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California Energy Commission

STAFF REPORT

California Energy Security Plan

Gavin Newsom, Governor

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PREFACE

California's economy depends upon its energy resources. An energy emergency or shortage could bring substantial injury to the personal health, safety, and welfare of California's residents as well as significantly disrupt commercial, industrial, and government activity.

In 2006, the Energy Emergency Response Plan was published in response to legislative requirements specified in Public Resource Code Sections 25216.5(b) and 25700. Those codes direct the California Energy Commission to prepare and submit to the Governor and Legislature a plan to deal with shortages of electrical energy or fuel supplies to protect public health, safety, and welfare. The 2014 Energy Assurance Plan, an update to the 2006 plan, was based on State Energy Assurance Guidelines developed by the National Association of State Energy Officials with the assistance of the National Association of Regulatory Utility Commissioners under the direction of the U.S. Department of Energy's Office of Electricity Delivery and Energy Reliability. In 2021 Congress passed the Infrastructure Investment and Jobs Act (IIJA), also known as the Bipartisan Infrastructure Law (BIL), that amended Section 366 of the Energy Policy and Conservation Act (EPCA) of 1974, to require all states and territories to have a State Energy Security Plan that fully addresses six Congressionally defined elements.

To meet the IIJA requirements, the California Energy Commission developed this report, the California Energy Security Plan, in accordance with the specifications identified by the U.S. Department of Energy. Specifically, State Energy Security Plans must:

1. Address all energy sources and energy providers.
2. Provide a state energy profile, including an assessment of energy production, transmission, distribution, and end-use.
3. Address potential physical and cybersecurity hazards to each energy sector or system.
4. Provide a risk assessment of energy infrastructure and cross-sector interdependencies.
5. Provide a risk mitigation approach to enhance reliability and end-use resilience.
6. Address multistate and regional coordination, planning, response, and coordination with Indian Tribes with respect to planning and response.

The guidelines and resources developed by the National Association of State Energy Officials and the U.S. Department of Energy served as a model for developing the California Energy Security Plan as a substantial revision and update to the existing Energy Assurance Plan.

Since 2021, Energy Commission staff have met the annual DOE submission requirements. The 2025 update to the California Energy Security Plan describes the state's strategy for responding to an energy emergency. The material is drawn from several existing state documents, including the broader State of California Emergency Plan, which guides planning across all sectors for emergencies in California. Implementing the California Energy Security Plan under the California State Emergency Plan requires collaboration among several state agencies, private sector utilities, energy and emergency stakeholders, and others to successfully minimize energy disruptions through conservation and other means. The goals and objectives outlined in this plan, and within its appendices, support this effort.

Accomplishments can be realized only by joint efforts, dedication, and commitment to energy shortage mitigation. Clear recognition is made that energy producers and suppliers have emergency response plans of their own.

The California Energy Commission encourages companies, institutions, and communities to develop and exercise plans that address energy disruptions and effective response and recovery during energy emergencies.

Elements of this plan are based on confidential information and operational documents that are essential for planning purposes. Consequently, Chapters 1 through 6 are public facing and do not contain confidential or sensitive information. The Appendices that contain confidential or sensitive information are not shared publicly and remain for official use only.

ABSTRACT

The California Energy Security Plan provides an overview of the state's energy use and infrastructure and identifies the roles state government agencies play in preventing and mitigating energy disruptions. It also identifies other state and federal government agencies that are responsible for energy emergency preparedness and response. Elements of this plan are based on confidential information and operational documents that are essential for planning purposes. Consequently, Chapters 1 through 6 will be public facing and not contain confidential or sensitive information. Appendices that contain confidential or sensitive information are not shared publicly and remain for official use only.

Keywords: Biodiesel, bioenergy, biofuels, building efficiency standards, electricity, electricity demand, energy security, ethanol, gas-fired generation, gasoline, greenhouse gas, jet fuel, natural gas demand, natural gas pipelines, nuclear power plants, once-through cooling, energy reliability, renewable energy, resiliency, transmission, transportation fuel demand.

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EXECUTIVE SUMMARY

As the State's primary energy policy and planning agency, the California Energy Commission is responsible for developing the California Energy Security Plan. This plan provides the Governor, the Legislature, state agencies and departments, the energy industry, and the public with a clear, concise, and comprehensive plan to reduce critical energy infrastructure risk and vulnerability, while improving planning across public and private sector agencies and entities charged with the state's energy infrastructure resiliency.

Energy assurance and security planning are critical to the state's ability to meet energy needs in the event of a potential or actual energy disruption or emergency caused by natural hazards, technological events, or human-caused situations. All emergency plans serve as management documents intended to be read and understood before an emergency occurs. Therefore, this plan presents information to identify and lessen risks associated with energy disruptions and energy emergencies and describes the roles and responsibilities of state agencies at various stages of an energy emergency.

California's energy infrastructure is the backbone of commerce, transportation, communications, government, health care, and home life for one of the largest economies in the world. California depends on robust, secure, and reliable energy systems to power its economy and provide for the well-being of its residents. Any energy interruption could be devastating to the state and its residents. Energy is a vital part of an interdependent network of critical physical and information infrastructures, and it must be protected from deliberate, natural, accidental, and systemic attacks or threats.

This plan focuses on the electric, natural gas, and transportation fuels energy sectors, and provides an overview of the state's energy resources, energy infrastructure, and risks to both. The importance of the energy sector to the state and the nation has led to the designation by the federal government as "critical infrastructure." This plan outlines the roles and responsibilities of state agencies in response to and recovery from energy disruptions and emergencies, including integration with the State Emergency Plan. The scope of the plan extends from establishing procedures for energy emergency response to identifying and minimizing risks to energy resources. The plan is designed to augment, not to supplant or redefine existing planning measures, risk analyses, or recovery/restoration processes.

This plan relies on an all-hazards approach to respond to varying degrees of energy disruption or emergency. Most energy disruption incidents tend to have minor impacts and are evaluated and monitored by the appropriate state and private entities while emergency response and private entities take appropriate levels of action to resolve the issue. For example, a localized loss of electricity can likely be handled by the local government and utility but if that power disruption has cascading impacts such as a critical pipeline, the event can quickly require state or federal intervention. Energy sector monitoring, coordination, and communication are essential in identifying the nature and scale of an event. For this reason, the State of California intervenes to the extent necessary to protect public health, safety, and welfare. The plan builds on multiple capabilities within the state energy system to address these varying degrees of energy emergencies.

In addition to developing this plan, the California Energy Commission is also charged with monitoring impacts to major energy systems within the state. This includes monitoring the current supply and assessing future potential supply of electric, natural gas (including liquefied natural gas), and transportation fuels. The California Energy Commission also monitors the status of the critical infrastructure in collaboration with other state agencies and the private sector. In its role as a monitor, the California Energy Commission:

- Identifies and assesses the impacts of energy disruptions.
- Identifies mitigation measures.
- Promotes energy technology development and emergency response tools.
- Elevates public awareness in energy assurance by promoting energy education and training.
- Promotes improvements to the state's energy systems.
- Enhances energy resiliency and improves response to energy disruptions.
- Coordinates state government energy emergency preparedness and energy critical infrastructure protection efforts.

Along with reviewing the state's energy resources and infrastructure, this plan identifies several ongoing energy investments that reduce the risk of energy disruptions or emergencies. These measures include conservation, increased renewable energy, and infrastructure improvements that increase resiliency. The California Energy Security Plan outlines the roles and responsibilities of state agencies in response to and recovery from energy disruptions and emergencies, including integration with the State Emergency Plan and the supporting emergency resources and programs.

The state is making great strides in ensuring reliable, affordable, technologically advanced, and environmentally sound energy, while ensuring the safety and effectiveness of its energy delivery systems. The overarching goal for California's energy assurance is for the state's energy to be provided when and where needed and with minimal environmental risks and impacts. The strategy is to provide affordable energy that optimizes economic growth, increases efficiency, reduces dependency on foreign oil and fossil fuels, increases energy diversity, and empowers Californians with the knowledge to assist in addressing energy disruptions or emergencies. The California Energy Commission expects to revise and update the California Energy Security Plan as necessary.

CHAPTER 1:
Introduction and Structure

Introduction

The California Energy Security Plan (CESP) is the state's strategy for responding to an energy emergency and broadly describes the energy resources and infrastructure, risks, and roles and responsibilities. The CESP is used in conjunction with the State Emergency Plan (SEP), which is the state's operational plan for responding to an emergency.[1] Both the CESP and SEP are intended to serve as management documents, guiding the state's approach to addressing energy emergencies. The bulk of energy assets and infrastructure are owned and operated by the private sector. Therefore, the CESP relies on a free market approach to control distribution and supply. Government intervention occurs only to the extent necessary to protect the interests of public health, safety, and welfare, along with critical community services and economic operations.

An energy emergency is an actual or impending shortage or curtailment of usable, necessary energy resources that affects public health, safety, and welfare, or critical infrastructure of the state. An energy emergency can be caused by natural disasters (such as earthquake, fire, flood, or weather) or geopolitical events (such as war, terrorism, civil disturbance, or embargo).

Since each energy emergency is unique, it is impossible to envision every potential event or combination of events that might contribute to, or result in, an energy emergency. The CESP is based on an "all hazards" approach that provides the flexibility to adapt to every energy emergency, regardless of the origin. The CESP provides both a management and operational structure that identifies the functional relationships that must exist to ensure effective identification, response, and recovery from an energy emergency.

The State of California organizes its emergency response resources and capabilities, as well as those of certain private-sector and nongovernmental organizations (NGOs), under the SEP and its associated Emergency Support Functions (ESF). ESFs are coordinated through the California Governor's Office of Emergency Services (Cal OES) as part of its lead role in response to emergencies and disasters affecting or disrupting essential services, including energy.

ESFs provide the structure for coordinating state interagency support in response to an incident. ESFs are developed by sector and group functions most frequently used to provide state support to other state agencies and local governments, both for declared disasters and

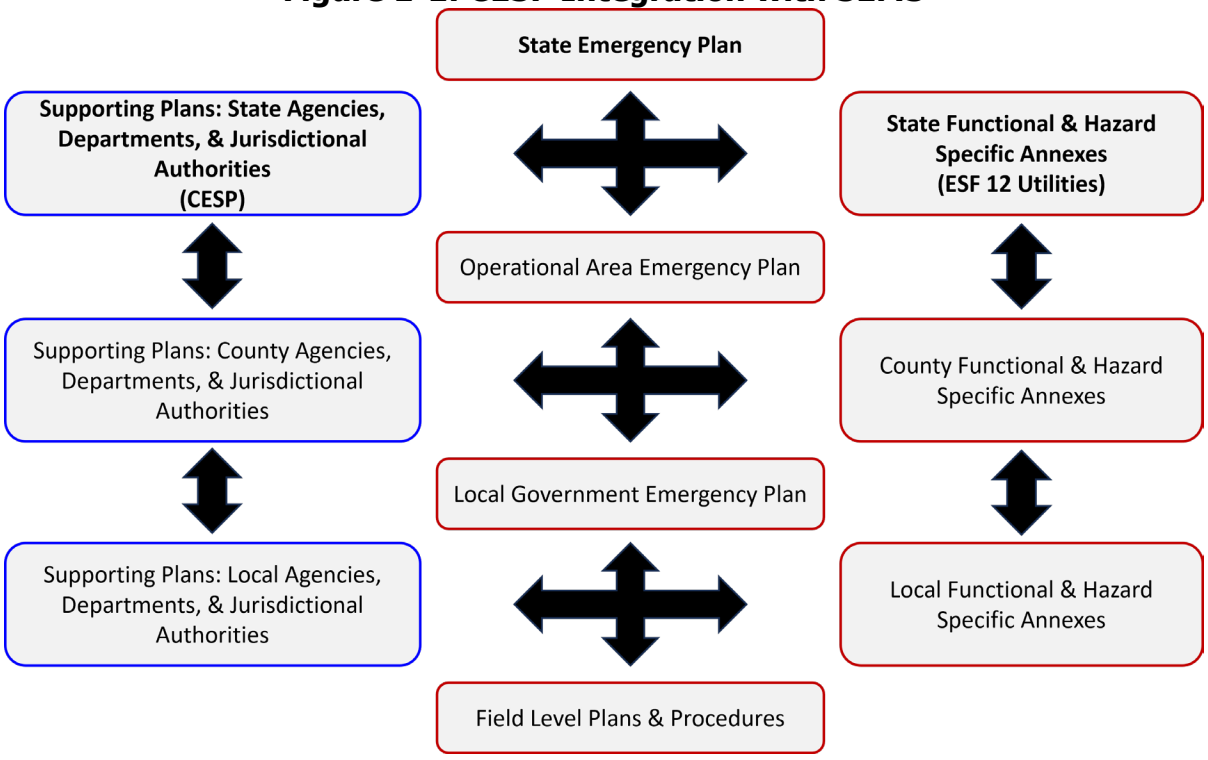
1 State of California Emergency Plan can be downloaded at Planning and Preparedness. https://www.caloes.ca.gov/office-of-the-director/operations/planning-preparedness-prevention/planning-preparedness/.

emergencies under the California Emergency Services Act (ESA)[2] and the federal Robert T. Stafford Act[3] and for nondeclared incidents. In California, CA-ESF 12 Utilities, is designated as energy industry utilities' coordination for energy infrastructure assessment, repair, and restoration in response to an energy emergency in coordination with stakeholders. Figures 1-1 and 1-2 below highlight how the CESP integrates with the state and federal emergency response structures and CA-ESF 12 Utilities. Figure 1-1 illustrates how the CESP integrates with the Standardized Emergency Management Systems (SEMS) (The State Emergency Plan and Program are a component of the National Incident Management System). The CESP is intended to support and integrate with the existing emergency framework. Figure 1-2 illustrates how the CESP and CA-ESF 12 support the common energy system critical emergency activities: preparedness, response, mitigation, and recovery. While CA-ESF 12 focuses on all utility components (electricity, water, telecom, etc.), the CESP focuses specifically on energy related components (electricity, petroleum, natural gas, etc). Moreover, though they both address the energy elements of the response framework they do it form slightly different perspectives. If we consider preparedness activities as an example, the private sector element of CA-ESF 12 approach is from the energy utilities perspective while the CESP will always look at preparedness from the state agency perspective.

2 Information on California Emergency Authorities can be downloaded at Authorities. https://www.caloes.ca.gov/office-of-the-director/policy-administration/legal-affairs/authorities/.

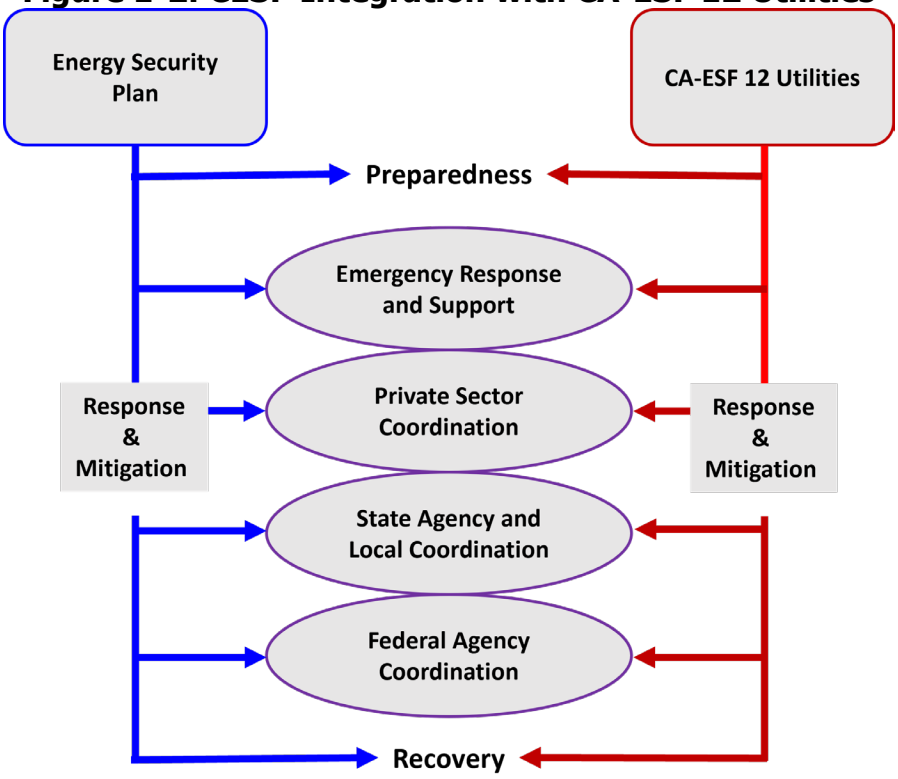
3 Information on the Stafford Act can be downloaded at Stafford Act. https://www.fema.gov/disaster/stafford-act.

Figure 1-1: CESP Integration with SEMS



Source: 2024 California State Emergency Plan

Figure 1-2: CESP Integration with CA-ESF 12 Utilities



Source: 2014 California Energy Assurance Plan

Purpose

During the early stages of an energy emergency, the primary role of state government is fact-finding, monitoring, exchanging information, and working with industry to restore services and satisfy customer requirements. The California Energy Commission (CEC) serves as a central source of credible and timely information relative to statewide energy emergency impacts. The CESP is intended to lessen the potential adverse impacts of an energy emergency by providing the Governor, legislature, state agencies, local government, and policy makers with accurate and timely information for decision-making.

Objective

The CESP is structured to support and integrate with the State Emergency Plan and also to fulfill the objectives and activities identified in the U.S. Department of Energy's (DOE) energy security program.

Maintenance

The CEC will review the CESP and supporting documents on a regular basis. Updates and revisions will include lessons learned from exercises and recent disasters and will be coordinated with state agencies, local governments, and relevant stakeholders.

Training

Training is an essential element to maintain program readiness for a successful response to an emergency impacting California's energy supply and distribution system. The California Energy Commission works with stakeholders (e.g., industry, federal, state, and local emergency response organizations) to implement, cooperate, coordinate, and participate in workshops, drills, tabletops, and exercises as needed to ensure program readiness.

Outreach

The CEC will coordinate CESP awareness with stakeholders, as appropriate. The CEC uses public workshops and relevant dockets to share information with stakeholders. The CEC also participates with other State Energy Offices in monthly energy security[4] calls and energy security cohorts[5].

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4 The National Association of State Energy Officials' (NASEO) Energy Security Committee provides a forum for State and Territorial Energy Officials to discuss, learn, and collaborate on energy emergency preparedness and response. State Energy Office staff serve as subject-matter-experts on energy and, in an emergency, are typically the state lead or key supporting state agency for the Emergency Support Function 12—Energy (ESF-12). https://www.naseo.org/issues/energy-security/committee.

5 The DOE Energy Security and Grid Resilience Cohorts are an opportunity for state energy offices, public utility commissions, consumer advocates, and emergency management agencies from different states to exchange ideas and input on best practices for advancing critical energy topics in their state. https://www.pnnl.gov/projects/doe-energy-security-and-grid-resilience-cohorts.

Structure

The CESP is divided into two components. The first part of the CESP contains the following six chapters.

1. **California Energy Security Plan Introduction and Structure**– Provides an overview of the plan.
2. **California Energy Profile and Sector Risks** – Provides an overview of state energy markets, infrastructure, threats, and vulnerabilities at a level appropriate for a public document. More detailed, non-public information is provided in Appendix C, which is for official use only.
3. **California Energy Security and Emergency Response Authorities** – Provides relevant authorities, and guiding statutes for energy security and emergency response activities, including federal, state, and local government authorities.
4. **Energy Security Planning and Preparedness** – Describes roles and responsibilities, energy market monitoring, mutual assistance work, staff training and exercise participation, stakeholder engagement, CESP updates, reporting, and training.
5. **Energy Emergency Response** – Describes response actions and roles for energy emergencies, including power outages/electricity shortages, liquid fuels shortages, and natural gas shortages.
6. **Energy Resiliency and Mitigation Measures** – Discusses California policies and programs on energy resiliency and impact mitigation.

The second part of the CESP contains appendices that include a combination of public and confidential or sensitive information. Appendices that contain confidential information are not included in the public portion of the CESP but are shared with key partners for official use. This structure allows CEC staff to selectively modify the more focused appendices as needed while maintaining the integrity of the plan. The CESP appendices consist of:

A. **Energy Emergency Contingency Programs** – Describes California energy emergency contingency programs.
B. **California Energy Profile** – Provides the most recent profiles that consist of maps, information on key energy infrastructure, and data on energy supply and demand for the electricity, petroleum, and natural gas sectors.
C. **California Risk Profile** – Contains the California risk profiles. Additionally, this appendix incorporates key sections of the State Hazard Mitigation Plan.
D. **California Historical Disasters** – Contains brief overview of California historical events.
E. **Federal Authorities and Organizational Structures** – Describes how the agencies within the federal government are involved in energy security and emergencies.
F. **Regional Coordination with Energy Emergency and Assurance Programs** – Describes the CEC coordination and engagement with regional energy assurance and security programs.
G. **Tribal Coordination** – Discusses how California agencies engage in Tribal coordination.

H. **Cybersecurity – California Informational Technology/Operational Technology and Cybersecurity Overview** – Describes the California cybersecurity and regulatory framework.

I. **Resilience Programs and Planning** – Describes state efforts, activities, and resources focused on resiliency programs.

J. **Department of Energy Office of Cybersecurity, Energy Security, and Emergency Response Energy Sector Risk Profiles** – Presents the 2021 California and Federal Emergency Management Agency Region 9 Energy Risk Profiles that examine the relative magnitude of risks at a regional and State level highlighting energy infrastructure trends and impacts.

CHAPTER 2:
California Energy Profile and Sector Risks

Energy Profile

California is the most populous state in the nation with the largest economy in the United States and the fourth-largest economy in the world.[6,7,8] California population was 39,431,263 people as of July 2024, with gradual growth expected in the near term.[9] California is the third-largest state by size, covering approximately two-thirds of the U.S. West Coast and spanning more than 1,000 miles from the northern to southern border and 500 miles from the coast to the eastern border.[10] Most of California's densely populated areas are dry and relatively mild for much of the year, even though the state has a diverse and varied climate.[11,12] California implements progressive policies that focus on increased energy efficiency and alternative technologies to help slow growth in energy demand. California is the second-largest total energy consumer after Texas, but its per capita energy consumption is the fourth-lowest in the

6 U.S. Census Bureau. 2023. U.S. and World Population Clock, Most Populous States. https://www.census.gov/popclock/.

7 U.S. Bureau of Economic Analysis, Interactive Data, Regional Data, GDP and Personal Income. 2023. Annual Gross Domestic Product (GDP) by State, GDP in current dollars, NAICS, All industry total, All Areas.

8 Winkler, Matthew A. June 14, 2021. "California Defies Doom with No. 1 U.S. Economy." Bloomberg. https://www.bloomberg.com/opinion/articles/2021-06-14/california-defies-doom-with-no-1-u-s-economy.

9 California Department of Finance July 1, 2024 Population Estimates Press Release, https://dof.ca.gov/wp-content/uploads/sites/352/2024/12/PressRelease_July2024-1.pdf

10 NETSTATE, California. February 25, 2016. The Geography of California. https://www.netstate.com/states/geography/ca_geography.htm.

11 U.S. Census Bureau. 2020 Census: California Profile, Population Density by Census Tract.

12 NETSTATE. February 25, 2016. Geography of California, Climate.

nation due in part to the state's progressive policies, and despite its many energy-intensive industries.[13,14,15,16]

Rich in energy resources, California ranks second in renewable electricity generation and leads the nation in electricity generation from solar, geothermal, and biomass energy.[17] California also contains fossil energy resources, including a supply of crude oil and approximately one-tenth of the U.S. crude oil refining capacity.[18,19]

In 2023, California was the fourth-largest electricity producer in the U.S. California is the nation's third-largest consumer of electricity, importing more electricity than any other state. As of 2022, approximately 30 percent of state households do not have air conditioning installed.[20] California benefits from a diverse mix of energy resources in state and from throughout the West but can be vulnerable to spikes in electricity demand and downstream disruptions, which have been occurring more frequently in recent years.

Transportation accounts for the largest share of energy consumption in California,[21] with the most registered motor vehicles, the most vehicle miles traveled, and some of the longest commute times of any state.[22,23] Additionally, California consumes more than one-seventh of

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13 California Energy Commission (CEC). Accessed January 30, 2022. Energy Efficiency.. https://www.energy.ca.gov/programs-and-topics/topics/energy-efficiency.

14 U.S. EIA. 2021. State Energy Data System, Table C11, Total Energy Consumption Estimates by End-Use Sector, Ranked by State.

15 U.S. EIA. 2021. Rankings: Total Energy Consumed per Capita.

16 U.S Energy Information Administration. California State Profile and Energy Estimates. https://www.eia.gov/state/?sid=CA#:~:text=Profile%20Overview&text=In%202023%2C%20California%20was%20the,gasoline%20among%20the%2050%20states.

17 U.S. EIA. February 2022. Electric Power Monthly, Tables 1.10.B, 1.11.B, 1.17.B.

18 U.S. EIA. December 31, 2020. Crude Oil Proved Reserves, Reserves Changes, and Production.

19 U.S. EIA. January 1, 2023. Number and Capacity of Petroleum Refineries, Atmospheric Crude Oil Distillation Operable Capacity (B/CD). https://www.eia.gov/dnav/pet/pet_pnp_cap1_a_(na)_8d0_bpcd_a.htm.

20 U.S. Energy Information Administration (EIA). Residential Energy Consumption Survey (RECS), 2020 RECS Survey Data. https://www.eia.gov/consumption/residential/data/2020/index.php?view=characteristics.

21 U.S. EIA. February 2022. Electric Power Monthly, Tables 1.10.B, 1.11.B, 1.17.B.

20 Federal Highway Administration. October 26, 2021. National Highway System Travel 2020, Annual Vehicle-Miles by Functional System, Table HM-44. https://www.fhwa.dot.gov/policyinformation/statistics/2020/pdf/hm44.pdf.

23 Index Mundi. United States, Average Commute Time by State, Rank, Mean travel time to work (minutes), workers age 16years+, 2014-18. https://www.indexmundi.com/facts/united-states/quick-facts/all-states/average-commute-time#map.

the nation's jet fuel.[24] In total, transportation accounts for two-fifths of the state's total end-use sector energy consumption.

The California industrial sector is the second-largest energy consumer, accounting for approximately one-fourth of state end-use consumption. The residential and commercial sectors are the third- and fourth-largest consumers respectively, each accounting for less than one-fifth of the state's total consumption.[25] California residential and commercial per capita energy consumption is one of the lowest in the nation, this is likely due to a combination of factors that include the state's climate, energy efficiency and energy-saving efforts.[26]

The CEC is California's central repository for data on all forms of energy supply, demand, efficiency, conservation, transportation, and related subjects. Energy sector data collection, analysis, and communication are an essential component of the CEC's core responsibilities.[27] The data and associated work products are disseminated as impartial information to promote policies, markets, and public understanding of the energy sector. The CEC provides current and historical energy-related data on its Energy Almanac. The Almanac website is located at https://www.energy.ca.gov/data-reports/energy-almanac and provides detailed analysis of electricity generation and use data and the natural gas and petroleum markets. The EIA has produced a high-level overview, which is provides as Figure 2-1.

Figure 2-1 shows the 2022 California end-use energy consumption estimates, providing a visual graphic of the state's end-use energy evolution of 2022.

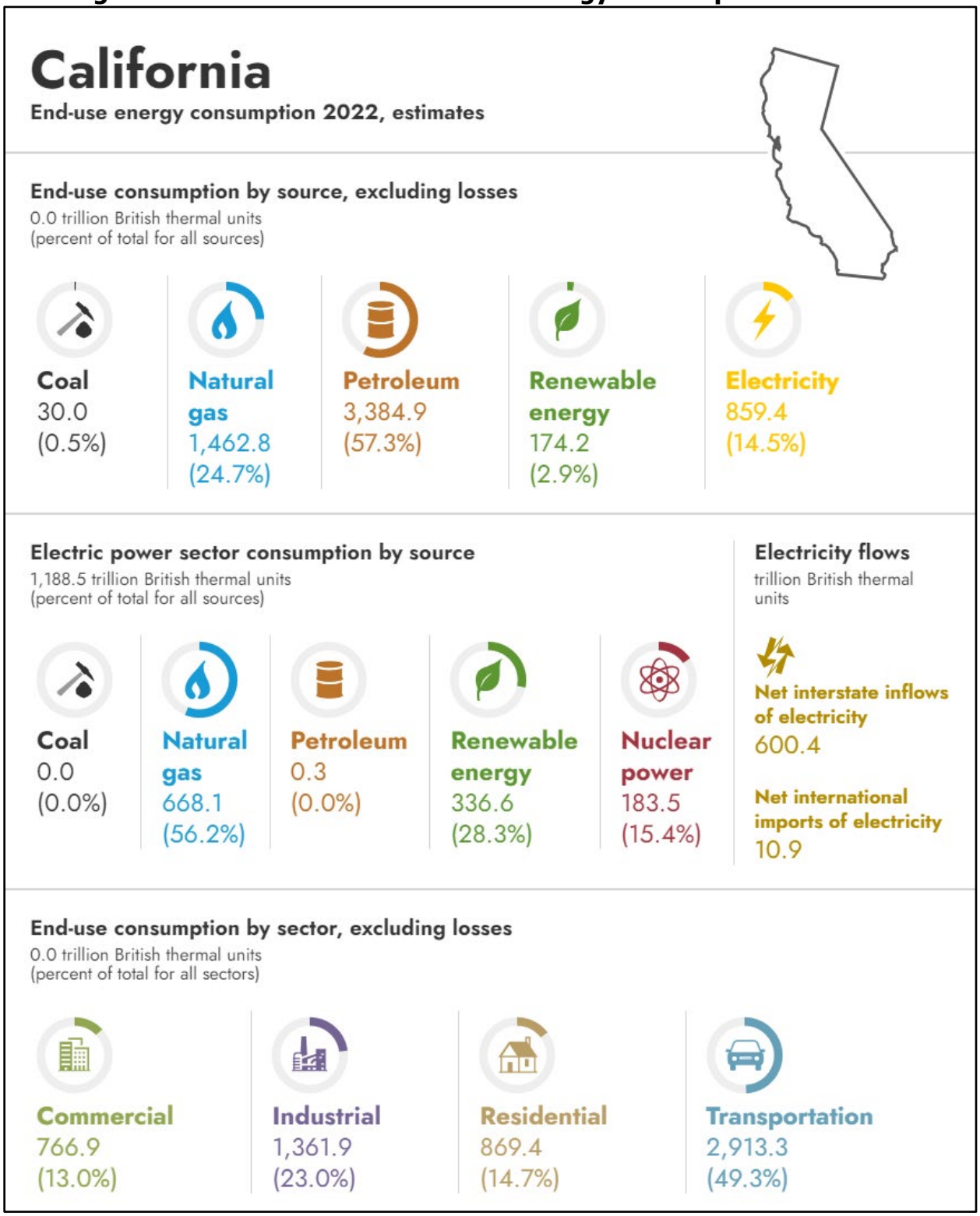
24 U.S. EIA. 2022. State Energy Data System, Table F1, Jet fuel consumption, price, and expenditure estimates.

25 U.S. EIA. 2021. State Energy Data System, Table C1, Energy Consumption Overview: Estimates by Energy Source and End-Use Sector.

26 U.S. EIA. 2021. State Energy Data System, Table C14, Total Energy Consumption Estimates per Capita by End-Use Sector, Ranked by State.

27 These fact sheets address the seven core responsibilities of the California Energy Commission and California's leading energy policies, https://www.energy.ca.gov/about/core-responsibility-fact-sheets.

Figure 2-1: 2022 California end-use energy consumption estimates



Source: U.S. Energy Information Administration (EIA), California End-use energy consumption 2022, estimates, https://www.eia.gov/beta/states/states/ca/overview. The EIA keeps updated state energy profiles, data, and estimates on their website. EIA's California Energy Profile and Estimates webpage is located at https://www.eia.gov/state/?sid=CA#tabs-1.

The CEC also prepares the Integrated Energy Policy Report (IEPR) every two years, which provides an overview of major energy issues and trends facing California. The IEPR contains updates on energy demand and supply forecasts for 15-year periods. It also makes energy policy recommendations based on CEC assessments and forecasts that are intended to conserve resources protect the environment, provide reliable energy, enhance the state's economy, and protect public health and safety. In alternate years, the CEC prepares an update that may include analyses conducted in support of the biennial IEPR or discuss new energy issues that have arisen.

In addition to the IEPR, the CEC staff conduct assessments of California's energy industry, supply, production, transportation, delivery and distribution, energy shortage contingencies, demand, and prices. CEC Data and Reports are posted at https://www.energy.ca.gov/data-reports.

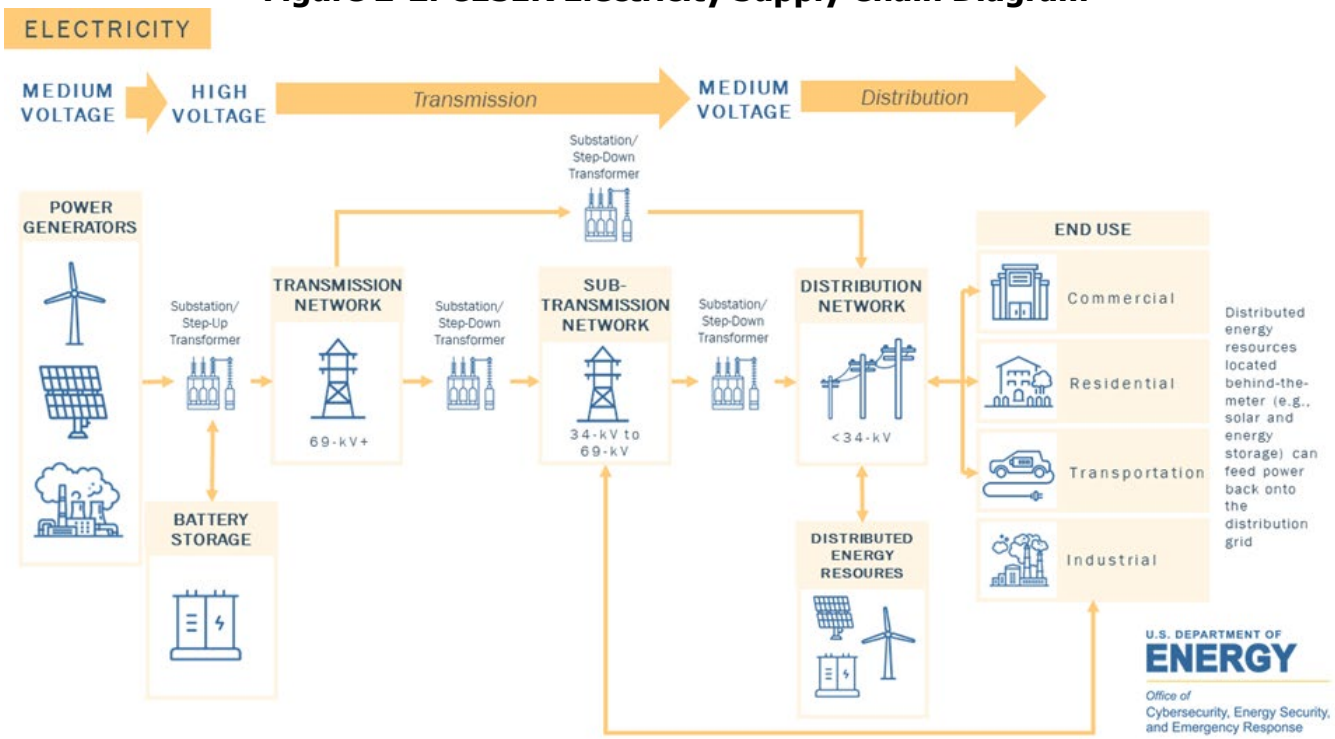
The U.S. Energy Information Administration (EIA) keeps updated state energy profiles, data, and estimates on their website. EIA's California Energy Profile and Estimates webpage is located at https://www.eia.gov/state/?sid=CA#tabs-1.

Energy Sector Assets and Monitoring

Electricity Sector Assets

Figure 2-2 provides an overview of the electric sector. Individual aspects of the system are described below.

Figure 2-2: CESER Electricity Supply Chain Diagram



Source: CESER, Energy Security Planning Resource Hub, https://www.energy.gov/ceser/energy-security-planning-resource-hub.

Power Generators

Most U.S. and world electricity generation are sourced from electric power plants that use a turbine to drive electricity generators. A turbine generator consists of a moving fluid—water, steam, combustion gases, or air that pushes a series of blades mounted on a rotor shaft. The force of the fluid on the blades spins (rotates) the rotor shaft of a generator. The generator, in turn, converts the mechanical (kinetic) energy of the rotor to electrical energy. Additionally, there are different types of electricity generators that do not use turbines to generate electricity. This includes solar photovoltaic (PV) systems, internal-combustion engines, fuel cells, Stirling engines (used in solar thermal parabolic-dish generators), and thermoelectric generators.[28]

The 2023 total system electric generation is the sum of all utility-scale in-state generation plus net electricity imports.[29] California has approximately 87,750 MW of electric generation capacity installed across the state amongst more than 1,600 power plants that utilize a broad array of technologies. Natural gas-fired power plants make up the largest share of capacity at

28 U.S. EIA. Electricity explained. https://www.eia.gov/energyexplained/electricity/how-electricity-is-generated.php.

29 CEC, (n.d.). *2023 Total System Electric Generation*. California Energy Commission. https://www.energy.ca.gov/data-reports/energy-almanac/california-electricity-data/2023-total-system-electric-generation.

