2025 REPORT CARD FOR CALIFORNIA'S INFRASTRUCTURE

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EXECUTIVE SUMMARY

California's infrastructure - everything from the roads we drive on and the water we drink, to the schools our children attend and the parks we enjoy - plays a vital role in our daily lives. Every few years, California infrastructure experts come together to assess how well these systems are working, where they're falling short, and what's needed to keep California moving forward. The 2025 California Infrastructure Report Card offers a comprehensive look at the state's most important infrastructure systems, highlighting both successes and ongoing challenges.

CALIFORNIA'S INFRASTRUCTURE: THE BIG PICTURE

California is home to nearly 40 million people and the world's fourth-largest economy. Our infrastructure supports a vast and diverse state, with bustling cities, rural communities, world-class ports, 25,392 bridges, 1,500 dams, 177, 576 miles of public roads, and 10,000 public schools.

WHAT'S WORKING WELL

California is at the forefront in Innovation and Modernization, Public Safety, and Environmental Leadership.

Innovation and Modernization. California is a leader in innovation, public safety, and environmental stewardship as evidenced by our investments in Advanced Treated Purified Water, clean energy sources, smart traffic systems, earthquake retrofits, airport safety enhancements, port electrification, proactive wildfire planning, and improved emergency response.

WHY DOES THIS MATTER?

When infrastructure is in good shape, it means safer roads, cleaner water, reliable electricity, better schools, and more enjoyable parks. When it falls behind, everyone feels the impact—through traffic jams, water main breaks, power outages, or schools that need repairs. Our way of life is impacted.

Public Safety Efforts. There's been real progress in making infrastructure safer. Earthquake retrofitting, wildfire planning, and emergency response improvements are helping protect communities. Many bridges and dams have been strengthened, and airports and transit systems have improved their safety and security measures.

Environmental Leadership. California is at the forefront of efforts to reduce pollution and fight climate impacts. The state is expanding clean energy, building more electric vehicle charging stations, and encouraging the use of recycled water. Many cities are investing in parks, green spaces, and projects that help manage stormwater and protect natural habitats.

EXECUTIVE SUMMARY (CONT.)

ONGOING CHALLENGES

Aging and Stressed Systems. Much of California's infrastructure was built decades ago and is now showing its age. Roads and bridges are wearing out, water pipes are leaking, and many schools and public buildings need repairs or upgrades. Deferred maintenance—putting off needed repairs—has led to a growing backlog and higher costs down the road.

Not Enough Funding. There isn't enough money to keep up with all the repairs and upgrades needed. Local governments especially struggle to find the funds to fix and modernize their systems. While recent federal and state investments have helped, the costs to maintain, upgrade, and expand infrastructure to meet current and future needs far exceed available resources.

Climate Risks and Natural Disasters. California faces unique threats from wildfires, droughts, floods, earthquakes, and rising sea levels. These risks are getting worse with climate impacts, putting extra pressure on already strained systems. Many roads, bridges, water systems, and levees need upgrades to handle these new challenges and keep communities safe.

Unequal Access and Equity Gaps. Not all communities have the same quality of infrastructure. Rural areas and some neighborhoods have older, less reliable systems, and small water systems in particular often struggle to provide safe, dependable service. Many parks and schools in lower-income areas need more investment to ensure everyone has access to safe and healthy environments.

Workforce and Capacity Issues. A shortage of skilled workers is making it harder to keep up with maintenance and new projects. Many agencies report difficulties in hiring and retaining staff, especially for specialized roles in water, energy, and transportation.

SUPPORTING A STRIVING CALIFORNIA ECONOMY

When infrastructure is neglected, the effects ripple through every part of life. Traffic congestion wastes time and money. Water main breaks can leave neighborhoods without clean water. Power outages disrupt homes and businesses. Schools with outdated facilities can't provide the best learning environment for students. Parks and public spaces become less accessible and enjoyable.

On the other hand, when infrastructure is strong, it supports a thriving economy, protects public health and safety, and improves quality of life for everyone. It also helps California stay competitive, attract new businesses, and prepare for the challenges of the future.

EXECUTIVE SUMMARY (CONT.)

RAISING THE GRADE

This report assigns a letter grade to each category and to the overall report card, to more effectively communicate the general state of our California infrastructure. The grade is based upon a simple "A through F" school report card format: "A" for exceptional, fit for the future, "B" for good, adequate for now, "C" for mediocre, requires attention, "D" for poor, at risk, and "F" for failing/critical, unfit for purpose. The 2025 California Infrastructure Report Card gave the overall infrastructure a **grade of C-**, which means California's infrastructure is in **mediocre condition and requires attention.**

To raise California's infrastructure grade, ASCE developed the following four recommendations:

- Promote legislation that provides consistent and reliable long-term funding.
- Raise public awareness of the connection between infrastructure condition and quality of life.
- Encourage collaborative leadership in infrastructure.
- Implement efficient Infrastructure delivery through improved policies and regulations.

Each chapter in this report includes additional recommendations specific to each assessed infrastructure category. As the stewards of our infrastructure, California's civil engineers have a moral duty to advocate for sustainable infrastructure capable of supporting our state's robust economy, while maintaining public safety and our quality of life. Join us in increasing infrastructure investment as it is a high priority for California.

LOOKING AHEAD

California's infrastructure is at a turning point. While there are some bright spots—like improvements in airports, ports, and rail systems—many other areas are overdue for repairs and upgrades. The state will need to find new ways to pay for improvements, prepare for climate impacts, and make sure all communities—no matter where they are—have access to safe and reliable infrastructure.

The bottom line. Investing in infrastructure isn't just about fixing what's broken. It's about building a better future for all Californians—one where roads are safe, water is clean, energy is reliable, schools are modern, and parks are open to everyone. By working together and making smart choices, California can ensure its infrastructure meets the needs of today and tomorrow.

GRADING METHODOLOGY

The 2025 Report Card for California's Infrastructure was completed by a committee of over 130 professionals and experts from California who dedicated their valuable time to collect and evaluate existing data, assess the infrastructure, document their findings, and develop recommendations. The committee worked with staff from ASCE National and ASCE's Committee on America's Infrastructure to provide a snapshot of our infrastructure, as it relates to us at home, and on a national basis.

The Report Card Sections are graded based on the following eight criteria:

CAPACITY Does the infrastructure's capacity meet current and future demands?

CONDITION What is the infrastructure's existing and near-future physical condition?

FUNDING What is the current level of funding from all levels of government for the infrastructure category as compared to the estimated funding need?

FUTURE NEED What is the cost to improve the infrastructure? Will future funding prospects address the need?

OPERATION AND MAINTENANCE What is the owners' ability to operate and maintain the infrastructure properly? Is the infrastructure in compliance with government regulations?

PUBLIC SAFETY To what extent is the public's safety jeopardized by the condition of the infrastructure and what could be the consequences of failure?

RESILIENCE What is the infrastructure system's capability to prevent or protect against significant multihazard threats and incidents? How able is it to quickly recover and reconstitute critical services with minimum consequences for public safety and health, the economy, and national security?

INNOVATION What new and innovative techniques, materials, technologies, and delivery methods are being implemented to improve the infrastructure?

GRADING SCALE

A — EXCEPTIONAL: FIT FOR THE FUTURE

The infrastructure in the system or network is generally in excellent condition, typically new or recently rehabilitated, and meets capacity needs for the future. A few elements show signs of general deterioration that require attention. Facilities meet modern standards for functionality and are resilient to withstand most disasters and severe weather events.

B — GOOD: ADEQUATE FOR NOW

The infrastructure in the system or network is in good to excellent condition; some elements show signs of general deterioration that require attention. A few elements exhibit significant deficiencies. Safe and reliable with minimal capacity issues and minimal risk.

C — MEDIOCRE: REQUIRES ATTENTION

The infrastructure in the system or network is in fair to good condition; it shows general signs of deterioration and requires attention. Some elements exhibit significant deficiencies in conditions and functionality, with increasing vulnerability to risk.

D — POOR: AT RISK

The infrastructure is in poor to fair condition and mostly below standard, with many elements approaching the end of their service life. A large portion of the system exhibits significant deterioration. Condition and capacity are of significant concern with strong risk of failure.

F — FAILING/CRITICAL: UNFIT FOR PURPOSE

The infrastructure in the system is in unacceptable condition with widespread advanced signs of deterioration. Many of the components of the system exhibit signs of imminent failure.

2025 REPORT CARD FOR CALIFORNIA'S INFRASTRUCTURE

AVIATION	B-	PORTS	B
BRIDGES	C-	PUBLIC PARKS	D+
DAMS	D+	RAIL	B
DRINKING WATER	D+	ROADS	D
ENERGY	D	SCHOOLS	D+
HAZARDOUS WASTE	C	SOLID WASTE	C-
INLAND WATERWAYS	D	STORMWATER	D
LEVEES	D+	TRANSIT	C-
WASTEWATER	C+		

NOTES ABOUT THE GRADES:

Across the country, budget issues, and deferred maintenance are taking their toll on critical infrastructure systems constructed by the generations before us and which now must be maintained and modernized.

The analysis in this report card and associated grades, are intended to increase understanding by the public and the state and local legislators, of the importance and value of long-term consistent infrastructure investments, the importance of leadership and planning, and the need to prepare for the future.

The Grades reflect the condition of the infrastructure, and not the diligent local agency personnel who are doing their best to manage, repair, renew, and replace aging systems, with the limited available resources. Rather, this Report Card is intended to reflect current infrastructure conditions and be a tool to help agencies request and receive the resources they need.

RECOMMENDATIONS TO RAISE THE GRADE

To Raise California's Infrastructure grade, ASCE developed the following four recommendations: 1) Promote legislation that provides consistent long-term funding, 2) Encourage collaborative leadership in infrastructure, 3) Raise public awareness of the connection between infrastructure condition and quality of life, 4) Implement efficient Infrastructure delivery through improved policies and regulations.

1. PROMOTE LEGISLATION THAT PROVIDES CONSISTENT AND RELIABLE LONG-TERM FUNDING

- **Secure Dedicated, Long-Term Funding Sources.** Advocate for robust, dedicated, and long-term funding streams for infrastructure sectors (e.g., transit, drinking water, bridges, dams, levees, schools, parks) through federal, state, and local legislation.
- **Remove Barriers to Funding Flexibility.** Support legislative changes to eliminate restrictions on certain funding uses that hinder local agencies from raising or accessing funds for infrastructure projects.
- **Implement Sustainable Funding Mechanisms.** Explore and implement new revenue models (e.g., mileage-based user fees, green bonds, innovative financing mechanisms) to ensure financial stability and resilience for infrastructure investment.
- **Protect Infrastructure Funds from Diversion.** Enact policies and budgetary firewalls to ensure that funds collected for infrastructure (e.g., airport taxes, aviation fuel tax, hazardous waste grants) are used solely for their intended purposes and not diverted to unrelated expenditures.

2. ENCOURAGE COLLABORATIVE LEADERSHIP IN INFRASTRUCTURE

- **Foster Partnerships and Collaboration.** Encourage partnerships among state, local, and federal agencies, private industry, universities, and non-profits to lead and coordinate infrastructure planning, funding, and delivery.
- **Support Workforce Development.** Invest in workforce development programs, including university-level education, K-12 outreach, and certifications, to ensure a pipeline of skilled professionals for infrastructure sectors.
- **Advance Asset Management and Predictive Maintenance.** Promote the adoption of asset management plans and predictive maintenance technologies to optimize infrastructure performance and longevity.
- **Champion Innovation and Best Practices.** Encourage infrastructure leaders to research, implement, and share innovative design, construction, and management methods, including the use of smart sensors, AI, and sustainable materials.

RECOMMENDATIONS TO RAISE THE GRADE (CONT.)

3. RAISE PUBLIC AWARENESS OF THE CONNECTION BETWEEN INFRASTRUCTURE CONDITION AND QUALITY OF LIFE

- **Engage Stakeholders and Communities.** Involve communities in infrastructure planning and decision-making, emphasizing the benefits such as job creation, environmental improvements, and disaster resilience.
- **Implement Public Education Campaigns.** Develop and deliver educational programs to inform the public about the importance of infrastructure (e.g., stormwater, wastewater, drinking water, roads) and its impact on safety, health, and quality of life.
- **Communicate Effectiveness and Hazards.** Make available documented evidence of infrastructure improvements and alert the public to known hazards (e.g., floodways, aging pipelines, dam safety) to increase awareness and preparedness.
- **Promote Transparency and Accountability.** Improve methods of reporting and communicating infrastructure funding, project outcomes, and safety data to build public trust and support for future investments.

4. IMPLEMENT EFFICIENT INFRASTRUCTURE DELIVERY THROUGH IMPROVED POLICIES AND REGULATIONS

- **Streamline Permitting and Regulatory Processes.** Support legislation and policies that expedite environmental and permitting reviews for infrastructure projects (e.g., dams, rail, bridges), reducing delays and costs.
- **Adopt Risk-Based and Data-Driven Approaches.** Implement asset management programs, risk-based evaluations, and data-driven enforcement to prioritize investments and improve infrastructure safety and efficiency.
- **Modernize Standards and Guidelines.** Work with agencies to update design, construction, and operational standards to accommodate innovative technologies and evolving best practices.
- **Facilitate Multimodal and Resilient Infrastructure Planning.** Integrate multimodal transportation options, climate resilience measures, and strategic development/planning to ensure infrastructure systems are efficient, adaptable, and future-ready.

Aviation

B-

AVIATION

EXECUTIVE SUMMARY

California has 214 general aviation airports, 26 commercial service airports, and 62 special-use airports. There are also 170 hospital heliports and 189 corporate, police, fire, agricultural, or private heliports. California is also home to 22 federal air bases and one joint-use facility.

The nearly 113 million passengers who moved through California's 26 commercial airports in 2024 represented approximately 11.5% of all aviation passenger traffic nationally. Over the last five years, many of California's commercial airports have invested heavily in improving areas of their infrastructure, from new terminals and airfield pavement to public transit connections. While the B- grade represents an overall improvement from the 2019 Report Card, the improvements in some areas have come at the expense of deferred maintenance or deterioration of other areas, such as utilities. Also, while the quantity of aviation improvement projects has increased only marginally since the 2019 Report Card, the estimated funding needed to perform these projects has risen by more than 500%. Continued investment in California's aviation infrastructure is needed not only to fund the projects, but also to support the robust workforce required for the planning, engineering, and construction to complete them.

BACKGROUND

California's 26 commercial airports are critical pieces of infrastructure, with five California airports (LAX, SFO, SAN, OAK, and SJC) ranking in the Top 40 US Passenger Gateways to the World and two airports (LAX and ONT) ranking in the Top 10 US Airports by Total Cargo Throughput. Simply put: California's airports connect people and goods to the world, and the health of these airports plays a vital role in the state's and nation's economy.

The aviation section of the 2025 ASCE CAIRC was prepared primarily based on information provided by airport management, planning, engineering, and operations staff. Information provided directly by airport agencies was supplemented by data from the following sources:

- Readily available data published online by airport agencies
- The aviation section of the 2019 Report Card for California's Infrastructure (CAIRC)
- The 2025 ASCE National Infrastructure Report Card
- The 2025 Caltrans Airport Capital Improvement Plan
- ACI North America's US Airport Infrastructure Needs Survey for 2025-2029

A summary of the airports that provided direct information for the preparation of the aviation section of the 2025 CAIRC is presented in Table 1. Enplanements from these airports alone comprise over 84% of the approximately 113 million total annual enplanements for the state, which was judged to provide a reasonably thorough representation of the state of aviation infrastructure that impacts most commercial passengers.

Table 1 – ENPLANEMENT SUMMARY FOR AIRPORTS SURVEYED FOR 2025 CAIRC

Airport	Annual Enplanements[1]	Service Level[2]	Hub Size[3]
Hollywood Burbank Airport (BUR)	3,383,237	Primary	Medium
Los Angeles International Airport (LAX)	37,760,834	Primary	Large
Long Beach Airport (LGB)	2,031,810	Primary	Small
Oakland San Francisco Bay Airport (OAK)	5,292,736	Primary	Medium
Palm Springs International Airport (PSP)	1,617,586	Primary	Small
San Diego International Airport (SAN)	12,780,013	Primary	Large
Santa Barbara Municipal Airport (SBA)	696,396	Primary	Small
San Francisco International Airport (SFO)	25,078,968	Primary	Large
Sacramento International Airport (SMF)	6,679,426	Primary	Medium
Van Nuys Airport (VNY)	3,016	Reliever	NA

Notes:
1. Defined as the number of revenue passengers that boarded aircraft at the airport during Calendar Year (CY) 24 (Fiscal Year 26).
2. For Commercial Service airports (i.e., publicly owned airports with at least 2,500 annual enplanements and scheduled air carrier service), Primary Service Level is defined as having more than 10,000 annual enplanements. Reliever airports are airports designated by the FAA to relieve congestion at Commercial Service Airports and to provide improved general aviation access to the overall community.
3. Hub Size is defined by the percentage of annual passenger boarding, with a Large hub airport servicing 1% or more of annual passenger boarding, a Medium hub airport servicing 0.2% to 1%, and a Small hub airport servicing 0.05% to 0.25%.

CAPACITY

Based on the FAA's preliminary enplanement data for CY24, twelve of California's airports rank within the top 100 commercial service airports nationally, with LAX and SFO ranking 5th and 13th, respectively. In January 2025, total passenger traffic across California's top airports reached 15.7 million, with domestic travelers making up 78% of the volume. However, data suggests that enplanements at California's commercial service airports have declined over the past two years with respect to total national enplanements and have yet to recover to pre-pandemic numbers, as summarized in Table 2.

Table 2 – COMPARISION OF CALIFORNIA COMMERCIAL SERVICE AIRPORT ENPLANEMENTS TO NATIONAL ENPLANEMENTS

Enplanements[1]	CY24	CY23	CY19
National	982,440,700	944,634,143	934,980,871
California	112,950,036	113,947,721	120,652,743
Percent of National	11.5	12.1	12.9

Notes:
1. US Federal Aviation Administration, "Passenger Boarding (Enplanement) and All-Cargo Data for US Airports," June 2025.

The capacity of the state's airport system is impacted by many factors, including the regulatory environment, airline business models, airport layouts and procedures, inadequate funding and revenue streams, weather conditions, aircraft types, airport staffing, and technology. Considerations associated with airport layout include the separation of parallel runways; the ability to separate operations by size; the presence of bypass taxiways, one-way taxiways, and taxiway holding bays; and operating curfews. However, perhaps the most important components of capacity are terminal facilities. Specifically, there must be:

- Sufficient quantity, size, and layout of terminals to satisfy airport demand
- Sufficient terminal frontage for drop-offs and pickups
- Enough gates and seating at each gate to fit the fleet mix serving each individual airport
- Sufficient quantity and efficiency of TSA screening lanes and baggage handling system (BHS) equipment
- Taxiway capacity to move aircraft to and from gates without gridlock

Many of the airports that provided input for the 2025 CAIRC are in highly developed areas with moderate to severe space constraints that impact the airports' ability to significantly increase capacity. The density, configuration, and condition of the developed areas that surround these airports impact the capacity to support airport growth, as do:

- Connectivity to various modes of transportation, such as highways, roadways, public and regional transit, and ground transportation. Some modes of transportation are not available at all for some airports or are limited by span and frequency of service at other airports
- Availability of, and ease of, access to parking.
- Ridesharing services that have decreased parking revenues while increasing congestion at terminal arrivals and departure areas, which has disrupted funding mechanisms.

Each of these considerations contributes to a leading indicator of capacity: delay. According to the Bureau of Transportation Statistics, delays have increased slightly at commercial airports in California over the last five years. On average, 21% of flights were delayed at the 11 busiest airports in California in 2024, just above the national average of 20%. Of the 11 busiest California airports, delays were most notable at SFO (29.5%) and SAN (23.9%) in 2024.

Significant investments have been made in terminal improvements and construction at California's busiest airports, with continued investment planned at many medium- and large-hub airports. Generally, the capacity of airport terminals and airside facilities to support this projection is improving, but significant investment in landside improvements is still needed.

CONDITION

Condition is generally a comparison of the physical state of an existing airport component (e.g., pavement, structure, utility, fencing) to its state when originally constructed. The primary focus of airport condition assessments and improvements tends to be airfield pavements, which include runways, taxiways, ramps, aprons, helipads, service roads, and the general airfield. Most of California's commercial airports have dedicated airfield pavement management programs (APMPs) that assess the condition of and need to replace/rehabilitate pavements every three to five years. Recent APMPs indicate the condition of airfield pavements at most of California's commercial

airports ranges from fair to good, which reflects the investments recently made to maintain and improve these important components of aviation infrastructure.

Several of California's commercial airports are expanding condition assessment plans to include other components of aviation infrastructure, such as terminals, perimeter security fencing, airfield lighting, navigational aid (NAVAID) systems, wayfinding signage, and utilities. These components of aviation infrastructure are critical to the passenger experience and overall functionality of California's airports. Regular assessments of these features will aid California's airports in identifying and proactively planning for improvements before deterioration advances to the point of infrastructure components needing to be reconstructed or replaced. Adopting and implementing technological advances such as digital twins will further enable airports to monitor infrastructure components remotely and in real-time to make the condition assessment process safer and more efficient.

FUNDING

Funding for many of California's airports comes from the Federal Aviation Administration (FAA) through Airport Improvement Program (AIP) grants, state, regional, and local sources, and passenger and cargo-based fees. Two such program are:

- FAA Reauthorization Act of 2024 (H.R. 3935) - approved by the U.S. Senate on May 9, 2024 and the House of Representatives on May 15, 2024. The $105.5 billion package provides funding for FAA programs through Federal Fiscal Year (FFY) 2028.
- Infrastructure Investment and Jobs Act (IIJA) which includes the following programs for funding: Airport Infrastructure Grants (AIG), Airport Terminals Program, and the Contract Tower Competitive Grant Program.

Table 3 shows the breakdown and awards under IIJA for airports in the state of California.

Table 3 – IIJA GRANT AWARD BREAKDOWN (FFY22-FFY25)1

PROGRAM	CALIFORNIA	NATIONAL
Airport Infrastructure Grants (AIG)	$1.16 Billion	$11.6 Billion
Airport Terminals Program	$316 Million	$2.8 Billion
Contract Tower Competitive Grant Program		$3 Billion
Total	**> $1.48 Billion**	**$17.4 Billion**

Note:
1. Data in this table reflects projects programmed and earmarked for their prospective categories. At the time of this report, remaining funds have not been programmed yet under the 2024 FAA Reauthorization.

However, many of California's busiest airports depend heavily on tax-exempt municipal airport revenue bonds to finance infrastructure improvement programs. Because these bonds are less prone to being impacted by changes in federal policy, airports can rely on the bonds to fund important, medium- and long-term aviation infrastructure improvements with less risk that funding will change before projects can be completed.

Other funding sources include Passenger Facility Charges (PFC), which are collected from passengers at commercial airports, and airport revenue such as concessionaires, parking fees, fuel sales, and landing fees. Current programmed funding (2024-2027) for California airports based on the Caltrans Division of Aeronautics' Capital Improvement Plan, 2023 – 2032 is summarized in Table 4. Additional details regarding the types of projects to which the funding is allocated are provided in the Future Need section of this chapter. To help preserve federal funding eligibility, California's aviation fuel tax policies need to be aligned with the FAA's Revenue Use Policy, which mandates that state and local taxes on aviation fuel must be used exclusively for aviation-related purposes. These include airport capital and operating costs, state aviation programs, and facilities directly related to air transportation. According to the FAA's compliance dashboard, California submitted an action plan to address revenue diversion concerns. Currently, the plan is marked "Qualified" but it has not yet been marked as fully compliant.

Table 4 - STATE OF CALIFORNIA AIRPORT FUNDING BREAKDOWN (IN MILLIONS OF $)

AIRPORT TYPE	AIP	STATE	LOCAL	TOTAL
Non-National Plan of Integrated Airport Systems (NPIAS)	$0.07	$9	$1	$11
General Aviation	$1	$60	$63.8	$1,144
Commercial Service	$4,800	$0.13	$620	$5,421
Total	**$5,821**	**$69**	**$685**	**$6,576**

OPERATION AND MAINTENANCE

The California Department of Transportation (Caltrans), in partnership with FAA, ensures that all permitted public-use airports in California are maintained in satisfactory to good condition. This includes adherence to state and federal safety and design standards. Significant federal funding from the FAA's AIP is allocated for maintenance projects, including $60 million in 2024. In addition, several California airports were awarded funds from the FAA AIP Cargo Airport Entitlement Program. These efforts and investments help California's airports remain safe, efficient, and environmentally responsible, supporting both the state and national economies.

Operation and maintenance of California airports are comprehensive processes that contribute heavily to safety, efficiency, and regulatory compliance. Summaries of airport operation and maintenance plan components are provided in Table 5.

Table 5 – SUMMARY OF AIRPORT OPERATION AND MAINTENANCE PLAN COMPONENTS

COMPONENT	DETAIL
Operations	
Airfield	Managing runways, taxiways, and aprons to ensure safe aircraft movements. Compliance with FAA regulations is crucial, as is adjusting airfield operation patterns to account for adverse weather conditions (e.g., marine fog) that regularly affect pilot visibility for California's airports.
Landside	Planning, design, management, and maintenance of passenger terminals, parking facilities, ground transportation, and the corresponding wayfinding signage to ensure smooth passenger flow.
Security	Adherence to Transportation Security Administration (TSA) regulations for passenger and staff safety, including screening procedures and emergency response plans.
Maintenance	
Facilities	Regular upkeep of terminals, hangars, and other infrastructure, including electrical systems, plumbing, HVAC, and structural repairs.
Airfield	Regular inspections and repairs of runways, taxiways, and aprons to maintain safe conditions for aircraft operations. Pavement management programs help maintain the integrity of these surfaces.
Lighting Systems	Upgrades and maintenance of airfield lighting systems are crucial for safe aircraft operations, especially during night and low visibility conditions.
Signage and Marking	Proper signage and pavement markings are essential for guiding aircraft and ground vehicles. These are regularly inspected and repainted as needed.
Environmental Standards	Management of environmental impacts, including noise control, waste management, limiting emissions, and water quality compliance.

Many commercial airports in California either have an asset management plan in place or are in the process of developing one. Continuing to adopt, invest in, and implement effective asset management plans will enable California's airports to pivot from reactionary repairs to more cost-effective, proactive maintenance strategies.

Similarly, most commercial airports in California have implemented a pavement maintenance and management system (PMMS) to help assess and prioritize airfield pavement improvements. Maintenance of airfield pavements is typically the responsibility of the airport itself, while the responsibility of maintenance of landside pavements is often shared with the local city or municipal agency.

Approximately 50 to 75 % of California's airports received sufficient budget and resources for their operation and maintenance; however, insufficient staffing of operation and maintenance teams and competing priorities led to a backlog of maintenance needs at many of California's airports.

PUBLIC SAFETY

Airport public safety includes a range of measures to protect passengers, staff, and facilities. Key components include security screening, access control, emergency response, law enforcement presence, fire and medical services, and health and environmental initiatives. Infrastructure design, safety standards, and community engagement efforts also play vital roles in maintaining a secure airport environment. A summary of some of the key public safety considerations for California airports is provided in Table 6.

Table 6 - SUMMARY OF AIRPORT PUBLIC SAFETY MEASURES

COMPONENT	DETAIL
Security Measures	
Screening Procedures	Advanced technologies for baggage and passenger checks by TSA.
Access Control	Biometric identification, surveillance systems, and physical barriers.
Emergency Response Plans	Comprehensive plans and regular emergency exercises.
Cybersecurity Threats	As airports become more reliant on digital systems for air traffic control and operations, the risk of cyberattacks grows. Ensuring system resilience and data protection is a growing priority.
Law Enforcement and Fire Safety	
Airport Police	Many commercial airports (e.g., LAX, SFO, BUR) have dedicated police units or units where the airport is a primary focus (e.g., Harbor Police Department that serves SAN).
Airport Rescue and Firefighting Facilities (ARFF)	Dedicated airport fire departments are staffed with specially trained personnel and specialty vehicles equipped to fight fire and provide medical services in the airport environment, including ARFF vehicles equipped with fire extinguishing materials that combat jet-fuel based fires.
Collaborative Efforts	In addition to providing service to the corresponding airport, dedicated airport police and fire units cooperate and collaborate regularly with local law enforcement and fire agencies. In recent years, wildfires and smoke have affected airport operations and performance, sometimes leading to delays or closures.
Health and Environmental Safety	
Zero-Emission Ground Support Equipment	Transition to reduce emissions and improve air quality.
Sustainable Aviation Fuel (SAF)	Increased use to reduce carbon footprint.
Wildlife Hazards	Airports near natural habitats or coastlines face frequent wildlife strikes, particularly from birds. These can damage aircraft and disrupt operations, prompting the need for robust wildlife management programs. Airports mitigate these risks by implementing traps and other devices that reduce the potential for wildlife to enter the air operations area (AOA) while reducing harm to the wildlife itself.

COMPONENT	DETAIL
Protected Environments	Development at many of California's airports accounts for the protection of wildlife via preserves and construction restrictions. Examples include the El Segundo Blue Butterfly refuge near LAX and construction noise restrictions during least tern nesting seasons for California's coastal airports (e.g., SAN).
Infrastructure, Operations, and Design	
Physical Barriers	Fencing, walls, systems, staffing, and buildings to prevent unauthorized entry, including perimeter intrusion detection systems (PIDS).
Safety Standards	Compliance with FAA regulations, including Runway Safety Areas (RSA). Airports receiving federal grant funding are designed to comply with safety requirements of FAA advisory circulars (ACs). Building code design criteria that are somewhat unique to California include seismic safety for all California airports as well as tsunami hazard and sea level rise for coastal airports at or near sea level (e.g., SFO, OAK, SAN).
Community Engagement and Health	
Public Awareness Campaigns	Educating passengers and staff about safety protocols.
Training Programs	Regular training for staff and law enforcement
Noise Abatement Procedures	Airports such as BUR, LAX, LGB, and SNA operate under strict noise control rules that limit flight paths and times, increase pilot workload, and reduce operational flexibility.

Public safety at airports is a shared responsibility involving multiple entities, including the FAA, TSA, local law enforcement, airport authorities, airlines and airport partners (e.g., Caltrans, local government agencies, rental car companies, concessionaires, ground service support, and general aviation), and the traveling public. These entities collectively ensure that airports maintain high standards of public safety, protecting all airport users.

Federal and state budgets also include funding dedicated to public safety, including:

- Federal Aviation Administration (FAA), Infrastructure Investment and Jobs Act (IIJA), Homeland Security Grants.
  - The IIJA provides $25 billion over five years for aviation infrastructure, with a strong safety component: $15 billion for airport infrastructure projects that increase safety and expand capacity; $5 billion for terminal upgrades, including airport-owned control towers; and $5 billion for improving FAA air traffic control facilities, which are critical to aviation safety
- State funding, such as Public Safety Budget, Citizens' Option for Public Safety (COPS) Program.
  - The 2024–25 California Public Safety Budget includes funding for the Office of Emergency Services (OES) and Board of State and Community Corrections (BSCC), which support emergency response and reentry programs that intersect with airport and aviation safety; and $15 million annually for the Military Department Counterdrug Task Force Program, supporting aerial surveillance and coordination.
  - Citizens' Option for Public Safety (COPS) Program allocates funds to frontline law enforcement, including airport police and sheriffs.
- Federal and state funds that are available to support the transition to zero-emission Ground Support Equipment (GSE) to reduce emissions and improve air quality and public safety.
  - California Air Resources Board (CARB): Committed to transitioning airport GSE to zero-emission by 2034, with policies and funding support beginning in 2027.
  - FAA Electrification Grants: Over $300 million awarded to electrify airport equipment, including GSE and charging infrastructure.
- Increased funding for SAF initiatives that helps reduce the aviation industry's carbon footprint contributing to overall public health.
  - The FAA's Fueling Aviation's Sustainable Transition (FAST) grants, funded by the Inflation Reduction Act, include $244.5 million for SAF production, blending, and infrastructure; and $46.5 million for low-emission aviation technologies. These efforts reduce aviation's carbon footprint, improving public health and environmental safety

FUTURE NEED

Projected 10-year funding needs for California public-use airports total $15.35 billion distributed amongst 1,775 projects at 18 commercial service and 161 general aviation airports based on the published Caltrans Division of Aeronautics Capital Improvement Plan, 2023 – 2032. Within that amount, $8.68 billion is eligible for federal funding through the AIP, $122 million is eligible for state grant funds, and $6.54 billion locally funded over the 2023-2032 timeframe. While the number of projects has increased nominally, the corresponding costs have increased fivefold as summarized in Table 7, illustrating the overwhelming funding challenges airports face in updating and expanding aging infrastructure through 2032.

Table 7 – COMPARISON OF RELATIVE PROJECT COST

ITEM	2019	2025	% CHANGE[1]
# of Aviation Projects[2]	1,735	1,775	+2.3%
Total Capital Need	$2.77 Billion	$15.35 Billion	+554%

Notes:
1. Based on comparison of data available at the time of the 2019 CAIRC to data available at the time of the 2025 CAIRC.
2. Summation of projects that are planned, in progress, or completed, as listed in airport CIP per Caltrans Division of Aeronautics Capital Improvement Plan, 2023-2032.

The future funding environment, particularly for California airports that rely heavily on federal AIP grants, has been impacted by inflation and more recently by transitions in the political environment, which include recently enacted tariffs on the international trade front that could cause price spikes and material shortages in the near term. California airports that rely more on airport bonds than on federal AIP grants anticipate being less affected by recent and future changes in the political environment, thereby giving them greater flexibility to implement their infrastructure improvement plans.

Table 8 summarizes some of the major programs, improvements, and expansions that major airports are undertaking at the time of this evaluation.

Table 8 – MAJOR IMPROVEMENT PROGRAMS AT CALIFORNIA AIRPORTS

AIRPORT	DESCRIPTION	ESTIMATED PROGRAM COST
BUR	New Replacement Passenger Terminal	$1.2 billion
LAX	Multiple Award Task Order Contracts (MATOC) for Construction Design-Build Projects Terminal 5 Renovation Automated People Mover	$5 billion $1.7 billion $3 billion
SAN	New Terminal	$3.8 billion
SMF	Concourse Gate Expansion, New Parking Garage, Overhead Pedestrian Walkway, Roadway Improvements, Consolidated Rental Car Center	$1.1 billion
SFO	Terminal Modernization	$2.6 billion

RESILIENCE

Airports are a critical element of the global supply chain of goods and facilitate domestic and international travel for millions of people every day. Beyond the challenges of daily operations, California airports continue to face immediate and long-term threats that require them to plan and adapt to remain resilient. These threats include the impacts of climate resulting in sea level rise, increased intense rain and wind events, extreme heat, and prolonged drought conditions. They may also include biological threats (pandemics), human-made threats (cyber-attacks), and natural disasters such as earthquakes, tsunamis, and fires. In a local or regional disaster, airports serve as important hubs for relief and recovery; therefore, it is critical they prioritize improvements that provide capacity to handle these events. California airports are taking steps to make necessary resilience improvements including building onsite energy generation and storage, implementing water conservation and recycling measures, using construction practices and methods that meet Leadership in Energy and Environmental Design (LEED) and Envision criteria, and continuously hardening information technology networks to protect critical infrastructure.

California airports must develop and implement policies to ensure resilient practices are incorporated in all aspects of their operations and maintenance. They must also have a resilient framework capable of addressing possible hazards and vulnerabilities. Furthermore, there must be emergency plans in place to prepare for catastrophic events, which are occurring more frequently. Information collected by the committee indicates that several of California's medium- to large-hub airports, including LAX, SFO, SAN, and SMF, have emergency plans and have implemented or are actively developing resiliency plans.

INNOVATION

As technology continues to advance, California airport officials must adapt and incorporate the latest innovations. Innovations can enhance the customer experience as well as improve safety and operations at airports.

Airports look to new technology that streamlines the check-in process, improves navigation, and reduces wait times to provide a smoother travel experience. Such technology includes real-time flight and luggage information, the use of facial recognition to expedite the boarding process, and data-driven queue monitoring to better adjust staffing. In addition, Advanced Visual Docking Guidance Systems feature electronic displays which perform the functions of an Azimuth Guidance for Nose-In Stands (AGNIS)/ Parallax Aircraft Parking Aid (PAPA) installation, although with much greater accuracy, can improve safety and efficiency.

On the safety and operations side, Next Generation Air Traffic Control System (NextGen) continues to be implemented throughout the country, including at SFO, SMF, and SNA. With NextGen, airports aim to improve airport infrastructure, revamp and incorporate new air traffic control technologies and procedures, and enhance safety and security protocols. The FAA Reauthorization Act of 2024 requires the FAA to operationalize the programs under NextGen by the end of 2025. Unmanned aircraft systems, or drones, help airports to perform critical operations tasks, such as obstacle assessment, runway and taxiway condition evaluations, wildlife risk mitigation, perimeter monitoring, situational awareness during emergency responses, detection of debris and foreign objects, and airfield illumination. Investments are also being made to extend the design life of runway pavement and limit the cost and environmental impact when repairs are needed, such as through the use of concrete and recycling of existing pavement. Energy-efficient airfield lighting has also become commonplace, with many of the airports surveyed by the committee indicating that such lighting has been implemented on their airfields.

In the near future, as Artificial Intelligence technology improves, predictive analytics can be incorporated to identify potential maintenance issues before a problem occurs. Electric Vertical Take-Off and Landing (eVTOL) aircraft, or electric flying taxis, may have a big impact on the aviation industry, but are in early stages of planning and development, as most of the airports surveyed by the committee have yet to implement eVTOL into their regular operations.

RECOMMENDATIONS TO RAISE THE GRADE

- Urge Congress to continue reauthorization of the full Airport Improvement Plan (AIP) funding and Airport and Airway Trust Fund via the FAA Reauthorization Act.
- Remove or increase the federally imposed cap on Passenger Facility Charges (PFCs), allowing commercial service airports to finance a greater share of their projects with local revenue, and leaving more of the limited AIP funding to be allocated to smaller general aviation airports that rely on federal assistance the most.
- Reinforce that all monies collected from airport taxes/user fees be deposited in the Aviation Trust Fund with budgetary firewalls to eliminate the diversion of these funds to non-airport capacity, air traffic, maintenance and improvement purposes.
- Encourage the state to conform to the FAA requirements to eliminate revenue diversion from the aviation fuel tax to the State general fund.
- Implement policy provisions to protect funding for new infrastructure and maintenance of existing infrastructure from being diverted for other measures (e.g., security measures).
- Continue to partner with the state, local, city, and county jurisdictions to seek matching funds for both onsite and offsite improvements to increase the efficiency and safety of airport operations.
- Encourage existing and future professionals to pursue careers in the aviation sector to address staffing shortages at airport authorities, airlines, and aviation services, as well as the consulting firms that support them.
- Mobilize rehabilitation earlier in pavement life-cycles to avoid more costly and in-depth reconstruction projects.
- Foster partnerships with regional transportation agencies to develop and enhance bus and fixed-rail transit links to airport facilities.
- Accelerate implementation of the NextGen air traffic control system.
- Research and implement innovative design and construction methods and materials that promote longer useful life and help reduce life-cycle costs.
- Work with federal, state, and local agencies to update design and construction standards, guidelines, and procedures to allow infrastructure improvement projects to take advantage of innovative ideas and strategies.
- Airport authority executives, planners, and managers should more fully commit to the implementation of asset management plans.

Aviation

B-

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Bridges

BRIDGES

EXECUTIVE SUMMARY

California's bridges are a vital part of the state's transportation network, but many face challenges due to age, structural deficiencies, and increasing environmental risks. While efforts have reduced the number of poor bridges, nearly half of the state's bridges require maintenance to prevent further deterioration. Funding from federal, state and local sources support repairs, but long-term financial challenges remain. With climate impacts bringing more wildfires, floods, and rising sea levels, it's also important that we focus on building stronger, more resilient infrastructure. Innovations like augmented reality for planning and sensors that track conditions in real time—help make maintenance and construction safer and more efficient. While the state is investing in seismic retrofits, sustainable construction to improve bridge safety and extend lifespan, many local agencies are struggling to secure steady funding for repairs or new construction, making ongoing support and proactive maintenance of half of California bridges challenging to keep safe and functional.

CAPACITY AND CONDITION

As of December 2024, there were 25,392 bridges in California, the fourth largest state inventory of bridges after Texas, Ohio, and Illinois. California's bridges cross a variety of terrains, including arid deserts, marine environments, and mountainous areas with winter snowfall. Each environment poses unique challenges to the service life of bridges.

Roughly half of California's bridges are owned and maintained by the California Department of Transportation (Caltrans). The remainder are owned and maintained by local jurisdictions such as cities, counties, railroads, ports, etc.

A bridge in poor condition requires significant maintenance, rehabilitation, or replacement because critical load-carrying elements are deteriorated or damaged. The number of poor condition bridges in California has remained relatively constant over the past decade, from 1,400 in 2016 to 1,527 in 2024, which is 6% of the state's inventory.

Nearly 30% of California's poor condition bridges are state-owned and maintained. The remaining 70% are owned and maintained by local jurisdictions. This represents a significant shift from the 2019 Report Card for California's Infrastructure, when the split between state-owned and locally owned poor condition bridges was roughly 50%/50%. This trend demonstrates investment in state-owned bridges over the past

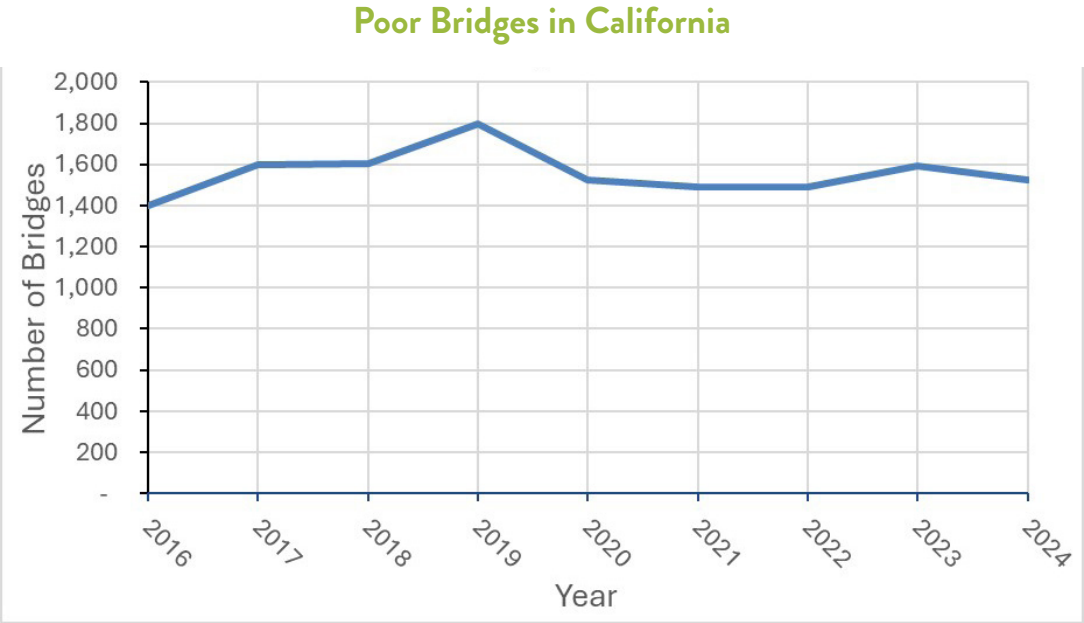


Figure 1. Number of Poor Bridges in California (2016 – 2024) (FHWA National Bridge Inventory)

five years, while locally owned bridges have continued to decline (primarily due to a lack of funding). Some local agency bridges have been closed to traffic due to disrepair.

The Federal Highway Administration (FHWA) collects data on the condition of bridges and classifies them as in good, fair, or poor condition. Bridge condition is determined based on the lowest rating assigned to its various components, including deck, superstructure, and substructure.

In California, as of December 2024, 11,798 bridges — or 46% of the total bridge stock in the state — are in good condition. Some 12,523 bridges — or 48% — are in fair condition and the remaining 1,527 bridges — or 6% — are in poor condition. In 2019, 65% of California's bridges were good and 30% were fair, and those distributions are now 46% good and 48% fair. A number of good bridges have slipped into the fair category, and those bridges require maintenance to ensure they do not slip down to the poor category.

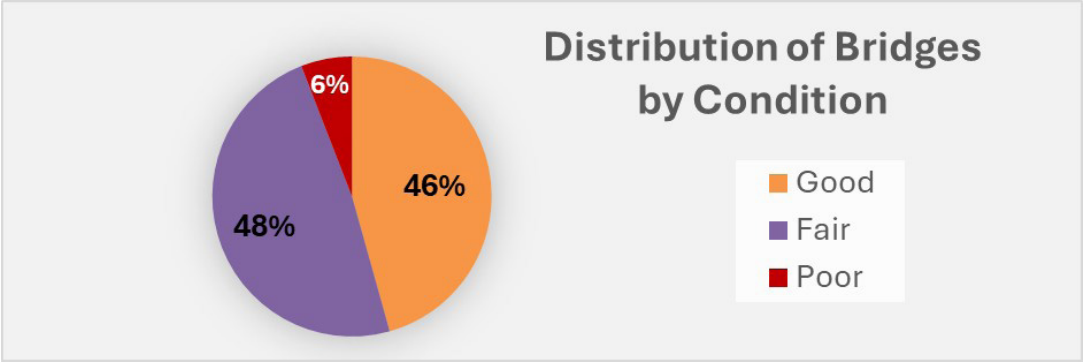


Figure 2. Distribution of Bridges in Good, Fair, and Poor Condition (FHWA National Bridge Inventory)

FUNDING AND FUTURE NEED

The California Transportation Asset Management Plan (TAMP) is a comprehensive plan developed by Caltrans and its partners to manage the state's transportation infrastructure assets and establish 10-year performance targets to support long-range investment strategies. TAMP is updated every 4 years and TAMP 2022 is the latest version available, which details the projected funding available from fiscal year 2022 through fiscal year 2031. It outlines multiple funding sources to support state and local bridge projects.

Caltrans administers approximately $300 million annually to replace and rehabilitate bridges, implement scour countermeasures, replace barriers, and conduct preventative maintenance. The Infrastructure Investment and Jobs Act (IIJA) has further bolstered federal support, providing additional funding for local bridges during the first five years of TAMP's 10-year plan. Additionally, the Federal Highway Bridge Program aids in the repair and replacement of poor condition or scour-critical bridges. In 2022, the largest federal investment ever made to upgrade bridges were implemented for California to receive estimated $4.2 billion over five years with $850 million in initial funding. At the state level, California relies on Senate Bill 1 (SB 1) and the Highway Users Tax Account (HUTA) to allocate funds to local agencies. Senate Bill (SB 1) (i.e. Road Repair and Accountability Act of 2017) is a major transportation investment in California aimed at improving the state's transportation infrastructure. It was signed into law by the state governor in 2017.

These funds are distributed based on population and mileage, though they do not directly account for the number of bridges each county maintains. The Local Bridge Seismic Retrofit Program also provides financial assistance to ensure seismic compliance for local agency bridges. Some counties have implemented tax measures under self-help counties measure funds to fund infrastructure improvements. For example, Stanislaus County has used measure funds for bridge and culvert projects.

To offset environmental impacts of transportation construction and encourage alternative modes of transportation, California Senate Bill 743 (SB 743) amended the California Environmental Quality Act (CEQA) in 2013. SB 743 requires local agencies to assess the environmental impacts of proposed transportation projects based on Vehicle Miles Traveled (VMT) instead of the previous Level of Service (LOS) method, which measures overall amount of driving (i.e. traffic flow. The change is intended to encourage reducing greenhouse gas emissions and promote active transportation like biking and walking. Sustainable practices and maintenance of existing infrastructure may be a tool to offset the significant environmental mitigation costs required by VMT laws.

Despite these funding sources, Caltrans faces long-term financial challenges in maintaining and improving its bridge network, with additional challenges for transportation projects in general introduced by SB 743 and related VMT laws. While IIJA funding has addressed some historical underinvestment, sustainability concerns persist due to the lack of a dedicated bridge-specific funding formula for local agencies. Additionally, evolving federal administrative policies create uncertainty regarding future funding availability and support mechanisms, further complicating long-term infrastructure planning.

Local agencies, which own and operate the majority of California's bridges, face the same financial pressures yet often lack the stable, dedicated funding streams available at the state level. Without targeted investment, local bridge programs risk falling behind in maintenance, innovation, and resiliency measures. To ensure the safety, reliability, and efficiency of the entire transportation network—not just the state system—funding solutions must explicitly include local agencies, empowering them to modernize infrastructure and meet new regulatory and operational challenges.

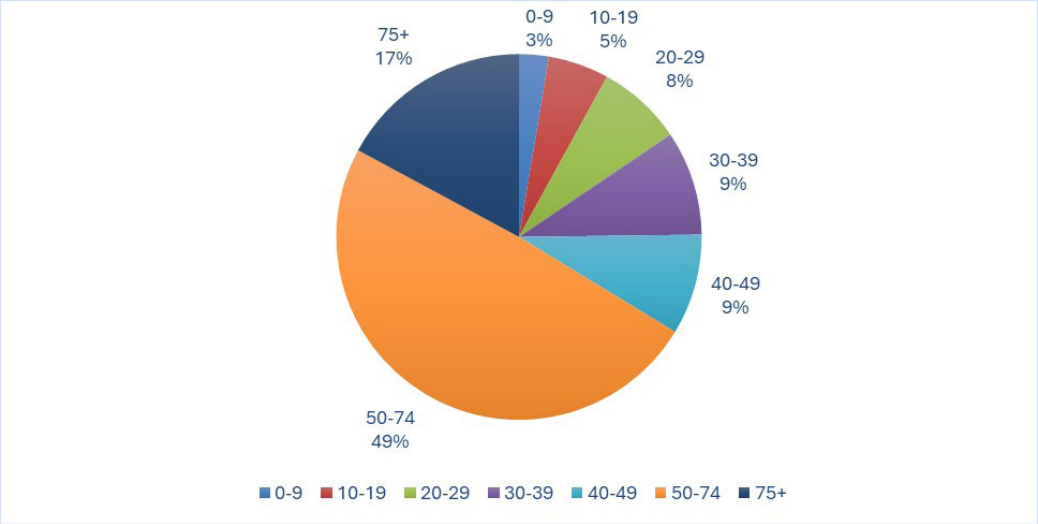
OPERATION AND MAINTENANCE

Caltrans employs a comprehensive strategy to monitor and manage traffic flow on bridges, ensuring minimal congestion and maintaining the steady movement of goods and people. Traffic management for emergency events involves collecting data on detour routes for bridges that are frequently impacted by closures, allowing for swift rerouting and reducing economic and social disruptions. Focus is given to the interstate route bridges to strengthen transportation assets along heavily used routes to ensure accessibility during critical situations. Additionally, to reduce the impact of repeated bridge collisions by tall or oversized vehicles, Caltrans monitors frequently struck bridges and takes preventive steps such as adding clearer signs or making structural changes.

Emergency preparedness is a key component of bridge operations, with proactive measures in place to address natural disasters and unforeseen structural damage. Bridges that have experienced repeated damage from events such as floods, landslides, and earthquakes undergo risk assessments to identify cost-effective and environmentally sustainable mitigation strategies. California state law grants the authority to expedite construction contracts in emergencies, allowing for rapid repairs or full reconstruction without the need for federal reimbursement if immediate safety risks exist.

Aging bridges are a growing concern. Many bridges in service today were designed for a 50-year lifespan. Today, over 65% of California bridges exceed 50 years in age and 17% are over 75 years old. Preventive maintenance can extend the lifespan of a bridge, but most of the older bridges – particularly those that are poor – will need major rehabilitation or reconstruction.

Figure 4. California Bridges by Age (Years) according to TAMP

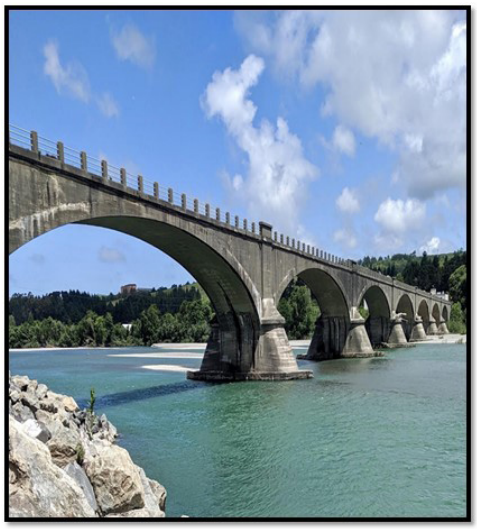


California takes a smart, data-driven approach to bridge maintenance, focusing on keeping bridges safe and extending their lifespan. Every bridge is inspected by engineers at least every two years, with inspection data guiding the timing and scope of repairs. Preventive measures—such as sealing decks, replacing joints, and applying protective layers—are prioritized to address small issues before they escalate. This targeted approach ensures that maintenance resources are used effectively, helping to avoid more costly repairs in the future. Despite these efforts, funding gaps remain: local governments spend about $290 million annually on bridge care, while the federal government contributes another $253 million through IIJA, which still falls short of meeting the overall need.

