

A STATEWIDE UTILITY PROGRAM

Local Energy and Water Efficiency Ordinances

Energy and Water Efficiency Cost-Effectiveness Study for Residential and Nonresidential New Construction

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1 Introduction

The California Codes and Standards Reach Codes program provides technical support to local governments considering adopting a local ordinance (reach code) intended to support meeting local and/or statewide energy and greenhouse gas reduction goals. The program facilitates adoption and implementation of the code when requested by local jurisdictions by providing resources such as cost-effectiveness studies, model language, sample findings, and other supporting documentation. This cost-effectiveness study was sponsored by Pacific Gas and Electric Company (PG&E). Local jurisdictions that are considering adopting ordinances may contact the program for support through its website, LocalEnergyCodes.com.

Building efficiency standards can result in significant energy and water savings. This report presents opportunities that local jurisdictions in California could consider adopting to achieve energy and water savings beyond what will be accomplished by enforcing building efficiency requirements that apply statewide. The intent of this report is to provide local jurisdictions with examples of water saving measures that they could consider adopting along with information that local jurisdictions may find helpful as they investigate the feasibility of pursuing water efficiency ordinances. The example measures presented herein focus on opportunities to reduce both hot and cold water use in California's residential and nonresidential buildings. Limiting water use is in itself beneficial to address California's ongoing water resource constraints, but it also results in energy savings associated with water supply, conveyance, treatment, and water heating.

The California Building Energy Efficiency Standards (Title 24, Part 6) and the California Green Building Standards (CALGreen) Title 24, Part 11 (Energy Commission 2015a) are maintained and updated every three years by two state agencies, the California Energy Commission (Energy Commission) and the Building Standards Commission (BSC). In addition to enforcing the code, local jurisdictions have the authority to adopt local efficiency ordinances, or reach codes, that exceed the minimum standards defined by Title 24, Part 6 (as established by Public Resources Code Section 25402.1(h)2 and Section 10-106 of the Building Energy Efficiency Standards). Local jurisdictions must demonstrate that the requirements of the proposed ordinance are cost-effective and do not result in buildings consuming more energy than is permitted by Title 24, Part 6. In addition, the jurisdiction must obtain approval from the Energy Commission and file the ordinance with the BSC for the ordinance to be legally enforceable.

1.1 Measures Addressed in Report

This report documents cost-effective combinations of measures that exceed the minimum state requirements relative to 2016 Title 24, Part 6 and provides cost-effectiveness results for a suite of measures that save water and energy but do not revise Title 24, Part 6 requirements. An update to this analysis will need to be completed to demonstrate cost effectiveness above 2019 Title 24, Part 6 before such measures can be adopted for implementation after 1/1/2020, the effective date of the 2019 standards. This update will be completed once the 2019 Title 24, Part 6 compliance software is finalized.

This report also documents cost-effectiveness analyses for water and energy saving measures that are not regulated by Title 24, Part 6. Such measures include graywater collection and distribution, recycled water in landscape irrigation and cooling towers, landscape irrigation efficiency, commercial kitchen water appliance efficiency, and expanding scope of coverage for swimming pool and spa covers. Table 1 lists the measures this report addresses by sector and whether the measures are related to requirements in Title 24, Part 6.



Table 1: List of Measures

Measure Number	Measure	Sector	Addresses Related Requirements under Title 24, Part 6
Measure 1A	Water Waste Reduction when Delivering Hot Water, Compact Hot Water Distribution Systems (CHWDS)	Residential (Single Family)	Yes
Measure 1B	Water Waste Reduction when Delivering Hot Water, Demand Recirculation with Drain Water Heat Recovery (DWHR)	Residential (Single Family)	Yes
Measure 2	Graywater Collection and Distribution System (“Graywater Ready”)	Residential (Single Family)	No
Measure 3	Recycled Water for Common Landscaping	Residential (Single Family)	No
Measure 4	Pool and Spa Covers (for Pools not Regulated by Title 24, Part 6)	Residential (Single Family)	Yes; measure expands scope of Title 24, Part 6 coverage and does not alter Title 24, Part 6 requirements
Measure 5	Exterior Hose Bib Locks	Residential (Multifamily); Nonresidential	No
Measure 6	Alternate Water Sources	Residential (Multifamily); Nonresidential	No
Measure 7	Landscape Irrigation Water Meters	Residential; Nonresidential	No
Measure 8	Irrigation Controllers	Residential; Nonresidential	No
Measure 9	Irrigation Systems	Residential; Nonresidential	No
Measure 10	Irrigation Audits	Residential; Nonresidential	No
Measure 11	Indoor Water Meters	Nonresidential	No
Measure 12	Nonpotable Water for Cooling Towers	Nonresidential	Cooling towers are regulated under Title 24, Part 6; however, blowdown treatment and reuse are



			not regulated by Title 24, Part 6
Measure 13	Manually Operated Toilets	Nonresidential	No
Measure 14	Commercial Kitchen Water Efficiency	Nonresidential	No
Measure 15	Selling Compliant Fixtures and Fittings	Nonresidential	Reiterates requirements established by California Appliance Efficiency Regulations (Title 20)
Measure 16	Installing Compliant Fixtures and Fittings	Nonresidential	Reiterates requirements established by Title 20

Source: Energy Solutions.

1.2 Water-Energy Nexus and Policy Drivers

Supplying and treating water consumes a significant amount of electricity across the state. However, that energy is usually consumed off-site at a centralized pumping station or treatment plant. Although not immediately apparent, the relationship between water use and energy use is direct and inter-dependent, and the reduced energy use can help justify additional water efficiency standards. Nearly twenty percent of the electricity and thirty percent of non-power plant-related natural gas use in California is associated with meeting California's water supply needs (Energy Commission 2006).¹ California consumes about 2.9 trillion gallons of water per year for urban uses (Christian-Smith, Heberger and Allen 2012).² These 2.9 trillion gallons of water correspond to approximately 12.2 Gigawatt (GWh) of embedded electricity.³ More than 4.4 GWh of electricity are used every year to supply and treat potable water that is used inside residential buildings. Conversely, water is required to produce electricity; if electricity demand increases so does the demand for water (California Sustainability Alliance 2013). The California Global Warming Action Plan, developed in response to Assembly Bill 32 (AB 32) in 2006, recognizes this water-energy nexus. The plan calls for the establishment of indoor and outdoor water efficiency standards, and water recycling initiatives to help achieve California state greenhouse gas (GHG) reduction goals.⁴

For recycled water, the California State Water Resources Control Board (State Water Board) has been required by state law to provide uniform water recycling criteria since 2013. In 2016, AB 574 directed the State Water Board to continue updating these criteria by 2023 and to establish a framework for the regulation of potable reuse projects by 2018. The State Water Board last updated the Policy for Water Quality Control for Recycled Water (Recycled Water Policy) in December 18, to support the use of recycled water. The Recycled Water Policy

¹ Water-related energy uses include energy consumed by water agencies for water collection, extraction, conveyance, treatment prior to use (e.g., potable), treatment and disposal after use (e.g., wastewater), and for distribution to end-users. It also includes energy used by the end-user after the water agency has delivered water, such as energy used to pump and heat water on-site.

² Urban uses include outdoor and indoor residential water use; water used in commercial, institutional, and industrial applications; and unreported water use, which is primarily attributed to leaks.

³ Assumptions: Embedded energy factor of 4,848 kilowatt hours (kWh)/million gallons (MG) for residential indoor water use and unreported leaks; embedded energy factor of 3,565 kWh/MG for residential outdoor; embedded energy factor of 4,206 kWh/MG for commercial, institutional, and industrial.

⁴ See Appendix D – Embedded Electricity Usage Methodology for information about the methodology used to calculate the embedded energy estimates presented in this report.



provides guidance to protect public health and the environment while still encouraging the use of recycled water and includes goals and mandates for the use of recycled water and stormwater as well as for increasing urban and industrial water conservation (California State Water Resources Control Board 2019).

AB 2282, signed into law in 2014, directed the California Building Commission (BSC) and Department of Housing and Community Development (HCD) to amend the California Plumbing Code and the California Green Building Standards Code (Title 24, Part 11 or CALGreen) for recycled water systems. Chapter 15 of the 2016 California Plumbing Code (Title 24, Part 5) provides guidelines and requirements for alternate water source systems to help conserve potable water while protecting public health.

2 Methodology and Assumptions

This analysis uses a customer-based lifecycle cost (LCC) approach to evaluating cost-effectiveness of the proposed ordinance, whereas the Energy Commission LCC methodology uses Time Dependent Valuation (TDV) as the primary metric for energy savings benefits. Both methodologies require estimating and quantifying the energy savings associated with energy efficiency measures, as well as quantifying the costs associated with the measures. The main difference between the methodologies is the way they value energy and thus the cost savings of reduced or avoided energy use. The Energy Commission LCC Methodology uses TDV, developed to reflect the “societal value or cost” of energy including long-term projected costs of energy such as the cost of providing energy during peak periods of demand and other societal costs such as projected costs for carbon emissions (Energy & Environment Economics 2017). The customer-based LCC methodology values energy and water based upon estimated site energy and water usage and utility rate schedules to estimate cost savings to the customer.

As TDV does not include a valuation of water savings, this metric would underestimate the value of most resources saved from this ordinance and is therefore not the most appropriate metric for determining cost-effectiveness of efficiency measures saving both energy and water.

2.1 Embedded Electricity Use Methodology

Energy is required for water supply (e.g., pumping), conveyance, treatment and distribution of potable water, and collection and treatment of wastewater. For this analysis, it was assumed that every million gallons (MG) of water used for an indoor application in California is attributable to 4,848 kWh of electricity use and every MG of water used for an outdoor application in California is attributable to 3,565 kWh of electricity use. These values were derived from a California Public Utilities Commission (CPUC) cost-effectiveness analysis of water and energy prepared by Navigant Consulting, Inc. (CPUC 2015b). The CPUC analysis was limited to evaluating the embedded electricity in water and does not include embedded natural gas in water. Since accurate estimates of the embedded natural gas in water were not available at the time of writing, the analysis in this report does not include estimates of embedded natural gas savings associated with water reductions.

See Appendix D – Embedded Electricity Usage Methodology for further discussion on the methodology used to develop the embedded energy factor.

2.2 Building Prototypes

The Energy Commission defines building prototypes that it uses to evaluate the cost-effectiveness of proposed changes to Title 24, Part 6. There exist two single family prototypes, whose basic characteristics are described in Table 2. Additional details on the prototypes can be found in the Alternate Calculation Method (ACM) Approval Manual (Energy Commission, 2015b).



Table 2: Prototype Characteristics

	Single Family One-Story	Single Family Two-Story
Conditioned Floor Area	2,100 ft ²	2,700 ft ²
Number of Stories	1	2
Number of Bedrooms	3	4
Window-to-Floor Area Ratio	20%	20%

Source: Energy Commission 2015b.

The analysis of the efficiency package for demand-initiated recirculation systems paired with drain water heat recovery (DWHR) builds on the DWHR analysis from the 2019 Title 24, Part 6 code cycle. To maintain consistent assumptions, this analysis used the 2,700 ft² prototype that was used in the Final 2019 CASE Report (Statewide CASE Team 2017b). For single family compact hot water distribution systems (CHWDS), this analysis includes savings estimates from the Final 2019 CASE Report (Statewide CASE Team 2017a), which utilized a weighted average of the two Energy Commission single family prototypes (2,700 and 2,100 ft²), with results presented for a 2,430 ft² single family home.

All other measures, which do not seek to revise Title 24, Part 6 requirements, use measure-specific methodologies presented in Appendix A – Measure-Specific Assumptions and Methodologies.

2.3 Efficiency Measures and Package Development

For measures that build upon the 2016 Title 24, Part 6 requirements, the project team used the California Building Energy Code Compliance (for Residential Buildings software (CBECC-Res) version 2016.3.0 to evaluate energy impacts. When using CBECC-Res to calculate savings, the baseline building design assumed minimum compliance with the 2016 Title 24, Part 6 prescriptive requirements (zero percent compliance margin). For all other measures, measure-specific methodologies are presented in Appendix A – Measure-Specific Assumptions and Methodologies.

The measures and packages contained in this report are examples only; any project meeting requirements of a local ordinance must independently evaluate and identify the most cost-effective approach (when required) based on project-specific factors.

2.3.1 Federal Preemption

The United States (U.S.) Department of Energy (DOE) sets minimum efficiency standards for equipment and appliances that are federally regulated under the National Appliance Energy Conservation Act (NAECA), including heating, cooling, and water heating equipment. State and local governments are prohibited from adopting higher minimum efficiencies than the federal standards require. This report presents measures that do not impose more stringent energy efficiency requirements on equipment that is covered by NAECA. Although equipment efficiency measures are not included in this analysis, they are often the simplest and most affordable measures to increase energy and water performance. While local jurisdictions are limited by federal preemption and cannot require high efficiency equipment, builders may use any package of measures to achieve the performance goals set out by a local ordinance, including high-efficiency equipment.

2.3.2 Energy and Water Efficiency Measures

Following are descriptions of each of the efficiency measures addressed in this analysis, including whether there are related requirements under Title 24, Part 6, the proposed requirements, and how each measure saves energy and water. Table 3: Measure Descriptions & Cost Assumptions lists the incremental costs assumed for each measure. Per direction from the Energy Commission to align with the methodology to calculate impacts of proposed changes to Title 24, Part 6, design costs are not included in the incremental first cost.

Measure 1A – Single Family Water Waste Reduction when Delivering Hot Water, CHWDS:



Requirement: Meet expanded compact hot water distribution system (CHWDS) compliance credit with Home Energy Rating System (HERS) Rater verification in accordance with the 2019 Title 24, Part 6 Residential Reference Appendices section RA4.4.16.

Measure Background and Relationship with Title 24, Part 6: The HERS verified CHWDS credit was originally developed under the 2013 Title 24, Part 6 standards development and continued as a compliance credit under 2016 Title 24, Part 6 to encourage builders to locate hot water fixtures close to the water heater to save water and energy. The credit has historically seen low uptake at around 0.1 percent (Statewide CASE Team 2017a). As a result, the compliance credit was updated for the 2019 Title 24, Part 6 Standards to allow for a basic credit option without HERS verification and an expanded credit option that yields increased energy savings from additional eligibility criteria and HERS verification. Because this is a compliance credit option, buildings are not required to have CHWDS design but designers have the option to pursue it for code compliance.

This measure is one of two options to reduce water waste when waiting for hot water to arrive at the fixture. This measure achieves this goal by reducing the length of pipe in the hot water distribution system in single family new construction (measure 1B, below, is the second option). It requires CHWDS design in accordance with the expanded credit that is described in the 2019 Title 24, Part 6 standards. If a local jurisdiction adopts this measure, all buildings would be required to comply with the HERS verified CHWDS credit. If pursuing this option, the designer and plumbing contractor must be aware of any local water supply pressure issues in which the plumbing code would dictate pipe sizing that would potentially not meet the eligibility criteria. The designer must also clearly communicate eligibility criteria to the plumber to ensure that the installed piping will pass the HERS verification.

Utilizing CHWDS design saves both water and energy by minimizing the volume of water in distribution system piping, therefore reducing the amount of water discharged from the plumbing system prior to the arrival of hot water. The magnitude of savings is directly related to the level of compactness of the plumbing design; therefore, jurisdictions could further increase energy and water savings and exceed the code by requiring a threshold for the Compactness Factor (minimum level of compactness) beyond the basic criteria; however, increased savings from increased compactness were not analyzed as part of this report. As the compactness of a hot water distribution system increases, so do cost savings for reduced materials and labor associated with installation.

Measure 1B – Single Family Water Waste Reduction when Delivering Hot Water, Demand Recirculation Coupled with DWHR:

Requirement: Where a hot water recirculation system or electric trace heating system exists, limit amount of water contained in each branch from the recirculating loop or electric trace heating element to the fixture to a maximum of 0.125 gallon of water. Recirculation systems may be controlled by either an occupancy sensing control or a manual control (pushbutton). In addition, meet requirements of a drain water heat recovery (DWHR) system, installed in an equal flow configuration, with HERS verification in accordance with the 2019 Reference Appendices RA4.4.21.

Measure Background and Relationship with Title 24, Part 6: Hot water recirculation systems reduce the amount of water discharged from the plumbing branch prior to the arrival of hot water and result in direct water savings and accompanying indirect (embedded) energy savings. As a standalone design, recirculation systems save water; however, the amount of energy used to operate a hot water recirculation system may exceed the amount of direct energy saved from reduced hot water use and therefore results in an increase in energy consumption. This measure is therefore paired with drain water heat recovery (DWHR) to offset the increased energy consumption. DWHR saves energy by capturing the waste heat in the drain line during shower events and using that reclaimed heat to pre-heat cold water to be delivered to the shower or the water heater. Installing a DWHR system in an equal flow configuration refers to the installation of the device with pre-heated



water routed to both the water heater and the shower to maximize energy savings (Statewide CASE Team 2017b).

In the Title 24, Part 6 standards, recirculation systems are permitted but not required. If taking the prescriptive approach to compliance, Title 24, Part 6 specifies that demand recirculation systems must have manual controls. If taking the performance approach, both systems with manual controls or occupancy sensor controls are permitted. DWHR is a new compliance credit under the 2019 standards.

Measure 2 – Single Family Graywater-Ready Collection and Distribution System:

Requirement: Build units “graywater-ready” including dedicated graywater collection plumbing, graywater collection system, and dedicated distribution plumbing for treated graywater. This measure does not apply to additions and alterations of existing buildings that use existing building drain(s) or sites with less than 500 ft² of irrigated landscape. The analysis in this report assumes that installed laundry-to-landscape systems are operational but that other components of the “graywater-ready” building would not yield additional savings until future treatment and storage components are installed.

Measure Background and Relationship with Title 24, Part 6: Graywater-ready components are not addressed by Title 24, Part 6. However, CALGreen (Title 24, Part 11) includes a voluntary measure in Section A4.305.1 that addresses using graywater for irrigation. The CALGreen measure allows alternative plumbing piping to be installed to use water from clothes washers or other fixtures for an irrigation system so long as the piping system complies with the California Plumbing Code (Title 24, Part 5). Chapter 15 of the California Plumbing Code addresses requirements for alternate water sources.

This measure includes both a laundry-to-landscape option (similar to CALGreen) as well as a more elaborate graywater system. This measure results in direct water savings and indirect (embedded) energy savings by offsetting the amount of potable water used in single family landscape irrigation.

Measure 3 – Recycled Water for Single Family Common Landscaping:

Requirement: Construct a system to enable recycled water to be easily connected to the irrigation system once recycled water supply is available within 200 feet of the property line.

Measure Background and Relationship with Title 24, Part 6: Recycled water for irrigation is not addressed by Title 24, Part 6. While the use of recycled water is not required by California mandatory building codes, several state policies encourage the use of recycled water and Chapter 15 of the California Plumbing Code (Title 24, Part 5) addresses requirements for alternate water source systems.

This measure requires single family common landscaping to be irrigated with recycled water rather than potable water if made available by the water provider. It results in direct water savings and indirect (embedded) energy savings by offsetting the amount of potable water used in single family common landscape irrigation.

Measure 4 – Pool and Spa Covers:

Requirement: Install covers on permanently installed outdoor in-ground swimming pools or spas not covered under Title 24, Part 6.

Measure Background and Relationship with Title 24, Part 6: Title 24, Part 6 already requires covers on pools and spas heated with a gas or heat pump water heater. This measure expands the scope of coverage to non-heated pools and spas or those using electric resistance heating combined with a solar thermal system providing at least 60 percent of the annual heating energy. This measure results in direct water savings and associated indirect (embedded) energy savings from reduced evaporation.

Measure 5 – Multifamily and Nonresidential Exterior Hose Bib Locks:

Requirement: Install locks on all publicly accessible exterior faucets and hose bibs.



Measure Background and Relationship with Title 24, Part 6: Hose bib locks are not addressed by Title 24, Part 6. This measure results in direct water savings and indirect (embedded) energy savings by preventing water theft from publicly-accessible faucets.

Measure 6 – Multifamily and Nonresidential Alternate Water Sources:

Requirement: Include dual plumbing systems to facilitate and maximize the use of alternate water sources for irrigation, toilet flushing, cooling towers, and other uses suitable for non-potable water.

Measure Background: The installation of dual plumbing and use of alternate water sources is not addressed by Title 24, Part 6. This measure results in water savings and associated embedded energy savings by offsetting the amount of potable water used for irrigation, toilet flushing, and cooling towers.

Measure 7 – Landscape Irrigation Water Meters:

Requirement: Install water meters for landscape irrigation and include flow sensors or hydrometers for all landscaped areas regardless how areas are metered.

Measure Background and Relationship with Title 24, Part 6: Title 24, Part 6 does not address requirements for landscape irrigation water meters. This measure results in water savings and associated embedded energy savings.

Measure 8 – Irrigation Controllers:

Requirement: Install irrigation controllers and sensors in new construction or building additions or alterations with over 500 ft² of cumulative landscaped area. Irrigation controllers are weather- or soil moisture-based and automatically adjust irrigation in response to changes in plants' needs as weather conditions change. Weather-based controllers without integral rain sensors or communication systems that account for local rainfall have a separate wired or wireless rain sensor that connects or communicates with the controller(s).