39,689 MW (45 percent) of the state total. Total renewable generation capacity is 32,925 MW (37.5 percent) with 20,871 MW (24 percent) from solar and 6,284 MW (7 percent) from wind. Large hydroelectric power plants, considered zero-carbon resources, provide an additional 12,281 MW (14 percent) of capacity while California's last remaining operational nuclear power plant, Diablo Canyon, provides 2,400 MW (2.7 percent) of capacity. Additional sources include geothermal (5.1 percent), biomass (2.34 percent), and combined petroleum sources (0.24 percent).

Transmission Lines

Transmission lines carry electric energy from point to point in an electric transmission system. Either alternating current, direct current, or a combination of both can be carried along the transmission lines. Transmission lines can be overhead or underground. The primary characteristics that distinguish transmission lines from distribution lines are that they operate at relatively high voltages, 69 – 500 kilovolts (kV), and transmit large quantities of power over large distances. California has approximately 25,526 miles of transmission lines.

Transmission and Distribution Substations

A transmission substation is a facility located along with a transformer that is used to change voltage levels, provide a central place for system switching, monitoring, protection, and redistribute power. Transmission substations typically operate at high voltage, 69 kV to 345 kV, or extra-high voltage over 345 kV.

Distribution substations take high transmitted voltages and further reduce the voltage for distribution which typically range from 12 kV to 13.8 kV. Distribution substations provide a location in the system near the end-user to easily test the system, adjust voltage output, add new lines, disconnect lines, and redirect power during system problems or disruptions.

Control Centers

Control centers have sophisticated monitoring systems and are staffed by operators 24 hours a day, 365 days a year. Operators are responsible for several key functions, including balancing power generation and demand, monitoring flows over the transmission system, planning, configuring systems to operate reliably, maintaining system stability, preparing for emergencies, and placing equipment out of service.

Control centers are operated by Balancing Authorities (BAs) and utilities to maintain a constant balance between electricity supply and demand, maintaining reliability and grid stability. Both entities dispatch generation, manage electricity flow, and respond to perturbations to maintain grid operations. BAs are responsible for operating a specific control area, geographic zone, of the electric grid. Utilities can operate as a BA, but this tends to be localized to their service territories.

Distribution Lines

Distribution lines carry electricity from substations to end users and typically operate between 4 kV up to 35 kV. Distribution systems are managed by independently operated companies,

electric cooperatives, and municipally operated electric systems. California has approximately 239,557 miles of distribution lines, of which approximately 147,000 miles are overhead.[30]

Control Systems

Supervisory Control and Data Acquisition Systems (SCADA) and Distributed Control Systems (DCS) monitor the flow of electricity from generators through transmission and distribution lines. These electronic systems enable efficient operation and management of electric systems using automated data collection and equipment control. DCSs are managed by balancing authorities and utilities and are critical components of modern power grids, to provide the necessary monitoring and control capabilities to ensure reliable, efficient electricity flow from generation sources to distribution points.

Monitoring Electricity Supply, Demand, and Disruptions

There are redundant functions in the state to monitor electricity supply, demand and interruptions. Utilities perform this function at the local level and balancing authorities at larger regional scales. CEC staff maintain critical communications paths with the CPUC, balancing authorities, and utilities to track local, regional and state-wide conditions. CEC also works directly with the State Water Project which is the single largest electric customer in the state, as well as an electricity generator. Over the last four years state agencies in coordination with the private sector have established a tool set to manage demand spikes and supply shortages that includes electricity demand response programs and other contingency resources. Additional information can be found in Appendix A.

Managing Supply and Needs

Since 2020, California has enhanced state response programs to grid emergencies through coordinated activities of the Governor's Office, CEC, CPUC, and the California ISO. These programs describe how the energy institutions will coordinate in advance of and throughout an anticipated electricity supply shortfall event in the California ISO balancing area and are discussed in Appendix A.

Appendix A also describes contingency resources that can support the grid during an anticipated shortfall, including additional generation and load reduction measures. The response programs describe the roles and responsibilities of each institution to identify and pursue contingency resources, as well as the triggers associated with engaging each resource.

Reducing Demand

Non-programmatic voluntary load reduction tools include Flex Alerts issued by the California ISO. In addition to voluntary conservation from customers, there are other potential generation sources and load reductions that the state can draw on, typically from larger customers who are not already participating in demand response programs.

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30 CPUC. CPUC Undergrounding Programs Description. https://www.cpuc.ca.gov/industries-and-topics/electrical-energy/infrastructure/electric-reliability/undergrounding-program-description.

Restricted Maintenance Operations

When high loads are anticipated, balancing authorities may caution utilities and transmission operators to avoid taking grid assets offline for routine maintenance, to ensure that all generators and transmission lines are available.

Overview of State Contingency Resource Programs:

As a results of the growing number of climate change-induced extreme heat events affecting the state, California has established statewide and California ISO territory programs to provide contingency resources in an emergency:

- Strategic Reliability Reserve (SRR) – AB 205 (Chapter 61, Statutes of 2022) established the SRR to have additional resources available in extreme events and grid emergencies. The SRR includes the Demand Side Grid Support (DSGS) program, Distributed Electricity Backup Assets (DEBA) program and DWR's Electricity Supply Strategic Reliability Reserve Program (ESSRRP).
    - The DSGS program is administered by the CEC and provides incentives to reduce customer load during grid emergencies with upfront capacity commitment and for per-unit reduction in net load.
    - The DEBA program provides incentives for clean energy backup systems.
    - The ESSRRP funds additional generation resources to be available during grid emergencies.
- Emergency Load Reduction Program (ELRP) – A voluntary CPUC program that is managed by the three largest IOUs (PG&E, San Diego Gas & Electric [SDG&E] and SCE). ELRP pays customers who voluntarily reduce electricity demand during grid emergencies.
- Power Saver Rewards (PSR) – PSR compensates CPUC-jurisdictional residential customers for reducing electricity use during grid emergencies.

Natural Gas Sector Assets

Natural gas continues to play a crucial role in supplying the state with reliable electricity generation. California relies on natural gas from both in-state and out-of-state sources, with the majority of natural gas supply coming from out-of-state basins, including the U.S. Southwest (New Mexico, west Texas, Oklahoma), the Rocky Mountains, and Canada. Highlighting the importance of monitoring and evaluating infrastructure providing natural gas to California and the overall national and international market trends.

The CPUC regulates natural gas utility rates and services provided by natural gas utilities and regulates independent gas storage operators.[31] PG&E and SoCalGas, the states' two largest gas utilities, own and operate several natural gas storage fields located in Northern and Southern California. These storage fields and four independently owned storage utilities – Lodi Gas Storage, Central Valley Gas Storage, Wild Goose Storage, and Gill Ranch (75 percent

31 CPUC does not regulate gas producers, and California's regulated utilities do not own any natural gas production facilities. These utilities must purchase gas from suppliers and/or marketers.

independently owned, 25 percent PG&E owned) – help meet peak seasonal natural gas demand and allow California natural gas customers to secure natural gas supplies more efficiently.

FERC deregulated the price of natural gas sold by suppliers and marketers in the mid-1980s.

In a December 2006 decision, the CPUC adopted a similar gas transmission framework for Southern California called the "firm access rights" (FAR) system. SoCalGas and SDG&E implemented the FAR system in October 2008, which allowed customers access to new supply sources and enhanced their ability to secure reasonably priced gas supplies on the integrated SoCalGas/SDG&E gas transmission system.

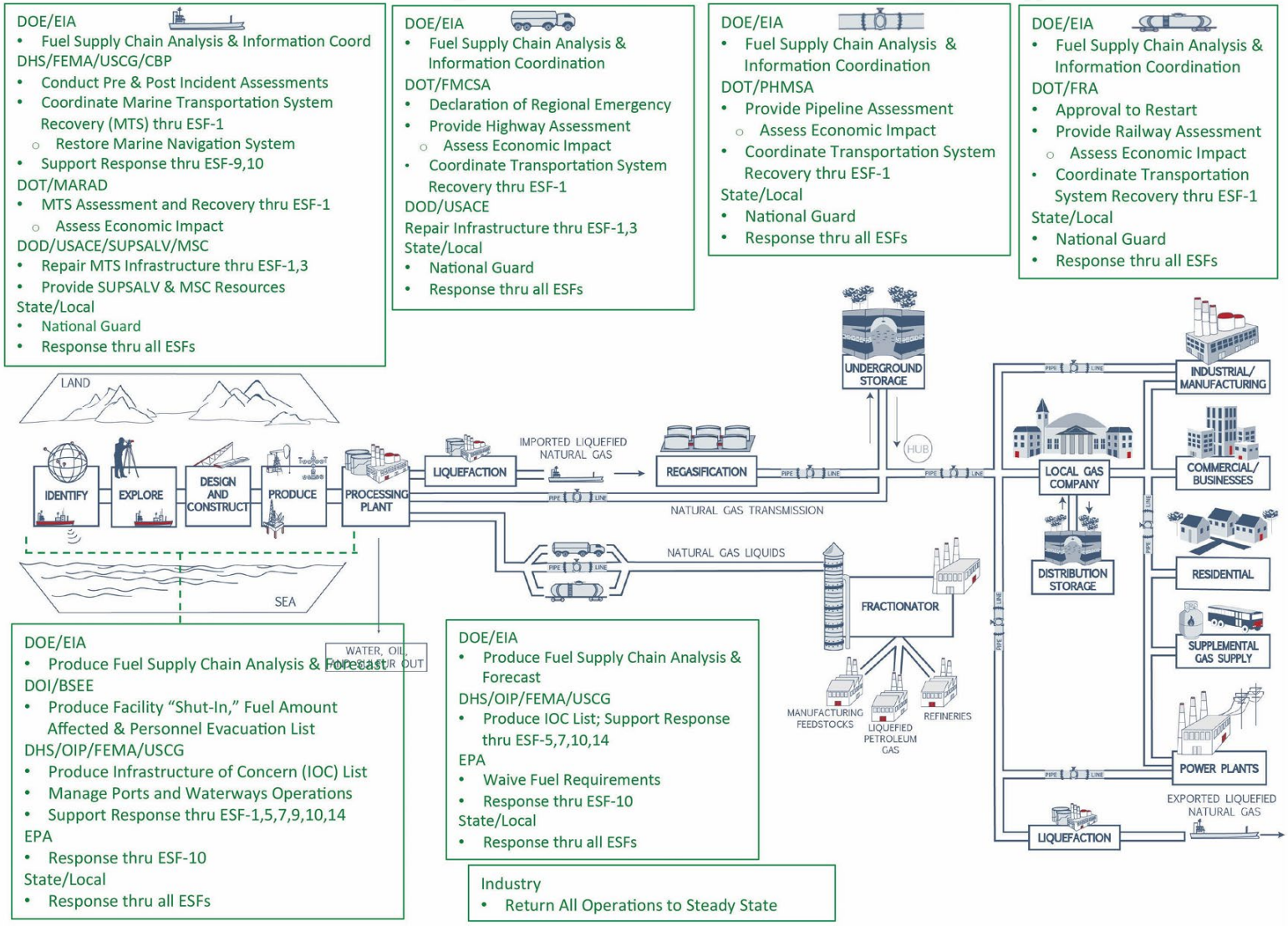
In 2025, nearly 45 percent of the natural gas burned in California was used for electricity generation, and much of the remainder consumed in the residential (21 percent), industrial (25 percent), and commercial (9 percent) sectors.[32] California's natural gas system is winter peaking, but natural gas plays an important role during the summer by providing fuel supply for electric generation. Natural gas has become an increasingly important source of energy since the state's power plants rely on this fuel. Natural gas provides the largest portion of the total in-state capacity and electricity generation in California. The Tracking Progress website[33] provides additional information.

Figure 2-3 shows the critical elements of the natural gas supply chain, including identifying and exploring lands for resources, developing production facilities, production, processing and handling of liquid and gas products, storage, transmission, distribution and end uses.

32 CEC. (2025). *Supply and Demand of Natural Gas in California*. https://www.energy.ca.gov/data-reports/energy-almanac/californias-natural-gas-market/supply-and-demand-natural-gas-california.

33 State of California. Tracking Progress Toward a Cleaner Energy Future. https://lab.data.ca.gov/dataset/tracking-progress-toward-a-cleaner-energy-future.

Figure 2-3: Critical Elements of the Natural Gas Supply Chain



Source: [Oil and Natural Gas Industry Preparedness Handbook](), July 2022, https://www.api.org/news-policy-and-issues/safety-and-system-integrity/oil-gas-industry-preparedness-handbook.

Natural Gas Production

Nearly 90 percent of gas supplies are from out-of-state production basins that are thousands of miles away. California receives supplies from diverse production basins in Alberta, Canada; Southern Wyoming; Northwest New Mexico; West Texas; and Southeast New Mexico. The remainder of gas supplies are from in-state gas production, which has been slowly declining since the 1980s. In-state gas production accounts for about 10 percent of the gas supplies for California. California's production is not significant on a national scale, however, constituting less than 1 percent of total United States gas production.

Raw natural gas comes primarily from three types of wells: gas wells, condensate wells, and crude oil wells. California production fields are primarily in geologic basins in the northern Central Valley and produce what is referred to as dry gas, meaning it contains low levels of liquids. Some gas fields are also located in the southern Central Valley and offshore along the Southern California coast, which tends to be associated with oil production and is referred to as wet gas due to the increased presence of liquids. Natural gas found in wells with crude oil is generally classified as associated-dissolved gas as the gas had been associated with or dissolved in crude oil. Natural gas extraction not associated with crude oil is classified as "non-associated." Gathering lines collect gas from wells and move them to processing stations or transmission lines.

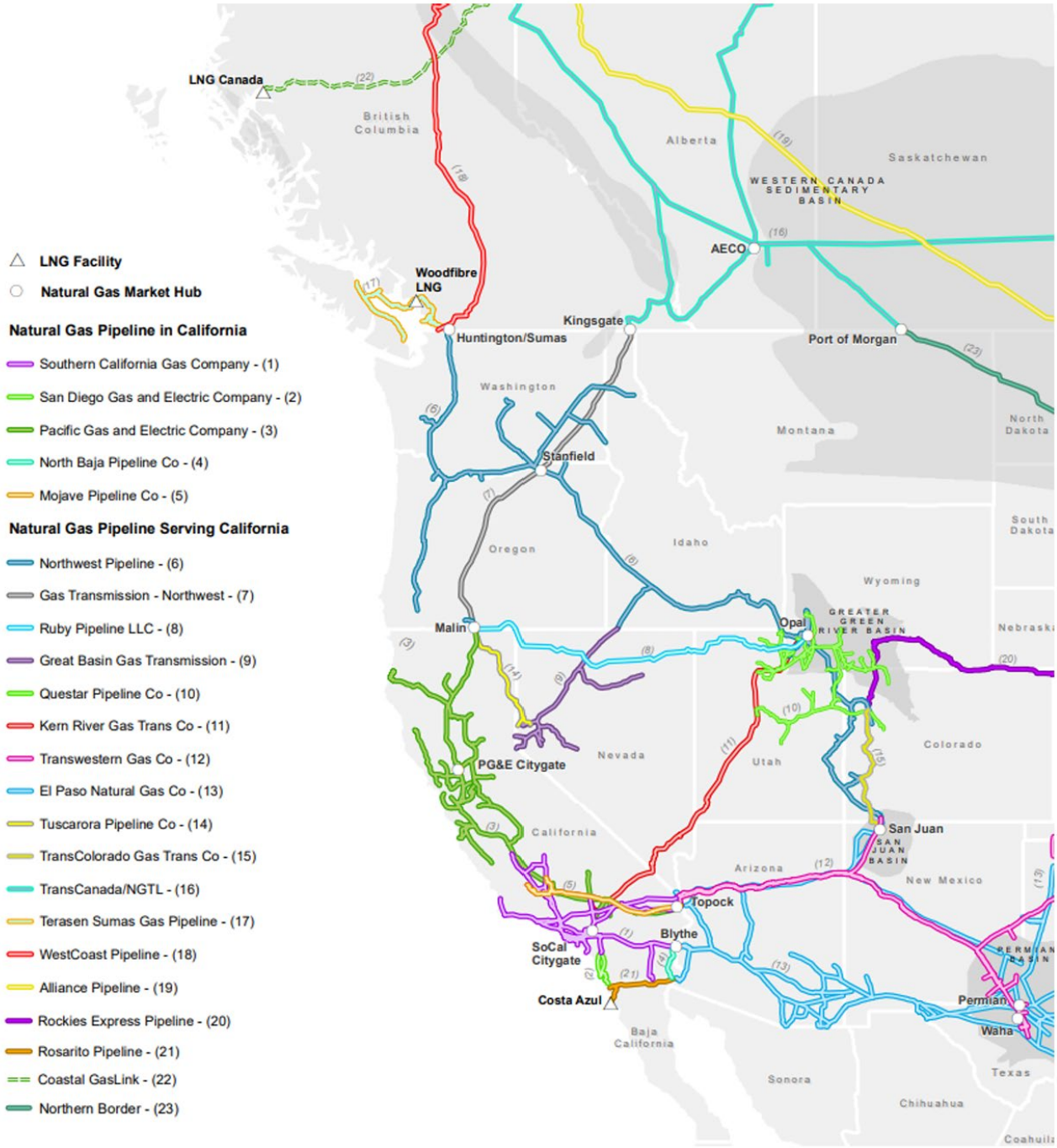
Natural Gas Processing

Natural gas processing covers a variety of industrial processes designed to purify raw natural gas by removing comingled materials such as solids, water, carbon dioxide, hydrogen sulfide, mercury, and higher molecular mass hydrocarbons (condensate) to produce quality dry natural gas for pipeline distribution. Natural gas pushed through the mainline natural gas transportation (pipeline) system in the United States must meet specific quality metrics for the pipeline network (or grid) to provide uniform-quality natural gas. In California, the gas sold by public utilities is subject to General Order No. 58-A, which includes provisions on heating values, purity, pressures, measuring, and metering. Once raw natural gas has been processed it can be safely transported through high-pressure, long-distance pipelines to consumers. Various materials found with natural gas have economic value and are further processed or sold. A range of hydrocarbons that are liquid at ambient temperature and pressure (i.e., pentane and heavier) are called natural-gas condensate (sometimes also called natural gasoline or simply condensate).

Natural Gas Transmission

The interstate gas system is composed of a network of pipelines that connect production basins, storage fields, and load centers, often thousands of miles apart, as shown in the Figure 2-4. These interstate gas pipelines deliver gas supplies to the California border, where gas is transferred to receipt points on the intrastate gas systems of California's two gas utilities — PG&E and SoCalGas — and to a few large customers directly served off the interstate gas system (Kern River Pipeline, North Baja, and Tuscarora). The gas transmission systems of PG&E (Northern and Central California) and SoCalGas (Central and Southern California) are not well-interconnected and act almost entirely as separate systems.

Figure 2-4: Western Natural Gas System



Source: [2024 California Gas Report](https://www.socalgas.com/regulatory/cgr) https://www.socalgas.com/regulatory/cgr.

The intrastate gas transmission system consists of wide-diameter pipes that deliver gas under high pressure and over long distances to power plants, petroleum refineries, large commercial and industrial gas users, and distribution systems. Also interconnected to this system are underground gas storage fields. Storage is an integral part of the utilities' gas systems, and a combination of storage and pipeline flows is needed to meet the peak winter heating demand of core customers. Without storage, much more pipeline capacity would be needed to meet peak demand.

Federal regulations require that gas transmission pipeline operators report how many miles of pipe travel through what are known as high consequence areas (HCA) - which are highly populated areas that fall under the criteria.[34] In their PHMSA filings, gas utilities report HCA mileage. Table 2-1 details the HCA mileage for 2022.

Table 2-1: Miles of Gas Utility Transmission and High Consequence Area Transmission (2022)

	PG&E	SDG&E	SoCalGas
Transmission miles	6,425	213	3,385
HCA Transmission Miles	1,572	175	1,208

Source: 2022 PHMSA Form 7100 filings.

Compressor stations along interstate and intrastate transmission systems enable the transportation of natural gas over long distances and through changes in elevation. The transmission systems of PG&E and SoCalGas have numerous compressor stations that ease the delivery of gas along their systems. These compressor stations use motors (in the form of an electric motor or a natural gas turbine) to pressurize the gas and pump it through the system. Figure 2-5 provides an overview of California's natural gas system.

34 Pipeline & Hazardous Materials Safety Administration. (12-01-2011). *Fact Sheet: High Consequence Areas (HCA)*. https://primis.phmsa.dot.gov/comm/factsheets/fshca.htm.

Figure 2-5: California Natural Gas System

Source: 2020 California Gas Report

Natural Gas Distribution

The distribution systems receive gas from transmission pipelines at points called citygates and distribute it to commercial and residential users. When natural gas arrives at end use locations, it flows into smaller diameter pipelines called mains and then into smaller service lines that go directly to homes or buildings. Distribution pipelines are generally smaller in diameter than gas transmission pipelines and operate at reduced pressures. Many gas

distribution pipelines are made of plastic pipe rather than steel. Table 2-2 details the gas utilities miles and number of services for 2022.

Table 2-2: Gas Utilities' Distribution Systems

	PG&E	SDG&E	SoCalGas
Total Distribution Miles	44,026	8,326	51,883
Number of Services	3,675,195	693,857	4,479,003

Source: 2022 PHMSA Form 7100 filings.

Natural Gas Storage

According to the EIA, California had 604 billion cubic feet of natural gas storage capacity in 2022. During that year, storage withdrawals totaled 199 billion cubic feet while injections totaled 151 billion cubic feet. California's underground gas storage facilities are located at depleted natural gas or oil fields. While other types of gas storage facilities are located in salt caverns or aquifers, California does not have these types of facilities.

The California Division of Geologic Energy Management (CalGEM) revised its regulations surrounding underground gas storage wells effective January 1, 2020.[35] The CalGEM revisions are designed to prevent a gas well from ever again being able to fail at a single point, such as occurred with the blowout of SoCalGas' SS-25 well at Aliso Canyon on October 23, 2015. In particular, CalGEM discovered that SoCalGas, consistent with standard industry practice, was injecting and withdrawing gas through the space within a well's inner tubing and outer casing. The new CalGEM rules make California safer by disallowing this operational practice so that there cannot be a single point of failure.

CalGEM is also requiring more frequent well inspections. The time to complete the well inspections and any extended outage for repairs means a loss of withdrawal capacity from the storage field. The gas utilities are faced with challenges to complete the inspections and maintain enough withdrawal capacity to meet reliability.

Demand for natural gas fluctuates based upon daily and seasonal demand, but production and pipeline imports are relatively constant over the short term. Natural gas stored during periods of low demand helps to ensure that enough natural gas is available during periods of high demand. Natural gas is typically stored in large volumes at underground facilities and in smaller volumes in above or below ground tanks.

Monitoring Natural Gas Supply, Demand, and Disruptions

Both the CPUC and CEC track natural gas supply, demand, and system impacts. CEC staff use multiple sources to monitor the natural gas industry levels of production, usage, and storage. These include industry journal subscriptions, industry contacts and reporting, the U.S. EIA

35 CalGEM. January 2022 "Statues and Regulations" can be found at "Statues and Regulations" (https://www.conservation.ca.gov/index/Documents/CALGEM-SR-1%20Web%20Copy.pdf) and the underground gas storage provisions begin at Article 5, pg. 245.

website, the National Pipeline Mapping System (NPMS) Pipeline Integrity Management Mapping System (PIMMA) – maps contact info[36], the U.S. Department of Transportation, Pipeline and Hazardous Material and Safety Administration[37], and additional resources.

Managing Supply and Needs

CEC staff track the amount of natural gas used in-state. Nearly 45 percent of the natural gas burned in California was used for electricity generation, with the remainder consumed in the residential (21 percent), industrial (25 percent), and commercial (9 percent) sectors. Most gas-fired generation has interruptible gas service; when gas supply becomes short, gas-fired generation can be interrupted. However, when generation supplies become short, much of the peaker plant generation comes from gas-fired combustion turbines. Ensuring adequate fuel supply for the power plants is essential to maintaining electric reliability.

Reducing Demand

California has robust utility efficiency efforts, driven by the CPUC and the CEC, focused on reducing energy consumption, lowering costs, and meeting climate goals. The CEC works with key partners to identify appropriate conservation strategies during times of shortages of natural gas supply. The CEC will also issue appeals, in conjunction with state agencies, for conserving natural gas supplies as necessary. Additional details can be found in the supporting appendices.

Petroleum Sector Assets

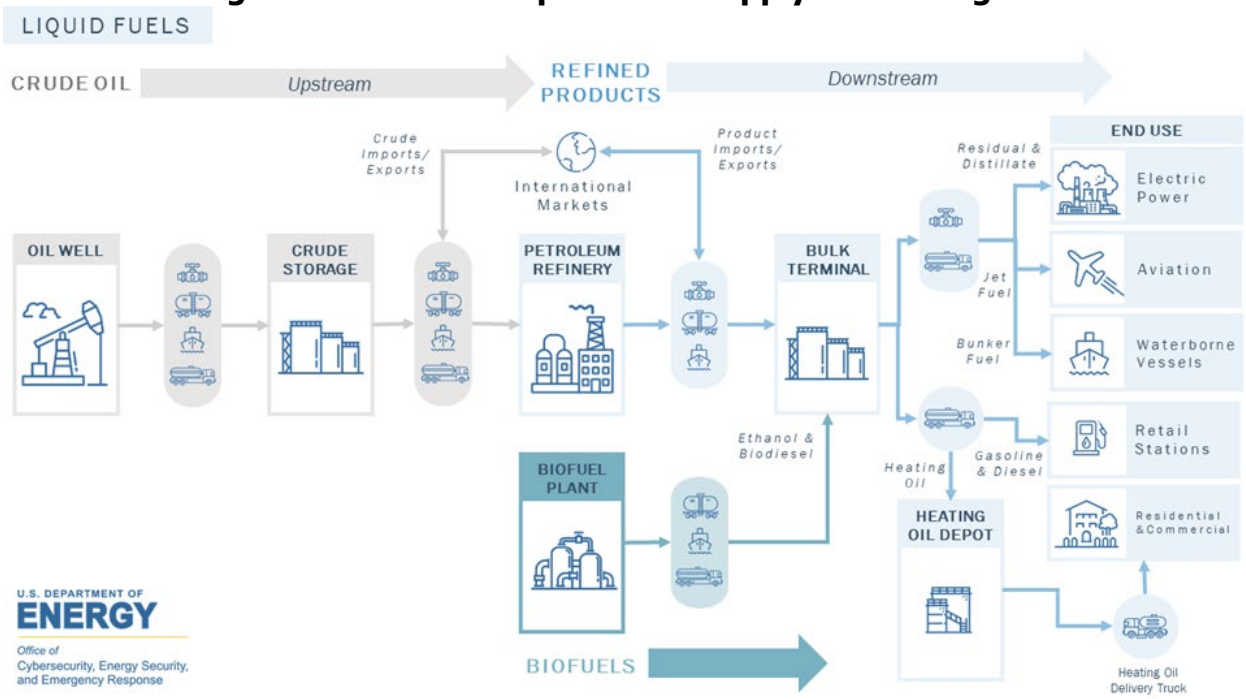
Petroleum fuels play an essential role in meeting Californians transportation needs, including gasoline for personal transportation, diesel for movement of goods and services, and aviation fuel for air travel. California's petroleum system includes crude oil production, storage, refining, transportation and distribution, and dispensation. California's refineries also process and distribute gases from crude oil, such as propane.

Figure 2-6 is a diagram provided by CESER describing the liquid fuels supply chain showing the progression from crude oil production to the storage of crude and refined products and end uses. Figure 2-7 is a similar diagram showing the progression for the propane supply chain.

36 National Pipeline Mapping System. Pipeline and Hazardous Materials Safety Administration. https://www.npms.phmsa.dot.gov/.

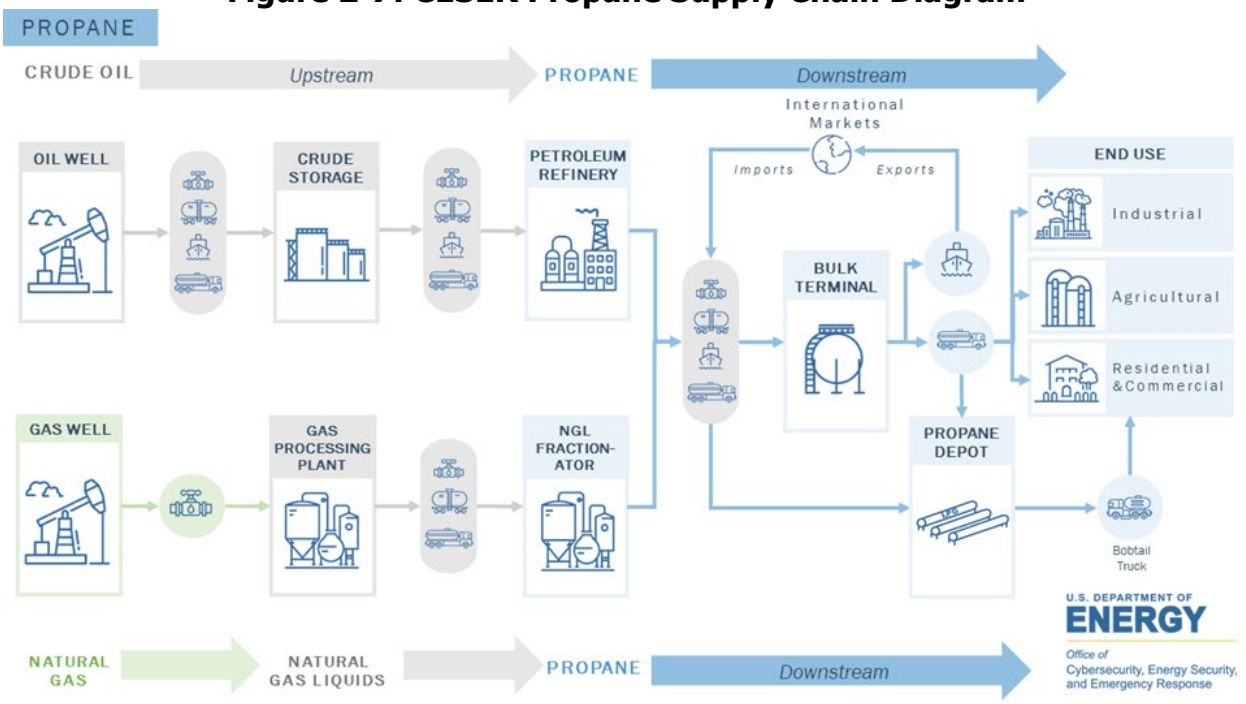
37 U.S. Department of Transportation, Pipeline and Hazardous Material and Safety Administration. https://www.phmsa.dot.gov/.

Figure 2-6: CESER Liquid Fuels Supply Chain Diagram



Source: CESER, Energy Security Planning Resource Hub, https://www.energy.gov/ceser/energy-security-planning-resource-hub.

Figure 2-7: CESER Propane Supply Chain Diagram



Source: CESER, Energy Security Planning Resource Hub, https://www.energy.gov/ceser/energy-security-planning-resource-hub.

Crude oil is produced from underground reservoirs. Once transported to refineries, crude oil is refined into finished petroleum products, such as gasoline, diesel, jet fuel, residual fuel oil, and

propane. Fuels are delivered to bulk terminals by pipeline, marine vessel, or ground transportation such as rail or road and stored in large tanks before being loaded onto distribution trucks (with appropriate blending of ethanol and additives for gasoline) for delivery to retail stations, heating oil distributor storage depots, and other end users.

Most U.S. propane is produced from natural gas liquids (NGLs), which are liquid components recovered during natural gas processing. NGLs are separated into purity products, including propane, ethane, and butane, at fractionation facilities. After fractionation, propane (also called liquid propane gas [LPG]) is compressed and stored as a liquid and moved by pipeline, truck, rail, or barge to bulk propane terminals or directly to distributor storage depots. From distributor sites, the propane is transported by smaller trucks, known as bobtail trucks, to end users like residential and commercial customers.

Petroleum Production

The largest natural gas producing regions in the United States are in the Gulf of Mexico, with approximately 6.4 billion and 17.9 billion cubic feet per day being produced in Louisiana and Texas, respectively. California was the seventh-largest crude oil producer among the states in 2023. Although California's annual crude oil production has steadily declined from its peak of 394 million barrels in 1985, the state still produced more than 122 million barrels of crude oil in 2023.[38] Reservoirs along California's Pacific Coast, including in the Los Angeles basin, and those in the state's Central Valley contain major crude oil reserves, and the state holds 4% of the nation's total proved crude oil reserves.

California has about one-tenth of the nation's total crude oil refining capacity and ranks third after Texas and Louisiana. A network of pipelines connects California crude oil production to the state's 10 crude oil processing petroleum refineries, which are located primarily in the Los Angeles area, the San Francisco Bay area, and the San Joaquin Valley. The P66 Wilmington refinery, located in the Los Angeles area, has announced its pending closure no earlier than October 2025. Two renewable diesel refineries in the San Francisco Bay area, P66 Rodeo and Marathon Golden Eagle, run renewable feedstocks instead of crude oil. As crude oil production in California and Alaska declined, the state's refineries increased their supply from foreign imports. Led by Iraq, Saudi Arabia, Brazil, and Ecuador, foreign suppliers provided almost half of the crude oil refined in California in 2023.[39]

California refineries are currently structured to produce gasoline to California’s unique gasoline specifications, known as California Reformulated Gasoline Blendstock for Oxygenate Blending (CARBOB), that meets the state’s environmental regulations. CARBOB is blended with 10 percent ethanol at distribution terminals to produce California Reformulated Gasoline (CaRFG). Refineries in the state often operate at or near maximum capacity because of the high demand for petroleum products. California is considered a fuel island because it only has

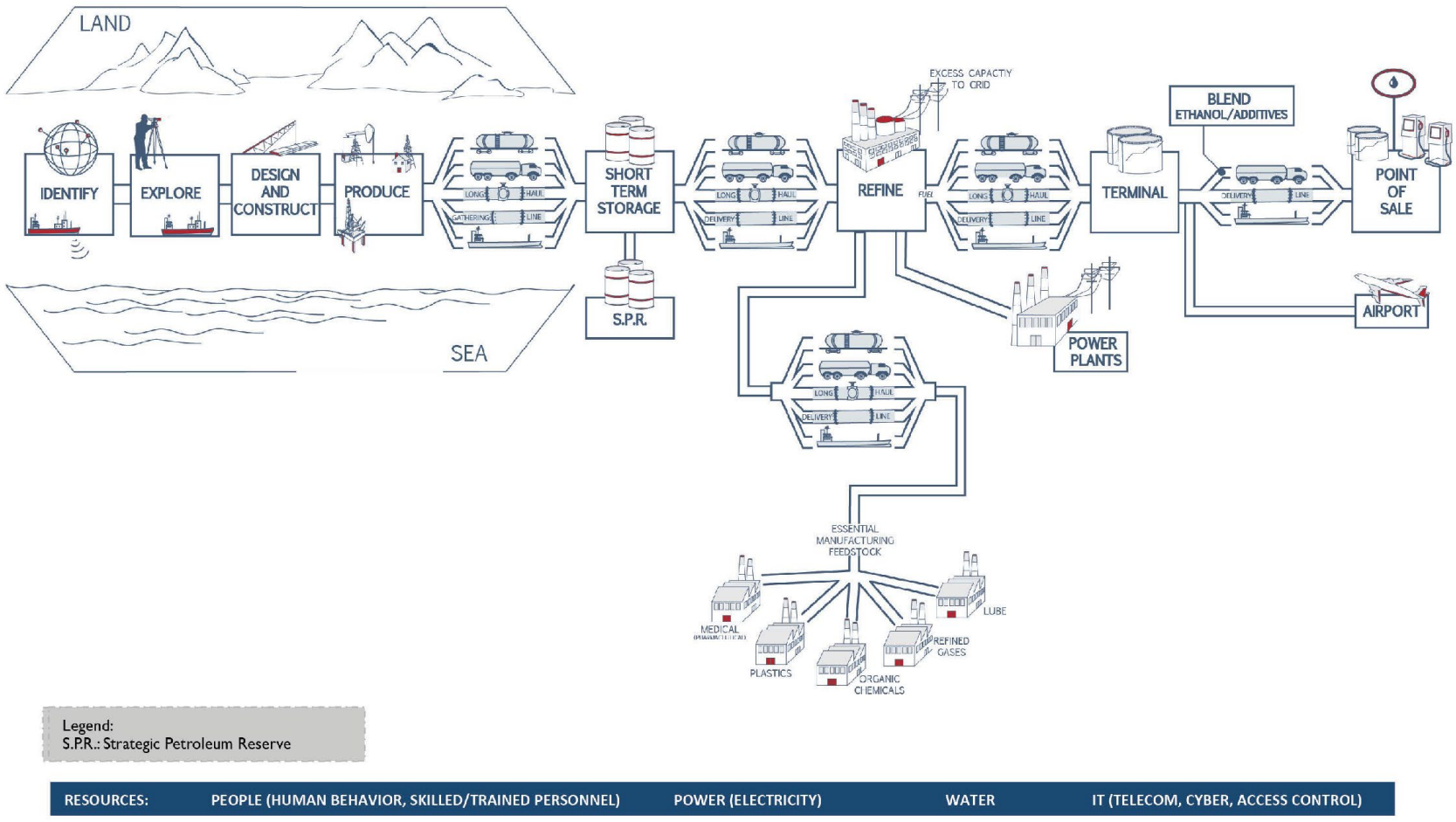
38 U.S. EIA. Petroleum & Other Liquids, Crude Oil Production, Annual-Thousand Barrels. https://www.eia.gov/dnav/pet/pet_crd_crpdn_adc_mbbl_a.htm.

