Sustainability Roadmap 2018-2019

Progress Report and Plan Update
on Meeting the Governor's Sustainability Goals
for State Departments

Caltrans

Edmund G. Brown Jr., Governor

March 2018

Caltrans Sustainability Roadmap 2018-2019

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Message from the Director

I am pleased to present the California Department of Transportation's (Caltrans) Sustainability Roadmap for 2018-2019, a progress report and action plan for implementing Executive Orders B-16-12, B-18-12, and B-30-15.

Caltrans has celebrated many sustainability milestones in the past two years, including decreased water and energy use, adding zero-emission vehicles to its fleet, and taking steps to maintain a healthy indoor environment at its facilities. In addition, thousands of inefficient lighting systems have been replaced with light-emitting diode (LED) lighting along the highway and in our buildings. The use of onsite solar power at facilities across the state has expanded; and, we're in the midst of a massive two-year effort to assess Caltrans' vulnerability to the effects of climate change.

As steward of more than 50,000 highway lane-miles and operator of more than 500 buildings, Caltrans has a great impact on the state's natural resources. Nearly forty percent of all greenhouse gas emissions in California come from vehicle emissions, not including emissions from construction materials and Caltrans facilities. Caltrans has a responsibility to continue reducing its carbon footprint and adopting sustainable practices while maintaining and operating the State Highway System.

Caltrans' mission is to "provide a safe, sustainable, integrated and efficient transportation system to enhance California's economy and livability." Sustainability, livability, and economy are goals in the Caltrans Strategic Management Plan, with targets for integrating sustainability practices into Caltrans' daily activities.

Caltrans will continue working towards Department and Administration sustainability targets. We look forward to continued progress.

Sincerely,

Laurie Berman
Director, Caltrans
March 2018

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Acronyms

AB	Assembly Bill
ADR	Automated Demand Response
APS	Advanced Planning Studies
BMP	Best Management Practices
CA	California
CEC	California Energy Commission
CPUC	California Public Utilities Commission
CVEF	Commercial Vehicle Enforcement Facility
DC	Direct Current
DGS	California Department of General Services
DO	Director's Order
DWR	California Department of Water Resources
EHT	Extreme Heat Threshold
EMS	Energy Management System (a.k.a., EMCS)
EMCS	Energy Management Control System (a.k.a., EMS)
ESPM	Energy Star Portfolio Manager
EO	Executive Order
EPP	Environmentally Preferable Purchasing
EUI	Energy Use Intensity (source kBTU/sq. ft.)
EV	Electric Vehicle
EVSE	Electric Vehicle Supply Equipment (charging equipment)
FCEV	Fuel Cell Electric Vehicle
GCM	Global Circulation Model
GGE	Gasoline Gallon Equivalent
GHG	Greenhouse Gas
GHGe	Greenhouse Gas Emissions
GSP	Groundwater Sustainability Plan
HVAC	Heating Ventilation and Air Conditioning
IEQ	Indoor Environmental Quality
IOU	Investor-Owned Utility
kBTU	Thousand British Thermal Units (unit of energy)
L1	Level 1
L2	Level 2

LCM	The Landscape Coefficient
LED	Light Emitting Diode
LEED	Leadership in Energy and Environmental Design
MAWA	Maximum Applied Water Allowance
MM	Management Memo
MWELO	Model Water Efficient Landscape Ordinance
OBF	On-Bill Financing
PG&E	Pacific Gas and Electric
PPA	Power Purchase Agreement
PUE	Power Usage Effectiveness
RCP	Representative Concentration Pathway
SABRC	State Agency Buy Recycled Campaign
SAM	State Administrative Manual
SARC	State Agency Reporting Center
SB	Senate Bill
SCADA	Supervisory Control and Data Acquisition
SCPRS	State Contracting and Procurement Registration System
SCM	State Contracting Manual
SD&GE	San Diego Gas and Electric
SGA	Sustainable Groundwater Agency
SGMA	Sustainable Groundwater Management Act
SHOPP	State Highway Operations and Protection Program
SUVs	Sport Utility Vehicles
TEC	Transportation Economics Branch
TMC	Transportation Management Center
W&WW	Water and Wastewater
WMC	Water Management Coordinator
WUCOLS	Water Use Classifications of Landscape Species
ZEV	Zero-Emission Vehicle
ZNE	Zero-Net Energy

Executive Summary

The Governor's Sustainability Roadmap is both a progress report and an action plan for implementing sustainable practices within California's state government. "Sustainability" as defined by the Roadmap includes taking action across five target areas: energy efficiency, water conservation, zero-emission vehicles, green operations, and adapting to the anticipated impacts from climate change. At Caltrans, this emphasis on the sustainability of government operations complements the Department's unique mission as the owner/operator of the State Highway System (SHS): "Provide a safe, sustainable, integrated and efficient transportation system to enhance California's economy and livability."

Caltrans has approximately 19,000 employees and a budget of $10.5 billion prior to Senate Bill 1 (2017), which added additional funding for repairing the SHS. Caltrans designs and oversees highway construction, operates and maintains the SHS, funds intercity passenger rail routes, and provides funding for local transportation projects. Caltrans owns and manages more than 50,000 lane-miles of pavement, 30,000 acres of irrigated landscape, 13,000 bridges, and 205,000 culverts on California's highway system, and owns more than 500 buildings across the state. The estimated total square footage of Caltrans facilities is 7,312,458 (not including Commercial Vehicle Enforcement Facilities, also known as CVEFs).

Caltrans owns and operates many different types of building facilities that serve varying functions to support travelers' ability to safely and efficiently get to their destinations. The building facilities include office buildings, maintenance stations, transportation management centers, equipment shops, laboratories, toll plazas, safety roadside rest areas (used by the public only, not occupied by state employees), and CVEFs (occupied by the California Highway Patrol).

Caltrans also leases satellite offices for a variety of purposes, mostly for project delivery staff to perform engineering design and construction administration work on highway projects. Most leased facilities, such as Resident Engineer (RE) offices, are rented for the life of a construction project. Leased facility energy data is not included in parts of this document due to the inability to access billing information.

Progress toward achieving the Governor's orders

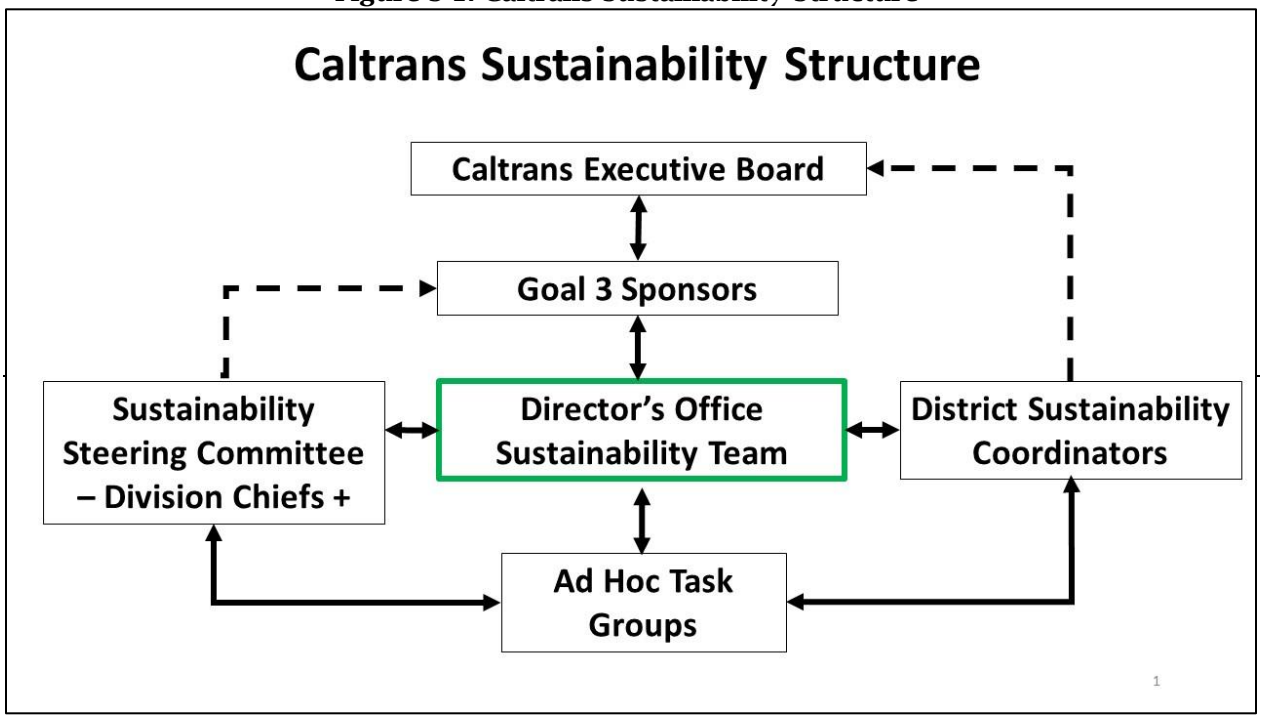
The Sustainability Roadmap reports on several important milestones achieved by Caltrans while implementing Executive Orders B-16-12, B-18-12, and the adaptation planning progress of EO B-30-15. A Sustainability Program was created within the Director's Office to collaborate with other state agencies on air quality and health, climate change adaptation and resiliency. Caltrans has reduced energy and water usage, and expanded zero-emission vehicle infrastructure. Accomplishments include:

- Reducing Caltrans' energy usage by 28 percent in 2016 compared to the baseline year — surpassing the 20 percent target required by EO B-18-12 and saving Caltrans approximately $23 million
- Reducing facility water use by 38 percent in 2016 compared to 2010; the number is even higher (42 percent) when compared with data from 2013
- Decreasing highway water usage by 67 percent in 2016 compared to 2010
- Surpassing targets for replacing fleet vehicles with zero-emission vehicles under Management Memo 16-07
- Installing LEDs in all Caltrans maintenance stations
- Completing construction on Caltrans' first Zero Net Energy pilot building

Moving Forward

Responsibility for incorporating sustainability into Department practices is shared throughout Caltrans. The Caltrans Strategic Plan includes "Sustainability, Livability and Economy" as Goal 3, and establishes an executive-level "Goal 3 Sponsors Team" that provides oversight and direction. The organization chart below (Figure S-1) shows the structure for leadership of sustainability efforts. Oversight of Roadmap implementation is the responsibility of the Director's Office Sustainability Team. Roadmap implementation will largely be undertaken through actions by Caltrans' 12 districts and the Headquarters divisions.

Figure S-1: Caltrans Sustainability Structure



Caltrans is grouping actions to implement the Sustainability Roadmap into seven "Key Initiatives" that will be incorporated into ongoing Department efforts to implement the

Director's Policy on Sustainability as well as Administration Executive Orders and relevant statute. The Caltrans Roadmap Initiatives are:

Table S-1: Caltrans Roadmap Initiatives

1. **Adaptation:** Identify, plan, and prepare for climate change risks to department assets (the roadmap focuses on assets other than the State Highway System)
2. **Energy:** Achieve Zero Net Energy in identified new and existing buildings
3. **Energy & Water:** Reduce grid-based energy and potable water use
4. **Green Operations I:** Improve green buildings operations
5. **Green Operations II:** Reduce waste sent to landfills
6. ZEV: Identify, increase, and streamline Zero Emission Vehicle Infrastructure and operations (the Roadmap focuses on fleet and employee charging)
7. **Cross-Cutting:** Improve data essential for sustainability initiatives

Each Roadmap section includes commitments and actions associated with each initiative. These are summarized in a table provided in Appendix A – Commitments and Actions. The commitments and actions reflect the Department's state of readiness in the various areas. For example, the Zero Emission Vehicles commitments identifies the Caltrans Division of Equipment as the leader of activities relating to fleet acquisition and charging as well as workplace charging for employees. This commitment has been made by the Division. In other cases Department stakeholders have not yet agreed on specific responsibilities for actions to be taken to implement the Executive Orders, so the commitments identified in the Roadmaps relate to the decisions needed in order to assign responsibility and timelines.

In addition to actions within the Department, Caltrans will continue to work closely with Administration partners to advance our shared sustainability mission.

Introduction

Sustainability Goals

The Governor's Sustainability Roadmap is both a progress report and an action plan for implementing sustainable practices within California's state government. "Sustainability" as defined by the Roadmap includes taking action across five target areas: energy efficiency, water conservation, zero-emission vehicles, green operations, and adapting to the anticipated impacts from climate change. Governor Jerry Brown and the California State Legislature have established numerous sustainability goals for agencies within these five areas, including the list of Governor's Executive Orders (EO) and state legislation found in section 1-2. These mandates form the basis and justification for the Sustainability Roadmap.

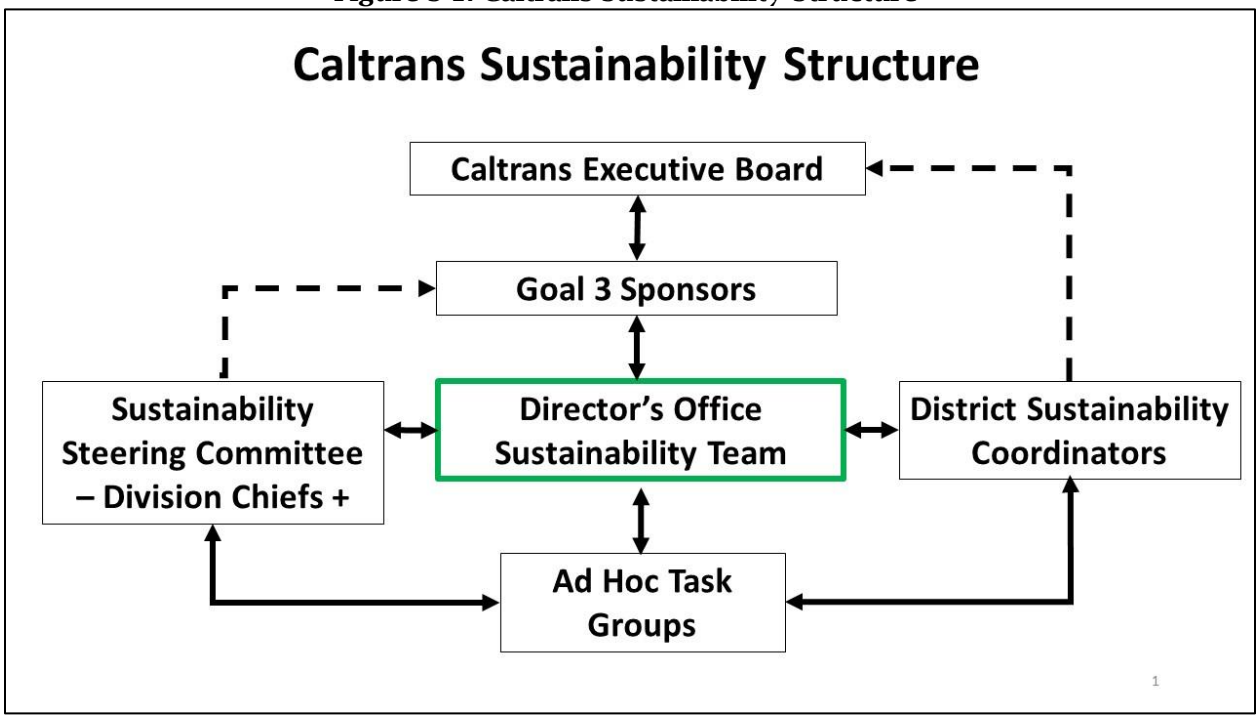
The format and content of the Roadmap reflect requirements applying across the Administration. At Caltrans, this emphasis on the sustainability of government operations complements the Department's unique mission as the owner/operator of the State Highway System (SHS): "Provide a safe, sustainable, integrated and efficient transportation system to enhance California's economy and livability."

This mission and the Department's Sustainability policy commit Caltrans to advancing sustainability through actions relating to the planning, design, construction, operation and maintenance of the State Highway System. This broad sustainability mission is addressed in the Caltrans Strategic Management Plan 2015-2020, in the California Transportation Plan (CTP 2040), the Caltrans two-year plan, and in other materials available on the Caltrans website. The Sustainability Roadmap references a subset of Department actions pertaining to the transportation system. Readers wishing for a more comprehensive view should consult these other materials. For example, Caltrans' Two-Year Plan (2016-2018) addresses support for the use of lower-emitting construction equipment by the Department's contractors, as well as the Department's current activities in providing electric vehicle charging infrastructure for the public.

Implementation Responsibilities

Responsibility for incorporating Sustainability into Department practices is shared throughout the organization. The Caltrans Strategic Plan includes "Sustainability, Livability and Economy" as Goal 3, and establishes an executive-level "Goal 3 Sponsors Team" that provides oversight and direction. The Caltrans Sustainability Structure organization chart (Figure S-1) shows the structure for leadership of sustainability efforts. Oversight of Roadmap implementation is the responsibility of the Director's Office Sustainability Team. Roadmap implementation will largely be undertaken through actions by Caltrans' 12 districts and the Headquarters divisions.

Figure S-1: Caltrans Sustainability Structure



Director's Office Sustainability Team

The Sustainability Team in the Headquarters Director's Office is the ongoing "owner" of the Sustainability Roadmaps, with the following related responsibilities:

1. Serve as ongoing "owner" of Roadmaps, convening discussions and facilitating decision-making regarding actions, roles and responsibilities, and timeline for implementation; preparing required updates.
2. Create and distribute material to inform internal and external stakeholders regarding mandates and directives addressed in the Roadmaps
3. Organize and support Caltrans task groups in identifying actions and implementation pathways
4. Participate in interdepartmental efforts such as the "Sustainable Buildings Working Group", ZEV Interagency Task Force, etc.
5. Support Divisions and Districts in planning, implementing and tracking progress

Caltrans' Roadmap Implementation Approach

Caltrans is grouping actions to implement the Sustainability Roadmap into seven "Key Initiatives" that will be incorporated into ongoing Department efforts to implement the Director's Policy on Sustainability as well as Administration Executive Orders and relevant statute. These are shown in Table S-1. Each of the Initiatives is described in terms of associated Department commitments. Most of the commitments are presented in the Roadmap with related actions to be undertaken before the end of FY 18/19. In some cases actions have already been clearly defined and lead responsibility has been agreed. In other cases actions

have not yet been fully defined, and responsibility has not yet been agreed. In these cases, the Roadmap presents the actions as "possible" with a designation beginning with 'P' after the action number.

The approach to actions will reflect the current status of Department work in the subject area, and the selection of specific strategies that will enable us to efficiently make progress. One of these strategies relates to the actions associated with Caltrans' buildings. While there are ten types of building facilities, Roadmap implementation actions will focus on building facilities managed by the four Divisions – Business Operations, Maintenance, Traffic Operations, and Equipment – that collectively manage 75% of the Department's buildings and use 95% of energy. This subset of the Department's buildings includes the four buildings reported as the Department properties with the highest energy consumption (Energy Roadmap Table 2-3).

The actions presented in tabular form at the end of each report and in Appendix A reflect Caltrans' state of readiness in the various areas. For example, the Zero Emission Vehicles commitments identifies the Caltrans Division of Equipment as the leader of activities relating to fleet acquisition and charging as well as workplace charging for employees. This commitment has been made by the Division. In other cases Department stakeholders have not yet agreed on specific responsibilities or actions so the commitments identified in the Roadmaps relate to the convening of discussions in order to assign responsibility and actions.

In some cases, the narrative in the Roadmap reports includes specific ideas for actions. Though some of these may not be individually referenced in the "Actions" sections and appendix, they will be referred to in Caltrans' ongoing efforts on each topic.

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Caltrans Roadmap Initiatives
1. **Adaptation:** Identify, plan, and prepare for climate change risks to department assets (the roadmap focuses on assets other than the State Highway System)
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Sustainability Mandates

Executive Order B-18-12

EO B-18-12 and the accompanying Green Building Action Plan require state agencies to reduce the environmental impacts of state operations by reducing greenhouse gas emissions, managing energy and water use, improving indoor air quality, generating onsite renewable energy when feasible, implementing environmentally preferable purchasing, and developing the infrastructure for electric vehicle charging stations at state facilities. The Green Building Action Plan also established two oversight groups, the staff-level Sustainability Working Group and the executive-level Sustainability Task Force, to ensure these measures are met.

Executive Order B-16-12

EO B-16-12 and the accompanying Governor's Zero-Emission Vehicle (ZEV) Action Plan direct state agencies to integrate ZEVs into the state vehicle fleet. It also directs state agencies to develop the infrastructure to support increased public and private sector use of ZEVs. Under this order, ZEVs must make up at least 25 percent of state agencies' replacement fleet purchases by 2020.

Executive Order B-30-15

EO B-30-15 declared climate change to be a threat to the well-being, public health, natural resources, economy, and environment of California. It established a new interim statewide greenhouse gas emission reduction target of 40 percent below 1990 levels by 2030, and reaffirms California's intent to reduce greenhouse gas (GHG) emissions by 80 percent below 1990 levels by 2050. To support these goals, this order requires numerous state agencies to develop plans and programs to reduce emissions. It also directs state agencies to take climate change into account in their planning and investment decisions, and employ life-cycle cost accounting to evaluate and compare infrastructure investments and alternatives. Under this order, state agencies are directed to prioritize investments that build climate preparedness, reduce greenhouse gas (GHG) emissions, prioritize natural infrastructure, and protect the state's most vulnerable populations.

The following were signed in 2015-16 that codified several elements of EO B-30-15:

- Assembly Bill (AB) 1482 (Gordon, 2015) requires the California Natural Resources Agency (CNRA) to update the State's adaptation strategy, *Safeguarding California*, every three years. The bill also directs State agencies to promote climate adaptation in planning decisions and ensure that state investments consider climate change impacts, as well as the use of natural systems and natural infrastructure. (Public Resources Code Section 71153)
- Senate Bill (SB) 246 (Wieckowski, 2015) established the Integrated Climate Adaptation and Resiliency Program within the Governor's Office of Planning and Research. The

Program coordinates regional and local efforts with state climate adaptation strategies to adapt to the impacts of climate change. (Public Resources Code Section 71354)

- Senate Bill 2800 (Quirk, 2016) requires State agencies to consider the current and future impacts of climate change when planning, designing, building, operating, maintaining, and investing in state infrastructure. CNRA will establish a Climate-Safe Infrastructure Working Group to determine how to integrate climate change impacts into state infrastructure engineering. (Public Resources Code Section 71155)

Executive Order B-37-16

EO B-37-16 builds on what were formerly temporary statewide emergency water restrictions in order to establish longer-term water conservation measures, including permanent monthly water use reporting, new permanent water use standards in California communities, and bans on clearly wasteful practices such as hosing off sidewalks, driveways and other hardscapes. The EO focuses on using water more wisely, and eliminating water waste by taking actions to minimize water system leaks. The California Department of Water Resources (DWR) estimates that leaks in water district distribution systems siphon away more than 700,000 acre-feet of water a year in California — enough to supply 1.4 million homes for a year.

The EO further strengthens local drought resilience and looks to improve agricultural water use efficiency and drought planning. State agencies are to cooperate with urban water management plans which include plans for droughts lasting for at least five years by assuring that the water efficiency and conservation plan has drought contingency actions.

Executive Order B-40-17

The EO ended the Drought State of Emergency in all California counties except Fresno, Kings, Tulare, and Tuolumne, where emergency drinking water projects will continue to help address diminished groundwater supplies. It maintains water reporting requirements and prohibitions on wasteful practices. The EO was built on actions taken in Executive Order B-37-16, which remains in effect. In a related action, state agencies, including DWR, released a plan to continue making water conservation a way of life.

Assembly Bill 4

The Legislature passed Assembly Bill (AB) 4 in 1989. The State Agency Buy Recycled Campaign (SABRC) statutes are in Public Contract Code Section 12153-12217. The intent of SABRC is to stimulate markets for materials diverted by California local government and agencies. It requires state agencies to purchase enough recycled content products to meet annual targets, report on purchases of recycled and non-recycled products, and submit plans for meeting the annual goals for purchasing recycled content products.

Assembly Bill 1103

Passed in 2007, the legislation created the Non-Residential Building Energy Use Disclosure Program administered by the California Energy Commission. This program requires non-residential building owners to benchmark their buildings and disclose the results at the time of

sale, lease or refinancing. Most non-residential buildings with a gross floor area of 10,000 sq. ft. or greater are required to comply. Buildings with floor area between 5,000 sq. ft. to 10,000 sq. ft. are required to comply by July 1st, 2016. All commercial customers who participate in energy efficiency programs offered by California's three electric Investor-Owned Utility (IOU) companies are required to benchmark their eligible building(s) using the Energy Star Portfolio Manager.

Assembly Bill 236

AB 236 requires the increased use of alternative fuels through the reduction or displacement of petroleum products in the state fleet based on the following benchmarks: (1) By January 1, 2012, a 10 percent reduction or displacement; and (2) by January 1, 2020, a 20 percent reduction or displacement.

Senate Bill 1

Senate Bill (SB) 1, the Road Repair and Accountability Act of 2017, was signed into law on April 28, 2017. The legislation will invest $54 billion over the next decade to fix roads, freeways, and bridges in communities across California and contributes more funding toward transit and safety.

It requires that the transportation funding, to the extent possible, be cost effective, and where feasible, be used to preserve, protect, and reduce environmental impacts through the use of:

- Advanced technologies and material recycling techniques that reduce the cost of maintaining and rehabilitating the streets and highways, and that exhibit reduced levels of greenhouse gas emissions through material choice and construction method
- Advanced technologies and communications systems in transportation infrastructure that recognize and accommodate advanced automotive technologies that may include, but are not necessarily limited to, charging or fueling opportunities for zero-emission vehicles, and provision of infrastructure-to-vehicle communications for transitional or full autonomous vehicle systems
- Features in the projects funded by the program to better adapt the asset to withstand the negative effects of climate change and make the asset more resilient to impacts such as fires, floods, and sea level rise
- Incorporate complete street elements into projects funded by the program, including, but not limited to, elements that improve the quality of bicycle and pedestrian facilities and that improve safety for all users of transportation facilities

Senate Bill 1265

SB 1265 requires the establishment of a minimum fuel economy standard for the purchase of passenger vehicles and light-duty trucks for the state that are powered solely by internal combustion engines utilizing fossil fuels.

Senate Bill 552

SB 552 adopted the recommendations from the California State Vehicle Fleet Fuel Efficiency Report and required the collection of statewide fleet data and the publishing of annual public reports pertaining to fleet composition.

Senate Bill 1168

SB 1168, also known as the Sustainable Groundwater Management Act, directs DWR to identify groundwater basins and sub-basins in conditions of critical overdraft. Conditions of critical overdraft result from undesirable impacts, which can include seawater intrusion, land subsidence, groundwater depletion, and/or chronic lowering of groundwater levels. As defined in the bill, "A basin is subject to critical overdraft when continuation of present water management practices would probably result in significant adverse overdraft-related environmental, social, or economic impacts."

As required in the bill, basins designated as high or medium priority *and* critically over-drafted shall be managed under a groundwater sustainability plan or coordinated groundwater sustainability plans by January 31, 2020. All other high and medium priority basins shall be managed under a groundwater sustainability plan by January 31, 2022.

Governor's 2016 Zero-Emission Vehicle Action Plan

The ZEV Action Plan identifies specific actions that state government should take to meet the milestones of EO B-16-12. The Plan establishes a goal for agencies to provide electric vehicle charging at 5 percent of state-owned parking spaces by 2022, and also sets fleet procurement targets at 50 percent of new light-duty vehicle purchases by 2025.

AB 32 Scoping Plan

The Scoping Plan assumes widespread electrification of the transportation sector as a critical component of every scenario that leads to the mandated 40 percent reduction in GHG by 2030 and 80 percent reduction by 2050.

Public Resources Code §25722.8

The statute requires reducing consumption of petroleum products by the state fleet compared to a 2003 baseline. It mandates a 10 percent reduction or displacement by January 1, 2012 and a 20 percent reduction or displacement by January 1, 2020.

Public Resources Code §25722.9

The statute requires the California Department of General Services (DGS) and the California Department of Transportation (Caltrans) to develop and implement advanced technology vehicle parking incentive programs, to the extent feasible, in public parking facilities of 50 spaces or more operated by DGS, and park-and-ride lots owned and operated by Caltrans to incentivize the purchase and use of alternatively fueled vehicles in the state.

SGC Resolution on Location Efficiency

Location efficiency refers to the greenhouse gas emissions arising from the transportation

choices of employees and visitors to a building as determined by the Smart Location Calculator. Adopted on the 6th of December in 2016, the resolution directs members of the Strategic Growth Council to achieve a 10 percent improvement in the Smart Location Score of new leases compared to the average score of leased facilities in 2016.

State Resources and Guidance Documents

California has invested significant resources in understanding the risks of climate change to the state, and developing actions for responding to and reducing these risks. These include the following:

- **Safeguarding California**: The state's climate adaptation strategy organized by sector. Each sector identifies risks from climate change and actions to reduce those risks.
- **Safeguarding California Implementation Action Plans**: Directed under EO B-30-15, the Implementation Action Plans outline the steps that will be taken in each sector to reduce risks from climate change.
- **Building a Resilient California**: Prepared under direction of EO B-30-15, this document provides a framework for state agencies to integrate climate change into planning and investment, including guidance on data selection and analytical approaches.
- **California's Climate Change Assessments**: California has completed three comprehensive assessments of climate change impacts on California. Each assessment has included development of projections of climate impacts on a scale that is relevant to state planning (i.e., downscaled climate projections). These projections are available through Cal-Adapt, an online data visualization and access tool.

State Administrative Manual & Management Memos

The following sections of the State Administrative Manual (SAM) and associated Management Memos (MM) impose sustainability requirements on state agencies under the Governor's executive authority:

- SAM 1800 et seq.: Energy and Sustainability
- SAM 1821.4: Drought moratorium
- SAM 1821.5: Landscaping practices
- SAM 1835.5: Water use requirements
- SAM 3620.1: Sets minimum miles per gallon requirements for light-duty passenger vehicles (38 mpg) and light-duty trucks, vans, and sport utility vehicles (SUVs) (22.2 mpg). It also requires all light-duty, non-emergency response vehicles to be ordered with solar reflective colors to maximize fuel economy by reducing the need for air conditioning.
- SAM 3627: Mandates the use of renewable diesel in lieu of conventional diesel and biodiesel fuel for bulk transportation fuel purchases.
- SAM 4121-4121.6: Updates the ZEV purchasing policy which, among other things, instituted a "ZEV and hybrid vehicles first" purchasing policy and increased the ZEV

purchasing mandate annually by 5 percent so that it will be 50 percent by 2025. The "ZEV and hybrids first" purchasing mandate requires departments to purchase light-duty vehicles according to the following priority structure, when available on the statewide contract: (1) pure ZEVs, (2) plug-in hybrid electric vehicles (PHEVs), and (3) hybrids.

- SAM 4120-4127: Updates the process that state agencies must follow in order to acquire additional or replacement fleet assets. It also mandates departments to be compliant with all fleet asset reporting requirements in order for DGS to process their fleet acquisition requests.
- MM 12-06: Reconditioned, used, or remanufactured automotive parts; re-refined or synthetic motor oil and lubricants
- MM 14-02: Water efficiency and conservation
- MM 14-05: Indoor environmental quality: new, renovated, and existing buildings
- MM 14-07: Standard operating procedures for energy management in state buildings
- MM 14-09: Energy efficiency in data centers and server rooms
- MM 15-03: Minimum fuel economy standards policy
- MM 15-04: Energy use reduction for new, existing, and leased buildings
- MM 15-06: State buildings and grounds maintenance and operation
- MM 15-07: Diesel, biodiesel, and renewable hydrocarbon diesel bulk purchases
- MM 16-07: Zero-emission vehicle purchasing and electric vehicle service equipment infrastructure requirements
- MM 17-04: Zero net energy for new and existing state buildings

1. CLIMATE CHANGE ADAPTATION ROADMAP

1.1 Background

This document only addresses the actions required of Executive Order (EO) B-30-15 as it relates to climate change adaptation. It does not address the mitigation component of EO B-30-15. EO B-30-15 directs State Agencies to integrate climate change into all planning and investment. Planning and investment can include the following[1]:

- Infrastructure and capital outlay projects
- Grants
- Development of strategic and functional plans
- Permitting
- Purchasing and procurement
- Guidance development
- Regulatory activity
- Outreach and education

Caltrans has invested nearly 10 years of research and analysis into the expected impacts of climate change on the State Highway System (SHS). Caltrans is currently conducting Climate Change Vulnerability Assessments of the SHS in each of Caltrans' 12 districts to project future impacts from wildfire, precipitation, temperature, sea level rise (SLR), and storm surge. The assessments will identify specific locations (where data is sufficient for this level of analysis) that may be impacted by each of these climate stressors. Caltrans intends to complete all 12 assessments by December 2019 and develop adaptation guidance by early 2021.

