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California Energy Commission

COMMISSION REPORT

Draft 2022 Integrated Energy Policy Report Update

Gavin Newsom, Governor

November 2022 | CEC-100-2022-001-CMD

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ABSTRACT

The *2022 Integrated Energy Policy Report Update* provides updates on a variety of energy issues facing California. These issues will require action if the state is to meet its climate, energy, air quality, and other environmental goals while maintaining reliability and controlling costs.

California continues to face the impacts and repercussions of challenging events, including the continued effects of the COVID-19 pandemic, extreme summer weather, and drought conditions. In addition to these events, the *2022 Integrated Energy Policy Report Update* discusses the California Energy Commission's equity and environmental justice efforts, its development of a more easily navigable online data platform via the California Energy Planning Library, and an update to the California Energy Demand Forecast. The report also provides information on emerging topics related to energy reliability, western electricity integration, hydrogen, gasoline prices, gas transition, and distributed energy resources.

Keywords: Integrated Energy Policy Report, equity, environmental justice, California Energy Planning Library, demand forecast, reliability, gasoline prices, gas transition, distributed energy resources, western electricity integration, hydrogen

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TABLE OF CONTENTS

LIST OF FIGURES

Page

LIST OF TABLES

Page

EXECUTIVE SUMMARY

The state is transforming its energy system away from fossil fuels to achieve a reliable, clean, affordable energy future that benefits *all* Californians. California is an international leader in energy policy, and in September 2022, Governor Gavin Newsom signed a suite of bills passed by the Legislature to accelerate California's bold commitment to reduce greenhouse gas (GHG) emissions through world-leading climate action. This package of bills is called the California Climate Commitment, which includes putting in statute a requirement that California reach net-zero GHG emissions by 2045 (Assembly Bill 1279, Muratsuchi, Chapter 337, Statutes of 2022) and mandating that renewable and zero-carbon sources make up 90 percent of the state's electricity by 2035 (Senate Bill 1020, Laird, Chapter 361, Statutes of 2022). Governor Newsom also issued an executive order directing all state agencies to embed policies and practices in their work to advance equity and address disparities.

Embedding Equity and Environmental Justice

As Governor Newsom said, "Our state has made great strides in redressing historic wrongs and stubborn disparities, but we know that much work remains to tackle the barriers that hold back too many Californians and undermine our collective prosperity." The California Energy Commission (CEC) recognizes its responsibility to address the barriers related to the energy system and supports the State's California for All vision.

The CEC has a history of taking action to embed equity and environmental justice throughout its work and the *2022 Integrated Energy Policy Report Update* (2022 *IEPR Update*) provided an opportunity to build on existing efforts. For this report, staff piloted a customized regional engagement process to take the IEPR to the people, increasing awareness about this proceeding and the CEC in general. Three regions — Salton Sea, Central Coast, and Central Valley — were selected to each host an IEPR workshop and for the CEC to directly engage with California Native American tribes, government entities, and community residents and organizations during the days before and after each workshop.

CEC staff reached out to local leaders and organizations early on to codesign the workshops and engagement, enabling local voices, especially tribes, government, and communities, to elevate priority topics to the CEC. Workshop and community outreach participants indicated the customized workshops and visits to their homes, neighborhoods, and community spaces were appreciated and should continue for the IEPR and other proceedings. These visits helped directly connect commissioners and staff to residents and helped provide better understanding of their lived experience. This connection enables leadership to make more informed policy decisions. The CEC should continue this regional approach for future IEPR proceedings and other major CEC proceedings.

During the 2022 IEPR Update, the CEC sought input and guidance from the public to develop and produce a comprehensive framework to align the agency on the shared values, principles, and best practices it should apply to further embed equity and environmental justice in CEC efforts. Workshop participants and others confirmed the CEC should have a framework to enable the public to more easily monitor the CEC's commitment and approach to equity and

environmental justice. Additionally, CEC staff reviewed CEC programs to standardize existing practices and conducted a literature review to inform the framework. After the final equity workshop concluded and the CEC staff reviewed public comments received, the CEC staff completed a draft framework to be shared for public comment. The CEC will continue engaging in an iterative process internally and with the public beyond the 2022 IEPR Update proceeding to produce a final framework in 2023.

Another effort the CEC initiated through the 2022 IEPR Update was to rework the CEC's Energy Equity Indicators tool, which was developed in 2018 to measure access to clean energy technologies and benefits. It had not been updated for several years and was rarely used. Through the 2022 IEPR Update, the CEC sought input from the public about whether the tool provided value, whether the CEC should invest resources to continue hosting it, and what else the CEC should consider in revisiting its use.

Workshop participants and public commenters confirmed that the tool has potential to provide valuable information and to make energy data more accessible and readily available, and that the CEC should continue working to determine how the tool can be improved. The CEC will apply a phased approach that includes internal review and engagement with peer agencies and the public to determine which indicators to modify, to update the relevant data sets accordingly, and to test the new inputs and outputs.

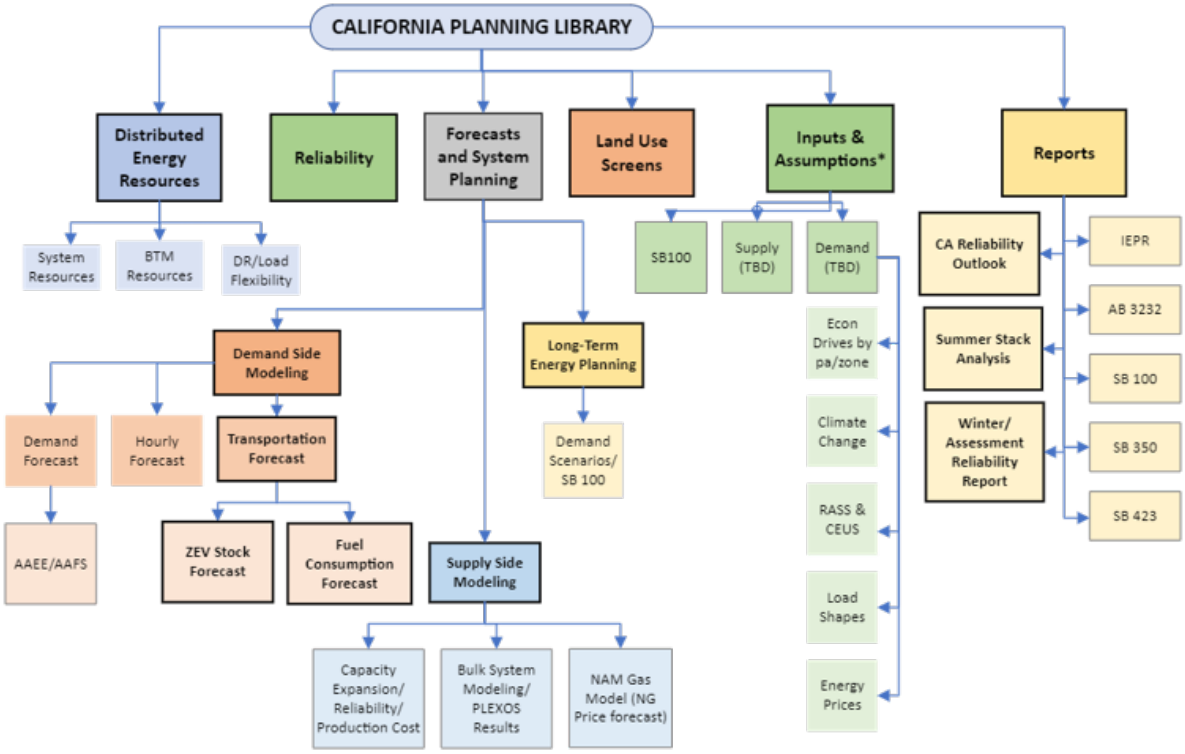
Making Information Readily Available: California Energy Planning Library

Information is foundational to building the policies and tools necessary to equitably achieve carbon neutrality by 2045. The CEC is working to make its data and analytics more easily available to all, from peer agencies engaged in energy planning to novices who want to learn more. Aims include:

- Making information more readily available to communities and tribes.
- Allowing for better collaboration between agencies.
- Providing leaders with the information they need.
- Highlighting deliverables which have been approved through the regulatory process (adopted) by the CEC.

The CEC is launching the California Energy Planning Library in early 2023 — an online platform available from the CEC's webpage. For the initial rollout, it will house commonly requested analytics developed for electricity planning (Figure ES-1), such as energy reliability and the energy demand forecast (discussed below), and include dashboards, visualizations, and spatial mapping tools. The CEC will seek feedback on how to improve the platform and look for opportunities to incorporate new products.

Figure ES-1: The California Energy Planning Library Structure



Source: CEC staff

Updating California's Energy Demand Forecast

The importance of California's energy demand forecast, which will be available from the California Energy Planning Library, has grown with the urgency of the climate crisis. The rapid changes in climate, and bold new policies to address climate change, have profound effects on California's electricity supply and demand. The speed and magnitude of these changes require the CEC to nimbly develop new analytical tools for forecasting California's 10-year energy demand. Billion-dollar investments in energy generation, storage, and transmission are rooted in the forecast of energy demand.

This year the CEC is updating the forecast that was developed for the *2021 IEPR*. It includes updates to historical data, economic and demographic projections, and electricity rates, as well as an update to the hourly forecast to consider the September 2022 heat event. It incorporates a new approach to assessing the transportation sector, given the rapid advancements in transportation electrification. Also, staff created a new framework that better aligns with how the forecast is used — it includes a *baseline forecast*, a *planning forecast*, and a *local reliability scenario*. The analysis is underway and will be presented for public comment at a December 2022 workshop. Forecast results will be included in the final draft of the *2022 IEPR Update*.

Exploring Emerging Topics

Emerging topics in the *2022 IEPR Update* include important developments and updates on longer-term analyses that extend beyond the annual IEPR cycle.

Energy Reliability

Since the heat event in August 2020 that led to rotating power outages, the CEC, California Public Utilities Commission (CPUC), and California Independent System Operator (California ISO) have been working diligently to better prepare the state for the accelerated impacts of climate change. Despite the focused effort to address energy reliability in 2021, risks persisted in 2022. The state continued to experience an extreme drought, supply chain issues, and wildfires that threatened the grid. The greatest reliability concerns are during the *net peak* (hours when energy demand minus wind and solar generation is largest). The net peak occurs after the highest demand (gross peak) when solar generation rapidly declines at the end of the day, and extends concern for meeting electricity demand until 4:00 p.m. to 9:00 p.m.

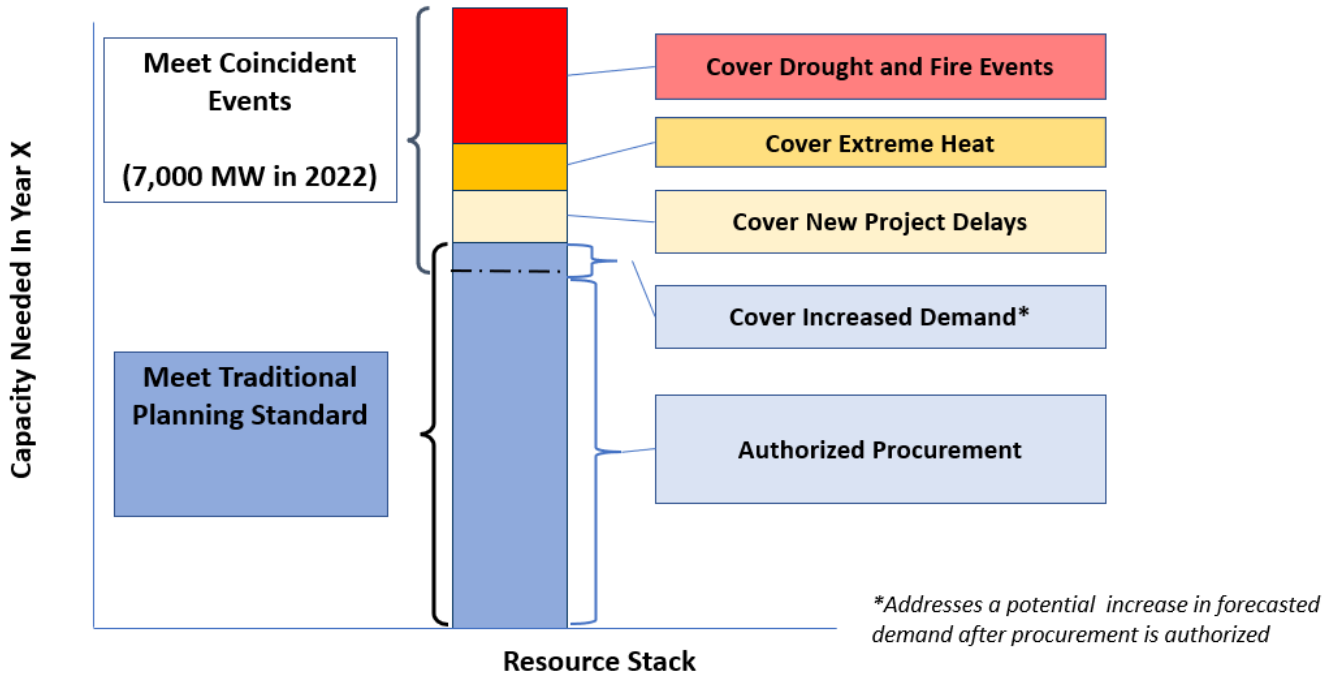
For summer 2022, the CEC and California ISO conducted an analysis that factored in large and rapid changes in supply and demand from climate change to estimate capacity needs (shown illustratively in Figure ES-2). The analysis was founded on an estimate of traditional planning requirements. Layered on top of that, the analysis estimated the potential need for further resources in the event of:

- Demand increases that may occur, due to economic or climate factors changing, after procurement is ordered (identified as a potential lag).
- Delays in on-line dates of authorized procurement under development due to issues such as supply chain problems.
- Extreme heat similar to August 2020.
- Drought (that reduces hydroelectric availability) and fire events (that threaten electricity infrastructure).

Assuming all these factors are realized, the analysis anticipated a potential shortfall of 7,000 megawatts (MW) in 2022, growing to 10,000 MW in 2025. This analysis guided the development of the Governor's May Revise of the state budget to propose a Strategy Electric Reliability Reserve (SRR) to support energy emergencies. Assembly Bill 205 (Committee on Budget, Chapter 61, Statutes of 2022) established the SRR to support grid reliability for the state and to provide additional emergency resources during extreme events.

The extreme heat event over the ten-day period from August 31 through September 9, 2022, set all-time high temperature records throughout the state and triggered the highest peak load recorded by the California ISO. On August 31, Governor Newsom issued an emergency proclamation that enabled multiple initiatives to be deployed, including those authorized by AB 205. While the AB 205 programs are in infancy, they helped meet the record demand experienced in September 2022. Californians also met the challenge and reduced their load during the critical net peak hours (between 4 p.m. and 9 p.m.) in response to FlexAlerts and a wireless emergency alert. All these efforts and more helped keep the power flowing and the lights on. A detailed analysis of the crises is underway.

Figure ES-2: Illustrative Analysis: Supplemental Electricity Capacity Needed



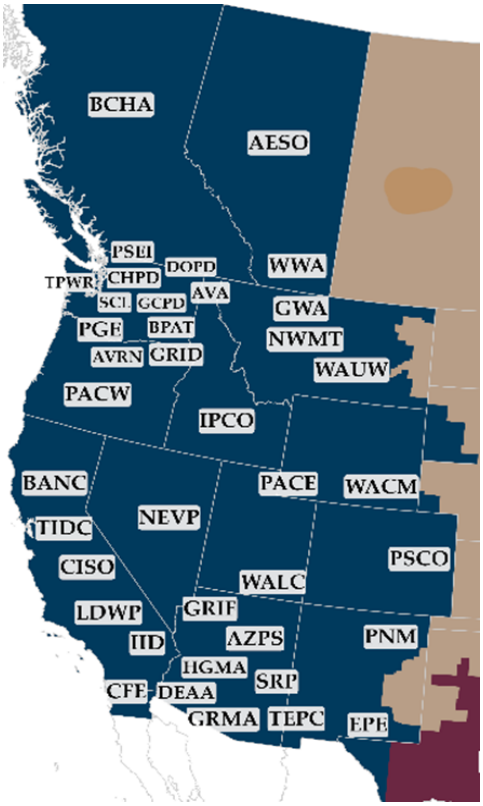
Source: CEC staff

Given concerns about energy reliability, Senate Bill 846 (Dodd, Chapter 239, Statutes of 2022) preserves the option to extend operation of the Diablo Canyon nuclear power plant, which serves about 6 percent of California's electricity, for five years beyond the 2025 retirement date. The statute also directs the CEC to develop a cost comparison by September 30, 2023, of implementing portfolios of alternative clean energy resources to keeping Diablo Canyon operating and any alternatives.

Western Electricity Integration

California's electricity system and energy reliability are part of a much larger whole — the Western Interconnection. The Western Interconnection includes electricity infrastructure in 11 western states, two Canadian provinces, and portions of Mexico and 34 independent balancing authorities that are governed by states and provinces, public boards, and the federal government (Figure ES-3). Coordination among these widely varied entities is complex but can yield tremendous benefits as realized by the Western Energy Imbalance Market (WEIM), a forum for real-time energy trading to balance energy supply and demand. Since its inception in 2014, California ISO analysis shows that the WEIM has created more than $2 billion in gross benefits and saved 700,000 metric tons of GHG emissions. Building on the success of the WEIM, the Extended Day-Ahead Market, or EDAM, is a proposal to coordinate energy scheduling in the Western Interconnection up to a day ahead rather than 5 to 15 minutes ahead. EDAM holds the potential for significantly greater benefits than the WEIM and is spurring further market coordination efforts.

Figure ES-3: Western Interconnection Balancing Authorities



Source: Western Electricity Coordinating Council

There is also a growing interest in coordinating reliability efforts and resource adequacy planning, given the weather extremes of a rapidly changing climate and changes in the resource mix to shift away from fossil fuels. Further, westwide coordination is key to developing the transmission lines needed for California to access renewable resources in other states and within California. The California ISO's *20-Year Transmission Outlook* anticipates that new transmission, beyond current planned projects, is needed to connect about 4,000 megawatts of out-of-state wind capacity into California.

The Role of Hydrogen in California's Clean Energy Future

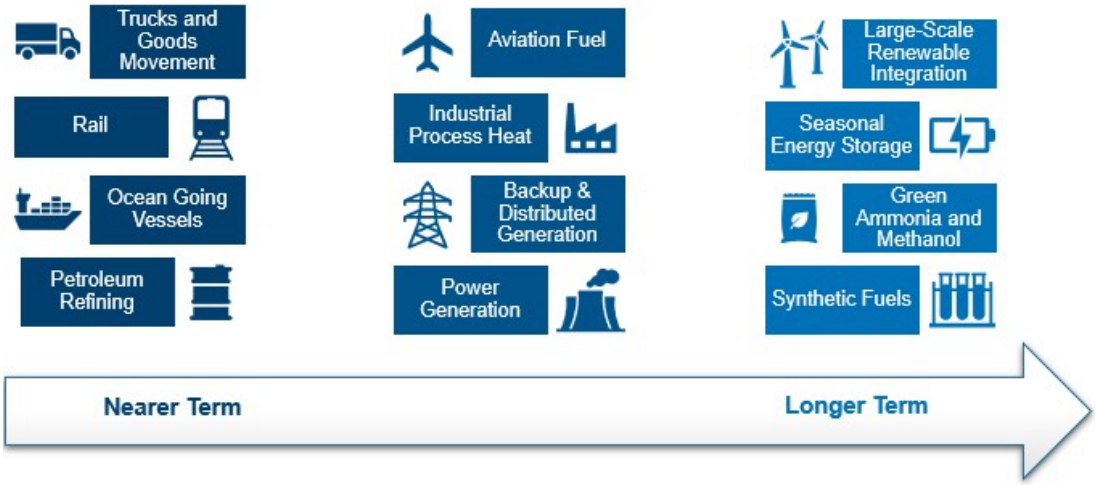
Hydrogen holds promise in playing important roles in California's clean energy future. Already, hydrogen is widely used in California and around the world in petroleum refining, and in smaller quantities in a variety of industrial uses, including fertilizer production, food processing, and treating metals. The California Air Resources Board's (CARB's) *Draft 2022 Scoping Plan Update* envisions a scenario in which a new industry producing low-carbon hydrogen will help decarbonize the transportation, buildings, and industrial sectors. In this scenario, production of low-carbon hydrogen would potentially increase by 60-fold and exceed by 70 percent that produced today using fossil fuels, primarily for petroleum refining. Barriers include higher production costs and the need to quickly develop large-scale hydrogen production plants in coordination with new renewable energy resources for use in production. Further, the state would need to address limits to the hydrogen concentration that can be blended in existing gas pipelines or the need for dedicated hydrogen pipelines and other distribution and storage infrastructure. Hydrogen is a climate pollutant, has a higher

diffusivity than fossil gas, and causes steel brittleness, so it will be important to minimize leakage for climate, safety, and economic reasons. Also, emissions of oxides of nitrogen from hydrogen combustion need to be controlled.

Today, hydrogen is almost exclusively produced from fossil fuels through steam methane reformation (SMR), in which methane molecules (a GHG) are split to extract hydrogen with carbon dioxide (another GHG) as a by-product. Using hydrogen to support California's clean energy future requires production using biomethane instead of fossil-based methane in SMR or using renewable electricity to split hydrogen from water molecules (electrolysis), resulting in low- or zero-carbon hydrogen. The *Draft 2022 Scoping Plan Update* also identifies pairing SMR with carbon capture, utilization, and storage (CCUS) as another potential near-term tool for reducing emissions until hydrogen production using electrolysis with renewables or other low-carbon processes can meet demand. However it is produced, hydrogen has a higher diffusivity than fossil gas and causes steel brittleness, so it will be important to minimize leakage for climate, safety, and economic reasons.

CEC staff identified hard-to-electrify industrial processes, transportation, and grid reliability as key areas with a high potential for increased use of low-carbon hydrogen made directly from renewable resources. Other opportunities include use as a replacement for fossil-fuel based hydrogen used in refineries — while the state phases out oil refining as it electrifies the transportation system — and in the production of chemicals such as ammonia for fertilizer production. (See Figure ES-4.)

Figure ES-4: Simplified Representation of Nearer and Longer-Term Opportunities for Hydrogen Decarbonization



Source: CEC staff

California's Fiscal Year 2022–2023 budget includes $100 million toward establishing a "hydrogen program" to provide financial incentives to in-state low-carbon hydrogen projects through electrolysis of water or reformation of biofuels using renewable energy. Further, California is competing in the $6–7 billion federal "Regional Clean Hydrogen Hubs" program to "create networks of hydrogen producers, consumers, and local connective infrastructure to accelerate the use of hydrogen as a clean energy carrier."

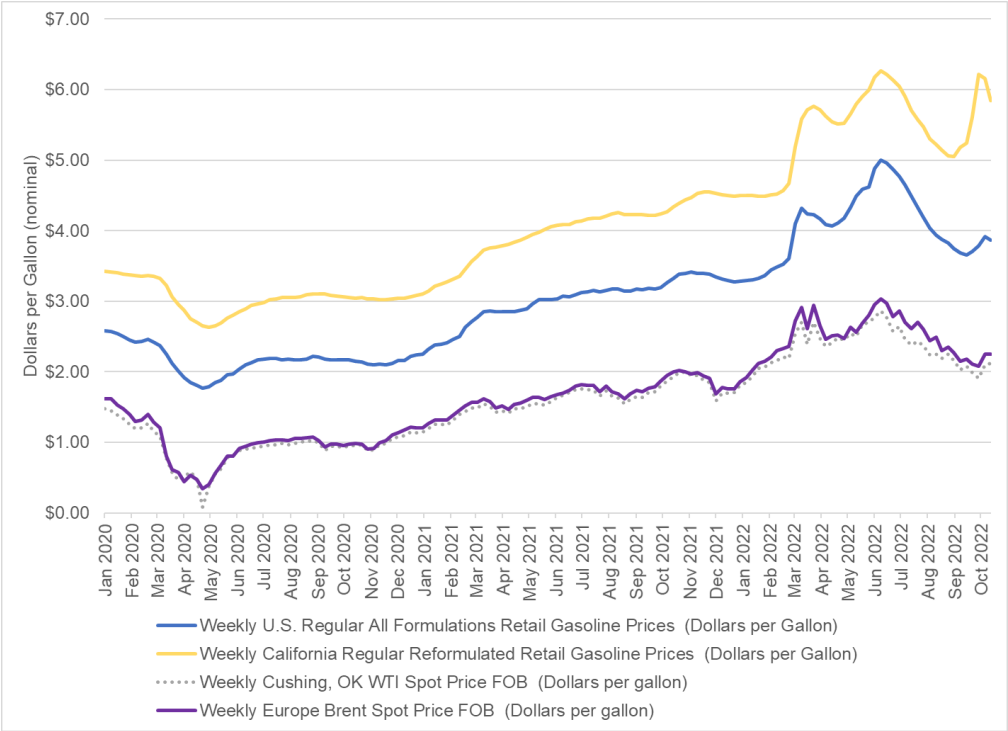
Transparency and accountability in public hydrogen investment could be furthered by clear policy that sets milestones for scaling up production of a low-carbon hydrogen. Also, policy makers and the public need a better way to assess the potential benefits and costs of using hydrogen as a decarbonization solution. A standard, well-defined taxonomy (or classification) that enables this type of assessment will allow for better informed decisions about investments in hydrogen. SB 1075 (Skinner, Chapter 363, Statutes of 2022) requires CARB, in consultation with the CEC and CPUC, to prepare an evaluation on the development, deployment, and use of hydrogen to develop a path forward for hydrogen development by June 1, 2024.

High Gasoline Prices

California's high gasoline prices were a top household concern in 2022, affecting businesses and consumers, with a disproportionate burden on low-income consumers. CEC analysis shows that California gasoline prices historically have roughly tracked global crude oil prices (Figure ES-5), which increased in the spring and summer of 2022 as global supplies became constrained due to Russia's invasion of Ukraine. The historical price premium for gasoline in California has been largely attributable to:

- Bigger price spikes related to unplanned refinery outages in California's isolated gasoline market and higher refinery cost and profit margins.
- Higher production costs for the least-polluting gasoline in the United States.
- Dependence on more expensive foreign and Alaskan crude oil sources than states with greater access to less expensive shale oil and discounted Canadian crude oil.
- Fees for environmental programs.
- Greater tax burden for gasoline in California.
- Higher distribution costs and retail margins, a relatively small factor.

Figure ES-5: California Gasoline Prices Historically Tracked National Retail and Crude Oil Price Trends



Data Source: CEC analysis of U.S. EIA data

Price increases in 2022 spurred the development of the Assembly Select Committee on Gasoline Supply and Pricing to conduct hearings on California's record high gasoline prices. On October 4, 2022, gas prices in California diverged from national prices by a record $2.61 per gallon — nearly a dollar per gallon higher than the previous record set in March 2022 — while oil refineries realized exceedingly high profits. The CEC will hold an informational hearing on November 29, 2022, to better understand why prices spiked and to identify solutions for avoiding future price spikes. The CEC will continue to support the Governor's Office and Assembly with expert analysis into the gasoline market.

Transitioning From Fossil Gas and Advancing Distributed Energy Resources

Recognizing that the challenges of rapidly transforming California's energy system require analysis and stakeholder engagement that do not necessarily align with the annual IEPR cycle, the CEC launched two proceedings in 2022 — one on distributed energy resources and a second on gas decarbonization. The CPUC has its own proceedings on both topics, and the agencies are working closely to advance California's goals to avoid duplicating efforts. In September 2022, the CPUC made a decisive step toward reducing GHG emissions and saving ratepayer money by eliminating subsidies for gas hookups to serve new buildings.

CHAPTER 1:
Embedding Equity and Environmental Justice at the California Energy Commission

Introduction

The year 2022 marks the first year that equity and environmental justice have been the primary focus of an IEPR proceeding. The California Energy Commission (CEC) is committed to prioritizing equity and environmental justice in programs, policies, and operations as it strives toward a 100 percent clean energy future. The CEC's vision of working with state partners to create the energy system of the future — one that is clean, affordable, modern, reliable, and ensures our economy continues to thrive — is a vision for *all* Californians to live with dignity and achieve prosperity. Without the participation of *all* Californians the state cannot achieve its energy and climate action goals.

California's clean energy transition provides an opportunity to learn and acknowledge how and where energy challenges exist. It also allows for implementing policies and programs that ensure those who have suffered the most from historical environmental injustices, economic disparities, racial inequities, and the current climate crisis — like California Native American tribes who have been targets of displacement and genocide or immigrants and people of color who suffered discriminatory redlining[1] practices — receive the benefits of strategic investments and transformational change to our energy system.

This chapter includes a summary of the historical context of inequity and environmental injustice as noted by peer agencies and presented by experts during CEC's regional IEPR workshops. It also discusses the California for All vision in the context of equity and the environment and provides an overview of the CEC's past and present actions to advance equity and environmental justice and a summary of the approaches taken during the 2022 IEPR Update process to inform those efforts moving forward.

Historical Context of Inequity and Environmental Injustice

Recognizing actions of the past is vital to understanding current challenges and disparate impacts and, more importantly, to developing solutions to ensure a better future. As Silvia Paz, Executive Director at Alianza — a community-based organization in the Salton Sea region —

1 *Redlining* refers to the government practice of designating some neighborhoods as hazardous to investments, thus denying the predominantly minority and low-income residents access to loans or investment.

stated at the June 29, 2022, IEPR workshop, equity and environmental justice are hard because things were not done correctly in the past.[2] State agencies are acknowledging past harms and addressing inequities and injustices head on through resolutions, action plans, and other efforts.[3]

It has been stated by peer agencies that, "[i]n California, race predicts a person's access to governmental services and the quality and affordability of the services they receive."[4] One of the first examples of inequity and injustice was against California Native American tribes. As Governor Gavin Newsom's Executive Order N-15-19 explains:

> "In the early decades of California's statehood, the relationship between the State of California and California Native Americans was fraught with violence, exploitation, dispossession, and the attempted destruction of tribal communities."[5]

As summed up by California's first Governor, Peter Burnett, in his 1851 address to the Legislature: "[a] war of extermination will continue to be waged between the two races until the Indian race becomes extinct must be expected."[6] In 2019, Governor Newsom's Executive Order N-15-19 states that, "the State of California's laws and policies discriminating against Native Americans and denying the existence of tribal government powers persisted well into the twentieth century."[7] In its Resolution number 2021-0050, the State Water Resources Control Board noted:

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2 Comments from Silvia Paz with Alianza at the June 29, 2022, IEPR Workshop on Centering Equity and Environmental Justice in CEC Efforts. The transcript is available at https://efiling.energy.ca.gov/GetDocument.aspx?tn=246201.

3 California Strategic Growth Council. August 26, 2020. "California Strategic Growth Council Passes Racial Equity Resolution." https://sgc.ca.gov/news/2020/08-26.html.

State Water Resources Control Board. November 16, 2021. Resolution No. 2021-0050: Condemning Racism, Xenophobia, Bigotry, and Racial Injustice and Strengthening Commitment to Racial Equity, Diversity, Inclusion, Access, and Anti-Racism. https://www.waterboards.ca.gov/board_decisions/adopted_orders/resolutions/2021/rs2021_0050.pdf.

4 State Water Resources Control Board. November 16, 2021. Resolution No. 2021-0050: Condemning Racism, Xenophobia, Bigotry, and Racial Injustice and Strengthening Commitment to Racial Equity, Diversity, Inclusion, Access, and Anti-Racism. https://www.waterboards.ca.gov/board_decisions/adopted_orders/resolutions/2021/rs2021_0050.pdf.

5 Governor Newsom. Executive Order N-15-19. June 18, 2019. https://tribalaffairs.ca.gov/wp-content/uploads/sites/10/2020/02/Executive-Order-N-15-19.pdf.

6 Former Governor Peter Burnett. January 6, 1851. State of the State Address. https://governors.library.ca.gov/addresses/s_01-Burnett2.html.

7 Ibid.

> "As a result, California Native American [t]ribes continue to face barriers to defining, quantifying, accessing, protecting, and controlling their ancestral lands, water rights, instream flows, cultural resources, and beneficial uses."[8]

Early governmental policies, redlining practices, and racial segregation also shaped energy and environmental planning and development throughout California, leading to disproportionate pollution burden in communities based on race.[9] As was discussed in the Pollution and Prejudice presentation at the August 31, 2022, IEPR workshop,[10] redlining maps were created by the Home Owners' Loan Corporation beginning in the 1930s to evaluate mortgage lending risk, using race and environmental factors as risk criteria.

The California Environmental Protection Agency's (CalEPA) Pollution and Prejudice story map[11] tells how redlining and racist land use practices led to environmental injustices such as the siting of polluting industries, waste facilities, freeways, and power plants in communities of color, resulting in health impacts, and further exacerbating economic disparities and social inequities.

The CalEnviroScreen tool,[12] used by state agencies for planning and policy, identifies disadvantaged communities on the basis of pollution burden, population characteristics, environmental effects, and socioeconomic factors. Overlaid, the historical redlining maps, ranging from red for least desirable or "hazardous" to green for most desirable or "best," correlate to present day disadvantaged communities in CalEnviroScreen, with red being the most pollution-burdened to dark green as the least pollution-burdened (see Figure 1). Today,

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8 State Water Resources Control Board. November 16, 2021. Resolution No. 2021-0050: Condemning Racism, Xenophobia, Bigotry, and Racial Injustice and Strengthening Commitment to Racial Equity, Diversity, Inclusion, Access, and Anti-Racism. https://www.waterboards.ca.gov/board_decisions/adopted_orders/resolutions/2021/rs2021_0050.pdf.

9 Ibid.

California Department of Water Resources. 2022. *Racial Equity Action Plan*. https://water.ca.gov/-/media/DWR-Website/Web-Pages/About/Files/DWR-REAP-06142022-FINAL_ay11.pdf.