39 CEC. Foreign Sources of Crude Oil Imports to California. https://www.energy.ca.gov/data-reports/energy-almanac/californias-petroleum-market/foreign-sources-crude-oil-imports.

product pipelines that export fuel, and none that import. Therefore, nearly all finished product is imported via marine vessel. When unplanned refinery outages occur, it can take several weeks to find and bring replacement gasoline from refineries located in other states or countries that meets California's unique specifications.

California is the nation's second-largest consumer of refined petroleum products, after Texas, and accounts for about 8% of U.S. total consumption. In 2021, California was the nation's largest consumer of jet fuel and the second-largest consumer of motor gasoline, after Texas. The transportation sector used about 83% of the petroleum consumed in the state. The industrial sector accounted for about 13% of state petroleum use, and the commercial sector consumed about 3%. The residential sector, where about 1 in 27 California households heat with petroleum products, mostly propane, used about 1%. Less than 0.1% of petroleum is used for electricity generation. Figure 2-8 shows the critical elements of the oil supply chain, including identifying and exploring for resources, developing facilities, oil production, storage, refining, distribution and transmission of products, and end uses.

Figure 2-8: Critical Elements of the Oil Supply Chain



Source: Oil and Natural Gas Industry Preparedness Handbook, July 2022, webpage https://www.api.org/news-policy-and-issues/safety-and-system-integrity/oil-gas-industry-preparedness-handbook.

Petroleum Processing

Petroleum refineries (also referred to as oil refineries) convert crude oil into useful products such as liquefied petroleum gas (LPG), gasoline, kerosene, jet fuel, diesel oil and fuel oils. Refineries are large, complex facilities that involve many different processing units and auxiliary facilities such as distillation units, reformers, crackers, and multi-component storage tanks. Refining breaks crude oil down into various components, which are then selectively reconfigured into the desired products. Each refinery has a unique arrangement and combination of refining processes largely determined by the refinery location, desired products, and economic considerations. California's largest refinery, the Marathon Los Angeles Refinery, can process 365,000 barrels per day of crude oil.

Petroleum Transportation

The interstate and intrastate petroleum pipeline network transports crude oil to processing centers and finished products from refineries in producing regions to terminals in the market areas with high requirements, particularly to large urban areas. Pumping stations along the pipeline transmission route keep the products moving at the desired volume and pressures.

The California pipeline network pushes finished product to the neighboring states of Arizona and Nevada. Additionally, barges may move finished products along the pacific coast.

Petroleum Distribution

Local distribution companies typically transport finished fuels from the pipeline terminals to end users via tanker truck. Many of the large commercial airports and marine ports in the state and in neighboring states are directly connected to the pipeline system. California provides Nevada with roughly 90 percent of its fuels and Arizona with a third through the pipelines from California into those states.

Petroleum Storage

Above ground tanks are used for crude and refined oil, finished oil products, and natural gas. At retail locations, such as gas stations, tanks are stored underground for safety reasons. The bulk of refined product storage is located at the various pipeline terminals and the refinery complex.

Monitoring Petroleum Supply, Demand, and Disruptions

The CEC is the state's primary petroleum data collection, monitoring, and reporting agency. The California Petroleum Industry Information Reporting Act (PIIRA) requires qualifying petroleum industry companies to submit weekly, monthly, annual, and event-based data to the CEC. In addition, the CEC pays for subscription services for additional industry reporting and tracking. The CEC also relies on industry contacts and petroleum market associations to communicate and stay informed about the petroleum industry.

The CEC's recovery efforts involve regular communication with key partners and private sector refineries, pipelines, vendors, state, and federal resources as necessary.

Petroleum Shortage Response Guidance

The CEC and other state agencies have a range of mitigation strategies to employ during any supply disruption. These options are discussed in the Petroleum Shortage Response section (Appendix A). An example of some of the actions that can be taken include regulatory waivers targeting supply-demand-distribution, air quality waivers, and energy emergency declarations. Additional information can be found on the NASEO webpage[40] and can serve as a reference guide for any impending/occurring petroleum emergencies.

Hydrogen Transportation Fuel Programs

The CEC is involved in supporting efforts to deploy hydrogen as a clean energy carrier for transportation and other sectors. These activities include analyzing feasibility and cost-effectiveness of hydrogen production and infrastructure. Efforts include funding research and development for clean hydrogen production, investing in hydrogen refueling infrastructure, and developing strategies to integrate hydrogen into California's energy system.

The CEC's Clean Hydrogen Program provides financial incentives to eligible in-state projects for the demonstration or scale-up of the production, processing, delivery, storage, or end use of clean hydrogen.[41] The goal of these projects is to help reduce sector-wide emissions. The Clean Hydrogen Program was established by Assembly Bill 209 (The Energy and Climate Change budget bill, Chapter 251, Section 12, Chapter 7.6, Article 4, enacted in September 2022) to demonstrate or scale-up hydrogen projects that produce, process, deliver, store, or use hydrogen derived from water using eligible renewable energy resources, or produced from these eligible renewable energy resources.

The California Energy Commission is supporting the adoption of zero-emission hydrogen fuel cell electric cars. Through the Clean Transportation Program, the CEC is supporting the adoption of zero-emission hydrogen fuel cell electric cars by expanding California's network of hydrogen refueling stations throughout the state.[42] A hydrogen refueling stations in California web-based dashboard can be found at: https://www.energy.ca.gov/data-reports/energy-almanac/zero-emission-vehicle-and-infrastructure-statistics-collection/hydrogen.

Energy Sector Risks and Vulnerabilities

Risks to the energy sector continue to evolve with climate change, advances in technology, and shifts in market patterns. [43] For example, more frequent and intense heat waves, droughts, and wildfires in California increase risks to generation, transmission, and use of

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40 National Association of State Energy Officials. *Regional Petroleum Response Collaboratives*. https://www.naseo.org/issues/energy-security/wpsrc.

41 CEC. *Clean Hydrogen Program*. https://www.energy.ca.gov/programs-and-topics/programs/clean-hydrogen-program.

42 CEC. *Hydrogen Vehicles & Refueling Infrastructure*. https://www.energy.ca.gov/programs-and-topics/programs/clean-transportation-program/clean-transportation-funding-areas-1.

43 CISA. *Energy Sector*. https://www.cisa.gov/energy-sector.

energy resources. Increasing use of smart devices presents greater cybersecurity risks, and changes in customer behavior (e.g., shift to electric vehicles and use of distributed energy resources) reduces some risks but increases others. In the context of emergency management, the terms "threat," "risk," and "vulnerability" can and are often used interchangeably, but they represent distinct concepts. In alignment with emergency management and planning resources, the following definitions and relationships are used for the purpose of this document.

- Definitions:
    - Threat: a potential danger or negative event that could cause damage or harm to life, property, operations, or the environment. Threats can be natural (earthquakes, tornados, floods) or man-made (cyberattacks, accidents, terrorism).
    - Vulnerability: refers to a susceptibility or weakness within a person, system, or asset that can be exploited by a threat. A vulnerability is the extent to which something is open to damage from a hazard.
    - Risk: is the potential for damage or loss that arises when a threat exploits a vulnerability. Risk represents the estimated impact a hazard would have on a community, its people, services, facilities, and infrastructure. Risk is often defined as the combination of the probability of a threat occurring and the severity of the consequences if it does.
- Relationships:
    - Threats only cause harm if they exploit a vulnerability.
    - The presence of both a threat and a vulnerability create a risk.
    - Risk is reduced by either mitigating the threat or reducing the vulnerability.
    - Risk management is the process of identifying and assessing threats and vulnerabilities and implementing measures that reduce the probability or impact of a potential emergency.

A broad range of stakeholders continuously assess risks and threats in the energy sector with significant attention devoted to threats to infrastructure, including cyber and physical security threats, space weather events, and possible physical attacks.[44]

Once a threat has been identified, consequences and vulnerabilities can be quantified to determine the benefits of risk mitigation measures. However, the diversity of threats faced by the various energy sector components vary widely and is further complicated by how the various parties perceive or interpret risk.[45] This section provides a high-level overview of the

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44 Solar activity associated with Space Weather can be divided into four main components: solar flares, coronal mass ejections, high-speed solar wind, and solar energetic particles. Source: NASA Science Editorial Team. November 6, 2024. Solar Storm and Space Weather – Frequently Asked Questions. https://www.nasa.gov/mission_pages/sunearth/spaceweather/index.html.

45 North American Electric Reliability Corporation. Reliability Risk Management. https://www.nerc.com/pa/rrm/Pages/Default.aspx.

various risks and threats to key elements of the energy sector. Figure 2-9 shows the FEMA National Risk Index for each California county. The National Risk Index is assessed based on 18 natural hazards that cover most emergency situations. The National Risk Index is a dataset and online tool designed and built by FEMA in close collaboration with various stakeholders and partners in academia; local, state and federal government; and private industry to help illustrate the United States communities most at risk for 18 natural hazards.[46]

46 The National Risk Index, https://hazards.fema.gov/nri/.

Figure 2-9 National Risk Index Natural Hazard Composite Risk Scores for California Counties

Source: FEMA National Risk Index (June 2024), https://hazards.fema.gov/nri/map, California State Profile and Energy Estimates, https://www.eia.gov/state/?sid=CA.

California Infrastructure Vulnerabilities

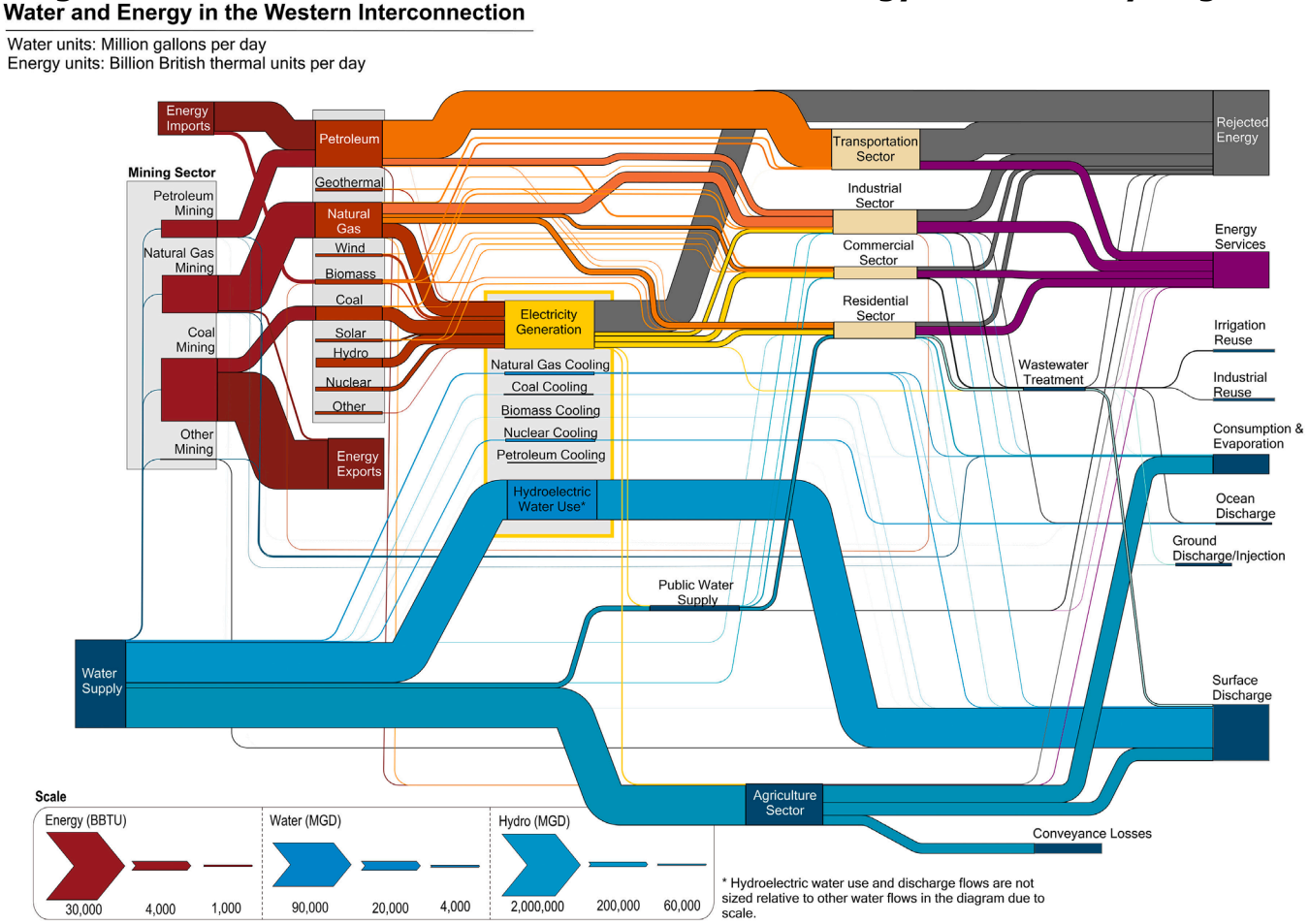
California's infrastructure system is diverse and extensive. The state contains more than 1,250 dams under state jurisdiction, and 11 seaports that handle over half of the shipping freight in the United States. Additionally, California has over 170,000 miles of roads, 50,000 miles of highways, over 12,000 bridges, over 6,800 miles of railroad track, and 246 public use airports. The state contains over 115,000 miles of oil and natural gas pipelines, 10 refineries and over

90 oil and natural gas terminal facilities, and more than a dozen large oil fields. California has over 7,400 public drinking water systems focused on serving safe, clean, potable water reliably and adequately. The California State Water Resources Control Board is mandated to regulate and oversee this critical infrastructure.

The State of California owns more than 20,000 buildings and leases space at more than 2,298 sites. Critical infrastructure is essential in supporting the state's normal operations. Critical infrastructure such as transportation routes, utilities, government facilities, schools, and hospitals also provide essential service and capacity to support emergency response. California's resiliency (the ability to withstand, respond to, and recover from a disaster) strongly depends on its capacity to quickly restore the functioning of critical infrastructure and facilities after disasters.

Over the last decade the western states have experienced heat waves and droughts, impacting both the energy and water sectors. In California, drought can have a cascading impact on the energy sector as reservoir water supplies can lead to hydroelectric and commercial curtailments, which require commercial users to secure water by other means (pumping, transport, desalination) and, in turn, use additional energy supplies. The multi-sectoral energy-water Sankey diagram, Figure 2-10, provides a visualization of the proportional energy and water flows across various sectors, subsectors, and applications of the Western Interconnection. The hydropower water use in the diagram below is the only water flow whose thickness (i.e., quantity) is not shown at the same scale as the other water flows due to the substantial difference in quantity.

Figure 2-10: Western Interconnect multi-sectoral energy-water Sankey diagram



Source: Mongird, K., Rice, J.S., Oikonomou, K., Homer, J. 2023. Energy-water interdependencies across the three major United States electric grids: A multi-sectoral analysis. Utilities Policy 85, 2023, 101673, https://doi.org/10.1016/j.jup.2023.101673.

Electric Energy Resource Risks and Vulnerabilities

Risks to the California electricity sector align with those identified nationally. A large range of organizations conduct a variety of risk assessments of the electricity subsector. For example, the North American Electric Reliability Corporation (NERC) assesses risks in terms of the potential impact to the reliability of the bulk power system (e.g., did an event result in the loss or interruption of service to customers?), while private companies and utilities examine risks and threats as they relate to the operational and financial security of each company (e.g., could a threat negatively impact the company's financial health?).

Recent reviews by U.S. electric utilities, as well as an analysis by NERC, identified a wide variety of threats to the electricity sector. Despite differences in interpretations of what constitutes risk, these entities identified the following key risks and threats to their infrastructure and/or continuity of business.[47]

47 NERC. ERO Reliability Risk Priorities Reports. https://www.nerc.com/comm/RISC/Pages/default.aspx.

- Cyber and physical security threats
- Natural disasters and extreme weather conditions
- Workforce capability and human errors
- Equipment failure and aging infrastructure
- Evolving environmental, economic, and reliability regulatory requirements
- Changes in the technical and operational environment, including changes in fuel supply

In 2000 and 2001, a supply and demand imbalance caused an energy crisis in California characterized by electricity price instability and four major blackouts. Multiple factors contributed to this imbalance, including:

- Heavy dependence on out-of-state electricity providers.
- Drought conditions in the Northwest that reduced hydroelectric power generation.
- Rupture on a major natural gas pipeline supplying California power plants.
- Strong economic growth leading to increased electricity demand in Western states.
- An increase in unplanned power plant outages
- Unusually high temperatures that increased electricity demand for air conditioning and other cooling uses.

Following the 2000-2001 energy crisis, California state government created an Energy Action Plan to eliminate outages and excessive price spikes.[48] To achieve these goals, the plan called for optimizing energy conservation, building sufficient new generation facilities, upgrading, and expanding the electricity transmission and distribution infrastructure, and ensuring that generation facilities can quickly come online when needed.

California is primarily retiring coastal power plants that use once-through cooling (OTC) technology. This policy, enacted in 2010, has the goal of protecting marine wildlife in compliance with the U.S. Clean Water Act.[49] While many of the OTC plants have since retired, the State Water Resources Control Board is allowing extensions beyond the current phase-out dates at three plants in order to bolster grid stability and reliability. To reduce harmful impacts, these plants will only be used during times of extreme events. This turn of events highlights a major challenge with this transition. Many of these older power plants are located in transmission-constrained areas that rely on local generation. Remotely located renewable resources can replace some of the needed capacity, but a portion of these will require new or upgraded transmission lines to deliver electricity to load centers. The advantage is that the

48 CPUC and CEC. February 2008. 2008 Update – Energy Action Plan.https://www.cpuc.ca.gov/-/media/cpuc-website/files/uploadedfiles/cpuc_public_website/content/utilities_and_industries/energy_-_electricity_and_natural_gas/2008-energy-action-plan-update.pdf.

49 US EPA. Clean Water Act. https://www.epa.gov/laws-regulations/summary-clean-water-act.

new (or repowered) facilities are more efficient than those they replace, which will help reduce GHG emissions.[50]

The CEC's monitoring of the supply and infrastructure is crucial to maintaining the ability to identify risks within the electric sector. For electricity-related information, the California ISO issues daily reports on electric flows.[51] Utilities are also required to report to the DOE any of the following events:

- Loss of firm system loads
- Voltage reductions
- Requests to the public to reduce usage (whether regional or along a distribution feeder)
- Vulnerabilities that could impact system adequacy or reliability
- Fuel supply emergencies

In addition, the EIA publishes electricity sales by state, month, and sector. Similarly, Electric Power Monthly published electricity production by fuel source. Information regarding generation capacity and power plant availability can be obtained from the EIA U.S Energy Atlas.[52] NERC publishes annual reports of regional system reliability. These reports assess regional reserve margins by comparing net system availability with peak - load projections and system - pool reserve availability. The National Weather Service (NWS) and National Oceanic and Atmospheric Administration (NOAA) publish cooling and heating degree - day. These data may be used to describe extreme weather conditions that create peak loads on the electrical generation system, which could more likely result in a compounded staged emergency (such as severe weather in conjunction with a transmission line trip or power plants going offline).

Added to these areas of research, the CEC Energy Assessments Division (EAD) researches and analyzes central station generation technologies, transmission analysis to support new generation resources, cost analysis of central station generation, and electricity procurement - related policy development. Division staff uses this information to compile data on the electrical market, which can be found on the Energy Almanac webpage.[53]

Overall, California has a robust electric delivery system with widespread transmission and distribution capabilities. However, relatively tight redundancy capacity in the state's high - voltage transmission lines means attacks or disasters that destroy towers or substations can

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50 Hydraulic fracturing is the use of fluid and chemicals to create or restore small fractures in a formation to stimulate production from new and existing oil and gas wells. This creates paths that increase the rate at which natural gas and crude oil can be produced from the reservoir formations.

51 California ISO Today's Outlook monitors real-time grid conditions. View current and historical data for demand, net-demand, supply, renewables, CO2 emissions and wholesale energy prices. California ISO. Today's Outlook. https://www.caiso.com/todays-outlook.

52 The U.S. Energy Atlas is a comprehensive reference for data and interactive maps of energy infrastructure and resources in the United States. https://atlas.eia.gov/.

53 CEC. Energy Almanac. https://www.energy.ca.gov/data-reports/energy-almanac.

be potentially devastating, especially at chokepoints. Even more so, the state's distribution grid, which emanates radially from substations, has even fewer opportunities for redundancy.

Most electricity is produced at large-scale power plants and transported to end users via transmission and distribution lines with substations stepping the voltage up or down. In recent years, however, electricity is increasingly generated at distribution-level generators and at consumer sites with behind-the-meter devices, in part due to growing small-scale renewable generation. In both utility-scale generation and distributed generation, energy storage may be connected to the electric grid, storing electricity when there is a supply surplus and later discharging it onto the grid as needed.

Natural Gas Risks and Vulnerabilities

California considers the following risks to natural gas when planning for, monitoring, and responding to events that could lead to energy disruption or emergency.

- Fuel Price Risk: the risk that the price of the fuel used to generate electricity will exhibit variability, resulting in an uncertain cost to generate electricity.
- Fuel Supply Risk: the risk that the fuel supply to a power plant will be unreliable, resulting in the inability to generate electricity predictably and dependably.
- Performance Risk: the risk that the seller may not be willing or able to deliver gas or electricity according to the contractually prescribed requirements in terms of time and quantity.
- Demand Risk: the risk that the energy that has been contracted for will not be needed as anticipated, or that there will not be enough to support electricity generation to meet fluctuating demand.
- Environmental Risk: the financial risk to which parties to an energy contract are exposed, stemming from existing environmental regulations and the uncertainty over possible future regulations.
- Regulatory Risk: the risk that future laws or regulations, or regulatory review or renegotiation of a contract, will alter the benefits or burdens of an energy contract to either party.
- Regulatory compliance risk: the risk that compliance with safety regulations could have unintended consequences on reliability and/or costs. For example, natural gas infrastructure maintenance could reduce capacity to the point of jeopardizing reliability.

Although California has more than 33 percent reserve capacity in its entire gas transmission system (15.5 Bcf/11.7 Bcf peak with poor hydro condition[54], projected for 2025), PG&E and SoCalGas have indicated concern about "real" gas capacity under certain conditions, especially on a regional basis. Due to long-standing FERC rules, about 90 percent of U.S. storage has migrated to now being "open access" to other third parties under the same terms and

54 Drought and water scarcity can create unique circumstances and challenges for the energy sector. Sources of energy require water in their processes. Hydroelectric generation can be curtailed during drought conditions. Energy is required to extract and move water. Consequently, the availability and predictability of water resources can directly affect energy systems and energy supply.

conditions. Given the strong interdependencies between natural gas demand and peaking electrical generation, the natural gas infrastructure is more constrained regionally. These issues will be further exacerbated by higher renewable resource penetration and relocation of power generation sites. Since California produces less than 10 percent of its gas needs in-state, imports of gas through interstate pipelines and their associated ripple effects must be thoroughly understood.

Natural gas is a heavily traded commodity in a market characterized historically by price volatility. Hydraulic fracturing used in natural gas extraction created substantial new natural gas supplies in North America and lowered prices around 2008. The increase in supply helped dampen price volatility for seven – 10 years. Today, prices are still very low despite some increased volatility.

The price indices reported by major natural gas industry publications are only for daily or monthly transactions. No major gas industry publication develops any reported indices for transactions with terms longer than a month. There is no law or regulation that requires market participants to report their deals to gas industry publications, so the price indices are based only on the prices voluntarily provided by market participants. California state agencies are not aware of any source of data that indicates the total amount of natural gas bought and sold at index prices or under long-term deals. However, CEC staff have access to major gas industry publications that report the number of deals, the volume, and the range of prices upon which they base their volume weighted average price indices.

The price of the natural gas commodity is unregulated. The market establishes natural gas prices at the time a trade of the physical commodity or a futures contract is executed. Buyers and sellers trade natural gas through private transactions, through over-the-counter transactions, and through trading forums or exchanges. The price for each transaction is established at the culmination of each trade and is the amount a willing buyer pays a willing seller for the commodity or futures contract.

Details of natural gas physical trades may be reported to the trade press by the executing parties. Details of natural gas futures contracts must be reported to the New York Mercantile Exchange (NYMEX). These entities collect data on the trades, compile them, and publish the results in indices that are central to the functioning of both the wholesale and futures markets.

Finally, another area for review is the potential implications to transmission infrastructure from increasingly stringent pipeline integrity requirements that could limit natural gas throughput on certain pipeline segments (such as post-San Bruno natural gas disaster requirements and derating on existing natural gas lines). As natural gas transmission lines are reassessed, especially as critical infrastructure running through dense urban areas, the state must conduct a more detailed review for energy disruption and disaster preparedness. Repairs and maintenance of the transmission lines means a loss of capacity during periods of inspections and testing, and possibly extended outages for repairs. The loss of capacity could impact reliability depending on the amount of the loss and the time of occurrence.

To help identify risks, the CEC monitors natural gas supply and infrastructure. California's major gas IOUs (PG&E, SDG&E, and SoCalGas) provide monthly data on:

- Their respective gas injection/takeout for gas storage in the state.
- California-based production purchases and imported natural gas inputs.
- Spot market and contract prices.
- Curtailment notices.
- Heating/cooling degree days.

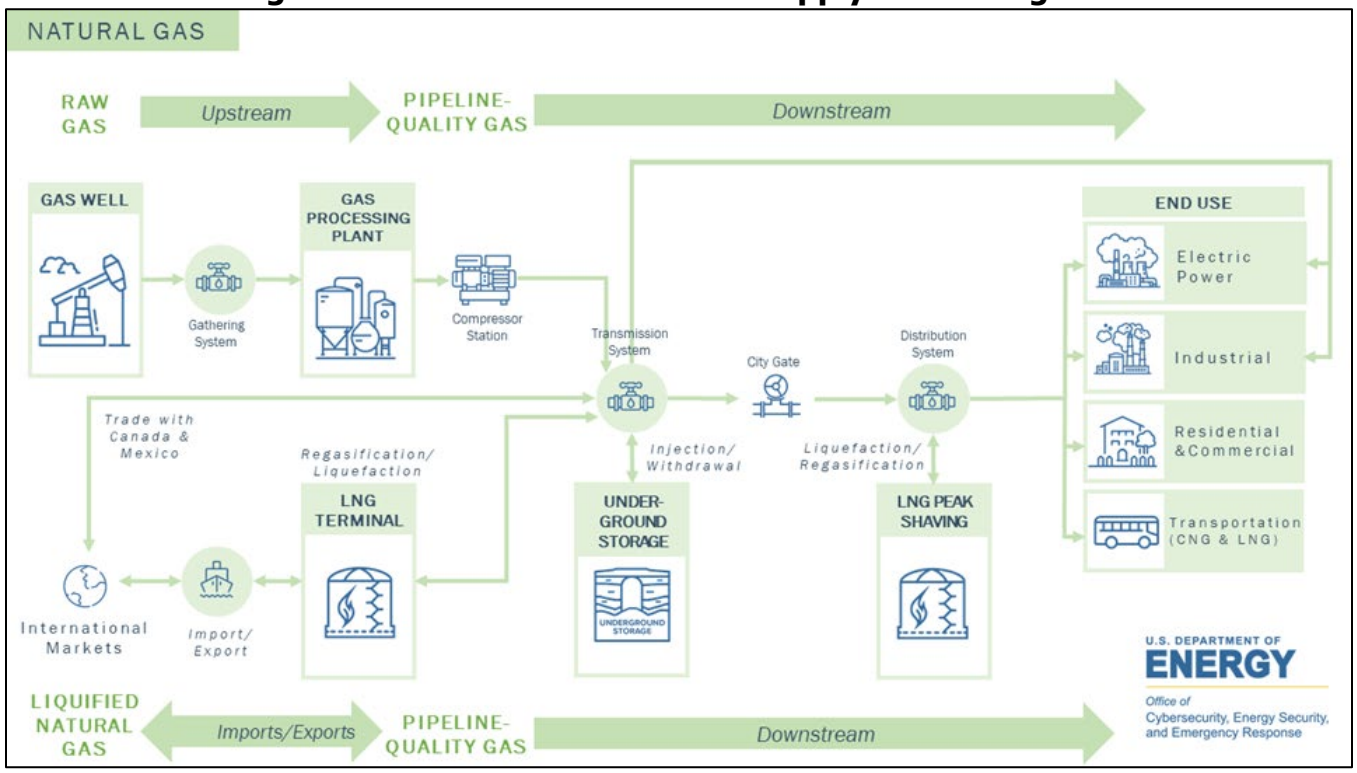
Natural gas deliveries by sector and local distribution company (LDC), as well as inventories and storage injection rates, are shown in the EIA Natural Gas Monthly. In addition to EIA sources, agencies collect data from various sources for analysis and reporting requirements.[55] Further, natural gas demand and supply projections are provided by the LDC as part of its annual Global Compliance and Reporting (GCR) filings. These projections include storage field inventory balances and ramp rates. Potential shortages can be identified when long-term supply is inadequate to meet projected demand. The EIA Natural Gas Monthly also publishes average citygate prices (price to the LDC as gas is received), and prices by sector used to determine if supply is short or more than demand and how critical the disparity is. In addition, the CEC's EAD publishes a seasonal gas reliability assessment to help identify potential reliability issues during normal or peak demand days during the gas seasons (summer and winter).

Interstate pipelines provide notices of curtailments to FERC as early indicators of reduced supply. The supplementary supply required to offset the reduction may need to be calculated and satisfied from other in-state supplies, which will depend on the current levels of storage volumes, natural gas transferred in the system, and intertie exchanges. Again, statewide weather data, regional, and even local data are available for use in predicting extreme winter periods for projecting natural gas demand. What are more troublesome in relation to pipelines are the risks and vulnerabilities of aging pipelines, or the fact that they are sited in geological hazard areas.

Figure 2-11 provides an overview of the various nodes and transport modes in the Natural Gas supply chain.

55 U.S. EIA. Natural Gas Monthly. https://www.eia.gov/naturalgas/monthly/.

Figure 2-11: CESER Natural Gas Supply Chain Diagram



Source: CESER, Energy Security Planning Resource Hub. https://www.energy.gov/ceser/energy-security-planning-resource-hub.

Petroleum and Transportation Fuels Resource Risks and Vulnerabilities

The oil and natural gas sector, particularly the oil industry, face a complex risk landscape due to its worldwide geographic presence, hazardous and evolving exploration techniques, production, operating conditions, and changes in the domestic regulatory domain. Some of the common risks identified by the sector are:[56]

- Natural disasters and extreme weather conditions.
- Regulatory and legislative changes and increased cost of compliance.
- Volatile oil and gas prices and demand.
- Operational hazards including blowouts, spills, and personal injury.
- Disruption due to political instability, civil unrest, or terrorist activities.
- Transportation infrastructure constraints impacting the movement of energy resources.
- Aging infrastructure and workforce.
- Cybersecurity risks, including insider threats.

The CEC's EAD staff has the responsibility to monitor and analyze the adequacy of California's transportation fuels infrastructure and potential impacts on petroleum, renewable and alternative fuel supply, and prices from infrastructure constraints and supply shortages. The

56 Rystad Energy. Data and analysis on O&G supply, demand, investment opportunities, portfolio valuation, and benchmarking. https://www.rystadenergy.com/energy-themes/oil--gas/.

transportation of crude oil falls under both federal and state jurisdiction. At the federal level, the appropriate regulatory agency for maintaining pipeline safety is PHMSA. At the state level, the appropriate regulatory agency is the Pipeline Safety Division of the California State Fire Marshal (CSFM). CEC staff work closely with industry, Nevada, Arizona, the Western States Petroleum Collaborative, state agencies, and federal partners when transportation fuel pipeline operations are disrupted.

California-based refineries can process more than 1,530,000 barrels of crude oil per day.[57] The supply infrastructure is expensive and diverse in its operation, including use of expensive equipment like pressure vessels, heat exchangers, storage tanks, pipelines and piping systems, petroleum depots, and transport equipment. All are critical to this industry. Disruption within the transportation fuels infrastructure and supply chain can be stimulated by changes in crude oil imports, fluctuating fuel energy prices, and the potential for accidental or intentional interruption to production or transport of liquid fuels.

For petroleum markets, CEC obtains detailed information from the EIA and the American Petroleum Institute (API), which maintain databases containing information used to determine recent market behavior and anticipate supply disruptions.[58] Since it is relatively easy to obtain aggregate petroleum data but more difficult to learn about individual companies, the CEC requires California's refineries, pipeline operators, terminal operators, importers, and major marketers to provide information regarding inventories, production, imports and exports of transportation fuels, and refinery feedstocks. In addition, these stakeholders periodically provide confidential information related to any significant potential fuel supply issues.

Because petroleum is distributed through a decentralized network, and antitrust laws prohibit oil companies from sharing information regarding supply availability and price, there is no single source of information by which to assess or characterize emerging problems. Consequently, the state's role in developing data and assessing supply is more critical for petroleum products than it is for electricity or natural gas.

The California Department of Tax and Fee Administration (CDTFA) compiles total number of taxable gallons of gasoline and diesel fuel used based on a monthly and annual basis of motor gasoline sales revenue. Similarly, parties that import into or export from California petroleum and renewable fuels submit data monthly to the CEC. In addition, Kinder Morgan Inc. provides weekly reports on exports of transportation fuels to neighboring states via pipelines that they operate.

Wholesale and retail petroleum prices are available through the EIA under the Refiner, Reseller, and Retail Monthly Prices heading and at the state level on the Weekly Petroleum Status Report that provides information on national and international prices and inventory information.

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57 CEC. California's Oil Refineries. https://www.energy.ca.gov/data-reports/energy-almanac/californias-petroleum-market/californias-oil-refineries.

58 U.S. EIA. Weekly Petroleum Status Report. https://www.eia.gov/petroleum/supply/weekly/.

The CEC also purchases daily pricing information from the Oil Price Information Service (OPIS) for petroleum and renewable fuels. In addition, the CEC subscribes to OPIS daily alerts that provide timely information regarding fuel supply issues.

The authority for monitoring and analysis is granted by PIIRA.[59] The PIIRA data collection program consists of a highly sensitive, confidential data reporting system that requires refiners, transporters, marketers, storers, distributors, and traders to submit proprietary information about transportation fuels product inventories, shipments, production, and prices. The monitoring helps identify:

- Availability, supply, price, and economic impacts relating to transportation fuels in California.
- Nature, cause, and extent of crude oil or transportation fuel shortages.
- Emerging trends related to supply, demand, and use of crude oil and transportation fuels.
- Present or future constraints in the transportation fuels supply infrastructure and distribution system.
- Potential for improvements to California's infrastructure to better facilitate economically adequate responses to unanticipated supply disruptions.

In addition to PIIRA data, other risk identification methods include:

- Analyzing information received from other data and research, including retail fuel stations, marine import-export, and refinery production and operations.
- Researching technical journals, reports, databases, and other sources to identify and compile the most appropriate data on pipeline movements, fuel terminal operations, refinery operations, and expansion projects to assess California's transportation fuels infrastructure and potential effects on supply and prices from infrastructure problems and supply shortages.

These sources include, but are not limited to, other state agencies, including CDTFA and the state Lands Commission, and subscriptions from:

- OPIS – for oil price information, including refining, transport, and retail pump prices.
- iPIERS – for import and export trade activity and to conduct market research on transportation fuels.
- PortVision – for information on maritime vessel activity and, in particular, fuels movements.
- IIR – for information on refinery turnarounds and maintenance.

59 CEC. Petroleum Industry Information Reporting Act Requirements – PIIRA. https://www.energy.ca.gov/rules-and-regulations/energy-suppliers-reporting/petroleum-industry-information-reporting-act-piira.

Senate Bill X1-2 expanded the authority of the CEC to collect additional information on the petroleum sector, including refinery maintenance, refiner profit margins, and petroleum product transactions.[60]

California also has critical nodes for petroleum product pipeline distribution infrastructure. Information on critical nodes and potential implications of disruption to specific points within the distribution infrastructure are considered homeland security-sensitive and not included in public documents. However, CEC staff have information for California's petroleum market including maps with locations of refineries, primary petroleum pipelines, marine terminals, and distribution terminals. CEC staff is highly qualified to initiate assistance to first responders and energy assurance partners to enable the continued distribution of transportation fuels if one or more of the "critical" distribution nodes are temporarily disrupted.

Threats to California Energy Infrastructure

A potential key vulnerability to the state's overall energy health is the fact that approximately 30 percent of the state's electric energy, 90 percent of the state's natural gas, and 75 percent of the state's petroleum are imported over high voltage wires, through pipelines, and by marine vessels, respectively. Additionally, because California is a major industrial center on the west coast, neighboring states rely on portions of California's energy infrastructure. Depending on the level of risk, measures are taken to detect, prevent, control, and manage the consequences of natural and man-made risk directed toward the energy infrastructure.