This Adaptation Roadmap is a parallel, but methodologically different, effort to Caltrans' Vulnerability Assessments for the SHS. Based on guidance provided by the California Government Operations Agency, this Roadmap focuses on the vulnerability of buildings. Since the roadway has different design parameters than buildings, the scenarios and datasets displayed in this Roadmap are different than those used in the Vulnerability Assessments. A brief explanation of the data and considerations specific to the SHS are provided in Section 1.6

Once complete, the combined results of this Roadmap and Caltrans' Climate Change Vulnerability Assessments will provide the basis for a more holistic understanding of the potential impact of climate change to Caltrans. Caltrans is already developing a Climate Action Report which will identify plans and strategies Caltrans can implement to adapt to more extreme weather.

The results of this analysis will be updated as additional and new climate change data are developed.

1 Note that this report will focus on the first three of the listed activities.

1.2 Climate Change Risks to Caltrans Facilities

For all infrastructure, it is important to assess the risk that a changing climate poses (such as sea level rise or increasing daily temperatures) to an asset or project. It is also important to recognize the impact that an infrastructure project has on the surrounding community and the impacts on individual and community resilience.

To determine how to consider climate change for a given project or plan or existing infrastructure, GovOps suggests the following screening questions:

1. Could the facility, planned project, or plan be exposed to changing average climate conditions or increases in extreme events over its lifetime?
2. What is the lifetime of the facility, planned project, or plan?
3. Is the facility in a sufficient state-of-repair and designed to withstand potential impacts?
4. What is the frequency of projected climate impacts?
5. When are climate impacts projected to occur?
6. What is the potential consequence of that disruption?
7. Will that disruption affect vulnerable populations, critical natural systems, critical infrastructure, or other assets?
8. Will that disruption cause irreversible effects or pose an unacceptable risk to public health and safety?

Caltrans developed similar criteria in 2011 for incorporating sea level rise (SLR) into Caltrans' project development process for facilities on the SHS. The criteria direct Project Development Teams (PDT) to evaluate SLR for all facilities that are: 1) in a coastal zone or area vulnerable to SLR, 2) potentially impacted by SLR based on the values in the California Climate Action Team's interim guidance from 2011, and 3) has a design life beyond 2030. Where impacts based on this screening criteria are expected, a PDT must consider the following factors:

1. Redundancy/alternative route availability
2. Anticipated travel delays
3. Goods movement/interstate commerce
4. Evacuations/emergencies
5. Traveler safety
6. Expenditure of public funds
7. Scope of project (size)
8. Effect of incorporating SLR on non-state highway (interconnectivity issues with local streets and roads)
9. Environmental constraints (impact on Environmentally Sensitive Areas)

Caltrans is in the process of updating climate change guidance for all climate stressors, and will establish a comprehensive set of metrics and questions that seek to integrate and enhance the two methods provided above.

1.3 Understanding Climate Risk to Existing Building Facilities

Under a changing climate, temperatures are expected to rise — both at the high and low end, leading to significant impact on state-owned properties. As a result, facilities are projected to experience higher maximum temperatures and higher minimum temperatures, more extreme heat events, greater rates of precipitation, and significant sea level rise. The following sections identify Department building facilities with the greatest projected exposure to these phenomena. Based on guidance from the California Government Operations Agency, the analysis within this Adaptation Roadmap uses scenarios and datasets developed for the Fourth Climate Change Assessment, and extracted from the ArcGIS tools Cal-Adapt, CalEnviroScreen, and the Urban Heat Island Index.

Risk from increasing temperatures

In addition to the roads of the SHS, Caltrans operates over 500 buildings in California. These facilities include maintenance stations, equipment shops, material labs, and transportation management centers.

The building facilities listed below are those most affected by changing maximum temperature according to a comparison between the historic maximum average temperature from 1961-1990 and the average annual modeled maximum temperature from 2070 - 2099. Out of these 505 facilities analyzed, Caltrans identified five (5) with the greatest modeled increase in annual mean temperatures over the same period based on a comparison to historic averages:

Table 1-1: Facilities with Greatest Change in Average Annual Maximum Temperature (˚F)

Facility	Annual Mean Maximum Temperature (1961–1990)	Annual Mean Max. Temp. (2031–2060)*	Annual Mean Max. Temp. (2070–2099)*	Change
Death Valley Maintenance Station and Mechanic Equipment Shop	87.29	92.58	96.88	+9.59
Needles Maintenance Station	87	92.60	96.53	+9.53
Inyokern Maintenance Station	80.01	85.28	89.14	+9.13
Equipment Shop 08 and San Bernardino Maintenance Station	79.81	85.20	88.82	+9.01
Brawley Maintenance Station and Mechanic Equipment Shop	87.96	93.04	96.83	+8.87

Data Source: Cal-Adapt http://cal-adapt.org/

Table 1-2: Facilities with Greatest Change in Average Annual Minimum Temperature (˚F)

Facility	Annual Mean Minimum Temperature (1961–1990)	Annual Mean Min. Temp. (2031–2060)*	Annual Mean Min. Temp. (2070–2099)*	Change
Needles Maintenance Station	55.62	61.21	65.71	+10.09
Inyokern Maintenance Station	61.43	66.89	71.49	+10.06
Equipment Shop 08 and San Bernardino Maintenance Station	46.77	52.06	56.55	+9.78
Brawley Maintenance Station and Mechanic Equipment Shop	51.15	56.46	60.58	+9.43
Death Valley Maintenance Station and Mechanic Equipment Shop	59.11	63.10	67.94	+8.83

Data Source: Cal-Adapt http://cal-adapt.org/

Risk from extreme heat events

In addition to increasing average temperatures, climate change will increase the number of extreme heat events across the State.[2] These types of events are likely to be experienced sooner than changes in average temperatures.

The facilities in Tables 1-3 and Table 1-4 were chosen from a preliminary list of facilities identified by the Caltrans Emergency Management Office due to their importance to emergency response and operations.

Table 1-3: Office Buildings Most Affected by Increase in Extreme Heat Events

Facility	Extreme heat threshold (EHT)	Average number of days above EHT (1961-1990)	Average number of days above EHT (2031-2060)	Increase in number of days above EHT by mid-century	Avg. # days above EHT (2070-2099)	Increase in Avg. # days above EHT by end of century
District 9 HQ office	102.3	4.3	32	27.7	61	56.7
District 6 HQ office	106.3	4.3	26	21.7	50	45.7
District 2 HQ office	108.1	4.3	19	14.7	48	43.7
District 1 HQ office	76.6	4.3	6	1.7	26	21.7
District 7 HQ Office	97.9	4.2	10	5.8	24	19.8

2 Cal-adapt defines an extreme heat day '…as a day in April through October where the maximum temperature (Tmax) exceeds the 98th historical percentile of maximum temperatures based on daily temperature data between 1961-1990. A heat wave is defined as 5 or more consecutive extreme heat days'.

Facility	Extreme heat threshold (EHT)	Average number of days above EHT (1961-1990)	Average number of days above EHT (2031-2060)	Increase in number of days above EHT by mid-century	Avg. # days above EHT (2070-2099)	Increase in Avg. # days above EHT by end of century
District 5 HQ Office	88.6	4.3	9	4.7	18	13.7
District 4 HQ office	90.4	4.3	6	1.7	12	7.7

Data Source: Cal-Adapt http://cal-adapt.org/

Table 1-4: Buildings Most Affected by Increase in Extreme Heat Events

Facility	Extreme heat threshold (EHT)	Average number of days above EHT (1961-1990)	Average number of days above EHT (2031-2060)	Increase in number of days above EHT by mid-century	Avg. # days above EHT (2070-2099)	Increase in Avg. # days above EHT by end of century
Blythe Maintenance Station	115	4.2	29	24.8	58	53.8
Victorville Maintenance Station	102.7	4.3	33	28.7	58	53.7
District 3 Warehouse	104.8	4.3	29	24.7	57	52.7
Barstow Sub-Shop	106.6	4.3	32	27.7	57	52.7
Indio Maintenance Station	113.7	4.3	22	17.7	47	42.7
Alternate Department Operations Center	104.1	4.3	21	16.7	43	38.7
Inland Empire Transportation Management Center (TMC)	104.3	4.3	22	17.7	42	37.7
Stockton Maintenance Station	104	4.3	16	11.7	34	29.7

Data Source: Cal-Adapt http://cal-adapt.org/

Implications for Department buildings. Extreme temperatures affect the efficient use of energy, water, and materials throughout a building's life cycle, and could potentially affect the indoor and outdoor air quality as well as state employee health and productivity. Extreme heat could decrease a building's service life by degrading roofs and walls, heating, ventilation and air conditioning (HVAC) systems, and insulation, as well as increasing wear and tear on building materials — leading to higher facility maintenance and operation costs.

Extreme heat events could create unsafe working conditions and lead to negative health affects for employees. Side effects from extreme heat could include general discomfort, respiratory difficulties, heat cramps and exhaustion, non-fatal heat stroke, and heat-related mortality. Furthermore, additional energy and water use in buildings will result in an increase in air pollutants and GHG emissions. Extreme heat could damage electrical infrastructure and HVAC equipment, increasing the possibility of premature or accelerated deterioration of equipment and a reduction of design safety factors. More extreme heat events could also overload local power infrastructure, requiring utility companies to impose rolling brownouts or blackouts to avoid power outages, exacerbating dilatory effects to productivity and working conditions.

Caltrans' equipment shops will face particular challenges from extreme heat. It's already difficult to cool these facilities; they consist of large indoor spaces and host activities that generate heat. In addition, many shops have evaporative cooling systems, which don't perform well in higher temperatures and could result in temperatures rising above allowed limits in facilities where technicians repair and maintain equipment. Extreme heat events could lead to unsafe conditions and affect employee health, which in turn would impact Caltrans' ability to maintain and repair California's roadways.

Adaptation Strategies. Preparing for changing conditions will require a variety of potential adaptation strategies. For starters, Caltrans will need to strengthen its preparedness for extreme heat events. Caltrans will likely need to modify components of buildings. Some adaptation strategies might be readily implemented while others will require additional planning, consultation and resources. Therefore, next steps will include discussions with each impacted program to identify adaptation strategies specific to at-risk facilities, and to consider whether a strategy can be implemented using existing resources or if there will be additional costs associated with implementation. Specific strategies for buildings could include:

- Monitoring potential climate change impacts; such as extreme heat.
- Shading buildings with vegetation (i.e., trees); use solar panels as canopies
- Insulating buildings more effectively
- Reviewing and improving use of air conditioning and other indoor cooling strategies
- Using cool roofing materials
- Applying energy efficiency measures such as wall insulation and energy efficient windows
- Applying current Energy Star efficient systems
- Using heat tolerant AC materials

Worst Case Scenarios. Extreme heat days would cause cooling equipment failures in buildings, leading to an increase in heat-related illnesses and loss of productivity if buildings were shut down. Building maintenance staff would have to work more hours to maintain and repair overworked equipment to keep buildings at an acceptable temperature

level. Extreme temperatures could cause buildings to deteriorate prematurely, shortening their service life and requiring more frequent maintenance and repair. Maintenance crews would have to work at night to avoid heatstroke. Additionally, increased temperatures and extreme heat days may cause wildfires to grow in scale and frequency. Caltrans is currently evaluating these risks using wildfire models and will work with District staff to develop adaptation strategies and plans to reduce risks to the traveling public, emergency crews, and Caltrans assets.

Risks from changes in precipitation

Compared to projections about rising temperatures, there is less certainty about how climate change will affect California's annual precipitation. Most models predict the state will maintain its Mediterranean climate pattern (dry summers and wet winters), but with more precipitation from rain instead of snow — resulting in a smaller snowpack. More rain could result in greater flooding, along with shifts in runoff timing (earlier) and runoff volumes (higher). Since the snowpack provides California with roughly 30 percent of the state's water supply, less snow would also affect reservoir levels and potentially lead to water shortages during the summer.

The office buildings identified in Table 1-5 were selected because they are located in regions with significant projected increases in rainfall and contain the largest number of employees. The buildings identified in Table 1-6 are provided as a preliminary list of facilities identified by the Caltrans Emergency Management Office because they are likely to experience a large increase in precipitation change at the end of the century and are important to emergency response and operations.

Table 1-5: Office Buildings that will be Most Impacted by Projected Changes in Precipitation (inches/year)

Facility	Annual Mean Maximum Precipitation (1961 – 1990)	Annual Mean Precipitation (2031 – 2060)	Percent Change by mid-century	Annual Mean Precipitation (2070 – 2099)	Percent change by end of century
District 9 HQ office	6.1	7	+15%	7.9	+30%
District 4 HQ office	19.9	23.4	+18%	25.3	+27%
District 5 HQ Office	18.1	20.6	+14%	22.2	+23%
District 7 HQ Office	15.6	16.9	+8%	18.9	+21%
District 2 HQ office	37.5	43.4	+16%	44.6	+19%
District 1 HQ office	40.6	46.5	+15%	47.8	+18%
District 6 HQ office	10.7	11.4	+7%	12.3	+15%

Data Source: Cal-Adapt http://cal-adapt.org/

Table 1-6: Buildings that will be Most Impacted by Projected Changes in Precipitation (inches/year)

Facility	Annual Mean Maximum Precipitation (1961 – 1990)	Annual Mean Precipitation (2031 – 2060)	Percent Change by mid-century	Annual Mean Precipitation (2070 – 2099)	Percent change by end of century
Stockton Maintenance Station	14.1	16	13%	17.5	24%
Alternate Department Operations Center	21.5	24.1	12%	25.9	20%
District 3 Warehouse	19.9	22.6	14%	23.7	19%
District 12 TMC	12.1	13.4	11%	14.4	19%

Data Source: Cal-Adapt http://cal-adapt.org/

Implications for Department buildings. Increased precipitation could severely damage Caltrans' buildings and lead to other problems. Changes in moisture levels can provoke dimensional changes (such as swelling or shrinking) of building materials, which in turn can cause cracking and/or fissuring in polymer-based materials such as vinyl cladding, window frames, sealants and gaskets. These moisture-related issues can lead to a reduction of design safety factors, more repairs and maintenance, service disruptions, risk for waterborne disease outbreaks from overloaded sewage systems and water treatment facilities, and increased liability as a result of premature aging or deterioration of the building.

Implications for Buildingss. Increased precipitation could include heavy rain events that would especially affect buildings. These events could cause structural building failures, undermined foundations, and collapsing roofs. Extreme precipitation could lead to higher levels of mold at these facilities. These side effects from more precipitation could require facility closures and/or prevent employees from entering specific buildings. In the future, Caltrans programs will need to request assistance from the Office of Hydraulics and Stormwater to identify buildings that are vulnerable to heavy rain events.

Heavy rain events also adversely affect shop personnel. These employees would need to move heavy tool boxes and a large number of vehicles during floods, reducing productivity and potentially causing injuries.

Heavy rain events would also affect traffic operations if they damage or close buildings. Caltrans employees cannot respond to highway emergencies or provide essential maintenance and operation for the safety of the traveling public whenever these facilities become inoperable or inaccessible.

Adaptation strategies. Caltrans will need to gather additional data in 2018-2019 on climate change impacts from increased precipitation. In addition, Caltrans will need to develop

adaptation measures for buildings that respond to this risk. The following five factors will be considered when developing these measures:

- Criticality (how important are the buildings for achieving development objectives)
- Likelihood (are the buildings likely to be impacted by climate change)
- Consequences (how severely will the building infrastructure or operations be affected)
- Length of disruption to facility use (temporary or permanent)
- Resources available (can adaptation measures be incorporated into ongoing maintenance and renovation; are improvements required to retain use of the building)

The following strategies will be considered in order to reduce the impact from changing precipitation (including drought) to buildings:

- Enhanced monitoring of climate change effects, such as changes in precipitation
- Developing and implementing an action plan to address climate change risks to Caltrans building facilities, statewide
- Prior to building, avoiding development in locations with increased flood risk locations whenever if possible
- Designing facilities and using materials that can withstand flooding
- Rain water capture for irrigation at the facility
- Using Energy Star efficient systems to replace the cooling effect of rain water
- Relocating facility sites outside of potential high wind zones and/or above new flood levels or to higher ground within the sites
- Further improving wastewater recycling to create new potable water
- As needed, replacing water-intensive landscaping with native, drought-resistant plants

Risks from Sea Level Rise

Rising global temperatures are contributing to rising sea levels. This phenomenon will inundate coastal areas and lead to increased flooding from storm surges. The California Ocean Protection Council (OPC) has issued guidance for state agencies on what amount of sea level rise to consider. The OPC guidance document includes the following sea level rise estimates for the California coast, based on a study by the National Academy of Sciences[3]:

3 An accompanying OPC resolution recommends that departments base analyses on estimates of sea level rise in the upper two-thirds of the range.

Table 1-7: Sea Level Rise Estimates

Time Period	North of Cape Mendocino	South of Cape Mendocino
2000 – 2030	-4 to 23 cm (-0.13 to 0.75 ft.)	4 to 30 cm (0.13 to 0.98 ft.)
2000 – 2050	-3 to 48 cm (-0.1 to 1.57 ft.)	12 to 61 cm (0.39 to 2.0 ft.)
2000 – 2100	10 to 143 cm (0.3 to 4.69 ft.)	42 to 167 cm (1.38 to 5.48 ft.)

Table 1-7 displays Department facilities currently at risk from rising sea levels, including three at risk of flooding during king tides and storm surge.

Table 1-8: Facilities at Risk from Rising Sea Levels

Facility	Model	Additional Sea Level needed to Experience Impacts/Flooding (m)
Manzanita Maintenance Station	SF and Coast	0
Redwood City Maintenance Station	Coast	0
Foster City Maintenance Station	Coast	0
South San Francisco Maintenance	SF Bay	0.5
San Mateo Paint Shop	SF Bay	0.5
Toll Bridge Region Maintenance	Coast	1
Ventura Maintenance Station	Coast	1.41

Data Source: Cal-Adapt http://cal-adapt.org/

Adaptation strategies. Potential measures for addressing SLR include:

- Relocating buildings outside of new potential flood zones associated with increases in sea level (yet to be determined) and/or above new flood levels or to higher ground within the facility sites
- Temporarily closing buildings and relocating services in the event of extreme weather and/or damage
- Elevating electrical equipment and structures above higher flood and expected sea levels

Natural Infrastructure to Protect Existing Facilities

EO B-30-15 directs state agencies to prioritize the use of natural and green infrastructure solutions. Natural infrastructure is the "preservation or restoration of ecological systems or the utilization of engineered systems that use ecological processes to increase resiliency to climate change, manage other environmental hazards, or both. This may include, but need not be limited to, flood plain and wetlands restoration or preservation, combining levees with restored natural systems to reduce flood risk, and urban tree planting to mitigate high heat days" (Public Resource Code Section 71154(c)(3)).

Caltrans is engaged in pilot adaptation projects with local partners to find innovative and natural infrastructure design solutions that account for rising sea levels. In general, potential strategies include adapting, protecting the facilities or highway using natural/hybrid infrastructure, or relocating buildings and realigning roadway segments at risk of inundation. Additionally, with funding from Senate Bill 1, Caltrans is supporting cities, counties, and regions in advancing their adaptation planning.

In addition, Caltrans works with local partners including transportation planners, engineers, economists, and geomorphologists to develop and identify cost-effective solutions to protect transportation corridors and the natural environment. For example, Caltrans has a partnership with the Nature Conservancy to develop nature-based adaptation measures for a vulnerable section of the Pacific Coast Highway in Monterey County.

In 2018-19, Caltrans will further study the use of natural infrastructure to reduce the risks of SLR at Caltrans' buildings. Caltrans could also study the possibility of urban tree planting to offset the effect of high heat days at buildings.

1.4 Understanding the Potential Impacts of Buildings on Communities

Certain populations are more susceptible to the effects of changing climate conditions, and have less capacity to recover from changing average conditions and more frequent and severe extreme events. A number of factors contribute to vulnerability, often in overlapping and synergistic ways. These can include a number of social and economic factors, and be determined by existing environmental, cultural, and institutional arrangements. Vulnerable populations can include, but are not limited to, people living in poverty; people with underlying health conditions; incarcerated populations; linguistically- or socially-isolated individuals; communities with poor access to healthcare or educational resources; or communities that have suffered historic exclusion or neglect.

Department facilities and vulnerable populations

Caltrans works with local and regional planning agencies to maintain a coordinated effort for addressing climate issues. Due to its mission and activities, most Caltrans' building facilities do not provide general access to the public. However, many of Caltrans' facilities, such as District Offices and Maintenance Stations, have communication capabilities that can provide coordination, assistance, and support for other agencies responding to climate-related events affecting regional and local populations as a whole, and vulnerable populations in particular.

As the owner-operator of the SHS, Caltrans works with multiple other key agencies during emergency response to climate-related events by coordinating the evacuation functions of the transportation system. Caltrans also works extensively with the California Office of Emergency Services to provide resources and personnel during catastrophic events, including the Safety Assessment Program, mission tasking, and Emergency Functions 1, 3, and 7 of the State of California Emergency Plan.

Disadvantaged communities

California is committed to investing in resources in disadvantaged communities (DACs). DACs can be identified using CalEnviroScreen, a tool that ranks census tracts based on a combination of social, economic, and environmental factors. While it does not capture all aspects of climate vulnerability, it is one tool that is available, and does include several relevant characteristics. In many cases, DACs are more likely to suffer damage under changing climate conditions, including extreme events. Caltrans' facilities located in these communities can contribute to or

alleviate the vulnerability of these communities. Table 1-8 includes a list of Caltrans facilities located in DACs, along with their CalEnviroScreen scores.

Table 1-9: Facilities Located in Disadvantaged Communities

Facility	CalEnviroScreen Score	Is it located in a disadvantaged community? Yes/No
District 8 Equipment Shop	100	Yes
San Bernardino Maintenance Station	100	Yes
Modesto Electric Shop	100	Yes
Stockton Landscape Maintenance Station	100	Yes
District 6 Equipment Shop	99	Yes
West Avenue Maintenance Station	99	Yes
Central Bandini Maintenance Station	99	Yes
Magna-Ortega Maintenance Station	98	Yes
Madera Maintenance Station	95	Yes
Mendota Maintenance Station	95	Yes
Ontario Maintenance Station	97	Yes
Artesia Maintenance Station	99	Yes
San Diego/Coronado Bridge Maintenance Station	99	Yes
Doran Maintenance Station	99	Yes
Alameda Maintenance Station	99	Yes
Richards Boulevard Maintenance Station	99	Yes
District 7 Equipment Subshop 2	99	Yes
Chollas Maintenance Station	99	Yes
North Region Maintenance (Fresno)	99	Yes
Long Beach Field Testing Lab	97	Yes
District 7 Lab	96	Yes
Riverside Materials Acceptance Lab	99	Yes
Porterville Maintenance Station	90	Yes
Corona Maintenance Station	94	Yes
Riverside Maintenance Station	92	Yes
District 10 Equipment Shop	92	Yes
Stockton Maintenance Station	92	Yes
Modesto Maintenance Station	92	Yes
Wasco Maintenance Station	92	Yes
Royal Oaks Warehouse	92	Yes
Metro Electrical	92	Yes
HQ Equipment Sale Yard	92	Yes
East Los Angeles Maintenance Station	93	Yes
Humphrey Maintenance Station	91	Yes
Lab-Plant Services	93	Yes
Burbank Electrical Station	90	Yes
Roseville Road Construction Lab	90	Yes

Data Source: CalEnviroScreen https://oehha.ca.gov/calenviroscreen/report/calenviroscreen-version-20

Department facilities located in disadvantaged communities. Twenty-three percent (116 out of 503), of all Caltrans facilities in the State Property Inventory are located within the top 25 percent of CalEnviroScreen DACs. The facilities listed in Table 1-8 are located in communities with a score at or above 90%. Caltrans is reviewing all facilities in communities with a score at or above 75, but are not all referenced in the table.

Caltrans also recognizes that its buildings have an economic impact on DACs. Caltrans employs individuals for a wide range of positions and skill levels, providing career opportunities for people who have struggled to find work and/or live in DACs.

Roadways located in disadvantaged communities. It's also worth noting that 20.7 percent of SHS lane miles are located in DACs. Caltrans-maintained roadways connect communities throughout California, act as "Main Streets", provide access to all destination types, and serve as a major economic driver. Caltrans' 2016 State Highway Operations and Protection Program (SHOPP) invested 20.2 percent of the program's $6.6 billion budget into DACs.

Although California's transportation system is associated with mobility and economic benefits, it also negatively impacts the health of communities adjacent to the system. Therefore, Caltrans is engaged in multiple efforts to reduce the negative impacts from the transportation system by reducing pollution associated with the system, reducing urban heat island effects with shade and functional green space, absorbing stormwater with green infrastructure, and increasing opportunities for active transportation. All these strategies support community health and resiliency.

Urban Heat Islands

Urban heat islands are areas with localized spikes in temperature, which impact human health, increase pollution, and increase energy demand. Urban heat islands occur during the hot summer months in areas with higher percentages of impervious surface and less vegetation. This is likely in areas with large parking lots, dense development, and lower tree density and shading. Urban heat islands can be mitigated through tree planting and other greening measures, cool roofs (e.g., lighter roofing materials that reflect light), cooler pavements, and other measures.

The seven (7) Caltrans facilities listed in Table 1-9 have greatest increase in heat due to urban heat island effects per day; all of them have large parking lots for operational use that contribute to greater heat.

Table 1-10: Facilities Located in Urban Heat Islands

Facility	Additional Degrees	Located in an urban heat island (yes/no)
Camp Angelus Maintenance Station	10.0	Yes
Banning Maintenance Station	9.5	Yes
Dry Creek Maintenance Station	8.2	Yes
Burnt Mill Maintenance Station	8.1	Yes
Hemet Maintenance Station	7.8	Yes
Elsinore Maintenance Station	7.5	Yes
Equipment Shop 8 and San Bernardino Maintenance Station	7.2	Yes

Data Source: Urban Heat Island Index https://calepa.ca.gov/climate/urban-heat-island-index-for-california/

Adaptation strategies. Urban greening and the use of green infrastructure could be utilized and expanded as part of cooling strategies whenever Caltrans constructs new buildings. Potential strategies include:

- Planting trees in parking areas,
- Using alternative vegetative solutions to alleviate urban heat island, and
- Shading open spaces with trees, especially in parking lots and impervious areas needed for operational facility use that generate high levels of heat
- Installing parking lot canopies with photovoltaic cells to shade parked vehicles while collecting solar energy
- Studying the feasibility of green roofs, additional wall insulation, energy efficient windows, and heat-tolerant air conditioning materials

Further study is also needed on developing a Caltrans facility energy plan for urban heat island effects at buildings. In addition, further study is also needed on the potential applicability of green roofs, additional wall insulation, energy-efficient windows, and heat-tolerant air conditioning materials.

1.5 Understanding Climate Risk to Planned Facilities

Table 1-10 lists new Caltrans facilities with the greatest exposure to identified climate stressors, while Table 1-11 shows planned facilities with the greatest potential to extreme heat events.

Table 1-11: Historic and Projected Temperature and Precipitation Risks to Planned Facilities

Facility	Annual Mean Max Temp. (1961 – 1990)	Annual Mean Max Temp. (2031 – 2060)	Annual Mean Min. Temp (1961 – 1990)	Annual Mean Min. Temp (2031 – 2060)	Annual Mean Precipitation (1961 – 1990)	Annual Mean Precipitation (2031 – 2060)
Mojave MS Crew Building	75.4	80.4	48.5	57.7	5.6	6.2
Southern Regional Equipment Repair	75.8	84.0	53.3	61.4	12.9	14.8
Pacific Place Paint Crew Building	74.1	81.4	54.2	61.8	12.4	15.2
San Bernardino MS Regional Office	78.2	87.1	48.9	58.5	10.9	12.1
Westley SRRA	72.7	81.1	45.8	54.2	9.9	12.4
Austin Road Paint Crew Facility	74.6	82.9	47.9	56.1	11.3	14.0
SFOBB MC3 Training Center	65.9	73.1	50.4	57.5	21.9	27.8

Data Source: Cal-Adapt http://cal-adapt.org/

Table 1-12: Historic and Projected Extreme Heat Events and Planned Facilities

Facility	Extreme heat threshold (EHT)	Average number of days above EHT (1961-1990)	Average number of days above EHT (2031-2060)	Increase in number of days above EHT
Mojave MS Crew Building	94.1	4.3	7	2.7
Southern Regional Equipment Repair	99.1	4.3	27	22.7
Pacific Place Paint Crew Building	94.5	4.3	17	12.7
San Bernardino MS Regional Office	105.8	4.3	48	43.7
Westley SRRA[4]	102.5	4.3	46	42.7
Austin Road Paint Crew Facility	103.1	4.3	41	36.7
SFOBB MC3Training Center	88.3	4.3	16	11.7

Data Source: Cal-Adapt http://cal-adapt.org/

Adaptation strategies. Caltrans will assess additional measures to reduce risk exposure to planned Department facilities associated with climate stressors. The following measures for siting, design, and construction, and operational activities will be considered for implementation:

- Considering different building orientations to limit solar gain into the structure to reduce energy needs
- Installing white roof membranes and/or roof-mounted solar panels that reduce heat generated from rooftops
- Using exterior shading devices on windows
- Minimizing impervious parking lot paving for vehicle parking and circulation; designing all other hardscapes to be pervious; using white-colored concrete or micro-surfaced asphalt with lighter color seals
- Providing landscaping for buildings and parking lot shading
- Providing parking lot canopies with reflective colors and/or solar panels
- Super-insulating building envelope to reduce energy needs

One possible strategy would be to require all designs to contain a certain percentage of hardscape that doesn't contribute to the heat island effect. A policy would be needed because these strategies will increase the cost of the project. This policy would need to be

4 Westley SRRA is in final design stages. Although it already addresses some of the adaptation strategies, others are are not feasible to implement.

applied early in the project scoping phase in order to ensure hardscape and building designs can be properly selected and budgeted.

Table 1-12 lists the facilities from the previous two tables by referencing whether their location is within DACs and/or an urban heat island.

Table 1-13: New Facilities and Disadvantaged Communities and Urban Heat Islands

Facility	Located in a Disadvantaged Community (yes/no)	Located in an urban heat island (yes/no)
Mojave MS Crew Building	No	No
Southern Regional Equipment Repair	No	No
Pacific Place Paint Crew Building	Yes	Yes
San Bernardino MS Regional Office	Yes	Yes
Westley SRRA	Yes	No
Austin Road Paint Crew Facility	Yes	No
SFOBB MC3*5 Training Center	Yes	Yes
Fontana Maintenance Center	Yes	Yes

Data Source: Urban Heat Island Index https://calepa.ca.gov/climate/urban-heat-island-index-for-california/

1.6 Understanding Climate Risk to the State Highway System

While the greater part of this Roadmap focuses on buildings, this section highlights Caltrans' adaptation efforts along the SHS.

Risk from increasing temperatures

As part of Caltrans' ongoing Climate Change Vulnerability Assessments, Caltrans has analyzed and identified vulnerable segments of the SHS by reviewing projections of the seven-consecutive-day maximum temperatures for 30-year-average periods centered on the specific years of 2025, 2055, and 2085. These values were derived for each of the 10 California Global Climate Models (GCMs), including the four required under Representative Carbon Pathway (RCP) 8.5, because they are values used to help select design mixes for asphalt. Caltrans highlighted the change in temperatures according to the median model across the state (CMCC_CMS).

Implications for roadways and Department right-of-way. In general, increasing temperatures alone will not likely have a significant effect on roadway performance. However, in locations where the range of temperature experienced may increase significantly, Caltrans pavement engineers might consider adjusting the material mix for roadway construction materials appropriate for each impacted location.

Changing temperatures will have a larger effect on the landscaping and vegetation within and near the right-of-way. As temperatures rise, existing landscaping will be more exposed

5 San Francisco Oakland Bay Bridge Maintenance Complex 3

to drought. Especially in areas affected by drought, Caltrans will continue to look for innovative and efficient roadside applications to conserve water and tolerate higher temperatures. Additionally, increasing temperatures and drought have made trees more susceptible to bark beetle infestation in certain areas of the state. Caltrans is one of five leading agencies for the state's Tree Mortality Taskforce which has already removed 107,000 dead trees, many of which are near the SHS, at a cost of $2,000 per tree. In order to prevent further cost and damage to the right-of-way and road, Caltrans is removing trees in the "strike zone" — the area in which a tree poses a risk to the roadway. Instead of replanting trees, maintenance crews are stabilizing these slopes by leaving the tree's root-ball and using emulsions to prevent slope deterioration.

Note: More comprehensive analysis of temperature change on roadway and landscaping facilities is underway as part of Caltrans' Climate Change Vulnerability Assessments.

Risk from extreme heat events

*Implications for California's roadways***.** Pavement design and material choice is a critical part of project development. Caltrans analyzes temperature variations at project locations when designing pavement and choosing materials; Caltrans does this in part by using annual daily average minimum and average seven–consecutive-day maximum temperatures. An increase in pavement maintenance issues can create service interruptions on highways and lead to higher costs for Caltrans. Rising temperatures could lead to a number of design concerns, including fluctuating water saturations, varying ground conditions, and higher levels of pavement stress. Therefore, Caltrans planners work with pavement engineers and testing labs to ensure that roadway design standards will continue to withstand larger daily variations in temperature.