In addition to routine maintenance, Caltrans prioritizes seismic safety and long-term durability for both existing and new bridges. The Seismic Safety Retrofit Program by the California Transportation Commission evaluates bridges for earthquake vulnerabilities and funds retrofit projects to bring them up to modern safety standards. Climate resilience is also a growing focus for the State, with measures such as upgrading drainage systems to withstand 100-year storms and elevating bridges at risk of sea-level rise. A data-driven asset management approach ensures performance targets are met and that maintenance investments are optimized for long-term sustainability.

INNOVATION

Advances in materials, construction approaches, and technology have broadened the conditions in which construction and bridge longevity is possible. Aside from the implementation of the state's Accelerated Bridge Construction (ABC) Manual, innovative construction methods in conjunction with emerging technologies have helped overcome many issues relating to limited space, environmental restrictions, or public safety in high-traffic areas.



Technology has leveraged rapid data collection, Bridge Information Modeling (BIM), and augmented reality to advance 2D and 3D modeling, identify and resolve conflicts early, and optimize construction. Sensors integrated into structures during construction provide continuous real-time feedback of the health of the bridge. In addition, the application of cutting-edge technologies such as digital twin virtual models and real-time monitoring systems for the lifespan of the structures could detect early signs of structural deterioration and allow bridge owners to strategically invest maintenance projects on their bridge inventory. LA County has started a pilot program in

using drone to capture 3D images and created digital twin replicas for their bridge program. The overall goal is to incorporate innovative technologies to enhance public safety, extend service life, and improve cost-efficiency.

Self-propelled modular transporters, a form of Accelerated Bridge Construction, are used to move a bridge from a staging area to its final location (Source: Biggs Cardosa Associates).

Many materials and manufacturers are offering sustainable options that are economically viable where recycling or other sustainable practices offer both reduced cost and higher performance. For example, stainless steel reinforcing bars can be 100% recycled while offering superior corrosion protection and strength. However, there is no current requirement or framework implemented to formerly promote sustainable design and construction practices in the transportation sector.

These innovations not only accelerate construction but also set the foundation for improved ass

et life-cycle management.

To fully realize the benefits of these innovations, action is needed beyond pilot programs and isolated successes. Local, state, and federal partners must provide sustained funding, establish supportive policies, and promote standards that encourage the adoption of new materials, digital tools, and sustainable practices. With adequate investment and coordinated support, California can transition from experimenting with emerging technologies to systematically embedding innovation into bridge programs—delivering safer, more resilient, and cost-effective infrastructure for the public.

PUBLIC SAFETY

California's approach to public safety on bridges encompasses security measures, fire resilience strategies, equity in access, and structural safety through weight restrictions. Additional measures include maintenance of fire hazard vegetation and removal of unsheltered encampment that may present a risk to safety and access to a bridge or structure.

Equity in transportation access is also a significant component of public safety, ensuring that bridges accommodate all users, including pedestrians and cyclists. TAMP supports Complete Streets policies, requiring that new and rehabilitated roadways incorporate bicycle and pedestrian facilities when feasible. The 2021 State Highway System Management Plan (SHSMP) introduced dedicated funding for bicycle and pedestrian infrastructure, aligning with climate goals and efforts to enhance equitable transportation access.

Mary Avenue Bicycle Footbridge, Santa Clara County

RESILIENCE

Resilience of infrastructure (bridges, highways, hospitals, etc.) is generally defined as the ability of society to prepare for, mitigate, respond to, and recover from natural and manmade hazards or multiple subsequent hazards, and may consider important factors such as of loss of use (functionality), user costs, and cost of repair. Natural and manmade hazards include earthquakes, flood and scour, tsunami, manmade fire and wildfire, security

(terrorism), and other extreme events.

Regarding seismic hazards, Caltrans has completed seismic vulnerability screening (and retrofit where needed) of all of California's bridges on the state highway system – over 13,200 bridges. Caltrans screening indicates over 98% of the on-network bridges are in good seismic condition and expected to perform to a "Life Safety" level of service. This means that during and following a major event, human life is the priority, and bridges may be damaged beyond repair. The screening efforts continue and extend to off-network systems of county-owned and maintained inventory of bridges –another more than 12,600 bridges.

Fires, both natural and man-made, pose serious threats to bridge integrity and safety, often resulting in extensive damage and even collapse. Fires from homeless encampments have also led to multiple instances of bridge damage and collapse. Often, storms following wildfires can inundate wildfire burn scars, which will have heavier mud and debris flow that compound bridge risks for multi-hazard demands. To address these issues, new strategies and guidelines must be developed to ensure bridge safety in the face of climate impacts and social challenges.

Small local bridges in mountainous areas are particularly vulnerable to flash floods, which can overwhelm their hydraulic opening capacity and lead to significant bridge and roadway damage from tree logs and debris. Many of these bridges, built in the early 1900s, were designed with very limited span and clearance, making them less capable of handling the hydrology and hydraulic demands of today's climate. However, very limited funding is available to address the issue.

Resilience analysis is a helpful tool to evaluate these multiple and escalating hazards, especially in light of climate impacts such as sea level rise and wildfires. In California, rising sea levels are a concern for coastal bridges where seismic and earthquake-related hazards such as liquefaction and lateral spreading may be compounded by secondary events, including tsunami, flood and scour, fire, and other risks.

For this Report Card, a multi-hazard bridge resilience analysis of the over 25,800 on and off-network bridges in California was conducted, considering single and multi-hazard combinations of seismic, tsunami, flood and scour, and fire risks. The results indicate that as a single hazard, bridges are more vulnerable to complete damage due to earthquakes as compared to tsunami, storm, and fire hazards, with fire damage presenting the next highest risk. However, in considering a combined hazard of a primary (1000-year return period, "YRP") and secondary event (~500 YRP), approximately 44% of bridges are generally most vulnerable to storm plus fire, following by earthquake plus storm and earthquake plus fire events each at generally 16% to 20%.

Figure R-1 graphically presents the resilience analysis for California bridges under multi-hazard demands. The relative cluster of red-colored bridge locations indicates bridges more vulnerable to storm and fire in central California where the seismic demands and California Department of Forestry and Fire Protection (CAL FIRE) Fire Hazard Severity Zones are relatively lower, while coastal brides are more vulnerable to Tsunami hazards. The bridge resilience analysis underscores the importance of assessing earthquake, flood, scour, and fire demands for asset management decisions related to design and maintenance.

The Mulholland Highway Bridge over Triunfo Creek near Malibu Lake was severely damaged by the Woolsey Fire in 2018 (Left). It was reconstructed in 2020 (Right).

Caltrans' Seismic Safety Retrofit Program has strengthened over 2,148 bridges to meet modern earthquake safety standards, increasing Life-Safety during seismic events. Climate adaptation efforts include upgrading bridges, materials, raising bridges vulnerable to sea-level rise, and improving drainage systems to withstand 100-year storm events. These initiatives ensure that California's bridge infrastructure remains safe, efficient, and resilient in the face of both immediate and long-term challenges.

California's bridge network faces escalating risks from earthquakes, fires, floods, and the compounded effects of climate. While progress has been made through seismic retrofits and resilience initiatives, the growing threats from multi-hazard events demand broader, sustained investment and innovative strategies. To protect public safety, ensure continuity of mobility, and safeguard economic stability, decision-makers must prioritize funding, policy support, and implementation of resilience-focused upgrades across the entire bridge system.

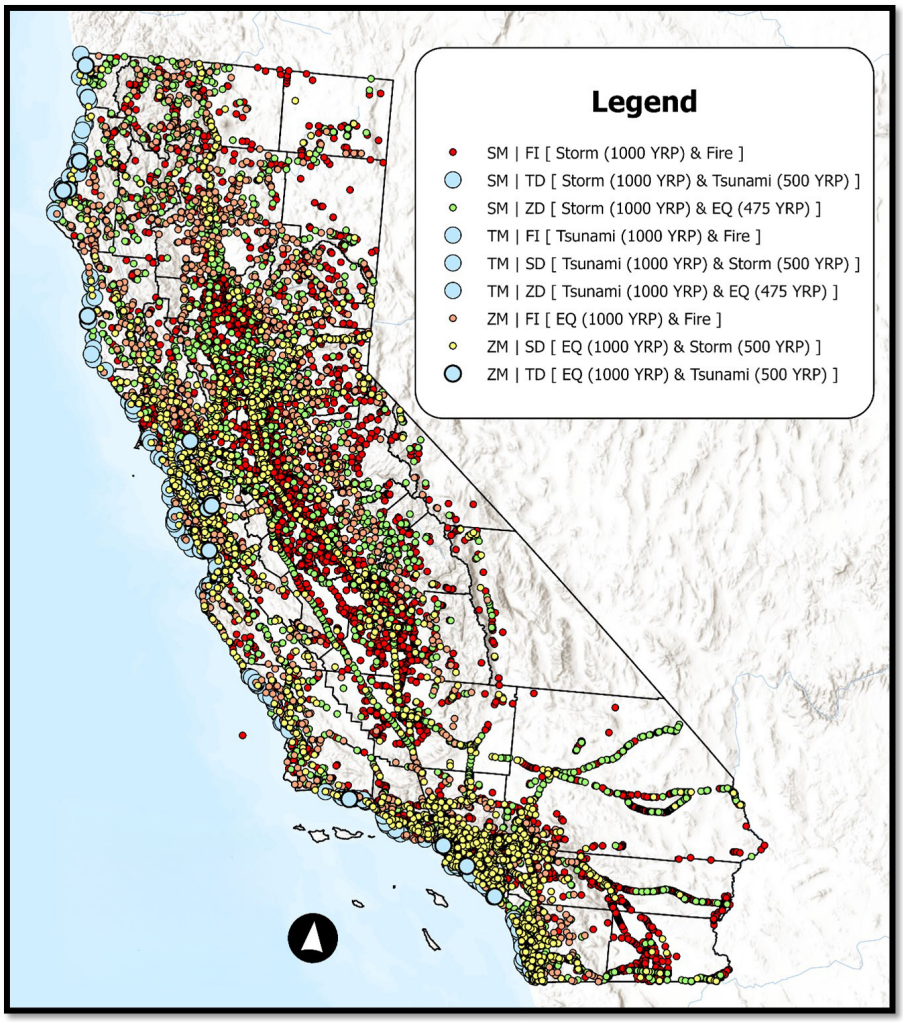
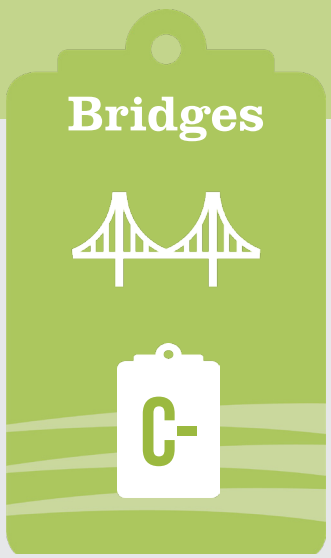


Figure R-1: Visualization of bridge vulnerability to multi-hazard demands (MNS, 2025)



RECOMMENDATIONS TO RAISE THE GRADE

- Expand funding sources (e.g. incentives for counties with tax measures) for local agencies to address bridges in poor condition, and bridges in fair condition at risk of falling into the poor category with deferred maintenance. Streamline bureaucratic hurdles that delay project approvals and funding disbursement access for bridges in poor and fair condition.

- Carbon-neutral philosophies, sustainable practices, and maintenance of existing infrastructure may be a tool to offset environmental mitigation costs required by state laws and will encourage multi-modal transportation and good environmental practices. Create programs to adopt and encourage more sustainable construction materials, such as ultra-high-performance concrete and corrosion-resistant reinforcements.

- Establish a rapid repair funding mechanism for bridges impacted by disasters to minimize long-term disruptions.

- Expand the use of smart sensors and Artificial Intelligence--driven predictive maintenance for real-time bridge health monitoring.

- Improve definition of resilience goals and metrics for national use and consistent comparison.

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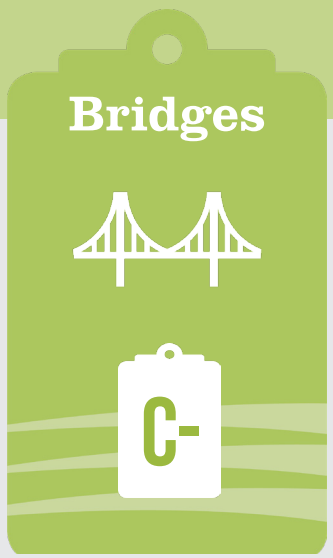

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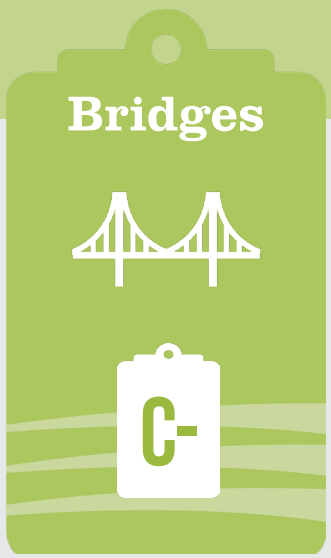

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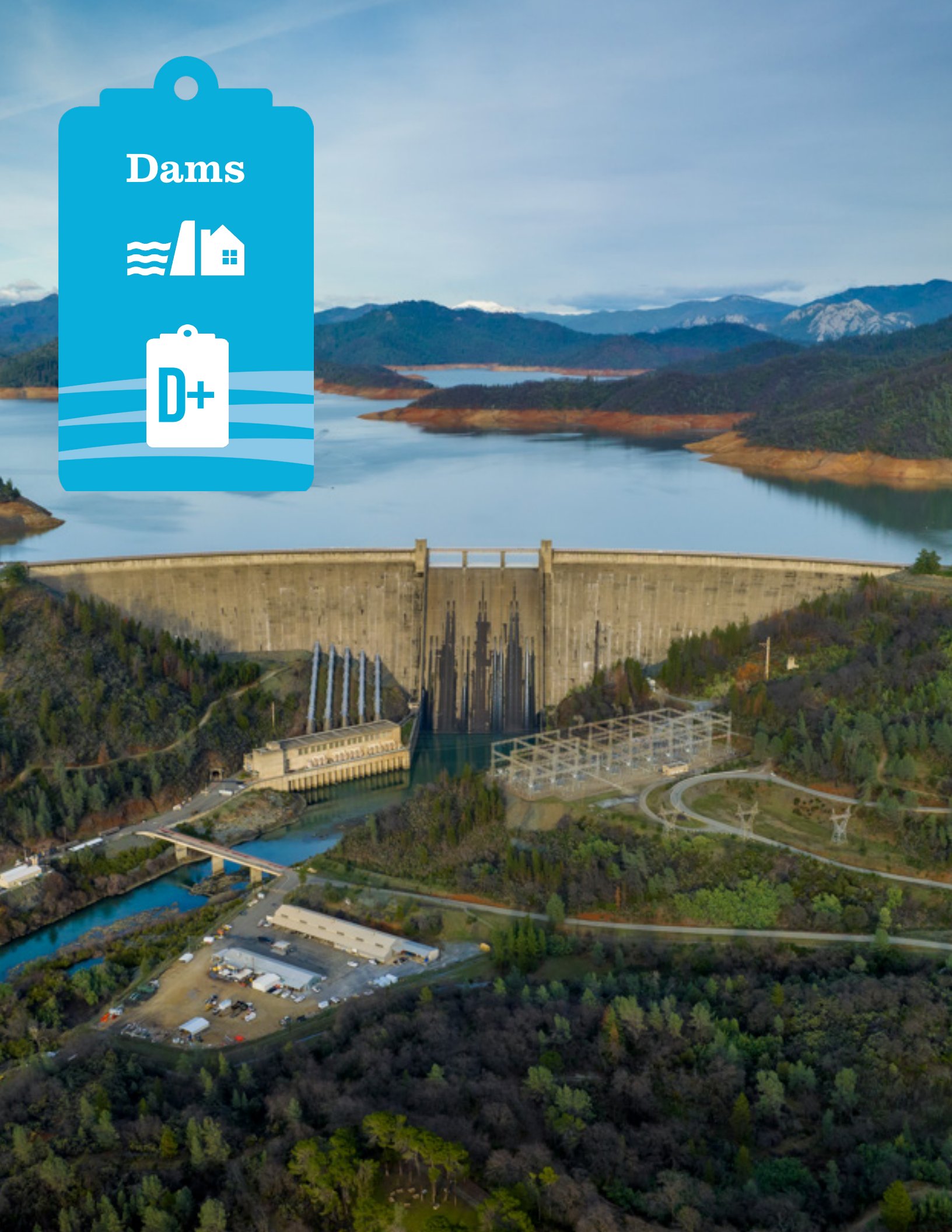
Dams
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DAMS

EXECUTIVE SUMMARY

Dams are a critical part of California's infrastructure, impounding reservoirs which provide a wide range of benefits including reliable water supply, flood protection, clean energy, recreational usage, and wildlife habitat. There are over 1,500 dams in the state, which provide about 70% of the state's water supply and 15% of the power supply. California has a robust dam safety program, administered by California's Division of Safety of Dams (DSOD), which has been bolstered by legislation to enhance dam safety oversight, emergency action planning, and enforcement, although recent budget reductions of approximately 8% have taken place which have impacted programs. Despite this increased focus on dam safety, the continued aging of dams and the impacts of climate have produced deficiencies at these facilities that have outstripped California's ability to address them. Environmental regulations continue to complicate and slow dam repairs and capacity expansion projects. Available private, agency, and grant funding sources do not fully fund rehabilitation, operation and maintenance, and other programs necessary to provide for safety and meet future needs.

BACKGROUND

In 1929, California established a dam safety program in the aftermath of the St. Francis Dam Failure, which ultimately came under the jurisdiction of DSOD. DSOD regulates approximately 1,230 non-federal dams in the state with a jurisdictional dam being defined as those structures that are 25 feet or higher and impound 50 acre-feet (AF) of water or more (Note that DSOD does not regulate USBR, USACE or other federal dams). DSOD's responsibilities include independent annual inspections of each significant, high and extremely high hazard dam, reviewing and approving new dams, dam enlargements, repairs, alterations, and removals to ensure dams and their appurtenant structures are designed, constructed

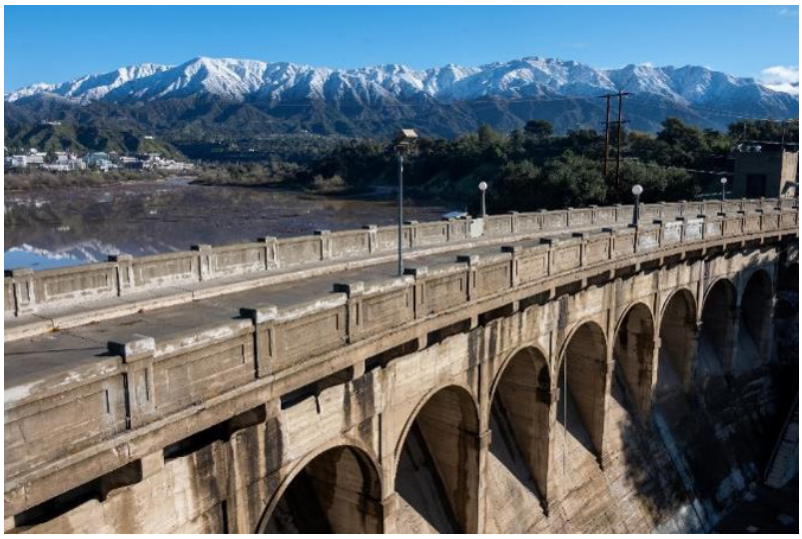


Photo 1: Devils Gate Dam (Credit: Los Angeles County Public Works)

and maintained to ensure the safety of the public. Low hazard dams are also inspected every other year. DSOD also performs in-depth independent evaluations. After the Orville Spillway Incident in 2017, there was significant legislation enacted to support dam safety and emergency action planning. Funding was provided to increase DSOD staffing to include additional engineers to perform re-evaluations of spillways and appurtenance structures, review and approve updated inundation modeling and mapping, and to implement DSODs new statutory enforcement authority.

In addition, the Federal Energy Regulatory Commission (FERC) co-regulates about 191 California hydropower dams with DSOD, and in addition, regulates about 80 additional hydropower dams that do not meet DSOD's jurisdictional requirements. Most large public agencies have dam safety programs within their organizations, while smaller and individual dam owners generally lack the resources to have in-house expertise. State regulations now require owners of significant, high and extremely high hazard dams to develop Emergency Action Plans, and even smaller dam owners are required to comply, with some not in compliance and under DSOD enforcement action.

CONDITION AND CAPACITY

According to National Inventory of Dams (NID), there are 1,531 dams in California that provide critical capacity for urban and agricultural water supply, flood protection, hydroelectric power, recreation usage, and downstream environmental management. About 42% of the state's dams are owned by private entities, a combined 41% are owned by local government agencies and public utilities, and 17% are owned by federal and state agencies (refer to Figure 1).

In California, dams are classified by their downstream hazard potential, i.e. the potential for adverse consequences to downstream communities in the event of dam failure. The downstream hazard potential classifications assigned to dams range from "low" to "high", where no life safety consequences are expected due to failure of low hazard dams, and significant life safety and property damage consequences are expected due to failure of high hazard dams. These hazard classifications are only based on potential downstream consequences and do not consider the condition of a dam. Over half of California's dams (57%) are classified as having "high" downstream hazard potential (refer to Figure 2).

Figure 1: Dam Ownership in California

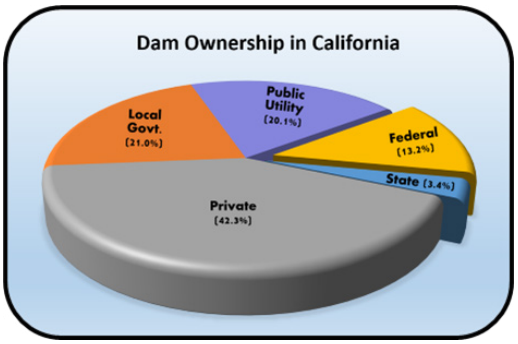
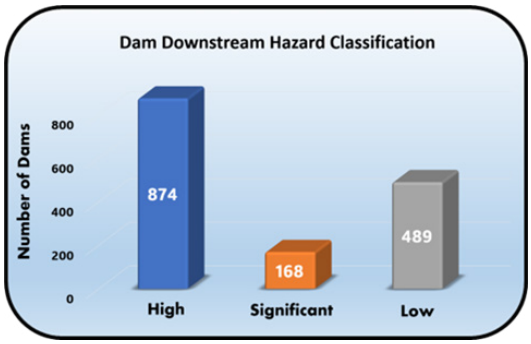
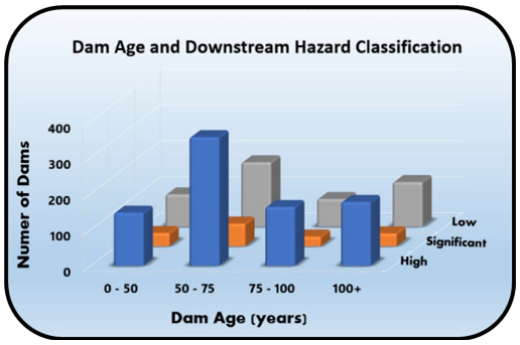


Figure 2: Dam Downstream Hazard Classification



* Dam ownership and downstream hazard classifications shown are based on data from the U.S. Army Corps of Engineers' National Inventory of Dams (NID) as of March 2025.

Figure 3: Dam Age and Downstream Hazard Classification



Approximately 78% of the dams in the state were constructed over 50 years ago with an average age of 76 years; this exceeds the national average dam age of 64 years. About 700 high hazard dams are over 50 years old, with approximately 40% exceeding 75 years and 20% exceeding 100 years of age (refer to Figure 3). While they continue to age, dams can provide useful service for well over 100 years with proper maintenance and operation; however, other critical components necessary for maintaining dam safety such as gates and valves have a much shorter service lives and require significant and costly periodic upgrades.

Photo 2: Rubio Canyon Debris Basin Dam – Post-Eaton Fire Sedimentation (Photo Credit: Los Angeles County Public Works)

The California DSOD published their latest condition assessment data for all the dams under its jurisdiction in 2024; out of the 1,233 dams regulated by the DSOD, 131 were rated less than satisfactory including 95 high hazard dams. In addition, dams that are jointly regulated by FERC receive additional reviews, which may call out additional concerns that impact the ratings. While similar condition data is not publicly available for federally-owned dams, a similar percentage of less than satisfactory dams is very likely.

Aging condition and climate impacts threaten the beneficial, or actually available storage capacity that California's dams provide. An estimated 380,000 acre-feet of storage capacity, the equivalent annual water usage for 3.6 million people, has been lost due to dam safety concerns prompting reservoir restrictions. Increasing climate impacts are also reducing available capacity through increased sedimentation due to wildfires and hotter, drier conditions which diminishes reservoir replenishment. Progress to expand capacity in California remains slow as funding, environmental, and permitting issues make construction of new dams or dam expansions challenging.

OPERATION AND MAINTENANCE; FUNDING AND FUTURE NEED

Effective operation and maintenance (O&M) is the most cost-efficient way to manage dam infrastructure, especially when compared to the high costs of major repairs or addressing the consequences of dam failure. DSOD mandates regular inspections and valve exercises to ensure satisfactory performance but managing dams at the local level in California presents significant challenges.

Dam owner budgets have not kept up with inflation, making even basic maintenance increasingly expensive. Although some federal programs provide loans and grants, securing financial support for regular O&M and dam improvements remains difficult. Dam rehabilitation and maintenance can be very costly, and dam owners are typically responsible for covering most of these expenses, which can be particularly burdensome for smaller or privately owned dams. Environmental regulations often hinder maintenance efforts, especially when it comes to spillway upkeep.

Photo 3: Diamond Valley Lake (Photo Credit: Metropolitan Water District of Southern California)

Traditionally, dam condition assessments have primarily focused on the main structure, with appurtenances, such as spillways and valves, considered secondary. Although recent efforts have placed greater emphasis on these ancillary components, dam owners and regulators

should continue prioritizing their maintenance and repair. Inadequate maintenance of dam appurtenances raises safety concerns, and more funding and priority need to be allocated to maintaining their condition.

Workforce challenges, such as the loss of institutional knowledge, a limited pool of qualified candidates, and poor records retention practices, are frequently cited as factors that further complicate O&M efforts. The American Water Works Association's 2025 State of the Water Industry report highlights ongoing workforce issues in the water sector, including difficulties with recruitment, an aging workforce, and gaps in training and education. Recognizing similar trends, the EPA developed a Water Sector Workforce Initiative in 2020 aiming to mitigate critical staffing shortages across the industry. Workforce issues continue to impact various subsectors of water infrastructure management and have been noted by various dam owners as a critical issue for dam operations and maintenance. This highlights the need for workforce planning and support of policies to create K-12 outreach and university level career development for dam safety professionals

Photo 4: Morris Dam Outlets
(Photo Credit: Los Angeles County Public Works)

Workforce issues have become more pressing as federal agencies have seen a significant decrease in their staffing with the Deferred Resignation Program. In addition to seeing funding cuts, the reduction in key technical staff will impact the ability to complete higher level risk assessments and modification studies, which then likely will shift how and when projects are completed. Funding cuts will halt some project activities and delay the start or significantly reduce the scope for projects that have not yet begun. Reduced staffing will also increase backlogs of work and permits, which will impact dam owners statewide.

Despite these hurdles, agencies are making some progress in developing more effective methods for tracking O&M issues and ensuring their resolution. However, as California's dams continue to age, more funding needs to be available at the federal, state, local, and private levels to conduct routine O&M amidst rising costs.

With recent advances in dam engineering and enhanced dam safety standards, deficiencies are being identified at a higher rate, while the available resources to address these deficiencies remain very limited. Significant funding is needed for repairing the state's deficient dams and their appurtenances, and federal funding streams to support these activities are limited. The Association of State Dam Safety Officials reported an estimated cost of $1.93 billion for repairing California's dams, however the actual cost is likely to be much higher and doesn't include federal needs, which are also expected to be high. Under the IIJA, $255 million was provided for the BF Sisk Dam upgrade. In addition, the state's Dam Safety and Climate Resilience Local Assistance Program was established in 2023 to provide grant funding for repairs and rehabilitation of dams. It is expected that about $480 million will be appropriated to fund the program in the next two years – while this is an improvement, there is still a significant funding gap to be filled.

PUBLIC SAFETY, RESILIENCE

California law mandates Emergency Action Plans (EAPs) for all dams, except low hazard dams, requiring owners to develop and regularly update these plans every 10 years, or if there are significant changes to the dam or downstream development, based on inundation maps. DSOD provides regulatory oversight for consequential dams through inspections and reviews, though adequacy of staffing levels to meet all program demands still needs attention. At both the state and federal levels, limited funding and staffing continue to make it difficult to manage the growing challenges of aging dams and increasing downstream populations.

The California Department of Water Resources' DSOD is responsible for the regulatory oversight of approximately 1,230 non-federally owned dams within the state, while federal agencies like the Army Corps of Engineers and the Bureau of Reclamation oversee federally owned dams.

California has made strides in improving dam safety in recent years, as demonstrated by the completion of updated inundation mapping and the preparation of EAPs by most dam owners, driven by legislation since 2017, following the Oroville Dam incident. Furthermore, dam owners have adopted more consistent post-earthquake dam inspection criteria, and public awareness of dams is growing, with increased engagement expected through the CalOES program. The continued passage of dam funding bills indicates sustained public support for this critical infrastructure. The establishment of DSOD Civil Administrative Enforcement authority, with a focus on collaborative problem-solving, marks another significant step forward.

A dam failure could have catastrophic and far-reaching consequences, significantly impacting the state's economy. Depending on the dam's size and location, such an event could unleash torrents of water leading to immense property damages in downstream communities. Businesses and commerce could face severe interruptions due to inundation, infrastructure destruction, and displacement of populations. The loss of vital infrastructure like roads, bridges, and utilities would further cripple economic activity and recovery efforts. California's crucial agricultural sector could suffer extensive losses from flooded fields, damaged irrigation systems, and long-term soil impacts. Furthermore, the environmental consequences, including habitat destruction and alteration of river systems, would be substantial. Most tragically, dam failure poses a grave risk of significant loss of life, underscoring the paramount importance of dam safety monitoring, maintenance, and emergency preparedness to protect both the economy and, most importantly, human lives.

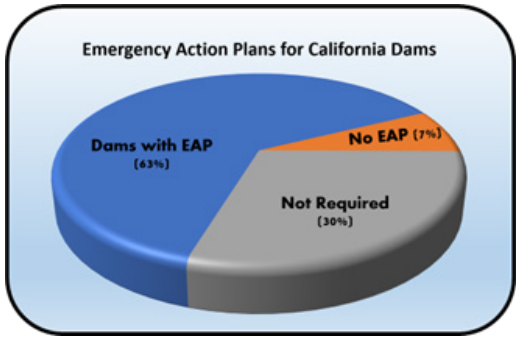
Based on recent data, 7% of California dams still require EAPs (refer to Table 1 and Figure 4). Notably, 66 of these dams lacking plans are classified as high hazard, underscoring the critical need for these preparedness measures for the State's most at-risk structures.

Table 1: Emergency Action Plans for California Dams

EAP Prepared	No. of Dams	%
Yes	946	62.9
No	114[1]	7.4
Not Required	453	29.5

(1) Out of the 114 dams with no EAPs, 66 are high hazard
* Based on NID data as of March 2025.

Figure 4: Emergency Action Plans for California Dams



Climate impacts are placing increasing demands on dam infrastructure. Increasing intensity and frequency of extreme precipitation strain flood management capabilities, post-wildfire sedimentation intensifies storm flows and reduces reservoir capacity, and periods of prolonged drought reduce reservoir replenishment. Under regulatory oversight, dam owners are performing flood modeling studies using updated precipitation data, which will help inform capacity needs and risk studies to provide greater climate resilience. Additionally, many of California's dams would be exposed to strong shaking in a major seismic event. Renewed emphasis on developing dam resilience standards

is necessary to mitigate downstream flooding and provide continuity of beneficial dam operations following extreme climatic or seismic events.

In California, there is a clear and growing emphasis on integrating sustainability and climate resilience into dam-related projects and funding programs. DSOD explicitly recognizes sustainability as central to its mission, embedding it within key planning documents such as the California Water Plan and Climate Action Plan, a commitment echoed by other major water agencies like the Metropolitan Water District (MWD), the Los Angeles Department of Water and Power (LADWP), and East Bay Municipal Utility District (EBMUD) through their comprehensive sustainability initiatives. While not mandated for all dam projects, other infrastructure entities in the state, such as Los Angeles County Public Works, utilize sustainable planning and design frameworks like the Envision rating system.

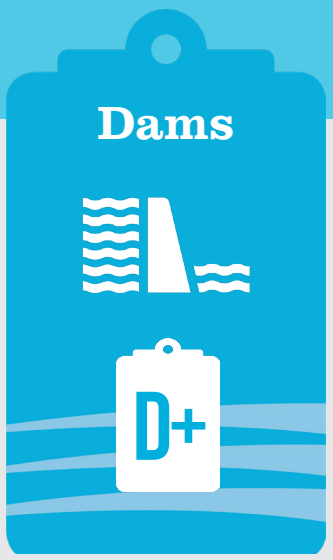
Complementing these efforts, DSOD's essential functions, including annual inspections, design reviews for modifications, construction oversight, and periodic re-evaluations, constitute fundamental elements of an asset management approach vital for ensuring the long-term safety and reliability of the state's dam infrastructure. Furthermore, in a move towards sustainable water management and restoring ecosystems, dam removals are actively occurring in California, exemplified by the significant undertaking on the Klamath River where four hydroelectric dams were removed to restore natural flows and revitalize critically impacted salmon populations.

Photo 5: The Oroville Dam Main Spillway and Emergency Spillway Repair. (Photo Credit: Department of Water Resources)

INNOVATION

Technology used to operate and monitor dams is steadily improving, making it easier and more efficient to manage these structures. Tools like sensors that measure water pressure (piezometers) and detect ground movement (seismographs) can now be automated, allowing for better tracking of how a dam is performing. Survey capabilities continue to improve with technologies such as GPS, LIDAR, and InSAR being used to identify changes on or within dams earlier and allow for intervention. Drone capabilities provide an opportunity to closely inspect areas where it is difficult or even unsafe for personnel to access and also allow for increased monitoring frequency. Software used to manage and predict storms and impacts continues to improve with the innovations in technology providing key planning tools to better manage emergencies. Additionally, risk-based dam safety evaluations are being employed by some large dam owners but there is not yet widespread acceptance of these approaches. Novel computer simulation approaches (e.g., modeling population redistribution during an evacuation) are being used to evaluate the consequences of dam failures.

With the aging dam inventory and the difficulty of building new dams, innovative technologies have the potential to improve overall dam management. Funding to support innovative approaches can be challenging particularly for smaller dam owners. Support should be provided for research and pilot testing of new technologies, so that the condition of dams in real-time can be more rapidly evaluated to inform day-to-day operations and emergency response.



RECOMMENDATIONS TO RAISE THE GRADE

- Support legislation to provide additional funding to expand the state's existing Dam Safety and Climate Resilience Local Assistance Program. Support funding for engineering studies to assess impacts to dams due to climate impacts and continue to support dam capital improvements and operational needs.

- Continue investment in early warning systems, enhanced technology, and strengthening communication protocols to improve public safety with respect to dams. Support effective community-level emergency preparedness with specific, actionable steps, such as signing up for emergency notifications and preparing emergency kits and plans.

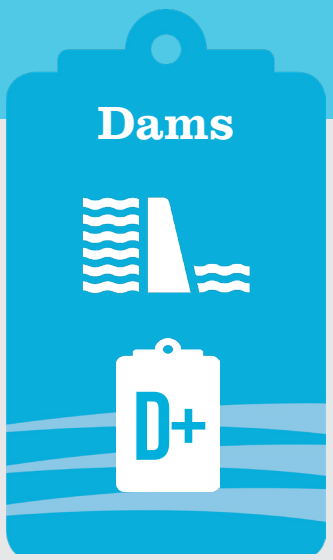
- Support the develop of standards and practical tools for risk-based dam safety evaluations and assessments, in collaboration with industry experts, regulators, and owners. Provide funding to help smaller dam owners perform risk-based assessments of their facilities.

- Support legislation to expedite environmental and permitting reviews associated with the repair and maintenance of dams. Support the development of legislation that allows for regular maintenance of dam spillway structures and dam capacity (vegetation clearing and sediment removal.)

- Support investments in innovative approaches for dam condition assessments, including instrumentation, surveillance and monitoring, and use of machine learning and Artificial Intelligence to predict dam performance.

- Support workforce development efforts to ensure an adequately trained dam safety workforce. Support university level education on dam design and maintenance, K-12 outreach for future careers, and certifications. Establish policies that require dam safety awareness training for dam owner staff and the public.

- Restore dam safety funding, and regulatory staffing at the state and federal levels to ensure adequate dam safety oversight, reviews, and inspections, particularly in light of recent cuts to dam capital and operating funding.



DEFINITIONS

AF – Acre Feet
CalOES – California Office of Emergency Services
DSOD – California Division of Safety of Dams
EAP – Emergency Action Plan
GPS – Global Positioning System
IIJA – Infrastructure Investment and Jobs Act, 2021
InSAR – Interferometric Synthetic Aperture Radar
LiDAR – Light Detection and Ranging
MWD – Metropolitan Water District
O&M – Operations and Maintenance
USACE – U.S. Army Corps of Engineers
USBR – U.S. Bureau of Reclamation

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Photo 5: The Oroville Dam Main Spillway and Emergency Spillway Repair. (Photo Credit: Department of Water Resources)

Drinking Water. iStockphoto.com\fizkes

DRINKING WATER

EXECUTIVE SUMMARY

California's drinking water infrastructure is under increasing strain, particularly in small and rural communities where aging pipelines frequently leak and break. While 98% of residents receive water that meets safety standards, nearly 400 small water systems remain non-compliant—highlighting persistent inequities in access and reliability. The state faces a significant funding shortfall: an estimated $11.5 billion is needed for infrastructure upgrades over the next five years, yet only $3.5 billion is currently available. This gap is a major contributor to the decline in California's overall drinking water infrastructure grade.

Prolonged droughts and natural disasters further intensify the pressure on water systems, underscoring the urgent need for resilient and emergency-ready infrastructure. Despite these challenges, California continues to lead the nation in water innovation, advancing technologies such as Direct Potable Reuse and cutting-edge treatment methods. Long-term success will depend on securing sustainable funding, ensuring affordability, and promoting equity—especially for underserved communities. Addressing these priorities is essential to meet the growing demands of climate resilience and infrastructure maintenance.

CAPACITY

The 2023 California Water Plan (Water Plan) water supply and use balance study is the most reliable statewide approach to compiling local water supply data. This study highlights the regional disparities when comparing local water supply and uses to statewide totals. California's water supply volumes and consumption can vary significantly during wet and dry years. Figures 1 and 2 compares 2019 wet year and 2020 dry year data available from the State. Volumes, sources, and relative percentages of water usage and supply vary significantly from year to year and throughout regions. Trends in groundwater levels, as determined by well measurements between 2003 and 2023, are displayed in Figure 3. Over 20 years, 45% of wells in the State reflect decreasing groundwater levels. Dry wells, land subsidence that impacts water transportation and infrastructure, and deterioration of groundwater quality are all consequences of declining groundwater levels.

Figure 1: California's Water Supply Volumes

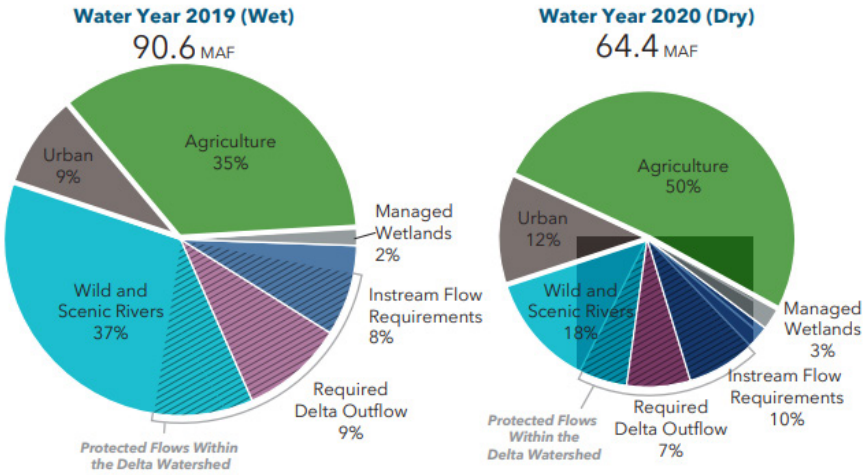
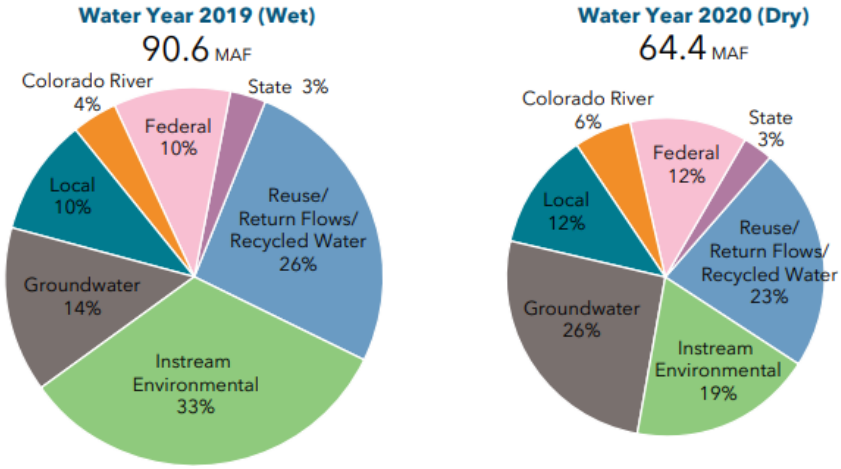


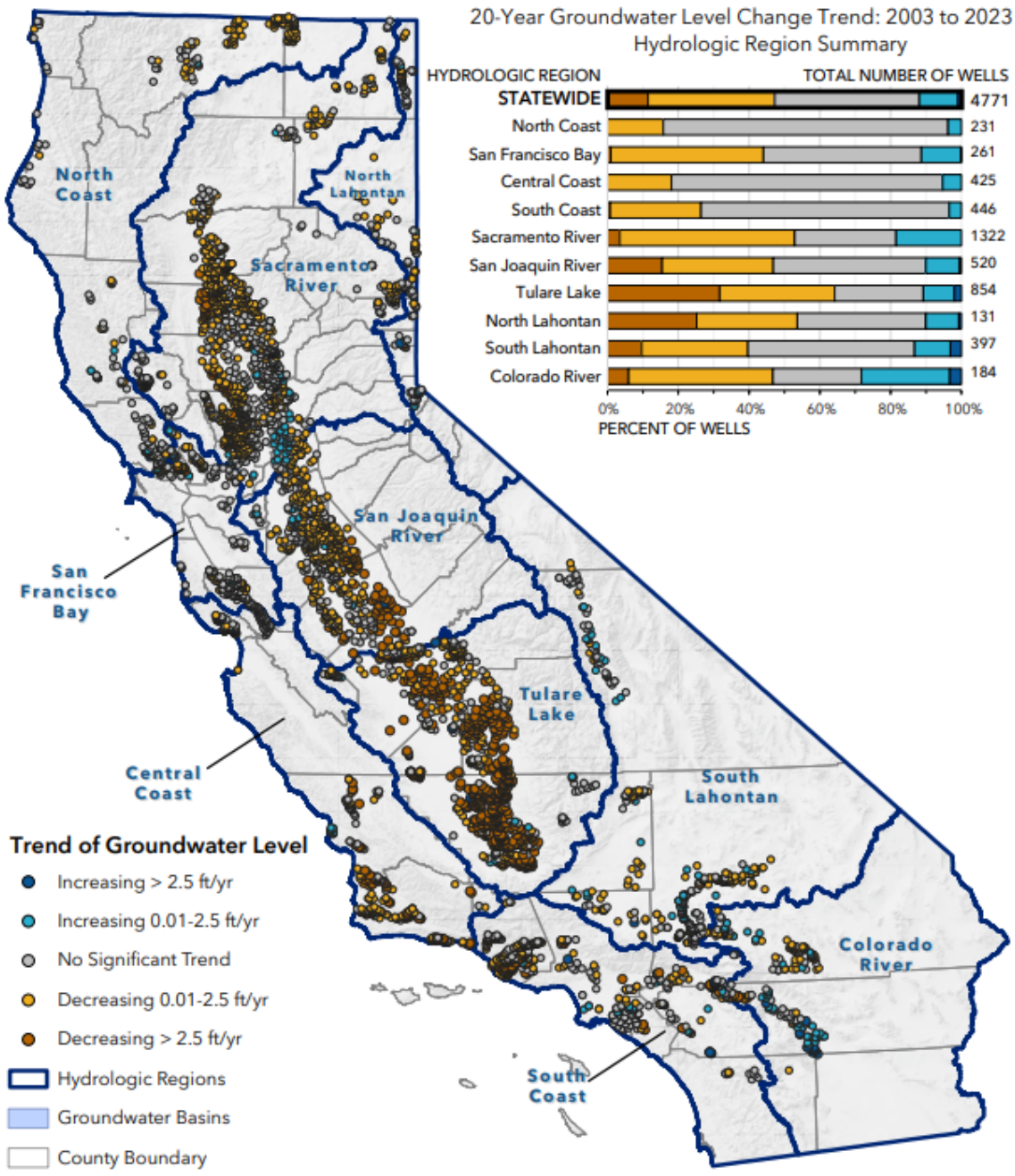
Figure 2: California's water supply consumption



The gap between water supply and demand has steadily widened as available supplies continue to decline. Significant changes in the seasonality and volume of runoff, increased consumption by crops, natural vegetation, and urban landscapes, and a significant decline in natural water storage in the form of snowpack, soil moisture, and aquifer replenishment are all results of the hotter and drier climate related conditions. If California's water supply drops by 10% by 2040, many vulnerable residents may face serious challenges accessing their basic human right to water.

California's drinking water systems have sufficient capacity to meet demands; however, many regional disparities, coupled with future stresses related to aging infrastructure, climate impacts, drought, water quality, population shifts, environmental considerations, and financial challenges, temper the outlook. Most large utilities report sufficient water supply for growth, and about half of surveyed agencies expect to manage population increases without straining their systems (1). Many communities use a mix of surface water and groundwater resources to enhance reliability. Statewide conservation efforts have flattened or reduced per-capita water use (1), reducing the need for additional capacity. However, diversified water sources will require a new distribution system, especially concerning recycled water.

Recurring droughts and other climate impacts have increased the risks, especially in rural areas that rely on small systems or a limited



number of wells or local streams. These small communities face chronic shortages during dry years. In one case, a small community lost 80% of its supply to pipeline leaks amid drought.

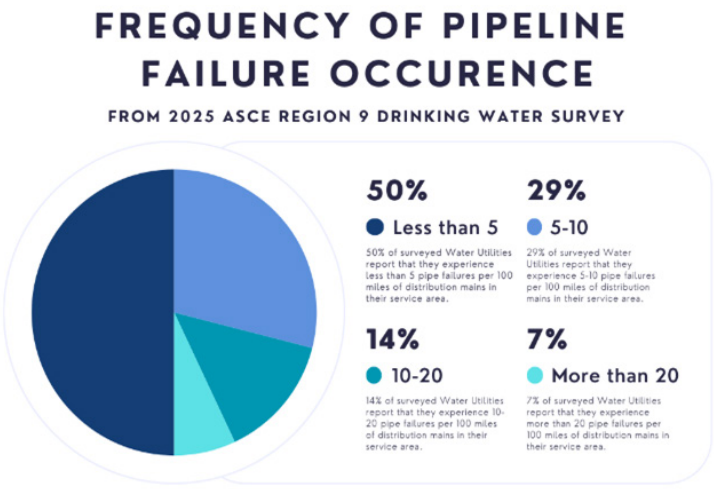
To increase their water supply resilience, many communities in California are implementing recycled water programs as a source of new supply. Examples of new supplies include Pure Water San Diego, Pure Water Monterey, Pure Water Soquel, Pure Water Southern California, Chino Basin Program Inland Empire Utility Agency and Orange County Water District's Groundwater Replenishment System, among others. These programs use advanced purification technologies such as microfiltration, reverse osmosis, and UV disinfection to recycle wastewater into potable water. These programs are critical in ensuring California's water security by creating sustainable, drought-resistant water supplies. These initiatives keep overall capacity at a good level, but continued vigilance is needed to ensure all regions can meet future demand.

CONDITION

Aging infrastructure and deferred maintenance are widespread challenges in California's drinking water systems. Over 85% of water utilities surveyed for this report, indicated that portions of their pipelines or facilities have exceeded their design life. Indeed, much of the State's water network was built before 1980. Aging pipes contribute to frequent breaks and water loss – about half of utilities reported more than five water main breaks per 100 miles annually. Some small systems suffer extreme leakage (up to 25–80% losses) due to deteriorated pipelines.

An average water supplier in California loses approximately 35 gallons per connection per day through leakage, which translates to total statewide water losses of about 316,000 acre-feet (AF) or 103 billion gallons on an annual basis, as per water loss auditing data reported by urban retail water suppliers from 2017 to 2020.

Figure 4: Frequency of Pipeline Failure Occurrence



OPERATION AND MAINTENANCE

Due to the lack of investment in replacing aging infrastructure, utilities are becoming more reliant on operation and maintenance (O&M) staff to make reactive repairs on drinking water infrastructure; in fact, only roughly one-third of utilities achieve a predominantly proactive maintenance regime. Asset management programs, a common feature for proactive utilities, are not fully mature across the State. Only a few utilities have fully implemented asset management plans, and many are still developing them. While larger utility districts maintain treatment plants, tanks, pumps, and valves on regular cycles, smaller and disadvantaged systems often lack the resources to do so. Without more significant investment in replacing aging infrastructure, utilities will likely need to allocate more and more resources to O&M activities.

The operational performance of California's drinking water utilities is a mixed picture of substantial compliance among large systems, most of which are in urban areas, and ongoing struggles for smaller ones, predominantly in rural areas. Ninety-eight percent of California's population is served by community water systems that meet Safe Drinking Water Act standards, and all surveyed agencies reported consistently meeting water quality standards in recent years. This reflects generally effective operations, skilled personnel, and robust treatment processes at the major utilities. However, according to the 2024 Drinking Water Needs Assessment, 385 unique small and medium-sized systems and K-12 schools serving a population of around 913,500 were failing. State programs like the Safe and Affordable Funding for Equality and Resilience (SAFER) initiative have helped improve operations in struggling systems – in the last five years, 251 previously non-compliant water systems (serving 2 million people) were brought back into compliance, often through technical assistance or consolidation.

Finally, many water utilities cite an aging workforce and difficulty recruiting qualified operators as key hurdles moving forward. Overall, day-to-day operations keep water flowing safely for most Californians, but workforce shortages and inconsistent management capacity in smaller systems keep this score in the mid-range.

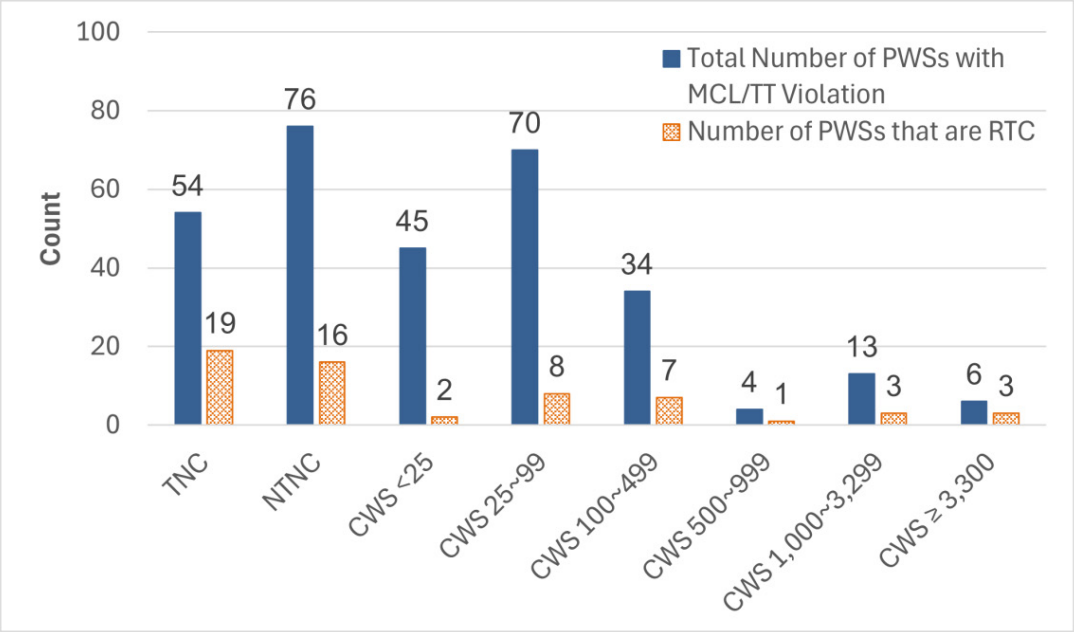
PUBLIC SAFETY

From a statewide perspective, California's drinking water safety is high for most residents, yet significant equity issues remain in disadvantaged communities. By 2024, 98% of Californians served by community water systems received water that met health standards. California's water quality standards meet or, in many cases, exceed Federal Standards. The State Water Board continues to track compliance.