Measure Background and Relationship with Title 24, Part 6: Title 24 does not address requirements for landscape irrigation controllers. As of this report's development in March 2019, the California Energy Commission is undergoing a rulemaking to establish efficiency standards for irrigation controllers. This measure results in water savings and associated embedded energy savings from reduced irrigation.

Measure 9 – Irrigation Systems:

Requirement: Install irrigation nozzles with a maximum precipitation rate of one inch per hour as part of landscape irrigation systems.

Measure Background and Relationship with Title 24, Part 6: Title 24, Part 6 does not address requirements for irrigation nozzles as part of landscape irrigation systems. As of this report's development in March 2019, the California Energy Commission is undergoing a rulemaking to establish efficiency standards for sprinkler spray bodies. This measure results in direct water savings and associated embedded energy savings from improved irrigation efficiency.

Measure 10 – Irrigation Audits:

Requirement: This measure would establish a program whereby the local agency administers an irrigation audit to verify the irrigation system complies with regulations.

Measure Background and Relationship with Title 24, Part 6: Title 24, Part 6 does not address irrigation audits. This measure has the potential to result in water and associated embedded energy savings when property owners follow through with audit recommendations to improve efficiency beyond the requirements. Jurisdictions may choose to develop more stringent audit requirements or requirements for property owners to pursue recommendations presented in audits. In this report, it is assumed that there are no additional savings from the audit itself; savings from irrigation improvements are presented under Measures 7, 8, and 9.



Measure 11 – Indoor Water Meters:

Requirement: Install separate water meters or submeters to measure indoor water use a) for each individual leased, rented, or other tenant space within buildings projected to consume more than 100 gallons per day; b) where potable water is used in cooling tower makeup water for industrial/commercial processes where flow is greater than 500 gallons per minute, makeup water for evaporative coolers greater than six gallons per minute, or boilers with energy input greater than 500,000 Btu/h; and c) for each building projected to use more than 100 gallons per day on a parcel containing multiple buildings. This measure applies to new nonresidential buildings with a total gross floor area of 50,000 ft² or more.

Measure Background and Relationship with Title 24, Part 6: The installation of separate indoor water meters or submeters is not required by Title 24, Part 6. This measure results in direct water savings and associated indirect (embedded) energy savings as well as direct energy savings from reduced hot water consumption.

Measure 12 – Cooling Towers:

Requirement: Newly instructed cooling towers include plumbing to facilitate the use of non-potable water supplies and devices to capture and reuse the blow down water discharged from the cooling tower.

Measure Background and Relationship with Title 24, Part 6: Cooling tower water efficiency is addressed by Title 24, Part 6 through requirements to install conductivity controllers and automated chemical feed systems, which intend to maximize cycles of concentration for cooling towers. This measure results in additional water savings and associated embedded energy savings beyond Title 24, Part 6 requirements by offsetting the amount of potable water used in nonresidential buildings with cooling towers.

Measure 13 – Manually Operated Toilets in Commercial Facilities:

Requirement: Install toilets and urinals with manual flush rather than sensor or automatic flush valves.

Measure Background and Relationship with Title 24, Part 6: Toilets must meet the efficiency standards of California Appliance Efficiency Regulations (Title 20); however, Title 24, Part 6 does not address requirements for manual versus sensor operation. Manually operated toilets have the potential to save water and associated embedded energy due to avoiding the “phantom flush” phenomenon, or activation of the flush valve when not required, that can occur with sensor operated toilets.

Measure 14 – Commercial Kitchen Water Efficiency:

Requirement: Install new and replacement commercial dishwashers, food steamers, combination ovens, and food waste pulping systems that meet or exceed water efficiency standards under 2016 Title 24, Part 11, Section A6.303.3.

Measure Background and Relationship with Title 24, Part 6: Title 24, Part 11 contains voluntary measures for increased efficiency. Several measures included in Title 24, Part 11, Section A6.303.3 are federally-regulated products (commercial pre-rinse spray valves and ice makers). As local jurisdictions are federally preempted from adopting more stringent standards for products with federal efficiency regulations, this measure can only apply to the installation of high efficiency products that are not preempted (commercial dishwashers, food steamers, combination ovens, and pulpers).

Measure 15 – Selling Compliant Fixtures and Fittings:

Requirement: Stores, outlets, and other retail establishments offer for sale plumbing fixtures and fittings in compliance with Title 20 .

Measure Background and Relationship with Title 24, Part 6: Fixtures and fittings sold or offered for sale must already meet the efficiency standards of Title 20. This measure does not result in any additional energy or water savings, rather, its redundancy serves to reiterate the Title 20 and Title 24, Part 6 requirements.



Measure 16 – Installing Compliant Fixtures and Fittings:

Requirement: Plumbers, contractors, and other service providers install plumbing fixtures and fittings in compliance with Title 20.

Measure Background and Relationship with Title 24, Part 6: Fixtures and fittings installed by plumbers, contractors, or other service providers must already meet the efficiency standards of Title 20. This measure does not result in any additional energy or water savings, rather, its redundancy serves to reiterate the Title 20 and Title 24, Part 6 requirements.

Table 3: Measure Descriptions & Cost Assumptions

Measure	Performance Level	Incremental First Cost – Per Building			Source & Notes
		Single Family	Multifamily	Nonresidential	
Measure 1A - Water Waste Reduction when Delivering Hot Water, CHWDS	HERS Verified	\$119	n/a	n/a	Materials: (\$5.04) – 16.8' reduction in ¾" PEX tubing, (\$30.78) – 34.2' reduction of 1" steel pipe, \$30.78 – 34.2' 1.25" steel pipe, \$24.66 – 13.7' 3" diameter, 1/16" thick wall steel vent (internet pricing). \$0 – labor (considered a wash between plumbing materials reduction and increase in water heater venting materials). \$100 – HERS verification (per local HERS rater). Pipe and vent length changes are sourced from the 2019 CHWDS CASE Report (Statewide CASE Team 2017a).
Measure 1B - Water Waste Reduction when Delivering Hot Water, Demand Recirculation + DWHR	0.125 gallons HERS Verified	\$1,792	n/a	n/a	Recirculation system (\$1,065.14 total): \$500 – pump with on demand controls, \$50 – check valve and fittings, \$240 – labor for recirculation system installation (assuming 3 hours of additional work to put in dedicated return line @\$80/hr), \$162.54 – pipe insulation (including labor) for 42' of pipe length (https://www.cityofpal Alto.org/civicax/filebank/documents/52054). 3" DWHR (\$727.01 total): \$400 – DWHR unit price, \$55.20 – (60') of ¾" PEX, \$5.43 – (8) PEX couplings, \$3.46 – ABS couplings, \$108.37 – labor, \$118.13 – plumbing overhead and profit, \$31.15 – sales tax @ 8% of materials, \$43.21 – location adjustment factor markup (Statewide CASE Team 2017b, converted to \$2018).
Measure 2 - Graywater Collection and Distribution System	Yes	\$1,964	n/a	n/a	Average cost of installed system from EcoAssistant and the National Academies of Science, Engineering, and Medicine 2012 (EcoAssistant 2017;NAP 2016). \$1600 – Installed system. \$100 - Average cost of additional circuit breaker from Fixr (https://www.fixr.com/costs/electrician). \$156 – Average cost of hose bib (internet pricing). \$75 – estimated permit price; based on cost in Davis, CA.



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Measure 3 - Recycled Water for Single Family Common Landscaping	Yes	\$1,078	n/a	n/a	Cost of additional piping, 200 feet of NSF certified polyvinyl chloride (PVC) reclaimed water pipe at average of \$0.86/ft, (10) PVC couplings for total of \$3.90, \$5.75 per half pint of solvent cement, \$19.62 per pint of primer (internet pricing). \$350 – Backflow prevention assembly and \$137.50 – Backflow prevention assembly average installation cost (https://home.costhelper.com/backflow-preventers.html). \$90 – Permit cost (https://www.tucsonaz.gov/water/consider-reclaimed). \$0 – meter connection fee, typically not assessed for dedicated irrigation meters serving small common area landscaping when managed by a homeowner's association. \$200 – labor to trench and install added pipe (https://www.fixr.com/costs/sprinkler-system). Costs do not include signage denoting that recycled water is in use.
Measure 4 - Pool and Spa Covers	Yes	\$243	n/a	n/a	\$95.66 – average cost of solar blanket pool cover and \$147.62 – average cost of manual reel (internet pricing). \$0 – average installation cost (per pool industry contact).
Measure 5 - Exterior Hose Bib Locks	Yes	n/a	\$112	\$56	Average lock cost (internet pricing). Typical prices range from \$7 to \$37 per lock. Assumed 4 publicly accessible units for multifamily buildings and 2 for nonresidential buildings.
Measure 6 - Alternate Water Sources	Yes	n/a	\$27,840	\$219,026	Nonresidential: From a San Francisco Public Utilities Commission case study, average cost of rainwater harvesting system plus graywater system for a commercial building is \$3.77 per square foot, assuming a nonresidential building prototype of 53,628 square feet. Based on that same document, calculations also account for a maintenance cost of 2.36 percent. (https://sfwater.org/Modules/ShowDocument.aspx?documentID=7089) Multifamily: \$4 per square foot - average cost of adding additional plumbing system (dual plumbing), assuming 6,960 square foot multifamily prototype. (https://homeguides.sfgate.com/estimate-plumbing-costs-new-construction-40805.html)
Measure 7 - Landscape Irrigation Water Meters	Yes	\$369	\$369	\$1,482	Residential: Average cost of water meter or flow sensor based on \$122.74 – average residential water meter and \$516 – average cost of residential flow sensor (internet pricing). \$50 – installation cost. (U.S. HUD 2002) Note: \$200 – annual meter service fee is not reflected in the first incremental cost but is included in benefit-cost calculations.



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					Nonresidential: Average cost of water meter or flow sensor based on \$1,667 – average nonresidential water meter and \$1,196 – cost of nonresidential flow sensor (internet pricing). \$50 – installation cost. (U.S. HUD 2002)Note: \$200 – annual meter fee is not reflected in the first incremental cost but is included in benefit-cost calculations.
Measure 8 - Irrigation Controllers	Yes	\$108	\$108	\$1,239	\$86.81 – rain sensor and additional installation cost (Statewide CASE Team 2017c). \$95.14 – residential weather-based controller and \$120.90 – residential soil-based controller (Statewide CASE Team 2017c). \$812.50 – commercial weather-based controller and \$1,665.29 – commercial soil-base controller (internet pricing). Assumed 50% of applications use weather-based and 50% use soil-based controllers. Assumed 18% of smart controllers do not have rain sensors (Aquacraft 2009).
Measure 9 - Irrigation System	Maximum Precipitation Rate = 1 in/hr	\$59	\$59	\$201	\$59.41 - (26) irrigation nozzles for residential application. \$316 – (88) irrigation nozzles for nonresidential application (internet pricing).
Measure 10 - Irrigation Audits	Yes	\$1,763	\$1,763	\$5,288	\$117.5 – average hourly rate for irrigation audit from personal communication with California Landscape Contractors Association. Assumed 15 hours for residential and 45 hours for nonresidential, based on estimate of time to complete for average landscape size, report development, and follow-up.
Measures 7 – 10 Total	Yes	\$2,299	\$2,299	\$8,209	Combined first incremental costs of Measure 7, Measure 8, Measure 9, and Measure 10.
Measure 11 - Indoor Water Meters	Yes	n/a	n/a	\$4,125	\$1,500 – meter cost and \$562.50 – installation cost, converted to \$2018 U.S. (Sher 2016). Assumed 2 tenant spaces per building consuming more than 100 gal/day.
Measure 12 - Cooling Towers	Yes	n/a	n/a	\$19,101 - \$31,305	Capital costs: \$690 (\$500 - 500 feet piping, \$50 – pipe fittings, \$50 – pipe cement, \$50 – check valve, \$40 – 3-way valve) (internet pricing). Treatment System Capital Cost (reverse osmosis): this cost ranges from \$18,411 to \$30,345 depending on the climate zone because blowdown discharge varies by climate zone and this cost is based on \$/gallon/day (http://www.conservaionmechs.com/wp-content/uploads/2016/11/TDS-reclaimed-water.pdf).
Measure 13 - Manually Operated Toilets	Yes	n/a	n/a	\$0	Conservative approach; manually-operated toilets are typically less expensive than sensor-operated toilets.
Measure 14 - Commercial Kitchen Water Efficiency	Title 24, Part 11, Section A5.303.3	n/a	n/a	\$2,472	\$377 – Dishwashers, \$653 – batch food steamers, \$653 – cook-to-order food steamers, \$789 – combination ovens (Statewide CASE Team 2015).
Measure 15 - Selling Compliant Fixtures and Fittings	Yes	n/a	n/a	n/a	There is no incremental cost for selling compliant fixtures and fittings. Retail stores are already required to sell compliant fixtures and fittings, as required by Title 20.



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Measure 16 - Installing Compliant Fixtures and Fittings	Yes	n/a	n/a	n/a	There is no incremental cost for installing compliant fixtures and fittings. Contractors are already required to install compliant fixtures and fittings, as required by Title 20.
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2.4 Lifecycle Cost-Effectiveness

The residential water and energy utility rates in place at the time of this analysis were used to calculate cost savings associated with the water and energy savings of the proposed measures and packages. Table 4 presents the rates used in the analysis which are the most commonly-used energy rates for each occupancy type. Water rates are summarized in Table 5 and Table 6.

Appendix B – Energy Utility Rate Schedules includes the detailed rate schedules used for this study and Appendix C – Water and Wastewater Rates describes the methodology for determining average statewide water rates.

Table 4: IOU Utility Tariffs Used Based on Climate Zone

Climate Zones	Electric / Gas Utility	Electricity (Standard)	Natural Gas	Electricity (Standard)	Natural Gas
		Residential		Commercial	
1-5, 11-13, 16	PG&E	E1	G1	A-10	G-NR1
6, 8-10, 14, 15	SCE/SoCalGas	D	GR	GS-2-A	G10
7	SDG&E	DR	GR	A	GN-3

Table 5: Water Rates - Potable

	Rate (\$/1,000 gallons)	Rate (\$/1,000 gallons)
	Residential	Commercial
Potable	\$6.44	\$4.82
Wastewater	\$1.54	\$5.19
Total	\$7.98	\$10.01

Table 6: Water Rates - Recycled

	Rate (\$/1,000 gallons)	Rate (\$/1,000 gallons)
	Residential	Commercial
Recycled	\$5.80	\$4.34
Wastewater	\$1.54	\$5.19
Total	\$7.34	\$9.53

Cost-effectiveness was evaluated for all sixteen climate zones and is presented based on lifecycle customer benefit-to-cost (B/C) ratio metric. The B/C ratio is a metric that represents the cost-effectiveness of energy and water efficiency over a 30-year period of analysis (for residential measures) or a 15-year period of analysis (for nonresidential measures). The metric takes into account discounting of future savings (real discount rate of three percent) and future incremental costs, including maintenance or replacement cost if replacement takes place prior to the end of the 15- or 30-year evaluation period. The ratio is the incremental energy and water cost savings divided by the total incremental costs. A value of one indicates the cost savings over the period of analysis are equivalent to the incremental cost of measure. The Energy Commission considers a measure to be cost-effective if the B/C ratio is equal to or greater than one. Simple payback is also presented and is calculated using Equation 1.

Equation 1:

$$\text{Simple payback} = \text{First incremental cost} / \text{Net annual cost savings}$$

Where:



Equation 2:

$$\text{Net annual cost savings} = \text{Annual customer utility cost savings} - \text{Annual costs}$$

2.5 Greenhouse Gas Emissions

Equivalent carbon dioxide (CO₂-e) emission reductions were calculated using the emission factors in Table 7. Electricity emission factors are specific to California electricity production.

Table 7: Equivalent CO₂ Emissions Factors

Energy Type	Emission Factor	Source
Electricity	0.724 lb. CO ₂ -e / kWh	U.S. Environmental Protection Agency's (EPA) 2007 eGRID data. ^a
Natural Gas	11.7 lb. CO ₂ -e / Therm	Emission rates for natural gas combustion as reported by the EPA GHG Equivalencies Calculator. ^b

^a Source: <https://www.epa.gov/ener4.9gy/ghg-equivalencies-calculator-calculations-and-references>.

^b Source: <https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator>.

3 Results

3.1 Single Family Results

3.1.1 Single Family Cost-Effectiveness Analysis

Cost-effectiveness results are shown for each climate zone in tabular form along with energy and GHG reductions for each single family measure as described in Section 2.3.2. Measures that are not cost-effective are shaded. Results represent the weighted average energy, water and cost impacts each of California's 16 climate zones.

3.1.1.1 Measure 1A – Single Family CHWDS

As presented in Table 8, single family CHWDS were found to be cost-effective in all climate zones. This analysis uses the electricity, gas, and water annual savings estimates from the 2019 CHWDS CASE Report, which assumes that most homes will achieve the CHWDS credit by re-locating the water heater. Adjusting the location of bathrooms to move them closer to the water heater would significantly reduce the incremental cost as system compactness increases.

If pursuing this option, the designer and plumbing contractor must be aware of any local water supply pressure issues in which the plumbing code would dictate pipe sizing that would potentially not meet the eligibility criteria. The designer must also clearly communicate eligibility criteria to the plumber to ensure that the installed piping will pass the HERS verification.

Table 8: Single Family CHWDS Cost-Effectiveness Results Per Building

Climate Zone	Annual Electricity Savings (kWh)	Annual Gas Savings (therms)	Annual Water Savings (gallons)	Annual Embedded Energy Savings (kWh)	Annual GHG Reductions (lb. CO ₂ -e)	First Incremental Cost	Net Annual Cost Savings	Simple Payback	Lifecycle B/C Ratio
Single Family Water Waste Reduction when Heating Water - CHWDS									
CZ1	0	6.0	962	4.66	63.18	\$119.62	\$15	7.8	2.52
CZ2	0	5.4	962	4.66	56.86	\$119.62	\$15	8.2	2.40
CZ3	0	5.4	962	4.66	56.86	\$119.62	\$15	8.2	2.40
CZ4	0	5.1	962	4.66	53.70	\$119.62	\$14	8.4	2.33



Climate Zone	Annual Electricity Savings (kWh)	Annual Gas Savings (therms)	Annual Water Savings (gallons)	Annual Embedded Energy Savings (kWh)	Annual GHG Reductions (lb. CO ₂ -e)	First Incremental Cost	Net Annual Cost Savings	Simple Payback	Lifecycle B/C Ratio
CZ5	0	5.5	962	4.66	57.92	\$119.62	\$15	8.1	2.42
CZ6	0	4.9	962	4.66	51.60	\$119.62	\$12	9.9	1.99
CZ7	0	4.8	962	4.66	50.54	\$119.62	\$14	8.8	2.23
CZ8	0	4.6	962	4.66	48.44	\$119.62	\$12	10.1	1.94
CZ9	0	4.6	962	4.66	48.44	\$119.62	\$12	10.1	1.94
CZ10	0	4.6	962	4.66	48.44	\$119.62	\$12	10.1	1.94
CZ11	0	4.7	962	4.66	49.49	\$119.62	\$14	8.7	2.25
CZ12	0	5.0	962	4.66	52.65	\$119.62	\$14	8.5	2.31
CZ13	0	4.6	962	4.66	48.44	\$119.62	\$14	8.8	2.23
CZ14	0	4.8	962	4.66	50.54	\$119.62	\$12	9.9	1.97
CZ15	0	3.3	962	4.66	34.75	\$119.62	\$11	11.2	1.75
CZ16	0	6.0	962	4.66	63.18	\$119.62	\$15	7.8	2.52

3.1.1.2 Measure 1B – Single Family Demand Recirculation + DWHR

As stated in the measure descriptions under Section 2.3.2 of this report, hot water recirculation systems result in an overall increase in energy consumption. To ensure that this measure results in energy savings beyond Title 24, Part 6 requirements, the analysis team sought to develop an efficiency package to offset the energy penalty generated by a recirculation system; the proposed measure pairs hot water recirculation with a requirement for drain water heat recovery (DWHR). The cost-effectiveness results for demand recirculation paired with DWHR are presented in Table 9. This package was found to be cost-effective in all climate zones.