Note: An analysis of extreme heat impacts to roadways is not currently included as part of Caltrans' Climate Change Vulnerability Assessments. The increase in average high and low temperatures described in the previous section (Risk in Increasing Temperatures) are considered the primary metrics of concern with regard to risks to roadways.

For roadway design, Caltrans will review its process for selecting asphalt binder. This material is chosen based primarily on temperature ranges at different locations, so Caltrans will need to review its regional specifications to determine whether changes should be made to the design mix.

Other implications. Extended periods of high temperatures will affect safety conditions for employees that work long hours outdoors. Right-of-way landscaping and vegetation will also have to survive longer periods of high temperatures.

Wildfires associated with extreme heat are also a concern. Caltrans is evaluating the increased risk of wildfire associated with extreme heat and changes in vegetation due to changing weather patterns. Generally, facilities in the Central Valley, high desert, and desert (southeastern California) are expected to encounter the greatest impacts from extreme heat.

Mitigation strategies. Caltrans has already taken steps to mitigate the effects of climate change in the highway right-of-way. Caltrans reduced water usage by 62 percent between 2013 and 2016. Caltrans' Division of Maintenance and Landscape Architecture Program continues to install drought-tolerant plants and water-efficient irrigation components, including smart irrigation controllers, to reduce the need for watering in the right-of-way.

Caltrans could also educate bicyclists and pedestrians about heat illness prevention and treatment. In order to provide shade on high-heat days, Caltrans will consider constructing shaded sidewalks and paths, as well as shelters at bus stops, along non-motorized facilities. Where possible, open-grade asphalt, which is pervious, is used to increase water infiltration.

Risks from changes in precipitation

*Implications for California's roadways***.** Increased precipitation significantly affects California's transportation assets in a number of ways including flooding, landslides, washouts, and structural damage. Culverts can be clogged by debris associated with heavy rainfall, causing water to flow along the highway and undermine the roadbed. Heavier snowstorms can cause delays and closures of roadways. In certain locations, entire sections of roads can be undermined and washed away, taking months to repair or replace. Bridges can also experience increased riverine flooding and temporary inundation. Coastal and estuarine roadways could experience more frequent closures when flooding is combined with higher sea levels and storm surge. Caltrans experienced several of these effects in 2017 when the state experienced record-setting precipitation.

Higher rates of precipitation can also lead to severe mudslides that temporarily close the highway, especially in regions that recently experienced severe wildfires. Roads along steep slopes are prone to slipouts, while roads at the base of floodplains may experience washouts during heavy rainstorms.

*Adaptation strategies***.** Caltrans has several measures in place to mitigate impacts to highways and bridges. The Division of Maintenance's Scouring Prevention Program conducts scour evaluations of all state and local bridges to identify whether precipitation and flooding have eroded the support for the bridge. The Maintenance Division also has a Culvert Inspection Program that maintains an inventory of those assets and assesses their physical condition.

Caltrans could develop adaptation strategies, including:

- Where downstream properties would not be impacted, resizing culverts in areas with expected higher precipitation based on climate change projections
- Upstream detention or retention facilities
- Clearing debris from watersheds
- Including green/natural infrastructure in designs that can reduce runoff affecting facilities
- Realigning roadway along steep slopes prone to slipouts

- Utilizing pervious pavement where reasonable depending on vehicle weight and traffic volume

Ongoing evaluation. Caltrans' Climate Change Vulnerability Assessments will analyze projected impacts from changing precipitation. Measurements used in these assessments will focus on the percentage change in 100-year storm precipitation depth and intensity, since Caltrans often designs culverts and roadways to these specifications /metrics. The 100-year storm value has been analyzed for 30-year-average periods centered on the specific years of 2025, 2055, and 2085. This value was derived for each of the 10 California GCMs, including the four required, using both RCP 4.5 and RCP 8.5. Caltrans highlighted the change in precipitation according to the median model (HadGEM2-CC), but will further investigate methods for applying additional or different modeled outputs when evaluating the risk to projects.

Determining which roadways are at greatest risk from changing precipitation (specifically increased precipitation) will require further study since there is a range of analysis methods that may be useful and will require varying levels of input. Therefore, the timeline for implementation will be dependent on the analysis method selected. Caltrans planners and stormwater/hydraulic engineers are working together to develop methods for statewide assessment of at-risk assets and project design analysis.

Risks from Sea Level Rise

Caltrans is analyzing the expected impacts of sea level rise (SLR) on roadways across the state as part of Caltrans' Climate Change Vulnerability Assessments. Caltrans is using data extracted from the CoSMoS model to identify specific postmiles along the SHS exposed to sea level rise and storm surge at 0.25 meter increments up to 2 meters, and a high value of 5 meters. These outputs are being generated for the entire coastline.

Urban Heat Island

Caltrans has studied urban heat island effects in relation to different roadway materials and is continuing to investigate potential treatments that could help reduce urban heat islands.

1.7 Additional Climate Adaptation Strategies

Natural Infrastructure

The Water and Wastewater (W&WW) Branch (located within the Caltrans Division of Engineering Services) identifies natural and green infrastructure solutions in all Advanced Planning Studies (APS) prepared for projects. These project alternatives reduce environmental impacts by reducing water and energy use, travel costs, greenhouse gases, etc. Some of the project alternatives include wetlands, anaerobic reactors, water recycling technology, Supervisory Control and Data Acquisition (SCADA) Electrical Systems and Ultra-low and waterless toilet fixtures.

Caltrans began implementing some of these strategies during the recent drought. Caltrans developed new practices to save water at facilities through underground drip irrigation systems, advanced recycling of wastewater, and waterless urinals. All facilities that are responsible for washing Caltrans' vehicles use "wash racks" where the wastewater is diverted and treated before discharge to protect environment and surrounding communities.

Full Life-Cycle Cost Accounting

EO B-30-15 directs state agencies to employ full life-cycle cost accounting in all infrastructure investment. Lifecycle cost accounting includes:

- Considering initial investment costs, as well as lifetime operation and maintenance costs under changing climate conditions, including changing average conditions and increases in extreme events.
- Applying non-market evaluation methods such as travel cost, avoided costs or contingent valuation to capture hard to quantify benefits and costs

In response to Caltrans' efforts to incorporate "life-cycle cost" accounting into programs and district processes, the Division of Transportation Planning's Transportation Economics Branch (TEB) conducted a 2017 cursory review of existing practices. The Branch discovered the application of this methodology is inconsistent or differs throughout Caltrans' district offices and departmental programs. In some instances, efforts differed from the traditional definition of a life-cycle cost analysis (LCCA) or there was a lack of guidance for incorporating LCCA into a program's assessment. This issue is evident with the SHOPP, where life-cycle cost analysis guidance and tools are available for less than 10 percent of projects (roughly 24 percent of the program's budget). Caltrans' SHOPP Pavement Programs 120 and 122 are the only ones that established LCCA guidelines and tools (RealCost 2.5.3CA). Guidelines for assessing adaptation projects by way of the life-cycle cost methodology do not currently exist. However, the Caltrans' Strategic Management Plan established a target that all SHOPP projects include a LCCA by 2020.

TEB published a white paper proposing a life-cycle work group/technical advisory committee be created consisting of internal subject matter experts. The goal of the work group, if established, would be to define and develop a uniform application of life-cycle cost analysis by clearly defining the methodology and developing guidance, tools, and recommendations for adoption. In the long-run, these guidance, tools, and recommendations would be a base methodology that programs and district offices could build upon and adjust to specific needs, including "adaptation." At a minimum, work group members would provide their program or district with a basic understanding of the life-cycle cost methodology. If implemented, TEB estimates this effort might take between 18 to 24 months to complete.

Caltrans' Division of Engineering Services uses life-cycle considerations in Caltrans facility design by utilizing enhanced material finish specifications or products that require less preventive maintenance. These additional steps increase initial costs, but allow for a longer maintenance interval. Whether the steps consists of a better finish on structural steel, use of a waterproof sealer on masonry or concrete, or better paint quality for wood, they all contribute to a more sustainable building and future savings on maintenance costs.

The Advanced Planning Studies (APS) conducted by the division's W&WW Branch (discussed in the Natural Infrastructure section) identify operation and maintenance (O&M) and capital costs for all project alternatives. In addition, each APS identifies environmental impacts (water quality, air, solid waste, etc.) and recommends alternatives based on costs and impacts.

1.8 Integrating Climate Change into Department Planning and Funding Programs

The following three tables list Caltrans' methodology, plans, engagement strategies, and activities for integrating climate change adaptation into planning and funding:

Table 1-14: Integration of Climate Change into Department Planning

Plan	Is Climate Addressed?	If no, when will it be integrated?	If yes, how has it been integrated?
California Transportation Plan	Yes	n/a	The Plan supports the state's climate goals and renewable energy goals, as described by CTP Goal 2, Policy 3: "Adapt the Transportation System to Reduce Impacts from Climate Change"
RTP Guidelines	Yes	n/a	Regional Transportation Planning Areas are encouraged to integrate policies and strategies that support state climate change policies in the development of Regional Transportation Plans
Pre-PID Project Nomination Process	Yes	n/a	As criteria in the scoping of all Caltrans projects
W&WW APSs	Yes	n/a	Preparation of each APS
California Aviation System Plan	No	December 2018	n/a

Table 1-15: Engagement and Planning Processes

Plan	Does this plan consider impacts on vulnerable populations?	Does this plan include coordination with local and regional agencies?	Does this plan prioritize natural and green infrastructure?
W&WW APSs	Yes	Yes	Yes
Planning Public Engagement Contracts	Yes	Yes	No
California Aviation System Plan	Yes	Yes	No, but recommended

Table 1-16: Climate Change in Funding Programs

Grant or funding program	Have you integrated climate change into program guidelines?	If no, when will it be integrated?	Does this plan consider impacts on vulnerable populations?	Does this program include coordination with local and regional agencies?
State Transportation Improvement Program	Yes		Yes	Yes
Congested Corridors Program	Yes, within the secondary criteria under "Efficient land use"		Yes. It has criteria for the change in cumulative job access for disadvantaged populations, and reductions in pollutants.	Yes
Trade Corridors Enhancement Program	Partially. It is one of the goals listed from the Sustainable Freight Action Plan that may be addressed in applications.		Yes	Yes
SHOPP Program	Ongoing	2019	Not directly. It has metrics to improve air quality and health through active transportation and transit. It also prioritizes preventing closure of rural roadways where redundant routes are not available.	No
Active Transportation Program	Yes; one of the program's goals is to "achieve greenhouse gas (GHG)		Yes	Yes

Grant or funding program	Have you integrated climate change into program guidelines?	If no, when will it be integrated?	Does this plan consider impacts on vulnerable populations?	Does this program include coordination with local and regional agencies?
	reduction goals" of SB 375 and SB 391			
Transit and Intercity Rail Capital Program (TIRCP)	Yes; the program addresses climate change by requiring projects to show GHG emission reduction.		Yes; a percentage of projects must meet specified Disadvantaged Community and Low-Income Community requirements.	Yes; local and regional agencies, specifically transit agencies, can apply.
Low Carbon Transit Operations Program (LCTOP)	Yes; the program addresses climate change by requiring projects to show GHG emission reduction.		Yes; a percentage of projects must meet specified Disadvantaged Community and Low-Income Community requirements.	Yes; local and regional agencies, specifically transit agencies, receive an allocation.

1.9 Measuring and Tracking Progress

Caltrans faces numerous challenges from climate change, especially to building and roadways. Caltrans is developing procedures for tracking changing climate conditions at these facilities.

Buildings

Caltrans' buildings face flood risks from heavier precipitation and heat waves from increasing temperatures. Caltrans currently does not have a structured method for tracking changing climate conditions at facilities, but will work to establish and implement a tracking methodology.

Roadways

In regard to the highway system, Caltrans faces different challenges in each region. Coastal regions face rising sea levels and storm surge, while Central Valley and desert regions will be increasingly susceptible to drought. Lastly, mountainous regions are at greatest risk from fires and landslides/mudslides when heavy precipitation follows a burn. Caltrans does continually compile data from emergency maintenance events on the state's roadways caused by weather. This data will help Caltrans create a baseline of climate impacts from which changes can be measured. The Division of Transportation Planning is working with the Divisions of

Maintenance and Emergency Management to coordinate and improve existing reporting procedures for emergency maintenance projects to clearly identify when failures are caused by climate events on roads and highways.

Measuring progress toward goals

In 2018, Caltrans is conducting a Department-wide review to establish a baseline of climate change adaptation efforts currently underway. Following this review, Caltrans is conducting vulnerability assessments to identify segments of the State Highway System that are vulnerable to the impacts of climate change including sea level rise, storm surge, changes in precipitation and heat, and increased wildfire. Using the findings of the vulnerability assessments, Caltrans will develop and implement adaptation measures to enhance the resiliency of the State Highway System. Upon development of adaptation measures, measurement processes will be implemented.

Flexibility and adaptability in long-term planning

Caltrans is working with climate scientists, other state agencies, and local and regional partners to develop new planning and design methods that incorporate climate change. In order to build flexibility and adaptability into long-term planning, Caltrans must understand the probability and range of multiple future climate scenarios, and then make decisions accounting for the associated risks of climate change. This requires close coordination between all stakeholders since decisions must incorporate the best estimates of climate change, costs, impact to communities, and impact of these decisions on the operation of the transportation system. As part of the Climate Change Vulnerability Assessments, Caltrans is working with cities, counties, regulatory bodies, climate researchers, federal counterparts, and scientific organizations, among others. Caltrans is in continual communication and coordination with these stakeholders and is dedicated to developing planning solutions that support and address the needs of each community at risk. Additionally, Senate Bill 1 dedicates $20 million to local and regional agencies for climate change adaptation planning. Caltrans developed the grant program guidance and evaluation criteria in consultation with an interagency working group. The first cycle of funding, totaling $7 million and supporting 21 projects across the State, was awarded in December 2017. The call for projects for the second cycle of funding was announced in January 2018.

Integrating climate change into infrastructure investment

Director's Policy 30 (DP-30) on Climate Change was signed on June 22, 2012. It requires all Caltrans divisions and programs, as appropriate and feasible, to "incorporate climate change mitigation and adaptation considerations into all facets of operations, and [to] work to partner with local, State, federal entities, and other stakeholders as appropriate to coordinate climate change related activities."

Caltrans is continuously reviewing the project development process to integrate climate change into each phase of project planning and delivery. The Division of Transportation Planning has released guidance to identify each project's risk from climate change, and to the extent possible coordinate with existing local/regional vulnerability assessments and adaptation plans during

the project scoping phase. The Transportation Asset Management Program has a "Multi-Objective Decision Analysis" (MODA) approach for project prioritization within Caltrans' SHOPP. Goal 3 of MODA, "Stewardship and Efficiency," includes a methodology for calculating and incorporating the expected cost of road closures due to hazards, which accounts for one likely impact of future climate conditions.

Caltrans will soon begin a Department-wide assessment of all policies, plans, and procedures to identify and provide guidance for remaining steps in the project development process where climate change should be incorporated. This assessment is expected to be completed by 2020.

Identifying and prioritizing natural and green infrastructure investment

Caltrans has partnered with non-profit organizations, research universities, and local and regional agencies on adaptation pilot projects to establish natural and green infrastructure designs that could reduce or eliminate expected climate impacts. Once effective methods and design solutions are identified, Caltrans will provide guidance to help project managers and external partners include these options in their project scoping, design, and selection processes. Funding for adaptation strategies that emphasize green infrastructure will be a continuing challenge. Caltrans will work with governmental and non-governmental partners to identify funding sources for high-priority projects.

1.10 Adaptation Commitments and Actions

Table 1-17: Adaptation Commitments

I-1. Adaptation: Identify, plan, and prepare for climate change risks to department assets (the Roadmap focuses on assets other than the State Highway System).		
Commitments	**Participating Department Units**	**Deadline**
I-1.C1: Convene cross-functional Adaptation Working Group to agree to actions, responsibilities and deadlines. Actions to be considered are listed in Table A-1A. Focus the Department's building related adaptation efforts on Caltrans-owned office buildings and buildings managed by the Maintenance and Operations Program that together account for 75% of Caltrans building facilities.	Sustainability (lead) Business Operations Traffic Operations Maintenance Equipment Transportation Planning Information Technology	9/30/18
I-1.C2: Continue participation in Administration-wide efforts including Safeguarding California and the Climate Safe Infrastructure Working Group.	Sustainability Design	Ongoing
I-1.C3: Develop communications and training material focused on climate adaptation and resilience in connection with the Department's sustainability priority "Prepare for climate change and extreme weather".	Sustainability	12/31/18
I-1.C4: Continue activities to integrate climate planning into the Department's planning and design activities (note: while some of these activities pertain to the Department's building assets that are the focus of the Roadmap, many relate to the State Highway System).	Transportation Planning Environmental Analysis Design	Ongoing

Note: See Climate Adaptation Roadmap Sections 1.6-1.9 for summary information about Department activities relating to Adaptation of the State Highway System

Table 1-17A: Adaptation Actions

Actions	Participating Department Units	Deadline
Actions items agreed upon:		
I-1.1: Obtain climate data from Cal-Adapt for all building facilities and finalize list of at-risk buildings.	Transportation Planning (lead) Sustainability	6/30/18
Potential Actions:		
I-1.1P: For all at-risk facilities, assess risks and state of repair, using the climate data provided by Transportation Planning.	Business Operations Equipment Shops Maintenance Traffic Operations	
I-1.2P: Create adaptation implementation plans specifying suitable adaptation strategies (including natural infrastructure) to increase resiliency of facility elements at risk, and project priorities.	Business Operations Equipment Shops Maintenance Traffic Operations	
I-1.3P: Create strategies and standards for building facility landscaping that help address urban heat islands (UHI).		
I-1.4P: Submit list and cost of facility improvements for at risk facilities for update of the 5-year plan and the Facility Infrastructure Plan.		
I-1.5P Establish and implement a methodology for tracking climate change conditions at facilities.		

2. ENERGY ROADMAP

2.1 Background

This Energy Report summarizes Caltrans' progress toward meeting the Governor's sustainability goals related to energy in buildings. This report identifies successful accomplishments, ongoing efforts, and outstanding challenges, and provides a report on Caltrans' activities to the Governor and the public.

The following table lists different types of buildings owned and operated by Caltrans, and energy use by type. It should be noted that leased facility energy data is not included in this report due to the inability to access billing information. Table 2-2 summarizes Caltrans' total energy purchases in 2016.

Table 2-1: Caltrans Facility Types

Building Type	# of facilities	Floor area (ft^2)	2016 Site Energy (kBTU)
CVEF	33	n/a	Reported by CHP
Equipment Shop	26	671,327	19,856,789
Laboratory	16	358,208	15,652,051
Maintenance Station*	369	3,370,745	94,252,881
Office	12	2,283,612	153,437,922
Resident Engineer (RE) office**	2	7,917	264,739
Safety Roadside Rest Areas (SRRAs)***	86	239,396	n/a
TMC	5	263,745	47,860,346
Toll Plaza****	2	14,950	2,311,482
Warehouse	1	102,558	1,687,259
Total	**552**	**7,312,458**	**335,323,469**

*The number of Maintenance Stations includes storage facilities used to only store material used for traveler safety.

**Most of the RE offices are leased for the construction phase of a project

***SRRA energy has not been uploaded due to trouble with the uploading initiation process.

****Most toll plazas share energy meters with the toll bridges so they are not included.

Table 2-2: Total Purchased Energy* 2016

Purchased Utility	Quantity	Estimated Cost ($)
Electricity	68,126,264 kWh	$46,777,624
Natural Gas	1,028,767 therms	$ 86,828
Total cost	---	**$46,864,452**

*The estimated cost of electricity and gas are based on the 2016 average commercial customer price of 13.95 cents per kWh and 8.44 cents per therm respectively, found on the U.S. Energy Information Administration website (www.eia.gov). Energy use from SRRAs and CVEFs have not been included.

Moving toward sustainability

Caltrans has made significant progress toward meeting the Governor's energy efficiency goals. Caltrans has begun converting indoor lighting to light-emitting diodes (LEDs) at district offices and maintenance stations. Outdoor lighting at maintenance stations has already been upgraded to LEDs. Those changes are anticipated to result in an annual energy savings of 30 percent in facility lighting when completed. Caltrans district offices are some of Caltrans' largest buildings by square footage and consume large amounts of energy. Maintenance stations are some of the smallest facilities, but their sheer number (70 percent of all Caltrans facilities) and age (many are older, with lighting systems containing old fixtures and bulbs) mean these locations will generate significant savings once retrofitted with more efficient equipment. These categories of buildings will be the focus of energy and water conservation efforts in this Roadmap cycle.

Outreach efforts

Caltrans has integrated sustainability into Caltrans' public affairs efforts. The Caltrans External Affairs Program produces a quarterly performance report called the "Mile Marker" that focuses on Caltrans' progress toward meeting its five strategic management goals: safety and health, stewardship and efficiency, sustainability, livability and economy, system performance, and organizational excellence. The third goal — sustainability, livability and economy — requires Caltrans to "make long-lasting, smart mobility decisions that improve the environment, support a vibrant economy, and build communities, not sprawl." The Mile Marker tracks efforts to meet this goal by including stories about Caltrans' larger projects, including sustainability initiatives that make the most significant impact. For example, the 2015 second quarter issue includes articles related to water and energy efficiency projects. The article titled "Serious Work Underway at Caltrans to Combat Drought" discusses Caltrans efforts to reduce water usage for irrigating highway landscaping. Another article in the same issue, "Sustainable Signs Shine without Electricity," details efforts to replace lighted highway signs with retroreflective signs that don't require electricity because they are fully illuminated by headlights.

Facilities planning

Caltrans has completed a five-year Facilities Infrastructure Plan (FIP)[6] highlighting new buildings or facilities approved for funding in the upcoming fiscal years. Based on the current version of the plan, Caltrans does not have any programmed projects for office buildings. However, Caltrans is committed to ensuring that the following proposed facilities (and other future projects) adhere to requirements in EO B-18-12

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6 Caltrans submits this plan every year to the California Department of Finance (DOF). In order to meet DOF requirements, the plan provides information on Caltrans' office building infrastructure deficiencies and requested projects for new, rehabilitated, modernized, improved, or renovated office building infrastructure. Caltrans presents additional information in the Facilities Infrastructure Plan (FIP) that is not part of the DOF reporting requirements including descriptions of Transportation-Related Facilities (TRFs), programmed TRF project information, and an overview of departmental resource conservation efforts.

- Equipment Shops
    - The District 7 Southern Regional Equipment Repair Shop in Santa Fe Springs is funded and began project design in Fiscal Year (FY) 2016-2017. This project will replace and consolidate Shop 12 in Orange County (closed due to safety and operational concerns) and the existing Commerce Sub-Shop in Los Angeles County. Both facilities were built in the 1960s and 1970s, and contain asbestos and/or lead paint. Neither of the existing facilities has adequate space for functional operation and equipment and vehicle storage.
- Laboratories
    - The District 1 Materials Laboratory (Lab) in Eureka will be funded for seismic retrofit and renovation design in FY 2020-21. This project will seismically retrofit and renovate the existing Eureka Materials Lab, which is more than 50 years old and does not meet operational needs. The new project will better accommodate new state-of-the-art testing equipment and provide a safer work environment for personnel.
    - The District 4 San Bruno Materials Lab Replacement project will be funded for project design in FY 2020-21. The existing laboratory facility, built in 1963, is obsolete and was closed due to numerous health, safety, and operational deficiencies. The project will include equipment testing areas to accommodate current testing methods, and provide a safe work environment for its personnel.
- Maintenance Stations
    - District 2 has funding to begin project design on a maintenance station in Adin in FY 2018-19. The project will replace the office/crew building, equipment storage bay, covered storage canopy, salt storage building, and detention basin, and repave the ground to accommodate trucks entering and exiting the facility. The existing facility, built in the 1960s, has exceeded its service life, has inadequate work space and is operationally deficient. Furthermore, the National Pollutant Discharge Elimination System (NPDES) requirements for storm water runoff need to be addressed.
    - The District 3 Sand/Salt Storage Facility in Floriston was funded for project design in FY 2016-17. The existing facility is operationally deficient, has exceeded its service life, is in deteriorating condition, and could be contributing to negative environmental impacts on the Truckee River.
    - The District 4 San Francisco Oakland Bay Bridge (SFOBB) Maintenance Complex Phase 3 Training Facility was funded for project design in FY 2016-17. The project includes a new maintenance training facility to consolidate all District 4 maintenance training to one location. In doing so, it will support the toll bridge maintenance program and ensure efficient safety training for maintenance employees and new hires.
    - The District 6 Maintenance Station Replacement project in Mojave was funded for design in FY 2016-17. The project will demolish the existing facility (which

has exceeded its service life and is operationally inefficient) and construct a new crew room and equipment storage building, and also modify the existing wash pad.

- The District 8 Maintenance Facility in San Bernardino is funded for project design in FY 2018-19. The project will consolidate staff that currently works in three different locations. This project will expand the maintenance station's capabilities as the North Regional Manager Regional Headquarters and alternative Emergency Operations Center.
- The District 8 Maintenance Station in Fontana will be funded for project design in FY 2020-2021. This project will be located adjacent to the Southern Regional Laboratory and Inland Empire Transportation Management Center (which also serves as an Emergency Operations Center). This project will reduce emergency response times to State Route (SR) 210; the next-closest station to SR 210 is the Magana-Ortega Maintenance Station, which means emergency response times for crews can be as much as 50 minutes.
- The District 1 Maintenance Facility in Idlewild is funded for project design in FY 2021-22. The project will replace the equipment service bay building, backup generator, and water supply pipe. The existing facility has exceeded its service life and is operationally deficient.
- The District 9 Maintenance Station Expansion project in Tehachapi has been proposed for funding in FY 2020-21. The project will relocate the existing station to a more suitable site in the Tehachapi area. New utilities, crew and office building, mechanic facilities, truck shed and an upgraded electrical system will be constructed at the new site. The existing facility is functionally obsolete and yard space is operationally deficient for crews and equipment. The existing building also does not comply with current building codes and Americans with Disabilities Act (ADA) laws.

Challenges

Caltrans has faced several challenges while working to meet the Governor's energy efficiency goals, such as:

- Lack of staff and financial resources to implement energy efficiency actions due to competing priorities, such as safety projects and repairing/replacing old infrastructure and equipment that have a minimal impact on energy use
- Key energy efficiency elements (such as photovoltaic panels for renewable energy which are required to offset energy usage for Zero Net Energy (ZNE)) often get reduced or cut during the design phase due to a lack of funding.
- Determining how to model renewable energy needs for new Caltrans buildings. By 2025, all new state buildings and 50 percent of existing buildings must consume ZNE — meaning every California government facility will likely need to start producing renewable energy (see following section). However, Caltrans often can't predict its

energy needs at facilities with “process loads,” meaning energy consumption from industrial and/or mechanical work. Process loads can fluctuate; sometimes there are high amounts of energy demand and other times there is little demand. Balancing this demand becomes harder with renewable energy compared to grid energy, especially because utility companies usually don’t accept surplus renewable energy. For that reason, Caltrans’ building designers will need to walk a fine line between over and under-generating renewable energy.

- Issues with potential sites for solar installation. Caltrans has reviewed several sites, but these reviews discovered significant challenges including snow, low amounts of sunlight, and roofs that were either too small or not strong enough to withstand the load of the solar panels. The original Clean Renewable Energy Bonds (CREBs) project sites were set for approximately 90 sites, but after re-evaluation only 70 sites were installed. The re-evaluation criteria considered the age, condition and design of the roof, the long-term building retention, the structural integrity, and a cost-benefit analysis.
    - Caltrans was utilizing traditional track monitoring, manual meter readings, and created a database in which monthly data readings were manually recorded. However, it was determined that traditional track monitoring led to inaccuracy of data collection, inability to detect breakdowns in a timely manner and inability to optimize production. Caltrans has contract with a third-party vendor to remotely monitor and report the monthly solar power production. As of December 2017, Caltrans has the ability to monitor 61 sites.

The following table shows the Caltrans buildings with the most energy consumption. These locations are opportunities for greater conservation and efficiency and will be among those targeted in this roadmap cycle:

Table 2-3: Properties with Largest Energy Consumption

Building Name	2016 Site Energy (kBTU)	Floor Area (ft^2)	Source EUI[7] ($kBTU/ft^2$-yr)
District 7 Office	43,036,910	716,200	165
District 4 Office	33,256,314	525,000	163
District 8 Office	32,688,833	235,714	332
Los Angeles Regional TMC	17,269,335	82,300	520
DOT Headquarters Office Building, Sacramento	14,935,919	462,392	101
Total for Buildings in This Table	141,187,311	2,021,606	---
Total for All Department Buildings	335,323,469	7,312,458	---
% of Totals	**42%**	**25%**	---

Note: Energy use from SRRAs not included.

2.2 Zero Net Energy (ZNE)

A building produces ZNE when its total energy consumption is equal to the amount of renewable energy produced at the same facility. The Governor has set forth the following milestones for state buildings to achieve ZNE status:

- 2020: 50 percent of new construction and major renovations will be ZNE
- 2025: 100 percent of new construction & major renovations will be ZNE
- 2025: 50 percent of total existing building area will be ZNE

DGS released the following ZNE guidelines for state agencies (MM 17-04 "Zero Net Energy for New and Existing State Buildings") in October 2017:

- All new state buildings, major renovations, and build-to-suit leases beginning design after October 23, 2017, and as many as possible already begun, shall be designed and built following cost-effective energy efficiency strategies for achieving ZNE.
- Departments shall work to improve energy efficiency in existing buildings in the most cost-effective manner to meet or exceed energy efficiency targets established in energy efficiency strategies for achieving ZNE.
- Renewable energy generation shall be added to state facilities either onsite and/or offsite to achieve EO B-18-12 targets by following renewable energy generation prioritization and strategies.

Caltrans is actively exploring paths to achieve ZNE. Caltrans' existing buildings do not have any square footage confirmed as ZNE; however, the new San Francisco-Oakland Bay Bridge (SFOBB) Warehouse (Phase2) building was designed with ZNE considerations and is now complete and

7 Source energy used to determine source EUI represents the total amount of raw fuel that is required to operate the building. It incorporates all transmission, delivery, and production losses.

has approval to be occupied (early January 2018). Once occupied it will require a full calendar year of energy monitoring to confirm ZNE status. Caltrans also hired a consultant to analyze existing facilities to determine the best sites for installing renewable energy and potentially ZNE[8].

New Construction

The Caltrans SFOBB Warehouse (Phase 2) is one of the first ZNE pilot projects for the state. The SFOBB Warehouse is part of the larger SFOBB Maintenance Complex that will replace the old existing Toll Bridge Maintenance Facility. The facility's ZNE design was modeled numerous times using EnergyPro software. Part of the design also includes meters for electricity, gas and solar. These meters and an online dashboard will enable Caltrans to verify energy usage after completing construction. The project has been delayed to December 2018 due to unforeseen issues with the fire sprinkler system. ZNE verification will be performed one year after construction is completed and all systems are fully operational.

As of November 2017, Caltrans does not have any other proposed ZNE facilities. The Division of Engineering Services (DES) intends to create a guidance document in early 2018 to ensure ZNE is considered in future Advanced Planning Studies and Project Initiation Documents. This document will identify high-efficiency system designs to help meet target energy use ratings required for ZNE facilities; energy modeling to determine yearly energy use; photovoltaic system sizing and yearly renewable energy production needed to offset energy consumption; and energy monitoring systems to track power use and generation to allow ZNE evaluation. While DES can create a ZNE guidance document it will be a challenge to find funding for the additional design hours and system cost for ZNE building designs.

Existing Facilities

The Caltrans Sustainability Program has identified 41 Department buildings[9] that consume high amounts of energy and could install solar panels to reduce consumption from the grid. Twenty of these sites already have panels and require additional investigation to assess their energy needs.

Table 2-4 compares Caltrans' total square footage of all buildings compared to square footage that adheres to ZNE standards.

8 The Sustainability Program hired a consultant from Sperry/KPMG to complete this analysis and prepare a Request for Information (RFI) to install solar panels at the identified sites; the RFI is currently on hold.

9 These sites were identified as part of the Sperry/KPMG analysis.

Table 2-4: Zero Net Energy Buildings

Status of ZNE Buildings	Number of Buildings*	Floor Area (ft^2)
Under Construction or Completed	1	28,000
Building In Design	0	0
Building Proposed for Before 2025 (but not yet in design)	0	0
Totals for ZNE Buildings	**1**	**28,000**
Totals for All Department Buildings	**444**	**7,048,390**
% ZNE	**0.2%**	**0.3%**

*128 facilities included in the total number of buildings are sheds used to store equipment and materials for roadway maintenance activities, or are SRRAs that would not benefit from renewable energy.

2.3 New Construction Exceeding Title 24 by 15 percent

All new state buildings and major renovations designed after July 1, 2012 must exceed energy standards in California Code of Regulations (CCR) by at least 15 percent. Table 2-5 includes Caltrans buildings that meet this requirement.