Table 1: Summary of California-Specific MCL Standards Violations and Public Water Systems Counts.

Contaminant/Rule	Violation Category	Number of Violations	Number of PWSs
1,2,3-TCP	MCL	169	60
Aluminum	Primary MCL	2	2
Fluoride	MCL	21	8
Iron	Secondary MCL	49	13
Manganese	Secondary MCL	94	30
Perchlorate	MCL	3	2
POU/POE	MCL	4	4
Total		**342**	**106***

Figure 5: Number of Public Water Systems (PWSs) that returned to compliance (RTC) in 2023 for a federal MCL/TT (Maximum Contaminant Level/Treatment Technique) violation.



Severe waterborne disease outbreaks are rare, and most utilities reported no significant public health incidents in the past decade. Utilities have been actively tackling contaminants of concern – nearly all surveyed agencies feel they are addressing issues like arsenic, chromium-6, lead, and per- and polyfluoroalkyl substances (PFAS), effectively or adequately. However, hundreds of small systems still fail to provide safe water. As previously noted, there are 385 public water systems (serving about 913,500 people) currently deemed "failing" by the State of California due to contamination or reliability problems. These are primarily in rural or economically disadvantaged areas, exposing those communities to health risks from nitrates, arsenic, and other pollutants. The State's ongoing SAFER program targets these gaps – over 140 system consolidations have been completed to improve at-risk systems. While incremental progress is being made, the existence of communities lacking safe drinking water harms public safety and prevents the overall grade for the state's drinking water from being higher. Continued investment in treatment upgrades, source cleanup, and system consolidation is critical to ensure safe water for all Californians.

FUNDING

Funding shortfalls pose a major challenge for California's drinking water infrastructure, with existing revenue streams falling short of the system's growing demands. Most water utilities rely on local ratepayers as the primary funding source. Even though water rates have increased over time, roughly 80% of surveyed agencies indicated their rate structures do not fully cover infrastructure costs – usually, there is a funding gap, whether small or significant. Over the next five years, capital needs are substantial; most systems report multimillion-dollar requirements, with nearly two-thirds estimating over $20 million needed for upgrades and maintenance, a significant portion of which is not currently funded. Statewide assessments echo these concerns. The 2024 Drinking Water Needs Assessment estimates a total need of $11.5 billion for long-term solutions in failing and at-risk water systems. Still, with only $3.5 billion in projected funding, an $8 billion shortfall remains over the next five years. In the long run, local communities and private well owners may need to shoulder an additional $13.9 billion to achieve universal safe water access even as California has ramped up grants – over $830 million awarded to disadvantaged communities since 2019 (10). To deal with the need for additional funds, some utilities raise rates or seek bonds; many projects remain unfunded. Affordability is also a challenge: small systems often charge higher rates (on average $32 more per month than large systems), and still, 3% of communities face high affordability burdens. Given the significant investment backlog and limited funding mechanisms, the present financial capacity of California's drinking water sector is well below what is needed for long-term sustainability.

Larger California water systems serve most of the State's population and are generally better at securing funding, increasing revenue, and maintaining affordable water rates. In contrast, smaller systems generally struggle with funding and charge higher rates. Around 13% of community water systems face medium to high affordability burdens. Although these smaller systems serve a smaller portion of the population, state funding efforts focus on addressing their deficiencies and improving their financial stability.
Sources of Funding for Drinking Water Systems: California's drinking water systems are funded through local, State, and federal sources. California water systems spend approximately $37 billion annually, 84% derived from local water bills and taxes, while state and federal contributions account for 13% and 3%, respectively.

Local Funding: The primary funding source for drinking water systems is direct fees, including water bills and taxes. State laws such as Propositions 218 and Proposition 26 govern public water system rates and impose restrictions on rate-setting. Investor-owned utilities, serving 16% of Californians, have rates approved by the California Public Utilities Commission. Political considerations often discourage local elected officials from raising rates, contributing to funding shortfalls. With the constant increase in costs, the primary funding sources are insufficient to meet the drinking water funding needs. Ongoing funding deficiencies and concerns for financially burdensome water rates remain as key concerns for California's ability to ensure long-term sustainability in drinking water infrastructure.

- State Funding Programs: California operates several state programs to support public drinking water systems including:
- Drinking Water State Revolving Fund (DWSRF): Provides financial assistance to address public health risks and compliance with the Safe Drinking Water Act. While this program is administered by the State, a significant portion of the DWSRF monies come

from the federal government.

- Small Community Drinking Water Funding Program (SCDW): Offers low-interest loans and grants for infrastructure projects in small, at-risk systems.
- Safe and Affordable Funding for Equity and Resilience (SAFER): Allocates $130 million annually to ensure safe drinking water for disadvantaged communities.
- Bond Financing: Voter-approved bonds, such as Propositions 50, 84, and 4, have historically funded water projects. The State repays nearly $1 billion annually for past bonds.

Federal Funding and Challenges: Federal funding provides about 3% of the State's water system budget. The 2021 Infrastructure Investment and Jobs Act has contributed over $1.6 billion to California's water infrastructure. However, significant funding gaps remain. California faces a $5.5 billion shortfall in grant funding for disadvantaged communities alone, with rising water costs increasing affordability concerns. Sustained investments are necessary to ensure safe, reliable, and affordable drinking water.
Affordability: California faces significant water affordability challenges, particularly in disadvantaged communities. Approximately 40% of the population served by the Los Angeles County Sanitation Districts is considered disadvantaged, highlighting the need for affordable water services.

FUTURE NEED

California's future water security faces mounting challenges due to climate impacts and growing demand, requiring proactive strategies focused on conservation, infrastructure upgrades, and alternative water sources. The state must prepare for intensified droughts, snowpack loss, and extreme weather events by diversifying water supplies and strengthening infrastructure. Legacy data systems and outdated reservoir operations hinder effective water management, underscoring the need for real-time data and improved forecasting tools. The Sacramento–San Joaquin Delta, critical to water distribution, faces rising sea levels, seismic risks, and ecological threats, jeopardizing supply for 27 million residents. To supplement traditional sources, California is advancing recycled water use—including direct potable reuse—stormwater capture, and desalination, though the latter presents environmental and cost concerns. Continuing to make progress in water conservation and minimizing losses from aging systems remain essential.

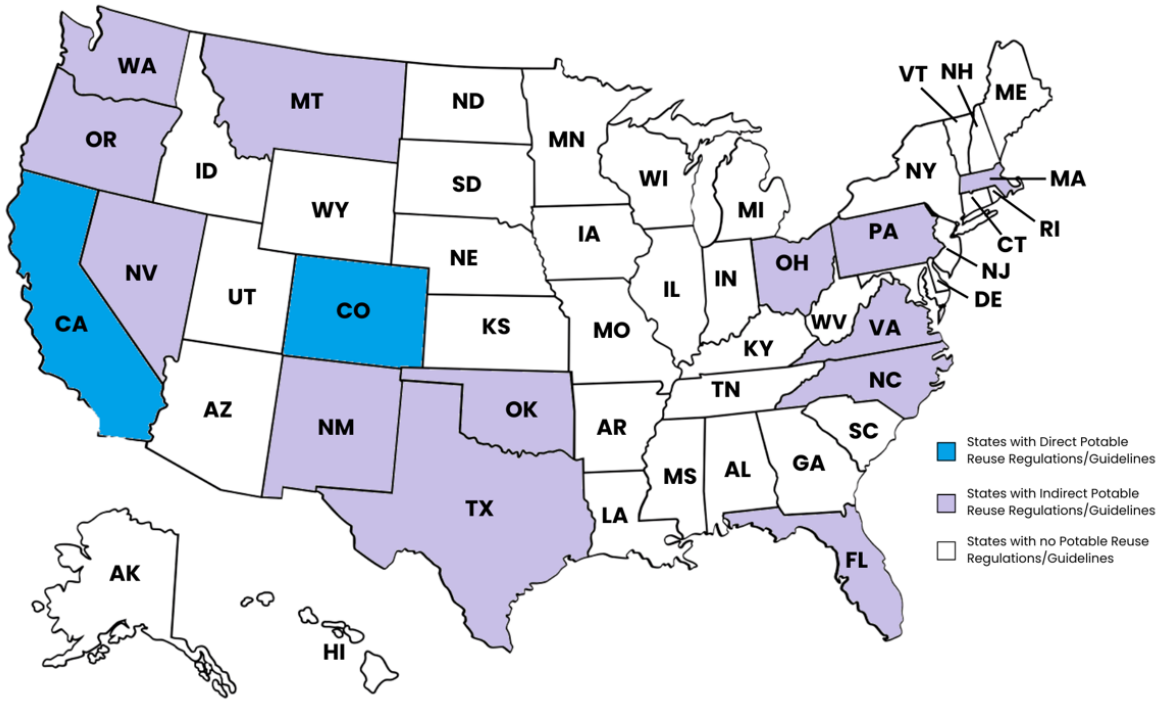
RESILIENCE

Despite recent investments, California still faces major challenges in building truly resilient drinking water systems. While programs like the State Water Board's SAFER initiative and major regional projects such as the expansion of Orange County's Groundwater Replenishment System, Valley Water's recycled water efforts, and the Metropolitan Water District's proposed Pure Water Southern California initiative demonstrate encouraging progress, these efforts only reach a portion of the state. Many small, rural, and disadvantaged communities continue to struggle with outdated infrastructure, limited local water sources, and a lack of financial and technical capacity to adapt to increasingly severe climate and seismic threats.

Statewide efforts, including the $10 billion Proposition 4 bond and over $8.6 billion committed through the California Water Supply Strategy, have laid important groundwork. However, much of the state's water infrastructure remains highly vulnerable to earthquakes, drought, wildfires, and extreme weather. As former USGS seismologist Lucy Jones warned, water systems are still "the single biggest vulnerability" in regions like Southern California.

In 2022, State Water Project deliveries were reduced to just 5% for the second consecutive year, significantly below worst-case projections. This marked a new level of uncertainty and strain on the State's water resources, with communities facing severe shortages. Historically dependent on fluctuating watersheds, the State's water system is further challenged by federally mandated pumping restrictions and changing precipitation patterns. To ensure future resilience, California must prioritize water storage solutions to safeguard supplies during dry years and protect against future droughts and seismic risks and continue investing in both recycled water and desalination. Despite ongoing efforts to bolster system resilience, the increasing frequency and intensity of natural disasters highlight the urgent need for accelerated and comprehensive upgrades to California's water infrastructure. While significant progress has been

Figure 6: States with Potable Water Reuse Regulations from EPA REUSExplorer



made in enhancing the resilience of the state's drinking water systems—particularly in improving seismic resilience, which has been a longstanding focus—recent events suggest that current measures may still be insufficient. Notably, some systems continue to face vulnerabilities, primarily due to persistent funding limitations that hinder necessary improvements. Addressing these challenges requires a concerted effort to modernize infrastructure and implement robust emergency response strategies to safeguard public health.

INNOVATION

California leads the nation in drinking water innovation by leveraging advanced technologies and forward-thinking policies to address challenges such as climate-driven water scarcity, water quality, and aging infrastructure.

In October 2024, regulations for Direct Potable Reuse (DPR) went into effect, allowing wastewater to be purified using advanced water treatment technology and added directly into drinking water systems. According to the EPA's REUSExplorer, only 15 states have potable water reuse regulations or guidelines. California became the second State after Colorado to adopt regulations for DPR, and the other 13 states only have regulations for Indirect Potable Reuse (IPR), which uses an environmental buffer between the treatment of wastewater and entering a drinking water system. With the new regulations into effect many drinking water providers are investigating the introduction of DPR water into their systems.

California is at the forefront of water-treatment innovation, leveraging cutting-edge technologies—from Orange County's expanded Groundwater Replenishment System that converts wastewater into drinking water via microfiltration, reverse osmosis and UV purification, now supplying nearly half of central Orange County's water, to new PFAS removal systems in Tustin and groundbreaking wave-powered desalination pilots and advanced brackish desalination projects—that together underscore the state's commitment to resilience and local supply diversification amid mounting climate and disaster pressures. However, progress in project implementation remains plagued by limited funding. To address aging infrastructure, utilities are implementing smart water systems that use real-time monitoring and predictive analytics to detect leaks and optimize distribution. According to a January 2025 ASCE Region 9 survey, over 85% of water agencies have partially implemented or are exploring these innovative solutions.

RECOMMENDATIONS TO RAISE THE GRADE

- Increase Funding for Drought-Resilient Water Infrastructure Projects:
  - Prioritize substantial investment in new infrastructure and the rehabilitation of existing systems to prepare for more frequent and severe water shortages.
  - Allocate funds for drought-resilient projects to ensure long-term water supply reliability.
  - Invest in new sources of sustainable water supply such as water recycling projects

- Modernize Aging Water Infrastructure:
  - Invest in updating and maintaining California's outdated water systems, including pipelines, wells, and distribution systems, to prevent inefficiencies, leaks, and contamination risks.
  - Invest in implementing Asset Management Programs that include the use of condition assessment tools to determines the state of water infrastructure assets and optimize renewal and replacement strategies.
  - Expand storage capacity to accommodate California's variable climate, ensuring enough water for all sectors during dry periods.

- Address Urban Water Infrastructure Challenges:
  - Repair and replace aging pipelines, especially those over a century old, to reduce frequent leaks and high repair costs.
  - Increase investments in water recycling, stormwater capture, and desalination projects to optimize existing water resources.

- Prepare for Climate Impacts:
  - Develop adaptive solutions like groundwater recharge programs, water storage expansion, and advanced conservation technologies to manage the effects of prolonged dry periods.
  - Develop water system resilience and emergency preparedness solutions for wildfires. Enhance system redundancy and infrastructure hardening to ensure water delivery during emergencies.
  - Enhance the State's capacity to address future droughts and fluctuating snowpack levels.

- Secure Long-Term Funding for Water Infrastructure Projects:
  - Ensure sustained financial support for water infrastructure projects, focusing on innovative strategies such as smart water monitoring systems and sustainable urban planning.
  - Emphasize the importance of proactive planning to avoid complacency after drought, ensuring the State remains resilient in future water crises.

DEFINITIONS

AF – Acre-Foot. A unit of volume commonly used in the U.S. to measure large-scale water resources. One acre-foot equals about 325,851 gallons and represents the volume of water needed to cover one acre of land to a depth of one foot.

Cr-6 – Hexavalent Chromium (Chromium-6). A toxic form of the element chromium that can contaminate drinking water and is regulated due to potential health risks, including cancer.

DPR – Direct Potable Reuse. The process of treating wastewater to a level safe for direct introduction into a drinking water supply system without an environmental buffer.

DWSRF – Drinking Water State Revolving Fund. A federal–state partnership that provides financial support to water systems and states to ensure safe drinking water. Managed in California by the State Water Resources Control Board.

EPA – Environmental Protection Agency. The U.S. federal agency responsible for protecting human health and the environment, including setting and enforcing national drinking water standards.

IPR – Indirect Potable Reuse. A water reuse method in which treated wastewater is discharged into a natural system (like groundwater or a reservoir) before being treated again for potable use.

MAF – Million Acre-Feet. A volume measure used in large-scale water planning. One MAF equals one million acre-feet of water.

MCL – Maximum Contaminant Level. The highest level of a contaminant that is legally allowed in drinking water, as set by regulatory agencies to protect human health.

O&M – Operation and Maintenance. The ongoing activities required to run a drinking water system safely and efficiently, including repair, replacement, and routine servicing.

POU/POE – Point-of-Use / Point-of-Entry. Water treatment devices installed at the tap (POU) or where water enters a building (POE) to remove contaminants for drinking water compliance.

Primary MCL – Primary Maximum Contaminant Level. Legally enforceable standards based on health risks associated with long-term exposure to specific contaminants in drinking water.

PWS – Public Water System. A system that provides water for human consumption to at least 15 service connections or serves an average of at least 25 people for at least 60 days a year.

REUSExplorer – Recycled Water Exploration Tool. An interactive online platform (developed by California agencies) used to explore and plan for recycled water and reuse projects in the state.

RTC – Response to Comments. A formal document issued by regulatory agencies responding to public or stakeholder input during rulemaking or permitting processes.

SAFER – Safe and Affordable Funding for Equity and Resilience. A California initiative designed to ensure safe, accessible, and affordable drinking water for all communities, especially disadvantaged ones.

SCDW – Small Community Drinking Water. Refers to drinking water systems that serve small or rural communities, often with limited resources and greater vulnerability to contamination and regulatory challenges.

Secondary MCL – Secondary Maximum Contaminant Level. Non-enforceable guidelines related to aesthetic qualities of drinking water such as taste, color, and odor.

TCP – 1,2,3-Trichloropropane. A man-made chemical used in industrial applications and pesticides, known to contaminate groundwater and considered a carcinogen; regulated in California.

TT – Treatment Technique. A required process intended to reduce the level of a contaminant in drinking water when an MCL is not feasible to determine.

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Energy
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ENERGY

EXECUTIVE SUMMARY

California's energy sector faces significant challenges in achieving its goal of 100% clean energy by 2045 while also ensuring reliability, affordability, and safety. The state must rapidly expand its renewable energy capacity and transmission infrastructure to meet increasing demand. The increased adoption of electric vehicles (EV), the associated charging infrastructure and the rapid growth of the data center industry is further compounding demand requirements. Aging infrastructure, wildfire risks, and outdated regulations further complicate this transition. High electricity costs and the need for substantial investment in grid modernization and transmission upgrades are creating financial pressures that cannot be managed by ratepayers alone. While advancements in battery storage, renewable energy technology, and fire mitigation efforts show promise, sustained funding and policy reforms will be essential to meeting California's future needs and goals.

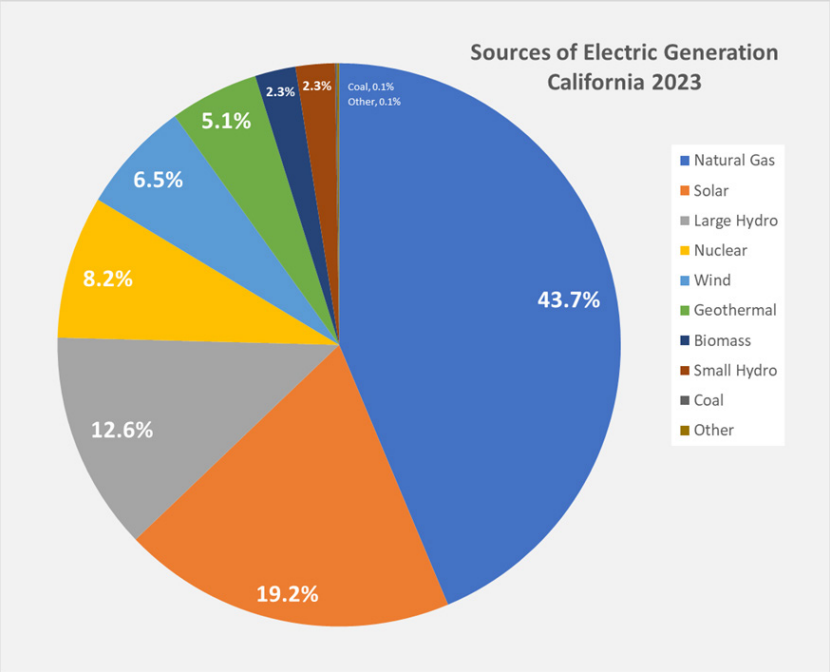
BACKGROUND

California's energy sector faces many challenges in accomplishing the State's goals. State law requires the grid to move to 100% clean energy by 2045, while supporting the rapid growth of electric vehicles and other energy needs such as data centers. Demand will continue to grow, but most sources of renewable and clean energy are intermittent in their availability. In addition, the energy sector must grapple with safety concerns, such as wildfires, the constant need for additional transmission and distribution lines, and a lack of resource adequacy. In 2023, California was the fourth-largest generator of electricity in the nation. It is also the nation's third-largest electricity consumer and imported more electricity than any other state. If generation cannot increase at the same rate, capacity needs will continue to grow, and California will need to increase reliance on out-of-state energy.

Progress has been made toward the goal of 100% clean energy. According to the California Energy Commission, from 2017 to 2023, in-state solar generation increased from 11.8% to 19.2% and in-state wind generation increased modestly from 6.2% to 6.5%. Overall, renewable energy increased from 29.6% in 2017 to 35.4% in 2023. Greenhouse gas emissions in California are down 20% since 2000. Though progress has been made, the goal of reaching 100% clean energy by 2045 is unlikely on the current growth trajectory.

This report will discuss challenges the California energy sector faces and make recommendations for how to address them in both the short and long term. The key will be to continue to move toward the State's goals, while taking a reasonable and attainable path to achieving them.

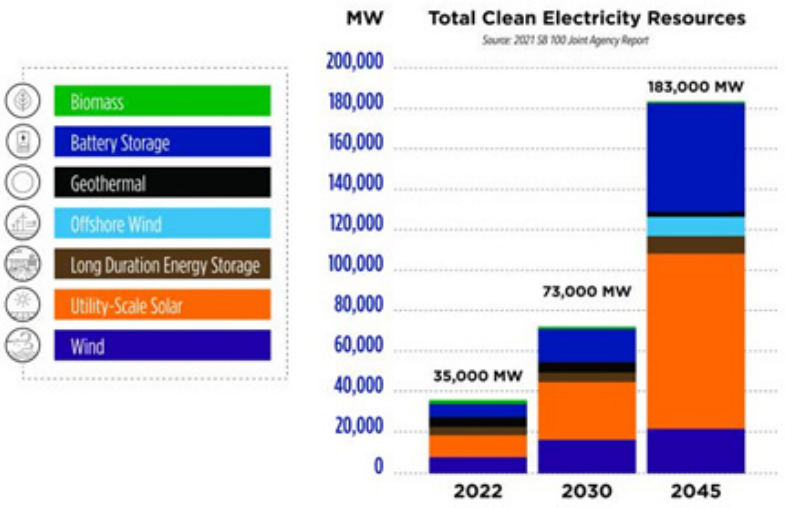
Figure 1. Sources of Electric Generation (California 2023)



CAPACITY

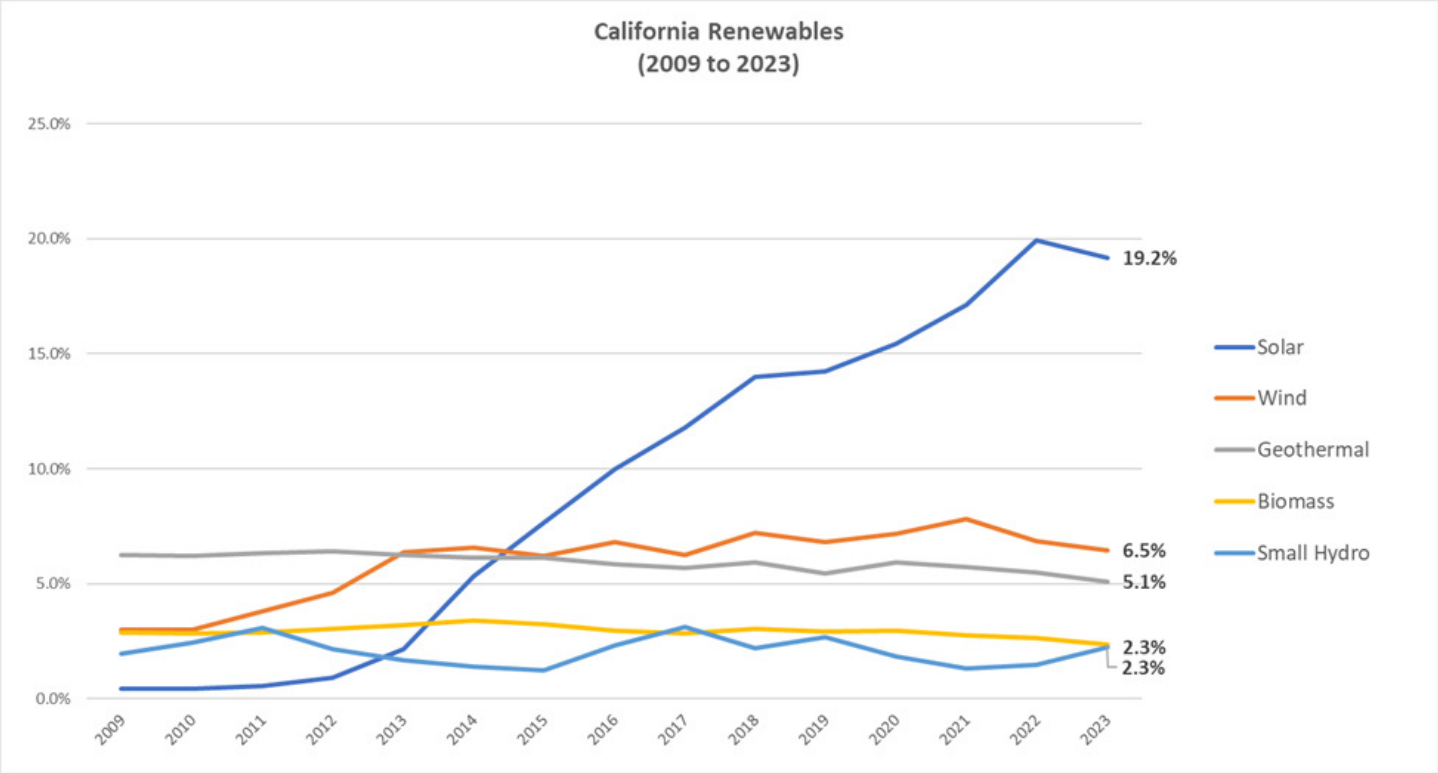
California must invest in expanding its power generation capacity to support rising electricity needs. Rapid electric vehicle adoption, expanding data centers, and critical infrastructure are some of the areas driving these needs. The growing energy demands of water purification and wastewater treatment facilities, which are under ever increasing regulations to treat emerging constituents of concern, are also impacting generation capacity. In the last 5 years, California has increased its energy capacity overall by adding 25,500 megawatts (MW) of in-state generation resources, averaging approximately 5,000 MW of additional capacity per year. In 2024 alone, California added approximately 7,000 MW of new clean energy. According to the CAISO 20-Year Transmission Outlook Update, 7,000 – 8,000 MW of new resources will be needed every year for the next 10 years. Additionally, with the passage of Senate Bill 100 (SB 100), some if not all of these resources must come from clean renewable energy as the State moves toward its goal of 100% clean energy in 2045. To reach this goal, the 2021 SB 100 Joint Agency Report estimates 183,000 MW will be needed by 2045. At the current average rate of growth (5,000 MW), by 2045 we will add 100,000 MW and may fall short of the anticipated need.

Figure 2. Total Clean Electricity Resources



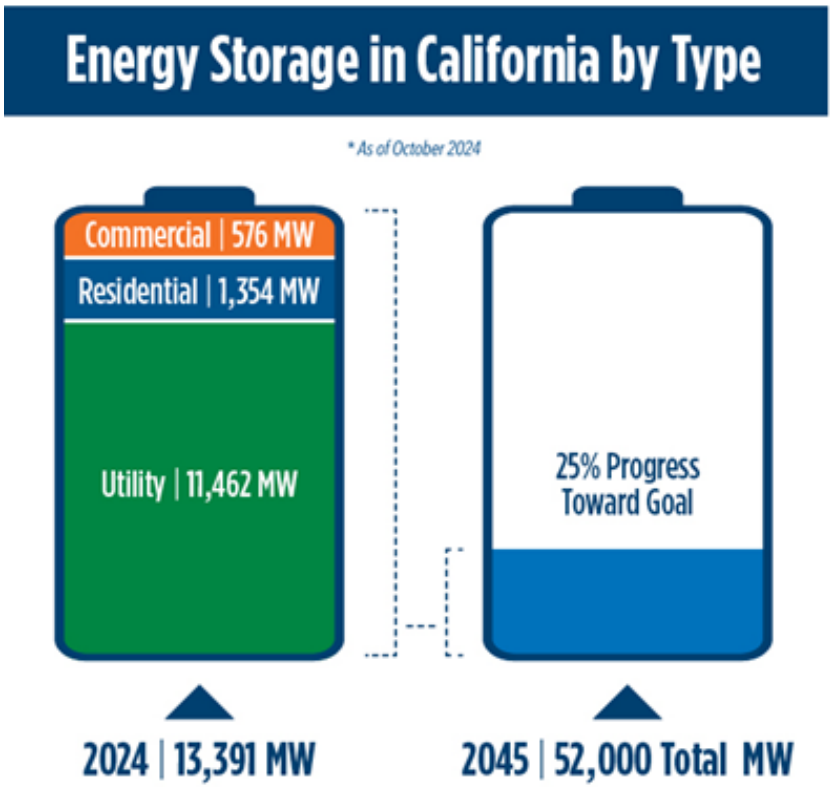
The majority of clean energy resources in California are Solar Photovoltaic (PV). Increased generation of renewable energies continues to have dramatic impacts on the overall capacity of the California electric transmission grid. Solar energy production peaks mid-day and dips as the sun goes down (sometimes referred to as a "duck curve"). Currently, if too much solar power is generated without demand, it is curtailed or transmitted elsewhere to avoid overloading and possibly damaging the power grid. While solar PV creates capacity challenges for the State, grid battery storage capacity is coming online faster than any other power source.

Figure 3. California Renewables



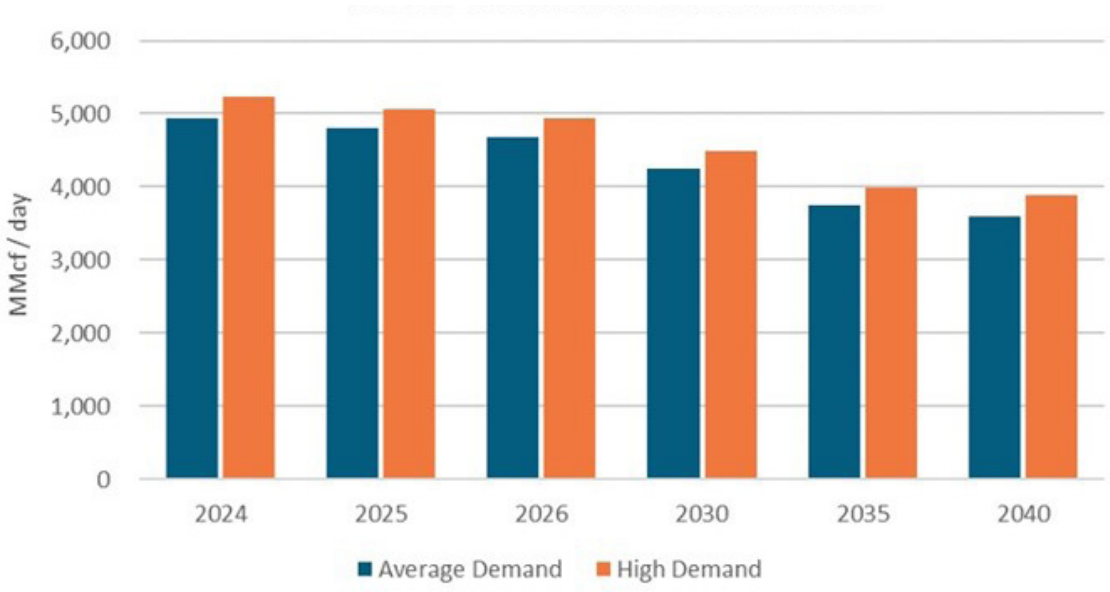
According to the California Energy Commission (CEC), From 2018 to 2024, battery storage capacity in California increased from 500 MW to more than 13,300 MW. In 2025, the total is now over 15,000 MW. The state projects 52,000 MW of battery storage will be needed by 2045. This important resource will store surplus solar power during the day and help provide the capacity the grid needs during those early evening hours when air-conditioning use is high and the solar production tails off.

Figure 4. Energy Storage in California



Natural gas continues to help meet peak electric and heating demands, as it has for decades. In 2023, California's natural gas-fired power plants provided 39% of the state's total net generation. However, California's demand for natural gas is forecasted to decline through 2040. The graph below summarizes statewide gas demand under the average demand case and the high demand case. Under the average demand case, gas demand for the entire state is projected to average 4,931 million cubic feet of gas per day (MMcf/d) in 2024, decreasing to 3,593 MMcf/d by 2040, a decline of 2.0% per year.

Figure 5. California Gas Demand Outlook from 2024 California Gas Report



California's policies to reduce greenhouse gases (GHGs) are expected to impact gas supply and assets. Natural Gas investor-owned utilities (IOUs) are responding to these policies and actively planning for and implementing programs to decarbonize existing gas throughput, supporting the emergence of renewable natural gas (RNG) and interconnecting biomethane into the existing gas system to facilitate the decarbonization of the gas grid.

The demand for EVs continues to increase in the state -- 1.5 million EVs were in the state in 2023 and 8 million are expected by 2030. This change represents another capacity challenge and the need to modernize the grid in California. The California Energy Commission (CEC) states that California will need to build 1.3 million public and shared private chargers (including 39,000 direct-current fast chargers) to support its passenger light-duty, medium-duty and heavy-duty plug-in EVs by 2030. Though the State continues to incentivize investments in EV charging infrastructure, the additional utility equipment needed to support this, including transformers, electrical equipment and substations, are not included and will need to be added to increase the capacity from the increased electrification of the transportation sector.

CONDITION

California utilities typically do not share the age or condition of their electric infrastructure. However, the utilities are modernizing their grids to accommodate the changing energy market. For example, on December 17, 2024, Pacific Gas & Electric (PG&E) announced it had secured a conditional commitment from the U.S. Department of Energy for a loan guarantee of up to $15 billion. The proposed financing would fund planned projects aimed at enhancing California's energy infrastructure, bolstering system reliability, and supporting distributed energy resources, such as battery storage and EVs.

From 2019 to 2023, the System Average Interruption Frequency Index (SAIFI) data indicated a decline in electrical outages across all California utilities. However, the state continues to exhibit volatility above the national average, reflecting the condition of the state's electrical infrastructure. Notably, SAIFI metrics account for weather-related events, underscoring the importance of developing new strategies to enhance system resilience against increasingly severe weather conditions.

California stands alone as the only state that opts out of the advanced national standards for overhead electric line design. While the other 49 states, the District of Columbia, and all U.S. territories adhere to the National Electrical Safety Code (NESC)—which mandates compliance with various ASCE Standards and Manuals of Practices—California relies on its own General Order 95 (GO 95). However, GO 95 is outdated and in urgent need of modernization. As a result, California's minimum design weather loadings for overhead electric lines are lower and minimum structural requirements are weaker than the rest of the U.S.

Much of California's energy infrastructure has exceeded its design life, with "run to fail" occurring in certain areas. Significant infrastructure investments will be required to both maintain and upgrade infrastructure to handle increased loads. Per the 2024 CAISO 20-year Transmission Outlook report, transmission projects have a typical lead time of eight to ten years. Proactive planning should have started years ago—and must continue today—to meet future needs.

FUNDING AND FUTURE NEED

According to the May 2024 Utility Compliance Filings (R.18-07-005), nearly one in five current IOU customers are behind on their

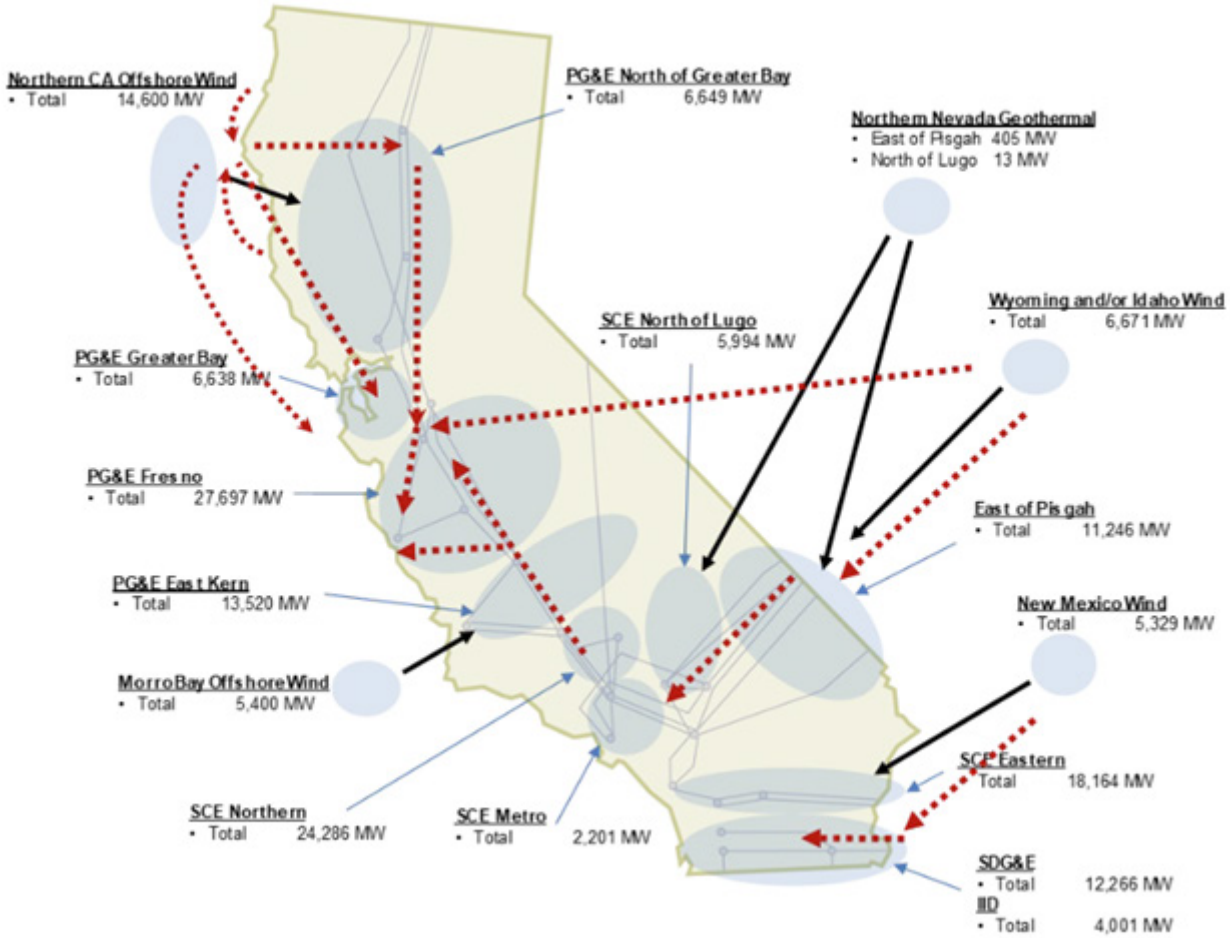
bills. California has the second highest average retail price per kWh in the nation, second only to Hawaii. Per the 2022 affordability index, customers needed to work up to 12 hours per week at minimum wage just to pay their electric bills. Affordability for customers is a major issue in California, and yet the need for funding continues to grow due to public safety concerns, additional capacity needs, and renewable energy requirements.

California's energy infrastructure is primarily funded by its ratepayers, who contribute an estimated 60–70% of total costs through utility bills that cover grid upgrades, wildfire mitigation, and system reliability improvements. The federal government provides approximately 20–30% of funding, largely through grants, tax incentives, and loan guarantees under programs like the Bipartisan Infrastructure Law and Inflation Reduction Act. The State of California contributes a smaller share—roughly 5–10%—focused mainly on grants, pilot projects, and clean energy initiatives administered by agencies like the California Energy Commission and Public Utilities Commission. This funding structure places a significant financial burden on customers, while federal and state resources supplement long-term modernization and resilience efforts.

The CAISO 2024 20-Year Transmission Outlook estimates that $45.8-$63.2 billion worth of new transmission lines will be needed in the next two decades not only within California but across the broader western regional grid serving the CAISO balancing authority area.

Figure 6 shows a high-level summary of the additional transmission development required.

Figure 6 – Additional Transmission Development Requirements



PG&E estimates that it will invest $62 billion from 2024-2028 in infrastructure. Southern California Edison (SCE) also expects heavy capital investments from 2024-2028 totaling $37.5 billion.

Utilities must continue to fund existing infrastructure maintenance, while upgrading to meet future demands, and dealing with wildfire mitigation. The need for significant expansion of infrastructure and conversion to renewable energy adds to this financial burden. Additional state and federal grant funding will be required to meet these needs. The State's Cap and Trade Program and the EPA's Greenhouse Gas Reduction Fund both provide funding for renewable and clean energy expansion. This includes $250 million for the State of California "Solar-For-All" program which provides access to solar initiatives for low-income households and disadvantaged communities.

Beginning in 2025 and in subsequent years, California is slated to receive an estimated $62 billion in federal funding from the Infrastructure Investment and Jobs Act (IIJA) and Bipartisan Infrastructure Law (BIL), including approximately $2.16 billion targeted for energy infrastructure, grid resilience, and clean energy programs. While key allocations—such as grid hardening grants and EV infrastructure funding—have been defined, much of this funding remains unobligated and dependent on state applications, federal approvals, and administrative processing. As a result, under the current federal administration, there is growing risk that portions of this funding could be delayed, paused, or rescinded, potentially impacting project timelines across California. This funding must stay in place to help push us toward our goals, but it simply isn't enough, additional federal and state funding will be required.

Meeting significant transmission and capacity needs if grant funding is not available and ratepayers are overburdened may require greater private industry involvement. Private industry has a vested interest in expanding electrical infrastructure. Data centers alone have such a significant need for power that partnering with utilities will make sense for them, as demonstrated on data center projects in other states such as Pennsylvania and Texas. Utilities could find incentives to attract private investors or to partner with private companies in building new infrastructure more quickly.

Regardless of the route taken, funding will be one of the most important issues the energy sector faces as we attempt to tackle climate impacts, expand our capacity, and maintain our existing infrastructure.

OPERATION AND MAINTENANCE

The evaluation of California's publicly available energy reports highlights the increasing challenges in the operation and maintenance of the state's electricity grid. The grid must undergo significant modernization and resilience measures to meet growing electricity demands and reliability expectations even with intensifying extreme conditions caused by wildfires and heatwaves. The main operation and maintenance challenges include:

The aging infrastructure including transmission and distribution lines, substations, and gas pipelines, face increasing stress, requiring continuous upgrades and proactive maintenance. Despite this, when all utilities are considered, System Average Interruption Duration Index (SAIDI) outages have remained consistent from 2019 to 2023 and continue to stay below the national average. Furthermore, when focusing on IOUs and the Los Angeles Department of Water and Power (LADWP), which serve the majority of customers, outages have decreased from 2019 to 2023 and have stayed below the national average since 2012.

The impacts of wildfire and extreme weather, along with poor right-of-way vegetation management and infrastructure failure, have contributed to some of the deadliest wildfires in recent years.

Renewable energy integration will be challenging as California attempts to transition to 100% clean energy by 2045. The existing grid infrastructure must be upgraded to accommodate fluctuating renewable energy sources like solar, wind, and offshore energy.

The state requires major investments in transmission upgrades to support renewable generation and long-duration energy storage

(LDES) to balance supply and demand. As mentioned previously, CAISO estimates those investments could reach $63.2 billion for transmission alone over the next 20 years.

Emergency response and grid resilience are improving, but further investment is needed in automated grid control systems and backup generation.

To maintain reliability in the future, improvements are needed to enhance preventive maintenance programs, strengthen wildfire mitigation measures, accelerate grid modernization, increase energy storage, improve demand responsiveness, and enhance emergency preparedness and response.

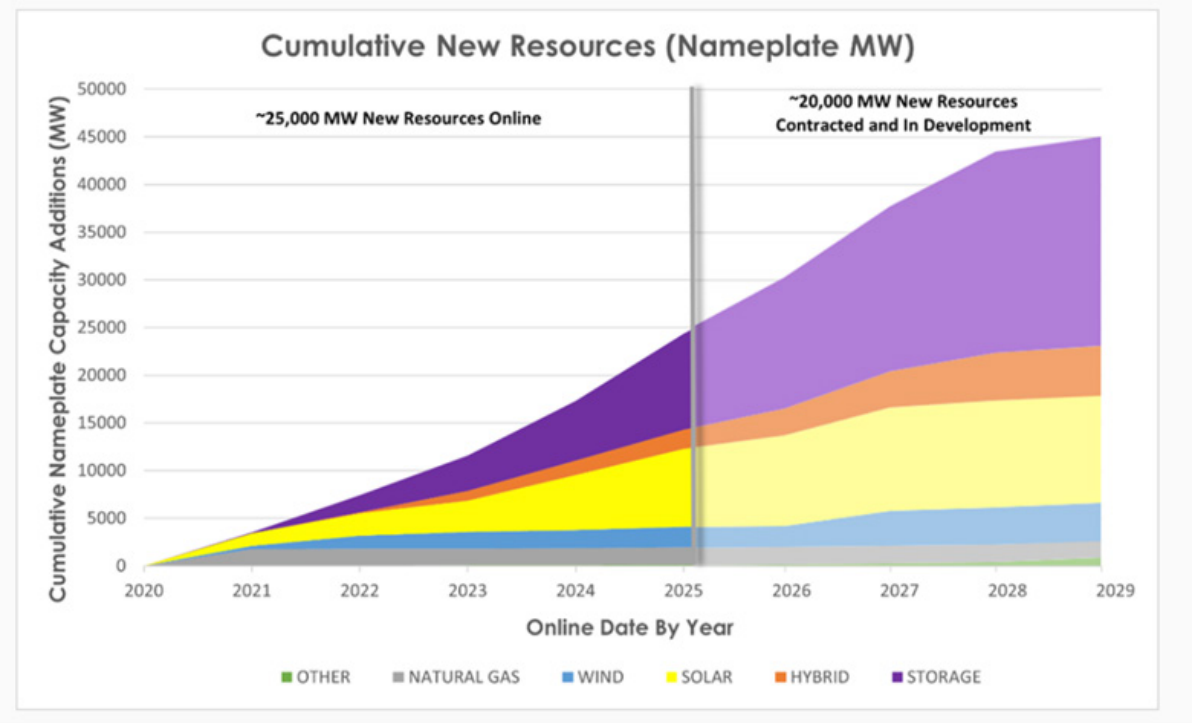
PUBLIC SAFETY AND RESILIENCE

Public safety continues to be a high priority and the emphasis has increased due to devastating wildfire activity. Public utilities in California have implemented and improved the Public Safety Power Shutoff (PSPS) program while advancing fire-hardening efforts to reduce wildfire risks. These efforts include replacement of more wood structures with steel, installation of more covered conductors, undergrounding of overhead power lines, vegetation management, and regular inspections of infrastructure to enhance system resilience. Despite these proactive measures, IOUs are still being held liable for wildfire incidents and continue to face fines.

Power safety shut off protocols during wind events are effective but create other challenges for customers. IOUs are investing in innovations such as microgrids, battery storage and other distributed energy resources to lessen potential PSPS events.

Though wildfires are the focus, we must not forget that California is known for its seismic activity. Little is known about how existing transmission line infrastructure would handle a major seismic event; however, California utilities are leading the U.S. in developing and implementing new technologies for substation equipment to resist damaging earthquakes.

Figure 7: Expected Clean Energy Capacity in California through 2029



Existing IOU efforts only mitigate the current risk and do not address the additional cost of managing the risk for increasing capacity. Between 2025 and 2040, California's electricity demand is projected to grow rapidly due to transportation electrification, data center expansion, and building decarbonization. More than 75,000 MW of new clean energy capacity is expected to come online by 2040 with approximately 20,000 MW of clean energy projects are already under contract and in development to serve California customers by 2030.

As the state prepares for an influx of new infrastructure, strengthening grid resilience will require major investments to both prevent igniting wildfires and ensure the grid can recover quickly from weather- , earthquake, or fire-related disruptions. In addition to the IOUs' current investments discussed above, fire-resistant equipment should be deployed and system automation should be enhanced to detect and isolate faults in real time. Additionally, California should transition from General Order 95 (GO 95) to the National Electrical Safety Code (NESC) to align with national safety standards and improve infrastructure reliability.

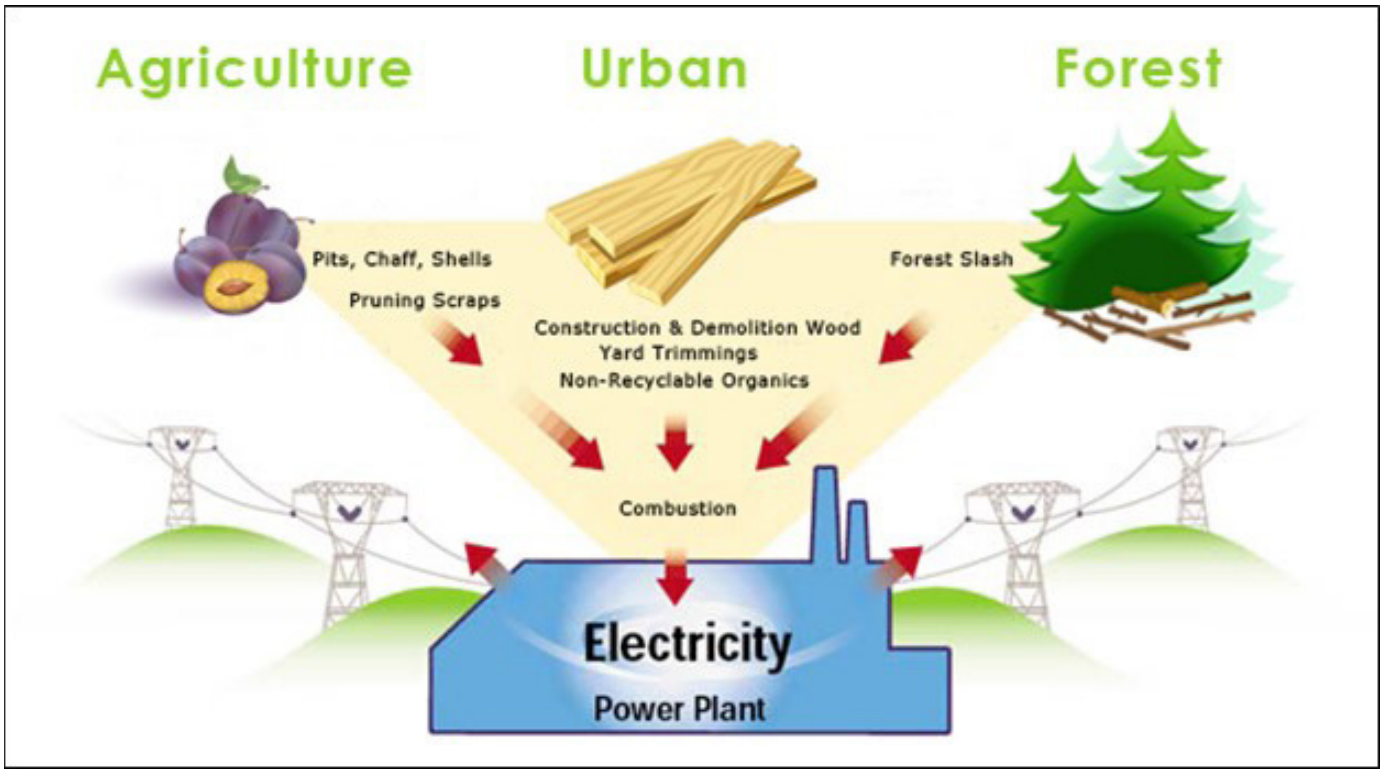
The state is facing a $12 billion funding shortfall in grid reliability and resilience programs, including proposed $423 million in cuts to emergency generation and load reduction initiatives, as outlined in the Governor's 2025–2026 budget. Funding public safety and other infrastructure improvements is a challenge that California must face while still promoting affordability for ratepayers.

INNOVATION

Continuous development in the solar photovoltaic (PV) technology field has led to great strides in recent years. According to the U.S. Energy Information Administration (EIA), the efficiency of commercially available solar PV panels has increased from approximately 15% in 2015 to 25% in 2023. Newer experimental PV modules have been able to capture nearly 50% efficiency.

More research is needed to improve the process of recycling solar photovoltaic panels. The current process is difficult and expensive

Figure 8: Biomass Energy Sources



and has not been implemented on a large scale in the U.S. Many panels end up in landfills rather than being recycled. The U.S. Environmental Protection Agency (EPA) reports that according to the International Renewable Energy Agency, by 2030, the cumulative value of recoverable raw materials from End-Of-Life (EOL) panels globally will be approximately $450 million, which could be enough to produce 60 million new panels.