Table 9: Single Family Demand Recirculation + DWHR Cost-Effectiveness Results Per Building

Climate Zone	Annual Electricity Savings (kWh)	Annual Gas Savings (therms)	Annual Water Savings (gallons)	Annual Embedded Energy Savings (kWh)	Annual GHG Reductions (lb. CO ₂ -e)	First Incremental Cost	Net Annual Cost Savings	Simple Payback	Lifecycle B/C Ratio
Single Family Water Waste Reduction when Heating Water – Demand Recirculation + DWHR									
CZ1	-2.3	6.21	15,184.59	73.62	70.99	\$1,792.15	\$125	14.3	1.37
CZ2	-2.3	5.58	15,184.59	73.62	63.62	\$1,792.15	\$124	14.4	1.36
CZ3	-2.3	5.67	15,184.59	73.62	64.67	\$1,792.15	\$124	14.4	1.36
CZ4	-2.3	5.4	15,184.59	73.62	61.51	\$1,792.15	\$124	14.4	1.36
CZ5	-2.3	5.76	15,184.59	73.62	65.73	\$1,792.15	\$125	14.4	1.36
CZ6	-2.3	5.13	15,184.59	73.62	58.36	\$1,792.15	\$125	14.4	1.36
CZ7	-2.3	5.04	15,184.59	73.62	57.30	\$1,792.15	\$105	17.0	1.15
CZ8	-2.3	4.95	15,184.59	73.62	56.25	\$1,792.15	\$124	14.4	1.36
CZ9	-2.3	4.77	15,184.59	73.62	54.14	\$1,792.15	\$124	14.4	1.36
CZ10	-2.3	4.77	15,184.59	73.62	54.14	\$1,792.15	\$124	14.4	1.36
CZ11	-2.3	4.77	15,184.59	73.62	54.14	\$1,792.15	\$123	14.5	1.35



Climate Zone	Annual Electricity Savings (kWh)	Annual Gas Savings (therms)	Annual Water Savings (gallons)	Annual Embedded Energy Savings (kWh)	Annual GHG Reductions (lb. CO ₂ -e)	First Incremental Cost	Net Annual Cost Savings	Simple Payback	Lifecycle B/C Ratio
CZ12	-2.3	5.13	15,184.59	73.62	58.36	\$1,792.15	\$124	14.5	1.35
CZ13	-2.3	4.68	15,184.59	73.62	53.09	\$1,792.15	\$123	14.6	1.35
CZ14	-2.3	4.86	15,184.59	73.62	55.20	\$1,792.15	\$124	14.4	1.36
CZ15	-2.3	2.97	15,184.59	73.62	33.08	\$1,792.15	\$121	14.8	1.23
CZ16	-2.3	5.85	15,184.59	73.62	66.78	\$1,792.15	\$125	14.4	1.36

When pursuing the performance approach to Title 24, Part 6 compliance, both manual and sensor controls are allowed for demand recirculation systems. To evaluate the energy impact of demand recirculation systems and determine whether pairing with DWHR results in increased savings, the analysis team modeled recirculation systems using both Demand Control Manual (manual control) with HERS verification (DCMH), or manual control, and Demand Control Occupancy (sensor control) with HERS verification (DCOH) and found that DCOH systems use more energy in all 16 climate zones than DCMH systems. Given that DCOH systems use more energy, the analysis takes the conservative approach of comparing the energy consumption of the higher energy system, DCOH, to the standard design to determine the amount of increased energy, both in therms and pumping electricity. This increased energy use was then subtracted from the DWHR savings in each climate zone to demonstrate that pairing DWHR with the worst-performing demand recirculation system would still result in increased energy savings.

As demonstrated in Table 10, in all climate zones, pairing DWHR with demand recirculation systems sufficiently offsets both the additional gas use from the water heater and the TDV of the electricity use from the recirculation pump and results in overall energy savings.

Table 10: Single Family Demand Recirculation + DWHR Energy Consumption Offset

Climate Zone	Standard Design (therms)	DCOH (therms)	DCOH Savings (therms)	DWHR Savings (therms)	DCOH Savings (kWh)	Savings, Accounting for Additional Gas Consumption (TDV kBtu)	Pumping Energy (TDV kBtu)	Savings, Accounting for Additional Gas Consumption and Pumping Energy (TDV kBtu)
CZ1	144.3	163.5	-19.2	26.1	-23	1138.85	-508.70	630.15
CZ2	129.4	146.6	-17.2	23.4	-23	1023.37	-508.56	514.81
CZ3	130	147.2	-17.2	23.5	-23	1040.13	-507.90	532.23
CZ4	123.8	140.1	-16.3	22.3	-23	990.60	-509.20	481.40
CZ5	133.1	150.8	-17.7	24.1	-23	1056.64	-508.60	548.04
CZ6	118.1	133.7	-15.6	21.3	-23	946.20	-490.40	455.80
CZ7	116.2	131.5	-15.3	20.9	-23	912.80	-511.40	401.40
CZ8	113.2	128	-14.8	20.3	-23	913.00	-493.00	420.00
CZ9	112.9	127.8	-14.9	20.2	-23	879.80	-486.70	393.10
CZ10	112.1	126.8	-14.7	20	-23	879.80	-484.90	394.90
CZ11	114.4	129.5	-15.1	20.4	-23	874.50	-510.10	364.40
CZ12	120.3	136.2	-15.9	21.6	-23	940.50	-511.10	429.40
CZ13	112.2	126.9	-14.7	19.9	-23	858.00	-510.50	347.50
CZ14	115.7	130.9	-15.2	20.6	-23	896.40	-488.00	408.40



Climate Zone	Standard Design (therms)	DCOH (therms)	DCOH Savings (therms)	DWHR Savings (therms)	DCOH Savings (kWh)	Savings, Accounting for Additional Gas Consumption (TDV kBtu)	Pumping Energy (TDV kBtu)	Savings, Accounting for Additional Gas Consumption and Pumping Energy (TDV kBtu)
CZ15	83.6	94.3	-10.7	14	-23	547.80	-488.60	59.20
CZ16	143.2	162.3	-19.1	25.6	-23	1079.00	-486.00	593.00

3.1.1.3 Measure 2 – Single Family Graywater Collection and Distribution System

As shown in Table 11, single family graywater collection and distribution systems were not found to be cost-effective in any climate zone. The requirement is for homes to be built graywater-ready so that they can be prepared to utilize appropriately treated graywater in the future. The cost of constructing buildings graywater-ready during new construction is much lower than retrofitting a building later to accommodate graywater reuse. A significant component of a graywater-ready unit, dual plumbing, would essentially require installation of another plumbing system throughout the building which is significantly costlier and challenging in a retrofit scenario. This measure enables newly constructed buildings to add a graywater system in the future with minimal cost and effort.

Although this measure does not require the graywater system to be hooked up and the ordinance itself will not result in savings unless homeowners voluntarily hookup and use the graywater plumbing, to provide a conservative estimate of the water savings that could be achieved the project team calculated water savings per home if graywater from the clothes washer were used for landscape irrigation. If other fixtures are also hooked up to the graywater system, the savings will be larger. Since the amount of graywater provided by a laundry-to-landscape system does not entirely offset the landscape irrigation needs in any climate zone, savings are the same in each climate zone.

Table 11: Single Family Graywater Collection and Distribution System Cost-Effectiveness Results Per Building

Climate Zone	Annual Electricity Savings (kWh)	Annual Gas Savings (therms)	Annual Water Savings (gallons)	Annual Embedded Energy Savings (kWh)	Annual GHG Reductions (lb. CO ₂ -e)	First Incremental Cost	Net Annual Cost Savings	Simple Payback	Lifecycle B/C Ratio
Single Family Graywater Collection and Distribution System									
CZ1	0	0	8562.9	30.53	0	\$1,964	\$68	28.7	0.68
CZ2	0	0	8562.9	30.53	0	\$1,964	\$68	28.7	0.68
CZ3	0	0	8562.9	30.53	0	\$1,964	\$68	28.7	0.68
CZ4	0	0	8562.9	30.53	0	\$1,964	\$68	28.7	0.68
CZ5	0	0	8562.9	30.53	0	\$1,964	\$68	28.7	0.68
CZ6	0	0	8562.9	30.53	0	\$1,964	\$68	28.7	0.68
CZ7	0	0	8562.9	30.53	0	\$1,964	\$68	28.7	0.68
CZ8	0	0	8562.9	30.53	0	\$1,964	\$68	28.7	0.68
CZ9	0	0	8562.9	30.53	0	\$1,964	\$68	28.7	0.68
CZ10	0	0	8562.9	30.53	0	\$1,964	\$68	28.7	0.68
CZ11	0	0	8562.9	30.53	0	\$1,964	\$68	28.7	0.68
CZ12	0	0	8562.9	30.53	0	\$1,964	\$68	28.7	0.68



Climate Zone	Annual Electricity Savings (kWh)	Annual Gas Savings (therms)	Annual Water Savings (gallons)	Annual Embedded Energy Savings (kWh)	Annual GHG Reductions (lb. CO ₂ -e)	First Incremental Cost	Net Annual Cost Savings	Simple Payback	Lifecycle B/C Ratio
CZ13	0	0	8562.9	30.53	0	\$1,964	\$68	28.7	0.68
CZ14	0	0	8562.9	30.53	0	\$1,964	\$68	28.7	0.68
CZ15	0	0	8562.9	30.53	0	\$1,964	\$68	28.7	0.68
CZ16	0	0	8562.9	30.53	0	\$1,964	\$68	28.7	0.68

Table 12 presents results for if a jurisdiction were to consider a laundry-to-landscape system only, without a permit. The results indicate this is cost-effective in all climate zones.

Table 12: Single Family Laundry-to-Landscape Cost-Effectiveness Results Per Building

Climate Zone	Annual Electricity Savings (kWh)	Annual Gas Savings (therms)	Annual Water Savings (gallons)	Annual Embedded Energy Savings (kWh)	Annual GHG Reductions (lb. CO ₂ -e)	First Incremental Cost	Net Annual Cost Savings	Simple Payback	Lifecycle B/C Ratio
CZ1-CZ16	0	0	8,563.00	30.53	0	\$1,200	\$68	17.6	1.12

3.1.1.4 Measure 3 – Recycled Water in Single Family Common Landscaping

As shown in Table 13, using recycled water in single family common landscaping was not found to be cost-effective in any climate zone. While this measure results in significant potable water savings from offsetting consumption of non-recycled water with recycled water, from the customer's perspective it is assumed that the amount of water consumption does not change based on whether the water is potable or recycled. To this regard, the on-bill savings only include the difference in cost between potable and recycled water rates. Costs and savings are presented on a per-building basis.

Table 13: Use of Recycled Water for Single Family Common Landscaping System Cost-Effectiveness Results Per Building

Climate Zone	Annual Electricity Savings (kWh)	Annual Gas Savings (therms)	Annual Water Savings (gallons)	Annual Potable Water Offset (gallons)	Annual Embedded Energy Savings (kWh)	Annual GHG Reductions (lb. CO ₂ -e)	First Incremental Cost	Net Annual Cost Savings	Simple Payback	Lifecycle B/C Ratio
Use of Recycled Water for Single Family Common Landscaping										
CZ1	0	0	0	26,515.00	0	0	\$1,078	-\$57	N/A	0.13
CZ2	0	0	0	47,428.99	0	0	\$1,078	-\$43	N/A	0.24
CZ3	0	0	0	48,619.70	0	0	\$1,078	-\$43	N/A	0.24
CZ4	0	0	0	56,548.93	0	0	\$1,078	-\$38	N/A	0.28
CZ5	0	0	0	59,921.51	0	0	\$1,078	-\$35	N/A	0.30
CZ6	0	0	0	52,870.35	0	0	\$1,078	-\$40	N/A	0.26
CZ7	0	0	0	61,132.18	0	0	\$1,078	-\$35	N/A	0.31
CZ8	0	0	0	61,451.47	0	0	\$1,078	-\$34	N/A	0.31
CZ9	0	0	0	57,009.91	0	0	\$1,078	-\$37	N/A	0.28
CZ10	0	0	0	75,819.86	0	0	\$1,078	-\$25	N/A	0.38



Climate Zone	Annual Electricity Savings (kWh)	Annual Gas Savings (therms)	Annual Water Savings (gallons)	Annual Potable Water Offset (gallons)	Annual Embedded Energy Savings (kWh)	Annual GHG Reductions (lb. CO ₂ -e)	First Incremental Cost	Net Annual Cost Savings	Simple Payback	Lifecycle B/C Ratio
CZ11	0	0	0	61,298.48	0	0	\$1,078	-\$35	N/A	0.31
CZ12	0	0	0	65,735.38	0	0	\$1,078	-\$32	N/A	0.33
CZ13	0	0	0	66,906.14	0	0	\$1,078	-\$31	N/A	0.33
CZ14	0	0	0	92,250.38	0	0	\$1,078	-\$15	N/A	0.46
CZ15	0	0	0	100,971.20	0	0	\$1,078	-\$9	N/A	0.50
CZ16	0	0	0	41,322.42	0	0	\$1,078	-\$47	N/A	0.21

3.1.1.5 Measure 4 – Pool and Spa Covers

As shown in Table 14, requiring pool and spa covers on non-heated pools is cost-effective in all climate zones. The costs modeled as part of this analysis include the average cost of the least expensive available pool cover, a solar bubble cover, and a manual reel. Cost of installing other types of manual or automated covers would be significantly higher but are not required.

This analysis also does not account for additional potential savings from reduced chemical usage, nor does it attempt to quantify other benefits offered by pool covers such as reduced cleaning, potential reduced maintenance costs, and safety benefits.

Table 14: Pool and Spa Covers Cost-Effectiveness Results Per Building

Climate Zone	Annual Electricity Savings (kWh)	Annual Gas Savings (therms)	Annual Water Savings (gallons)	Annual Embedded Energy Savings (kWh)	Annual GHG Reductions (lb. CO ₂ -e)	First Incremental Cost	Net Annual Cost Savings	Simple Payback	Lifecycle B/C Ratio
Single Family Pool and Spa Covers									
CZ1	0	0	6,275.74	22.37	0	\$243	\$50	4.9	1.87
CZ2	0	0	11,093.63	39.55	0	\$243	\$89	2.7	3.31
CZ3	0	0	12,357.11	44.05	0	\$243	\$99	2.5	3.69
CZ4	0	0	17,032.18	60.72	0	\$243	\$136	1.8	5.08
CZ5	0	0	13,926.04	49.65	0	\$243	\$111	2.2	4.15
CZ6	0	0	7,338.89	26.16	0	\$243	\$59	4.2	2.19
CZ7	0	0	12,648.68	45.09	0	\$243	\$101	2.4	3.77
CZ8	0	0	8,403.36	29.96	0	\$243	\$67	3.6	2.51
CZ9	0	0	8,780.88	31.30	0	\$243	\$70	3.5	2.62
CZ10	0	0	14,272.16	50.88	0	\$243	\$114	2.1	4.26
CZ11	0	0	12,663.06	45.14	0	\$243	\$101	2.4	3.78
CZ12	0	0	13,859.93	49.41	0	\$243	\$111	2.2	4.13
CZ13	0	0	19,225.91	68.54	0	\$243	\$154	1.6	5.73
CZ14	0	0	20,373.6	72.63	0	\$243	\$163	1.5	6.08
CZ15	0	0	16,911.19	60.29	0	\$243	\$135	1.8	5.04
CZ16	0	0	12,177.8	43.41	0	\$243	\$97	2.5	3.63



3.2 Multifamily and Nonresidential Results

3.2.1 Multifamily and Nonresidential Cost-Effectiveness Analysis

Cost-effectiveness results are shown for each climate zone in tabular form along with energy and GHG reductions for each multifamily and nonresidential measure as described in Section 2.3.2. Shaded rows in the tables reflect those cases which are not cost-effective.

3.2.1.1 Measure 5 – Exterior Hose Bib Locks

Due to lack of data availability, there is no strong defensible way to estimate per-building savings. The conservative approach is to assume zero water savings for most buildings. However, given the low measure cost, the annual per-building water savings required for the measure to be cost-effective are only approximately 1,650 gallons for multifamily buildings and 1,075 gallons for nonresidential buildings. For a 25-foot hose, 1,650 gallons can be roughly equivalent to 33 minutes of usage per year, or approximately one minute of usage every 11 days.⁵

While it is difficult to approximate the frequency of water theft from publicly-available faucets to assume an average per-building savings value, anecdotal instances of water theft suggest that, when it occurs, 1,650 gallons of savings are achievable.

Table 15: Multifamily and Nonresidential Exterior Hose Bib Locks Cost-Effectiveness Results Per Building

Climate Zone	Annual Electricity Savings (kWh)	Annual Gas Savings (therms)	Annual Water Savings (gallons)	Annual Embedded Energy Savings (kWh)	Annual GHG Reductions (lb. CO ₂ -e)	First Incremental Cost	Net Annual Cost Savings	Simple Payback	Lifecycle B/C Ratio
Multifamily Exterior Hose Bib Locks									
CZ1 - CZ16	0	0	0	0	0	\$112	\$0	N/A	0
Nonresidential Exterior Hose Bib Locks									
CZ1 - CZ16	0	0	0	0	0	\$56	\$0	N/A	0

3.2.1.2 Measure 6 – Alternate Water Sources

As shown in Table 16, requiring dual plumbing of multifamily buildings and connection to a recycled water line is cost-effective in climate zones 2 through 15, though only marginally cost-effective in climate zones 2 through 9. While this measure results in significant potable water savings from offsetting all consumption with recycled water, from the customer's perspective it is assumed that the amount of water consumption does not change based on whether the water is potable or recycled. On-bill savings include the savings associated with rainfall and foundation drainage offsetting the need to purchase such water, as well as the difference in cost associated with using potable and recycled water rates for other alternate water sources. Costs and savings are presented on a per-building basis.

⁵ Using a [Washington State University garden hose flow tool](https://www.lowes.com/projects/gardening-and-outdoor/garden-hose-buying-guide/project), this statement assumes a 5/8 inch hose size (<https://www.lowes.com/projects/gardening-and-outdoor/garden-hose-buying-guide/project>) and water pressure of 50 psi (<https://www.plumbingsupply.com/residential-water-pressure-explained.html>).



As shown in Table 17, requiring installation of rainwater, graywater, and foundation drainage collection, treatment, and reuse systems in nonresidential buildings is not cost-effective in any climate zone.

Rainwater collection occurs when irrigation demand is lowest and rainwater cannot be stored for long periods of time to last through dry seasons. This mismatch of supply and demand is particularly an issue in climate zones with extended rainy periods and overall lower irrigation demand. This analysis utilizes a daily rainwater model to track the available stored supply relative to the size of the water tank. However, as this can vary significantly across climate zones, water budgets for each individual project will have to be precisely predicted to fully utilize the combination of the rainwater collection system, the graywater collection system, and the foundation drainage system without having to add in additional systems or oversized storage capacity.

For jurisdictions opting to require that 100 percent of water demand be met with onsite potable reuse (for suitable applications), while demands could eventually be met by requiring additional collection and treatment systems such as stormwater retention and blackwater treatment and reuse, this would increase project costs. This points to a need to carefully develop water budgets and/or to consider adjusting ordinance language to not require meeting all demands with onsite non-potable reuse. Jurisdictions with little or no irrigation demand will be more readily able to match onsite reuse with building water demand.

Finally, while onsite non-potable water systems can help reduce costs related to delivery and treatment of water, results are presented from the customer perspective and therefore upstream and downstream savings are not calculated.