Table 2-5: New Construction Exceeding Title 24 by 15 percent

Facility	Completion Date	Percentage Exceeding Title 24
Phillip S. Raine Safety Roadside Rest Area (SRRA)	October 2012	73%
Gaviota SRRA crew building	February 2014	28%
Lee Vining Maintenance Station crew building	September 2014	15%
Mojave Maintenance Station mechanics' facility	July 2015	15%
West Sacramento Maintenance Station crew room	Recently completed	33.7%
*Dunsmuir Grade Commercial Vehicle Enforcement Facility (CVEF)	In construction	6.5% (as designed)
SFOBB Maintenance Complex Warehouse (Phase 2)	In construction	22% (as designed)
El Centro Maintenance Station sub-shop (Phase 2)	In construction	13.2% (as designed)
Mojave Maintenance Station	In construction	20% (as designed)
Westley SRRA	In design phase	30% (as designed)

*Note: the Title 24 compliance percentage for the Dunsmuir CVEF facility design was lower because much of the building wasn't modified, but the entire building was included in the energy model calculations.

2.4 Reduce Grid-Based Energy Purchased by 20 percent

Executive Order B-18-12 requires state agencies to reduce grid-based energy purchased by 20 percent by 2018, compared with a 2003 baseline. There are numerous Management Memos and State Administrative Manual (SAM) sections that support this goal and provide direction.

Basic Policy 4819.31

The California Department of Technology's Basic Policy 4819.31 (item 13) requires state agencies to implement power management practices on all desktop and laptop computing devices, printers, copiers, scanners, and monitors. According to this policy, devices not in use for 30 minutes should be set to automatically go into energy-saver mode and all devices should be shut down at the end of the day.

All Caltrans workstations and laptops have power management software installed. Caltrans uses a system called Verdiem that enables Department employees to centrally control and reduce the energy used by personal computers. The system maximizes energy savings by placing machines into a lower power state without interfering with end-user productivity, desktop maintenance, or upgrades.

Management Memo 14-09

Management Memo 14-09 ("Energy Efficiency in Data Centers and Server Rooms") includes the following directives:

- All state-owned and leased data centers and server rooms greater than 200 square feet must be operated within the American Society of Heating, Refrigerating, and Air-Conditioning Engineers – Technical Committees (ASHRAE-TC) 9.9, Class A1-A4 guidelines, including operating at temperatures between 73-81 degrees Fahrenheit.
- All state-owned data centers over 1,000 square feet must report their power usage effectiveness (PUE) to the California Department of Technology each year.
- All state-owned data centers over 1,000 square feet with a PUE above 1.5 must reduce their PUE by a minimum of 10 percent per year until they achieve a PUE of 1.5 or lower.

Table 2-6 includes a list of Caltrans buildings with data centers over 1,000 square feet and the PUE measured in October 2016. Caltrans hired a consultant to measure PUE at office buildings with data centers over 1,000 sq. ft. Caltrans has not measured its Transportation Management Centers (TMCs). However, Caltrans needs a more efficient and cost-effective way to measure PUE in all facilities, including installing meters to give employees the ability to instantly read consumption data rather than relying on experts and/or technicians.

Table 2-6: Data centers over 1000 square feet and their PUE

Location	Address	Size (sq. ft.)	PUE
District 3 Office*	703 B Street, Marysville, CA 95901	1,800	1.77
District 4 Office	111 Grand Avenue, Oakland, CA 94612	3,000	1.74
District 7 Office	100 S Main St. Los Angeles, CA 90012	4,400	1.5
District 8 Office	464 W. 4th Street, San Bernardino, CA 92401	1,792	2.92
District 11 Office (lease)	4050 Taylor Street, San Diego, CA 92110	1,760	1.8
District 7 TMC	2901 West Broadway, Los Angeles, CA 90041	1,200	**
District 11 TMC	7183 Opportunity Road, San Diego, CA 92111	1,200	**
District 12 TMC	6681 Marine Way, Irvine, CA 92618	2,040	**
HQ Office	1120 N Street, Sacramento, CA 95814	2,584	2.4
Farmer's Market Plaza Building (lease)	1801 30th Street, Sacramento CA 95816	1,102	3.34

* Buildings owned by DGS

** The PUE readings in these buildings are scheduled to be completed by December 2017.

Caltrans has paused planning efforts to lower PUE until it finds the best way to measure usage.. As of now, District 4 has replaced two (2) Liebert systems in its office with more efficient models, and Information Technology (IT) staff are replacing the universal power supply (UPS) systems. Caltrans staff intend to meet with contractors to determine costs associated with reducing the PUE in the Headquarters and Farmers Market Plaza buildings.

IT standards for energy efficiency. Caltrans' purchases of network switches and routers meet the Energy Efficient Ethernet IEEE 802.3-2012 Section 6 standard. Caltrans also uses the Cisco Discovery Protocol (CDP) with attached Cisco devices, saving energy whenever the devices are inactive.

Additionally, the Division of Infrastructure Management Division's Server and Storage Management Section has fully implemented virtualization. Server virtualization allows business to encapsulate the operating systems and applications normally residing on individual servers into unique, software-based Virtual Machines (VMs), many of which can

reside on a single server. This dramatically increases the portability, efficiency, manageability, reliability and end user accessibility of an organization's computing resources. It also dramatically lowers the energy consumption of a data center. The program that controls virtual machines is called a hypervisor. Caltrans' current virtualization hypervisor standards include:

- VMware
- Oracle Virtual Machine (OVM)

Caltrans' current practice ensures that all requests for any multi-tiered server/compute resource are virtualized. This includes web servers, application servers and database servers. In some cases a server or computing resource would not be virtualized if a specific computer's memory requirement exceeded the virtual server's limit. Those specific server requests are addressed on a case-by-case basis; it's possible in some instances to accommodate these types of requests.

Management Memo 14-07

Management Memo 14-07 is a directive on Standard Operating Procedures for Energy Management in State Buildings. Caltrans has produced several guidance documents that indirectly address this memo. Director's Policies DP-23 (Energy Efficiency, Conservation, and Climate Change), DP-30 (Climate Change), and DP-33 (Sustainability) all highlight ways for Caltrans to reduce its carbon footprint. They also identify roles and responsibilities for various positions within Caltrans to carry out these policies. However, Caltrans does not have a formal policy on energy efficiency and conservation. The Caltrans Sustainability Program intends to coordinate the creation of such a policy along with an annual memo to remind employees about ways to save energy.

Despite lacking a formal policy, Caltrans has adopted several best practices for improving energy efficiency, such as:

- Installing motion sensors for indoor lighting systems
- Posting notices to remind employees to turn off lights and power down electronic equipment at day's end
- Requiring onsite security and DGS staff to turn off unnecessary lights and equipment
- Setting all computers, copiers, and printers to utilize energy saving modes during periods of inactivity.
- Purchasing Energy Star-rated equipment whenever practical and available
- Minimizing lighting and HVAC usage outside of normal operating hours (except in buildings open 24 hours a day).

Building heating and cooling systems. Caltrans often sets its building HVAC economizers to take advantage of the cool nighttime and morning temperatures. Caltrans only uses "night flush cycles" on specific occasions, including certain hours of the night, various seasons, or when temperatures fall below 65 degrees Fahrenheit.

Caltrans does not set its domestic hot water systems hotter than 105 degrees Fahrenheit, except at the District 1 office where local health ordinances require hot water to be 115 degrees Fahrenheit.

Year-round maintenance. Caltrans follows DGS guidelines in all buildings. Either DGS or Department personnel regularly inspect and maintain HVAC ducts, filters, and equipment for maximum effectiveness. Inspections typically occur monthly, filters are replaced quarterly and air handlers and evaporated coil washings occur annually. DGS staff or certified independent boiler technicians perform annual boiler maintenance.

Lighting. Caltrans has not assessed the need to remove superfluous lighting systems (known as "delamping"). There are no plans within Caltrans to measure light levels to prevent excessive lighting, except in District 1 where lighting optimization was conducted as a part of the Fire, Life, and Safety retrofit conducted in 2014. In addition, Caltrans has installed sensors at some locations that shut off systems based on light levels.

Caltrans also does not regularly use daylight controls in its buildings. District 12 in Orange County is the only location that has installed them, using the controls in every maintenance station except at the San Juan, Costa Mesa, and Orange locations. The District 1 office in Eureka is the only location that has been surveyed to identify spaces near windows that do not have lighting controls. District 1 surveyed the building for photovoltaic light meters as part of the 2014 retrofit mentioned in the previous paragraph. New facilities that are being designed with skylights or windows (that create day lit areas) now are having daylight lighting controls included in the designs.

Caltrans still has many facilities that use incandescent bulbs and fluorescent ballasts. However, Caltrans has made significant progress on installation of LEDs at district offices, maintenance stations, equipment shops, transportation laboratories, and within the highway right-of-way. As of November 2017, Caltrans had completed 75 percent of its planned LED installations at district office buildings. The remaining installations should be completed by December 2018. Caltrans is also installing LEDs at every maintenance station.

Plug load practices. Caltrans facility and security staff perform regular inspections to prevent employees from using devices such as personal space heaters, microwaves, refrigerators and coffee makers in unauthorized areas. The Office of the State Fire Marshal conducts annual inspections in some locations. Employees also receive email reminders about unauthorized devices. Supervisors will receive notifications whenever their staff violate this policy, and employees are ask to remove or replace any unauthorized item.

Refrigerators. Approximately 95 percent of Caltrans' refrigerators were manufactured after 2000.

Roughly half of all vending machines at Department buildings are refrigerated. Caltrans has only one vending machine in the state that's known to comply with Energy Star standards. Many of the other machines lack tags or other indications of Energy Star compliance.

Water coolers. Caltrans currently does not have plans to install timers on water coolers.

As a result of making the efficiency upgrades outlined in the previous pages, Caltrans' energy use intensity[10] (EUI) has fallen 11 percent since 2013 and continues to decrease. As shown in Table 2-7, Caltrans' EUI decreased by 28 percent in 2016 compared to the baseline year[11] — surpassing the 20 percent target required by EO B-18-12 and saving Caltrans approximately $23 million that year. And Caltrans has already reduced its grid-based energy purchases by 28 percent in 2017 compared to the baseline year.

Table 2-7: Department-wide Energy Trends

Year	Total kBTU Consumption	Floor Area (ft^2)*	Department Average EUI	Percent Reduction from Baseline Year
Baseline Year	**463,457,983**	**6,773,339**	**67**	**---**
2013	381,366,516	7,261,835	53	18%
2014	338,817,232	7,257,835	47	27%
2015	354,481,859	7,256,035	49	24%
2016	335,323,469	7,312,458	46	28%
2018 Goal**	**370,766,386**	**7,312,458**	**53**	**20%**

*Does not include SRRAs and CVEFs.

** Caltrans has already surpassed this goal.

When comparing Tables 2-7 and 2-8, the energy reduction data is not identical. As shown in Table 2-7, Caltrans reduced energy use by 19 million kBTUs in 2016 — but Table 2-8 shows a reduction of only 270,000 kBTUs. The difference could be from a variety of factors. Table 2-8 doesn't include data from all Caltrans energy efficiency projects because that information wasn't recorded for every project. Table 2-8 also doesn't include energy savings from solar panels, adjustments from weather variances, or changes to Caltrans' standard operating procedures. Finally, data from previous years aren't transferable to the current document; those reports calculated the percentage of energy savings for each facility and couldn't be summarized to fit Table 2-8.

10 Calculated by dividing total energy consumed of a building (or buildings) by gross floor area (as defined by "What is energy use intensity (EUI)?" Energystar.gov. Accessed on November 22, 2017 at https://www.energystar.gov/buildings/facility-owners-and-managers/existing-buildings/use-portfolio-manager/understand-metrics/what-energy)

11 The first full year of data available for each individual facility, since 2003 energy data is not available for each facility.

Table 2-8: Summary of Energy Projects Completed or In Progress

Year Funded	Energy Saved (kBTU/yr)	Floor Area Retrofit (ft^2)	Percent of Department Floor Area
2015	5,000	24,112	0.3%
2016	270,722	699,367	10%

In addition to the projects reflected in Table 2-8, Caltrans has planned over 40 new energy efficiency projects with the potential to save an additional 1.4 million kBTUs over the next three years that are pending funding.

Part of increasing energy efficiency at Caltrans includes conducting energy audits. Table 2-9 shows Caltrans' square footage that has undergone energy surveys that match ASHRAE[12] standards. In the short-term, office buildings in Districts 1 and 4 will soon have Level 1 energy surveys conducted as part of obtaining Leadership in Energy and Environmental Design (LEED) certification. Caltrans also plans to conduct surveys by the end of FY 2017-18 in all District 9 maintenance facilities and safety roadside rest areas.

Table 2-9: Energy Surveys

Year	Total Department Floor Area (ft^2)	Energy Surveys Underway (ft^2)		Percent of Department Floor Area (ft^2)	
		Level 1	Level 2	Level 1	Level 2
2013	7,261,835	0	0	0	0
2014	7,257,835	0	0	0	0
2015	7,256,035	235,714	0	3.3%	0
2016	7,312,458	462,392	0	6.6%	0

Caltrans intends to continue finding ways to save energy and reduce GHG emissions. Caltrans' 2015 Strategic Management Plan requires Caltrans to reduce GHG emissions by 20 percent by 2020 compared to 2010 levels per EO B-18-12. This goal applies to all operational areas of Caltrans — from facilities management to highway projects — and directly informs the following action items.

2.5 Demand Response

Executive Order B-18-12 directed all state agencies to participate in demand response programs and to obtain financial incentives for reducing peak electrical loads when called upon, to the

12 American Society of Heating, Refrigerating and Air-Conditioning Engineers

maximum extent cost-effective. Demand response programs[13] give customers incentives for reducing electricity usage during peak periods.

Caltrans operates in virtually every utility service territory in the state, meaning Caltrans is eligible for demand response programs. Three of the state's investor-owned utilities (IOUs) — Pacific Gas & Electric (PG&E), Southern California Edison (SCE), and San Diego Gas & Electric (SDG&E) — all offer variants of the following programs:

Automated Demand Response (Auto-DR)

This program offers free technical assistance and incentives to customers for installing auto-DR equipment. Auto-DR automatically implements a customer's chosen pre-programmed load reductions during peak events, while still leaving the customer in complete control. The program criteria include:

- Participation open to customers enrolled in a qualifying DR or time-varying pricing programs (such as PG&E's Peak Day Pricing or SCE and SDG&E's Critical Peak Pricing program)
- Incentives ranging from $125 to $400 per kilowatt (kW) of reduction capability, depending on level of automation and utility

Base Interruptible Program (BIP)

This program pays participants to reduce their energy usage to (or below) a level pre-selected by the customer (called the firm service level or FSL) that is below its historic average maximum demand. Customers receive a monthly incentive payment or credits for committing to reduce energy usage to the FSL when notified by the utility within thirty minutes. Criteria include:

- Incentives from $7 to $9 per committed kW per month, even if no events are called.
- Minimum curtailment commitment of 100 kW, or 15 percent of the monthly average peak demand (whichever is larger).
- Variable notice times in exchange for a lower/higher incentive options

Capacity Bidding Program (CBP)

Participants receive incentives for pledging to lower their monthly energy usage by a set amount during peak hours between May and October. Customers receive the monthly payment (varies by utility, time of year and notification option) even if the utility doesn't call any load reduction events. Criteria include:

- Reduced incentives if the pledge isn't met
- Flexible notification schedules
- Added incentives for energy load reduction events.

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13 "Demand Response." U.S. Department of Energy. Accessed on November 22, 2017 at https://energy.gov/oe/activities/technology-development/grid-modernization-and-smart-grid/demand-response

Some demand response and time-of-use programs are not common to all California utilities, including the following:

Critical Peak Pricing (CPP)
Also called the Summer Advantage Incentive (offered by SCE and SDG&E), CPP offers lower electricity rates year-round in return for setting a higher rate on specific summer afternoons.

Peak Day Pricing (PDP)
This PG&E program is very similar to SCE's and SDG&E's Critical Peak Pricing (see above). It's a "time varying" pricing plan with additional charges added during critical peak times (2 p.m. to 6 p.m. on 9 to 15 "peak event days" per year, with some alternative durations available).

Demand Bidding Program (DBP)
This program (offered by PG&E and SCE) offers incentives of up to $0.50/kWh for customers that promise to reduce energy by set amounts. Participants place bids online the day before a peak event for the amount of power they are willing to reduce (the minimum 10 kW each hour), in increments of two hours or more.

Optional Binding Mandatory Curtailment Program
This program (offered by PG&E and SCE) offers exemptions from rotating power outages for customers who reduce their power consumption by 15 percent during Stage 3 emergencies. The program does have a $6/kWh penalty for exceeding established baselines.

Discount plans for summer
SCE's Summer Discount Plan and SDG&E's Summer Saver program offer bill credits for allowing utilities to remotely or automatically reduce customers' air conditioning usage during peak months.

Scheduled Load Reduction Program (SLRP)
This SCE program offers $0.10 per kWh on-bill credit for reducing energy consumption on prescheduled weekdays from June 1 through September 30.

Thermal Energy Storage Program
PG&E and SCE offer financial incentives for implementing technologies that permanently shift electric load by storing thermal cooling capacity during off-peak hours (e.g., by chilling water or making ice) in order to meet cooling load demand during subsequent peak hours.

Programs from other utilities
A number of the state's public and municipal utilities offer demand response programs.

> *Glendale Water and Power (GWP).* This utility offers incentives for participating in one of two available demand response programs: a voluntary economic-based self-scheduled program provides a 1-day advance notice for events and pays customers for actual energy usage curtailed based on a customer-defined bid ("trigger price"); or a utility-defined market price, during 1-hour time blocks between 6 a.m. and 10 p.m.

The “Day-of” Performance Program pays participants a monthly reservation fee for committing to a specific level of curtailable load, whether a demand response event is called or not. Customers must be able to shed the agreed-upon load with a 30-minute notice, and are charged a penalty if they do not meet the contracted kW reduction.

Los Angeles Department of Water and Power (LADWP). LADWP’s program is incentive-based and voluntary. From June 15 through October 15, the program offers incentives and a variety of energy saving opportunities to qualifying businesses. The program is available to commercial, industrial, and institutional (CII) customers.

Sacramento Municipal Utility District (SMUD). SMUD’s PowerDirect Automated Demand Response Program pays organizations to install and use automated energy control technologies. The program offers incentives of up to $125/kW of automated energy reduction or 100 percent of the PowerDirect project cost. After the technology is installed, the systems automatically reduce energy use when demand for electricity is highest, although customers still have the flexibility to choose how the facility will respond.

Facilities enrolled in demand response programs

Table 2-10 displays all Caltrans facilities enrolled in demand response programs. It’s important to note that many Department buildings are not eligible for these programs because they don’t have an Energy Management Control System (EMCS), a requirement for many demand response programs.

Out of the 552 building facilities that Caltrans owns, 80 are in locations in which the electricity company does not offer a demand response program. Additionally, 13 equipment shops and six labs are co-located and share energy meters with other facilities. Of the 377 maintenance stations, 72 are storage sheds for materials and equipment to keep the roads safe. Additionally, demand response is only available for facilities with HVAC systems which would exclude the 86 SRRAs.

The 33 CVEFs are occupied by California Highway Patrol (CHP). Caltrans will work with CHP to ensure demand response programs are considered for the CVEFs. So only 262 of the 552 Caltrans buildings would be eligible for demand response. 45 Caltrans sites have or are in the process of obtaining demand response which is 17% of Caltrans’ eligible buildings.

Table 2-10: Facilities enrolled in Demand Response

District	Property	Facility Type	Utility	DR Program
01	Clearlake Oaks Maintenance Station	Maintenance Station	PG&E	Peak-Day Pricing (PDP)
01	Lakeport Maintenance Station	Maintenance Station	PG&E	Peak-Day Pricing (PDP)
01	District Office	Office	PG&E	Peak-Day Pricing (PDP)
02	Quincy Maintenance Station	Maintenance Station	PG&E	Peak-Day Pricing (PDP)
02	Red Bluff Maintenance Station	Maintenance Station	PG&E	Peak-Day Pricing (PDP)
03	Auburn Maintenance Station	Maintenance Station	PG&E	Peak-Day Pricing (PDP)
03	Chico Maintenance Station	Maintenance Station	PG&E	Peak-Day Pricing (PDP)
03	Kyburz Maintenance Station	Maintenance Station	PG&E	Peak-Day Pricing (PDP)
03	Nevada City (Sutter/Sierra Region) Maintenance Station	Maintenance Station	PG&E	Peak-Day Pricing (PDP)
03	Placerville Maintenance Station	Maintenance Station	PG&E	Peak-Day Pricing (PDP)
03	Special Crews Maintenance Station	Maintenance Station	PG&E	Peak-Day Pricing (PDP)
03	Woodland Maintenance Station	Maintenance Station	PG&E	Peak-Day Pricing (PDP)
04	Equipment Shop 04	Equipment Shop	PG&E	Peak-Day Pricing (PDP)
04	East Bay Region Maintenance Station	Maintenance Station	PG&E	Peak-Day Pricing (PDP)
04	Fairfield Maintenance Station	Maintenance Station	PG&E	Peak-Day Pricing (PDP)
04	Gilroy Maintenance Station	Maintenance Station	PG&E	Peak-Day Pricing (PDP)
04	Livermore Maintenance Station	Maintenance Station	PG&E	Peak-Day Pricing (PDP)
04	Milpitas Landscape Maintenance	Maintenance Station	PG&E	Peak-Day Pricing (PDP)
04	San Francisco Maintenance Station	Maintenance Station	PG&E	Peak-Day Pricing (PDP)
04	Seminary Landscape Maintenance	Maintenance Station	PG&E	Peak-Day Pricing (PDP)
04	SFOBB Maintenance Station	Maintenance Station	PG&E	Peak-Day Pricing (PDP)
04	Specialty Region Hesperian	Maintenance Station	PG&E	Peak-Day Pricing (PDP)
04	Specialty Region	Maintenance Station	PG&E	Peak-Day Pricing (PDP)
04	District Office	Office	PG&E	Peak-Day Pricing (PDP)
04	Antioch Bridge Toll Plaza	Other - Toll Plaza	PG&E	Peak-Day Pricing (PDP)
05	Equipment Shop 05	Equipment Shop	PG&E	Peak-Day Pricing (PDP)
05	Buellton Maintenance Station	Maintenance Station	PG&E	Peak-Day Pricing (PDP)
05	Monterey Maintenance Station	Maintenance Station	PG&E	Peak-Day Pricing (PDP)

District	Property	Facility Type	Utility	DR Program
05	Salinas Maintenance Station	Maintenance Station	PG&E	Peak-Day Pricing (PDP)
05	Santa Cruz Maintenance Station	Maintenance Station	PG&E	Peak-Day Pricing (PDP)
05	Santa Maria Maintenance Station	Maintenance Station	PG&E	Peak-Day Pricing (PDP)
05	Shandon Maintenance Station	Maintenance Station	PG&E	Peak-Day Pricing (PDP)
05	District Office	Office	PG&E	Peak-Day Pricing (PDP)
06	Coalinga Yard Maintenance Station	Maintenance Station	PG&E	Peak-Day Pricing (PDP)
06	Fresno Maintenance Station	Maintenance Station	PG&E	Peak-Day Pricing (PDP)
06	Lemoore Yard Maintenance Station	Maintenance Station	PG&E	Peak-Day Pricing (PDP)
06	District Office	Office	PG&E	Peak-Day Pricing (PDP)
08	District Office	Office	SCE	Critical Peak Pricing (CPP)
09	District Office	Office	SCE	Critical Peak Pricing (CPP)
10	Stockton Equipment Shop	Equipment Shop	PG&E	Peak-Day Pricing (PDP)
10	Altaville Command Trailer	Maintenance Station	PG&E	Peak-Day Pricing (PDP)
10	Altaville Maintenance Station	Maintenance Station	PG&E	Peak-Day Pricing (PDP)
10	Camp Connell Maintenance Station	Maintenance Station	PG&E	Peak-Day Pricing (PDP)
10	Coulterville Maintenance Station	Maintenance Station	PG&E	Peak-Day Pricing (PDP)
10	Groveland Maintenance Station	Maintenance Station	PG&E	Peak-Day Pricing (PDP)
10	Ione Maintenance Station	Maintenance Station	PG&E	Peak-Day Pricing (PDP)
10	Long Barn Maintenance Station	Maintenance Station	PG&E	Peak-Day Pricing (PDP)
10	Los Banos Maintenance Station	Maintenance Station	PG&E	Peak-Day Pricing (PDP)
10	Merced Maintenance Station	Maintenance Station	PG&E	Peak-Day Pricing (PDP)
10	Midpines Maintenance Station	Maintenance Station	PG&E	Peak-Day Pricing (PDP)
10	Pine Grove Maintenance Station	Maintenance Station	PG&E	Peak-Day Pricing (PDP)
10	Sonora Maintenance Station	Maintenance Station	PG&E	Peak-Day Pricing (PDP)
10	Stockton Landscape	Maintenance Station	PG&E	Peak-Day Pricing (PDP)
10	Tracy Maintenance Station	Maintenance Station	PG&E	Peak-Day Pricing (PDP)
10	West Point Maintenance Station	Maintenance Station	PG&E	Peak-Day Pricing (PDP)
11	San Diego Equipment Shop	Equipment Shop	SDG&E	Time of Use Plus (TOU-P)
11	Kearney Mesa Lab	Lab - District	SDG&E	Time of Use Plus (TOU-P)

District	Property	Facility Type	Utility	DR Program
11	Camino Del Rio Maintenance Station	Maintenance Station	SDG&E	Time of Use Plus (TOU-P)
11	Carlsbad Maintenance Station	Maintenance Station	SDG&E	Time of Use Plus (TOU-P)
11	Chollas Maintenance Station	Maintenance Station	SDG&E	Time of Use Plus (TOU-P)
11	Chula Vista Maintenance Station	Maintenance Station	SDG&E	Time of Use Plus (TOU-P)
11	Escondido Maintenance Station	Maintenance Station	SDG&E	Time of Use Plus (TOU-P)
11	Imperial Avenue Maintenance Station	Maintenance Station	SDG&E	Time of Use Plus (TOU-P)
11	Kearney Mesa Maintenance Station	Maintenance Station	SDG&E	Time of Use Plus (TOU-P)
11	Otay Maintenance Station	Maintenance Station	SDG&E	Time of Use Plus (TOU-P)
11	Pacific Highway Maintenance Station	Maintenance Station	SDG&E	Time of Use Plus (TOU-P)
11	San Diego/Coronado Maintenance Station	Maintenance Station	SDG&E	Time of Use Plus (TOU-P)
11	South Electrical	Maintenance Station	SDG&E	Time of Use Plus (TOU-P)
11	Archaeology Building	Other	SDG&E	Time of Use Plus (TOU-P)
11	San Diego TMC	TMC	SDG&E	Time of Use Plus (TOU-P)
12	D12 TMC	TMC	SCE	Critical Peak Pricing (CPP)
HQ	Headquarters Office Building	Office	SMUD	ADR

Table 2-11: Demand Response

Demand Response Participation	Number of Buildings/Sites	Estimated Available Energy Reduction (kW)
Number of Buildings Participating in 2016	35	unknown
Number of Additional Buildings Participating in 2017	10	unknown
Department participation* (Percent)	**17%**	-

*Out of 262 department buildings eligible for demand response programs

Results. Caltrans' efforts to implement demand response programs have been both successful and challenging. The following issues have been observed:

- Utility companies recommended enrolling in programs with incentives for manually reducing energy instead of using automated programs; enrolling in the latter would most likely have a greater impact on energy conservation. Automated programs were only available for the (larger) facilities with EMCSs. Only recently have the smaller facilities had the option to install smart meters that have an automated demand response option.

- Some programs could be adjusted to be more customer-friendly. Caltrans attempted to enroll multiple maintenance stations in SCE's program, but found the process to be time-consuming and cumbersome. Caltrans also had to remove its Southern Regional Laboratory from the program because SCE changed its net-energy metering rates.
- Not all electric utility companies offer a demand response program.
- Caltrans enrolled its Headquarters building into the SMUD demand response program in May 2017. However, the Headquarters transportation laboratory isn't eligible; most of the buildings at that facility use less than 100kW, a requirement of the SMUD program.
- District 7 intends to enroll its main office in LADWP's demand response program after completing adjustments to the building's EMCS. The district is working with the onsite DGS stationary engineer to make those adjustments.
- Caltrans has a number of facilities and building types (e.g., safety roadside rest areas and maintenance sheds) that do not have HVAC systems and are not occupied by Caltrans personnel. These buildings use minimal amounts of energy and probably are not good candidates for demand response programs.

2.6 Renewable Energy

New or major renovated state buildings over 10,000 square feet must use clean, on-site power generation and clean back-up power supplies if economically feasible. Facilities with available open land must consider large-scale distributed generation through various financing methods, including, but not limited to, third-party power purchase agreements (PPAs).

Although there are no specific kW goals for renewable energy, renewable energy does count towards meeting the following goals:

- Zero net energy targets by 2025
- Zero net energy goals of MM17-04 for designs after October 23, 2017
- 20 percent grid-based energy use reduction targets by 2018

Table 2-12 displays figures on Caltrans' renewable energy usage. Out of the 552 building facilities that Caltrans owns, 13 equipment shops and seven labs[14] are co-located and share energy meters with other facilities. Of the 377 maintenance stations, 72 are storage sheds for materials and equipment to keep the roads safe. So only 460 of the 552 buildings are eligible for solar. Eighty-eight Caltrans sites have or are in the process of obtaining renewable energy solar which is 19% of Caltrans' eligible buildings. Not shown in this table are six more Department locations waiting to utilize the solar PPA program administered by DGS (see the Financing section below for an explanation of this program). One of those projects will have a capacity of 400 to 500 kW, with the rest to be determined later. Caltrans will continue to work

14 The Southern Regional Laboratory shares the solar farm energy generation with the co-located Inland Empire TMC.

with DGS to ensure those and other projects are accepted into the program and provide the necessary information to satisfy program requirements.

Table 2-12: On-Site Renewable Energy

Status	Number of Sites	Capacity[15] (kW)	Estimated Annual Power Generation (kWh)
Buildings with renewables in operation or construction	74	3,240	6,156,000
Renewables proposed	14	unknown	unknown
Totals	**88**	**3,240**	**6,156,000**

2.7 Monitoring Based Commissioning (MBCx)

New and existing state buildings must incorporate Monitoring Based Commissioning (MBCx) to support cost-effective and energy-efficient building operations, using an Energy Management Control System (EMCS). State agencies managing state-owned buildings must pursue MBCx for all facilities over 5,000 square feet with EUIs exceeding thresholds described in Management Memo 15-04.

Caltrans has 21 buildings with an EMCS, but the new San Francisco Bay Bridge (SFOBB) Maintenance Complex is the only group of Department facilities that utilize MBCx. This facility uses the Solar Log 1000 system to monitor solar production and consumption. Energy generation and consumption data is available online. The system at the SFOBB Phase 1 building allows remote viewing of the Photovoltaic system and energy usage at the main utility cabinet. The SFOBB Phase 2 building has an energy monitoring system installed that allows remote viewing of the energy usage of the various electrical panels metered, gas usage, and generated photovoltaic power. In the future, the yet-to-be-completed SFOBB Phase 3 Training Facility will have a similar energy monitoring system as the Phase 2 building.

The Caltrans Sustainability Program intends to work with the appropriate facility managers to include MBCx capabilities in buildings with EMCS systems.

Table 2-13: Planned MBCx Projects

Building	Location	Floor Area (ft^2)	EMCS Exists? (MBCx Capable, MBCx Difficult, No EMCS)	MBCx Projected To Start	Projected Cost ($)
n/a					

15 The maximum amount of solar generation able to be generated by the number/size of solar panels installed.

2.8 Financing

State agencies are required to pursue all available financing and project delivery mechanisms to achieve these goals including, but not limited to: state revolving loan funds, utility On-Bill Financing (OBF), Power Purchase Agreements (PPAs), GS $Mart, Energy Service Contractors (ESCOs), or other available programs

Caltrans has actively pursued using the DGS Solar PPA program. Caltrans installed a one megawatt/19-acre solar farm on the Transportation Management Center and Southern Regional Laboratory campus in Fontana under this program. Other Caltrans facilities have been accepted into the program, but haven't yet moved past the acceptance phase. In the past, facility energy and water efficiency upgrades have used existing funding. Most water fixture upgrades were made during the drought when emergency funds were available. Caltrans programs will continue to explore financing programs as options for future efficiency upgrades.

