Urban Design, the Statewide CASE Team was able to confirm that the design practice required to comply with the proposed code change is very common in California. Some stakeholders confirmed that several cities are already choosing to go beyond the proposed requirements and implement all-electric aquatic centers in support of their climate action plans.

4.1.1.1 Solar Thermal Heating Systems at Municipal Pools

Through stakeholder interviews and market research the Statewide CASE Team found that municipal and school pools are implementing solar heating technologies. The Statewide CASE Team also found examples of solar thermal heating applications from installer Maktinta Energy. Maktinta Energy shares a collection of solar thermal projects

in a few high schools, as well as aquatic centers in El Sobrante and El Dorado County (Maktinta Energy 2024). Another example of indoor pool applications is the Richmond Municipal Natatorium in the City of Richmond, which uses glazed solar thermal collectors to heat their Olympic-sized pool. Glazed solar collectors function the same way as unglazed solar collectors but include a transparent cover to reduce heat loss. Both types of solar collectors are acceptable to meet proposed requirements (Heliodyne Solar Hot Water 2011).

Overall, the Statewide CASE Team found that solar thermal collectors are currently used to heat many municipal pools, with more municipal pools planning solar thermal applications.

4.1.1.2 Solar Thermal Heating Systems at Indoor Swim School Pools

The Statewide CASE Team received comments contesting the feasibility of solar thermal pool systems for indoor swim school pools, which have higher temperature needs than other nonresidential pools. Through further market research, the Statewide CASE team identified a swim school and therapy pool in City of Long Beach, California that uses solar thermal collectors as the primary heating source for their two pools, which are kept at 91° to 94° F. The California Aquatics Therapy & Wellness Center was an early adopter of solar thermal heating, installing their original solar pool heating system in 1981 and choosing to update it in 2015 (Ameco Solar 2015) and expecting significant savings on their monthly heating expense (Segura 2017). Their continued use of the system demonstrates the feasibility for swim school and therapy center pool applications.

4.1.1.3 Solar Thermal Collector Quality and Product Lifetime

The Statewide CASE Team previously assumed a product lifetime of 25 years for solar collectors, which some stakeholders scrutinized. In response, the team conducted a survey of major solar collector manufacturers' warranties and found that they range from 10 to 18 years, suggesting that the previously assumed lifetime might be too high. The Statewide CASE Team met with SRCC, which independently tests and certifies solar collectors, to better assess the variability in product lifetime. SRCC explained that solar collectors are typically constructed from very durable polypropylene and that certified collectors often last more than 25 years. Under the SRCC OG-100 Certification Program, certified collectors go through rigorous tests, including internal pressure and thermal shock tests, based on the ISO 9806 standard. The Statewide CASE Team concluded that the previous assumed product lifetime was adequate based on industry standards but decided to use a lower 15-year lifetime for a more conservative cost-effectiveness analysis that better aligns with stakeholder feedback and experience.

4.1.1.4 Heat Pump Pool Heater Product Availability

The Statewide CASE Team interviewed the design team for two fully electric aquatic facilities in City of Mountain View and City of Piedmont, ELS Architecture and Urban Design, respectively. This stakeholder shared that many communities are moving toward solar heating and heat pump designs to meet their climate action goals (Mamuyac and Singh 2026).

Many manufacturers (such as Rheem and Raypak) produce electric Heat Pump Pool Heaters (HPPH) commonly used by pool designers. In the 2025 Final Solar Pool Heating CASE Report Appendix H, the Statewide CASE Team published an electric HPPH analysis demonstrating significant natural gas savings and cost-effectiveness when electric HPPHs replace gas heaters across all climate zones.

4.1.1.5 Advances in Heater Control Technology

There have been notable advancements in pool automation system technologies from manufacturers such as Pentair (Pentair 2023) and Hayward (Hayward 2023), and implemented by designers like Maktinta Energy, that allow pool configurations which automatically prioritize efficient heating sources based on sensors. The Statewide CASE Team found that these configurations usually consist of an automation controller taking inputs from a sensor array measuring water temperatures, solar collector temperature, and ambient air temperature. The automation controller will then open or close motorized actuators that prioritize a specific heater, moving water to the solar collectors when there is sufficient solar availability and bypassing the solar collectors when not to avoid heat loss, and sending it to the heat pump or supplemental gas heater. The availability and use of these controllers would allow for simple coexistence of these systems to meet the heating requirements for various pool types.

Raypak provides both the Crosswind V electric HPPH and AVIA gas heater designed to work together to alternate operation based upon weather and pool conditions. The system chooses the heater best suited for the conditions to optimize efficient heating of the pool (PoolZoom 2024).

Pentair IntelliCenter controls allow a pool owner to select preferences when two or more heating sources are available. Figure 4 shows options available to a user to select what heat source is preferred. The controller uses these inputs to choose the heating source and adjusts source to meet user needs such as heat up time (Pentair 2023).

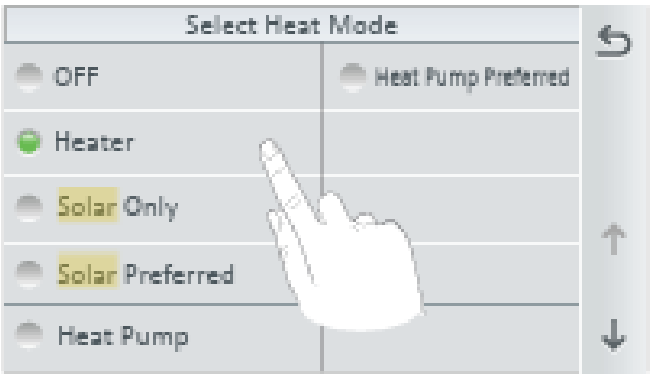

Figure 4: User heat source preference screen on Pentair IntelliCenter.

4.1.2 Market Challenges and Solutions

The Statewide CASE Team worked with various stakeholder groups such as swim schools and rehabilitation programs regarding their concern that the incremental cost of the original proposal's solar collector sizing requirement could have a significant impact on pool budgets. The original proposal for the 2028 cycle required sizing solar collectors to 65 percent of the pool surface area for nonresidential applications with an exception for inadequate SARA similar to the existing exception for permanent spas in Section 800.3. Based on feedback received through stakeholder outreach, it was understood that the amount of rooftop space available to existing outdoor pools in their adjacent buildings might not be enough to support the 65 percent solar collector sizing requirement. Therefore, the SARA exception would be invoked for many projects.

In addition, some stakeholders were concerned about additional first costs that could occur if electrical capacity service upgrade, or rooftop modifications were required to comply with the proposal.

In response, the Statewide CASE Team conducted a survey of 32 municipal pools in Los Angeles County, which provides a list of municipal pools, and found that most pools did not have enough roof space to accommodate the solar collector requirement, which confirmed stakeholder concerns. These findings led the Statewide CASE Team to reduce the solar collector sizing requirement from 65 percent to 40 percent, reducing upfront cost and rooftop space needed to comply with the requirement, while maintaining cost-effectiveness. Figure 5 below contains the satellite images that show existing municipal pools in Los Angeles, where indoor and outdoor pools are likely heated year-round. The images include adjacent roof (or other) areas outlined in red, to demonstrate potential locations that could be used to install the designed solar thermal heating system that would heat these pools.

See Figure 6 for an example of how the solar collector size requirement changes when going from 65 percent to 40 percent collector size for a 2,000 sq. ft pool.

To address the concern about first costs related to potential electrical upgrades or rooftop modifications, this proposal added an additional compliance option for 94 percent efficient condensing natural gas heaters. The cost savings of this proposal could provide long-term financial benefits to public facilities.

See Section 4.1.1.2 for an example of a public facility successfully using solar thermal collectors for a therapy pool in Long Beach.

Figure 5: Los Angeles municipal pools retrofit survey.

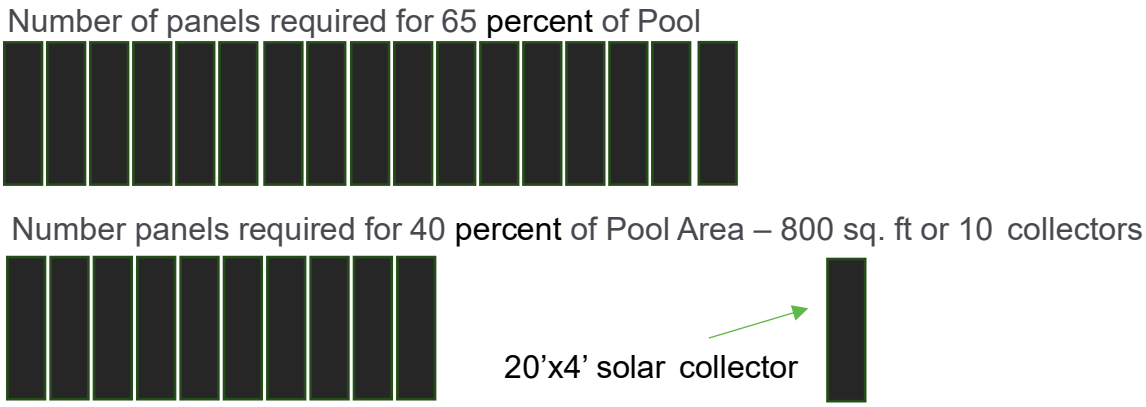

Figure 6: Example comparison of 65 percent pool area solar size requirement versus 40 percent solar size requirement for a 2,000 sq. ft pool.

4.2 Design and Construction Practices

4.2.1 Current Design and Construction Practices

The Statewide CASE Team worked with many industry actors to determine the most common practice for retrofit scenarios when installing solar thermal pool heating systems. This research showed that retrofits are fairly common, and in addition to the installation of solar collectors, it may include additional piping and pumps to bring pool

water up to solar collectors on roofs. However, such additional design components minimally impact overall cost since the main upfront costs comes from the solar collectors.

4.2.1.1 Solar Design Software

The Statewide CASE Team received comments from stakeholders questioning the alignment of modeling results to operational realities. It should be noted that solar pool heating simulation software has been in development and use for 40 years. Polysun and TRNSYS (TRAN-sis) are two software tools widely used by solar pool designers. In collaboration with stakeholders from the previous code cycle, the Statewide CASE Team determined that Enerpool is an accurate tool for modeling pools for this CASE Report. The Statewide CASE Team discussed the use and reliability of solar pool heating modeling software with CALSSA and SRCC and agreed that accurate inputs are essential for reliable results. Modeling inaccuracies can occur when inputs such as a weather file, pool size, collector size, or assumed activity levels are incorrect. The Statewide CASE Team carefully reviewed the inputs using research and stakeholder feedback and determined they accurately represent real-world pool conditions.

The Statewide CASE Team met with Natural Resources Canada that provides the enerpool Pro solar pool heating simulation software. Natural Resources Canada provided a study of a highly instrumented solar heated pool to show that enerpool can deliver simulations within 1.7 percent of actual performance when the weather conditions are precisely known. (SolarCity Partnership 2012)

4.2.1.2 Solar Thermal and Supplemental Heating Pairing

Solar thermal systems are not typically installed with the intent of completely replacing all other heating sources. In most California climates, supplemental heating is used to share the heating load and maintain desired temperatures. The Statewide CASE Team met with Aquatherm and CALSSA to discuss design practices for supplemental heating and learned that solar manufacturers emphasize that solar thermal collectors are not expected to heat a pool as fast as heat pumps or gas heaters. Manufacturers explain that solar thermal is intended to offset the consumption of fossil fuel heating by utilizing free solar energy when it is available. Using solar thermal heating when it is available can help maintain a higher baseline pool temperature and reduce the amount of natural gas that would otherwise be needed to keep a pool heated to the desired temperature.

The Statewide CASE Team expects that current design practices would continue if the proposed code change were adopted, since supplemental gas heating would continue to be allowed for pool heating.

4.2.2 Health and Safety Considerations

The proposed code change does not alter any existing federal, state, or local regulations pertaining to safety and health, including rules enforced by the California Division of Occupational Safety and Health (DOSH). All existing health and safety rules would remain in place. Complying with the proposed code change is not anticipated to have adverse impacts on the safety or health of occupants or those involved with the construction, commissioning, and maintenance of the building.

4.2.3 Design and Construction Challenges and Solutions

Although solar thermal technologies are well established in the market, there are several technical barriers that need to be considered with the adoption of this proposal. When speaking with PHTA, Drowning Prevention Foundation, and U.S. Swim Schools Association the Statewide CASE Team learned that one such barrier is the high upfront costs of installing solar thermal pool heaters. To address this concern, the Statewide CASE Team explored additional changes to the proposal that would reduce upfront costs and achieve similar benefits for California and are proposing a reduced solar collector area (40 percent) and highly efficient gas heaters (≥94 percent thermal efficiency) as a compliance path moving forward.

The location and orientation of a pool can also impact the effectiveness of a solar pool water heater, with pools in areas with limited sunlight or poor orientation potentially unsuitable for solar heating.

For facilities that need cooler pool water during warmer months to meet competition standards, solar thermal systems can be designed so that they can simply be turned off, in the same way a gas heater would be shut down, as needed. Solar thermal systems may also be used to cool the pool at night by running water through them.