Table 16: Multifamily Use of Alternate Water Sources Cost-Effectiveness Results Per Building

Climate Zone	Annual Electricity Savings (kWh)	Annual Gas Savings (therms)	Annual Water Savings (gallons)	Annual Embedded Energy Savings (kWh)	Annual GHG Reductions (lb. CO ₂ -e)	First Incremental Cost	Net Annual Cost Savings	Simple Payback	Lifecycle B/C Ratio
Multifamily Alternate Water Sources									
CZ1	0	0	67,915	242.12	0	\$27,840	\$586	47.5	0.79
CZ2	0	0	88,829	316.68	0	\$27,840	\$766	36.3	1.04
CZ3	0	0	90,020	320.92	0	\$27,840	\$777	35.8	1.05
CZ4	0	0	97,949	349.19	0	\$27,840	\$845	32.9	1.15
CZ5	0	0	101,322	361.21	0	\$27,840	\$874	31.8	1.19
CZ6	0	0	94,270	336.07	0	\$27,840	\$813	34.2	1.10
CZ7	0	0	102,532	365.53	0	\$27,840	\$885	31.5	1.20
CZ8	0	0	102,851	366.67	0	\$27,840	\$887	31.4	1.20
CZ9	0	0	98,410	350.83	0	\$27,840	\$849	32.8	1.15
CZ10	0	0	116,987	417.06	0	\$27,840	\$1,009	27.6	1.37
CZ11	0	0	100,581	358.57	0	\$27,840	\$868	32.1	1.18
CZ12	0	0	104,017	370.82	0	\$27,840	\$897	31.0	1.22
CZ13	0	0	105,286	375.35	0	\$27,840	\$908	30.6	1.23
CZ14	0	0	123,714	441.04	0	\$27,840	\$1,067	26.1	1.45
CZ15	0	0	129,813	462.78	0	\$27,840	\$1,120	24.9	1.52
CZ16	0	0	82,589	294.43	0	\$27,840	\$713	39.1	0.97



Table 17: Nonresidential Use of Alternate Water Sources Cost-Effectiveness Results Per Building

Climate Zone	Annual Electricity Savings (kWh)	Annual Gas Savings (therms)	Annual Water Savings (gallons)	Annual Embedded Energy Savings (kWh)	Annual GHG Reductions (lb. CO ₂ -e)	First Incremental Cost	Net Annual Cost Savings	Simple Payback	Lifecycle B/C Ratio
CZ1	0	0	71,268	254.07	0	\$213,975	\$1,283	N/A	0.12
CZ2	0	0	72,984	260.19	0	\$213,975	\$1,314	N/A	0.12
CZ3	0	0	74,352	265.06	0	\$213,975	\$1,338	N/A	0.13
CZ4	0	0	79,446	283.23	0	\$213,975	\$1,430	N/A	0.14
CZ5	0	0	90,153	321.40	0	\$213,975	\$1,623	N/A	0.15
CZ6	0	0	88,873	316.83	0	\$213,975	\$1,600	N/A	0.15
CZ7	0	0	91,273	325.39	0	\$213,975	\$1,643	N/A	0.16
CZ8	0	0	92,469	329.65	0	\$213,975	\$1,664	N/A	0.16
CZ9	0	0	87,569	312.18	0	\$213,975	\$1,576	N/A	0.15
CZ10	0	0	91,128	324.87	0	\$213,975	\$1,640	N/A	0.16
CZ11	0	0	79,008	281.66	0	\$213,975	\$1,422	N/A	0.14
CZ12	0	0	79,694	284.11	0	\$213,975	\$1,434	N/A	0.14
CZ13	0	0	81,672	291.16	0	\$213,975	\$1,470	N/A	0.14
CZ14	0	0	85,839	306.02	0	\$213,975	\$1,545	N/A	0.15
CZ15	0	0	81,221	289.55	0	\$213,975	\$1,462	N/A	0.14
CZ16	0	0	76,537	272.85	0	\$213,975	\$1,377	N/A	0.13

3.2.1.3 Measures 7-10 – Combined Results for Landscape Irrigation Water Meters, Irrigation Controllers, Irrigation Systems, and Irrigation Audits

Landscape irrigation measure (Measure 7, Measure 8, Measure 9, and Measure 10) savings and cost-effectiveness results are presented as a package since the primary purpose of the irrigation audit (Measure 10) is to ensure compliance with all irrigation measures. Results presented in Table 18 suggest that this package of measures is cost-effective in climate zones 10, 14, and 15 for residential (multifamily) applications. The lifecycle B/C ratio remains low in most climate zones due to an assumed \$200 annual meter fee, and replacement of irrigation meters, controllers, and nozzles after 18, 11, and 10 years respectively based on average product lifetimes over a period of 30 years. For nonresidential applications, this package of measures was found to be cost-effective in all climate zones except 1 and 16, with climate zone 16 on the cusp of being cost-effective.

Overall, these measures result in a small increase in annual electricity consumption due to the increased energy consumption of smart irrigation controllers and that, as cold-water measures, these measures do not result in direct energy savings associated with heating water to offset this additional consumption. While there is a small increase in energy consumption resulting from smart irrigation controllers, the irrigation controllers account for approximately 39 to 52 percent of the total residential water savings and for 57 to 62 percent of the total nonresidential water savings, depending on climate zone.

The analysis takes a conservative approach for landscape audit cost and benefits and assumes that an audit takes place each time the entire landscape system is replaced but that there are no associated savings from the audit. While additional savings from audits are possible, the audit itself does not result in savings; rather, repairs or adjustments made to the system will impact overall savings. Realization of such savings depends on the building owner implementing the audit recommendations, which will vary based on the particular landscape and



result in additional cost of implementing such changes. Therefore, assuming savings from audits may improve the lifecycle B/C ratio but may or may not be cost-effective depending on the costs of the improvements.

Table 18: Landscape Irrigation Water Meters, Irrigation Controllers, Irrigation Systems, and Irrigation Audits Cost-Effectiveness Results Per Building

Climate Zone	Annual Electricity Savings (kWh)	Annual Gas Savings (therms)	Annual Water Savings (gallons)	Annual Embedded Energy Savings (kWh)	Annual GHG Reductions (lb. CO ₂ -e)	First Incremental Cost	Net Annual Cost Savings	Simple Payback	Lifecycle B/C Ratio
Multifamily Landscape Irrigation System (Meters, Controllers, Systems, and Audits)									
CZ1	-18	0	13,468.50	48.02	-13.03	\$7,768	-\$96	N/A	0.27
CZ2	-18	0	29,620.70	105.60	-13.03	\$7,768	\$33	70.4	0.60
CZ3	-18	0	30,799.20	109.80	-13.03	\$7,768	\$42	54.6	0.62
CZ4	-18	0	37,751.50	134.58	-13.03	\$7,768	\$98	23.6	0.77
CZ5	-18	0	40,041.20	142.75	-13.03	\$7,768	\$116	19.8	0.81
CZ6	-18	0	35,289.60	125.81	-13.03	\$7,768	\$79	29.2	0.72
CZ7	-18	0	40,924.00	145.89	-13.03	\$7,768	\$109	21.1	0.79
CZ8	-18	0	41,072.60	146.42	-13.03	\$7,768	\$125	18.4	0.84
CZ9	-18	0	37,980.60	135.40	-13.03	\$7,768	\$100	23.0	0.77
CZ10	-18	0	50,805.30	181.12	-13.03	\$7,768	\$202	11.4	1.03
CZ11	-18	0	40,001.10	142.60	-13.03	\$7,768	\$116	19.9	0.81
CZ12	-18	0	43,400.90	154.72	-13.03	\$7,768	\$143	16.1	0.88
CZ13	-18	0	44,592.10	158.97	-13.03	\$7,768	\$152	15.1	0.91
CZ14	-18	0	61,914.40	220.72	-13.03	\$7,768	\$291	7.9	1.26
CZ15	-18	0	67,829.40	241.81	-13.03	\$7,768	\$338	6.8	1.38
CZ16	-18	0	20,085.40	71.60	-13.03	\$7,768	-\$43	N/A	0.40
Nonresidential Landscape Irrigation System (Meters, Controllers, Systems, and Audits)									
CZ1	-18	0	68,611.6	244.60	0	\$17,914	\$593	13.9	0.60
CZ2	-18	0	129,097.3	460.23	0	\$17,914	\$1,114	7.4	1.13
CZ3	-18	0	132,839.4	473.57	0	\$17,914	\$1,146	7.2	1.16
CZ4	-18	0	156,726.2	558.73	0	\$17,914	\$1,351	6.1	1.37
CZ5	-18	0	166,117.4	592/21	0	\$17,914	\$1,433	5.8	1.45
CZ6	-18	0	146,523.4	522.36	0	\$17,914	\$1,265	6.5	1.28
CZ7	-18	0	169,558.1	604.47	0	\$17,914	\$1,461	5.7	1.48
CZ8	-18	0	170,367.9	607.36	0	\$17,914	\$1,471	5.6	1.49
CZ9	-18	0	157,913.4	562.96	0	\$17,914	\$1,363	6.1	1.38
CZ10	-18	0	210,352.3	749.91	0	\$17,914	\$1,816	4.6	1.84
CZ11	-18	0	168,827.5	601.87	0	\$17,914	\$1,457	5.7	1.47
CZ12	-18	0	181,629.5	647.51	0	\$17,914	\$1,567	5.3	1.59
CZ13	-18	0	185,346.0	660.76	0	\$17,914	\$1,599	5.2	1.62
CZ14	-18	0	256,051.2	912.82	0	\$17,914	\$2,211	3.7	2.24
CZ15	-18	0	280,327.9	999.37	0	\$17,914	\$2,421	3.4	2.45
CZ16	-18	0	105,887.5	377.49	0	\$17,914	\$918	9.0	0.93



For comparison, Table 19, Table 20, and Table 21 show the separate results for landscape irrigation meters, irrigation controllers, and irrigation systems respectively. Landscape irrigation meters are not cost-effective for multifamily applications in any climate zone but are cost-effective for nonresidential applications in all climate zones. Irrigation controllers and irrigation systems are both cost-effective in all climate zones for both multifamily and nonresidential applications.

Table 19: Measure 7 – Landscape Irrigation Meters Cost-Effectiveness Results Per Building

Climate Zone	Annual Electricity Savings (kWh)	Annual Gas Savings (therms)	Annual Water Savings (gallons)	Annual Embedded Energy Savings (kWh)	Annual GHG Reductions (lb. CO ₂ -e)	First Incremental Cost	Net Annual Cost Savings	Simple Payback	Lifecycle B/C Ratio
Multifamily Landscape Irrigation Meters									
CZ1	0	0	3,977	14.18	0	\$369.37	-\$168	N/A	0.14
CZ2	0	0	7,114	25.36	0	\$369.37	-\$143	N/A	0.25
CZ3	0	0	7,293	26.00	0	\$369.37	-\$142	N/A	0.25
CZ4	0	0	8,482	30.23	0	\$369.37	-\$132	N/A	0.29
CZ5	0	0	8,988	32.04	0	\$369.37	-\$128	N/A	0.31
CZ6	0	0	7,931	28.27	0	\$369.37	-\$137	N/A	0.28
CZ7	0	0	9,170	32.69	0	\$369.37	-\$127	N/A	0.32
CZ8	0	0	9,218	32.86	0	\$369.37	-\$126	N/A	0.32
CZ9	0	0	8,551	30.48	0	\$369.37	-\$132	N/A	0.30
CZ10	0	0	11,373	40.55	0	\$369.37	-\$109	N/A	0.39
CZ11	0	0	9,195	32.78	0	\$369.37	-\$127	N/A	0.32
CZ12	0	0	9,860	35.15	0	\$369.37	-\$121	N/A	0.34
CZ13	0	0	10,036	35.78	0	\$369.37	-\$120	N/A	0.35
CZ14	0	0	13,838	49.33	0	\$369.37	-\$90	N/A	0.48
CZ15	0	0	15,146	53.96	0	\$369.37	-\$79	N/A	0.53
CZ16	0	0	6,198	22.10	0	\$369.37	-\$151	N/A	0.22
Nonresidential Landscape Irrigation Meters									
CZ1 – CZ16	0	0	34,500	122.99	0	\$1,481.60	\$145	10.2	1.07

Table 20: Measure 8 – Irrigation Controllers Cost-Effectiveness Results

Climate Zone	Annual Electricity Savings (kWh)	Annual Gas Savings (therms)	Annual Water Savings (gallons)	Annual Embedded Energy Savings (kWh)	Annual GHG Reductions (lb. CO ₂ -e)	First Incremental Cost	Net Annual Cost Savings	Simple Payback	Lifecycle B/C Ratio
Multifamily Landscape Irrigation Controllers									
CZ1	-18	0	7,027	25.05	-13.03	\$108.02	\$52	2.1	4.23
CZ2	-18	0	12,569	44.81	-13.03	\$108.02	\$97	1.1	7.81
CZ3	-18	0	12,884	45.93	-13.03	\$108.02	\$99	1.1	8.01
CZ4	-18	0	14,986	53.42	-13.03	\$108.02	\$116	0.9	9.37
CZ5	-18	0	15,879	56.61	-13.03	\$108.02	\$123	0.9	9.94
CZ6	-18	0	14,011	49.95	-13.03	\$108.02	\$109	1.0	8.79



Climate Zone	Annual Electricity Savings (kWh)	Annual Gas Savings (therms)	Annual Water Savings (gallons)	Annual Embedded Energy Savings (kWh)	Annual GHG Reductions (lb. CO ₂ -e)	First Incremental Cost	Net Annual Cost Savings	Simple Payback	Lifecycle B/C Ratio
CZ7	-18	0	16,200	57.75	-13.03	\$108.02	\$111	1.0	9.00
CZ8	-18	0	16,285	58.06	-13.03	\$108.02	\$127	0.9	10.26
CZ9	-18	0	15,108	58.86	-13.03	\$108.02	\$117	0.9	9.5
CZ10	-18	0	20,092	71.63	-13.03	\$108.02	\$157	0.7	12.72
CZ11	-18	0	16,244	57.91	-13.03	\$108.02	\$126	0.9	10.18
CZ12	-18	0	17,420	62.10	-13.03	\$108.02	\$135	0.8	10.94
CZ13	-18	0	17,730	63.21	-13.03	\$108.02	\$138	0.8	11.14
CZ14	-18	0	24,446	87.15	-13.03	\$108.02	\$192	0.6	15.53
CZ15	-18	0	26,757	95.39	-13.03	\$108.02	\$210	0.5	17.02
CZ16	-18	0	10,950	39.04	-13.03	\$108.02	\$84	1.3	6.76
Nonresidential Landscape Irrigation Controllers									
CZ1 – CZ16	-18	0	60,950	217.29	-13.03	\$1,238.90	\$487	2.6	2.71

Table 21: Measure 9 – Irrigation System Cost-Effectiveness Results Per Building

Climate Zone	Annual Electricity Savings (kWh)	Annual Gas Savings (therms)	Annual Water Savings (gallons)	Annual Embedded Energy Savings (kWh)	Annual GHG Reductions (lb. CO ₂ -e)	First Incremental Cost	Net Annual Cost Savings	Simple Payback	Lifecycle B/C Ratio
Multifamily Landscape Irrigation System									
CZ1	0	0	2,465	8.79	0	\$136.51	\$20	3.0	2.83
CZ2	0	0	9,938	35.43	0	\$136.51	\$79	0.7	11.39
CZ3	0	0	10,622	37.87	0	\$136.51	\$85	0.7	12.18
CZ4	0	0	14,284	50.92	0	\$136.51	\$114	0.5	16.37
CZ5	0	0	15,174	54.10	0	\$136.51	\$121	0.5	17.39
CZ6	0	0	13,348	47.59	0	\$136.51	\$107	0.6	15.30
CZ7	0	0	15,554	55.45	0	\$136.51	\$124	0.5	17.83
CZ8	0	0	15,570	55.51	0	\$136.51	\$124	0.5	17.85
CZ9	0	0	14,322	51.06	0	\$136.51	\$114	0.5	16.42
CZ10	0	0	19,340	68.95	0	\$136.51	\$154	0.4	22.17
CZ11	0	0	14,562	51.91	0	\$136.51	\$116	0.5	16.69
CZ12	0	0	16,121	57.47	0	\$136.51	\$129	0.5	18.48
CZ13	0	0	16,826	59.98	0	\$136.51	\$134	0.4	19.29
CZ14	0	0	23,630	84.24	0	\$136.51	\$189	0.3	27.09
CZ15	0	0	25,926	92.43	0	\$136.51	\$207	0.3	29.72
CZ16	0	0	2,937	10.47	0	\$136.51	\$23	2.5	3.37
Nonresidential Landscape Irrigation System									
CZ1	0	0	8,217	29.29	0	\$201.08	\$66	3.1	2.23
CZ2	0	0	33,124	118.09	0	\$201.08	\$264	0.8	9.00



Climate Zone	Annual Electricity Savings (kWh)	Annual Gas Savings (therms)	Annual Water Savings (gallons)	Annual Embedded Energy Savings (kWh)	Annual GHG Reductions (lb. CO ₂ -e)	First Incremental Cost	Net Annual Cost Savings	Simple Payback	Lifecycle B/C Ratio
CZ3	0	0	35,405	126.22	0	\$201.08	\$283	0.7	9.62
CZ4	0	0	47,609	169.73	0	\$201.08	\$380	0.5	12.94
CZ5	0	0	50,577	180.31	0	\$201.08	\$404	0.5	13.75
CZ6	0	0	44,490	158.61	0	\$201.08	\$355	0.6	12.09
CZ7	0	0	51,844	184.82	0	\$201.08	\$414	0.5	14.09
CZ8	0	0	51,897	185.01	0	\$201.08	\$414	0.5	14.10
CZ9	0	0	47,737	170.18	0	\$201.08	\$381	0.5	12.97
CZ10	0	0	64,463	229.81	0	\$201.08	\$515	0.4	17.52
CZ11	0	0	48,536	173.03	0	\$201.08	\$388	0.5	13.19
CZ12	0	0	53,734	191.56	0	\$201.08	\$429	0.5	14.60
CZ13	0	0	56,083	199.94	0	\$201.08	\$448	0.4	15.24
CZ14	0	0	78,760	280.78	0	\$201.08	\$629	0.3	21.41
CZ15	0	0	86,412	308.06	0	\$201.08	\$690	0.3	23.48
CZ16	0	0	9,790	34.90	0	\$201.08	\$78	2.6	2.66

3.2.2 Nonresidential Cost-Effectiveness Analysis

Cost-effectiveness results are shown for each climate zone in tabular form along with energy and GHG reductions for each nonresidential measure as described in Section 2.3.2. Shaded rows in the tables reflect those cases which are not cost-effective.

3.2.2.1 Measure 11 – Indoor Water Meters

As shown in Table 22, requiring separate indoor water meters for nonresidential tenant spaces was found to be cost-effective in all climate zones.

Table 22: Indoor Water Meters Cost-Effectiveness Results Per Building

Climate Zone	Annual Electricity Savings (kWh)	Annual Gas Savings (therms)	Annual Water Savings (gallons)	Annual Embedded Energy Savings (kWh)	Annual GHG Reductions (lb. CO ₂ -e)	First Incremental Cost	Net Annual Cost Savings	Simple Payback	Lifecycle B/C Ratio
Indoor Water Meters									
CZ1	368.27	182.79	100,921	203.1	2,405.27	\$4,125	\$1,782	2.3	3.14
CZ2	368.27	182.79	100,921	203.1	2,405.27	\$4,125	\$1,782	2.3	3.14
CZ3	368.27	182.79	100,921	203.1	2,405.27	\$4,125	\$1,782	2.3	3.14
CZ4	368.27	182.79	100,921	203.1	2,405.27	\$4,125	\$1,782	2.3	3.14
CZ5	368.27	182.79	100,921	203.1	2,405.27	\$4,125	\$1,782	2.3	3.14
CZ6	368.27	182.79	100,921	203.1	2,405.27	\$4,125	\$1,482	2.8	2.61
CZ7	368.27	182.79	100,921	203.1	2,405.27	\$4,125	\$1,950	2.1	3.44
CZ8	368.27	182.79	100,921	203.1	2,405.27	\$4,125	\$1,482	2.8	2.61
CZ9	368.27	182.79	100,921	203.1	2,405.27	\$4,125	\$1,482	2.8	2.61



Climate Zone	Annual Electricity Savings (kWh)	Annual Gas Savings (therms)	Annual Water Savings (gallons)	Annual Embedded Energy Savings (kWh)	Annual GHG Reductions (lb. CO ₂ -e)	First Incremental Cost	Net Annual Cost Savings	Simple Payback	Lifecycle B/C Ratio
CZ10	368.27	182.79	100,921	203.1	2,405.27	\$4,125	\$1,482	2.8	2.61
CZ11	368.27	182.79	100,921	203.1	2,405.27	\$4,125	\$1,782	2.3	3.14
CZ12	368.27	182.79	100,921	203.1	2,405.27	\$4,125	\$1,782	2.3	3.14
CZ13	368.27	182.79	100,921	203.1	2,405.27	\$4,125	\$1,782	2.3	3.14
CZ14	368.27	182.79	100,921	203.1	2,405.27	\$4,125	\$1,482	2.8	2.16
CZ15	368.27	182.79	100,921	203.1	2,405.27	\$4,125	\$1,482	2.8	2.61
CZ16	368.27	182.79	100,921	203.1	2,405.27	\$4,125	\$1,782	2.3	3.14

3.2.2.2 Measure 12 – Cooling Towers

As shown in Table 23, capturing cooling tower blowdown water, treating it, and reusing it in cooling towers was not found to be cost-effective in any climate zone. Cost and savings were only calculated for climate zones 3, 4, 6, 7, 8, 9, 10, 12, and 13 because cooling towers will only exist on large buildings with chilled water plants and the nine climate zones analyzed contain 90 percent of large buildings that are forecast to be built in the future.

As this measure is presented and analyzed separately from Measure 6 – Alternate Water Sources, savings include only the reuse of blowdown for cooling tower makeup water and that the remaining makeup water still needs to be delivered to the system by the water provider. Cost savings could increase if a building provides sufficient treated rainwater or graywater to replace the remaining makeup water in the cooling tower.

Table 23: Cooling Towers Cost-Effectiveness Results Per Building

Climate Zone	Annual Electricity Savings (kWh)	Annual Gas Savings (therms)	Annual Water Savings (gallons)	Annual Embedded Energy Savings (kWh)	Annual GHG Reductions (lb. CO ₂ -e)	First Incremental Cost	Net Annual Cost Savings	Simple Payback	Lifecycle B/C Ratio
Cooling Towers									
CZ3	-88	0	54,052	262.04	-63.71	\$19,101	\$375	N/A	0.20
CZ4	-123	0	75,277	364.94	-89.05	\$22,720	\$587	N/A	0.23
CZ6	-132	0	81,169	393.51	-95.57	\$22,226	\$646	N/A	0.26
CZ7	-147	0	90,149	437.04	-106.43	\$33,015	\$736	N/A	0.20
CZ8	-168	0	103,156	500.10	-121.63	\$34,676	\$866	N/A	0.22
CZ9	-179	0	109,803	532.32	-129.60	\$34,676	\$933	N/A	0.23
CZ10	-199	0	122,339	593.10	-144.08	\$37,198	\$1,058	N/A	0.24
CZ12	-145	0	88,990	431.42	-104.98	\$32,858	\$724	N/A	0.20
CZ13	-198	0	121,519	589.12	-143.35	\$42,842	\$1,050	N/A	0.21

3.2.2.3 Measure 13 – Manual Toilets

As shown in Table 24, manually operated toilets are cost-effective in all climate zones due to the lack of first incremental cost and significant water savings. The analysis assumes zero incremental costs, resulting in a conservative modeling approach, as manual flush toilets typically have a negative incremental cost compared to sensor-operated toilets.