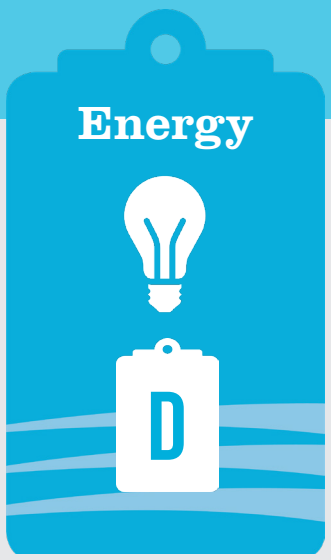
While focusing primarily on solar makes sense for California, diversification is critical. Wind, geothermal, and hydro are restricted to areas where the required resources are abundant. Biomass energy generation can come from various sources such as methane gas produced from large landfills, food waste, fermented crops, algae, wood, and crop residue and could be a significant source of energy.

The implementation of AI-driven energy management systems on microgrids in California has led to improved forecasts of solar and wind outputs with sub-hour precision. Real-time optimization by AI balances distributed energy resources (DERs), batteries, and critical loads which can cut operational costs by up to 15%. CAISO has also begun piloting OATI's Genie AI platform to automate outage planning and detection. Genie AI is able to parse outage reports, compare them to past events, and detect anomalies to help avert unplanned transmission or generator outages before they cascade.

In the 2025 Joint IOU Grid Hardening Working Group Report, PG&E reported that they are applying new technologies such as fluid-free boring technologies to reduce the production of mud related to undergrounding, and spider plows to install multiple conduits without the need for excavation. San Diego Gas & Electric (SDG&E) is exploring the use of ground-level distribution systems (GLDS), or the installation of distribution conductors in above-ground trays encased in epoxy resin concrete.

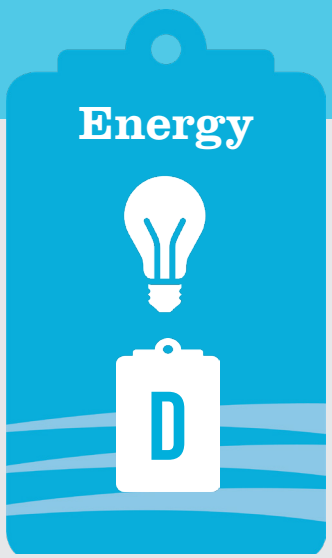
In 2024, several utilities began piloting Eaton's HiZ Protect solution, a collaboration among Eaton, the US Army Engineer Research and Development Center (ERDC), National Renewable Energy Laboratory (NREL), and multiple IOUs. This edge-based system blends integrated line sensors with machine learning models to detect elusive high-impedance faults (HiZ) caused by downed tree limbs or damaged insulators. Lab and field tests have demonstrated over 90% accuracy in isolating these low-current faults, dramatically cutting wildfire risk compared to traditional protection schemes.

As California strives to provide clean and reliable sources of energy to our state, we must innovate to enhance safety, expand energy diversity, and manage the byproducts of energy sources.



RECOMMENDATIONS TO RAISE THE GRADE

- The State should consider revising clean energy goals to be more realistic considering resources and growth projections.
- Continue to increase capacity of bulk energy storage infrastructure throughout the state.
- Update California compliance standards to the National Electric Safety Code.
- Maintain existing and pursue additional federal and state funding for new energy generation and transmission infrastructure.
- Partner with the private industry to fund new infrastructure and facilitate energy infrastructure growth more rapidly.
- Enhance preventive maintenance programs statewide and modernize the grid.
- Strengthen wildfire mitigation measures and enhance emergency preparedness.
- Local government agency and joint powers authority should lead partnerships between utilities, tech firms, and universities to apply for grants.
- Diversify our supply of renewable energy to promote reliability and innovation.
- Accelerate transmission upgrades to ensure the grid can handle increased renewable energy capacity.
- Develop clear regulatory guidelines that can adapt to evolving technologies.
- Explore cost-effective solutions and innovative financing mechanisms, like green bonds, to incentivize investment in renewable energy.
- Engage communities to create local support through stakeholder involvement and community benefits programs that focus on job creation and environmental improvements.



DEFINITIONS

BIOMASS – Plant materials and animal waste used as a source of fuel.

COVERED CONDUCTOR LINES – Overhead electric conductor lines covered with insulating materials to provide incidental contact protection. Often used to prevent wildfires.

CURTAILMENT - The deliberate reduction in generation output below what could have been produced in order to balance energy supply and demand or due to transmission constraints.

INVESTOR-OWNED UTILITIES (IOU) - A utility company that is owned by investors with the objective of providing energy to the public while making a profit for their shareholders. Major California IOUs are SCE, PG&E and SDG&E.

MICROGRIDS – A local electrical grid with defined electrical boundaries that can operate in grid-connected and in island mode. It is a small-scale, low-voltage power system with distributed energy sources, storage devices and controllable loads.

PUBLIC SAFETY POWER SHUTOFFS (PSPS) - s a planned power outage used to protect public safety and prevent major wildfires during severe weather conditions. It is implemented by turning off power to specific areas where wildfire risk is high due to extreme weather conditions, such as low humidity levels, high winds, and dry vegetation.

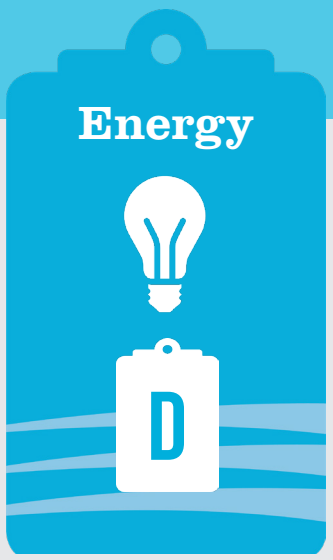
RENEWABLE NATURAL GAS - Renewable natural gas (RNG) is a biogas that has been upgraded to a quality similar to fossil natural gas and has a methane concentration of 90% or greater. It is produced from multiple sources, including livestock waste, landfills, wastewater sludge, food waste and other organic waste operations. RNG is a 100% renewable product that can be used to power homes, businesses and even vehicles.

RESOURCE ADEQUACY - The ability of the electric grid to satisfy the end-user power demand at any time.

SYSTEM AVERAGE INTERRUPTION FREQUENCY INDEX (SAIFI) - The number of times an average customer was without power in a year due to service interruptions lasting more than 5 minutes (measured in interruptions per customer).

SYSTEM AVERAGE INTERRUPTION DURATION INDEX (SAIDI) - The amount of time on average a customer was without power in a year due to sustained interruptions (measured in minutes per customer).

UNDERGROUNDING – The replacement of overhead power cables with underground cables. Often used to prevent wildfires.



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Hazardous
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HAZARDOUS WASTE

EXECUTIVE SUMMARY

California's hazardous waste infrastructure principally consists of the management of generated hazardous waste and the cleanup of contaminated sites. In 2023, California entities generated 1.6 million tons of hazardous waste and cleaned up 700 contaminated sites. It is estimated that 90,000 properties in California are contaminated with some level of toxic substances. The cost of operating California's existing hazardous waste infrastructure is around $4 billion per year, with most of this funding coming from the private sector. The results of this spending are improved human health and a cleaner environment. Economic benefits result from reduced health-care costs for exposure-related illness and increased land values. The infrastructure is challenged by the fluctuating funding levels, new contaminants and new knowledge of health effects, uncertain and uneven regulatory oversight, a vast increase in use of consumer electronics, and rising compliance costs for private businesses and public entities. California does not meet its own hazardous waste disposal needs. Nearly half of all hazardous waste generated is exported to surrounding states for landfill disposal.

CAPACITY AND CONDITION

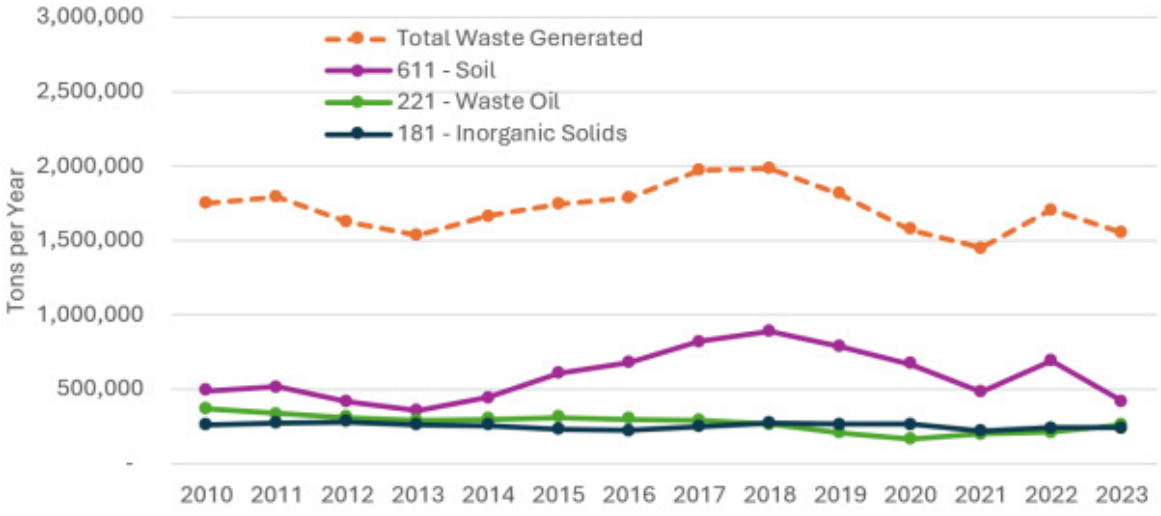
California hazardous waste infrastructure principally consists of onsite management by hazardous waste generators or offsite management at treatment, storage and disposal facilities (TSDFs). The number of permitted TSDFs in California decreased from over 400 in 1983 to only 74 in 2021. Of the remaining TSDFs, 47 had a federal-equivalent permit, 24 had a California standardized permit, and three facilities had a state-only permit. Although the decline in permitted TSDFs may be due to a decline in hazardous waste generation since at least 2000 and increased onsite treatment or recycling by hazardous waste generators, the association is unclear as a result of data gaps. In general, California's hazardous waste management program is more stringent and broader in scope than the federal program.

The California Department of Toxic Substances Control (DTSC) is the primary state agency that regulates hazardous waste and its cleanup in California. The California State Water Resources Control Board (SWRCB) also regulates cleanup of contaminated sites when the quality of groundwater or surface waters of the state is threatened. These state agencies are assisted on the local level by the Certified Unified Program Agencies who provide county- and city-level oversight for hazardous waste generators.

Hazardous Waste Generation

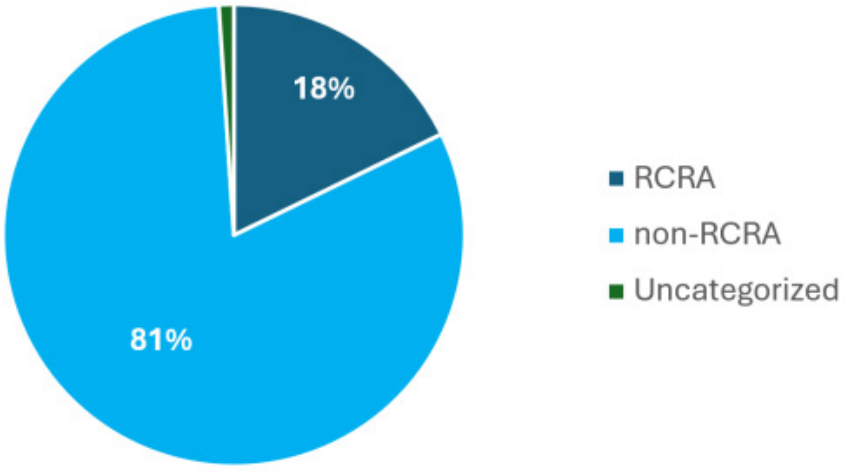
California's diverse economy produces a variety of hazardous waste each year. From 2010 through 2023, between 1.5 and 2.0 million tons of manifested hazardous waste were generated each year. The number of generators in California increased between 2010 to 2021 from about 55,000 to 94,500. In 2023, approximately 1.6 million tons were generated, and the top three waste streams included contaminated soils (~27%), used oil and mixed oil (~17%), and inorganic solid waste (~16%) (Figure 1).

Figure 1. Yearly Hazardous Waste Tonnage



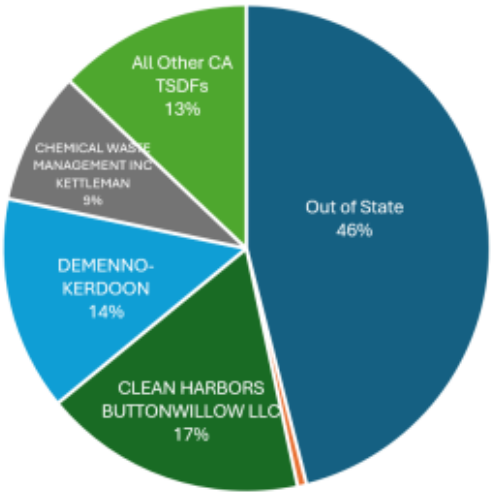
California's hazardous waste criteria are more stringent and broader in scope than the federal criteria outlined in regulations associated with Resources Conservation and Recovery Act (RCRA), which results in more waste being identified as hazardous in California than the federal program. As such, California's manifested hazardous waste can be organized into two categories: "RCRA hazardous waste" exceeding federal criteria and "non-RCRA hazardous waste" exceeding California criteria. From 2010 through 2023, almost 24 million tons of hazardous waste was generated and managed offsite; 81% was non-RCRA manifested hazardous waste and 18% was RCRA manifested hazardous waste (Figure 2).

Figure 2. Amount of RCRA and Non-RCRA Manifested Hazardous Waste



Of the 1.6 million tons of hazardous waste generated in 2023, 63% was disposed of in a landfill, 31% was recycled or recovered offsite, 4% was managed offsite for treatment (e.g. incineration, evaporation, neutralization, etc.), and 1% was handled in some other way. California's two permitted hazardous waste landfills, Chemical Waste Management Kettleman City and Clean Harbors Buttonwillow, together manage about 25% of the waste generated in California. About half of the hazardous waste generated has been shipped to neighboring states like Utah, Arizona, or Nevada from 2010 through 2023 (Figure 3).

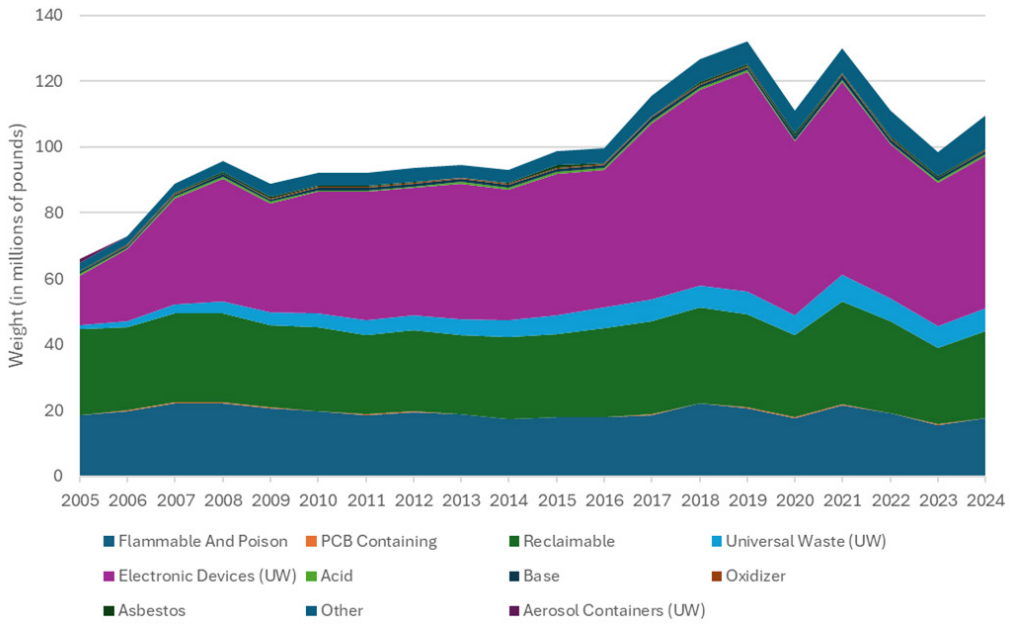
Figure 3. Management Facilities that Received Hazardous Waste Generated in California, 2010-2023



Household Hazardous Waste

In addition to hazardous waste generated and disposed under manifest, household hazardous waste (HHW) is generated by residents through typical household activities. California managed around 55,000 tons of HHW in 2024, distributed across various categories including flammable and poison materials, reclaimable waste (motor oil, paint), universal waste, and electronic waste (e.g., TVs, computer monitors, cell phones). Electronic devices are by far the largest single waste stream (Figure 4). HHW collection is conducted through community-based efforts and programs typically managed at the city and county level.

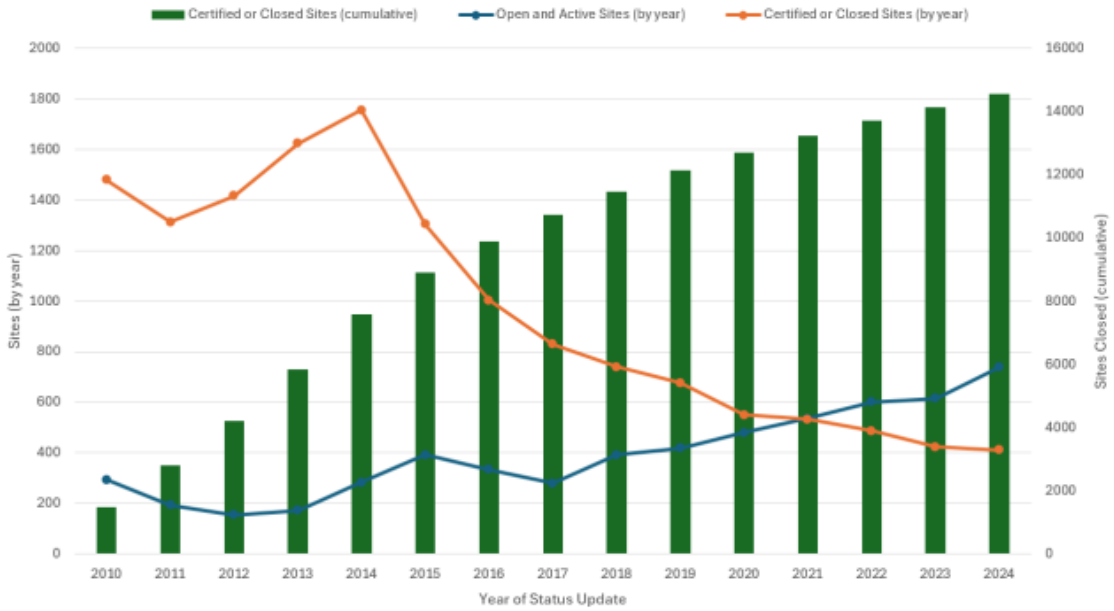
Figure 4. California HHW Collection by Material Categories (2005 to 2024)



Contaminated Site Cleanup

DTSC estimates that 90,000 sites in California are contaminated with some level of toxic substances. DTSC and SWRCB together manage over 60,000 cleanup sites, with their progress and documents continually updated on DTSC's Envirostor and SWRCB's Geotracker websites. Recent data (Figure 5) show that 14,000 of these sites have been remediated to agency satisfaction between 2010 and 2024, and that in 2024, 400 sites were closed, and 700 sites were undergoing active remediation.

Figure 5. Summary of DTSC and SWRCB Cleanup Sites (2010-2024)



OPERATION AND MAINTENANCE

Both the government and private sector share responsibility for operating and maintaining hazardous waste infrastructure. The two hazardous waste landfills in California are privately owned and maintained. Operations and maintenance (O&M) for TSDFs includes ensuring site integrity to prevent releases and encourage safe handling and environmental monitoring to detect releases. Operators of active TSDFs conduct and report O&M under DTSC's regulatory oversight, with DTSC issuing permits, performing inspections, enforcing compliance, and requiring financial assurance for operation and closure.

HHW collection in California continues to face persistent and complex challenges. Participation remains low with fewer than half of households engaging in HHW programs, largely due to limited public awareness, confusion about qualifying materials, and underfunded outreach efforts that fail to build lasting habits. Access to collection services is uneven; many rural or under-resourced areas lack permanent facilities and rely on infrequent mobile collection events. Urban curbside pickup programs, while helpful, are costly, exclude many hazardous items, and require users to safely manage materials prior to collection. Infrastructure shortfalls are compounded by the aging and shrinking number of permitted hazardous waste facilities. These gaps disproportionately affect low-income communities which are more likely to lack access to drop-off sites and education, increasing the risk of illegal dumping or unsafe disposal. Finally, the lack of stable, long-term funding—most programs rely on limited municipal fees and temporary state grants—constrains the ability to expand services, modernize infrastructure, and improve HHW tracking and safety.

Site cleanup, which is considered O&M for contaminated land, is driven by regulatory directive due to illegal discharge or unacceptable risk, or more commonly, undertaken voluntarily to improve land for development or continued safe use. In both cases, regulatory oversight is exerted by SWRCB's regional boards or DTSC and often additionally by the United States Environmental Protection Agency (EPA) and local health departments. Laws defining the cleanup process and contaminant screening levels (de facto cleanup goals) are unique to each agency. Due to the inherent complexities of site cleanup, individual staff and agencies are granted wide latitude in overseeing remediation plans. This uncertain and uneven regulatory oversight often discourages or delays site cleanups.

FUNDING AND FUTURE NEED

The 2024 combined hazardous waste and site cleanup costs in the United States are estimated at approximately $47 billion, of which

approximately $4 billion is attributed to California. Most hazardous waste and site cleanup spending is undertaken by waste generators and responsible cleanup parties. The 2024/2025 DTSC budget only included $11 million for response actions at sites where responsible parties cannot be found or don't provide timely cleanup.
Government funding via grants directs some resources to encourage outcomes in the state that might not otherwise occur using private funding sources.

Launched in 2022 and administered by DTSC, the Cleanup in Vulnerable Communities Initiative (CVCI), encompassing the Equitable Community Revitalization Grant (ECRG) program, has awarded over $250 million to cities, nonprofits, and tribal entities for environmental assessments and cleanups, particularly in disadvantaged communities.
The Underground Storage Tank Cleanup Fund (USTCF), managed by the SWRCB, supports cleanup operations and regulatory oversight costs associated with petroleum storage tank leaks. Funded by a $0.02 per gallon storage fee on petroleum, the USTCF has historically generated approximately $300 million annually. In the 2023–24 fiscal year, USTCF expenditures were $594 million. In 2023, the USTCF program was extended ten years and will now be sunset in 2036.

The Orphan Site Cleanup Fund (OSCF), managed by the SWRCB, provides grants for cleaning up sites contaminated by leaking petroleum underground storage tanks when no responsible party is identified. As of early 2025, the OSCF has received significant funding boosts, including a $15 million transfer from the UST Cleanup Fund in the 2024–25 fiscal year above the approximately $30 million annual budget.

The Site Cleanup Subaccount Program (SCAP), managed by the SWRCB, receives an annual appropriation of $34 million to fund the investigation and remediation of contaminated sites. SCAP funding is highly competitive. Recent reports indicate that fewer than 4% of applications were funded in 2025.

HHW programs remain chronically underfunded. Some jurisdictions fund HHW collection programs through property tax levies or general funds. CalRecycle's HHW Grant Program provides a paltry $1.5 million in grant funding statewide per year for public education, source reduction, reuse, recycling initiatives, and the construction, expansion, or upgrade of permanent HHW collection facilities.

While the hazardous waste and site cleanup industries are overall driven by government mandates and a need to protect the public, government funding is insignificant compared to the overall operating cost of this infrastructure.

PUBLIC SAFETY

The California Office of Environmental Health Hazard Assessment operates the CalEnviroScreen website, a mapping tool that ranks environmental impacts to public safety by census tract using a pollution burden score derived from the presence of hazardous waste facilities, population health metrics, and other indicators. CalEnviroScreen directly influences funding from a variety of public and private sources and is reported to have directed an estimated $12.7 billion in funding. While the program is lauded as an innovative environmental justice tool, recent concern has been raised about opaque methodology and proprietary data that limit its effectiveness.

Attention has recently focused on Per- and polyfluoroalkyl substances (PFAS), a highly recalcitrant and ubiquitous class of chemicals that show potential to accumulate in living organisms and have growing links to health effects. PFAS chemicals are widely used for their water-, grease-, and stain-resistant properties in products like nonstick cookware, firefighting foams, food packaging, and textiles. Their widespread presence combined with limited existing treatment and disposal options makes PFAS one of the most pressing environmental health challenges today. In 2024, two common PFAS chemicals were officially designated as hazardous substances under the Comprehensive Environmental Response, Compensation, and Liability Act, giving EPA and states the authority to order cleanups, recover cleanup costs, and hold polluters financially liable.

The explosion in production of electric vehicles (EVs), personal electronics, and solar storage, and micromobility (e-scooters, bikes)

has led to safety risks from disposal of lithium ion (Li-ion) batteries. The U.S. Li-ion battery market is valued around $30 billion and is expected to continue to grow at very high rate. The state classifies spent Li-ion batteries as hazardous waste, prohibiting their disposal in regular trash and mandating proper recycling. According to CalRecycle, approximately 7,294 tons of batteries are improperly disposed of in California landfills each year, posing fire hazards and environmental risks. An EPA report found 64 waste facilities that experienced 245 fires between 2013 and 2020 across 28 states that were caused by Li-ion batteries. The U.S. is facing a significant bottleneck in recycling capacity for lithium-ion batteries. While demand for battery-powered devices and EVs continues to surge, the infrastructure to process end-of-life batteries has not kept pace. As of 2024, there are fewer than 10 large-scale Li-ion battery recycling facilities operating in the U.S. and many of these are still in ramp-up or pilot phases.

Figure 6. Photo of the Aftermath of a Li-ion Battery Fire

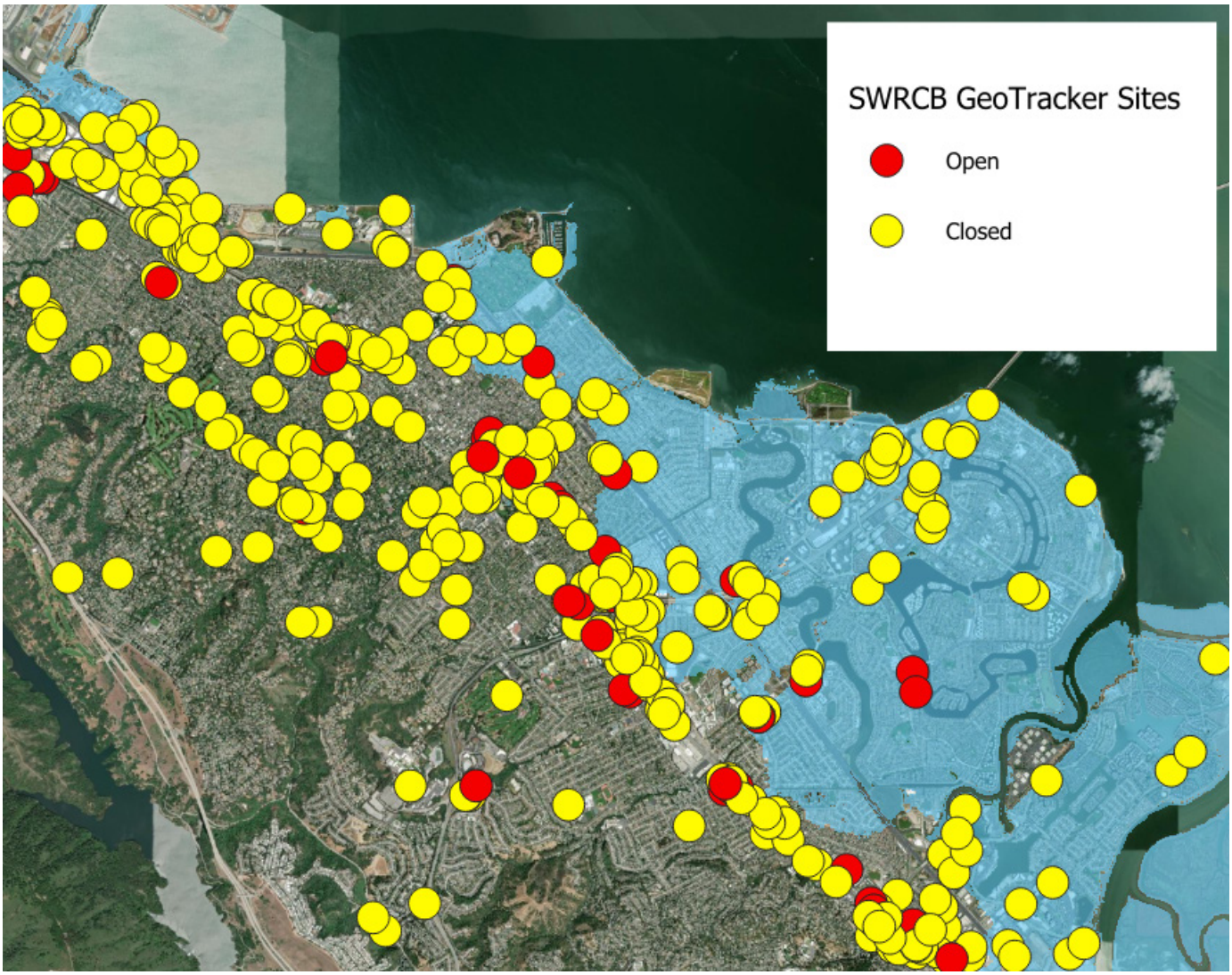
RESILIENCE

Interactions between climate and hazardous waste sites will pose various risks to public health in California. For example, sea level rise and coastal erosion may lead to flooding of hazardous waste sites that were previously considered outside the floodplain, rising groundwater levels could mobilize subsurface contaminants that are currently above the groundwater table, and more frequent wildfires may contribute to increased airborne pollutant dispersal.

In the 2024 California Ocean Protection Council publication titled “State of California Sea Level Rise Guidance”, the sea level rise projections for year 2050 ranges between 0.2 foot (low scenario) and 1.2 feet (high scenario), with an intermediate scenario of 0.8 foot. The projections for year 2100 ranges between 1.0 foot (low scenario) and 6.6 feet (high scenario), with an intermediate scenario of 3.1 feet.

Hundreds of hazardous waste sites throughout California are in coastal areas that will be impacted by this level of sea level rise. Many hazardous waste sites are at risk of being submerged during an intermediate scenario by year 2100 (Figure 7). In addition, sites that are not submerged by sea level rise may experience periodic flooding, potentially leading to migration of contaminated soil.

Figure 7. Contaminated Sites Submerged in 3-Feet Sea Level Rise Scenario (San Francisco Bay, California)



As sea level rises, saline groundwater is pushed landward and raises the groundwater table. When this occurs, contaminants currently isolated to soil above the groundwater table may enter the saturated zone. Highly soluble contaminants pose an elevated risk, as they readily dissolve in groundwater and could migrate to new locations and/or contaminate drinking water supply. In some areas, emergent groundwater (i.e., the groundwater table rises above ground surface) is expected. Direct contact with contaminated emergent groundwater is an exposure pathway that may not have been considered at the time hazardous waste sites were granted closure.

Additionally, wildfire intensity and frequency are expected to increase. When manmade structures burn, the combustion of construction materials, household items, and appliances and other electronic devices produces toxic ash and particulate that can disperse into nearby soil or become airborne. Rubble generated from structure fires also requires hazardous waste profiling and removal.

In response, DTSC issued guidance for ensuring remedies at contaminated sites will function as intended despite future sea level rise. To date, the State Water Resources Control Board has not issued similar guidance for sites overseen by regional boards.

INNOVATION

California continues to expand digital tools that enable faster, more transparent hazardous waste oversight. DTSC's Hazardous Waste Tracking System Envirostor and SWRCB's upgraded Geotracker web-accessible databases offer near real-time visualization of waste flows, site status, and compliance data. Integration with CalEnviroScreen 4.0 enables layering of demographic and pollution burden data, helping state agencies prioritize site cleanups. These platforms increasingly support mobile access and community-facing dashboards, and it is expected in the very near term that they will serve as a platform for artificial intelligence (AI)-assisted risk flagging.

For manifested solid hazardous waste, DTSC is innovating by reevaluating the operation of its hazardous waste program to drive forward modern hazardous waste management practices such as supporting the circular economy by investing in source reduction, reuse, and recycling. DTSC is also revisiting characteristic water standards to integrate modern toxicology and advances in landfill technology to secure soluble inorganic compounds.

For e-waste and battery waste, U.S. firms are scaling up hydrometallurgical and direct recycling processes to recover lithium, cobalt, and rare earth elements. California is working to advance extended producer responsibility (EPR) programs through new legislation. For industrial-scale power storage batteries, California has adopted new standards for battery-safe storage containers and fire-resistant transport packaging.

For household hazardous waste, California jurisdictions are investing in decentralized collection infrastructure, including community-based pickup events integrated with digital scheduling platforms. Public outreach is increasingly supported by app-based platforms that guide residents through safe disposal options. At material recovery facilities, innovations in waste sorting—using optical sensors and AI-based categorization—are improving efficiency and safety.

Remediation technologies continue to advance. Effectiveness of in-situ chemical oxidation, bioremediation, and thermal desorption continue to advance at groundwater remediation sites. To address PFAS contamination, water agencies and industry are piloting and implementing novel adsorbents like ion exchange resins and engineered biochars, along with advanced oxidation and plasma-based destruction technologies that minimize secondary waste. In parallel, AI-driven modeling is being used to predict PFAS migration in groundwater and to prioritize sites based on exposure risk.

RECOMMENDATIONS TO RAISE THE GRADE

- Support DTSC in securing the necessary resources and partnerships to advance efforts outlined in DTSC's DRAFT 2025 Hazardous Waste Management Plan with the goal of enabling California to meet its own hazardous waste management needs while protecting its citizens.
- Expand funding and eligibility requirements for Equitable Community Revitalization Grants (ECRGs) within the Cleanup in Vulnerable Communities Initiative (CVCI) to increase efficient utilization of Round 2 funds by lowering the CalEnviroScreen Score to 50 which would expand eligible areas and authorize use of ECRG funds for hazardous building materials (e.g., asbestos and lead paint).
- Build on efforts from CVCI related to discovery and cleanup of dry-cleaning facilities by establishing a dedicated fund akin to the Underground Storage Tank Cleanup Fund for remediation of abandoned or high-risk cleaners.
- Establish a statewide system to assess cost and outcomes for common cleanup conditions (e.g., non-RCRA lead in soil, chlorinated solvents in groundwater where drinking water is not impacted, residual petroleum hydrocarbons from fueling) with the goal of streamlining and standardizing processes related to agency notification and cleanup.
- Continue to implement and expand extended producer responsibility (EPR) programs that result in efficient capture of hazardous constituents in consumer materials with optimum economic cost to consumers and producers.
- Support CalRecycle in securing the necessary resources and partnerships to establish consistent funding mechanisms across the state to increase awareness, deployment, and efficient operations of HHW collection facilities.

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Inland Waterways

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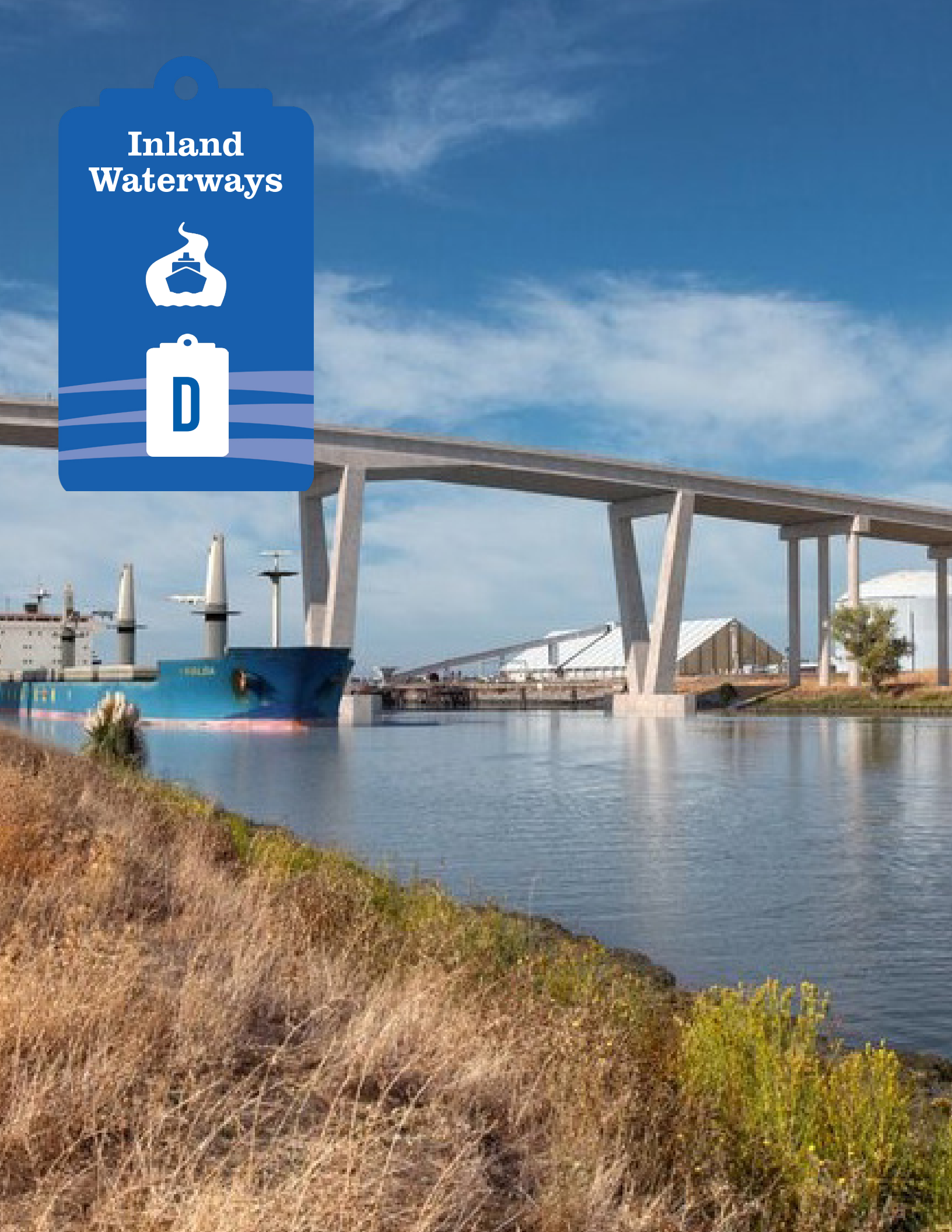


INLAND WATERWAYS

EXECUTIVE SUMMARY

A system of inland waterways connect California's greater San Francisco Bay Delta Region (the Delta) to the Pacific Ocean enabling ocean going vessels to access the inland Ports of Stockton and West Sacramento which annually support over $90 million in foreign trade. Dramatically increased shoaling due to extreme weather events as well as the seismic and vessel strike vulnerability of six vitally important overcrossing bridges have increased the need for maintenance dredging and infrastructure upgrades/repairs. With ongoing annual dredging barely maintaining the navigability of the Stockton and Sacramento Deep Water Shipping Channels (DWSC), no substantive upgrades have been authorized in decades. As such, California's inland waterways continue to merit their 2019 D grade and will remain so until adequate maintenance and deepening funding is made available.

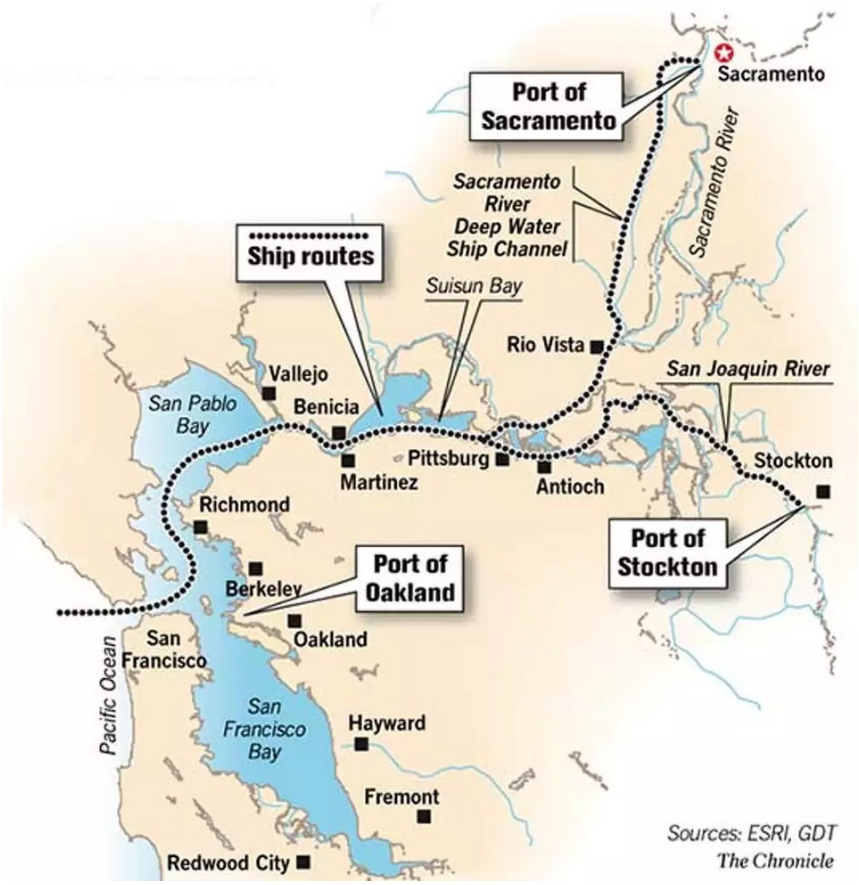
BACKGROUND

Providing deep-drafting vessel access to the inland Ports of West Sacramento and Stockton, California's inland waterway system consists of a series interrelated navigable channels as shown in Figure 1. Commencing in the San Francisco Bay, vessels travel northward through the Pinole Shoals Channel near Richmond into the San Pablo Bay, then continue through the Suisun Bay Channel, where they either veer northward into the Sacramento River DWSC or eastward into the Stockton DWSC (San Joaquin River). This inland waterways system and ports support California's Central Valley agricultural industry, handling 90% of regional fertilizer imports and the bulk of the Valley's agricultural exports, generating 5.8 million tons of cargo or $90 million in annual revenue. There are no locks or dams along these waterways.

CAPACITY AND CONDITION

As noted, California's inland waterways consist of the Pinole Shoals Channel, the Suisun Bay Channel, the Sacramento DWSC and the Stockton DWSC. The Pinole Shoals Channel is 11-miles long and optimally maintained at 35-feet deep and 600 feet wide. The Suisun Bay Channel is 17-miles long and optimally maintained at 35-feet deep while varying from 300 to 400-feet wide. The Sacramento DWSC is a relatively low-use 80-mile-long passage and optimally maintained at 30-feet deep and 200-feet wide. Constructed in

Figure 1. Northern California's Sacramento-San Joaquin River Delta.



the 1960s, the Sacramento DWSC includes 33-miles of dual-purpose navigation and flood protection levees. The Stockton DWSC has a length of 41-miles, a depth of 35-feet, and with no width restriction allows the passage of Panamax size vessels. Environmental studies for deepening the Stockton DWSC to 40-feet are underway. The Port of Stockton's plans for expansion will also require the deepening of the Pinole Shoals and the Suisun Bay Channels to 40-feet, i.e., an additional 5-feet beyond their currently authorized depth of 35-feet.

The condition of California's inland waterways varies year-to-year but overall, is deteriorating. Mariners are forced to "play" the tides and/or light load their vessels due to draft restrictions. Extreme weather, including atmospheric rivers and heavy rainfall, has led to increased deposits of sediment, erosion, and shoaling in the Suisun Bay and Pinole Shoal Channels as well as in the Stockton and Sacramento DWSCs. These events are causing significant erosion and damage to channel banks, requiring more frequent debris removal, erosion protection, and levee repairs and has resulted in localized diminished capacity.

FUNDING AND FUTURE NEED

Funding for the construction and maintenance of federal inland waterways comes from three sources: the Harbor Maintenance Trust Fund (HMTF), the USACE federal budget, and the Inland Waterways Trust Fund (IWTF). These programs play a critical role in the U.S. maritime economy through support of commerce, the supply chain, and military readiness.

The HMTF, funded by a 0.125% tax on commercial cargo, supports harbor and channel operations and maintenance. Despite a surplus of over $5 billion, only half of the obligated funds are appropriated for maintenance resulting in the above-described sediment build-up and reduced channel depths. Additionally, the IWTF is funded by a tax on commercial barge fuel, but the Stockton and Sacramento DWSCs are not eligible for this funding because they are not fuel-taxed waterways.

The USACE budget is authorized through the Water Resources Development Act (WRDA), passed every two years since 2014. WRDA allows USACE to address local needs but does not include direct funding. Projects are funded through the annual Energy and Water Development appropriations. Section 203 of WRDA also enables collaboration with Indian tribes on water resource projects. The current administration in Washington DC is proposing cuts to the FY2025 USACE budget that would potentially affect California construction projects aimed at improving levees and reducing flooding risks along the Sacramento DWSC and the Stockton DWSC. There are no cuts proposed to the operation and maintenance budgets, which include annual dredging, so the status quo is secure.

While the HMTF and the IWTF sources of revenue are not currently targeted for cuts, additional financial resources are needed if the USACE is to address the above-described growing maintenance demands and desired expansion plans.

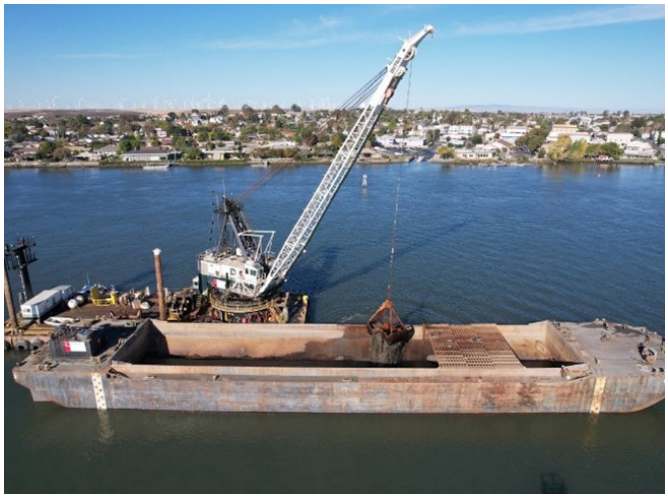
The Port of Stockton is studying the feasibility of deepening the Stockton DWSC to support its Denmar Natural Soda Ash Export Terminal Project which would boost their export to between 10 and 12-million metric tons (up from the current range of 3.5 to 5 million metric tons). This project would place the Port in the top 50 US Ports grouping (i.e., into the high use category). This status change could help secure federal funding for maintenance dredging and deepening to 40-feet, the depth desired for the soda-ash terminal to be internationally competitive. (Note: The Port of Stockton is applying for a Section 203 study to deepen the Stockton DWSC to 40-feet.) About 30% of U.S. commercial vessel calls at the ports of Sacramento and Stockton are constrained due to inadequate channel depths. A potential solution is for Congress to align the tax obligation with annual appropriations, as is done with other similar trust funds.

OPERATION AND MAINTENANCE

The Marine Exchange of the San Francisco Bay Region is a nonprofit organization that provides shipping information, including vessel tracking, forecasting, and port logistics support. It partners with the U.S. Coast Guard, California Fish & Wildlife, NOAA, and Maritime Information Services of North America to track real-time ship positions using AIS transponders. The Bay-Delta Office (BDO) of the California Department of Water Resources manages water supply and environmental needs in the Sacramento-San Joaquin Delta, using advanced computer models to monitor water flow, quality, and sea water intrusion.

The inland waterways system from San Francisco Bay through the Delta to the Ports of West Sacramento and Stockton is maintained by the San Francisco District of the USACE. Pinole Shoals Channel is dredged biannually, and Suisun Bay Channel is dredged annually to allow safe passage of vessels. Approximately 120,000 cubic yards are dredged from Suisun Bay Channel every year. The Suisun Bay Channel is dredged by clamshell dredging due to the presence of the endangered Delta Smelt. In 2023, $729,550 was allocated for Pinole Shoals Channel, and $6.2 million for Suisun Bay Channel maintenance dredging.

Figure 2. Annual dredging of the Sacramento River DWSC to -30-ft (MLLW).



Source: Dredgingtoday.com, Nov. 4, 2022

The upper 43-miles of the 80-mile-long Sacramento DWSC is authorized for annual maintenance dredging to a depth of 30-feet. The Stockton DWSC is authorized for annual maintenance dredging to a depth of 35-feet. Historically, dredging of both channels was contracted together, causing delays and under-dredging in Stockton. To address this, USACE plans to now dredge the channels separately, with options for more efficient mechanical dredging. Dredging is performed in compliance with mandated water quality certification and continued updating of programmatic agreements for the Endangered Species Act. In 2024, $10.9 million was allocated for Stockton DWSC and

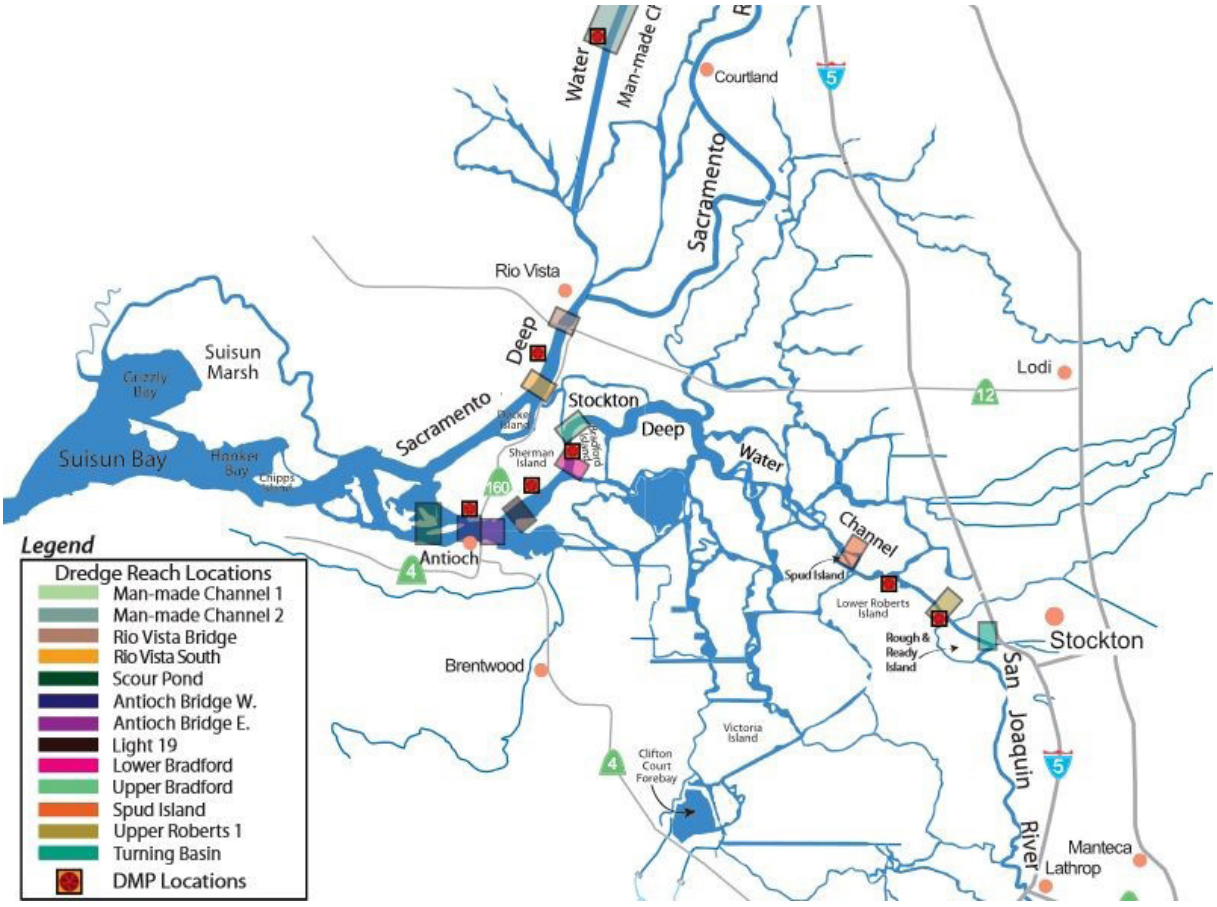
$6.7 million for Sacramento DWSC dredging.

PUBLIC SAFETY

Vessel strikes on bridges are a major safety concern, brought to the forefront by the March 26, 2024, collision of the containership Dali with the Francis Scott Key Bridge in Baltimore, MD. The resulting bridge collapse and six deaths caused a significant disruption to vessel and vehicular traffic. Subsequently, the National Transportation Safety Board (NTSB) identified 68 bridges at risk of similar strikes, with six of them located within the California Delta inland waterway. This includes the Antioch Bridge (State Route 160), a major route for traffic between the Bay Area and the Central Valley crossing directly over the Stockton DWSC. These bridges need to be assessed for the risk of collapse from vessel collisions based on standards from the American Association of State Highway and Transportation Officials (AASHTO).