The Statewide CASE team analyzed pools in all climate zones and found that the proposal may not be cost effective in Climate Zone 1 due to their short solar window. This was also confirmed by Redwood Coast Energy Authority (Terry 2026), which reported that within the coastal fog belt most pools use natural gas for heating and the limited sunlight makes solar thermal heating difficult. In response, the Statewide CASE Team is not proposing new requirements for pools located in Climate Zone 1, allowing existing pools in this climate zone to replace gas heaters with like-for-like technology without triggering compliance with the new requirements.

Furthermore, regular maintenance is required to ensure the proper functioning of solar pool water heaters, and technical expertise is needed for installation and maintenance, which can increase overall costs. However, despite these barriers, solar pool water heaters can be a cost-effective and environmentally friendly way to heat pool water in areas with plentiful sunlight.

4.3 Energy Equity and Environmental Justice

Each measure in this CASE Report was evaluated for ESJ impacts using 4 criteria: cost, health, resiliency, and comfort. The details of that evaluation can be found in Section 1.4 and the 2028 CASE Methodology Report.

The proposal would result in incremental costs assumed by the pool owner when retrofitting their heating source, however the technology would also provide significant energy cost savings and has been shown to be cost effective in all applicable climate zones. The Statewide CASE Team has also introduced gas pool heaters with a thermal efficiency of 94% or greater as a compliance option for pool heating alterations. This option has lower incremental first costs and would be available for pools where solar thermal is not a feasible option, closing potential gaps in affordability. The Statewide CASE Team does not expect this proposal to cause a disproportionate impact to ESJ building owners. See Section 5 and Appendix F for more information on incremental costs and cost effectiveness of solar thermal systems and condensing gas systems, respectively.

The proposed code change would reduce the use of natural gas heaters as a primary heating source for swimming pools and spas, reducing point source air emissions that disproportionately affect low-income communities and communities of color. The value of improved air quality from the proposed code changes is amplified by the fact that many industrial facilities are more often located near ESJ and Low- and Moderate-Income (LMI) housing, thus disproportionally exposing these residents to lower air quality. As a result, the Statewide CASE Team expects that ESJ communities would see a disproportionate health benefit from these changes over time.

The Statewide CASE Team does not expect this proposal to have an impact on building resilience.

The proposal would contribute to occupants' thermal comfort by providing a reliable heat source for swimming pools. As mentioned in Section 4.2, current design practices pair solar thermal technologies with supplemental heating sources, allowing for reliable heating whenever the pool is in operation. The Statewide CASE Team expects ESJ communities to see a benefit from this proposal, as these communities see a higher usage of public and municipal pools.

4.4 Impacts on Jobs and Businesses

The Statewide CASE Team does not anticipate significant employment or financial impacts on any particular sector of the California economy. However, the proposed change may have modest impacts on employment in California. The Statewide CASE Team estimates the proposed change would affect statewide employment and

economic output directly and indirectly through its impact on builders, designers, energy consultants, and building inspectors. Table 6, Table 7, and Table 8 outline the statewide implications for these job categories. For more information on the Statewide CASE Team's economic impacts methodology, see the 2028 CASE Methodology Report.

The Statewide CASE Team does not anticipate that the proposed changes would lead to the creation of new types of jobs or the elimination of existing types of jobs. In other words, the Statewide CASE Team's proposed change would not result in economic disruption to any sector of the California economy. Rather, it would lead to modest changes in the employment of existing jobs.

Table 6: Estimated Impact that Adoption of the Proposed Measure would have on the California Nonresidential Construction Sector

Type of Economic Impact	Employment (Jobs)	Labor Income	Total Value Added	Output
Direct Effects (Additional spending by Commercial Builders)	38.0	$3,022,591	$4,550,814	$9,846,576
Indirect Effect (Additional spending by firms supporting Commercial Builders)	22.2	$1,747,192	$2,999,542	$5,251,361
Total Economic Impacts	**60.2**	**$4,769,782**	**$7,550,356**	**$15,097,936**

Source: Statewide CASE Team analysis of data from the IMPLAN modeling software.[6]

Table 7: Estimated Impact that Adoption of the Proposed Measure would have on the California Building Designers and Energy Consultant Sectors

Type of Economic Impact	Employment (Jobs)	Labor Income	Total Value Added	Output
Direct Effects (Additional spending by building designers and energy consultants)	12.9	$1,415,721	$1,401,547	$2,215,277
Indirect Effect (Additional spending by firms supporting building designers and energy consultants)	5.2	$421,531	$585,845	$943,090
Total Economic Impacts	**18.1**	**$1,837,253**	**$1,987,392**	**$3,158,367**

Source: Statewide CASE Team analysis of data from the IMPLAN modeling software.

[6] IMPLAN® model, 2020 Data, IMPLAN Group LLC, IMPLAN System (data and software), 16905 Northcross Dr., Suite 120, Huntersville, NC 28078 www.IMPLAN.com

Table 8: Estimated Impact that Adoption of the Proposed Measure would have on California Building Inspectors

Type of Economic Impact	Employment (Jobs)	Labor Income	Total Value Added	Output
Direct Effects (Additional spending by building inspectors)	0.1	$10,467	$12,413	$15,084
Indirect Effect (Additional spending by firms supporting building inspectors)	0.0	$969	$1,510	$2,630
Total Economic Impacts	**0.1**	**$11,437**	**$13,923**	**$17,714**

Source: Statewide CASE Team analysis of data from the IMPLAN modeling software.

The proposed change represents a modest adjustment that is not expected to excessively burden or competitively disadvantage California businesses, nor is it expected to lead to a competitive advantage for California businesses. Therefore, the Statewide CASE Team does not expect the proposed code changes to result in the creation of new businesses or the elimination of existing ones.

The proposed code changes would apply to all businesses operating in California, regardless of whether the business is incorporated inside or outside of the state.[7] Therefore, the Statewide CASE Team does not anticipate that the proposed changes would have an advantageous or an adverse effect on the competitiveness of California businesses.

The Statewide CASE Team derived a reasonable estimate of the change in investment by California businesses based on the estimated change in economic activity associated with the proposed measure and its expected effect on business income. The Statewide CASE Team's IMPLAN modeling estimated a $1,328,163 increase in California business income due to the proposed code change. The Statewide CASE Team assumed that net business investment is positively correlated with business income and that a portion of business income will be allocated to net business investment.[8]

To estimate the portion of business income that would be allocated to net investment, the Statewide CASE Team analyzed national data on corporate profits and net capital investment by businesses that expand a firm's capital stock (referred to as net private domestic investment, or NPDI).[9] As Table 9 shows, between 2020 and 2024, NPDI as a

[7] Gov. Code, §§ 11346.3(c)(1)(C), 11346.3(a)(2); 1 CCR § 2003(a)(3) Competitive advantages or disadvantages for California businesses currently doing business in the state.

[8] 26 percent of proprietor income was assumed to be allocated to net business investment; see Table 9.

[9] Net private domestic investment is the total amount of investment in capital by the business sector that is used to expand the capital stock, rather than maintain or replace due to depreciation. Corporate profit is the money left after a corporation pays its expenses.

percentage of corporate profits ranged from a low of 18 percent in 2020 due to the worldwide economic slowdowns associated with the COVID-19 pandemic to a high of 28 percent in 2022, with an average of 23 percent. While only an approximation of the proportion of business income used for net capital investment, it provides a reasonable estimate of the proportion of proprietor income that business owners would reinvest into expanding their capital stock.

Table 9: Net Domestic Private Investment and Corporate Profits, U.S.

Year	Net Domestic Private Investment by Businesses, Billions of Dollars	Corporate Profits After Taxes, Billions of Dollars	Ratio of Net Private Investment to Corporate Profits (Percent)
2020	389	2,212	18
2021	545	2,888	19
2022	825	2,951	28
2023	836	3,069	27
2024	885	3,441	26
5-Year Average	Intentionally blank	Intentionally blank	23

Source: (Federal Reserve Economic Data (FRED) n.d.)

Given the estimated total increase in California business income and net business investment ratio described above, the Statewide CASE Team estimates the proposed code change would result in a $311,772 increase in net private investment by California businesses.

4.5 Economic and Fiscal Impacts

The Statewide CASE Team does not anticipate that the economic impacts associated with the proposed measure would lead to a significant change (increase or decrease) in investment, directly or indirectly, in any affected sectors of California's economy. The proposed change would not result in economic disruption to any sector of the California economy. For more information on the Statewide CASE Team's economic and fiscal impacts methodology, see the 2028 CASE Methodology Report.

Adoption of this code change proposal would result in relatively modest economic impacts through the additional direct spending by those in the commercial building industry, architects, energy consultants, and building inspectors. The Statewide CASE Team does not anticipate that money saved by commercial building owners or other organizations affected by the proposed 2028 code cycle regulations would result in additional spending by those businesses.

4.5.1 Effects on the State General Fund, State Special Funds, and Local Governments

The Statewide CASE Team does not expect the proposed code changes to have a measurable impact on California's General Fund, any state special funds, or local government funds.

Cost to State: The state government already has a budget for code development, education, and compliance enforcement. While the state government would be allocating resources to update the Title 24, Part 6 Standards, including updating education and compliance materials and responding to questions about the revised requirements, these activities are already covered by existing state budgets. The proposed code change may impact state buildings that contain heated swimming pools or spas. The costs for the state government are small when compared to the overall cost savings and policy benefits associated with the code change proposal, and this proposal is cost effective in all climate zones where it applies.

Cost to Local Governments: All proposed code changes to Title 24, Part 6 would result in changes to compliance determinations. Local governments would need to train building department staff on the revised Title 24, Part 6 Standards. While this retraining is an expense to local governments, it is not a new cost associated with the 2028 code change cycle. The building code is updated on a triennial basis, and local governments plan and budget for retraining every time the code is updated. There are numerous resources available to local governments to support compliance training that can help mitigate the cost of retraining, including tools, training, and resources provided by the IOU Codes and Standards program (such as Energy Code Ace). As noted in Section 3.2, the Statewide CASE Team considered how the proposed code change might impact various market actors involved in the compliance and enforcement process and aimed to minimize negative impacts on local governments.

4.5.2 Mandates on Local Agencies or School Districts

The Statewide CASE Team does not expect the proposed code changes would have a measurable impact on California's General Fund, any state special funds, or local government funds.

4.5.3 Costs to Local Agencies or School Districts

There may be added non-discretionary costs or savings imposed on local agencies due to the proposed measure. If school districts own or operate facilities with heated swimming pools and spas, they may incur added costs or savings to comply with the proposed measure. However, the extent of the costs or savings would depend on the specific circumstances of each district.

4.5.4 Costs or Savings to Any State Agency

There are no added costs or savings imposed on any state agency by the proposed measure, as its provisions do not affect the operations or funding of any state agency.

4.5.5 Other Non-Discretionary Cost or Savings Imposed on Local Agencies

There may be added non-discretionary costs or savings imposed on local agencies due to the proposed measure. If local agencies own or operate facilities with heated swimming pools and spas, they may incur added costs or savings to comply with the proposed measure. However, the extent of the costs or savings would depend on the specific circumstances of each agency.

4.5.6 Costs or Savings in Federal Funding to the State

There are no costs or savings in federal funding to the state resulting from the proposed measure.

5. Cost Effectiveness

5.1 Cost Effectiveness Methodology

The Statewide CASE Team collaborated with CEC staff to confirm that the cost-effectiveness methodology aligns with CEC guidelines, including cost inclusion parameters. The 2028 CASE Methodology Report and Appendix A provide reproducibility details.

Per California Law (Public Resources Code 25000), a measure is considered cost effective if its Benefit-Cost Ratio (BCR) is 1.0 or greater, amortized over the economic life of the structure. The Statewide CASE Team calculates BCR by dividing total dollar benefits by total dollar costs over a 30-year analysis period.

Benefits are based on Long-term System Cost (LSC), which assigns an hourly dollar value to energy use. LSC hourly factors weigh the long-term value of each hour differently, with peak-demand hours valued more than off-peak hours. These factors are not utility rates, forecasts, or bill estimates. The CEC develops and publishes LSC hourly conversion factors for each code cycle.

Costs include first costs and ongoing maintenance costs assessed over the 30-year period. Benefits and costs are evaluated incrementally, relative to the most recently adopted Energy Code. The analysis excludes design costs and incremental code compliance verification costs.

In accordance with CEC's guidance, only one compliance pathway must demonstrate cost effectiveness. As described throughout this report, the proposal offers six options to comply with the updated requirements for altered pool and spa heating. The Statewide CASE Team selected the solar pool heating option to demonstrate cost effectiveness. Key assumptions for the solar pool heating cost effectiveness analysis are presented in Appendix A.

The Statewide CASE Team also evaluated the cost effectiveness of the condensing gas system. The methodology, assumptions, and results from this analysis are presented in Appendix F.

5.2 Energy and Energy Cost Savings Results

Energy savings (natural gas and source energy) per pool are presented in Table 10 through Table 13. Per-pool savings for the first year are expected to range from 59,000 to 2,600,000 kBtu/year, depending upon climate zone and prototypical pool. Per-pool source energy savings for the first year are expected to range between 51,000 kBtu and 2,200,000 kBtu, depending on climate zone and prototypical pool.

Table 14 and Table 15 present a breakdown of total LSC savings from natural gas cost savings per prototypical pool by climate zone.