Table 24: Manually Operated Toilets Cost-Effectiveness Results Per Building

Climate Zone	Annual Electricity Savings (kWh)	Annual Gas Savings (therms)	Annual Water Savings (gallons)	Annual Embedded Energy Savings (kWh)	Annual GHG Reductions (lb. CO ₂ -e)	First Incremental Cost	Net Annual Cost Savings	Simple Payback	Lifecycle B/C Ratio
Manually Operated Toilets									
CZ1 – CZ16	0	0	24,216.98	117.40	0	\$0	\$243	0.0	∞

3.2.2.4 Measure 14 – Commercial Kitchen Water Efficiency

As shown in Table 25, the commercial kitchen water efficiency package of non-preempted measures (including dishwashers, food steamers, combination ovens, and pulpers) is cost-effective in all climate zones, with a B/C ratio much larger than the threshold of 1.

Table 25: Commercial Kitchen Water Efficiency Cost-Effectiveness Results Per Building

Climate Zone	Annual Electricity Savings (kWh)	Annual Gas Savings (therms)	Annual Water Savings (gallons)	Annual Embedded Energy Savings (kWh)	Annual GHG Reductions (lb. CO ₂ -e)	First Incremental Cost	Net Annual Cost Savings	Simple Payback	Lifecycle B/C Ratio
Commercial Kitchen Water Efficiency									
CZ1	1,851.2	918.9	125,550	1152	12,091.4	\$2,472	\$6,255	0.4	13.46
CZ2	1,851.2	918.9	125,550	1152	12,091.4	\$2,472	\$6,255	0.4	13.46
CZ3	1,851.2	918.9	125,550	1152	12,091.4	\$2,472	\$6,255	0.4	13.46
CZ4	1,851.2	918.9	125,550	1152	12,091.4	\$2,472	\$6,255	0.4	13.46
CZ5	1,851.2	918.9	125,550	1152	12,091.4	\$2,472	\$6,255	0.4	13.46
CZ6	1,851.2	918.9	125,550	1152	12,091.4	\$2,472	\$4,747	0.5	10.22
CZ7	1,851.2	918.9	125,550	1152	12,091.4	\$2,472	\$7,101	0.3	15.28
CZ8	1,851.2	918.9	125,550	1152	12,091.4	\$2,472	\$4,749	0.5	10.22
CZ9	1,851.2	918.9	125,550	1152	12,091.4	\$2,472	\$4,749	0.5	10.22
CZ10	1,851.2	918.9	125,550	1152	12,091.4	\$2,472	\$4,749	0.5	10.22
CZ11	1,851.2	918.9	125,550	1152	12,091.4	\$2,472	\$6,255	0.4	13.46
CZ12	1,851.2	918.9	125,550	1152	12,091.4	\$2,472	\$6,255	0.4	13.46
CZ13	1,851.2	918.9	125,550	1152	12,091.4	\$2,472	\$6,255	0.4	13.46
CZ14	1,851.2	918.9	125,550	1152	12,091.4	\$2,472	\$4,749	0.5	10.22
CZ15	1,851.2	918.9	125,550	1152	12,091.4	\$2,472	\$4,749	0.5	10.22
CZ16	1,851.2	918.9	125,550	1152	12,091.4	\$2,472	\$6,255	0.4	13.46



4 Conclusions & Summary

This report evaluated the feasibility and cost-effectiveness of prescriptive energy- and water-savings measures in all 16 California climate zones. For this analysis, PG&E rates were used for gas and electricity in climate zones 1 through 5, 11 through 13, and 16. SCE electricity rates and SoCalGas rates were used for climate zones 6, 8 through 10, 14 and 15. SDG&E rates were used for electricity and gas for climate zone 7.

The following describes the results of cost-effectiveness analysis for the prescriptive measures modeled in this report.

Measure 1A – Single Family Water Waste Reduction when Delivering Hot Water, CHWDS: Single family compact hot water distribution systems were found to be cost-effective in all climate zones. This analysis builds upon the 2019 CHWDS CASE Report, which assumes that most homes will achieve the CHWDS credit by re-locating the water heater. Adjusting the location of the wet rooms would significantly reduce the incremental cost as system compactness increases. Calculated savings include electricity, natural gas, water, and embedded energy.

Measure 1B – Single Family Water Waste Reduction when Delivering Hot Water, Demand Recirculation with DWHR: As stated in the measure descriptions under section 2.3.2 of this report, hot water recirculation systems result in an overall increase in energy consumption. To ensure that this measure results in energy savings beyond Title 24, Part 6 requirements, the analysis team sought to develop an efficiency package to offset the energy penalty generated by a recirculation system; the proposed measure pairs hot water recirculation with a requirement for drain water heat recovery (DWHR). This package was found to be cost-effective in all climate zones. Calculated savings include electricity, natural gas, water, and embedded energy.

Measure 2 – Single Family Graywater Ready Collection and Distribution System: Building new homes to be graywater-ready was not found to be cost-effective in any climate zone. There are no electricity or gas savings associated with this measure. Water savings are low until future equipment is installed to make full use of the collection and distribution system. Calculated savings include water and embedded energy.

Measure 3 – Recycled Water for Single Family Common Landscaping: Using recycled water in single family common landscaping was not found to be cost-effective in any climate zone. While this measure results in significant potable water savings from offsetting consumption with recycled water, from the customer's perspective it is assumed that the amount of water consumption does not change based on whether the water is potable or recycled. The on-bill savings only include the difference in cost between potable and recycled water rates. Calculated savings include the potable water savings offset by recycled water consumption.

Measure 4 – Pool and Spa Covers: With the lowest cost pool cover, a solar pool cover, requiring reel system pool and spa covers on non-heated pools was found to be cost-effective in all climate zones. Due to limited data availability, this analysis also does not account for additional savings from reduced chemical usage, nor does it attempt to quantify other possible benefits offered by pool covers, such as reduced cleaning, reduced maintenance costs, and increased safety. Calculated savings include water and embedded energy from reduced evaporation.

Measure 5 – Multifamily and Nonresidential Exterior Hose Bib Locks: Installing exterior hose bib locks on publicly accessible faucets on multifamily and nonresidential buildings was not found to be cost-effective in any climate zone, given a lack of defensible methodology for estimating any potential water savings. However, the analysis results indicate the annual water savings per building required to break-even is as low as 1,650 gallons for multifamily buildings and 660 gallons for nonresidential buildings to offset the installation and replacement costs. Savings were not calculated.

Measure 6 – Multifamily and Nonresidential Alternate Water Sources: Requiring dual plumbing of multifamily buildings and connection to a recycled water line was found to be cost-effective in climate zones 2 through 15, though only marginally cost-effective in climate zones 2 through 9. While this results in significant potable water

savings from offsetting consumption with recycled water, from the customer's perspective it is assumed that the amount of water consumption does not change based on whether the water is potable or recycled. The on-bill savings include the savings associated with rainfall and foundation drainage offsetting the need to purchase such water, as well as the difference in cost associated with using potable and recycled water rates for other alternate water sources. Costs and savings are presented on a per-building basis. Calculated savings include the potable water savings offset by recycled water consumption.

Requiring installation of rainwater, graywater, and foundation drainage collection, treatment, and reuse systems in nonresidential buildings was also found to not be cost-effective in any climate zone. Careful refinement of water budgets and project-specific calculations are needed to more accurately reflect potential costs and savings associated with onsite non-potable reuse. Calculated savings include water and embedded energy.

Measure 7-10 – Landscape Irrigation Systems (including Landscape Irrigation Water Meters, Irrigation Controllers, Irrigation Systems, and Irrigation Audits): This package of measures (Measure 7, Measure 8, Measure 9, and Measure 10) is cost-effective in climate zones 10, 14, and 15 for multifamily applications. For nonresidential applications, the analysis found this package of measures to be cost-effective in all climate zones except 1 and 16, with climate zone 16 on the cusp of being cost-effective. Calculated savings include electricity, water, and embedded energy.

Measure 11 – Indoor Water Meters: Requiring separate indoor water meters for nonresidential tenant spaces was found to be cost-effective in all climate zones. Calculated savings include electricity, natural gas, water, and embedded energy.

Measure 12 – Cooling Towers: Capturing cooling tower blowdown water, treating, and reusing in cooling towers was not found to be cost-effective in climate zones 3, 4, 6, 7, 8, 9, 10, 12, and 13. Cost-effectiveness was not calculated for the remaining climate zones because cooling towers will only exist on large buildings with chilled water plants and the nine climate zones analyzed contain 90 percent of large buildings that will be built in the future. As this measure is presented and analyzed separately from Measure 6 – Alternate Water Sources, savings include only the reuse of blowdown for cooling tower makeup water and that the remaining makeup water still needs to be delivered to the system by the water provider. Cost savings could increase if a building provides sufficient treated rainwater or graywater to replace the remaining makeup water in the cooling tower. Calculated savings include electricity, water, and embedded energy.

Measure 13 – Manually Operated Toilets in Commercial Facilities: Installing toilets and urinals with manual rather than sensor operation was found to be cost-effective in all climate zones. Calculated savings include water and embedded energy.

Measure 14 – Commercial Kitchen Water Efficiency: Requiring commercial kitchens to meet or exceed water efficiency requirements for new and replacement commercial dishwashers, food steamers, combination ovens, and food waste pulping systems under 2016 Title 24, Part 11 of the California Green Building Code (CALGreen) was found to be cost-effective in all climate zones. Calculated savings include electricity, natural gas, water, and embedded energy.

Measure 15 – Selling Compliant Fixtures and Fittings: Retailers are already required to sell fixtures and fittings compliant with Title 20. There are no additional savings from this measure.

Measure 16 – Installing Compliant Fixtures and Fittings: Contractors are already required to install fixtures and fittings compliant with Title 20. There are no additional savings from this measure.



5 Additional Resources

The following lists address rebate programs and additional resources directly relevant to the measures addressed in this report. This does not constitute a comprehensive list of available rebate programs and resources.

5.1 Rebate Programs

5.1.1 Indoor Water Efficiency

- **EPA WaterSense Rebate Finder.** Tool to help identify rebate programs for WaterSense labeled products.
- **SoCal Water\$mart Commercial Food Equipment.** Rebates for connectionless food steamers and air-cooled ice machines. http://socalwatersmart.com/commercial/?page_id=3050
- **Solano County Water Agency Hot Water Recirculating System Components Rebate.** <http://solanosaveswater.org/water-conserving-products-rebate/>

5.1.2 Landscape Efficiency

- **Alameda County Water District (ACWD) Weather-Based “Smart” Irrigation Controller Rebate Program.** Rebates available to commercial, industrial, institutional, or multifamily/HOA customers within ACWD territory for replacing conventional irrigation controller(s) with smart controller(s). <https://www.acwd.org/DocumentCenter/View/389>
- **California Water Service Rebates and Programs.** Various rebate programs available to residential and commercial customers. Include rebates for smart irrigation controllers and high efficiency nozzles. Commercial customers may also pursue rebates for large rotary nozzles and spray sprinkler bodies with integrated pressure regulation and check valves. <https://www.calwater.com/conservation/rebates-and-programs/residential/av/>
- **City of Sacramento Irrigation Upgrade Rebates; Smart Controller Rebates.** Includes rebates for conversion to high efficiency sprinkler nozzles and smart irrigation controllers. <https://www.cityofsacramento.org/Utilities/Conservation/Residents/Residential-Rebates>
- **East Bay Municipal Utility District (EBMUD) Efficient Irrigation Equipment.** Includes rebates for high efficiency nozzles, smart irrigation controllers, and irrigation submeters. <https://www.ebmud.com/water/conservation-and-rebates/residential/rebates/lawn-conversion-irrigation-upgrade-rebates/>
- **EPA WaterSense Rebate Finder.** Tool to help identify rebate programs for WaterSense labeled products.
- **North Marin Water District Water Smart Home Survey.** Free outdoor water efficiency checks and landscape irrigation system efficiency test. https://www.nmwd.com/conservation_exterior.php
- **North Marin Water District Water Smart Landscape Rebate.** Rebates for qualifying high efficiency irrigation equipment including check valves, rotating sprinkler nozzles, and rain shut-off devices. https://www.nmwd.com/conservation_exterior.php
- **North Marin Water District Weather Based Irrigation Controller Rebate.** https://www.nmwd.com/conservation_exterior.php
- **North Marin Water District Large Landscape Water Audit Program and Large Landscape Budget Program.** https://www.nmwd.com/conservation_exterior.php
- **SoCal Water\$mart Irrigation Controllers.** Residential rebates for weather-based irrigation controllers. http://www.socalwatersmart.com/?page_id=2979; http://socalwatersmart.com/?page_id=2979



- **SoCal Water\$mart Commercial Landscaping Equipment.** Rebates for smart irrigation controllers, high efficiency nozzles, flow regulators, and soil moisture sensors. http://socalwatersmart.com/commercial/?page_id=3050
- **Santa Clara Valley Water District (SCVWD) Landscape Rebate Program.** Rebate program for irrigation equipment upgrades. Includes high-efficiency nozzles, rotor sprinklers or spray bodies with pressure regulation and/or check valves, rain sensors, dedicated landscape meters/flow sensors/hydrometers, and weather-based irrigation controllers. <https://scvwd.dropletportal.com/irrigation-equipment-details>
- **SCVWD Large Landscape Survey Program.** Free landscape surveys for minimum ½ acre irrigated landscape and/or 1,000 CCF of water consumption for irrigation in multifamily, commercial, industrial, and institutional sites. <https://www.valleywater.org/saving-water/commercial/large-landscape-surveys>
- **SCVWD Water Wise Survey Program.** Free irrigation survey for single family and small multifamily sites (under ½ acre irrigated landscape). <https://www.valleywater.org/saving-water/residential/water-wise-surveys>
- **Solano County Water Agency Rain Sensors Rebate.** Rebate for rain sensors that shut-off irrigation systems when 1/8 inch or greater precipitation is detected. <http://solanosaveswater.org/water-conserving-products-rebate/>
- **Zone 7 Water Agency Weather-Based Irrigation Controller Rebates.** Rebates for replacing irrigation controllers with smart controllers. Available to single family residences, multifamily residences, and nonresidential properties. Zone 7 Water Agency covers City of Livermore, California Water Service Company-Livermore, City of Pleasanton, Dublin San Ramon Services District) <http://zone7water.com/conservation-rebates/rebate-programs/weather-based-irrigation-controllers>

5.1.3 ***Alternate Water Sources and Onsite Non-Potable Water Systems***

- **Bay Area Water Supply and Conservation Agency (BAWSCA) Rain Barrel Rebates.** BAWSCA and [participating member agencies](http://bawasca.org/conserve/rebates/barrels) offer rebates for purchase and installation of qualifying rain barrels. <http://bawasca.org/conserve/rebates/barrels>
- **City of Sacramento Rain Barrel Rebates; Laundry-to-Landscape Rebates.** <https://www.cityofsacramento.org/Utilities/Conservation/Residents/Residential-Rebates>
- **North Marin Water District Rainwater / Graywater Rebate.** Pilot program to incentivize capture and distribution of rainwater or graywater for landscape irrigation. https://www.nmwd.com/conservation_exterior.php
- **SCVWD Laundry-to-Landscape Rebate Program.** Rebate for connection a clothes washer to a simple graywater irrigation system. <https://www.valleywater.org/graywater-rebate-program>
- **San Francisco Public Utilities Commission (SFPUC) Non-potable Grant Program.** Encourages alternate water source collection, treatment, and distribution <https://www.sfwater.org/index.aspx?page=686>
- **SFPUC Rainwater Harvesting Program:** Participating customers receive up to two 50-gallon rain barrels (must pay tax), plus large discounts on 250 to 750-gallon cisterns. <https://www.sfwater.org/index.aspx?page=178>
- **SoCal Water\$mart Rain Barrels & Cisterns.** Rebates for rain barrels or cisterns. http://www.socalwatersmart.com/?page_id=2973
- **Solano County Water Agency Laundry-to-Landscape System Components Rebate.** Rebate for eligible components to distribute graywater from clothes washers to landscape irrigation. <http://solanosaveswater.org/water-conserving-products-rebate/>



- **Solano County Water Agency Rain Barrel Rebate.** Rebate for eligible components to distribute graywater from clothes washers to landscape irrigation. <http://solanosaveswater.org/water-conserving-products-rebate/>

5.1.4 Submetering

- **Santa Clara Valley Water District Submeter Rebate Program.** Rebate per installed submeter for mobile home parks and condominium complexes. <https://www.valleywater.org/saving-water/commercial/submeter-rebate-program>

5.1.5 Swimming Pools & Spa Covers

- **North Marin Water District Pool Cover Rebate.** Rebates to residential customers for installing a new solar or safety pool cover. https://www.nmwd.com/conservation_exterior.php
- **Solano County Water Agency Pool Cover Rebate.** Rebates for new pool covers. <http://solanosaveswater.org/water-conserving-products-rebate/>

5.1.6 Water Efficient Technology (WET) Rebates

- **Santa Clara Valley Water District WET Rebates for Businesses and Facilities.** Rebates available to commercial, industrial, and institutional water customers for water conservation projects directly reducing water consumption by at least 75,800 gallons per year. <https://www.valleywater.org/saving-water/commercial/commercial-facility-rebates>

5.2 Other Resources

5.2.1 MWELQ

- **California DWR: The 2015 Updated Model Water Efficient Landscape Ordinance Guidance for California Local Agencies**
<https://water.ca.gov/LegacyFiles/wateruseefficiency/landscapeordinance/docs/2015%20MWELQ%20Guidance%20for%20Local%20Agencies.pdf>

5.2.2 Onsite Non-Potable Water Systems

- [National Blue Ribbon Commission for Onsite Non-Potable Water Systems \(NBRC\)](#)
- [A Guidebook for Developing and Implementing Regulations for Onsite Non-Potable Water Systems.](#) 2018.
- [Risk-Based Framework for the Development of Public Health Guidance for Decentralized Non-Potable Water Systems.](#) Water Research Foundation. March 2017.

5.2.3 Water-Energy Nexus

- **Energy Code Ace Title 20 Essentials: The Water Energy Nexus.** Free online self-study to learn about the water-energy nexus and the importance to California, Title 20 and CALGreen (Title 24, Part 11) water efficiency requirements, and compliance with Title 20 water efficiency requirements. <https://energycodeace.com/training>



6 References

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Appendix A – Measure-Specific Assumptions and Methodologies

Irrigation Measures – Irrigation Water Needs by Climate Zone

The Pacific Institute study addressing alternative water supply and efficiency calculates irrigation demand in gallons per year based on the monthly reference evapotranspiration, monthly effective rainfall, plant factor of the irrigated area, distribution uniformity of irrigation, irrigation management efficiency, irrigated landscape area, and a conversion factor to convert inches of water to gallons (Pacific Institute 2016). For each climate zone’s representative city (Energy Commission 2017), reference evapotranspiration values were provided by the California Department of Water Resources (DWR) Model Water Efficient Landscape Ordinance (MWELO) (CCR 2018) and monthly rainfall from usclimatedata.com. The rainfall was adjusted by a factor of 0.25 to account for evaporation, runoff, and deep percolation, all of which affects the water that is beneficially used by plants based on an adjustment factor given by Pacific Institute (Pacific institute 2016). This analysis uses an average plant factor of 0.55 based on 0.3 for low water plants and 0.8 for turf grass (Pacific Institute 2016). Additionally, this analysis aligns with the Pacific Institute assumption for the product of distribution uniformity and irrigation management efficiency of 0.62 to account for how efficiently the irrigation system performs, the uniformity of distribution, and how well crops respond to irrigation (Pacific Institute 2016). The landscape area for residential landscapes was assumed to be 2,648 ft², which was the median from an Aquacraft study regarding end use water profiles (Aquacraft 2011a).

Measure 1A – Single Family Water Waste Reduction when Delivering Hot Water, CHWDS: For single family HERS verified CHWDS, this uses the savings estimates from the Final 2019 CASE Report (Statewide CASE Team 2017a).⁶ The analysis assumes the pipe insulation credit available under the 2016 Title 24, Part 6 Standards was in place as the base system design and assumes a minimum efficiency gas instantaneous water heater (primary prescriptive path). The CASE Report analysis uses the 2016 baseline and calculates savings for the CHWDS Basic Credit; as the expanded credit yields higher savings resulting from higher compactness and reduction of larger diameter pipe lengths, the results presented in this report are conservative estimates for HERS verified CHWDS. The assumed measure life is 30 years.