During California's development of the State Multi-Hazard Mitigation Plans, a multitude of hazards were identified that impact the energy sector.[61] Earthquakes were noted as a hazard of highest concern for both the public and private sectors, including the risk of more than 200 faults that are considered potentially hazardous based on their slip rates in the last 10,000 years.[62] More than 70 percent of the state's population resides within 30 miles of a fault where high ground shaking could occur in the next 50 years.[48] Overlaid on this foundation is the risk of several active volcanic regions.

Observations of damage from California earthquakes have also shown that ground shaking may be locally attenuated but amplified farther away due to varying soil conditions and

60 CEC. Senate Bill X1-2 Implementation. https://www.energy.ca.gov/proceeding/senate-bill-x1-2-implementation.

61 Cal OES Hazard Mitigation (HM) Section is responsible for supporting state and local mitigation efforts to reduce the negative impacts of future disasters on lives, property, and the environment. Cal OES. Hazard Mitigation. https://www.caloes.ca.gov/office-of-the-director/operations/recovery-directorate/hazard-mitigation/#:~:text=The%20Cal%20OES%20Hazard%20Mitigation,%2C%20property%2C%20and%20the%20environment.

62 California Department of Conservation. Earthquakes. https://www.conservation.ca.gov/cgs/earthquakes#:~:text=How%20common%20are%20faults%20in,(the%20last%2010%2C000%20years).

structural response. This amplification can lead to disruptions to the electric, natural gas, and petroleum fuel infrastructure far from the earthquake epicenter.

The next most concerning hazards are urban and rural wildfires, and floods. More than 5 million Californians are subject to federal flood insurance zoning that is adjacent to 1,400 dams and 13,000 miles of earthen levees. The 2022 California wildfire season consisted of 7,667 fires, totaling approximately 363,939 acres across the state. California wildfires in 2022 killed nine people, destroyed 772 structures, and damaged another 104.

Energy shortages can affect any resident, but the impacts are often most significant to vulnerable populations. For example, those who rely on electric power for life-saving medical equipment, such as respirators, are extremely vulnerable to power outages. Also, during periods of extreme heat emergencies, the elderly and the very young are more vulnerable to the loss of cooling systems requiring power sources. Predicted increases in heat waves and increasingly severe winter storms continue to put ever greater strain on California's energy systems.

California's largest industries include trade, transportation, utilities, professional and business services, and government. California is strong in the manufacturing of electronic equipment, computers and related chips and software, machinery, transportation equipment, and metal products. The state continues to be a major center for motion picture, television, film, and related entertainment industries. Tourism is another important source of state income.

The state is the nation's largest producer of agricultural products. The Central Valley covers about 20,000 square miles and contains 75 percent of California's irrigated land. Using less than 1 percent of U.S. farmland, the Central Valley supplies 8 percent of U.S. agricultural output (by value) and produces 25 percent of the nation's food, including 40 percent of the nation's fruits, nuts, and other table foods.[63] California's total market value of agriculture products sold in state reached $15.9 billion in 2022.[64] Furthermore, about 20% of the nation's groundwater demand is supplied from pumping Central Valley aquifers, making it the second-most-pumped aquifer system in the U.S.

The State Energy Risk Profiles (Appendix C) examine the relative magnitude of the risks that the state energy infrastructure routinely encounters relative to the probable impacts. Man-made and natural hazards with the potential to cause significant disruption to the energy infrastructure are identified. Certain natural and adversarial threats are not well-suited to a location or regional specific probabilistic risk assessment as they may not adhere to geographic boundaries, have limited occurrence, or have limited historic data.

Terrorism

Energy security is and will be among the most serious challenges that state's face over the next decade. Energy infrastructure is highly vulnerable to coordinated and nearly simultaneous

63 USGS. California's Central Valley. https://ca.water.usgs.gov/projects/central-valley/about-central-valley.html.

64 California Department of Food and Agriculture. California Agricultural Production Statistics. https://www.cdfa.ca.gov/Statistics/.

terrorist attacks on the electrical, natural gas, and petroleum infrastructures. While California has substantial electrical generation, it produces less than 10 percent of its natural gas needs in-state. While the state has substantial natural gas storage, imports of gas through interstate pipelines and the associated ripple effects must be thoroughly understood. The natural gas system peaks during the winter and is designed to meet winter demand with flowing pipeline supply and natural gas storage. The gas utilities are required to maintain a certain level in storage for its core customers only, which are comprised of residential and small commercial customers. Electrical generation and large industrial customers interconnected to Pacific Gas and Electric Company's (PG&E) gas transmission system can procure storage services from non-utility owned independent storage providers (ISPs).

For instance, in the event of a terrorist attack, California may have enough reserve capacity to meet projected peak demand, but if other nearby sourcing states have their own gas extreme peak days or experience supply interruptions coincident with California, there may not be enough reserves. Electricity and natural gas systems are at risk of pipeline incidents at production sites and supply routes in other states and Canada.

Natural gas storage can replace some of the loss of flowing pipeline supply, but it is not a complete substitute. Some areas of the natural gas system, such as San Diego cannot be served by storage. While not a terrorist event, curtailment and significant natural gas restrictions occurred in 2013 and 2023 when severe gas demand or transmission failures in neighboring states led to actual curtailment orders in California. The August 2021 rupture of a section of El Paso Natural Gas Line 2000, a transmission pipeline operated by Kinder Morgan, Inc. in Coolidge, Arizona, resulted in the deaths of two occupants of a farmhouse and severe injuries to a third person.[65] Line 2000 delivers gas to the Southern California Gas Company (SoCalGas) at Ehrenberg, Arizona, and the rupture resulted in the temporary reduction of the utility's receipt capacity. Kinder Morgan, Inc. restored the line to full service in 2023 after repairing the line and receiving approval from the U.S. Department of Transportation, Pipeline and Hazardous Material and Safety Administration (PHMSA).

California is planning to substantially reduce natural gas and petroleum use, and over time, the threats to the electricity sector from terrorist activity will be greater than the direct risks to natural gas and petroleum sectors. However, threats to these sectors outside of California can impact the state.

Energy resources in other countries are increasingly being targeted by terrorists for political and media gain, resulting in short-term supply shortages, tight production characteristics (little spare capacity for oil production) and market speculation. This can lead to limited availability of certain energy supplies and higher energy costs for California residents. Therefore, the energy markets will continue to be sensitive to the risk of disruptions from perceived or real terrorist threats.

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65 National Transportation Safety Board. April 27, 2023. Pipeline Investigation Report: PIR-23/01 "Kinder Morgan Natural Gas-Fueled Explosion." https://www.ntsb.gov/investigations/AccidentReports/Reports/PIR2301.pdf.

Energy infrastructure disruption may take the form of terrorist attacks targeting power plants, and in particular, the state's only operating nuclear power plant. Over the last 20 years, the U.S. Nuclear Regulatory Commission (NRC) has instituted several measures to improve the security of U.S. reactors. The NRC's process for prioritizing and responding to safety concerns has not always been open and public. This makes understanding how NRC decisions are made or why certain issues receive more attention than others difficult.[66]

Disruptions

Both intentional and unintentional disruptions have the potential to harm, damage, incapacitate, or destroy critical infrastructure. The type of disruption can affect all four phases of emergency management: mitigation, preparedness, response, and recovery.

Some of the typical causes of disruptions include the following.

- Severe Weather: tropical storms, ice storms, thunderstorms, tornadoes, and hurricanes, can damage power infrastructure and lead to widespread outages.
- Natural disasters: hurricanes, earthquakes, wildfires, mudslides, and floods can cause catastrophic damage to energy systems.
- Human error: outages can occur due to accidents like vehicular collisions with energy infrastructure or errors during routine maintenance.
- Vandalism: major infrastructure attacks, though rare, can disrupt systems resulting in significant financial losses.
- Equipment failure: aging equipment, surpassing its lifespan, often fails to meet modern energy demands and withstand extreme weather conditions.
- Fallen trees: trees knocked down by heavy winds can damage power lines and transmission poles, leading to power outages and even damage exposed pipelines.
- Animals and Rodents: animals may gnaw on electrical equipment or become caught in it, causing localized power disruptions.
- High energy demand: utilities may implement rolling blackouts to manage increased power demand, preventing complete grid failure.
- Planned outages: utility companies conduct pre-arranged outages for maintenance and safety reasons, sometimes lasting for days or weeks, especially in wildfire-prone areas.
- Excavation: unintentional damage to underground energy systems during digging or construction projects can result in outages.
- Space weather: solar storms and particle events can disrupt power grids, as seen in the 1989 Quebec blackout.
- Cyber-attacks: although less common, cyberattacks on energy systems can potentially cause outages, as cybercriminals become more sophisticated.

There are four types of intentional electricity disruptions, which are as follows.

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66 Nuclear Power: Analysis of Regional Differences and Improved Access to Information Could Strengthen NRC Oversight, GAO-13-743. Published: Sep 27, 2013. Publicly Released: Oct 17, 2013.

1. **Planned:** Some disruptions are intentional and can be scheduled. An example is the Public Safety Power Shutoff (PSPS) Program designed to enhance community wildfire safety. A PSPS is the intentional de-energization of distribution and transmission lines by a utility to help reduce the likelihood of a wildfire. Scheduled intentional disruptions can last from several minutes to several hours, and customers are usually notified in advance.
2. **Unscheduled:** Some intentional disruptions can be immediate and necessary to address unforeseen issues, such as mechanical failure of a component, or a fire department or a police department may request a disruption in service during a fire or an accident. As a result, advance notice cannot be provided.
3. **Load Shedding:** When the power system is under extreme stress due to heavy demand and/or failure of critical components, it is sometimes necessary to intentionally interrupt the service to selected customers to prevent the entire system from collapsing. In such cases, customer service (or load) is cut, sometimes with little or no warning. Load shedding is usually achieved through rotating power outages, which cut service to selected customers for a predetermined period usually not more than a couple of hours. As power is restored to one block of customers, power to another block of customers is interrupted to reduce the overall load on the system.
4. **Demand-Side Management:** Some customers have entered into an agreement with their utility to curtail their demand for electricity during periods of peak system loads. In return these customers receive a lower electric rate or rebate.

Unintentional or unplanned disruptions are outages that come with essentially no advance notice. This type of disruption is the most problematic. The following are categories of unplanned disruptions.

- Accident by a utility or other energy sector infrastructure owner/operator, contractor, or others.
- Malfunction or equipment failure due to, for example, age, improper operation, excessive operation, or manufacturing defect.
- Equipment overload due to infrastructure owner/operators or customer action.
- Reduced capability due to equipment that cannot operate within its design criteria.
- Tree or vegetation contacts.
- Vandalism or intentional damage.
- Weather, including ice/snow, lightning, wind, earthquake, flood, landslide, and debris taking down power lines.
- Wildfire that damages energy sector transmission and distribution lines.

For the electric sector, balancing authorities in the state follow the NERC Energy Emergency Alert (EEA) system. As of May 2022, all balancing authorities in California use the NERC EEA system. This was done to align with the alert system used by the Reliability Coordinator West (RC West) and other balancing authorities in the Western Electricity Coordinating Council (WECC). Balancing authorities in California include:

- Balancing Authority of Northern California (BANC)

- California Independent System Operator (CAISO)
- Imperial Irrigation District (IID)
- Los Angeles Department of Water and Power (LADWP)
- PacifiCorp-West
- NV Energy
- Turlock Irrigation District (TID)
- Western Area Lower Colorado (WALC)

Balancing authorities issue alerts to provide awareness of potential grid stress and emergency notifications when operating reserves or transmission capacity limitations threaten the ability to operate the grid safely and reliably to keep the public and market participants informed.[67] The alerts are categorized as:

- **Flex Alert –** A Flex Alert is a call to consumers to voluntarily conserve electricity when balancing authorities anticipate using nearly all available resources to meet demand. Reducing energy use during a Flex Alert can prevent more dire measures, such as moving into EEA notifications, emergency procedures, and even rotating power outages.
- **Restricted Maintenance Operations –** When high loads are anticipated, grid participants are cautioned to avoid taking assets offline for routine maintenance to ensure that all generators and transmission lines are available.
- **Transmission Emergency –** Declared for any event threatening or limiting transmission capability, including line or transformer overloads or loss.
- **Energy Emergency Alert Watch (EEA Watch) –** Analytics show all available resources are committed or forecasted to be in use, and energy deficiencies are expected. Market participants are encouraged to offer supplemental energy. This notice can be issued the day before the projected shortfall or if a sudden event occurs.
- **Energy Emergency Alert 1 (EEA 1) –** Real-time analysis shows all resources are in use or committed, and energy deficiencies are expected. Market participants are encouraged to offer supplemental energy and ancillary service bids. Consumers are encouraged to conserve energy.
- **Energy Emergency Alert 2 (EEA 2) –** Balancing Authorities request emergency energy from all resources and has activated emergency demand response programs. Consumers are urged to conserve energy to help preserve grid reliability.
- **Energy Emergency Alert 3 (EEA 3) Preparing for rotating power outages –** The grid operator is unable to meet minimum reliability reserve requirements. Rotating power outages have not been ordered, but utilities have been alerted to prepare for outages if conditions worsen.
- **Energy Emergency Alert 3 (EEA 3) Ordering rotating power outages –** The grid operator has ordered utilities to begin rotating power outages to protect grid reliability.

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67 Cal ISO. Emergency notifications. https://www.caiso.com/documents/emergency-notifications-fact-sheet.pdf.

The final step of an EEA 3 is declared when electricity supplies are not sufficient to meet demand, and the grid operator is unable to maintain required reserves.

Natural Disasters

California's large area and diverse environment coupled with active seismic faults creates a complex risk profile. Extreme snowfall can disrupt transportation, electricity, and fuel infrastructure. Heatwaves can put excessive pressure on the state's electric grid which can then cascade into dependent sectors due to curtailments or blackouts. Extended drought conditions can impact dependent sectors putting additional strain on related infrastructure. Wildfires can have cascading impacts causing damage to exposed infrastructure.

In August 2020, an extreme West-wide heat event led to a California ISO grid emergency requiring brief rolling outages. The event served pointed to the challenges in addressing grid reliability during extreme, wide-spread heat events, which are becoming more prevalent with climate change. These events can also disrupt electric transmission and generation facilities.[68]

Another California ISO transmission emergency occurred in July 2021 due to the Bootleg Fire in Oregon,[69] and another in September 2022 due to West-wide extreme heat.[70] While neither the 2021 or 2022 events resulted in rolling outages, extraordinary measures were required to maintain bulk service and both events underscore the need for the enhanced reserves, diversity of resource and response options and planning for the short-, medium- and long-term.

Like wildfires, flooding can result in infrastructure damage and evacuations for extended periods. Finally, any large earthquake is likely to cause significant disruption and damage to the infrastructure which can create a significant humanitarian issue. This could be further exacerbated if the seismic event leads to a tsunami, as most of the California population lives within 50 miles of the coast, and five of the top 10 most populated cities are coastal.

Energy System Interdependencies

Over the past 20 years, the energy sector has undergone significant changes, including rapid changes in manufacturing technologies and supply chains leading to increased deployment of solar and wind energy; widespread uptake of efficient LED lighting; significant digitization of the electric grid, communication, and transportation systems; and the birth of an electric vehicle marketplace.

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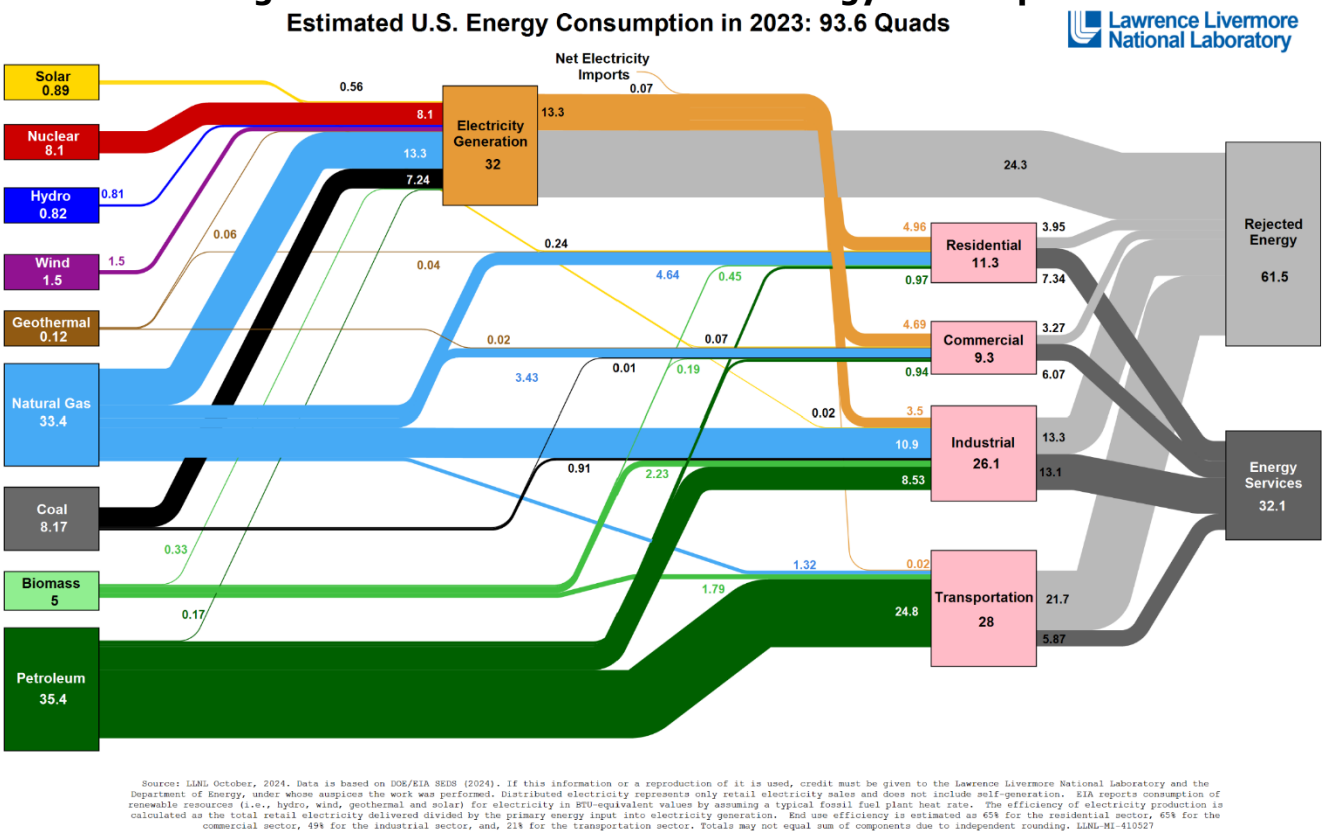
68 California ISO, CPUC and CEC. Final Root Cause Analysis - Mid-August 2020 Extreme Heat Wave. http://www.caiso.com/Documents/Final-Root-Cause-Analysis-Mid-August-2020-Extreme-Heat-Wave.pdf.

69 Governor Newsom. July 9, 2021.Press Release on Bootleg Fire transmission emergency. https://www.gov.ca.gov/2021/07/09/governor-newsom-takes-action-to-increase-energy-capacity-amid-heat-wave-and-disruption-to-regional-transmission-system-due-to-oregon-wildfire/.

70 California ISO. November 2, 2022. California ISO posts analysis of September 2022 heat wave. https://www.caiso.com/Documents/california-iso-posts-analysis-of-september-heat-wave.pdf.

Over the coming decades, the energy sector is expected to evolve at an accelerated pace driven by continued innovation, investment trends in private capital markets, and the urgent need to combat global climate change. Demand for clean energy is projected to increase dramatically as we work toward the nation and California's climate goals to cut emissions, create an emissions-free power sector, electrify transportation, and achieve net-zero emissions economy-wide. Figure 2-12, the 2023 energy flow chart released by Lawrence Livermore National Laboratory, details the sources of energy production in quadrillion British thermal units (quads), how the U.S. is using energy and how much waste exists.

Figure 2-12: 2023 Estimated U.S. Energy Consumption



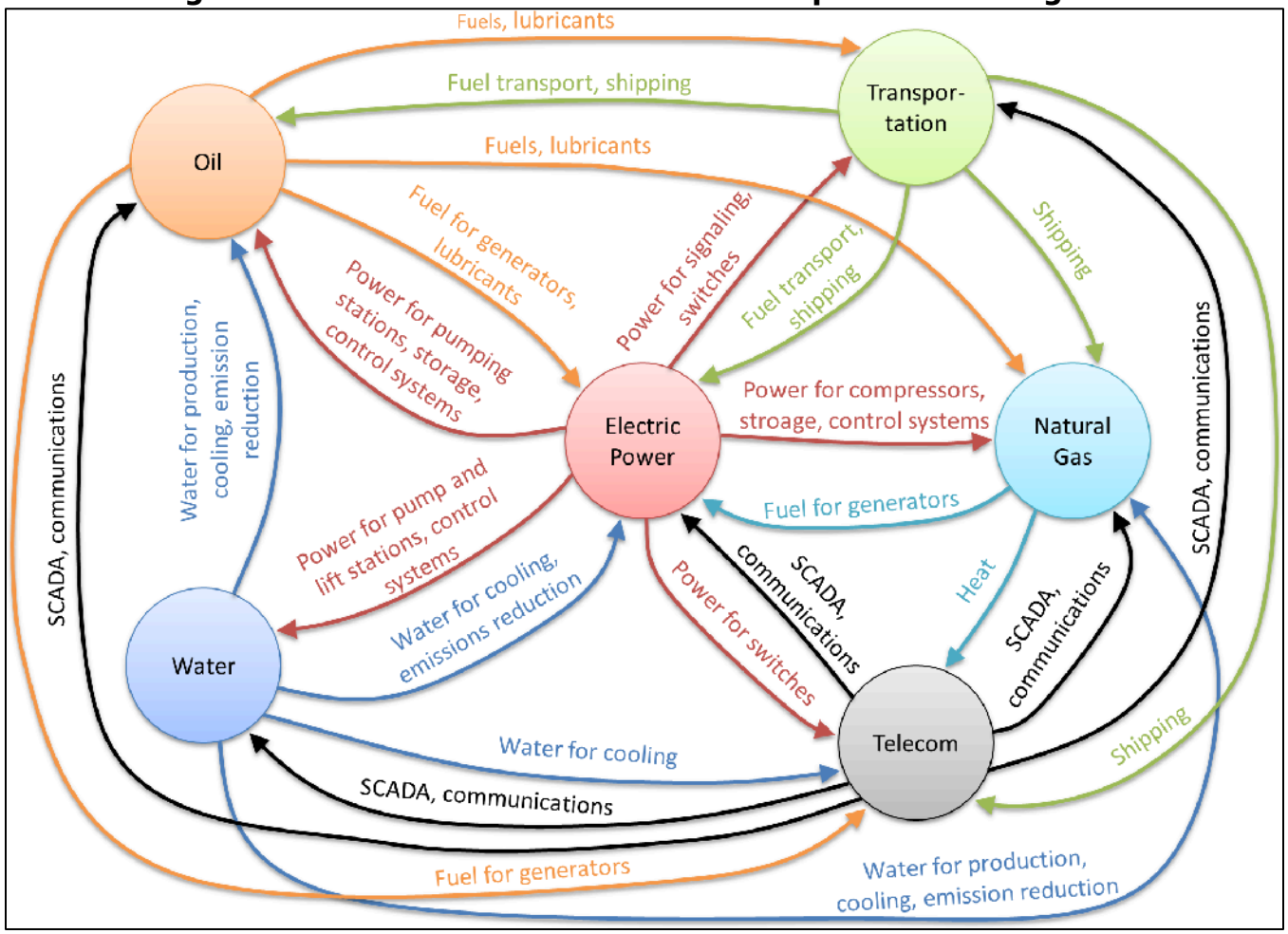
Source: Lawrence Livermore National Laboratory and DOE, Energy Flow Charts, https://flowcharts.llnl.gov/.

State leadership recognizes that a secure, resilient energy supply chain will be critical in achieving California's climate goals while capturing the economic opportunity inherent in the energy transition. The need to modernize and increase the performance of the California power grid is increasing due to population changes, aging infrastructure, grid resilience requirements, operational flexibility needs, and a growing portfolio of renewable energy and electricity storage. However, essential components supporting the power grid have either limited or no domestic manufacturing capacity and face complex challenges supporting rapid grid technology deployment.

The illustration in Figure 2-13 highlights the interdependencies among the critical infrastructure sectors, including the four most crucial lifeline sectors, communication, transportation, water, and energy. There are 16 critical infrastructure sectors whose assets, systems, and networks, whether physical or virtual, are considered so vital to the United

States that their incapacitation or destruction would have a debilitating effect on security, national economic security, national public health or safety, or any combination thereof (see Figure 2-14).[71] All of the other critical infrastructure sectors depend on power and/or fuel to operate. A disruption or loss of the services provided by the energy sector can directly affect the security and resilience within and across numerous sectors. The energy sector also depends on other sectors to help provide its services.

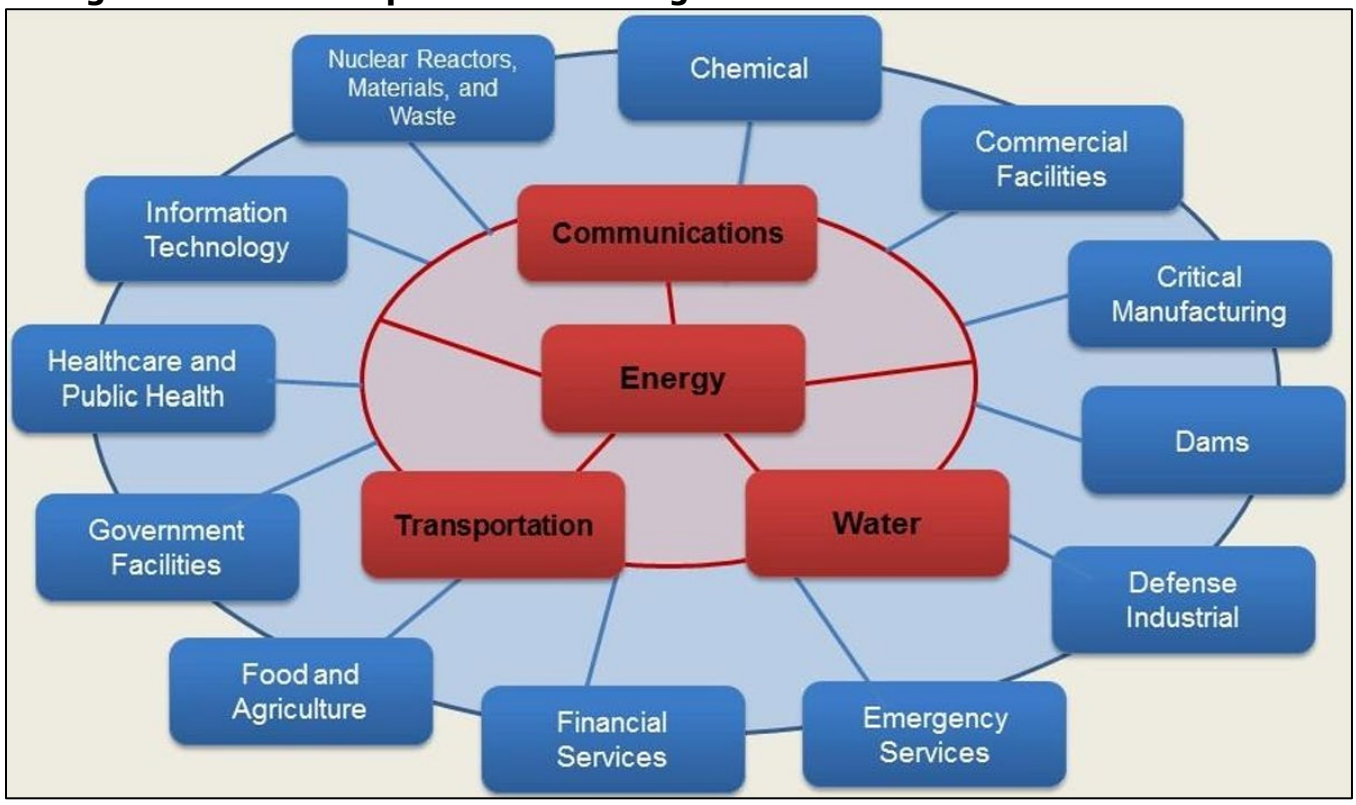
Figure 2-13: Critical Infrastructure Interdependencies Diagram



Source: [Common Operating Picture of Critical Infrastructure: System Design and Implementation](), 2014, Lauri Lääperi, Jussi Timonen. https://www.semanticscholar.org/paper/Common-Operating-Picture-of-Critical-Infrastructure-L%C3%A4%C3%A4peri-Timonen/fc9af2fc33b2f2e33cf9e2498275d56a5542ffb0.

71 Cybersecurity and Infrastructure Security Agency. [Critical Infrastructure Sectors]().
https://www.cisa.gov/critical-infrastructure-sectors.

Figure 2-14: Interdependencies Among the 16 Critical Infrastructure Sectors



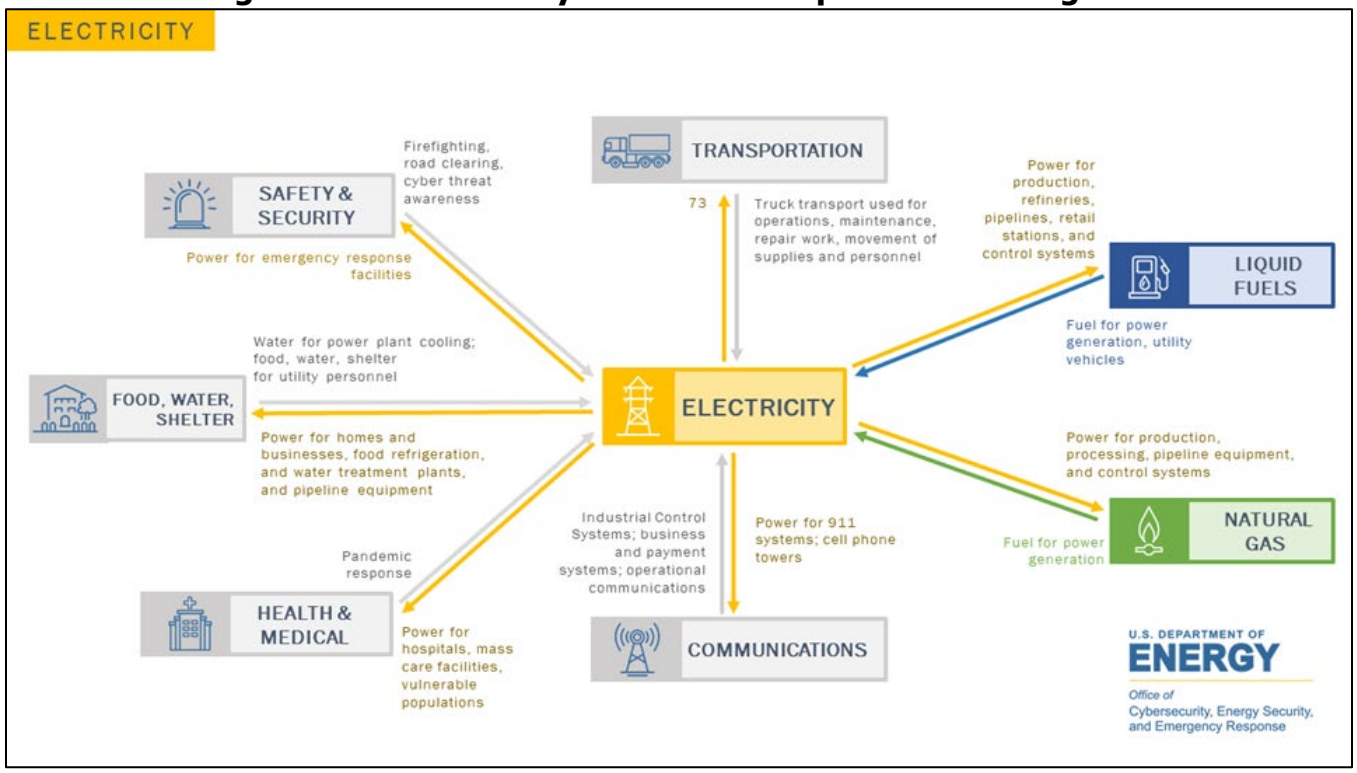
Source: CISA Energy Sector-Specific Plan 2015.

A comprehensive understanding of the energy sector interdependencies opens pathways for relevant parties to mitigate potential vulnerabilities and helps ensure that the state continues to operate during extraordinary events. A robust and diverse energy infrastructure system allows transportation, communications, water, and wastewater systems to maintain their functionality. This understanding is the basis for energy-related resilience, which in turn serves to mitigate the potential consequences of large-scale system failures.

The energy sector serves the community lifeline functions, which means that its reliable operation is so critical that a disruption or loss of energy function will directly affect the security and resilience of other critical infrastructure sectors.[72] In turn, the energy sector depends on critical infrastructure sectors, such as transportation, information technology (IT), communications, water, financial services, and government facilities. A disruption in a key node can generate disturbances within other infrastructure or sectors. Consequently, a cascading series of interconnections can extend or amplify the effects of a disruption. The Figures 2-15 through 2-17 highlight sector-specific interdependencies that relate to energy supply management.

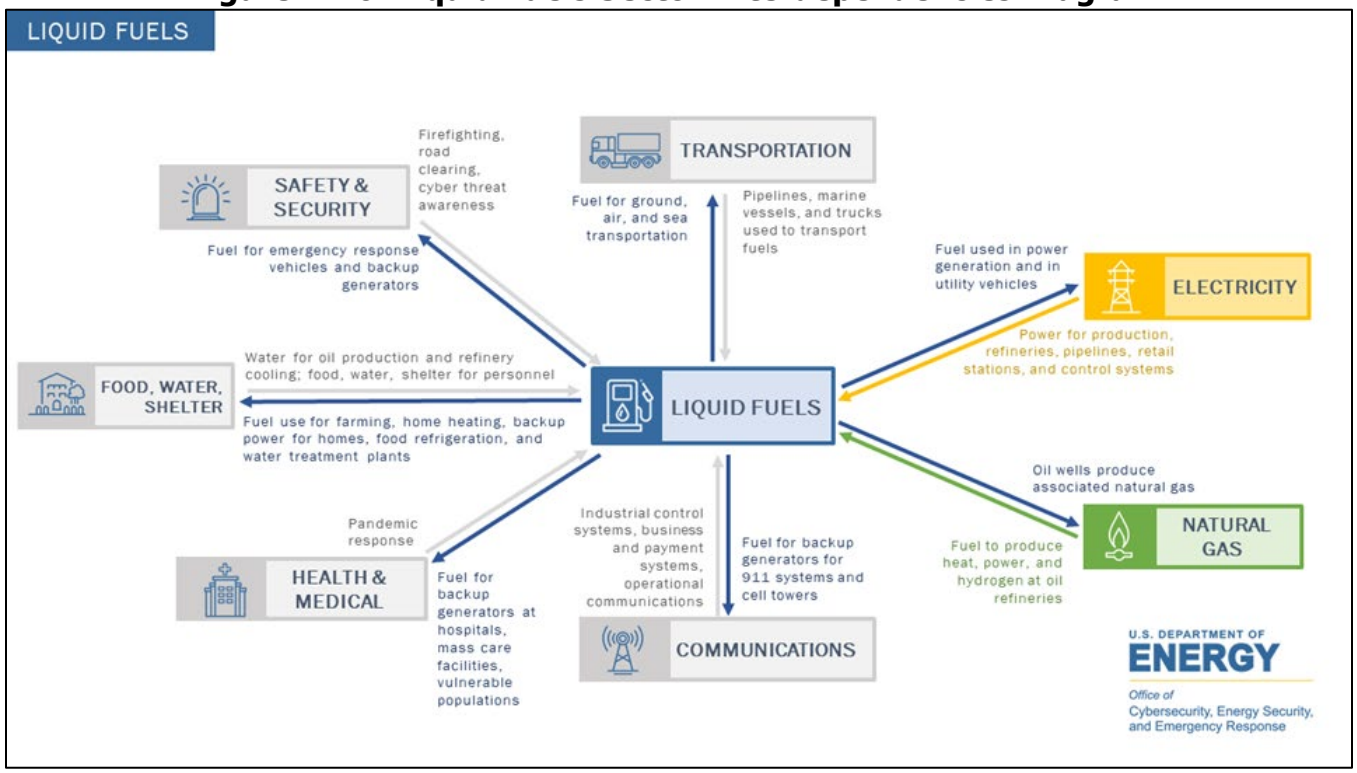
72 FEMA. Community Lifelines. https://www.fema.gov/fact-sheet/community-lifelines.