According to the California Energy Commission's (CEC) website, a wide variety of public-purpose-funded energy efficiency programs are administered by the state's IOUs: PG&E, SCE, SoCal Gas, and SDG&E, and Southwest Gas Corporation (SWG). Programs offered by more than one IOU include:

- *Savings by Design (PG&E, SCE, SDG&E, SoCal Gas, and SMUD).* This program offers building owners and their design teams a range of services, including design assistance, owner's incentives (up to $0.40 per annualized kWh and $1.00 per annualized therm savings), and design team incentives (up to $50,000, plus an extra $5,000 stipend for early collaboration). Owner Incentives include a separate 20% bonus for incorporating end-use monitoring and a 10 percent bonus for enhanced commissioning. The maximum total incentive per project is $150,000.
- *Statewide Customized Offering for Business (PG&E, SCE, SDG&E, SoCal Gas, and SWG).* This program offers financial incentives (up to 50 percent of total project costs) for efficiency upgrades that may include lighting, air conditioning, refrigeration, motors, variable speed drives, and natural gas equipment, as well as controls, building shell retrofits and demand reduction measures. Incentives are based on fixed rates for actual energy savings (kWh and/or therms) and peak electric demand (kW) reduction achieved in the first year after implementation.
- *Prescriptive rebates (PG&E, SCE, SDG&E, and SWG*). The IOUs also offer prescriptive rebates for upgrading to more efficient lighting, HVAC, water heaters, food service equipment, refrigeration, motors, window film, insulation and other specific equipment and measures. Fuel switching and new construction projects do not qualify for these prescriptive programs.
- *Retro-commissioning (PG&E, SCE, SDG&E, and SoCal Gas).* This type of program offers no-cost diagnostic and engineering resources for identifying sub-optimal performance of equipment and building systems. The program also offers financial incentives (up to $0.08/kWh, $1.00/therm, and $100/on-peak kW saved) for implementing no- and low-cost measures that increase energy efficiency and occupant comfort through

adjustments, minor repairs or enhancements. Rates are based on the amount of energy savings and peak demand reduction. Customers may be able to use on-bill financing (see below) to help pay for retro-commissioning implementation costs.

- *On-bill financing (PG&E, SCE, SDG&E, and SoCal Gas).* This type of program offers zero percent/no-fee loans of up to $250,000 (or $1 million under certain conditions) to government agencies for installing qualified energy-efficiency measures under specified utility incentive programs. Terms can last up to 10 years; loans are paid back on the monthly utility bill. In some cases, monthly energy savings may be equal to or greater than the monthly payment. Through this program, PG&E and SDG&E offer incentives for HVAC equipment tune-ups, maintenance and equipment upgrades.

In addition, California's IOUs offer other programs, educational resources, and training.

- PG&E's programs include the following:
    - The LED Street Light Program offers incentives for replacing customer-owned and customer-maintained street lights billed at PG&E's fixed LS-2 rate.
    - PG&E also offers the LED Streetlight Turnkey Replacement Service for customers who want to avoid project management expenses associated with city personnel or city-acquired contract labor.
    - PG&E's services for federal government agencies include utility energy service contracts (UESCs), in which the utility arranges funding for project capital costs that are then repaid through cost savings from the energy efficiency measures.
- SDG&E offers the Direct Install Program which is open to qualifying small commercial customers with electric demand that does not exceed 100kW for three consecutive months, and provides no-cost replacement of certain types of equipment with more energy-efficient products.
- SoCal Gas non-residential programs include:
    - Natural gas equipment rebates, which are available to large commercial, small commercial, industrial, and institutional customers for a wide variety of efficiency projects. Qualifying equipment includes boilers, pipe and tank insulation, steam traps, water and pool heaters, energy management systems, furnaces and food service equipment.
    - The Energy Efficiency Calculated Incentive Program provides incentives of up to $1 million per project ($2 million per location) per year for large gas efficiency projects not covered by the basic rebate program (including new or replacement equipment, as well as for process improvements or new processes). The payment is $1.00 per annualized therm savings or 50 percent of project cost, whichever is less. Eligible projects are required to undergo an energy analysis, but projects saving less than an estimated 200,000 therms/year may qualify to receive a no-cost analysis.
    - The Energy Assessments for Industrial Customers program offers free energy assessments to customers that use 250,000 therms or more per year to in order

to help identify energy efficiency projects that may qualify for rebates (maximum $1 million per project or $2 million per site per year).

California's largest municipal utilities also offer energy efficiency programs.

- LADWP has a number of generous rebate and incentive programs for its non-residential customers, including Commercial Lighting Efficiency, the Custom Performance Program, Chiller Efficiency, Energy Load Monitoring, Commercial Water Conservation, New Construction, the Custom Express Program, Small Business Direct Install (no-cost efficient lighting and water conservation measures), Refrigeration, and the Retro-Commissioning Express Program.
- SMUD offers both customized and prescriptive incentives for a wide variety of efficient equipment and measures including air-conditioning, refrigeration, lighting, lighting sensors, custom data center cooling, server virtualization, motor systems and process improvement equipment, food service equipment, plug load sensors and PC software.
- Burbank Water and Power's (BWP) Energy Solutions program provides up to $100,000 in cash rebates for energy-efficient retrofits including lighting, motor replacements, heat pumps, HVAC equipment, chillers, cool roofing, and computer power management software. BWP's Business Bucks Program also provides free energy and water use audits and up to $5,000 in retrofit rebates to customers with annual energy usage below 250,000 kWh.
- GWP offers a variety of incentives for energy efficiency retrofits and energy-efficient new construction projects for business customers whose monthly electric bill is greater than $3,000. Rebates can cover up to 20 percent of installed cost and 100 percent of incremental cost (maximum $50,000 per year per customer, not to exceed the estimated value of saved energy over the life of the measures). GWP's Smart Business Energy Saving Upgrade Program offers free energy upgrades (value up to $2,000) to small business customers (monthly bill less than $3,000).

DGS works with state agencies to develop and implement energy savings projects by providing multiple financing programs:

- Solar Power Purchase Agreements (PPA): Under these agreements, the solar provider installs solar power systems using third-party financing, and then sells the renewable electricity generated by the solar panels at a competitive cost to the host facility and no up-front costs.
- Energy Savings Program: The DGS Energy Savings Program manages the development and implementation of energy savings projects in existing state facilities, and assists state agencies in meeting energy reduction requirements. Through a team of construction professionals, skilled engineers and quality contractors, they manage projects from conception through construction and are authorized to design and implement energy savings projects.
- GS $mart: Pronounced "G S Smart," GS $Mart is a financial marketplace is designed to facilitate installment or lease purchases, and meets all requirements of a competitively

bid process. All state and local government agencies who purchase goods and services are eligible for a GS $Mart low-interest loan.

2.9 Energy and Water Commitments and Actions

Table 2-14: Energy and Water Conservation Commitments

I-2. Energy: Achieve Zero Net Energy (ZNE) at new and existing buildings consistent with EO B-18-12		
I-3. Energy & Water: Reduce grid-based energy and potable water use		
Commitment	**Participating Department Units**	**Deadline**
I-2.C1: Focus the Department's efforts towards ZNE on Caltrans-owned office buildings and buildings managed by the Maintenance and Operations Program that together account for 75% of Caltrans building facilities and 95% of Department energy use.	Sustainability (lead) Business Operations Traffic Operations Maintenance Equipment Information Technology Engineering Services	Ongoing. To be initiated by 7/1/18.
I-3.C1: Focus the Department's efforts to reduce grid-based energy and potable water use on Caltrans-owned office buildings and buildings managed by the Maintenance and Operations Program that together account for 75% of Caltrans building facilities and 95% of Department energy use.	Sustainability (lead) Business Operations Traffic Operations Maintenance Equipment	Ongoing. To be initiated by 7/1/18.
I-3.C2: Continue participation in related Administration-wide efforts including the Sustainable Buildings Working Group.	Sustainability	Ongoing

Table 2-14A: ZNE Actions

Actions	Participating Department Units	Deadline
Actions items agreed upon:		
I-2.1: Create a document to help ensure ZNE is considered in Advanced Planning Studies and Project Initiation Documents.	Engineering Services	2/1/18
I-2.2: Verify ZNE status of SFOBB Warehouse one year after construction completion.	Engineering Services	One year after construction completion
Potential Actions:		
I-2.1P: Determine existing facilities that have ZNE potential and work towards making the buildings ZNE (best candidates will be larger, newer facilities that use a lot of energy and have a lot of adjacent land for renewables).		
I-2.2P: Develop plans and propose future new building projects to achieve the Governor's ZNE goals for state buildings.		

Table 2-14B: Energy and Water Reduction Actions

Potential Actions	Participating Department Units	Deadline
I-3.1P: Ensure all future new construction and major renovations exceed Title 24 by at least 15%.		
I-3.2P: Educate all employees on the importance of minimizing electrical plug loads with an annual email from the Director.		
I-3.3P: Determine and document potential energy savings of energy efficiency projects in buildings.		
I-3.4P: Measure and report PUE in data centers over 1,000 sq. ft., and develop and implement strategies to reduce PUE by 10% each year until a PUE ratio of 1.5 or lower is achieved.		
I-3.5P: Follow "Standard Operating Procedures for Energy Management in State Buildings" found in MM 14-07		
I-3.6P: Pursue energy surveys in facilities with high energy use (i.e. Transportation Management Centers).		
I-3.7P: Upgrade/replace inefficient energy fixtures, lighting and systems.		
I-3.8P: Enroll all facilities in demand response programs (particularly facilities with Energy Management Control Systems - EMCSs).		
I-3.9P: Use equipment that will reduce load automatically (for example: purchase smart thermostats for smaller facilities).		
I-3.10P: Determine additional locations for renewable energy.		
I-3.11P: Ensure all future new construction and major renovations over 10,000 sq ft. use renewable energy.		
I-3.12P: Determine which facilities should use Monitoring-Based Commissioning (based on the requirements in MM 15-04).		

I-3.13P: Track ongoing energy use with Energy Management Control Systems, and modify or replace systems without the capability.		
I-3.14P: Use California Department of General Services (DGS) Energy Service Company (ESCO) program to evaluate energy use, recommend changes, and find vendor to make changes.		
I-3.15P: Determine and document potential water savings of water efficiency projects at buildings.		
I-3.16P: Develop water contingency plans for buildings in critical ground water basins.		
I-3.17P: Upgrade/replace/repair all broken or inefficient water fixtures, and boiler and cooling systems, where feasible.		
I-3.18P: Install flow sensors at buildings with landscaping over 5,000 sq. ft.		
I-3.19P: Prioritize valuable landscaping when considering watering needs.		
I-3.20P: Create a water budget for buildings with landscape over 20,000 square feet.		
I-3.21P: Install water meters to track outdoor water use separately at buildings with landscape over 20,000 square feet.		
I-3.22P: Train landscape maintenance staff in US Environmental Protection Agency (EPA) "WaterSense".		
I-3.23P: Follow Best Management Practices (BMPs) listed in MM 14-02.		
I-3.24P: Verify/measure area of landscaping at buildings.		

3. GREEN OPERATIONS ROADMAP

3.1 Background

Executive Order B-18-12 directed California's state agencies to take actions to reduce entity-wide GHG emissions by at least 10 percent by 2015 and 20 percent by 2020, as measured against a 2010 baseline. Caltrans has already met and exceeded these targets, reducing GHG emissions from internal operations by 40 percent in 2016[16] (see Table 3-1 and Graph 3-1). Caltrans took the following actions to achieve that reduction, including:

- Reducing energy 30 percent by replacing old streetlights with LEDs
- Reducing energy by nearly 25 percent through HVAC upgrades and new energy efficiency policies
- Installing roof-mounted solar panels at 70 transportation facilities with a capacity of 2.4 megawatts (MW), funded by $20 million in Clean Renewable Energy Bonds (CREBs)
- Enrolling in the SMUD Greenergy Program to indirectly purchase power from renewable resources, such as wind, sun, and biomass
- Replacing 83 percent of diesel fuel purchases in 2016 with renewable biodiesel; Caltrans also purchased 75,488 gallons of E85 fuel, and 161,107 gallons of CNG.
- Adding new ZEVs to the Caltrans fleet by scheduling the purchase of 17 fuel cell vehicles (FCEVs), 15 battery electric vehicles (BEVs), and 87 plug-in hybrid electric vehicles (PHEVs).

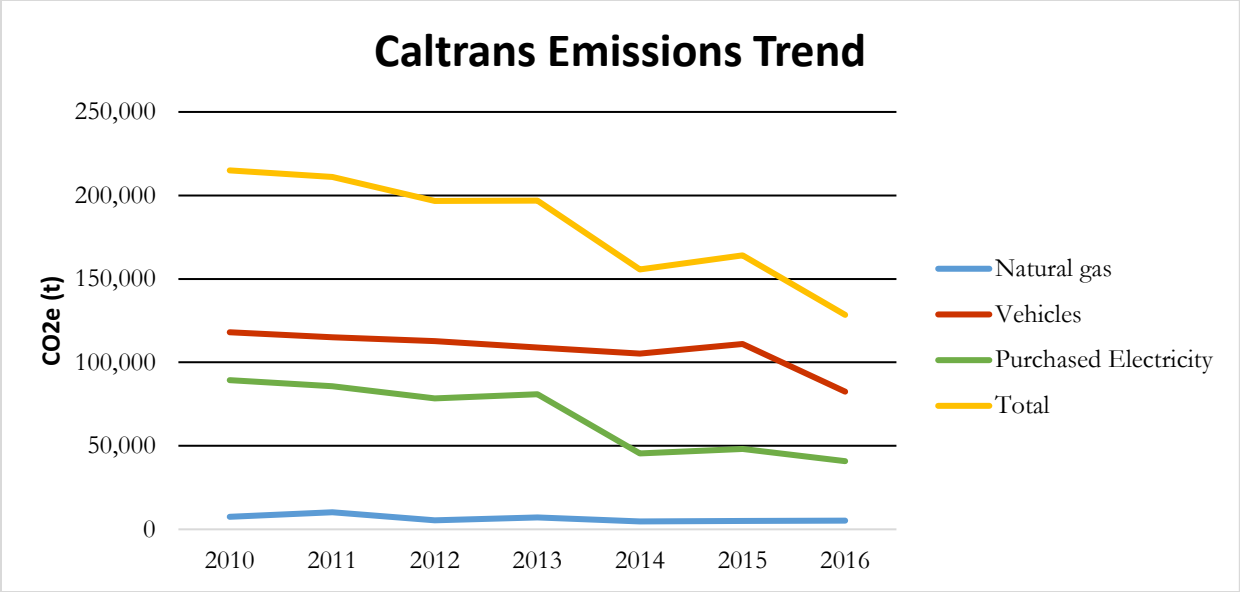
Table 3-1: Caltrans GHG Emissions since 2010 (CO_2e)

Source	2010	2011	2012	2013	2014	2015	2016	Percent Change since Baseline
Natural gas	7,585	10,223	5,484	7,179	4,735	5,003	5,140	-32%
Vehicle fuel	118,042	115,119	112,758	108,810	105,339	110,998	82,474	-30%
Purchased Electricity	89,356	85,725	78,373	80,841	45,538	48,172	40,829	-54%
Total	**214,983**	**211,067**	**196,615**	**196,830**	**155,612**	**164,173**	**128,444**	**-40%**

Data Source: Natural gas – Caltrans Info Advantage database. Vehicle fuel – Caltrans Division of Equipment records. Purchased electricity from the highway system – Headquarters Division of Maintenance. Purchased electricity from buildings – Energy Star Portfolio Manager.

16 The reduction was measured from natural gas used in buildings, petroleum from fleet vehicles, and electricity purchased in buildings and along the highway system.

Graph 3-1: GHG Emissions since 2010



3.2 Building Design and Construction

EO B-18-12 requires that all new buildings, major renovation projects, and build-to-suit leases over 10,000 square feet shall obtain LEED Silver certification or higher. All new buildings under 10,000 square feet shall meet applicable CALGreen Tier 1 Measures. New buildings and major renovations greater than 5,000 square feet are also required to be commissioned after construction.

Caltrans has completed several buildings that meet these criteria. The Philip S. Raine Safety Roadside Rest Area in Tulare County achieved LEED Platinum in 2013. It also received the 2014 LEED Parade-Water Efficiency Award and the 2014 Green School/Government Award. Post-construction commissioning was performed on the new equipment to verify its working condition.

The Caltrans District 5 Midway Building in San Luis Obispo was constructed in September 2016 to house facilities and project delivery staff. The facility (which is leased) achieved LEED Gold status. Post-construction commissioning was performed on the new equipment to verify its working condition.

The Caltrans District 12 office building in Santa Ana is a leased facility that achieved a Silver LEED rating.

The SFOBB Maintenance Building (Phase 1) was designed to exceed LEED-Silver ratings; however, changes in personnel, inadequate funding, and lack of staffing resources have been obstacles to continuing the credit submittal process required for LEED certification. Caltrans' Division of Engineering Services will continue to work with responsible parties to find the resources to complete LEED certification by July 2018.

Incorporating LEED and CALGreen

Early in the design process, Caltrans building designers ensure that mandatory LEED and CALGreen requirements are incorporated into a project's scope. A LEED charrette is conducted early in the design phase (and sometimes in the planning phase) where sustainable elements are selected. Future projects should always include a LEED charrette in the planning phase of a project so the requirements for LEED can be included in the scope and budget of the project.

Table 3-2: New Construction since July 2012

Project Name	LEED Level Achieved	Commissioning Performed (Y/N)
Phillip S. Raine SRRA (Tulare)	Platinum	Yes
Caltrans Midway Building (San Luis Obispo)	Gold	Yes
SFOBB Maintenance Building (Phase 1)	In progress	Yes
SFOBB Maintenance Building (Phase 2)	In progress	No

Per the California Green Building Standards Code (CALGreen), Part 11, state agencies shall implement mandatory measures and relevant and feasible voluntary measures related to indoor environmental quality (IEQ) that are in effect at the time of new construction or alteration and shall use adhesives, sealants, caulks, paints, coatings, and aerosol paints and coatings that meet the volatile organic chemical (VOC) content limits specified in *CALGreen.* All new and remodeled buildings designed by Caltrans must and do comply with the mandatory Tier 1 CALGreen requirements since the implementation of the 2010 CALGreen Building Code. All projects have low VOC specifications included for paints, adhesives, flooring, etc. Once the low VOC specifications are included, the submittal approval process will ensure the facility has only approved products installed. The Division of Engineering Services will create a "Memo to Designers" by February 2018 to ensure all Tier 1 CALGreen criteria get pursued on projects.

3.3 LEED for Existing Buildings Operations and Maintenance

All state buildings over 50,000 square feet were required to complete LEED-EBOM certification by December 31, 2015 and meet an Energy Star rating of 75 to the maximum extent cost effective.

Caltrans faced several barriers to achieving certification. While Caltrans employs many LEED-certified staff with Building Design and Construction expertise, there are no staff members with Building Operations and Maintenance certification. The complexity of the LEED-EBOM process and facilities' need for additional preparation before certification also contributed to Caltrans' challenges.

Table 3-3: LEED for Existing Buildings and Operations Status

Name of Buildings over 50,000 sq. ft. and eligible for LEED-EBOM	Status and Barriers to Achievement
District 1 Office (Eureka)	Caltrans is currently pursuing LEED contracts for the District 1 office building in Eureka using a consultant. LEED certification of this facility is scheduled to be complete in February 2018.
District 2 Office (Redding)	Caltrans will be pursuing a LEED-EBOM contract for the District 2 office building in Redding in 2018.
District 4 Office (Oakland)	Caltrans is currently pursuing LEED contracts for the District 4 office building in Oakland using a consultant. LEED certification of these facility is scheduled to be complete in February 2018.
District 6 Office (Fresno)	The LEED contract for the District 6 Office in Fresno was cancelled because the building shares energy meters with other facilities. In order to certify the one relevant building, submeters must be installed and tracked for one year. The District 6 office submeter has been installed; the contract is currently being created and will go out to bid by April 2018.
District 7 Office (Los Angeles)	The LEED contract for the District 7 office building in Los Angeles is being managed by DGS.
District 8 Office (San Bernardino)	The District 8 office building is currently not eligible for LEED-EB certification because its Energy Star score is too low. An energy audit was performed on the building in June 2015. Several measures were recommended that would reduce energy use significantly. Facilities staff also attended a REV® Sustainability Circle in their area, in which a sustainability action plan was created for this facility with strategies to conserve energy, water, waste, and money. There have already been many changes implemented to save energy, including adjustments to the HVAC and chilled water systems, and the installation of LEDs. There are a number of planned activities to reduce energy use at this facility. Some items are awaiting funding. LEED eligibility will depend on when the changes are made and how they affect the Energy Star score. The Energy Star score has gone up 14 points in the last year; however, there are still 20 points to make up before the building is eligible for LEED certification.

Name of Buildings over 50,000 sq. ft. and eligible for LEED-EBOM	Status and Barriers to Achievement
District 10 Office (Stockton)	The LEED contract for the District 10 Office in Stockton was cancelled because the building shares energy meters with other facilities. Submeters need to be installed and tracked for one year to certify this building.
Headquarters Office (Sacramento)	The Caltrans Headquarters building in Sacramento achieved LEED-EBOM Silver certification in 2016 using a consultant
Los Angeles TMC	The LEED contract for the Los Angeles Regional TMC was cancelled because energy use is too high and the building's Energy Star score is too low to meet the requirement. The Caltrans Sustainability Program will meet with responsible parties to determine next steps to LEED certification, including an energy audit and necessary changes to make the building more energy efficient.
Southern Regional Laboratory (Fontana)	The LEED contract for the Southern Regional Laboratory in Fontana was cancelled; the building has more lab space than office area, so it is not certifiable.
Transportation Laboratory (Sacramento)	The LEED contract for the Transportation Laboratory in Sacramento was cancelled because the building shares energy meters with other facilities. Submeters need to be installed and tracked for one year to certify this building.

The goal date for submeter installation for all buildings is June 2018, while the target date for LEED certification of all remaining buildings is December 2020.

Table 3-4: LEED for Existing Buildings and Operations Summary

Number of Buildings over 50,000 sq. ft. and eligible for LEED-EBOM	Number of Building over 50,000 sq. ft. that have achieved LEED-EBOM	Percentage of buildings over 50,000 sq. ft. required to achieve LEED-EBOM that have achieved it
9	1	11%

3.4 Indoor Environmental Quality

When accomplishing alterations, modifications, and maintenance repairs and when relevant and feasible, state agencies shall implement the mandatory and voluntary measures of the California Green Building Standards Code (CALGreen), Part 11, related to indoor environmental

quality. Indoor Environmental Quality must also be maintained through the use of low emitting furnishings, cleaning products and cleaning procedures.

New construction and renovation

Caltrans has created low VOC specifications to ensure voluntary measures related to indoor environmental quality (IEQ) from CALGreen are implemented in all building projects. Caltrans will include these specifications in a "Memo to Designers" by February 2018.

Caltrans engineers verify that the mechanical systems meet air requirements during design and check it during construction on small projects. A true "commissioning authority" may be necessary for larger projects, but is rarely assigned due to a lack of available personnel or budgetary resources to hire consultants for this effort. Caltrans has specification sections for an IEQ management plan and air filter changing requirements that may be included if needed. Outdoor airflow monitoring systems are rarely required or installed.

During the building design phase, Caltrans' mechanical engineers typically run EnergyPro software on the facility to check air requirements. After entering the building layout and HVAC unit information, the program will evaluate if standards from Title 24 have been met. If not, the program will give warnings on what features didn't comply (airflows, etc.). All HVAC systems get construction and system testing in the field by the mechanical designer and/or commissioning authority. Typically, computer-based preventative maintenance programs are not installed for HVAC units. Caltrans conducts system training and testing related to HVAC equipment for maintenance personnel.

The required daylighting (see the following section on HVAC operation) and lighting controls are addressed in new buildings according to Title 24. Direct line of sight to the outdoors is attempted for most occupied spaces, but only full documentation of the views are pursued for projects where Caltrans attempts to obtain LEED credits.

Furnishings

All furniture orders must be approved by the Caltrans Division Chief of Business Operations to ensure compliance with established guidelines and directives. The Caltrans Division of Procurement and Contracts (DPAC) does not process requests that do not meet the DGS' Purchasing Standard and Specifications. Caltrans must also consider if California Prison Industry Authority (CALPIA) has commodities and services that meet Caltrans' needs. A waiver must be obtained from CALPIA prior to purchasing items from commercial vendors. All Caltrans office furniture complies with either of the following standards:

- DGS' Purchasing Standard and Specifications[17]

17 CALPIA manufacturing and associated products are compliant with the DGS' Purchasing Standard and Specifications

- ASHRAE Standard

Caltrans is in compliance with the DGS Purchasing Standard and Specifications Technical Environmental Bid Specification 1-09-71-52 when acquisitions are made using:

- Established DGS Leveraged Procurement Agreement (LPA) or Master Agreement (MA) contracts
- California Prison Industry Authority (CALPIA)

Going forward, Caltrans will revise staff procedures by June 2019 to include mandatory compliance requirements in situations where goods and/or services are acquired outside of these methods.

Cleaning products and procedures

DGS is responsible for the janitorial services at most state-owned facilities that Caltrans occupies. DGS ensures all cleaning products/procedures meet the Green Seal Standard. If DGS does not provide janitorial services, the work is performed by other state employees or is contracted out. However, all cleaning products/procedures still meet the Green Seal Standard.

HVAC operation

DGS is responsible for the operations and maintenance at most large state-owned facilities that Caltrans occupies. DGS is responsible for ensuring HVAC systems provide no less than the required minimum outdoor requirements, maintenance, and inspections. If DGS does not provide the operations and maintenance, Caltrans employees are responsible for ensuring the HVAC systems are properly maintained, inspected, and required minimum outdoor requirements are met.

Caltrans follows these steps to ensure its HVAC systems contribute to a healthy indoor environment:

- Using indoor products and materials that emit little or no harmful chemicals
- Providing appropriate ventilation, filtration, and HVAC equipment maintenance
- Preventing water intrusion and the growth of mold
- Implementing line of sight and “daylighting” for new buildings

3.5 Integrated Pest Management

Department staff and contracted pest management companies will follow an integrated pest management (IPM) strategy that focuses on long-term prevention of pest problems through monitoring for pest presence, improving sanitation, and using physical barriers and other nonchemical practices. If nonchemical practices are ineffective, Tier 3 pesticides may be used, progressing to Tier 2 and then Tier 1 if necessary.

The Caltrans Sustainability Program will facilitate the identification of the entity responsible for developing a document by June 2018 and communicating with districts about the use of IPM. The document will include a timeline for implementing IPM into all future contracts.

Table 3-5: Pest Control Contracts

Pest Control Contractor	IPM Specified (Y/N)
Bullert Enterprises, Inc. (District 1 office – Eureka)	N
Applied Pest management (District 4 office – Oakland)	N
John Stafford Pest Control (District 5 office – San Luis Obispo)	N
Tamarack Pest Control (District 6 office – Fresno)	N
Cats USA Pest Control (District 7 office – Los Angeles)	Y
Terminex (District 9 office – Bishop)	No; integrated pest management not required, but utilizing prevention at the least hazardous treatment
Royce Corporation (District 10 office – Stockton)	No; integrated pest management not required, but the company only uses non-chemical products onsite
Corky's Pest Control (District 11 TMC – San Diego)	Yes; current contract utilizes IPM as it relates to DGS Best Practices Manual Chapter 3, 1: B., C., F., G., H., I., J., but does not specify 1. A. Objectives and Strategies.
Strictly Commercial Pest Control (Caltrans Headquarters - Sacramento	Y

3.6 Environmentally Preferable Purchasing

State agencies are required to purchase and use environmentally preferable products (EPP) that have a reduced effect on human health and the environment when compared with competing goods that serve the same purpose.

Reducing Impacts

Caltrans' Construction Standard Specifications include guidance on the composition of materials to be used in construction projects. The specifications require Caltrans to consider environmentally friendly treatments and materials with recycled content to the extent feasible.

Caltrans' DPA) is in compliance with DGS Purchasing Standards and Specifications when acquisitions are made using:

- Established DGS Leveraged Procurement Agreement (LPA) or Master Agreement (MA) contracts
- CALPIA

DPAC requires acquisitions of commodities (such as paint, IT goods, janitorial supplies, paper products, desk lamps, office equipment and toner cartridges) to be made through the established DGS LPA or MA contracts or through CALPIA whenever possible. Commodities acquired through these channels are EPP compliant.

Going forward, Caltrans intends to evaluate the feasibility of incorporating EPP data into its financial management system (AMS Advantage) and the State Contracting and Procurement

Registration System (SCPRS). Caltrans doesn't conduct transactions in SCPRS; instead, it uploads information from Advantage into the state system. Advantage does not include an option to include EPP data; therefore, in order for EPP data to get into SCPRS, Caltrans will need to make changes to Advantage — which will require new funding.

Caltrans is also committed to increasing the procurement of recycled products across all State Agency Buy Recycled Campaign (SABRC) categories. The Caltrans Sustainable Purchasing Program (administered by DPAC) will implement new strategies to increase procurement of EPP products in the top five spend categories over the next two years. Table 3-6 displays Caltrans' SABRC compliance rate:

Table 3-6: State Agency Buy Recycled Campaign 2015-2016 Performance

Product Category	SABRC Reportable Procurement	SABRC-Compliant Procurement	SABRC Compliance (%)
Antifreeze	$183,514.74	$101,711.12	55.42%
Compost and Mulch	$5,585,990.01	$5,566,260.02	99.65%
Glass Products	$1,315,972.48	$1,101,970.34	83.74%
Lubricating Oils	$1,161,083.18	$980,805.41	84.47%
Paint	$3,366,620.99	$971,564.47	28.86%
Paper Products	$789,923.93	$277,534.05	35.13%
Plastic Products	$6,334,976.25	$4,197,087.20	66.25%
Printing and Writing Paper	$258,492.12	$210,320.07	81.36%
Metal Products	$43,183,529.19	$35,738,116.96	82.76%
Tire Derived Products	$4,045,884.82	$4,032,026.24	99.66%
Tires	$3,644,951.94	$618,434.38	16.97%

Caltrans' SABRC reporting for FY 2015-16 identified three areas of non-compliance (antifreeze, paint and tire categories).

- *Antifreeze*. Caltrans increased SABRC compliance by almost 44 percent during Fiscal Year 2015-16. Despite the significant increase, Caltrans was unable to meet the required 70 percent minimum postconsumer recycle percentage. Caltrans continues to have difficulty locating vendors to deliver certified bulk antifreeze at the required recycled content level. Caltrans continues to include requirements for certifying recycled content in all solicitations for antifreeze, to maximize efforts in finding responsible vendors.
- *Paint*. Caltrans' reportable SABRC-related purchases increased by almost $2.4 million in Fiscal Year 2015-16 — an increase of roughly $300,000 from the previous fiscal year. However, SABRC compliance decreased by just under 40 percent. The decrease came from a single paint purchase valued at $2,381,466 to a vendor not listed on the statewide contract (1-13-80-03A) for paint. The paint vendor was subsequently added to the renewed statewide paint contact (1-17-80-03A) for Fiscal Year 2016-17.
- *Tires*. Caltrans is unable to meet the SABRC requirement for recycled tires because many tires cannot be recapped, retread, or recycled for safety reasons, including the following:

- Most non-steel casing tires are not strong enough to support the extra weight from recapping.
- Tires with a "P" size rating can very rarely be recapped because they are non-steel casing tires. This type of tire is typically used in light-duty fleet vehicles such as sedans, sport utility vehicles (SUVs), and small pickup trucks.
- Most light truck tires are not steel casing tires.
- Foam-filled forklift tires are not recapped.
- Solid tires are not recapped.
- Some off-road tires, such as all-terrain vehicle (ATV) tires, cannot be recapped.
- Caltrans' policy dictates recapped tires shall not be used on steering axle applications of vehicles for safety reasons.
- Use of recapped tires is always affected by availability from the recapping vendors. Tire casings are not always available for the application being purchased at the time. Without casings, the vendor has nothing to recap.

To comply with PCC 12209, Caltrans has instituted the following policy on retread tires: All passenger vehicle and 17-inches and below light truck tires (P) will not be retread. Medium truck and all heavy truck tires 17.5-inches and above will be retread. Only all-steel casings will be retread and the retreads will be limited to non-steering axle applications:

- Trailer tires, including heavy-duty design (i.e. lowboy trailers), will be retread whenever feasible.
- Construction equipment (e.g. graders, loaders, etc.), will use retread tires on all axles, whenever feasible.
- Tire carcasses will be retread a maximum of two times.
- "Certified" retreads will not be used.

When using retread tires, all casings must match brand-for-brand because of diameter and circumference differences. This standard becomes especially critical on all-wheel-drive heavy equipment applications where all casings must match on front and rear tires. It is also critical to make sure that all load ranges match; load range and/or ply identification is located on the sidewall of the tire. Internal policy dictates which tires can be recycled, limiting our purchase options.

DPAC plans to hire a consultant to conduct a spend analysis by June 2018. The results of the spend analysis will serve as a benchmark for continued measurement in the efforts to improve EPP spend.

Table 3-7: Commodities categories with the greatest Potential to Green

Commodity	2016 Total Spend ($)	2016 Percent EPP Spend (%)	EPP Target (%)[18]
Asphalt	$26,583,137	Unknown	Unknown
Fuel	$21,113,256	Unknown	Unknown
Mulch	$4,995,056	Unknown	Unknown
Signage	$4,042,214	Unknown	Unknown
Emulsions	$3,024,413	Unknown	Unknown

Sustainability Development and Education

The Caltrans Sustainable Purchasing Program (SPP) is in the early stages of development and eventually will accomplish the following goals:

- Identify opportunities to infuse EPP into acquisition activities statewide
- Provide training, resources, and tools to Caltrans buyers in support of increasing EPP
- Continue conducting outreach and providing education to external suppliers.