Measure 1B – Single Family Water Waste Reduction when Delivering Hot Water, Demand

Recirculation with DWHR: Using the 2016 Title 24, Part 6 baseline as the starting point, both demand control manual (manual control) with HERS verification (DCMH) and demand control occupancy (sensor control) with HERS verification (DCOH) recirculation systems were modeled and compared to the consumption of the standard design with no recirculation system. Given that the DCOH systems use more energy in every climate zone than the DCMH systems, the difference in annual therm consumption between DCOH systems and the standard design was compared with the annual therm savings from the DWHR as presented in the Final 2019 CASE Report (Statewide CASE Team 2017b). There are existing Title 24, Part 6 Standards that cover water heating systems, so the existing conditions assume a building minimally complies with the 2016 Title 24, Part 6 Standards. Key assumptions include:

- An instantaneous water heater (prescriptive baseline)

⁶ The full methodology can be found in Sections 4.1 and 4.2 of the Final 2019 CHWDS CASE Report (Statewide CASE Team 2017a).



- Pipe insulation is assumed to be included in the demand recirculation calculations. While the ACM does not specify whether the water distribution system multipliers in Table B-1 assume pipe insulation, CBECC-RES does not allow selection of both the type of recirculation system and pipe insulation, and according to Title 24, Part 6 Section 150.0(j)2.A.iii, all piping associated with a domestic hot water recirculation loop must be insulated regardless of pipe diameter.
- Distribution system multipliers reflect the energy impact of reduced hot water consumption associated with recirculation systems, as stated in Table B-1 of the ACM.

To determine water savings associated with the demand recirculation system, the duty cycle per end use (shower, bathroom, and kitchen) were used from the Faucets CASE Report (Statewide CASE Team 2013a). Based on the Energy Commission Staff Report for faucets, the analysis assumes 45 feet pipe length to each fixture (Energy Commission 2014). The base case water entrapment volume was calculated according to the formula $A = \pi * (\text{Inside Diameter})^2 / 4$ using this 45-foot pipe length for 3/4" PEX pipe and assuming an average inside diameter of 0.681 inches. The resulting base case and measure case entrapment volumes (0.85 gallons and 0.125 gallons, respectively) were multiplied by each duty cycle to yield total base case and measure case water consumption. The water savings is the difference between these two values. The assumed measure life is 30 years.

Measure 2 – Single Family Graywater Collection and Distribution System: To calculate water savings, annual indoor household water usage was assumed to be 50,370 gallons based on 2016 Water Research Foundation study on residential end uses of water (WRF 2016) and aligns assumptions with the percentage of water used in different household end uses from the WRF study and a 2011 Aquacraft study regarding water end use profiles (WRF 2016, Aquacraft 2011a). The average values from the two studies for allowable end uses for graywater resulted in 20 percent used in showers, three percent used in baths, ten percent used in lavatory faucets, and 17 percent used in laundry usage. These percentages were applied to the indoor household water usage to determine how many gallons per year are used in each of those end uses. The assumed measure life is 30 years.

Measure 3 – Recycled Water for Single Family Common Landscaping: It was assumed that potable water consumption is offset by recycled water for the total irrigation water use in each climate zone. For more information regarding residential irrigation needs, see methodology description for Irrigation Water Needs by climate zone. The assumed measure life is 30 years.

Measure 4 – Pool and Spa Covers: While evaporation rates depend on many factors including pool size, climate, and wind, this analysis applies average pan evaporation rates by building climate zone based on measured evaporation rates from the Western Regional Climate Center and Los Angeles County Watershed Model Configuration and Calibration report, as shown in

Table 26 (Western Regional Climate Center 2018, County of Los Angeles 2010). As these reports present pan evaporation in inches per year, the rates were converted to gallons per year using standard conversions and assuming an average pool size of 392 ft². Total evaporation per year was multiplied by an average efficiency of 81 percent based on a National Plasters Council report addressing pool cover effectiveness of reducing evaporation (National Plasterers Council 2016). The assumed measure life is four years.

Table 26: Average Annual Evaporation by Climate Zone

Climate Zone	Average Annual Evaporation (inches/year)
CZ1	31.64
CZ2	55.93
CZ3	62.30
CZ4	85.87
CZ5	70.21
CZ6	37.00
CZ7	63.77
CZ8	42.37
CZ9	44.27
CZ10	71.96
CZ11	63.84
CZ12	69.88
CZ13	96.93
CZ14	102.72
CZ15	85.26
CZ16	61.40

Measure 5 – Multifamily and Nonresidential Exterior Hose Bib Locks: Due to lack of data availability, there is no strong defensible way to estimate per-building savings. As such, this analysis took the conservative approach of assuming the average building would not achieve energy or water savings as a result of lock installation. The assumed measure life is 10 years.

Measure 6 – Multifamily and Nonresidential Alternate Water Sources:

For nonresidential buildings, building assumptions were based on the three-story, 53,628 square foot medium sized office building prototype. While the prototype does not give any sense of how many bathrooms or fixtures are located in the building, it was estimated that the building contains five toilets and one urinal per story with an annual water usage of 1,974 gallons per year per toilet and 585 gallons per year per urinal for a total of 31,365 gallons per year of toilet and urinal water use (Statewide CASE



Team 2013b). For irrigation water usage, 230,000 gallons per year demand was assumed regardless of climate zone (Statewide CASE Team 2017c). The calculations include 72,438 gallons graywater per year from sinks, resulting in a total building water usage of 696,970 gallons per year, with 37 percent of that usage going to bathrooms and 28 percent of that bathroom usage going to faucets (Statewide CASE Team 2017c; U.S. EPA 2017). The calculations do not include graywater production from showers as this was assumed to be low or nonexistent in the typical medium-sized office building. For rainwater, the average rainfall per month was calculated in each climate zone, multiplied by the assumed footprint of the building (17,876), converted to gallons received per month, adjusted by 90 percent to account for the rainwater that cannot be collected (Greywater Action 2018), and evenly distributed across the respective days in each month. Using the same methodology for the irrigation water needs per climate zone, a daily irrigation demand value was calculated. Assuming the storage tank is empty starting January 1st, the values for irrigation and water demand were then combined with the daily graywater production and needs of the building to determine the net capacity of the tank. By doing this, it is also possible to track the potential water lost due to the tank being full when the irrigation needs and the graywater demand does not exceed the rainwater production and the graywater production. It is also possible to track how much additional water is needed from the municipal water supply.

For multifamily buildings, building assumptions were based on the two-story, 6,960 square foot building with four one-bedroom, 780 square foot units and four two-bedroom, 960 square foot units multifamily prototype. 85 gallons per capita per day and an average of 2.46 people per unit (LAO 2017, WRF 2018) were used to calculate total annual consumption of 610,572 gallons of water per building (for both indoor and outdoor water usage). It was assumed that all of this potable water would be saved, or rather offset, because the building would be dual plumbed for recycled water in order to comply with the ordinance. The assumed measure life is 30 years.

Measure 7 – Landscape Irrigation Water Meters: For residential water meter savings, average savings from water meters and flow sensors (15 percent) were applied to the irrigation water use in each climate zone (AWE 2018). For more information regarding residential irrigation needs, see methodology description for Irrigation Water Needs by Climate Zone. For nonresidential water meter savings, the same average value of 15 percent savings from water meters and flow sensors was applied to the average irrigation water use in nonresidential buildings of 230,000 gallons per year. This value came from the Landscape Irrigation Controllers CASE Report (Statewide CASE Team 2017c). The assumed measure life is 18 years.

Measure 8 – Irrigation Controllers: Based on the Landscape Irrigation Controllers CASE Report, the analysis assumes that weather-based controllers save 15 percent of irrigation water use and soil-moisture-sensor-based controllers save 38 percent of irrigation water use (Statewide CASE Team 2017c). A 50/50 split was assumed for adoption rate of soil or weather-based controllers respectively. Estimated savings were applied to the water usage for irrigation water use in each climate zone. For more information regarding residential irrigation needs, see methodology description for Irrigation Water Needs by Climate Zone. Commercial irrigation needs were assumed to be 230,000 gallons per year, based on the Landscape Irrigation Controllers CASE Report (Statewide CASE Team 2017c). The assumed measure life is 11 years.

Measure 9 – Irrigation Systems: For irrigation systems, this analysis uses an equation from the Spray Sprinkler Bodies CASE Report to calculate the amount of irrigation needed given a base case irrigation efficiency of 50 percent and measure case efficiency of 65 percent (Statewide CASE Team 2017d). This accounts for the plant factor for the types of plants being irrigated, the annual ETo by climate zone, the

average annual precipitation by climate zone, and the unusable fraction of precipitation the deficit irrigation adjustment factor. The equation was adjusted to be consistent with other values throughout the analysis, to address the residential irrigation water needs calculated for each climate zone, and account for the average irrigated area for both residential and nonresidential buildings. The irrigation needed per climate zone was then applied to the average landscape area for residential (2,648 square feet) and nonresidential properties (8,826 square feet), respectively (Aquacraft 2011b, Statewide CASE Team 2017c). The assumed measure life is 10 years.

Measure 10 – Irrigation Audits: Based on personal communications with representatives from the California Landscape Contractors Association, the analysis team estimated total hours for conducting the audit, developing the report, and follow-up appointment for both residential and nonresidential irrigation audits. It was assumed that audits do not result in direct savings.

Total hours will vary depending on landscape size, complexity of the irrigation system, whether applicant or auditor develops audit report, and what the jurisdiction will require as part of the audit. For instance, what is required by an irrigation audit may differ if a jurisdiction requires it is consistent with the Irrigation Association’s Certified Landscape Irrigation Auditor requirements as compared to a specific EPA WaterSense labeled auditing program. Some water providers may offer irrigation audits for free. The assumed measure life is 20 years, because it is assumed that the audit takes place when the irrigation system is replaced.

Measure 11 – Indoor Water Meters: Based on the Landscape Irrigation Controllers CASE Report, the analysis assumes that nonresidential buildings use approximately 696,970 gallons of water per year (Statewide CASE Team 2017c). It was estimated that water meters would save about 14.5 percent of indoor water consumption per year (Ornaghi, Carmine, and Tonin 2017; The Guardian 2014). The amount of hot water used in each of those end uses was calculated based on an EPA breakdown of the total office building water use for bathrooms (37 percent), cooling and heating (28 percent), landscaping (22 percent), and dishwashing (13 percent). It was assumed that 50 percent of kitchen use is faucet use and 50 percent is dishwashing use and that 100 percent of water used in dishwashers is hot water. It was assumed that toilets use 1.28 gallons of water to flush and handwashing uses 0.5 gallons per minute but, since toilets do not use any hot water, nonresidential bathroom water usage was assumed to be 28 percent hot water. This, combined with the average percentage of hot water from two additional studies (Energy Commission 2014, WRF 2016), results in a total of 44,260 gallons of hot water per year in bathrooms and 71,1126 gallons of hot water per year in kitchens. The analysis assumes that the “Other” category in the Energy Commission publication represents hot water usage in cooling and heating of buildings (67 percent) and that only large buildings (those 50,000 ft² or greater) used hot water for cooling and heating (smaller buildings only used furnaces and direct expansion). Based on CBECS data, it was assumed that approximately 44 percent of buildings in California are large buildings, resulting in a total of 57,114 gallons of hot water per year in cooling and heating processes. Since results are presented for both electricity and natural gas on a per-building basis, savings are weighted by water fuel type assuming 90 percent of new construction will utilize natural gas water heating. The assumed measure life is 15 years.

Measure 12 – Cooling Towers: Due to high capital costs of Zero Liquid Discharge (ZLD) treatment systems, and the need for specially-designed cooling towers to enable the use of high total dissolved solids water operation, the analysis assumes a packaged reverse osmosis treatment system for treating cooling tower blowdown water. These systems have an installed cost of \$5-10 per gallon of daily capacity, so the analysis assumes an average of \$7.50 per gallon of daily capacity (Nall, Faia, and Sedlak 2013). It was assumed the system would be dedicated to cooling tower blowdown water reuse. Given that most of the cooling tower water use is makeup for evaporative losses (the primary heat rejection



mechanism), blowdown water reuse will not sufficiently provide all makeup water needs. If other on-site treated graywater or rainwater exists in sufficient quantities, recycled water from that treatment system can serve as cooling tower makeup water as well. It was assumed that the blowdown water treatment loop, as shown in Figure 1, would be mounted on the roof with the cooling tower and calculated piping length costs and pumping energy accordingly.

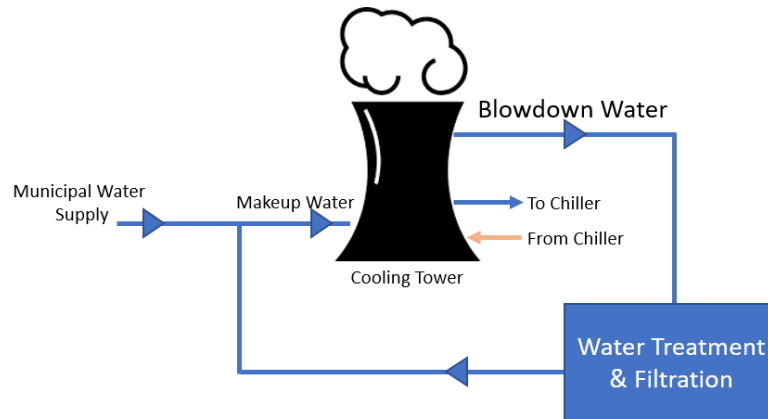


Figure 1: Assumed cooling tower blowdown treatment and reuse setup.

Source: Energy Solutions.

Cost-effectiveness was calculated for climate zones 3, 4, 6, 7, 8, 9, 10, 12, and 13 as these climate zones account for approximately 90 percent of large office buildings in the nonresidential construction forecast (Statewide CASE Team 2011). The system was assumed to be installed on the 117,000 square foot large office prototype, the same prototype used in the 2013 Cooling Tower Water Savings CASE Report. The analysis uses chiller sizing, cooling tower sizing, condenser water flow, annual cooling tower water use, and annual blowdown water use results for each climate zone from the cooling tower water use model used in the 2013 CASE Report.

As part of the analysis for the 2013 CASE Report, the authors ran energy simulations in EnergyPro to produce an annual hourly output of chiller load in each climate zone. This output was used to calculate the full load equivalent hours for the chiller on the cooling design day in each climate zone. One percent of the cooling tower flow rate was used for the flow rate of blowdown water and to calculate the design day gallons per day (gpd) of effluent through the treatment system (one percent). This value was used to size the treatment system and corresponding capital cost in each climate zone. To calculate operational energy use of the reverse osmosis treatment system, the analysis assumed an average value of 0.00114 kWh/gal of treated water (Nall, Faia, and Sedlak 2013; Laborde et al 2001) and multiplied this by the annual blowdown water in each climate zone. The reverse osmosis membrane needs to be replaced every three years, accounted for in operational costs. To calculate annual water savings, the analysis assumes a reverse osmosis treatment system recovery rate of 70 percent (Puretec 2018). The assumed measure life is 20 years.

Measure 13 – Manually Operated Toilets in Commercial Facilities: Based on a 2010 study conducted by Koeller & Company and Veritec Consulting (Gauley and Koeller 2010), the analysis assumes a 5.7 percent decrease in savings from manual flush urinals and a 54 percent increase in savings from manual flush toilets relative to sensor-operated toilets and urinals. Per unit annual water consumption for toilets and urinals were used from the 2013 Toilets and Urinals Case Report and multiplied by average number of toilets and urinals per medium-sized office building (Statewide CASE Team 2013b). While the Energy Commission prototypes do not specify number of bathrooms or plumbing fixtures, it was estimated that

there are 23 toilets and nine urinals in each 53,628 ft² 3-story medium-size office building prototype. The assumed measure life is 12 years.

Measure 14 – Commercial Kitchen Water Efficiency: All savings values for dishwashers, food steamers, combination ovens, and pulpers were pulled from the Commercial Food Service Equipment CASE Report (Statewide CASE Team 2015). The analysis does not consider costs and savings from pre-rinse spray valves as they are federally preempted with an upcoming effective date of January 19, 2018. The savings from ice makers came from the automatic commercial ice makers rulemaking (U.S. DOE 2012). It was assumed that the average commercial kitchen contains one of each of the following pieces of equipment: dishwasher, ice maker, food steamer, and combination oven. Pulpers were not assumed to be present in the average commercial kitchen due to low statewide shipments at approximately 35 units per year. The assumed measure life is 11 years.

Measure 15 – Selling Compliant Fixtures and Fittings: This measure is reiterating Title 20 requirements and therefore it is assumed that there are no associated savings.

Measure 16 – Installing Compliant Fixtures and Fittings: This measure is reiterating Title 20 requirements and therefore it is assumed that there are no associated savings.



Appendix B – Energy Utility Rate Schedules

Below are hyperlinks to the energy rates used for each utility. Detailed rate schedules are provided in subsequent sections.

Residential

- ◆ Southern California Edison
 - Electric: Schedule D. Available at: <https://www.sce.com/NR/sc3/tm2/pdf/ce12-12.pdf>
- ◆ Southern California Gas
 - Gas: Schedule GR. Available at: <https://www.socalgas.com/regulatory/tariffs/tm2/pdf/GR.pdf>
- ◆ Pacific Gas and Electric
 - Electric: Schedule E1. Available at: https://www.pge.com/tariffs/assets/pdf/tariffbook/ELEC_SCHEDS_E-1.pdf
 - Gas: Schedule G-1. Available at: https://www.pge.com/tariffs/assets/pdf/tariffbook/GAS_SCHEDS_G-1.pdf
- ◆ San Diego Gas and Electric
 - Electric: Schedule DR. Available at: <https://www.sdge.com/sites/default/files/regulatory/11-1-18%20Schedule%20DR%20Total%20Rates%20Table.pdf>
 - Gas: Schedule GR. Available at: http://regarchive.sdge.com/tm2/pdf/GAS_GAS-SCHEDS_GR.pdf

Commercial

- ◆ Southern California Edison
 - Electric: Schedule GS-2-A. Available at: <https://www.sce.com/NR/sc3/tm2/pdf/ce30-12.pdf>
- ◆ Southern California Gas
 - Gas: Schedule G-10. Available at: <https://www.socalgas.com/regulatory/tariffs/tm2/pdf/G10.pdf>
- ◆ Pacific Gas and Electric
 - Electric: Schedule A-10. Available at: <https://www.pge.com/tariffs/electric.shtml#COMMA10>
 - Gas: Schedule G-NR1. Available at: https://www.pge.com/tariffs/tm2/pdf/GAS_SCHEDS_G-NR1.pdf
- ◆ San Diego Gas and Electric
 - Electric: Schedule A Secondary. Available at: https://www.sdge.com/sites/default/files/A_3.pdf
 - Gas: Schedule GN-3. Available at: http://regarchive.sdge.com/tm2/pdf/GAS_GAS-SCHEDS_GN-3.pdf



Residential Electric Rates

Southern California Edison
Rosemead, California (U 338-E)

Revised Cal. PUC Sheet No. 64914-E
Cancelling Revised Cal. PUC Sheet No. 64474-E

Schedule D
DOMESTIC SERVICE

Sheet 2

(Continued)

RATES

	Delivery Service Total ¹	Generation ²	
		UG ³	DWREC ⁴
Energy Charge- \$/kWh/Meter/Day			
Baseline Service			
Summer	0.08942 (R)	0.08470 (I)	0.00000
Winter	0.08942 (R)	0.08470 (I)	0.00000
Nonbaseline Service*			
101% - 400% of Baseline - Summer	0.16102 (I)	0.08470 (I)	0.00000
Winter	0.16102 (I)	0.08470 (I)	0.00000
High Usage Charge			
(Over 400% of Baseline) - Summer	0.26092 (I)	0.08470 (I)	0.00000
- Winter	0.26092 (I)	0.08470 (I)	0.00000
Basic Charge - \$/Meter/Day			
Single-Family Accommodation	0.031		
Multi-Family Accommodation	0.024		
Minimum Charge** - \$/Meter/Day			
Single-Family Accommodation	0.338		
Multi-Family Accommodation	0.338		
Minimum Charge (Medical Baseline)** - \$/Meter/Day			
Single-Family Accommodation	0.169		
Multi-Family Accommodation	0.169		
California Climate Credit ⁴	(36.00)		

* Nonbaseline Service includes all kWh in excess of applicable Baseline allocations as described in Preliminary Statement, Part H, Baseline Service.

** The Minimum Charge is applicable when the Delivery Service Energy Charge, minus the DWRBC, plus the applicable Basic Charge is less than the Minimum Charge. The difference between these two amounts is the Balance of Minimum Charge and is included on a customer's bill. (P)

*** The ongoing Competition Transition Charge (CTC) of \$0.00075 per kWh is recovered in the UG component of Generation. (P)

1 Total = Total Delivery Service rates are applicable to Bundled Service, Direct Access (DA) and Community Choice Aggregation Service (CCA Service) Customers, except DA and CCA Service Customers are not subject to the DWRBC rate component of this Schedule but instead pay the DWRBC as provided by Schedule DA-CRS or Schedule CCA-CRS. (P)

2 Generation = The Generation rates are applicable only to Bundled Service Customers.

3 DWREC = Department of Water Resources (DWR) Energy Credit - For more information on the DWR Energy Credit, see the Billing Calculation Special Condition of this Schedule.