Table 10: Natural Gas Savings (kBtu/yr) Per Prototypical Pool (Climate Zones 1-8)

Prototype	CZ 1	CZ 2	CZ 3	CZ 4	CZ 5	CZ 6	CZ 7	CZ 8
Average-Sized Nonresidential Outdoor Year-round Exercise Pool	66,000	190,000	120,000	260,000	140,000	160,000	190,000	250,000
Average-Sized Nonresidential Outdoor Seasonal Exercise Pool	28,000	130,000	74,000	150,000	69,000	81,000	75,000	120,000
Average-Sized Nonresidential Indoor Exercise Pool	51,000	190,000	100,000	250,000	130,000	140,000	170,000	270,000
Average-Sized Nonresidential Indoor Swim School Pool	29,000	160,000	59,000	220,000	86,000	90,000	120,000	240,000
Olympic-Sized Nonresidential Outdoor Year-round Exercise Pool	370,000	1,200,000	700,000	1,700,000	860,000	950,000	1,100,000	1,700,000
Olympic-Sized Nonresidential Outdoor Seasonal Exercise Pool	170,000	880,000	470,000	1,000,000	450,000	540,000	520,000	910,000
Olympic-Sized Nonresidential Indoor Exercise Pool	330,000	1,200,000	660,000	1,700,000	830,000	930,000	1,100,000	1,800,000

Table 11: Natural Gas Savings (kBtu/yr) Per Prototypical Pool (Climate Zones 9-16)

Prototype	CZ 9	CZ 10	CZ 11	CZ 12	CZ 13	CZ 14	CZ 15	CZ 16
Average-Sized Nonresidential Outdoor Year-round Exercise Pool	260,000	270,000	230,000	210,000	200,000	280,000	320,000	180,000
Average-Sized Nonresidential Outdoor Seasonal Exercise Pool	130,000	170,000	170,000	150,000	160,000	200,000	200,000	88,000
Average-Sized Nonresidential Indoor Exercise Pool	260,000	280,000	230,000	220,000	210,000	240,000	390,000	130,000
Average-Sized Nonresidential Indoor Swim School Pool	220,000	240,000	200,000	190,000	180,000	200,000	360,000	100,000
Olympic-Sized Nonresidential Outdoor Year-round Exercise Pool	1,700,000	1,800,000	1,500,000	1,400,000	1,300,000	1,700,000	2,200,000	1,000,000
Olympic-Sized Nonresidential Outdoor Seasonal Exercise Pool	960,000	1,200,000	1,200,000	1,000,000	1,100,000	1,300,000	1,600,000	540,000
Olympic-Sized Nonresidential Indoor Exercise Pool	1,700,000	1,800,000	1,500,000	1,500,000	1,400,000	1,600,000	2,600,000	860,000

Table 12: Source Energy Savings (kBtu/yr) Per Prototypical Pool (Climate Zones 1-8)

Prototype	CZ 1	CZ 2	CZ 3	CZ 4	CZ 5	CZ 6	CZ 7	CZ 8
Average-Sized Nonresidential Outdoor Year-round Exercise Pool	57,000	170,000	100,000	220,000	120,000	140,000	160,000	210,000
Average-Sized Nonresidential Outdoor Seasonal Exercise Pool	24,000	110,000	63,000	130,000	59,000	69,000	64,000	100,000
Average-Sized Nonresidential Indoor Exercise Pool	44,000	160,000	87,000	220,000	110,000	120,000	150,000	230,000
Average-Sized Nonresidential Indoor Swim School Pool	25,000	130,000	51,000	190,000	74,000	76,000	100,000	210,000
Olympic-Sized Nonresidential Outdoor Year-round Exercise Pool	320,000	1,100,000	610,000	1,400,000	740,000	810,000	970,000	1,400,000
Olympic-Sized Nonresidential Outdoor Seasonal Exercise Pool	150,000	760,000	400,000	900,000	380,000	460,000	450,000	780,000
Olympic-Sized Nonresidential Indoor Exercise Pool	280,000	1,100,000	570,000	1,400,000	710,000	800,000	950,000	1,500,000

Table 13: Source Energy Savings (kBtu/yr) Per Prototypical Pool (Climate Zones 9-16)

Prototype	CZ 9	CZ 10	CZ 11	CZ 12	CZ 13	CZ 14	CZ 15	CZ 16
Average-Sized Nonresidential Outdoor Year-round Exercise Pool	220,000	230,000	190,000	180,000	180,000	240,000	280,000	150,000
Average-Sized Nonresidential Outdoor Seasonal Exercise Pool	110,000	150,000	150,000	120,000	130,000	170,000	170,000	75,000
Average-Sized Nonresidential Indoor Exercise Pool	220,000	240,000	190,000	190,000	180,000	200,000	330,000	110,000
Average-Sized Nonresidential Indoor Swim School Pool	190,000	210,000	170,000	170,000	160,000	170,000	310,000	86,000
Olympic-Sized Nonresidential Outdoor Year-round Exercise Pool	1,400,000	1,500,000	1,300,000	1,200,000	1,200,000	1,400,000	1,900,000	850,000
Olympic-Sized Nonresidential Outdoor Seasonal Exercise Pool	820,000	1,100,000	1,000,000	880,000	940,000	1,100,000	1,300,000	460,000
Olympic-Sized Nonresidential Indoor Exercise Pool	1,400,000	1,600,000	1,300,000	1,300,000	1,200,000	1,300,000	2,200,000	740,000

Table 14: Total 30-Year LSC Savings (2029 PV$) Per Prototypical Pool (Climate Zones 1-8)

Prototype	CZ 1	CZ 2	CZ 3	CZ 4	CZ 5	CZ 6	CZ 7	CZ 8
Average-Sized Nonresidential Outdoor Year-round Exercise Pool	54,000	150,000	99,000	210,000	120,000	130,000	160,000	210,000
Average-Sized Nonresidential Outdoor Seasonal Exercise Pool	21,000	96,000	54,000	110,000	51,000	60,000	55,000	87,000
Average-Sized Nonresidential Indoor Exercise Pool	41,000	150,000	81,000	200,000	100,000	120,000	140,000	220,000
Average-Sized Nonresidential Indoor Swim School Pool	24,000	120,000	47,000	180,000	69,000	74,000	100,000	200,000
Olympic-Sized Nonresidential Outdoor Year-round Exercise Pool	300,000	970,000	570,000	1,300,000	700,000	790,000	950,000	1,400,000
Olympic-Sized Nonresidential Outdoor Seasonal Exercise Pool	130,000	650,000	350,000	770,000	330,000	400,000	390,000	670,000
Olympic-Sized Nonresidential Indoor Exercise Pool	260,000	960,000	530,000	1,300,000	670,000	770,000	920,000	1,400,000

Table 15: Total 30-Year LSC Savings (2029 PV$) Per Prototypical Pool (Climate Zones 9-16)

Prototype	CZ 9	CZ 10	CZ 11	CZ 12	CZ 13	CZ 14	CZ 15	CZ 16
Average-Sized Nonresidential Outdoor Year-round Exercise Pool	220,000	220,000	180,000	170,000	160,000	230,000	270,000	140,000
Average-Sized Nonresidential Outdoor Seasonal Exercise Pool	99,000	130,000	120,000	110,000	120,000	150,000	150,000	65,000
Average-Sized Nonresidential Indoor Exercise Pool	210,000	220,000	170,000	170,000	160,000	190,000	310,000	100,000
Average-Sized Nonresidential Indoor Swim School Pool	180,000	190,000	150,000	150,000	140,000	150,000	290,000	78,000
Olympic-Sized Nonresidential Outdoor Year-round Exercise Pool	1,400,000	1,500,000	1,100,000	1,100,000	1,100,000	1,300,000	1,800,000	790,000
Olympic-Sized Nonresidential Outdoor Seasonal Exercise Pool	710,000	910,000	850,000	750,000	810,000	940,000	1,100,000	400,000
Olympic-Sized Nonresidential Indoor Exercise Pool	1,400,000	1,500,000	1,200,000	1,100,000	1,100,000	1,200,000	2,100,000	670,000

5.3 Incremental First Cost

Incremental first cost refers to the added expense of integrating a solar thermal system into an existing pool. This analysis outlines the scope of alterations and associated costs for retrofitting two common pool sizes with solar collectors sized at 40 percent of the pool area. The Statewide CASE Team gathered cost data from industry sources and the California Solar Initiative (CSI) Commercial Pool Solar Thermal Rebate Program, which includes information on over a thousand commercial pool projects (California Public Utilities Commission 2020).

Retrofitting an existing pool with a solar thermal system requires modifications to the pool's mechanical system and, often, the adjacent building structure (Solar Panels Plus 2012). The primary alterations include:

1. Collector installation: Mounting solar panels on either the roof, an adjacent structure, or on the ground.
2. Plumbing integration: Running new supply and return piping from the existing pool equipment pad to the collectors. This may involve:
    a. Trenching: Excavation to bury pipes between the pool pad and the collectors
    b. Roof penetration: Creating and securing all necessary roof penetrations, which must be properly flashed and sealed in accordance with standard roofing practices to ensure weather integrity.
    c. Insulation: Installing high-temperature, weather-resistant piping insulation on all exposed sections of the solar loop to minimize heat loss.
3. Mechanical additions: Potentially adding a dedicated pump to lift water from the ground-level equipment pad to the elevated collectors.

The Statewide CASE Team assumed that for an average-sized pool with a capacity of 60,000 gallons, the incremental cost was approximately $19,640 (March 2025). For a nonresidential Olympic-size pool (660,000 gallons), the assumed incremental cost was approximately $113,940 (March 2025).

The Statewide CASE Team more comprehensively incorporated the installed costs of the solar collectors, plumbing costs, and additional piping costs. The solar thermal collector costs were derived from the CSI Thermal Rebate Program and equated to $20 per square foot of panels. The costs for plumbing and pumps are based on industry estimates for trenching and mechanical components, which cover the materials and labor required to integrate the new solar loop with the existing pool mechanical system.

5.4 Incremental Maintenance and Replacement Costs

Description of the incremental maintenance and replacement costs, as well as estimation of present value of maintenance and replacement costs, are provided in the 2028 CASE Methodology Report.

The Statewide CASE Team used the same approach outlined in the 2025 CASE Report to calculate Incremental Maintenance and Replacement Costs; however, to incorporate stakeholder feedback, the assumed expected useful life of the solar thermal system was updated from 25 years to 15 years.

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 30-year period of analysis. Incremental maintenance costs were assumed to be two percent of the first cost of the system (Moezzi 2020).

Routine upkeep for a solar pool heating system should include cleaning the collector's surface, examining for leaks, and ensuring foliage has not obstructed the collectors, which the property owner can perform. Less common tasks include altering the system to correct design or installation errors, repairing leaks, or replacing components (Moezzi 2020).

The Statewide CASE Team assumed only the replacement costs of the solar thermal collectors and pool pumps. The lifetime of pool pumps was assumed to be seven years, with replacement occurring in years 7, 14, 21, and 28. Retrofit costs for associated plumbing were not included, as the expected lifespan for Schedule 40 PVC pipe (the standard material for commercial pool systems) exceeds the 30-year CASE period analysis (In The Swim n.d.).

5.5 Cost Effectiveness

This measure proposes a mandatory requirement. As such, California Statutes require a cost analysis to identify the costs and benefits of the measure and demonstrate that the measure is cost effective over the 30-year period of analysis.

The CEC establishes the procedures for calculating cost effectiveness. The Statewide CASE Team collaborated with CEC staff to confirm that the methodology presented in this report is consistent with CEC guidelines, specifying which costs are included in the analysis. Assumptions were shared with stakeholders for review and feedback. Appendix E provides a summary of stakeholder engagement.

A measure is cost-effective if the BCR is greater than 1.0. Results of the per-unit cost-effectiveness analyses are presented in Table 16 through Table 19 for all prototypical pools, per climate zone. Based on the costs gathered, the proposed measure would

provide monetary savings over the 30-year analysis period relative to existing conditions. Solar thermal heating does not show cost-effectiveness for all pool prototypes in Climate Zone 1; therefore, the Statewide CASE Team is not proposing requirements for pool heating alterations in this climate zone. The proposed code change shows to be cost effective in every applicable climate zone for alterations.