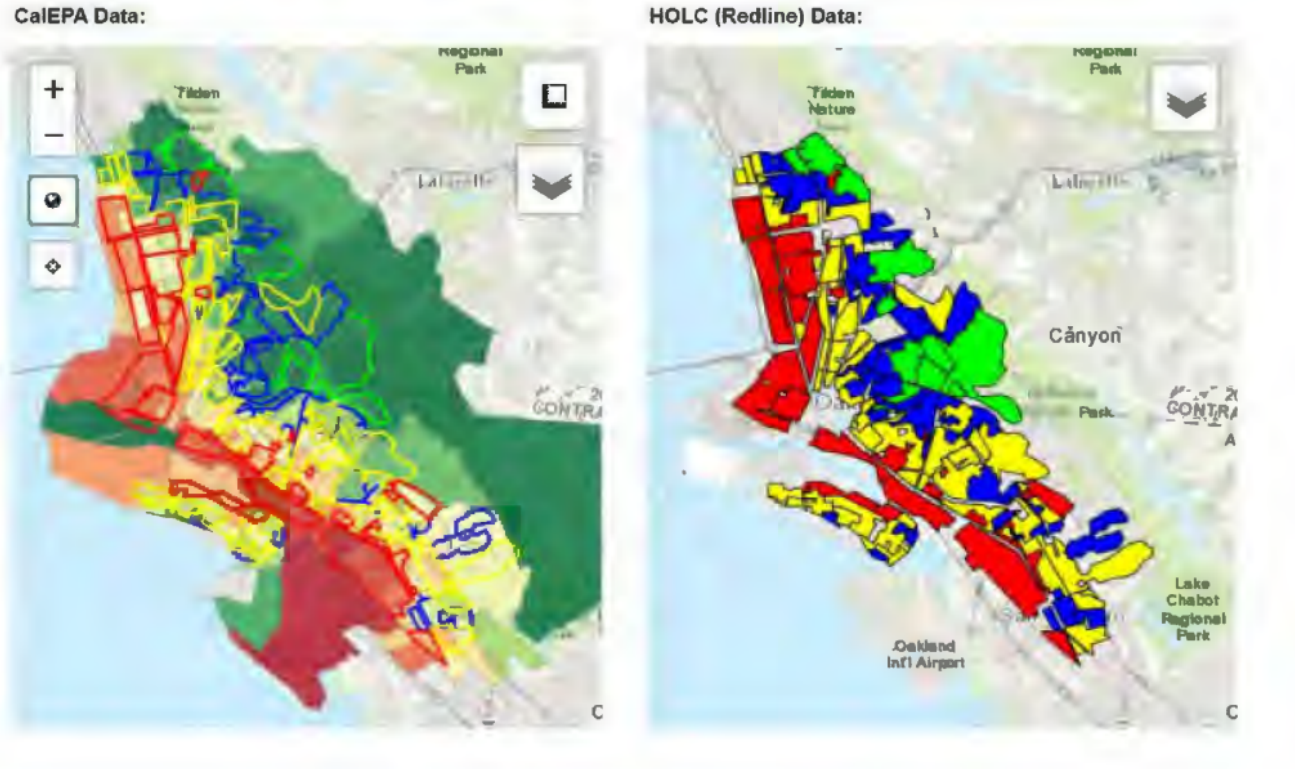
10 Presentation by Kevin Olp, Jennifer McGovern, and Jaimie Huynh, "Pollution and Prejudice," at the August 31, 2022, IEPR workshop on Centering Equity and Environmental Justice Throughout CEC Efforts. https://efiling.energy.ca.gov/GetDocument.aspx?tn=245728.

11 CalEPA. 2021. *Pollution and Prejudice: Redlining and Environmental Injustice in California*. https://storymaps.arcgis.com/stories/f167b251809c43778a2f9f040f43d2f5.

12 California Office of Environmental Health Hazard Assessment. CalEnviroScreen webpage, https://oehha.ca.gov/calenviroscreen.

the top 10 percent most polluted neighborhoods in California have 90 percent people of color.[13]

Figure 1: Comparison of CalEnviroScreen Scores to Redline Maps



Credit: CalEPA

While the state is transitioning to a clean energy future, many Californians are still burdened by the polluting energy system of the past and present and lack equitable access to clean, affordable, and reliable energy. As Lori Pesante with the Dolores Huerta Foundation emphasized at the July 20, 2022, IEPR workshop, we have been historically extractive in nature, extractive from our people, from our land, and from our resources.[14]

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13 California Office of Environmental Health Hazard Assessment. October 2021. "Analysis of Race/Ethnicity and CalEnviroScreen 4.0 Scores." https://oehha.ca.gov/media/downloads/calenviroscreen/document/calenviroscreen40raceanalysisf2021.pdf. (See Figure 2 on page 3.)

14 Comments from Lori Pesante at the July 20, 2022, IEPR workshop on Centering Equity and Environmental Justice Throughout CEC Efforts. A recording of the morning session is available at

Often, these same communities are facing increasing climate vulnerabilities (such as extreme heat and drought) exacerbated by existing inequities. During a discussion at the June 29, 2022, IEPR workshop, promotores[15] who served as panelists shared that a crisis like the pandemic makes people realize the importance of energy and how it can be taken for granted. During the pandemic, promotores were in demand, but they had difficulty reaching the community due to the dearth of lighting, no energy storage back up, and multiple power outages, impeding their ability to walk around safely in the evenings to get from place to place. Workshop participants emphasized that these practices of the past create systemic issues that need to be addressed in parallel to addressing energy challenges; when a state agency goes to a community to address one issue, the community informs them of many other problems that need solving.

At the June 29, 2022, IEPR workshop, Dr. Manuel Pastor suggested that the crises we face of climate change, inequality, and challenges in a multiracial democracy are a failure to recognize the *commons*.[16] *Solidarity Economics: Why Mutuality and Movements Matter*, a book by Chris Benner and Dr. Pastor, offers a new framework that is built on mutuality and movements, and seeks to nurture values of cooperation, reciprocity, altruism, and caring as opposed to

https://energy.zoom.us/rec/share/hXtKJ_Cp2P7wD0saO8o2k-LoX_21Q0117fG-sE_CizvyXlckwDpRBNC-xNHsf8Bo.ccHoK6lVi8NchDjR.

15 *Promotores* are community members who act as liaisons between their communities and health and social service providers. For more information on the promotores model, see the Vision y Compromiso webpage at https://visionycompromiso.org/who-we-are/who-are-promotores/.

Presentation by Maria Lemus with Vision y Compromiso, "Integrating the Promotora Community Transformational Model." June 29, 2022, IEPR Workshop on Centering Equity and Environmental Justice Throughout CEC Efforts. https://efiling.energy.ca.gov/GetDocument.aspx?tn=243767.

A recording of the workshop's afternoon session is available at https://energy.zoom.us/rec/share/ryDPnJk_ThN0TFMJzGe1HKp0KY2WJ5qZOD_0HaoqZMd6Iq842_tu5XNYSx8nF9Oh.Fg0xsrdEMaHaApgR.

16 In this context, the *commons* refers to natural resources that people manage for the benefit of individuals and the collective community. For more information on this economic concept, see *Governing the Commons: The Evolution of Institutions for Collective Action* by Elinor Ostrom. https://oehha.ca.gov/media/downloads/calenviroscreen/document/calenviroscreen40raceanalysisf2021.pdf.

Keynote address by Dr. Manuel Pastor with the University of Southern California at the June 29, 2022, IEPR Workshop on Centering Equity and Environmental Justice Throughout CEC Efforts. A recording of the morning session is available at https://energy.zoom.us/rec/share/hXtKJ_Cp2P7wD0saO8o2k-LoX_21Q0117fG-sE_CizvyXlckwDpRBNC-xNHsf8Bo.ccHoK6lVi8NchDjR.

individualistic and competitive values.[17] *Solidarity Economics* has three basic premises (1) mutuality is key to prosperity — it is *our* economy, not *the* economy, (2) we actually do better when we work and act together, especially against the climate threat that is common to all of us, and (3) because some people do benefit from current arrangements, social movements are crucial to generate change. This change will require difficult conversations, but we must lean into conflict and expect to feel uncomfortable to make progress.

The California for All Vision

In his January 2019 inaugural address, Governor Newsom offered a vision for the state rooted in a commitment to a "California for all" that makes bold and smart investments and policy shifts to broaden economic security and opportunity for Californians, especially those struggling to make ends meet.[18] Also in 2019, through Executive Order N-15-19, Governor Newsom issued an apology to California Native American tribes for "the many instances of violence, maltreatment, and neglect California inflicted on tribes" and established the Truth and Healing Council to begin the healing process.[19]

In September 2022, Governor Newsom strengthened the state's commitment to a "California for All" by issuing Executive Order N-16-22, directing state agencies and departments to design and deliver state programs to advance equity and address existing disparities in opportunities and outcomes so all Californians may reach their full potential.[20] The CEC, working closely with the California Natural Resources Agency (CNRA), is required to submit a strategic plan outlining additional actions to reflect the use of data analysis and inclusive practices to more effectively advance equity. The plan must also respond to identified disparities with changes to the CEC's mission, vision, goals, data, tools, policies, programs, operations, community engagement, tribal consultation policies and practices, and other actions with a focus on Californians who reside in communities that have historically been underserved and marginalized. Further, the CEC must describe actions to increase access to the grant or contract selection process for small business and disadvantaged business enterprises for all federal Infrastructure Investment and Jobs Act (IIJA) opportunities and

17 Benner, Chris, and Dr. Manuel Pastor. 2021. *Solidarity Economics: Why Mutuality and Movements Matter*. Polity Press. https://solidarityeconomics.org/se-book/#:~:text=With%20its%20focus%20on%20how,economy%20that%20works%20for%20all.%E2%80%9D.

18 Governor Gavin Newsom. January 7, 2019. Inaugural Address. https://www.gov.ca.gov/2019/01/07/newsom-inaugural-address/.

19 Executive Order N-15-19. June 18, 2019. https://tribalaffairs.ca.gov/wp-content/uploads/sites/10/2020/02/Executive-Order-N-15-19.pdf.

20 Executive Order N-16-22. September 13, 2022. https://www.gov.ca.gov/wp-content/uploads/2022/09/9.13.22-EO-N-16-22-Equity.pdf?emrc=c11513.

submit an action plan to meaningfully engage with tribes, nonprofits, and other community organizations to increase access to IIJA funding. Executive Order N-16-22 describes equity as:

> "Taking action to address existing disparities in opportunities and outcomes by designing and delivering services and programs, consistent with federal and state constitutional requirements, to address unequal starting points and drive equal outcomes so all Californians may reach their full potential and lead healthy and rewarding lives."[21]

The Legislature and Governor Newsom have also passed a sweeping set of legislative bills and funding allocations, called the California Climate Commitment, designed to transition California to a clean energy system, address impacts from climate change, and invest in the state's workforce and communities with an emphasis on equity and scale. The CEC will receive a significant amount of these funds to accelerate the clean energy transition. The state's vision aligns with key themes raised by workshop participants, including Dr. Pastor, who explained, "We should recognize the mutuality that actually drives our economy — and stress how mutuality, fairness, and inclusion can generate prosperity for many."[22]

CEC's History of Equity and Environmental Justice Efforts

Established in 1975 by the Warren-Alquist Act to respond to the energy crisis of the early 1970s, the CEC was created to lead the state to a more sustainable, reliable, and cleaner future. Since then, the CEC has taken many strides to improve the energy system for all Californians. The CEC established its first environmental justice policy to guide siting proceedings and ensure meaningful community awareness and engagement, including significant outreach, public participation opportunities, language services, and working with local government.[23] The CEC established its tribal program in 2011 in response to then Governor Brown's Executive Order B-10-11, emphasizing engagement and consultation with tribes that is done early, often, and meaningfully.[24] In 2015, the CEC adopted a resolution committing to improving fair and equal opportunities for disadvantaged communities and for

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21 Ibid.

22 Keynote address by Dr. Manuel Pastor with the University of Southern California at the June 29, 2022, IEPR Workshop on Centering Equity and Environmental Justice Throughout CEC Efforts. A recording of the morning session is available at https://energy.zoom.us/rec/share/hXtKJ_Cp2P7wD0saO8o2k-LoX_21Q0117fG-sE_CizvyXlckwDpRBNC-xNHsf8Bo.ccHoK6lVi8NchDjR.

23 Discussion with Shawn Pittard, former Director of the Siting Transmission and Environmental Protection Division, September 8, 2022.

24 Executive Order B-10-11. September 19, 2011. https://www.ca.gov/archive/gov39/2011/09/19/news17223/index.html.

small and diverse owned businesses to participate in and benefit from CEC programs and launched the annual diversity report in 2016 to track progress.[25]

California's leadership has continued to influence CEC efforts. Senate Bill 350 (De León, Chapter 547, Statutes of 2015) required the CEC to examine barriers that low-income and disadvantaged communities face when considering adopting clean energy measures. As part of this legislation, the CEC was tasked with identifying barriers and recommending solutions to increase access of low-income residents, including those in disadvantaged communities, to opportunities in energy efficiency and weatherization, as well as solar and other renewable generation. The CEC was also directed to address contracting opportunities for local small businesses in disadvantaged communities.

The CEC embarked on a robust engagement process that generated input from advocacy groups and residents of low-income and disadvantaged communities across the state. Published in 2016, the study,[26] identifies barriers hindering people and businesses in those communities from investing in, adopting, or taking advantage of clean energy technologies. The study includes a host of possible solutions and recommendations, including the creation of an advisory body for the CEC of representatives from disadvantaged communities and the Energy Equity Indicators tool (discussed further below) that the CEC is revisiting through the 2022 IEPR Update. Both were established in 2018.

The California Public Utilities Commission (CPUC) and the CEC jointly created the Disadvantaged Communities Advisory Group (DACAG)[27] to advise both agencies on how programs can effectively reach and benefit communities disproportionately burdened by pollution and socioeconomic challenges, including rural and tribal communities. The DACAG has been vital in providing input on an array of policies and programs and created an equity framework[28] that staff have used to assess benefits being generated by programs such as the Electric Program Investment Charge (EPIC) program. The DACAG has pressed both agencies

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25 CEC. Resolution Regarding Diversity Policy Statement. April 8, 2015. https://www.energy.ca.gov/sites/default/files/2020-07/diversity_policy_resolution_ada.pdf.

26 Scavo, Jordan, Suzanne Korosec, Esteban Guerrero, Bill Pennington, and Pamela Doughman. 2016. *Low-Income Barriers Study, Part A: Overcoming Barriers to Energy Efficiency and Renewables for Low-income Customers and Small Business Contracting Opportunities in Disadvantaged Communities.* California Energy Commission. Publication Number: CEC-300-2016-009-CMF. https://efiling.energy.ca.gov/getdocument.aspx?tn=214830.

27 DACAG webpage, https://www.energy.ca.gov/about/campaigns/equity-and-diversity/disadvantaged-communities-advisory-group.

28 DACAG. Equity Framework. https://www.energy.ca.gov/about/campaigns/equity-and-diversity/disadvantaged-communities-advisory-group.

to consider adopting its equity framework but neither has adopted it in full; instead, each agency has decided to create its own framework informed by the DACAG's equity framework.

Another resource that has expanded the CEC's outreach is Empower Innovation, a professional networking platform established in 2019 that helps everyone — including local governments, community-based organizations, small businesses, diverse business enterprises, and cleantech start-ups — identify funding and partnering opportunities to advance a clean energy future for all. It now has over 3,000 members. Assembly Bill 865 (Alejo, Chapter 583, Statutes of 2015) requires the CEC to develop and implement an outreach program that encourages the participation of certified women, minority, disabled veteran, and LGBT business enterprises in relevant programs and shall consider including them in capacity building activities. Empower Innovation supports the CEC's outreach efforts to enhance the inclusivity of its programs by cultivating a diverse network of stakeholders and curating valuable resources for advancing clean technologies.

The CEC's Siting, Transmission, and Environmental Protection Division works closely with the Office of the Public Advisor, Energy Equity, and Tribal Affairs to ensure meaningful public participation and tribal consultation in siting proceedings through strategic outreach efforts. The CEC Tribal Consultation Policy[29] outlines the CEC's commitment to meaningful tribal engagement to foster relationship building in recognition of the critical role of California Native American tribes in achieving a clean energy future and addressing climate change. In partnership with the Strategic Growth Council, the CEC funded the California Tribal Gap Analysis (CTGA)[30] to identify gaps and barriers to better support tribes in addressing their clean energy and climate priorities through CEC programs. The upcoming Tribal Climate Research Grant Program will enable the CEC to support tribes in accelerating clean technology adoption as a climate solution.[31]

The CEC has also made investments in tribes and disadvantaged and low-income communities through an array of grant programs. As of December 2021, the CEC had invested $1.1 billion, or 15 percent of its funds, through nine of its grant programs in projects located in disadvantaged communities throughout the state.[32]

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29 CEC. *Tribal Consultation Policy*. November 2021. https://www.energy.ca.gov/sites/default/files/2022-02/CEC-700-2022-001.pdf.

30 California Tribal Gap Analysis webpage, https://caltribalgapanalysis.org/.

31 For more information on the CEC's Tribal Program, see https://www.energy.ca.gov/programs-and-topics/programs/tribal-program.

32 Presentation by Noemí Gallardo at the August 10, 2022, CEC Business Meeting, "Diversity Report." https://efiling.energy.ca.gov/GetDocument.aspx?tn=244405.

One of the CEC's most robust grant programs is the EPIC program. Since being established in 2012, EPIC has expanded outreach and engagement with underrepresented groups and incorporated equity in its administration throughout the funding life cycle, far exceeding investments in low-income and disadvantaged communities as required by Assembly Bill 523 (Reyes, Chapter 523, Statutes of 2017).[33] The CEC has set a goal to have 25 percent of EPIC technology demonstration and deployment funding allocated to sites located in, and benefiting, disadvantaged communities and an additional 10 percent allocated to sites located in, and benefiting, low-income communities; however, as of 2021, the CEC is investing 67 percent in these communities, far exceeding its goals.[34] Equity considerations are integrated into the EPIC program's investment plan, community engagement and outreach, scoping of competitive solicitations and proposal scoring, agreement implementation, and evaluation of impacts and benefits.

In the clean transportation sphere, Senate Bill 1000 (Lara, Chapter 368, Statutes of 2018) requires the CEC to assess whether electric vehicle charging infrastructure is disproportionately deployed by population income level.[35] This assessment helps inform Clean Transportation Program investments to improve charging infrastructure access. In 2021, the CEC set a goal to provide more than 50 percent of Clean Transportation Program funds toward projects that benefit low-income and disadvantaged communities, to quantify benefits beyond where a project is located, and to continue to investigate new metrics to ensure these investments enhance equity within the state.

Recently established equity-centered funding programs, such as the Building Initiative for Low-Emissions Development (BUILD) Program,[36] enable the CEC to further support the state in advancing a "California for All" by ensuring equitable investments in clean energy and climate solutions. BUILD is a residential building decarbonization program that provides incentives and technical assistance to support the adoption of advanced building design and all-electric technologies in new, low-income all-electric homes. It encourages adoption of clean energy technologies in affordable housing developments, thereby improving access to clean energy for low-income Californians.

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33 CEC. 2020. EPIC Annual Report. https://www.energy.ca.gov/publications/2021/electric-program-investment-charge-2020-annual-report.

34 CEC. April 2022. "2021 EPIC Highlights." https://www.energy.ca.gov/sites/default/files/2022-05/CEC-500-2022-002-SUM.pdf.

35 For more information on the CEC's SB 1000 efforts, see https://www.energy.ca.gov/programs-and-topics/programs/clean-transportation-program/electric-vehicle-infrastructure.

36 CEC. BUILD program webpage, https://www.energy.ca.gov/programs-and-topics/programs/building-initiative-low-emissions-development-program.

Aside from focusing on programmatic and policy efforts, the CEC has also increased its focus on the CEC's workplace and workforce. In 2019, the CEC established the Justice Access Equity Diversity Inclusion (JAEDI) Initiative — formerly IDEA — as a comprehensive process to advance justice, access, equity, diversity, and inclusion, both in and outside the agency. The concept is similar to "reaping what you sow." To embed equity and environmental justice through programs and policies, there must also be a focus on the staff. The CEC is striving for a workforce that reflects the diversity of California and with a culture of belonging. When staff feel supported and can be themselves and work without barriers, they thrive. The aim is that by experiencing equity and justice first-hand and understanding what it means, staff and managers will be inspired to create more opportunities and better outcomes for all Californians.

Moving Forward

The CEC leveraged the 2022 IEPR Update proceeding to inform equity and environmental justice efforts moving forward by:

- Piloting a customized regional engagement process to take the IEPR to the people.
- Seeking input and conducting a literature review to develop and produce a comprehensive framework to further embed equity and environmental justice in CEC efforts.
- Revisiting the CEC's Energy Equity Indicators to obtain input and conduct a literature review to determine the future of the tool.

Regional Engagement

The CEC chose to apply a regional engagement approach for the three equity and environmental justice IEPR workshops. Staff used the Fourth Climate Change Assessment[37] regions to develop its own regional engagement map. Staff chose three regions — Inland Empire/Salton Sea, San Joaquin Valley, and Central Coast — to have one workshop located in each region. (See Figure 2 with regions outlined in red.)

37 *California's Fourth Climate Change Assessment*. 2019. https://www.energy.ca.gov/sites/default/files/2019-11/Statewide_Reports-SUM-CCCA4-2018-013_Statewide_Summary_Report_ADA.pdf.

Figure 2: IEPR Workshop and Regional Engagement Map

Credit: CEC's GIS Staff Travis David and Gabriel Blossom

The three regions selected for this pilot face significant pollution burden, climate vulnerabilities, and economic and social disparities based on disadvantaged community status under CalEnviroScreen 4.0.[38] The CEC is actively involved in initiatives in these regions, such as the Blue Ribbon Commission on Lithium Extraction in the Salton Sea area, reliability and gas transition in the San Joaquin Valley, and offshore wind development in the Central Coast.

38 California Office of Environmental Health Hazard Assessment. CalEnviroScreen webpage, https://oehha.ca.gov/calenviroscreen.

IEPR workshops on Centering Equity and Environmental Justice Throughout CEC Efforts have been held in Imperial County (https://www.energy.ca.gov/event/workshop/2022-06/iepr-commissioner-workshop-centering-equity-and-environmental-justice), San Joaquin Valley, (https://www.energy.ca.gov/event/workshop/2022-07/iepr-commissioner-workshop-centering-equity-and-environmental-justice), and Central Coast (https://www.energy.ca.gov/event/workshop/2022-08/iepr-commissioner-workshop-centering-equity-and-environmental-justice) regions.

The regional outreach concept began with reaching out to local leaders, including California Native American tribes, governmental entities, and community residents, in each region and partnering with them to codesign the workshops and select topics of regional importance. This allowed the CEC to hear directly about the unique local concerns, needs, and opportunities in each of the three regions visited. Local leaders were also able to inform the CEC about language assistance needed for each workshop. Spanish interpreting services were provided for each workshop and related materials were made available in Spanish to meet the needs of the substantial Spanish-speaking population in each workshop location. Regional engagement provided the opportunity to build relationships, experience the landscape, and better understand local conditions, including extreme heat. As well as IEPR workshops, CEC participants visited regional energy and workforce projects, met with tribes and local communities, and conducted other outreach activities. (See Appendix B.)

The regional IEPR workshops attracted local, state, and national leaders and experts as presenters and panelists, as well as robust public participation. Local public comments expressed appreciation for the effort that was made to hold IEPR workshops in their regions. They emphasized the importance of policy makers experiencing firsthand the energy needs and environmental impacts in different areas of California. As Tim Rainey explained during the July 20, 2022, IEPR workshop, the importance of this type of collaboration and experience can be defined as "epistemic regions."[39] Dr. Manuel Pastor and Chris Benner expanded on this idea at the June 29, 2022, IEPR workshop:

> "A shared vision in a region among key groups that have influence and power, community groups, government, of course, organized labor, industry, civic organizations and advocates, having a shared understanding and vision for where the region should be in five, ten, fifteen years, economically and socially, and when you have that, they wrote — they did studies all around the country — where you have that shared vision, you'll get greater economic equity."[40]

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39 *Epistemic regions* refer to having a true understanding of the region and its needs.

Remarks by Tim Rainey at the July 20, 2022, IEPR Workshop on Centering Equity and Environmental Justice Throughout CEC Efforts. A recording of the morning session is available at https://energy.zoom.us/rec/share/hXtKJ_Cp2P7wD0saO8o2k-LoX_21Q0117fG-sE_CizvyXlckwDpRBNC-xNHsf8Bo.ccHoK6lVi8NchDjR.

40 Keynote address by Dr. Manuel Pastor with the University of Southern California at the June 29, 2022, IEPR Workshop on Centering Equity and Environmental Justice Throughout CEC Efforts. A recording of the morning session is available at https://energy.zoom.us/rec/share/hXtKJ_Cp2P7wD0saO8o2k-LoX_21Q0117fG-sE_CizvyXlckwDpRBNC-xNHsf8Bo.ccHoK6lVi8NchDjR.

Public comments from other regions throughout the state expressed interest in being included in future engagement efforts.

Economic Opportunity and Workforce Focus

The July 20, 2022, IEPR workshop held in Bakersfield (located in the San Joaquin Valley) focused on economic opportunities and clean energy workforce efforts. Workshop presenters and panelists included CEC leadership and local, state, and federal level workforce experts.

Workshop participants and public comments emphasized several opportunities to support the clean energy workforce:

- California can create high quality, high road clean energy jobs for a California workforce at all technical and training levels.
- Collective bargaining is a key component for job quality, economic stability, health, and many other positive workforce impacts.
- The most impactful workforce training programs focus on transferrable skills, career development, and removing barriers for accessing training and educational opportunities.
- Workforce partnerships can foster a wider pool of trained, and available workers for evolving clean energy needs. Partners can include workforce training facilities, government agencies, community organizations, employers, community colleges, trainees/apprentices, and others.
- Creating more opportunities for small businesses, tribal enterprises, and diverse business enterprises is a pathway to developing local economic engines that stimulate the region.
- Local chambers of commerce seek opportunities to connect with the state about their members' homes and businesses that can greatly benefit from energy savings, technology adoption, and more infrastructure. These organizations have a wide reach and are trusted sources of information for their members.

Addressing Barriers through Technical Assistance and Engagement

The August 31, 2022, IEPR workshop held in Oxnard (located in the Central Coast) focused on addressing barriers to clean energy adoption and exploring approaches to providing effective technical assistance at the local level to accelerate the state's transition to a clean energy future for all. During that workshop, CPUC Commissioner Darcie Houck emphasized that the focus on equity and environmental justice through the IEPR, "is an important part of building a

just, and equitable future for everyone in California."[41] She explained that the CPUC formalized efforts to make energy affordability a core component of its decision making in August 2022 by requiring an analysis of the affordability impacts in any proceeding that raises revenue requirements by more than one percent for a utility, and in all general rate cases.[42] The CPUC and CEC will continue collaborating to reach out to tribes, communities, and governmental entities on efforts to embed equity and environmental justice in each agency's efforts.

Panelists emphasized the importance of collaboration at the local level among tribes, local governments, community-based organizations, and trusted energy partners to develop projects that provide resilient clean energy, greater economic opportunity, and benefits to the local community. Peter Alstone of Cal Poly Humboldt presented on a Energy Tech Hub concept for tribal, rural, disadvantaged, and hard-to-reach communities that could increase engagement in policymaking and program design, provide effective technical assistance, and support education and jobs for just energy transitions.[43] The Energy Tech Hub concept would address the primary recommendations from the California Tribal Gap Analysis to improve tribal engagement, increase participation in state programs, and build capacity for tribes while also serving broader community energy needs and enhancing local partnerships and energy initiatives.

At all three regional IEPR workshops, and especially during the Oxnard workshop, the CEC received considerable feedback on the continued need for community engagement on policy and funding decisions. In community engagement discussions and in public comments, several key themes emerged:

- **Participation by all** — California will not achieve its climate and energy goals without the participation of all Californians. Tribal, disadvantaged, low-income, and other communities are critical to, and want to be part of, the clean energy transition.

41 Comments by CPUC Commissioner Darcie Houck at the August 31, 2022, IEPR Workshop on Centering Equity and Environmental Justice Throughout CEC Efforts. Workshop recording is available at https://energy.zoom.us/rec/play/2kgdrYkQ9I5mf6FcHrxph6S32h17la62ck1IacWl633-Gk82QFmgGBrtQsHzNMt80nM_2L--sGvP24RP.WhhI46QdqMgQhfPR?continueMode=true&_x_zm_rtaid=__mOwxQxQtCZAYykpTEgJw.1667862003743.1328081b56b5b2fb181b1dfe6cfa9fbd&_x_zm_rhtaid=911.

42 CPUC. Decision Implementing the Affordability Metrics. August 9, 2022. Decision 22-08-023. Rulemaking 18-07-006. https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M496/K428/496428621.PDF.

43 Presentation by Peter Alstone, "Technical Assistance for Resilient Communities." August 31, 2022, IEPR Workshop on Centering Equity and Environmental Justice Throughout CEC Efforts. https://efiling.energy.ca.gov/GetDocument.aspx?tn=245745.

- **Early and often** — Engagement is most effective when initiated early and done often. This approach is not only more efficient for program and policy development; it also improves outcomes.
- **Communities know best** — Communities are best situated to determine their needs and wants. Communities are interested in energy and nonenergy benefits from CEC programs and policies such as energy resiliency, lower utility bills, quality jobs, clean energy infrastructure, and more. Consider leveraging learnings from other outreach efforts and codeveloped policies so as not to burden communities with repeated requests for similar feedback.
- **Words matter** — The state has many terms and definitions that refer to similar or overlapping equity communities such as *disadvantaged*, *frontline*, *priority*, and *environmental justice communities*. Workshop discussions and public comment noted that uniform and transparent definitions where possible would be helpful. Most comments that mentioned "disadvantaged" and "underserved" indicated that these terms are not preferred because they make communities seem deficient, dependent, and powerless. Some comments stated that "priority communities" was vague and unclear what the priority was about. Others mentioned the extensive use in the San Diego area of "communities of concern."
- **More targeted, customized resources are needed** — California's communities have diverse needs and capacities. Uniform statewide funding and other programs do not always reach their intended beneficiaries. Many tribes, community-based organizations, and advocates that raise and represent community interests are under-resourced, which impacts their ability to both engage and participate in state programs.
    - **Engagement** — State agencies, such as the CEC, rely on community-based organizations and advocates for expertise and feedback in developing and implementing effective programs. Less effective community engagement means less effective state programs.
    - **Participation** — Statewide programs are most effective when there is a diverse broad-reaching applicant pool and participant base. Communities note that they are often not able to participate in valuable statewide funding opportunities due to a lack of resources and technical knowledge to learn about opportunities and apply for them.
    - **Access** — Workshop participants and other residents indicated a need for more support accessing proceedings and events, in the form of food during meetings, especially when events are half-day or full-day. Also noted was the need for childcare services at events to ensure their children can attend with them and allow participants to concentrate on the substance of the event.

To improve their ability to effectively represent community interests at the state level, tribes, community-based organizations, advocates, and their partners note that long-term, sustained, system level funding is needed. Communities have the desire to create change from within — sometimes transformational changes for their communities. Advocates asked the CEC to target funding programs to under-resourced community needs and also asked that funding and staff

be allocated toward technical assistance to bridge the resource gap and allow more communities to engage with and participate in CEC programs.

Developing Tools

Silvia Paz, during the first IEPR workshop, stated that "every project is an opportunity to improve someone's life." It is with that and other input provided through the three regional IEPR workshops that confirms that the CEC should develop a framework to guide equity and environmental justice efforts and refresh the existing Energy Equity Indicators tool (discussed below). These tools are in the early development stage and will be further formulated and finalized through an iterative public engagement process that will extend beyond the *2022 IEPR Update*. In September 2022, during the drafting of the *2022 IEPR Update*, Governor Newsom issued an Executive Order directing all state agencies to develop and submit action plans to embed equity in all efforts. The action plan developed by CEC will be another tool to advance the agency's work.

Framework to Embed Justice Access Equity Diversity and Inclusion (JAEDI)

Over its history, the CEC has endeavored to prioritize equity in its activities but has not adopted a comprehensive framework or other overarching strategies to align the CEC's policies, programs, investments, and practices with equity and environmental justice at the forefront. The 2015 Resolution of the Diversity Commitment memorialized, within a narrow scope, a commitment to provide opportunities and increase participation of economically disadvantaged communities and small and diverse business enterprises. The CEC's draft JAEDI framework (see Appendix A) takes this a step further.

It outlines the CEC's vision, values, and best practices to advance equity in California's energy system. It will serve as the central ethos for the CEC's work across all divisions and will be the starting point to guide staff as they design policy, programs, and projects, which should all aim to center equity and environmental justice. The JAEDI framework contains considerations that staff can use to stimulate ideas about what types of questions to ask to prepare for engagement work and can also be included in their work. The considerations can be used to evaluate the work completed and assess whether equity was prioritized and help staff consider what to do better in the future. The JAEDI framework honors the work of environmental justice groups and incorporates the principles and best practices outlined in other sources of scholarship and literature focused on equity and environmental justice, including The Jemez Principles,[44] the California Environmental Justice Alliance (CEJA) Environmental Justice

44 For more information on the Jemez Principles, see https://www.ejnet.org/ej/jemez.pdf.

Principles,[45] and the Disadvantaged Community Advisory Group (DACAG) Equity Framework.[46] It also incorporates the values, principles, and practices CEC staff has learned from internal experience, peer agencies, and at tribal and community engagement sessions during regional workshops.

The draft JAEDI Framework is a repository for new terms and a shared language for conversations around equity within the CEC as well as externally. It outlines the principles to embed equity in programs and policies across the entire organization and describes specific best practices related to process, benefits, access, decision-making, evaluation, accountability. Development and adoption of the draft framework will include additional input from tribes and communities.

The draft framework, in combination with other tools, aims to provide:

- Guidance for CEC leadership, divisions, and offices on how to prioritize equity and environmental justice in tribal and stakeholder engagement, regulatory decision-making, program development and implementation, investment decisions, policy analysis, and other practices.
- Baseline definitions for terms used by the CEC, including energy equity and the processes to be employed, along with benefits, nonenergy considerations, and social costs.
- Recommendations for an outreach and engagement approach, improvements for existing efforts, and ways to create an action plan for future activities.

Further, the CEC will develop an equity action plan that will outline the concrete actions the CEC will take on priority efforts. It will align with Governor Newsom's Executive Order N-16-22 to reflect the use of data analysis and inclusive practices to advance equity more effectively into the CEC's work, by embedding concrete steps to address existing disparities in opportunities and outcomes in CEC's policies and programs.[47] The timeline for this work is under development.