4 Applied on an equal basis, per household, semi-annually. See the Special Conditions of this Schedule for more information.

(Continued)

(To be inserted by utility)

Advice 3868-E
Decision 18-07-037

2011

Issued by
Caroline Choi
Senior Vice President

(To be inserted by Cal. PUC)

Date Submitted Sep 25, 2018
Effective Oct 1, 2018
Resolution _____





**Pacific Gas and
Electric Company®**

U 39

San Francisco, California

Revised
Cancelling Revised

Cal. P.U.C. Sheet No. 42707-E
Cal. P.U.C. Sheet No. 41845-E

**ELECTRIC SCHEDULE E-1
RESIDENTIAL SERVICES**

Sheet 1

APPLICABILITY: This schedule is applicable to single-phase and polyphase residential service in single-family dwellings and in flats and apartments separately metered by PG&E; to single-phase and polyphase service in common areas in a multifamily complex (see Special Condition 8); and to all single-phase and polyphase farm service on the premises operated by the person whose residence is supplied through the same meter.

The provisions of Schedule S—Standby Service Special Conditions 1 through 6 shall also apply to customers whose premises are regularly supplied in part (but not in whole) by electric energy from a nonutility source of supply. These customers will pay monthly reservation charges as specified under Section 1 of Schedule S, in addition to all applicable Schedule E-1 charges. See Special Conditions 11 and 12 of this rate schedule for exemptions to standby charges.

TERRITORY: This rate schedule applies everywhere PG&E provides electric service.

RATES: Total bundled service charges are calculated using the total rates below. Customers on this schedule are subject to the delivery minimum bill amount shown below applied to the delivery portion of the bill (i.e. to all rate components other than the generation rate). In addition, total bundled charges will include applicable generation charges per kWh for all kWh usage.

Customers receiving a medical baseline allowance shall pay for all usage in excess of 200 percent of baseline at a rate \$0.04000 per kWh less than the applicable rate for usage in excess of 200 percent of baseline. No portion of the rates paid by customers that receive a Medical Baseline allowance shall be used to pay the DWR Bond charge. For these customers, the Conservation Incentive Adjustment is calculated residually based on the total rate less the sum of: Transmission, Transmission Rate Adjustments, Reliability Services, Distribution, Generation, Public Purpose Programs, Nuclear Decommissioning, Competition Transition Charges (CTC), New System Generation Charges, and Energy Cost Recovery Amount. Customers receiving a medical baseline allowance shall also receive a 50 percent discount on the delivery minimum bill amount shown below.

Direct Access (DA) and Community Choice Aggregation (CCA) charges shall be calculated in accordance with the paragraph in this rate schedule titled Billing.

TOTAL RATES

Total Energy Rates (\$ per kWh)	
Baseline Usage	\$0.21536 (I)
101% - 400% of Baseline	\$0.28478 (I)
High Usage Over 400% of Baseline	\$0.44095 (I)
Delivery Minimum Bill Amount (\$ per meter per day)	\$0.32854
California Climate Credit (per household, per semi-annual payment occurring in the April and October bill cycles)	(\$39.42)

(Continued)

Advice	5339-E	Issued by	Date Filed	July 27, 2018
Decision	18-06-011	Robert S. Kenney	Effective	September 1, 2018
		Vice President, Regulatory Affairs	Resolution	



2016 Energy and Water Efficiency Ordinance Cost-Effectiveness Study

Schedule DR - RESIDENTIAL SERVICE Effective 11/1/2018

This is SDG&E's standard UDC schedule for domestic residential electric service. If you're a typical household, you're most likely on this rate.

SCHEDULE DR										Schedule DWR-BC Rate	Schedule EECC + DWR Credit Rate	Total Electric Rate	
Energy Charges (\$/kWh)		Transm	Distr	PPP	ND	CTC	LGC	RS	TRAC	UDC Total			
Summer													
Up to 130% of Baseline Energy	Tier 1	0.03622	0.09854	0.01517	(0.00005)	0.00165	0.01031	0.00004	(0.06699)	0.09489	0.00549	0.16837	0.26875
131% to 400% of Baseline	Tier 2	0.03622	0.09854	0.01517	(0.00005)	0.00165	0.01031	0.00004	0.13540	0.29728	0.00549	0.16837	0.47114
Above 400% of Baseline	HUC	0.03622	0.09854	0.01517	(0.00005)	0.00165	0.01031	0.00004	0.21320	0.37508	0.00549	0.16837	0.54894
Winter													
Up to 130% of Baseline Energy	Tier 1	0.03622	0.09854	0.01517	(0.00005)	0.00165	0.01031	0.00004	(0.00844)	0.15344	0.00549	0.06908	0.22801
131% to 400% of Baseline	Tier 2	0.03622	0.09854	0.01517	(0.00005)	0.00165	0.01031	0.00004	0.16326	0.32514	0.00549	0.06908	0.39971
Above 400% of Baseline	HUC	0.03622	0.09854	0.01517	(0.00005)	0.00165	0.01031	0.00004	0.22926	0.39114	0.00549	0.06908	0.46571
Other Charges/Discounts													
Minimum Bill		0.000	0.329	0.000	0.000	0.000	0.000	0.000	0.000	0.329			0.329
The total rates presented reflect the UDC rates associated with service under Schedule DR and the generation rates associated with Schedules EECC and DWR-BC. The UDC rate-by-rate components presented are associated with service under Schedule DR as presented in the utility's tariff book.													



Residential Gas Rates



**Pacific Gas and
Electric Company®**
U 39 San Francisco, California

Cancelling Revised
Revised

Cal. P.U.C. Sheet No. 34592-G
Cal. P.U.C. Sheet No. 34549-G

GAS SCHEDULE G-1 RESIDENTIAL SERVICE

Sheet 1

APPLICABILITY: This rate schedule¹ applies to natural gas service to Core End-Use Customers on PG&E's Transmission and/or Distribution Systems. To qualify, service must be to individually-metered single family premises for residential use, including those in a multifamily complex, and to separately-metered common areas in a multifamily complex where Schedules GM, GS, or GT are not applicable. Common area accounts that are separately metered by PG&E have an option of switching to a core commercial rate schedule. Common area accounts are those accounts that provide gas service to common use areas as defined in Rule 1.

Per D.15-10-032 and D.18-03-017, transportation rates include GHG Compliance Cost for non-covered entities. Customers who are directly billed by the Air Resources Board (ARB), i.e., covered entities, are exempt from paying AB 32 GHG Compliance Costs through PG&E's rates.² A "Cap-and-Trade Cost Exemption" credit for these costs will be shown as a line item on exempt customers' bills.^{3, 4}

TERRITORY: Schedule G-1 applies everywhere within PG&E's natural gas Service Territory.

RATES: Customers on this schedule pay a Procurement Charge and a Transportation Charge, per meter, as shown below. The Transportation Charge will be no less than the Minimum Transportation Charge, as follows:

Minimum Transportation Charge:⁵

	<u>Per Day</u>	
	\$0.09863	
	<u>Per Therm</u>	
	<u>Baseline</u>	<u>Excess</u>
<u>Procurement:</u>	\$0.35368 (I)	\$0.35368 (I)
<u>Transportation Charge:</u>	\$0.93438	\$1.49502
Total:	\$1.28806 (I)	\$1.84870 (I)
California Natural Gas Climate Credit (per Household, annual payment occurring in October 2018 bill cycle, and thereafter in the April bill cycle)	(\$29.85)	

Public Purpose Program Surcharge:

Customers served under this schedule are subject to a gas Public Purpose Program (PPP) Surcharge under Schedule G-PPPS.

See Preliminary Statement, Part B for the Default Tariff Rate Components.

The Procurement Charge on this schedule is equivalent to the rate shown on informational Schedule G-CP—Gas Procurement Service to Core End-Use Customers.

¹ PG&E's gas tariffs are available online at www.pge.com.

² Covered entities are not exempt from paying costs associated with LUAF Gas and Gas used by Company Facilities.

³ The exemption credit will be equal to the effective non-exempt AB 32 GHG Compliance Cost Rate (\$ per therm) included in Preliminary Statement – Part B, multiplied by the customer's billed volumes (therms) for each billing period.

⁴ PG&E will update its billing system annually to reflect newly exempt or newly excluded customers to conform with lists of Directly Billed Customers provided annually by the ARB.

⁵ The Minimum Transportation charge does not apply to submetered tenants of master-metered customers served under gas rate Schedules GS and GT.

(Continued)

Advice	4034-G	Issued by	Submitted	October 25, 2018
Decision	97-10-065 and D.98-07-025	Robert S. Kenney Vice President, Regulatory Affairs	Effective	November 1, 2018
			Resolution	



SOUTHERN CALIFORNIA GAS COMPANY Revised CAL. P.U.C. SHEET NO. 55635-G
 LOS ANGELES, CALIFORNIA CANCELING Revised CAL. P.U.C. SHEET NO. 55601-G

Schedule No. GR
RESIDENTIAL SERVICE
 (Includes GR, GR-C and GT-R Rates)

Sheet 1

APPLICABILITY

The GR rate is applicable to natural gas procurement service to individually metered residential customers.

The GR-C, cross-over rate, is a core procurement option for individually metered residential core transportation customers with annual consumption over 50,000 therms, as set forth in Special Condition 10.

The GT-R rate is applicable to Core Aggregation Transportation (CAT) service to individually metered residential customers, as set forth in Special Condition 11.

The California Alternate Rates for Energy (CARE) discount of 20%, reflected as a separate line item on the bill, is applicable to income-qualified households that meet the requirements for the CARE program as set forth in Schedule No. G-CARE.

TERRITORY

Applicable throughout the service territory.

RATES

	<u>GR</u>	<u>GR-C</u>	<u>GT-R</u>
<u>Customer Charge</u> , per meter per day:	16.438¢	16.438¢	16.438¢

For "Space Heating Only" customers, a daily Customer Charge applies during the winter period from November 1 through April 30 ^{1/} :			
.....	33.149¢	33.149¢	33.149¢

Baseline Rate, per therm (baseline usage defined in Special Conditions 3 and 4):

Procurement Charge: ^{2/}	35.980¢	35.980¢	N/A
<u>Transmission Charge</u> : ^{3/}	<u>54.841¢</u>	<u>54.841¢</u>	<u>54.991¢</u>
Total Baseline Charge:	90.821¢	90.821¢	54.991¢

Non-Baseline Rate, per therm (usage in excess of baseline usage):

Procurement Charge: ^{2/}	35.980¢	35.980¢	N/A
<u>Transmission Charge</u> : ^{3/}	<u>87.852¢</u>	<u>87.852¢</u>	<u>88.002¢</u>
Total Non-Baseline Charge:	123.832¢	123.832¢	88.002¢

^{1/} For the summer period beginning May 1 through October 31, with some exceptions, usage will be accumulated to at least 20 Ccf (100 cubic feet) before billing.

(Footnotes continue next page.)

(Continued)

(TO BE INSERTED BY UTILITY)

ADVICE LETTER NO. 5379

DECISION NO.

ICS

ISSUED BY

Dan Skopec

Vice President

Regulatory Affairs

(TO BE INSERTED BY CAL. PUC)

SUBMITTED Nov 8, 2018

EFFECTIVE Nov 10, 2018

RESOLUTION NO. G-3351





San Diego Gas & Electric Company
San Diego, California

Revised Cal. P.U.C. Sheet No. 23514-G
Canceling Revised Cal. P.U.C. Sheet No. 23501-G

SCHEDULE GR

Sheet 1

RESIDENTIAL NATURAL GAS SERVICE (Includes Rates for GR, GR-C, GTC/GTCA)

APPLICABILITY

The GR rate is applicable to natural gas procurement service for individually metered residential customers.

The GR-C, cross-over rate, is a core procurement option for individually metered residential core transportation customers with annual consumption over 50,000 therms, as set forth in Special Condition 10.

The GTC/GTCA rate is applicable to intrastate gas transportation-only services to individually metered residential customers, as set forth in Special Condition 11.

Customers taking service under this schedule may be eligible for a 20% California Alternate Rate for Energy (CARE) program discount, reflected as a separate line item on the bill, if they qualify to receive service under the terms and conditions of Schedule G-CARE.

TERRITORY

Within the entire territory served natural gas by the utility.

RATES

	<u>GR</u>	<u>GR-C</u>	<u>GTC/GTCA^{1/}</u>
<u>Baseline Rate</u> , per therm (baseline usage defined in Special Conditions 3 and 4):			
Procurement Charge: ^{2/}	\$0.36001	\$0.36001 I	N/A
Transmission Charge:	<u>\$0.87416</u>	<u>\$0.87416</u>	<u>\$0.87416</u>
Total Baseline Charge:	\$1.23417	\$1.23417 I	\$0.87416
<u>Non-Baseline Rate</u> , per therm (usage in excess of baseline usage):			
Procurement Charge: ^{2/}	\$0.36001	\$0.36001 I	N/A
Transmission Charge:	<u>\$1.05166</u>	<u>\$1.05166</u>	<u>\$1.05166</u>
Total Non-Baseline Charge:	\$1.41167	\$1.41167 I	\$1.05166
<u>Minimum Bill</u> , per day: ^{3/}			
Non-CARE customers:	\$0.09863	\$0.09863	\$0.09863
CARE customers:	\$0.07890	\$0.07890	\$0.07890

^{1/} The rates for core transportation-only customers, with the exception of customers taking service under Schedule GT-NGV, include any FERC Settlement Proceeds Memorandum Account (FSPMA) credit adjustments.

^{2/} This charge is applicable to Utility Procurement Customers and includes the GPC and GPC-A Procurement Charges shown in Schedule GPC which are subject to change monthly as set forth in Special Condition 7.

^{3/} Effective starting May 1, 2017, the minimum bill is calculated as the minimum bill charge of \$0.09863 per day times the number of days in the billing cycle (approximately \$3 per month) with a 20% discount applied for CARE customer resulting in a minimum bill charge of \$0.07890 per day (approximately \$2.40 per month).

(Continued)

1CS
Advice Ltr. No. 2719-G
Decision No.

Issued by
Dan Skopec
Vice President
Regulatory Affairs

Submitted Nov 8, 2018
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Resolution No.



Commercial Electric Rates



Southern California Edison
Rosemead, California (U 338-E)

Revised Cal. PUC Sheet No. 64951-E
Cancelling Revised Cal. PUC Sheet No. 64511-E

Schedule GS-2
GENERAL SERVICE - DEMAND

Sheet 2

(Continued)

RATES

	Delivery Service							Generation ⁹	
	Trans ¹	Distrib ²	NSGC ³	NDC ⁴	PPPC ⁵	DWRBC ⁶	PUCRF ⁷	UG ^{**}	DWREC ¹⁰
Net TOU									
Energy Charge - \$/kWh/Meter/Month									
Summer	(0.00172)	0.00254	0.00513	0.00005	0.01072 (I)	0.00549	0.00046	0.02267 (I)	0.05945 (I) 0.00000
Winter	(0.00172)	0.00254	0.00513	0.00005	0.01072 (I)	0.00549	0.00046	0.02267 (I)	0.05942 (I) 0.00000
Customer Charge - \$/Meter/Month		231.17							231.17
Facilities Related Demand Charge - \$/kW	4.20	11.58							15.78
Summer Time Related Demand Charge - \$/kW		0.00						0.00	20.73 (I)
Single Phase Service - \$/Month		(14.88)						(14.88)	
Voltage Discount, Demand - \$/kW									
Facilities Related									
From 2 kV to 50 kV	0.00	(0.21)						(0.21)	
Above 50 kV but below 220 kV	0.00	(6.44)						(6.44)	
At 220 kV	0.00	(11.16)						(11.16)	
Time Related									
From 2 kV to 50 kV		0.00						0.00	(0.55) (P)
Above 50 kV but below 220 kV		0.00						0.00	(1.52) (P)
At 220 kV		0.00						0.00	(1.54) (P)
Voltage Discount, Energy - \$/kWh									
From 2 kV to 50 kV	0.00000	0.00000						0.00000	(0.00099) (P)
Above 50 kV but below 220 kV	0.00000	0.00000						0.00000	(0.00227) (P)
At 220 kV	0.00000	0.00000						0.00000	(0.00229) (P)
California Alternate Rates for Energy Discount - %		100.00*							100.00*
California Climate Credit - \$/kWh		(0.00484)						(0.00484)	

* Represents 100% of the discount percentage as shown in the applicable Special Condition of this Schedule.

** The ongoing Competition Transition Charge (CTC) of \$0.00063 per kWh is recovered in the UG component of Generation. (P)

1 Trans = Transmission and the Transmission Owners Tariff Charge Adjustments (TOTCA) which are FERC approved. The TOTCA represents the Transmission Revenue Balancing Account Adjustment (TRBAA) of \$(0.00144) per kWh, Reliability Services Balancing Account Adjustment (RSBAA) of \$0.00005 per kWh, and Transmission Access Charge Balancing Account Adjustment (TACBAA) of \$(0.00033) per kWh.

2 Distribn = Distribution

3 NSGC = New System Generation Charge

4 NDC = Nuclear Decommissioning Charge

5 PPPC = Public Purpose Programs Charge (includes California Alternate Rates for Energy Surcharge where applicable.)

6 DWRBC = Department of Water Resources (DWR) Bond Charge. The DWR Bond Charge is not applicable to exempt Bundled Service and Direct Access Customers, as defined in and pursuant to D.02-10-063, D.02-02-051, and D.02-12-052.

7 PUCRF = The PUC Reimbursement Fee is described in Schedule RF-E.

8 Total = Total Delivery Service rates are applicable to Bundled Service, Direct Access (DA) and Community Choice Aggregation Service (CCA Service) Customers, except DA and CCA Service Customers are not subject to the DWRBC rate component of this Schedule but instead pay the DWRBC as provided by Schedule DA-CRS or Schedule CCA-CRS.

9 Generation = The Generation rates are applicable only to Bundled Service Customers.

10 DWREC = Department of Water Resources (DWR) Energy Credit - For more information on the DWR Energy Credit, see the Billing Calculation Special Condition of this Schedule.

(Continued)

(To be inserted by utility)

Advice 3868-E

Decision 18-07-037

2010

Issued by

Caroline Choi
Senior Vice President

(To be inserted by Cal. PUC)

Date Submitted Sep 25, 2018

Effective Oct 1, 2018

Resolution





**Pacific Gas and
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U 39

San Francisco, California

Revised
Cancelling Revised

Cal. P.U.C. Sheet No. 42686-E
Cal. P.U.C. Sheet No. 41812-E

ELECTRIC SCHEDULE A-10
MEDIUM GENERAL DEMAND-METERED SERVICE

Sheet 3

RATES: Standard Non-Time-of-Use Rate

Table A

	TOTAL RATES		
	Secondary Voltage	Primary Voltage	Transmission Voltage
<u>Total Customer/Meter Charge Rates</u>			
Customer Charge (\$ per meter per day)	\$4.59959	\$4.59959	\$4.59959
Optional Meter Data Access Charge (\$ per meter per day)	\$0.98563	\$0.98563	\$0.98563
<u>Total Demand Rates (\$ per kW)</u>			
Summer	\$19.85 (I)	\$18.85 (I)	\$13.00 (I)
Winter	\$11.96 (I)	\$12.26 (I)	\$9.31 (I)
<u>Total Energy Rates (\$ per kWh)</u>			
Summer	\$0.17113 (I)	\$0.15972 (I)	\$0.12518 (I)
Winter	\$0.13174 (I)	\$0.12691 (I)	\$0.10488 (I)

Total bundled service charges shown on customers' bills are unbundled according to the component rates shown below.

(Continued)

Advice	5339-E	Issued by	Date Filed	July 27, 2018
Decision	18-06-011	Robert S. Kenney	Effective	September 1, 2018
		Vice President, Regulatory Affairs	Resolution	



Customer Rate Information

Schedule A Secondary



Applicability:

Applicable to general service including lighting, appliances, heating, and power, or any combination thereof, including common use. This schedule is not applicable to residential customers, except for those three-phase residential customers taking service on this schedule as of April 12, 2007 who may remain on this schedule while service continues in their name at the same service address. Those three-phase residential customers remaining on this schedule who choose to switch to a residential rate schedule may not return to this schedule. This schedule is not applicable to any customer whose Maximum Monthly Demand equals, exceeds, or is expected to equal or exceed 20 kW for 12 consecutive months. When demand metering is not available, the monthly consumption cannot equal or exceed 12,000 kWh per month for 12 consecutive months. This schedule is the utility's standard tariff for commercial customers with a demand less than 20 kW.

Rates Effective 01/01/2016:

Secondary customers who receive metered electric service after the voltage has been reduced from SDG&E's distribution level.