Table 16: 30-Year Cost-Effectiveness Summary Per Solar Thermal Prototypical Pool – Alterations – Average-Sized Nonresidential Outdoor Year-round and Seasonal Pools

Climate Zone	Outdoor Year-round Pool Benefits LSC Savings + Other PV Savings (2029 PV$)	Outdoor Year-round Pool Costs Total Incremental PV Costs (2029 PV$)	Outdoor Year-round Pool Benefit-to-Cost Ratio	Outdoor Seasonal Pool Benefits LSC Savings + Other PV Savings (2029PV$)	Outdoor Seasonal Pool Costs Total Incremental PV Costs (2029 PV$)	Outdoor Seasonal Pool Benefit-to-Cost Ratio
1	61,038	44,301	1.4	28,137	44,301	0.6
2	161,521	44,301	3.6	103,189	44,301	2.3
3	106,480	44,301	2.4	61,662	44,301	1.4
4	217,273	44,301	4.9	120,350	44,301	2.7
5	125,502	44,301	2.8	57,853	44,301	1.3
6	140,512	44,301	3.2	67,051	44,301	1.5
7	163,646	44,301	3.7	62,448	44,301	1.4
8	217,245	44,301	4.9	94,126	44,301	2.1
9	225,051	44,301	5.1	106,206	44,301	2.4
10	230,803	44,301	5.2	133,363	44,301	3.0
11	183,745	44,301	4.1	131,956	44,301	3.0
12	178,407	44,301	4.0	114,254	44,301	2.6
13	168,891	44,301	3.8	123,063	44,301	2.8
14	232,787	44,301	5.3	153,576	44,301	3.5
15	277,549	44,301	6.3	157,485	44,301	3.6
16	151,385	44,301	3.4	72,272	44,301	1.6

Table 17: 30-Year Cost-Effectiveness Summary Per Solar Thermal Prototypical Pool – Alterations – Average-Sized Nonresidential Indoor Exercise and Swim School Pools

Climate Zone	Indoor Exercise Pool Benefits LSC Savings + Other PV Savings (2029 PV$)	Indoor Exercise Pool Costs Total Incremental PV Costs (2029 PV$)	Indoor Exercise Pool Benefit-to-Cost Ratio	Indoor Swim School Benefits LSC Savings + Other PV Savings (2029 PV$)	Indoor Swim School Costs Total Incremental PV Costs (2029 PV$)	Indoor Swim School Benefit-to-Cost Ratio
1	48,236	44,301	1.1	30,891	44,301	0.7
2	152,991	44,301	3.5	130,088	44,301	2.9
3	88,120	44,301	2.0	54,316	44,301	1.2
4	205,389	44,301	4.6	182,480	44,301	4.1
5	109,840	44,301	2.5	76,690	44,301	1.7
6	124,799	44,301	2.8	81,179	44,301	1.8
7	147,726	44,301	3.3	108,163	44,301	2.4
8	223,943	44,301	5.1	202,907	44,301	4.6
9	214,930	44,301	4.9	189,482	44,301	4.3
10	229,119	44,301	5.2	201,737	44,301	4.6
11	181,404	44,301	4.1	156,667	44,301	3.5
12	179,418	44,301	4.0	157,336	44,301	3.6
13	172,014	44,301	3.9	150,497	44,301	3.4
14	194,380	44,301	4.4	161,524	44,301	3.6
15	316,173	44,301	7.1	296,896	44,301	6.7
16	110,124	44,301	2.5	84,957	44,301	1.9

Table 18: 30-Year Cost-Effectiveness Summary Per Solar Thermal Prototypical Pool – Alterations – Olympic-Sized Nonresidential Outdoor Year-round and Seasonal Pool

Climate Zone	Outdoor Year-round Pool Benefits LSC Savings + Other PV Savings (2029 PV$)	Outdoor Year-round Pool Costs Total Incremental PV Costs (2029 PV$)	Outdoor Year-round Pool Benefit-to-Cost Ratio	Outdoor Seasonal Pool Benefits LSC Savings + Other PV Savings (2029 PV$)	Outdoor Seasonal Pool Costs Total Incremental PV Costs (2029 PV$)	Outdoor Seasonal Pool Benefit-to-Cost Ratio
1	341,876	273,980	1.2	172,731	273,980	0.6
2	1,012,404	273,980	3.7	694,386	273,980	2.5
3	614,146	273,980	2.2	391,220	273,980	1.4
4	1,373,121	273,980	5.0	818,844	273,980	3.0
5	746,422	273,980	2.7	374,997	273,980	1.4
6	836,342	273,980	3.1	441,310	273,980	1.6
7	991,180	273,980	3.6	430,699	273,980	1.6
8	1,447,575	273,980	5.3	718,664	273,980	2.6
9	1,430,325	273,980	5.2	752,620	273,980	2.7
10	1,502,049	273,980	5.5	957,328	273,980	3.5
11	1,176,158	273,980	4.3	899,359	273,980	3.3
12	1,155,423	273,980	4.2	797,732	273,980	2.9
13	1,098,864	273,980	4.0	854,662	273,980	3.1
14	1,388,907	273,980	5.1	983,308	273,980	3.6
15	1,863,774	273,980	6.8	1,195,576	273,980	4.4
16	833,939	273,980	3.0	445,508	273,980	1.6

Table 19: 30-Year Cost-Effectiveness Summary Per Solar Thermal Prototypical Pool – Alterations – Olympic-Sized Nonresidential Indoor Exercise Pool

Climate Zone	Indoor Exercise Pool Benefits LSC Savings + Other PV Savings (2029 PV$)	Indoor Exercise Pool Costs Total Incremental PV Costs (2029 PV$)	Indoor Exercise Pool Benefit-to-Cost Ratio
1	307,734	273,980	1.1
2	1,005,014	273,980	3.7
3	571,507	273,980	2.1
4	1,356,664	273,980	5.0
5	714,940	273,980	2.6
6	810,641	273,980	3.0
7	961,550	273,980	3.5
8	1,475,202	273,980	5.4
9	1,415,453	273,980	5.2
10	1,513,880	273,980	5.5
11	1,201,288	273,980	4.4
12	1,183,092	273,980	4.3
13	1,133,973	273,980	4.1
14	1,284,399	273,980	4.7
15	2,120,871	273,980	7.7
16	716,399	273,980	2.6

6. Statewide Impacts

6.1 Statewide Energy and Energy Cost Savings

The Statewide CASE Team estimated the first-year statewide savings from alterations by multiplying the per-pool savings (presented in Section 5.2) by assumptions regarding the percentage of existing pools that would be impacted by the proposed code. Table 25 in Appendix C presents the statewide pool forecast for 2029, along with the Statewide CASE Team's assumptions about the number of pools impacted by the proposal, broken down by climate zone.

For more details on the methodology and context about estimating the current market share rate, as well as statewide energy and energy cost savings, see the 2028 CASE Methodology Report.

Table 20 presents the first-year statewide energy and LSC savings for all prototypical pools, categorized by climate zone. Climate Zone 1 is excluded because no requirements are proposed for this climate zone. PK data was used to estimate the total number of pools and their split for indoor and outdoor commercial pools. The Statewide CASE team then applied a conservative assumption to estimate the number of commercial outdoor seasonal pools based on a survey of pools in Los Angeles County. The Statewide CASE Team assumed that all year-round pools are heated for this analysis.

Table 20: Statewide Energy and LSC Impacts – All Prototypical Pool Alterations

Climate Zone	Statewide Alterations Impacted by Proposed Change in 2029 (Pools)	First-Year Electricity Savings (GWh)	First-Year Peak Electrical Demand Reduction (MW)	First-Year Natural Gas Savings (Million Therms)	First-Year Source Energy Savings (Million kBtu)	30-Year Present Valued LSC Savings (Million 2029 PV$)
1*	N/A	N/A	N/A	N/A	N/A	N/A
2	13	N/A	N/A	0.04	3.36	$3.05
3	50	N/A	N/A	0.09	7.53	$6.94
4	25	N/A	N/A	0.11	9.07	$8.32
5	5	N/A	N/A	0.01	0.93	$0.87
6	58	N/A	N/A	0.14	11.55	$11.02
7	37	N/A	N/A	0.10	8.46	$8.12
8	84	N/A	N/A	0.35	29.70	$28.27
9	136	N/A	N/A	0.56	48.08	$45.46
10	115	N/A	N/A	0.52	44.44	$41.74
11	12	N/A	N/A	0.05	4.06	$3.62
12	59	N/A	N/A	0.21	18.46	$16.68
13	27	N/A	N/A	0.10	8.22	$7.40
14	24	N/A	N/A	0.10	8.89	$8.17
15	12	N/A	N/A	0.07	6.20	$5.80
16	7	N/A	N/A	0.02	1.37	$1.25
Total	**666**	**N/A**	**N/A**	**2.46**	**210.32**	**$196.70**

*Climate Zone 1 is exempt from the requirements of the proposal

6.2 Statewide Greenhouse Gas Emissions Reductions

Table 21 presents the estimated first-year reduction in GHG emissions resulting from the proposed code change, by prototype. In this initial year, the Statewide CASE Team expects to avoid 12,806 metric tons of carbon dioxide equivalent (CO_2e) emissions. The emission reductions would be realized through reduced gas use as pool owners adopt solar thermal or other energy-efficient solutions as their primary heating source, since solar technology has no GHG emissions. These savings would be expected even with gas heaters meeting minimum federal compliance standards being maintained as supplemental heating sources to meet the individual pool's needs. The GHG emissions reduction represents a significant fraction of code savings and would provide direct and indirect benefits to the California communities. These reductions, along with their associated monetary value, were calculated using hourly GHG emissions factors published alongside the LSC hourly factors and source energy hourly factors in the research versions of CBECC, as well as data from the CEC's 2028 Metrics Report. See the 2028 CASE Methodology Report for additional information.

Table 21: First-Year Statewide GHG Emissions Impacts

Construction Type	Reduced GHG Emissions from Electricity Savings (Metric Tons CO_2e)	Reduced GHG Emissions from Natural Gas Savings (Metric Tons CO_2e)	Total Reduced GHG Emissions (Metric Ton CO_2e)	Total Monetary Value of Reduced GHG Emissions ($2029)
Average-Sized Pool – Alterations	-	5,963	5,963	734,325
Olympic-Sized Pool – Alterations	-	6,843	6,843	842,668
Total	**-**	**12,800**	**12,800**	**1,576,994**

6.3 Statewide Water Use Impacts

The proposed code change would not result in water use impacts.

6.4 Statewide Material Impacts

The proposed code change requiring solar thermal pool and spa heating systems would increase the use and production of copper and plastic in commercial applications. For more information on the Statewide CASE Team's methodology and assumptions used to calculate embodied GHG emissions, see the 2028 CASE Methodology Report.

Table 22: First-Year Statewide Impacts on Material Use

Material	Impact	Per-Pool Impacts (Pounds per pool)	First-Year Statewide Impacts (Pounds)	Embodied GHG Emissions Saved (Metric Tons CO_2e)
Mercury	No Change	0	0	0
Lead	No Change	0	0	0
Copper	Increase	10	6,700	-8
Steel	No Change	0	0	0
Plastic	Increase	620	410,000	-347
TOTAL	**N/A**	**630**	**416,700**	**-355**

6.5 Environmental Impacts

The proposed measure would provide significant direct environmental benefits. Most notably, the projected increase in solar technology adoption for pool heating under this proposal would result in a significant decrease in greenhouse gas emissions by reducing dependence on nonrenewable resources, such as natural gas. Furthermore, reducing greenhouse gas emissions would yield indirect benefits associated with solar collector production and disposal if not performed properly and sustainably. However, these indirect impacts are generally small when compared to the greenhouse gas emissions avoided with the measure. Appendix D of this report provides a more in-depth analysis of environmental benefits and impacts.

6.6 Other Non-Energy Impacts

The Statewide CASE Team has not identified additional non-energy impacts.

7. Proposed Language Code

7.1 Guide to Markup Language

The proposed changes to the standards are provided below. Changes to the 2025 restructured documents are marked with dark blue underlining (new language) and ~~strikethroughs~~ (deletions). Defined terms will be italicized in the 2028 Title 24, Part 6, as a new feature to help those reading the code to know that there are corresponding definitions.

Markups are provided to the restructured 2025 Energy Code that the CEC developed in response to feedback that aligning the structure of Title 24, Part 6 with other parts of the California Building Standards Code (Title 24) would improve readability, usability, and navigation. New section numbers are shown as bold followed by square brackets that document the section in the 2025 Title 24, Part 6 section numbers prior to the restructuring. For example, “Section 800.3 [Section 110.4(c)] Heat source sizing” contains the content that is in the current Section 110.4(c).

Posting the proposed code language in this format is useful as it helps describe how the Energy Code changes proposed for nonresidential occupancies are separated from the requirements for residential occupancies. The requirements for residential occupancies will not be changed this code cycle to comply with Assembly Bill 130.

7.2 Administrative Code (Title 24, Part 1)

There are no proposed changes to Title 24, Part 1.

7.3 Energy Code (Title 24, Part 6)

SUB CHAPTER 8

POOL AND SPA

SECTION 800 – MANDATORY REQUIREMENTS FOR ALL OCCUPANCIES (NEWLY CONSTRUCTED, ADDITIONS, ALTERATIONS)

800.3 *[Section 110.4(c)]* **Heating source sizing.**

Heating systems or *equipment* for *pool and/or spa* shall meet one of the sizing requirements of 1 through 5 below:

1. **Solar pool heating system**. A *solar pool heating system* with a solar collector surface area that is equivalent to the following:
   1.1. For *nonresidential and multifamily buildings*, 65 percent or greater of the pool and/or spa surface area.

1.2. For single-family buildings, 60 percent or greater of the pool and/or spa surface area.

2. **Heat pump pool heater**. A *heat pump* pool heater as the primary heating system that meets the sizing requirements of Reference Joint Appendix JA16.3. The supplementary heater can be of any energy source; or
3. **On-site renewable or recovered energy**. A heating system that derives at least 60 percent of the annual heating energy from on-site renewable energy or *on-site recovered energy.*
4. **Solar and heat pump combination system.** A combination of a *solar pool heating system* and *heat pump* pool heater without any additional supplementary heater; or
5. **Alternative system approved by Executive Director**. A pool heating system determined by the *Executive Director* to use no more energy than the systems specified in Items 1, 2, 3, or 4 above.

Exception 1 to Section 800.3: *Portable electric spas* compliant with 20 CCR § 1605.3(g)(7) of the *Appliance Efficiency Regulations*.