Additionally, the Union Pacific (UP) Railroad Benicia-Martinez drawbridge built in 1930 is of concern due to its age and potential seismic vulnerability. The bridge carries both passenger and freight trains - including hazardous materials across Carquinez Strait - and its collapse would disrupt shipping through both the Stockton and Sacramento DWSCs. While railroad bridges are not regulated under AASHTO requirements, assessment of the UP bridge for collapse risk from vessel strikes is recommended.

Figure 3. Stockton and Sacramento Deep Water Shipping Channels.



Source: "San Joaquin River", Wikipedia.org

RESILIENCE AND INNOVATION

As noted, the California Inland Waterway system is increasingly vulnerable to extreme weather, which is escalating erosion, sedimentation, and channel damage. Efforts to fortify channel slopes and implement rock protections are critical. Additionally, the Sacramento and Stockton DWSCs' proximity to the San Andreas Fault heightens the risk of earthquake-induced damage, underscoring the need for seismic stability measures.

Marine Exchange of the San Francisco Bay Region plays a vital role in managing Delta vessel traffic through forecasting, tracking, and operational support. Advancements in AIS transponders, artificial intelligence, and other technologies will be crucial as vessel traffic grows.

NOAA has made significant strides in storm forecasting with improved models and computational power, leading to more accurate, timely warnings. New models can integrate ocean and atmospheric data to predict storm tracks and intensity, while the upgraded P-Surge model enhances storm surge forecasting. NOAA's improved weather and climate supercomputing system allows for higher-resolution weather forecasts, including individual thunderstorms. (Cuts to the NOAA budget may have adverse effects on this program.)

The 2015 Uniform California Earthquake Rupture Forecast (UCERF3) provides estimates of earthquake rupture likelihood and severity, aiding engineering designs, building codes, and disaster planning. The Bay-Delta Office of the California Department of Water Resources uses advanced computer models to monitor water flow, quality, and seawater intrusion, ensuring the reliability of water supply and environmental health in the Delta.

Figure 4. Proposed West Sacramento north-south bridge on Enterprise across Deep Water Ship Channel.

Source: Sacramento Business Journal, March 21, 2024

RECOMMENDATIONS TO RAISE THE GRADE

- Congress should align the Harbor Maintenance Trust Fund tax obligation with projected appropriations, similar to the Highway Trust Fund.
- Environmental studies for deepening of the Stockton DWSC and passageways to 40 feet should be authorized in WRDA, with funding approved through the Energy and Water Development appropriations process to boost foreign trade and the local economy.
- Funding should be allocated for vulnerability assessments of the six bridges on the NTSB list and the railroad bridge, calculating the risk of vessel collision and potential collapse based on AASHTO thresholds.
- Environmental studies for reinforced channel side slopes to withstand extreme weather should be authorized in WRDA, with funding through the Energy and Water Development appropriations process.

DEFINITIONS

DELTA:	Accumulation of sediments borne by the river to form a landmass
DWSC:	Deep Water Ship Canal
INLAND WATERWAY:	Viable alternatives or additions to road and rail transportation.
IWTF:	Inland Waterway Trust Fund
USACE:	United States Army Corps of Engineers
WRRDA:	Water Resources Reform & Development Act

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Levees

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LEVEES

EXECUTIVE SUMMARY

More than seven million Californians—about one in five residents—live in areas at risk of flooding. These regions also contain structures worth $920 billion, including agricultural land valued at approximately $12 billion. All 58 counties of the State comprising these areas have a history of severe flood damage, making flood risk the most widespread natural hazard Statewide, more pervasive than earthquakes or wildfires

Much work has been done since the last California Infrastructure Report Card in 2019, particularly on the Sacramento River flood control system. However, flood risk remains the most widespread natural hazard in California. Local agencies bear the majority of the financial burden to manage flooding, and it is estimated that approximately $59 billion in capital investment is needed to address flood management infrastructure, including levees. Recent and historic state bond funding to reduce this flood hazard has largely been exhausted, leaving California to rely on the federal process for improving, repairing, rehabilitating, and building levees.

CONDITION AND CAPACITY

More than seven million Californians—about one in five residents—live in areas at risk of flooding. These regions also contain structures worth $920 billion, including agricultural land valued at approximately $12 billion. These estimates are projected from the California Department of Water Resources 2013 “California’s Flood Future” report, which was the most recent quantitative assessment of potential flood damage throughout California. An update of this useful report has been indefinitely delayed by the California Department of Water Resources due to budget constraints.

All 58 counties of the State comprising these areas have a history of severe flood damage, making flood risk the most widespread natural hazard Statewide, more pervasive than earthquakes or wildfires according to the Public Policy Institute of California (2024). Many of those at risk of flooding are protected by more than 13,800 miles of levees which vary greatly in condition and capacity, depending on age, maintenance, region, local standards, hydrologic setting, funding and population density. Low-income communities throughout the State are disproportionately at risk. Many of the highest risk levees are located in the Central Valley. Climateimpacts are having a continuing

and increasing effect on the condition and capacity of levees. The whiplash weather effects of droughts followed by floods cause structural weakening of levees and remain a principal threat to areas protected by those levees. Recent research also discloses increased frequency of atmospheric rivers, which are narrow corridors of concentrated moisture flowing through the atmosphere. When atmospheric rivers move over land – especially when they rise up over mountains – the air condenses rapidly, releasing heavy precipitation. According to the UCLA Institute of Environment and Sustainability, projections indicate a 25-45% increase in hourly rainfall rates during peak events, and an average runoff increase of approximately 50% by 2070. This increase in precipitation now means a 100-year flood (one that would be expected to occur once every 100 years) is much larger than a 100-year flood when the levee was originally designed and constructed, rendering the levee undersized and outdated. In December 2022 and early 2023, a series of atmospheric rivers caused levee failures on the Pajaro and Cosumnes Rivers, resulting in federal and state emergencies in the Central Valley.

Major urban levee systems within the California Central Valley are held to the 200-year storm event level of protection required by California Senate Bill 5 (2007), while most other urban centers are held to the FEMA 100-year storm event standard. More highly populated areas within and outside the Central Valley have criteria for many levees that exceed the FEMA 100-year storm event standards, with some agencies targeting a 500-year storm event standard. Rural Flood Control Districts (Districts) are held to lesser standards, including Bulletin 192-82 (California Department of Water Resources [DWR]) and PL 84-99 (United States Army Corps of Engineers [USACE]).

Many construction projects have been completed to improve levee systems in urban areas since 2019, as shown in Table 1, including major projects protecting large population centers along the Sacramento River. Many of the levee systems in Southern California are just maintaining the existing capacity of their systems. On the San Joaquin River System, significant improvements have been or are being implemented on the federal Lower San Joaquin River Project. However, much of the San Joaquin River System still does not meet the 200-year storm event standard within many densely populated and economically disadvantaged areas, and improvement in those areas is slow. This region is also emblematic of the impacts of flooding that are disproportionately borne by lower income communities. Within the San Francisco Bay Area and the Central Coast, little has been done to increase the capacity or improve the condition of existing levee infrastructure, even in the face of climate impacts and associated sea level rise. Within the California Delta and the Tulare Basin, a majority of the largely rural regions do not meet minimum standards, either due to lack of funding or public interest. California Delta levees pose unique threats to the State. The State Water Project and Federal Central Valley Project, the largest water storage and delivery projects in

Table 1: Recently Completed Levee Construction Projects in California – M: Million

Levee Improvement Project Completed Since 2019	Estimated Cost
Folsom Dam Raise and Spillway Modifications	$185M
Sacramento River East Levees	$190M
Sacramento Weir Widening	$173M
Lower Elkhorn Setback Levees	$132M
Natomas Levees	$303M
Smith Gate Canal	$100M
West Sacramento Levee Improvement Project	$100M
East Garden Grove-Wintersburg Channel Improvements	$90M
RD17 Levee Seepage Repair Project	$88M
Lower American River Levees	$81M
Huntington Beach and Talbert Channels Improvements	$70M
Lower Santa Ana River Reach 9 Phases 4, 5A, 5B	$60.5M

Levee Improvement Project Completed Since 2019	Estimated Cost
Feather River West Levee—Sutter Basin	$60M
Lower San Joaquin River TS30L	$18M

the State, both pump water out of the south Delta. A levee breach could result in increased saltwater intrusion into the Delta, disrupting deliveries of drinking water to 25 million people and fresh irrigation water for 3 million acres of farmland.

Wildfires are also having an impact on levees and flood protection infrastructure. In the last decade, California has experienced 9 of the top 10 largest wildfires in the state's history. The impacts from secondary disasters following wildfires, including flood, erosion, debris flows and landslides, create additional harm and costs for communities and infrastructure. With respect to levee management, wildfires cause significant change to the hydrology of watersheds, potentially increasing runoff, flow rates, and river stages that further strain the already vulnerable levee systems.

OPERATION AND MAINTENANCE

Statewide, challenges to proper operation & maintenance (O&M) of levees include regulatory permitting, areas of repeat failure, competing priorities, and limited resources. Levees are threatened by animal burrows, vegetation, excessive erosion and other factors that require diligent maintenance. Within several urban levee Districts, people experiencing homelessness have caused significant damage to levees due to human-induced burrowing. Operation and maintenance activities within major population centers are typically well organized and structured. However, many rural agencies struggle with funding regular maintenance, prioritizing emergency repairs over routine, cost-saving maintenance.

USACE plays an important role before, during and following a flood through a federal authority termed Public Law 84-99; many cash-strapped agencies have difficulty meeting PL 84-99 requirements, to the extent that some agencies decline to participate. This has resulted in levee systems that are underprepared to meet increasing flood demands, with increasing consequences for flooding down-

stream. In Districts that have managed to successfully navigate California's difficult taxpayer protection laws, O&M are supported by regular assessments, but there is little appetite from local constituents to fund capital improvement projects, even if those projects may reduce long-term maintenance costs.

FUNDING AND FUTURE NEED

Statewide, the California Department of Water Resources estimates that $59 billion (escalated from DWR's 2013 California's Flood Future Report) in capital investment is necessary to rehabilitate and improve levees and associated structures to meet modern federal, state, and local standards. At the same time, the national backlog of USACE construction of flood projects has continued to climb to $109 billion, reducing California's ability to garner federal funding for large capital levee projects in a competitive fiscal environment.

Flood control costs are primarily borne by local governments, with most of the $1.8 billion annual funding generated and spent at the local level on all flood management activities. Levees within the Southern California region are generally well maintained, and routine improvements can be covered through local funding sources. In all areas of the State, major capital and O&M levee work must go through a costly and difficult Proposition 218 process, which requires voter approval of proposed property assessments. The resources and effort to gain voter approval is often beyond the capacity of small and/or rural flood agencies. Where local funding has been established through Proposition 218, Proposition 13 (1978) limits property taxes based on assessed values. This further restricts local funding for maintenance or capital improvement projects. In some areas of the State, public works investment in levees has steadily declined over the last several decades due to a variety of factors, including lack of public interest or awareness of hazards posed by degrading levee systems.

Since 2006, more than $4.5 billion in state funding for new flood control infrastructure from bond sales and State budget surpluses has been invested but is now largely exhausted. As a result, flood control agencies have increasingly returned to the lengthy federal process (USACE) for levee projects. Californians passed Proposition 4 in 2024, authorizing $10 billion in general obligation bonds for safe drinking water, wildfire prevention, and protecting communities and natural lands from climate risks. While the measure was a step in the right direction for mitigation of climate risks, the expected funding for levee capital improvement projects represents a proverbial drop in the bucket, leaving large capital improvement projects to the traditional federal process.

California is a unique and proactive partner with the USACE, the federal agency traditionally charged with constructing the nation's highest risk levees. Since California's passage of historic legislation and voter approved bonds in 2006-2007, state and local agencies have rehabilitated and improved the highest risk levees in the Central Valley. While this funding is now exhausted, this strategic effort has resulted in tremendous cost and time savings over conventional USACE Civil Works implementation. Delivery of large, complex, or mega-projects will always be the domain of the Corps; however, this relatively recent state/local effort has demonstrated efficiencies and risk reduction benefits of non-federal planning and implementation. Since 1986, non-federal sponsors have been authorized to undertake certain levee feasibility studies (under Section 203) and levee construction (under Section 204) that have traditionally been the purview of the USACE Civil Works program. While rarely used to date, these authorities can be used immediately to improve California's levees and increase the value of limited funding.

PUBLIC SAFETY

Since 2019, much work has been done to improve levee infrastructure within the vicinity of major population centers. There have been substantial improvement projects in the Sacramento River basin, including Natomas, American River Common Features, Sacramento River East Levee, South Sacramento Streams Group, Feather River West Levee, and the Marysville Ring Levee. Along the San Joaquin River, the Smith Canal Gate was constructed in Stockton, removing approximately 5,000 low-income properties from the 100-year floodplain. In addition, the Lower San Joaquin River Project has been advanced, with the objective of rehabilitating and improving many of the levees that protect the urban communities around the Stockton Metropolitan Area.
Outside of these urban areas, however, the approach to flood control by local maintaining agencies (LMAs) continues to be more

reactive rather than proactive, due to a variety of factors. Levees within the Northern San Francisco Bay Area have done little to improve levee conditions since 2019, despite increasing risk due to atmospheric rivers and/or sea level rise. In many rural Districts within the Delta or the Lower San Joaquin River Systems, much work is necessary to understand the flood risk including hydrologic and/or geotechnical studies. Consequential damages resulting from a failure of these systems includes significant loss of life, fertile agricultural properties and loss of critical infrastructure such as highways, water conveyance, and power transmission.

A privately owned levee system on the Cosumnes River ruptured on New Year's Eve in 2022 during a powerful rainstorm. The resultant flooding killed three people, swamped homes, shut down a major highway and washed away vehicles. This rural levee is not part of the state/federal system and therefore has less stringent performance and maintenance standards, yet has disproportionate impacts on public safety, critical infrastructure and the environment.

In March of 2023, the levee on the Pajaro River breached, flooding the town of Pajaro. The levees, constructed in 1949, were generally in poor condition due to erosion, rodent burrows, and insufficient original design. Levee deficiencies were generally known prior to the breach, but local agencies did not have the resources to improve the condition of the levees. A series of atmospheric rivers in January and March 2023 put significant pressure on the levees, ultimately leading to the failure and breach. The flooding displaced approximately 1,700 people in the Pajaro area, which is home to almost 3,000 residents. Construction of levee improvements within the failed levee reach is expected to start in the Summer of 2025, with completion of the project projected within the next decade. However, other portions of the Pajaro River system will not be improved though the current project, leaving approximately half of the Pajaro system with less than a 100-year storm event level of flood protection. These type of levee failures are likely to be repeated without further investment.

In the late summer of 2024, two "sunny day" near-failures occurred at the opposite ends of the California Delta: a sinkhole developed on Twitchell Island, caused by the gradual failure of 30-year-old levee repairs, and a seepage boil on Victoria Island developed into the near-total erosion of the levee foundation. While both levee systems are located away from major population centers, failure in either

or both systems would have resulted in inordinate and major disruptions of the California highway systems, power transmission, and water conveyance system. In addition, failures of the systems would potentially cause saltwater intrusion into the Delta, resulting in a shutdown of the State's two major water supply systems and consequent life safety and economic impacts.

RESILIENCE AND INNOVATION

Resilience is the capability of levees to withstand and/or quickly recover from a single or multiple hazards. Extreme weather is predominant among the many hazards threatening California's levees. A community is flood-resilient—recovering rapidly in the event of a flood—when the flood system is robust, incorporates redundant features, and is supported by ample resources. Many of California's aging levees were not designed to meet modern engineering standards, much less current and future climate impacts. Multiple agencies and standards noted above also complicate a statewide resiliency standard.

Recent levee projects are now planned on a system-wide scale, rather than as separate levees or water courses. Because projects are often scoped on a project-by-project or hydraulic basin basis, the benefits of a systemwide context are often lost. Moreover, improved forecasting methods have increased the safety of levee systems downstream of flood control reservoirs. Resiliency measures like these must be funded and implemented to face the ongoing uncertainty of extreme weather.

Because the USACE plays such a crucial role in leveed areas of the State, a finding of federal interest determines whether a levee is built, improved or rehabilitated. Real-world consequences of levee projects are often not reflected in the methodology commonly used by the Corps. Current USACE flood risk management planning studies rely heavily on avoided damages to determine a benefit-cost ratio (BCR), and typically the higher the BCR the more likely a project is to receive federal approval and funding. However, quantifying benefits in this way neglects the distribution of benefits across a community and does not account for how a project is valued by a community. The Corps has long understood this disparity and recently the Corps' Agency Specific Procedures (December 2024) stated that distributional analyses "could provide a more equitable way to measure the welfare impacts of these projects on people and their communities, by reducing the extent to which the average value of the property that is at risk affects the estimated project benefits." Unfortunately, USACE has not provided implementation guidance, rendering such methodologies moot.

RECOMMENDATIONS TO RAISE THE GRADE

- Increase investments to meet the need of $77 billion in capital improvements to improve California levees and appurtenant structures through additional federal, state and local funding.
- Increase appropriations to USACE Civil Works construction account to reduce the $109 billion backlog.
- Provide federal guidance to implement distributional analyses for determining federal interest in flood risk reduction projects authorized by USACE.
- Facilitate and encourage non-federal sponsors to plan and implement USACE Civil Works Projects, or portions thereof.
- Implement resiliency measures for all new levee projects, such as systemwide planning for climate impacts, or improved forecasting methods for upstream facilities.

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Ports

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PORTS

EXECUTIVE SUMMARY

California's ports play a critical role in the U.S. economy. As the nation's leading trade gateway, they handle approximately 38% of all containerized cargo entering the United States and 28% of U.S. exports, generating more than $38 billion in tax revenue and supporting over 3 million jobs nationwide. The state is home to three of the country's largest container ports—Los Angeles, Long Beach, and Oakland—as well as nine smaller, specialized, but essential ports, including Benicia, Hueneme, Humboldt Bay, Redwood City, Richmond, San Diego, San Francisco, Stockton, and West Sacramento.

These ports often require billions of dollars in ongoing investment to maintain, modernize, and expand infrastructure. In recent years, major funding initiatives—such as the EPA's Clean Ports Infrastructure Program, which awarded over $1 billion to seven California ports—have helped close long-standing funding gaps and accelerate the transition to zero-emission equipment and operations. The ports have also invested in capital improvement projects to address efficiency and innovation, like the Long Beach Container Terminal, a state-of-the-art, mostly electrified terminal that, on its own, would rank as the sixth-busiest container port in the U.S. However, despite significant investments and progress, California ports continue to face the challenge of having to secure funding to address ongoing urgent waterside and landside infrastructure needs, while maintaining the smooth flow of goods essential to the U.S. economy.

CONDITION AND CAPACITY

California seaports comprise 12 major maritime facilities, ranking among the most active in the nation. These ports vary in size, operations, financial structure, and the types of goods they handle. They manage a wide range of cargo, including containers, petroleum products, bulk materials, chemicals, manufactured goods and equipment, food and agricultural products, and automobiles. In addition to cargo services, California ports offer a variety of non-cargo (visitor-serving) amenities, such as cruise ship terminals, hotels, restaurants, entertainment

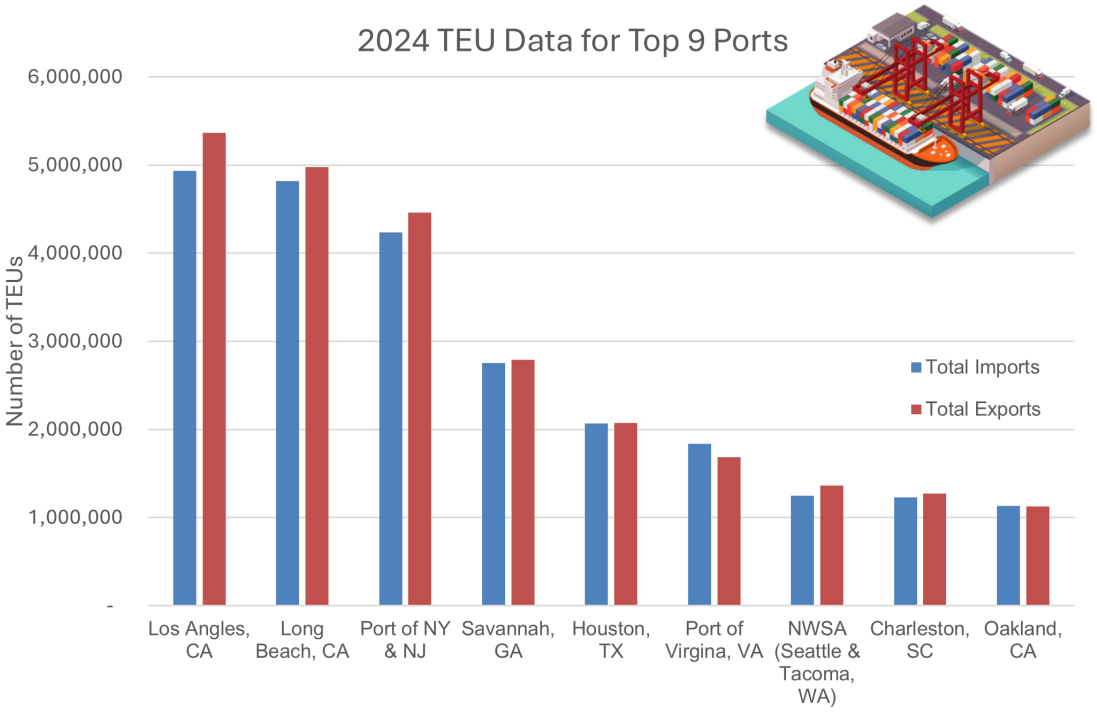
venues, tourist attractions, commercial fishing operations, and recreational harbors.

The Los Angeles / Long Beach port complex served as the top U.S.-international freight gateway by total trade value in 2023 with approximately $340 billion in import value and approximately $400 billion in total value (imports and exports combined). Additionally, the Ports of Los Angeles and Long Beach ranked as the top two ports in the U.S. in 2024 for container volume (measured in twenty-foot equivalent units, or TEUs) for imports and exports. The Port of Oakland was ranked as the ninth largest port by container volume in 2024, see Table 1. Other ports in the state provide other critical goods, including autos, agricultural products, and bulk cargo, see Table 2 for a detailed list.

Table 1. Total TEUs (2024)

Port	Export, Empty TEU	Export, Loaded TEU	Import, Empty TEU	Import, Loaded TEU	Total
Los Angeles, CA	3,438,942	1,494,201	7,529	5,356,680	10,297,352
Long Beach, CA	3,616,713	1,204,453	171,094	4,803,981	9,796,241
Port of NY & NJ	2,882,422	1,354,421	23,553	4,439,140	8,699,536
Savannah, GA	1,377,541	1,376,889	51,503	2,739,629	5,545,562
Houston, TX	570,350	1,497,749	171,784	1,900,028	4,139,911
Port of Virginia, VA	701,605	1,138,960	55,786	1,627,165	3,523,516
NWSA (Seattle & Tacoma), WA	612,361	636,508	72,192	1,289,199	2,610,260
Charleston, SC	571,875	655,498	24,052	1,245,723	2,497,148
Oakland, CA	358,996	776,219	163,380	964,242	2,262,837

Source: U.S Department of Transportation, Bureau of Transportation Statistics "TEU Volumes at Ports", 2024



A critical component of the state's complex freight transportation system, ports are responsible for roughly one-third of jobs in California and over $700 billion in revenue from freight-dependent industries, serving a vital and unique role for the state and the nation.

Table 2: California Port Cargo Summary (2022)

Port	Total Thousand Tons of Cargo Transported 2022	Highest-Traffic Exports (by tonnage)	Highest Traffic Imports (by tonnage)
Port of Long Beach	92,959	Petroluem Products, Chemicals, Bulk Materials, Food and Farm Products, Manufactured Equipment	Petroluem Products, Chemicals, Manufactured Goods, Food and Farm Products, Manufactured Equipment
Port of Los Angeles	59,819	Chemicals, Bulk Materials, Food and Farm Products, Manufactured Equipment	Petroluem Products, Chemicals, Manufactured Goods, Food and Farm Products, Manufactured Equipment
Port of Richmond	23,578	Petroleum Products	Petroleum Products, Bulk Materials, Food and Farm Products, Autos
Port of Oakland	18,011	Bulk Materials, Food and Farm Products	Manufactured Goods, Food and Farm Products, Manufactured Equipment
Port of Stockton	4,944	Bulk Materials	Chemicals, Manufactured Goods, Food and Farm Products
Port of Hueneme	3,158	Manufactured Goods	Food and Farm Products, Manufactured Equipment
Port of San Francisco	2,009	N/A	Bulk Materials, Petroleum Products
Port of San Diego	1,912	N/A	Food and Farm Products, Manufactured Equipment
Port of Redwood City	1,823	Bulk Materials	Bulk Materials, Manufactured Goods
Port of West Sacramento	1,417	Food and Farm Products	Manufactured Goods
Humboldt Bay Harbor District	269	Petroleum Products, Bulk Materials	Petroleum Products
Port of Benicia	276	Bulk Materials	Autos

Source: U.S. Army Corps of Engineers Waterborne Commerce of the United States, Part 4 - Waterways and Harbors: Pacific Coast, Alaska and Hawaii, 2022.

As ports look to increase capacity and remain competitive, they have to continue to invest in port infrastructure, which includes not only traditional maritime elements such as piers and navigation channels but also an extensive network of connected systems. These can include sewer and stormwater systems, electrical grids, roadways, rail lines, and other civil infrastructure.

For instance, in 2020, the Port of Long Beach, in collaboration with Caltrans and the U.S. Department of Transportation, completed the $1.5 billion Long Beach International Gateway Bridge. This project improved truck traffic flow and enabled access for taller ships. Similarly, the Port of Los Angeles recently completed a $73 million On-Dock Rail Expansion, adding 31,000 feet of new rail track to enhance cargo movement.

While California's ports are meeting existing capacity requirements and have proven to be adaptable by investing in upgrades, future increases in goods movement will put greater demands on port capacity,..

Automobiles being loaded at the Port of Richmond

OPERATION AND MAINTENANCE

California ports are typically managed by a government agency working with a mix of private terminals and operators; the Port of Benicia is the only exception as the facility is privately owned and operated.

Port maintenance need is extensive and covers a wide range of infrastructure systems, facilities, and equipment and requires substantial investment. The Port of Los Angeles alone estimates the total need for navigation maintenance and repair projects at $6.7 billion, covering essential infrastructure work such as dredging, seismic upgrades, wharf and fender repairs, pile replacements, sediment removal, and enhancements to slips and channels.

On an annual basis, ports face the challenge of splitting their limited resources between capital investments required for efficiency/competitiveness and tackling maintenance of existing infrastructure required to keep operating smoothly. In 2025, for example, the Port of Los Angeles plans to allocate $66.8 million—nearly 29% of its capital improvement program—toward upgrades and repairs to existing facilities.

Some ports also face challenges in recruiting and retaining trained staff to operate and maintain their infrastructure. To address future port labor, the ports of Los Angeles and Long Beach in partnership with the local unions, have partnered to construct the Goods Movement Training Campus, which will provide a centralized facility to attract and retain dockworkers, truck drivers, warehouse employees, and other logistics workers and train them on new technology, such as zero-emissions cargo handling equipment.

Phase 3 of the Port of Long Beach Container Terminal under Construction. Photo Courtesy of the Port of Long Beach

FUNDING AND FUTURE NEED

Funding is required at every California port to continue to maintain existing infrastructure, react to market opportunities, and stay competitive. Port operations are primarily funded by revenue generated through shipping fees as well as landside operation and tenant leases. These resources also provide funds for ongoing capital programs. With no other local or state funding specifically allocated for port operations or infrastructure projects, ports instead apply for state funding through a few competitive funding programs. These programs include the Trade Corridor Enhancement Program (TCEP), which offers about $400 million in state funds and $120 million in federal funds annually, several Low Carbon Transportation Incentives administered by the California Air Resources Board, for which funding varies annually, and programs administered by the California Energy Commission for charging infrastructure. In 2021-2022, TCEP provided $4.4 million to the Port of Stockton for rail improvements and $8 million to the Port of Long Beach for rail expansion. Similarly at the federal level, ports apply for competitive grants. Since 2019, the following federal grant programs have provided critical funding for California ports included the following approximate value of awards:

Table 3. Critical California Ports Grant Rewards Since 2019

Program	Agency	Amount
Port Infrastructure Development Program (PIDP)	Maritime Administration	$325 million
Nationally Significant Multimodal Freight & Highway Projects (INFRA)	Department of Transportation	$425 million
National Infrastructure Project Assistance (Mega) Program	Department of Transportation	$283 million
Better Utilizing Investments to Leverage Development (BUILD) Grant Program	Department of Transportation	$25 million
Port Security Grant Program	Federal Emergency Management Agency (FEMA)	$85 million
Clean Ports Program	Environmental Protection Agency (EPA)	$1 billion

Federal funding for channel maintenance and dredging to maintain waterways is provided through the Harbor Maintenance Trust Fund (HMTF), which is supported by a tax levied on cargo. In 2020, the Water Resources Development Act introduced changes to the allocation of funds from the HMTF, aiming to address a surplus that could not be appropriated by Congress in the past. California ports benefited from this change by being allocated higher awards than in previous years; for example, the Port of Los Angeles received $58 million in 2024, compared to $6 million in 2023.

California ports are planning investments in upgrading their marine terminals, berths, piers, roads, yard equipment, storage facilities, security systems, rail links, environmental controls, shipping channels, and more. Strong federal and state funding in recent years has helped to close the funding gap on critical facility investment to approximately $5 billion over the next five years for California ports. However, California ports require reliable funding going forward to maintain existing facilities and to continue to support future growth.

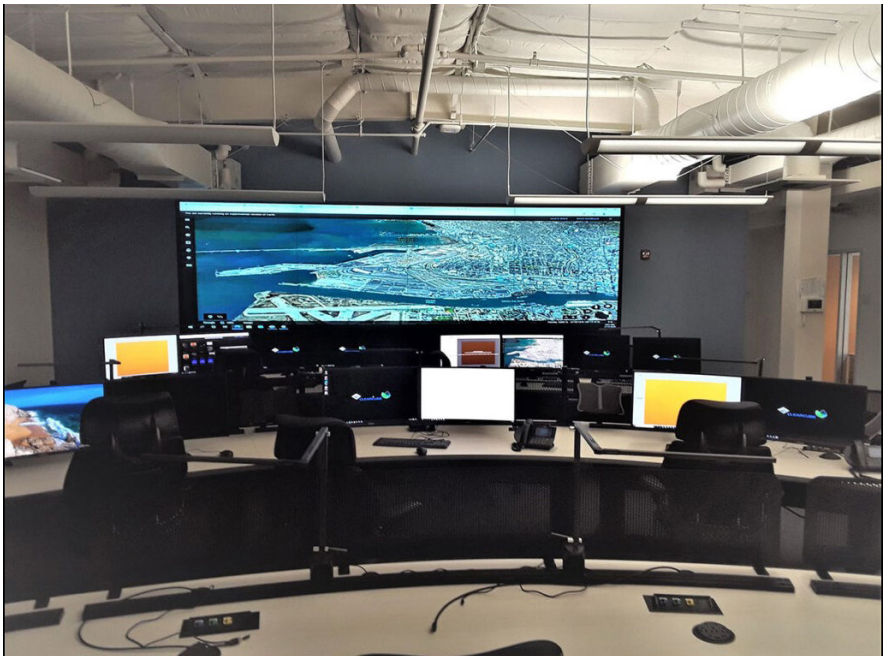
Zero Emission yard tractor deployed at Port of Long Beach

PUBLIC SAFETY AND RESILIENCE

California has been at the forefront of developing and implementing port infrastructure design codes and guidelines, including inspection and assessment guidelines to protect public safety.

The 2020 pandemic highlighted the critical role ports play in the nation's recovery, underscoring the need for increased support in the face of major disruptions, such as earthquakes or other disasters. Better adaptation plans must be put in place to help ports respond effectively and enable a rapid recovery in the future.

California is at significant and increasing risk of major seismic, flood, or terrorist events at and around its seaports. The state's port facilities, typically built on dredged fill or weak soils, are particularly at risk of failure in the event of a large earthquake. Ports serve as the transportation link for post-disaster emergency resources and stage military operations, so preparing for recovery from operational disruption due to external events is a high priority. To meet this goal, ports need to prioritize repairs and upgrades to their infrastructure through the lens of emergency preparedness, innovation, and resiliency.



The Freight Intelligent Transportation System at the Port of Oakland provides real-time traffic, terminal, vessel and other data to help reduce congestion and improve traffic flow

INNOVATION

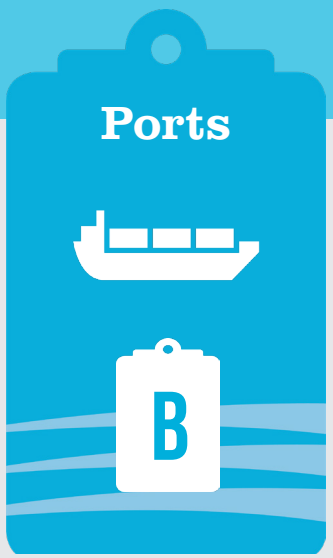
To stay competitive and address infrastructure needs, ports are innovating individually and collaboratively. In 2024, the California Governor's Office of Business and Economic Development awarded $27 million to the ports of Los Angeles, Long Beach, Oakland, San Diego, and Hueneme for shared data system improvements. The funding supports ten projects, including Artificial Intelligence deployment, cargo routing optimization, climate resiliency, emissions reduction, trucking appointment systems, and new cargo data standards.

Brought on by pandemic-induced consumer demand, the number of container ships waiting to enter U.S. ports surged in 2021. To address this backlog, the ports of Los Angeles and Long Beach participated in an innovative vessel queuing system to improve the efficiency of cargo movement and reduce congestion. Other initiatives focus on improving traffic flow and security. The Port of Oakland uses a Freight Intelligent Transportation System to provide real-time operational data and includes emergency operations and traffic management center.

California ports are also continuously looking to improve efficiency and productivity within their own operations. For example, the Port of Long Beach is in the middle of building a $1.5 billion high-tech on-dock rail support facility. This facility is a key infrastructure project designed to improve the efficiency of container transportation through the port. It allows for direct rail access to the docks, which will eliminate the need for trucks to move containers between the port and rail yards.

California ports are actively electrifying their equipment and undertaking major clean-energy transformations. Most California ports have begun transitioning cargo handling equipment to electricity to meet a California goal of zero-emission cargo handling equipment by 2030. Full electrification of all port operations in California will require heavy investment on power grid upgrades.

To improve efficiency, ports have begun using automation as an option in some port operations. Concerns from labor representatives as well as high costs have limited wider implementation.



RECOMMENDATIONS TO RAISE THE GRADE

- Encourage and fund cutting-edge technology improvements in operations—powered by public and private investment—to transform our ports into cleaner, smarter, and more resilient gateways. These innovations will boost efficiency, enhance security, and significantly reduce environmental harm—benefiting our economy, communities, and future generations.

- Ensure our ports remain competitive, safe, and sustainable by securing continued federal and state investment in maintenance of our ports. Targeted funding is urgently needed to modernize aging infrastructure and tackle long-overdue repairs, helping ports operate more efficiently, reduce delays, and support local jobs.

- Encourage and fund ways for ports to play a bigger role in supporting the future of marine manufacturing or energy resilience. This would require specialized infrastructure, streamlined logistics, and collaborative innovation hubs that accelerate the development and deployment of next-generation vessels and new energy technologies.

- Invest in stronger freight and landside connections—like on-dock rail and transfer facilities—to move goods faster, cut traffic congestion, and deliver cleaner air for our communities. These improvements are key to a more efficient, sustainable freight system.

- Make ports a key part of comprehensive disaster planning and invest in critical redundancies—like resilient energy systems—to ensure port operations can continue during disasters or market disruptions.

- Ensure ports of varying sizes can compete in both existing and new competitive grant programs to create redundant supply chains and better economic stability.

DEFINITIONS

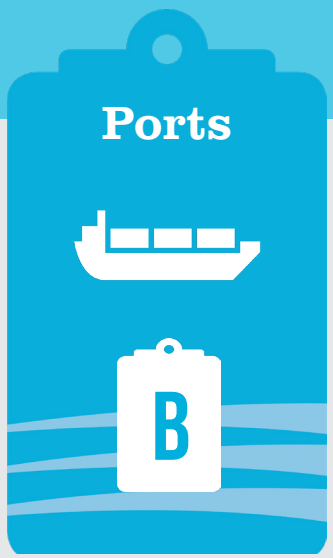
Bulk Cargo: cargo that is stowed loose in the hold and is not enclosed in any container. Such cargo is also described as bulk freight. bulk cargo is composed of either:

(1) Free flowing articles such as oil, grain, coal, ore, and the like, which can be pumped or run through a chute or handled by dumping; or

(2) Articles that require mechanical handling such as bricks, pig iron, lumber, steel beams, and the like

TEUs: Measure in container volume measured in twenty-foot equivalent units

Trade Corridor Enhancement Program (TCEP): Federal program which offers about $400 million in state funds and $120 million annually for port operations or infrastructure projects.



DEFINITIONS (cont.)

United States Army Corps of Engineers (USACE): Federal agency responsible for deepening and maintaining federal shipping channels to keep them safe and navigable.

Harbor Maintenance Trust Fund (HMTF): Federal trust fund supported by tax levied on cargo for channel maintenance and dredging to maintain waterways.

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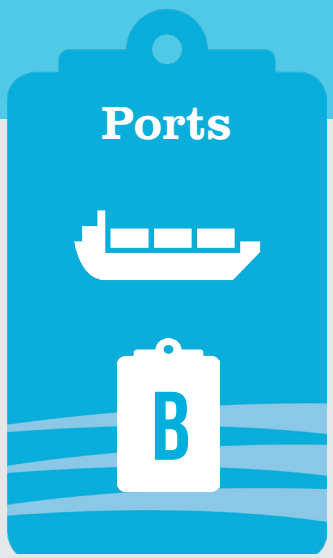

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Los Angeles Echo Park. iStockphoto.com\simonkr

PUBLIC PARKS

EXECUTIVE SUMMARY

California is home to 30 national park units which include 9 national parks and 21 national monuments, two World Heritage Sites, 280 state parks, and approximately 14,000 local parks managed by nearly 1,000 agencies. The state offers approximately 47 million acres of outdoor recreational areas that serve both residents and visitors. However, funding for parks has declined due to budget cuts, while infrastructure needs continue to grow. Deferred maintenance is now estimated at $5.6 billion. Despite the large acreage and numbers of parks in California, access to parkland is limited for many: 60% of Californians live in areas that fall short of the California Department of Parks and Recreation's standard of three acres of parkland per 1,000 residents. Fortunately, voters approved Proposition 4 in 2024, which will partially address the deferred maintenance shortfalls by providing $175 million for maintenance and $200 million to parks of underserved communities. Preserving parks and enhancing recreational opportunities is an investment that benefits the residents of California.

CAPACITY

In addition to its many National and State Parks, World Heritage Sites and numerous local parks, California has more than 280 miles of coastline, 15,000 campsites, and 3,000 miles of trails. California landmarks continue to be sought out for their marveled beauty, attracting more than 85 million day-use visitors and 7.7 million overnight users in the 2021/22 fiscal year; both totals are up 14.5% and 17.9%, respectively, over the 2018/19 fiscal year visitation data reported by California Department of Parks and Recreation (DPR) which are conservative estimates.

Despite the large numbers of parks and recreation acreage, California falls well short of the DPR

Credit: David Evans and Associates, Inc.

recommendation of three acres of park land per 1,000 residents. Sixty percent of California's nearly 40 million residents live in areas that do not meet this criterion. According to DPR, a park should exist within half a mile of neighborhoods. On a positive note, one million more Californians have park access located within a half mile radius of their homes in 2020 compared to 2015. This progress has been partially reached through the Statewide Park Development and Community Revitalization Program, which created more than 100 parks within a half mile radius of more than 1 million Californians through two rounds of Proposition 84 funding. The program is a competitive grant program that creates new parks and recreation opportunities for underserved communities, which are communities identified as having limited access to park space.

Credit: County of Fresno

CONDITION

California's state parks are facing a mix of challenges and successes, reflecting the state's diverse landscapes and growing population. Extreme weather events, wildfires, droughts, and flooding have damaged ecosystems and park facilities, and ongoing maintenance has become a significant concern due to budget constraints. In 2020, over 90 % of Big Basin Redwoods State Park burned in what was one of the worst fire seasons in California history. More recently, the 2025 California wildfires, particularly the Palisades and Eaton fires impacted Will Rogers State Park and Topanga State Park. The frequency and severity of wildfires continue to impact natural resources in California.

The NPS estimates approximately $4.4 billion in deferred maintenance at California National Parks. Additionally, the State estimates another $1.2 billion in deferred maintenance for California State Parks. These overwhelming backlogs , limit the ability to restore and preserve these natural treasures. The U.S. Forest Service (USFS) also faces significant challenges in managing its lands, with 24 % of its land burned. Fifty-seven percent of the USFS land is at High Wildfire Risk and only 3% of its acreage was treated to reduce wildfire risks. Despite these challenges, California state parks continue to be an essential part of the state's natural heritage and play a critical role in conservation, recreation, and education. Despite these challenges, California state parks continue to be an essential part of the state's natural heritage and play a critical role in conservation, recreation, and education.

Credit: Bureau of Land Management

OPERATION & MAINTENANCE

Funds for operation and maintenance of park and recreational facilities are limited; it is often easier to secure funding for planning and construction of new amenities than for ongoing operations and maintenance needs.

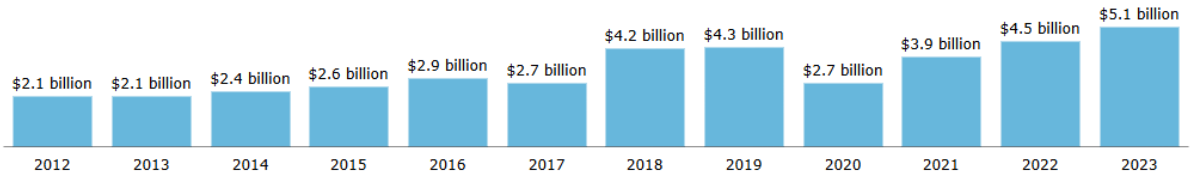
Deferred maintenance across national, state, and local parks in California has accumulated to an estimated $5.6 billion. Deferred maintenance can result in unsafe environments and create undesirable social activity. Additionally, old maintenance equipment cannot keep up with park needs. The 2025-26 California Budget included the Deferred Maintenance Program, allocating $84.4 million to help address deferred maintenance projects throughout the State Park System. This amount does not include cost for improved accessibility, upgrades to meet current building codes, installation of fire suppression systems, expansion of capacity or annual recurring maintenance needs which typically run into hundreds of millions of dollars.

Credit: County of Los Angeles Public Works

FUNDING

According to the 2023 National Parks Service Visitor Spending Effects report, in-state park users spend $3.2 billion annually on goods and services directly related to park visits, while out-of-state visitors spend $13.3 billion. National parks attendance has been increasing since the pandemic (Figure 1), as has the total economic output for National Parks in California.

Figure 1: Total Economic Output Contributed to the California Economy



*2018 - Visitor Spending Effects profile data was updated for the following California parks: Golden Gate National Recreation Area, Yosemite National Park, Muir Woods National Monument.

Recognizing both the long-term mental and physical health benefits of outdoor recreation as well as its investment potential, California policies have expanded to provide equitable outdoor access for all. Outdoors for All is an initiative championed by Governor Newsom to expand parks and nature access in communities with little outdoor space, supporting programs to connect people who lack access and to help foster a sense of belonging in the outdoors for all Californians In 2021, California made a $1 billion-plus investment to expand access to the outdoors.

California voters also recognized the importance of investing in water, climate resilience, wildfire and natural resources, with 60 % voter approval of Proposition 4 in 2024. The proposition provides funding for California state parks only including $175 million for deferred maintenance, $50 million for sea level rise adaptation projects, and $200 million for the Statewide Park Development and Community Revitalization Program. Additionally, the 2025-26 State Budget proposes to use $190 million to create new parks and make improvements, $84.4 million for deferred maintenance projects and $11 million to enhance visitor access on and increase the resilience of public lands.

Proposition 68 Per Capita Program, administered by the California Department of Parks and Recreation's Office of Grants and Local Services (OGALS), provided funding for land acquisition and improvements to existing properties beyond their original condition. However, operation, maintenance, and repairs are not eligible expenses. Proposition 68 was approved by voters in 2018 and allocated $4.1 billion to support local parks, natural resource protection, climate adaptation, water quality and supply, and flood protection.

Despite the efforts to secure funding to expand recreational spaces and perform critical maintenance services over the years, funding for State Parks has not increased enough to meet needs. In 2024 Proposition 4 allocated $425 million for state parks, only slightly higher than the $218 million allocated in 2018's Proposition 68. In addition to Propositions 4 and 68, there have also been many previous parks related propositions, which are typically funded through the sale of bonds. That Bond history over the past 25 years is summarized in Table 1.

Table 1: California Bond History

CALIFORNIA BOND HISTORY

and how they've impacted state parks.

CALIFORNIA STATE PARKS FOUNDATION

Year	Proposition	Title	Bond Funds	Allocated for State Parks	Pictogram = $100 Million Allocated for State Parks = $100 Million Bond Funds
2000	Prop 12	Safe Neighborhood Parks, Clean Water, Clean Air and Coastal Protection Bond Act of 2000	$2.1 Billion	$519 Million	
2002	Prop 40	The California Clean Water, Clean Air, and Safe Neighborhood Parks, and Coastal Protection Act of 2002	$2.6 Billion	$230 Million	
2006	Prop 84	The Safe Drinking Water, Water Quality and Supply, Flood Control, River and Coastal Protection Bond Act of 2006	$5.4 Billion	$400 Million	
2018	Prop 68	Parks, Environment, and Water Bond Act of 2018	$4.1 Billion	$218 Million	
2024*	Prop 4*	Safe Drinking Water, Wildfire Prevention, Drought Preparedness, and Clean Air Bond Act of 2024*	$10 Billion*	$225 Million*	

*Potential future funding

In 2018, Proposition 68 allocated $4.1 billion in bonds for state and local environmental protection and restoration water projects. It provided opportunities to create new parks and renovations. Using Proposition 84 and Proposition 68 funds, California's Statewide Park Development and Community Revitalization Program (SPP) has provided more than $1 billion in grant funding for community parks, the creation of 130 new parks and 60 park expansions or renovations. However, demand for park funding remains high. In 2019 alone, SPP received 478 project proposals totaling $2.3 billion in requested funding, but only $254.9 million was available-enough to fund just 62 projects.

The Statewide Park Development and Community Revitalization Program found that each $600 million investment results in approximately one million additional Californians gaining new or expanded park access within a half mile of their homes. Nearly 21 % of Californians live over half mile from a park or open space. Land acquisition and construction cost has increased by $1,500,000 per project site from 2010 to 2020.

There are more funding opportunities for new parks and improvements versus ongoing maintenance and operations. Through the Great American Outdoors Act National Parks and Public Land Legacy Restoration Fund (GAOA LRF) $911.2 million were provided for maintenance and repairs over fiscal years 2021 through 2025. According to the Department of the Interior, GAOF LRF would invest $976.5 million towards improving nearly 330 assets across 34 projects in California. However, there is currently no funding beyond 2025. To continue reducing the backlog of deferred maintenance it is essential to extend GAOA LRF and secure $2 billion annually through 2033. As of August 2025, Congress has not extended the program.

The public reservation system for federal lands issued through Recreation.gov website reported an average 3 million reservations annually from 2014 to 2019, the number spiked in 2020 with 5 million reservations, and that has increased to 9 million for 2022 and 2023. Additionally, the Department of Interior has also reported overcrowding in National Parks. Despite the reported increase in demand, the federal budget plan for fiscal year 2026 includes a reduction of more than $1 billion to the National Parks Service, including:

- $900 million cuts to operation of national parks
- $73 million cut to park construction funding
- $77 million cut to recreation and preservation funding
- $197 million cut to Historic Preservation Fund

The past decade has been challenging for local parks and recreational services at all levels of government in California. Approximately 45 % of land in California is owned by the federal government. The federal cuts will affect the conditions of federal lands. Reduced funding for parks will lead to fewer programs, stalled capital development, and further deterioration of infrastructure.

Credit: County of Los Angeles Public Works

FUTURE NEED

As California continues to experience population growth and increasing environmental challenges, the future need for its parks has never been more urgent. These parks at federal, state and local levels serve as vital sanctuaries for preserving the state's rich biodiversity, protecting natural resources, and providing public access to outdoor recreation. With extreme weather exacerbating wildfires, droughts, and rising sea levels, California's parks will play a critical role in environmental conservation, serving as refuge for wildlife and helping to mitigate the effects of climate impacts. Additionally, as urban areas grow and more people seek outdoor experiences, the demand for accessible, well-maintained parks will rise, necessitating greater investment in infrastructure, education, and park management. California's parks must evolve to meet these challenges, ensuring they remain resilient, inclusive, and capable of fostering a deeper connection to nature for future generations.

The California 2021-2025 Statewide Comprehensive Outdoor Recreation Plan (SCORP) reported that based on a 10-year review of statewide park investments an average of 60 park projects are creating new park access for approximately 500,000 Californians within a half mile radius per funding cycle under Proposition 68.

Over the past two decades state bond acts for local park funding have been extremely deficient. A large share of the funding from state park bonds has gone to large open space organizations, state conservancies, and the urban core communities. Suburban and rural park systems are now dependent on their own resources to fund the capital needs and development of their park systems. Many have gone to developer fees for new park development but cannot use that methodology for capital improvements at existing parks. Hence, their systems are declining. Unless development occurs in their communities, they have no funding for new park development. Without state per capita funding, their existing parks deteriorate. Unfortunately, this phenomenon is being seen all through the state. The solution is a funding structure that is continuous and adequate for at least capital development of deteriorating systems. A successful regional park system in California is the East Bay Regional Park District which has adequate, continuous funding structure via park user fees combined with a property assessment. Other park districts, both local and regional, that use assessments and user fees enjoy the same success.

The largest County in California, Los Angeles County Parks and Recreation, faces a $22 million budget reduction. Reduction in services include ending the summer pool season early, suspending some park programs, reduce parks hours and staffing. Fees for services will increase including entrances fees to regional parks and facility rental fees.

Greater investment in park restoration, maintenance, and sustainable management practices is needed to ensure these parks can continue to serve the public and protect the environment in the years to come. Currently, the available funding falls short of addressing the backlog of deferred maintenance, meeting requests for new parks, and offsetting recent budget cuts.

Credit: County of Los Angeles Public Works

PUBLIC SAFETY

California has the largest state park system in the United States—with an average of 70 million visitors annually—ensuring public safety is essential to maintaining a positive park experience. When people do not feel safe, they are less likely to visit, which can contribute to the overall decline of the park system. State Park Rangers are charged with enforcing park regulations while helping to promote the safety of the public.

Since 2015, the state's park ranger workforce has declined by about 20% while almost 30% of the state's park ranger positions are currently vacant. 2025 began with the NPS canceling ranger programs and limiting visitor center hours at two California parks. Parks with off-road recreation areas have a crime rate and safety incident rate seven times higher than the state park average.

Credit: County of Los Angeles Public Works

RESILIENCE

California seeks to be on the forefront of environmental protections and climate resilience. As climate affects landscape and biodiversity, California has established policies to address the impact. In October 2020, Governor Newsom issued Executive Order N-82-20 which establishes a state goal of conserving 30% of California's lands and coastal waters by 2030 – known as 30x30. This goal is intended to accelerate conservation of lands and coastal waters through voluntary, collaborative action with partners across the state to meet three objectives: conserve and restore biodiversity, expand access to nature, and mitigate and build resilience to climate impacts. California's 30x30 commitment is part of a global effort to increase biodiversity conservation, including in the United States. In January of 2021, the Biden administration issued an executive order on tackling the climate crisis and committed the United States to 30x30 through its America the Beautiful initiative. At the end of 2024, 25.2% of lands and 16.2% of coastal waters had been conserved according to a California state progress report. In January of 2025, the Trump administration rescinded the order and its goal to conserving US lands and waters.

In the 2024 California Ocean Protection Council publication titled "State of California Sea Level Rise Guidance", the sea level rise projections for year 2050 range between 0.2 foot (low scenario) and 1.2 foot (high scenario), with an intermediate scenario of 0.8 foot. The projections for year 2100 range between 1.0 foot (low scenario) and 6.6 feet (high scenario), with an intermediate scenario of 3.1 feet. As of 2020, agencies adopted a set of principles to further inform California's adaptation actions in response to sea level rise. As part of these principles, state agencies, including state parks, committed to the goal of preparing for up to 3.5 feet of sea level rise.