Reworking the Energy Equity Indicators

As noted above, the report developed by the CEC in response to Senate Bill 350, the *Barriers* Study included a recommendation that the CEC develop a series of "energy equity indicators."

45 For more information on the CEJA Environmental Justice Principles, see https://ceja-action.org/ej-decision-maker/ej-principles/.

46 DACAG. Equity Framework. https://efiling.energy.ca.gov/GetDocument.aspx?tn=224742.

47 Executive Order N-16-22. September 13, 2022. https://www.gov.ca.gov/wp-content/uploads/2022/09/9.13.22-EO-N-16-22-Equity.pdf?emrc=c11513.

Subsequently, the CEC developed Energy Equity Indicators in 2018 to identify opportunities and track progress of implementing recommendations in the *Barriers Study*. The data in the Energy Equity Indicators has not been updated since its creation and the tool is used infrequently. As part of this IEPR, the CEC explored whether to invest resources to update or otherwise revise the Energy Equity Indicators.

The goals of Energy Equity Indicators were to:

- Identify opportunities to improve access to clean energy technologies for low-income customers and disadvantaged communities.
- Increase clean energy investment in those communities.
- Improve community resilience to grid outages and extreme events.

The Energy Equity Indicators consisted of nine key subfields within the overall topic of energy equity, along with relevant data, recommendations, and past achievements. The nine 2018 Energy Equity Indicators cover the following topics: high energy bills, energy efficiency (broken down into savings and amount invested/number served), rooftop solar systems, zero-emission vehicles, abatement of health and safety issues, energy resilience, clean energy jobs, small business contracts, and the amount invested in innovation. As a follow-up to the *Barriers Study*, the CEC issued the Energy Equity Indicators Tracking Progress Report,[48] which provided metrics for each of the equity indicators, as well an assessment of the state's progress in achieving its energy equity objectives.

Opportunity to Revisit and Revitalize Energy Equity Indicators

Developments to California's energy system since the CEC developed the indicators in 2018 include the expansion of public safety power shutoffs, improved data availability, the centering of the CEC as the state's energy data repository, expanded funding opportunities, and the heightened importance of an equitable clean energy transition. Also, while there have been steps taken to advance equity on most of the topics covered by the indicators, they have been sporadic and piecemeal rather than systematic and comprehensive. As such, there is an opportunity to update the indicators, assess any shifts in energy equity, and use the analysis to inform the CEC's efforts to embed energy equity in its work. Updating the energy equity indicators would also provide an opportunity to connect with the public and partners and to leverage the CEC's access to new data and analytical tools. This effort to revisit and revitalize is timely given Governor Newsom's directive to determine gaps and set goals in all state agencies' strategic plans.

48 CEC. *Energy Equity Indicators Tracking Progress Report*. June 25, 2018. https://www.energy.ca.gov/sites/default/files/2019-12/energy_equity_indicators_ada.pdf.

First Phase of Revitalizing the Energy Equity Indicators

An interdivisional team of CEC staff has undertaken the first phase of revisiting the Energy Equity Indicators by completing a literature review of existing tools. Staff developed a matrix to compare how each tool advances energy equity and to identify analytical gaps. Examples of tools and resources included in the literature review are the Integrated Climate Adaptation and Resiliency Program, CalEnviroScreen 4.0, and California Building Resilience Against Climate Effects. The main takeaways from the literature review shown in Table 1 are the following:

- Existing tools do not provide information about equity gaps related to energy.
- The CEC is in the best position to develop energy equity data.
- Energy Equity Indicators should use CalEnviroScreen 4.0 and the definition of a "disadvantaged community" as provided in Senate Bill 535.
- No tool exists that contains metrics specific to energy equity.

Table 1: Literature Review Summary Matrix

Tools	Energy	Environmental	Health	Socioeconomic	Disadvantaged Communities and Tribes
2018 Equity Indicators	X				X
CalEnviroScreen 4.0		X	X	X	X
Integrated Climate and Adaptation Resiliency Program			X	X	Excludes Tribes
California Building Resilience Against Climate Effects Project				X	Excludes Tribes

Credit: CEC

Based on this literature review, CEC staff determined that there was potential for updated indicators to add value. Data access and responsible data usage are pivotal to advancing

equity and the backbone of ground-truthing[49] at the state agency level, and it is imperative that the CEC make energy equity data available, accessible, and understandable. The 2022 Energy Equity Indicators will be a tool developed and maintained by the CEC that helps enable and empower individuals and communities to retrieve, understand, and use their data, supports communities pursuing strategies and investments to aid in a clean energy transition, addresses gaps and creates opportunities to direct resources to the communities that need it the most, and increases data availability and usability.

During the community connections session at the August 31, 2022, IEPR workshop, a participant noted, "A key challenge … is making sure [data are] presented in a way that all community members are able to understand, regardless of educational background or other barriers."[50] An aim of revitalizing Energy Equity Indicators is to make data available and understandable to a wide variety of audiences including the public, community-based organizations, and local governments.

Revitalizing Energy Equity Indicators will take an iterative phased approach, with each iteration being intentional, informed by communities and their needs, and reflective of what is valuable and feasible. During their presentation on localized indicators in the Salton Sea,[51] Silvia Paz and Dr. Benner emphasized the importance of bringing their work back to the communities to gather more information, refine, and ensure work is valuable and serving the community. Dr. Benner noted, "It is important to recognize that the truth that exists on the ground, independent of any outside monitoring or connection, is incredibly valuable knowledge, and it needs to be respected, and understood, and valued."[52] The CEC will take this approach by returning to focus groups, CBOs, and communities to ensure the Energy Equity Indicators is useful and can serve its intended audience. This iterative phased approach includes:

- Scoping and research.

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49 *Ground-truthing* refers to the process of gathering objective, directly observed data as opposed to data gained through inference.

50 Recording from the August 31, 2022, IEPR Workshop on Centering Equity and Environmental Justice Throughout CEC Efforts afternoon session, https://energy.zoom.us/rec/play/23cyOI4xQS1SLILOClsTvPaZMRT1m4f2BddZDEQ1SCDb0tOMVEQHKpew-3AVl614WYHhWMdNKNSNmNH5.pOEpe43x7NoqSpDm?continueMode=true&_x_zm_rtaid=T9EFLJXvTIG8A1xzFLH1WA.1662137810081.6350ebaabedefb651ff0f8ed20d44776&_x_zm_rhtaid=645.

51 Presentation by Silvia Paz and Dr. Chris Benner, "Our Salton Sea Initiative," at the June 29, 2022, IEPR Workshop on Centering Equity and Environmental Justice Throughout CEC Efforts. https://efiling.energy.ca.gov/GetDocument.aspx?tn=243766.

52 Transcript from the June 29, 2022, IEPR Workshop on Centering Equity and Environmental Justice Throughout CEC Efforts, https://efiling.energy.ca.gov/GetDocument.aspx?tn=246201.

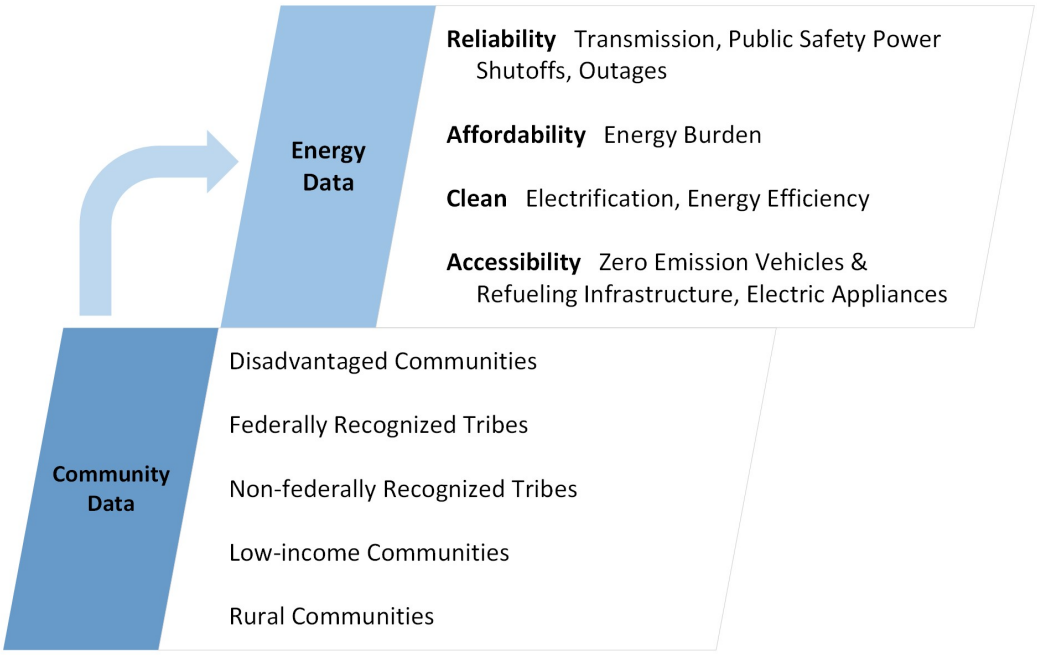
- Framework, metrics, and indicators.
- Ground-truthing.[53]
- Publication.

Each phase of the Energy Equity Indicators will follow this process.

The Future of Energy Equity Indicators

CEC staff are still determining which indicators should be included and what conclusions can be drawn from the data. The Energy Equity Indicators tool may render maps showing where there are polluting power plants or a dearth of clean energy infrastructure, or the tool may have sufficient granular data to identify neighborhoods with high energy burdens (where energy bills are a relatively large portion of income). This energy equity *landscape* could then guide decisions about where to focus investments or research and development or other opportunities. Figure 3 highlights examples of community and energy data that could be included in phase one of Energy Equity Indicators.

Figure 3: Energy Equity Indicators Phase One



Credit: CEC

53 *Ground-truthing* refers to the process of gathering objective, directly observed data as opposed to data gained through inference.

Future phases will begin to identify gaps in analysis, incorporate CEC program data to track internal progress toward achieving energy equity goals, and be used to focus efforts, investments, and policy on vulnerable communities in need of additional support. A vital part of each new phase is engaging communities to ensure that the work reflects their needs and provides value.

CHAPTER 2:
California Energy Planning Library

Introduction

The California Energy Planning Library will be a new platform on the California Energy Commission's (CEC's) website that aims to house data in a more user-friendly way. It is consistent with the CEC's commitment to provide stakeholders with transparent data and analytical tools that are readily accessible and easy to navigate. The platform will allow policy makers and stakeholders to more easily explore frequently requested CEC deliverables and analysis that directly affect their work. As part of this effort, the CEC plans to include a timeline for deliverables used by sister agencies and partners to help ensure that user needs are met. The initial phase of the online library will include land-use screens (draft staff report, *Land-Use Screens for Electric System Planning*[54]), the energy demand forecast (Chapter 3), energy reliability assessments (Chapter 4), and information about gasoline prices (Chapter 4).

Many products developed by CEC staff need to be adopted (approved by the CEC) before they can be used by energy system stakeholders, which often require the data within a specific timeframe. The CEC recommends routinely soliciting stakeholders and state partners, such as the Joint Agency Steering Committee (senior staff from the CEC, California Public Utilities Commission [CPUC] and California Independent System Operator [California ISO]), to provide feedback on how to make it easier to find frequently requested deliverables.

This platform is expected to go live the first quarter of 2023. This initial phase focuses on work developed by the Energy Assessments Division. In later phases, the aim is to use this approach as a template for making analytics readily available from other divisions in the CEC.

54 Hossainzadeh, Saffia, Erica Brand, Travis David, Gabriel Blossom, and Paul Deaver. 2022. *Land-Use Screens for Electric System Planning: Using Geographic Information Systems to Model Opportunities and Constraints for Renewable Resource Technical Potential in California*. California Energy Commission. Publication Number: CEC-700-2022-006-SD.

Background Information

CEC as Energy Data Repository

The CEC serves as the state's energy data repository[55] and is home to a variety of technical and subject matter experts — including scientists, engineers, and researchers who collect and analyze data. The data and analytical products developed by the CEC are key inputs to inform state energy planning, operations, and policy.

As the state's energy data repository, the CEC is responsible for collecting, validating, storing, and making available state energy data. The energy data repository role is an expansive workload, undertaken by staff with an emphasis on four main objectives: access, organization, exploration, and analysis, as follows:

- **Access** reinforces the CEC's commitment to making datasets available for users to retrieve and download. Data access is the CEC's most fundamental data-related role, allowing policy makers and other stakeholders to analyze data to meet their needs.
- **Organization** of data products provides an intuitive user experience and makes the CEC's data and data products easier and faster to locate.
- **Exploration** includes adopting new ways to enhance data integration. Considering the incorporation of interactive data dashboards and maps supports the idea of approachable, interactive tools, allowing users to explore, visualize, filter, and ultimately better understand energy data.
- **Analysis** is ongoing, and the CEC will continue to develop and publish expert analysis on a range of energy policy trends and topics for the public, policy makers, and industry stakeholders. Information will be provided in clear and innovative ways that include timely updates on emerging trends and other important topics.

Role of Data

Data transparency and public availability are essential to the CEC. Availability of data is key to an equitable energy transition and to bringing clean, reliable, and affordable energy to all Californians. The California Energy Planning Library is part of a larger and ongoing effort to make the CEC's data and analytical products publicly available and understandable and present

55 Public Resources Code Section 25216.5(d) requires the CEC to "Serve as a central repository within the state government for the collection, storage, retrieval, and dissemination of data and information on all forms of energy supply, demand, conservation, public safety, research, and related subjects."

them in modern ways. Energy Insights[56] and Energy Equity Indicators[57] (discussed in Chapter 1) are two examples of products developed in alignment with this effort.

Concept for California Energy Planning Library

CEC data and analytical products are important tools, not only internally, but also to energy system stakeholders and policy makers. To date, information is often organized on the CEC's website by the proceeding in which it was developed, making it difficult for users to navigate. The California Energy Planning Library will make data and analytical products easier to find, modernize the presentation of data, link to widely used reports, and showcase important analytical products adopted by the CEC.

Rather than a particular group or organization, the CEC has prioritized serving a diverse group of stakeholders. Staff plans to include a terminology guide, data dictionaries, links to state partners and external sources, and contact information. The CEC recommends enhancing and modernizing the California Energy Planning Library on an ongoing basis.

CEC Products Timeline

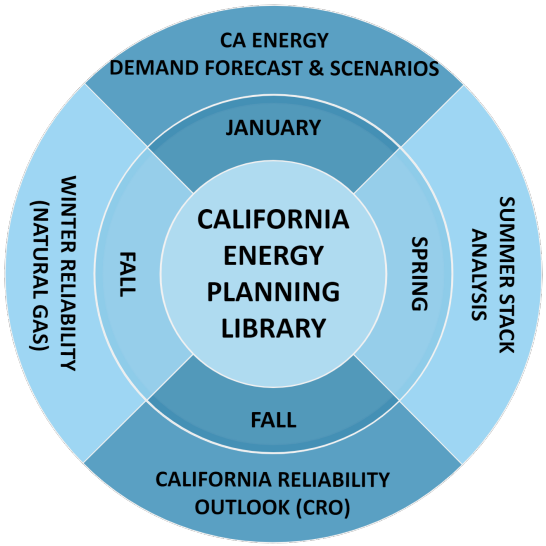
To ensure transparency and communicate the expected timeline of analyses, the California Energy Planning Library will include a calendar. The calendar will identify and highlight the release or update of major planning products and links to products that have been adopted. Prioritized for inclusion in the first phase is the CEC's update to land-use screens,[58] the California Energy Demand Update 2022, and reliability analyses, including Summer Stack Analysis, California Reliability Outlook, and Winter Reliability.

56 CEC. Energy Insights webpage, https://www.energy.ca.gov/data-reports/energy-insights.

57 CEC. Energy Equity Indicators webpage, https://www.energy.ca.gov/rules-and-regulations/energy-suppliers-reporting/clean-energy-and-pollution-reduction-act-sb-350-3.

58 *Land-use screens* are map-based footprints delineating important environmental and physical characteristics of the land. They are assembled from an integration of raw data into modeled results at the statewide scale and can show access limitations or competing land-use priorities. Land-use screens are a key input to several state electricity planning processes.

Figure 4: Calendar of Annual Products/Updates



Credit: CEC staff

Public Input and Next Steps

CEC staff sought input from stakeholders at the April 27, 2022, Integrated Energy Policy Report workshop.[59] Staff's takeaways from the workshop included:

- There are specific, essential data and analysis that stakeholders need to access routinely.
- Current barriers exist to accessing, understanding, and being able to use available data.
- Disaggregation and certain granularity are difficult to manipulate.
- Consistency across several forums supports clarity about the availability, use, and location of various datasets.
- Interface should focus on external, novice users.
- Ease of use is paramount.
- Modernization of tools allows increased user experience.

59 April 27, 2022, IEPR Commissioner Workshop on the California Planning Library. https://www.energy.ca.gov/event/workshop/2022-04/iepr-commissioner-workshop-california-planning-library.

This invaluable feedback is driving the launch of the California Energy Planning Library. As one of the panel participants commented at the IEPR workshop, "I think the planning library for existing information is going to make our lives a lot easier and more organized."[60]

Phases for Implementation

As part of the planning process and to identify priorities for implementation, the CEC plans to launch the California Energy Planning Library with an immediate focus on organizing existing data sets and work products from the Energy Assessments Division.

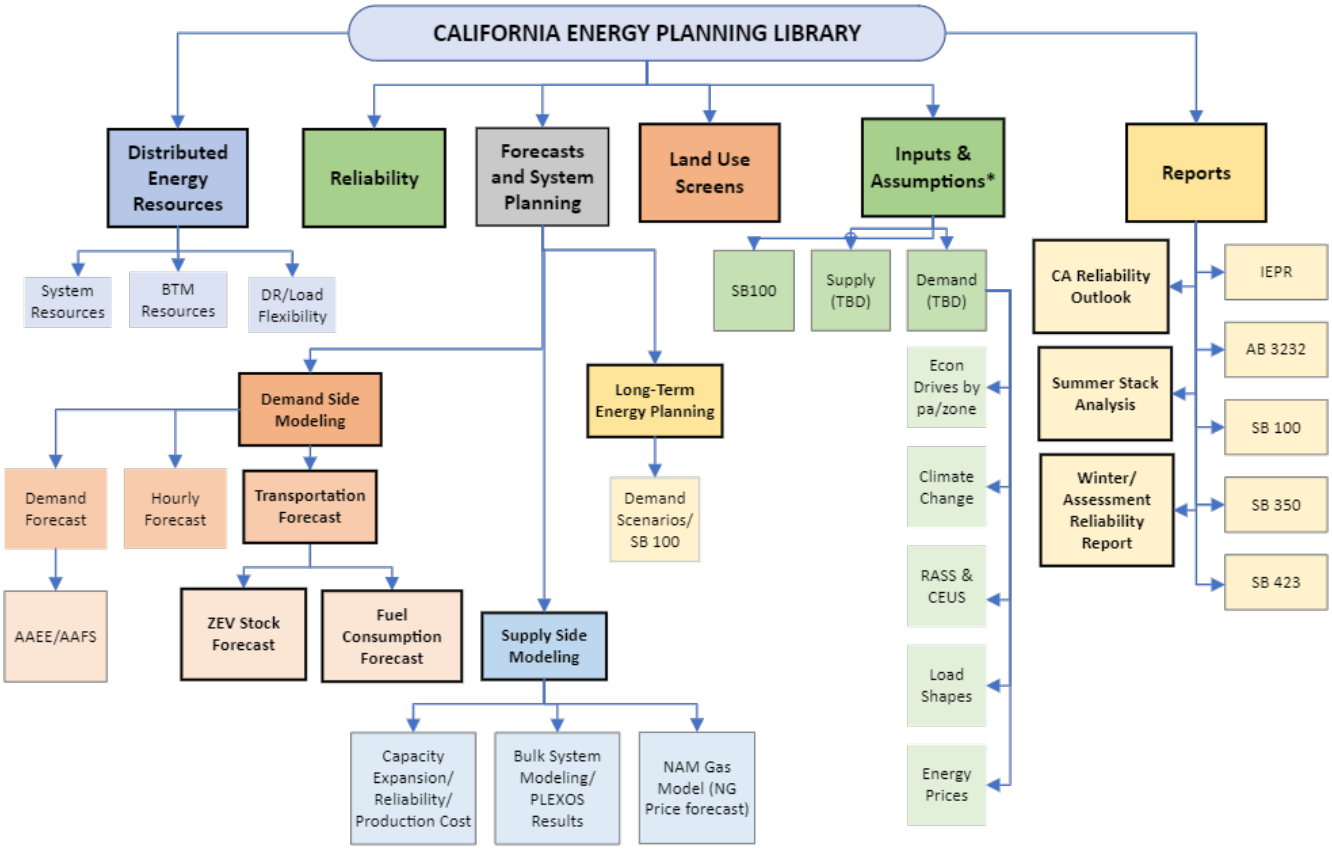
After completion of the first phase, the CEC will solicit feedback from sister agencies and other stakeholders during an "open feedback window." Feedback garnered during this period will influence the data and analytical products incorporated into the library, guide data modernization, and drive other improvements to the platform. Ongoing stakeholder engagement and user feedback are vital to the success of the California Energy Planning Library and the CEC will provide opportunities for feedback on an ongoing, annual basis.

Figure 5 outlines the proposed structure and design of the new platform and proposed content for each of the six initial categories and Figure 6 shows a draft of the landing page. Housing data in more than one category will allow users to find products in more than one location, making it easier to navigate the platform.

Subsequent and ongoing phases will focus on the modernization of data and analytical tools, as well as expanding data products and incorporating links to data partners. Also in subsequent phases, the intent is to use this approach as a template for making data developed by other divisions within the CEC more readily available and user friendly. The site map will continue to grow as new analysis, innovative products, and links to state partners are added.

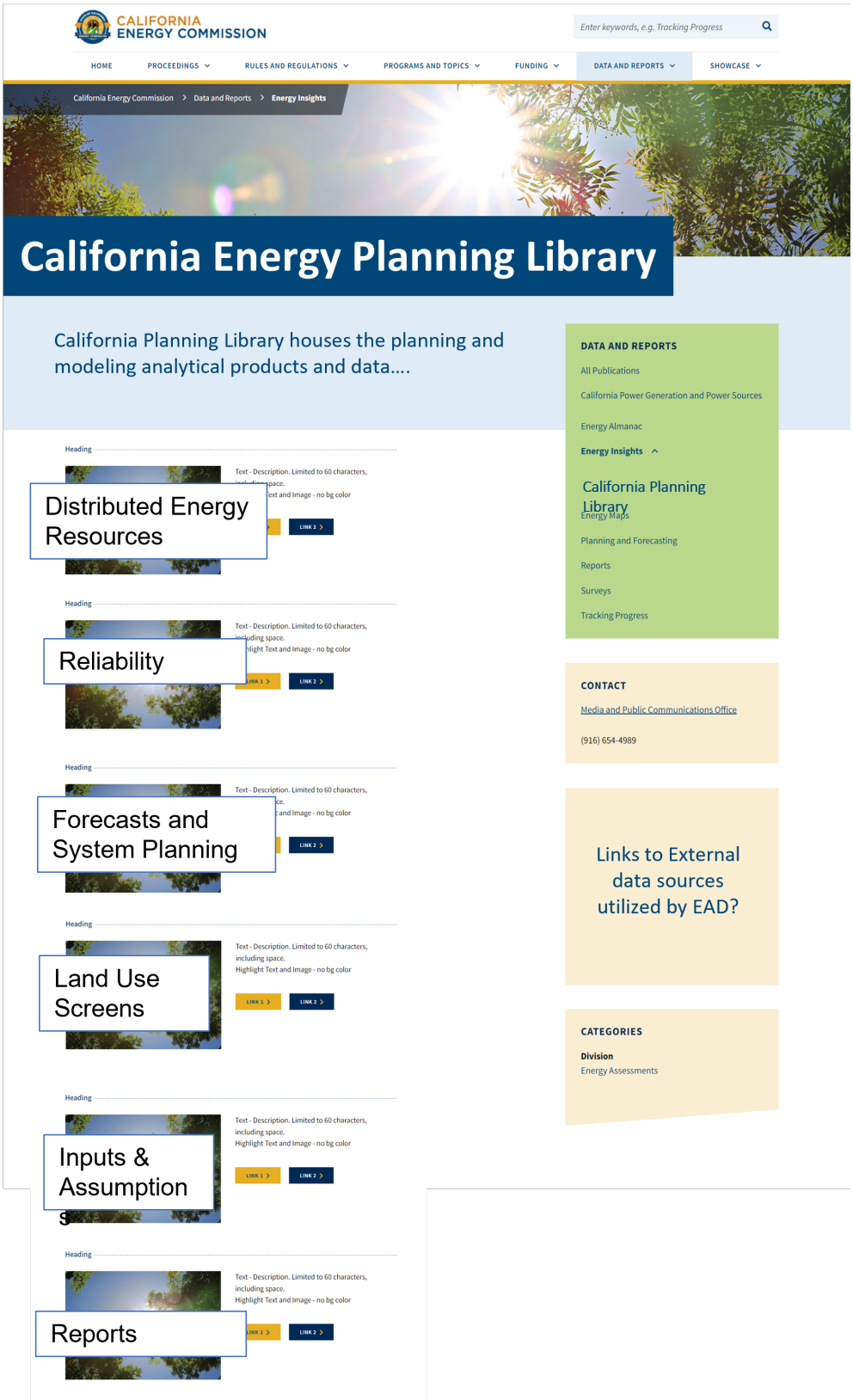
60 Ibid.

Figure 5: Future Site Map



Credit: CEC staff

Figure 6: California Energy Planning Library Landing Page



Credit: CEC staff

CHAPTER 3:
California Energy Demand Forecast

A foundational component of the state's energy planning is the California Energy Commission's (CEC's) California Energy Demand Forecast (CED).[61] The CED is a set of several forecasting products that are used in various energy planning proceedings, including the California Public Utilities Commission's (CPUC's) oversight of energy procurement and the California Independent System Operator's (California ISO's) transmission planning. The demand forecast includes:

- Ten-year annual consumption forecasts for electricity and gas by customer sector, eight planning areas, and 20 forecast zones.
- Annual peak electric system load with different weather variants for eight planning areas.
- Annual projections of load-modifier impacts including adoption of photovoltaic (PV) and other self-generation technologies, battery storage, electric vehicles (EVs), and energy efficiency and electrification standards and program impacts.

Presented here is a discussion of the process for developing the forecast, an update on the method used, and a description of the key drivers and trends. Forecast results will be presented in a workshop in December and included in the final *2022 Integrated Energy Policy Report Update (2022 IEPR Update)*.

Background

California's energy system planning has been challenged in recent years due to several significant events that impact energy supply and demand. The most recent was the September 2022 extreme heat event, but other recent challenges include a pandemic, more frequent extreme weather events, historic drought conditions, and an alarming number of wildfires that have blanketed the state in smoke. These events have had a profound impact on the lives of all Californians, including the way they use energy. That impact contributes to a more challenging balancing of energy supply and demand that is critical to maintaining a reliable

61 Public Resources Code Section 25301(a) requires the CEC to "conduct assessments and forecasts of all aspects of energy industry supply, production, transportation, delivery and distribution, demand, and prices" and to "use these assessments and forecasts to develop and evaluate energy policies and programs that conserve resources, protect the environment, ensure energy reliability, enhance the state's economy, and protect public health and safety."

energy system. Climate change increases uncertainty in near- and long-term planning and recent extreme weather events in California and the rest of the West have had a real impact on energy demand and system planning. California's energy system planning must continuously adapt and evolve to keep pace with changing climate conditions.

The impacts of climate change, along with California's efforts to reduce greenhouse gas (GHG) emissions, are changing how energy is used in the state. To support planning to meet GHG emission reduction targets, CEC staff completed and adopted their first round of demand scenarios.[62] This work led to questions around near-term actions that could be taken within the state's system planning to prepare for building and transportation electrification, as many types of system upgrades require a lead time of 7 to 10 years. An interagency working group was established to define grid-planning scenarios that included proposed electrification strategies deemed likely to occur, which CEC staff then analyzed. There was consensus among leadership at the CPUC, California ISO, and CEC to deviate from the use of the "single forecast set" in the *2021 IEPR* forecast for system planning and procurement.

On May 24, 2022, the CEC adopted two scenarios — the Additional Transportation Electrification scenario and the High Electrification Scenario — to allow for use in the California ISO's 2022–2023 Transmission Planning Process (TPP) and the CPUC's Integrated Resource Planning (IRP) for the 2023–2024 TPP.[63] The Additional Transportation Electrification scenario incorporates the California Air Resources Board's (CARB's) Advanced Clean Cars II[64] regulation and proposed Advanced Clean Fleets[65] regulation and is the scenario that the California ISO and CPUC agreed to use for the TPP and IRP. The High Electrification Scenario also incorporates the Advanced Clean Cars II regulation and proposed Advanced Clean Fleets regulation and includes higher adoption of fuel substitution and energy efficiency.

62 The demand scenarios were presented at an IEPR staff workshop April 7, 2022. https://www.energy.ca.gov/event/workshop/2022-04/iepr-staff-workshop-demand-scenarios. The demand scenarios were adopted at the May 24, 2022, CEC business meeting. https://www.energy.ca.gov/event/meeting/2022-05/energy-commission-business-meeting-0.

63 May 24, 2022, CEC business meeting, https://www.energy.ca.gov/event/meeting/2022-05/energy-commission-business-meeting-0.

64 CARB. "Proposed Advanced Clean Cars II Regulations: All New Passenger Vehicles Sold in California to be Zero Emissions by 2035." Advanced Clean Cars II webpage. https://ww2.arb.ca.gov/our-work/programs/advanced-clean-cars-program/advanced-clean-cars-ii. Adopted in August 2022.

65 CARB. Advanced Clean Fleets webpage, https://ww2.arb.ca.gov/our-work/programs/advanced-clean-fleets. Expected to be adopted in October 2022.

Forecast Process

The CEC seeks input into its forecast development through various venues including public workshops and the public Demand Analysis Working Group (DAWG)[66] to review proposed methodological updates. A September 8, 2022, DAWG meeting covered topics related to the updated economic and demographic data, proposed changes to the forecast framework, and development of an additional achievable framework for the transportation forecast. Staff will present a preview of the forecast results at a DAWG meeting in mid-November.

A final workshop will be held December 7, 2022, to present draft results and receive additional stakeholder comments before the forecast is finalized and presented for adoption in January 2023.

Overview of Method and Updates for 2022

As part of the IEPR process, the CEC develops and adopts 10-year forecasts of end-user electricity demand every two years, in odd-numbered years. Recognizing the process alignment needs and schedules of the CPUC and California ISO planning work, the CEC provides an update to the IEPR forecast in even-numbered years.

For the *2022 IEPR Update*, the CEC will update its forecast of electricity demand that was developed for the *2021 IEPR* and the grid-planning scenarios adopted in May 2022. The major updates consist of a simplification to the baseline forecast framework and implementation of an "additional achievable" framework for the transportation energy demand forecast component. The update also includes revising economic and demographic drivers with current projections, revising electricity rate projections, adding one year of historical energy data and behind-the-meter PV system adoption and storage adoption data, and updating the hourly and peak demand forecast.

No updates will be made to the additional achievable energy efficiency (AAEE) or fuel substitution (AAFS) components. The CEC will review the single-forecast-set language with the California ISO, CPUC, and CARB and update the language to reflect the scenarios that will be used for planning and procurement. The single-forecast-set language will be included in the final *2022 IEPR Update.*

Revised Forecast Framework

For the California Energy Demand Update (CEDU) 2022, the CEC will revise the standard forecasting framework to create a more transparent forecasting process, more clearly describe

66 Demand Analysis Working Group webpage, https://www.energy.ca.gov/programs-and-topics/topics/energy-assessment/demand-analysis-working-group-dawg.

scenario assumptions, and better capture uncertainty for "demand modifiers" such as energy efficiency, building electrification, and transportation electrification. (Examples are the AAEE and AAFS scenarios.) To increase transparency in forecasting assumptions, the three baseline energy demand cases (low, mid, high) will be reduced to one primary set of baseline assumptions, and more attention will be given to assumptions guiding the impacts of demand modifiers that can significantly influence the results of long-term energy demand forecasts. Further, the transportation forecast will shift to an additional achievable framework, as described below.

The CED forecast framework was initially built around a set of low, mid, and high baseline assumptions to capture a range of possible future energy demand outcomes due to uncertainty in economic and demographic outcomes. The mid-case scenario was typically assumed to be the most likely outcome while high and low scenarios captured a range of uncertainty, though ultimately characterized unlikely outcomes particularly over the long-term forecast period. As well as these baseline assumptions, a set of AAEE and AAFS assumptions were paired with the baseline assumptions to create as many as five statewide forecasts (up to 100 when developing planning area and zone forecasts). Of these forecasts, only two, the "Mid-Mid" (mid baseline paired with the mid AAEE and AAFS scenarios) and "Mid-Low," (mid baseline paired with the low AAEE and high AAFS scenarios) have been routinely used for statewide planning. The Mid-Mid forecast has been used primarily for resource adequacy and procurement, while the Mid-Low has been used for transmission planning and local reliability studies where more conservative projections are preferred.

For CEDU 2022, the CEC will streamline the forecast framework by eliminating the unused high and low baseline forecasts and will instead prepare one baseline demand forecast modeled after the previous mid demand case and pair that with assumptions for AAEE, AAFS,[67] and now additional achievable transportation electrification (AATE). The proposed set of assumptions that will be used for CEDU 2022 is outlined in Table 2, along with the new naming convention (for example, "Mid-Mid" becomes "Planning Forecast") and use cases.

For CEDU 2022, the CEC will streamline the forecast framework by eliminating the unused high and low baseline forecasts and will instead prepare one baseline demand forecast modeled after the previous mid demand case and pair that with assumptions for AAEE, AAFS,[68] and now additional achievable transportation electrification (AATE). The proposed set of

67 For additional information on AAEE and AAFS, see the *2021 Integrated Energy Policy Report Volume IV: California Energy Demand Forecast*. https://efiling.energy.ca.gov/GetDocument.aspx?tn=241581.

68 Ibid.

assumptions that will be used for CEDU 2022 is outlined in Table 2 below, along with the new naming convention (for example, "Mid-Mid" becomes "Planning Forecast") and use cases.