Exception 2 to Section 800.3: *Alterations* to existing *pools and/or spas* with existing heating systems or equipment in *hotel/motel* buildings and *nonresidential buildings* with Group R occupancies.

Exception 3 to Section 800.3: A *pool and/or spa* that is heated solely by a *solar pool heating system* without any backup heater.

Exception 4 to Section 800.3: Heating systems which are used exclusively for permanent *spa* applications in existing buildings with gas availability.

Exception 5 to Section 800.3: Heating systems which are used exclusively for permanent *spa* applications where there is inadequate Solar Access Roof Area (SARA) as specified in Section 702.3.1 [Section 150.1(c)14] for a *solar pool heating system* to be installed.

Skipping sections 800.4 to 801

…

SECTION 801

NONRESIDENTIAL AND HOTEL/MOTEL OCCUPANCIES

(NEWLY CONSTRUCTED, ADDITIONS, ALTERATIONS)

RESERVED.

801.1 General.

Nonresidential and *Hotel/motel buildings* shall comply with the applicable requirements of Section 801.

NOTE: The requirements of Sections 801.2 through 801.4 apply to newly constructed pools and spas. Section 801.5 applies to alterations.

801.2 Mandatory requirements (Newly Constructed).

Pool and *spa* systems shall meet the requirements of the sections listed below:

101.2, 101.4, *[Section 110.0, 110.5]* Systems and Equipment

800.1, 800.2, 800.3, 800.4, *[Section 110.4)]* Mandatory Requirements for Pool and Spa Systems

801.3 Prescriptive requirements (Newly Constructed).

RESERVED.

801.4 Performance requirements (Newly Constructed).

RESERVED.

801.5 *[New section]* **Alterations to existing pools and spas.**

801.5.1 Alterations

Alterations to *pool* and *spa* systems shall meet the mandatory requirements of Section 801.5.2.1.

801.5.1.1 Mandatory requirements (Alterations).

Any *alteration* shall meet the applicable requirements of the sections listed below:

101.2, 101.4 Systems and Equipment

800.1, 800.2, 800.4, 800.5 Mandatory Requirements for Pool and Spa Systems

801.5.1.1.1 Heating source requirements.

Heating systems or equipment for pool and/or spa located in climate zones 2 through 16, shall meet one of the requirements of 1 through 6 below:

1. **Solar pool heating system.** A *solar pool heating system* with a solar collector surface area that is equivalent to 40 percent or greater than the pool and/or spa surface area; or
2. **Heat pump pool heater.** A *heat pump* pool heater as the primary heating system that meets the sizing requirements of Reference Joint Appendix JA16.3. The supplementary heater can be of any energy source; or
3. **On-site renewable or recoverable energy.** A heating system that derives at least 60 percent of the annual heating

energy from onsite renewable energy or on-site *recovered energy*; or

4. **Condensing gas pool heater.** A pool heating system that relies solely on a gas pool heater(s) with a minimal thermal efficiency of 94. Multiple units are allowed to meet this requirement with an input capacity-weighted average of at least 94 percent; or
5. **Solar and heat pump combination system.** A combination of a *solar pool heating system* and *heat pump* pool heater without any additional supplementary heater; or
6. **Alternative system approved by Executive Director.** A pool heating system is determined by the Executive Director to use no more energy than the systems specified in Items 1, 2, 3, 4 or 5 above.

Exception 1 to Section 801.5.1.1.1: *Portable electric spas* compliant with 20 CCR §1605.3(g)(7) of the Appliance Efficiency Regulations.

Exception 2 to Section 801.5.1.1.1: A *pool* and/or *spa* that is heated solely by a solar pool heating system without any backup heater.

Exception 3 to Section 801.5.1.1.1: Heating systems which are used exclusively for permanent *spa* applications in existing *buildings* with natural gas availability.

Exception 4 to Section 801.5.1.1.1: Heating systems which are used exclusively for permanent spa applications where there is inadequate SARA as specified in Section 701.3.1.1 for a *solar pool heating system* to be installed.

Exception 5 to Section 801.5.1.1: Pool alterations at *hotel/motel buildings* and *nonresidential* buildings with Group R occupancies

801.5.2.2 Prescriptive requirements (Alterations).

RESERVED

801.5.2.3 Performance requirements (Alterations).

RESERVED

7.4 CALGreen (Title 24, Part 11)

~~**A5.204.1.1 Altered pool and/or spa heating for existing buildings.**~~

~~Alteration of existing nonresidential pool and/or spa heating system shall meet the following.~~

~~**Heating source sizing.**~~

~~Heating systems or equipment for pools or spas shall meet one of the sizing requirements of items 1 through 5 below:~~

1. ~~Solar pool heating system with a solar collector surface area that is equivalent to 65 percent or greater of the surface areas of the pool or spa or combination of both respectively; or~~
2. ~~A heat pump pool heater as the primary heating system that meets the sizing requirements of Reference Joint Appendix JA16.3. The control for the heat pump pool heater shall meet the requirements specified in Section 110.4(d). supplementary heater can be of any energy source; or~~
3. ~~A heating system that derives at least 60 percent of the annual heating energy from on-site renewable energy or on- site recovered energy; or~~
4. ~~A combination of a solar pool heating system and heat pump pool heater without any additional supplementary heater; or~~
5. ~~A pool heating system determined by the Energy Commission Executive Director to use no more energy than the systems specified in Item 1, 2, 3, or 4 above.~~

~~**Exception 1 to A5.204.1.1:** Portable electric spas compliant with 20 CCR, Section 1605.3(g)(7) of the Appliance Efficiency Regulations.~~

~~**Exception 2 to A5.204.1.1:** A pool or spa that is heated solely by a solar pool heating system without any supplementary heater.~~

~~**Exception 3 to A5.204.1.1**: An existing building with inadequate Solar Access Roof Area (SARA) as specified in Section 140.10(a) for a solar pool heating system to be installed.~~

~~**Exception 4 to A5.204.1.1:** Heating systems which are used exclusively for permanent spa applications in existing buildings with gas availability.~~

7.5 Reference Appendices

There are no proposed changes to the Reference Appendices.

7.6 Compliance Manuals

The Statewide CASE Team will provide CEC with recommended revisions to compliance manuals after the 45-Day Language is published.

7.7 ACM Reference Manual

There are no proposed changes to the ACM Reference Manual.

7.8 Compliance Forms

As discussed in Section 2.4.6, the NRCC-PLB-E and NRCI-PLB-E compliance forms would be updated to reflect the proposed change. The Statewide CASE Team can support the CEC in implementing these updates if the proposed change is adopted.

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Appendix A: Assumptions for Cost-effectiveness Analysis

Key Assumptions for Energy Savings Analysis

The Statewide CASE Team analyzed seven nonresidential pool applications to determine the energy savings associated with a solar pool heating code change. These represented two pool sizes in both outdoor and indoor configurations:

- An average-sized nonresidential 60,000-gallon pool (2,005 square feet surface area) is assumed to have the following gas-fired pool heater capacities: 722 thousand British thermal units per hour (kBtu/h) for outdoor pools (both seasonal and year-round), 241 kBtu/h for indoor exercise pools, and 502 kBtu/h for indoor swim school pools. For these pools, the solar collector size is assumed to be 802 square feet, meeting the minimum proposed requirement of 40 percent for nonresidential pools.
- An Olympic-sized 660,000-gallon pool (13,455 square feet surface area) is assumed to have heater capacities of 4,844 kBtu/h for outdoor pools (seasonal and year-round) and 1,615 kBtu/h for indoor exercise pools. The associated solar collector size area is 5,382 square feet.

For outdoor pool applications, the sensitivity of using a pool cover was analyzed as part of the 2025 CASE effort. However, as the difference in savings was not significant, pool covers were not evaluated for this analysis. The Statewide CASE Team assumed no pool cover for indoor pools since the controlled indoor environment prevents most evaporation from the pool. All scenarios assume continuous pool heating and the use of unglazed solar collectors, as these are the most common type used in pool heating applications.

The Statewide CASE Team could not use the 2028 Research Version of the California Building Energy Code Compliance (CBECC) software, as was done for the other Title 24 measures, because CBECC does not model pool energy use. Instead, the Statewide CASE Team leveraged the same modeling software used during the 2025 code cycle, Enerpool Pro 3.0 Pool Heater Simulation Software (developed by Natural Resources, Canada). This software was chosen due to its validated ability to model pool temperature fluctuations and its adaptability to California's climate-specific conditions.

The Enerpool Pro 3.0 software simulates the heat loss through conduction, convection, radiation, and evaporation of pool water. This software accepts a range of inputs and assumptions, including weather data, pool size, heater and collector size, use of a cover, and pool activity and usage levels.

Key Assumptions for Cost-effectiveness Analysis

For the cost-effectiveness analysis, the Statewide CASE Team obtained stakeholder feedback on potential retrofit costs associated with adding solar collectors to existing pools and determined an average through market research for all pool scenarios. In addition to the incremental first cost of the solar collectors, the additional retrofit costs considered include piping costs and additional pump costs. The Statewide CASE Team also assumed incremental maintenance costs to be two percent of the total cost of collectors per year of the benefit-cost analysis.

Table 23: Assumed Per-unit Cost of Additional Retrofit Work, by Pool Size

Prototype Name	Pool Surface Area (Square Feet)	Collector Size (Square Feet)	Solar Collector Installation Cost Per Unit	Additional Piping	Additional Pump
Average-Sized Nonresidential Pool	2,005	802	$20 per square foot of panel	100ft of piping at $20 per linear foot	1 pump
Olympic-Sized Nonresidential Pool	13,455	5,382	$20 per square foot of panel	150ft of piping at $20 per linear foot	3 pumps

All scenarios assume an expected useful life (EUL) of the solar collectors and additional pool pump to be 15 years and 7 years, respectively, as determined by stakeholder feedback and market research.

Energy Savings Methodology per Prototypical Building

The 2028 CASE Methodology Report provides details on estimating energy savings per prototypical building and unit. The CEC directed the Statewide CASE Team to model energy impacts using specific prototypical building models that represent typical building geometries for different building types. Table 24 presents the prototype buildings used in the analysis.

Table 24: Prototype Buildings Used for Energy, Demand, Cost, and Environmental Impacts Analysis

Prototype Name	Surface Area (Square Feet)	Pool Volume (Gallons)	Description
Average-Sized Nonresidential Outdoor Year-round Exercise Pool	2,005	60,000	Outdoor exercise pool typical of nonresidential application with no pool cover and heated year-round
Average-Sized Nonresidential Outdoor Seasonal Exercise Pool	2,005	60,000	Outdoor exercise pool typical of nonresidential application with no pool cover and heated seasonally
Average-Sized Nonresidential Indoor Exercise Pool	2,005	60,000	Indoor exercise pool typical of nonresidential application with no pool cover
Average-Sized Nonresidential Indoor Swim School Pool	2,005	60,000	Indoor pool typical of swim schools in nonresidential applications with no pool cover
Olympic-Sized Nonresidential Outdoor Year-round Exercise Pool	13,455	660,000	Outdoor Olympic-sized exercise pool with no pool cover and heated year-round
Olympic-Sized Nonresidential Outdoor Seasonal Exercise Pool	13,455	660,000	Outdoor Olympic-sized exercise pool with no pool cover and heated seasonally
Olympic-Sized Nonresidential Indoor Exercise Pool	13,455	660,000	Indoor Olympic-sized exercise pool with no pool cover

The Statewide CASE Team analyzed each pool prototype listed in Table 24 for a standard and baseline design for existing pools.

There is an existing Title 24, Part 6 requirement that covers the building system in question and applies to both new construction/additions and alterations, so the Standard Design is minimally compliant with the 2025 Title 24 requirements.

The Standard Design represents the geometry and usage patterns of the prototypical pool and incorporates features that achieve a long-term system-wide energy budget and source-energy budget that are minimally compliant with the 2025 Title 24, Part 6 requirements.

The Proposed Design represents the same geometry as the Standard Design, but it assumes the energy sources required by the proposed code change.

To develop savings estimates for the proposed code changes, the Statewide CASE Team created a Standard Design and a Proposed Design for each prototypical pool, with the Standard Design representing compliance with the 2025 code and the

Proposed Design representing compliance with the proposed requirements. Comparing the energy impacts of the Standard Design to the Proposed Design reveals the impacts of the proposed code change relative to a pool that is minimally compliant with the 2025 Title 24, Part 6 requirements and follows typical industry practices.

The energy impacts of the proposed code change vary by climate zone. The Statewide CASE Team simulated the energy impacts across all climate zones and applied the climate-zone-specific LSC hourly factors when calculating energy and LSC impacts.

Appendix B: Purpose and Necessity of Proposed Code Changes

Introduction

The sections below provide the purpose and necessity of proposed changes to Title 24, Part 1; Title 24, Part 6; and the reference appendices. This section intends to provide the CEC with the information needed for the Initial Statement of Reasons.

See Section 7 of this report for marked-up code language.

Purpose and Necessity of Changes to Title 24, Part 1

There are no proposed changes to Title 24, Part 1.

Purpose and Necessity of Changes to Title 24, Part 6

Section: Exception 2 to Section 800.3

Purpose: The purpose of this change is to expand the scope of the pool heating system sizing requirement to certain existing pool heating systems.

Necessity: The necessity for this exception is to ensure that existing pool heating systems achieve cost-effective energy savings.