The state is investing $2.5 billion to ramp up and implement the Governor's Wildfire and Forest Resilience Action Plan, increasing the pace of fuel reduction, prescribed fire, and forest health. 100% of the 99 key actions outlined in the plan are underway or completed. This is in addition to $200 million invested annually through 2028-29 for healthy forest and fire prevention programs.

INNOVATION

State Parks continue to create innovative ways of connecting people with the parks that they visit. For example, the Virtual Adventurer App connects users to a park's history using augmented reality, 3D images and reconstructions. In 2025, nine State Parks have created content for the app and additional parks will be added in the future.

The state parks system has a digital Passports Program which is designed to increase access and engagement in each of the state's 280 parks. This app invites users to compete with others by collecting badges. By visiting more parks, users can acquire more badges. The hope is that interactive experience creates lasting connections to the park. The Passports Program is an enhancement of the original state parks mobile app that updates users with current parks conditions, park and trail information, directions, interactive maps and park brochures.

Another digital enhancement to highlight is the California State Parks website offers free assistive technology for people with physical disabilities that ensures it is accessible to all visitors. This technology uses features such as hands-free mouse capability, voice command, on-screen keyboard and text-to-speech commands.

RECOMMENDATIONS TO RAISE THE GRADE

- Local government entities should create funding alternatives by partnering with local assistance and non-profits to invigorate park finances and address local needs. Provide a per capita component for local communities in future park bond acts.
- State government entities should work with the state legislature to provide for a continuous capital development funding methodology for state park systems.
- National government entities such as the National Park Service should work with interest groups in an effort to secure additional funding from Congress.
- Continue a sustainable approach to infrastructure improvements.
- Improve methods of writing and reporting bond measures and propositions data for accuracy, reliability, accountability and understanding of future allocation needs.

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Rail

B

Amtrak Train in Downtown San Diego.

RAIL

EXECUTIVE SUMMARY

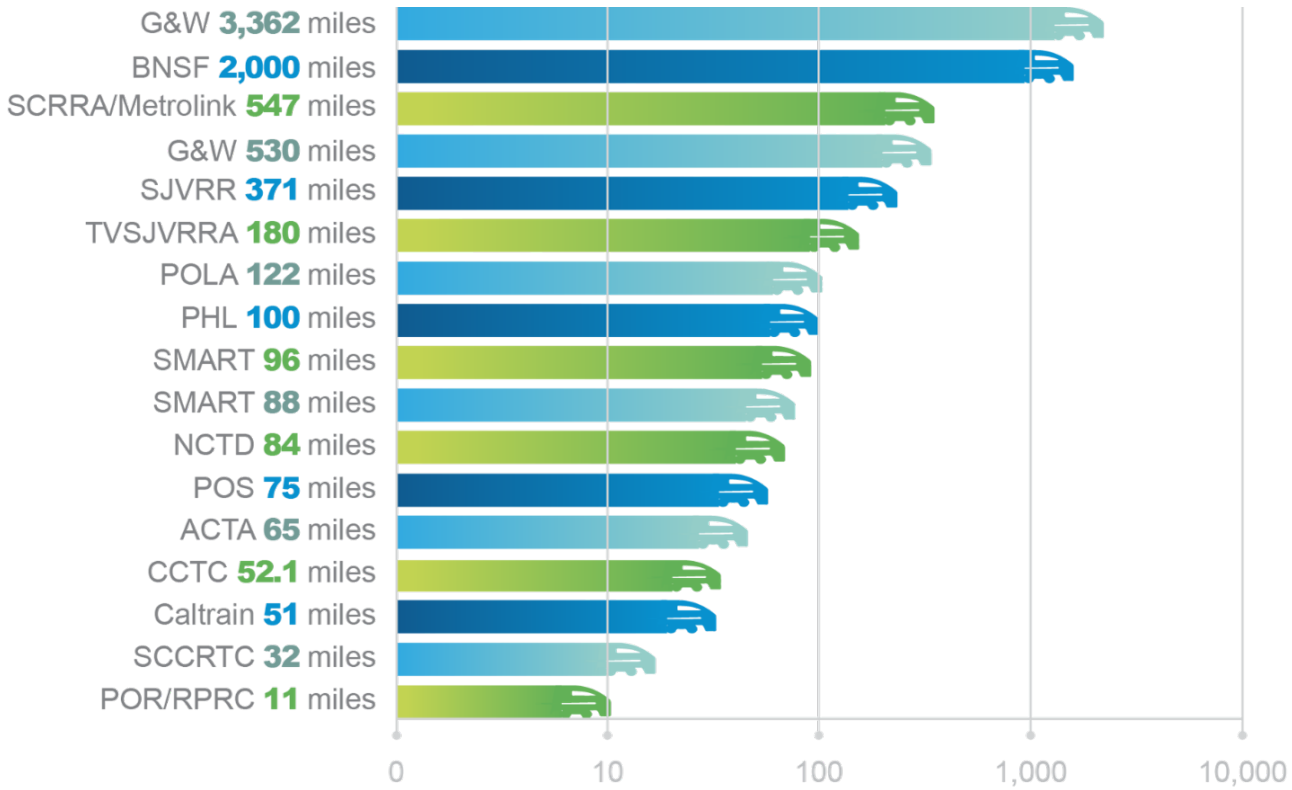
In 2024, California GDP reached $4.1 trillion, making it the fourth largest economy in the world. With a population of 39.4 million (11.8% U.S.) and annual tourist visits of nearly 264 million, the state requires a rail system of equal strength. California's rail infrastructure generally meets current demand but requires significant upgrades to handle future growth. While infrastructure conditions are mostly good, aging assets such as rail bridges and tunnels along with congestion issues necessitate continued modernization efforts. Funding is sufficient for ongoing rail operations, but falls short for large-scale expansion projects, with substantial funding gaps for initiatives like California High-Speed Rail and Metrolink's Southern California Optimized Rail Expansion (SCORE) program. Improvement costs are estimated in the billions and agencies will need to secure additional financial support through public-private partnerships and grants. Operations and maintenance are largely compliant with government regulations, but agencies face challenges with aging infrastructure and the need for advanced predictive maintenance systems. California investment in innovation—including battery-electric locomotives, system electrification and predictive maintenance—enhances efficiency, safety, and sustainability, and establish the best path toward creating a world-class system.

CAPACITY

California is home to 21 rail agencies and owners falling under Federal Railroad Administration (FRA) governance, and covers 6,500 miles of freight and commuter rail lines.

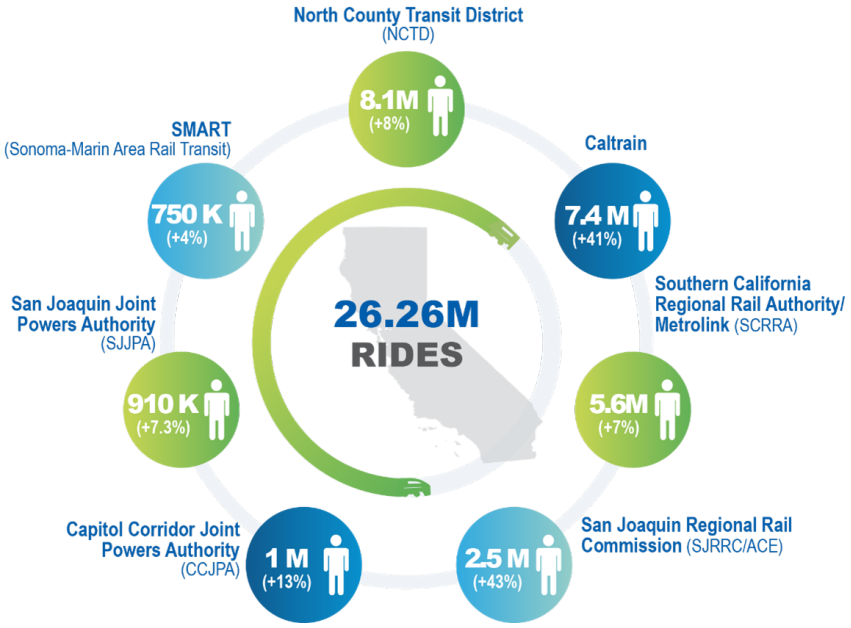
California rail infrastructure moves over 146 million tons of freight and 26 million passenger rides annually, generally meeting current demands. But it will require significant upgrades to handle future growth, anticipated to reach 250 million tons of freight and over 200 ridership miles per day by 2050. Key systems like the Alameda Corridor Transportation Authority (ACTA) and BNSF Railway face congestion in high-traffic areas such as Los Angeles, with expansion projects planned to manage increasing freight and intermodal traffic. The Ports of Los Angeles (POLA) and Long Beach (POLB) are experiencing strained rail capacities, prompting expansion initiatives to accommodate growing cargo volumes. Southern California Regional Rail Authority, or Metrolink, which serves five southern Cal-

Figure 1. California rail agencies and corresponding rail miles



ifornia counties, is increasing service, but faces capacity challenges on its busiest lines, necessitating further investments in infrastructure. Similarly, Union Pacific Railroad (UPRR) has made substantial investments to improve capacity and reliability, with ongoing projects targeting future demands. San Diego's North County Transportation District (NCTD) and the Bay Area's Caltrain require additional infrastructure, such as double tracks, to address rising demand and to accommodate plans like California High-Speed Rail. Short line railroads like the Central California Traction Company (CCTC) and multiple lines owned by Genesee & Wyoming Railroad Services (G&W) maintain sufficient capacity for near-term needs, but long-term growth will require ongoing attention. The California High-Speed Rail Authority's (CHSRA) project will meet future demand once completed, while the Port of Stockton (POS) and Santa Cruz County Regional Transportation Commission (SCCRTC) are enhancing their capacities to manage growing traffic. However, infrastructure challenges such as congestion at Stockton Diamond and potential sea-level rise risks for all coastal railroads underscore the need for continued investment. Overall, while current capacity is mostly adequate, strategic expansions and improvements are essential to meet projected increases in demand across California's rail systems

Figure 2. Passenger rail increase.



CONDITION

The physical condition of California's rail infrastructure is generally good, though some areas require updates and upgrades to meet future demands. ACTA and BNSF maintain their rail lines and intermodal facilities well, but aging signal systems and certain older bridges and tunnels need improvements to handle modern traffic loads. POLA and POLB have both made significant infrastructure investments in the last ten years, expanding their yards and decreasing the average age of their rails accordingly. Metrolink's infrastructure is undergoing expansion and maintenance through the Southern California Optimized Rail Expansion Program (SCORE) and their State of Good Repair (SOGR) Program, but ongoing maintenance is crucial. UPRR's infrastructure is also in good condition, with continued investments aimed at improving capacity. NCTD and Caltrain are focused on modernization projects, such as double tracking and electrification, which enhances capacity and renews condition. While short-line operators like CCTC and G&W maintain well-conditioned assets, they may require future adaptations for passenger services. Many rail owners continue improvements like rail rehabilitation, connector projects, and new passenger services. Challenges like congestion in certain areas, including the Martinez Bridge and Stockton Diamond, indicate the need for future investments to ensure smooth operation and capacity expansion.

Overall, California rail infrastructure is well-maintained, but requires attention to its bridges and tunnels while considering upgrades to accommodate growing demand.

Photo courtesy of Zephyr Rail 2025.

FUNDING

Current funding for California's rail infrastructure is sourced from a mix of federal, state, and local grants, private investments, and operational revenues. While funding levels are generally adequate for maintaining existing rail infrastructure assets to support current operations, significant gaps remain for large-scale expansion and modernization projects. For instance, Metrolink, despite receiving local, state, and federal support, faces a funding shortfall for major projects like the SCORE program, which has a capital cost of $10 billion. Caltrain, while benefiting from federal and state funds, requires additional revenue sources to cover shortfalls, with a projected deficit of $33 million for FY 2026. CHSRA has secured $28.8 billion through 2030, yet still faces substantial funding gaps, with the total cost for Phase 1 estimated between $88.5 billion and $127.9 billion. Other entities, like the POLA and POLB, face challenges in securing adequate funding for planned expansions, with improvements often relying on a mix of operational income and state or federal grants. San Joaquin Regional Rail Commission's (SJRRC) Valley Rail program will significantly expand service in Sacramento and has secured over $1.6 billion,but still requires more than $3.5 billion to cover rising capital costs. Other agencies like NCTD and Capital Corridor Joint Powers Authority (CCJPA) have partially funded priority projects, and require additional resources to address future

infrastructure needs. A considerable funding gap remains to address long-term infrastructure growth and upgrades across California's rail systems.

FUTURE NEED

California railroads, transportation agencies and rail operators anticipate significantly increased demand for freight and passenger rail over the coming decades. The cost to improve California's transportation infrastructure to meet this demand is substantial, with projects across various sectors requiring billions in investment. For instance, ACTA needs over $500 million for system upgrades, while BNSF estimates over $2 billion for capacity enhancements. POLA and POLB each require over $1.5 billion and $1.8 billion, respectively, for rail yard and infrastructure expansions. Metrolink's SCORE program alone is projected to cost $10 billion. Additionally, CHSRA faces a funding gap of over $17 billion for Phase 1, despite securing significant funding for the Central Valley portion. Other projects, like San Joaquin Joint Powers Authority's (SJJPA) Valley Rail program and Sonoma-Marin Area Rail Transit's (SMART) northern extension, also face significant financial needs, with costs ranging from $364 million to over $3 billion.

While some improvements are funded through a mix of federal, state, and local sources, the funding gaps remain substantial, particularly for large-scale projects. Agencies like Caltrain and the CCJPA continue to secure funds for their capital improvement plans but still

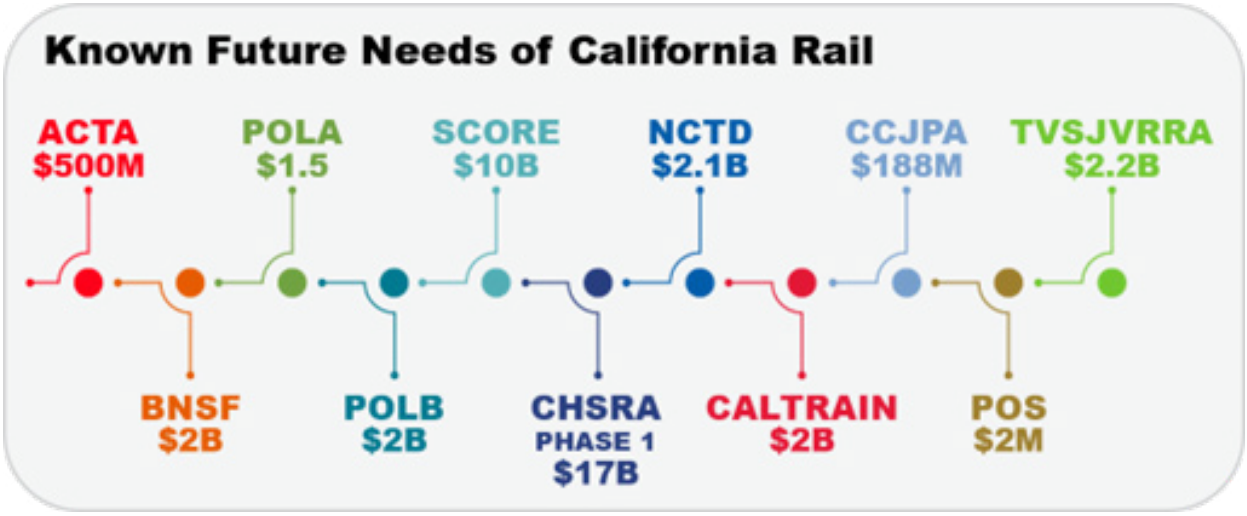


Figure 3. Needs of California Rail.

require additional financial support. Given the magnitude of these needs, future funding prospects will need to expand through more aggressive public-private partnerships, grants, and state and federal investments to meet the infrastructure demands. Without a more robust funding strategy, the gap between the required capital investments and available funding will hinder timely improvements and capacity expansions necessary to accommodate California's growing transportation needs.

OPERATION AND MAINTENANCE

California's rail infrastructure owners consistently demonstrate the capacity to operate and maintain their assets in full compliance with federal and state regulations. Most major operators have well-established maintenance programs focused on safety, reliability, and regulatory adherence and prioritize maintenance in their capital improvement programs. Despite the challenge of aging infrastructure, agencies such as Metrolink, which operates a vigorous SOGR program, and freight operators such as BNSF, which employs a robust maintenance program, ensure compliance with FRA standards. Many rail owners utilize dedicated maintenance teams, and coordinate with other rail operators and contractors like Amtrak to meet regulatory requirements. Challenges exist to California rail operations and

maintenance, including reliance on discretionary grant funding, aging infrastructure and the need for expanding advanced predictive maintenance, but overall, the commitment to maintain regulatory compliance is strong. As new technologies and increased responsibilities emerge, agencies are positioning themselves to meet future maintenance needs. Ongoing investment and strategic planning are essential to maintaining the infrastructure's operational integrity and compliance with evolving regulations.

PUBLIC SAFETY

In California, trespassing is the leading cause of rail-related fatalities and incidents. The condition of infrastructure plays a much smaller role in train incidents, averaging 16% of all incidents for the past five years. No injuries or fatalities in California are attributable to track, roadbed, structures or signals during this period. California's rail owners and operators have made significant strides in ensuring public safety with extensive safety measures. Initiatives such as grade separations, Positive Train Control (PTC), and automated signaling systems have been implemented to minimize risks, particularly at grade-crossings in populated areas. Agencies like BNSF, Metrolink, and Caltrain prioritize safety by upgrading infrastructure, improving crossings, and using advanced technologies such as Unmanned Aerial Systems (UAS) for inspections. The California High-Speed Rail project, designed with grade separation, will further reduce safety risks associated with at-grade crossings. Regular maintenance, collaboration with local agencies, and community education programs are vital components of safety programs across agencies. Safety and security are core values for many organizations, including the SJJPA, SMART, and UPRR, ensuring that each phase of rail operations, from design to maintenance, prioritizes the protection of the public. While challenges remain, such as aging infrastructure and hazardous materials handling, the ongoing commitment to safety, including proactive safety upgrades and innovative solutions, ensures that California's rail system is well-equipped to safeguard the public. The focus on continuous improvement and future safety measures demonstrates a strong commitment to minimizing risks and enhancing the overall safety of the state's rail network.

RESILIENCE

California's rail infrastructure is proactively designed to withstand multi-hazard threats, ensuring resilience in the face of seismic events, climate-related disruptions, and other emergencies. Agencies and railroads like BNSF, Metrolink, and CHSRA have implemented seismic standards and retrofits, flood protection, and earthquake warning systems to safeguard against natural disasters. Measures such as elevated tracks, reinforced bridges, and climate adaptation strategies such as the NCTD's Sustainability and Climate Action Plan, ensure the infrastructure is prepared for extreme weather and sea-level rise. The multiple agencies administering and maintaining the Los Angeles-San Diego-San Luis Obispo Rail (LOSSAN) Corridor have both emergency and long-range plans in place for addressing right-of-way erosion along the coastal freight and passenger route. Rail systems focus on rapid recovery, with protocols in place to restore services quickly and minimize public impact. Collaboration with local agencies, along with regular staff training, enhances emergency responsiveness and operational efficiency. Agencies like Caltrain and CCJPA emphasize sustainability and resilience in their strategic planning, ensuring systems are equipped to address long-term climate challenges. California ports are investing in environmental resilience, including elevated tracks and flood-proofing rail yards, while Port of Richmond (POR) is working with the EPA on

a remediation plan to prevent erosion and exposure of pre-existing contamination, and POS has implemented air and water quality monitoring and wildlife protection programs. Overall, California's rail and transportation systems are not only designed to withstand a variety of hazards, but also feature robust recovery and communication plans to minimize disruptions, safeguard public health, and ensure economic stability in the face of emergencies.

INNOVATION

California's rail infrastructure is embracing a wide array of innovative techniques, materials, and technologies to enhance safety, efficiency, and sustainability. Railroads such as BNSF and UPRR are integrating cutting-edge technologies including Positive Train Control (PTC), automated inspection systems, and Precision Train Builder (PTB), which optimize train operations and safety. Metrolink has implemented the Wireless Crossing Nearside Station Stop (WCNSS) system to address traffic congestion and improve safety. CHSRA is pioneering innovations in construction and clean energy to establish the nation's first high-speed rail system. Other innovative approaches include battery-electric locomotives at POLA and the use of smart rail systems and predictive maintenance technologies at POLB. Caltrain adopted numerous innovative technologies to enhanced operations, including system-wide electrification, and overhauling, upgrading and implementing four major critical systems: the Fiber Optic System, the Rail Operations Control System (ROCS), the Predictive Arrival and Departure System (PADS), and the Positive Train Control (PTC) System. SJRRC is developing a locomotive simulator to provide realistic training for operators, while SCCRTC explores autonomous vehicles for improving safety and mobility. San Joaquin Valley Regional Rail Authority (TV-SJVRRA) is exploring hydrogen fuel and hybrid battery technology for trains. These innovations reflect California's commitment to a smarter, greener, and more efficient transportation future, integrating new technologies and sustainable practices to improve the rail system's overall performance.

RECOMMENDATIONS TO RAISE THE GRADE

- Large-scale, transformative programs—such as CHSRA and Metrolink's SCORE program—require consistent multi-level funding to ensure timely delivery and regional connectivity.
- Agencies like Caltrain, which is electrifying its corridor and modernizing operations, must continue to receive support to expand capacity and service reliability.
- The Altamont Corridor Express (ACE) and CCJPA are implementing corridor improvements that will reduce emissions, enhance regional mobility, and expand service frequency—these efforts should be prioritized and replicated.
- Across all agencies, sustained investment in predictive maintenance technologies, advanced signaling, and unmanned inspection tools will reduce lifecycle costs and improve safety.
- Additional capacity-enhancing projects—such as grade separations and double tracking—will relieve congestion and meet growing freight and passenger demand. Finally, targeted resilience measures including seismic retrofits, flood mitigation, and adaptation to sea-level rise must remain central to long-term planning.
- Secure long-term, sustainable funding sources to close capital investment gaps.
- Accelerate state and federal permitting for rail infrastructure projects.
- Expand grade separation programs to enhance safety.
- Promote shared freight-passenger corridor agreements.
- Increase use of innovative financing and project delivery.
- Continue investment in predictive maintenance technologies.
- Strengthen climate resilience standards statewide.
- Expand zero-emission locomotive adoption.
- Support workforce development in rail operations and maintenance.
- Ensure consistent coordination across agencies for regional mobility goals.

Rail

B

DEFINITIONS

ACTA:	Alameda Corridor Transportation Authority
BNSF:	BNSF Railroad
Caltrain:	San Mateo County Transit District
CCJPA:	Capitol Corridor Joint Powers Authority
CCTC:	California Central Traction Company
CFNR:	California Northern Railroad, subsidiary of G&W
CHSRA:	California High Speed Rail Authority
Double tracks:	Two sets of complete tracks within one right-of-way.
EPA:	Environmental Protection Agency
FRA:	Federal Railroad Administration
G&W:	Genesee & Wyoming
LOSSAN:	Los Angeles-San Diego-San Luis Obispo Rail Corridor, 351 miles of coastal rail line serving six counties, and numerous rail operators, including Amtrak, UPRR, BNSF and Metrolink, with projects administered by a variety of planning agencies.
NCTD:	North County Transit District
PADS:	Predictive Arrival and Departure System
PHL:	Pacific Harbor Line
POLA:	Port of Los Angeles
POLB:	Port of Long Beach
POR/RPRC:	Port of Richmond/Richmond Pacific Railroad
POS:	Port of Stockton
PTB:	Precision Train Builder, program which optimize train operations
PTC:	Positive Train Control, a multifaceted computer system that monitors trains and rail, relaying that information to the trains and a central control point, allowing for real-time management of speed and position.
ROCS:	Rail Operations Control System
SCCRTC:	Santa Cruz County Regional Transportation Commission
SCORE:	Southern California Optimized Rail Expansion. A Metrolink program.
SCRRA:	Southern California Regional Rail Authority, Metrolink
Short line:	Smaller rail lines and operators serving “first mile/last mile,” connecting industry to main lines and markets.
SJJPA:	San Joaquin Joint Powers Authority
SJRRC/ACE:	San Joaquin Regional Rail Commission
SJVRR:	San Joaquin Valley Railroad
SMART:	Sonoma-Marin Area Rail Transit
SOGR:	State of Good Repair Program, a Metrolink initiative.
TVSJVRRA:	Tri-Valley San Joaquin Valley Regional Rail Authority
UAS:	Unmanned Aerial Systems, a system of drones, data capturing systems, and data processing that provides detailed images and information for design, construction, and maintenance.
UPRR:	Union Pacific Railroad
WCNSS:	Wireless Crossing Nearside Station Stop

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Roads

Downtown Los Angeles Traffic Jam. Wikimedia.net

ROADS

EXECUTIVE SUMMARY

California's roads are crucial for its economy and nearly 40 million residents. However, this infrastructure faces significant challenges including worsening congestion, deteriorating pavement, and a growing funding gap, further exacerbated by noticeable increases in the frequency of extreme weather events. The state ranks first in the nation for urban highway congestion, with drivers in major metropolitan areas losing over 100 hours annually due to traffic delays. Nearly one-third of California's roads are in poor condition, placing the state among the worst for pavement quality. Despite efforts like the Road Maintenance and Rehabilitation Program (Senate Bill 1, 2017), increasing demand, inflation, declining gas tax revenues, and the impacts of extreme weather conditions are contributing to a multi-billion-dollar unfunded backlog in existing maintenance and rehabilitation. It is estimated the state will face a $70 billion funding shortfall over the next 10 years.

Looking ahead, strategic investments in infrastructure upgrades, congestion management, and innovative funding solutions are essential for a resilient and efficient transportation network. Priorities include expanding smart road technologies, improving safety for travelers, and enhancing climate resilience. Exploring new revenue models like mileage-based user fees is critical for the long-term financial sustainability of the road system. By integrating innovation, sustainability, and strategic funding, California can build a road network that supports economic growth, environmental goals, and future mobility needs.

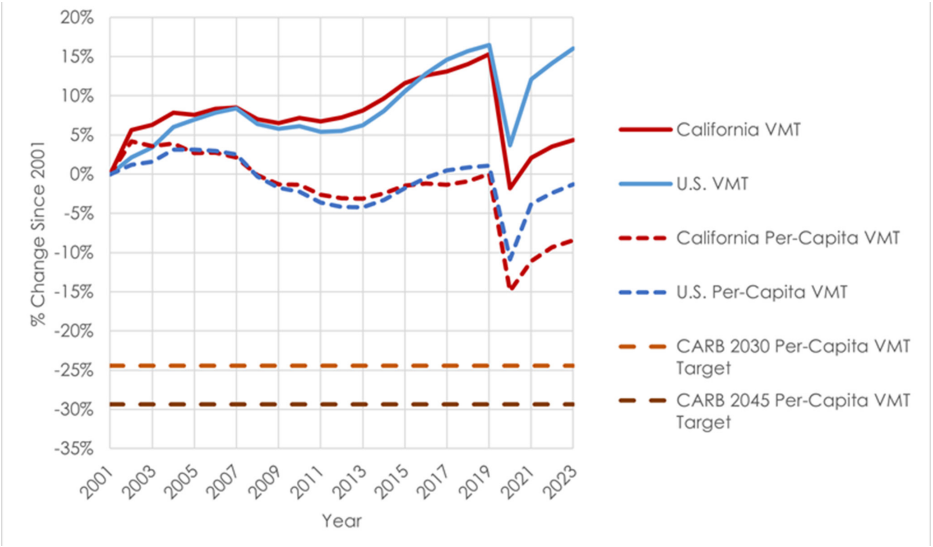
CAPACITY

California's transportation system is vital for the state's economy and growing population but is significantly challenged by congestion and increasing vehicle-miles-traveled (VMT). California leads the nation in congested urban interstate highways during peak travel hours, with 87% of lanes experiencing congestion. Vehicle travel in the state increased by 17% from 2000 to 2019, growing from 307 billion to 359 billion miles annually. Even with a 41% decrease in travel during the early COVID-19 pandemic, it rebounded to just

7% below pre-pandemic levels by 2023. As California's population has increased by 15% since 2000, demand remains high for road capacity and effective congestion management.

This congestion costs residents $28 billion annually in wasted fuel and lost time. According to the Bureau of Transportation Statistics' (BTS) ranking for the months of April through June of 2025, the Los Angeles metropolitan statistical area is the most congested urban area nationally, with 7:27 hours of congested hours[1]. The San Francisco-metropolitan area ranked 10th, with 5:33 congested hours. While roadways primarily serve private vehicles, it's important to recognize their shared function for pedestrians, cyclists, transit users, and freight movement. The prioritization of vehicular travel has led to an inequitable active transportation network that needs much investment to meet statewide mobility goals.

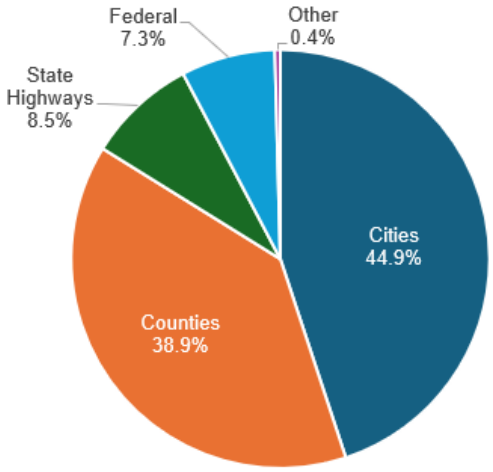
Figure 1: Trendlines of California and National Growth of VMT 2001-2023[2]



CONDITION

California has a vast public road network, totaling 177,576 miles (458,866 lane miles), which is the second largest in the United States. Of these, 42.8% are rural (75,993 miles) and 57.2% are urban (101,583 miles). Federal agencies maintain 12,919 miles, and state highways account for 15,133 miles; the rest are maintained by local jurisdictions. Pavement conditions are typically assessed using the Pavement Condition Index (PCI), a scale from 0 to 100. Per the California Statewide Local Streets and Roads Needs Assessment Final Report dated April 2023, the average statewide PCI was 65.3, falling into at-risk or poor categories in 54 out of 58 counties. While PCIs for major and local roads are similar across urban areas, local roads in rural areas often have lower scores.

Figure 2: Road Centerlines Miles by Agency in California[3]

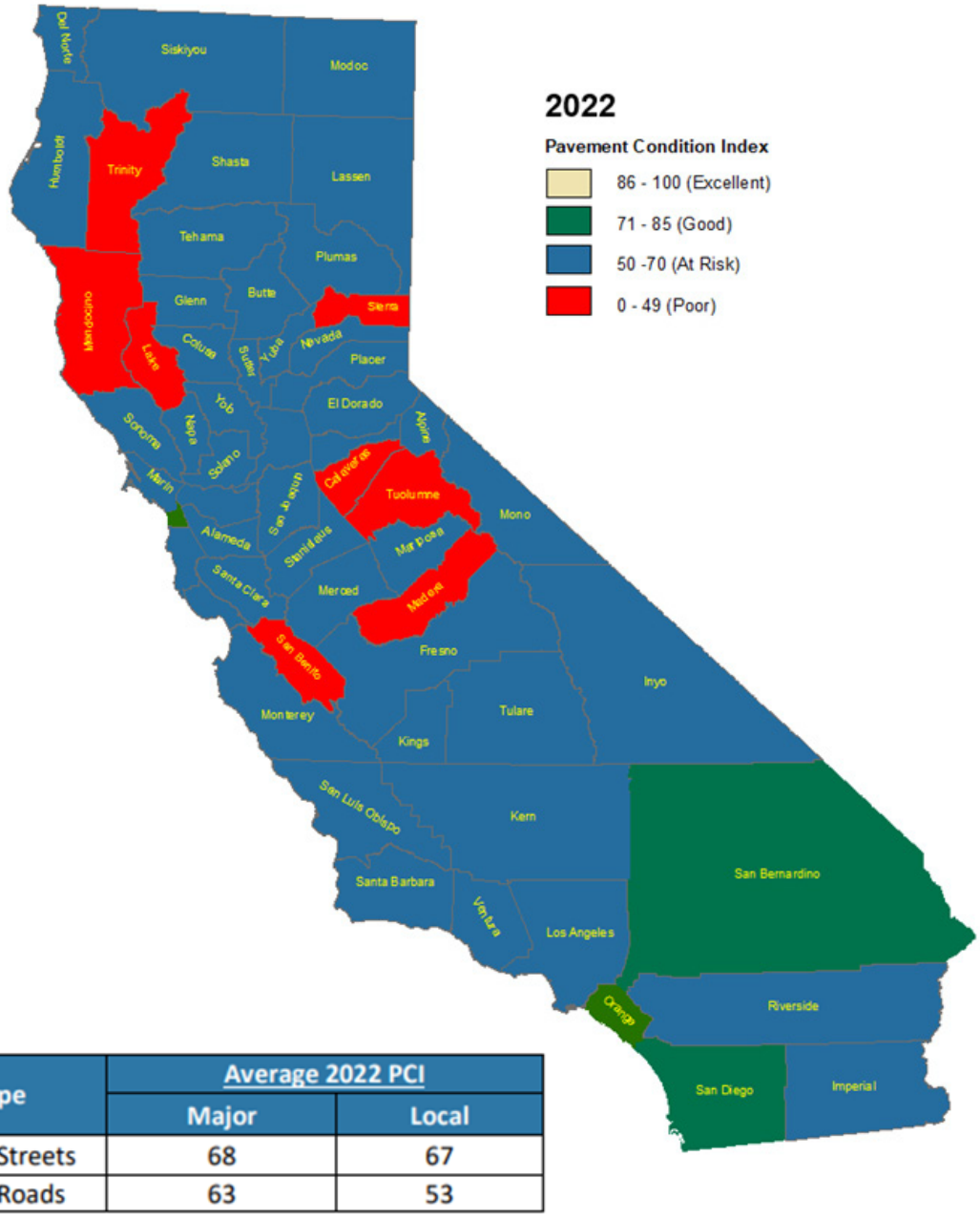


[1] "Congested Hours are computed as the average number of hours during specified time periods in which road sections are congested — speeds less than 90 percent of free-flow speed (e.g., 54 mph if free-flow speed is 60 mph). This measure is reported for weekdays (6 am to 10 pm). Averages are weighted across road sections and urban areas by VMT using volume estimates derived from FHWA's HPMS."

[2]California VMT Data from Caltrans (https://dot.ca.gov/programs/sustainability/sb-743/ca-vmt, accessed Sep. 2025)

[3]Caltrans, California Public Road Data, 2023: Statistical Information Derived from the Highway Performance Monitoring System (HPMS), Published Dec. 2024 (https://dot.ca.gov/-/media/dot-media/programs/research-innovation-system-information/documents/hpms2023-prd-final.pdf, accessed Sep. 2025)

Figure 3: Average Pavement Condition Index (PCI) Values per County in California[4]



Type	Average 2022 PCI	
	Major	Local
Urban Streets	68	67
Rural Roads	63	53

Based on Bureau of Transportation Statistics' State Transportation by the Numbers, in 2023, 28% of California roads were considered in 'poor' condition, ranking the state among the worst states in this regard. Beyond pavement, the road network includes essential safety and traffic components like traffic signs, curb ramps, sidewalks, catch basins, streetlights, and traffic signals. These components require their own dedicated maintenance budget, which highlights the significant financial challenges beyond just pavement upkeep.

[4]California Statewide Local Streets and Roads Needs Assessment Final Report April 2023 (https://savecaliforniastreets.org/wp-content/uploads/2023/05/Statewide-Needs-2022-FINAL.pdf, accessed Sep. 2025).

[5]State of California, Build CA, IIJA by the numbers (https://build.ca.gov/iija-by-the-numbers, accessed Sep 2025).

FUNDING

The primary funding source for transportation infrastructure is the motor fuels tax at both federal and state levels.
The federal motor fuels tax (18.4 cents-per-gallon on gasoline and 24.4 cents- per-gallon on diesel) has not been raised since 1993. This has led to a significant reduction in purchasing power due to increased fuel efficiency, the rise of electric vehicles (EVs), and a failure to index the tax to inflation. These federal funds are deposited into the Highway Trust Fund and allocated back to states based on formulas. The Infrastructure Investment and Jobs Act (IIJA, also known as the Bipartisan Infrastructure Law, BIL) is estimated to provide California an additional $28.2 billion in transportation funds between FY 2022 and 2026 through a formulated distribution and competitive grants.

At the state level, California charges excise taxes (currently 59.6 cents per gallon) and state and local sales taxes for gasoline purchases (averaging 3.8%). These taxes are projected to raise $7.5 billion annually. A portion ($2.46 billion) is allocated to cities based on population, and to counties based on a formula of population (75%) and maintained road miles (25%). This allocation formula can lead to disparities. For example, Fresno County has the most maintained road miles but receives half the funding of Orange County. Caltrans uses the remaining $5 billion for maintaining highways and transit as well as competitive state grants.

While the Road Maintenance and Rehabilitation Program (RMRA, SB1 passed in 2017) provides crucial revenue, a significant maintenance funding gap (around $70 billion) remains for the next 10 years. To address this, cities and counties must increase their own investments, and the state must explore innovative funding models, including greater private sector involvement. Many counties (25) have transportation sales tax measures, supported by a majority of voters, which help to reduce the funding gap. The state could look into a federal partnership through substantial and sustainable funding, ideally via an increase in the federal fuel tax (with modification to account for EVs). The possibility of mileage-based taxes at both state and federal levels is being considered. As of 2025, the federal government is considering reducing competitive grant funding and increasing formula funding to states, with the effects of this potential shift yet unknown.

FUTURE NEED

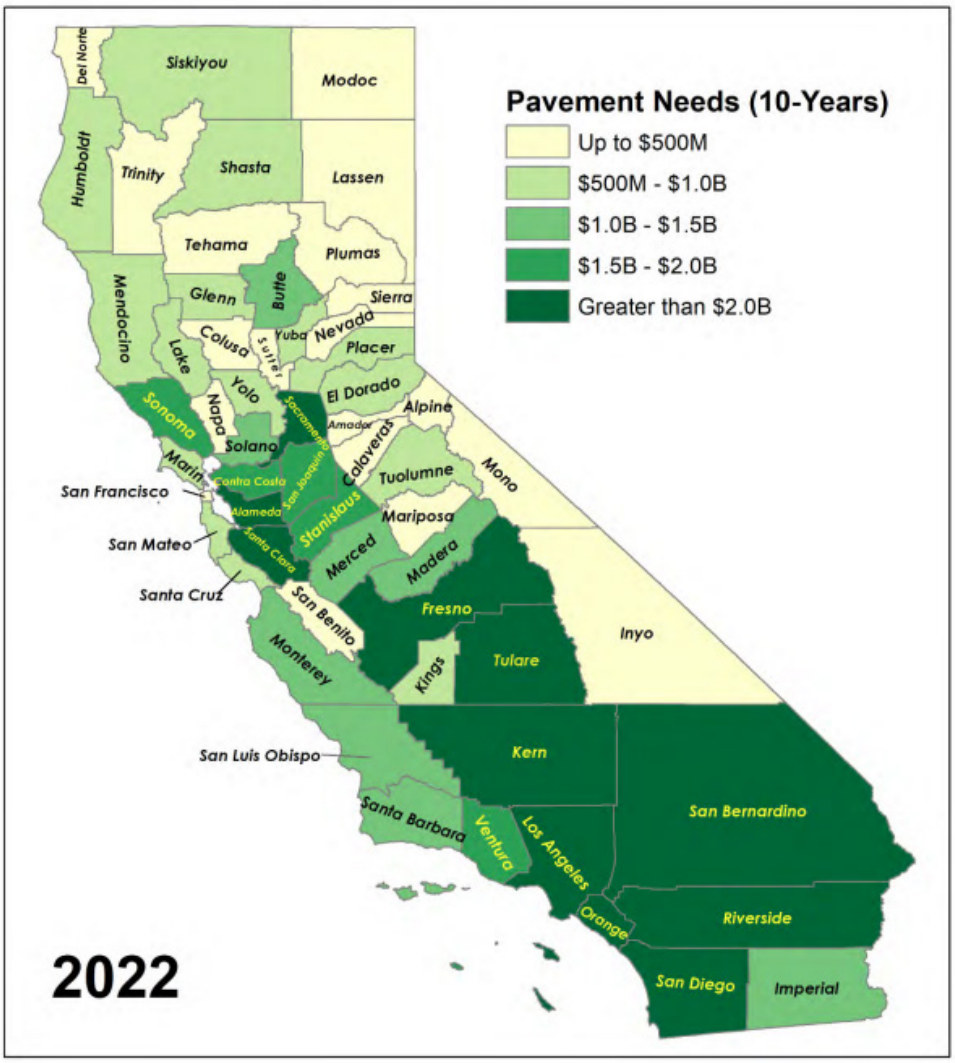
California's road infrastructure must adapt to meet the growing demands, population, evolving mobility needs, and changes in extreme weather events. Although California's overall population growth has recently slowed (as stated by the CA Dept. of Finance, 2023), demand on the road network continues to increase. Vehicle miles traveled (VMT) have grown steadily, reflecting sustained congestion pressures (Caltrans, CTP 2050; FHWA Highway Statistics). Reports like the California Transportation Plan (CTP) 2050 emphasize the urgency of addressing persistent traffic congestion in major urban areas, which results in lost productivity, increased emissions, and a lower quality of life. Strategic investments in road capacity, multimodal improvements, intelligent transportation systems (ITS), and improved traffic management are necessary to alleviate congestion and optimize the movement of people and goods. Multimodal improvements include investments in pedestrian and bicycle facilities through Caltrans' Active Transportation Program (ATP), as well as Complete Streets approaches that enhance safety and mobility for all users[6]. Furthermore, maintaining and rehabilitating the state's aging infrastructure, including highways, bridges, and local roads, remains critical, According to the 2025 State and Local Transportation System Needs Assessment, prepared by Caltrans and approved by the California Transportation Commission, the projected funding gap for maintenance, rehabilitation, and multimodal transportation needs over the next 10 years is approximately $216 billion (needs: ~$757 billion; revenues: ~$541 billion)[7].

Compounding these issues is the need for sustainable funding mechanisms, as the increasing adoption of electric vehicles reduces revenue from traditional fuel taxes. Exploring alternatives such as mileage-based user fees and expanded tolling will be vital for the long-term financial stability of California's transportation network.

[6]FHWA, "Complete Streets Transformations: Six Scenarios to Transform Arterials using a Complete Streets Implementation Strategy," 2022.

[7]California Transportation Commission, Senate Bill 1121: State and Local Transportation Full Needs Assessment, May 2025.

Figure 4: 10-Year Pavement Needs by County in California[8]



Note: pavement needs are only one piece of the overall set of system needs. Data about other parts of the system (e.g. bike and pedestrian infrastructure) are not captured in this data.

Safety, climate resilience, and active transportation are equally important priorities. Reducing traffic fatalities and severe crashes requires targeted interventions, including roadway system improvements, better pedestrian and cyclist protections, and advanced vehicle-to-infrastructure safety systems.

Adapting infrastructure to withstand climate impacts like wildfires, floods, and extreme heat is crucial for long-term reliability. Promoting mobility options through active transportation, including expanded bike lanes, pedestrian pathways, and multimodal connections, can help reduce congestion, improve public health, and lower greenhouse gas emissions. These measures, along with a commitment to equity, sustainability, and technological integration, are essential for a road network that supports California's economic vitality, environmental goals, and the quality of life for all residents.

OPERATION AND MAINTENANCE

California's roads face a critical point, with current funding insufficient for existing operations and maintenance needs. This is compounded by the uncertainty of future funding due to the state's goals for electric vehicle transition and current state budget shortfalls.

[8]https://savecaliforniastreets.org/wp-content/uploads/2023/05/Statewide-Needs-2022-FINAL.pdf

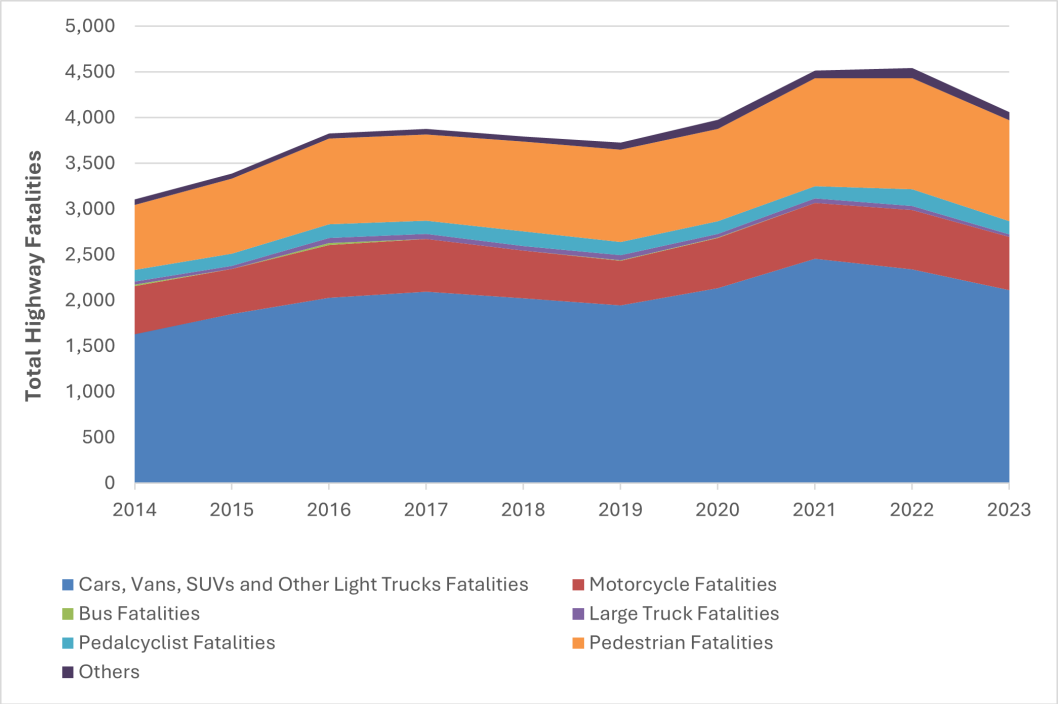
With current funding levels, municipalities must rely on pavement preservation strategies to maximize the benefit to their network. These treatments are often the most cost-effective when compared to pavement reconstruction, allowing cities and counties to address a larger percentage of their jurisdiction's roadways. Based on current RMRA funding, this would slow the decline in pavement conditions over the next 10 years but increase the amount of unfunded long-term pavement rehabilitation needs.

In addition to roadway pavement, California cities and counties manage an extensive network of traffic control devices. In particular, the City of Los Angeles maintains over 4,800 traffic signals. Additionally, Caltrans is responsible for approximately 5,300 traffic signals. Agencies statewide employ strategies and technologies like traffic signal synchronization, intelligent transportation systems, and traffic management and operations centers to monitor traffic flow, reduce congestion, and improve decision-making. Maintenance and expansion of these strategies regionally is crucial for optimal operations across different jurisdictions.

To improve operations and maintenance, agencies should continue upgrading to smart, adaptive systems that adjust to real-time traffic conditions. Implementing predictive maintenance using sensors and data analytics can proactively identify and resolve issues, reducing downtime and costs. Regular training for maintenance staff and the use of drones and automated technologies can enhance inspection and repair efficiency.

Impacts of increased frequency of extreme weather conditions exacerbates the demand for increased road operations and maintenance. As extreme weather events become more common, gas tax revenue is being diverted from traditional operations and maintenance to address the increased risk of severe winter storms, flooding, wildfires, and the resulting mud and debris flows[9]. Eight of California's top 20 most destructive wildfires have occurred in the past five years. As climate-related disasters grow in frequency and severity, diverting gas tax revenue is no longer a temporary fix but a necessary shift. By integrating climate risk into financial planning, agencies can better safeguard both infrastructure and public safety against the growing threat of extreme weather events.

Figure 5: 10-Year Highway Fatalities by Vehicle Category[10]



[9]In October 2019, Governor Newsom signed Executive Order N-19-19, leveraging over $5 billion in annual state transportation spending to reduce greenhouse gas emissions and promote climate goals

[10]Data from the Bureau of Transportation Statistics (BTS), State Transportation Statistics

PUBLIC SAFETY

In spite of dropping in 2023, California traffic fatalities increased 31% over the past decade. After a 30-year decline, motor vehicle fatalities experienced a significant surge in 2021. In 2021, California reported 4,513 traffic fatalities—a 13% increase from the previous year. In 2021, CA roads were the 3rd deadliest in the US for pedestrians. Pedestrian fatalities rose by 16% to 1,179, while pedalcyclist fatalities declined by 1% to 134. The state's traffic fatality rate of 1.26 per 100 million miles traveled aligns with the national average. The economic toll of traffic crashes in 2023 reached $41.1 billion, driven by factors like lost productivity, property damage, medical expenses, legal fees, and emergency services. Speeding, aggressive driving, and impaired driving are major contributors, along with limited roadway safety features, which are linked to roughly one-third of fatal crashes.

Local Road Safety Plans (LRSPs) and Vision Zero (municipal plans for reducing transportation accident) strategies can help agencies identify high-risk locations and prioritize safety improvements. Key engineering interventions include updating striping and addressing geometry such as sight distance and turn pocket lengths, widening shoulders, implementing roundabouts, enhancing signage and markings, and introducing traffic-calming features – such as speed humps, raised sidewalks and curb extensions in pedestrian zones. These measures play a critical role in reducing crash risks, especially for active transportation users such as pedestrians. However, engineering alone is not enough to curb the rise in fatalities.

To maximize impact, efforts must also focus on engagement and enforcement. The Office of Traffic Safety (OTS) and Caltrans have increased statewide funding for public awareness campaigns and educational initiatives, particularly around work zone safety. Collaboration with local communities and advocacy groups is vital to protect bicyclists and pedestrians. On the enforcement side, data-driven policing can help target risky behaviors and locations, promoting safer driving. Federal programs like Safe Streets for All and Safe Routes to School offer crucial funding for the three "Es" of safety—Engineering, Engagement, and Enforcement. Meanwhile, embracing technology such as smart traffic signals and vehicle-to-infrastructure communication presents promising solutions for reducing human error and improving overall traffic safety.

RESILIENCE

California's transportation infrastructure is increasingly vulnerable to the impacts of climate, facing critical threats from sea level rise, wildfires, and other extreme weather events. In the 2024 California Ocean Protection Council publication titled "State of California Sea Level Rise Guidance", the sea level rise projections for year 2050 range between 0.2 foot (low scenario) and 1.2 foot (high scenario), with an intermediate scenario of 0.8 foot. The projections for year 2100 range between 1.0 foot (low scenario) and 6.6 feet (high scenario), with an intermediate scenario of 3.1 feet.

A 5.5-foot sea level rise could put approximately 130 miles of state highways at risk due to rising seas, accelerated soil erosion, and cliff retreat. In addition to sea level rise, nearly 8,000 miles of State highways are expected to be at risk of wildfires this century, with 7,068 miles at risk by 2025. Combined with the threat of storm surges and the potential for landslides due to changing precipitation patterns, California's highway system is facing multifaceted climate perils.

In response to the Promoting Resilient Operations for Transformative, Efficient, and Cost-Saving Transportation (PROTECT) Federal Aid Program, California devised its own state transportation resilience strategy through the State Climate Resilience Improvement Program for Transportation (SCRIPT), which is now effective in the California Transportation Plan 2050. SCRIPT highlights the urgency of addressing these risks through long-term investments and adaptive policies and summarizes existing policies, tools, and approaches to combat climate impacts concerning surface transportation. In 2020, Adaption Priorities Reports (APRs) were completed by Caltrans that served to identify thousands of high priority assets, including roadways, vulnerable to the impacts of climate. To address asset management related to climate adaption and resilience, Caltrans has also proposed a $1.8 billion dollar budget over five years within the draft 2023 State Highway Operation and Protection (SHOPP) Program, administered through the State Highway System Management Plan (SHSMP). This $1.8 billion dollars is specifically allocated toward sea level rise and cliff retreat investments and was officially adopted in the 2024 SHOPP by the California Transportation Commission.