Table 2: Revised Forecast and Additional Achievable Scenario Framework

New Name	Baseline Forecast	Planning Forecast	Local Reliability Scenario
Previous Name	Mid Baseline Forecast	Mid-Mid	Mid-Low
Use Cases	• Baseline • Reference forecast	• Resource Adequacy • CPUC IRP	• California ISO TPP • Local Studies
Economic, Demographic, and Price Scenarios	Baseline (Mid)	Baseline (Mid)	Baseline (Mid)
AAEE Scenario	-	Mid (Scenario 3)	Low (Scenario 2)
AAFS Scenario	-	Mid (Scenario 3)	High (Scenario 4)
AATE Scenario	-	Mid (Scenario 3)	Mid (Scenario 3)

Credit: CEC

Transportation

The major update to the *2022 IEPR Update* is the modification of the transportation energy demand forecast. Recent bold state goals for zero-emission vehicles (ZEVs), combined with strong supporting regulatory and programmatic initiatives, call for large increases in ZEV adoption. Further, recent market trends and increasing consumer demand for ZEVs align well with state policies and goals. The previous transportation energy demand forecast is a sophisticated set of modeling tools that provides a skillful forecast for transportation energy demand based upon consumer choice modeling, but it is not designed to capture rapid policy and consumer preference shifts. As new ZEV sales grow, careful planning is needed to integrate them into the grid, including making early investments in the grid updates necessary to support new load. A new framework for modeling transportation electrification that accounts for the potential for rapid market transformation is necessary.

Considering this need, staff changed the transportation forecast structure to align with other electrification scenario components. Similar to AAEE and AAFS, this new AATE framework will more directly account for the effects of policy under a set of scenarios, each of which is reasonably expected to occur given market, policy, and programmatic conditions. The new AATE scenarios still forecast load at the forecast zone level, consistent with the rest of the

forecast. This approach raises geographical questions involving load *within* forecast zones. Because transportation electrification represents a large source of new load and the geographic distribution of such load is not well understood, the AATE framework may expand in future forecasts to align with other infrastructure needs.

The AATE framework begins with a baseline scenario, which is nearly identical to the mid case forecast in the previous IEPR. In the baseline, economic and demographic inputs, coupled with vehicle choice models and vehicle travel models, determine total vehicle stock and energy demand for light-duty (LD) and medium- and heavy-duty (MDHD) sectors. Key inputs and assumptions for the baseline scenario include vehicle attributes such as price, range, refueling time, acceleration, and model availability. They also include incentives for ZEVs, such as federal tax credits, state rebates and rewards, and high-occupancy vehicle access incentives. The other major category of model inputs is consumer preferences for ZEVs.

Policies are included in the baseline scenario when they are capable of being modeled within the demand-side forecast framework, such as CARB's existing Innovative Clean Transit regulation. More recent regulations that are incompatible with the demand-side vehicle choice model, such as CARB's supply-side Advanced Clean Cars II regulation, are not included in the baseline.

Following the baseline scenario are three additional scenarios, each of which has additional electricity demand during each of the forecast years. Scenario 1 has more aggressive vehicle attributes, incentives, and preferences that increase ZEV adoption in the vehicle choice models. Scenario 2 involves a direct, post-process alignment of vehicle sales that captures delayed compliance or some exemptions with CARB's policies, in particular CARB's Advanced Clean Cars II regulation and its proposed Advanced Clean Fleets regulation. Scenario 3 represents full compliance with all regulations again with a post-process alignment of new vehicle sales with state LD regulations or proposed MDHD regulations.

Summary of Key Drivers and Trends

The CED has numerous underlying assumptions and inputs including economic and demographic data and climate trends that affect how the state uses energy. It also accounts for policies and goals that guide forecast assumptions for energy efficiency, building and transportation electrification, distributed generation, and battery storage technologies.

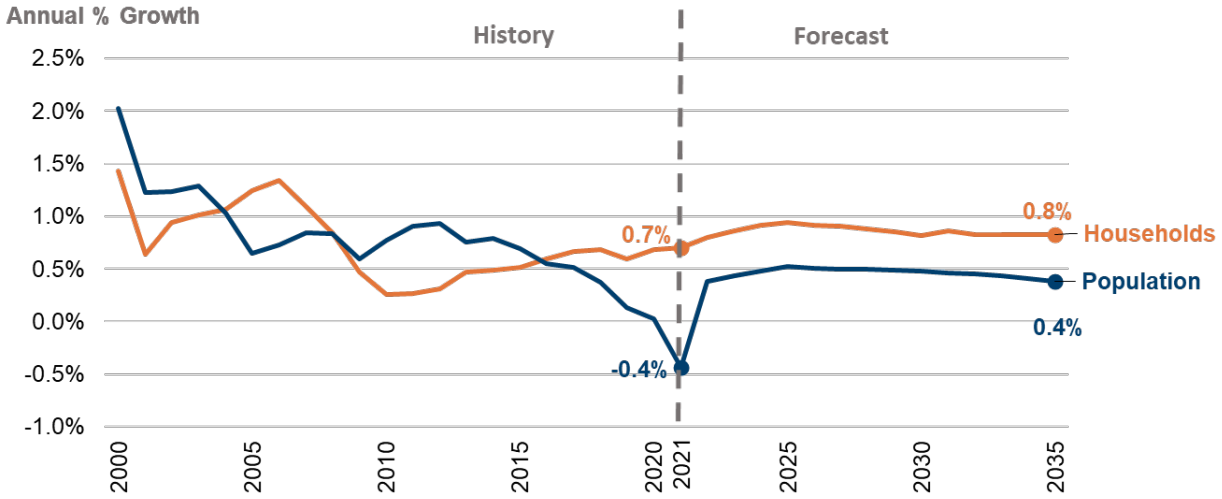
Economic and Demographic Trends

Statewide population for CEDU 2022 continues to grow 0.5 percent annually from 2022 to 2035, as with the previous population projections from the California Department of Finance (DOF). The 2022 total population estimate is 39.5 million and is projected to reach roughly 42 million by 2035 (6.35 percent total growth). In 2021, statewide population declined by about 0.4 percent, as noted in Figure 7. The slowdown in population growth can be attributed to COVID-19 deaths, federal restrictions on immigration, and increased outmigration on top of aging Baby Boomers and declining fertility.

Statewide household growth is expected to grow at 0.9 percent annually from 2022 to 2035, slightly above previous household projections from DOF. The 2022 household estimate is 13.4

million households and is projected to reach roughly 15 million by 2035 (11.9 percent total growth).

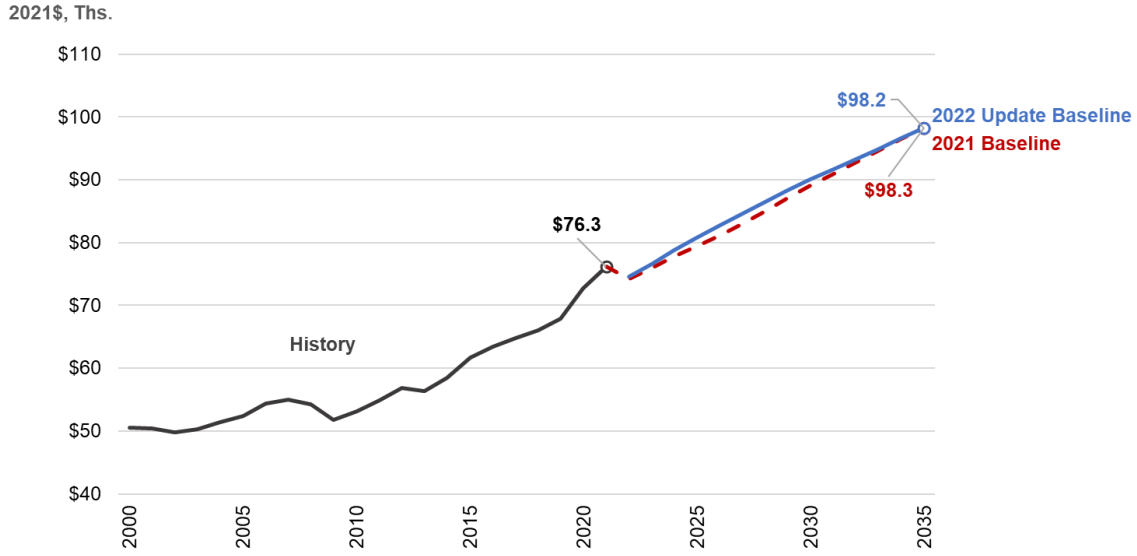
Figure 7: Statewide Population and Household Growth, CEDU 2022



Credit: CEC using data from DOF

Figure 8 compares baseline statewide per capita income for CEDU 2022 against the CED 2021 baseline. Statewide per capita income is expected to grow at a similar rate with CED 2021, at an average annual growth rate of 2.1 percent from 2022 to 2035. Over the same period, statewide per capita income is expected to increase by 32 percent, reaching $98,200 by 2035.

Figure 8: Statewide Per Capita Personal Income Comparison, CEDU 2022

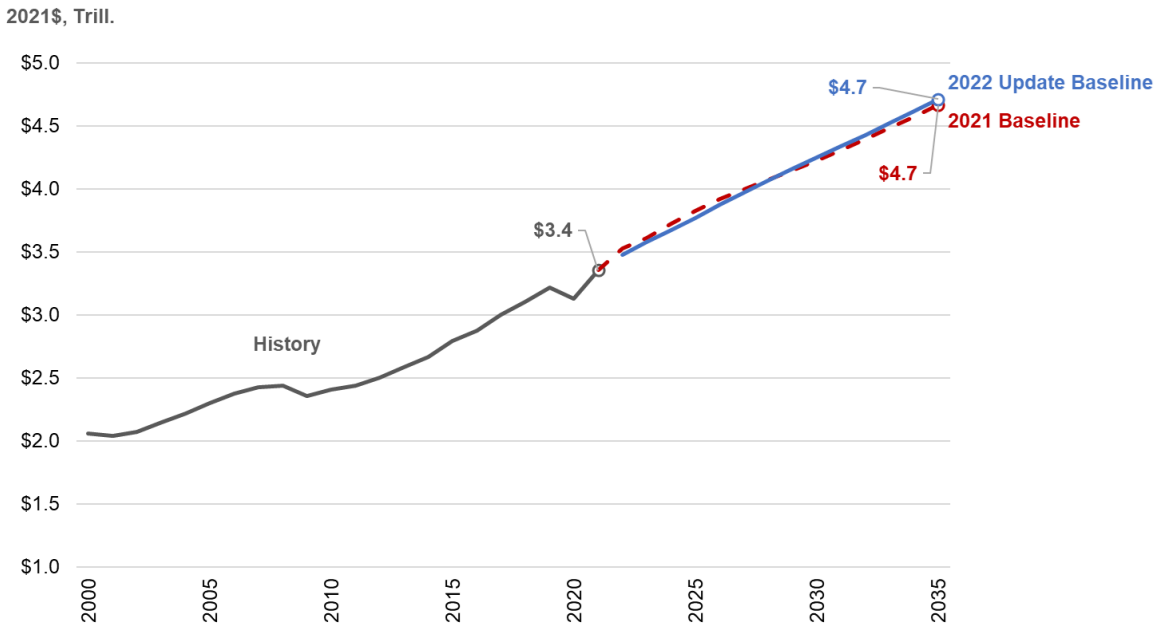


Credit: CEC using data from Moody's Analytics and DOF

Figure 9 compares baseline gross state product projections for CEDU 2022 and CED 2021. Gross state product is expected to grow at a similar rate with CED 2021, at an average annual growth rate of 2.4 percent from 2022 to 2035. Over the same period, gross state product is

expected to increase by 36 percent, reaching $4.7 trillion by 2035. The 2022 data are from May, and do not reflect more recent developments such as Federal Reserve rate hikes, inflation, and high oil prices that have led to concerns about a potential economic slowdown. Still, as of early October, Moody's Analytics, a key source of data, suggested that they have not "dramatically changed [their] expectations since spring."[69]

Figure 9: Gross State Product Comparison, CEDU 2022

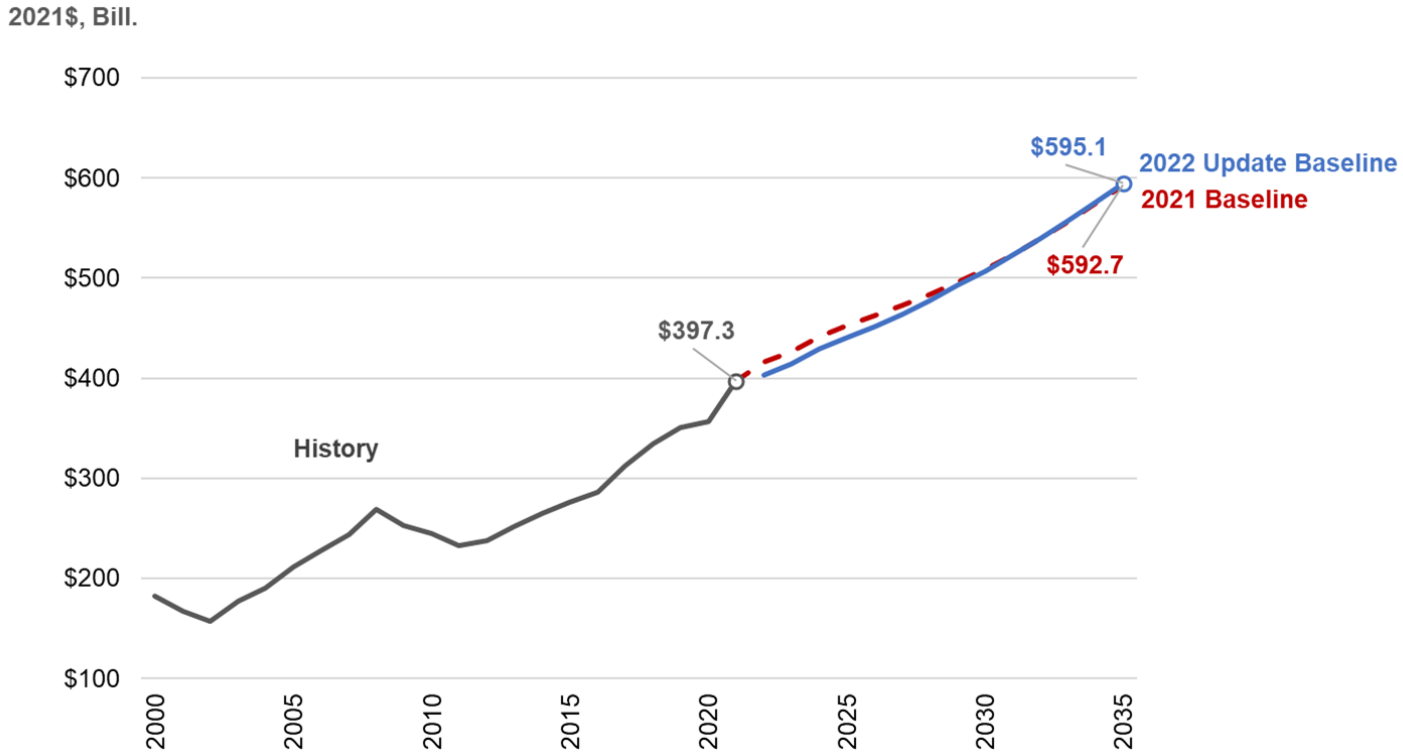


Credit: CEC using data from Moody's Analytics from May 2021 and May 2022

Figure 10 compares gross manufacturing output projections for CEDU 2022 and CED 2021. Gross manufacturing output is expected to grow at a similar rate as CED 2021, at an average annual growth rate of 3 percent from 2022 to 2035. Over the same period, gross manufacturing output is expected to increase by 40 percent, reaching $595 billion by 2035.

69 Personal correspondence with Moody's Analytics California Economist Laura Ratz. October 12, 2022.

Figure 10: Gross Manufacturing Output Comparison, CEDU 2022



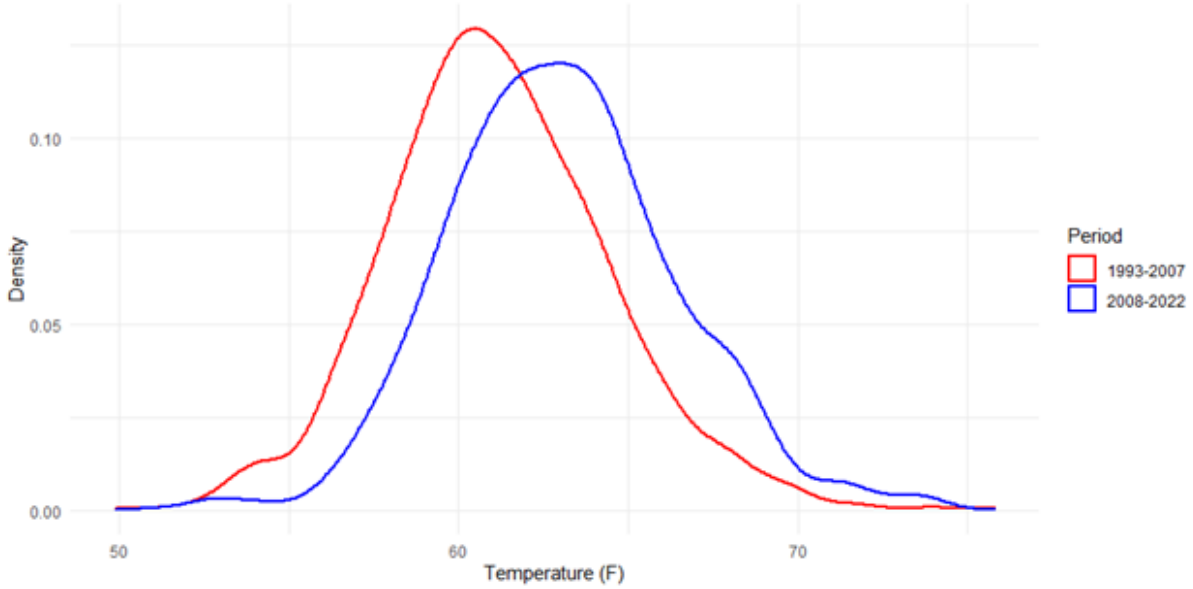
Credit: CEC using data from Moody's Analytics from May 2021 and May 2022

Climate Trends

Rising temperatures are an important factor affecting the CEC's demand forecasts, particularly forecasts of peak electricity demand which is highly sensitive to temperature. The CEC's peak forecast must consider demand under normal peak conditions as well as for the types of extreme temperatures that would be expected only once in five, ten, or 20 years.

Figure 11 shows the density — a measure of the likelihood that a particular value will occur — of daily minimum temperatures averaged across the California ISO control area. Examining the most recent 30 years of historical temperature data shows that the latest 15-year period exhibits a clear upward shift in the distribution of temperatures relative to the proceeding 15 years. A similar trend can be observed with daily maximum temperatures.

Figure 11: Distribution of Daily Minimum Temperatures Averaged Across California ISO Region



Credit: CEC analysis

The above chart illustrates the increased likelihood of high or even record-setting temperatures. This point is underscored by the September 6, 2022, extreme heat event which gave rise to a peak load on the California ISO system far surpassing all previously recorded loads. CEC forecasters examined September 6 temperatures within the context of the most recent 30 years of weather history and determined it to be a 1-year-in-27 event. However, after examining the event through the lens of the 20 most recent weather years, staff found it to be much more likely — a 1-year-in-14 event.

Analysts at the California ISO conducted a similar analysis. Though based on a different selection of models, weather stations, and statistics, the results were well-aligned with CEC estimates. When considering 28 years of weather history, the California ISO concluded that September 6 represented a 1-year-in-25 event. When considering just the last 20 years of weather, however, the likelihood increased to 1-year-in-11. While such estimates are sensitive to their underlying methods and assumptions, clearly the most impactful decision is around the choice of historical context used to define a typical distribution of weather.

Climate change complicates the CEC's long-standing practice of using 30 years of historical weather to establish benchmarks for extreme peak load conditions. Staff took steps to address this problem during the 2021 IEPR cycle by assigning greater weight to more recent years within the historical data set. Looking ahead to the 2023 IEPR, staff is working to leverage climate model data for this purpose rather than relying solely on the historical record.

State Policies and Goals

Legislation and executive orders are focused on reducing GHG emissions economywide, including Executive Order B-55-18, which set a goal to achieve economywide carbon neutrality

no later than 2045[70] and was codified through Assembly Bill 1279 (Muratsuchi, Chapter 337, Statutes of 2022) in 2022. Statewide and local jurisdiction strategies to reduce GHG emissions including energy efficiency, electrification of buildings, zero-emission transportation, and renewable energy are relevant to the forecast and how electricity is used in California. All these efforts are driving trends for advancing building and transportation electrification.

Over the last two budget cycles, California has committed a record $54 billion for climate-related investments, including $10 billion for zero-emission transportation. The transportation-related funds support incentives both for the purchase of ZEVs and for the build-out of ZEV refueling infrastructure. CARB manages the vehicle incentive programs, including the Clean Vehicle Rebate Project for LD ZEVs and the Hybrid and Zero-Emission Truck and Bus Vehicle Incentive Project for MDHD ZEVs. The CEC manages incentive programs for zero-emission vehicle refueling infrastructure, including CALeVIP and EnergIIZE Commercial Vehicles.

CARB has adopted and continues to develop other vehicle regulations to implement Governor Newsom's executive order to zero out emissions from transportation over the next 15 to 25 years. The state ZEV regulations include the Advanced Clean Cars II regulation for light-duty vehicles and the Advanced Clean Trucks as well as upcoming Advanced Clean Fleets regulations for medium- and heavy-duty vehicles.

Federal vehicle regulations focus on fuel economy or greenhouse gas emissions from vehicles, and unlike the California regulations, do not require ZEVs. However, the Inflation Reduction Act of 2022[71] introduces new changes to ZEV incentives, primarily through vehicle tax credits. CEC staff is accounting for these new federal incentives in modeling transportation energy demand for the 2022 IEPR Update in the two scenarios that evaluate consumer preferences.

California and local jurisdictions are leading the way in advancing building decarbonization. Many cities and counties are implementing gas bans in new construction in their jurisdictions. California, supported by legislation, is continuing to advance equitable building electrification throughout the state. The $120 million Technology and Equipment for Clean Heating (TECH) program and the $80 million Buildings Initiative for Low-Emissions Development (BUILD) program are pilot programs aimed at market transformation and offering incentives for all-electric new construction in low-income communities. Based on the 2022–2023 fiscal year budget, California will launch an equitable building decarbonization program, where a billion dollars will be dedicated to a statewide direct-install building retrofit program for low-income households to replace fossil fuel appliances with electric appliances. However, additional electrification is needed to meet the 2030 GHG goals discussed in the Assembly Bill 3232

70 Executive Order B-55-18 to Achieve Carbon Neutrality, signed by Governor Brown in September 2018.

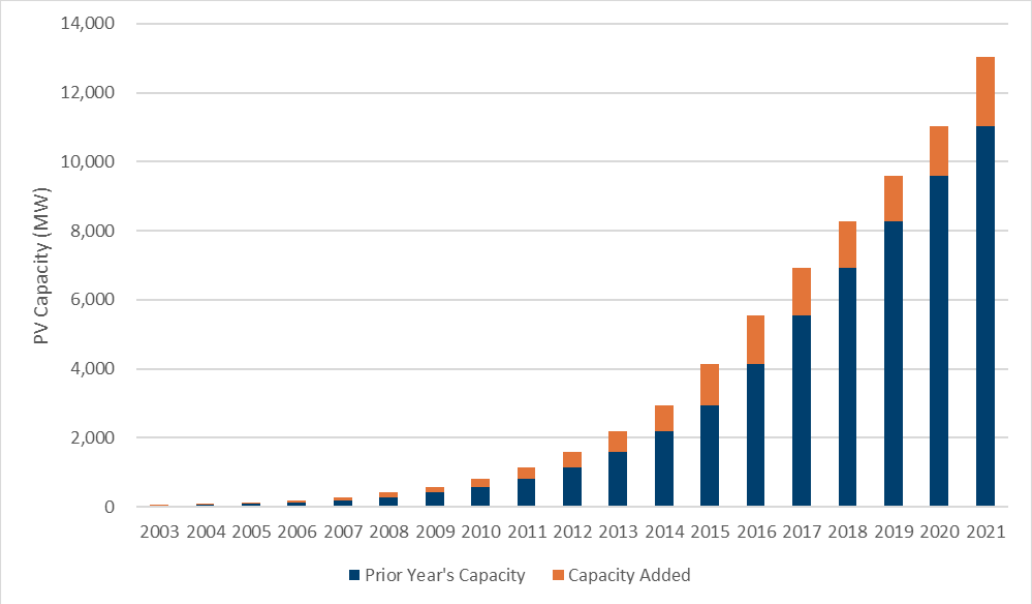
71 H.R. 5376. Inflation Reduction Act of 2022. https://www.congress.gov/bill/117th-congress/house-bill/5376.

(Friedman, Chapter 373, Statutes of 2018) California Decarbonization Assessment. In July 2022, the CPUC opened a proceeding (R. 22-07-005) that seeks to (1) reform fixed charges consistent with AB 205, (2) consider policies to enable widespread demand flexibility through retail rate reform in support of the state's electrification initiatives, and (3) ease IOU compliance with updates to Load Management Standards[72] adopted by the CEC. The CARB 2022 State Implementation Plan includes a strategy to limit oxides of nitrogen emissions from space and water heaters which would effectively limit new sales of gas space and water heaters. CARB will be developing this regulation for potential implementation in 2030.[73]

Behind-the-Meter PV and Storage Trends

Since 2017, California has added about 1,400 to 2,000 megawatts (MW) of new behind-the-meter (BTM) PV capacity annually. By the end of 2021, there were roughly 13,000 MW of installed BTM PV capacity in California, as shown in Figure 12. The CEC estimates that more than 22,000 gigawatt hours (GWh) of electricity was produced by BTM PV systems in 2021.

Figure 12: Total and Incremental BTM PV Capacity in California by Year



Credit: CEC

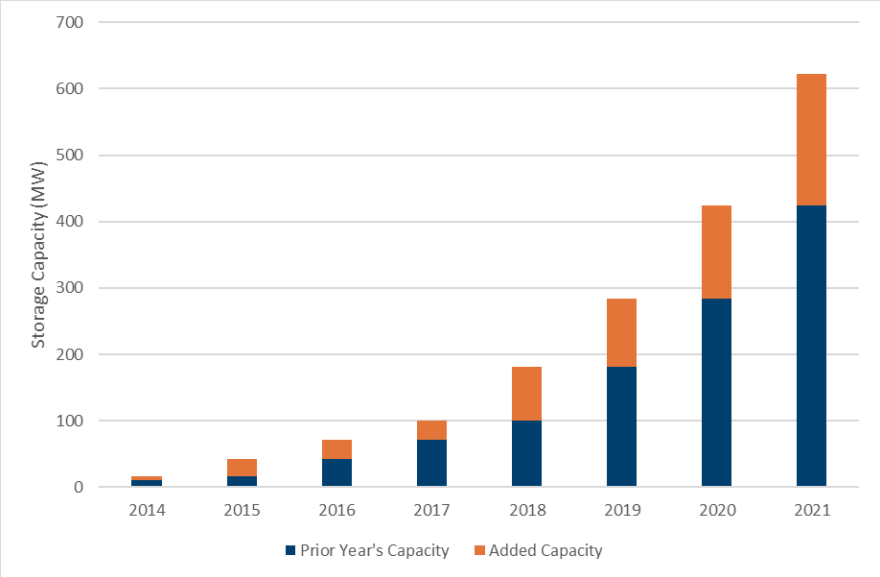
72 CEC. Load Management Rulemaking. https://www.energy.ca.gov/proceedings/energy-commission-proceedings/load-management-rulemaking?utm_medium=email&utm_source=govdelivery.

73 California Air Resources Board. *2022 State Strategy for the State Implementation Plan*. https://ww2.arb.ca.gov/resources/documents/2022-state-strategy-state-implementation-plan-2022-state-sip-strategy.

BTM storage adoption in California continues to increase at a rapid pace, as demonstrated by data collected from weekly Self-Generation Incentive Program (SGIP) reports. The SGIP, a CPUC program, provides incentives to support distributed energy resources. As of August 2022, the total on-line SGIP energy storage capacity across customer sectors was roughly 1.8 GWh.

In total, an estimated 622 MW of BTM SGIP energy storage has been installed in California through 2021, with more than half installed in the last three years. (See Figure 13.)

Figure 13: Total and Incremental BTM Storage Capacity in California by Year



Credit: CEC analysis of SGIP reported data

Transportation Trends

California's retail gasoline and diesel fuel prices increased substantially from 2021 to 2022, in part due to economic recovery from the pandemic, and in the first half of 2022, mostly in response to oil supply constraints related to Russia's invasion of Ukraine. In September and October 2022, prices increased further due to refinery shutdowns and a preexisting reduction in gasoline imports. For more information about California's transportation fuel markets, see Chapter 4.

Statewide vehicle miles traveled (VMT) decreased significantly in 2020 and partially recovered in 2021. Complete 2021 data are not yet available, but highway data for 2021 show about a 4 percent decline in comparison to 2019 and 2021. Partial highway data from 2022 suggest a near-complete recovery.

CEC analysis of California Department of Motor Vehicles (DMV) data show nearly 840,000 LD ZEVs registered in the state for 2021.[74] LD ZEV sales increased markedly from 2020 to 2021 and continued to grow in the first half of 2022. Through the end of June 2022, ZEVs represent 16.5 percent of new light-duty vehicles sold. This pattern holds despite supply chain challenges that have increased the price of vehicles generally, with ZEVs particularly affected. Most market analysts expect these challenges to partially ease by the end of 2022, so continued growth in the ZEV market is likely. Similar supply chain challenges exist in the MDHD ZEV market as well, with similar supply chain issues expected to become less severe toward the end of the year. Current DMV registration data shows about 2,000 MDHD ZEVs as of mid-2022.[75]

Forecast Updates for 2023

Staff plan to expand and update the forecast to improve how climate change is incorporated into forecasted demand and to account for fuel switching driven by the state's decarbonization goals. To this end, staff is working on several updates for the 2023 IEPR forecast, including:

- Updating the residential and commercial sector end use models to incorporate the latest Residential Appliance Saturation Survey and Commercial End Use Survey data, improve incorporation of recent codes and standards, and add flexibility to model decarbonization and other changes in these sectors.
- Developing a new distributed generation and battery storage adoption model based on economic and behavioral considerations.
- Reviewing how the forecast accounts for climate change and assessing where improvements could be implemented.
- Developing new travel demand models for the transportation forecast that provide increased flexibility for modeling vehicle miles travelled by different travel modes.
- Expanding the pipeline gas demand forecast to assess monthly demand and peak winter day demand.
- Ensuring scenarios capture a range of possibilities and are useful and relevant to stakeholders.

74 For more information on ZEV sales and other light-duty passenger vehicle sales, see the CEC's Zero-Emission Vehicle Dashboard webpage, https://www.energy.ca.gov/data-reports/energy-almanac/zero-emission-vehicle-and-infrastructure-statistics.

75 For more information on MDHD ZEVs registered for on-road travel, see the CEC's dashboard webpage, https://www.energy.ca.gov/data-reports/energy-almanac/zero-emission-vehicle-and-infrastructure-statistics/medium-and-heavy.

Shifts in Energy Use Patterns

Electrification of buildings and transportation will change energy use patterns, and there are numerous uncertainties around this that will need to be considered and monitored as electrification becomes more prevalent. The uncertainties include the rate of adoption of electric vehicles and heat pumps, EV charging patterns and *vehicle-to-building*[76] charging and discharging, the amount of electricity needed for instate production of hydrogen for use in fuel cell electric vehicles, battery storage charging and discharging, load flexibility and demand response, and ways that these factors may shift building load shapes and the overall system load shape. At the same time, utilities are considering rate strategies, such as real-time pricing, that encourage electrification and load shifting while ensuring grid reliability.

Long-Term Energy Demand Scenarios

The impacts of climate change and decarbonization policies have created a need for a routinely produced set of long-term energy demand scenarios to be used for planning purposes. To meet this need, in 2021 CEC staff developed long-term demand scenarios to identify energy demand and supply, as well as GHG emission reductions, from existing and near-term policies. The CEC adopted the analysis and results from the first round of scenarios May 24, 2022.[77] A subsequent round of scenarios will be completed for the 2023 IEPR cycle and will feed into the modeling conducted for the 2025 Senate Bill 100 (De León, Chapter 312, Statutes of 2018) report.

76 *Vehicle-to-building* and *vehicle-to-home* refer to using the battery of an EV like energy storage where there is a two-way power flow between the building and the vehicle, and the energy stored in the EV battery could be used to power the building.

77 May 24, 2022, CEC Business Meeting webpage, https://www.energy.ca.gov/event/meeting/2022-05/energy-commission-business-meeting-0.

CHAPTER 4:
Emerging Topics

Introduction

This chapter reports on developments over the last year on several important topics in which the California Energy Commission (CEC) is engaged to help advance California's clean energy goals. Topics include energy reliability, western electricity integration, hydrogen, and gasoline prices. Further, to address the need for ongoing analysis that extends beyond an annual Integrated Energy Policy Report (IEPR) cycle, the CEC launched two proceedings this year — one on gas decarbonization[78] and a second on distributed energy resources.[79] This chapter includes an update on these proceedings, and ongoing work is expected to be summarized in subsequent IEPRs.

Reliability

Energy reliability remains a key focus and driver of energy policy in California. In 2021, the California Independent System Operator (California ISO), California Public Utilities Commission (CPUC), and CEC focused substantial effort on addressing reliability, as discussed in the *2021 IEPR*. Further, in response to increasing reliability risks, the Governor and Legislature took unprecedented actions to establish a reserve of resources to support grid reliability through at least 2026. Still, reliability impacts persisted in 2022. The state continued to experience an extreme drought, supply chain issues, and threats to the grid from wildfires. Further, the state experienced an extreme heat event August 31–September 9, 2022, which set all-time high temperature records and the highest peak load in the California ISO's history.