Section: Section 801.5.1.1.1

Purpose: The purpose of this change is to introduce heating system requirements for existing nonresidential pools, replacing a gas heater in climate zones 2-16.

Necessity: The necessity for this change is to provide clarity and flexibility regarding the compliance pathways for existing pools that replace gas heaters.

Section: Exception 1 to Section 801.5.1.1.1

Purpose: The purpose of this exception is to exclude portable electric spas from the scope of pool and spa systems alteration requirements.

Necessity: The necessity for this exception is to ensure that portable electric spas are excluded since they already comply with 20 CCR § 1605.3(g)(7) of the Appliance Efficiency Regulations.

Section: Exception 2 to Section 801.5.1.1.1

Purpose: The purpose of this exception is to exclude pools or spas that only rely on solar heating systems from the scope of pool and spa systems alteration requirements.

Necessity: The necessity for this exception is to provide clarity for pools and spas that already use solar thermal heating as their only heating source, so they are not bound to these requirements since they are already utilizing the technology. This exception would align with existing code language in Section 800.3.

Section: Exception 3 to Section 801.5.1.1.1

Purpose: The purpose of this exception is to support the new heating source requirements in 801.5.1.1.1 and align with the existing code language in Section 800.3. A heating system used solely for a permanent spa in an existing building with gas availability is not required to comply.

Necessity: The necessity for this exception is to address stakeholder feedback. The typical user behavior and expectations for a permanent spa call for rapid heating in the evening. It is more difficult to align the energy-efficiency benefits of the requirements in 801.5.1.1.1 with the typical usage patterns for permanent spa-only systems.

Section: Exception 4 to Section 801.5.1.1.1

Purpose: The purpose of this exception is to support the new heating source requirements in 801.5.1.1.1 and align with the existing code language in Section 800.3. A heating system used solely for a permanent spa in an existing building with inadequate solar access is not required to comply

Necessity: The necessity for this exception is to address stakeholder feedback. Typical user behavior and expectation for a permanent spa call for rapid heating in the evening. It is more difficult to align the energy-efficiency benefits of the requirements in 801.5.1.1.1 with the typical usage patterns for permanent spa-only systems.

Section: Exception 5 to Section 801.5.1.1.1

Purpose: The purpose of this exception is not require the pool heating sizing requirements for pool alterations at hotel and motel buildings and nonresidential buildings with Group R occupancies.

Necessity: The necessity for this exception is to comply with the statutory requirements of AB130.

Purpose and Necessity of Changes to Title 24, Part 11

Section: A5.204.1.1

Purpose: The purpose of this change is to remove the requirements for heating source sizing for alterations to existing pools/spas from CALGreen.

Necessity: The necessity of this change is to avoid duplicative and conflicting requirements for pool heating source alterations between Part 6, which would be mandatory, and Part 11, which are voluntary.

Purpose and Necessity of Changes to the Reference Appendices

There are no proposed changes to reference appendices.

Appendix C: Assumptions for Statewide Savings Estimates

The Statewide CASE Team estimated statewide first-year impacts by multiplying per-pool savings estimates by statewide pool forecasts developed for this analysis. Details of the pool forecast are in Table 25.

The statewide savings and cost estimates take into account the current market share rate. The Statewide CASE Team estimated the current market share rate for the proposed code change in the retrofit market is 3.8 percent. The current market share rate is estimated based on the Statewide CASE Team's professional judgment and solar pool heating installation data from a 2010 Solar Energy Industries Association (SEIA) report (Solar Energy Industries Association 2010).

The Statewide CASE Team used 2023 PKdata and a listing of Olympic-sized pools from the Swimmer Guide (SwimmersGuide n.d.) to estimate the number of nonresidential pools in California (P.K. Data, Inc. 2023). PKdata indicated that 17 percent of all national pool installations occur in the state. The analysis focused on nonresidential pools located at luxury clubs, health clubs, gyms (e.g., YMCA), medical facilities, water parks, schools, and municipal pools. The PKdata was assumed to include all nonresidential pools, and the Swimmers Guide was used to estimate the number of Olympic-sized pools within that dataset.

To project total stock from the 2023 PK Data installation data to 2026, a four percent annual growth rate was applied, based on pre-pandemic trends. A more conservative one percent growth rate was assumed for projections to 2029, consistent with prior analysis (Adler 2015). Commercial pools were assumed to consist of 22 percent indoor and 78 percent outdoor pools, based on PK Data and corroborated by PHTA data for the western United States. Outdoor pools were further divided into year-round (30 percent) and seasonal (70 percent) facilities, reflecting PK Data's characterization of the majority of outdoor pools operating seasonally. All indoor pools and all year-round outdoor pools were assumed to be heated, while 25 percent of seasonal outdoor pools were assumed to be heated based on a targeted survey of facilities in the Los Angeles area. Consistent with 2019 RASS data, 90 percent of heated nonresidential pools were assumed to use natural gas, with the remaining 10 percent electrically heated. All nonresidential pools were assumed to operate continuously during their active seasons as reported by SEIA (2011).

Based on data from the 2019 RASS, the Statewide CASE Team assumed that nonresidential pools would be heated by gas or electricity in equal proportions. All nonresidential pools were assumed to be heated continuously based on information

from SEIA (Solar Energy Industries Association 2011). The projected number of pools impacted in Climate Zone 1 is zero because it is exempted.

Table 25: Estimated Number of Retrofit Pools Impacted by Proposed Code Change in 2029 by Climate Zone

Climate Zone	City Name	Average-Sized Nonresidential Outdoor Pools	Average-Sized Nonresidential Indoor Pools	Olympic Outdoor Pools	Olympic Indoor Pools
1	Arcata	0	0	0	0
2	Sonoma	7	4	1	1
3	Oakland	27	16	5	3
4	Paso Robles	14	8	2	1
5	Santa Maria	3	2	0	0
6	Los Angeles	31	19	5	3
7	San Diego	20	12	3	2
8	Fullerton	45	27	8	5
9	Hollywood Burbank	73	43	12	7
10	Riverside	62	37	11	6
11	Red Bluff	7	4	1	1
12	Sacramento	32	19	5	3
13	Fresno Yosemite	15	9	2	1
14	Palmdale	13	8	2	1
15	Palm Springs	7	4	1	1
16	Blue Canyon Nyack	4	2	1	0
	TOTAL	**358**	**212**	**61**	**36**

Appendix D: Environmental Analysis

Potential Significant Environmental Effect of Proposal

The Statewide CASE Team has considered the environmental benefits and adverse impacts of its proposal, including—but not limited to—an evaluation of factors contained in the California Code of Regulations, Title 14, section 15064, and has determined that the proposal will not result in a significant effect on the environment.

Direct Environmental Impacts

Direct Environmental Benefits

The Statewide CASE Team concludes, after careful consideration of the project, that there would be no direct environmental benefits or impacts resulting from the proposed Building Energy Efficiency Standards for solar thermal pool heating. The proposed regulations would not affect the health and welfare of California residents, worker safety, or the state's environment. The most probable means to achieve the standards would not require the use of materials that are hazardous to the environment.

Direct Adverse Environmental Impacts

There are no direct adverse environmental impacts.

Indirect Environmental Impacts

Indirect Environmental Benefits

The Statewide CASE Team found that this proposal would provide significant indirect environmental benefits by reducing demand for natural gas, which is associated with GHG emissions. Communities near pools would benefit from improved air quality resulting from reduced emissions from natural gas combustion for pool or spa heating.

Indirect Adverse Environmental Impacts

The proposed code change provides significant environmental benefits, but there may still be indirect adverse environmental impacts associated with the manufacture and disposal of solar collectors.

The manufacturing of solar collectors uses materials such as polypropylene and polyethylene, glass, aluminum, and copper, which can result in negative environmental impacts if they are not sustainably sourced. Additionally, the manufacturing of these collectors may produce greenhouse gas emissions and other air pollutants. The materials used in solar collectors may be reused or recycled. If not, they must be

disposed of properly to minimize environmental pollution and harm to wildlife and ecosystems.

Considering these indirect impacts, the Statewide CASE Team found that they are generally small compared to the significant greenhouse gas emission reductions resulting from increased use of solar thermal technology.

Mitigation Measures

The Statewide CASE Team has considered opportunities to minimize the environmental impact of the proposal, including an evaluation of "specific economic, environmental, legal, social, and technological factors" (Cal. Code Regs., tit. 14, § 15021). The Statewide CASE Team did not determine this measure would result in significant direct or indirect adverse environmental impacts and therefore, did not develop any mitigation measures.

Reasonable Alternatives to Proposal

The Statewide CASE Team has considered alternatives to the proposal and determined that no alternative would achieve its purpose with a lesser environmental impact. The following section presents the alternatives and the Statewide CASE Team's justification for not proposing them.

The Statewide CASE Team considered proposing a standard similar to the solar thermal pool heating requirements in ASHRAE Addendum cf to Standard 90.1 2019 and the 2027 International Energy Conservation Code (IECC) CE86-24 standard. The Statewide CASE team did not choose this option since it would have had no environmental impact, while it was less stringent and yielded fewer environmental benefits.

Water Use and Water Quality Impacts Methodology

There are no impacts to water quality or water use.

Appendix E: Summary of Stakeholder Engagement

Introduction to Stakeholder Engagement

Collaborating with stakeholders who may be affected by proposed code changes is a core component of the Statewide CASE Team's process. The Statewide CASE Team engages interested parties to identify and address issues related to the proposals, with the goal of submitting recommendations to the CEC in this Final CASE Report that reflects broad support. Public stakeholders provide valuable feedback on draft analyses and help identify and address adoption challenges, including cost effectiveness, market and technical barriers, compliance and enforcement, and potential impacts on human health or the environment. Some stakeholders also provide data that the Statewide CASE Team uses to support analyses.

This appendix summarizes the stakeholder engagement conducted by the Statewide CASE Team during the development and refinement of the report's recommendations.

Utility-Sponsored Stakeholder Meetings

Utility-sponsored stakeholder meetings provide an opportunity to learn about the Statewide CASE Team's role in the advocacy effort and to hear about specific code change proposals that the Statewide CASE Team is pursuing for the 2028 code cycle. The goal of these meetings is to solicit input on proposals from stakeholders early enough to ensure the proposals and the supporting analyses are vetted and have as few outstanding issues as possible. To promote transparency in the development of code change proposals, the Statewide CASE Team uses stakeholder meetings to solicit feedback on:

- Proposed code changes
- Draft code language
- Draft assumptions and results of analysis
- Data to support assumptions
- Compliance and enforcement
- Technical and market feasibility

The Statewide CASE Team hosted three stakeholder meetings for the Solar Pool Heating measure via webinar, as described in Table 26. Please see below for dates and links to event pages on Title24Stakeholders.com. Materials from each meeting, such as slide presentations, proposal summaries with code language, and meeting notes, are included in the bibliography section of this report.

Table 26: Utility-Sponsored Stakeholder Meetings

Meeting Name and Link to Materials	Meeting Date	Summary of Items Discussed
2028 Title 24 Energy Code Update: Nonresidential Topics	January 8, 2025	• Welcome and Introduction to the 2028 code cycle from the California Energy Commission and discussion of the Statewide CASE Team role. • An introduction to proposed, nonresidential measures including Pool heating measures. • Information on how you can engage with the Statewide CASE Team.
First Round: Covered Processes and Envelope Utility-Sponsored Stakeholder Meeting (link to notes)	September 30, 2025	• For Solar Pool Heating topic: presented initial draft code language for review; requested data and feedback on specific approaches, assumptions, methodologies for the energy impacts and cost-effectiveness analyses, and potential technical and market barriers.
Repeat/ make-up First Round: Covered Processes, Envelope, AWHP Utility-Sponsored Stakeholder Meeting (link to notes)	October 29, 2025	• For Solar Pool Heating topic: summary of proposed code change, including benefits, cost and savings estimates, market and technical considerations, current market conditions, and draft code language.
Second Round: Solar Heating for an Existing Pool and Spa (link to notes)	March 17, 2026	• Update on proposed code changes, incremental cost framework, energy and cost impacts, statewide impacts

The first round of utility-sponsored stakeholder meetings began in September 2025 (Statwide CASE Team (a) 2025) and served as an early forum to promote transparency and gather stakeholder feedback on measures under consideration by the Statewide CASE Team.

The objectives of the first round of stakeholder meetings were to solicit input on the scope of the 2028 code cycle proposals; request data and feedback on the specific approaches, assumptions, and methodologies for the energy impacts and cost-effectiveness analyses; and understand potential technical and market barriers. The Statewide CASE Team also presented the initial draft code language for stakeholders to review.

Due to technical difficulties experienced during the first stakeholder meeting, the Statewide CASE Team repeated the first meeting in October 2025 and provided updated details on proposed code changes. These meetings introduced early results of energy, cost effectiveness, and incremental cost analyses, and solicited feedback on refined draft code language.

A third utility-sponsored stakeholder meeting was held in March 2026 and provided significant changes to the proposal as a result of stakeholder input and Statewide CASE Team research findings.

Utility-sponsored stakeholder meetings were open to the public. For each stakeholder meeting, two promotional emails were distributed from info@title24stakeholders.com. One email was sent to the full Title 24 Stakeholders listserv, which includes over 3,000 individuals. A second email targeted specific recipients based on their subscription preferences.