Figure 6: Centerline Miles of CA Highway Exposed to Natural Disasters

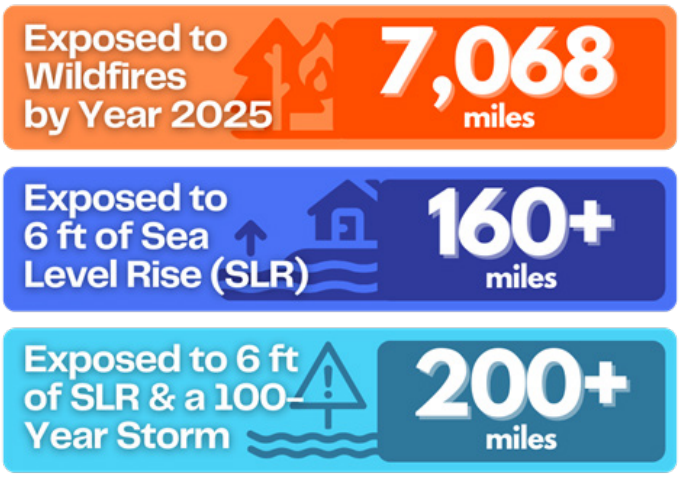
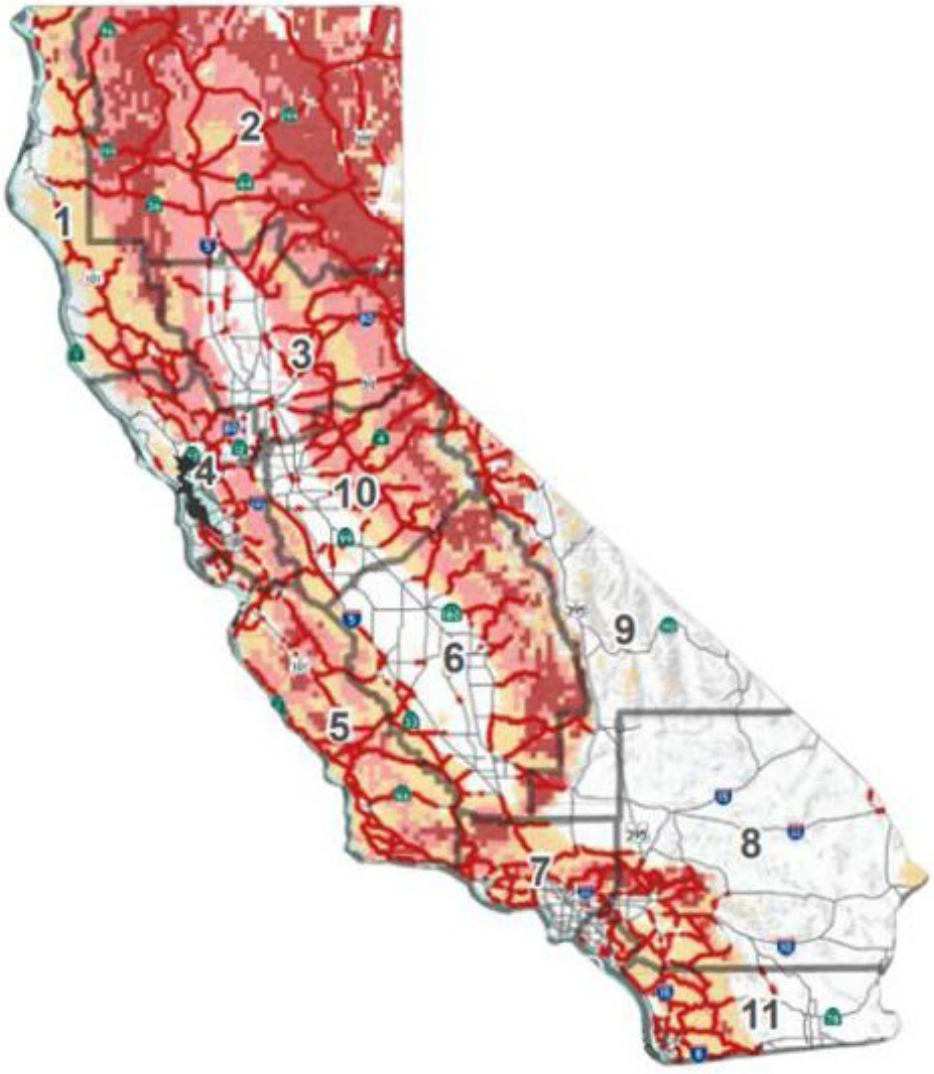


Figure 7: CA Highways Exposed to Wildfires by Year 2025



California is at risk from all six major climate stressors: temperature rise, changing precipitation, wildfire, sea level rise, storm surge, and cliff retreat. Proactive measures, such as hazard mitigation, are crucial to reduce these risks, and studies show that every dollar spent on such mitigation efforts can save six dollars in future costs. Investing in resilience is crucial for ensuring the long-term reliability of California's highways[11].

INNOVATION

Addressing the challenges of California's road infrastructure requires a forward-thinking approach that embraces technological innovation. Integrating smart road technologies is crucial for enhancing traffic management and safety. Smart roadway sensors can provide real-time data on traffic flow, road conditions, and maintenance needs, enabling predictive maintenance and reducing costly repairs. Utilizing artificial intelligence with this data can optimize traffic signal timing, reduce congestion, and improve incident response effectiveness. Planning for the widespread adoption of autonomous and connected vehicles is essential, requiring updates to road designs, lane markings, and communication infrastructure to support vehicle-to-infrastructure (V2I) connectivity.

While California is investing in these (and other) different innovative technologies, it is also pioneering wireless charging roadways for electric vehicles, using embedded inductive technology to recharge vehicles while driving. In addition, California is advancing beyond conceptual frameworks by implementing pioneering pilots and scaling new technologies to modernize its transportation network. However, to address the existing and future challenges, more innovation and work are needed. Examples of some of California different innovative projects include the following.

Caltrans' I-210 Connected Corridors Program in Los Angeles integrates roadway sensors, adaptive traffic signal control, and predictive modeling through an Integrated Corridor Management (ICM) framework. This pilot, conducted in partnership with UC Berkeley PATH, LA Metro, Foothill Transit, and local jurisdictions, demonstrates real-time coordination across freeways, arterials, and transit systems. It is a precursor to a statewide effort that could expand ICM strategies to approximately 50 congested corridors.

The California Integrated Travel Project (Cal-ITP) is developing statewide data systems to improve real-time traveler information and multimodal connectivity, laying the foundation for more efficient, technology-enabled trip planning and fare payment across the state. California is also investing in vehicle-to-infrastructure (V2I)-ready express lanes in the Bay Area and San Diego to prepare for widespread adoption of connected and automated vehicles.

In the area of electrification, California is a national leader in wireless charging roadway demonstrations. In 2023, the California Energy Commission awarded funding to Electreon to deploy inductive charging technology in Los Angeles County, making California one of the first states to pilot this innovation. Building on this momentum, the Port of Long Beach is hosting the first U.S. demonstration of high-power wireless charging for heavy-duty freight vehicles, supported by a $3.3 million CEC Clean Transportation Program grant. This freight-focused application represents a critical step in decarbonizing goods movement infrastructure.

By integrating corridor-level traffic management, multimodal data innovations, and cutting-edge EV infrastructure, California is establishing itself as a leader in the deployment and scaling of transportation technologies that enhance safety, sustainability, and mobility. Future road infrastructure must also prioritize climate resilience. Roads and bridges need to be designed and retrofitted with sustainable materials capable of withstanding extreme conditions while minimizing environmental impact. Permeable pavements, reflective coatings, and the use of recycled materials like rubber and plastics can enhance durability and sustainability. Advanced construction techniques, such as 3D printing of road components, can streamline the building process and reduce costs. By investing in innovations that support autonomous, connected, and electric vehicles, address environmental challenges, and integrate emerging technologies, California can ensure its road infrastructure remains reliable, efficient, and resilient for future generations.

[11]National Institute of Building Science's Mitigation Saves: 2018 Interim Report.

RECOMMENDATIONS TO RAISE THE GRADE

- Increase Investment in Maintenance and Rehabilitation: Address the growing backlog and prevent further deterioration of the existing road network.
- Implement Sustainable Funding Mechanisms: Explore and adopt new revenue models such as mileage-based user fees and consider increasing traditional funding sources to ensure long-term financial stability.
- Expand Smart Transportation Technologies: Invest in and deploy intelligent transportation systems, connected vehicle technology, and data analytics to improve traffic flow, safety, and efficiency. Capitalize on novel Generative AI tools for enhancements in the different areas of roadway infrastructure and systems.
- Enhance Climate Resilience: Design and retrofit infrastructure to withstand the impacts of natural disasters from sea-level rise, wildfires, and extreme weather.
- Promote Multimodal Transportation Options and Strategic Development/ Planning: Integrate various modes of transportation and ensure land-use planning supports efficient transportation networks, reducing reliance on single-occupancy vehicles.
- Expand Investments, Research, Programs, and Implementations for Roadway Safety: Increase investments and research. Adopt Vision Zero and Local Roadway Safety Plans (LRSPs). Expand Complete Streets and active-transportation-focused safety upgrades. Deploy proven safety countermeasures and smart technologies like V2I and adaptive signals. Use data-driven enforcement to target high-risk areas and driver behaviors.

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Schools
D+

SCHOOLS

EXECUTIVE SUMMARY

As of 2025, California's nearly 10,000 public schools, serving approximately 6,000,000 students, face major facility challenges. While structural safety has improved since the 1933 Field Act, aging infrastructure remains critical—30% of schools are over 50 years old and require significant modernization. California's K-12 public schools are facing a complex set of challenges shaped by budget constraints, economic pressures, and shifting priorities. Although state funding remains near historic highs—with Proposition 98 allocating approximately $18,935 per student to each School District in the 2025–26 fiscal year—many Districts are struggling financially due to declining enrollment, rising operational costs, and the expiration of key federal programs.

These issues are particularly acute in rural areas, where the loss of funds from the Secure Rural Schools Act of 2000 has created significant gaps. At the same time, inflation and staffing shortages have increased costs, making it more difficult for schools to maintain quality services.

BACKGROUND

California serves approximately 6.4 million K–12 students, with 90% (5.8 million) enrolled in public schools. This report focuses on public school infrastructure.

As of 2024, the state has 9,997 public schools across 1,019 districts, ranging in size from Los Angeles Unified (529,902 students) to Alpine County (2 students). Districts operate as municipal agencies with elected trustees, funded through property taxes and voter-approved bonds. Proposition 13 (1978) limits property tax revenue, leading many districts to rely on bonds for facility funding. Public school enrollment has declined 7% since 2017–18, with shifts from coastal to inland regions.

CAPACITY AND CONDITION

California, the most populous U.S. state with 39.4 million residents, has seen stagnant population growth from 2020 to 2024, marked by small declines. Driven by reduced birth rates, aging demographics, and shifting migration patterns, this trend has led to a steady drop

in the school-age population and public K–12 enrollment.

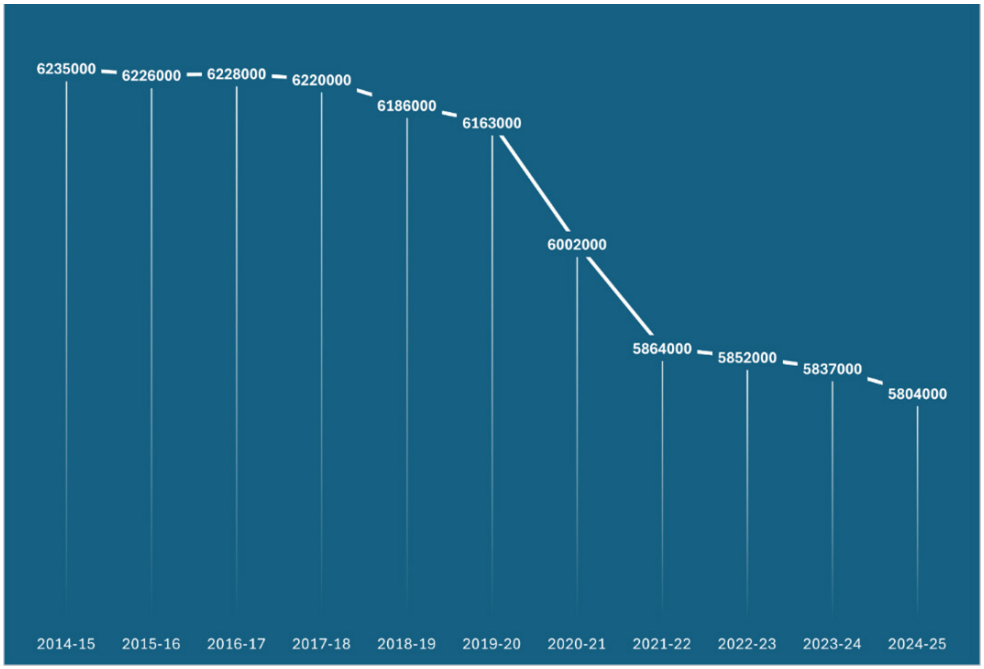
Over the past five years, nearly 75% of school districts have experienced enrollment declines. Projections indicate a continued downturn, with the California Department of Finance forecasting a loss of over 500,000 students by 2030—and federal estimates suggesting declines may exceed one million.

The decline is most severe in coastal and urban areas. Greater Los Angeles, for example, is expected to see a 19% drop by 2030, following a 15% decline over the past decade. San Francisco, San Diego, and similar regions face similar losses due to high living costs and outward migration of families.

In contrast, parts of the north Central Valley and Sierra foothills are seeing modest enrollment increases (3–4%) driven by lower housing costs and growing residential development.

As of 2025, California's nearly 10,000 public schools serving six million students face major facility challenges. While structural safety has improved since the 1933 Field Act, aging infrastructure remains critical—30% of schools are over 50 years old and require significant modernization.

Figure 1: California Public K-12 Enrollment



In 2024, the California State Auditor estimated funding of $15-$17 billion is needed annually to meet basic facility needs, to ensure safety, resilience, and climate-readiness. Total statewide capital needs for modernization and new construction exceed $100 billion over the next decade. Proposition 2, passed in 2024, provides $10 billion for renovations and construction—but only addresses a fraction of the need.

Facility disparities persist, with wealthier districts better able to pass local bond measures, while low-income and rural areas fail to pass local funding and therefore fall behind. An estimated 38% of students attend schools with substandard conditions, including leaky roofs and outdated HVAC systems.

FUNDING

California's K-12 public schools are funded through a combination of state, local, and federal sources, with the state providing the majority of funding. The state's funding system is shaped by voter-approved policies, local tax revenues, and federal contributions aimed at supporting education programs, including those targeted at high-need students.

A survey conducted by the California Department of Education (CDE) revealed that many districts lack the capacity to apply for state grants or match local contributions due to insufficient data on their facility conditions (PPIC, 2023).

To address these challenges, California should consider reform to School Facility Program (SFP) to ensure equitable access to funding across all districts. Policymakers should prioritize comprehensive data collection on facility conditions and climate risks to inform future investments.

The state government provides approximately 55–60% of total K-12 funding, primarily through Proposition 98, a constitutional amendment passed by voters in 1988. Additionally, Proposition 2 passed in Nov 2024 authorized $10 billion in general obligation bonds for repair, upgrade and construction of K-12 public schools, community colleges, and career technical education programs

State funding includes Local Control Funding Formula (LCFF), categorical aid, and grants for school construction and modernization. Local school districts contribute around 33% of total funding, mainly from property taxes, parcel taxes, and developer & facility use fees. Property taxes are the largest source of local revenue, though Proposition 13 (1978) limits how much districts can collect from property tax increases. The federal government provides about 7–10% of K-12 funding, supporting programs such as Title I grants for low-income schools, special education (IDEA) funding, school nutrition programs, and COVID-19 Relief Funds (ESSER) for pandemic-related learning loss and health measures.

California's per-pupil spending has increased significantly in recent years, but it remains below the national average when adjusted for cost of living. Nominally ranked, the state is in the middle nationally in per-student spending. In addition to high housing and labor costs, California proves to be more expensive to support education compared to other states.

Figure 2: California Public K-12 Funding

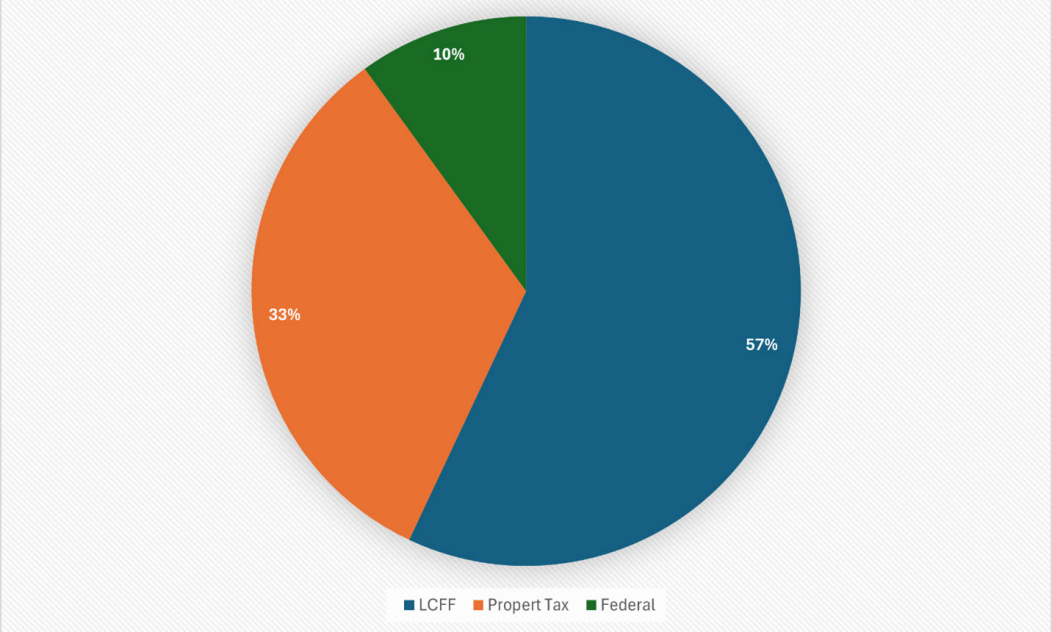
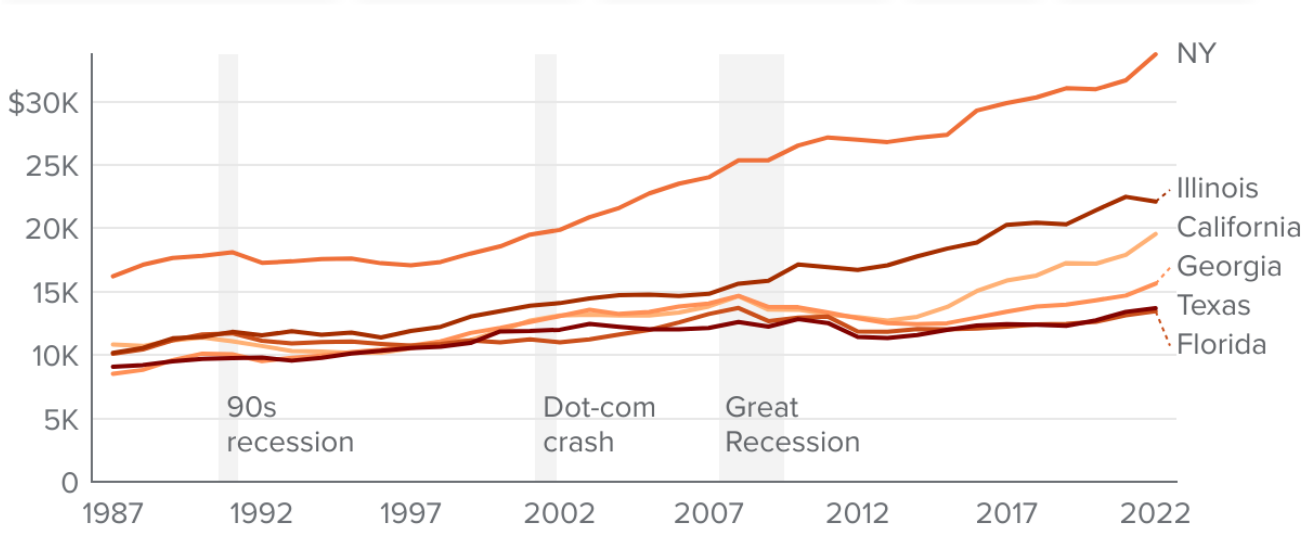


Figure 3: California Comparison to Other States



Source:
Ed-Data.org, Fiscal, Demographic, and Performance Data on California's K-12 Schools
Public Policy Institute of California, Financing California's Public Schools

FUTURE NEED

In the near term, successful districts will take a measured approach: aligning facility master plans with enrollment projections, consolidating selectively, and channeling limited capital dollars toward modernization, resiliency, and student wellness infrastructure. At the operational level, attention must remain on financial sustainability through staffing alignment, community partnerships, and evidence-based programs that protect attendance and engagement.

California's K-12 system faces fewer students but greater expectations. The next three to five years will require thoughtful balancing: preserving educational quality and community presence amid demographic decline, leveraging every available state and federal funding stream, and modernizing schools not only as learning environments but as resilient public assets capable of serving communities in both ordinary and extraordinary times.

OPERATION AND MAINTENANCE

Everywhere in California, students are relying on the safety and functionality of their schools to receive a satisfactory education. Routine upkeep on school facilities, such as custodial services and HVAC upgrades, is essential for maintaining a safe and functional learning environment. However, in California, funding for facility operation and maintenance is severely underfunded; over 74% of California school districts do not meet the spending standards in place to keep their facilities safe and functional .

One area that has seen improving investment in recent years is HVAC. Increased frequency and severity of wildfires, as well as the COVID-19 pandemic have contributed to the prioritization of facility upgrades that focus on air quality. As part of the American Rescue Plan Act, a 2021 federal COVID-19 relief package, California received over $540 million for facilities and repairs with over half being allocated for HVAC projects (FutureEd 2023).

The California Schools Healthy Air, Plumbing, and Efficiency Program (CalSHAPE) was authorized in the fall of 2020 with an aim to improve the health and safety of students and educators. This program provides funding and grants to public schools to upgrade HVAC

systems and replace or upgrade plumbing fixtures and appliances in schools that fail to meet water efficiency standards. As of August 2023, more than $182 million worth of indoor air quality-related grants have been awarded with more than $235 million of funds that were available up to May 2024.

Though the availability of this funding is an improvement, it is not sufficient to fully address the deficiencies in HVAC and water efficiency conditions. Even with grants and programs such as CalSHAPE, data shows that schools are consistently falling short in both of these categories.

According to the principals of return on investment (ROI), the amount spent on operations and maintenance should be 3% of the current replacement value (CRV) of the facilities, while capital spending should be 4% of the current replacement value. California has at least 730 million square feet of public K-12 facilities as of 2020. Given the average square foot replacement value in California, the statewide CRV for all school facilities should be $412 billion (2022$). Using this information, the average operations and maintenance spending per student should be $1,889 and the average capital spending should be $2,519 per student (Vincent et al. 2022).

Figure 4: Characteristics of School Districts Based on Average Annual Capital Spending and Annual Maintenance and Operations Spending

	Number of School Districts	Total enrollment, 2018-19	Average Annual M&O Spending per Student	Average Annual Capital Spending per Student	Average District Share of Disadvantaged Students	Average Property Value per Student	Median Property Value per Student	Average Annual Capital Revenue from State of California
Districts Rated "Good" on both M&O and Capital Spending	32 (4%)	322,525	$1,756	$3,094	54%	$3,230,565	$1,560,580	$391
Districts Rated "Good" in One Spending Category	196 (22%)	2,224,968	1,466	$2,476	56%	$2,459,296	$1,409,657	$334
Districts Rated "Fair" or "Poor" in Both Spending Categories	668 (74%)	3,368,138	$1,340	$848	62%	$2,128,818	$1,115,547	$208

However, the majority of schools are not meeting these standards. As seen in Figure 4, only 4% of districts in California are rated "good" on both M&O and Capital Spending, meaning they meet at least 75% of the spending standard, and 74% of districts are rated "fair" or "poor" in both of these categories. This significant gap in school district spending harms students by limiting their access to safe and functional facilities.

Overall, the operations and maintenance of school facilities in California require significant improvement to ensure clean, safe, and properly maintained environment for students to focus on their education.

PUBLIC SAFETY

The California Department of Education oversees the development of Comprehensive School Safety Plans, which address risks like seismic safety, fire protection, and emergency communication systems (CDE 2024). Risks continue to rise as a result of aging infrastructure, growing frequency of extreme weather-events, and steadily increasing temperatures.

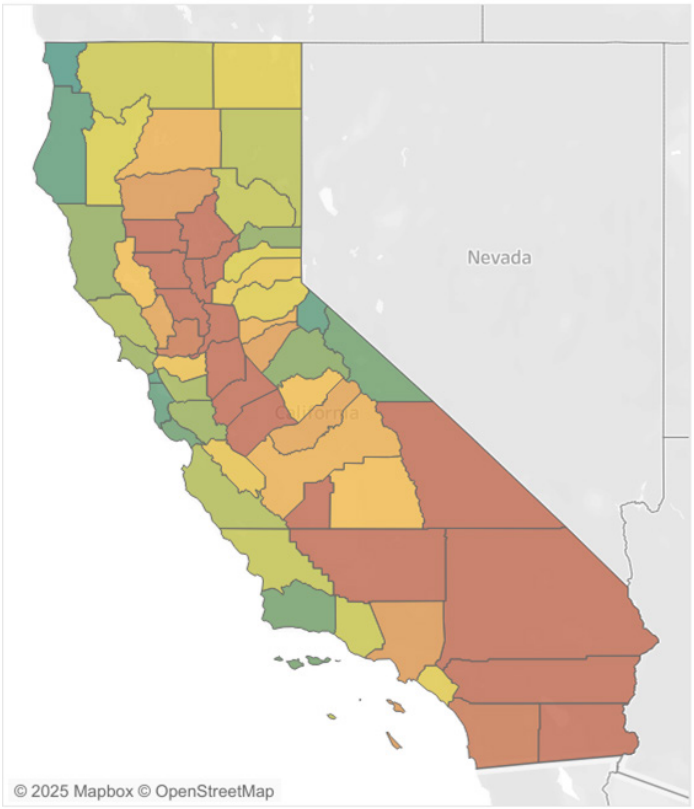
Approximately 30 % of California public schools were built more than 50 years ago. As such, a significant portion of school facilities are approaching the end of their intended life span. As these facilities begin to age, prioritizing upgrades can support both the structural integrity of campuses and the long-term educational experience for students.

The condition of facilities is critical to the safety of students, especially as extreme weather events, such as wildfires, become more frequent. Wildfires and the resulting poor air quality significantly impact daily life. In California, more than four million students live in areas with high wildfire risk. Beyond structural integrity, updated HVAC and air quality mitigation measures can greatly improve student health and safety throughout wildfire season.

Facilities can protect students from these risks and continue operations by taking appropriate preventative measures like maintaining HVAC systems and creating "clean air rooms." While all schools ideally have the means to support clean air in all classrooms, creating and maintaining a large clean air room is a baseline goal for all schools, as they can also serve the greater community as a clean air shelter outside of school hours in emergency situations (WSPEHSU 2021).

Higher temperatures present additional challenges for California schools with the past decade experiencing some of the highest average temperatures in the last 100 years (Extreme Weather Watch 2024). Prolonged exposure to excessive heat not only negatively impacts students but also affects infrastructure, such as school buildings. High temperatures cause materials in buildings to expand and contract, accelerating deterioration, while dry weather can lead to subsidence, causing buildings to sink as the surrounding environment shifts. In this decade, over 1.6 million students are projected to experience over 120 days of above-87 degrees, which could lead to learning disruption if they lack the proper facilities, like HVAC and shade on school grounds (Brunner & Vincent 2020).

Figure 5: Average Days above 87 Degrees in a Year (Brunner & Vincent 2020)



Increasingly frequent heat waves, wildfires, and flooding events disrupt education and strain aging facilities. Many schools lack energy-efficient HVAC systems and wildfire-resistant materials necessary for safe operations during extreme weather events (Muratsuchi 2023). By prioritizing these actions, California can ensure that all students have access to safe, modern, and equitable learning environments.

Inadequate cooling infrastructure is associated with higher absenteeism, increased disciplinary referrals, and educational inequities. Schools serving low-income and minority students are less likely to have air conditioning, with excessive heat linked to 5% of the test score gap between Black and Latinx students and their White peers (American Economic Journal 2020). Developing a comprehensive hazard mitigation plan can help schools strengthen infrastructure against extreme heat and climate-related risks, ensuring long-term resilience and a safer learning environment.

RESILIENCE

Collaboration between school districts, local governments, and state agencies is key to integrating climate resilience into broader adaptation plans. Studies show that energy-efficient school buildings reduce operational costs by up to 30%, freeing up funding for other operations and maintenance needs (EPA 2015). By prioritizing sustainable design and disaster readiness, California can ensure that schools remain safe, functional, and environmentally responsible for future generations.

California K-12 public schools frequently serve as community shelters during disasters such as wildfires, floods, and power shutoffs. Authority for this use is provided under the Civic Center Act, which allows schools to be used for public purposes when not in session. Counties and the American Red Cross typically operate these shelters under agreements with school districts. While planning frameworks and programs exist statewide, readiness varies significantly. Many modernized schools are shelter-capable; others lack backup power, sufficient HVAC, or ADA access. Facility modernization gaps directly affect a district's ability to host displaced residents safely and comfortably.

INNOVATION

School districts can implement designs that can enhance the learning experience of their facilities, such as using solar panels, acquiring state-of-the-art technology, installing advanced air filtration systems that help mitigate impacts of wildfires, COVID-19, and other respiratory risks.

Schools are redesigning classrooms and outdoor areas to accommodate hybrid learning models, improve ventilation, and combat the spread of respiratory illnesses. By creating flexible learning environments that also mitigate health risks, districts can help students stay engaged and productive in class.

Smart climate monitoring is one of the innovations that can help improve not only the energy efficiency of schools, but also the daily environmental quality for the student body. Schools can implement AI-driven sensors to track indoor temperatures and air quality, ensuring safe learning environments during extreme heat or wildfire events. These sensors allow facilities to save money by using less energy while still accommodating student/faculty needs such as reducing instances of fatigue or heat strokes.

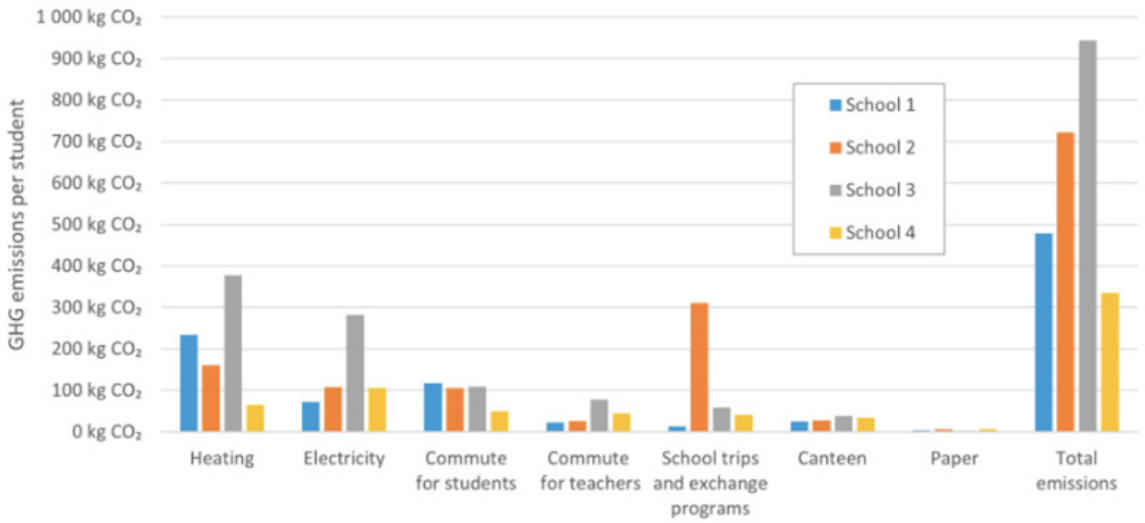
Multiple school districts in California have already implemented smart monitoring systems. Los Angeles Unified School District (LAUSD) has implemented an Advanced Energy Management System (AEMS) that includes smart climate monitoring. The system uses sensors to track indoor air quality, temperature, and humidity, ensuring safe learning environments and adjusting HVAC systems to maintain optimal conditions during extreme heat events. This technology is a part of a broader strategy to make schools more energy-efficient and comfortable for students (Los Angeles Unified School District, 2022).

Another advancement involves energy storage for school facilities. Battery storage and microgrid setups, such as solar panels can be a major upgrade for facilities seeking to increase resiliency in the face of increasingly volatile environmental conditions.

In 2020, the Santa Monica-Malibu Unified School District installed solar panels with battery storage at several campuses. This microgrid system provides a backup power source during grid failures caused by wildfires or other emergencies. The system allows the district to maintain power for critical systems such as lighting, cooling, and security while reducing reliance on the grid (Santa Monica Daily Press, 2024).
Air filtration is another important innovation necessary for the health and safety of students and staff. Air quality during wildfire season, as well as the transmission of viral and respiratory illnesses, are particular concerns.

For respiratory health, the Centers for Disease Control and Prevention (CDC) recommends that citizens take steps to maintain an

Figure 6: - Comparison of Green House Gas Emissions per Student for four different schools for various purposes.



environment with clean air. Clean air may not directly reduce the chances of getting sick but it helps prevent the transmission of small respiratory viruses (such as COVID-19) in smaller areas with lots of people, such as classrooms or lunchrooms in schools [National Center for Immunization and Respiratory Diseases, 2024].

Our goal is to enhance the operations and use of our K-12 school facilities. To achieve this, we must not only address existing issues but proactively identify and resolve potential hazards before they arise.

COVID-19 added additional restrictions and needs for improvement that schools must consider. Some of these conditions included a need for social distancing to meet safety requirements. Schools adjusted how they currently use their physical spaces, implemented thorough disinfection of school buildings, and are working to improve ventilation and air quality.

RECOMMENDATIONS TO RAISE THE GRADE

- Separate school funding into operations and capital infrastructure for better tracking and focus.
- Develop a program to record and maintain data on the age, status, and condition of K-12 school buildings state-wide.
- Reform Prop 13 by closing commercial property tax loopholes to increase school funding.
- Create a dedicated education rainy-day fund protecting schools from severe budget cuts during economic downturns.
- Target infrastructure investment to modernize school buildings and ensure equitable facility funding across districts.
- For students to perform their best, more funding needs to be put into operations and maintenance across California in order to meet the investment standards.
- Schools should retrofit existing facilities, improve stormwater infrastructure, and enhance emergency preparedness plans to maintain operations during crises.

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Solid Waste
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SOLID WASTE

EXECUTIVE SUMMARY

California relies on the Solid Waste infrastructure for the source reduction, collection, hauling, processing, recycling, and disposing of solid waste to protect human health, public safety, and the environment with its 1,350 active existing solid waste facilities and operations, including 141 active permitted landfills.

Looking to the future, the existing infrastructure is considered inadequate to meet the needs dictated by existing and recent legislative and regulatory solid waste reduction and recycling goals. While well intentioned, these policies are being implemented without sufficient markets, planning, infrastructure development and funding, and consideration of ongoing restrictions by other countries on imported recyclables as well as limits on export options outside of California. Increased recycling goals, combined with lower contaminant levels demanded by current end-markets, will make recycling much more expensive. The funding necessary to make up recycling capacity shortfalls is estimated at approximately $2.0-$4.0 billion per year, by 2035.

Overall, the condition of the solid waste category has declined over the last decade, largely due to the inadequacy of the infrastructure to meet new recycling goals and the closure of major solid waste disposal and processing facilities across the state. While this degrading condition is a state-wide issue, California rural areas face these same challenges with less resources, less funding, and inadequate infrastructure. Education of public and commercial customers remains a significant effort on jurisdictions, private industry, and the state.

BACKGROUND

California has established a significant solid waste infrastructure, expanded to align with local government mandates for implementing local Integrated Waste Management Plans (AB 939, 1989), which include elements for source reduction and recycling, siting of solid waste facilities, 15-year landfill capacity requirement, and household hazardous waste elements. Each jurisdiction is required to provide an annual report on progress meeting these mandates with potential enforcement for failure to achieve mandates on program imple-

mentation. Despite the success at achieving these requirements, illegal dumping continues to be an increasing problem facing the state. Land disposal tonnages continue to increase despite increased investment in diversion programs. Increasing statutory and regulatory efforts continue to increase the demands on the state solid waste infrastructure for collection and management.

As of the last year fully analyzed and reported on by Cal Recycle (2022), the state's solid waste agency, California's 38.9 million residents and 1.7 million businesses generated an estimated 76 million tons of material. Of the total materials generated, 53 % were sent to landfill; 15 % were exported as recyclables; and nearly 26 % were source reduced, recycled, composted, anaerobically digested, or mulched. The remainder of the material, less than 6 %, went to alternative daily cover (ADC), beneficial reuse, transformation, alternative intermediate cover (AIC), and waste-tire derived fuel.

Markets for diverted materials continue to fluctuate, placing increasing pressure on limited resources. California jurisdictions primarily rely on funding programs by the solid waste disposal tipping fee that is increasingly unreliable to maintain program implementation that is focused on decreasing solid waste disposal. California cities and counties are still struggling to comply with the Statewide organic waste diversion mandate (SB 1383, 2016). The recent adoption of a Plastic Pollution Prevention and Packaging Producer Responsibility Act (SB 54, 2022) imposes extended producer responsibility (EPR) program to manage packaging and single-use plastic food. California needs to address how the existing and future solid waste infrastructure will manage the increasing demands.

California has implemented various policies to reduce both the generation and disposal of solid waste including extended producer responsibility, waste reduction programs, organics diversion, food waste management, limitations on plastics and packaging, and increased waste fees.

CAPACITY

For more than three decades, Cal Recycle has been tasked with increasing recycling capacity in the state. New increased recycling capacity for 24 million tons of recyclables is now required to meet existing 75% recycling and waste disposal reduction goals – a virtual impossibility given the lack of recycling infrastructure and markets for recovered materials. In contrast to State recycling and disposal reduction goals, California's overall landfill disposal rate has remained flat over the last five years, hovering around 40 million tons (about 53% of generation), and recycling rates have only slightly increased to around 41% due to insufficient recycling infrastructure and end markets, including a continued decline in international exports.

California has 141 active, permitted landfills and the 30 rural areas account for 33 of them, or 23% of the total number of landfills. These landfills receive about 40 million tons per year of refuse with the rural facilities accepting about 2 million tons per year. The rural landfills have about 236 million cubic yards (about 175 million tons) of remaining landfill capacity (9%) of California's 2.6 billion cubic yards (about 1.9 billion tons) of remaining capacity. Overall, while there is sufficient landfill capacity for the current volume of waste disposed, certain areas in the state are facing capacity deficits fueled by closures of several major landfills over the last decade.

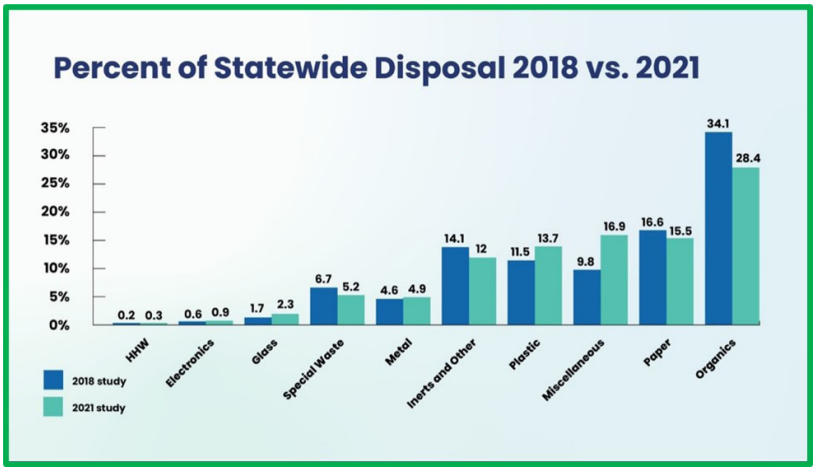
Multiple state, regional, and local government agencies regulate solid waste management in California, all with their own set of regulations and priorities. California's regulatory structure complicates the permitting of new or expanded facilities – much more so than other states.

The California Air Resources Board (CARB) has identified methane generated by organic waste decomposition in landfills as a priority greenhouse gas (GHG) pollutant. Even though California has one of the most robust landfill methane capture and destruction regulatory programs in the world, CalRecycle/CARB have mandated additional regulations, especially SB 1383, to further indirectly reduce

landfill methane emissions through organics diversion and recycling/food waste recovery. SB 1383 puts additional burdens on California's recycling and food waste recovery infrastructure. The organic waste diversion mandate established by SB 1383 was accompanied by highly prescriptive regulations that placed significant unfunded mandates on local governments, requiring among other things that every resident and business to sign up for organic waste collection services and local governments to provide the service, ensure collected organic materials are diverted from landfills, educate residents and businesses about the new service and enforce participation, including issuing fines if needed.

landfill methane emissions through organics diversion and recycling/food waste recovery. SB 1383 puts additional burdens on California's recycling and food waste recovery infrastructure. The organic waste diversion mandate established by SB 1383 was accompanied by highly prescriptive regulations that placed significant unfunded mandates on local governments, requiring among other things that every resident and business to sign up for organic waste collection services and local governments to provide the service, ensure collected organic materials are diverted from landfills, educate residents and businesses about the new service and enforce participation, including issuing fines if needed.

California's waste disposal infrastructure is adequate to meet needs for the foreseeable future, especially as diversion programs move waste away from landfills freeing up capacity. However, recycling infrastructure and commodity markets for recycled materials are currently inadequate to meet new recycling goals. The regulations to divert organics and recyclables from landfills require building a more robust state-of-the-art recycling infrastructure. This is especially true for procurement targets associated with SB 1383, which require the purchase of substantial quantities of compost that do not have markets in urbanized areas or comparable volumes of renewable natural gas, which requires substantial new infrastructure. Similar to landfills, these new recycling and processing facilities can face significant permitting challenges and will make recycling much more expensive.



Further exacerbating its capacity problem, California's Biomass and Mixed Waste to Energy (MWTE) infrastructure is in a state of near collapse. All three MWTE plants and numerous biomass plants have now closed, and there has been a steady decrease in the number of operational biomass plants over the last two decades with only 24 remaining biomass facilities in the state, but half of them located in rural areas where access to the largest volumes of waste streams is limited. Competition from cheaper energy sources (e.g., natural gas, wind, solar), increased costs to meet

more stringent air quality, GHG standards, and uncertainty of power purchase agreements, limit the continuing viability of many traditional energy from waste operations.

CONDITION

According to CalRecycle's most recent Enforcement Report (2023), enforcement actions indicate that the majority of solid waste facilities operate in conformance with state minimum standards. Of the 13,024 inspections conducted in 2023, 11,830 (91%) showed compliance with the standards and permits. In 2023, there were only 14 active or pending enforcement actions at California's 1,350 active solid waste operation (~1%), and the vast majority of those were resolved within a short period of time. There were only three facilities on the state's Inventory of Facilities Violating Minimum Standards for extended violations.

However, new policies mandate decreased disposal and increased recycling which exceeds the capability of existing recycling infrastructure. While existing recycling infrastructure was able to meet the historical quality standards for export recyclables to other countries, the majority of California's existing recycling facilities cannot cost effectively meet the latest quality standards imposed by end-markets. Further, existing facilities are not designed to handle the amount of material to be diverted for recycling under the various California program, such that major facility expansions and new facilities will be needed to meet the demand.

FUNDING AND FUTURE NEED

Unfunded mandates to achieve 75% recycling levels vastly exceed California's existing recycling infrastructure capacity. California does offer loan and financing options to help support investment, but nothing approaching the level necessary.

CalRecycle has a $25 million annual grant/loan program that represents less than 1% of funding needed for recycling and organics programs required by state policies. Current refuse collection rates range from $25 to over $75 per household in California, consistent with the national average. The rest will likely come from fee increases ranging from $12.50 to $25.00 per household per month (estimated) and more for commercial enterprises. These fees could take the form of recycling fees or added fees on the cost of commodities to be recycled, or both. At least a 50% increase in refuse collection rates may be required to achieve California's recycling goals. Recent increases in monthly household trash collection bills to accommodate SB 1383 have already resulted in public backlash.

Future solid waste infrastructure will combine existing disposal capacity with new and expanded recycling infrastructure. However, there is widespread public misunderstanding that recycling pays for itself. An estimated expenditure of $2 billion per year for the foreseeable future is estimated to be necessary to cover capital expenditures, operation and maintenance expenses, and logistical expenses to achieve California's recycling goals.

Increased recycling goals, combined with lower contaminant levels demanded by current end-markets, will make recycling much more expensive. The funding necessary to make up recycling capacity shortfalls is estimated below, based on an average annual net recycling cost range of $50 to $100/ton/year (costs minus revenues). This includes the increased cost of collecting, processing, recycling and marketing all forms of recycled solid waste to achieve an overall 75% reduction in disposal by 2025 as mandated by existing statutes and regulations. The cost implications are tabulated in this section.

FUTURE NEED	COSTS	TIMELINE
• 25 million tons per year existing capacity shortfall	$1.25 to $2.5 Billion/yr	5-10 Years
• 10 million tons per year lost export capacity	$0.50 to $1.0 Billion/yr	5-10 Years
• 5 million tons per year lost Biomass/MWTE capacity	$0.25 to $0.5 Billion/yr	5 Years
Total Added Recycling cost	$2.0 to $4.0 Billion/yr	By End of 10 Years

Additionally, the cost of further collecting and managing trash to achieve zero storm water discharge by 2030, as mandated by the State Water Resources Control Board, is estimated to exceed $1 billion/year. These needs and related costs not only include capital costs but also additional operations costs, including staffing, to mee the increased recycling goals while maintaining disposal capacity.

OPERATION AND MAINTENANCE

For the most part, solid waste facilities operate in compliance with established standards with adequate funding to meet existing operation and maintenance (O&M) costs, which vary widely by facility. Local solid waste fees on waste generators cover O&M costs. California imposes strict financial assurance requirements for closure and post-closure, corrective action and third-party liability. Solid waste facility permitting, operations, and compliance are overseen by a Local Enforcement Agency authorized by the state. Most facilities are subject to monthly inspection although some smaller operations are inspected quarterly. Although O&M is currently sufficient to meet facility requirements, the cost for O&M is expected to continue to increase in the future. Fees will have to be increased to keep up with these additional O&M demands. Additionally, the investments needed to upgrade California's waste recycling infrastructure to replace existing disposal capacity and achieve mandated recycling and waste reduction goals will have to be supported by increased fees. These fees will have to be sufficient to not only cover capital costs of new and expanded facilities but also the additional O&M costs that will also occur. Similar to other areas, there is sufficient staffing and operational capacity for disposal operations, but at the present, there is not adequate operational capacity and staffing to manage the additional diversion and recycling capacity that is anticipated.

PUBLIC SAFETY

Landfills are highly regulated but face continual increases in regulatory requirements on solid waste management, water quality regulations, and air emission monitoring and controls. Landfill design standards in California are more extensive than the federal standards especially for liner requirements, leachate collection removal systems, and groundwater monitoring requirements. There are extensive regulations on landfill closure and post closure maintenance is required to be maintained until the landfill no longer poses a threat which has never been defined so the expectation is to maintain the closed landfill indefinitely. Landfills are experiencing increasing public scrutiny yet the public continues to produce more and more waste for disposal.

Despite these regulatory requirements and safeguards, solid waste operations in the state pose a risk to public safety. Landfill and recycling facilities can impact nearby residents with air emissions, odor, and dust. Overall, these risks to the public are well managed, but individual facilities can impact the communities that surround them, resulting in regulatory enforcement and occasionally lawsuits. Nonetheless, California regulators take proactive measures by collaborating with non-compliant facilities to implement corrective actions that safeguard public health and safety.

Vehicular and on-the-job accidents are an ongoing concern but are being aggressively addressed by advanced safety technology and practice; however, solid waste management remains one of the most dangerous professions based on health and safety data. Public concerns persist regarding the acceptability of certain disposal practices such as landfills and combustion. This is an underlying reason the state is emphasizing waste minimization and recycling over solid waste disposal. Although viewed by many as an outdated, unsafe, and wasteful practice, landfill disposal is still heavily relied upon for more than 50% of the solid waste produced. Recycling technologies are becoming increasingly advanced (and expensive) for paper, plastics, glass, and metals. California policies discourage the production of energy, fuels, and chemicals from wastes due to past public health concerns, although technology to safely process wastes has advanced significantly – but with increasing costs.

RESILIENCE AND INNOVATION

California has developed an extensive program for the management of solid waste with statutory and regulatory requirements. Jurisdictions are required to implement programs and continually evaluate their progress. However, California faces threats such as earthquakes, fires, and floods, which have significantly impacted solid waste infrastructure. Wildfires have resulted in significant increases in disposal of debris far beyond local resources. These can temporarily disrupt waste collection, processing, recycling, and composting services. Waste debris from disasters is difficult to recycle, usually requiring some degree of hazardous waste and recyclable material sorting, but largely relying on landfill disposal to manage disaster debris. Fortunately, California has significant remaining landfill capacity – at least at the present – but if these disasters continue, there is certainly a threat that the debris will reduce remaining landfill capacity while adversely affecting long-term landfill management.

The Plastic Pollution Prevention and Packaging Producer Responsibility Act (SB 54) imposes requirements on producers to manage their products and pay for the management of these materials including development and funding of infrastructure to manage these materials. This effort will likely result in product redesign to reduce waste and increase recyclability.

RECOMMENDATIONS TO RAISE THE GRADE

- Reevaluate mandatory recycling goals based on available capacity and market demand for recyclables. Incentives and funding along with capacity and markets must be planned in advance to ensure recycling goals can be realistically achieved.
- Explore whether organic waste diversion from landfills is the most cost effective (and verifiable) means to reduce landfill methane emissions. Provide more flexibility for how local governments can comply. A comprehensive and transparent evaluation of natural resource, energy, and GHG lifecycle impacts is also essential.
- Revisit statutes that limit the use of solid waste to produce lower carbon fuel and to displace other higher carbon fuels, energy and chemical sources. Provide incentives to customers, such as utilities, agriculture, or manufacturing, to purchase fuels, energy, chemicals and recyclables derived from wastes.
- Implement a Waste Management Hierarchy that includes energy recovery above disposal and seeks to minimize unmanaged dispersion of waste into the environment.
- Adequately educate the public on proper recycling practices to reduce contamination and encourage markets.
- Develop a funding structure not dependent on the declining solid waste disposal tipping fee. Regulatory oversight programs should be a shared cost with other facilities such as transfer stations, recycling facilities, and organics management.
- Continue to develop source reduction and other circular economy strategies to reduce the increasing solid waste disposal tonnages.
- Continue to support Extended Product Stewardship programs, such as SB 54, to increase producer responsibility for creating products to be more recyclable and less disposable, including public education.
- Increase statewide efforts to support local efforts to combat illegal dumping.
- California needs to refocus its attention on technologies and internal markets that can help meet its recycling goals/policies, including waste conversion technologies to safely and cost-effectively convert waste residuals (e.g., organics, paper, plastics) into low carbon fuels, energy, and chemicals.

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Stormwater

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Stormwater Landscapes in South San Francisco. Akel Engineering Group

STORMWATER

EXECUTIVE SUMMARY

Stormwater infrastructure in California encompasses storm drains, pipes, ditches, canals, basins, and channels. It also includes green infrastructure best management practices such as vegetated areas that provide groundwater recharge, trash capture, low impact development (LID), habitat, flood protection, and cleaner water. Much of the drainage infrastructure in California has been in place for over 50 years and requires repair or replacement to continue to provide proper level of protection. Furthermore, drainage system improvements needed to meet water quality standards and promote a sustainable environment are significantly underfunded. For instance, Los Angeles County voters passed Measure W in 2018 which will generate approximately $5.6 billion in tax revenue for stormwater quality improvement projects over the next 20 years. However, the cost of achieving water quality objectives has been estimated at approximately $24 billion, over that same time period, leaving a significant gap in funding. Recognizing that clean water is essential to life in California, additional substantial investment will be necessary to ensure sustainable clean water for future generations.

Over the past 50 years, stormwater protection has shifted from rapid removal to treating it as a valuable resource requiring quality measures. This change has made the field more complex and expensive, with evolving regulations demanding increased funding. Continued support relies on scientific evidence and public trust, but science-based decisions now face political challenges that threaten funding. To overcome these obstacles, it is vital to clearly demonstrate and communicate the effectiveness of current water quality measures and their impact, ensuring transparency about our progress and results.

BACKGROUND

This Stormwater chapter covers local drainage and water quality infrastructure across the state. Local drainage systems must mitigate flood risks and comply with the Clean Water Act (CWA) and the Porter-Cologne Water Quality Control Act. Funding is a major bar-

rier to improving these systems, as maintenance and improvements typically rely on city or county general funds unless tax increases are approved in accordance with state requirements, such as Proposition 218, also known as the Right to Vote on Taxes Act, in the California Constitution. Engineers must implement a holistic approach that balances flood mitigation and implementation of natural systems to capture, infiltrate and biotreat runoff.

California's population growth since the CWA's adoption has strained stormwater infrastructure, originally designed to quickly convey runoff containing pollutants to receiving waters. Many waterbodies no longer meet quality objectives, and emerging pollutants and climate impacts add further challenges.

Modernization of local drainage systems is crucial to meeting CWA objectives. Public education and outreach are necessary to overcome funding restrictions and secure investment in the health of our receiving waters.

CAPACITY

Continued land development activity and more stringent design criteria standards in the state puts a strain on existing system capacity. To date, these impacts have been largely mitigated through managed urban development and good engineering design practices that incorporate local, statewide and/or federal best management practices across the state. New requirements, such as those specified in the Central Valley Flood Protection Plan, require new development to meet a higher standard. However, flooding also occurs in rural areas having limited drainage infrastructure and climate impacts may increase the frequency of these flooding events. Property damages have also increased due to fires across California, leading to more debris flows during storm events, as shown in Photo 1.