Figure 2-15: Electricity Sector Interdependencies Diagram



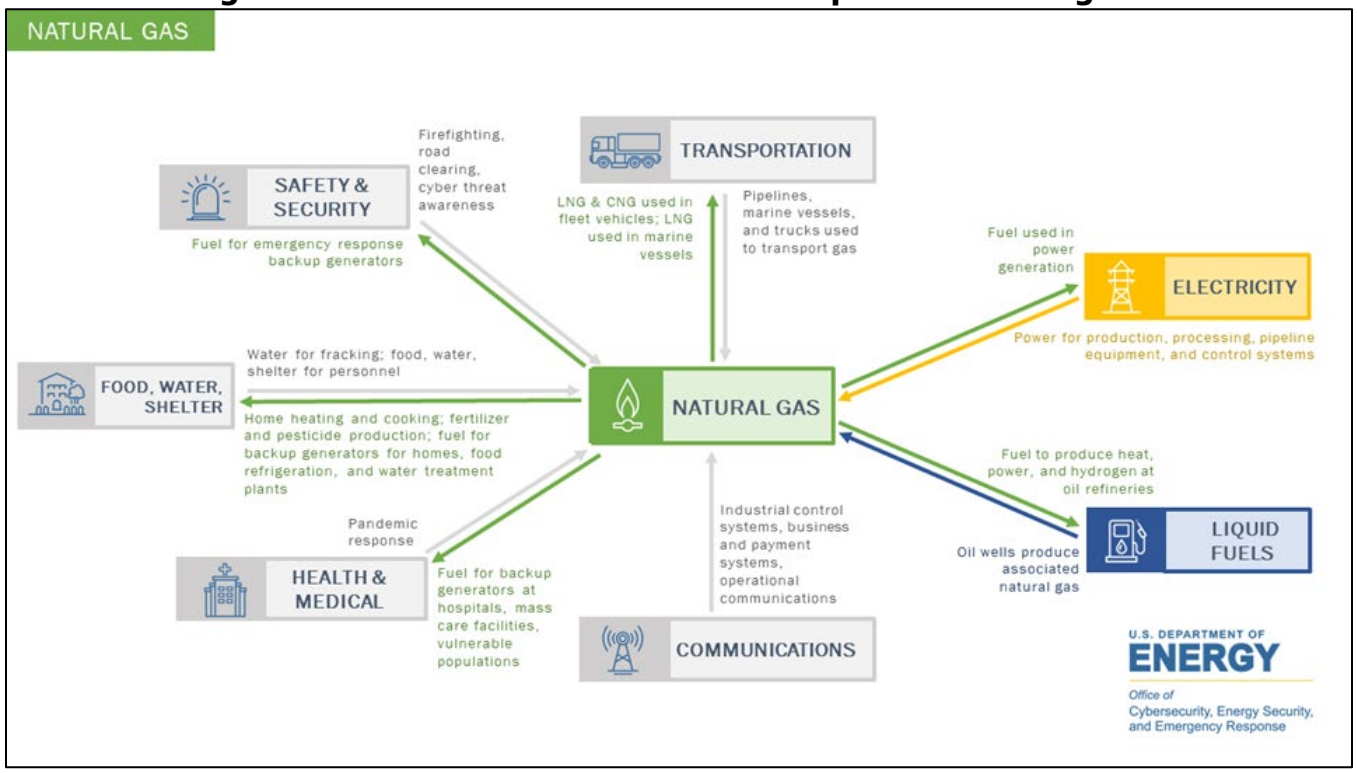
Source: CESER, Energy Security Planning Resource Hub, https://www.energy.gov/ceser/energy-security-planning-resource-hub.

Figure 2-16: Liquid Fuels Sector Interdependencies Diagram



Source: CESER, Energy Security Planning Resource Hub, https://www.energy.gov/ceser/energy-security-planning-resource-hub.

Figure 2-17: Natural Gas Sector Interdependencies Diagram



Source: CESER, Energy Security Planning Resource Hub, https://www.energy.gov/ceser/energy-security-planning-resource-hub.

Energy Security Coordination

The CEC engages in multiple regional coordination efforts to conduct effective government-to-government cooperation, collaboration, communication, and other activities with neighboring states and political entities. The CEC's regional energy security engagement focuses on regional planning, collaboration, memorandums of understanding, and coordination around support and response activities. These efforts are primarily focused through two forums, the NASEO Energy Security Committee and CESER's Energy Security programs.

The NASEO Energy Security Committee provides a forum for state energy officials to discuss, learn, and collaborate on energy emergency preparedness and response. The committee seeks to address all natural and man-made hazards as part of its energy assurance efforts. It supports state efforts in the areas of energy data and analysis, intrastate and interstate communications and training, and public-private sector coordination.[73]

NASEO sponsors the State Energy Office participation in the Energy Emergency Assurance Coordinators (EEAC), which are the state points of contact in an energy emergency. The committee collaborates with relevant federal partners and industry stakeholders to promote comprehensive energy sector security. The committee leverages its network to assist states in carrying out their responsibilities as state energy data repositories, providing technical

73 NASEO. Energy Security Committee. https://www.naseo.org/issues/energy-security/committee.

assistance to other state government agencies, and conducting energy assurance planning and preparedness activities.

The committee structure is designed as a conduit to solicit diverse state perspectives on a variety of subjects to inform future activities and resource requests, and guide NASEO advocacy. Furthermore, NASEO helps to advance national and state energy goals by assisting states in ensuring the energy system is reliable, affordable, and secure. NASEO supports these objectives by delivering state energy policy and program expertise, facilitating peer learning among state energy officials, assessing states' energy security needs, and developing tools and resources for state energy office use. NASEO works with federal partners, utilities, key energy stakeholders (regional, state, and local policy makers), state associations, academia, and private sector energy organizations, including emerging energy technology companies, to ensure that state energy officials have the support and resources they need to prepare for, respond to, and mitigate against all hazards.[74]

CESER coordinates with NASEO in supporting state energy security planning. CESER develops and maintains multiple resources to assist state programs. Additional information can be found at the CESER Energy Security Planning Resource Hub webpage.[75] Additional details can be found in Appendix F.

74 NASEO. Energy Security. https://www.naseo.org/issues/energy-security.

75 CESER. Energy Security Planning Resource Hub. https://www.energy.gov/ceser/energy-security-planning-resource-hub.

CHAPTER 3:
California Energy Security and Emergency Response Authorities

The statutes described within this chapter serve as the legal and authority basis for the various energy emergency response options discussed in this document. Federal emergency response authorities derive from the Stafford Act (Act), 42 U.S.C. § 5121 *et seq*. The Act provides the authority for the federal government to respond to disasters and emergencies, especially as they pertain to Federal Emergency Management Agency activities and programs. The Act authorizes the President, among other things, to:

- Establish a program of disaster preparedness that uses services of all appropriate agencies;
- Make grants to states, upon their request, for the development of plans and programs for disaster preparedness and prevention; and
- Ensure that all appropriate federal agencies are prepared to issue warnings of disasters to state and local officials.

The California Emergency Services Act (ESA) gives the state and local governments the authority to respond to prepare and respond to emergencies. The ESA applies to disasters caused by natural events, humans, or war. The ESA is found in California Government Code sections 8550–8669.87. The ESA among other things:

- Allows the state to use resources to mitigate the effects of emergencies;
- Authorizes the governor to make orders and regulations to carry out the ESA; and
- Applies to conditions of extreme peril to people and property.

The CEC works with and supports the Cal OES which is the primary agency for responding to all California emergencies. The CEC provides information gathering, technical expertise, energy emergency programs, and contingency planning. Since its formation, the Commission has responded to energy disruptions that include fires, earthquakes, political unrest, and energy supply disturbances. The CEC is co-lead for CA-ESF 12 with CUEA. In an emergency, the CEC provides advice, technical assistance, and public outreach to respond to an energy shortage or disruption. This includes providing the location of critical energy facilities and offering technical assistance for energy shortages (electricity, natural gas, and fuel) while developing specific state actions in the event of a serious shortage of energy. During an energy emergency, the CEC coordinates with the CPUC and the CAISO to develop specific actions in the event of a serious shortage of energy and at the direction of the Governor, implements programs for events requiring regional or statewide coordination.

In an energy emergency, the CEC's primary role is to serve as the State's primary repository of energy-specific information. CEC has substantial authority to collect energy data under the California Code of Regulations Title 20, Division 2, Chapter 3, §§ 1301 to 1395.6. Within these sections of code, two data collection programs, the Quarterly Fuels and Energy Reports

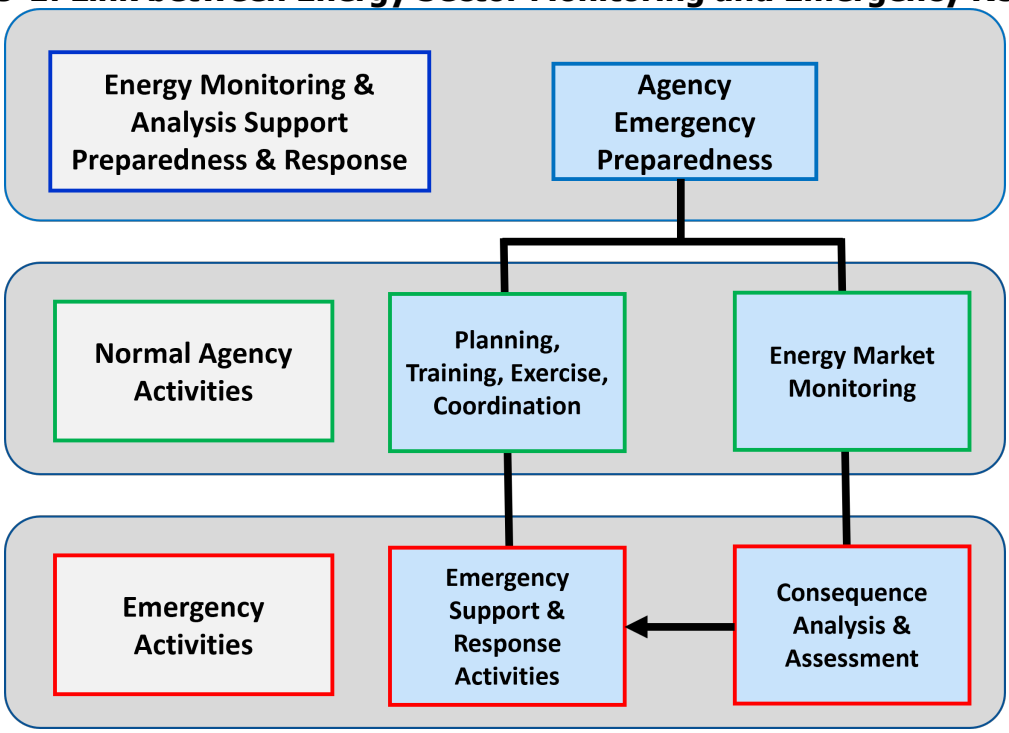
(QFER) and Petroleum Industry Information Reporting Act (PIIRA) serve as examples of major data repositories for assessing the status of energy supply and infrastructure in California.[76, 77]

QFER reporting requires both natural gas and electric utilities and non-utilities operating in California to report information on electricity generation, consumption, and operational information, as well as natural gas operational and consumption information. The complexity of the various energy infrastructure systems highlight the value and importance of collecting and analyzing this information.

Under PIIRA, the CEC collects data from refiners, oil producers, petroleum product transporters and marketers, petroleum pipelines, petroleum storage operators, and retail fuel outlets. Each entity is required to submit to the CEC weekly, monthly, and annual reports on receipts, inventory levels, imports, exports, prices, and transportation sources.

Figure 3-1 provides a simplified graphic showing how energy agencies work on energy sector monitoring and analysis during normal activities and during an event to support emergency preparedness and response activities.

Figure 3-1: Link between Energy Sector Monitoring and Emergency Response



Source: CEC

76 CEC Quarterly Fuel and Energy Report (QFER) Data Tables. California Code of Regulations Title 20, Division 2, Chapter 3, §§ 1301 to 1314. https://www.energy.ca.gov/data-reports/energy-almanac/california-electricity-data/quarterly-fuel-and-energy-report-qfer-data.

77 CEC Petroleum Industry Information Reporting Act Reporting Requirements – PIIRA. California Code of Regulations Title 20, Division 2, Chapter 3, §§ 1361 to 1371. https://www.energy.ca.gov/rules-and-regulations/energy-suppliers-reporting/petroleum-industry-information-reporting-act-piira.

State Emergency Plan

The State of California Emergency Plan (SEP) provides an overview of how to prepare for, mitigate, respond to, and recover from natural or human-caused emergencies in California.[78] The plan is a requirement of the California ESA, and describes:

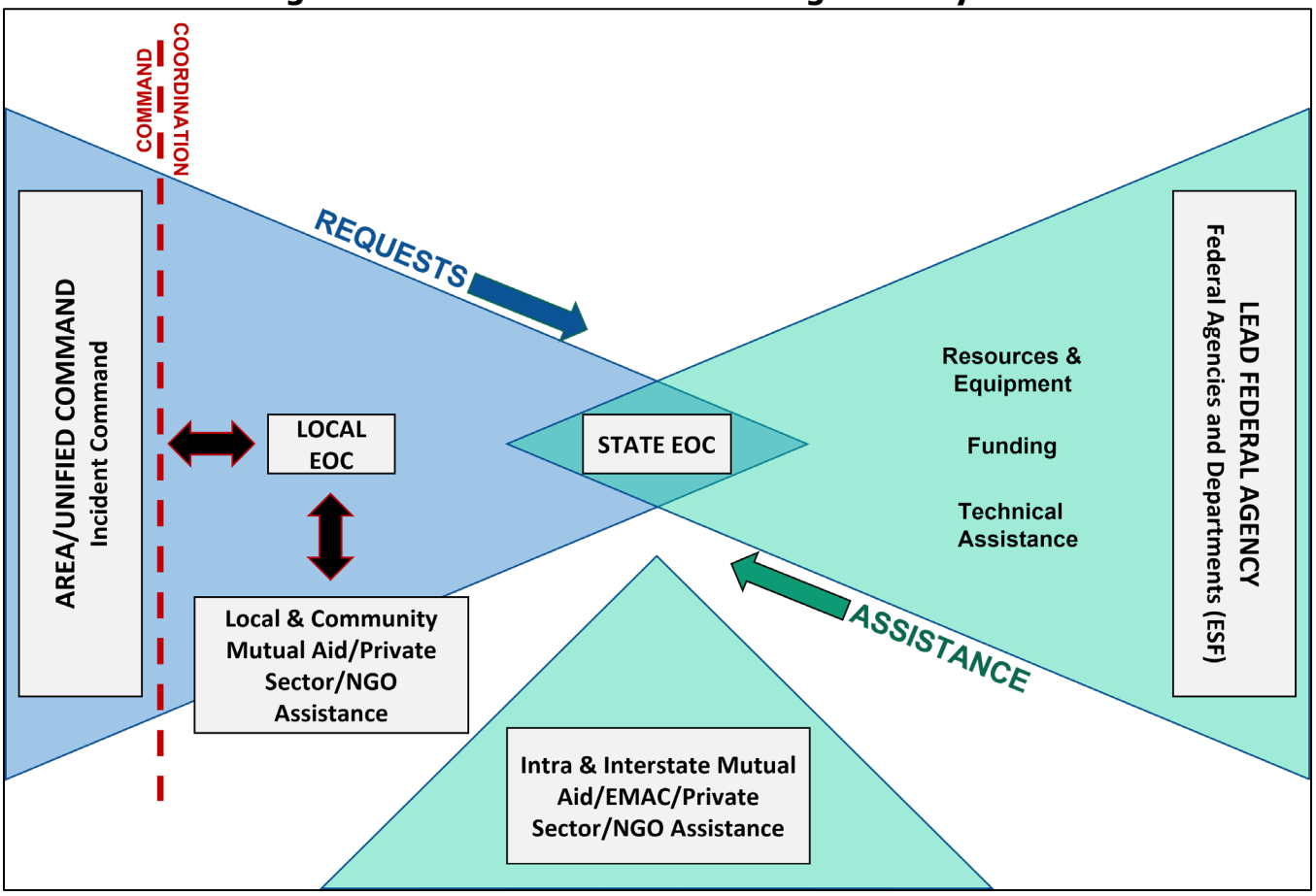
- California's hazards and vulnerabilities.
- The state's emergency management organization.
- Integrating considerations for people with Access and Functional Needs.
- Resource mobilization.
- Roles of government during an emergency.
- Mitigation programs.
- Emergency planning and preparedness.
- Whole Community Planning.
- Response operations.
- Mutual aid.
- Public information.
- California Emergency Support Functions.
- Recovery operations.
- California Recovery Support Functions.
- Continuity of government and essential functions.
- Roles and responsibilities of state government agencies and departments during emergencies.
- Plan development and maintenance.

The concepts presented in the SEP include mitigation programs to reduce vulnerabilities to disasters and preparedness activities to ensure capabilities and resources are available for an effective response. To assist communities and governments to recover from a disaster, the SEP outlines programs that promote a return to normalcy. The SEP is a management document intended to be read and understood before an emergency occurs. It outlines the activities of all California jurisdictions within a statewide emergency management system, and it embraces the capabilities and resources in the broader emergency management community that includes individuals, businesses, non-governmental organizations, tribal governments, other states, federal government, and international assistance. In the context of emergency management, resource requests and resources flow are key elements for effective incident response. A Standardized system ensures that resources can be efficiently requested, mobilized, and tracked during incidents. Figure 3-2 describes the flow of requests and

78 Cal OES. 2024 California State Emergency Plan. https://www.caloes.ca.gov/office-of-the-director/operations/planning-preparedness-prevention/planning-preparedness/2024-state-emergency-plan/.

resources in NIMS. The SEP and associated resources are hosted and maintained by Cal OES.[79]

Figure 3-2: National Incident Management System



Source: FEMA NIMS

Authority and Statutes

Multiple government agencies coordinate to prepare for an energy emergency in California. These agencies include, but are not limited to, the CEC, Cal OES, Governor's Office, California Natural Resources Agency (CNRA) and FEMA. Coordination and planning activities are required by the SEP, the ESA (California Government Code § 8550 *et seq.*), the Warren-Alquist Act (California Public Resources Code § 25000 *et seq.*), CEC Administrative Orders, and other authorities. These require the CEC to maintain up-to-date information on energy infrastructure and operations within the state. This information could be crucial to first responders and emergency services during an emergency.

Additionally, the CEC is authorized to develop and maintain the Fuels Set-Aside Program (FSAP) as a part of the SEP. These activities are authorized by the above references and the

79 Cal OES. Planning & Preparedness. https://www.caloes.ca.gov/office-of-the-director/operations/planning-preparedness-prevention/planning-preparedness/.

following statutes: California Public Resource Code §§ 25216, 25216.5, 25350, 25354, 25700, 25701, 25702, 25703, 25704; California Government Code §§ 179, 179.5, 179.9, 8567, 8595, 8596, 8607; Title 19, California Code of Regulations, §§ 2403-2415, 2448; Title 20, California Code of Regulations, §§ 1366-1371; and Executive Orders W-9-91, S-4-06.

The Governor of California chartered the California Utilities Emergency Association (CUEA) in 1952 as part of the State's Civil Defense Plan. The Association was created by a Joint Powers Agreement to represent California utilities on emergency related issues. The governor of California chartered the CUEA in 1952 as part of the state's Civil Defense Plan. CUEA was created by a joint powers agreement to represent California utilities on emergency related issues. In March of 1998, the CUEA received federal tax-exempt status as a 501(c)4 corporation. In January of 1999, the CUEA received state tax exempt status.

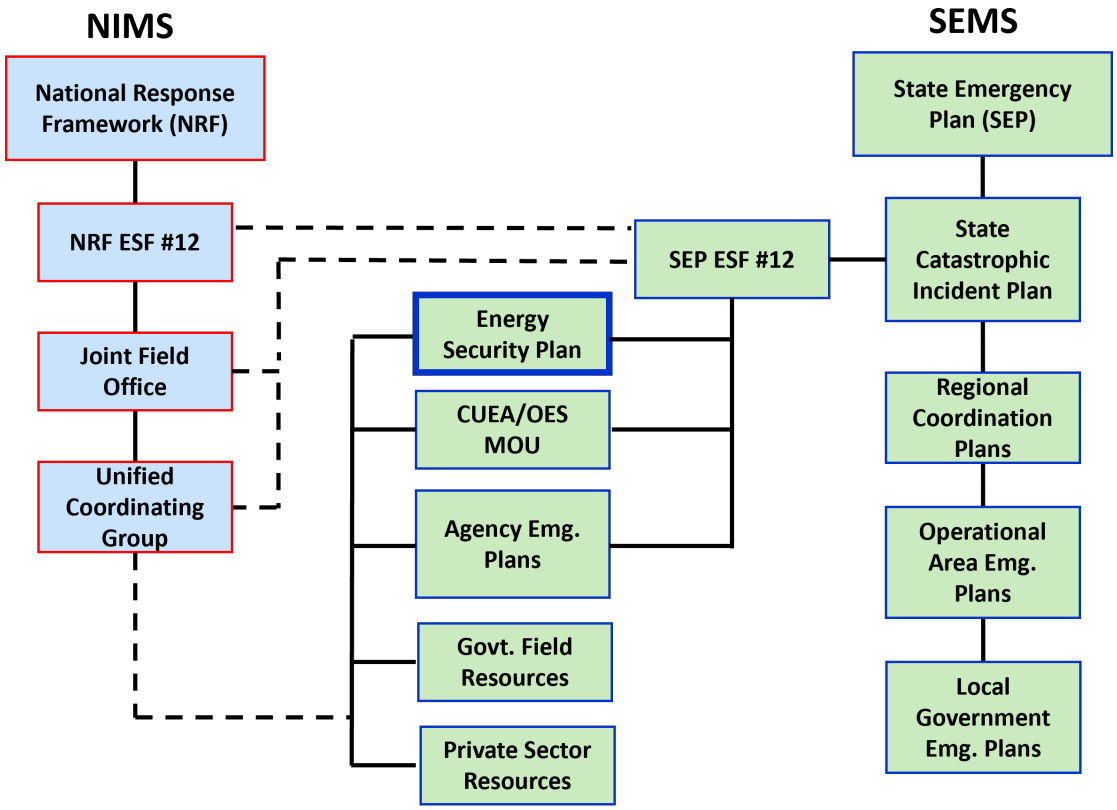
Being co-located at the Cal OES headquarters in Mather, California, allows the CUEA immediate access to regional, state, and federal information. The CUEA, via the executive director, actively participates in senior leadership and executive level planning sessions and working groups. The executive director serves as the Cal OES Utilities Branch Liaison at the State Operations Center or one of the Regional Operations Centers, representing the CUEA member utilities.

State and Federal Requirements

California Government Code Section 8607 mandates the use of SEMS for all state agencies during a proclaimed disaster or emergency. The five primary functions defined by SEMS are Management, Operations, Planning, Logistics, and Finance Administration. As previously stated, the SEP is consistent with FEMA's NIMS and the National Response Plan. NIMS is a multi-agency coordination system that has functions like SEMS.[80] Figure 3-3 shows CESP integration with both NIMS and SEMS.

80 California Standardized Emergency Management System resources, https://www.caloes.ca.gov/office-of-the-director/operations/planning-preparedness-prevention/planning-preparedness/standardized-emergency-management-system/.

Figure 3-3: Federal and State Emergency Management System Integration



Source: 2014 California Energy Assurance Plan

For more information on the California emergency management process, see the SEP.[81] Additionally, the State of California Emergency Management Mutual Aid Plan[82] describes the process the state and its political subdivisions use to coordinate and support emergency management operations in affected jurisdictions under the California Disaster and Civil Defense Master Mutual Aid Agreement.

Emergency Support Functions

The Federal Emergency Support Function 12 Annex (ESF #12)[83] is a construct established within the National Response Framework (NRF).[84] ESF #12 - Energy helps manage the

81 Cal OES. 2024. State of California Emergency Plan. https://www.caloes.ca.gov/office-of-the-director/operations/planning-preparedness-prevention/planning-preparedness/2024-state-emergency-plan/.

82 Cal OES. March 2022. State of California Emergency Management Mutual Aid Plan. https://www.caloes.ca.gov/office-of-the-director/operations/planning-preparedness-prevention/planning-preparedness/2024-state-emergency-plan/.

83 U.S. DOE, Office of Electricity. Emergency Support Function #12. https://www.caloes.ca.gov/office-of-the-director/operations/planning-preparedness-prevention/planning-preparedness/2024-state-emergency-plan/.

84 FEMA. National Response Framework. https://www.energy.gov/oe/emergency-support-function-12.

resources required to support energy infrastructure systems, and public and private services and resources. The purpose of the Emergency Support Functions is to unify the discipline specific community and coordinate capabilities, services, technical assistance, and engineering expertise during disasters and incidents that require a coordinated Federal Response. Under ESF #12, the DOE works with local, state, tribal, territorial, and federal government entities; NGOs; and the private sector to prepare for and respond to these potential incidents or disasters. In this, DOE or the designated agency or office serves as the lead coordinating and primary agency.

California Emergency Support Functions (CA-ESFs) are composed of 18 primary disciplines or activities essential to addressing community emergency management needs during all phases of an emergency.[85] Led by a designated state agency, each CA-ESF is designed around discipline-specific state agencies, departments, and relevant stakeholders with similar discipline-specific responsibilities. The California State Emergency Support Function 12 – Utilities (CA-ESF 12) addresses utility infrastructure system damage and outage response, as well as to restoration of service. Under the SEP, CNRA is identified as the lead agency for CA-ESF 12 but in 2019, CNRA delegated the responsibilities of lead agency to the CEC.

Federal Authorities

There are two primary federal agencies with authority over energy emergency response: FEMA and DOE. FEMA is under the authority of the United States Department of Homeland Security (DHS) and coordinates response for disasters that have occurred in the United States or when the resources of local and state authorities are overwhelmed. The governor of a state must declare a state of emergency and formally request assistance. The DOE's Office of Cybersecurity, Energy Security, and Emergency Response (CESER) Office[86] leads emergency preparedness and coordinated response to disruptions to the energy sector, including physical and cyber-attacks, natural disasters, and human-caused events. As the federal lead for ESF #12, CESER's role includes:

- Assisting energy asset owners and operators and State, Local, Tribal, and Territorial (SLTT) Program partners–with the restoration of damaged energy systems.
- Coordinating with interagency partners to identify supporting resources to stabilize and reestablish energy systems.
- Facilitating legal and regulatory waivers to help restore damaged energy systems and ensure adequate supply.
- Providing technical expertise to assess damage to energy systems and assist with restoration, logistics, and longer-term recovery planning.

85 Cal OES. California Emergency Support Functions. https://www.caloes.ca.gov/office-of-the-director/operations/planning-preparedness-prevention/planning-preparedness/california-emergency-plan-emergency-support-functions/.

86 CESER. Emergency Response. https://www.energy.gov/ceser/emergency-response.

- Collecting, evaluating, and sharing energy sector information and visualizations to promote shared situational awareness and a common operating picture.

In specific situations, the DOE can utilize emergency authorities to further support the restoration and/or reliability of the energy infrastructure. Those authorities include:

- Federal Power Act (FPA) Emergency Authority: The FPA 202(c) grants the DOE authority to issue emergency orders and coordinate and respond to situations in which there are increases in demand for electric energy or shortages of electric energy.
- The Defense Production Act: The Secretary of Energy can require performance on a priority basis of contracts or orders "deemed necessary or appropriate to promote the national defense." When a "priority" rating is applied, it requires that the order be fulfilled ahead of others in the marketplace to meet the negotiated performance or delivery date.
- The Natural Gas Policy Act: Authorizes DOE to purchase natural gas and allocating supplies of natural gas during an imminent shortage.

A more thorough breakdown of federal authorities and structures can be found in Appendix E: Federal Authorities & Organization Structure.

The Federal Energy Regulatory Commission (FERC) is an independent regulatory agency within the DOE that regulates the transmission and sale for resale of natural gas in interstate commerce; regulates the transmission of oil by pipeline in interstate commerce; regulates the transmission and wholesale sales of electricity in interstate commerce; licenses and inspects private, municipal, and state hydroelectric projects; oversees related environmental matters; and administers accounting and financial reporting regulations and conducts of jurisdictional companies.

Tribal Governments

There are 109 federally recognized California Native American tribal governments and 62 non-federally recognized California Native American Tribes with an estimated total population of 535,468 as of 2021 (United States Census Bureau, 2021). The United States government recognizes tribes as domestic, independent nations with the right to self-governance, tribal sovereignty, and self-determination. The CEC's Tribal Program helps the CEC conduct effective government-to-government cooperation, collaboration, communication, and other activities with California Native American tribes.[87] The program has many functions, including:

- Ensuring effective consultation between the CEC and tribes to advance the CEC's mission and provide meaningful tribal input into the development of regulations, rules, policies, plans, and activities that may affect them.

87 California Energy Commission's Tribal Program helps the organization conduct effective government-to-government cooperation, collaboration, communication, and other activities with California Native American tribes, https://www.energy.ca.gov/programs-and-topics/programs/tribal-program.

- Conducting outreach to tribes on topics such as impacts of California energy planning on tribes and tribal resources, tribal energy funding, and tribal cultural resources assessments.
- Partnering with tribes on tribal cultural resources assessments such as climate change assessments related to traditional ecological knowledge and studies on cultural landscapes.
- Assisting in administering energy research and project funding opportunities eligible to tribes.
- Hosting or sponsoring tribal energy events to promote collaboration and relationship building between the CEC and tribal leaders and their staff.

The Cal OES Office of Tribal Coordination's (OTC) role is to improve and maintain communication and collaboration between all Native American Tribes in California. OTC aims to create effective collaboration and provide relevant information that allow for informed decision-making. OTC's priorities are to educate internal and external agencies and partners, to become informed about the cultural settings of California Native Americans, understand and relay their priorities for emergency management and homeland security issues, as well as provide cultural awareness and sensitivity, for the purpose of improving Cal OES's understanding of all Native American Tribes and related issues in California.

Executive Order B-10-11 is intended to implement effective government to government consultation with California Indian Tribes on policies that affect tribal communities. Additional details can be found in the Cal OES Tribal Consultation Policy.

Tribal governments are responsible for the protection and preservation of life, property, and the environment on tribal lands. Responsibilities may include deploying field-level emergency response personnel, activating emergency operations centers, and issuing orders to protect the public. [88]

- Federal / State Authorities: The Stafford Act, 42 U.S.C., Section 5122(B), defines an Indian tribe or authorized tribal organization as local governments. Under 28 U.S.C Section 1360, California has enforcement jurisdiction over offenses committed by or against tribes, and civil law enforcement jurisdiction over offenses to which the tribes are a party. Local ordinances are not applicable to tribes or tribal land.
- Emergency Management: Tribal governments maintain various levels of emergency preparedness, coordination, communication, and collaboration with federal, state, and local governments. When there is threat of an emergency or actual emergency, tribal authorities must take the appropriate actions to cope with the situation and activate their tribal emergency preparedness procedures and plans.
- Agreements: Developing Memorandums of Understanding (MOU) or Memorandums of Agreement (MOA) between state, local, and tribal governments could maximize

88 Cal OES. 2024 California State Emergency Plan, Section 4 pages 71. https://www.caloes.ca.gov/office-of-the-director/operations/planning-preparedness-prevention/planning-preparedness/2024-state-emergency-plan/

capabilities at all levels, expedite mobilization during an emergency, and promote sharing of equipment, skilled personnel, and other needed resources in an emergency.

- Disaster Assistance: The state and its political subdivisions will make every effort to support the tribal communities in response and recovery efforts. As conditions require and upon request from the tribe, the available and appropriate federal, state, and local government resources will, in accordance with prior arrangements and as authorized by law, be committed to tribal lands to protect lives, property, and the environment.

Tribal Councils and local government may enter into intergovernmental agreements for fire protection and emergency services mutual aid. In 2021, the California Master Mutual Aid Agreement was amended to include federally recognized California Indian Tribes. The amendment allows eligible tribes to enter into the agreement. This allows tribal officers to enforce state and county law on reservation land and allows the departments to work together to improve public safety.

CHAPTER 4:
Energy Security Planning and Preparedness

Emergency Plans are a management document intended to be read and understood before an emergency occurs. The SEP establishes a framework for California's comprehensive emergency management program but does not provide details for specific response scenarios or disasters. The SEP serves as a guide for state agencies, local jurisdictions, and the public on emergency management. The SEP describes the methods for conducting emergency operations, rendering mutual aid, emergency response capabilities of state agencies, resource mobilization, public information, and continuity of government during an emergency or disaster. Emergency planning and preparedness is the process of systematically preparing for future events such as major incidents or disasters. Emergency plans that go beyond the SEP are needed for responding to the impacts of disasters and to maintain business continuity while managing the crisis. Consequently, the CESP provides provisional information and specific guidance for energy emergencies in the state. This structure outlines the coordinated and integrated structure that state government departments and agencies, along with designated private sector partners and non-governmental organizations, operate from when supporting local efforts before, during, and after an energy emergency event. The planning and preparedness structure includes the identification and organization of assigned roles among designated entities based upon their unique expertise, resources, and capabilities.

Energy security planning is an evolving and continuing process that necessitates frequent reviews and updates to stay in line with the constant changes to technology and energy systems. The CESP is intended to serve as an evolving, working document.

CEC Roles and Responsibilities

The CEC in its role as the state's primary energy policy and planning agency, supports emergency response efforts by serving as a central source of credible and timely information on emergency impacts to the state's energy infrastructure. Support activities include:

- Planning for shortages and major crises affecting the availability of electricity, natural gas, and petroleum fuels.
- Assisting local governments with energy resiliency planning.
- Encouraging reduced energy demand during emergencies.
- Coordinating with state and federal Emergency Support Function partners around planning, preparedness, and response.

Supporting Emergency Response

The CEC supports the state's emergency response efforts by gathering and analyzing critical information, maintaining subject specific technical expertise, and coordinating contingency planning activities with key stakeholders. In support of the Cal OES response efforts, the CEC monitors the activities of the energy sector and provides strategic analysis. CEC coordinates directly with other government agencies including Cal OES, CNRA, DOE, and FEMA.

Furthermore, agency leadership advises the Governor on the nature, extent, and duration of energy emergencies and appropriate state responses.

Monitoring Energy Markets

The CEC assesses and analyzes both supply and demand within California's energy industry. The CEC also prepares forecasts of energy demand and supply for a period of at least 15 years and conducts assessments to determine potential risk of shortfalls. These products are published on CEC's website and also provided to the Governor's Office and California Legislature. Detailed information on the various data streams, analytics and published reports can be found at the CEC Data and Reports webpage.[89]

CEC staff maintain communications with key private sector and regional entities in the energy markets to ensure a direct line of communication in emergencies. CEC also monitors regional and international energy markets for their potential impacts on California. When determined necessary, CEC leadership directs staff to communicate critical information to key stakeholders, develop briefing and recommendation materials, and coordinate with appropriate state and federal agencies. Further discussion on monitoring and assessment tools can be found in Appendix A – Energy Emergency Contingency Programs. Additional discussion on mitigation, impact and response actions can be found in Chapter 5, Chapter 6, and Appendix A.

Stakeholder Engagement

Public and stakeholder participation and feedback are valuable components of the CEC's processes. The CEC has an established history of transparency, engagement, outreach, and collaboration. The CEC engages stakeholders through an extensive number of public workshops and the Commission's monthly business meetings. Stakeholder input is encouraged for all public meetings, hearings, workshops, and rulemaking. CEC maintains dockets on all activities to provide information directly to stakeholders and give them another venue to share their perspectives with CEC. The CEC webpage provides updated information on the various proceedings, reports, meetings, rulemakings, and public workshops. CEC has a Public Advisor's Office that provides information on how to participate in business meetings, workshops, and formal proceedings at the CEC.[90]

CEC staff maintain and regularly update contact lists for stakeholders, private sector entities, government entities, and recognized experts. Key staff across the commission have access to these lists with critical contacts maintained in both a digital and physical folder. Additional details regarding energy sector coordination can be found in Appendix F.

89 CEC. Data and Reports. https://www.energy.ca.gov/data-reports.

90 CEC. Office of the Public Advisor, Energy Equity, and Tribal Affairs. https://www.energy.ca.gov/about/divisions-and-offices/office-public-advisor.

Staff Training, Exercises, and Reporting

Successful implementation of the CESP requires personnel that are qualified to access restricted information and communications systems to possess in-depth knowledge of energy system operations and markets while maintaining proficiency in the application of the procedures, analytical methods, and specified resources.

Training exercises are an important element of preparedness and planning, ensuring the energy sector, industry and government are operationally ready. As part of the emergency management training curriculum, the SEP recommends that personnel with emergency responsibilities complete emergency management courses as described in the SEMS Approved Course of Instruction (ACI) and the NIMS integration criteria. Cal OES provides training for emergency managers and first responders through its California Specialized Training Institute (CSTI).[91] Agencies are responsible for maintaining training and exercise records that demonstrate self-certification and compliance with SEMS and NIMS. CEC staff involved in emergency response also participate in a variety of training activities, and CEC has internal guidance documents and procedures that are tested and reviewed annually. Exercises provide personnel with an opportunity to become familiar with the procedures, facilities, and systems used during an emergency. Cal OES recommends that state agencies plan for and/or participate in an all-hazards exercise program that involves emergency management/response personnel from multiple disciplines and/or multiple jurisdictions. Exercises should:

- Be as realistic as possible.
- Stress the application of standardized emergency management.
- Be based on risk assessments (credible threats, vulnerabilities, and consequences).
- Include non-governmental organizations and the private sector, when appropriate.
- Incorporate the concepts and principles of SEMS and NIMS.
- Demonstrate continuity of operations issues.
- Incorporate issues related to individuals with disabilities and others with access and functional needs.

Agencies supporting emergency operations are responsible for gathering timely, accurate, accessible, and consistent intelligence during an emergency. Situation reports should create a common operating picture and be used to adjust the operational goals, priorities, and strategies. Depending on the nature and urgency of the energy emergency, CEC staff prepare written reports on its analysis of the nature, extent, and duration of the event. In addition, administrative reports may be required if CEC staff are activated as part of a larger response effort. Agency leadership may make direct use of the following six types of reports.