The CEC described potential impacts to summer reliability in a public workshop May 20, 2022.[80] A joint analysis conducted by the CEC and California ISO focused on summer 2022 but

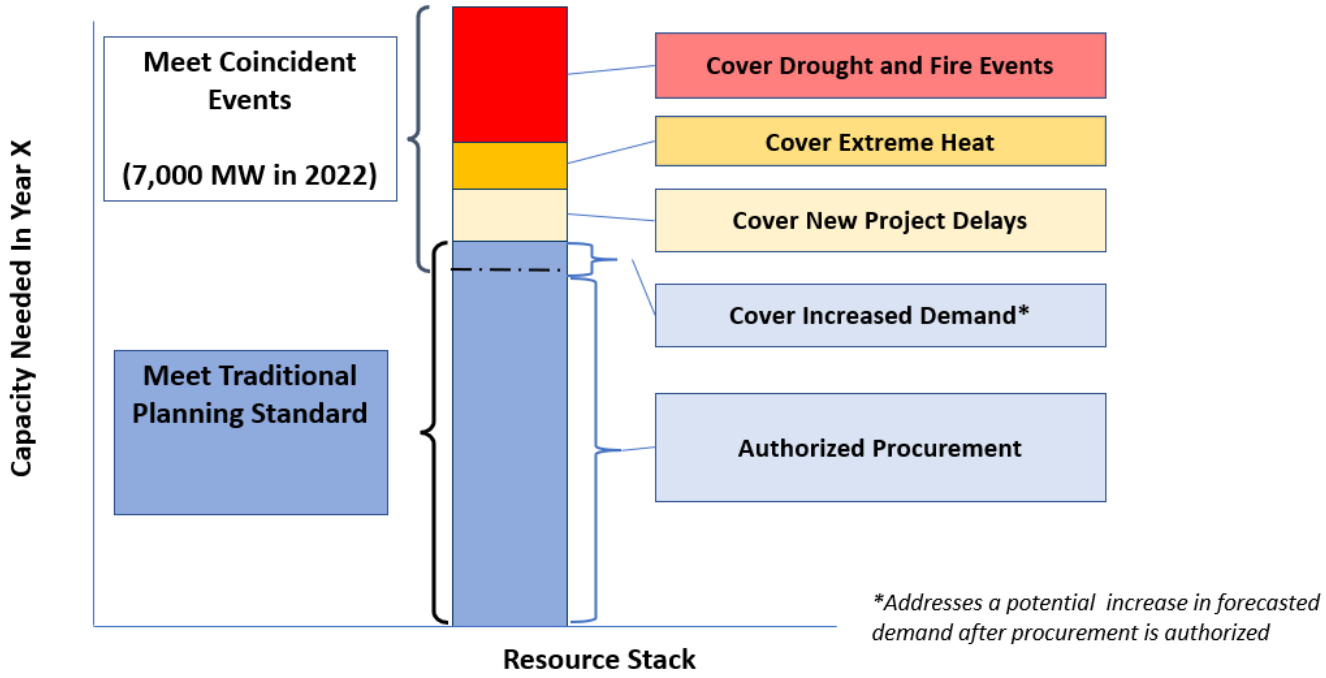
78 Order Instituting Informational Proceeding on Gas Decarbonization (22-OII-02), https://www.energy.ca.gov/proceedings/energy-commission-proceedings/order-instituting-informational-proceeding-gas.

79 Order Instituting Informational Proceeding on Distributed Energy Resources in California's Energy Future (22-OII-01), https://www.energy.ca.gov/proceedings/energy-commission-proceedings/order-instituting-informational-proceeding-distributed.

80 May 20, 2022, CEC Staff Workshop on Summer and Midterm Reliability. Docket 21-ESR-01. Staff presentations are available online at https://efiling.energy.ca.gov/Lists/DocketLog.aspx?docketnumber=21-ESR-01.

also evaluated reliability through 2025. The analysis identified four broad categories of capacity needed to address coinciding extreme events, as illustrated in Figure 14.

Figure 14: Reliability Impacts



Source: CEC staff

The first category reflects capacity needed to meet traditional grid reliability planning, shown in dark blue in Figure 14. Resource procurement requirements are based on evaluating the supply necessary to meet demand such that the system is not likely to have more than one outage event in 10 years — or 1 in 10 loss of load expectation (1-in-10 LOLE). Both supply and demand side issues can affect the quantity of resources needed to meet the 1-in-10 LOLE standard. For example, the CPUC's 2021 unprecedented energy procurement requirement for 11,500 MW by 2026 was based on CEC's demand forecast adopted in early 2021.[81] The CEC's 2021 CED forecast, adopted in January 2022, projects a greater demand through 2026 than was anticipated in the 2020 CEDU. The 2020 CEDU was used by the CPUC to develop the procurement order for 2022 and beyond. The peak demand in the 2021 CED increased compared to the 2020 CEDU in part due to an update to the weather normalization

81 CPUC. Decision 21-06-035. p. 94. https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M389/K603/389603637.PDF.

methodology to more heavily weight recent years to better capture climate change impacts.[82] Additional capacity will be needed to meet this greater demand and maintain a 1-in-10 LOLE for the year.

The second category (shown in light blue in Figure 14) is capacity to cover development delays to already authorized procurement of new generation and storage resources. As California procures unprecedented quantities of clean energy resources, load serving entities and project developers face issues that may lead to project delays or even cancellations. Most new generation will consist of solar, storage, or a combination of these two resources, both of which have experienced supply chain issues.

The third category consists of capacity resources to address conditions not incorporated in the traditional planning standard. These include extreme events such as the westwide heat wave experienced in August 2020, which led to multiple incidents of load curtailment, and the September 2022 extreme heat event.

The fourth category consists of resources to address coincident extreme events, such as extreme drought and wildfires. For example, the Bootleg Fire in Oregon reduced imports to the California ISO footprint by 3,000 MW in 2021 during an extreme drought year. (Shown in red in Figure 14.)

Table 3: Estimated Impact on Energy Reliability

Issue	2022	2025
Lag in incorporation of updated demand forecasts and policy goals in procurement targeting 1-in-10 traditional planning metric	1,700 MW	1,800 MW
Extreme weather and fire risks to energy assets not completely captured in 1-in-10 traditional planning efforts	4,000-5,000 MW	4,000-5,000 MW
Project development delay scenarios (estimated)	600 MW	1,600-3,800 MW

Source: Erne, David, CEC Staff Workshop on Summer and Midterm Reliability, Docket 21-ESR-01, May 20, 2022, "Reliability Workshop Overview," slide 8.

82 Javanbakht, Heidi, Cary Garcia, Ingrid Neumann, Anitha Rednam, Stephanie Bailey, and Quentin Gee. 2022. *2021 Integrated Energy Policy Report Volume IV: California Energy Demand Forecast*. California Energy Commission. Publication Number: CEC-100-2021-001-V4. https://efiling.energy.ca.gov/GetDocument.aspx?tn=241581.

The combination of the conditions (described in Table 3) suggested the potential need for roughly 7,000 MW of additional capacity in 2022 to maintain grid reliability in a coinciding event. However, the analysis identified 2,000 MW of additional contingency resources that could be called on in the event of an emergency above the 1-in-10 LOLE, thus reducing the outstanding capacity need to 5,000 MW. These contingency resources include additional voluntary or reimbursed load reduction and additional emergency generation. Despite the identified contingency resources, a large shortfall remains that increases to more than 10,000 MW in 2025.

As discussed below, this analysis was supported by the CEC's summer stack analysis and informed the Governor's and Legislature's actions to establish a reliability reserve for the state.

Stack Analysis

The CEC conducts an analysis ahead of summer to project how supply compares to demand under average and extreme weather conditions, termed the *stack analysis*. The CEC first conducted a stack analysis for summer 2021 and updated it for summer 2022. The analysis supplements traditional planning methods and is intended only to provide a snapshot of a potential worst-case scenario on the California ISO system, thus informing the need to prepare for adequate contingencies.

The CEC released two reports on the summer 2022 stack analysis results. The first, the *2022 Summer Stack Analysis*,[83] was a preliminary assessment conducted early in the calendar year and analyzed potential reliability conditions during the net peak for July, August, and September. The analysis looks at the highest potential hourly demand for a month. The analysis was updated just prior to summer to include the California Department of Water Resources' (DWR) final assessment of summer hydroelectric conditions, with results captured in the *2022 Summer Stack Analysis Update*.[84]

The updated analysis identified better summer net peak conditions for summer 2022 than were originally projected, in part because of the procurement ordered by the CPUC. For July and August 2022, resources were projected to be sufficient to address an average and an extreme heat event. However, the updated analysis showed the potential need to secure an additional 200 MW to 2,400 MW of contingencies during net peak demand hours in September 2022 to meet a 22.5 percent planning reserve margin (PRM). (See Figure 15.) *PRM* is a metric

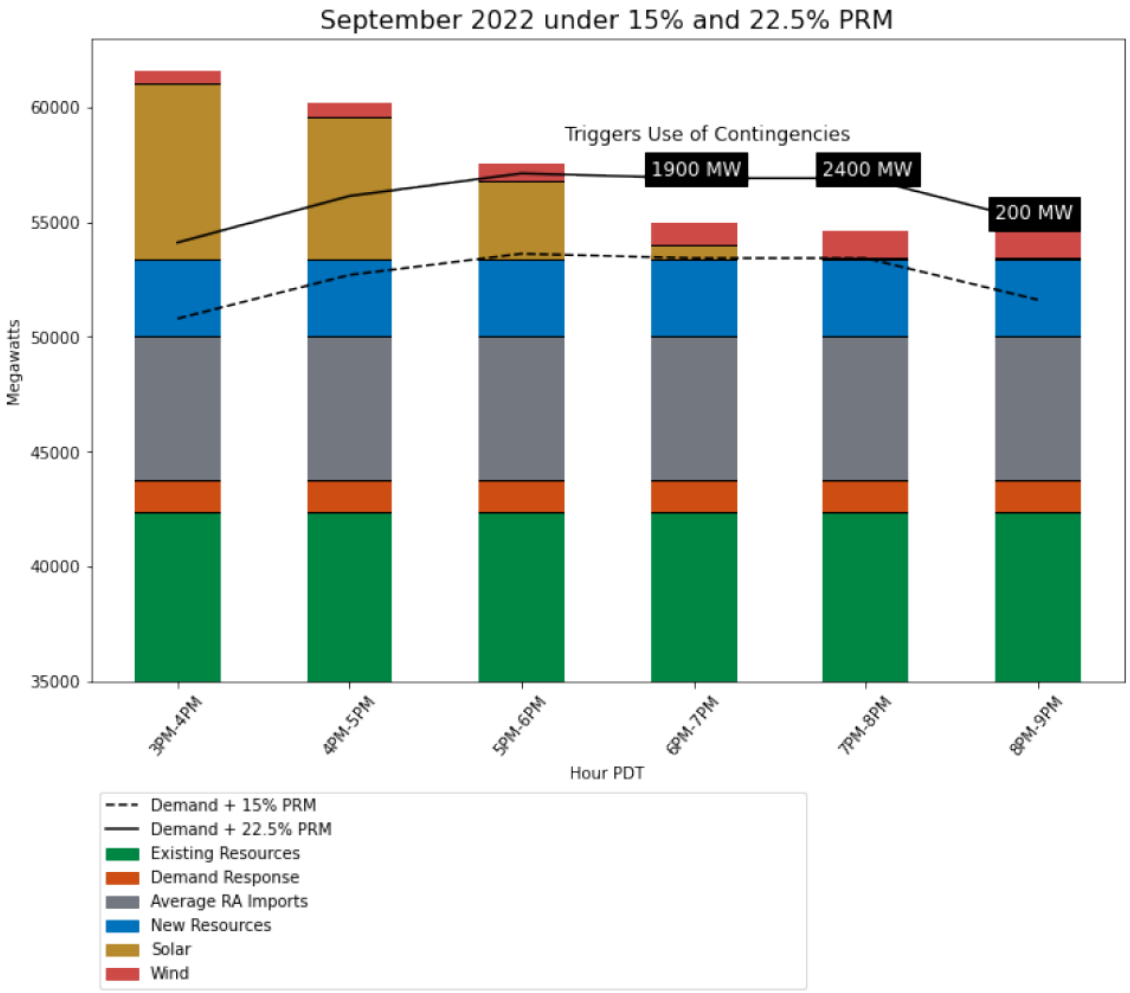
83 Tanghetti, Angela, Liz Gill, and Lana Wong. 2021. *2022 Summer Stack Analysis*. California Energy Commission. Publication Number: CEC-200-2021-006. https://efiling.energy.ca.gov/getdocument.aspx?tn=239635.

84 Tanghetti, Angela and Hannah Craig. 2022. *2022 Summer Stack Analysis Update*. California Energy Commission. Publication Number: CEC-200-2021-006-UPDT. https://efiling.energy.ca.gov/getdocument.aspx?tn=241145.

used to ensure there is sufficient supply to meet the demand under strained grid conditions, such as the loss of a generating resource or extreme weather. The analysis did not consider other potential impacts to supply, such as further supply chain issues, and coincident events such as extreme heat and a wildfire affecting transmission.

To reduce electricity shortfall, several contingency resources were identified. These resources include voluntary customer conservation, additional generation, load reductions, imports from other balancing authorities, and additional thermal generation.

Figure 15: September 2022 Stack Update



Source: CEC

Strategic Reliability Reserve

On June 30, 2022, Governor Gavin Newsom signed into law Assembly Bill 205 (Committee on Budget, Chapter 61, Statutes of 2022) to support grid reliability for the state and to provide additional emergency resources during extreme events. AB 205 also established the Strategic Reliability Reserve, which consists of three programs:

- **Demand-Side Grid Support (DSGS) Program** creates incentives for utility customers to reduce load and dispatch backup generation on an on-call basis. It is

similar to the CPUC's Emergency Load Reduction Program, which includes customers in investor-owned utility (IOU) territories but instead supports customers in non-IOU territories. The CEC adopted program guidelines August 10, 2022, and immediately opened the program to publicly owned utilities to register and enroll customers.

- **Distributed Electricity Backup Assets (DEBA) Program** provides incentives for the construction of clean and efficient distributed energy resources. The CEC is developing the program, and it will fund the deployment of new zero- or low-emission technologies such as fuel cells and energy storage at existing or new facilities.
- **The Electricity Supply Reliability Reserve Fund (SRRF)** is being implemented by the DWR to provide additional generation capacity to support grid reliability. Actions include extending the operating life of existing generation facilities planned for retirement, procuring new emergency or temporary power generators, or procuring energy storage. At its September 30, 2022, meeting, the Statewide Advisory Committee on Cooling Water Intake Structures recommended that the State Water Board extend the compliance dates for three once-through-cooling plants[85] to support the SRRF. This would allow the power plants to be available for contract to DWR as emergency resources.

Additional resources were allocated to these programs in subsequent legislation resulting in $295 million for DSGS, $700 million for DEBA, and $2.37 billion for SRRF, for a cumulative Strategic Reliability Reserve of $3.365 billion.

AB 205 also directed the CEC to expedite the certification of DWR facilities from October 31, 2022, to October 31, 2026. The CEC will provide guidance on optimal locations for facilities based on potential to:

1. Improve reliability.
2. Reduce Power Safety Power Shutoffs.
3. Decrease emissions from backup generation.
4. Minimize air pollution.
5. Avoid impacts to disadvantaged communities.

85 The advisory committee recommended extending the operation of Alamitos Generating Station Units 3, 4, and 5; Huntington Beach Generating Station Unit 2; and Ormand Beach Generating Station Units 1 and 2 for three years from December 31, 2023, though December 31, 2026, to support system reliability.

Draft 2022 Special Report of the Statewide Advisory Committee on Cooling Water Intake Structures. September 20, 2022. https://www.waterboards.ca.gov/water_issues/programs/ocean/cwa316/docs/2022/saccwis_report.pdf.

Diablo Canyon Extension

Through Senate Bill 846 (Dodd, Chapter 239, Statutes of 2022), the Governor and Legislature preserved the option to extend operation of the Diablo Canyon nuclear power plant for five years beyond the 2025 retirement date. This action was taken to enable the state to provide additional resources to support grid reliability while building new clean energy resources. Diablo Canyon serves about 6 percent of the state's electricity load. The bill requires the CPUC to set new retirement dates for the Diablo Canyon power plant, conditioned on the Nuclear Regulatory Commission extending the operating licenses of the power plant. The bill also established a $1.4 billion Diablo Canyon Extension Fund through DWR for funding the extension. The bill requires the CEC and CPUC to submit to the Legislature a joint reliability planning assessment that estimates future reliability of the electricity system, including a timeline to develop renewable energy resources and transmission capacity. Moreover, the bill directs the CEC before September 30, 2023, to (1) make available to the public a cost comparison of other potential resource portfolios as alternatives to the Diablo Canyon extension, (2) reevaluate the cost-effectiveness of extending operations of the Diablo Canyon power plant if costs exceed the loan value, (3) make a determination in a public process of the need for the Diablo Canyon extension, and (4) in coordination with the CPUC and California ISO, publish an assessment of the operation of the Diablo Canyon power plant.

Separately, the bill requires the CEC to develop two additional products: a Clean Energy Investment Plan and a goal for load shifting. The Clean Energy Investment Plan will identify investments that accelerate the deployment of clean energy resources, support demand response, assist ratepayers, and increase energy reliability. The load-shifting goal will focus on reducing net peak electrical demand, and the accompanying report will include recommended policies to increase demand response and load shifting without increasing greenhouse gas emissions or electric rates.

September 2022 Extreme Heat Event

An extreme heat event over the ten-day period from August 31 through September 9, 2022, set all-time high temperature records throughout the state. The extreme heat triggered the highest peak load recorded by the California ISO that exceeded the 22.5 percent PRM. On August 31, the Governor issued an emergency proclamation that enabled multiple initiatives to be deployed, including those authorized by AB 205. While the programs are in infancy, they helped meet the record demand experienced in September 2022. Californians also met the challenge and reduced their load during the critical net peak hours (between 4 p.m. and 9 p.m.) in response to FlexAlerts each day during the heat event and a wireless emergency alert on September 6. These efforts and more helped keep the power flowing and the lights on. A detailed analysis of the crises is underway and will be available by the end of the year.

Reliability Planning Assessment

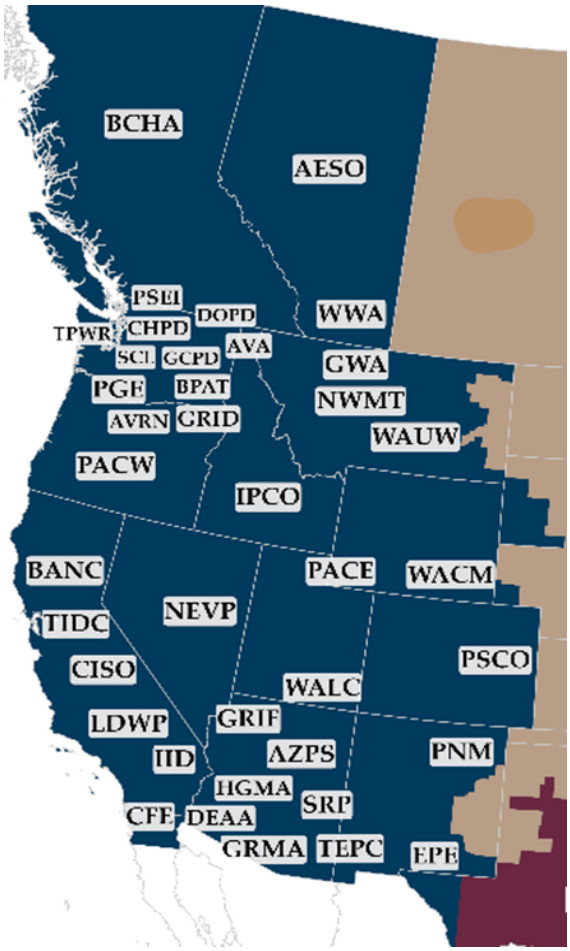
As required by SB 846, the CEC and CPUC are developing a Reliability Planning Assessment to estimate the balance of electricity supply and demand for 5 and 10 years forward. The analysis includes high-, medium-, and low-risk scenarios and will be completed by December 15, 2022.

Western Electricity Integration

Introduction

California's electricity system is an integral part of a much larger whole, the Western Interconnection (WI). The WI consists of electricity infrastructure in 11 western states, two Canadian provinces and portions of Mexico. It is composed of 34 balancing authorities (BA) that are independently governed by states and provinces, public boards, and the federal government. (See Figure 16.) To maintain stability, the interconnected system of balancing authorities must adhere to strict federal and provincial reliability standards, grid codes, and operating practices. This complex system continues to evolve through coordination efforts to address market development, resource adequacy, and transmission development.

Figure 16: WI Balancing Authorities



Source: Western Electricity Coordinating Council

Western Market Implementation and Enhancement

Electricity markets in the west continue to evolve and increase in complexity and capability. Two major market developments in the west include the California ISO Extended Day Ahead Market and the Southwest Power Pool Markets+.

California ISO Extended Day-Ahead Market and Related Elements

The California ISO led the major initial breakthrough in coordinating western markets, in the years following its day-ahead market launch in 2009, by designing a framework for sharing real-time energy imbalances (differences between supply and demand) across multiple balancing authorities. These efforts resulted in the implementation of the California ISO Western Energy Imbalance Market (WEIM) in 2014 with PacifiCorp as the first participant. The WEIM includes representatives serving nearly 80 percent of the Western Electricity Coordinating Council's load and provides a platform for participants to buy and sell power in increments of 5 to 15 minutes from when it is generated and consumed. This platform reduces transmission congestion and enhances reliability, allows participants to meet their needs with least-cost resources, and allows more efficient use of excess renewable energy that would otherwise be curtailed. Total benefits since inception include savings of more than $2 billion in gross benefits and reductions of more than 700,000 metric tons of GHGs.[86]

Most recently, the California ISO and stakeholders are working to create an even more critical *Extended Day Ahead Market* (EDAM) with the potential to achieve benefits significantly greater than real-time imbalance markets. California ISO staff managed a complex and multifaceted process culminating in an EDAM Revised Straw Proposal published in August 2022.[87]

The key objective of the EDAM design is to improve market efficiency by integrating renewable resources into the market using day-ahead (rather than only the real-time market used in WEIM) unit commitment and enabling resource scheduling across a geographic area larger than the California ISO footprint. The EDAM proposal would extend participation to WEIM entities. The proposal leverages a framework similar to the WEIM and maintains structures critical to balancing area operations.

Also impacting the day-ahead market is the Day-Ahead Market Enhancements (DAME) initiative, which would incorporate a new day-ahead product designed to cover both ramping needs and uncertainty between the day-ahead and real-time markets. The EDAM includes three categories of core design elements: prior to day-ahead, day-ahead, and after day-ahead, as shown in Table 4.

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86 California ISO. August 4, 2022. Fact Sheet, Western Energy Imbalance Market. https://www.westerneim.com/Documents/WEIM-2-Billion-in-Benefits-Fact-Sheet.pdf.

California ISO. 2022. *Western Energy Imbalance Market Benefits: Second Quarter 2022*. https://www.westerneim.com/Documents/iso-western-energy-imbalance-market-benefits-report-q2-2022.pdf. (Bottom line of Table 7, p. 29).

87 California ISO. EDAM webpage, https://stakeholdercenter.caiso.com/StakeholderInitiatives/Extended-day-ahead-market.

Table 4: EDAM Design Elements

Prior to the Day-Ahead Market	Day-Ahead Market Processes	After Day-Ahead Market
• Resource Sufficiency Evaluation • Transmission Commitment	• Integrated Forward Market & Residual Unit Commitment • Market Power Mitigation • Convergence Bidding • External Resource Participation • GHG Accounting	• Transfer Revenue Allocation • Settlements

Credit: California ISO

The California ISO is proposing initially to use a GHG accounting system that is effectively an extension of that used in the WEIM. This approach has the benefit of being well defined and requiring few design changes. The California ISO proposes to continue evaluating alternate approaches for accounting for GHGs.

The EDAM proposal process targets publishing a draft final proposal by late October 2022 and a final proposal by early December 2022. California ISO staff would bring the proposal before a joint session of the California ISO Board of Governors and the WEIM Governing Body for approval December 14, 2022.

Southwest Power Pool (SPP) Markets+

On the eastern side of the interconnection, a non-WI entity — SPP — is implementing a modest imbalance market and proposing an extensive "more than day-ahead market" termed *Markets+*. SPP staff began designing Markets+ in December 2021. To date, its efforts have attracted the interest of potential participants from across the WI, particularly hydroelectric utilities embedded within, or adjacent to, the federal system of the Bonneville Power Administration (BPA) and the BPA itself, along with several Arizona utilities.

BPA committed to provide funding toward developing Markets+ in August 2022, which came with assurances that no decision had yet been made with respect to joining the market. This commitment spurred several others to commit funding in August and September 2022, as SPP works toward publishing a service offering for Markets+ in November 2022. SPP identified March 2023 as a critical time frame for western utilities to express its intent to participate.

The SPP market design proposes to bundle services to centralize day-ahead and real-time unit commitment and dispatch. The aim is to provide seamless transmission service across the footprint and reliably integrate an ever-growing renewable generation fleet. Markets+ offers a voluntary market with the potential to realize significant benefits and represents a competing market design alternative to those of the California ISO with the potential for broad implications around regional coordination.

Western Resource Adequacy Program Emergence

The changing resource mix in the WI (including renewable generation and battery energy storage systems coming on-line and the retirement of aging thermal and coal fired resources)

and increasing weather extremes are driving a need for coordinated resource adequacy planning. Generally, effective resource adequacy planning ensures reliable electric service by guiding resource procurement decisions and promoting resource infrastructure investment.

Western Power Pool

The Western Power Pool (formerly the Northwest Power Pool), Powerex, and other major western utilities/states are developing the Western Resource Adequacy Program (WRAP) to help address resource adequacy concerns. The program covers much of the Western Interconnection (north and east of California), and the Western Power Pool has engaged a wide range of WI stakeholders in the program development.

The Western Power Pool staff presented the program at the California ISO in early September 2022 to an audience of largely California ISO WEIM participants and stakeholders. The Western Power Pool staff emphasized the need to build flexibility into the program design so that WRAP can integrate with emerging electricity market designs.

WRAP aims to reduce requirements on members to demonstrate commitments of generating capacity without compromising system adequacy. This aim includes a proposal for a *binding forward showing process*, a requirement for members to demonstrate procurement of their share of the expected regional capacity needed for a given season. Further, WRAP proposes requiring members with surplus capacity to assist those with a deficit during the hours of highest need. The WRAP stakeholders and developers have elected to retain SPP as program operator. In an August 2022 filing to the Federal Energy Regulatory Commission (FERC), the Western Power Pool requested a WRAP implementation effective date of January 1, 2023.[88]

Western Electricity Coordinating Council (WECC) Facilitation of Resource Adequacy Discussions

Stakeholders in the WI have increasingly expressed resource adequacy concerns to WECC staff and membership. Resource adequacy work from WECC staff and committees has identified potential reliability risks to the bulk power system driven by changes in loads and resources over the coming decade.[89] Through WECC stakeholder initiatives like the Western Assessment of Resource Adequacy, analysis and information on resource adequacy are provided to stakeholders and decision makers. The WECC resource adequacy work supports broader

88 The WRAP FERC filing, which includes transmittal letter, supporting affidavits, and the tariff is available at https://www.westernpowerpool.org/private-media/documents/ER22-2762_WRAP_Tariff_Filing.pdf.

89 WECC. 2021 Western Assessment of Resource Adequacy. https://www.wecc.org/Administrative/WARA%202021.pdf. and North American Electric Reliability Corporation. 2020 Summer Reliability Assessment. June 2020. https://www.wecc.org/Administrative/NERC_SRA_2020.pdf.

evaluations of systems adequacy at the national level by providing information for inclusion in the North American Electric Reliability Corporation's long-term reliability assessments, probabilistic assessments, and seasonal assessments.

In mid-summer 2022, WECC also began hosting a resource adequacy discussion series to explore current and emerging issues with stakeholders. By sharing challenges and reviewing analytical approaches, the WECC staff is gathering stakeholder input on resource adequacy analytics.

Multistate Transmission Project Development

Transmission lines throughout the West enable the transfer of electricity from one region to the next; the lines are the highways that allow the markets to function. Major transmission paths connect California balancing authorities directly to the Northwest, Utah, Nevada, Arizona, and Mexico. These lines carried more than 92,000 GWh into California in 2021,[90] and this number is expected to grow as California relies on new resources, primarily wind, in other parts of the West to attain its climate goals. Figure 17 shows the major transmission lines in California and connections to other states.

90 CEC Energy Almanac. California Electrical Generation - Imports and Exports. https://www.energy.ca.gov/data-reports/energy-almanac/california-electricity-data/california-electrical-energy-generation.

Figure 17: California Transmission

Credit: Homeland Infrastructure Foundation Level Database, CEC staff

Transmission Proposals in the Western Region

The California ISO's *20-Year Transmission Outlook*[91] provides a general look at California's resource and transmission needs through 2040. The California ISO's 20-year outlook anticipates the need to import around 12,000 MW of out-of-state wind resources. This capacity includes roughly 2,000 MW on existing transmission and the remaining 10,000 MW requiring new transmission lines. Proposed transmission projects can carry around 6,000 MW to the California ISO, but the remaining 4,000 MW will require new transmission. The California ISO's 20-year outlook also anticipates the need for numerous transmission upgrades within California to connect new in-state resources, including offshore wind, and reliability enforcements to the existing system to deliver energy to load centers. Figure 18 is the

91 California ISO, 20-Year Transmission Outlook. May 2022. http://www.caiso.com/InitiativeDocuments/20-YearTransmissionOutlook-May2022.pdf.

California ISO's illustrative look at resource areas and the associated transmission identified in its 20-Year Transmission Outlook.

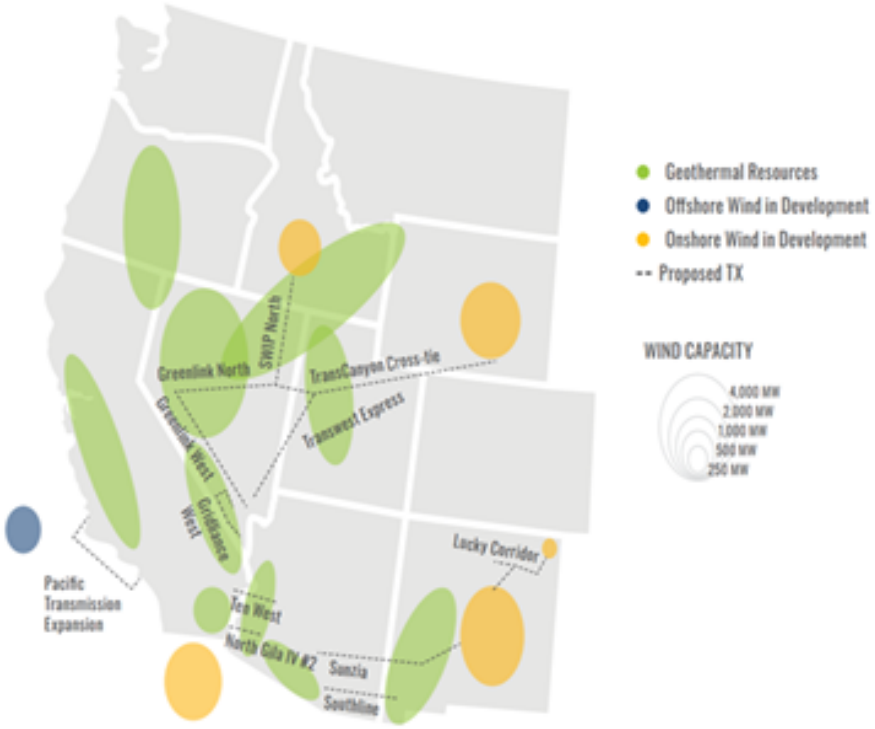
Figure 18: California ISO's Illustrative Transmission Needs From California ISO 20-Year Outlook

Credit: California Independent System Operator, *20-Year Transmission Outlook*, May 2022, Figure 5.4-1: Illustrative Diagram of Transmission Development, page 47

With regard to out-of-state wind, there are three primary resource areas in New Mexico, Wyoming, and Idaho, each with thousands of MW of potential high-quality wind resources, with transmission proposals to bring this wind generation to California. Figure 19 shows regional renewable resource areas and proposed transmission projects in various stages of permitting. Four proposed projects — the Sunzia Southwest Transmission Project, the Transwest Express Project, the Cross-tie, and the Southwest Intertie Project North — could deliver a total of 6,000 MW of wind generation to California. These four projects have been under development for many years. Portions could begin construction as soon as financing is approved and be operating within a few years.

The California ISO is evaluating a novel subscriber participating transmission owner (SPTO) application from the Transwest Express Transmission Project developers. The SPTO would fund transmission revenue requirements from subscribers (sources) or off-takers from the subscriber (sinks), rather than through the California ISO transmission access charge revenue mechanism.

Figure 19: Resources Areas and Proposed Transmission Projects



Credit: Resolving interconnection Queue Logjams, Grid Strategies LLC for the California ISO, October 2021, Figure 9.

Transmission Summary

California will require significant investment in both its own and regional transmission to achieve its 2045 climate goals. There are several regional transmission projects designed to deliver renewable generation to California, but significantly more transmission is necessary. One option is to move forward with the existing projects in their current forms, knowing that new projects will be required. Another is to redesign these projects to accommodate future resource needs. A challenge for the next few years is balancing near-term (10-year) and long-term (about 20 years or more) transmission needs without hampering new transmission development.

Role of Hydrogen in California's Clean Energy Future

As part of the CEC's continuing assessment of the role of hydrogen in achieving the state's decarbonization goals, the CEC held a public workshop June 21, 2022. Drawing on staff analysis and information from the workshop, this section provides an overview of how hydrogen is used today and a look ahead to emerging opportunities, including pursuit of a California Hydrogen Hub, that will shape the state's hydrogen future.

Hydrogen Use in California and the United States is Commonplace

Hydrogen is produced and used around the world. Hydrogen production can be categorized into three types (1) *merchant* hydrogen, which is sold to a customer and transported via pipeline, bulk tank, or cylinder truck; (2) *captive* hydrogen, which is produced and used onsite

(such as by oil refineries); and (3) *by-product* hydrogen, which is recovered as a by-product from process streams and can either be sold or used onsite.

Hydrogen production capacity in the U.S. is estimated at around 10 million metric tons per year (MMT/yr), with variance depending on the source and inclusion of by-product hydrogen.[92] California is estimated to produce 1.05 MMT/yr of hydrogen,[93] or about 10.5 percent of the national capacity, at a combination of petroleum refineries and merchant hydrogen production plants.