The following table displays a list of Caltrans buyers who have completed EPP training:

Table 3-8: Buyers who have completed EPP Training

CalHR Classification	Total No. of Buyers	Percent Completing EPP Training	Commitment to have buyers complete EPP training (%)
CAL-Card Holders - Various Classifications	2,464	0.00%	DGS CalPCA EPP training has not been offered since 2013. DGS anticipates the EPP training module will be available in 2018. Caltrans is fully committed to requiring all buyers complete EPP training once it is available.
Associate Governmental Program Analyst	65	3.08%	
Staff Services Analyst	10	10.00%	
Associate Information Systems Analyst	4	25.00%	
Senior Transportation Engineer	5	0.00%	
Staff Services Manager I, II, III	23	0.00%	
Program Tech II	1	0.00%	
Equipment Materiel Coordinator	3	0.00%	
Chief Counsel	1	0.00%	
Deputy Chief Counsels	4	0.00%	
Assistant Chief Counsels	12	0.00%	
Attorneys	132	0.00%	
Legal Support Supervisors	4	0.00%	
Librarian	1	0.00%	
Equipment Materiel Manager II	16	0.00%	
Equipment Materiel Manager I	15	0.00%	
Senior Equipment Materiel Specialist	12	0.00%	
Equipment Materiel Specialist	66	0.00%	
Equipment Materiel Manager III	4	0.00%	
Equipment Materiel Operations Manager	1	0.00%	
Total Number of Employees Assigned as Buyers	**2,846**	**>0.00%**	

18 The EPP target cannot be determined until a baseline has been established. The baseline will be established after EPP spend data is tracked

DPAC will revise the following training modules to include information on EPP:

- CAL-Card Holder
- CAL-Card Manager
- Contract Manager
- Architectural and Engineering Contract Manager
- Buyer Responsibilities

Environmental Product Declarations (EPDs)
Caltrans is researching the practice of requiring Environmental Product Declarations (EPDs) to collect high-quality, regionally applicable, standardized data for the environmental impacts of manufacturing select construction materials to support better decision-making and create market incentives to reduce the climate impact of construction materials we commonly use.

Caltrans has developed a roadmap to help guide personnel on potential uses of EPDs. Future activities include engaging DGS, industry partners, and academia to collect EPD data for material types like concrete and asphalt, when available, and use the collected data to perform analysis, set baselines, and decide on further applications. The data will be collected through future pilot projects.

3.7 Location Efficiency

Location efficiency refers to the effect of a facility's location on travel behavior and the environmental, health and community impacts of that travel behavior including emissions from vehicles. Locating department facilities in location-efficient areas reduces air emissions from state employees and users of the facilities, contributes to the revitalization of California's downtowns and town centers, helps Caltrans compete for a future workforce that prefers walkable, bikeable and transit-accessible worksites, and aligns department operations with California's planning priorities.

Caltrans works with DGS to find new office space. DGS reviews and researches how the proposed building selection aligns with green building laws and other related laws or executive orders, public transportation and location. As shown below, Caltrans does not have any new executed leases that began the site search after January 1, 2017.

Table 3-9: Smart Location Score for new Leases

Facility name	Smart Location Calculator Score
n/a	n/a

Table 3-10: Lowest Smart Location Score Leases

Facility name	Smart Location Calculator Score
2885 S. Higuera, San Luis Obispo	64
1515 River Park Drive, Suite 210, Sacramento	64
3390 Lanatt Street, Sacramento	68
3232 S. Higuera, San Luis Obispo	69
1750 E. 4th Street, Santa Ana	69
1727 30th Street, Sacramento	83
1801 30th Street, Sacramento	87
1820 Alhambra Boulevard, Sacramento	87
1616 29th Street, Sacramento	87

3.8 Landfill Disposal

The Caltrans 2015 Strategic Management Plan sets goals to reducing resource consumption by cutting the amount of materials taken to landfills. The provisions of the State Agency Integrated Waste Management Act (IWMA) require all state agencies and large State facilities to divert at least 50 percent of their solid waste from disposal facilities starting January 1, 2004. Another requirement of the law is that each state agency and large facility shall submit an annual report to the California Department of Resources Recycling and Recovery (CalRecycle) summarizing its yearly progress in implementing waste diversion programs. In 2008, the Per Capita Disposal Measurement System Act (SB 1016, Wiggins, Public Resources Code Section 42920-42927, Statutes of 2008) was passed. This legislation changed the way state agencies and local governments measure their progress toward meeting the statutory waste diversion mandates. State agencies are still required to maintain the 50 percent waste diversion requirement as mandated by the State agency IWMA; however, with the passage of the Per Capita Disposal Measurement System Act, state agencies and large state facilities use per capita disposal as an indicator of their progress toward meeting the mandate. State agency annual reports are due May 1 of each year for activities conducted during the prior calendar year.

Table 3-11 shows the amount of Department waste taken to landfills in tons per year. These amounts reflect solid waste generated from construction projects, maintenance operations, and building facilities reported to CalRecycle annually in the State Agency Reporting Center (SARC) report. Caltrans has hired personnel in the Headquarters Division of Design and the Division of Business Operations to lead the recycling effort in these areas. The Sustainability Program will work with appropriate programs to identify key personnel within each division to determine the activity origin of the waste reported, how to measure the waste, and the best methods of tracking waste diverted from landfills. Afterwards, a baseline and goal will be established. At the same time, tracking trends in recycling is in its initial phases of development.

Table 3-11: Waste Taken to Landfills

District	Weight per Calendar Year (tons)						
	2010	2011	2012	2013	2014	2015	2016
HQ	536	600	468	412	664	647	631
1	12,223	742	811	3,078	3,077	6,227	1,791
2	962	1,789	1,712	1,972	1,236	804	not available
3	96,102	31,384	12,445	20,235	20,399	11,287	not available
4	11,736	11,011	17,492	16,847	11,948	81,754	not available
5	2,026	1,856	2,159	2,159	2,247	2,253	2,183
6	250	889	855	3,101	4,406	3,136	2,924
7	88,341	69,909	124,762	69,103	145,006	173,165	not available
8	57,842	43,180	32,029	38,133	22,036	43,496	not available
9	50	406	3,021	3,926	647	2,092	not available
10	413	592	652	1,812	76	3,946	247
11	14,187	124,227	125,359	7,321	26,167	24,713	not available
12	12,141	13,901	1,793	1,890	5,873	6,100	not available
Total	**296,809**	**300,486**	**323,558**	**169,989**	**244,082**	**359,620**	

3.9 Green Operations Commitments and Actions

Table 3-12: Green Operations Commitments

I-4 Green Operations I: Improve green building operations **I-5 Green Operations II:** Reduce waste sent to landfills		
Commitment	**Participating Department Units**	**Deadline**
I-4.C1: The Sustainability Team will organize and support task groups in identifying actions to improve green building operations. Focus the Department's efforts in green building operations on Caltrans-owned office buildings and buildings managed by the Maintenance and Operations Program that together account for 75% of Caltrans building facilities and 95% of Department energy use.	Sustainability Business Operations Traffic Operations Maintenance Equipment Procurement and Contracts Engineering Services	9/30/18
I-4.C2: Institute sustainable purchasing policies and practices.	Procurement and Contracts	Ongoing
I-5.C1: The Sustainability Team will organize and support task groups in identifying actions to reduce waste sent to landfills.	Sustainability Business Operations Construction Design Maintenance	9/31/18

Table 3-12A: Green Operation Actions

Actions	Participating Department Units	Deadline
Actions items agreed upon:		
I-4.1: Install submeters in the District 10 office to continue the Leadership in Energy Environmental Design (LEED) certification process.	Business Operations	12/31/18
I-4.2: Complete LEED certification of SFOBB Phase 1 Maintenance Complex (dependent on extension granted by GBCI).	Engineering Services	7/31/18
I-4.3: Create "Memo to Designers" to ensure all California Green Building Code (CALGreen) Tier 1 criteria get pursued and to include low VOC specifications in all building projects.	Engineering Services	2/28/18
I-4.4: Work with DGS, industry partners, and academia to collect Environmental Product Declaration (EPD) data for several material types, and use the collected data to perform analysis, set baselines, and decide on further applications.	Engineering Services	Ongoing
I-4.5: Reevaluate contractual provisions to improve requirements for the use and reporting of EPP goods in service contracts.	Procurement and Contracts	7/31/18
I-4.6: Develop strategies and infuse sustainable purchasing practices to increase environmentally preferable products (EPP) in the following high spend categories: architectural and engineering contracts, asphalt, fuel, mulch.	Procurement and Contracts	1/31/19
I-4.7: Evaluate contractor selection requirements and implement selection criteria that increase the use of EPP goods and State Agency Buy Recycled Campaign (SABRC) compliance in service contracts.	Procurement and Contracts	10/31/18
I-4.8: Hire a consultant to conduct a spend analysis. The results of the spend analysis will serve as a benchmark for continued measurement in the efforts to improve EPP spend.	Procurement and Contracts	6/30/18
I-4.9: Incorporate information regarding qualified products into solicitation documents to assist vendors and buyers in maximizing recycled products in their contracts/purchases with Caltrans.	Procurement and Contracts	6/30/19

I-4.10: Market the use of EPP, provide resources and tools, and educate buyers on the benefits and methods of buying EPP products.	Procurement and Contracts	6/30/19
I-4.11: Revise staff procedures to specify the use of resources on DGS Buying Green website when acquiring goods and/or services.	Procurement and Contracts	Based on completion of DGS module
Potential actions:		
I-4.1P: Continue actions to reduce the use of natural gas, vehicle fuel and purchased electricity to reduce operational Greenhouse Gas Emissions (GHG).		
I-4.2P: Develop a strategy for ensuring that all future new construction and major renovations exceed Title 24 by at least 15%.		
I-4.3P: Ensure new buildings and major renovations greater than 5,000 square feet are commissioned properly from design thru post construction.		
I-4.4P: Ensure all future new construction and major renovations over 10,000 sq. ft. obtain LEED Silver or higher certification.		
I-4.5P: Ensure all new buildings under 10,000 square feet shall meet applicable CALGreen Tier 1 Measures.		
I-4.6P: Implement measures that will reduce energy use in the District 7 Transportation Management Center (TMC) and the District 8 office building to make eligible for LEED certification.		
I-4.7P: Determine where the Integrated Pest Management implementation function resides, and ensure pest control contracts require integrated pest management.		
I-4.8P: Work with DGS to ensure that the location efficiency scores are 10% higher than average for all new leases.		
I-4.9P: Install submeters in the Translab to continue LEED certification process.		

Table 3-12B: Waste Reduction Actions

Potential Actions	Participating Department Units	Deadline
I-5.1P: Determine method to track amount of waste taken to and/or diverted from landfills.		
I-5.2P: Determine origin activity and division of waste reported to the California Department of Resources Recycling and Recovery (CalRecycle) (i.e. construction, maintenance, office, etc.).		
I-5.3P: Establish a baseline and goal.		
I-5.4P: Identify recycling leads in applicable divisions.		
I-5.5P: Identify methods to reduce waste.		

4. WATER EFFICIENCY AND CONSERVATION ROADMAP

4.1 Background

This Water Efficiency and Conservation Report demonstrates to the Governor and the public the progress Caltrans has made toward meeting the Governor's goals. This report identifies successful accomplishments, ongoing efforts, and outstanding challenges.

California experiences the most extreme variability in yearly precipitation in the nation. The state suffered its four driest consecutive years in recorded history from 2012 to 2014, and the snowpack shrank to just five percent of its seasonal average in 2015. The 2017 water year, however, was one of the state's wettest. These wide swings in precipitation from one year to the next show why California must be prepared for either flood or drought — and why using water wisely is critical.

The Executive Orders and SAM sections listed earlier in this document help demonstrate the connection between water and energy use, (the water-energy nexus), water and climate change, and water and landscaping. Furthermore, the impact of water use by state agencies goes beyond the scope of these Executive Orders, SAM sections and DGS management memos as these documents do not address related issues such as water runoff from landscaping and various work processes and the potential for water pollution or the benefits of water infiltration, soil health and nutrient recycling. However, by using holistic water planning, a well-crafted water plan can not only meet all state requirements, but add considerable value and benefits to the organization and surrounding communities.

Caltrans took extraordinary measures to meet the Administration's goal of cutting water use by 50 percent during the recent drought. For example, Caltrans' Director authorized emergency funding for repairing and modernizing irrigations systems along the highway, and for replacing water fixtures in facilities to maximize efficiency. Caltrans also supported the Save Our Water campaign by using electronic highway message signs to raise awareness of the severe drought and encourage all Californians to conserve water. As a result of these measures, Caltrans reduced water use by 66 percent from 2010 to 2016.

The following table displays water use by Caltrans facility type:

Table 4-1: Caltrans Facility Types*

Building Type	# of facilities	Floor area (ft^2)	2016 Water Usage (gal)
CVEF	33	n/a	Reported by CHP
Equipment Shop**	26	671,327	5,175,500
Laboratory	16	358,208	13,479,500
Maintenance Station	369	3,370,745	95,633,400
Office	12	2,283,612	50,293,000
Resident Engineer (RE) office**	2	7,917	131,900
Safety Roadside Rest Areas****	86	239,396	
TMC	5	263,745	8,326,200

Building Type	# of facilities	Floor area (ft^2)	2016 Water Usage (gal)
Toll Plaza	2	14,950	951,400
Warehouse	1	102,558	298,900
Total	**552**	**7,312,458**	**174,289,800**

* Leased facility water data is not included in this report due to inability to access the billing information.
**Thirteen of the equipment shops are co-located and share a meter with maintenance stations
***Most of the RE offices (Construction) are not owned by Caltrans; they are leased for the life of the highway/bridge project
****Safety Roadside Rest Area water usage has not been included. Rest areas are used by the public with no state employee occupancy. Most rest areas receive water from groundwater wells with un-metered water use.

Caltrans' facilities have various operational needs for water beyond usage in restrooms, kitchens, and outdoor landscaping. The following tables display usage by water type and Caltrans' properties with the largest per capita usage:

Table 4-2: 2016 Total Purchased Water (for facilities)

Purchased Water	Quantity (Gallons)	Cost ($/yr)
Potable	173,551,870	$1,182,419
Recycled Water	1,007,930	$3,907
Total	**174,559,800**	**$1,186,326**

Source: Caltrans InfoAdvantage database records

Table 4-3: 2016 Properties with Largest Water Use

Building Name	Water Use Total (Gallons)	Area (ft^2)
District 08 Office (San Bernardino Gov't Center Office Bldg)	17,425,400	235,714
District 07 Office	14,017,200	716,200
Southern Regional Laboratory	7,214,100	80,450
District 04 Office	6,631,600	525,000
North Bay Region	5,521,100	13,426
Total for Buildings in This Table	**50,809,400**	**1,570,790**
Total for All Department Buildings*	**174,559,800**	**7,073,062**
% of Totals	**29%**	**22%**

Source: Caltrans Asset Management Inventory (AMI) database, Caltrans InfoAdvantage database
*Safety Roadside Rest Area square footage was not included since water use is currently unavailable

Table 4-4: Properties with Largest Landscape Area

Building Name	Landscape Area (ft^2)
South San Jose Maintenance Station	64,900
Geyserville Maintenance Station	39,000
Fort Ross Maintenance Station	36,000
Tri-Bridge Yard (Benicia)	34,300
Gilroy Maintenance Station	28,600
Total Landscape Area for Buildings in This Table	**202,800**
Total Landscape Area for All Department Buildings	**1,012,800**
% of Totals	**20%**

Source: Distance measured in Google Maps

Achievements and challenges

Caltrans has reduced water use in buildings by 38 percent from the 2010 baseline and by 42 percent from the 2013 drought baseline (as shown in Table 4-5, surpassing the Governor's goals by 18 percent and 17 percent, respectively).

Table 4-5: Department Building Water Use Trends

Year	Total Amount Used (Gallons/year)
Baseline Year: 2010	282,690,500
Baseline Year: 2013	298,494,800
2016	174,559,800
2010-2016 reduction	**108,130,700**
2013-2016 reduction	**123,935,000**
2020 target (20% reduction from 2010 baseline)	**226,152,400**

Source: Caltrans InfoAdvantage Database records

Table 4-6: 2016 Total Water Reductions Achieved

2016 Total Water Use Compared to Each Baseline	Reduction Achieved	Actual Percent Change in Water Use	Total Amount Saved (gallons per year)
2010 baseline: 20% Reduction Achieved	☒Yes ☐ No	-38%	108,130,700
2013 baseline: 25% Reduction Achieved	☒Yes ☐No	-42%	123,935,000

Source: Caltrans InfoAdvantage Database records.

The largest effort to conserve water occurred in response to the drought. The Caltrans Director authorized emergency funding to repair and replace water fixtures to make them more

efficient. In response, programs and districts replaced approximately 1,300 fixtures with more efficient hardware throughout the state.

Caltrans has regularly tracked its progress toward the Governor's goals. The Caltrans External Affairs Program produces a quarterly performance report called the "Mile Marker" that focuses on Caltrans' progress in meeting its strategic management goals. The 2015 Second Quarter Issue includes an article titled "Serious Work Underway at Caltrans to Combat Drought," highlighting the various efforts Caltrans implemented to reduce water used to irrigate highway landscaping.

While meeting the Governor's goals, Caltrans faced challenges including:

- Lack of staff and financial resources due to competing priorities
- Lack of the availability of recycled water to use for landscape irrigation at facilities
- Lack of trained water management staff dedicated to facilities
- Inaccuracies in tracking usage information from water bills. This information comes from paper copies hand-keyed into Caltrans' accounting system, leaving the opportunity for human error. Changes have been made to the process to improve accuracy since 2014.
- The inability to obtain accurate water usage information for un-metered facilities, where measuring groundwater is difficult to track and would require the installation of a cloud-based monitoring system.

Current projects

Caltrans has several water-saving initiatives that are underway across the state. These efforts could significantly reduce Caltrans' water use; for example, the current water efficiency program at the District 1 office building will save at least 36,000 gallons of water per year when completed. In general, Caltrans intends to change all remaining water fixtures to more efficient hardware where feasible, evaluate potential water savings in future projects prior to installation, and conduct better documentation of projects for reporting and analysis purposes. The Caltrans Sustainability Program intends to work with programs starting in early 2018 to discuss ways to continue these activities.

The following table summarizes Caltrans' completed or ongoing indoor water efficiency projects.

Table 4-7: Summary of Indoor Water Efficiency Projects Completed or In Progress*

Year Started	Water Saved (Gallons/yr)	Cost Savings per Year
2014	1,300,000	$20,000
2015	54,545	Unmetered water
2016	0	0

Source: Caltrans District facility representatives

*This table does not include all of the 1,300 fixtures that were replaced with Director's Orders Emergency Funds. Estimated potential water savings was not recorded at the time projects were completed. This also does not include other projects where estimated potential savings was not recorded.

The following three tables (Tables 4-8, 4-9, and 4-10) display additional details about completed or ongoing projects, although these tables do not correspond to the data in Table 4-7 for a few reasons. Out of the three rounds of emergency funded projects, many of the first round of projects were subjected to a time constraint that resulted in a failure to document potential water and cost savings. In addition, there were many activities that were suspended or reduced to save water during the drought, such as:

- Landscape watering on the highway system
- Vehicle washing
- Interior and exterior window washing at facilities
- Power-washing at facilities
- Irrigation of turf and annuals at facilities

Table 4-8: Summary of Boilers and Cooling Systems Projects*

Year Funded	Water Saved (Gallons/yr)	Number of Systems with Water Efficiency Projects	Percent of Department Heating and Cooling systems
2014	0	0	0
2015	unknown	1	0.3%
2016[19]	211,951	4	1.1%

Source: Caltrans District facility representatives

*This table does not include other projects where estimated potential savings was not recorded.

Table 4-9: Summary of Landscaping Hardware Water Efficiency Projects*

Year Funded	Water Saved (Gallons/yr)	Estimated Annual Cost Savings	Total Number of Projects per Year
2014	316,000	$3,110	2
2015	24,960	$130	2
2016	21,120	Unknown	3

Source: Caltrans District Facility Representatives

*This table does not include other projects where estimated potential savings was not recorded.

19 A project to repair three boilers at the District 8 office was completed in September 2016 and a project to test and treat the water in the cooling towers is currently ongoing.

Table 4-10: Summary of Living Landscaping Water Efficiency Projects*

Year Funded	Water Saved (Gallons/yr)	Landscape Area MWELO (ft2)	Climate Appropriate Landscape Area (ft2)
2014	0	0	0
2015	5,200	0	2,050
2016	8,000	0	unknown

Source: Caltrans District facility representatives

*This table does not include other projects where estimated potential savings was not recorded.

4.2 Water Shortage Contingency Plans and Critical Groundwater Basins

Urban water suppliers are required to maintain Water Shortage Contingency Plans that are customized to local conditions. These plans include a staged response to water shortages and droughts lasting up to three years. When implementing the stages of the Water Shortage Contingency Plan, the water supplier will require increasingly stringent reductions in water use.

State agencies should be aware of their water suppliers' Water Shortage Contingency Plan and the potential impact each stage may have on their water use. State agencies should have their own contingency plans in place for their building and landscaping water use in order to respond to any stage implemented by the water supplier.

The Sustainable Groundwater Management Act (SGMA) established a new structure for managing California's groundwater resources at a local level by local agencies. SGMA requires, by June 30, 2017, the formation of locally-controlled groundwater sustainability agencies (GSAs) in the State's high- and medium-priority groundwater basins and subbasins (basins). A GSA is responsible for developing and implementing a groundwater sustainability plan (GSP) to meet the sustainability goal of the basin to ensure that it is operated within its sustainable yield, without causing undesirable results. For those facilities located in critical groundwater basins, state agencies are to work with the local GSA plan.

There are 29 Caltrans buildings located in critical groundwater basins (displayed in tables 4-11 and 4-12). These facilities do not have water shortage contingency plans, but efforts are being made to minimize water usage by replacing inefficient water fixtures.

Table 4-11: Number of Buildings with Urban Water Shortage Contingency Plans and in Critical Groundwater Basins

Number of buildings with urban water shortage contingency plans.	Number of buildings in critical groundwater basins	Total amount of water used by buildings in critical groundwater basins (gallons)
0	29	13,469,300

Source: Caltrans District facility representatives

Table 4-12: Facilities located within Critical Groundwater Basins

Facility Name (from ESPM)	City	Basin Name
Cuyama Maintenance Station	Cuyama	Cuyama Valley – Santa Barbara County
Santa Cruz Maintenance Station	Santa Cruz	Santa Cruz – mid-county
Shandon Maintenance Station	Shandon	Salinas Valley – Paso Robles Area
Salinas Maintenance Station	Salinas	Salinas Valley – 180/400 Foot Aquifer
District 6 Materials Lab	Fresno	San Joaquin Valley – Kings
Lemoore Yard Maintenance Station	Lemoore	San Joaquin Valley – Tulare Lake
District 6 Office	Fresno	San Joaquin Valley – Kings
Bakersfield Maintenance Station	Bakersfield	San Joaquin Valley – Kern County
Mendota Maintenance Station	Mendota	San Joaquin Valley – Delta-Mendota
Visalia Maintenance Station	Visalia	San Joaquin Valley – Kaweah
Fresno Maintenance Station	Fresno	San Joaquin Valley – Kings
Delano Maintenance Station	Delano	San Joaquin Valley – Kern County
Lost Hills Maintenance Station (Satellite)	Lost Hills	San Joaquin Valley – Kern County
Porterville Maintenance Station	Porterville	San Joaquin Valley – Tule
Taft Maintenance Station	Taft	San Joaquin Valley – Kern County
McKittrick Maintenance Station	McKittrick	San Joaquin Valley – Kern County
Kettleman City Maintenance Station	Kettleman City	San Joaquin Valley – Tulare Lake
Lemon Cove Maintenance Station	Lemon Cove	San Joaquin Valley – Kaweah
Bakersfield Equipment Sub-Shop 2	Bakersfield	San Joaquin Valley – Kern County
West Region Maintenance Station	Camarillo	Pleasant Valley – Ventura County
Inyokern Maintenance Station	Inyokern	Indian Wells Valley – Kern County
District 10 Office	Stockton	San Joaquin Valley – Eastern San Joaquin
Patterson Maintenance Station	Patterson	San Joaquin Valley – Delta-Mendota

Facility Name (from ESPM)	City	Basin Name
Stockton Equipment Shop	Stockton	San Joaquin Valley – Eastern San Joaquin
Los Banos Maintenance Station	Los Banos	San Joaquin Valley – Delta-Mendota
Merced Maintenance Station	Merced	San Joaquin Valley – Merced
Lodi Maintenance Station	Lodi	San Joaquin Valley – Eastern San Joaquin
Stockton Maintenance Station	Stockton	San Joaquin Valley – Eastern San Joaquin
Stockton Maintenance Station (1690)	Stockton	San Joaquin Valley – Eastern San Joaquin

It's important to note that District 10 will soon take a number of steps to conserve water. The district intends to install cisterns to capture rain water, revamp landscaping with drought-tolerant plants at offices, and possibly use recycled water. The district has already installed diffusers at every faucet, in addition to replacing some areas of landscape with rock and concrete. The district is also installing recycled water systems at SRRA to sustain drought-tolerant landscape.

Going forward, the Sustainability Program will work with the districts' facility representatives to determine how they will meet each of the water supplier's water shortage contingency plan stages and how it meets the necessary reductions.

4.3 Building Inventories Summary

SAM section 1835.5 requires state agencies to purchase, install and operate WaterSense or equivalent industry standard fixtures and equipment (including irrigation equipment) whenever it is available, cost-effective, and meets quality requirements. Caltrans made significant efforts during the drought to replace water fixtures, with the goal of reducing water by at least 25 percent. Caltrans surpassed that goal; however, there are still a number of fixtures that need to be replaced (as shown in Table 4-13). The Sustainability Program intends to work with facility managers to determine how they will replace the items and a timeline for replacement.

Table 4-13: Summary of Building Inventory Needs

# of toilets to be replaced with 1.25 gallon per flush	#of urinals to be replaced	# of faucet aerators to be replaced	# of showerheads to be replaced @ 2.0 gpm and trickle flow control	# of clothes washers to be replaced with Energy Star washers	# of garbage disposals to be replaced.	# of pre-rinse valves to be purchased and replaced
869	451	827	209	25	13	4

Source: Caltrans District facility representatives

4.4 Heating and Cooling Systems Inventories Summary

DGS personnel typically maintain boiler and cooling systems in Caltrans buildings, and repairs and maintenance are performed regularly. Table 4-14 displays Caltrans' inventory of these systems.

Table 4-14: Summary of Boilers and Cooling Systems Inventory

Amount of Water Used for make up (Gallons)	Number of flash tanks to purchase and install	Number of meters to purchase and install	Amount currently reused? (Gallons)	Remaining additional water suitable for other purposes such as irrigation (Gallons)
350.5	0	5	0	0

Source: Caltrans District facility representatives

4.5 Irrigation Hardware Inventories Summary

Facilities landscaping typically makes up at least 50 percent of an agency's total facility water use. While landscaping serves critical functions, the accompanying irrigation hardware, if not properly installed and maintained, can contribute to water waste. By reviewing and inventorying all irrigation hardware, it is possible to achieve significant water savings.

Caltrans has begun to develop several irrigation upgrade projects. District 1 has proposed a staged comprehensive replacement of the landscaping on the north side of the district office via a contract landscape vendor. This process will include replacing materials with climate appropriate landscaping, dripline and associated hardware, placement of new weed mat, and mulch. Project cost is expected to be between $8,000 and $10,000. District 10 plans to retrofit water fixtures at all of its maintenance facilities in FY 2018-19

Table 4-15: Summary of Irrigation Hardware Inventory

Number of separate meters or sub-meters to purchase and install. (landscaping over 20,000 sf).	Number of irrigation controllers required with weather or soil moisture adjustment and flow sensing capabilities to purchase and install.	Number of backflow prevention devices to purchase and install.	Number of flow sensors to be purchased and installed	Number of automatic rain shut-off devices needed	Number of new pressure regulators to purchase and install.	Number of new hydrozones needed.	Number of new valves to purchase and install.	Number of filter assemblies to purchase and install.	Amount (area covered) of drip irrigation to purchase and install (in sq. ft.)	Number of booster pumps to purchase and install	Number of rotary nozzles or other high efficiency nozzles to purchase and install
0	0	2	3	2	1	3	0	4	1,600	0	0

Source: Caltrans District facility representatives

4.6 Living Landscape Inventory

Far from being just an aesthetic or ornamental feature, landscaping plays a critical role around public buildings and facilities. From providing safety and security, to reducing local heat islands, suppressing dust, reducing water runoff, maintaining soil health, aiding in water filtration and nutrient recycling, landscaping around public buildings is essential. Further, landscaping in public places frequently surrounds historic places and public memorials as well as provides pleasant public gathering spaces. The health and proper maintenance of these landscapes is vital to the physical wellbeing of California's people as well as to its social, cultural, political and historical life.

Additionally, the many vital ecosystem functions carried out by living public landscaping are critical in helping California meet its goals for greenhouse gas reduction, climate adaptation, and water and energy efficiency and water conservation.

Urban forests are vital to improve site conditions for occupants and visitors to buildings and the surrounding community.

District 1 replaced three zones on the west side its district office with native and drought resistant plants, drip lines and associated hardware, and weed mat/mulch to reduce water consumption. District 2 installed artificial grass at its office, and previously irrigated landscaped areas have been converted to hardscape areas throughout its maintenance stations. District 10 is testing many new varieties of landscaping for more resilient landscapes at its maintenance facilities. District 12 is planting drought tolerant plants.

Table 4-16: Summary of Living Landscape Inventory

Total Landscape area >5000 Sq. ft.)	Total Turf Area (Sq. ft.)	Number of historical sites Or memorials	MWELO landscape area (sq. ft.)	Total Climate appropriate landscape area (sq. ft.)
678,250	133,000	7	0	1,012,800

Source: Google Maps, Caltrans District Facility Representatives

4.7 Large Landscape Water Use

Large landscape water use often represents a significant percentage of a facility's water use and significant water savings can often be achieved through better irrigation scheduling or inexpensive improvements in irrigation hardware. As part of the Water Use Guidelines and Criteria, the water use for landscape areas over 20,000 sq. ft. shall be tracked through a water budget program. Table 4-17 displays a summary of Caltrans' progress.

Table 4-17: Summary of Large Landscape Inventory and Water Budget

Number of Facility Sites/Locations with > 20,000 sq. ft. of Landscaping	Total Landscape Area for facilities over 20,000 sq. ft.	Total Water Budget per facility	Total EPA WaterSense or Irrigation Association Certified Staff
7	250,650	unknown	6

Source: Google Maps, Caltrans District Facility Representatives

District 10 has established a CalSense training facility to train WaterSense-certified staff, encompassing all aspects of landscape training for Caltrans employees. The Sustainability Program intends to work with the district to determine a plan for training water managers across the rest of Caltrans.

4.8 BMPs

Building Best Management Practices (BMPs) are ongoing actions that establish and maintain building water use efficiency. State agencies are required by DGS Management Memo 14-02 to implement the building BMPs outlined below.

Building Water Management BMPS

General Water Management. Water usage is tracked monthly, where metered. Leaks are monitored where leak detectors are used.

Leak Detection and Repair. Visual leak detection is performed by facility staff at least monthly, and at some locations daily and weekly. Faucet aerators have been replaced with the proper flows. The Maximo system is used to track building issues and repairs at the District 3 TMC in Sacramento and District 7 office in Los Angeles.

Kitchens. Broken or damaged dishwasher racks are replaced, and the dishwashers are only run when full to maximize capacity where utilized. Equipment water temperatures and flow rates are checked against the manufacturer recommendations, and the recommended minimum temperature and flows maximize savings. Utensils and dishes are pre-soaked in basins of water, rather than in running water. Running water is not used to melt ice in bar sink strainers or defrost food. Water is not allowed to flow unnecessarily.

Laundry Facilities. Washers are only ran when full to maximize capacity. Water level and water temperature is set appropriate according to the load.

Building Heating and Cooling Systems BMPs

Steam traps and leaks are inspected, repaired, and replaced by DGS stationary engineers or hired contractors. Leaks are repaired and faulty steam traps are replaced as soon as possible. Boilers are tuned by certified, trained boiler technicians annually or per the contract scope of work. Stationary engineering staff ensure central storage tanks and steam and condensate return piping have proper insulation. For both cooling towers and boilers, water treatment specialist services are obtained to prevent system scale and corrosion, and to optimize cycles of concentration. Treatment programs include routine checks of boiler water chemistry. Condensate pumps are routinely inspected and maintained by stationary engineers. Both the water side and fire side of the boiler are regularly inspected by stationary engineers. If needed, the tube surfaces are cleaned to ensure optimal heat transfer thereby maximizing system energy efficiency. Boiler and cooling tower blowdown rates are adjusted to maintain total dissolved solids (TDS) at levels recommended by manufacturers' specifications at respective locations. Water-cooled air conditioning units are shut-off when not needed, or water-cooled equipment is replaced with air-cooled systems.