- Internal advisory reports
- Situation reports
- Governor's memos

91 Cal OES. California Specialized Training Institute. https://www.caloes.ca.gov/office-of-the-director/operations/planning-preparedness-prevention/california-specialized-training-institute/.

- Press releases
    - Media teams may coordinate to release notices via social media accounts and agency websites
- Internal status reports
- After-action reports

Following any emergency activation or exercise, agency leadership may organize and conduct a post-incident review and produce an After-Action Report (AAR) to identify needed improvements and best practices to include in future updates or modifications of the CESP (and its annexes/procedures), facilities, and equipment. Reviews and updates will be coordinated with all parties' assigned responsibilities in this CESP, including the CEC and other CA-ESF 12 agencies and private stakeholders deemed necessary for a thorough review and update.

Energy Emergency Responsibilities

The CEC is co-lead with California Utilities Emergency Association (CUEA) for CA-ESF 12. The CEC's role is to serve as California's primary repository of energy-specific information. Per the SEP, the CEC will provide advice, technical assistance, and public outreach in response to energy shortages or disruptions. The CEC supports energy sector information gathering an analysis while providing technical assistance for forecasting energy shortages (electricity, natural gas, and fuel) and developing specific state actions in the event of an energy shortage. At the direction of the Governor, the CEC will implement energy emergency programs for events requiring regional or statewide coordination. The CUEA provides emergency operations support for gas, electric, water, wastewater, telecommunications (including wireless), cable, and petroleum pipeline utilities. CUEA and CEC staff have a well-established communication path and regularly provide updates on key issues.

Additional details on roles, responsibilities, and coordination activities can be found in Chapter 3 and Appendix F.

Public Information Program

The CEC Media Office has an established communications program that includes actively monitored and updated websites.[92] The SEP describes the structure and responsibility of the Joint Information System. The CEC media team will work closely with the Governor's communication team and the Public Information Officer while supporting the Joint Information Center. Moreover, the California Emergency Support Function 15 - Public Information is comprised of an alliance of discipline-specific subject matter experts who work together to provide timely, accurate, and coordinated information within the state of California.

92 CEC. Newsroom. https://www.energy.ca.gov/newsroom.

Federal and State Entity Roles in Energy Security and Assurance

ESF #12 Federal Agencies

The ESF #12 – Energy (ESF #12) provides support to DHS by assisting local, state, tribal, territorial, and federal government entities, NGOs, and the private sector by coordinating government capabilities, services, technical assistance, and engineering expertise during disasters and incidents that require a coordinated Federal response. As the lead agency, the DOE coordinates directly with federal and state agencies, the private sector, and stakeholders to support energy emergencies in California.

Table 4-1 and 4-2 lists the response core capabilities that ESF #12 supports, along with the ESF #12 actions related to each of these core capabilities. Though not listed in the table, all ESFs support the following core capabilities: planning, operational coordination, and public information and warning.

Table 4-1: Federal ESF #12 – Energy Core Capabilities

Core Capabilities	ESF #12 – Energy
Infrastructure Systems	• Assists energy asset owners and operators and local, state, tribal, and territorial authorities with requests for emergency response actions, as required, to meet the Nation's energy demands. Identifies supporting resources needed to stabilize and restore energy systems. • In coordination with ESF #7 (Logistics, Management and Resource Support), assists Federal departments and agencies by locating fuel for transportation, communications, emergency operations, and national defense, pursuant to the authorities available to the agency providing assistance. • Addresses significant disruptions in energy supplies for any reason, whether caused by physical disruption of energy transmission and distribution systems; unexpected operational failure of such systems; acts of terrorism or sabotage; or unusual economic, international, or political events. • In coordination with the Energy Sector-Specific Agency (DOE), addresses the impact that damage to an energy system in one geographic region may have on energy supplies, systems, and components in other regions relying on the same system. • Consults with energy asset owners and operators and the Energy Sector-Specific Agency to advise local, state, tribal, territorial, and Federal authorities on priorities for energy system restoration, assistance, and supply during response and recovery operations.

Core Capabilities	ESF #12 – Energy
Logistics and Supply Chain Management	• Provides subject matter expertise to the private sector, as requested, to assist in restoration efforts. Through coordination with DOE (refer to Primary Agency Functions), serves as a federal point of contact with the energy industry for information sharing and requests for assistance from private and public sector owners and operators.
Situational Assessment	• Works with the DHS/FEMA Regions; the private sector; and local, state, tribal, and territorial authorities to develop procedures and products that improve situational awareness to effectively respond to a disruption of the energy sector. • Coordinates preliminary damage assessments in the energy sector. • Identifies requirements to repair energy systems and monitors repair work. • Coordinates with DOE to: Serve as a source for reporting critical energy infrastructure damage and operating status for the energy systems within an impacted area, as well as on regional and National energy systems. • Assess the energy impacts of the incident and provide analysis of the extent and duration of energy shortfalls. • Analyze and model the potential impacts to the electric power, oil, natural gas, and coal infrastructures, and determine the effect a disruption has on other critical infrastructure.

Source: National Response Framework, https://www.fema.gov/emergency-managers/national-preparedness/frameworks/response

Table 4-2: Federal ESF #12 – Energy

Federal Agencies ESF #12 – Energy	
ESF Coordinator	Department of Energy
Lead Agency	Department of Energy
Support Agencies	Department of Agriculture
Support Agencies	Department of Commerce
Support Agencies	Department of Defense
Support Agencies	Department of Homeland Security
Support Agencies	Department of the Interior
Support Agencies	Department of Justice
Support Agencies	Department of Labor

Federal Agencies ESF #12 – Energy	
Support Agencies	Department of State
Support Agencies	Department of Transportation
Support Agencies	Environmental Protection Agency
Support Agencies	Nuclear Regulatory Commission
Support Agencies	Tennessee Valley Authority

Source: National Response Framework, https://www.fema.gov/emergency-managers/national-preparedness/frameworks/response

CA-ESF 12 Utilities State Agencies

Within a collaborative organization, the CA-ESF 12 stakeholders coordinate and enhance the state of California's capabilities to provide emergency utility response and recovery services and resources to save lives, protect health and safety, protect property, and preserve the environment. The CA-ESF 12 stakeholders also provide, through a collaborative and consensus process, recommendations and subject matter expertise related to the utility infrastructure situations to Cal OES within all phases of emergency management.

The CA-ESF 12 Annex[93] addresses how CEC, CUEA, Cal OES, and the other governmental agencies work before, during, and after an event to:

- Facilitate communications and cooperation between member utilities and public agencies, and with non-member utilities (where resources and priorities allow).
- Provide emergency response support wherever practical for electric, petroleum pipeline, telecommunications, gas, cable, water, and wastewater utilities.
- Support utility emergency planning, mitigation, training, exercises, and education among utilities stakeholders.

The CA-ESF 12 consists of core functions, or essential elements of service or support, that the ESF's stakeholders perform to collaboratively prepare for, respond to, mitigate against, and recover from emergencies. The core functions for the CA-ESF 12 include:

- Utility Emergency Response and Restoration Support
- Mobilization and Transportation of Resources
- Construction Supervision and Inspection
- Engineering Services
- Energy and Utility systems Subject Matter Expertise

93 California Emergency Support Functions, https://www.caloes.ca.gov/office-of-the-director/operations/planning-preparedness-prevention/planning-preparedness/california-emergency-plan-emergency-support-functions/.

Table 4-3 lists the current members of CA-ESF 12. The Support functions are split into two tiers. The first tier are those agencies that are frequently activated.

Table 4-3: CA-ESF 12 – Utilities

State Agencies CA-ESF 12 – Utilities	
ESF Coordinator	California Natural Resources Agency (CNRA)
Lead Agencies	California Energy Commission (CEC) (CNRA delegated lead agency authority to CEC on April 2, 2019) California Utilities Emergency Association (CUEA)
Support Agencies*	California Public Utilities Commission (CPUC) Department of Technology (DOT) Governor's Office of Emergency Services (Cal OES) California National Guard (CNG) California Environmental Protection Agency (Cal EPA) Air Resources Board (ARB) State Water Resources Control Board (SWRCB) Department of General Services (DGS) California State Transportation Agency (CalSTA) Department of Transportation (CALTRANS) *Business and Consumer Services and Housing Agency (BCSH)* *Seismic Safety Commission (SSC)* *California Department of Food and Agriculture (CDFA)* *California Health and Human Services Agency (CHHS)* *Department of Public Health (CDPH)* *Labor and Workforce Development Agency* *Department of Industrial Relations (DIR)* *Government Operations Agency (GovOps)*

Source: California Emergency Support Functions, https://www.caloes.ca.gov/office-of-the-director/operations/planning-preparedness-prevention/planning-preparedness/state-of-california-emergency-plan-emergency-support-functions/

*Note: Support agencies listed in italics are usually only activated for CA-ESF 12 under specific circumstances.

The five CA-ESF 12 Agencies listed below provide the majority of energy sector expertise and support. Their primary CA-ESF 12 functions as described in the SEP and additional details on each agency's functions can be found in the SEP and the appropriate CA-ESF Annexes.

- California Energy Commission
    - Provides advice, technical assistance, and public outreach to respond to energy shortage or disruption. Provides Cal OES the location of energy facilities and technical assistance for forecasting energy shortages (electricity, natural gas, and fuel) and develops specific state actions in the event of a serious shortage of energy. At the direction of the Governor, implements contingency programs for events requiring regional or statewide coordination of energy.
- CNRA oversees policies and activities that addresses natural resource issues ranging from conservation, water, fish and game, forestry, parks, energy, coastal, marine and landscape. CNRA serves as the lead agency for coordinating emergency activities related to utilities. The agency has assigned primary and support roles to the CEC for ESF 12.
- California Department of Technology (DOT) integrates the state's IT functions to better manage equipment, personnel, and purchasing while optimizing the use of technology.
    - Coordinates the disaster recovery planning efforts in compliance with Government Code Section 11549.3 and the State Administrative Manual (SAM) (Section 5325 *et seq*.) related to information technology computing and telecommunications infrastructure to ensure availability of essential systems, networks, applications, data, and telephones (both voice and data).
    - Coordinates with the California Cyber Security Integration Center - which consists of the following core members: Cal OES, California Department of Technology, California Highway Patrol, and California Military Department – for cyber critical incident response including the detection, mitigation, and information sharing related to statewide cyber-related events.
- Department of Water Resources
    - Maintains a seat on the board of the CUEA. Participates on the Energy and Pipeline and Water/Wastewater Committees that CUEA oversees. Continues to provide energy and ancillary services from the State Water Project supporting the California electrical grid.
- California Public Utilities Commission
    - Requires IOUs companies to develop emergency plans and reviews those plans. Provides lists of utility offices and contacts, oversees the activities of privately-owned natural gas and electric utilities, and provides safety and other engineers as well as public information staff to assist in recovery efforts. Evaluates major outages affecting 10 percent or more of customers, identifies ways to prevent major transmission outages and adopt standards for utility distribution systems.

Energy Emergency Partner Integration

Depending upon the level of the emergency (as defined in the California SEP), various local, regional, state, and federal resources and entities would be activated. At the federal level, the DOE OE, ISER, maintains a password protected Energy Emergency Assurance Coordinators (EEAC) website, through which authorized state energy emergency coordinators may access energy security information, daily news summaries, emergency situation reports, lessons learned from other states, links to outage and curtailment information, and the ability to email messages to colleagues in other jurisdictions. The NASEO Energy Security Committee assists state efforts by providing information resources, monthly energy security meetings, and supporting communication coordination across federal-state-private sector entities.

Additionally, CESER addresses energy infrastructure security and supports the DOE's national security mission. CESER's focus is preparedness and response activities to natural and man-made threats.

Federal Government

The CESP is designed to be compatible with the NRF, specifically the state and federal Emergency Support Functions. The U.S. DOE is the lead federal agency for ESF #12 Energy and is the point of contact during an incident of national significance requiring the activation of the NRF. In the event the federal government is mobilized in support of the state, the California Catastrophic Incident Base Plan will be activated.[94]

During this type of emergency, the CEC will provide both DOE and FEMA with situation reports. Requests for federal energy assistance will be coordinated between the CEC and DOE. Additional communication and coordination with ESF #12 supporting agencies such as FERC and NRC may be required if there are interstate impacts or risk to nuclear power stations.

Other State Governments

FEMA partitions the states and territories into ten regions. California is assigned to region 9 with the states of Arizona, Hawaii, and Nevada with Oregon, Washington, and Idaho assigned to Region 10. The combination of FEMA regions and interconnected energy infrastructure helps to define the extent of coordination with neighboring state governments and agencies. CEC staff regularly engage in communication and information sharing with the states in both Region 9 and 10. Moreover, NASEO holds monthly calls that bring together all 50 states and the territories to share information relevant to energy security and emergency response.

The North America transmission grid is divided into multiple wide area synchronous grids. The Eastern Interconnection and Western Interconnection are the largest. The three other connected regions include the Texas Interconnection, the Quebec Interconnection, and the Alaska Interconnection. These regions are not directly connected or synchronized to each

94 The California Catastrophic Incident Base Plan can be found at Catastrophic Planning (https://www.caloes.ca.gov/office-of-the-director/operations/planning-preparedness-prevention/planning-preparedness/catastrophic-planning/#:~:text=The%20Catastrophic%20Incident%20Base%20Plan,catastrophic%20disasters%20(pdf%20download)).

other, but there exist some high voltage direct current interconnectors. The Eastern and Western grids are connected via seven links that allow electricity flow between them. CEC staff coordinate with the various entities involved in the Western Interconnection and the broader transmission system.

The United States is also divided into Petroleum Administration Defense Districts (PADDs). California is in PADD V, with Alaska, Arizona, Hawaii, Nevada, Oregon, and Washington. The states in PADD V are closely linked by their dependency on an oil supply system that is essentially self-contained. Because PADD V is somewhat isolated from the other PADDs, a continuum of cooperation and coordination is needed during a supply disruption. The CEC emergency planning staff will keep all PADD V states informed of potential supply impacts, as appropriate.

Other Out-of-State Entities

North American Electric Reliability Coordinator (NERC) is a voluntary organization that develops, promotes, and enforces standards for a reliable North American bulk electric system. Coordination with NERC will be through the FERC or WECC, which is responsible for coordinating and promoting electric system reliability in the Western Interconnection. NERC is a non-profit organization that seeks to ensure an effective electric grid through the promulgation and enforcement of reliability standards. NERC is able to delegate some of its authority to different regional entities. WECC is the regional entity for the western interconnection. FERC created the Western Interconnection Regional Advisory Body (WIRAB) which advises FERC, NERC, and the associated regional entity (WECC) on grid reliability within the western interconnection. The CEC is a member of WIRAB and CEC Energy Assessment Division Staff are responsible for reviewing WIRAB's potential "advice" (i.e., comments) to FERC, NERC, and WECC. Thus, the primary lever that the CEC uses for grid reliability coordination with FERC and NERC are through WIRAB's formal advice process. Additionally, the CEC participates in various committees hosted by WECC. These committees are where substantive WECC products are developed via regional coordination with interested parties and stakeholders. The committees also report to WECC's Board of Directors. The CEC sits on many of these committees including the Reliability Assessment Committee, the Reliability Risk Committee, and the WECC Standards Committee.

California State Entities

Various state entities have key roles in the energy supply disruption management structure, including preparedness, response, and recovery from emergencies and disasters. Within the state, Cal OES is charged with coordinating these activities. Therefore, Cal OES is the key point of contact for the Governor's Office in the event of any emergency or significant situation. This notification process is not intended to dilute the statutory authority of agencies that have emergency operational responsibilities, but rather to ensure that consistent procedures are followed in providing information to the Governor and his staff in a timely manner. Communication links shall be established and maintained throughout all levels of the incident to support efficient emergency operations, internal information needs, and the delivery of regular status updates to the public, external agencies, and the media. These reporting requirements include Cal OES, the CEC, the CPUC, California ISO, the California Department of Water Resources (DWR), and all utilities within the state as the situation dictates. Local

governments in California use SEMS when requesting assistance during a disaster or other emergency. Tribal and regional coordination are discussed in Appendix G and F respectively.

Governor

The Governor is ultimately responsible for assuring the energy needs of the state and in preparing for and responding to energy emergencies affecting California. The Governor relies upon state, public-, and private-sector entities to assist in this assurance. This is due to the energy sector being largely privately owned, which limits the Governor's regulatory and statutory authority.

Governor's Office of Emergency Services (Cal OES)

During a disaster, Cal OES is the lead agency, and other state agencies, including the CEC, provide support relative to their mission assignment and capability. The CEC responsibilities include information gathering, energy infrastructure impact analysis, response coordination, and supporting the Cal OES with fuel distribution to ensure that emergency and essential services can adequately respond to a disaster.

Cal OES is divided into three administrative regions throughout California. The regions and their headquarters locations are:

- Inland Region (Sacramento/Mather).
- Coastal Region (Fairfield).
- Southern Region (Santa Ana).

If the disaster affects multiple regions, however, the SOC becomes the primary coordination center for state agency representatives. Agency representatives respond to the SOC in lieu of assigning multiple regional representatives.

Although Cal OES is the lead state agency during a disaster, the CEC assumes the lead agency role in situations where the energy emergency is the result of non-disaster related event, such as an embargo. In non-disaster energy emergencies, Cal OES will assist the CEC in coordinating the statewide distribution of fuel supplies and ensuring that the Governor and Legislature are kept informed.

California Assembly Committee on Natural Resources

Primary jurisdictions are air quality, climate change, energy efficiency, renewable energy, California Environmental Quality Act (CEQA), coastal protection, forestry, land conservation, oil spills, solid waste and recycling.

California Assembly Committee on Utilities and Energy

Primary jurisdictions are CEC; California ISO; CPUC; CPUC oversight and reform; electric generation: biogas, biomass, coal, geothermal, hydroelectric, natural gas, nuclear, renewables, solar, and wind; electric grid; energy efficiency, energy conservation, and demand response; energy service providers; natural gas; power plant siting; railroads; supplier diversity related to CPUC regulated energy, water, and railroad; utility rates: electric, gas, water, and vessels; water utilities.

California Department of Water Resources

The DWR operates the California State Water Project (SWP).[95] The SWP is a water storage and delivery system of reservoirs, aqueducts, power plants, and pumping plants. The main purpose of the SWP is to store water and distribute it to 29 urban and agricultural water suppliers in Northern California, the San Francisco Bay Area, the San Joaquin Valley, the Central Coast, and Southern California.

In addition to water, the SWP is one of the largest power systems in the world. Power plants and pumping facilities are critically important to the generation and consumption of power in California. Large hydroelectric projects account for about 11 percent of overall energy generation in the state. Generating capacity and energy supply are influenced by water supply, environmental requirements, and flood management policies and regulations. Hydroelectric and other facilities, along with contractual arrangements, are the major power sources for power operations. The DWR uses its power resources primarily to run the pumps that move water to California farmlands and cities, but also to provide peak power to utilities.

Because the DWR has the flexibility to regulate pumping on an hourly basis, maximum pumping is generally scheduled when power costs are low. By scheduling as much off-peak pumping as possible, the DWR can take advantage of less expensive surplus electrical generation. Conversely, the DWR maximizes its power generation for the benefit of the interconnected electrical grid during the on-peak hours when electric demand is highest. DWR participates in the California ISO supplemental electric energy market and ancillary services markets. In case of system emergencies, DWR can drop pump loads to help California ISO maintain reliable electric power for California.

The DWR's power planning process begins with a review of all projected loads and resources, including pump load, generation from the DWR's facilities, generation from joint facilities, sales, purchases, and exchanges. The net of these loads and resources yields a power portfolio in which the DWR often has a net deficit during the off-peak hours and a net surplus in the on-peak hours. DWR then procures the deficit and markets the surplus in stages, baseline amounts are transacted in advance, and the remaining deficit and surplus quantities are transacted as the year progresses and more information becomes available regarding hydrology, water demands, and so forth.

During emergency response, DWR will mobilize incident command teams to assess DWR-controlled hydroelectric and dam infrastructure and report the initial assessment information back to Cal OES in accordance with established emergency plans and programs. DWR will also direct private sector dam owners to initiate their Energy Assurance Plans and report their assessments through established reporting channels to provide the state with a clear common operating picture of the incident extent.

California Energy Commission

Officially known as the California Energy Resources Conservation and Development Commission, but better known as the CEC, it was formed in 1975 to assess energy needs,

95 DWR. What We Do. https://water.ca.gov/What-We-Do.

license power plants, promote energy conservation, and develop alternative energy resources. Furthermore, the original statute[96] directed the CEC to prepare an integrated plan specifying actions to be taken in the event of an impending or serious shortage of energy, or a clear threat to public health, safety, or welfare. In 1996, the legislation directed the CEC to develop the state's first energy emergency response plan and develop an energy assurance plan. The CEC takes an active role in identifying strategies for energy assurance and security alongside the energy partners noted in this plan.

California Independent System Operator

The California ISO is an impartial link between the electrical generating power plants and the utility companies that provide electricity to more than 38 million consumers. The California ISO balances electricity supply and demand across high voltage transmission lines. When the California ISO anticipates risks that demand for electricity will exceed electric supply, the California ISO may issue energy emergency alerts. . Electrical energy shortages are classified in emergency "stages".[97] The California ISO is not required to move through the stages sequentially. System conditions are dynamic, and, therefore, it may be necessary to skip a stage to respond to the emergency.

The CEC coordinates with the California ISO in the following areas:

- Shares information and participates in reports of the electricity grid status during times of peak energy use.
    - If needed, uses the informal fuels set-aside program to ensure sufficient fuel supplies for essential utility support services. If required during a declared emergency, the CEC implements the formal petroleum fuels set-aside program to ensure a continuum of power generating capability.
- Assists with conservation announcements to the public, as needed.

The California ISO also works closely with WECC. The California ISO must operate the electrical power system in accordance with NERC standards and regional coordinating council standards. The California ISO also provides services such as day-ahead demand forecasts, real-time demand forecasts, and near real-time operations. The California ISO possesses near real-time knowledge of the status of the electric system within its operating area and adjacent operating areas.

Below are steps that California ISO operators may take before and during system emergencies:

- Continually monitor system operations and conditions.

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96 California Legislative Information. 1974. Warren-Alquist State Energy Resources Conservation and Development Act. https://leginfo.legislature.ca.gov/faces/codes_displayText.xhtml?lawCode=PRC&division=15.&title=&part=&chapter=1.&article=.

97 California ISO. 2023. Emergency Notification Fact Sheet. https://www.caiso.com/Documents/Emergency-Notifications-Fact-Sheet.pdf.

- Reduce power exports/increase power imports.
- Modify operation of generating units for emergency relief.
- Request selected customers to reduce load.
- Request all customers to voluntarily reduce load.
- Reduce voltage.
- Implement controlled rotating interruptions (rolling blackouts).

California Natural Resources Agency

CNRA is tasked as the lead agency in developing the California ESF 12 Utilities, in support of the SEP. CA-ESF 12 Utilities addresses related aspects of disasters and emergencies. It establishes policies and procedures for response to and recovery from shortages and disruptions in the supply and delivery of electricity, natural gas, and other forms of energy and fuels that impact or threaten to impact large numbers of the state's residents and visitors. CNRA oversees policies and activities of more than 17,000 employees in 25 departments, commissions, boards, and conservancies. The agency addresses natural resource issues ranging from conservation, water, fish and game, forestry, parks, energy, coastal, marine and landscape.

California Public Utilities Commission

The CPUC regulates privately owned electric, natural gas, telecommunications, water, railroad, rail transit, and passenger transportation companies. The CPUC serves the public interest by protecting consumers and ensuring the provision of safe, reliable utility service and infrastructure at just and reasonable rates, with a commitment to environmental enhancement and a healthy economy.

The CPUC regulates investor-owned electric and natural gas utilities, ensuring the reliability and safety of electric and natural gas systems, and works to advance renewable energy and climate goals. The CPUC continually ensures that jurisdictional electric utilities are prepared for emergencies and disasters to minimize damage and inconvenience to the public that may occur as a result of electric system failures, major outages, or hazards posed by damage to electric distribution facilities under General Order 166.[98] Furthermore, the CPUC establishes safety and service requirements (General Order 95) for overhead transmission line design, construction, maintenance and operations; and reliability standards (General Order 167) for maintenance and operation of power plants.

The CPUC also has an agreement with the United States Department of Transportation Pipeline and Hazardous Materials Safety Administration to enforce minimum gas pipeline safety standards codified in 49 Code of Federal Regulations (CFR), Part 192. The CPUC's General Order 112-F references and adopts 49 CFR, Part 192, in its entirety. GO 112-F and General Orders 58-A and 58-B identify the minimum safety requirements for the operation and maintenance of natural gas transportation systems. The CPUC oversees the safety and

98 CPUC. May 20, 2021. General Order No. 166. https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/safety-policy-division/reports/general-order-no-166.pdf.

reliability aspects of operator pipeline safety programs through audits, inspections, and investigations of incidents reported by operators.

The CPUC develops and implements policies for the telephone communications and broadband markets, including ensuring fair, affordable universal access to necessary services. This includes regulating intrastate telecommunications service and also the terms and conditions of service of wireless phone providers but not entry or rates, which are the responsibility of the Federal Communications Commission.

The CPUC is responsible for ensuring that investor-owned water utilities deliver clean, safe, and reliable water to their customers at reasonable rates. The CPUC regulates more than100 investor-owned water and sewer utilities under the CPUC's jurisdiction. This includes investigating water and sewer system service quality issues, analyzing, and processing utility rate change requests.

The CPUC oversees the safety of railroads and rail transit systems, for-hire passenger carriers (limousines, airport shuttles, charter and scheduled bus operators) and Transportation Network Companies (uses an online-enabled platform to connect passengers with drivers using their personal, non-commercial, vehicles).

California Senate Committee on Energy, Utilities and Communications

Primary jurisdictions are utilities, energy companies, alternative energy development and conservation, and communications development and technology.

California Senate Committee on Natural Resources and Water

Primary jurisdictions are conservation and management of public resources, and regulation of oil, mining, and geothermal development.

California State Lands Commission

In 1921, the Legislature authorized the issuance of prospecting permits and leases for oil and gas development of the state's tide and submerged lands by the Surveyor General, the predecessor of the California State Lands Commission. In 1938, the Legislature gave exclusive jurisdiction over all oil and gas development on the state-owned property to the Commission.

The state now administers more than 100 sites on which oil companies have developed some 1,000 wells that take oil and gas from state lands. Royalty is paid on each barrel of oil that is removed. In addition, more than 1,000 wells produce oil from granted tidelands in Long Beach. The revenues received from oil and gas are deposited in the state's General Fund and allocated to be used for the State Lands Commission budget, support of the SWP capital outlay for higher education, and many other important projects. The State Lands Commission authorizes, through leases and permits, geothermal or mineral prospecting permits, and oil and gas leases.

Department of Conservation – Geologic Energy Management Division (CalGEM)

The division oversees the drilling, operation, maintenance, plugging, and abandonment of oil, natural gas, and geothermal wells. Regulatory programs emphasize development of oil, natural gas, and geothermal resources through sound engineering practices that protect the environment, prevent pollution, and ensure public safety.

California Utilities Emergency Association

The CUEA is a nonprofit organization. Its mission is to provide emergency operations support for gas, electric, water, wastewater, telecommunications (including wireless), and petroleum pipeline utilities necessary for the preservation of lives and property. CUEA also provides for the coordination of joint planning, training, exercising, and partnering to further collaborative efforts with utilities and governmental agencies within the emergency management environment. This support enhances the overall protection of California's economic infrastructure.

The CUEA Energy Operations Center (EOC) serves as a coordination and facilitation point for communication between utilities and Cal OES. The CUEA EOC consists of volunteers from the utility sector who bring critical industry expertise to assist in the information flow into the SOC through the Utilities Liaison. The CUEA EOC may operate as an element of the Cal OES Private Sector EOC.

The CUEA EOC can activate under multiple scenarios and when the State Operations Center is activated for an event that may involve or affect California's utilities, including activation of the Cal OES SOC Utilities branch, with operations relating to significant utility response and recovery operations. The CUEA coordinates resources and technical assistance among utility organizations during the response, restoration, and recovery efforts under a memorandum of agreement (MOU) between the CUEA and Cal OES.

The CUEA is the lead for gaining assistance from the private sector utilities operating within California and for utilities' mutual aid under CA-ESF 12 of the California SEP, which works in coordination with this plan.

Major Investor-Owned Utilities (IOUs)

IOUs are utilities organized as tax-paying businesses usually financed by the sale of securities in the free market, and whose properties are managed by representatives regularly elected by their shareholders. IOUs, which may be owned by an individual proprietor or a small group of people, are usually publicly traded corporations. In California, the CPUC regulates IOUs.

Publicly Owned Utilities (POUs)

POUs are organizations that maintain the energy infrastructure for a public service. POUs are subject to forms of public control and regulation ranging from local community-based groups to the CEC. Additionally, POUs may fall under specific statutory requirements such as the AB 162 Power Source Disclosure Program.[99]

99 CEC. Power Source Disclosure Program. https://www.energy.ca.gov/programs-and-topics/programs/power-source-disclosure-program.

CHAPTER 5:
Energy Emergency Response

This CESP includes planning documents and resources (regulations, policies, plans, reports, etc.) that support the reliability and resiliency planning processes and energy security activities.

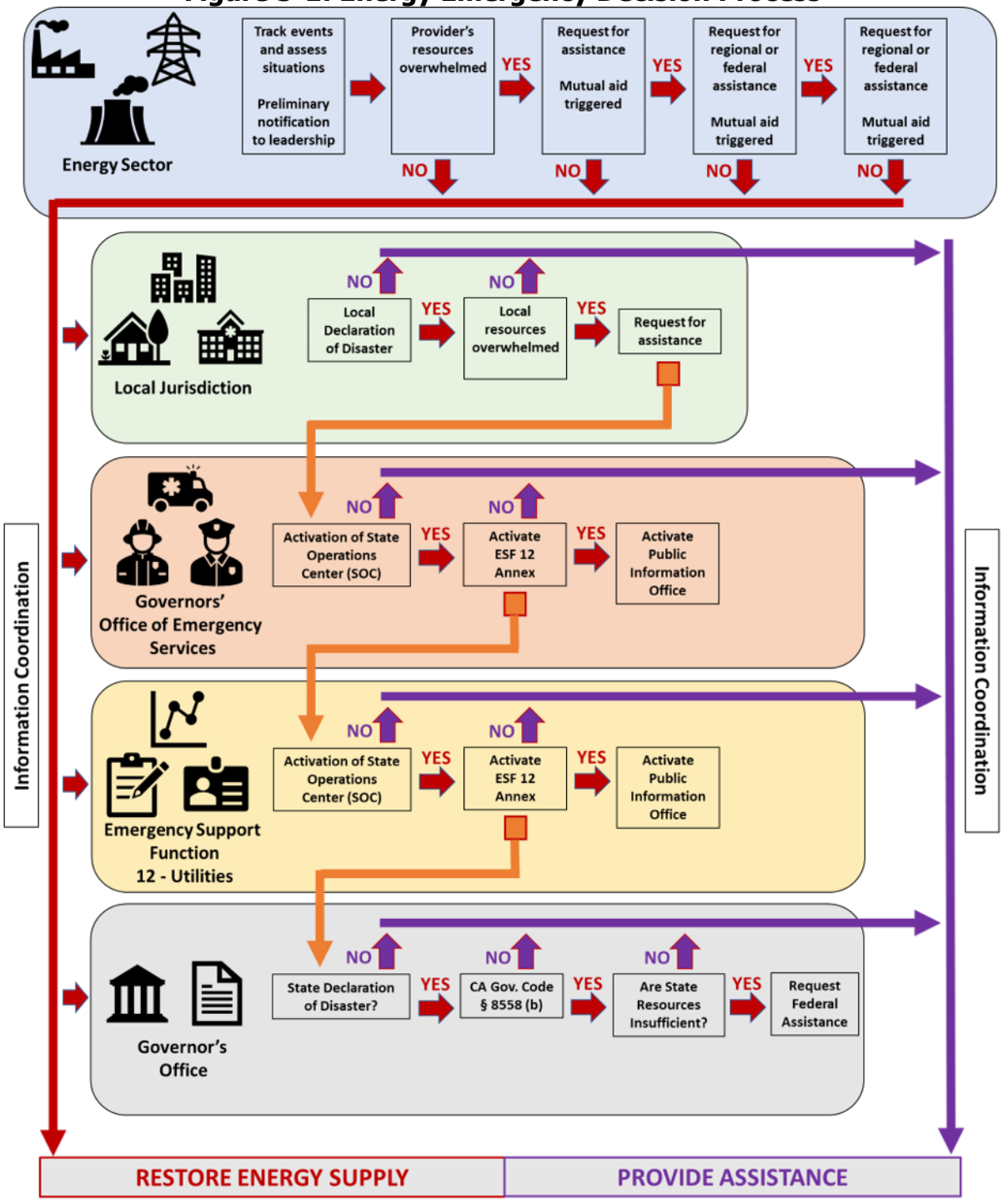
This CESP outlines the roles and responsibilities of state agencies in response to and recovery from energy disruptions and emergencies, including integration with the SEP and CA-ESF 12 Utilities. CA-ESF 12 responds to federal requirements and identifies the critical public and private sector partners that form the state's holistic energy security and reliability system (supply and infrastructure). This includes the entities directly responsible for producing and overseeing the transmission and distribution of the state energy system and are the primary response and recovery entities that respond and restore utilities from energy emergencies or disruptions.

This CESP connects multiple energy security and reliability activities within the four areas of mitigation, preparedness, response, and recovery. Figure 5-1 provides an overview of this high-level integration and interrelationship.

Energy Emergency Response Phases

In the event of an energy emergency, all local and state response entities will operate under the California SEMS using the Incident Command System (ICS) which is also supported by NIMS. Figure 5-1 shows a simplified flow diagram of the energy emergency decision process.

Figure 5-1: Energy Emergency Decision Process



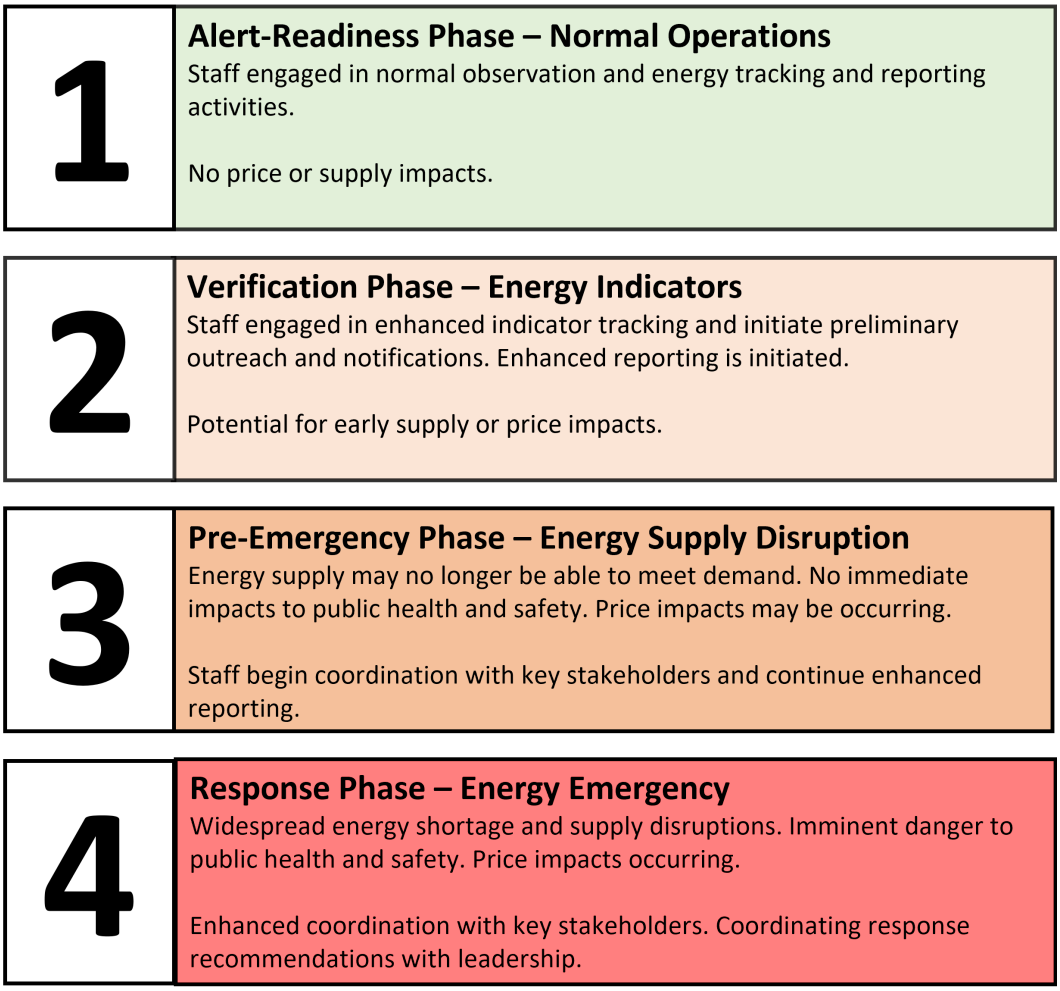
Source: CEC

This CESP contains four increasing phases of activity depending on the severity of the energy disruption or emergency, shown in Figure 5-2. These phases describe how California will:

- Identify energy security and reliability risks (risk identification level).
- Attempt to address identified energy security and reliability risks (risk minimization level).