Most hydrogen production and use are in petroleum refining, but there are also a wide variety of industrial uses, including fertilizer production, food processing, and treating metals. Hydrogen is also used as rocket fuel for spacecrafts.[94] Nationally, 55 percent of hydrogen usage is for petroleum refining, 35 percent for producing ammonia and methanol, 2 percent for treating metals, and 8 percent for all other uses.[95] California largely imports ammonia fertilizer and has an insignificant amount of in-state ammonia production, as shown in Figure 20, meaning that in California the percentage of hydrogen used for petroleum refining exceeds the national average. In the second quarter of 2022, the hydrogen refueling station network in

92 U.S. DOE. "Current Hydrogen Market Size: Domestic and Global." October 1, 2019. https://www.hydrogen.energy.gov/pdfs/19002-hydrogen-market-domestic-global.pdf.

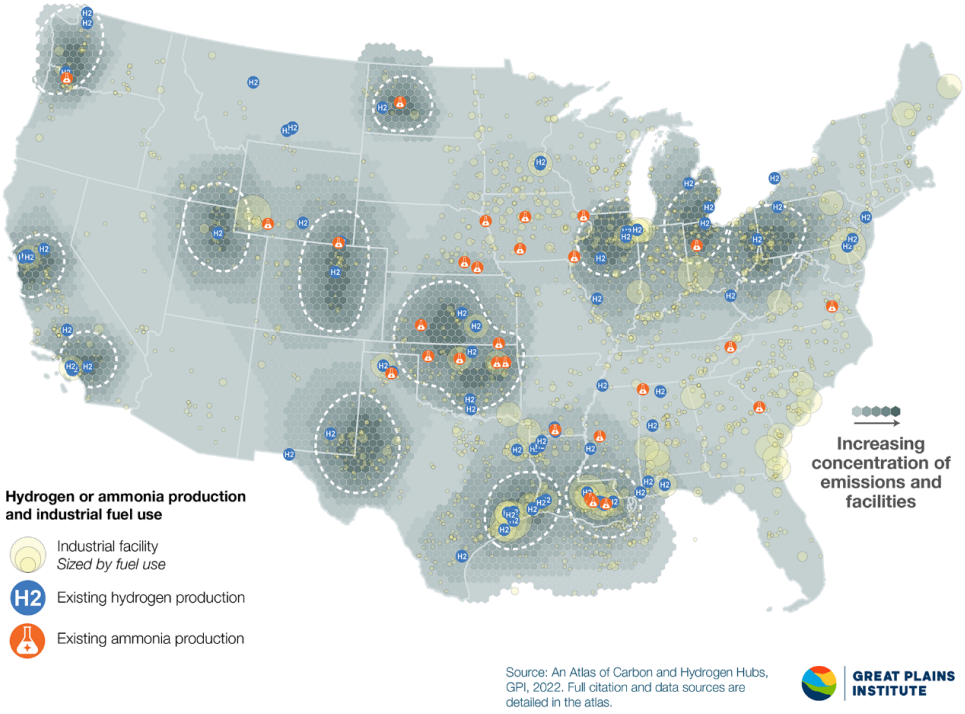
93 CEC staff calculation. Used Documentation of California's 2000-2019 GHG Inventory, https://ww2.arb.ca.gov/applications/california-ghg-inventory-documentation, files for 2 – Industrial Processes and Product Use, 2H – Other, 2H3 – Hydrogen Production. Calculated the average of the emissions from hydrogen production emissions from fuel conversion from natural gas and refinery gas from 2017, 2018, and 2019, which is 5.4 $MMTCO_2e/yr$. Used 52 percent, the ratio of fuel conversion emissions to total emissions, calculated using Table 2 from Bonaquist, Dante. 2010. *Analysis of CO2 Emissions, Reductions, and Capture for Large-Scale Hydrogen Production Plants*. https://www.linde.com/-/media/linde/merger/documents/sustainable-development/praxair-co2-emissions-reduction-capture-white-paper-w-disclaimer-r1.pdf?la=en, to result in 10.45 $MMTCO_2e/yr$. Converted these emissions to tons of hydrogen produced using the GHG benchmark for on-purpose hydrogen gas production of 8.94 $MTCO_2e/MT\ H_2$ from CARB, Unofficial electronic version of the Regulation for the California Cap on Greenhouse Gas Emissions and Market-Based Compliance Mechanisms, Table 9-1: Product-Based Emissions Efficiency Benchmarks. https://ww2.arb.ca.gov/sites/default/files/2021-02/ct_reg_unofficial.pdf, and the GHG benchmark formula of 90 percent of the average emissions intensity from CARB. March 2014. Appendix A: Additions and Amendments to Product-Based Benchmarks in the Cap-and-Trade Regulation, pp. 19-20. https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2013/capandtrade13/2appabenchmarks.pdf (10.45 $MMTCO_2e/yr$ / 8.94 $MTCO_2e/MT\ H_2$) * 0.9 = 1.05 $MMT\ H_2/yr$.

94 U.S. EIA. "Hydrogen Explained – Use of Hydrogen." https://www.eia.gov/energyexplained/hydrogen/use-of-hydrogen.php.

95 Satyapal, Sunita. U.S. DOE. June 6, 2022. 2022 Annual Merit Review Plenary Session. Slide 5. Accessed October 10, 2022. https://www.energy.gov/sites/default/files/2022-06/hfto-amr-plenary-satyapal-2022.pdf.

California was on average dispensing nearly 7 tons of hydrogen per day, which translates to 2,500 tons per year or about 0.2 percent of total production.[96]

Figure 20: National Hydrogen and Ammonia Production and Industrial Facilities



Source: Great Plains Institute. February 2022. An Atlas of Carbon and Hydrogen Hubs for United States Decarbonization. https://betterenergy.org/blog/gpi-carbon-and-hydrogen-hubs-atlas/. p. 18.

Opportunities to Reduce GHG Emissions

The 1.05 MMT/yr of hydrogen production in California results in 10.4 MMT carbon dioxide equivalent ($MMTCO_2e$) of in-state emissions annually, about 2.5 percent of California's total GHG emissions.[97] Emissions from fossil gas production and transmission to support hydrogen

96 Data collected and extrapolated by the Fuels and Transportation Division from hydrogen refueling stations. Latest figures will be published in the 2022 Joint Agency Staff Report on Assembly Bill 8 (forthcoming).

97 Using the hydrogen production benchmark of 8.94 based on 90 percent of the average emissions intensity of the sector = 9.93 MT CO_2e/MT H_2, from California Air Resources Board, Product-Based Benchmarks in the Cap-and-Trade Regulation (March 2014), https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2013/capandtrade13/2appabenchmarks.pdf.

Using total of 418.2 $MMTCO_2e$ for California's total GHG emissions, from California Air Resources Board. 2000-2019 GHG Inventory (2021 Edition). https://ww2.arb.ca.gov/ghg-inventory-data.

production in California (about 1.2 $MMTCO_2e/yr$[98]) and emissions associated with imported ammonia fertilizer produced from hydrogen (about 2 $MMTCO_2e/yr$[99]) are also significant.

Hydrogen is almost exclusively produced by steam methane reformation (SMR), in which methane (CH_4) molecules are split to extract the hydrogen and CO_2 is released into the atmosphere. The source of methane is almost exclusively from fossil gas. Emission reductions can be achieved by directly producing hydrogen from biomethane using SMR, or by using renewable or zero-carbon electricity to make hydrogen using electrolysis, that result in zero or minimal fossil GHG emissions. Emissions reductions are also possible by capturing and sequestering carbon emissions.

In passing Assembly Bill 1279 (Muratsuchi, Chapter 337, Statutes of 2022) in August 2022, the California Legislature set targets to achieve statewide carbon neutrality no later than 2045 and to ensure anthropogenic emissions are reduced 85 percent from 1990 levels by 2045. This legislation requires CARB to identify and implement policies that enable CCUS projects within California to support achieving the 2045 targets. The Legislature also passed Senate Bill 905 (Caballero, Chapter 359, Statutes of 2022) in August 2022, giving CARB significant authority to establish a Carbon Capture, Removal, Utilization, and Storage Program.

Need for Consistency and Standardization to Measure Climate Benefits

As discussed, the climate benefit of hydrogen depends largely on the feedstock and process used for production. A color scheme has been used as a useful shorthand to explain the inputs and process used to produce hydrogen (Table 5) but has limitations. There is a lack of consistent understanding in — and use of — colors to describe hydrogen. For instance, another color chart lists black hydrogen in the same category as gray hydrogen[100] and green hydrogen

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98 Using 1.05 MMT/yr H_2 production, 2 kg CH_4 needed per 1 kg H_2 for SMR.

Using 2.3 percent leak rate for the U.S. oil and gas supply chain from Alvarez et al. 2018. "Assessment of Methane Emissions From the U.S. Oil and Gas Supply Chain." *Science*, 361(6398): pp. 186-188. doi: 10.1126/science.aar7204.

Using 25 kg $CO_2e/kg\ CH_4$ from CARB GHG Global Warming Potentials, https://ww2.arb.ca.gov/ghg-gwps.

99 Using 589,524 MT N/yr total fertilizer use in California for 2017 from CARB Emission Inventory Methodology for Soil Nitrogen Oxides. March 16, 2022. https://ww2.arb.ca.gov/natural-non-anthropogenic-source-methodologies.

Using 2.6 MT $CO_2e/MT\ NH_3$ from Liu, Xinyu, Amgad Elgowainy, and Michael Wang. 2020. "Life Cycle Energy Use and Greenhouse Gas Emissions of Ammonia Production From Renewable Resources and Industrial By-Products." *Green Chemistry 24: 4830-4844*. https://pubs.rsc.org/en/content/articlelanding/2020/gc/d0gc02301a.

100 North American Council for Freight Efficiency. December 2020. "Hydrogen Color Spectrum." https://nacfe.org/news/nacfe-december-2020-newsletter/.

can encompass more than just electrolysis of renewables, as is the case in the draft 2022 Scoping Plan Update.[101] Established production methods, such as using biomass as feedstock in SMR and gasification, are missing from the colors shown, while other methods not very relevant to California, such as production using coal as a feedstock, are represented in the colors. The color scheme provides only a high-level insight into the relative benefits of using one color of hydrogen over another.

Table 5: The Many Colors of Hydrogen for Illustrative Purposes

Production Fuel	Terminology	Technology	Feedstock/ Electricity Source	GHG Footprint*
Electricity	Green Hydrogen	Electrolysis	Wind, Solar, Hydro, Geothermal, Tidal	Minimal
Electricity	Purple/Pink Hydrogen	Electrolysis	Nuclear	Minimal
Electricity	Yellow Hydrogen	Electrolysis	Mixed-origin Grid Energy	Medium
Fossil Fuels	Blue Hydrogen	Gas Reforming + CCUS Gasification + CCUS	Natural Gas, Coal	Low
Fossil Fuels	Turquoise Hydrogen	Pyrolysis	Natural Gas	Solid Carbon (By-product)
Fossil Fuels	Grey Hydrogen	Gas Reforming	Natural Gas	Medium
Fossil Fuels	Brown Hydrogen	Gasification	Brown Coal (Lignite)	High
Fossil Fuels	Black Hydrogen	Gasification	Black Coal	High

Source: World Energy Council. 2021. *Working Paper, National Hydrogen Strategies*. https://www.worldenergy.org/assets/downloads/Working_Paper_—_National_Hydrogen_Strategies_—_September_2021.pdf. *GHG footprint is a general guide, but each category can be higher in some cases.

Several solutions could clarify hydrogen terminology. The colors could be further defined to enable consistency and transparency in accounting for GHG reductions. For instance, the

101 California Air Resources Board. May 10, 2022. *Draft 2022 Scoping Plan Update*. Green hydrogen defined in Executive Summary, page i. https://ww2.arb.ca.gov/sites/default/files/2022-05/2022-draft-sp.pdf.

Green Hydrogen Coalition defines green hydrogen as "hydrogen produced from non-fossil-fuel feedstocks and emits zero or de minimis GHG emissions on a lifecycle basis."[102] Alternatively, different terminology from the color scheme could be employed, such as *renewable hydrogen* (defined in the Low Carbon Fuel Standard, Title 17, California Code of Regulations § 95481) or *clean hydrogen* — the term used in the federal Bipartisan Infrastructure Law, having the definition of "hydrogen produced with a carbon intensity equal to or less than 2 kilograms of carbon dioxide-equivalent produced at the site of production per kilogram of hydrogen produced" (Title 42, United States Code § 16166).

Further, the Inflation Reduction Act provides hydrogen production credits on a sliding scale, with more credits given the lower the carbon emissions, with credits being offered to *qualified clean hydrogen* projects that result in a life cycle GHG emission rate of not greater than 4 kilograms of CO_2e per kilogram of hydrogen.[103]

Given the competing definitions and variety of naming conventions for hydrogen, staff continue to grapple with terminology in documents such as this report. SB 1075 requires CARB, in consultation with the CEC and CPUC, to analyze the GHG emissions from various forms of hydrogen and provides an opportunity to address the challenges of the current lack of standardization.

Further, there is a need to better track and understand direct emissions of hydrogen (for example, due to leaks), their global warming impact, and mitigation measures to assess more accurately the potential environmental, health, and safety impacts of hydrogen use. Hydrogen released into the atmosphere (either through leaks during storage and transport or unburned in a power plant) is mostly removed (70 to 80 percent) by soils via diffusion and bacteria. The remainder (20 to 30 percent) reacts with naturally occurring hydroxyl radical (OH), which leads to a buildup of methane and ozone (both potent greenhouse gases), and stratospheric cooling (also contributing to global warming).[104]

The 20-year global warming potential (GWP) for hydrogen is estimated at about 33 and the 100-year GWP at 11.[105] Hydrogen has a higher diffusivity than fossil gas and causes steel brittleness, so it is important to minimize leakage for climate, safety, and economic reasons. Hydrogen-specific infrastructure will be needed for hydrogen-only end uses. California had 26

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102 Green Hydrogen Coalition. "Green Hydrogen." https://www.ghcoalition.org/green-hydrogen.

103 Congress.gov. H.R. 5376 – Inflation Reduction Act of 2022. SEC. 13204. Clean Hydrogen. https://www.congress.gov/bill/117th-congress/house-bill/5376/text.

104 Ocko, I. B., and S. P. Hamburg. 2022. "Climate Consequences of Hydrogen Leakage." *Atmospheric Chemistry and Physics*, 22: 9349-9368. https://acp.copernicus.org/articles/22/9349/2022/acp-22-9349-2022.html.

105 Ibid.

miles of hydrogen-dedicated pipeline in 2021[106] and transporting hydrogen from production sites near renewable solar, wind, and biowaste sources will require additional pipelines or transport via trucks or trains. While investing in hydrogen production, storage, and transport infrastructure, the state must appropriately measure and monitor leakage.

Regardless of the approach taken to clarify terminology and accurately measure emissions from the full hydrogen life cycle, policy makers and the public need a way to assess consistently and confidently the benefits and costs of using hydrogen as a decarbonization solution. A standard, well-defined taxonomy can inform the public about the potential applications and climate benefit.

Future Role of Hydrogen

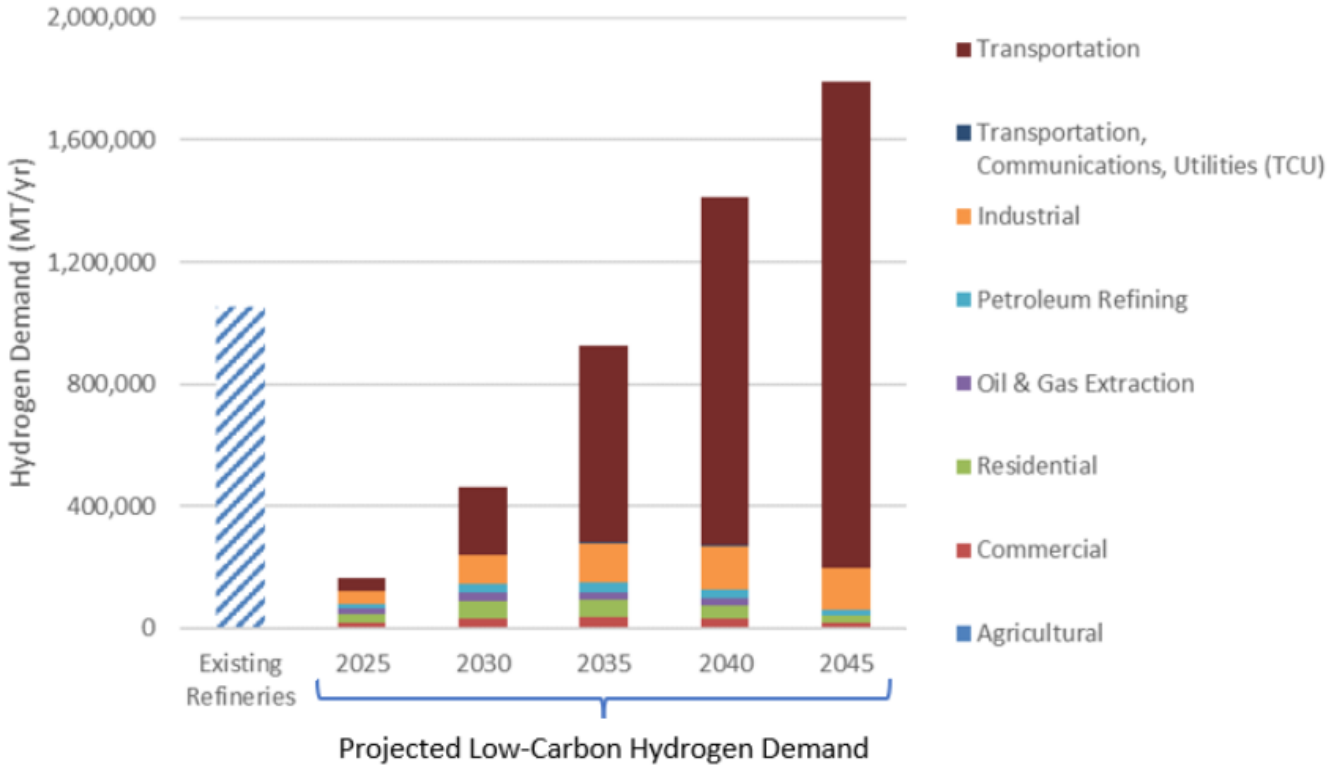
Besides eliminating emissions from existing production, low-carbon hydrogen may be used in a variety of sectors to achieve GHG emissions reductions. While a preliminary assessment of the role of hydrogen is provided here, SB 1075 (Skinner, Chapter 363, Statutes of 2022) requires CARB, in consultation with the CEC and CPUC, to develop policy recommendations on the use of hydrogen by June 1, 2024. The statute also requires the CEC to model the potential growth of hydrogen and its role in decarbonizing the electrical and transportation sectors as part of the 2023 and 2025 IEPRs.

As part of its *Draft 2022 Scoping Plan Update*, CARB modeled the potential growth of low-carbon hydrogen demand. The analysis shows demand for low-carbon hydrogen in 2045 increasing to nearly 70 percent more than current levels of fossil-fuel-based hydrogen — or a 60-fold increase in existing low-carbon production in California (Figure 21).[107] Cleaning up the SMR-produced hydrogen used today at refineries can have a large emissions reduction impact in the near-term due to the scale of established demand. Emerging end uses will take time to scale-up, but beyond 2035, they may dominate statewide hydrogen demand.

106 Pipeline and Hazardous Materials Safety Administration (PHMSA), "Gas Distribution, Gas Gathering, Gas Transmission, Hazardous Liquids, Liquefied Natural Gas (LNG), and Underground Natural Gas Storage (UNGS) Annual Report Data," Form 7100.2-1 Part H operator filings database, 2021 (as of October 3, 2022), https://www.phmsa.dot.gov/data-and-statistics/pipeline/gas-distribution-gas-gathering-gas-transmission-hazardous-liquids.

107 CARB. Draft 2022 Scoping Plan Update webpage. https://ww2.arb.ca.gov/our-work/programs/ab-32-climate-change-scoping-plan/2022-scoping-plan-documents#:~:text=The%202022%20Scoping%20Plan%20Update%20focuses%20on%20outcomes%20needed%20to,economic%2C%20environmental%2C%20energy%20security%2C.

Figure 21: 2022 Draft Scoping Plan Proposed Scenario — Modeled Hydrogen Demand Growth by Sector



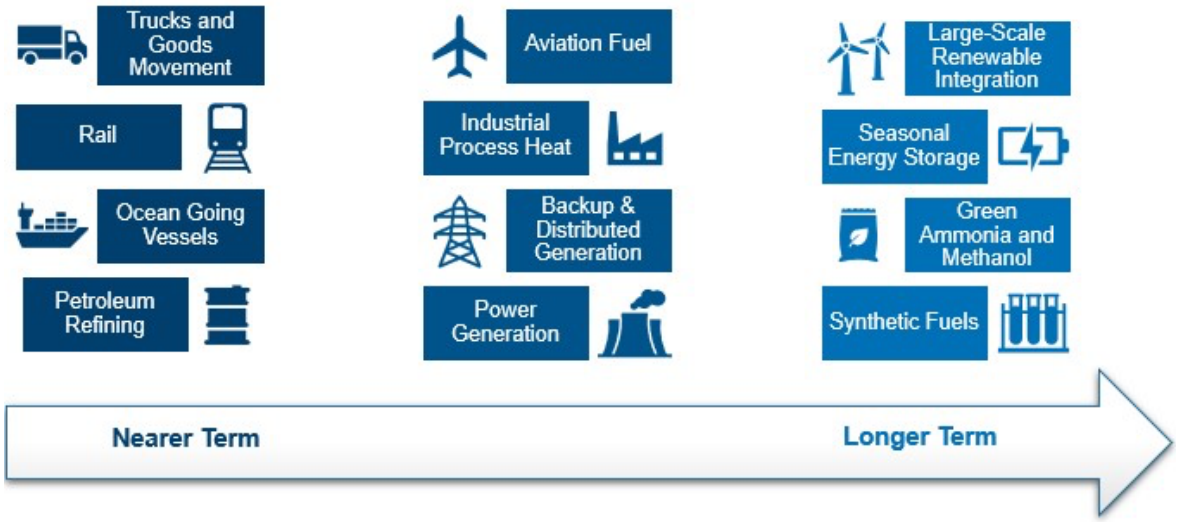
Note: Staff assumed 1.05 MMT/yr demand at existing refineries, met by fossil-derived hydrogen, based on a calculation of annual hydrogen production in California (2017-2019), almost all of which is used in refineries.

Credit: CEC staff using data from the draft *2022Scoping Plan Update* – AB 32 GHG Inventory Sectors Modeling Data Spreadsheet for 2025-2045 low-carbon hydrogen demand by sector in the Proposed Scenario

Hard-to-electrify transportation and industrial processes, and grid reliability are key areas with a high potential for increased hydrogen use, which is broadly consistent with hydrogen growth modeled in the draft *2022 Scoping Plan Update*.[108] These and other opportunities are shown in Figure 22.

108 In the draft *2022 Scoping Plan Update*, CARB refers to clean electricity generation rather than grid reliability. The 2021 SB 100 Joint Agency Report, Achieving 100 Percent Clean Electricity in California: An Initial Assessment developed by the CEC, CPUC, and CARB discusses using hydrogen for grid reliability. https://efiling.energy.ca.gov/EFiling/GetFile.aspx?tn=237167&DocumentContentId=70349. p. 109.

Figure 22: Simplified Representation of Nearer and Longer-Term Opportunities for Hydrogen Decarbonization



Credit: CEC staff

Hard-to-Electrify Transportation

Governor Newsom's Executive Order N-79-20 calls for a 100 percent zero-emission vehicle (ZEV) future, including all new passenger ZEV sales by 2035, all medium- and heavy-duty trucks and buses be ZEV by 2045 everywhere feasible, and all drayage trucks be ZEV by 2035. The current ZEV market is dominated by battery-electric vehicles (BEVs), but manufacturers are also making investments in fuel cells, including transit buses and long-haul trucks.

Hydrogen fuel cell electric vehicles (FCEVs) offer certain advantages over BEVs, including quicker refueling, lighter weight, and longer ranges, which could be particularly important for goods movement. There are potential environmental benefits of using fuel cells over lithium-ion batteries. While fuel cells have cost and resource challenges because of rare-earth metals like platinum used in production, they do not have the same reliance on cobalt and lithium that are challenges in battery production, and they also have fewer challenges in disposal and recycling.[109] On the other hand, BEVs have certain advantages over FCEVs. BEVs are the least expensive ZEVs available in terms of unsubsidized costs. While refueling takes longer, recharging infrastructure can be more convenient than hydrogen refueling stations. Using electricity to power vehicles using a battery is a more efficient process than converting energy first to hydrogen and then to electricity.

109 Shafi, Mohammed. Greenbiz. March 29, 2022. "In the Battle Over Electric Vehicles, Could Hydrogen Win?" Accessed October 10, 2022. https://www.greenbiz.com/article/battle-over-electric-vehicles-could-hydrogen-win.

A comparison of making hydrogen from electrolysis and using it in an FCEV with using electricity to charge a battery in a BEV found the BEV to be approximately 2.3 times more energy efficient as of 2020, with hydrogen efficiency improving but still about half the efficiency of batteries by 2050.[110] Also, BEV technology has matured and scaled faster than FCEV technology, resulting in many more makes and models of BEVs available in the market. These competing factors reflect the complexity of determining the "best" zero-emission technology for each transportation use case.

The CEC's Clean Transportation Program has already invested $166 million, with plans to invest a total of $279 million, in publicly available hydrogen refueling infrastructure to support the commercial launch of FCEVs. These investments are aimed at achieving the 200-station goal set by former Governor Edmund G. Brown Jr.'s Executive Order B-48-18.[111] Through the third quarter of 2022, 13,998 FCEVs have been cumulatively sold or leased in California and 62 publicly available hydrogen refueling stations have opened to serve them.[112] Further, hydrogen and hydrogen carriers have the potential to power vehicles such as trains, ships, and aircraft. For example, ammonia and methanol made from hydrogen will be used as maritime fuels for a green shipping corridor between the Port of Los Angeles and the Port of Shanghai.[113]

110 Shahan, Zachary. February 1, 2021. "Chart: Why Battery Electric Vehicles Beat Hydrogen Electric Vehicles Without Breaking A Sweat." CleanTechnica, with chart credit to Transport & Environment. https://cleantechnica.com/2021/02/01/chart-why-battery-electric-vehicles-beat-hydrogen-electric-vehicles-without-breaking-a-sweat/.

111 Baronas, Jean, Belinda Chen, et al. 2021. *Joint Agency Staff Report on Assembly Bill 8: 2021 Annual Assessment of Time and Cost Needed to Attain 100 Hydrogen Refueling Stations in California*. California Energy Commission and California Air Resources Board. Publication Number: CEC-600-2021-040. https://www.energy.ca.gov/sites/default/files/2021-12/CEC-600-2021-040.pdf.

112 California Energy Commission. "Zero Emission Vehicle and Infrastructure Statistics." https://www.energy.ca.gov/data-reports/energy-almanac/zero-emission-vehicle-and-infrastructure-statistics.

113 C40 Cities press release. January 28, 2022. "Port of Los Angeles, Port of Shanghai, and C40 Cities Announce Partnership to Create World's First Transpacific Green Shipping Corridor Between Ports in the United States and China." https://www.c40.org/news/la-shanghai-green-shipping-corridor/. Green shipping corridors discussed in ABS. October 2022. "Green Shipping Corridors: Leveraging Synergies." https://safety4sea.com/wp-content/uploads/2022/10/ABS-Green-Shipping-Corridors-Leveraging-Synergies-2022_10.pdf.

Hard-to-Electrify Industrial Processes

The industrial sector accounts for 25 percent of fossil gas demand in California,[114] and many industrial end-use applications are hard to convert from fossil gas usage to electricity.[115] Heavy industrial processes that use fossil fuels for high-temperature heat could be candidates for the use of hydrogen as a replacement, zero-carbon energy source. Such opportunities were discussed in the *2021 IEPR*.[116]

Grid Reliability

Hydrogen from renewable resources can play an important role in helping achieve 100 percent renewable electricity by supporting grid reliability. As intermittent renewable resources such as wind and solar become a larger proportion of grid-connected resources, ramping needs will increase, and hydrogen has the potential to help support grid reliability. (See prior section of this chapter for more information about reliability.)

A study by Energy+Environmental Economics (E3) found that by 2050, gas power plants will need to stay on-line as firm resources, but most will have a capacity factor of 10 percent or less, leading to expected retirements due to uneconomic operating conditions. Further, in a July 22, 2022, letter, Governor Newsom directed CARB and other state agencies to plan for an energy transition that avoids the need for new fossil gas plants to meet long-term state energy goals while ensuring reliability and meeting growing demand for electricity. The lower use of gas plants and access to inexpensive hydrogen — assuming cost reductions are achieved as predicted by 2050 — would enable expanded repowering with hydrogen.

Given technology development trends, new engines and turbines will have the ability for higher blends of hydrogen, thus filling the need for dispatchable zero-carbon resources.[117] Projects are already exploring upgrading gas turbines for hydrogen combustion, including the

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114 CEC. "Supply and Demand of Natural Gas in California." Accessed August 15, 2022. https://www.energy.ca.gov/data-reports/energy-almanac/californias-natural-gas-market/supply-and-demand-natural-gas-california.

115 Jones, Melissa, Jennifer Campagna, Catherine Elder, and Stephanie Bailey. 2022. *Final 2021 Integrated Energy Policy Report, Volume III: Decarbonizing the State's Gas System*. California Energy Commission. Publication Number: CEC-100-2021-001-V3, p. 4. https://efiling.energy.ca.gov/GetDocument.aspx?tn=242233.

116 Kenney, Michael, Jacob Wahlgren, Kristina Duloglo, Tiffany Mateo, Danuta Drozdowicz, and Stephanie Bailey. 2022. Final 2021 Integrated Energy Policy Report, Volume I: Building Decarbonization. California Energy Commission. Publication Number: CEC-100-2021-001-V1.

117 E3. June 2020. *Hydrogen Opportunities in a Low-Carbon Future: An Assessment of Long-Term Market Potential in the Western United States*. Energy and Environmental Economics, Inc. https://www.ethree.com/wp-content/uploads/2021/11/E3_MHPS_Hydrogen-in-the-West-Report_Final_June2020.pdf. pp. 40-42.

Los Angeles Department of Water and Power's Intermountain Power Plant project in Utah[118] and the Northern California Power Agency's Northern California Pacific H_2ub project at the Lodi Energy Center.[119]

Hydrogen can also provide an alternative to batteries to support grid reliability or in fuel cell resources to provide long-duration or seasonal storage. E3 finds that anticipated falling costs of electrolyzers, if paired with low-cost renewable electricity, including otherwise curtailed renewable energy, could lead to a lower levelized cost of energy for hydrogen, enabling it to compete with other storage technologies. E3 estimated the potential market size for hydrogen storage in California to be 1.5–4.5 GW in 2035 and 5–10 GW in 2045.[120]

Other Opportunities

Refineries

Low-carbon hydrogen produced from renewable resources and pathways such as electrolysis can be used to displace fossil-derived hydrogen already in use at California refineries. Executive Order N-79-20 calls on state agencies to support the transition of fuel production facilities away from fossil fuels while supporting community participation, labor standards, and protection of public health, safety, and the environment. While California works to phase out petroleum refining and electrify transportation, hydrogen demand for refineries will remain high in the near term and midterm. And, when this demand decreases in the long-term, it is likely to be replaced by need from biogenic fuel production.

California could look to Europe for ways to use hydrogen to reduce emissions from fuel refining. Germany and the European Union are using a 10 MW electrolyzer to produce up to 1,300 metric tons of electrolytic hydrogen per year for Shell's Rhineland refinery complex.[121] A third of German refiners are moving toward electrolytic hydrogen production, with 100 MW-

118 Intermountain Power Agency. "IPP Renewed." Accessed October 18, 2022. https://www.ipautah.com/ipp-renewed/.

119 Northern California Power Agency. "Northern California Pacific H_2ub Public Info Sheet." http://www.ncpa.com/wp-content/uploads/2022/04/NorCalH2Hub_PublicInfoSheet_Final-04223.pdf.

120 E3. June 2020. *Hydrogen Opportunities in a Low-Carbon Future: An Assessment of Long-Term Market Potential in the Western United States*. Energy and Environmental Economics, Inc. https://www.ethree.com/wp-content/uploads/2021/11/E3_MHPS_Hydrogen-in-the-West-Report_Final_June2020.pdf. p 37.

121 Shell. "Hydrogen - What Is It? | Hydrogen Fuel & Projects | Shell Global." https://www.shell.com/energy-and-innovation/new-energies/hydrogen.html#:~:text=At%20the%20Shell%20Rhineland%20Refinery%20in%20Wesseling%2C%20Germany%2C,and%20produces%201%2C300%20tonnes%20of%20hydrogen%20per%20year.

scale projects planned for mid-decade operation.[122] While the Shell Rhineland electrolyzer is one of the largest operating in the world, its production capacity is still below 0.1 percent of the total existing refinery hydrogen demand in California. This spotlights the scale of the challenges and opportunities in decarbonizing hydrogen used in California refineries.

To further add context to the scale of the challenge, California would need to dedicate 11 GW of new solar and wind capacity to fully displace fossil-derived hydrogen used by refineries with electrolytic hydrogen produced from renewable electricity.[123] Adding this capacity would not only be a challenge in terms of time and cost, but also space constraints at refineries and other practical barriers limit the potential of this solution. Making hydrogen from biomethane using SMR, gasification, or other novel methods of production, as well as employment of CCUS technology, represent additional opportunities for reducing GHG emissions from hydrogen production.

CARB's Low Carbon Fuel Standard (LCFS) contains a provision that allows refineries to generate credits when producing gasoline and diesel using renewable hydrogen derived from biogas or electricity.[124] However, there have been no applications for LCFS renewable hydrogen refinery credits to date.[125] Despite the opportunity for near-term and large-scale carbon reductions, investments in low-GHG hydrogen production dedicated to refinery use must consider the long-term phaseout of fossil fuels and competing demand in emerging markets, such as FCEVs.