Basic Service Fee (\$/Mth):

	Transm	Distr	PPP	ND	CTC	LGC	RS	TRAC	GHG	UDC Total
0-5 kW	0.00	7.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.00
5-20 kW	0.00	12.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	12.00
20-50 kW	0.00	20.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	20.00
>50 kW	0.00	50.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	50.00

Energy Charge (\$/kWh):

Summer:	0.03077	0.07307	0.01609	0.00052	0.00156	0.00040	0.00014	0.00000	0.00000	0.12285
Winter:	0.03077	0.07307	0.01609	0.00052	0.00156	0.00040	0.00014	0.00000	0.00000	0.12285

Notes: Transmission Energy charges include the Transmission Revenue Balancing Account Adjustment (TRBAA) of \$(0.00060) per kWh and the Transmission Access Charge Balancing Account Adjustment (TACBAA) of \$(0.01359) per kWh. PPP rate is composed of: Low Income PPP rate (LI-PPP) \$0.00709 /kWh, Non-low Income PPP rate (Non-LI-PPP) \$0.00061 /kWh (pursuant to PU Code Section 399.8, the Non-LI-PPP rate may not exceed January 1, 2000 levels), and Procurement Energy Efficiency Surcharge Rate of \$0.00611/kWh.

Commodity Rates - EECC (\$/kWh): (Eff. 01/01/2016)

Summer:	0.11707	Winter:	0.06051
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The Electric Energy Commodity Cost known as the EECC price that is passed through to customers who purchase their commodity from SDG&E is not included in the above UDC rates.

DWR Credit - \$/kWh:	(0.00021)
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Dept. of Water Resources Bond Charge (DWR-BC): (Eff. 01/01/2016)

Energy Rate - \$/kWh:	0.00539
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This schedule is applicable to all electric commodity customers, excluding customers receiving discounts under the California Alternate Rates for Energy (CARE) Program and customers receiving a medical baseline allowance.

Commercial questions? Please contact our Business Contact Center at 1-800-336-7343



Commercial Gas Rates

SOUTHERN CALIFORNIA GAS COMPANY Revised CAL. P.U.C. SHEET NO. 46445-G
 LOS ANGELES, CALIFORNIA CANCELING Revised CAL. P.U.C. SHEET NO. 46215-G
 43002-G

Schedule No. G-10

Sheet 1

CORE COMMERCIAL AND INDUSTRIAL SERVICE
(Includes GN-10, GN-10C and GT-10 Rates)

APPLICABILITY

Applicable to core non-residential natural gas service, including both procurement service (GN rates) and transportation-only service (GT rates) including Core Aggregation Transportation (CAT). This schedule is also available to residential customers with separately metered service to common facilities (swimming pools, recreation rooms, saunas, spas, etc.) only and otherwise eligible for service under rates designated for GM-C, GM-CC, GM-BC, GM-BCC, GT-MC or GT-MBC, as appropriate, if so elected by the customer. Also applicable to service not provided under any other rate schedule. Pursuant to D.02-08-065, this schedule is not available to those electric generation, refinery, and enhanced oil recovery customers that are defined as ineligible for core service in Rule No. 23.B.

The California Alternate Rates for Energy (CARE) discount of 20%, reflected as a separate line item on the bill, is applicable to Nonprofit Group Living Facilities and Qualified Agricultural Employee Housing Facilities (migrant farmworker housing centers, privately owned employee housing, and agricultural employee housing operated by nonprofit entities) that meet the requirements for the CARE as set forth in Schedule No. G-CARE.

TERRITORY

Applicable throughout the service territory.

RATES**Customer Charge**

Per meter, per day:

All customers except	
"Space Heating Only"	49.315¢
"Space Heating Only" customers:	
Beginning Dec. 1 through Mar. 31	\$1.48760
Beginning Apr. 1 through Nov. 30	None

(Continued)

(TO BE INSERTED BY UTILITY)

ADVICE LETTER NO. 4152

DECISION NO. 98-07-068

1C11

ISSUED BY

Lee SchavrienSenior Vice President
Regulatory Affairs

(TO BE INSERTED BY CAL. PUC)

DATE FILED Sep 30, 2010

EFFECTIVE Oct 1, 2010

RESOLUTION NO. _____



SOUTHERN CALIFORNIA GAS COMPANY Revised CAL. P.U.C. SHEET NO. 55640-G
 LOS ANGELES, CALIFORNIA CANCELING Revised CAL. P.U.C. SHEET NO. 55608-G

Schedule No. G-10
CORE COMMERCIAL AND INDUSTRIAL SERVICE
 (Includes GN-10, GN-10C and GT-10 Rates)

Sheet 2

(Continued)

RATES (Continued)

All Procurement, Transmission, and Commodity Charges are billed per therm.

		<u>Tier I^{1/}</u>	<u>Tier II^{1/}</u>	<u>Tier III^{1/}</u>	
<u>GN-10^{6/}</u>	Applicable to natural gas procurement service to non-residential core customers, including service not provided under any other rate schedule.				
Procurement Charge: ^{2/}	G-CPNR	35.980¢	35.980¢	35.980¢	
Transmission Charge:	GPT-10	55.413¢	30.219¢	13.327¢	
Commodity Charge:	GN-10	91.393¢	66.199¢	49.307¢	
<u>GN-10C^{6/}</u>	Core procurement service for previous non-residential transportation-only customers returning to core procurement service, including CAT customers with annual consumption over 50,000 therms, as further defined in Schedule No. G-CP.				
Procurement Charge: ^{2/}	G-CPNRC	35.980¢	35.980¢	35.980¢	I,I,I
Transmission Charge:	GPT-10	55.413¢	30.219¢	13.327¢	
Commodity Charge:	GN-10C	91.393¢	66.199¢	49.307¢	I,I,I
<u>GT-10^{4/6/}</u>	Applicable to non-residential transportation-only service including CAT service, as set forth in Special Condition 13.				
Transmission Charge:	GT-10	55.563¢ ^{3/}	30.369¢ ^{3/}	13.477¢ ^{3/}	

^{1/} Tier I rates are applicable for the first 250 therms used per month. Tier II rates are applicable for usage above Tier I quantities and up through 4,167 therms per month. Tier III rates are applicable for all usage above 4,167 therms per month. Under this schedule, the winter season shall be defined as December 1 through March 31 and the summer season as April 1 through November 30.

^{2/} This charge is applicable for service to Utility Procurement Customers as shown in Schedule No. G-CP, in the manner approved by D.96-08-037, and subject to change monthly, as set forth in Special Condition 5.

^{3/} These charges are equal to the core commodity rate less the following two components as approved in D.97-04-082: (1) the weighted average cost of gas; and (2) the core brokerage fee.

^{4/} CAT Transmission Charges include a 0.150 cents per therm debit to amortize an undercollection in the FERC Settlement Proceeds Memorandum Account during 2018 as authorized in Advice No. 5202 approved on December 18, 2017.

(Footnotes continue next page.)

(Continued)

(TO BE INSERTED BY UTILITY)
 ADVICE LETTER NO. 5379
 DECISION NO.
 2018

ISSUED BY
Dan Skopec
 Vice President
 Regulatory Affairs

(TO BE INSERTED BY CAL. PUC)
 SUBMITTED Nov 8, 2018
 EFFECTIVE Nov 10, 2018
 RESOLUTION NO. G-3351





**Pacific Gas and
Electric Company®**

U 39

San Francisco, California

Revised
Cancelling Revised

Cal. P.U.C. Sheet No. 34596-G
Cal. P.U.C. Sheet No. 34553-G

GAS SCHEDULE G-NR1
GAS SERVICE TO SMALL COMMERCIAL CUSTOMERS

Sheet 2

RATES (CONT):

	<u>0 – 5.0</u>		<u>5.1 to 16.0</u>		<u>ADU (Therms)</u> <u>16.1 to 41.0</u>		<u>41.1 to 123.0</u>		<u>123.1 & Up</u>	
Customer Charge: (per day)	\$0.27048		\$0.52106		\$0.95482		\$1.66489		\$2.14936	
					<u>Per Therm</u>					
			<u>Summer</u>				<u>Winter</u>			
	<u>First 4,000 Therms</u>		<u>Excess</u>		<u>First 4,000 Therms</u>		<u>Excess</u>			
Procurement Charge:	\$0.33687	(I)	\$0.33687	(I)	\$0.33687	(I)	\$0.33687	(I)	\$0.33687	(I)
Transportation Charge:	\$0.65673		\$0.40291		\$0.77013		\$0.47248			
Total:	\$0.99360	(I)	\$0.73978	(I)	\$1.10700	(I)	\$0.80935	(I)		

Cap-and-Trade Cost Exemption (per therm): **\$0.02600**

The Cap-and-Trade Cost Exemption is applicable to customers who are identified by the California Air Resources Board (CARB) as being Covered Entities for their Greenhouse Gas (GHG) emissions as part of the Cap-and-Trade program. Applicable Cap-and-Trade Cost Exemptions may be provided from the date CARB identifies a customer as being a Covered Entity, or provided based upon documentation satisfactory to the Utility for the time period for which the customer was a Covered Entity, whichever is earlier.

Public Purpose Program Charge: Customers served under this schedule are subject to a gas Public Purpose Program (PPP) Surcharge under Schedule G-PPPS.

See Preliminary Statement, Part B for the Default Tariff Rate Components.

The Procurement Charge on this schedule is equivalent to the rate shown on informational Schedule GCP—
Gas Procurement Service to Core End-Use Customers.

SEASONS: The Summer Season begins April 1 and ends on October 31. The Winter Season begins November 1 and ends on March 31.

CARE DISCOUNT FOR QUALIFIED FACILITIES: Facilities which meet the eligibility criteria in Rules 19.2 or 19.3 are eligible for a California Alternate Rates for Energy (CARE) Discount under Schedule G-CARE.

(Continued)

Advice	4034-G	Issued by	Submitted	<u>October 25, 2018</u>
Decision	97-10-065 and D.98-07-025	Robert S. Kenney Vice President, Regulatory Affairs	Effective	<u>November 1, 2018</u>
			Resolution	





San Diego Gas & Electric Company
San Diego, California

Revised Cal. P.U.C. Sheet No. 18445-G
Canceling Revised Cal. P.U.C. Sheet No. 18058-G

SCHEDULE GN-3

Sheet 1

NATURAL GAS SERVICE FOR CORE NON-RESIDENTIAL CUSTOMERS (Includes Rates for GN-3, GN-3C, GN-3/GTC and GN-3/GTCA)

APPLICABILITY

Applicable to core nonresidential natural gas service, including both procurement service and transportation-only service including Core Aggregation Transportation (CAT). Also applicable to service not provided under any other rate schedule. This schedule is not available to electric generation customers who generator's rated capacity exceeds one megawatt, refinery customers, and enhanced oil recovery customers, whose gas consumption exceeds 250,000 therms per year.

The GN-3 rate is applicable to natural gas procurement and transportation service to nonresidential core customers and to separately metered, common area use service to residential detached homes. This schedule is optionally available to customers with separately metered, common area use service to residential, multi-family accommodations, as defined in Rule 1.

The GN-3C cross-over rate is a core procurement service for previous transportation-only customers returning to core procurement service customers with annual consumption over 50,000 therms, as set forth in Special Condition 8.

The GN-3/GTC (GTC) and GN-3/GTCA (GTCA) rates are applicable to intrastate gas transportation-only services as set forth in Special Conditions 9-14.

Non-profit group living facilities taking service under this schedule may be eligible for a 20% low-income rate discount on their bill, if such facilities qualify to receive service under the terms and conditions of Schedule G-CARE.

Agricultural Employee Housing Facilities, as defined in Schedule G-CARE, may qualify for a 20% CARE discount on the bill if all eligibility criteria set forth in Form 142-4032 or Form 142-4035 is met.

TERRITORY

Within the entire territory served natural gas by the Utility.

RATES

	<u>GN-3</u>	<u>GN-3-C</u>	<u>GTC/GTCA</u>
<u>Customer charges</u> , \$ per meter per month:	\$10.00	\$10.00	\$10.00

(Continued)

1C11

Advice Ltr. No. 1980-G
Decision No. _____

Issued by
Lee Schavrien
Senior Vice President
Regulatory Affairs

Date Filed Oct 15, 2010
Effective Nov 14, 2010
Resolution No. _____

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San Diego Gas & Electric Company
San Diego, California

Revised Cal. P.U.C. Sheet No. 23517-G
Canceling Revised Cal. P.U.C. Sheet No. 23504-G

SCHEDULE GN-3

Sheet 2

NATURAL GAS SERVICE FOR CORE NON-RESIDENTIAL CUSTOMERS (Includes Rates for GN-3, GN-3C, GN-3/GTC and GN-3/GTCA)

RATES (continued)

Volumetric charges, \$ per therm:

	<u>GN-3</u>	<u>GN-3C</u>	<u>GTC/GTCA²</u>
Procurement Charge (0 to 1,000)	\$0.36001	\$0.36001 I	N/A
<u>Transportation Charge</u>	<u>\$0.33296</u>	<u>\$0.33296</u>	<u>\$0.33296</u>
Total Charge	\$0.69297	\$0.69297 I	\$0.33296
Procurement Charge (1,001 to 21,000)	\$0.36001	\$0.36001 I	N/A
<u>Transportation Charge</u>	<u>\$0.20095</u>	<u>\$0.20095</u>	<u>\$0.20095</u>
Total Charge	\$0.56096	\$0.56096 I	\$0.20095
Procurement Charge (Over 21,000)	\$0.36001	\$0.36001 I	N/A
<u>Transportation Charge</u>	<u>\$0.16366</u>	<u>\$0.16366</u>	<u>\$0.16366</u>
Total Charge	\$0.52367	\$0.52367 I	\$0.16366

² The rates for core transportation-only customers, with the exception of customers taking service under Schedule GT-NGV, include any FERC Settlement Proceeds Memorandum Account (FSPMA) credit adjustments.

Standby Service Fee for GTC/GTCA Customers

Per decatherm \$10

This fee shall be assessed to customers only during curtailments of transportation services to firm noncore customers. This fee will apply only to the difference between the customer's nominations and their confirmed deliveries.

The customer's storage volumes, if available, may be used to offset the standby service fee. Revenues collected from this fee shall be credited to the Utility's Non-Margin Fixed Cost Account (NMFCA). Curtailments of standby services provided to core customers are described in Rule 14.

GTC/GTCA customers who receive service under this schedule shall also be eligible for standby services ahead of such services offered to noncore customers, including core subscription customers.

Billing adjustments may be necessary to reflect changes in volumes used in developing prior periods' transportation charges.

(Continued)

205

Advice Ltr. No. 2719-G
Decision No. _____

Issued by
Dan Skopec
Vice President
Regulatory Affairs

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Effective Nov 10, 2018
Resolution No. _____



Appendix C – Water and Wastewater Rates

Water rates vary significantly across the state of California and even within individual building climate zones. The 2018 potable water rates used in the analysis are based on residential water rate data from a Black & Veatch study that includes the eight largest cities in California (Black & Veatch 2016). This data was weighted by the number of single family homes in each city based on data from the California Department of Finance (2018). About 30 percent of Californians live in one of the eight cities, and the consultants authoring this report assumed that rates for these cities are representative of rates throughout the state. It was assumed that a typical customer with irrigation uses 11,000 gallons per month as a baseline (Aquacraft 2011b) and the 7,500–15,000 gallons per month rate tier would apply to water saved by this measure. The estimate only considers the variable portion of the residential potable water bill and does not include fixed charges that occur regardless of the amount of water consumption. Costs in 2016 were escalated to 2018 rates using Black & Veatch annual increases. The commercial rates are based on data from the 2008 American Water Works Association Water and Wastewater Survey using values from the western region, converted to \$2018 (Raftelis 2008).

To determine the statewide average wastewater rates, average volumetric residential wastewater rates of \$6.44 per 1000 gallons were calculated based on the data for the four California cities that were listed with volumetric (volume-related) wastewater (Black & Veatch 2016). Thirty percent of California residents pay a volumetric wastewater rate, which is typically linked to the potable water meter (Chesnutt 2011). The average wastewater rate in cities were multiplied with volumetric rates (assuming the same baseline water usage noted above) by 0.30 resulting in an average state-wide residential volumetric wastewater cost of \$1.54 for 2018.⁷ The 2009 commercial wastewater rates were derived from cost data that assumes customers use 100,000 gallons per month and converted to \$2018.

Recycled water rates are assumed to be 90 percent of potable rates based on common non-tiered pricing structure for both northern and southern California water agencies (NBS 2016).

Table 27 lists the estimated water costs to consumers in each city and the number of single family houses in each city in 2016 dollars from Black & Veatch. No potable water or wastewater rate escalation past 2018 is assumed (conservative assumption).

Table 27: Residential Water and Wastewater Costs (in \$2016)

	Fresno	Long Beach	Los Angeles	Oakland	Sacramento	San Diego	San Francisco	San Jose
Number of single family detached homes	105,031	74,394	557,495	73,991	113,494	237,084	65,783	175,614
Incremental Res Water Cost (\$/1000gal)	\$1.81	\$4.84	\$7.48	\$6.92	\$0.00	\$9.01	\$11.76	\$2.24
Incremental Res Wastewater Cost (\$/1000gal)	\$0.00	\$0.53	\$5.05	\$0.00	\$0.53	\$5.08	\$14.80	\$0.00

⁷ Wasted irrigation water, about 50 percent of flow rate for spray sprinkler bodies (AWE 2016), may be lost to runoff to sanitary sewers, storm sewers, surface water, or deep percolation. The cost avoided from reduced runoff to sanitary sewers and stormwater collection systems or surface waters were not quantified in this analysis because the Energy Commission determines cost-effectiveness from a consumer cost perspective.



Appendix D – Embedded Electricity Usage Methodology

The following embedded electricity in water values were used in this analysis: 4,848 kilowatts (kWh)/million gallons of water (MG) for indoor water use and 3,565 kWh/MG for outdoor water use. Embedded electricity use for indoor water use includes electricity used for water extraction, conveyance, treatment to potable quality, water distribution, wastewater collection, and wastewater treatment. Embedded electricity for outdoor water use includes all energy uses upstream of the customer; it does not include wastewater collection or wastewater treatment. The embedded electricity values do not include on-site energy uses for water, such as on-site pumping. On-site energy impacts are accounted for in the energy savings estimates presented in this report.

These embedded electricity values were derived from research conducted for CPUC Rulemaking 13-12-011 (CPUC 2013). The CPUC study aimed to quantify the embedded electricity savings associated with IOU incentive programs that result in water savings, and the findings represent the most up-to-date research by CPUC on embedded energy in water throughout California (CPUC 2015a, 2015b). The CPUC analysis was limited to evaluating the embedded electricity in water and does not include embedded natural gas in water. Since accurate estimates of the embedded natural gas in water were not available at the time of writing, this report does not include estimates of embedded natural gas savings associated with water reductions.

The CPUC embedded electricity values used in the report are shown in Figure 2. These values represent the average energy intensity by hydrologic region, which are based on the historical supply mix for each region regardless of who supplied the electricity (IOU supplied and non-IOU supplied). The CPUC calculated the energy intensity of marginal supply but recommended using the average IOU and non-IOU energy intensity to estimate total statewide average embedded electricity of water use in California.

Region	Extraction, Conveyance, and Treatment	Distribution	Wastewater Collection + Treatment	Outdoor (Upstream of Customer)	Indoor (All Components)
NC	235	163	418	398	816
SF	375	318	418	693	1,111
CC	513	163	418	677	1,095
SC	1,774	163	418	1,937	2,355
SR	238	18	418	255	674
SJ	279	18	418	297	715
TL	381	18	418	399	817
NL	285	18	418	303	721
SL	837	163	418	1,000	1,418
CR	278	18	418	296	714

Hydrologic Region Abbreviations:

NC = North Coast, SF = San Francisco Bay, CC = Central Coast, SC = South Coast, SR = Sacramento River, SJ = San Joaquin River, TL = Tulare Lake, NL = North Lahontan, SL = South Lahontan, CR = Colorado River

Source: Navigant team analysis

Figure 2: Embedded electricity in water by California Department of Water Resources hydrologic region (kWh per acre foot (AF)).

Source: CPUC 2015b.

CPUC indoor and outdoor embedded electricity estimates by hydrologic region and population data from the U.S. Census Bureau (separated by hydrologic region) were used to calculate the statewide population-weighted average indoor and outdoor embedded electricity values that were used in this report (see Table 28). The energy intensity values presented in Table 28 were converted from kWh per



acre foot to kWh per million gallons to harmonize with the units used in this report. There are 3.07 acre feet per million gallons.

Table 28: Statewide Population-Weighted Average Embedded Electricity in Water

Hydrologic Region	Outdoor Water Use (kWh/MG)	Indoor Water Use (kWh/MG)	Percent of California Population
North Coast	1,221	2,504	2.1%
San Francisco	2,127	3,410	18.2%
Central Coast	2,078	3,360	3.8%
South Coast	5,944	7,227	44.8%
Sacramento River	783	2,068	8.1%
San Joaquin River	911	2,194	4.7%
Tulare Lake	1,224	2,507	6.3%
North Lahontan	930	2,213	0.1%
South Lahontan	3,069	4,352	5.5%
Colorado River	908	2,191	6.5%
Statewide Population-weighted Average	3,565	4,848	

^{a,b} Source: CPUC 2015b.

^c Source: U.S. Census Bureau 2014 and California Department of Conservation 2007.