- Direct response to perceived or identified energy security and reliability disruptions or emergencies (energy emergency response level).
- Initiate actions to recover from energy security and reliability disruptions or emergencies (energy supply/infrastructure recovery/restoration level).

Figure 5-2: Energy Emergency Activity Phases



Source: 2014 California Energy Assurance Plan

1 – Alert-Readiness Phase

The CEC's emergency program staff remain in the Alert-Readiness Phase under normal operating conditions and on an ongoing basis. In the Alert-Readiness Phase, the emergency program and agency staff:

- Monitors international and domestic events.
- Attends periodic exercises to establish and test emergency protocols.
- Trains appropriate CEC staff.
- Updates and maintains a network of public and private sector contacts.
- Prepares internal advisory reports, as needed.

2 – Verification Phase

The Verification Phase may be activated if the CEC determines that an energy emergency has occurred or may shortly occur. During this phase, the emergency program staff will:

- Rapidly determine the nature, extent, and duration of a potential, impending, or actual energy emergency.
- Coordinate energy emergency response activities with Cal OES, other appropriate state agencies, the DOE, other state governments, local government agencies, and private industry.
- Provide a detailed situation report that assesses the potential or actual impacts of the emergency on energy prices and supplies.
- If required, use the informal fuels set-aside program to ensure that emergency and essential services receive adequate supplies of fuel.
- Recommend further actions (if any) to the CEC's Chair.

3 – Pre-Emergency Phase

If the CEC determines the existence of a protracted or growing energy problem, the Pre-Emergency Phase may be activated. This phase is characterized by an increased level of government activity as the energy problem worsens.

During this phase, the emergency program staff will:

- Continue to coordinate energy emergency response activities with Cal OES, other appropriate state agencies, the DOE, other state governments, local government agencies, and private industry.
- Continue to provide periodic situation reports that describe the nature of the energy emergency, the potential or actual impacts on energy prices and supplies, and the expected duration of the event.
- If required, continue to use the informal response/support program to ensure that emergency and essential services receive adequate energy supplies.
- Recommend to the chair appropriate voluntary demand reduction measures that may be used to mitigate the impacts of the energy emergency.

4 – Response Phase

If the problem becomes more severe, the chair may activate the Emergency Response and Support programs and teams, based upon the recommendations of the energy emergency manager and Cal OES. The chair will confer with key stakeholders and state leadership on this decision. This phase involves all activities initiated during the Pre-Emergency Phase, along with additional voluntary or mandatory programs.

To impose mandatory programs, the governor must first issue the proclamation of a state of emergency and file an emergency order specific to the Emergency Program with the Office of the Secretary of State. The emergency order takes effect immediately upon being filed. All mandatory programs automatically terminate when the governor rescinds the emergency

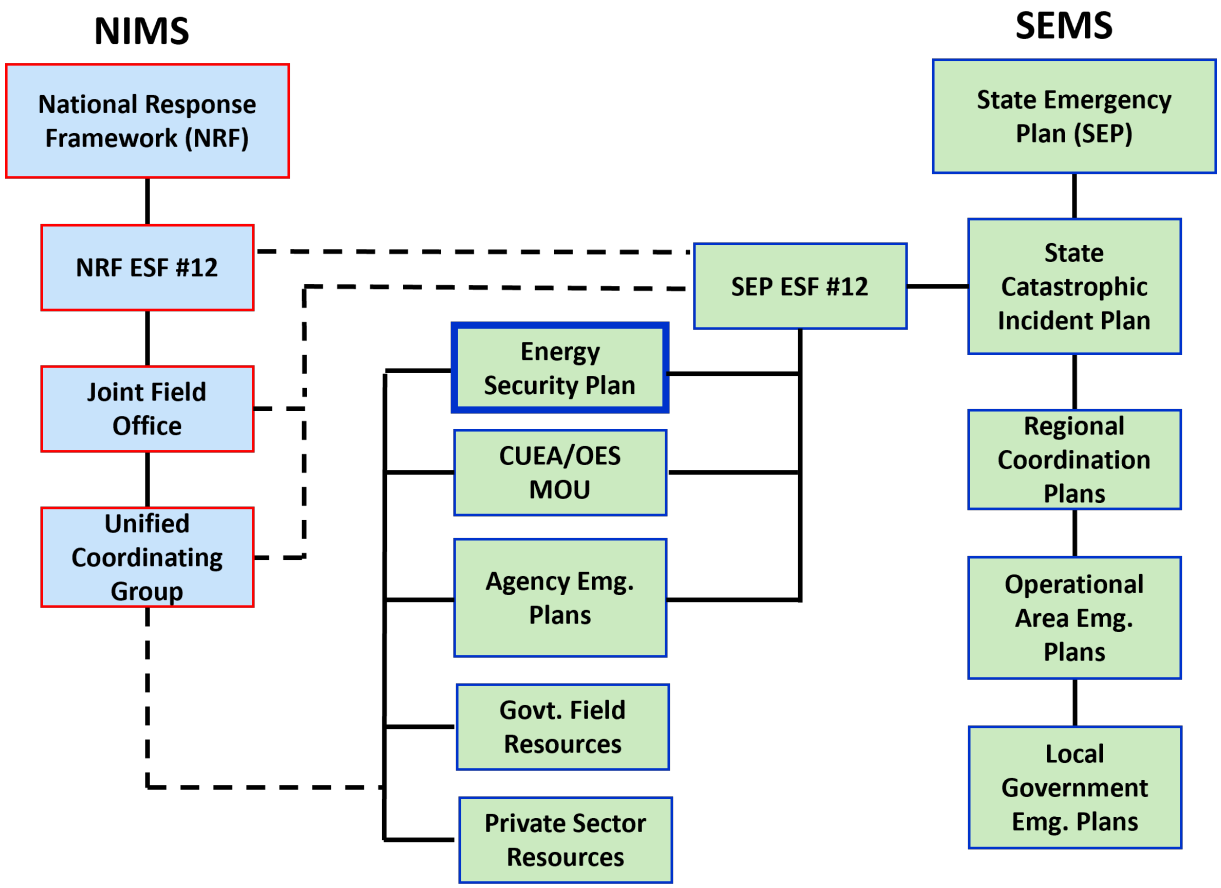
proclamation though some early notification with key entities and private sector partners may be required.

During this phase, staff continue to coordinate response activities, prepare situation reports, and use the informal emergency programs as described in the Pre-Emergency Phase. In addition, the staff will:

- If directed by management, activate the appropriate energy emergency programs.
- If required, implement recommended demand programs, and coordinate appropriate communication of recommended regulatory waivers and actions.
- Recommend to the chair appropriate mandatory demand reduction measures that may be used to reduce the impacts of the energy emergency.

In the event the Response Phase is activated, CA-ESF 12 will be jointly activated in conjunction with this plan and require coordination with key CA-ESF 12 stakeholders. In addition, Cal OES, under the governor's direction, may request mutual aid from the federal government. In this instance, in addition to CA-ESF 12 being activated, the California Catastrophic Incident Base Plan and other state emergency plans will be activated. Figure 5-3 shows the interrelationship of emergency plans involved during the Response Phase.

Figure 5-3: Federal and State Emergency Management System Integration



Source: 2014 California Energy Assurance Plan

State Emergency Response

The SEP describes how response to natural or human-caused emergencies occurs in California.[100] The plan is a requirement of the California ESA, and describes methods for conducting emergency operations, the process for rendering mutual aid, emergency services of government agencies, how resources are mobilized, how the public is informed, and how continuity of government is maintained during emergency. The SEP further describes hazard mitigation (actions to reduce risk), as well as preparedness and recovery from disasters. There are three parts to the SEP: The Base Plan, Functional Annexes, and Appendices.

Base Plan: The Base Plan describes the fundamental systems, strategies, policies, assumptions, responsibilities, and operational priorities California will use to guide and support emergency management efforts. Essential elements of the Base Plan include:

- Emergency services provided by governmental agencies and how resources are mobilized.
- Methods to carry out emergency operations and process for mutual aid.
- Overview of the public information system.
- Continuity planning to ensure uninterrupted government operations.

Functional Annexes: The plan defines Emergency Support Functions. These are discipline-specific groups that develop functional annexes to describe goals, objectives, operational concepts, capabilities, organization structures, and related policies and procedures. Functional Annexes are developed and maintained separate from the Base Plan and reference specific agency and department plans and procedures.

Appendices: Mutual aid plans, hazard-specific plans, catastrophic plans, and related procedures are incorporated by reference and maintained separately from the Base Plan. These supporting plans may be appended to the end of the Base Plan.

The SEP conforms to California's SEMS, a requirement of Government Code § 8607, NIMS, a requirement of Presidential Policy Directive 8, and is compatible with federal emergency planning concepts such as the NRF and the California Catastrophic Concept of Operations (CONOPS) developed jointly with FEMA.

Emergency Management Organization

The SEMS is the cornerstone of California's emergency response system and the fundamental construct of emergency management. SEMS is required by law for managing multiagency and multijurisdictional responses to emergencies in California. The system unifies all elements of California's emergency management community into a single integrated system.

The SEP further describes California's emergency management organization to include compatibility with NIMS; activation and staffing levels for Emergency Operations Centers; functions and organization of the State Operations Center and Regional Emergency Operations

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100 Cal OES. Planning and Preparedness. https://www.caloes.ca.gov/office-of-the-director/operations/planning-preparedness-prevention/planning-preparedness/.

Centers; and the emergency management community which is comprised of both the public and private sectors.

Emergency Preparedness

Preparedness includes activities in advance of an emergency to improve response operations. A comprehensive preparedness program includes developing plans and procedures, maintaining prevention programs, managing, and maintaining resources, establishing mutual aid agreements, training personnel, and educating the public.

Emergency Response Concept of Operations

The SEP describes the following components which are put into action during response to emergencies:

- Establish response goals, priorities, and strategies to protect life, property, and the environment.
- Establish direction, control, and coordination.
- Provide alert and warning to the public.
- Gather intelligence and provide situation reporting.
- Provide emergency public information.
- Establish the Joint Information System.
- Coordinate and provide mutual aid under established agreements for fire, law enforcement, public health/medical, and the Emergency Management Assistance Compact (EMAC).
- Assign state agencies mission tasks to provide resources and assistance.

The Response Concept of Operations further describes the sequence of events and actions at each stage of response:

Pre-Impact >> Disaster Impact >> Sustained Response Operations >>

Transition to Recovery >> Emergency Proclamations

Emergency Support Functions

The plan establishes the CA-ESFs. The CA-ESFs are 18 disciplines essential to address emergency management needs. CA-ESFs are each led by a state agency and represent an alliance of state government and other stakeholders with similar functional responsibilities. Table 5-1 lists all California ESFs and the lead agency.

Table 5-1: List of California ESF and Lead Agency

CA-ESF: Coordinating State Agency/Department	Description	Federal ESF
CA-ESF 1 **Transportation:** Transportation Agency (CalSTA)	Assist in the management of transportation systems and infrastructure during threats or emergencies. Also manages the Air Coordination Group for federal and state aviation support.	ESF #1 – Transportation
CA-ESF 2 **Communications:** Governor's Office of Emergency Services (Cal OES)	Provide resources, support, and restoration of government emergency telecommunications, including voice and data.	ESF #2 – Communications
CA-ESF 3 **Construction and Engineering:** Government Operations Agency (GovOps)	Organize the capabilities and resources of the state government to facilitate the delivery of services, technical assistance, engineering expertise, construction management, and other support to local jurisdictions.	ESF #3 – Public Works and Engineering
CA-ESF 4 **Fire and Rescue:** Governor's Office of Emergency Services (Cal OES)	Monitor the status of fire mutual aid activities. Coordinate support related to detection and suppression of fires; rescue activities; and provide personnel, equipment, and supplies to support local jurisdictions.	ESF #4 – Firefighting
CA-ESF 5 **Management:** Governor's Office of Emergency Services (Cal OES)	Provides guidance and coordination and resolves issues between the CA-ESFs. Ensures consistency in the development and maintenance of the SEP Annexes. Serves in an advisory capacity to the SOC Director during an emergency.	ESF #5 – Information and Planning
CA-ESF 6 **Mass Care and Shelter:** Health and Human Services Agency (CalHHS)	Coordinate and assist responsible jurisdictions with displaced survivors during an incident. Support survivor needs including food, clothing, non-medical care and sheltering, family assistance, and recovery.	ESF #6 – Mass Care, Emergency Assistance, Housing, and Human Services

CA-ESF: Coordinating State Agency/Department	Description	Federal ESF
CA-ESF 7 **Resources:** Government Operations Agency (GovOps)	Coordinate plans and activities to locate, procure, and pre-position resources to support emergency operations.	ESF #7 – Logistics Management and Resource Support
CA-ESF 8 **Public Health and Medical:** Health and Human Services Agency (CalHHS)	Coordinate public health, environmental health, mental/ behavioral health, and emergency medical services activities statewide to support local jurisdiction resource needs.	ESF #8 – Public Health and Medical Services
CA-ESF 9 **Search and Rescue:** n/a	CA-ESF 9 merged into CA-ESF 4 Fire and Rescue for urban search and rescue requests and CA-ESF 13 Law Enforcement for wilderness search and rescue.	ESF #9 – Search and Rescue
CA-ESF 10 **Hazardous Materials:** California Environmental Protection Agency (CalEPA)	Provides for a coordinated response from agencies and governmental entities with jurisdictional and regulatory authority to conduct all phases of emergency management in the response to and recovery from an actual or potential release of oil or hazardous materials to save lives, protect health and safety, protect property, and preserve the environment.	ESF #10 – Oil and Hazardous Materials Response
CA-ESF 11 **Food and Agriculture:** Department of Food and Agriculture (CDFA)	Coordinate activities and support the responsible jurisdiction when a disaster impacts the agriculture and food industry. Support the recovery of impacted industries and resources post-disaster.	ESF #11 – Agriculture and Natural Resources
CA-ESF 12 **Utilities:** California Natural Resources Agency (CNRA)	Provide resources and support to responsible jurisdictions in partnership with the private sector to restore gas, electric, fuel pipelines, water, wastewater, and telecommunications.	ESF #12 – Energy

CA-ESF: Coordinating State Agency/Department	Description	Federal ESF
CA-ESF 13 **Law Enforcement:** Governor's Office of Emergency Services (Cal OES)	Coordinate state law enforcement personnel and equipment to support responsible jurisdictions' law enforcement and coroner offices, wilderness search and rescue, and public safety activities in accordance with law enforcement and coroner's mutual aid plans	ESF #13 – Public Safety and Security
CA-ESF 14 **Recovery:** Governor's Office of Emergency Services (Cal OES)	Support and enable state and local jurisdictions' recovery of communities and businesses from the long-term consequences of emergencies and disasters.	ESF #14 – Cross-Sector Business and Infrastructure
CA-ESF 15 **Public Information:** Governor's Office of Emergency Services (Cal OES)	Support accurate, coordinated, timely, and accessible information to disaster-impacted audiences, including governments, media, private sector, and all members of the community.	ESF #15 – External Affairs
CA-ESF 16 **Evacuation:** n/a	CA-ESF 16 merged into CA-ESF 13 Law Enforcement.	n/a
CA-ESF 17 **Volunteer and Donations Management:** California Volunteers	Support responsible jurisdictions in their use of volunteers (affiliated and non-affiliated), monetary donations, and in-kind donations for incidents requiring state response.	n/a
CA-ESF 18 **Cybersecurity:** Governor's Office of Emergency Services (Cal OES)	Coordinate cyber critical response including the detection, mitigation, and information sharing for statewide cyber-related events.	n/a

Source: California State Emergency Plan

CA-ESFs require a coordinated approach between all members. The lead state agency, with support and coordination from Cal OES, brings together supporting state agencies, departments, and stakeholders from the public and private sector to develop and maintain a

Functional Annex to the SEP. The Functional Annex contains the concept of operations with protocols and procedures for each CA-ESF.

Agency and Department Roles and Responsibilities

In addition to the CA-ESFs, the governor may call upon the services, resources, and capabilities of the 125 state agencies, departments, offices, boards, commissions, councils, and authorities in times of emergency. The plan describes key agencies and departments that have primary or support roles in an emergency. Even those state agencies not specifically listed in the plan may be called upon to carry out activities necessary to mitigate the effects of an emergency.

Emergency Support Function 12 – Utilities Integration

The CA-ESF 12 Utilities describes the alliance of discipline-specific stakeholders which possess common interests and share a level of responsibility to collaboratively provide emergency management expertise, support and services related to utility infrastructure system damage and outage response, as well as to restoration of service. The stakeholders will support and coordinate with each other in the mission to protect life and property through collaborative efforts within the four phases of emergency management as prescribed by the SEP.

The purpose of the CA-ESF 12 Annex is to define the scope of the CA-ESF 12 and the emergency management activities of its stakeholders. The development of the CA-ESF 12 is a dynamic process involving time, resources, and consensus building. The Annex is reviewed and maintained on a regular basis to reflect the inclusion of additional stakeholders, the expansion of resources and capabilities, and the revision of policies and procedures.

The CA-ESF 12 stakeholders provide, through a collaborative and consensus process, recommendations and subject matter expertise related to the utility infrastructure situations to Cal OES within all phases of emergency management.

Information Gathering and Situational Awareness

The CEC hosts multiple offices that are involved in data analytics, using a suite of analysis and information gathering tools. Multiple offices within the CEC also support efforts around energy security and emergency planning and preparedness. The mission of one of the CEC Divisions, the Energy Assessments Division (EAD) is to assess California's energy systems and trends, providing information for decision-makers and the public that produce policies that balance the need for adequate resources with economic, public health, safety, and environmental goals.

Some of the analysis and assessment work performed at the CEC:

- Energy efficiency and fuel substitution, including electrification and hydrogen.
- Electrification of the transportation sector, vehicle-grid integration, and analysis of all transportation fuels.
- Longer-term energy demand scenarios for all fuels and sectors of the economy, with geography included for the seven major electricity planning areas.
- Producing electricity and natural gas demand forecasts used by other energy agencies and utilities for energy system planning.

    - Collecting and analyzing data on annual and hourly electricity demand, and annual and daily natural gas consumption.
- In developing the forecasts, the CEC uses projected economic and demographic growth, projected changes in rates and other cost factors, historical and projected weather and climate change data, and projections for behind-the-meter PV and storage.
- Providing essential statistics and facts used to assess and develop energy policy and situational awareness dashboards, including categories such as:
    - Electric generation supply
    - Electricity and natural gas consumption
    - Economic/Demographics
    - Electricity procurement and greenhouse gas emissions
    - Power plant reporting
- The CEC collects, analyzes, and provides policy expertise on a range of petroleum and natural gas resource issues. The branch is responsible for assessing petroleum and natural gas markets, available supply, and strategies to support changing demand as the state pursues a low carbon future. The branch provides essential statistics and facts used to assess and develop energy policy and situational awareness dashboards, including categories such as:
    - Natural gas supplies
    - Natural gas prices
    - Petroleum refinery production of transportation fuels
    - Transportation fuels supplies
    - Imports and exports of crude oil and transportation fuels
- The CEC collects data, produces analyses, and provides policy expertise on a range of electric resource planning and reliability issues. The analysis focuses on electrical energy supply and technologies, markets, infrastructure, natural and human-made impacts on these resources, and emergency response.

Subject matter experts within EAD support the state's emergency planning, preparedness, and response efforts. Additional discussion of the existing tools and process used for data collection, analytics, and situational awareness can be found in Appendix A. Multiple divisions and branches across the CEC support data collection and analysis efforts and can be called on to support emergency planning and response activities.

Data Acquisition and Information Coordination

The EEAC establishes a secure cooperative data information acquisition and dissemination environment for state and local government personnel with access to information on energy supply, demand, pricing, and infrastructure. Designated members have expertise in electricity, petroleum, and natural gas. The current membership of nearly 200 people is made up of representatives from state energy offices, public utility organizations, state legislatures,

emergency management agencies, homeland security offices, local governments, and governors' offices. In a major energy emergency, all these resources would be called upon.[101]

California has designated several primary and secondary designees per energy source (electricity, natural gas, and petroleum) for inclusion in the EEAC. In the event of an energy supply disruption or emergency, DOE Office of Electricity (DOE EO) relies upon the EEAC contacts to provide an up-to-date assessment of energy markets in the affected states. During these emergencies, as well as other nonemergency situations in which the list may be used, the EEAC serves as the link between the state, industry, and DOE OE.

In an energy emergency, DOE OE may need to disclose sensitive and privileged information and, in these situations, may contact only the primary coordinator. From that point, it is the designated primary coordinator's responsibility to follow California's plan for disclosure of information. In most other nonemergency or less sensitive emergency or disruption situations, both the primary and secondary coordinators may be contacted. Communications can be sent directly to the DOE OE via email, and EEAC can use listservs to send information to different regions. In addition, the EEAC bulletin board provides a great way for coordinators to share information and best practices.

California's EEAC coordinators and designees must keep in touch with the state's key energy sector contacts, including key players in the state's primary energy supply and energy-consuming sectors, as well as key emergency or energy-related personnel in other state and local government agencies. Moreover, it is important to keep in contact with other EEACs in the state. If a responder's first contact with other EEACs is during an emergency, it is already too late. The types of events that warrant communication with the EEAC network include:

- Large-scale events, such as an attack on the power grid, international oil disruption, catastrophic storm damage, and similar events.
- Emerging problems, such as the spring gasoline change in nonattainment air quality areas that cause a significant increase in the number of terminals without a supply, price spikes, and other indicators of stress on ability of the supply/distribution system to supply fuel (oil, gas, gasoline, and so forth).
- Routine summer and winter energy assessments.
- Simulations and exercises.

The types of nonproprietary information that should be shared include:

- Information that quantifies the size, scope, and potential duration of the problem.
- Geographic area affected.
- Effects upstream and downstream in the energy supply/distribution system.
- Public statements by state officials.
- Specific actions taken by state or local governments to mitigate impacts.

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101 2009. NASEO State Energy Assurance Guidelines, V3.1, p39. https://www.naseo.org/data/sites/1/documents/energyassurance/eaguidelines/State_Energy_Assurance_Guidelines_Version_3.1.pdf.

- Requests from industry for assistance and response.
- In-state media reports that accurately describe the problem.

The California EEAC coordinator should consider sending information to the EEAC list when market indicators suggest the potential for supply problems and monitoring will be increased. In addition, information should be sent when an event occurs that affects energy supply, demand, or price or when an energy emergency or state of disaster is declared that affects energy supply.

In the case of an international event that affects energy supply, DOE OE will likely communicate its analysis to the EEAC list and/or California. EEACs may request such information from DOE OE. The EEAC list may also be used by DOE OE to request information if there are reports of energy problems. California EEAC should also use this list to communicate regionally to counterparts because problems are often not limited to a single jurisdiction. Too much information is often better than little or no information. If in doubt, use the list. A brief message can be beneficial, and communication is key.

Data Communications and Interagency Coordination

During an energy emergency, the state will establish and maintain information networks and operational relationships with all levels of government, as described below.

Consequence Assessment Guidelines

Energy security is an essential component of modern societies and economies. Digital technologies, communications infrastructure, and industrial operations all rely on an efficient and dependable energy supply. As countries, states, and communities transition to less carbon-intensive sources of energy, system operators face several ongoing and developing challenges, as renewable sources generally require a higher degree of flexibility to compensate for their intermittency. As such, governments must increasingly work on policies and regulations around the ability of existing markets and regulatory frameworks to continue providing a reliable, affordable, and efficient supply of energy.

Threats and hazards must be assessed and analyzed to determine their potential impacts and how likely they are to occur. Threats and hazards encompass a broad range of categories such as:

- **Climatological Events** (extreme temperatures, drought, wildfires)
- **Hydrological Events** (floods, dam/levy failures, landslides)
- **Meteorological Events** (tropical cyclones, severe convective storms, severe winter storms, atmospheric rivers)
- **Geophysical Events** (earthquakes, tsunamis, volcanic eruptions)
- **Pandemics** (global disease outbreaks, panzootic impacting livestock)
- **Space Weather Events** (geomagnetic storms, solar coronal mass ejection)
- **Technological and Industrial Accidents** (structural failures, industrial fires, hazardous substance releases, chemical spills, nuclear/radiological accident)

- **Unscheduled Disruptions** (aging infrastructure, equipment malfunction, large scale power outages, energy supply disruptions)
- **Criminal Incidents and Terrorist Attacks** (vandalism, theft, property damage, active shooter incidents, kinetic attacks)
- **Cyber Incidents** (denial-of-service attacks, malware, phishing)
- **Supply Chain Attacks** (exploiting vulnerabilities to cause system or network failure)
- **Foreign Influence Operations** (spread misinformation, undermine public processes, social media manipulation)
- **Untrusted Investment** (foreign powers with significant influence over critical systems or infrastructure)

Event Indicators

Identifying consequence indicators involves assessing quantitative and qualitative data collected during the information-gathering/situational awareness stage. A consequence assessment builds on normal or "blue sky" day baselining activities. A baseline activities assessment requires an understanding of the state energy profile that identifies key energy infrastructure and standard volumes of energy supply and demand. A clear grasp of the typical market dynamics, energy prices, and other metrics can be used as a point of comparison during an energy emergency.

Information considered in the consequence assessment includes but is not limited to:

- **Threat indicators** – assessment of how different types of threats impact energy systems.
- **Consumer impacts** – magnitude and anticipated duration of impacts.
- **Impacts to critical sectors** – infrastructure that supports safety and security, health and medical, and transportation are fundamental community services.
- **Population impacts** – what communities are disproportionately affected by energy disruptions. Vulnerable communities typically require more assistance during energy events, including additional resources and targeted outreach.
- **Impacts to critical energy systems** – critical power plants, refineries, pipelines, storage facilities, and transmission impacts on supply chains and the availability of alternative supply options.
- **Impacts to energy markets** – bulk fuel and additives, electric balancing authority reserve margins, and to what extent disruptions impact prices.

The NIMS Incident Complexity Guide[102] and DOE's response activation guidance utilizes a tiered approach. This document adopt a tiered response method. To better align with the DOE guidance, tiers use an inverted scale with lower numbers indicating greater event consequences. Tiers 3, 2, and 1 generally correspond to NIMS Types 3, 2, and 1. Furthermore,

102 FEMA. June 2021. NIMS Incident Complexity Guide. https://www.fema.gov/sites/default/files/documents/nims-incident-complexity-guide.pdf.

NIMS event Types 4 and 5 can be assumed to be energy events requiring minimal involvement from State Energy Offices and thus are not addressed.

- **Tier 3**: **Enhanced Watch** events are characterized by impacts to energy supply chains and/or energy services that are largely remediated by industry with little to no need for support from the state or federal governments. CEC teams enhance situational monitoring and coordination/communication with key partners.
- **Tier 2**: **Significant Events** are significant disruptions to energy supply chains and/or energy services with longer timelines for restoration. Response to these events typically exceeds local resources. Impacted industries will typically enhance regulatory engagement and seek government assistance in the form of waivers and resource management to expedite restoration and mitigate impacts.
- **Tier 1**: **Major Events** are characterized by extensive disruption to energy supply chains and/or energy services with extended or indefinite timelines for restoration. Tier 1 events require a massive response at every level of government to assist and expedite restoration and to mitigate the impact on affected populations and sectors.

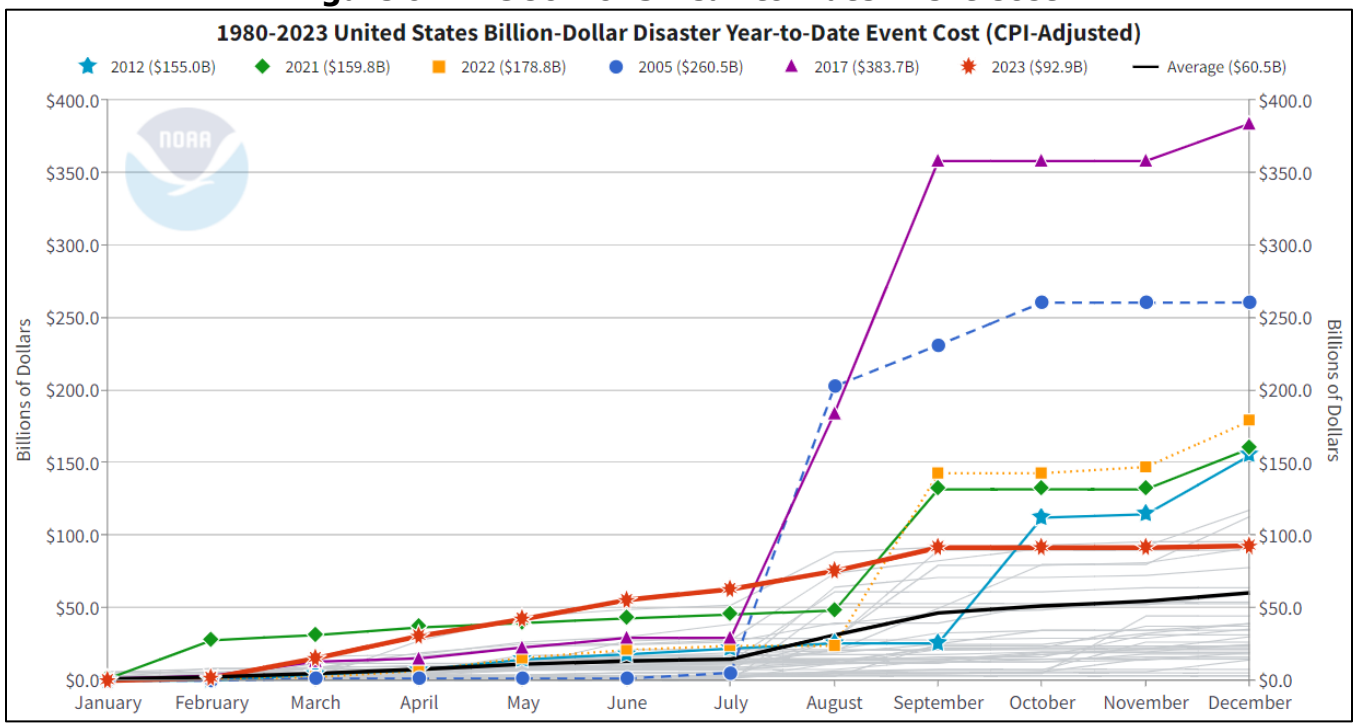
A more detailed discussion around the topics of risk, consequences, response, and mitigation can be found in Chapter 6 – Energy Resiliency and Mitigation Measures, Appendix A – Energy Emergency Contingency Programs, Appendix C – California Risk Profiles, Appendix D – California Historical Disasters, and Appendix H – Cybersecurity.

CHAPTER 6:
Energy Resiliency and Mitigation Measures

In 2023, the U.S. experienced 28 weather and climate disasters costing at least $1 billion, surpassing the previous record of 22 in 2020. These disasters resulted in at least 492 direct or indirect fatalities—the 8th highest number of disaster-related fatalities for the contiguous U.S. since 1980. Damages from the 2023 events totaled at least $92.9 billion. (All cost estimates are adjusted based on the Consumer Price Index, 2023). The costliest events being the Southern/Midwestern Drought and Heat Wave ($14.5 billion) and the Southern and Eastern Severe Weather in early March ($6.0 billion). Adding the 2023 events to the account record that began in 1980, the U.S. has sustained 376 weather and climate disasters with damages reaching or exceeding $1 billion. The cumulative cost for the 376 events exceeds $2.660 trillion.

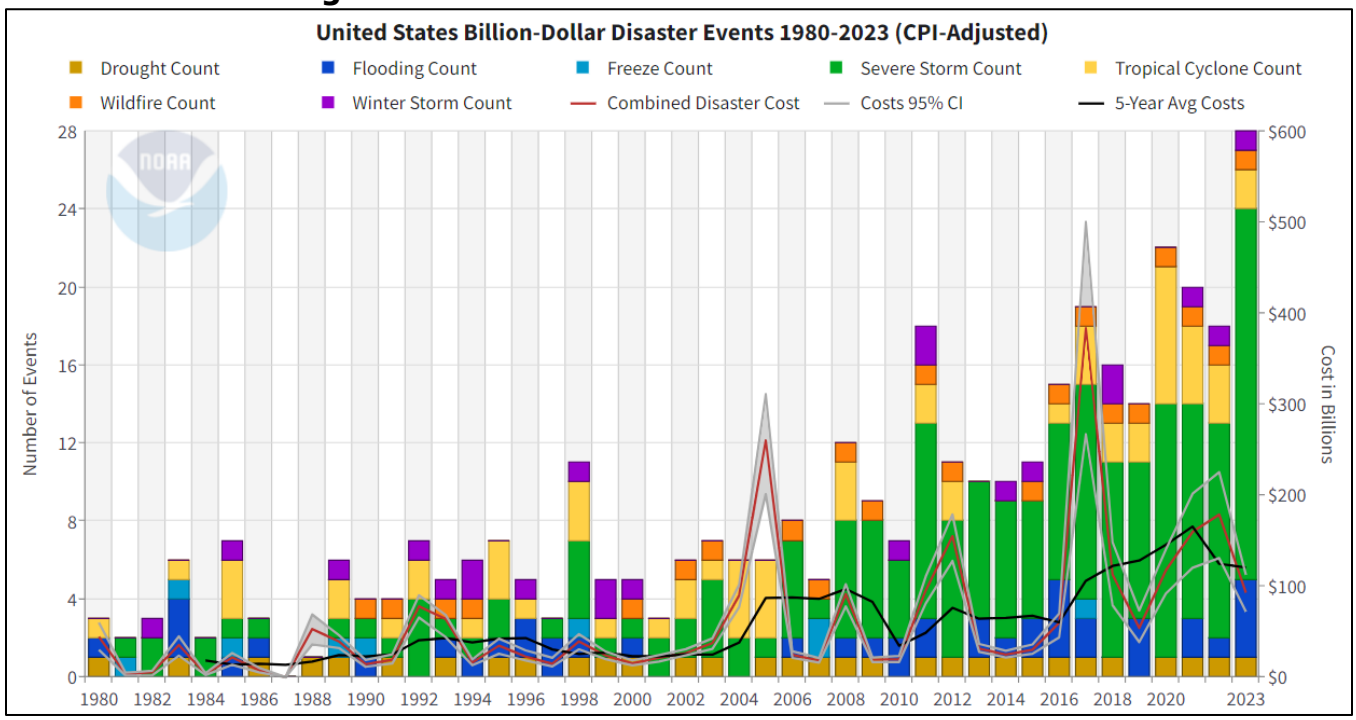
For the fourth consecutive year, the U.S. experienced 18 or more, billion-dollar disaster events in 2023 (red line), marking a consistent pattern that is becoming the new normal. The 1980–2023 annual average (black line) is 8.5 events (CPI-adjusted); the annual average for the most recent 5 years (2019–2023) is 20.4 events (CPI-adjusted). Figures 6-1 through 6-3 provides a historical overview of both the costs and nature of events.

Figure 6-1: 1980-2023 Year-to-Date Event Cost



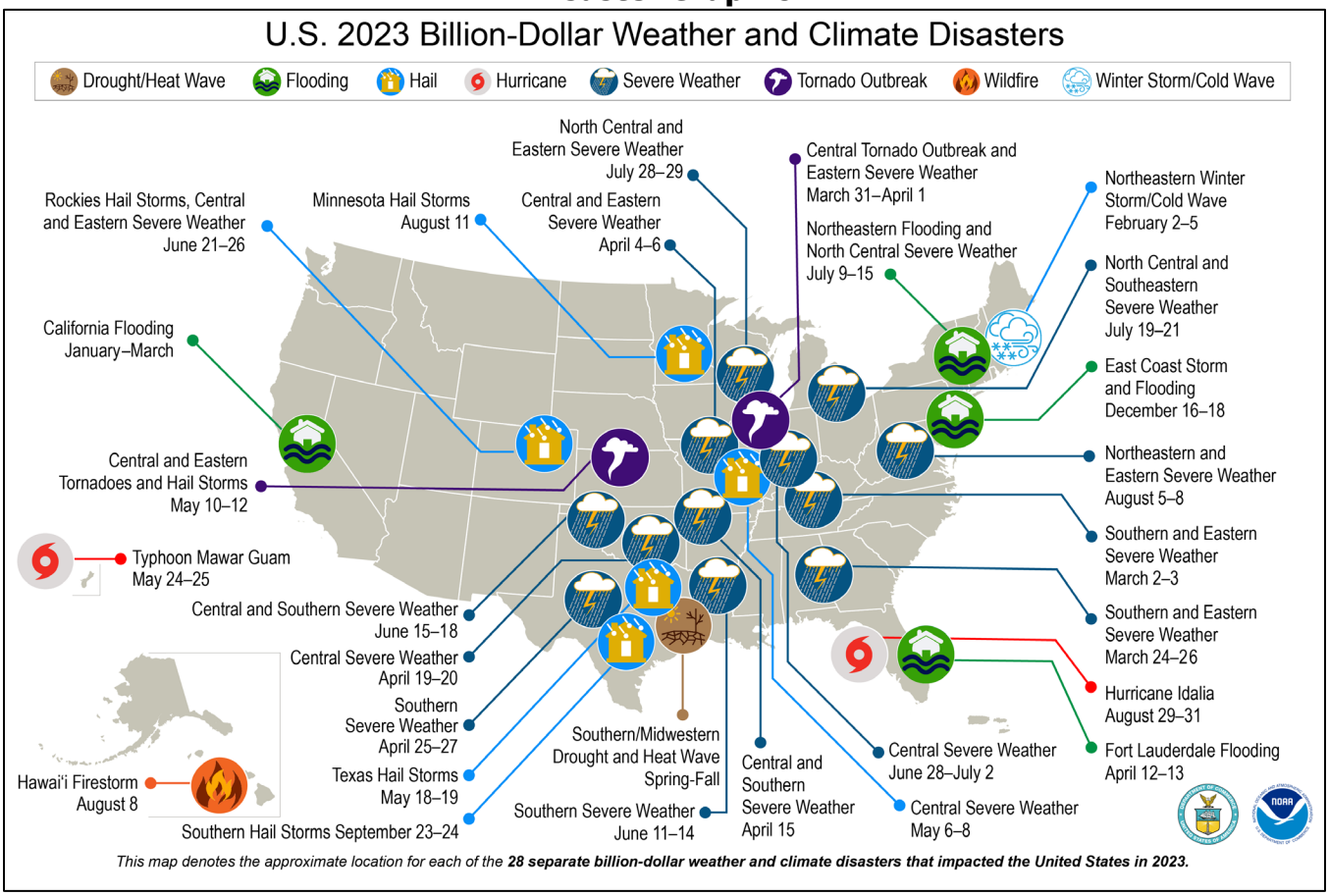
Source: Month-by-month accumulation of estimated costs of each year's billion-dollar disasters, with colored lines showing 2023 (red) and the previous top-10 costliest years. Other years are light gray. 2023 finished the year in tenth place for annual costs. NOAA image by NCEI.