Landscaping Hardware Maintenance BMPS

Check valves and swing joints are installed and nozzles are replaced as needed. Faucet timers are used for hose or hand irrigation at the District 7 office. Shut-off nozzles are installed at the District 3 TMC in Sacramento and the District 10 office in Stockton.

Living Landscape BMPs

Plants are prioritized and assigned value within a landscape. Trees and large shrubs are given highest priority for survival during drought or other water shortages. Trees and shrubs continue to be watered as needed. Mulch is refreshed as needed. All bare soil is covered by a minimum of three (3) inches of mulch.

Facilities adjust their irrigation schedules to account for seasonal changes. Some facilities test the irrigation system monthly to check for leaks and misalignment, and other malfunctions. Other facilities use software systems to detect leaks. Leaks are repaired immediately. Irrigation systems are adjusted as needed. Watering happens early in the morning or in the evening when wind and evaporation are lowest, and never between 10 a.m. and 6 p.m. The sprinklers are directing water to landscape areas, avoiding hardscapes such as parking lots, sidewalks, or

other paved areas. No irrigation water is permitted to leave the site. Water Use Classifications of Landscape Species (WUCOLS) are used to find plant water use requirements and only water landscapes according the plant water needs.

Plant species native to the climate zone are already in place. Drought tolerant plants are considered in certain areas. Bio-swales and other forms of rainwater capture are used to keep water onsite. Incorporating plantings for pollinators will be considered, although some native plants can be harmful to pollinators. When planting new areas or replacing plants, adding compost to the soil (entire planting areas, not just planting holes) at a rate of four (4) cubic yards per 1,000 square feet to a depth of six inches (unless contradicted by a soil test) will be considered.

4.9 Monitoring, Reporting and Compliance

Each state agency is responsible for monitoring water use and reporting baseline and annual water use for compliance with the water use reduction targets. Water use shall be measured at facilities that have meters and submeters. Water use must be estimated at state facilities that do not have water meters. All estimates and assumptions of water use should be well documented.

4.10 Highway Landscape Water Conservation

While the greater part of this Roadmap focuses on buildings, this section highlights Caltrans' water conserving efforts and accomplishments for highway landscaping. Approximately 70 percent of Caltrans' water consumption comes from the maintenance and preservation of highway landscaping. However, this consumption has considerably declined in absolute terms. In the 24-year period from 1990 to 2014, Caltrans' highway landscape water usage decreased 63 percent, even as landscaped acreage increased by 77 percent.

Graph 4-1: Decrease in Landscape Acreage

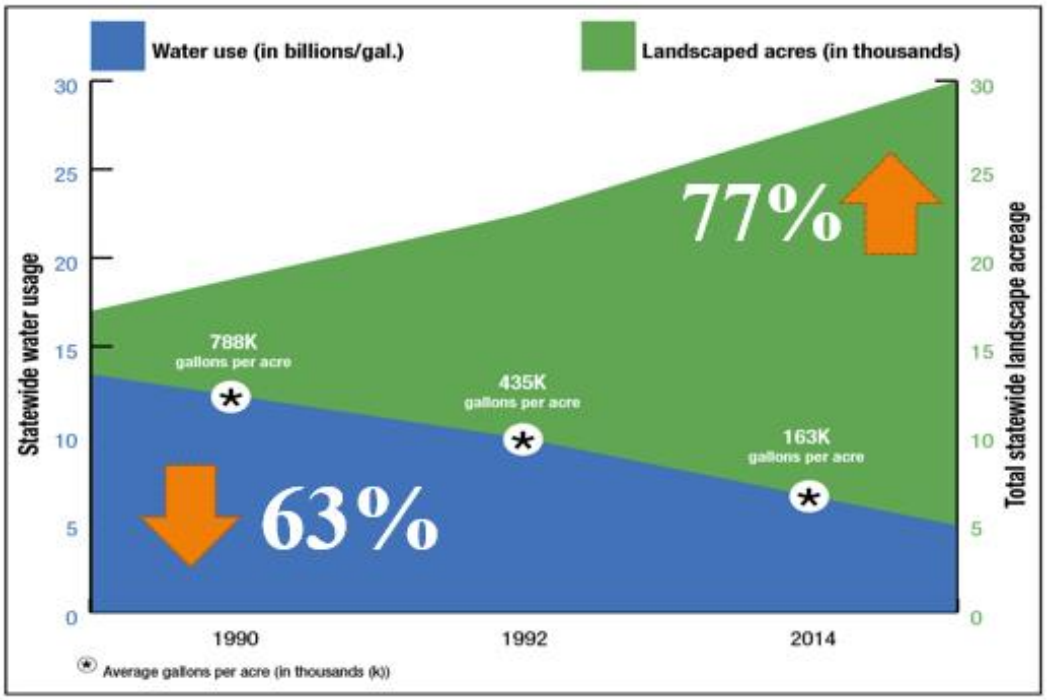


Table 4-18: Caltrans Irrigation Consumption

Year	Landscaped acres	Recycled water usage (gallons)	Potable water usage (gallons)	Total (gallons)
2014	≈30,000	n/a	n/a	≈4.9 billion
2015	≈30,000	400,835,000	2,369,202,000	≈2.7 billion
2016*	≈30,000	316,592,000	2,406,730,000	≈2.7 billion

Source: IMMS Dashboard

It's important to note that Caltrans anticipates its non-potable water use will increase as recycled water projects are implemented to meet the Director's goal of 100 percent non-potable water use by 2036 (explained in greater depth later in this section).

Water conservation goals and actions

Caltrans' goals include the following targets for irrigation conservation:

- 100 percent conversion to smart irrigation control technology
- 100 percent conversion to non-potable water sources for highway planting
- 50 percent reduction in potable water use

In addition, Caltrans initiated the following actions to conserve water.

Postponed and delayed planting. The drought delayed most planned planting work sponsored by Caltrans or its partners from February 2014 until November 2016. The cost from these delays amounted to more than $96 million.

It's important to note that all delayed planting has been accomplished. Commitments made by the STIP[20] and Local Agencies program must continue to be fulfilled by the original funding source.

Guidance updates. The Highway Design Manual and Landscape Architecture Program website have been updated to reflect recent departmental water conservation goals including non-potable and recycled water (as December 2016).

Director's Orders for emergency water conservation. Caltrans secured $216 million in emergency funding for 106 water conservation projects. Caltrans initiated three rounds of Director's Orders (DO) between January 2014 and May 2016. These orders resulted in water conservation contracts that repaired and modernized irrigation systems, implemented recycled water conversion, and replaced irrigation controllers with "smart" technology installations (details shown in Table 4-19).

Table 4-19: Director's Orders Summary Item List

All rounds	Totals
Installed new or upgraded smart controllers (each)	2,544
Upgraded remote irrigation control systems and communication technology (each)	661
Landscaped areas converted to recycled water acres (acres)	549
Landscaped areas estimated recycled water usage (gallons/yr)	228,713,210
State right-of-way recycled water pipe (LF)	151,510
Outside right-of-way recycled water pipe (LF)	547
Recycled water meters (each)	90
Flow meters/sensors (each)	1,439
Remote control valves/master valves (each)	3,753
Replaced sprinklers or assemblies (each)	49,727

20 State Transportation Improvement Program

All rounds	Totals
Irrigation supply line repair and replacement (LF)	371,382
Efficient water delivery (regulations, backflow preventer assembly, pumps, faucets, toilets) (each)	1,244
Theft deterrence – anti-theft enclosures/boxes (each)	2,157

Caltrans' rate for completing three rounds of DOs can be summarized as follows (through July 2017):

- Round 1 – $57.7 million, 100 percent complete *(35 projects)*
- Round 2 – $24.6 million, 100 percent complete *(13 projects complete)*
- Round 3 – $133.5 million, 100 percent complete *(58 projects complete)*

Specific accomplishments to date include:

- Installing 2,544 of 2,954 planned "smart" irrigation controllers
- Receiving approximately $700,000 in rebates from water purveyors.
- Implementing new non-potable and recycled water sources on 24 projects.
- Increasing recycled water use from 14 percent to 23 percent of all usage for highway planting. This rate will increase to over 30 percent once five projects being developed in the SHOPP are implemented.

Director's Order recycled water conversion

Former Caltrans Director, Malcolm Dougherty, directed Caltrans to convert 100 percent of its landscape irrigation to non-potable (recycled or other non-drinkable) water sources by 2036. Wherever fiscally feasible, designers should bring non-potable or recycled water transmission lines to the highway right-of-way and modify associated existing irrigation systems to operate properly without the use of potable water. Table 4-20 displays the results from this conversion.

Table 4-20: Director's Order Recycled Water Conversion

DO round	# of projects	Recycled water (gallons)	Total cost
1	4	34,968,000	$6.3 million
2	3	6,660,200	$6.1 million
3	17	187,085,000	$28.3 million
Totals	**24**	**228,713,200**	**$40.7 million**

Future water conservation projects

Work related to the DOs water conservation contracts has been completed. Although these contracts accomplished enormous amounts of work, they didn't address all of Caltrans' needs.

The District Drought Action Teams and Water Managers will continue analyzing remaining needs and determine how improvements can best be implemented.

Going forward, Caltrans should address the following water conservation measures:

- Providing elements to continue to meet our 50 percent water-use reduction (as compared to 2013 usage)
- Converting to 100 percent recycled water use by 2036, and addressing the following issues:
    - Providing points of connection
    - Installing main and/or supply lines
    - Providing hydrants or standpipes for construction or maintenance activities
- Installing remaining smart controllers to meet the goal of 100 percent implementation
- Installing elements needed to meet Drought Action Plan goals
- Installing facilities or other equipment to efficiently manage and track water consumption
- Repairing and protecting existing irrigation systems.
- Incorporating compost into the soil to reduce storm water runoff and to hold water in the root zone
- Spreading wood mulch or installing inert ground covers such as gravel to conserve soil moisture
- Selecting regionally appropriate, drought-tolerant, or native plant material.
- Preserving established existing vegetation to the maximum extent possible
- Replacing plant material lost due to the drought with an emphasis on restoring classified landscaped freeway areas

Since Caltrans does not have set-aside water conservation funds, this work will need to be included with ongoing transportation projects, SHOPP Roadside Rehabilitation (201.210), or District Minor programs. Where appropriate, water conservation needs should be included in current 10-Year SHOPP planning efforts. Needs could also be included with other work or as standalone projects. Asset management and inventory efforts should include water conservation needs, condition (Good/Fair/Poor), estimated improvement costs, and number of activity units.

District landscape architects, district SHOPP coordinators, and Landscape Architecture Program SHOPP advisors should be consulted for prioritizing needs for the SHS Management Plan (SHSMP), and developing standalone or multi-objective projects.

Continuing water conservation requirements

California's climate varies throughout the state, with most of the population residing in temperate Mediterranean zones. Reoccurring drought will continue to be a part of the state's

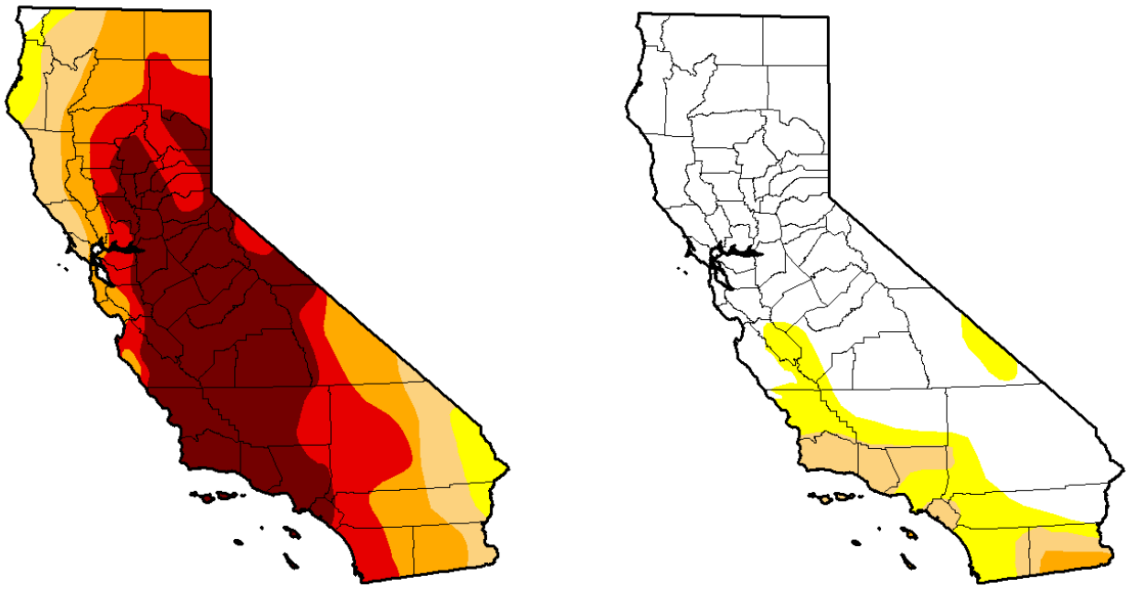
future. For this reason, the following water conservation requirements should always be in effect:

- Reducing potable water use by a minimum of 50 percent compared to the 2013 baseline, per Caltrans "Water Conservation for Highway Projects" memo from February 6, 2014
- Compliance with the "Storm Water Management Plan Implementation and Model Water Efficient Landscape Ordinance" (MWELO) memo from October 23, 2013
- Compliance with Deputy Directive 13 ("Water Conservation") from September 1, 1993.
- Planting limited to native and non-native material appropriate for the project micro-climate so no water beyond natural rainfall is required for healthy survival.
- Supplemental irrigation provided by non-potable water, unless not practical.
- Inclusion of the Maximum Applied Water Allowance (MAWA) calculations for new and rehabilitated landscapes as project supplemental information.

Despite the wet winter of 2016-17, droughts are expected to persist in California and perhaps be more frequent due to climate change and warm winter temperatures. For that reason, the promotion and implementation of water conservation strategies should continue to be a high priority at Caltrans. Graph 4-2 is a comparison of drought conditions over a one-year period from March 2016 to March 2017.

Graph 4-2: Drought Heat Maps

March 1, 2016 **March 7, 2017**



Source: United States Drought Monitor
http://droughtmonitor.unl.edu/CurrentMap/StateDroughtMonitor.aspx?CA

The graphic on the left (March 1, 2016) depicts the effects of five years of drought when 99.6 percent of California was facing exceptional to abnormally dry conditions. As of March 1, 2017, only 23.46 percent of California faced severe to abnormally dry conditions. Graph 4-3 provides a more detailed look at conditions during the drought.

Graph 4-3: Drought Conditions[21]

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	76.54	23.46	8.24	1.10	0.00	0.00
Last Week *02-28-2017*	74.49	25.51	8.73	4.08	0.00	0.00
3 Months Ago *12-06-2016*	12.03	87.97	73.04	60.27	42.80	21.04
Start of Calendar Year *01-03-2017*	18.07	81.93	67.61	54.02	38.17	18.31
Start of Water Year *09-27-2016*	0.00	100.00	83.59	62.27	42.80	21.04
One Year Ago *03-08-2016*	0.43	99.57	97.49	83.16	60.86	38.48

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

Source: United Sate Drought Monitor http://droughtmonitor.unl.edu/CurrentMap/StateDroughtMonitor.aspx?CA

21 Source: http://droughtmonitor.unl.edu/MapsAndData/MapArchive.aspx

Landscape water conservation challenges

Caltrans has made significant steps in recent years to conserve water in its landscaped areas, and is pursuing opportunities to do more in the following areas:

- Using “smart” controllers for flow monitoring and reporting to their fullest extent
- Looking for ways to access recycled and non-potable water sources
- Working with recycled water purveyors to implement projects that meet capacity allocations, environmental health requirements, system testing, plan reviews, and use and permit fees, in addition to construction/installation practices and requirements
- Addressing declining and deteriorating irrigation infrastructure that reduces delivery efficiency
- Providing funds to convert irrigated landscapes into non-irrigated sustainable landscape systems
- Implementing MWELO and MAWA

4.11 Energy and Water Commitments and Actions

Table 4-21: Energy and Water Conservation Commitments

I-3. Energy & Water: Reduce grid-based energy and potable water use		
Commitment	**Participating Department Units**	**Deadline**
I-3.C1: Focus the Department's efforts to reduce grid-based energy and potable water use on Caltrans-owned office buildings and buildings managed by the Maintenance and Operations Program that together account for 75% of Caltrans building facilities and 95% of Department energy use.	Sustainability (lead) Business Operations Traffic Operations Maintenance Equipment	Ongoing. To be initiated by 7/1/18.
I-3.C2: Continue participation in related Administration-wide efforts including the Sustainable Buildings Working Group.	Sustainability	Ongoing

Table 4-21A: Energy and Water Reduction Actions

Potential Actions	Participating Department Units	Deadline
I-3.1P: Ensure all future new construction and major renovations exceed Title 24 by at least 15%.		
I-3.2P: Educate all employees on the importance of minimizing electrical plug loads with an annual email from the Director.		
I-3.3P: Determine and document potential energy savings of energy efficiency projects in buildings.		
I-3.4P: Measure and report PUE in data centers over 1,000 sq. ft., and develop and implement strategies to reduce PUE by 10% each year until a PUE ratio of 1.5 or lower is achieved.		
I-3.5P: Follow "Standard Operating Procedures for Energy Management in State Buildings" found in MM 14-07		
I-3.6P: Pursue energy surveys in facilities with high energy use (i.e. Transportation Management Centers).		
I-3.7P: Upgrade/replace inefficient energy fixtures, lighting and systems.		
I-3.8P: Enroll all facilities in demand response programs (particularly facilities with Energy Management Control Systems - EMCSs).		
I-3.9P: Use equipment that will reduce load automatically (for example: purchase smart thermostats for smaller facilities).		
I-3.10P: Determine additional locations for renewable energy.		
I-3.11P: Ensure all future new construction and major renovations over 10,000 sq ft. use renewable energy.		
I-3.12P: Determine which facilities should use Monitoring-Based Commissioning (based on the requirements in MM 15-04).		

I-3.13P: Track ongoing energy use with Energy Management Control Systems, and modify or replace systems without the capability.		
I-3.14P: Use California Department of General Services (DGS) Energy Service Company (ESCO) program to evaluate energy use, recommend changes, and find vendor to make changes.		
I-3.15P: Determine and document potential water savings of water efficiency projects at buildings.		
I-3.16P: Develop water contingency plans for buildings in critical ground water basins.		
I-3.17P: Upgrade/replace/repair all broken or inefficient water fixtures, and boiler and cooling systems, where feasible.		
I-3.18P: Install flow sensors at buildings with landscaping over 5,000 sq. ft.		
I-3.19P: Prioritize valuable landscaping when considering watering needs.		
I-3.20P: Create a water budget for buildings with landscape over 20,000 square feet.		
I-3.21P: Install water meters to track outdoor water use separately at buildings with landscape over 20,000 square feet.		
I-3.22P: Train landscape maintenance staff in US Environmental Protection Agency (EPA) "WaterSense".		
I-3.23P: Follow Best Management Practices (BMPs) listed in MM 14-02.		
I-3.24P: Verify/measure area of landscaping at buildings.		

ZERO-EMISSION VEHICLES ROADMAP

5.1 Background

California is initiating a widespread shift to zero-emission vehicles (ZEVs) to meet its targets for reducing GHG emissions. EO B-16-12 directs state agencies to take actions that help expand the market for these vehicles, such as incorporating larger numbers of ZEVs into their vehicle fleets. Starting in Fiscal Year (FY) 2017-18, the percentage of new light-duty fleet ZEVs must increase by 5 percent each year, reaching 25 percent by FY 2019-20 and 50 percent by FY 2024-25.

Caltrans has been a leader among state agencies in adopting ZEVs. Caltrans has continuously replaced older, dirtier light-duty vehicles with battery electric vehicles (BEVs), hydrogen fuel cell vehicles (FCEVs), and plug-in hybrid electric vehicles (PHEVs), whenever feasible. As shown in Table 5-1, Caltrans has consistently surpassed the Administration's targets for replacing fleet vehicles with ZEVs. Caltrans is scheduled to have 227 ZEVs in its fleet by the end of Fiscal Year 2017-2018.

Table 5-1: ZEV Additions to Caltrans Light-DutyFleet

Vehicle Type	FY 2014-15	FY 2015-16	FY 2016-17	FY* 2017-18	*FY 2018-19	*FY 2019-20	*FY 2020-21	*FY 2021-22
Battery Electric Vehicles (BEVs)	54	10		15				
Plug-in Hybrid Vehicle (PHEVs)		14		61	8	4	4	53
Fuel Cell Electric Vehicles (FCEVs)**			20	17	26	39	48	13
Percent of total fleet purchases	**100%**	**11%**	**100%**	**24%**	**20%**	**25%**	**30%**	**35%**
Required ZEV Percentage	**10%**	**10%**	**10%**	**15%**	**20%**	**25%**	**30%**	**35%**
Total number of fleet ZEVs	**90**	**114**	**134**	**227**	**261**	**304**	**356**	**422**

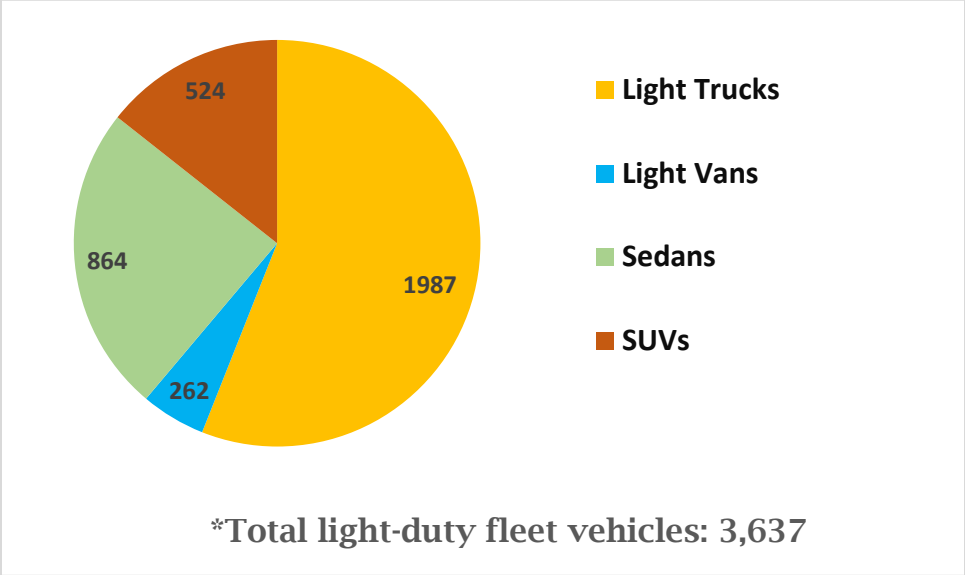
*ZEV addition projections are based on the Catrans Electric Vehicle (EV) Readiness Survey, which assumes $5 million budget for light duty fleet replacement for planning purposes. However, Caltrans does not have a line-item budget for light-duty fleet. Fleet replacement decisions are based on replacing the vehicles with the highest need for repair.

**Projections of additional of FCEV assume availability of SUVs

5.2 Integrating ZEVs into the Fleet

The Caltrans fleet consists of more than 12,000 vehicles and pieces of equipment, including more than 3,500 light-duty vehicles. Caltrans uses these vehicles for a myriad of functions. Light-duty passenger vehicles transport workers to and from job site locations; light-duty pickup trucks; and four-wheel-drive vehicles are used on unpaved surfaces where additional ground clearance and traction are required. Graph 5-1 displays the number of Caltrans light-duty fleet vehicles by type.

Graph 5-1: Composition of the 2016 Caltrans Light-Duty Fleet*



*Light duty fleet composition as of December 31, 2016

The Average Mileage per Gallon for the light-duty fleet is 19 mpg, up from 18 mpg in 2012.

Each Caltrans program uses fleet vehicles for different duties:

- The Capital Outlay Support Program oversees capital improvement projects and is primarily responsible for highway construction. This program uses its vehicles to transport personnel, equipment, and sensitive sampling/testing equipment to rugged job sites.
- The Maintenance Program uses the most vehicles of all the Caltrans programs. The Division of Maintenance protects public safety and preserves California's SHS through routine maintenance and repair of the system. Maintenance work requires light- and heavy-duty vehicles and equipment. The Division of Maintenance also responds to emergencies (such as those caused by severe weather) so travelers and goods reach their destination safely and efficiently.
- The Administration Program uses its vehicles to transport staff and equipment to job sites, and also to monitor capital outlay projects throughout the state.
- The Division of Traffic Operations performs technical traffic analyses, responds to incidents on state highways, and provides traffic design support for project delivery.

The division uses its vehicles to manage the operation of lanes, traffic signals, highway signs and freeway cameras.

- The programs described above are supported by the Division of Equipment, which purchases, fabricates, maintains, and repairs Caltrans' fleet. The Division of Equipment is also responsible for delivering products and services provided by personnel in the Offices of Budgets & Administration, Engineering & Production, Fleet Asset Management & Quality Assurance, and Maintenance & Repair.

Fleet replacement plan

There are 1,324 vehicles in the Caltrans fleet that are currently eligible for replacement in vehicle classes for which ZEVs are available on contract.

Table 5-2: Vehicles in Caltrans Light-Duty Fleet Currently Eligible for Replacement*

	Sub-Compact Sedan	Compact Sedan	Midsize Sedan	Mini Van	Total
Number of vehicles eligible for replacement	293	181	80	770	1,324

*Replacement criteria based on DGS SAM Section 4126

Vehicles over specified mileage and age thresholds are eligible for replacement. Caltrans typically replaces these vehicles with ZEVs available on statewide commodity contracts in the sub-compact, compact, mid-size sedan and minivan vehicle classes. Replacing light-duty trucks is more challenging because automakers haven't begun producing ZEV pickups, leaving Caltrans with few options. One possible solution would be to replace Caltrans' light-duty trucks with Hyundai Tucson sport utility vehicles (SUVs). The Tucson is an all-wheel-drive FCEV that could replace fleet pickups and small SUVs for divisions needing vehicles with off-road capability. For instance, field supervisors who don't haul heavy payloads might use this vehicle.

For the most part, Caltrans has been replacing light-duty trucks with models that get better gas mileage. As technology continues to improve to support the necessary power for heavier payloads and hauling, Caltrans will continue to investigate whether divisions and programs can replace larger pickup trucks and SUVs with cleaner options.

Caltrans has faced other challenges with replacing fleet vehicles with ZEVs. ZEVs cost more than conventional autos and trucks. Caltrans has a finite amount of funds for equipment replacement each year and heavy-duty vehicles cost significantly more than light-duty vehicles. While Caltrans created a five-year purchasing plan that included many ZEVs, annual budgeting decisions have to prioritize fleet replacements based on the greatest need. Caltrans will continue to meet the ZEV requirement for future purchases.

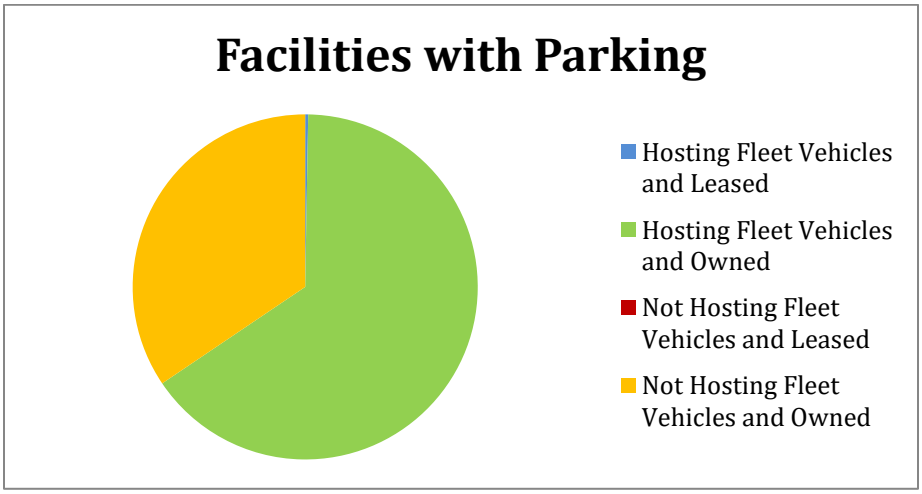
It's also challenging to operate and maintain ZEVs. These vehicles require adequate infrastructure to support fueling and charging. However, electric fast-charging stations and hydrogen fuel stations are only available in limited areas. Caltrans has begun plans to develop a statewide ZEV fueling network that would address some of these issues.

5.3 ZEV Infrastructure

This document only addresses electric vehicle charging as it pertains to charging Caltrans fleet and access for employee use. It does not address other initiatives related to electric vehicle charging access to the public on Caltrans property. As discussed in previous sections of this document, Caltrans operates and occupies many types of facilities. The most common Department facilities are office buildings, equipment shops, maintenance facilities, material laboratories, and transportation management centers. Overall, Caltrans owns 99 percent of its building and parking facilities.

Department facilities have different types of parking lots; some only host fleet vehicles, others host fleet and employee vehicles, and still others host a mix of public, fleet, and employee parking spaces. Caltrans' parking lots are either co-located with a facility on the same parcel or located on a nearby parcel. Graph 5-2 shows a breakdown of Caltrans' facilities with parking lots. For reference, 59 percent (236) of Caltrans parking facilities host fleet vehicles.

Graph 5-2: Parking Facilities *



* Leased facilities do not show in chart due to low quantities

Caltrans currently has more 100 EV chargers in use at its facilities, including permanently affixed wall- and pedestal-mounted units and standalone mobile solar units. Given the nature of Caltrans fleet operations and the length of stay for visitors and employees, Caltrans is still evaluating how to balance the appropriate mix of level 1 (L1) and level 2 (L2) electric vehicle (EV) chargers at its facilities. The availability of external funding opportunities may also influence the quantity and levels of charging available at each site.

Based on estimates of future ZEV fleet purchases and a count of visitor and workplace parking spaces, Caltrans will need to install more than 200 additional chargers for fleet vehicles and approximately 1,000 workplace chargers within the next 5 years to achieve the Administration's targets. The facilities with the most urgent need for EV charging are locations where the domiciled fleet vehicles will not be adequately served by the available charging access.

5.4 External Funding Sources for ZEV Infrastructure

Caltrans has made progress in identifying external funding opportunities to expand ZEV infrastructure. Caltrans participates in the Governor's Office of Business and Economic Development (GO-Biz) Lead by Example team to share experience and learn from other state agencies implementing similar funding opportunities. In addition, Caltrans is engaged with the following partners to identify potential funding opportunities for EV charging stations:

- A Caltrans facility has been selected as a trial site in the PG&E EV Charge Network Program. If successful, the trial site may provide a model for Caltrans and other state agencies to participate in the utility's program.
- Caltrans received a California Energy Commission grant to install workplace charging at 22 locations in 2014 and will explore future funding opportunities through the CEC's annual grant program.
- Caltrans is using EVgo settlement funds for charging infrastructure.
    - One portion of the settlement provides funds to install "make-ready" infrastructure at workplaces in either SD&GE, SCE, or PG&E service territory. As of September 2017, Caltrans has used EVgo settlement funds to complete 102 make-ready spaces at 11 facilities. An additional 210 make-ready spaces at 21 facilities are awaiting State Fire Marshall or EVgo approval to begin construction. There is potential for more sites to be added in the future if funds are available.
    - The settlement also funds publically available DC fast-charging stations, but many Caltrans sites do not meet specific criteria for population density, proximity to food and services, and multi-unit dwellings. Caltrans has provided EVgo with data regarding potential sites, and is in discussion.

Caltrans might quality for additional opportunities through the state's three IOU electrical utilities in the future once those companies have been approved by the California Public Utilities Commission (CPUC) to provide funding for DC fast-charging infrastructure. As of December 2017, all three IOUs have proposals pending before the CPUC to provide this funding under SB 350. Caltrans will seek to participate in these programs if and when the CPUC approves these proposals. In the meantime, Caltrans will also continue to participate in the IOUs' funding programs for workplace charging.

5.5 Hydrogen Fueling Infrastructure

Caltrans has 37 hydrogen FCEVs in its fleet and has begun evaluating its need for hydrogen fueling stations throughout the state. Caltrans is working with stakeholders in San Luis Obispo — including San Luis Obispo County Air Pollution Control District, Clean Cities Coalition, California Fuel Cell Partnership, and San Luis Obispo County — to partner with a retail station developer in District 5. This effort could become a model for other locations throughout the state if successful. Caltrans is also in the early stages of planning a hydrogen fueling station in District 8.

The lack of an established Department hydrogen fueling network has limited adoption of these vehicles. At the same time, it has been challenging to find original equipment manufacturer (OEM)-compliant fueling equipment at reasonable cost and to resolve permitting issues. In the meantime, Caltrans has been fueling its FCEVs at public retail hydrogen fueling stations.

Despite these challenges, Caltrans continues to look for opportunities to incorporate FCEVs into the fleet. Caltrans has purchased a Global hydrogen fuel cell street sweeper to pilot in Southern California, and continues to explore the purchase of FCEV sport utility vehicles in select locations.