The LCFS has been more effective at encouraging supply of "renewable hydrogen,"[126] as defined by CARB's LCFS program, through incentives for light-duty refueling stations through hydrogen refueling infrastructure (HRI) capacity credits. HRI credits are available for companies that achieve a weighted average carbon intensity of fewer than 150 grams per megajoule and at least 40 percent renewable content across all stations in the company's

122 IHS Markit. June 16, 2021. "German Refineries Kick Off Complex Green Hydrogen Switch." https://cleanenergynews.ihsmarkit.com/research-analysis/german-refineries-kick-off-complex-green-hydrogen-switch-.html.

123 Presentation and analysis by Matthew Bravante with Bloomberg NEF – roughly scaled up to estimated California hydrogen production of 1.05 MMT/yr, "Hydrogen Market Growth." June 21, 2022, IEPR Commissioner Workshop on Role of Hydrogen in California's Clean Energy Future.

124 CARB. LCFS Basics webpage. https://ww2.arb.ca.gov/resources/documents/lcfs-basics.

125 CARB. "LCFS Credit Generation Opportunities: Project-Based Crediting." https://ww2.arb.ca.gov/our-work/programs/low-carbon-fuel-standard/lcfs-credit-generation-opportunities.

126 The LCFS program allows direct and indirect sourcing of attributes for renewable hydrogen. Indirect sourcing means that the renewable attributes are secured and credited toward hydrogen production but are not directly used to produce the hydrogen.

network registered in the LCFS.[127] Most of the hydrogen dispensed in the California transportation market is produced by SMR coupled with the purchase of indirect biomethane attributes to receive LCFS credits (in lieu of renewable hydrogen produced directly from renewable sources).[128] LCFS HRI credits and CEC grants encourage industry investments to achieve California's goal of 200 retail hydrogen stations by 2025, which will support the growing market for FCEVs.

*Green Chemi*cals

Other opportunities include green chemicals (such as ammonia and methanol) and synthetic fuels. Renewable hydrogen could be used instead of fossil fuels in fertilizer production. Most U.S. ammonia production capacity is in Louisiana, Oklahoma, and Texas near fossil gas fields (Figure 20) as fossil gas constitutes about 80 percent of the cost of producing ammonia.[129] Green ammonia produced from hydrogen made from renewable sources in California could be used by California farmers (saving on transportation costs and taking advantage of in-state distribution infrastructure). Spain has a commercial-scale green ammonia plant on-line, and many other projects have been announced in Europe, the Middle East, North Africa, and Australia.[130]

Barriers to Widespread Adoption

There are technological and financial barriers to scale up low-carbon hydrogen for use in the opportunities identified. These barriers include higher production costs for low-carbon hydrogen than fossil-based hydrogen and the need to quickly develop large-scale production and storage capacity. Scaling up low-carbon hydrogen production would need to be coordinated with the development of renewable resources for use in production or, potentially, with the development of carbon capture/storage and utilization. Further, the state would need to address leakage and limits to the hydrogen concentration that can be blended in existing gas pipelines or the need for dedicated hydrogen pipelines and other distribution and storage

127 CARB. August 2021. *Zero-Emission Vehicle (ZEV) Infrastructure Crediting within the LCFS: How Does it Work?* https://ww2.arb.ca.gov/sites/default/files/classic/fuels/lcfs/guidance/zev_infra_crediting_overview.pdf.

128 Baronas, Jean, Belinda Chen, et al. 2021. *Joint Agency Staff Report on Assembly Bill 8: 2021 Annual Assessment of Time and Cost Needed to Attain 100 Hydrogen Refueling Stations in California*. California Energy Commission and California Air Resources Board. Publication Number: CEC-600-2021-040. https://www.energy.ca.gov/sites/default/files/2021-12/CEC-600-2021-040.pdf. p 21.

129 Smith, Aaron. January/February 2022. "The Story of Rising Fertilizer Prices." *Agricultural and Resource Economics ARE Update.* Volume 25, No. 3. https://s.giannini.ucop.edu/uploads/pub/2022/02/24/v25n3.pdf.

130 Greenhalgh, Keiron. June 20, 2022. "European Green Ammonia Is Profitable Now and Will Be Again." *S&P Global*. https://cleanenergynews.ihsmarkit.com/research-analysis/european-green-ammonia-is-profitable-now-and-will-be-again-aft.html.

infrastructure. (Leakage is discussed further below in respect to the need to standardize the measure of climate benefits.) Also, the state will need to control the emissions of oxides of nitrogen from combusting hydrogen. Some of these barriers can be addressed by the new hydrogen funding opportunities described below.

New Hydrogen Production Projects

In the past few years, public and private investment has spurred new hydrogen production projects. For the most part, this new production capacity is in addition to existing capacity dedicated to refineries and targets emerging markets such as FCEVs. The CEC's Gas Research and Development Program has invested $4 million in hydrogen production research on emerging technologies and pilot-scale demonstrations.[131] Further, the CEC's Clean Transportation Program has invested nearly $17 million in four new renewable hydrogen production plants and an upgrade to an existing plant, with a combined 8,760 metric tons per year of capacity directed toward transportation.[132] Examples of projects to expand hydrogen production for California markets include the following:

- Plug Power is planning a 30-metric-ton-per-day liquid hydrogen plant in Mendota (Fresno County) for operation in 2024.[133] The project includes electrolyzers, 300 MW of solar generation, 500,000 gallons of liquid hydrogen storage, and a 1.2-million-gallon-per-day tertiary water treatment plant for the City of Mendota.
- SG H2 Energy is building a 11-metric-ton-per-day facility in Lancaster (Los Angeles County) using a new high-temperature gasification technology that will process 42,000 tons of recycled paper waste each year. The facility is expected to be operational by 2023 and will supply hydrogen for refueling stations.
- Air Products is building a 10-metric-ton-per-day green liquid hydrogen facility in Casa Grande, Arizona, to serve California in 2023. [134] The facility will use two alkaline water

131 California Energy Commission. "GFO-21-502 – Advancing Cost and Efficiency Improvements for Low Carbon Hydrogen Production." https://www.energy.ca.gov/solicitations/2021-08/gfo-21-502-advancing-cost-and-efficiency-improvements-low-carbon-hydrogen.

132 Brecht, Patrick. 2022. *2022–2023 Investment Plan Update for the Clean Transportation Program*. California Energy Commission. Publication Number: CEC-600-2022-053-SD. https://www.energy.ca.gov/programs-and-topics/programs/clean-transportation-program/clean-transportation-program-investment-7. p. 24.

133 Presentation by Brenor Brophy with Plug Power, "Plug Power CEC IEPR Workshop." June 21, 2022, IEPR Commissioner Workshop on Role of Hydrogen in California's Clean Energy Future. https://efiling.energy.ca.gov/GetDocument.aspx?tn=243620.

134 Air Products press release. March 8, 2022. "Air Products to Build Green Liquid Hydrogen Production Facility in Arizona." https://www.airproducts.com/news-center/2022/03/0308-air-products-green-liquid-hydrogen-production-facility-in-arizona.

electrolyzers to produce gaseous hydrogen, which will be converted to liquid hydrogen. The facility will be powered with zero-carbon renewable electricity.

New Hydrogen Funding From California and U.S. Department of Energy

Replacing fossil gas and other conventional fuels with hydrogen requires investment in the development of the technologies and infrastructure needed for broad deployment. Consequently, California and the federal government are releasing unprecedented appropriations for research, development, demonstration, and deployment (RDD&D) of hydrogen technologies.

In past years, much of California's hydrogen budget drew from three sources: CARB's Clean Vehicle Rebate Project; the CEC's Clean Transportation Program, which has provided $20 million per year for public hydrogen refueling infrastructure and additional funding for private infrastructure for medium- and heavy-duty vehicles, including transit buses; and the CEC's Gas Research and Development Program's annual budget of $24 million. In the last two California budget cycles, the Clean Transportation Program received more than $3 billion of general fund monies, with $60 million designated for hydrogen refueling infrastructure for FCEVs through Fiscal Year 2025–2026. This $60 million is in addition to the $279 million invested or proposed for investment in publicly available hydrogen refueling infrastructure from the Clean Transportation Program and General Funds previously announced.[135]

California's Fiscal Year 2022–2023 budget also committed to more than $1 billion in clean energy investment funding to be administered by the CEC. Of that amount, $100 million will go toward establishing a hydrogen program to provide financial incentives to in-state low-carbon hydrogen production through electrolysis or biofuels using renewable energy. Other new programs, such as the Climate Innovation Program, may also be positioned to support investments in hydrogen technology development and commercialization.

California is competing for a federal hydrogen RDD&D funding opportunity administered by the U.S. Department of Energy (U.S. DOE). The "Regional Clean Hydrogen Hubs" program is offering up to $6–7 billion to six to ten qualifying applicants (with additional $1–2 billion

135 Baronas, Jean, Belinda Chen, et al. 2021. *Joint Agency Staff Report on Assembly Bill 8: 2021 Annual Assessment of Time and Cost Needed to Attain 100 Hydrogen Refueling Stations in California*. California Energy Commission and California Air Resources Board. Publication Number: CEC-600-2021-040. Page 3. https://www.energy.ca.gov/publications/2021/joint-agency-staff-report-assembly-bill-8-2021-annual-assessment-time-and-cost.

potentially reserved for future H2Hub launches or other supporting activities)[136] and "will create networks of hydrogen producers, consumers, and local connective infrastructure to accelerate the use of hydrogen as a clean energy carrier."[137] The Governor's Office of Business and Economic Development (GO-Biz) is preparing a competitive application to establish a renewable hydrogen hub in California.[138] In coordinating this effort, GO-Biz and other partners launched the Alliance for Renewable Clean Hydrogen Energy Systems (ARCHES) network, a public private partnership to create a sustainable statewide clean hydrogen hub in California, of which the CEC is a member.[139]

Gasoline Cost Factors and Price Spikes

In 2022, global crude oil prices spiked, resulting in gasoline prices spikes throughout the United States with even higher spikes for Californians. Consistently higher gasoline prices in California increase costs for consumers and businesses and particularly burden low-income consumers.

California Gasoline Price Breakdown and Comparison to National Average

Gasoline prices in California have historically been higher than the rest of the nation. The CEC conducted an analysis of March 2022 average gasoline costs in California and nationally when the price differential was $1.34 per gallon. The analysis was comprised of six factors, including refinery practices, fees for environmental programs, taxes, oil prices, production costs, and distribution costs. It is important to note that these cost estimates are only applicable for the month of March 2022 and will vary throughout the year. Further, while some of the cost estimates are based upon incontrovertible facts (such as taxes), others are based upon modeling or subjective analytical assumptions that are subject to uncertainty (such as

136 U.S. Department of Energy. DE-FOA-0002779: Bipartisan Infrastructure Law: Additional Clean Hydrogen Programs (Section 40314): Regional Clean Hydrogen Hubs. Accessed October 12, 2022. https://oced-exchange.energy.gov/Default.aspx#FoaId4dbbd966-7524-4830-b883-450933661811.

137 U.S. Department of Energy. June 6, 2022. "DOE Launches Bipartisan Infrastructure Law's $8 Billion Program for Clean Hydrogen Hubs Across U.S." Accessed August 12, 2022. https://www.energy.gov/articles/doe-launches-bipartisan-infrastructure-laws-8-billion-program-clean-hydrogen-hubs-across.

138 Governor's Office of Business and Economic Development (GO-Biz). May 18, 2022. "California Formally Announces Intention to Create a Renewable Hydrogen Hub." Accessed October 19, 2022. https://business.ca.gov/california-formally-announces-intention-to-create-a-renewable-hydrogen-hub/.

Governor's Office of Business and Economic Development (GO-Biz). October 6, 2022. "California Launches Statewide Alliance to Establish Federally Co-Funded Hydrogen Hub California Formally Announces Intention to Create a Renewable Hydrogen Hub." Accessed October 19, 2022. https://business.ca.gov/california-formally-announces-intention-to-create-a-renewable-hydrogen-hub/.

139 Alliance for Renewable Clean Hydrogen Energy Systems. Accessed October 19, 2022. https://archesh2.org/.

production costs for cleaner California gasoline and estimated impacts from unplanned refinery outages).

The analysis found that nearly two-thirds, or 65 percent, of the retail price of gasoline in March 2022 consisted of crude oil costs, taxes, and environmental program fees. Refining costs and profits, along with retail costs and profits, made up the remaining 35 percent. The factors that make California gasoline prices routinely the most expensive nationwide are:[140]

- Larger price spikes related to unplanned refinery outages in California's isolated gasoline market and higher refinery cost and profit margins. (Costing an extra 46.7 cents per gallon [cpg], excluding the extra expense of producing California reformulated gasoline in the March 2022 analysis.)[141]
- Fees for environmental programs, such as the Low Carbon Fuel Standard and the Cap-and-Trade Program (costing an extra 33.4 cpg in March 2022).
- Greater tax burden (costing an extra 23.1 cpg in March 2022).
- Higher production costs for the least-polluting gasoline in the United States, requiring greater use of hydrogen and more expensive refining (costing an extra 15.0 cpg in March 2022).[142]

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140 Costs are from March 2022, when the average price of retail gasoline in California was 134 cents per gallon (cpg) more expensive than the national average. Tax data obtained from the American Petroleum Institute values for January 2022. Environmental program costs for the Low Carbon Fuel Standard and Cap-and-Trade programs were calculated from daily values published by the Oil Price Information Service for both California and Oregon. Crude oil cost difference was calculated by subtracting the U.S. average crude oil acquisition cost for the United States during March 2022 (as published by the Energy Information Administration) from the CEC estimated cost of crude oil based on an average of the weekly values from March 2022 that are published on the CEC's "Estimated Gasoline Price Breakdown and Margins" website.

141 An approximation of potential impacts from unplanned refinery outages in the California fuels market was calculated by comparing southern California refinery wholesale gasoline prices (Los Angeles spot pipeline price) versus the New York Mercantile gasoline contract price. Any levels greater than the average difference during 2014 calendar year were assumed to be primarily attributed to unplanned refinery outages and delays experienced by some refiners of returning to service from planned maintenance as originally anticipated in their schedules. This issue and analytical approach were raised in the CEC's *Gasoline Prices in California* memo published May 15, 2019. CEC. October 21, 2019. *Additional Analysis on Gasoline Prices in California*. https://www.energy.ca.gov/sites/default/files/2019-11/Gas_Price_Report.pdf.

142 Refinery production cost difference obtained from documentation of CARB's California reformulated gasoline regulation development and initial statement of reasons. CARB used a range of 10 to 15 cpg greater than conventional gasoline. CEC staff has consistently used the higher end of that range (15 cpg) in previous gasoline price spike analysis work and staff presentations related to the Petroleum Market Advisory Committee activities.

- Dependence on more expensive foreign and Alaskan crude oil sources than refiners in states that have greater access to less expensive shale oil and discounted Canadian crude oils (costing an extra 14.0 cpg in March 2022).
- Higher distribution costs and retail margins are another, relatively smaller factor (costing an extra 1.7 cents cpg in March 2022).

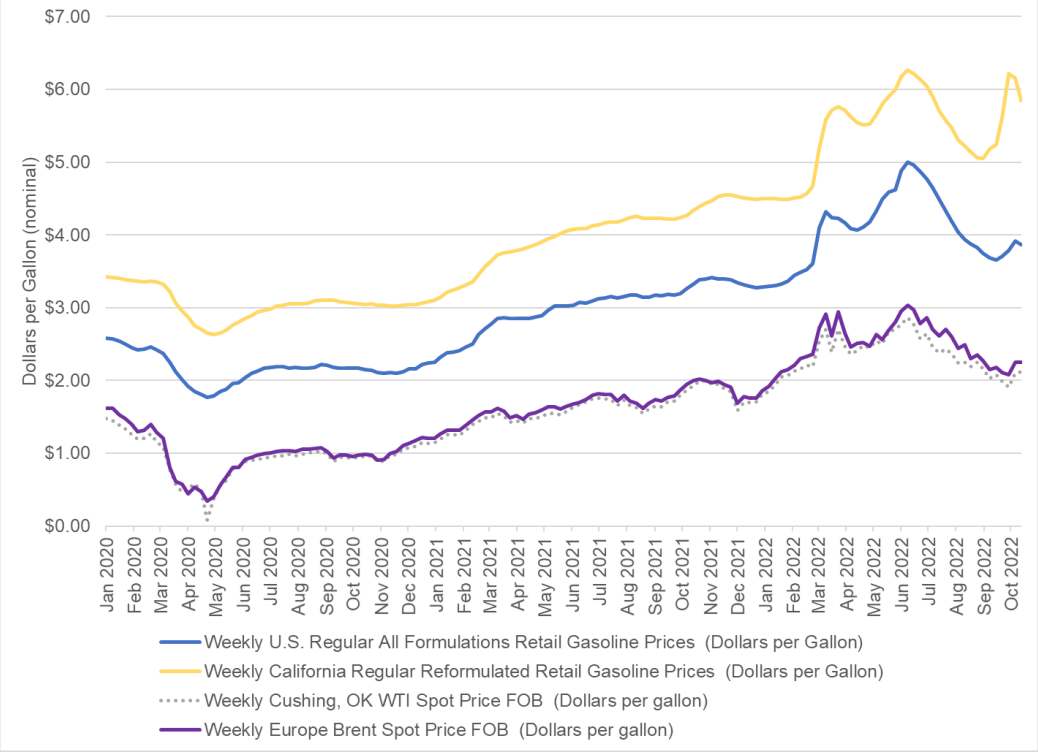
Other Factors That Influence Gasoline Prices

Crude oil is a global commodity and prices increased in the spring and summer of 2022 largely in response to the war in Ukraine. Factors affecting the price of crude oil fluctuate due to:

- Changes in supply from non-Organization of the Petroleum Exporting Countries regions, such as the United States.
- Geopolitical events that increase supply disruption risk, such as the war in Ukraine.
- Rising or falling global demand for oil.
- Rising or falling global crude oil inventories.
- Heightened activity in the futures market as an investment opportunity.
- The value of the U.S. dollar — a stronger dollar relative to other currencies places downward pressure on global crude oil prices.

Figure 23 shows that national and California gasoline prices are heavily influenced by changing crude oil costs, with a larger price differential in September and October 2022 which is discussed below.

Figure 23: California and U.S. Oil and Gasoline Prices



Data Source: CEC analysis of U.S. EIA data

California gasoline prices can also spike even higher during periods of refinery outages, which have greater price impact due to the state's isolated fuels market. Factors affecting the wholesale and retail gasoline prices include:

- **Upward pressure** from refinery outages or changes from winter to summer gasoline recipe that decreases gasoline production capability of refineries.
- **Upward *or* downward pressure** from changes in futures contract prices linked to wholesale prices, fluctuations of fuel inventory levels, or changes in fuel taxes.
- **Downward pressure** from transitioning to the winter gasoline recipe, which increases refinery gasoline production capability, or from idled refineries returning to operation.

The indefinite idling of Marathon's Martinez refinery during April 2020 and pending conversion of the Phillips 66 Rodeo refinery by the first quarter of 2024 will result in a combined 13 percent reduction in the refining capacity for facilities producing California reformulated gasoline. This change is expected to potentially exacerbate price spikes associated with future significant unplanned refinery outages.

Gasoline Price Spikes

Economists[143] have found that retail gasoline prices increase at a similar rate as wholesale cost increases during gasoline price spikes yet decline at a slower rate. A report[144] from the Federal Reserve Bank of Dallas likens gasoline prices going up like a rocket and dropping like a feather and offered two possible explanations:

- "[S]tation operators are recapturing margins lost during the upswing, when gas stations were initially slow to increase pump prices."
- "[C]onsumers' tendency to more intensively search for lower pump prices as gasoline prices rise than when they decline."

143 Chesnes, Matthew William. September 11, 2012. *Asymmetric Pass-Through in U.S. Gasoline Prices*. U.S. Federal Trade Commission Bureau of Economics Working Paper No. 302. https://ssrn.com/abstract=1629340 or http://dx.doi.org/10.2139/ssrn.1629340. Accessed on October 24, 2022.

144 Golding, Garrett and Lutz Kilian. May 10, 2022. "Don't Look to Oil Companies to Lower High Retail Gasoline Prices." Federal Reserve Bank of Dallas. Accessed August 22, 2022. https://www.dallasfed.org/research/economics/2022/0510.

California Price Spike Analysis in 2019

In April 2019, Governor Gavin Newsom asked the CEC to analyze the causes of the differential between national and California gasoline prices. The CEC reported[145] that while all California retailers have margins above the national average, higher-priced brands have increased those margins far beyond their off-brand competitors.

The report described the possible reasons why consumers buy higher-priced gasoline, including station location, the acceptance of credit cards, availability of amenities, and brand loyalty. There may also be perceived differences in gasoline quality based on retailers' claims regarding gasoline specifications or additive packages.

There are also illegitimate business practices that could lead to higher prices for similar products, such as price fixing and false advertising. The CEC requested that the gasoline industry provide research comparing the quality of gasoline which meets the minimum quality standards required by California law and brands that advertise superior quality, but the industry provided none. The CEC also sought available research that would substantiate this but found none. Evidence that gasoline retailers fixed prices or engaged in false advertising was not found in CEC's analysis.

Summer 2022 Gasoline Price Spikes

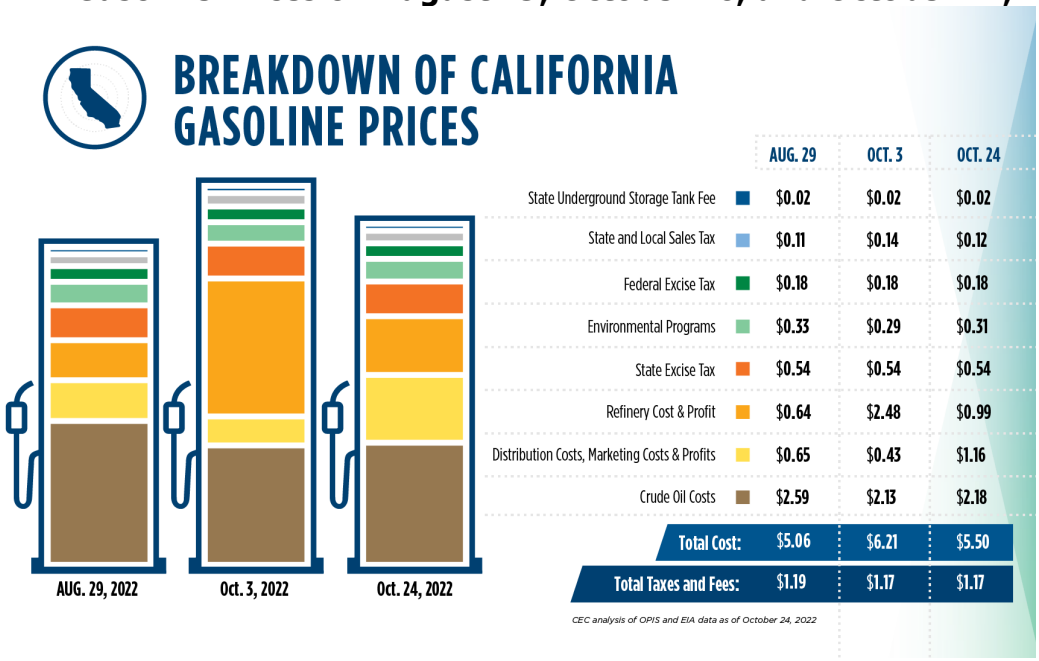
In the spring and summer of 2022, gasoline prices in California rose to record highs. In June 2022, the Assembly formed the Assembly Select Committee on Gasoline Supply and Pricing to look into the causes of and solutions for gasoline price increases in California. Hearings in June and August included expert witnesses from the CEC, academia, Consumer Watchdog, Western States Petroleum Association, and other industry groups to discuss recent trends.

In September and October 2022, California gasoline prices continued to rise and California experienced the highest absolute prices for gasoline in history, along with the highest price differential compared to the rest of the United States. The differential peaked on October 4, 2022, with gasoline costing $2.61 per gallon more on average in California than the nation, compared to the previous record of $1.67 per gallon on March 29, 2022. This price spike reflects increased refinery costs and profits, as oil prices dropped. However, gasoline inventory levels were at their lowest in the last decade. Further, gasoline production dropped to levels not seen for at least six years for five weeks beginning the middle of August before rebounding through the third week of October. Figure 24 shows a snapshot comparison of the

145 CEC. October 21, 2019. *Additional Analysis on Gasoline Prices in California*. https://www.energy.ca.gov/sites/default/files/2019-11/Gas_Price_Report.pdf.

breakdown of gasoline costs in California on a day in August 2022 and two days in October 2022.

Figure 24: Gasoline Prices on August 29, October 10, and October 24, 2022



Source: CEC staff using OPIC and EIA data as of October 24, 2022

The higher-than-normal refiner margins for the summer months and early part of fall contributed to a significant increase of net income for most companies with refining operations throughout the United States. Reuters reported that in the third quarter of 2022, the profits of PBF Energy, a refining company serving California, jumped to $1.06 billion in 2022, up from $59.1 million in the third quarter of 2021.[146] Third quarter profits of the refiner Valero Energy Corporation were $2.82 billion in 2022, up from $463 million the previous year.[147] The higher profits in these examples were accrued from refining operations throughout California and the rest of the United States and included profits primarily from gasoline, diesel, and jet fuel sales.

146 Arunia Kumar. Reuters. U.S. News. *PBF Energy Beats Profit Estimates on Margin, Demand Boost; Shares Surge*. October 27, 2022. https://money.usnews.com/investing/news/articles/2022-10-27/refiner-pbf-energys-profit-surges-on-fuel-demand-boost.

147 Arunia Kumar. Reuters. *Valero Kicks Off U.S. Refiners Earnings Season With Bumper Profit*. October 25, 2022. https://www.reuters.com/markets/us/valero-kicks-off-us-refiners-earnings-season-with-surging-quarterly-profit-2022-10-25/#:~:text=Excluding%20items%2C%20Valero%20posted%20a,per%20share%2C%20according%20to%20Refinitiv.

The CEC is planning to hold an informational hearing on November 29, 2022, inviting oil companies, academia, and other petroleum market experts to speak to the conditions that led to the highest gasoline prices ever in California, while oil companies and refiners saw exceedingly high profits. The Assembly Select Committee on Gasoline Supply and Pricing plans to hold another hearing in December 2022.

Transitioning Away from Fossil Fuels in Transportation

An analysis by CEC staff showed that, over the last two decades, price spikes in California weekly retail gasoline prices above 10 percent have been correlated to refinery outages.[148] The gasoline price spikes experienced this year bring increasing focus to the dynamics of shifting away from fossil fuels. Increasing instability of outputs from refineries within the context of California's existing isolated gasoline market will likely lead to additional challenges with gasoline price volatility.

These challenges may become even more serious as the state transitions away from gasoline and more refineries begin to either shut down or reduce gasoline output. For instance, a smaller refinery in Santa Maria, operated by Phillips 66, will permanently close in early 2023.[149] Further shutdowns will mean more reliance on a smaller number of refineries, and various planned or unplanned temporary shutdowns of those remaining will have an even greater impact on volatility.

With price volatility issues becoming more problematic in future years, a more detailed understanding is necessary to ensure that Californians are not overly burdened. The state has investigated ways to address price volatility in the past, such as a strategic fuels reserve to help manage temporary spikes.[150] In the 2003 discussion of a reserve, the CEC recommended against developing one. However, a reconsideration of the matter is warranted considering the recent record high prices and fuel company profits.

Other policy and program opportunities merit a closer look as well. Similar to the CEC's efforts to improve the reliability of the state's electricity system after the 2020 heat event (discussed in the "Reliability" section above), a concentrated effort is needed to protect Californians from gasoline price spikes. This will include assessing:

- Factors that drive gasoline price spikes, including refinery dynamics and fuel inventory management.

148 CEC staff analysis of EIA weekly gasoline retail prices, OPIS alerts, and AAA daily retail price data.

149 Phillips 66 Santa Maria Refinery webpage, https://www.phillips66.com/refining/santa-maria-refinery/.

150 CEC. *Feasibility of a Strategic Fuel Reserve in California*. Publication Number: P600-03-013CR.

- Tools available or that can be acquired to better predict price spikes, such as enhanced analytics through expanded data collection.
- Policy levers the state should consider to reduce price spikes, including a potential strategic fuels reserve.

The CEC is initiating a study to understand the impact of climate goals on the demand, reliability, safety, and affordability of petroleum fuels under a variety of scenarios of ZEV adoption. Plans for the Fuels Transition Study will be discussed at the November 29, 2022, informational hearing.

Fossil Gas Transition

Introduction

The combustion of fossil gas accounts for about 110 million tons (MMT) of carbon dioxide equivalent (CO_2e) emissions per year in California, or about 26 percent of statewide emissions.[151] Further, leaked fossil gas from California's transmission, distribution and storage systems accounts for approximately 5 MMT of CO_2e annually.[152] CARB's 2019 estimate of out-of-state GHG emissions (on a 20-yr global warming potential time horizon) are 25.9 $MMTCO_2e$ for gas imported to California.[153] Fossil gas is the most consumed fuel in the state, making up about 31 percent of total energy consumption in California in 2020 (Figure 25).[154] California needs to make substantial changes to its fossil gas use and supply and delivery system to meet the state's climate and equity goals.

151 CARB. "GHG Inventory Query Tool (2000–2019)," Emissions from Fuel Combustion, Natural Gas. Accessed April 18, 2022. https://ww2.arb.ca.gov/applications/greenhouse-gas-emission-inventory-0.

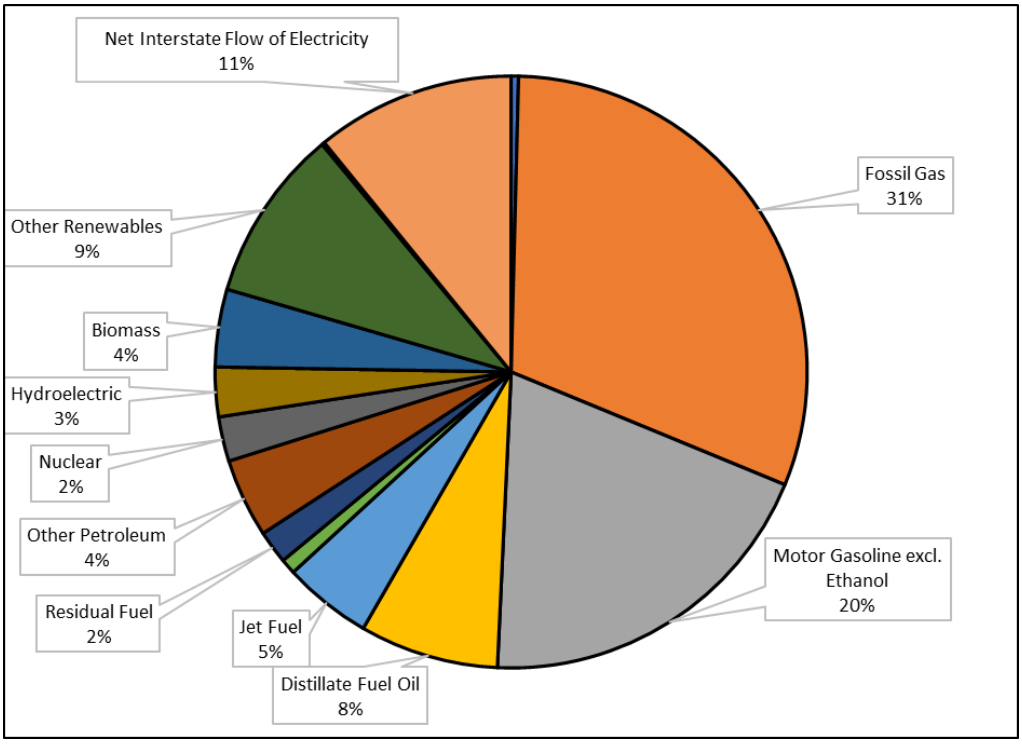
152 CARB. GHG Emissions Inventory Summary (2000-2019), Updated 9/20/2021. https://ww2.arb.ca.gov/applications/greenhouse-gas-emission-inventory-0.

Methane emissions are even larger when considering the gas production facilities supplying fossil gas burned in California. More than 90 percent of methane emissions from gas production occur out of state because California imports more than 90 percent of its gas supplies. Nonetheless, these out-of-state emissions result from the burning of fossil gas within California. These out-of-state methane emissions are not in the CARB GHG inventory for California but are clearly significant.

153 CARB. August 3, 2021. *Out-of-State Greenhouse Gas Emissions from Loss, Release, and Flaring of Natural Gas Imported to California: 2018-2019*. https://ww3.arb.ca.gov/cc/inventory/pubs/reports/2000_2019/ab_2195_out_of_state_natural_gas_emissions.pdf.

154 Although the share of gas used for energy has increased to 31 percent since 2019, the volume of actual gas usage has declined from 2.217 to 2.144 trillion btus. This is largely because gasoline and hydroelectric power consumption were down in 2020 (hydroelectric was down 50 percent from 2019).

Figure 25: Gas Accounts for 31 Percent of California's Energy Consumption (2020)



Source: CEC using EIA data

To reach its long-term climate goals, California faces some challenges in the transition away from fossil gas:

- How to reduce emissions through strategies such as building electrification or substitution with lower carbon alternatives (for example, renewable gas and low-carbon hydrogen, including projects with carbon capture/utilization and storage).
- How to ensure that the gas system remains safe and reliable. How to ensure that the gas system remains safe and reliable.
- How to minimize the potential rate impacts to gas customers and ensure equity.

Joint Agency Coordination

The CEC, CPUC, and CARB have initiatives underway to address the complex challenges associated with the gas transition and decarbonization strategies. The agencies are also coordinating to identify any issues not covered by ongoing efforts and if new initiatives are needed.

CEC

The CEC established the Gas Decarbonization Order to Institute Informational Proceeding (Gas Decarb OIIP) at its business meeting March 9, 2022.[155] The proceeding is a multiyear effort for conducting assessments to address the *2021 IEPR* recommendations on long-term gas transition planning, gas issues associated with building decarbonization, and the role of clean fuels in a decarbonized gas system.[156] Further, the proceeding expands collaboration with the energy agencies and stakeholders on gas transition planning. Work in the proceeding will be conducted in phases and reported on in the annual IEPR process.