Figure 6-2: 1980-2023 Year-to-Date Event Cost



Source: The history of billion-dollar disasters in the United States each year from 1980 to 2023, showing event type (colors), frequency (left-hand vertical axis), and cost (right-hand vertical axis.) The number and cost of weather and climate disasters is rising due to a combination of population growth and development along with the influence of human-caused climate change on some type of extreme events that lead to billion-dollar disasters. NOAA NCEI.

Figure 6-3: National Centers for Environmental Information Weather and Climate Disaster Graphic



Source: In 2023, the United States experienced 28 separate weather or climate disasters that each resulted in at least $1 billion in damages. NOAA map by NCEI, https://www.ncei.noaa.gov/access/billions/.

Energy-efficient facilities and other distributed energy resources can reduce danger to public safety, security, and health, resulting in resilient communities. Resiliency is the ability to anticipate, prepare for, and adapt to changing conditions while withstanding, responding to, and rapidly recovering from disruptions by implementing adaptable and holistic planning and technical solutions. To mitigate hazards and risks, relevant parties must coordinate to develop comprehensive adaptable and holistic planning. This requires a multijurisdictional approach, cooperation across boundaries, considerable reliance on partnerships and multiagency collaborations, and significant utilization of interdisciplinary teams.

Statewide Resiliency/Reliability Policies and Strategies

California's electrical grid is a critical component of the state's aggressive decarbonization goals, targeting 60 percent renewable power by 2030 and 100 percent carbon-free electricity by 2045. At the same time the California grid has been a major source of vulnerability, with power lines causing many of the record-setting wildfires of the past five years. In recent years, utilities and regulators have instituted preemptive public safety power shutoffs (PSPS) to limit and mitigate risk, but these events can leave vulnerable populations without access to essential services. CPUC regulations require IOUs to minimize, and mitigate harmful effects of

PSPS events include implementation of grid hardening measures such as undergrounding of electrical lines, installation of covered conductors, and building remote grids to eliminate long lines in High Fire-Threat Districts (HFTD), as well as mitigating impacts through operational changes to reduce the duration of events, distribution of backup batteries, installation of backup power transfer meters, opening community resource centers during events, and enhancing customer communication and coordination. Customer impacts from PSPS events dramatically declined since peaking in 2019.

New technologies like distributed renewable generation, microgrids, energy storage, building energy management, and vehicle-grid integration offer paths to promote and increase community safety and resilience while advancing the decarbonization efforts. These strategies can complement, or in some cases replace, traditional "wire" alternatives (e.g., new circuits, capacity upgrades, etc.) or grid hardening measures (e.g., covered conductor, undergrounding, etc.). Significant policy and financial support have been provided in these areas through recent IOU general rate case approvals of covered conductor and undergrounding investments, storage incentive programs such as the Self-Generation Incentive Program (SGIP), and implementation of legislation to advance microgrids.

CEC Resiliency and Reliability Policies and Strategies

The CEC is committed to a reliable, affordable, and equitable transition to clean energy. [103] As the state experiences challenges associated with climate change, management of the electricity grid remains paramount. The CEC collaborates with other state agencies to prepare annual reliability analysis that informs the public.

Integrated Energy Policy Report – California Energy Policies and Strategies

The IEPR provides a cohesive approach to identifying and solving the state's pressing energy needs and issues. The report, which is crafted in collaboration with a range of stakeholders, develops and implements energy plans and policies. The report provides policy recommendations to conserve resources, protect the environment, ensure reliable, secure, and diverse energy supplies, enhance the state's economy, and protect public health and safety. Topics covered in the report vary by year and are proposed and refined via the IEPR Scoping Order. An example of IEPR topics are those proposed in the 2025 scoping order: advancing clean energy deployment, a full update to the 15-year electricity and gas forecast, updates on California's load-shift resource potential and policy recommendations to reduce net-peak electricity demand.

CEC Research and Development Programs

The Energy Commission's Energy Research and Development Division helps California meet its energy and greenhouse gas reduction goals by investing in cutting-edge research that:

- Improves the energy efficiency of buildings.
- Advances the state's electric vehicle infrastructure.

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103 CEC. Reliability. https://www.energy.ca.gov/data-reports/california-energy-planning-library/reliability.

- Improves water and energy management.
- Supports new clean energy innovations.
- Reduces environmental pollutants.
- Makes the state's electrical and natural gas infrastructure safer, more reliable, and more efficient.
- Improves the resiliency of the energy system to the impacts of climate change.

Two of the research and development programs that support resiliency and reliability efforts are:

- The Long Duration Energy Storage (LDES) program provides grants to projects pursuing longer duration energy storage projects to improve reliability and resiliency in under-resourced communities and tribes. The program focuses on non-lithium technologies.
- The Community Energy Resilience Investment (CERI) Program will fund projects across California that increase community energy resilience and grid reliability.

CEC Summer Reliability

Climate change is accelerating and impacting the grid. [104] The CEC has begun evaluating the reliability outlook using climate-driven extreme conditions. Recent summer events have demonstrated how the increased frequency of climate-driven extreme heat, drought, and wildfires have strained California's electricity supply and demand. The following sections highlight varied analyses that have been conducted in recent years related to extreme events that fall outside of traditional electricity sector planning.

Summer 2023 and Beyond Analysis:

- Joint Agency Reliability Planning Assessment - Addresses requirements for electricity reliability reporting in Senate Bill 846 (Dodd, Chapter 239, Statutes of 2022) and Assembly Bill 205 (Committee on Budget, Chapter 61, Statutes of 2022). The report provides a quarterly review, including the demand forecast, supply forecast, and potential high, medium, and low risks to reliability in the California Independent System Operator territory from 2023 to 2032. The report also provides a joint reliability progress report that reviews system and local reliability, with a particular focus on summer reliability, identifies challenges and gaps to achieving system and local reliability, and identifies the amount and cause of any delays to achieving compliance with all energy and capacity procurement requirements set by the CPUC.
- Clean Energy Reliability Investment Plan - Addresses a requirement in SB 846 for the CEC to develop a $1 billion investment plan for clean energy resources.

Strategic Reliability Reserve

Extreme heat events and wildfires remain a threat to grid reliability and can strain the grid for days or weeks. The SRR was developed in 2022 as part of to expand the resources capable of

104 CEC. *Summer Reliability*. https://www.energy.ca.gov/data-reports/california-energy-planning-library/reliability/summer-reliability.

managing or reducing net-peak demand during extreme events. The SRR provides funding to secure conventional generation, efficiency upgrades at existing natural gas plants, demand response, distributed generation, and long-duration storage. The SRR consists of three programs, two of which are administered by the CEC, and one is administered by the Department of Water Resources.

The SRR includes three programs developed to provide resources during extreme events, one program managed by DWR, Electricity Supply Strategic Reliability Reserve Program, and two programs managed by the CEC and the DWR managed:

- Distributed Electricity Backup Assets Program - Incentivizes the construction of cleaner and more efficient distributed energy assets that would serve as on-call emergency supply or load reduction for the state's electrical grid during extreme events.
- Demand Side Grid Support Program - Provides incentives to reduce customer net energy load during extreme events with upfront capacity commitments and per-unit reductions in net load.

Emergency Rulemaking for Opt-In Certification Provisions

The CEC (CEC) has been authorized under Assembly Bill 205 (Committee on Budget, Chapter 61, Statutes of 2022) to establish a new certification program for eligible non-fossil-fueled power plants and related facilities to optionally seek certification from the CEC. Opt-In Certification Program Webpage: https://www.energy.ca.gov/programs-and-topics/topics/power-plants/opt-certification-program#:~:text=Under%20AB%20205%2C%20the%20CEC,report%20(EIR)%20under%20CEQA.

Diablo Canyon Power Plant Extension

The two Diablo Canyon Power Plant reactor units are licensed by the U.S. Nuclear Regulatory Commission to operate until November 2, 2024 (Unit 1), and August 26, 2025 (Unit 2). In 2016, PG&E announced a joint proposal to increase investment in energy efficiency, renewable energy, and storage while phasing out nuclear power. PG&E's application to close Diablo Canyon was approved by CPUC in January 2018 with PG&E withdrawing its application for a licensing extension in February 2018. In 2022, at the direction of California leadership, PG&E initiated the relicensing process with the NRC.

Recent extreme heat events and wildfires have highlighted the need to plan for additional risk to California's energy reliability. Senate Bill 846 (Dodd, Chapter 239, Statutes of 2022) (SB 846) requires the state to pursue an evaluation assessing the cost, benefits, and possible role of the Diablo Canyon Power Plant in reliability planning efforts. The analyses developed by the CEC as part of the SB 846 requirements are captured in a series of reports.

- The Diablo Canyon Power Plant Extension – CEC Analysis of Need to Support Reliability addresses a requirement in SB 846 for the CEC to determine the need to extend the operation of the Diablo Canyon Power Plant from 2024 through 2030. The analysis is based on a CEC assessment of the state's electricity reliability based on forecasted demand and supply for that period. The CEC determined it is prudent for the state to pursue an extension of DCPP. This determination is driven by the risk that sufficient

electricity resources may not be built in time to reach the ordered procurement and to address potential grid demands in extreme heat events associated with climate change.

California Public Utilities Commission Resiliency and Reliability Policies and Strategies

CPUC's infrastructure related work includes oversight of utility electric and gas infrastructure. Significant new infrastructure investments are required to support the state's transition to a low-carbon energy infrastructure. To realize these goals, including bringing renewable energy from remote areas of the state to urban load centers, new transmission lines have been planned and built. At the same time, significant investments to improve distribution level infrastructure are required to improve the safety and reliability of electricity and gas.

The CPUC has primary ratemaking jurisdiction over the funding of distribution related expenditures generally for power lines of 66 kV or less. While the CPUC does not have ratemaking responsibility for transmission lines, the CPUC has a role in permitting transmission and substation facilities. Staff oversee the development of environmental documents in accordance with CEQA. In addition to permitting responsibilities, the CPUC actively oversees a variety of other infrastructure related policy and program areas, including interconnection (utility tariffs related to interconnection of non-utility generators to the electric grid), reliability and distribution infrastructure, California Public Utilities Code § 851 approval process, undergrounding, microgrids, and lastly, electric and communications infrastructure safety.

Infrastructure-related policy areas at the CPUC include:

- General Rate Case
- Transportation Electrification
- CEQA
- Distribution Planning
- Electric Reliability and Safety
- Energy Storage
- Interconnection
- Integrated Resource Plan and Long-Term Procurement Plan
- Mobile Home Parks
- Pole and Conduit Databases & Application
- Resiliency and Microgrids
- Smart Grid
- Smart Meter
- Undergrounding

Electric Generation

CPUC manages an Integrated Resource Planning process to ensure that sufficient generation resources are available to meet projected demand in the long run, and a Resource Adequacy program to ensure those resources are under contract to provide reliable power. CPUC also

requires utilities to prepare and maintain plans for curtailing load in the event of a generation shortfall. Finally, CPUC has established power plant maintenance and operation standards (GO 167-B) and regularly monitors and audits power plants to ensure compliance.

Electric Distribution

The standards and procedures listed below apply to the distribution operations (below 69,000 volts generally) of the electric investor-owned utilities (IOUs) regulated by the (CPUC).

- Reliability Reporting Standards
- Emergency Preparedness Standards
- Inspection and Maintenance Standards

Electric Transmission

For more information on transmission standards (above 69,000 volts generally) and on recent transmission projects proposed for reliability, economics, or renewable purposes please refer to California Transmission Projects and Information and to the website links listed at the end of the description of the CPUC's Reliability Program.

CPUC Resiliency and Microgrids

Microgrids enhance resiliency by providing localized power generation coupled with the ability to operate independently from the main grid. This allows microgrids to supply power to critical facilities and services, even when the primary grid is disrupted. Details are available on the CPUC Resiliency and Microgrid website, https://www.cpuc.ca.gov/industries-and-topics/electrical-energy/infrastructure/resiliency-and-microgrids.

Department of Water Resources Electric Reliability Policies and Strategies

The DWR also produces electricity, which ultimately helps meet SWP's power demands. [105] The energy produced—which is highly variable due to changes in annual hydrologic conditions—averages around 6 billion kilowatt-hours (kWh) a year.

As a producer of electricity, DWR is subject to regulation under the authority of the Federal Power Act. DWR have three hydropower licenses and two conduit exemptions under the authority of FERC. To maintain these licenses, DWR must comply with the terms and conditions to protect, mitigate, and enhance beneficial public uses of hydropower projects.

The SWP uses five hydroelectric generating plants and four hybrid pumping/generating plants to generate clean power. The SWP's flexible pumping operations help it to manage the timing of its power needs. This flexibility is allowed by SWP reservoirs, which temporarily store water until it is needed to meet the daily and seasonal demands of its contracting agencies.

To reduce power costs, pumping is minimized during on-peak hours when power prices are highest. Maximum pumping is scheduled during off-peak periods (nights, solar hours,

105 DWR. Power. https://water.ca.gov/What-We-Do/Power.

weekends, and holidays) when power costs are cheaper. Thus, the SWP can purchase, when needed, inexpensive surplus generation from other power suppliers for its pumping operations.

Buying Power

DWR has also been in the business of purchasing power. In response to the turn-of-the-millennium energy crisis, Governor Gray Davis signed an Executive Order in January 2001 for DWR to purchase energy for California's three IOUs.

At that time, PG&E, SCE, and SDG&E were on the verge of bankruptcy and unable to make purchases. DWR established the California Energy Resources Scheduling division (CERS) to buy and sell electricity on behalf of big utilities and to purchase the remaining energy requirements ("net short") for their retail customers.

CERS actions helped stabilize the wholesale power markets in California and returned electricity prices to reasonable levels. CERS was transitioning operating responsibility back to the utilities with a sunset of 2022. The CERS program was renamed to the Electric Power Fund and the CERS division was renamed to the California Energy Bond Office. The Electric Power Fund program is continuing to wind down and is now focused on litigation related to the 2001 energy crisis and returning any litigation settlements and excess dollars to the IOUs' retail customers.

Electricity Supply Strategic Reliability Reserve Program (ESSRRP)

In support of a broader effort to safeguard our state's energy grid in the face of climate-induced drought, wildfires, and extreme heat waves, DWR has procured temporary power generators throughout California.

Because of DWR's expertise as a water and power utility, Governor Newsom's emergency proclamation issued on July 30, 2021 directed DWR to work with the CEC to develop projects to expand power generation.

DWR began the process of procuring temporary power generators in Summer 2021 for use during extreme events. With new legislation enacted in June 2022, the ESSRRP was created, led by DWR in conjunction with the CEC, the CPUC and the California ISO, to address energy and grid reliability needs. In support of the program, DWR continues to develop new emergency and temporary generators and has the authority to contract with existing facilities pending retirement.

Of the generators already procured and installed, two units are located at sites in Roseville and Yuba City. The additional units will be positioned in the San Joaquin Valley region and placed at existing facilities where they can feed directly into the electrical grid and be dispatched as needed by the local balancing authority to respond to an extreme event per California Public Resources Code § 25790.5 *et seq*.

Mitigation Measures

This document presents an inventory of potential risk mitigation measures for energy infrastructure. This inventory is not comprehensive; it is intended to be a starting place for conversations and for developing a risk mitigation approach to enhance energy sector reliability and end-use resilience, including maintaining electric, liquid fuels, and natural gas

system reliability, and securing energy infrastructure. Cyber resilience measures, while important, are outside of the intended scope of this document.[106]

Energy infrastructure is typically constructed to safety, security, and reliability standards set by the North American Electric Reliability Corporation, Pipeline Hazardous Materials and Safety Administration, and other federal, state, and industry regulating bodies. To mitigate impacts from evolving threats including climate change, states and energy infrastructure operators may consider risk mitigation technologies and operational measures that enhance system resilience beyond the standards set by regulators. For example, deploying infrastructure and procedures necessary for effective and rapid system restoration in the event of a wide scale energy outage. As defined in Presidential Policy Directive (PPD)-21:

> *"Resilience is the ability to prepare for and adapt to changing conditions and withstand and recover rapidly from disruptions. Resilience includes the ability to withstand and recover from deliberate attacks, accidents, or naturally occurring threats or incidents."*

When evaluating whether to invest in new risk mitigation measures, infrastructure operators evaluate the cost of the measures against the level of risk and the potential benefits of greater system reliability and faster recovery after emergency events. For regulated electric and natural gas utilities, these investments may require approval from state public utility commissions.

The measures summarized on the subsequent pages are categorized into two main groups: "All Hazards" measures can apply to a range of threats; and "Hazard-Specific" measures are designed to mitigate a specific threat or risk, such as cold weather or wildfires. All Hazard measures are divided into categories that align with three of the "infrastructural qualities" outlined in DHS's Resilience Framework:

1. Robustness – measures that strengthen a system to withstand external hazards without degradation or loss of functionality.
2. Redundancy – measures that allow for alternate options, choices, and substitutions when a system is under stress.
3. Rapid Detection/Recovery – measures that accelerate the time it takes to overcome a disruption and restore energy services.

The last two sections provide a list of potential general resources on ways to increase the resilience of energy systems and resources related to specific risk mitigation measures. Table 6-1 provides the DOE CESER list of hazard mitigation measures. Tables 6-2 through 6-10 are a generic tabulated list of potential hazard risk mitigation measures provided by DOE CESER.

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106 **Cyber Resilience** is the ability to anticipate, withstand, recover from, and adapt to adverse conditions, stresses, attacks, or compromises on systems that use or are enabled by cyber resources. For additional information see: IEA: Cyber Resilience, Report Extract (https://www.iea.org/reports/power-systems-in-transition/cyber-resilience) and NIST: "Developing Cyber-Resilient Systems; A Systems Security Engineering Approach" (https://nvlpubs.nist.gov/nistpubs/SpecialPublications/NIST.SP.800-160v2r1.pdf).

Table 6-1: Hazard Mitigation Measure

All Hazards Risk Mitigation Measures	Hazard-Specific Risk Mitigation Measures
Robustness	Cold Weather
Redundancy	Extreme Heat and Drought Resistance
Rapid Detection/Recovery	Flooding
	Seismic
	Wildfire
	Wind

Source: DOE CESER, State Energy Security Plan (SESP) Resources, https://www.energy.gov/ceser/state-energy-security-plan-sesp-resources.

Tabulated List of Generic Potential All-Hazards Risk Mitigation Measures

Table 6-2: Robustness

Measure	Description	Sector
Demand response programs	Demand response programs relieve pressure on electric supply and delivery systems by reducing or time-shifting customer energy usage. Demand reduction during peak periods reduces the chance of system overload and service failure. In addition to enhancing reliability, demand response can also help integrate intermittent renewables, avoid GHG emissions from peaker plants, reduce energy prices and generator or supplier market power and lessen price volatility.	Electricity
System segmentation	Energy systems (power grids, gas pipeline networks, and petroleum pipeline networks) can be sub-divided to more efficiently isolate damaged areas, allowing undamaged segments to continue serving customers. By segmenting networks, service isolations can be more targeted and affect fewer customers.	Electricity, Liquid Fuel, Natural Gas

Measure	Description	Sector
Under-grounding power lines	Placing transmission lines underground protects them against external threats, including high winds and falling branches, wildfires, extreme heat or cold, icing, dirt/dust/salt accumulation, and animals. Buried lines may be more vulnerable to flooding if located in low-lying areas and may be more difficult and expensive to maintain and repair.	Electricity

Table 6-3: Redundancy

Measure	Description	Sector
Backup generators	Fixed or portable backup generators can provide backup power to critical facilities when grid-supplied power is interrupted. Backup generators may be designed to power emergency functions, such as emergency lighting, fire suppression, or stormwater removal, or may be designed to power some or all a facility's operational functions. Mobile generators can power utility or emergency responder base camps (sites where response personnel and equipment are staged). Backup generators require adequate fuel supply to operate.	Electricity, Liquid Fuel, Natural Gas
Battery storage	Battery energy storage can be used to provide backup power during electric grid outages. Batteries can be deployed at utility-scale as front-of-the-meter systems, providing services like utility load peak shaving or behind-the-meter by customers. Batteries are often paired with solar PV systems and included in microgrid designs.	Electricity
Microgrids	A microgrid is a group of interconnected loads and distributed energy resources that acts as a single controllable entity with respect to the grid. It can connect and disconnect from the grid to operate in grid-connected or island mode. Microgrids can improve customer reliability and resilience to grid disturbances.	Electricity
Ties between gas pipelines	Natural gas system operators can add ties between gas distribution lines or "mains" to diversify the transmission system and allow additional pathways to route natural gas in the event some sections of transmission mains are damaged.	Natural Gas

Measure	Description	Sector
Critical Component Inventories	Spare part inventories, mutual aid agreements, and supplier agreements are additional resources that provide redundancy/robustness/rapid recovery	Electricity, Liquid Fuel, Natural Gas

Table 6-4: Rapid Detection/Recovery

Measure	Description	Sector
Advanced distribution management systems	Advanced distribution management systems integrate numerous utility systems and provide automated outage restoration and optimization of distribution grid performance. These functions improve the resilience of the distribution system and decrease the length of customer outages.	Electricity
Artificial intelligence analysis	Artificial intelligence analysis can augment the abilities of subject matter experts to prioritize transmission line operations, identify defects, and update asset management systems.	Electricity, Liquid Fuel, Natural Gas
Distribution automation	Distribution automation uses digital sensors and switches with advanced control and communication technologies to automate feeder switching; voltage and equipment health monitoring; and outage, voltage, and reactive power management.	Electricity
Drones for asset inspection	The use of drones to inspect pipelines, transmission lines, or other assets allows for safer and more frequent inspections, enhanced asset information, reduced operational costs and failure rates, and extended asset lifetimes.	Electricity, Liquid Fuel, Natural Gas
Electric system restoration	Ensuring black start capability exists to restore the high-voltage electric transmission system in an effective and timely manner after the occurrence of a major electric system outage.	Electricity, Natural Gas

Measure	Description	Sector
LiDAR for vegetation management	Vegetation is the primary cause of overhead power line outages. "Light Detection and Ranging" (LiDAR), is remote-sensing technology that can measure how close vegetation is to power lines. LiDAR units can be deployed on the ground, drones, or aircraft, to enable more effective vegetation management reducing the impact of storms on electric infrastructure.	Electricity
Remote-operated valves	Remote-operated valves more efficiently isolate systems during disruptions or peak event load management (e.g., temporarily disconnecting gas customers).	Liquid Fuel, Natural Gas
Advanced Metering Infrastructure	Advanced metering infrastructure (AMI) is an integrated system of smart meters, communications networks, and data management systems that enables bi-directional communication between utilities and customers. Smart meters can provide near-real-time visibility into customer outages and help utilities allocate resources and restoration activities more efficiently.	Electricity
Supply chain resilience planning	Assessing current supply chains and working with relevant stakeholders to strategically plan for the continuity and rapid restoration of those supply chains after major disruptions improves supply chain resilience.	Electricity, Liquid Fuel, Natural Gas

Table 6-5: Cold Weather Protection Measures

Measure	Description	Sector
Pipeline insulation & trace heating	Fiberglass insulation used to enclose piping can protect against freezing. Additionally, an electrical heating element installed along the length of a pipe and covered by thermal insulation can be used to maintain or raise the temperature of the pipe during cold weather.	Liquid Fuel, Natural Gas
Water line management	Draining water lines prevents rupturing that would otherwise be caused by the freezing water caught inside. Water lines that cannot be drained can be set to drip. The small amount of flow caused by the steady drip can help prevent the water inside the lines from freezing and rupturing the lines.	Liquid Fuel, Natural Gas

Measure	Description	Sector
Heating & pitch adjustment for wind turbines	Wind turbine blades and lubricant housings can be fitted with heating elements that prevent ice accumulation that would otherwise impair operations. Wind turbines can also be configured to operate in winter ice operation mode, which changes the pitch of the blades to allow continued operation as they accumulate ice.	Electricity
Thermal enclosures	Instrumentation can be enclosed and heated to ensure functionality and operational continuity during extreme cold conditions.	Electricity, Liquid Fuel, Natural Gas

Table 6-6: Extreme Heat & Drought Resistance Measures

Measure	Description	Sector
Advanced water-cooling technologies	Power plants require significant volumes of water for thermoelectric cooling. Asset owners can employ approaches to reduce their water use to make them more resilient to drought conditions. Alternative approaches include recirculating cooling, dry cooling (highlighted below), and wet-dry hybrid cooling technologies. Cooling equipment capable of using alternative water sources (e.g., brackish water, wastewater) can reduce the impact of droughts.	Electricity
Dry cooling	Nearly all thermal generation, including nuclear and coal-fired power plants, requires large quantities of water for cooling. Extreme heat can lead to water shortages or make the water used for cooling too warm, forcing power plant operators to curtail electricity output. Dry cooling technologies use air-cooled heat exchangers and other technologies to significantly reduce water use.	Electricity
Hydropower reservoir capacity	Increasing reservoir storage capacity at hydroelectric power plants can offset the effects of precipitation variability.	Electricity
Turbine efficiency	Higher-efficiency hydroelectric turbines require less water per unit of electricity generated and are more resilient to drought.	Electricity

Table 6-7: Flood Protection Measures

Measure	Description	Sector
Elevate equipment	Elevating equipment located in low-lying areas can protect it from flooding that would otherwise damage or destroy it.	Electricity, Liquid Fuel, Natural Gas
Environmental management	Preserving certain kinds of natural habitats (e.g., coastal wetlands) provides a natural barrier to lessen the impact of storm surge.	Electricity
Flood walls/gates	Installing flood walls, gates, and/or barriers can protect essential equipment in flood prone areas from water intrusion and avoid restoration delays after major storms and floods.	Electricity, Liquid Fuel, Natural Gas
Relocate assets	Relocating energy assets away from flood-prone areas can reduce or eliminate their exposure to flooding and inundation threats.	Electricity, Liquid Fuel, Natural Gas
Stormwater pumps	Stormwater pumps can remove flood water and help prevent equipment from being submerged.	Electricity, Liquid Fuel, Natural Gas
Submersible equipment	Equipment located in flood-prone areas, such as underground power distribution systems in low-lying areas, can be modified or replaced with equipment that is designed to continue functioning when subjected to flooding from water containing typical levels of contaminants such as salt, fertilizer, motor oil, and cleaning solvents.	Electricity, Liquid Fuel, Natural Gas
Vent line protectors	A vent line protector (VLP) protects gas regulator vent lines from encroaching water. The VLP is usually open, but if water enters the vent line via the VLP, a float will seal the vent line shut. The float will drop when the water recedes, re-opening the vent to its normal position.	Natural Gas
Vented manhole covers	In flooding scenarios, manhole covers can dislodge, and the exposed manhole creates a hazard for pedestrians and vehicles. Proper vent design can allow for the flow of excess water without dislodging the cover.	Electricity

Table 6-8: Seismic Protection Measures

Measure	Description	Sector
Base isolation transformer platform	Substation transformers can be placed on platforms designed to absorb the shaking from earthquakes that would otherwise damage the equipment.	Electricity
Culverts	Placing fuel pipelines within buried concrete trenches, called culverts, significantly reduces the fracturing, buckling, and other damage caused to buried pipelines during an earthquake.	Liquid Fuel, Natural Gas
Flexible joints	Flexible joints between steel pipe segments absorb the deformations caused during an earthquake and lessen the damage caused to pipeline infrastructure.	Liquid Fuel, Natural Gas

Table 6-9: Wildfire Protection Measures

Measure	Description	Sector
Covered conductors	To mitigate wildfire risk, utilities can replace bare wire overhead conductors on high-voltage transmission lines with conductors that have a plastic covering (also called tree wire). Covered conductors greatly reduce the number of faults, and the risk of ignition. Similar products include spacer cables and aerial cables.	Electricity
Fire-resistant poles	Wood poles can be replaced with ones made from fireproof materials, or wrapped in fireproof sheaths (e.g., wool-ceramic fiber).	Electricity
Line-break-protection systems	Automated monitoring equipment, called phasor measurement units, installed on transmission lines can detect a voltage change associated with the breakage of a power line. The system can respond in near real-time by de-energizing that segment of the transmission line so that the broken power line does not spark a fire as it falls to the ground.	Electricity
Pre-treat assets in path of fire	Pre-treating infrastructure (e.g., by applying flame retardant coatings or wrapping assets such as utility poles in flame retardant sheaths) decreases wildfire damage and expedites restoration of service.	Electricity

Measure	Description	Sector
Re-conductoring	Reconductoring is the process of installing new conductor wires on existing towers to increase transmission capacity, thus reducing propensity for high loads and line sag, which can cause ignition. Reconductoring typically involves replacing traditional steel-reinforced lines with composite core lines.	Electricity
Vegetation management	Clearing vegetation away from transmission and distribution lines helps prevent damage (e.g., falling tree branches) to power lines that cause outages.	Electricity

Table 6-10: Wind Protection Measures

Measure	Description	Sector
Breakaway service connectors	A breakaway service connector is designed to disconnect when the power line it is attached to is pulled by a falling limb or other debris. This avoids damage caused when a service wire is pulled down in a way that damages the meter receptable. Meter receptables are not owned by the utility, and a private electrician is needed to first make repairs, delaying service restoration.	Electricity
Dead-end towers	Dead-end towers (also called anchor towers or anchor pylons) are self-supporting structures made with heavier material than suspension towers. Dead-end towers are used at the end of a transmission line; where the transmission line turns at a large angle; on each side of a major crossing such as a large river or highway, or large valley; and at intervals along straight segments to provide additional support. Suspension towers are typically used when the transmission line continues along a straight path. When weaker suspension towers are compromised or topple, the stronger dead-end structures can stop a domino effect that takes down multiple towers. Reducing the spacing between dead-end structures can limit the impacts of domino effect failures.	Electricity
Stronger utility poles	This can involve reinforcing wood poles, replacing wood poles with concrete ones, or replacing wood cross-arms with fiberglass ones.	Electricity

Measure	Description	Sector
Vegetation management	Clearing vegetation away from transmission and distribution lines helps prevent damage (e.g., falling tree branches) to power lines that cause outages.	Electricity

Source: DOE CESER, State Energy Security Plan Resources, https://www.energy.gov/ceser/state-energy-security-plan-sesp-resources.

Specific Measure Resources

Mitigating impacts from hazards to the energy system is a topic that is constantly being reevaluated, and the guidance for best practices is ever-changing. The following reports focus on ways to increase the resilience of energy systems. Note: this is not a comprehensive list of resources.

Institute of Electrical and Electronics Engineers (IEEE). 2020. *Resilience Framework, Methods, and Metrics for the Electricity Sector.*

This report provides an overview of resilience definitions (including its relationship with reliability), the existing frameworks for holistically defining resilience planning and implementation processes, and the metrics to evaluate and benchmark resilience. It also evaluates technologies, tools, and methods to improve electrical system resilience.

National Renewable Energy Laboratory. 2019. *Energy Resilience Assessment Methodology.*

This report presents a replicable energy resilience assessment methodology for sites, military bases, and campuses to assess energy risks and develop prioritized solutions to increase site resilience.

National Renewable Energy Laboratory. 2019. *Power Sector Resilience Planning Guidebook: A Self-Guided Reference for Practitioners.*

This guidebook introduces policymakers, power sector investors, planners, system operators, and other energy-sector stakeholders to the key concepts and steps involved in power sector resilience planning.

U.S. Climate Resilience Toolkit. 2019. *Building Resilience in the Energy Sector.*

Examines climate change challenges for the energy sector, possible actions to mitigate risk and links to resources.

U.S. Department of Homeland Security. 2019. *National Mitigation Investment Strategy.*

The National Mitigation Investment Strategy ("NMIS"), developed by the Mitigation Framework Leadership Group is a single national strategy for advancing mitigation investment to reduce risks posed by natural hazards and increasing the nation's resilience to natural hazards. This report outlines the investment strategy and how federal and non-federal partners can coordinate community mitigation investments.

National Academies of Sciences, Engineering, and Medicine. 2017. *Enhancing the Resilience of the Nation's Electricity System.*

This report focuses on identifying, developing, and implementing strategies to increase the electric system's resilience in the face of events that can cause large-area, long-duration outages: blackouts that extend over multiple service areas and last several days or longer.

U.S. Dept. of Energy. 2016. *Climate Change and the Electricity Sector: Guide for Climate Change Resilience Planning.*

This report provides basic assistance to electric utilities and other stakeholders in assessing vulnerabilities to climate change and extreme weather, and in identifying an appropriate portfolio of resilience solutions.

Electric Power Research Institute (EPRI). *2016. Electric Power System Resiliency.*

This report describes innovative technologies, strategies, tools, and systems that the electricity sector is developing and applying to address resiliency. The report explores three elements of resiliency: damage prevention, system recovery, and survivability.

Argonne National Laboratory. 2016. *Front-Line Resilience Perspectives: The Electric Grid.*

This report summarizes how states and local utilities approach all-hazards resilience in planning, construction, operations, and maintenance of the electric system, as well as challenges faced when addressing all-hazards resilience.

U.S. Dept. of Energy. 2014. *United States Fuels Resiliency Volume III: U.S. Fuels Supply Infrastructure Vulnerabilities and Resilience.*

This study evaluates the ability of the nation's oil and natural gas transportation, storage, and distribution infrastructure to respond to and recover from natural disasters and intentional acts, system chokepoints and interdependencies, and other supply interruptions.

U.S. Dept. of Energy. 2010. *Hardening and Resiliency: U.S. Energy Industry Response to Recent Hurricane Seasons.*

This report examines the storm hardening and resilience measures that refiners, petroleum product pipeline operators, and electric utilities in the Gulf Coast area took in response to the 2005 and 2008 hurricane seasons. It focuses on the segments of the energy industry that contribute most to the delivery of gasoline and diesel to the Southeast U.S.

Advanced Distribution Management Systems

- NREL: Advanced Distribution Management Systems
- U.S. DOE: Insights into Advanced Distribution Management Systems

Battery Storage

- NREL: Valuing the Resilience Provided by Solar and Battery Energy Storage Systems
- NREL: Battery Storage for Resilience

- NREL: Renewable Energy Integration and Optimization Tool (ReOpt)
- SolarResilient: Sizing tool for solar PV and battery storage systems
- DOE: Solar-Plus-Storage 101

Demand Response Programs

- EIA: Demand-Side Management Programs Save Energy and Reduce Peak Demand
- FERC: Demand Response

Dry Cooling

- U.S. Energy Information Administration - EIA - Independent Statistics and Analysis
- DOE ARPA-E: Advanced Research in Dry (ARID) cooling program

Environmental Management

- EPA: What is Green Infrastructure?
- EPA: Green Infrastructure - Manage Flood Risk
- NOAA: Green Infrastructure Options to Reduce Flooding

Microgrids

- LBNL: Distributed Energy Resources Customer Adoption Model (DER-CAM)
- NREL: Voices of Experience Microgrids for Resiliency
- DOE: Microgrid Portfolio of Activities
- Sandia National Laboratories: Microgrid Design Toolkit

Advanced Metering Infrastructure

- DOE: Smart Grid Investments Improve Grid reliability, Resilience and Storm Responses
- DOE: Advanced Metering Infrastructure and Customer Systems Report
- NREL: Government Program Briefing: Smart Metering

Supply Chain Resilience Planning

- DOE: America's Strategy to Secure the Supply Chain for a Robust Clean Energy Transition
- DHS: Supply Chain Resilience Guide

Undergrounding Power Lines

- DOE: Resilient Power Grids: Strategically Undergrounding Powerlines
- FEMA: Reduce Wildfire Risk Case Study

Use of Drones for Asset Inspections

- Oak Ridge National Laboratory: An Early Survey of Best Practices for the Use of Small Unmanned Aerial Systems by the Electric Utility Industry

Vegetation Management

- U.S. EPA: Benefits of Integrated Vegetation Management (IVM) on Rights-of-Way
- FERC: Tree Trimming and Vegetation Management