The Title 24 Stakeholders listserv is an opt-in service comprising participants from a diverse industries and trades, such as manufacturers, advocacy groups, local government, and building and energy professionals. Each meeting was announced on the Title 24 Stakeholders LinkedIn page and cross-promoted on the CEC LinkedIn page approximately two weeks in advance to engage individuals, organizations, and broader channels outside beyond the listserv. The Statewide CASE Team conducted extensive personal outreach to stakeholders identified in initial work plans who had not yet opted in to the listserv. Exported webinar meeting data captured attendance numbers, individual comments, and results from live attendee polls to help evaluate stakeholder participation and support.

Statewide CASE Team Communications

The Statewide CASE Team held personal communications over email and phone with numerous stakeholders when developing this report, listed in Table 27.

Table 27: Engaged Stakeholders

Organization/Individual Name	Market Role	Mentioned in CASE Report Sections
Aquatherm Industries, Inc.	Manufacturer	Section 1.3, Section 4.1, Section 4.2
California Pool and Spa Association (CPSA)	Trade Association	
California Solar and Storage Association (CALSSA)	Industry Association	Section 1.3, Section 4.2
Counsilman-Hunsaker	Designer	Section 1.3
California Coalition for Children's Safety and Health (CCCSH)	Pool Safety Advocate	Section 1.3
Drowning Prevention Foundation	Pool Safety Advocate	Section 1.3, Section 4.2
Hot Sun Industries, Inc.	Manufacturer	Section 1.3, Section 3.2, Section 4.1
International Code Council -Solar Rating & Certification Corporation (ICC-SRCC)	Third-party certification body for renewable energy products	Section 2.5.1, Section 4.1.1, Section 4.2.1.1
J. Hatfield & Associates	Non-profit	
Martin Aquatic Design & Engineering.	Designer	Section 1.3
Natural Resources Canada	Government	Section 4.2
Norwood Associates, LLC	State / Local government	
Pentair Water	Manufacturer	Section 4.1
Pool and Hot Tub Alliance (PHTA)	Trade Association	Section 1.3
Redwood Coast Energy Authority	Utility	Section 4.2
Rheem Manufacturing Company/Raypack	Manufacturer	Section 4.1
U.S. Swim School Association (USSSA)	Swim School, Non-profit	Section 1.3
Stop Drowning Now	Pool Safety Advocate	Section 1.3
WaterWorks Swim Schools	Swim School	Section 1.3

Engagement with ESJ communities

The Statewide CASE Team identified potential ESJ impacts of the proposed code change via research and stakeholder input. The Statewide CASE Team engaged organizations such as Drowning Prevention Foundation, Stop Drowning Now, and California Coalition for Children's Safety and Health (CCCSH) to better understand ESJ-focused community priorities and challenges. Input from these organizations shaped further research and analysis performed by the Statewide CASE Team and the

proposed requirements presented in this report. The Statewide CASE Team ensured that these organizations, as well as others, were informed of and had an opportunity to comment on cost assumptions, modeling inputs, and potential changes to the proposal.

Appendix F: Condensing Gas Pool Heater Analysis

Condensing Gas Heater Analysis

The Statewide CASE Team modeled pools heated by condensing gas heaters to show cost effectiveness as a result of stakeholder feedback. The purpose of this investigation was to verify that the proposed code change would be cost effective for the proposed alternative requirements for pool heating.

A condensing gas pool heater is a high-efficiency heater that captures heat that otherwise would be lost in the exhaust of a traditional (non-condensing) gas pool heater. It works by cooling the exhaust gases enough to condense the water vapor back into liquid, allowing the heater to recover additional heat and use that extra energy to warm the pool water. This process is what makes condensing heaters significantly more efficient—often exceeding 90 percent efficiency—compared to the typical 82–84 percent efficiency of noncondensing gas heaters.

Because the condensate produced during this process is acidic, condensing heaters are built with corrosion-resistant materials and require a condensate drain line, and in some cases a neutralizer, to safely remove the condensate. Overall, these heaters deliver more heat per unit of fuel, reducing operating costs with only minor differences in installation and maintenance requirements relative to traditional gas pool heaters.

Energy and Energy Cost Savings Results

The Statewide CASE Team calculated the energy savings for pools heated by condensing gas pool heaters using the same method as described in Section 5.1 and Section 5.2 of this Final CASE Report. Table 28 below shows the prototypical pools and assumptions used for the analysis.

Table 28: Prototypes Used for Energy and Cost-Effectiveness Analysis

Prototype ID	Pool Surface Area (sq. ft.)	Pool Volume (gal)	Baseline Heat Source	Measure Heat Source	Description
Average-Sized Nonresidential Outdoor Year-round Exercise Pool	2,005	60,000	84%-efficient gas heater	94%-efficient condensing gas heater	Outdoor exercise pool typical of nonresidential application with no pool cover and heated year-round
Average-Sized Nonresidential Outdoor Seasonal Exercise Pool	2,005	60,000	84%-efficient gas heater	94%-efficient condensing gas heater	Outdoor exercise pool typical of nonresidential application with no pool cover and heated seasonally
Average-Sized Nonresidential Indoor Exercise Pool	2,005	60,000	84%-efficient gas heater	94%-efficient condensing gas heater	Indoor exercise pool typical of nonresidential application with no pool cover
Average-Sized Nonresidential Indoor Swim School Pool	2,005	60,000	84%-efficient gas heater	94%-efficient condensing gas heater	Indoor pool typical of swim schools in nonresidential applications with no pool cover
Olympic-Sized Nonresidential Outdoor Year-round Exercise Pool	13,455	660,000	84%-efficient gas heater	94%-efficient condensing gas heater	Outdoor Olympic-sized exercise pool with no pool cover and heated year-round
Olympic-Sized Nonresidential Outdoor Seasonal Exercise Pool	13,455	660,000	84%-efficient gas heater	94%-efficient condensing gas heater	Outdoor Olympic-sized exercise pool with no pool cover and heated seasonally
Olympic-Sized Nonresidential Indoor Exercise Pool	13,455	660,000	84%-efficient gas heater	94%-efficient condensing gas heater	Indoor Olympic-sized exercise pool with no pool cover

Per Unit Energy Impact Results

The natural gas and energy savings per prototypical residential and nonresidential pools are presented in Table 29 through Table 36 and alterations. There are no electricity savings for this measure. Climate zone 1 has been omitted from the analysis because it is exempt from requirements in Section 801.5.2.1.3.

Table 29: Natural Gas Savings (kBtu/yr) for Condensing Gas Heaters Per Prototypical Pool (Climate Zones 1-8)

Prototype	CZ 1	CZ 2	CZ 3	CZ 4	CZ 5	CZ 6	CZ 7	CZ 8
Average-Sized Nonresidential Outdoor Year-round Exercise Pool	N/A	280,000	310,000	290,000	290,000	250,000	220,000	200,000
Average-Sized Nonresidential Outdoor Seasonal Exercise Pool	N/A	110,000	120,000	100,000	82,000	81,000	51,000	59,000
Average-Sized Nonresidential Indoor Exercise Pool	N/A	68,000	68,000	68,000	68,000	67,000	67,000	67,000
Average-Sized Nonresidential Indoor Swim School Pool	N/A	170,000	170,000	170,000	170,000	170,000	170,000	170,000
Olympic-Sized Nonresidential Outdoor Year-round Exercise Pool	N/A	1,800,000	2,000,000	1,900,000	1,900,000	1,600,000	1,500,000	1,300,000
Olympic-Sized Nonresidential Outdoor Seasonal Exercise Pool	N/A	760,000	800,000	710,000	560,000	550,000	340,000	400,000
Olympic-Sized Nonresidential Indoor Exercise Pool	N/A	460,000	460,000	460,000	460,000	460,000	460,000	460,000

Table 30: Natural Gas Savings (kBtu/yr) for Condensing Gas Heaters Per Prototypical Pool (Climate Zones 9-16)

Prototype	CZ 9	CZ 10	CZ 11	CZ 12	CZ 13	CZ 14	CZ 15	CZ 16
Average-Sized Nonresidential Outdoor Year-round Exercise Pool	240,000	230,000	290,000	260,000	260,000	350,000	210,000	380,000
Average-Sized Nonresidential Outdoor Seasonal Exercise Pool	73,000	98,000	100,000	98,000	120,000	150,000	78,000	62,000
Average-Sized Nonresidential Indoor Exercise Pool	67,000	67,000	68,000	68,000	67,000	66,000	66,000	71,000
Average-Sized Nonresidential Indoor Swim School Pool	170,000	170,000	170,000	170,000	170,000	170,000	170,000	170,000
Olympic-Sized Nonresidential Outdoor Year-round Exercise Pool	1,600,000	1,500,000	1,900,000	1,800,000	1,700,000	2,300,000	1,400,000	2,500,000
Olympic-Sized Nonresidential Outdoor Seasonal Exercise Pool	500,000	670,000	690,000	680,000	830,000	1,000,000	530,000	420,000
Olympic-Sized Nonresidential Indoor Exercise Pool	460,000	460,000	460,000	460,000	460,000	450,000	450,000	480,000

Table 31: Source Energy Savings (kBtu/yr) for Condensing Gas Heaters Per Prototypical Pool (Climate Zones 1-8)

Prototype	CZ 1	CZ 2	CZ 3	CZ 4	CZ 5	CZ 6	CZ 7	CZ 8
Average-Sized Nonresidential Outdoor Year-round Exercise Pool	NA	240,000	260,000	250,000	250,000	210,000	190,000	170,000
Average-Sized Nonresidential Outdoor Seasonal Exercise Pool	NA	95,000	100,000	88,000	70,000	69,000	43,000	50,000
Average-Sized Nonresidential Indoor Exercise Pool	NA	59,000	59,000	59,000	58,000	58,000	57,000	58,000
Average-Sized Nonresidential Indoor Swim School Pool	NA	150,000	150,000	150,000	150,000	140,000	140,000	140,000
Olympic-Sized Nonresidential Outdoor Year-round Exercise Pool	NA	1,600,000	1,800,000	1,700,000	1,600,000	1,400,000	1,200,000	1,100,000
Olympic-Sized Nonresidential Outdoor Seasonal Exercise Pool	NA	650,000	690,000	610,000	480,000	470,000	290,000	340,000
Olympic-Sized Nonresidential Indoor Exercise Pool	NA	400,000	400,000	400,000	400,000	390,000	390,000	390,000

Table 32: Source Energy Savings (kBtu/yr) for Condensing Gas Heaters Per Prototypical Pool (Climate Zones 9-16)

Prototype	CZ 9	CZ 10	CZ 11	CZ 12	CZ 13	CZ 14	CZ 15	CZ 16
Average-Sized Nonresidential Outdoor Year-round Exercise Pool	200,000	200,000	250,000	230,000	220,000	300,000	180,000	320,000
Average-Sized Nonresidential Outdoor Seasonal Exercise Pool	62,000	84,000	87,000	85,000	100,000	130,000	66,000	53,000
Average-Sized Nonresidential Indoor Exercise Pool	58,000	58,000	59,000	58,000	58,000	57,000	56,000	60,000
Average-Sized Nonresidential Indoor Swim School Pool	140,000	140,000	150,000	150,000	150,000	140,000	140,000	150,000
Olympic-Sized Nonresidential Outdoor Year-round Exercise Pool	1,300,000	1,300,000	1,700,000	1,500,000	1,500,000	2,000,000	1,200,000	2,200,000
Olympic-Sized Nonresidential Outdoor Seasonal Exercise Pool	420,000	570,000	600,000	580,000	720,000	860,000	450,000	360,000
Olympic-Sized Nonresidential Indoor Exercise Pool	390,000	390,000	400,000	400,000	390,000	390,000	380,000	410,000

Energy Cost Savings Results

Table 33 and Table 34 below present a breakdown of total LSC savings from natural gas cost savings, by prototypical pool.

Table 33: Total 30-Year LSC Savings (2029 PV$) for Condensing Gas Pool Heaters Per Prototypical Pool (Climate Zones 1-8)

Prototype	CZ 1	CZ 2	CZ 3	CZ 4	CZ 5	CZ 6	CZ 7	CZ 8
Average-Sized Nonresidential Outdoor Year-round Exercise Pool	NA	230,000	260,000	240,000	240,000	220,000	190,000	180,000
Average-Sized Nonresidential Outdoor Seasonal Exercise Pool	NA	82,000	87,000	76,000	60,000	60,000	37,000	43,000
Average-Sized Nonresidential Indoor Exercise Pool	NA	57,000	57,000	57,000	56,000	57,000	56,000	57,000
Average-Sized Nonresidential Indoor Swim School Pool	NA	140,000	140,000	140,000	140,000	140,000	140,000	140,000
Olympic-Sized Nonresidential Outdoor Year-round Exercise Pool	NA	1,600,000	1,700,000	1,600,000	1,600,000	1,400,000	1,300,000	1,200,000
Olympic-Sized Nonresidential Outdoor Seasonal Exercise Pool	NA	560,000	590,000	520,000	410,000	400,000	250,000	300,000
Olympic-Sized Nonresidential Indoor Exercise Pool	NA	380,000	380,000	380,000	380,000	380,000	380,000	380,000

Table 34: Total 30-Year LSC Savings (2029 PV$) for Condensing Gas Pool Heaters Per Prototypical Pool (Climate Zones 9-16)

Prototype	CZ 9	CZ 10	CZ 11	CZ 12	CZ 13	CZ 14	CZ 15	CZ 16
Average-Sized Nonresidential Outdoor Year-round Exercise Pool	210,000	200,000	250,000	230,000	220,000	300,000	190,000	330,000
Average-Sized Nonresidential Outdoor Seasonal Exercise Pool	54,000	73,000	75,000	73,000	90,000	110,000	58,000	46,000
Average-Sized Nonresidential Indoor Exercise Pool	57,000	57,000	57,000	56,000	56,000	56,000	55,000	59,000
Average-Sized Nonresidential Indoor Swim School Pool	140,000	140,000	140,000	140,000	140,000	140,000	140,000	140,000
Olympic-Sized Nonresidential Outdoor Year-round Exercise Pool	1,400,000	1,400,000	1,700,000	1,500,000	1,500,000	2,000,000	1,200,000	2,200,000
Olympic-Sized Nonresidential Outdoor Seasonal Exercise Pool	370,000	500,000	510,000	500,000	620,000	740,000	390,000	310,000
Olympic-Sized Nonresidential Indoor Exercise Pool	380,000	380,000	380,000	380,000	380,000	380,000	380,000	400,000

Cost and Cost-Effectiveness

Incremental First Cost

The Statewide CASE Team used the same cost-effectiveness calculation methodology and assumptions as described in Section 5.1 of the Final CASE Report. The following tables show the cost estimates for the pools heated by a 94 percent efficient condensing gas heater.