Photo 1: Apple Fire debris and mudflows in Beaumont, CA (RCFC&WCD, December 2021)

Local governments are working to meet increasingly stringent Municipal Separate Storm Sewer System (MS4) Permit water quality requirements. MS4 Permits are issued by the State Water Resources Control Board through their nine Regional Boards, in compliance with the CWA's National Pollution Discharge Elimination System (NPDES), requiring stormwater capture and reuse or treatment. Currently, few MS4 systems within the state have water quality treatment installed to meet all NPDES standards. For example, less than 19 % of urbanized areas in Orange County drain to a structural water quality treatment system (Source #2). The MS4 Permits generally require water quality runoff from urbanized areas be captured and infiltrated, biotreated before release into waterways, or recycled, treated and reused, consistent with water standards under Title 22 of California Code of Regulations.

CONDITION

Based on extensive inspection programs currently in place at many local and regional stormwater agencies, California's stormwater infrastructure is in moderate condition. Many stormdrain systems were constructed over fifty years ago, indicating they are approaching the end of their useful design life or are insufficient to protect the community. Though most agencies have extensive inspection

programs to detect and repair issues before a failure occurs, budgetary constraints slow the pace of inspection and rehabilitation.

The health and condition of the state's waters are best represented by the fact that most major creeks and rivers in the state have at least one approved Total Maximum Daily Load (TMDL) receiving water objective. Water bodies that do not meet water quality standards have TMDLs established to reduce pollution, comply with the Clean Water Act, and ensure waters are fishable, swimmable, and drinkable. TMDLs require dischargers to reduce the quantity of pollutants released into the water body until they meet the water quality standards to allow waterways to support beneficial uses again, such as for recreation or as a drinking water supply. Municipalities have also made significant progress in capturing trash and debris from their MS4s under the Statewide Trash Amendments. Although municipalities are investing in stormwater capture and treatment infrastructure to reduce pollutant loads, there has been limited improvement in receiving water quality, as evidenced by the 303(d) listings (California's list of impaired and threatened water bodies) and TMDL metrics that are not achieved within the required timelines. Attempts to obtain updates on the effectiveness of constructed water quality improvement devices in the San Francisco Bay area from the Contra Costa County clean water program, San Francisco estuary institute, and CASQA (California Stormwater Quality Association) have been inconclusive (Source #8).

Additional studies are being conducted to evaluate whether existing impairments are caused by anthropogenic sources. For example, South Orange County Permittees have been performing source tracking of bacterial indicators to develop and implement source-specific strategies that address human-generated water quality exceedances (Source #25).

FUNDING

Funding for water quality and flood risk mitigation comes from various sources, including state grants, bonds, general funds, stormwater fees, loans, and property taxes. There is limited funding available for municipalities to support programmatic and maintenance costs for existing infrastructure, additional funding sources are needed to meet current and future needs. The availability of funding for future stormwater infrastructure may be constrained by financial limitations at the local, state, and federal levels. For example, the majority of the Clean Water State Revolving Fund projects are for wastewater and water projects with few stormwater project receiving funding, which is likely due to both the ranking approach of projects as well as the requirement to have capital funding availability (Source #3). Several counties and cities have noted an upward trend in stormwater funding needs driven by the requirement to address aging infrastructure, provide adequate capacity to mitigate flood impacts, meet regulatory requirements, and enhance resilience to climate impacts.

Long-term projections indicate a significant funding shortfall. For example, over the next 20 years, it will cost Riverside County Permittees an estimated $15.4 billion to develop, implement, and maintain a Watershed Management Plan for the Santa Ana River (Source #9). In the Central Valley, investment in flood management is estimated to cost $25 billion to $30 billion over the next 30 years to avoid the high costs of catastrophic flooding, which is estimated to be as much as $1 trillion, according to the 2022 Central Valley Flood Protection Plan (Source #5). In Los Angeles County, the cost of achieving water quality objectives is estimated at about $24 billion, and in San Diego County, it is estimated at about $5 billion (Source #23, #7). In Orange County, implementing water quality capital improvement projects would cost a minimum of $2.8 billion (Source #2). To cite another example, the City of San Diego Think Blue Stormwater Department, estimates an average annual funding gap of $240 million over the next decade to address flood resilience and water quality. Much of their short-term funding is secured through low-interest rate WIFIA (Water Infrastructure Finance and Innovation Act) loans which will support a portion of the city's capital needs over the next 5 years. Outside of their general fund revenue, loans, and grants, the city has no other dedicated funding sources.

Adding to the challenge of developing stormwater revenue in California, in 1996, CA voters passed Proposition 218 (Prop 218) requiring voter approval of almost all local taxes, including assessments, charges, and fees, thereby limiting the ability for municipalities to raise fees to cover increased costs of stormwater regulations. While water and sewer services are exempt from some of the Prop 218 requirements, a 2002 court case ruled that stormwater fees did not qualify for those exemptions. In 2017, Senate Bill 231 (SB231) was signed into law, clarifying the definition of "sewer" to include both sanitary sewers and storm sewers, effectively allowing municipalities to adopt fees to support stormwater programs. Since the adoption of SB231, only a handful of California municipalities enacted storm-

water fees, and those that did have been challenged in court stating that under the State constitution (in which Prop 218 is enshrined), municipalities cannot levy stormwater fees without first holding a Prop 218 hearing.

The County of Los Angeles is one of the few municipalities that has successfully passed a stormwater funding measure within the constraints of Proposition 218. In 2018, the County electorate voted to provide additional revenue for stormwater management and associated infrastructure with the passage of "The Safe, Clean Water Act," or Measure W. They voted to tax themselves for parcels located in the Los Angeles County Flood Control District at a rate of 2.5 cents per square foot of impermeable area. An estimated $280 million is being collected annually and is used for projects that help the county meet state and federal water quality laws and capture, treat, and recycle runoff. Since the passage of this funding mechanism in 2018, Los Angeles County has been able to program $513.5 million towards 126 multi-benefit projects anticipated to capture stormwater from over 265,000 acres and provide an increase in local water supply of over 59,000 acre-ft per year. Additionally, $446.2 million has been allocated to fund over 360 projects and programs across the 85 Los Angeles County municipalities.

FUTURE NEED

Significant increases in funding will be required to support future drainage infrastructure and water quality maintenance and improvements. Preliminary estimates indicate a minimum of $50 billion will be needed over the next 20 years statewide in southern California alone. Current master planning efforts within the state are in the process of developing detailed cost estimates for this initiative. Proposition 4-Parks, Environment, Energy and Water Bond (2024) allocates $3.8 billion for stormwater management, capture & reuse, and low impact development infrastructure. While Proposition 4 allocates $110 million for urban stormwater management, this is significantly below the $50 billion projected to meet long-term needs in southern California over the next 20 years.

Furthermore, there is an urgent need to enhance programs aimed at educating the public and elected officials about the purpose, condition, and importance of drainage infrastructure in meeting flood risk mitigation and water quality objectives. Across the state and nationally, municipalities consistently report a lack of support for increased funding for drainage infrastructure. This lack of support is primarily due to insufficient information regarding the crucial role of drainage systems in environmental protection and in reducing the risk of personal injury and property damage during flood events. It is important that we have source data available to the public to demonstrate the effectiveness of the improvements that have been constructed to date.

Photo 2: Testing of Biofiltration Basins (Orange County Public Works, November 2024)

OPERATION AND MAINTENANCE

Local agencies typically strive to be proactive in maintaining existing drainage infrastructure to ensure proper operation, as shown in Photo 2. Public agencies have been recently developing and implementing asset management and inspection framework systems. However, both the inadequate infrastructure funding and the historical lack of a comprehensive asset management have necessitated a reactive approach, resulting in repairs being conducted only after failures occur. This financial shortfall presents a challenge compounded by an increase in drainage and water quality assets, aging infrastructure, and rising maintenance costs, which have strained an already limited budget. Key court cases, including the 2001 Los Angeles County MS4 Permit and the 2007 San Diego County MS4 Permit, represent unfunded-mandate challenges that were brought regarding municipal stormwater (MS4) permit requirements under the Clean Water

Act (Source #3).

New water quality facilities are generally well maintained due to their inclusion into the implemented asset management systems. However, as major water quality features age and require significant maintenance, increasing improvement costs due to inflation have restricted the ability to undertake substantial updates such as dredging or liner replacement. The State of California Water Resources Control Board (Water Board) mandates new water quality facility projects to develop operation and maintenance plans, along with committing to fund and execute these plans indefinitely. Additionally, the Water Board maintains a publicly accessible database and reporting system for all new water quality facility developments. Private citizens and local residents have the ability to report stormwater issues online or via phone with their municipality and State Agency for prompt resolution.

Private developments and new drainage infrastructure must adhere to uniform design guidelines and standards, or stormwater implementation program documents that are prepared and adopted by each local jurisdiction (or group of), to ensure proper sizing for storm drainage and flood control infrastructure. In contrast to water quality facilities, storm drainage operation and maintenance plans and their associated funding appear deficient, with limited mechanisms for adjusting rates to match inflation. Insufficient maintenance exacerbates watershed constraints faced by municipalities.

Local municipalities collaborate with the U.S. Army Corps of Engineers (USACE) to maintain large federal drainage systems like levees and related infrastructure. However, most operation and maintenance expenditures are covered by general funds, which tend to compete with other services and priorities. Municipalities and County agencies, such as Orange County Public Works and City of San Diego, have been implementing modern asset management and improvement programs for drainage infrastructure. An asset management system inventories all components of the MS4 systems and assesses their condition to estimate the remaining useful life. Asset management systems support planning for necessary repairs, upgrades, and construction of new components to provide sustainable flood risk management and water quality improvement. Currently, relatively few municipalities across the state maintain an asset management system.

PUBLIC SAFETY

There are several challenges to public safety from stormwater: drought, pollutants in stormwater runoff, adequate supply of water for

Photo 3: Poche Clean Water Project in San Clemente, CA impacted by high tides. (Orange County Public Works, December 2024)

groundwater recharge and surface reservoirs, impacts of changing climate and sea level rise, aging infrastructure and flooding due to inadequate maintenance.

To maintain public safety, ongoing assessment management and maintenance efforts are necessary. Local municipalities often collaborate with the USACE to address potential deficiencies in the federal storm drain network and with the Federal Emergency Management Agency (FEMA) for any development within the floodplain. Most state agencies participate in the National Flood Insurance Program (NFIP) administered by FEMA. Public safety is a high priority throughout the state; however, failures can occur, typically associated with infrastructure that has exceeded its design life.

In 2024, the City of San Diego removed roughly 10,000 tons of debris from flood control channels to enhance function and restore capacity. The city invested $235 million in EPA loan funding to support design and construction aimed at strengthening flood resilience through upgrades to channels, stream restoration, and storm drain improvements. These investments in infrastructure safeguard communities from flooding to ensure public safety (Source #7).

Expected sea level rise will further impact coastal stormwater infrastructure, as shown in Photo 3. In the 2024 California Ocean Protection Council publication titled "State of California Sea Level Rise Guidance", the sea level rise projections for year 2050 range between 0.2 foot (low scenario) and 1.2 foot (high scenario), with an intermediate scenario of 0.8 foot. The projections for year 2100 range between 1.0 foot (low scenario) and 6.6 feet (high scenario), with an intermediate scenario of 3.1 feet.

RESILIENCE

Municipalities, such as San Francisco, Los Angeles and San Diego, Sacramento and Oakland, are adopting climate resiliency protocols, including stormwater system design guidelines to address hazards like sea level rise and extreme rainfall. These guidelines integrate climate hazards into planning and decision-making processes. Watershed master plans also incorporate climate impact scenarios to identify infrastructure solutions that mitigate flood risks and enhance resilience.

Stormwater and flood control infrastructure consists of interconnected components such as pipes, catch basins, ditches, creeks, detention basins, levees, and dams. Failure in one part can affect the entire system, leading to costly damage and disruption. Flooding impacts residential areas, commercial zones, roadways, and public transit networks. Resilience depends on condition assessment, asset management, maintenance, rehabilitation, upgrades, and awareness of changing conditions due to development and extreme weather events.

Two national industry surveys show significant gaps remain in stormwater resilience. The 2021 Black & Veatch survey found only 29% of MS4 Phase II participants have emergency response plans. Similarly, the WEF's MS4 survey reported just 26% of municipalities use updated design standards to address extreme weather and stormwater resilience (Source #26).

INNOVATION

Recent innovative stormwater control measures improve water quality and conservation such as city of Anaheim's State College Stormwater Tank Project, which will capture stormwater runoff and direct it into repurposed wastewater pipes through a partnership with Metropolitan Water District (Source #15). California's water standards encourage these solutions, focusing on pretreatment, retention, and reuse. Efficient proprietary systems manage stormwater well, and agency collaboration aids in developing innovations. State MS4 NPDES Permits mandate green infrastructure integration in new developments and incentivize retrofits.

Public agencies are addressing new pollutants in runoff and groundwater, especially PFAS. Several PFAS treatment plants are being implemented in Greater Los Angeles.

RECOMMENDATIONS TO RAISE THE GRADE

- Communication. Implement a program to enhance communication and messaging that clearly explains the necessity of municipal stormwater services. This program should inform the public about the environmental benefits and improvements to the quality of life resulting from these services. Also the recent tragedy in Texas at the summer camp highlights the dangers of the general public being unaware of well-known and documented hazards from floodways.

- Planning. Municipalities and Counties should develop an infrastructure improvement plan. The initial step is creating an asset management plan, including a condition assessment. Upon completion of the asset management plan, an infrastructure improvement plan can be formulated to address necessary system repairs and upgrades to meet water quality standards and mitigate flood risks.

- Cost Estimate. Prepare a realistic, specific, and comprehensive cost estimate for the infrastructure improvement plan, encompassing repairs and enhancements to the existing drainage system as well as the construction of new facilities.

- Funding and Finance. Identify methods to finance the implementation of the infrastructure improvement plan. Funding may derive from various sources such as the jurisdiction's general fund, a new or existing improvement district, new taxes or fees, or traditional and emerging financing methods, including private sector financing. Legislative changes are also necessary to overcome current funding restrictions imposed by Proposition 218.

- Public Awareness. Make available to the public the documented effectiveness of stormwater improvements that have been constructed to date. Alert the public of known flood hazards that have already been identified.

DEFINITIONS

ASCE:	American Society of Civil Engineers
CASQA:	California Stormwater Quality Association
CWA:	Clean Water Act
EPA:	Environmental Protection Agency
FEMA:	Federal Emergency Management Agency
MS4:	Municipal Separate Storm Sewer System
NFIP:	National Flood Insurance Program
NPDES:	National Pollution Discharge Elimination System
PFAS:	Per- and Polyfluoroalkyl Substances
Prop 218:	California Proposition 218
SB231:	California Senate Bill 231

DEFINITIONS (cont.)

SFEI:	San Francisco Estuary Institute
TMDL:	Total Maximum Daily Load
USACE:	United States Army Corp of Engineers
WIFIA:	Water Infrastructure Finance and Innovation Act

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San Diego Rail in Front of Convention Center. Istockphoto.com\Laser1987

TRANSIT

EXECUTIVE SUMMARY

In California, 57 of the state's 58 counties are served by some form of mass transit. Passengers in the state took approximately 874 million transit trips in 2023. Getting riders onto transit – whether bus, light rail, heavy rail, ferry, or paratransit van service – is crucial to helping the state meet its ambitious greenhouse gas reduction goals. Increases in federal, state, and local funding have contributed to modest improvements in the condition of transit infrastructure, as measured by bus and light rail fleet age. The funding has also helped transit providers in the state keep service levels consistent. However, agencies are facing enormous headwinds. Increased operating and capital costs, stagnant fare revenue, and the cost of complying with the statewide zero-emission bus mandate are contributing to an uncertain future. Transitioning buses to zero emissions will cost approximately $9.5 billion alone, and the combined transit and rail capital and operations needs for the state are a reported $350.4 billion.

BACKGROUND

California's more than 200 transit agencies provide crucial service for the most populous state in America. Transit providers in California are national leaders in sustainability and have made major investments in electric buses, bike-sharing programs, and more. The table below provides shows the scale of some of California's major transit agencies' bus programs, demonstrating how important they are to their customers.

CAPACITY

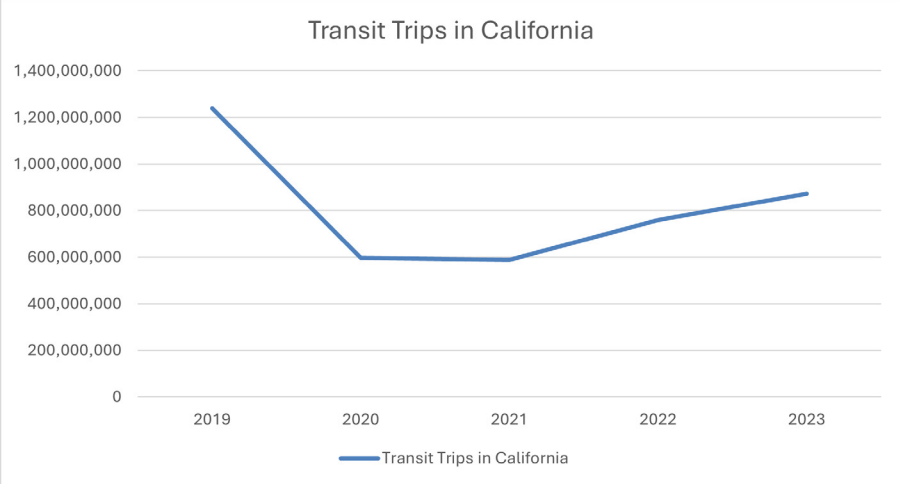
California transit providers are still feeling the impacts of the COVID-19 pandemic. Passengers took approximately 874 million trips on transit in 2023, down from 1.2 billion in 2019. However, there is reason for optimism. Ridership is still increasing on many systems, and agencies report particularly strong recovery trends during non-peak and weekend hours. Some transit agencies are back to pre-pandemic passenger counts; for example, Glendale – a city of 200,000 in

Top California Transit Agencies

City	Bus Fleet*	Annual Bus Passengers**
Los Angeles Metro	167	242,042,827
San Francisco MTA	510	129,605,824
San Diego MTS	475	38,796,905
Orange County TA	361	37,181,960
Santa Clara Valley TA	342	22,836,553

** From 2023 NTD Profile includes Bus, Trolley Bus, Commuter Bus Operating in Maximum Service*
*** From NTD Monthly Ridership 6/24 - 5/25 includes Bus, Trolley Bus, Commuter Bus*

Los Angeles County – reports 100% ridership recovery. In general, bus ridership has returned faster than light or heavy rail ridership. Commuter rail, which is covered in more detail in the rail chapter, has been among the slowest modes to return as it primarily serviced commuters working in-person jobs with regular business hours.



Source: Federal Transit Administration Monthly Ridership Reports

Because service has been maintained and overall ridership remains below pre-COVID-19 levels, current transit capacity is generally sufficient. Furthermore, there has been some system expansion. For example, the Los Angeles County Metropolitan Transportation Authority (LA Metro) has expanded its light rail system considerably, with several new stations and line modifications opening in the last three years, including one to Los Angeles International Airport.

Glendale Transit Buses in service

Looking forward, it is crucial that agencies maintain service in order to incentivize new and returning riders and help meet the state's ambitious greenhouse gas reduction goals of cutting air pollution by 71% and slashing greenhouse gas emissions by 85% by 2045. In 2022, the latest year data is available, just 3.1% of Californians took public transportation to work, whereas in 2019, 4.9% of Californians took public transit to the office. While working from home is more prevalent now than before 2020, many workers are returning to the office at least once a week, and policymakers and transit operators need to think strategically about how to encourage commuters to use public transit over driving to the office.

Glendale Transit Buses in maintenance

CONDITION

Transit agencies across the state have been investing in state of good repair projects and other enhancements to improve passenger experience and increase the reliability of service. For example, Bay Area Rapid Transit (BART) replaced 5.6 miles of rail in 2023, which reduced delays and created a quieter and smoother ride for passengers. The agency also plans to purchase 252 new rail cars by 2030.

Meanwhile, transit agencies are also investing in new rolling stock. Most agencies' buses are well under the useful life threshold of 14 years. Transit agencies across the state are also replacing their legacy rolling stock with zero-emission buses.

Transit Agency	Average Bus Age in Years (2023)
Sonoma County Transit	8.7
Foothill Transit	7.2
Mendocino Transit Authority	9.2
San Luis Obispo Regional Transit Authority	12.5

Source: 2023 National Transit Database Profile

Heavy rail, meanwhile, is only operated by two transit agencies in California. The operators report average car ages well below the useful life threshold of 31 years. For example, LA Metro's heavy rail cars average 26.4 years, while BART's cars average 18.9 years.
Light rail vehicles tend to be much newer in California than the national average of 19.5 years old and well below the useful life of 31 years. For instance, LA Metro's light rail vehicles are just 7.5 years old, while the San Francisco Municipal Transportation Agency's Muni service in the Bay Area reports an average vehicle age of 16.1 years and San Diego MTS reports an average age of 19.5 years, matching the national average.

FUNDING AND FUTURE NEED

Transit service – and its associated infrastructure – is funded by a combination of federal, state, regional, and local revenue sources. At the federal level, Congress passed the Infrastructure Investment and Jobs Act (IIJA) in 2021, which provides more than $6 billion in formula funding to California transit agencies over five years. This funding is distributed through formula programs for urban area transit capital and operating assistance, improving mobility for seniors and individuals with disabilities, and support for capital, planning, and operating needs for rural transportation agencies. An additional $284 million in formula funding from the IIJA is available to support the electrification of California buses, ferries, and other transit modes.

The federal government also provides additional revenue through competitive grants. As of 2025, California transit agencies have secured $3.33 billion in infrastructure grants and an additional $961 million to electrify buses, ferries, and more. Operators and infrastructure owners have accessed available federal dollars, in no small part thanks to support and coordination from California Department of Transportation (Caltrans), the California State Transportation Agency (CalSTA), and the Federal Transit Administration. Unfortunately, federally available funding is likely to be significantly reduced or eliminated and future investments will need to come from state and local sources.

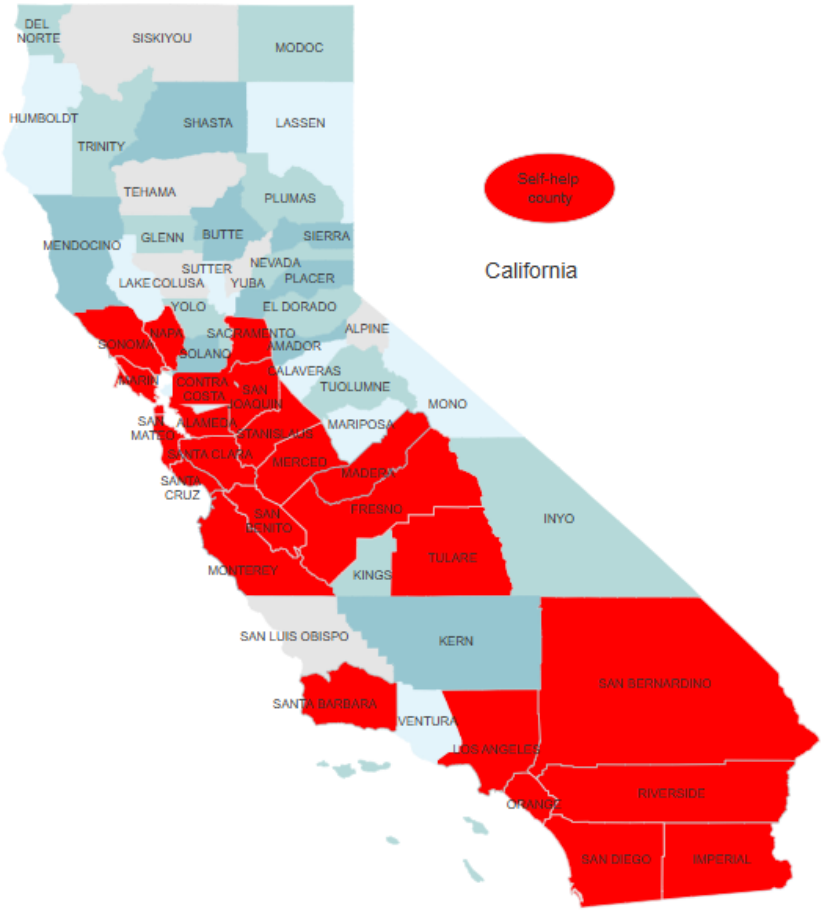
Glendale Transit Buses in service

State funding is available for transit through several mechanisms. Senate Bill (SB) 1, the Road Repair and Accountability Act of 2017, provides significant and reliable funding for both state- and locally-owned transportation systems, funded in part by an increase in the state gas tax. SB1 provides $750 million annually for the Transit Operations and Capital Program and significantly augments the funding originally available through the Transportation Development Act (TDA) of 1971, which is funded by a quarter-cent state general sales tax and legislative appropriations.

Additional funding is available each year through the state's Cap-and-Trade Program, which sets limits on greenhouse gas emissions and allows businesses to buy and sell permits to pollute within those limits. The proceeds of the permits are then invested in a variety of climate-related priorities, including 10% of annual revenues reserved for transit and intercity rail programs and an additional 5% re-

served for low-carbon transit operations. However, access to supplementary funding from this program depends on legislative decisions each year.

Finally, local funding plays a major role in supporting transit agency capital and operation needs. California has 25 "self-help" counties, where voters have approved dedicated sales tax measures to support transportation services. These counties often provide services like free rides to elderly, disabled, and veteran riders. Additional local revenue sources may include property taxes, developer fees, tolls, parking charges, and more. As part of SB 1, the state provided $200 million per year to further support counties where voters had opted into self-help.



Source: ASCE Transit Committee graphic; Source Self-Help Counties Coalition Membership list as of 7/29/25

The additional funding from the federal government through the IIJA and from the state through SB 1 has been enormously helpful, but aging systems and large state of good repair backlogs continue to challenge transit operators. The state is currently undertaking a comprehensive effort to determine the full extent of underinvestment in transit across California, but individual systems already report significant needs. For example, North County Transit District in the San Diego region reports a $1.2 billion gap in capital funding needed to meet its state of good repair needs and capacity enhancement projects. San Francisco Muni has identified only $2.5 billion (31%)

Transit Agency Size	Cost to Transition to Zero Emission Buses	Overall Cost
Large Transit Agency	$ 400 million per agency	$8.4 billion for all
Small Transit Agency	$ 38 million per agency	$1.06 billion for all

Source: California Transportation Commission's State and Local Transportation System Needs Assessment

of the funding needed for its $8 billion five-year Capital Improvement Program. Due to these funding challenges, 29 projects were deferred from Muni's short-term Capital Improvement Program to its long-term backlog.

Meanwhile, compliance with the statewide mandate to transition transit vehicles to zero emissions brings its own significant costs. The California Transportation Commission estimates it will cost $9.46 billion for transit agencies statewide to transition their fleets, excluding needed investments in clean fueling and charging infrastructure.

The California Air Resources Board estimates that compliance with the Innovative Clean Transit Regulation – the zero-emission vehicle mandate – alone will cost $1.9 billion.

OPERATION AND MAINTENANCE

Emergency funding has kept transit service steady over the tumultuous last five years. Specifically, in response to the COVID-19 pandemic, Congress provided California transit agencies with a total of $9.8 billion that could be used for capital or operating needs. As that funding began to run out, and with fare revenue still below pre-pandemic levels, state lawmakers stepped in and passed SB 125 in 2023, which includes $5.1 billion in operational funding for transit agencies over the next three years.

While this funding is greatly appreciated, long-term structural challenges remain. For example, BART expects an annual operating deficit of $375 million to $400 million beginning in FY 2027. Smaller operators and agencies also face serious fiscal challenges, exemplified by Santa Barbara Metropolitan Transit District, which reports a forecasted fiscal cliff of $4.6 million by 2028. As mentioned above, continued operations support is vital to maintaining or improving service levels, which in turn drive ridership and reduce greenhouse gas emissions from transportation sources, including passenger vehicles. A statewide working group, the Transit Transformation Task Force, is examining these challenges and is expected to issue recommendations in 2025 on how to address long-term operations needs, among other items. In the interim, the State Legislature voted in June to provide BART and Muni with a $750 million loan to help bridge the gap. If long-term funding is not identified, transit agencies across the state will face aging bus fleets, less reliable track, power, and signal systems for rail networks, and worsening conditions at stations.

Meanwhile, transit agencies throughout the state are facing work force shortages, particularly for front line roles like bus drivers and operators. Lingering impacts from the pandemic including demanding schedules, lower ridership and safety and security concerns for both workers and riders, contributing to recruitment and retention challenges. For example, the North County Transit District in San Diego reports that ongoing bus operator shortages have resulted in impacted service, and the agency has created a Training and Organizational Development Department to try to head off these challenges. New technologies like the deployment of zero emission vehicles are requiring new training and workforce development to operate and maintain the new fleets.

PUBLIC SAFETY

Ensuring safety on public transit is critical. Data generally show public safety is improving on some of the large systems across the state. BART reported a 15% drop in overall crime and a 10% drop in violent crime at the end of August 2024 compared to the same period in 2023. This follows a commitment to increased safety efforts, including additional police and intervention specialists present on the system.

After five years of rising crime rates on the LA Metro system and a string of violent incidents in the spring of 2024, LA Metro increased the presence of police and security officers and established its own police force in an effort to increase public perception of transit safety. The agency is also piloting a tap out program that requires riders to use their fare card when entering and exiting the system, as opposed to just when entering.

Other agencies are also innovating to ensure a safe experience for their customers. For example, Fresno is providing funding to the local police departments to incentvize cooperation and responsiveness on transit lines. This extra funding can be used by police departments

for new equipment, police dogs, and other needs.

RESILIENCE

California is no stranger to extreme weather. In the past year alone, the state has faced earthquakes, catastrophic wildfires, and flooding. The state has increasingly made resources available to transit agencies to help guide long-term planning to prepare for increasingly severe weather and sea-level rise. For example, the 2020 California Adaptation Planning Guide 2.0 outlines a detailed, four-phase process to help local governments, regional planning agencies, and tribal governments develop and integrate climate adaptation and resilience strategies. Regional transportation planning agencies in California have issued regional resilience frameworks, often building on the APG framework. These planning documents help identify threats such as extreme heat, rain events, wildfires, sea level rise, and more, while also suggesting mitigation measures and estimating adaptation costs. While comprehensive planning activities are necessary and informative, funding to implement the necessary retrofits and resiliency improvements is limited.

INNOVATION

The California Air Resources Board's (CARB) Innovative Clean Transit (ICT) regulation requires that, by 2029, all new buses purchased by transit agencies must be zero emission and that, by 2040, all buses in the transit fleet must be zero-emission.

This transition to a zero-emission fleet is creating significant challenges for transit agencies. For example, there is currently limited charging infrastructure to support electric buses, making it difficult for agencies to deploy new vehicles. As agencies install charging infrastructure to accommodate their electric fleets, they may encounter limited capacity of the electrical grid. Zero-emission vehicles require a level 2 (microtransit and paratransit) and level 3 (bus) kilowatt charger and place greater demand on the electrical grid. If a location lacks sufficient grid capacity, this creates a barrier for charging infrastructure deployment and the transition to electric vehicles.

Transit agencies are addressing these challenges in various ways. For example, in the Central Valley, the Fresno County Rural Transit Agency has converted one-third of its fleet to zero emission and is currently constructing a new maintenance and operations facility with solar charging units and battery storage to support the electric fleet and address charging infrastructure and grid resiliency needs. The new maintenance facility is an early example of how a transit agency can facilitate microgrid innovations.

Another challenge facing transit agencies is the lack of both vendors and standardization in zero-emission technology. Because zero-emission commercial bus technology is relatively new in the U.S., many manufacturers are start-ups. Several have gone out of business or filed for bankruptcy and have discontinued maintenance support. Compounding the problem is the lack of standardization in charging units; because different companies use different charging technology, infrastructure deployment is difficult. These issues pose obstacles to meeting the 2040 deadline for a full transition to zero-emission fleets. Finally, agencies must also contend with rising energy costs.

RECOMMENDATIONS TO RAISE THE GRADE

- Encourage robust, dedicated, and long-term funding to support transit operations in the state, following the pending recommendations from the Transit Transformation Task Force. Reliable and dedicated revenue for transit service will help the state achieve its ambitious greenhouse gas reduction goals.

- Implement a state-led long-term, comprehensive funding and investment strategy for climate adaptation. This strategy should outline pathways to secure sustained, predictable funding for adaptation and resilience that align with the goals of the California Climate Adaptation Strategy. A comprehensive funding strategy will help ensure that adaptation and resilience efforts are not only maintained, but also expanded in response to growing climate threats. By securing stable funding and planning for budget fluctuations, the state can avoid the boom-and-bust cycles that have impeded long-term planning and implementation efforts in the past.

- Accommodate the ongoing transition to zero-emission vehicles by providing coordination, funding, and other support. The transition to zero-emission vehicles has been, and will continue to be, led by California and reflects the state's priorities and values. Therefore, funding and coordination must also come from the state.

- Ensure that smaller operators have preserved and enhanced access to funding.

- Urge the renewed funding for transit in self-help counties. This local funding enables transit agencies to source matching funds that allow them to qualify for and significantly augment available federal and state funding.

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Wastewater
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WASTEWATER

EXECUTIVE SUMMARY

California's wastewater systems are critical infrastructure, serving a population nearing 40 million residents across millions of households. These systems collectively treat approximately four billion gallons of sewage daily, playing a key role in protecting the state's surface waters, extensive coastline, and general public health. While approximately 900 publicly-owned collection and treatment systems manage the majority of this flow, an estimated 1.2 million onsite wastewater systems, like septic tanks, still serve the public.

California's wastewater infrastructure faces significant challenges when considering the age of this infrastructure; many collection system pipes and manholes are decades old, with average ages often exceeding 50 to 60 years and continuing to increase. A number of treatment plants are approaching 30 to 40 years of age and need to schedule upgrades. While many systems currently possess adequate capacity, future pressures from population shifts, changing land use, and the impacts of climate necessitate ongoing assessment and upgrades.

The EPA's 2022 Clean Watersheds Needs Survey estimated California's wastewater infrastructure needs exceed $65 billion, or about $1,657 per person. With California's population projected to surpass 40 million by 2033, conveyance systems are estimated to require up to $15 billion for repairs and new construction, and advanced treatment needs another $10 billion. Overall, California's wastewater financial needs have doubled since 2012. In spite of the financial needs, California remains a leader in adopting advanced wastewater treatment technologies, increasingly focusing on water reclamation, energy recovery, and waste reduction.

CAPACITY AND CONDITION

California wastewater systems collect and treat 4 billion gallons of sewage per day for over 13 million households in 58 counties and 482 cities. Approximately 10% of the 39.4 million people are served by 1.2 million onsite septic systems, with the remainder being served by publicly and privately owned wastewater treatment facilities. Population growth in California can put a strain on wastewater systems if

upgrades are not timed carefully through mandated master planning, hydraulic modeling and capital improvement plan development.

California includes over 106,000 miles of sewer collection pipelines, ranging in size from 6- to 150-inches in diameter, and over 900 wastewater treatment plants with approximately 500 being publicly owned treatment facilities. Most of these treatment plants are small or moderate in size and treatment capacity; only 270 in the state can treat over one million gallons per day (MGD). The largest individual treatment plants in California are in San Francisco and Los Angeles and each treat approximately 450 MGD. The average age of collection system pipes and manholes is approximately 50 to 60 years. Additionally, older population centers may have areas where more than half the collection systems are over 50 years old. These older systems typically demand more maintenance and increased funding for inspection and rehabilitation. Due to the critical nature of treatment facilities and pump stations, they typically receive more frequent maintenance and renewal when compared with buried collection systems. Changing regulatory factors on these vertical assets result in a replacement and renewal period that is generally between 30 and 40 years. New and replacement piping materials continue to include vitrified clay, reinforced concrete and polyvinyl chloride along with newer pipe replacement and rehabilitation materials and techniques such as cured-in-place pipe, fiberglass reinforced pipe and high-density polyethylene pipe are bringing new and extended lives to collection systems.

Most, but not all, systems and treatment plants appear to have adequate capacity to treat average dry weather flows as well as peak wet weather flows and are planned to meet future population needs. Some wastewater systems require future growth in their collection systems and treatment plants to meet peak wet weather flow conditions during intense storm events as it burdens the gravity and pumped pipelines as well as treatment systems. Some of the treatment facilities experience spills related to condition and maintenance, wet weather capacity, as well as nuisance ground surface inflows and groundwater infiltration. There is an ongoing focus to reduce sanitary sewer spills by focusing on failing private sewer laterals and aging infrastructure. Significant investments are being made in upgraded and new wastewater treatment plants to meet growing demand and regulatory requirements. The State is to be commended on its California Integrated Water Quality System (CIWQS) program which provides for accountability through mandatory Sewer System Management Plans (SSMPs), spills reporting and auditing.

OPERATION AND MAINTENANCE

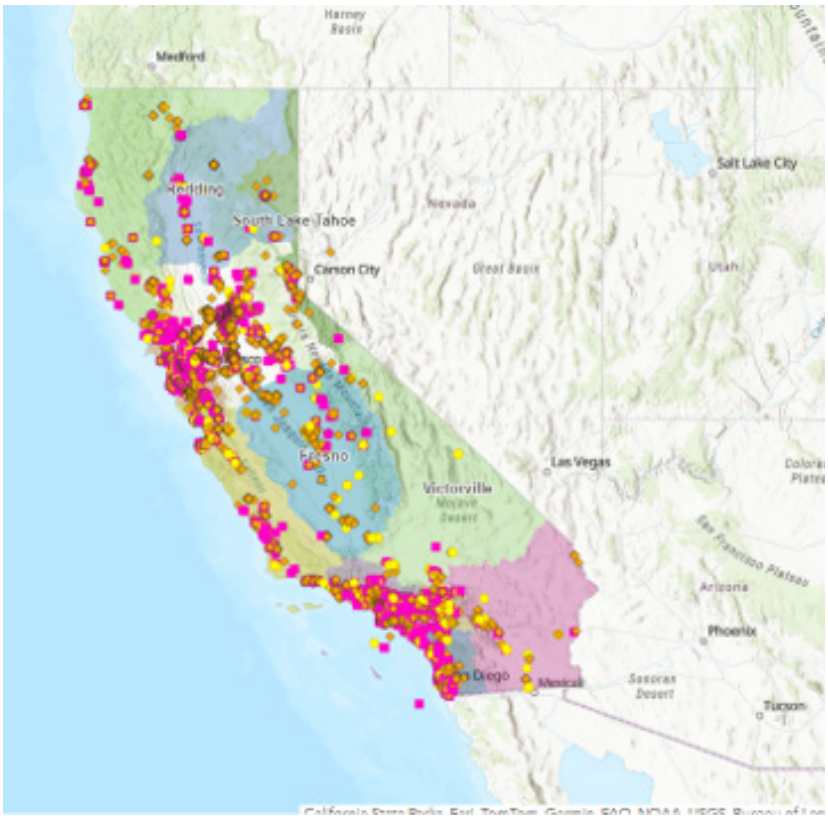
In California, county and municipal governments, sanitation districts, and special districts are primarily responsible for the day-to-day operation and maintenance of wastewater systems. Some agencies contract private operators, but most manage their systems internally, handling staffing, maintenance, and compliance.

Maintenance involves repair and upkeep of treatment plants, pump stations, storage tanks, pipelines, and appurtenances. Tasks include valve exercising, system cleaning, condition assessments, and emergency repairs. Larger agencies use preventive and predictive maintenance informed by asset management plans, while smaller or under-resourced systems often rely

on reactive maintenance due to limited staff, equipment, and funding.

About 70 % of medium-to-large California utilities now use asset management plans to prioritize risk, track asset condition, and guide long-term reinvestment strategies (AWWA, 2019; SWRCB, 2023). These plans are often supported by Computerized Maintenance Management Systems (CMMS).

Figure: SSOs reported throughout California from Jan 1, 2019 to Dec 31, 2024



Staffing remains a significant challenge. Agencies face widespread retirements, competition from other industries, and limited applicant pools. Recruiting certified operators, mechanics, and technical supervisors is particularly difficult for smaller or remote systems. Workforce gaps slow response times, increase reliance on reactive maintenance, and reduce system resilience.

Operation and maintenance costs are increasing statewide. In 2024, California agencies spent an estimated $3.7 billion on wastewater pipeline rehabilitation, covering approximately 5,300 miles of infrastructure. Costs are projected to rising due to aging infrastructure, regulatory demands, and the need to address contaminants of emerging concern like perfluoroalkyl and polyfluoroalkyl substances (PFAS).

Improving system reliability will require greater investment, regional coordination, and workforce development to keep pace with infrastructure needs and regulatory pressures.

FUNDING AND FUTURE NEED

Funding and future needs are largely dictated during the formation of long-term planning documents. These can range from a master plan to in-depth asset management plans, and may cover over 40 years of infrastructure need. Once these needs are identified, typically, four sources drive the budgetary funding of wastewater systems, including:
Tax Revenue
User Fees
Connection Charges
Grants and Loans

Average monthly user charges and new connection fees are the primary sources of funding for wastewater collection and treatment systems. Between 2012 and 2018, the State Water Resources Control Board (SWRCB) Wastewater User Charge Survey indicated that the average monthly user fee for wastewater services was approximately $43 for a single-family dwelling, while the average connection fee for new single-family dwellings is reported as approximately $4,600. The State of California is in the process of creating the Wastewater Needs Assessment report, which will provide updates to these figures. However, this report is not anticipated until 2027.

California's Clean Water State Revolving Fund (CWSRF) has historically been the primary funding mechanism for improving water

quality in California, with over 995 binding commitments totaling over $14.6 billion since the inception of the program. In Fiscal Year 2022-23, eight agreements were executed for $527 million. Over $1.2 billion were requested in total applications, with projects that were not funded in FY 2022-23 rolled over to FY 2023-24. Small Disadvantaged communities received $73 million in principal forgiveness in the same time period. Other programs, such as technical assistance and leveraging (bonding), were updated with the State continually monitoring cash flows to determine additional opportunities for bond sales.

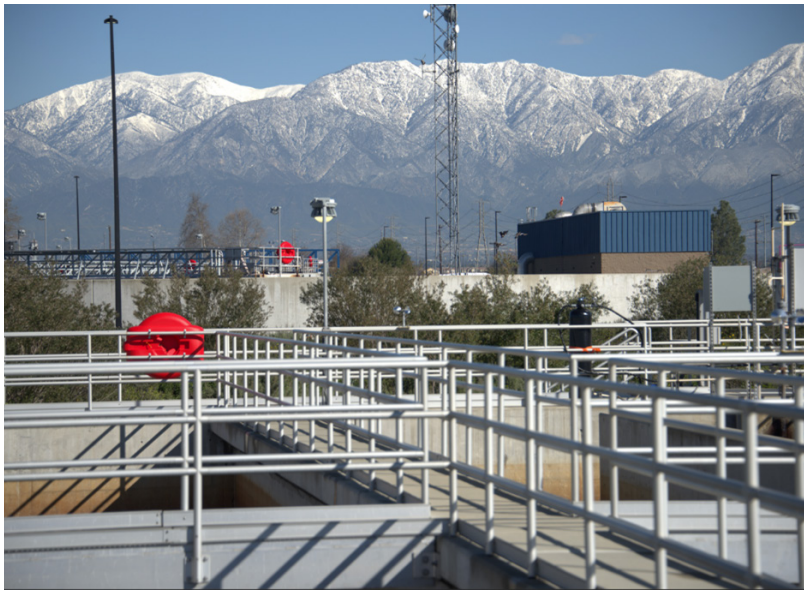
While the CWSRF is an important financing source for wastewater projects, it is insufficient to cover all needs and typically funds only a nominal portion of the cost to own and operate a wastewater system. California's Water Quality, Supply, and Infrastructure Improvement Act of 2014 (Proposition 1) authorized an additional $7.545 billion in general obligation bonds to fund ecosystems and watershed protection and restoration, water supply infrastructure projects, including surface and groundwater storage, and drinking water protection. These funds, along with other corresponding bills such as Proposition 68, continue to provide a much-needed funding source. The Environmental Protection Agency (EPA) Clean Watersheds Needs Survey, updated in April 2024, estimated California wastewater systems required more than $65 billion in investments, or approximately $1,657 per person. Meanwhile, the population of California is expected to reach over 40 million by the year 2033 according to the State Department of Finance. Conveyance systems are expected to need up to $15 billion in repair and new systems, and another $ 10 billion in advanced treatment needs. Overall, it is estimated that the financial needs of wastewater systems in California have doubled since 2012.
Areas where the condition of the wastewater system is still unknown (approximately 50% of non-surveyed sewer agencies) will rely on a reactive approach to aging and potentially failing infrastructure. Thus, on-going funding programs should be maintained to allow the continued rehabilitation and expansion of existing infrastructure, without placing an undue burden on the agency and their ratepayers. The Clean Watersheds Needs Survey estimates another $3.3 billion dollars will be needed to maintain and replace decentralized systems in California.

PUBLIC SAFETY & RESILIENCE

Wastewater agencies throughout California are very sensitive to public safety and are ensuring that the consequences of an infrastructure failure are minimized. Wastewater managers are documenting the state of infrastructure by completing condition assessments, developing asset management programs, and managing through CMMS. The increased use of CMMS by medium and large wastewater agencies will highlight the current hidden costs to safeguard the general public from consequences of failure. However, small to medium wastewater agencies do not typically have the resources (funds or staffing) to implement such maintenance management systems and may be at a higher risk for failed infrastructure, thus impacting public safety.

Furthermore, through active implementation of State-mandated SSMPs, municipal sewer systems are receiving more regular maintenance and operational reviews. More recent revisions to the State Waste Discharge Requirements have required more strenuous reporting of spills, and how to categorize those spills. However, spills related to wet weather conditions and other operational challenges are still common in the industry and cannot be addressed without increased funding for enhanced maintenance programs.

Finally, as the State of California continues exploration of wastewater for beneficial reuse, public safety and environmental protection continues to be a priority for both regulators and operators. Wastewater



Regional Water Recycling Plant No. 5 in Chino, Inland Empire Utilities Agency

managers continue to adapt to constituents in the wastewater stream through their National Pollutant Discharge Elimination System (NPDES) permits and other regulatory documents. Challenges include stopping the migration of constituents like PFAS in the effluent stream or managing by-products from the advanced treatment process. Typical water resource recovery facilities are not equipped to destroy these compounds, and they are concentrated in the effluent stream. The EPA released a memo in 2022 that addressed potential strategies for addressing PFAS through the NPDES permit. While these documents are currently strategies and not enforceable, it is expected that these implementation strategies are likely to become enforcement actions in the future. As more agencies look to beneficial reuse of wastewater as a means to supplement and augment potable water sources, addressing the removal of these and other emerging contaminants from the wastewater stream will become critical to ensuring public safety.

Resiliency and security, together, are a major priority in wastewater agencies in California to protect the treatment facilities and public health. The focus on resiliency and security, specifically cybersecurity, has intensified due to evolving threats. Several agencies have experienced security breaches, reporting minor thefts, break-ins and vandalism, which are being mitigated by having fenced and gated facilities as well as security monitoring systems. Most facilities also have a plan to address cyber threats, making sure to have both physical and virtual security measures to prevent security breaches. Enhanced security measures include the implementation of cameras, alarms, software, and frameworks to protect against security threats. In case of power outages, most agencies have on-site standby generators at key pumping facilities and lift stations, allowing wastewater conveyance to continue and preventing spills. Redundancy and backup systems ensure the continuous operation of critical treatment and collection system assets during power outages. These efforts are crucial to maintaining reliability and resiliency of wastewater treatment and conveyance facilities, ensuring they can continue operation effectively under various conditions to protect public health.

INNOVATION

Wastewater agencies in California remain at the forefront of innovative practices to maximize water reclamation efforts, promote energy recovery, reduce waste products, and explore new wastewater treatment technologies. Most wastewater agency respondents indicated they have active energy recovery programs and facilities at treatment plants and continue to improve effluent quality for potable reuse initiatives.

PFAS substance monitoring is practiced throughout California and some larger, regional wastewater agencies are beginning to explore technologies to remove PFAS from wastewater effluent and other waste streams. For example, the Orange County region is conducting an $8 million pilot project to treat and potentially remove PFAS from its biosolids with the use of supercritical water oxidation technology. Deep well injection is also being considered as an alternative disposal method for some biosolids and is already used for a portion of Los Angeles region biosolids. Wastewater agencies in California continue to advocate for elimination of non-essential uses of PFAS in consumer and industrial products.

Water conservation efforts have generally resulted in lower per capita flows into many wastewater systems and in turn increased influent wastewater loading into treatment plants. In some cases, additional capital improvements, changes to operations, etc. have been required in order to adapt to the changed wastewater characteristics. For example, the Orange County region is evaluating projects to optimize the capture of dry weather urban runoff and maximize water reclamation efforts. However, in other wastewater systems additional costs due to water conservation efforts have not been observed or are more difficult to quantify. Other regions of California are more focused on offsetting potable water demands with high quality recycled water to indirectly aid in groundwater replenishment, build drought resilient water supplies, and protect ecosystems. For example, the Sacramento region is currently constructing a $585 million agricultural recycled water project, and the San Francisco region continues to spearhead development of $184 million in regional recycled water projects.

Most municipalities, especially in the drier portions of California, have already begun, or are planning to implement, some form of indirect potable reuse (IPR). For example, the Ventura region continues to progress through a $529 million project to construct local IPR facilities. The Santa Cruz region completed construction of a $145 million project in 2024 which adds local IPR facilities to act both as

groundwater replenishment and barriers to seawater intrusion. Additionally, the SWRCB adopted regulations for direct potable reuse (DPR) in 2023, and these regulations went into effect in October 2024. Currently there are no agencies in California permitted to operate a DPR project, however the Los Angeles region is in the environmental permitting phase for a $26 billion project that includes both IPR and DPR facilities. With the addition of DPR regulations, it is expected continued efforts will be made to reuse wastewater to offset potable water supply.

In addition to liquid waste streams, all wastewater treatment plants also create solid waste at the end of the treatment process in the form of biosolids. Under SB 1383, California jurisdictions are required to buy products of recycled organics and some are facing additional costs to comply with this measure. However, not all agencies are facing additional costs from SB 1383. For example, the Los Angeles region is taking advantage of several biosolids compost facilities that are less expensive than nearby landfills. Products derived from biosolids can be used to meet those requirements as long as at least 75% of the biosolids are recycled.

To summarize, wastewater agencies in California have made significant strides in addressing various challenges and executing innovative projects to continue providing high-quality services to residents. However, as regulations in California become increasingly stringent advancing and scaling innovations will not only require continued commitment, but also significantly greater funding and energy resources to support research, implementation, and long-term operation.

RECOMMENDATIONS TO RAISE THE GRADE

- Urge risk-based decisions on capital improvements, maintenance, and operations (i.e. – implement asset management programs).
- Enhance state loans and grant funding for the repair and rehabilitation of wastewater collection and treatment systems, as well as reuse projects.
- Encourage indirect potable reuse projects, and explore the feasibility of, and public outreach for, direct potable reuse projects.
- Continue to encourage inspection, evaluation, and monitoring of sewer collection systems to minimize the risk of sewer spills and increase public safety.
- Continue to implement adequate source control to reduce nuisance contaminants that may lead to clogs and other adverse impacts to the wastewater stream.
- Implement an education program at the state and local level about what a wastewater treatment plant is, what kind of wastes it can treat, as well as what impact wastes have on the sewer pipes such as grease and flushable wipes, and related information. Continue educational programs on how to identify sewer spills and who to call if such an event occurs.
- Continue advancements in water reuse/recycling, including the removal of emerging contaminants like PFAs.
- Increase funding to accommodate the EPA Clean Watersheds Needs Survey findings and to meet the increasing regulatory needs of the State.

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GRADE COMPARISONS

	CALIFORNIA				NATIONAL
Category	2006	2012	2019	2025	2025
Aviation	C-	C+	C+	B-	D+
Bridges		C-	C-	C-	C
Dams			C-	D+	D+
Drinking Water	C+	C	C	D+	C-
Energy			D-	D	D+
Hazardous Waste			C-	C	C
Inland Waterways			D	D	C-
Levees		D	D	D+	D+
Ports	C+	B-	C+	B	B
Public Parks	D+		D+	D+	C-
Rail			C	B	B-
Roads	D+	C-	D	D	D+
Schools			C	D+	D+
Solid Waste	B	B	C-	C-	C+
Stormwater	D+	D+	D+	D	D
Transit		C-	C-	C-	D
Wastewater	C+	C+	C+	C+	D+
GPA	**C-**	**C**	**C-**	**C-**	**C**

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ASCE Region 9 assembled an incredible team of professionals and experts in leadership positions throughout California, and who volunteered to work diligently on developing the *2025 California Infrastructure Report Card*.

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