5.6 Comprehensive Facility Site and Infrastructure Assessments

Caltrans has begun performing site assessments, through EVgo make-ready program to evaluate the cost and feasibility of installing EV infrastructure at different facilities. Table 5-3 displays a list of facilities with completed site assessments and facilities proceeding with the installation of charging infrastructure. Remaining sites will proceed as funding becomes available.

Table 5-3: Results of Site Assessments

Facility Address	Facility Location	Proceeding with Infrastructure Installation
1090 Bristol Street	Costa Mesa	X
120 Rickard Street	San Francisco	
13072 Old Bolsa Chica Road	Westminster/Bolsa Chica	X
13230 Firestone Blvd	Santa Fe Springs	X
13571 Central Avenue	Brea	
15700 Tustin Village Way	Tustin	
1750 East 4th Street	Santa Ana	
1808 North Batavia Street	Orange	X
1901 East 1st Street	Santa Ana	
1940 South Workman Mill Road	Whittier	
19601 Beach Boulevard	Huntington Beach	
1993 Marina Boulevard	San Leandro	
210 Burma Road	Oakland	
224 Lincoln St	Santa Rosa	
28820 The Old Road	Valencia	
320 South Sierra Way	San Bernardino	
32941 Camino Capistrano	San Juan Capistrano	X
3521 1/4 University Drive	Newport Beach	
4821 Adohr Lane	Camarillo	X
500 Queens Lane	San Jose	
5160 W Imperial Highway	El Segundo	
600 Lewelling Blvd	San Leandro	

Facility Address	Facility Location	Proceeding with Infrastructure Installation
6010 Monterey Road	San Jose	
611 Payran St	Petaluma	
6521 Marine Way	Irvine	
66 Madonna Road	San Luis Obispo	
6641 Marine Way	Irvine	
6681 Marine Way	Irvine	
6685 Marine Way	Irvine	
691 South Tustin Street	Orange	X
7177 Opportunity Road	San Diego	X
7179 Opportunity Road	San Diego	X
8122 Katella Avenue	Stanton	X
8502 Railroad Avenue	Santee	X
Total	**34**	**11**

5.7 Electric Vehicle Supply Equipment (EVSE) Construction Plan

Caltrans has the expertise to design, solicit bids, and construct charging stations at its facilities. Caltrans intends to evaluate the most efficient way to implement EV charging stations. It might be more cost-efficient, for example, to add EV chargers to facility renovation or construction projects instead of installing chargers as standalone projects. Smaller projects that require minimal electrical upgrades may be more efficient to install by contracting out to a vendor to complete the installation. Some external funding opportunities require that the design and construction be performed by the partner. While there are many pathways to install EV chargers, Caltrans is exploring all opportunities to provide efficient and cost-effective projects.

5.8 EVSE Operation

Caltrans plans to provide charging for its fleet, and to also lead by example by installing EVSE to support employee and public charging. Caltrans is taking a proactive approach to utilization and efficiency by partnering and collaborating with DGS, other state agencies, public utility companies, and private industry to stay engaged with new technology and ensure a quantifiable means of collecting data to provide transparency and justify benefits to the public. Caltrans plans to create internal guidelines that will govern the use of Caltrans-owned EVSE, including roles and responsibilities for fleet card use, data collection, purchasing, maintenance, and parking and cost recovery policies and procedures.

5.9 Fuel Purchases

The following table displays Caltrans' total fuel purchases in 2015, the most up-to-date information.

Table 5-4: Total Purchased Fuel 2015

Purchased Utility	Quantity*	Cost ($)
Gasoline	6,449,552 Gallons	$ 18,187,737
Diesel	5,068,654 GGE**	$ 12,620,948
Renewable Diesel	19,609 GGE**	$ 47,062
5% Biodiesel	139,288 GGE**	$ 353,792
Propane	17,519 GGE**	$ 58,753
Compressed Natural Gas	157,499 GGE**	$ 389,636
85% Ethanol	94,682 GGE**	$ 218,715
Electricity[22]	3,595 GGE**	$16,827
TOTAL GGE	**11,950,398 GGE****	**$ 31,893,470**

*Quantity from State of California Green Fleet website (http://www.green.ca.gov/Fleet/department/CALTRANS). Cost calculated using an average of 2015 calendar year costs.

**GGE = Gasoline Gallon Equivalent

5.10 Public Safety Exemption

Caltrans fleet does not qualify for the public safety exemption.

5.11 Telematics Plan

Telematics is a method for monitoring vehicle use. Using Global Positioning System (GPS) and on-board vehicle diagnostics, telematics provides valuable information that often results in fuel savings and improved vehicle utilization. Telematics is especially important for verifying that PHEVs maximize the use of battery power rather than gasoline.

Following a telematics pilot, the Caltrans Executive Board approved the use of telematics devices for Caltrans' fleet. In June 2014, the California State Transportation Agency Secretary approved the use of telematics devices on all of Caltrans' fleet vehicles. Installing telematics in the Caltrans fleet has resulted in:

- Automated and accurate collection of fleet management data and reporting for most fleet assets (not compatible with ZEVs)
- Reduced fuel usage
- Enhanced asset warranty management
- Reduced manual reporting and elimination of the web-based CarTags system
- Deterrence of theft
- Reduced physical smog tests
- Lowered GHG levels

22 Using GGE = Electricity kWh x 0.031 (https://epact.energy.gov/fuel-conversion-factors) $0.1451/kWh https://www.eia.gov/electricity/monthly/epm_table_grapher.php?t=epmt_5_6_a

- Improved overall fleet asset management

Caltrans continues to look for innovative ways to improve and expand the available data provided by telematics. Caltrans is also collaborating with DGS in the creation of a statewide mandatory telematics contract. The contract will incorporate all asset platforms including ZEVs within the scope of work providing improved data collection and availability.

5.12 ZEV Commitments and Actions

Table 5-5: Zero Emission Vehicle (ZEV) Commitments

I-6 ZEV: Identify, increase, and streamline Zero Emission Vehicle infrastructure and operations		
Commitment	**Participating Department Units**	**Deadline**
I-6.C1: Lead the Department's activities relating to fleet, equipment, and workplace charging, including coordinating District activities.	Equipment (Lead)	Ongoing
I-6.C2: Develop and disseminate Department policy on workplace charging.	Business Operations	Draft Policy for review by 4/1/18
I-6.C3: Continue to represent the Department in Administration-wide and industry activities including the ZEV Inter-Agency Task Force.	Sustainability	Ongoing
I-6.C4: Sponsor an internal "ZEVFest" educational and decision-making workshop in Spring 2018 to accelerate ZEV policy development and resolve specific implementation barriers.	Sustainability	Workshop in Spring 2018
I-6.C5: Develop communications and training material focused on climate adaptation and resilience in connection with the Department's sustainability priority "Advance clean vehicles, fuels and materials."	Sustainability	12/31/18

Table 5-5A: ZEV Actions

Potential Actions	Participating Department Units	Deadline
I-6.1P: Create guidance for maintenance and operation for charging stations, including charging fees and fleet card for electric vehicles (EVs).		
I-6.2P: Create installation and purchase guidance to streamline data collection and reporting.		
I-6.3P: Identify high-priority locations for EV installation (fleet and workplace).		
I-6.4P: Identify locations for the installation of hydrogen stations to support fleet vehicles.		
I-6.5P: Identify and pursue outside funding sources for all types of charging.		
I-6.6P: Identify, prioritize, and install ZEV Infrastructure at state owned facilities.		
I-6.7P: Improve Caltrans vehicle telematics including data collections for ZEVs.		

Appendix A – Commitment and Actions

Table A-1: Adaptation Commitments

I-1. Adaptation: Identify, plan, and prepare for climate change risks to department assets (the Roadmap focuses on assets other than the State Highway System).		
Commitments	**Participating Department Units**	**Deadline**
I-1.C1: Convene cross-functional Adaptation Working Group to agree to actions, responsibilities and deadlines. Actions to be considered are listed in Table A-1A. Focus the Department's building related adaptation efforts on Caltrans-owned office buildings and buildings managed by the Maintenance and Operations Program that together account for 75% of Caltrans building facilities.	Sustainability (lead) Business Operations Traffic Operations Maintenance Equipment Transportation Planning Information Technology	9/30/18
I-1.C2: Continue participation in Administration-wide efforts including Safeguarding California and the Climate Safe Infrastructure Working Group.	Sustainability Design	Ongoing
I-1.C3: Develop communications and training material focused on climate adaptation and resilience in connection with the Department's sustainability priority "Prepare for climate change and extreme weather".	Sustainability	12/31/18
I-1.C4: Continue activities to integrate climate planning into the Department's planning and design activities (note: while some of these activities pertain to the Department's building assets that are the focus of the Roadmap, many relate to the State Highway System).	Transportation Planning Environmental Analysis Design	Ongoing

Note: See Climate Adaptation Roadmap Sections 1.6-1.9 for summary information about Department activities relating to Adaptation of the State Highway System

Table A-1A: Adaptation Actions

Actions	Participating Department Units	Deadline
Actions items agreed upon:		
I-1.1: Obtain climate data from Cal-Adapt for all building facilities and finalize list of at-risk buildings.	Transportation Planning (lead) Sustainability	6/30/18
Potential Actions:		
I-1.1P: For all at-risk facilities, assess risks and state of repair, using the climate data provided by Transportation Planning.	Business Operations Equipment Shops Maintenance Traffic Operations	
I-1.2P: Create adaptation implementation plans specifying suitable adaptation strategies (including natural infrastructure) to increase resiliency of facility elements at risk, and project priorities.	Business Operations Equipment Shops Maintenance Traffic Operations	
I-1.3P: Create strategies and standards for building facility landscaping that help address urban heat islands (UHI).		
I-1.4P: Submit list and cost of facility improvements for at risk facilities for update of the 5-year plan and the Facility Infrastructure Plan.		
I-1.5P Establish and implement a methodology for tracking climate change conditions at facilities.		

Table A-2: Energy and Water Conservation Commitments

I-2. Energy: Achieve Zero Net Energy (ZNE) at new and existing buildings consistent with EO B-18-12		
I-3. Energy & Water: Reduce grid-based energy and potable water use		
Commitment	**Participating Department Units**	**Deadline**
I-2.C1: Focus the Department's efforts towards ZNE on Caltrans-owned office buildings and buildings managed by the Maintenance and Operations Program that together account for 75% of Caltrans building facilities and 95% of Department energy use.	Sustainability (lead) Business Operations Traffic Operations Maintenance Equipment Information Technology Engineering Services	Ongoing. To be initiated by 7/1/18.
I-3.C1: Focus the Department's efforts to reduce grid-based energy and potable water use on Caltrans-owned office buildings and buildings managed by the Maintenance and Operations Program that together account for 75% of Caltrans building facilities and 95% of Department energy use.	Sustainability (lead) Business Operations Traffic Operations Maintenance Equipment	Ongoing. To be initiated by 7/1/18.
I-3.C2: Continue participation in related Administration-wide efforts including the Sustainable Buildings Working Group.	Sustainability	Ongoing

Table A-2A: ZNE Actions

Actions	Participating Department Units	Deadline
Actions items agreed upon:		
I-2.1: Create a document to help ensure ZNE is considered in Advanced Planning Studies and Project Initiation Documents.	Engineering Services	2/1/18
I-2.2: Verify ZNE status of SFOBB Warehouse one year after construction completion.	Engineering Services	One year after construction completion
Potential Actions:		
I-2.1P: Determine existing facilities that have ZNE potential and work towards making the buildings ZNE (best candidates will be larger, newer facilities that use a lot of energy and have a lot of adjacent land for renewables).		
I-2.2P: Develop plans and propose future new building projects to achieve the Governor's ZNE goals for state buildings.		

Table A-2B: Energy and Water Reduction Actions

Potential Actions	Participating Department Units	Deadline
I-3.1P: Ensure all future new construction and major renovations exceed Title 24 by at least 15%.		
I-3.2P: Educate all employees on the importance of minimizing electrical plug loads with an annual email from the Director.		
I-3.3P: Determine and document potential energy savings of energy efficiency projects in buildings.		
I-3.4P: Measure and report PUE in data centers over 1,000 sq. ft., and develop and implement strategies to reduce PUE by 10% each year until a PUE ratio of 1.5 or lower is achieved.		
I-3.5P: Follow "Standard Operating Procedures for Energy Management in State Buildings" found in MM 14-07		
I-3.6P: Pursue energy surveys in facilities with high energy use (i.e. Transportation Management Centers).		
I-3.7P: Upgrade/replace inefficient energy fixtures, lighting and systems.		
I-3.8P: Enroll all facilities in demand response programs (particularly facilities with Energy Management Control Systems - EMCSs).		
I-3.9P: Use equipment that will reduce load automatically (for example: purchase smart thermostats for smaller facilities).		
I-3.10P: Determine additional locations for renewable energy.		
I-3.11P: Ensure all future new construction and major renovations over 10,000 sq ft. use renewable energy.		
I-3.12P: Determine which facilities should use Monitoring-Based Commissioning (based on the requirements in MM 15-04).		

I-3.13P: Track ongoing energy use with Energy Management Control Systems, and modify or replace systems without the capability.		
I-3.14P: Use California Department of General Services (DGS) Energy Service Company (ESCO) program to evaluate energy use, recommend changes, and find vendor to make changes.		
I-3.15P: Determine and document potential water savings of water efficiency projects at buildings.		
I-3.16P: Develop water contingency plans for buildings in critical ground water basins.		
I-3.17P: Upgrade/replace/repair all broken or inefficient water fixtures, and boiler and cooling systems, where feasible.		
I-3.18P: Install flow sensors at buildings with landscaping over 5,000 sq. ft.		
I-3.19P: Prioritize valuable landscaping when considering watering needs.		
I-3.20P: Create a water budget for buildings with landscape over 20,000 square feet.		
I-3.21P: Install water meters to track outdoor water use separately at buildings with landscape over 20,000 square feet.		
I-3.22P: Train landscape maintenance staff in US Environmental Protection Agency (EPA) "WaterSense".		
I-3.23P: Follow Best Management Practices (BMPs) listed in MM 14-02.		
I-3.24P: Verify/measure area of landscaping at buildings.		

Table A-3: Green Operations Commitments

I-4 Green Operations I: Improve green building operations **I-5 Green Operations II:** Reduce waste sent to landfills		
Commitment	**Participating Department Units**	**Deadline**
I-4.C1: The Sustainability Team will organize and support task groups in identifying actions to improve green building operations. Focus the Department's efforts in green building operations on Caltrans-owned office buildings and buildings managed by the Maintenance and Operations Program that together account for 75% of Caltrans building facilities and 95% of Department energy use.	Sustainability Business Operations Traffic Operations Maintenance Equipment Procurement and Contracts Engineering Services	9/30/18
I-4.C2: Institute sustainable purchasing policies and practices.	Procurement and Contracts	Ongoing
I-5.C1: The Sustainability Team will organize and support task groups in identifying actions to reduce waste sent to landfills.	Sustainability Business Operations Construction Design Maintenance	9/31/18

Table A-3A: Green Operation Actions

Actions	Participating Department Units	Deadline
Actions items agreed upon:		
I-4.1: Install submeters in the District 10 office to continue the Leadership in Energy Environmental Design (LEED) certification process.	Business Operations	12/31/18
I-4.2: Complete LEED certification of SFOBB Phase 1 Maintenance Complex (dependent on extension granted by GBCI).	Engineering Services	7/31/18
I-4.3: Create "Memo to Designers" to ensure all California Green Building Code (CALGreen) Tier 1 criteria get pursued and to include low VOC specifications in all building projects.	Engineering Services	2/28/18
I-4.4: Work with DGS, industry partners, and academia to collect Environmental Product Declaration (EPD) data for several material types, and use the collected data to perform analysis, set baselines, and decide on further applications.	Engineering Services	Ongoing
I-4.5: Reevaluate contractual provisions to improve requirements for the use and reporting of EPP goods in service contracts.	Procurement and Contracts	7/31/18
I-4.6: Develop strategies and infuse sustainable purchasing practices to increase environmentally preferable products (EPP) in the following high spend categories: Architectural and engineering contracts, Asphalt, Fuel, Mulch.	Procurement and Contracts	1/31/19
I-4.7: Evaluate contractor selection requirements and implement selection criteria that increase the use of EPP goods and State Agency Buy Recycled Campaign (SABRC) compliance in service contracts.	Procurement and Contracts	10/31/18
I-4.8: Hire a consultant to conduct a spend analysis. The results of the spend analysis will serve as a benchmark for continued measurement in the efforts to improve EPP spend.	Procurement and Contracts	6/30/18
I-4.9: Incorporate information regarding qualified products into solicitation documents to assist vendors and buyers in maximizing recycled products in their contracts/purchases with Caltrans.	Procurement and Contracts	6/30/19

I-4.10: Market the use of EPP, provide resources and tools, and educate buyers on the benefits and methods of buying EPP products.	Procurement and Contracts	6/30/19
I-4.11: Revise staff procedures to specify the use of resources on DGS Buying Green website when acquiring goods and/or services.	Procurement and Contracts	Based on completion of DGS module
Potential actions:		
I-4.1P: Continue actions to reduce the use of natural gas, vehicle fuel and purchased electricity to reduce operational Greenhouse Gas Emissions (GHG).		
I-4.2P: Develop a strategy for ensuring that all future new construction and major renovations exceed Title 24 by at least 15%.		
I-4.3P: Ensure new buildings and major renovations greater than 5,000 square feet are commissioned properly from design thru post construction.		
I-4.4P: Ensure all future new construction and major renovations over 10,000 sq. ft. obtain LEED Silver or higher certification.		
I-4.5P: Ensure all new buildings under 10,000 square feet shall meet applicable CALGreen Tier 1 Measures.		
I-4.6P: Implement measures that will reduce energy use in the District 7 Transportation Management Center (TMC) and the District 8 office building to make eligible for LEED certification.		
I-4.7P: Determine where the Integrated Pest Management implementation function resides, and ensure pest control contracts require integrated pest management.		
I-4.8P: Work with DGS to ensure that the location efficiency scores are 10% higher than average for all new leases.		
I-4.9P: Install submeters in the Translab to continue LEED certification process.		

Table A-3B: Waste Reduction Actions

Potential Actions	Participating Department Units	Deadline
I-5.1P: Determine method to track amount of waste taken to and/or diverted from landfills.		
I-5.2P: Determine origin activity and division of waste reported to the California Department of Resources Recycling and Recovery (CalRecycle) (i.e. construction, maintenance, office, etc.).		
I-5.3P: Establish a baseline and goal.		
I-5.4P: Identify recycling leads in applicable divisions.		
I-5.5P: Identify methods to reduce waste.		

Table A-4: Zero Emission Vehicle (ZEV) Commitments

I-6 ZEV: Identify, increase, and streamline Zero Emission Vehicle infrastructure and operations		
Commitment	**Participating Department Units**	**Deadline**
I-6.C1: Lead the Department's activities relating to fleet, equipment, and workplace charging, including coordinating District activities.	Equipment (Lead)	Ongoing
I-6.C2: Develop and disseminate Department policy on workplace charging.	Business Operations	Draft Policy for review by 4/1/18
I-6.C3: Continue to represent the Department in Administration-wide and industry activities including the ZEV Inter-Agency Task Force.	Sustainability	Ongoing
I-6.C4: Sponsor an internal "ZEVFest" educational and decision-making workshop in Spring 2018 to accelerate ZEV policy development and resolve specific implementation barriers.	Sustainability	Workshop in Spring 2018
I-6.C5: Develop communications and training material focused on climate adaptation and resilience in connection with the Department's sustainability priority "Advance clean vehicles, fuels and materials."	Sustainability	12/31/18

Table A-4A: ZEV Actions

Potential Actions	Participating Department Units	Deadline
I-6.1P: Create guidance for maintenance and operation for charging stations, including charging fees and fleet card for electric vehicles (EVs).		
I-6.2P: Create installation and purchase guidance to streamline data collection and reporting.		
I-6.3P: Identify high-priority locations for EV installation (fleet and workplace).		
I-6.4P: Identify locations for the installation of hydrogen stations to support fleet vehicles.		
I-6.5P: Identify and pursue outside funding sources for all types of charging.		
I-6.6P: Identify, prioritize, and install ZEV Infrastructure at state owned facilities.		
I-6.7P: Improve Caltrans vehicle telematics including data collections for ZEVs.		

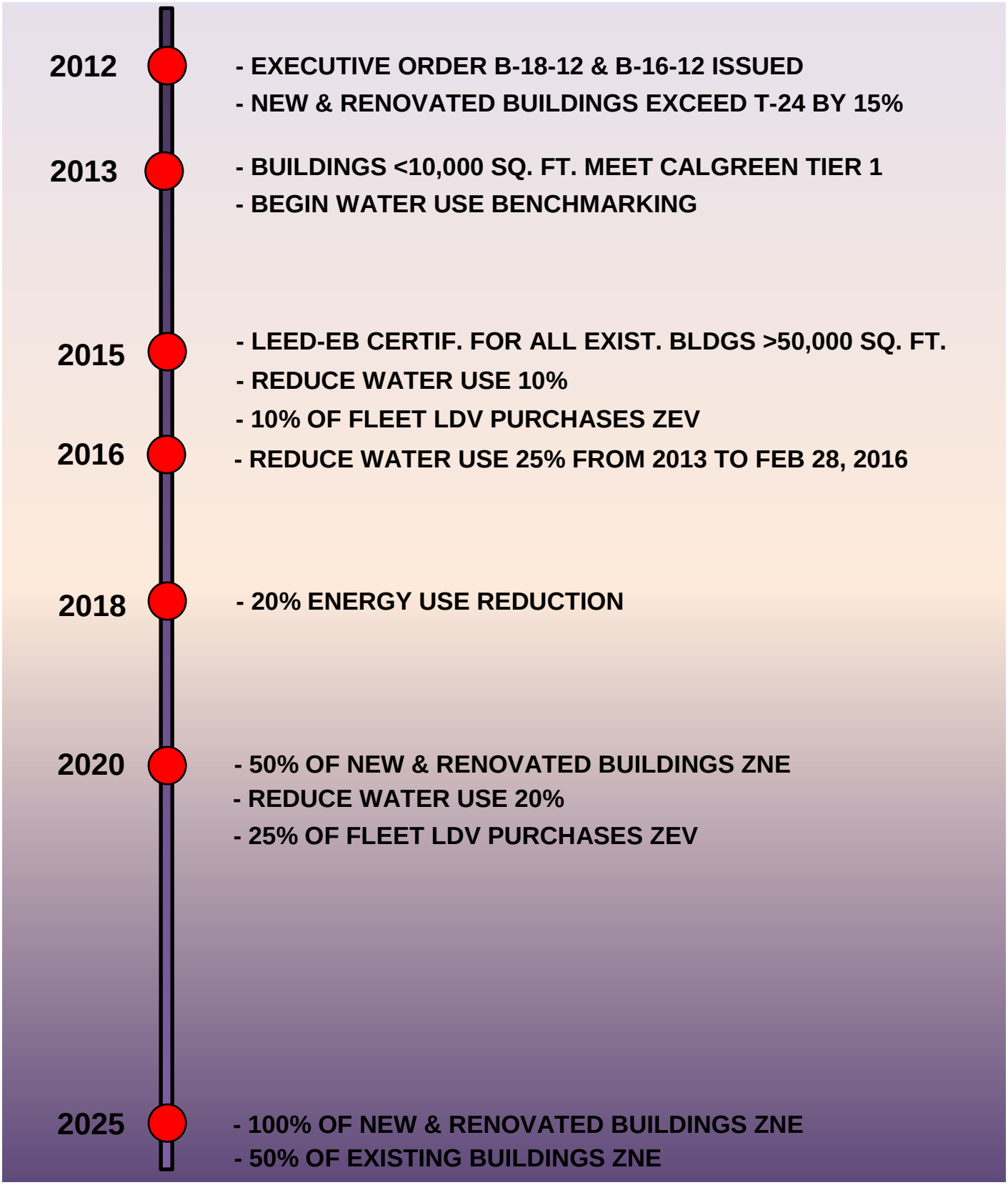
Table A-5: Cross-Cutting Commitments

I-7 Cross-Cutting: Improve data essential for sustainability initiatives		
Commitment	**Participating Department Units**	**Deadline**
I-7.C1: Organize and support task group in identifying and completing actions.	Sustainability (lead) Business Operations Traffic Operations Maintenance Equipment Information Technology Right of Way Planning and Modal	9/30/18

Table A-5A: Cross-Cutting Actions

Actions	Participating Department Units	Deadline
Action items agreed upon:		
I-7.2: Identify and compile data needs for Sustainability.	Sustainability	6/30/18
Potential actions:		
I-7.1P: Compare DGS-provided list of facilities to Caltrans' list of Caltrans-owned facilities.		
I-7.2P: Create and compile an inventory of existing charging stations types, i.e. Level 1 (L1), Level 2 (L2), American Disability Act (ADA) L1, ADA L2.		
I-7.3P: Create and compile an inventory of facilities and parking space types, i.e. fleet, employee, public, mixed fleet/employee, etc.		
I-7.4P: Identify all facility types and managing Divisions.		

Appendix B - Sustainability Milestones & Timeline



Appendix C - Department Stakeholders

Climate Change Adaptation Report

Understanding Climate Risk at Existing Facilities	
Headquarters, Division of Maintenance	Dana Hendrix, Acting Chief, Office of Emergency Management and Infrastructure Protection
Headquarters, Division of Business Operations	Mary Ann Mitchell, Division Chief
Headquarters, Division of Equipment	Robert Myers, Division Chief

Understanding Climate Risk at Planned Facilities	
Division of Engineering Services	Jeff DeFevere, Chief, Office of Transportation Architecture

Integrating Climate Change into Department Planning and Funding Programs	
Headquarters, Division of Transportation Planning	Reza Navai, Assistant Division Chief
Headquarters, Asset Management	Michael Johnson, State Asset Management Engineer

Measuring and Tracking Progress	
Headquarters, Division of Transportation Planning	Reza Navai, Assistant Chief, Division of Transportation Planning
Headquarters, Division of Local Assistance	Ray Zhang, Division Chief
Headquarters, Division of Maintenance	Tony Tavares, Division Chief

Energy Report

Zero Net Energy (ZNE)	
Headquarters, Division of Business Operations	Mary Ann Mitchell, Division Chief
Headquarters, Division of Engineering Services	Michael Keever, Division Chief
Headquarters, Division of Equipment	Robert Myers, Division Chief
Headquarters, Division of Maintenance	Tony Tavares, Division Chief
Headquarters, Division of Traffic Operations	Jasvinderjit Bhullar, Division Chief

New Construction Exceeds Title 24 by 15%	
Headquarters, Division of Engineering Services	Michael Keever, Division Chief

Reduce Grid-Based Energy Purchased by 20% by 2018	
Headquarters, Division of Business Operations	Mary Ann Mitchell, Division Chief
Headquarters, Division of Equipment	Robert Myers, Division Chief
Headquarters, Division of Maintenance	Tony Tavares, Division Chief
Headquarters, Division of Traffic Operations	Jasvinderjit Bhullar, Division Chief
Headquarters, Information Technology, Infrastructure Management Division	Mike Nguyen, Division Chief

Demand Response	
Headquarters, Division of Business Operations	Mary Ann Mitchell, Division Chief
Headquarters, Division of Equipment	Robert Myers, Division Chief
Headquarters, Division of Maintenance	Tony Tavares, Division Chief
Headquarters, Division of Traffic Operations	Jasvinderjit Bhullar, Division Chief

Renewable Energy	
Headquarters, Division of Business Operations	Mary Ann Mitchell, Division Chief
Headquarters, Division of Equipment	Robert Myers, Division Chief
Headquarters, Division of Maintenance	Tony Tavares, Division Chief
Headquarters, Division of Traffic Operations	Jasvinderjit Bhullar, Division Chief

Monitoring-Based Commissioning (MBCx)	
Headquarters, Division of Business Operations	Mary Ann Mitchell, Division Chief
Headquarters, Division of Equipment	Robert Myers, Division Chief
Headquarters, Division of Maintenance	Tony Tavares, Division Chief
Headquarters, Division of Traffic Operations	Jasvinderjit Bhullar, Division Chief

Financing	
Headquarters, Division of Business Operations	Mary Ann Mitchell, Division Chief
Headquarters, Division of Equipment	Robert Myers, Division Chief
Headquarters, Division of Maintenance	Tony Tavares, Division Chief
Headquarters, Division of Traffic Operations	Jasvinderjit Bhullar, Division Chief

Green Operations Report

Greenhouse Gas Emissions	
Headquarters, Division of Business Operations	Mary Ann Mitchell, Division Chief
Headquarters, Division of Equipment	Robert Myers, Division Chief
Headquarters, Division of Maintenance	Tony Tavares, Division Chief
Headquarters, Division of Traffic Operations	Jasvinderjit Bhullar, Division Chief
Headquarters, Division of Transportation Planning	Chris Schmidt, Division Chief

Building Design and Construction	
Headquarters, Division of Engineering Services	Michael Keever, Division Chief

LEED for Existing Buildings Operations and Maintenance	
Headquarters, Division of Business Operations	Mary Ann Mitchell, Division Chief
Headquarters, Division of Maintenance	Tony Tavares, Division Chief
Headquarters, Division of Traffic Operations	Jasvinderjit Bhullar, Division Chief
Headquarters, Division of Engineering Services	Michael Keever, Division Chief

Indoor Environmental Quality	
Headquarters, Division of Business Operations	Mary Ann Mitchell, Division Chief
Headquarters, Division of Equipment	Robert Myers, Division Chief
Headquarters, Division of Maintenance	Tony Tavares, Division Chief
Headquarters, Division of Traffic Operations	Jasvinderjit Bhullar, Division Chief

Integrated Pest Management	
Headquarters, Division of Business Operations	Mary Ann Mitchell, Division Chief
Headquarters, Division of Equipment	Robert Myers, Division Chief
Headquarters, Division of Maintenance	Tony Tavares, Division Chief
Headquarters, Division of Traffic Operations	Jasvinderjit Bhullar, Division Chief

Environmentally Preferable Purchasing	
Headquarters, Division of Procurement and Contracts	David Prizmich, Division Chief
Headquarters, Division of Engineering Services	Michael Keever, Division Chief

Location Efficiency	
Headquarters, Division of Business Operations	Mary Ann Mitchell, Division Chief

Landfill Disposal	
Headquarters, Division of Business Operations	Mary Ann Mitchell, Division Chief
Headquarters, Division of Design	Janice Benton, Division Chief

Water Efficiency and Conservation Report

Indoor Water Efficiency Projects In Progress First initiative	
Headquarters, Division of Business Operations	Mary Ann Mitchell, Division Chief
Headquarters, Division of Equipment	Robert Myers, Division Chief
Headquarters, Division of Maintenance	Tony Tavares, Division Chief
Headquarters, Division of Traffic Operations	Jasvinderjit Bhullar, Division Chief

Boilers and Cooling Systems Projects In Progress	
Headquarters, Division of Business Operations	Mary Ann Mitchell, Division Chief
Headquarters, Division of Equipment	Robert Myers, Division Chief
Headquarters, Division of Maintenance	Tony Tavares, Division Chief
Headquarters, Division of Traffic Operations	Jasvinderjit Bhullar, Division Chief
Headquarters, Division of Transportation Planning	Chris Schmidt, Division Chief

Landscaping Hardware Water Efficiency Projects In Progress	
Headquarters, Division of Business Operations	Mary Ann Mitchell, Division Chief
Headquarters, Division of Design	Janice Benton, Division Chief
Headquarters, Division of Equipment	Robert Myers, Division Chief
Headquarters, Division of Maintenance	Tony Tavares, Division Chief
Headquarters, Division of Traffic Operations	Jasvinderjit Bhullar, Division Chief

Living Landscaping Water Efficiency Projects In Progress	
Headquarters, Division of Business Operations	Mary Ann Mitchell, Division Chief
Headquarters, Division of Design	Janice Benton, Division Chief
Headquarters, Division of Equipment	Robert Myers, Division Chief
Headquarters, Division of Maintenance	Tony Tavares, Division Chief
Headquarters, Division of Traffic Operations	Jasvinderjit Bhullar, Division Chief

Buildings with Urban Water Shortage Contingency Plans In Progress	
Headquarters, Division of Business Operations	Mary Ann Mitchell, Division Chief
Headquarters, Division of Equipment	Robert Myers, Division Chief
Headquarters, Division of Maintenance	Tony Tavares, Division Chief

Zero-Emission Vehicles Report

Incorporating ZEVs Into the Department Fleet	
Headquarters, Division of Equipment	Robert Myers, Division Chief

Telematics	
Headquarters, Division of Equipment	Rob Stearns, Highway Equipment Superintendent

Outside Funding Sources for ZEV Infrastructure	
Headquarters, Sustainability Program	Jeremy Matsuo, Senior Engineer

Hydrogen Fueling Infrastructure	
Headquarters, Division of Equipment	Lisa Kunzman, Chief, Office of Fleet Asset Management & Quality Assurance

Comprehensive Facility Site and Infrastructure Assessments	
Headquarters, Division of Business Operations	Mary Ann Mitchell, Division Chief

EVSE Operation and Construction Plan	
Headquarters, Division of Equipment	Michael Mayor, Chief, Office of Budgets & Administration

Appendix D - Department Organizational Chart