The incremental cost is assumed to be the cost of 94 percent-efficient condensing gas heater.

To estimate the incremental cost of the heater, the Statewide CASE Team compared non-condensing (minimally compliant) and condensing (94 percent efficiency) models with the same heating capacity. For swim school pools, the Statewide CASE Team evaluated 500 kBtu heaters and found the incremental cost of the condensing heater alone to be ~$14,000.

Furthermore, the Statewide CASE Team assumed a 10 percent increase in installation cost for a condensing unit compared to a non-condensing one, based on the U.S. Department of Energy's (DOE) Technical Support Document, which evaluated costs for consumer pool heaters.

For the analysis, all four 60,000-gallon pool scenarios and the indoor Olympic pool were assumed to have one heater, while the outdoor Olympic pool was assumed to have three heaters.

Incremental Maintenance and Equipment Costs

The Statewide CASE Team assumed an incremental maintenance cost of $10.89 per heater per year, reflecting the additional work to check the condensate removal system and, when present condensate neutralizer.

The condensing gas heater was assumed to have a design life of 11 years, with the replacement required in years 11 and 22.

Residual Value

The condensing gas heater's residual value was calculated at the end of the 30-year evaluation period, assuming a straight-line depreciation of its cost. The residual value represents the value of the condensing gas heater in year 30 of the analysis, assuming it was installed in year 22. The residual value is a benefit for the cost-effectiveness analysis.

Cost-Effectiveness

The table below presents the cost effectiveness using the same methodology as in the Final CASE Report. The proposed measure saves money over the 30-year period of analysis relative to the existing conditions and is cost effective in every climate zone. Climate Zone 1 has been omitted because no requirements are proposed.

Table 35: 30-Year Cost-Effectiveness Summary Per Prototypical Pool – Alterations – Average-Sized Nonresidential Outdoor Year-round and Seasonal Pools

Climate Zone	Outdoor Year-round Pool Benefits LSC Savings + Other PV Savings (2029 PV$)	Outdoor Year-round Pool Costs Total Incremental PV Costs (2029 PV$)	Outdoor Year-round Pool Benefit-to-Cost Ratio	Outdoor Seasonal Pool Benefits LSC Savings + Other PV Savings (2029 PV$)	Outdoor Seasonal Pool Costs Total Incremental PV Costs (2029 PV$)	Outdoor Seasonal Pool Benefit-to-Cost Ratio
1	N/A	N/A	N/A	N/A	N/A	N/A
2	236,180	37,444	6.3	83,493	37,444	2.2
3	260,680	37,444	7.0	88,830	37,444	2.4
4	246,074	37,444	6.6	77,697	37,444	2.1
5	246,136	37,444	6.6	62,108	37,444	1.7
6	218,315	37,444	5.8	61,666	37,444	1.6
7	192,815	37,444	5.1	39,189	37,444	1.0
8	179,224	37,444	4.8	45,286	37,444	1.2
9	208,843	37,444	5.6	55,443	37,444	1.5
10	204,728	37,444	5.5	74,554	37,444	2.0
11	252,037	37,444	6.7	76,834	37,444	2.1
12	227,033	37,444	6.1	74,476	37,444	2.0
13	225,210	37,444	6.0	91,845	37,444	2.5
14	301,716	37,444	8.1	110,980	37,444	3.0
15	189,077	37,444	5.0	59,509	37,444	1.6
16	329,934	37,444	8.8	47,600	37,444	1.3

Table 36: 30-Year Cost-Effectiveness Summary Per Prototypical Pool – Alterations – Average-Sized Nonresidential Indoor Exercise and Swim School Pools

Climate Zone	Indoor Exercise Pool Benefits LSC Savings + Other PV Savings (2029 PV$)	Indoor Exercise Pool Costs Total Incremental PV Costs (2029 PV$)	Indoor Exercise Pool Benefit-to-Cost Ratio	Indoor Swim School Benefits LSC Savings + Other PV Savings (2029 PV$)	Indoor Swim School Costs Total Incremental PV Costs (2029 PV$)	Indoor Swim School Benefit-to-Cost Ratio
1	N/A	N/A	N/A	N/A	N/A	N/A
2	58,620	37,444	1.6	143,378	37,444	3.8
3	58,620	37,444	1.6	143,378	37,444	3.8
4	58,620	37,444	1.6	143,378	37,444	3.8
5	58,123	37,444	1.6	142,881	37,444	3.8
6	58,458	37,444	1.6	144,244	37,444	3.9
7	58,291	37,444	1.6	143,824	37,444	3.8
8	58,458	37,444	1.6	144,244	37,444	3.9
9	58,458	37,444	1.6	144,244	37,444	3.9
10	58,458	37,444	1.6	144,244	37,444	3.9
11	58,620	37,444	1.6	143,378	37,444	3.8
12	58,123	37,444	1.6	142,881	37,444	3.8
13	57,781	37,444	1.5	142,539	37,444	3.8
14	57,578	37,444	1.5	143,364	37,444	3.8
15	57,044	37,444	1.5	142,829	37,444	3.8
16	61,066	37,444	1.6	146,852	37,444	3.9

Table 37: 30-Year Cost-Effectiveness Summary Per Prototypical Pool – Alterations – Olympic-Sized Nonresidential Outdoor Year-round and Seasonal Pool

Climate Zone	Outdoor Benefits LSC Savings + Other PV Savings (2029 PV$)	Outdoor Costs Total Incremental PV Costs (2029 PV$)	Outdoor Benefit-to-Cost Ratio	Indoor Benefits LSC Savings + Other PV Savings (2029 PV$)	Indoor Costs Total Incremental PV Costs (2029 PV$)	Indoor Benefit-to-Cost Ratio
1	N/A	N/A	N/A	N/A	N/A	N/A
2	1,573,926	151,306	10.4	566,032	151,306	3.7
3	1,731,305	151,306	11.4	598,720	151,306	4.0
4	1,643,640	151,306	10.9	529,410	151,306	3.5
5	1,630,028	151,306	10.8	416,462	151,306	2.8
6	1,443,365	151,306	9.5	411,844	151,306	2.7
7	1,272,402	151,306	8.4	260,669	151,306	1.7
8	1,188,294	151,306	7.9	302,918	151,306	2.0
9	1,386,988	151,306	9.2	373,381	151,306	2.5
10	1,359,349	151,306	9.0	502,547	151,306	3.3
11	1,678,106	151,306	11.1	519,682	151,306	3.4
12	1,512,767	151,306	10.0	506,169	151,306	3.3
13	1,500,743	151,306	9.9	624,839	151,306	4.1
14	2,007,569	151,306	13.3	749,472	151,306	5.0
15	1,256,499	151,306	8.3	401,041	151,306	2.7
16	2,191,529	151,306	14.5	317,671	151,306	2.1

Table 38: 30-Year Cost-Effectiveness Summary Per Prototypical Pool – Alterations – Olympic-Sized Nonresidential Indoor and Outdoor Pool

Climate Zone	Indoor Exercise Benefits LSC Savings + Other PV Savings (2029 PV$)	Indoor Exercise Costs Total Incremental PV Costs (2029 PV$)	Indoor Exercise Benefit-to-Cost Ratio
1	N/A	N/A	N/A
2	387,371	56,022	6.9
3	387,371	56,022	6.9
4	387,371	56,022	6.9
5	384,359	56,022	6.9
6	386,884	56,022	6.9
7	385,753	56,022	6.9
8	386,884	56,022	6.9
9	386,884	56,022	6.9
10	386,884	56,022	6.9
11	387,371	56,022	6.9
12	384,359	56,022	6.9
13	382,288	56,022	6.8
14	381,551	56,022	6.8
15	378,312	56,022	6.8
16	402,693	56,022	7.2

Appendix G: Code Language Markup (Non-restructured)

The Statewide CASE Team presents a version of the proposed code change using the adopted 2025 Title 24 Part 6 language and section numbers.

SECTION 110.4 – MANDATORY REQUIREMENTS FOR POOL AND SPA SYSTEMS AND EQUIPMENT

(c) **Heating Source Sizing.** Heating systems or equipment for pool and/or spa shall meet one of the sizing requirements of 1 through 5 below:

1. A solar pool heating system with a solar collector surface area that is equivalent to the following:
    A. For nonresidential and multifamily buildings, 65 percent or greater of the pool and/or spa surface area.
    B. For single family buildings, 60 percent or greater of the pool and/or spa surface area.
2. A heat pump pool heater as the primary heating system that meets the sizing requirements of Reference Joint Appendix JA16.3. The supplementary heater can be of any energy source; or
3. A heating system that derives at least 60 percent of the annual heating energy from onsite renewable energy or on-site recovered energy.
4. A combination of a solar pool heating system and heat pump pool heater without any additional supplementary heater; or
5. A pool heating system determined by the Executive Director to use no more energy than the systems specified in Items 1, 2, 3, or 4 above.

Exception 1 to Section 110.4(c): Portable electric spas compliant with 20 CCR § 1605.3(g)(7) of the Appliance Efficiency Regulations.

Exception 2 to Section 110.4(c): Alterations to existing pools and/or spas with existing heating systems or equipment in *hotel/motel* buildings and *nonresidential buildings* with Group R occupancies.

Exception 3 to Section 110.4(c): A pool and/or spa that is heated solely by a solar pool heating system without any backup heater.

Exception 4 to Section 110.4(c): Heating systems which are used exclusively for permanent spa applications in existing buildings with gas availability.

Exception 5 to Section 110.4(c): Heating systems which are used exclusively for permanent spa applications where there is inadequate Solar Access Roof Area (SARA) as specified in Section 150.1(c)14 for a solar pool heating system to be installed.

SECTION 141.0 – ADDITIONS, ALTERATIONS, AND REPAIRS TO EXISTING NONRESIDENTIAL, AND HOTEL/MOTEL BUILDINGS, TO EXISTING OUTDOOR LIGHTING, AND TO INTERNALLY AND EXTERNALLY ILLUMINATED SIGNS

….

(b) Alterations. Alterations to components of existing nonresidential, hotel/motel, or relocatable public school buildings, including alterations made in conjunction with a

change in building occupancy to a nonresidential, high-rise residential, or hotel/motel occupancy shall meet item 1, and either Item 2 or 3 below:

1. **Mandatory Requirements.** Altered components in a nonresidential, or hotel/motel building shall meet the minimum requirements in this Section.

…

F. **Pool and Spa Systems and Equipment**. Existing heating systems in located in climate zones 2 through 16 shall meet the:

i. Mandatory requirements in 110.4(a), (b) and (d); and

ii. One of the requirements of a through f below:

a. A solar pool heating system with a solar collector surface area that is equivalent to 40 percent or greater of the pool and/or spa surface area; or

b. An electric heat pump pool heater as the primary heating system that meets the sizing requirements of Reference Joint Appendix JA16.3. The supplementary heater can be of any energy source; or

c. A heating system that derives at least 60 percent of the annual heating energy from onsite renewable energy or on-site recovered energy; or

d. A pool heating system that relies solely on a gas pool heater(s) with a thermal efficiency of 94 percent or greater; or

f. A combination of a solar pool heating system and heat pump pool heater without any additional supplementary heater; or

g. A pool heating system determined by the Executive Director to use no more energy than the systems specified in Items a, b, c, d or e above.

Exception 1 to Section 141.0(b)1Fii: Portable electric spas compliant with 20 CCR § 1605.3(g)(7) of the Appliance Efficiency Regulations.

Exception 2 to Section 141.0(b)1Fii: A pool and/or spa that is heated solely by a solar pool heating system without any backup heater.

Exception 3 to Section 141.0(b)1Fii: Heating systems which are used exclusively for permanent spa applications in existing buildings with natural gas availability.

Exception 4 to Section 141.0(b)1Fii: Heating systems which are used exclusively for permanent spa applications where there is inadequate SARA as specified in Section 140.10(a) for a solar pool heating system to be installed.

Exception 5 to Section 141.0(b)1Fii: Pool alterations at hotel/motel buildings and nonresidential buildings with Group R occupancies