The CEC launched the Gas Decarb OIIP on June 3, 2022, at an IEPR Commissioner Workshop.[157] The workshop included updates from the CEC, CARB, and CPUC, and panel discussions on three key topics (1) gas system planning and analytics, (2) advancing equity during the gas transition, and (3) California utilities' decarbonization efforts. The CEC envisions holding targeted workshops in 2022 and 2023 to further examine emerging gas issues. The gas modeling data and results developed in the OIIP will be readily accessible from the California Energy Planning Library. (See Chapter 2.)

CPUC

The CPUC has several ongoing proceedings and investigations that relate to decarbonization, safety, and reliability of the gas system. The main CPUC proceeding relevant to gas planning and decarbonization is the long-term gas-planning rulemaking (R.20-01-007) opened in 2020.[158] The first track included updating gas system reliability standards and improving coordination between gas utilities and gas-fired electric generators. The focus in 2022 and beyond is on developing and implementing a long-term planning strategy for California's gas system that maintains safety, reliability, and affordability as fossil use declines. As part of that effort, the CPUC is developing a new site-specific approval process for large gas infrastructure projects.

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155 CEC webpage for March 9, 2022, Business Meeting, https://www.energy.ca.gov/event/meeting/2022-03/energy-commission-business-meeting.

156 Jones, Melissa, Jennifer Campagna, Catherine Elder, and Stephanie Bailey. 2022. *Final 2021 Integrated Energy Policy Report, Volume III: Decarbonizing the State's Gas System*. CEC. Publication Number: CEC-100-2021-001-V3. https://efiling.energy.ca.gov/GetDocument.aspx?tn=242233.

157 Recording of June 3, 2022, Commissioner Workshop to Launch Gas Decarbonization Proceeding, https://efiling.energy.ca.gov/GetDocument.aspx?tn=243430&DocumentContentId=77241.

158 January 16, 2020, CPUC Order Instituting Rulemaking to Establish Policies, Processes, and Rules to Ensure Safe and Reliable Gas Systems in California and perform Long-Term Gas System Planning. https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M324/K792/324792510.PDF.

Consistent with the requirements of Senate Bill 380 (Pavley, Chapter 14, Statutes of 2016),[159] the CPUC opened a proceeding (I.17-02-002) to determine the feasibility of minimizing or eliminating use of the Aliso Canyon gas storage facility while maintaining energy reliability for the Los Angeles region.[160] To date, an extensive stakeholder process has developed models to evaluate the effects of minimizing or eliminating the use of Aliso Canyon, and a contractor has evaluated potential portfolios of resources to replace the services provided by Aliso Canyon by 2027 or 2035.

On September 23, 2022, the CPUC issued a staff proposal initiating a process to identify the investment in new clean resources to obviate the need for Aliso Canyon.[161] The CPUC concurrently issued a ruling finding that Aliso Canyon is currently needed for SoCalGas to reliably meet energy demand in the Los Angeles basin; therefore, sufficient replacement resources must be available for the eventual elimination of Aliso Canyon's use. The ruling issued a staff proposal that estimates that an annual reduction of 214 million metric cubic feet per day (MMcfd) in forecast peak gas demand — or an annual increase of 1,084 MW of non-gas-fired electric generation capacity, or some combination of both — will be necessary to reliably service all energy demand in 2027 without the use of Aliso Canyon. These annual reductions equate to about two percent of electric capacity or four percent of forecast peak gas demand.

Related initiatives include the CPUC's proceeding to support decarbonizing buildings in California (R.19-01-011),[162] which on September 15, 2022, eliminated gas line extension subsidies for residential and nonresidential new gas hookups to homes and commercial buildings.[163] Also, the CPUC's multiphased Renewable Gas Rulemaking (R.13-02-008)

159 Senate Bill 380 (Pavley, Chapter 14, Statutes of 2016). https://leginfo.legislature.ca.gov/faces/billCompareClient.xhtml?bill_id=201520160SB380&showamends=false.

160 CPUC. February 9, 2017. Order Instituting Investigation pursuant to Senate Bill 380 to determine the feasibility of minimizing or eliminating the use of the Aliso Canyon natural gas storage facility located in the County of Los Angeles while still maintaining energy and electric reliability for the region.

161 September 23, 2022, Assigned Commissioner Ruling Entering Into The Record Energy Division Proposal and Ordering Testimony. I.17-02-002.

162 CPUC. *CPUC Order Instituting Rulemaking Order Instituting Rulemaking Regarding Building Decarbonization*. February 8, 2019. https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M264/K629/264629773.PDF.

163 CPUC. *Phase III Decision Eliminating Gas Line Extension Allowances, Ten-Year Refundable Payment Option, and Fifty Percent Discount Payment Option Under Gas Line Extension Rules*. September 15, 2022. https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M496/K876/496876177.PDF

establishes policy related to the production, procurement, and interconnection of renewable gas, including renewable hydrogen and biomethane.[164]

CARB

CARB is required to develop a scoping plan for achieving California's GHG emissions reduction targets with updates at least every five years. CARB developed its first scoping plan in 2008 and released a draft of its most recent update, the *Draft 2022 Scoping Plan Update*, in May 2022. The 2022 update assesses progress toward the statutory 2030 target to reduce emissions by 40 percent from 1990 levels and lays out pathways for how California can achieve carbon neutrality by 2045 or earlier. It also assesses paths for clean technology, energy deployment, natural and working lands, and others that have outcomes for achieving carbon neutrality. It is designed to meet the state's long-term climate objectives and support a range of economic, environmental, energy security, environmental justice, and public health priorities.

The final *2022 Scoping Plan Update*, expected to be released in November 2022 for Board consideration in December, will address the types of actions and magnitude of the needed transition of the gas sector to help meet the state's climate targets. Consistent with Governor Newsom's July 2022 direction, the Scoping Plan modeling assumes no new natural gas plants to meet our long-term energy goals. Decarbonization of the buildings and industrial sectors is achieved in part by blending renewable natural gas and renewable hydrogen in natural gas pipelines.

Distributed Energy Resources

Introduction

California has embraced the adoption of distributed energy resources (DERs)[165] as an important strategy to meet its commitments to increase renewable and zero-carbon resources

164 CPUC. February 13, 2013. Order Instituting Rulemaking to Adopt Biomethane Standards and Requirements, Pipeline Open Access Rules, and Related Provisions.

165 *DER* refers to a diverse category of devices and technologies that interface with the electricity system at the distribution level, either directly connected to a distribution utility's wires or on an end-use customer's premises, behind the utility meter. In this context, the CEC includes the following as DER: distributed generation and storage, electric vehicles and charging stations, grid-interactive buildings and microgrids, as well as more traditional demand response or load flexibility resources and energy efficiency strategies.

and support transportation and building electrification. Building on the *2019 IEPR*,[166] the *2021 IEPR* makes recommendations about improving the suite of technology options available to consumers to better adapt their load to system conditions.

The *2021 IEPR* also makes recommendations about DER innovations to improve grid reliability and resiliency and accelerate California's transition to a zero-carbon electric grid. DERs can help minimize grid operating challenges such as balancing supply and demand when solar generation drops in the evening hours while demand remains high or may increase. DERs can also help manage grid constraints and the need for distribution and transmission upgrades.

Californians from all customer classes are adopting onsite DERs. They are motivated to a great extent by retail rates and incentive programs. Environmental concerns, a desire to reduce vulnerability to grid outages, or other reasons beyond the return on investment, are also spurring market growth.

Technology trends are rapidly lowering DER costs and improving functional capabilities, scalability, and flexibility, while grid costs, on the other hand, are increasing, making DERs more attractive. These factors mean adoption by customers will likely accelerate and exceed analysts' best predictions, like forecasts of rooftop solar adoption.

Challenges Ahead for the State

There are many challenges that must be addressed to make the energy transition in a way that optimizes the role of DER in California's energy future, including:

- How can the state harness customers' private DER investment decisions to provide benefits to the grid and to society at large?
- How can the state ensure that policies that promote DER adoption do not result in additional costs and rate increases for nonparticipating households?
- How can the state equitably wind down prior DER incentive structures to align DER incentives with grid needs, rate stability, and promote electrification efforts?
- What rate designs are needed to encourage customers to install and manage DERs in ways that support the state's affordability, reliability, and electrification goals?
- How must the state encourage DER deployment and capturing potential DER value, while ensuring the potential costs associated with DER deployment are not shifted to non-DER customers?

166 California Energy Commission staff. 2020. *Final 2019 Integrated Energy Policy Report*. California Energy Commission. Publication Number: CEC-100-2019-001-CMF. https://efiling.energy.ca.gov/getdocument.aspx?tn=232922.

- How can DER owners and operators be fairly compensated when they are able to provide value to the grid, such as avoided infrastructure costs?
- How must the state encourage DER deployment and capturing potential DER value, while ensuring the potential costs associate with DER deployment is not shifted to non-DER customers?
- How could DERs supply a major share of the new electrification load?
- What policies are needed to ensure that DERs are not just affordable by affluent households and businesses? How can the state ensure that DER growth reduces rather than exacerbates existing inequities?[167]
- What policies could rapidly bring resilience, health, economic, and other benefits of carbon-free DERs to all communities, starting with those most vulnerable and historically burdened by energy-related externalities?

Joint Agency Coordination

Both the CEC and CPUC have proceedings underway focusing on these and other challenges to realizing the potential benefits of DER.

CPUC High DER Rulemaking

The CPUC proceeding (Rulemaking 21-06-017) is focused on preparing the electric grid for a high DER future and has three tracks:

1) Distribution planning process and data improvements.
2) Distribution system operator roles and responsibilities.
3) Smart inverter optimization and grid modernization planning.

167 AB 2143 (Carrillo, Chapter 774, Statutes of 2022) includes a requirement for the CPUC to annually publish "(a) A report on the progress made to grow the use of distributed energy resources among residential customers in disadvantaged communities and in low-income households. (b) An aggregated list, by census tract and ZIP Code, of all renewable electrical generation facilities, as defined in Section 2827, that began to receive service pursuant to a net energy metering contract or tariff during the preceding calendar year, including, but not limited to, median household income, home ownership, and racial composition, as applicable." Public Resources Code 913.13.

CEC DER Informational Proceeding

The CEC proceeding is focused on the potential benefits of DER[168] and involves the following three steps:

1) Identifying energy-related needs for which DER could provide a solution and estimating the magnitude of these needs statewide.
2) Estimating the magnitude of DER deployment that could fully meet these needs.
3) Using steps 1 and 2 to formulate DER growth scenarios and applying them in planning studies (such as SB 100) to estimate total value.

Community engagement is foundational to the CPUC and CEC proceedings. Both agencies want to hear from environmental and social justice communities about the needs in step 1. Both agencies are working to incorporate these and broad equity principles into issue framing, evaluation and analysis, and decision-making regarding DER in California's energy future.

CEC Demand Response Working Group

After the CEC opened the OIIP on DER, the CEC integrated its ongoing Demand Response Working Group effort into the new OIIP. Since July 2021, the CEC has led a stakeholder working group focused on the qualifying capacity (QC) of supply-side demand response (quantifying what the resource can produce during periods of peak electricity demand). The CEC established this working group in response to a June 2021 CPUC request (Decision 21-06-029). By October 2021, it became clear that there was insufficient time to develop a permanent QC methodology for the 2023 resource adequacy year and that stakeholders believed that the working group should await the outcome of the CPUC resource adequacy proceeding before making a long-term recommendation. As a result, the CEC submitted its report to the CPUC on February 18, 2022, recommending three proposed approaches on an interim basis for the 2023 resource adequacy year. The CEC interim report also recommended that the CPUC extend the working group process beyond February 2022 to develop long-term recommendations beginning with the 2024 resource adequacy year.

After considering the CEC recommendations in its interim report and taking comments from stakeholders, the CPUC issued Decision 22-06-050 in Rulemaking 21-10-002 on June 24,

168 In this proceeding, the CEC initially defined DER broadly as defined above to allow consideration of new technologies that interface with the electricity system at the distribution level and that can help the state achieve its clean energy goals. The CEC is interested in developing a more precise definition of DER through this proceeding. Order Instituting Informational Proceeding on Distributed Energy Resources in California's Energy Future. https://www.energy.ca.gov/proceedings/energy-commission-proceedings/order-instituting-informational-proceeding-distributed.

2022.[169] The CPUC found that to implement a new QC method for demand response resources for the 2023 resource adequacy year, even on an interim basis, there would be significant timing and resource constraints. The CPUC found insufficient record to adopt a DR QC counting proposal for the 2023 resource adequacy year. Consequently, the CPUC determined that the status quo would remain in effect unless superseded by a future decision.

The CPUC agreed that the CEC working group should continue to develop long-term recommendations. The CPUC found that to adopt a new demand response QC methodology for the 2024 resource adequacy year, in advance of the load impact protocol process that begins in December 2022, a working group recommendation would need to be submitted by August 2022. The CPUC found that given the short time remaining, it would be unlikely that the working group would have sufficient time to develop an implementable proposal for 2024, and more realistic to submit recommendations for the 2025 resource adequacy year and beyond. Thus, the CPUC requested that the CEC working group develop recommendations for 2025 resource adequacy year.

Further, CEC staff has been consulting with CPUC staff on the QC of demand resources submitted through the CPUC's load impact protocols (LIP) process for 2023 resource adequacy. The insights gained through the LIP process may inform the CEC staff's final recommendations from the demand response working group.

CHAPTER 5: Recommendations

Chapter 1: Embedding Equity and Environmental Justice at the California Energy Commission

The California Energy Commission (CEC) is committed to continuing its work to embed equity and environmental justice. These recommendations are actions for the CEC to consider in its work to advance equity and environmental justice in a clean energy future that contributes to all Californians living with dignity and securing prosperity.

- **Open order instituting informational proceeding (OIIP) on equity and environmental justice to continue formal dialogue with the public**. To continue the formal dialogue with the public initiated through this IEPR update, the CEC should establish a proceeding focused on equity and environmental justice. The proceeding would be initiated through an OIIP. This OIIP would also have an associated docket to receive public comment and additional resources to support the ongoing development of the Justice Access Equity Diversity Inclusion (JAEDI) Framework and the Energy Equity Indicators tool. The OIIP should set a timeline with milestones for the framework and indicators to engage with the public, complete the items, and revisit to determine lessons learned and apply course correction, as needed.
- **Check CEC progress through future IEPR Proceedings on Embedding Equity and Environmental Justice**. As a method to hold itself accountable to its commitment to embedding equity and environmental justice and to assess its progress, the CEC should require an analysis focused on equity and environmental justice to be completed in each IEPR. The assessment could include progress of Energy Equity Indicators and a determination of whether any other recommendations made in the Senate Bill 350 Barriers Study should be accomplished (De León, Chapter 547, Statutes of 2015).
- **Hold an annual equity and environmental justice summit**. For state agencies to more easily share information, practices, and lessons learned, the CEC, in coordination with other state agencies and environmental justice leaders, should hold an annual equity/environmental justice summit. The format should be set up to include listening and learning from tribes, local government, community leaders, residents, and others. The summits should be in varying regions and include site visits and engagement sessions. A possible topic would be to update, across all state agencies, language describing tribes and communities. To continue uplifting tribes and communities, state leadership should consider a statutory change to remove or replace the use of terms based on deficiencies such as "disadvantaged" and "underserved" to describe communities and tribes. The state could engage with community leaders and the public to determine better terms that align with how communities refer to themselves or perhaps lean towards using more nuanced language that is customized to people and areas they are prioritizing.

- **Provide more customized support to tribes and communities**. To respond to the various and consistent requests from tribes and communities, state leadership should determine ways to provide more customized support and resources to accelerate the adoption of clean energy technology. Steps could include
    - Removing caps on technical assistance in legislative mandates to enable state agencies more flexibility to use funds to cover internal costs while supporting more external engagement of tribes and community-based organizations.
    - Modifying laws to allow state agencies to directly pay or compensate for resources that enable tribes and disadvantaged communities to participate in proceedings and events more meaningfully (for example, funding food and childcare services for events). These laws are set up to prevent corruption due to "gifts" to interested parties that can influence decisions but are inadvertently hindering engagement by tribes and communities.
    - Provide funding to support a needs assessment of community-based organizations in all regions of California to help determine most effective models to engage (for example, promotores) and how agencies can best engage and partner with them on efforts to achieve a clean energy future.
    - Provide funding to support partnerships with local governments focused on removing barriers to participation and ensuring clean energy benefits reach more tribes and disadvantaged communities.
    - Provide funding to support a technical assistance program that creates regional hubs throughout the state that can provide immediate support, current information, and technical assistance to tribes and disadvantaged communities.
- **Secure more workforce development expertise**. To meet the needs of a clean energy economy, the CEC must increase its expertise around workforce development policy, practice, and operations. The CEC should consider establishing at least one or more dedicated positions to advance workforce development efforts. These staff could advise and guide CEC staff on how to design and implement programs and policies focused on or that include workforce development. The staff could also offer trainings to better understand workforce development and they could also function as liaisons between the CEC and workforce- and labor-related agencies.
- **Continue a regional approach**. Given the success of the engagement conducted during the *2022 IEPR Update,* the CEC should continue a regional approach to engagement with tribes and community for future IEPR proceedings and other major efforts. The engagement should include partnering closely with local leaders to codesign outreach, engagement, and other efforts. The CEC should involve peer agencies to conduct more robust joint engagement that lessens burdens on tribes and communities.
- **Consider a supplier diversity program**. To continue increasing economic opportunities for tribes and communities, the CEC should expand its supplier diversity efforts. CEC could explore recommendations in Assembly Bill 865 to identify steps to

expand the connections, resources, and engagement customized for the needs of small businesses, tribal enterprises, and diverse business enterprises.

Chapter 2: California Energy Planning Library

The initial launch of the California Energy Planning Library represents a milestone for the CEC in its effort to ensure that key data and analysis developed by the CEC are timely, transparent, and readily accessible.

- **For future annual updates, the CEC should solicit stakeholder engagement and feedback on how to continue to improve the new platform.** This engagement and feedback can be accomplished both in workshops as well as through ongoing collaboration with frequent data users. The CEC is committed to modernizing access to information through exploratory dashboards, visualizations, and spatial mapping tools that best meet user needs. The CEC should also look for opportunities to incorporate new products used by stakeholders and highlight and house them in the California Energy Planning Library.

Chapter 3: California Energy Demand Forecast

It is critical that California's energy forecasting and planning continue to evolve and improve to keep pace with the changing dynamics of the energy sector. As described in Chapter 3, staff plans to expand and update the forecast to improve how climate change is incorporated into it and reflect fuel switching driven by the state's decarbonization goals.

Chapter 4: Emerging Topics, Role of Hydrogen in California's Clean Energy Future

Senate Bill 1075 (Skinner, Chapter 363, Statutes of 2022) requires CARB, in consultation with the CEC and CPUC, to prepare an evaluation on the development, deployment, and use of hydrogen by June 1, 2024. The CEC should coordinate with CARB on the implementation of the following recommendations.

- **Develop an agreed-upon and standardized method to measure the climate benefits of hydrogen while accounting for varying feedstocks and production processes.** CEC staff will continue to explore effective and efficient applications for hydrogen to decarbonize various sectors in California. In the process, promoting transparency in how hydrogen is made and the associated carbon intensity will be critical. The CEC staff recommends developing methods to measure climate benefits of hydrogen that are consistent and standardized and clear as to the actual renewable content of the hydrogen molecules to objectively compare the GHG implications of potential hydrogen applications and proposals. In addition, externalities such as hydrogen leakage, air quality impacts from combusting hydrogen, and water usage in hydrogen production must be considered carefully when assessing potential hydrogen applications and assessing impacts on low-income and disadvantaged communities.
- **Set targets for reducing GHG emissions from directly produced hydrogen production.** Transparency and accountability in public hydrogen investment could be

furthered by clear policy that sets milestones for reaching a low-carbon hydrogen future, just as the vision has been set for a fully renewable electrical grid. Indeed, because excess renewable electricity can be converted to hydrogen for use in other sectors or for long-term storage, there is a link between the decarbonizing the grid and hydrogen that puts them on a parallel path. Without a clear commitment to and path drawn for achieving low-carbon hydrogen, there can be uncertainty about appropriate requirements for hydrogen projects today and the long-term trajectory of public investments.

- **Expand Senate Bill 100 analysis of hydrogen**. Given the potential roles that hydrogen may play in achieving decarbonization in transportation and hard to electrify industries, and in strengthening grid reliability, the CEC should prepare for additional analyses of hydrogen supply adequacy and impacts of additional electrolytic hydrogen production to the electricity system. The Senate Bill 100 (de León, Chapter 312, Statutes of 2018) work can be expanded to include evaluation of the need for low-carbon hydrogen production in California and implications for the grid. The analysis should evaluate scenarios for increased hydrogen use (1) in the transportation sector, (2) to decarbonize fossil gas-fired power plants and store excess renewable power, and (3) in hard-to-electrify industrial sectors. This type of evaluation can in turn guide appropriate and equitable state investment in hydrogen. Other types of analyses to continue and expand relate to hydrogen availability for transportation fuel and other hard-to-electrify industries.
- **Fully engage in the federal Hydrogen Hub initiative.** The CEC must continue to work with the Alliance for Renewable Clean Hydrogen Energy Systems and to coordinate with the Governor's Office of Business and Economic Development, other state agencies, and private sector partners to ensure that California secures a federal Hydrogen Hub and capitalizes on the opportunity presented by the initiative. A California Hydrogen Hub can leverage the significant investment the state has already made in hydrogen infrastructure to further the state's leadership in developing a low-carbon hydrogen economy that has potential to bring new types of industry, such as green ammonia production, to California.

Glossary

1 1 1 is the Hydrogen Energy Earthshot goal of reducing the cost of clean hydrogen by 80 percent to $1 per 1 kilogram in one decade.

A ***binding forward showing process*** is the requirement for Western Resource Adequacy Program entities to demonstrate procurement of their share of the expected regional capacity needed for a given season.

Community-based organizations are organizations run by a majority of local residents and located in the communities they serve. Their priorities and proposed solutions are identified by residents and residents are involved in the design, implementation, and evaluation of services offered.

DER refers to a diverse category of devices and technologies that interface with the electricity system at the distribution level, either directly connected to a distribution utility's wires or on an end-use customer's premises, behind the utility meter. In this context, the CEC includes the following as DER: distributed generation and storage, electric vehicles and charging stations, grid-interactive buildings and microgrids, as well as more traditional demand response or load-flexibility resources and energy efficiency strategies.

Energy burden refers to poor air quality and increased health hazards due to proximity to polluting facilities (such as fossil fuel power plants), disproportionately high energy bills as compared to income, and difficulty accessing clean energy technologies due to financial and other barriers.

Equity-in means increased participation from communities of interest and enhanced diversity within the program, projects, and funded organizations. ***Equity-out*** refers to access to affordable and reliable clean energy, and direct benefits from project implementation.

The **Federal Energy Regulatory Commission** is a federal agency of the United States which regulates the following aspects of interstate commerce:

- the transmission of electricity
- the wholesale sales of electric energy and natural gas
- the transportation of oil by pipeline

It also reviews proposals to build interstate natural gas pipelines, natural gas storage projects, and liquefied natural gas terminals, in addition to licensing non-federal hydropower projects.

Ground-truthing refers to the process of gathering objective, directly observed data as opposed to data gained through inference.

A ***heavy-duty*** vehicle is a vehicle with a gross vehicle weight rating of less than 26,000 pounds and greater than 10,000 pounds, which includes the vehicle, fuel, occupants, and cargo. Common examples of heavy-duty vehicles include large transit buses, common tractor-trailer trucks, and refuse trucks.

Land-use screens are map-based footprints delineating important environmental and physical characteristics of the land. They are assembled from an integration of raw data into modeled results at the statewide scale and can show access limitations or competing land-use priorities. Land-use screens are a key input to several state electricity planning processes.

A ***light-duty*** vehicle is a vehicle with a gross vehicle weight rating of less than 10,000 pounds, which includes the vehicle, fuel, occupants, and cargo. Common examples include passenger cars and light- and medium-sized pickup trucks.

A ***medium-duty*** vehicle is a vehicle with a gross vehicle weight rating of less than 26,000 pounds and greater than 10,000 pounds, which includes the vehicle, fuel, occupants, and cargo. Common examples include moving trucks, large step vans, and some heavy-duty pickups.

A ***metric ton*** is a unit of weight equal to 1,000 kilograms (2,205 pounds).

The **North American Electric Reliability Corporation** is a nonprofit corporation with the mission to ensure the reliability of the North American bulk power system. It oversees six regional reliability entities and encompasses all of the interconnected power systems of Canada and the contiguous United States, as well as a portion of the Mexican state of Baja California. The Federal Energy Regulatory Commission, per the Energy Policy Act of 2005, designated the North American Electric Reliability Corporation as the Electric Reliability Organization responsible to develop and enforce compliance with mandatory reliability standards in the United States.

Planning reserve margin is a metric used to ensure there is sufficient supply to meet the demand under strained grid conditions, such as the loss of a generating resource or extreme weather.

Redlining refers to the government practice of designating some neighborhoods as hazardous to investments, thus denying the predominantly minority and low-income residents living there access to loans or investment.

Steam methane reformation is the process in which methane molecules are split to extract the hydrogen and carbon dioxide is released into the atmosphere.

Vehicle-to-building and ***vehicle-to-home*** refer to using the electric vehicle's battery like energy storage where there is a two-way power flow between the building and the vehicle, and the energy stored in the EV's battery could be used to power the building.

The **Western Electricity Coordinating Council** promotes bulk electric system reliability for the entire Western Interconnection system. The North American Electricity Reliability Corporation delegated authority to the Western Electricity Coordinating Council as the regional reliability entity responsible for compliance monitoring and enforcement.

Acronyms

1 1 1	$1 per kilogram in 1 decade
AAEE	additional achievable energy efficiency
AAFS	additional achievable fuel substitution
AATE	additional achievable transportation electrification
AB	Assembly Bill
BA	balancing authority
BEV	battery-electric vehicle
BPA	Bonneville Power Administration
BTM	behind the meter
BUILD	Building Initiative for Low-Emissions Development
California ISO	California Independent System Operator
CARB	California Air Resources Board
CBO	community-based organization
CCUS	carbon capture utilization and storage
CEC	California Energy Commission
CED	California Energy Demand Forecast
CEDU	California Energy Demand Update
CEJA	California Environmental Justice Alliance
CH_4	methane
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent
cpg	cents per gallon
CPUC	California Public Utilities Commission
DACAG	Disadvantaged Communities Advisory Group
DAME	Day-Ahead Market Enhancements
DAWG	Demand Analysis Working Group
DER	distributed energy resources
DMV	California Department of Motor Vehicles

DOF	California Department of Finance
DEBA	Distributed Electricity Backup Assets Program
DSGS	Demand Side Grid Support Program
DWR	California Department of Water Resources
E3	Energy and Environmental Economics
EDAM	Extended Day-Ahead Market
EE	energy efficiency
EERE	U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy
EV	electric vehicle
FCEV	fuel-cell electric vehicle
FERC	Federal Energy Regulatory Commission
GHG	greenhouse gas
GO-Biz	California Governor's Office of Business and Economic Development
GW	gigawatt
GWh	gigawatt-hour
GWP	global warming potential
HRI	hydrogen refueling infrastructure
IEPR	*Integrated Energy Policy Report*
IOU	investor-owned utility
IRP	Integrated Resource Plan
JAEDI	Justice Access Equity Diversity Inclusion
kW	kilowatt
kWh	kilowatt-hour
LCFS	Low Carbon Fuel Standard
LD	light-duty
LOLE	loss of load expectation
MDHD	medium-duty/heavy-duty
MMT	million metric tons
MMTCO_2e	million metric tons carbon dioxide equivalent
MW	megawatt

OIIP	order instituting informational proceeding
PRM	planning reserve margin
PV	photovoltaic
RDD&D	research, development, demonstration, and deployment
SB	Senate Bill
SGIP	Self-Generation Incentive Program
SMR	steam methane reformation
SPP	Southwest Power Pool
SPTO	Subscriber Participating Transmission Owner
SRRF	Electricity Supply Reliability Reserve Fund
TECH	Technology and Equipment for Clean Heating
TOU	time of use
TPP	Transmission Planning Process
U.S. DOE	United States Department of Energy
U.S. EIA	United States Energy Information Administration
VMT	vehicle miles traveled
WEIM	Western Energy Imbalance Market
WI	Western Interconnection
WRAP	Western Resource Adequacy Program
ZEV	zero-emission vehicle

Appendix A:
Draft Justice Access Equity Diversity Inclusion (JAEDI) Framework

This framework outlines the California Energy Commission's (CEC's) commitment to embedding energy equity and environmental justice in *our* energy future. This framework is not a one-size-fits all approach, check list, or an endpoint. This is a mechanism to help establish a common understanding and approach for the CEC to its part to address climate change and ensure all Californians have dignity, health, and prosperity.

To embed equity and environmental justice, the CEC must focus both on external and internal efforts. The framework takes this approach into account and will be used during the CEC's existing Justice Access Equity Diversity Inclusion (JAEDI) Initiative which started in 2019. By applying a JAEDI-in and JAEDI-out approach, the CEC will continue its journey to diligently and intentionally improve its internal operations and workplace to ensure its workforce feels welcome and supported (JAEDI-in) and to improve what goes out of the CEC in the form of our programmatic and policy work (JAEDI-out). The CEC wants a workforce that reflects the diversity of California and a workplace that has a culture of belonging. When staff feel supported and can be themselves and work without barriers, they thrive. The CEC also believes that if its employees experience equity and justice first-hand and understand what it means, they will be inspired to create more opportunities and better outcomes for all Californians through the agency's policies, programs, projects, and operations.

The CEC is grateful to the participants of the *2022 IEPR Update* and other justice leaders who inspired and informed this framework with their comments, scholarship, and experience. The agency embedded as much of their original words directly into the framework to maintain the language and essence of their statements, while still making it its own and in compliance with state and federal laws. This framework was also inspired and informed by various sources including peer agency efforts, federal level efforts like the Justice40 Initiative, The Principles of Environmental Justice (EJ),[170] Jemez Principles for Democratic Organizing,[171] Disadvantaged

170 EJ Principles. http://www.columbia.edu/cu/EJ/Reports_Linked_Pages/EJ_principles.pdf.

171 Jemez Principles. http://www.ejnet.org/ej/jemez.pdf. The Jemez Principles for Democratic Organizing were adopted in a December 1996 meeting in Jemez, New Mexico hosted by the Southwest Network for Environmental and Economic Justice with the intention of hammering out common understandings between participants from different cultures, political affiliations, and organizations.

Communities Advisory Group (DACAG) Equity Framework,[172] California Environmental Justice Alliance (CEJA) Environmental Justice Principles,[173] The Greenlining Institute's Make Equity Real,[174] The Energy Justice Workbook,[175] and Energy Equity Project Report.[176]

Vision

Achieving an energy system of the future — one that is clean, modern, reliable and ensures our economy continues to thrive while serving *all* Californians regardless of their race, income, or location.

Mission

Leading the state to a 100 percent clean energy future for all.

Terms and Definitions

Environmental Justice: According to California statute GOV § 65040.12 (e): "...Environmental justice means the fair treatment of people of all races, cultures, and incomes with respect to the development, adoption, implementation, and enforcement of environmental laws, regulations, and policies."[177]

Energy Justice: The goal of achieving equity in both the social and economic participation in the energy system, while also remediating social, economic, and health burdens on marginalized communities. Energy justice explicitly centers the concerns of Tribes and Justice Communities and aims to make energy more accessible, affordable, and clean, and democratic for all communities.

Just Transition: The transition away from fossil fuels to renewable energy to achieve a low-carbon regenerative economy that will remedy the injustices of the fossil-fuel energy system and extractive economy across multiple sectors.

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172 Disadvantaged Communities Advisory Group. https://efiling.energy.ca.gov/GetDocument.aspx?tn=224742.

173 CEJA. Environmental Justice Principles webpage. https://ceja-action.org/ej-decision-maker/ej-principles/.

174 Greenlining. Make Equity Real webpage. https://greenlining.org/make-equity-real/.

175 Initiative for Energy Justice. The Energy Justice Workbook. https://iejusa.org/wp-content/uploads/2019/12/The-Energy-Justice-Workbook-2019-web.pdf.

176 University of Michigan, School for Environment and Sustainability. 2022. "Energy Equity Framework: Combining Data and Qualitative Approaches too Ensure Equity in the Energy Transition." Energy Equity Project. https://seas.umich.edu/sites/all/files/2022_EEP_Report.pdf?utm_source=pr&utm_campaign=eep&utm_id=eep+framework.

177 CalEPA. Environmental Justice Program webpage, https://calepa.ca.gov/envjustice/.

Energy Equity: Energy Equity recognizes the historical and cumulative burdens of the energy system borne by Tribes and Justice Communities and by Black, Brown, and Native people in particular. To eliminate these disparities, energy equity centers the voices of Tribes and Justice Communities in energy planning and decision-making and ensures the fair distribution of clean energy benefits and ownership. Energy Equity includes multiple dimensions; the four key dimensions to consider are:

- Recognitional Equity: Recognitional equity aims to identify the communities that have been harmed by the energy system and deserve a larger share of benefits and investments in the future.
- Procedural Equity: Procedural equity aims to implement inclusive, accessible, authentic engagement and representation in policies, programs, projects, and operations. Decisions should be informed by those who will be affected by the decisions while recognizing historical, cultural, and institutional dynamics.
- Distributional Equity: Tribes and Justice Communities have not received the complete suite of resources that ensure community success, especially those with the highest need. Resources for the energy system, including funding allocations, must be distributed strategically to those communities with the highest need first and at a level that will adequately address needs. Distributional equity creates opportunities for people and communities to participate in the energy system supply/value chain, operations, service, and ownership and minimizes potential harm.
- Restorative Equity: Restorative equity aims to remedy past harms from the energy system and prevent future harms from occurring.

Racial Equity: Racial equity is realized when race can no longer be used to predict life outcomes and outcomes for all groups are improved.[178]

NOTE: This framework enables the use of the terms "energy equity" and "energy justice" interchangeably, leaning towards a preference for "justice" because it synthesizes and commemorates the traditions of justice-based efforts, including social justice and civil rights, environmentalism and climate justice, just transition, energy equity, and energy democracy. The CEC recognizes that "equity" has been used more commonly at the CEC and other state agencies.

178 Curren, Ryan, Julie Nelson, Dwayne S. Marsh, Simran Noor, and Nora Liu. 2016. "Racial Equity Action Plans: A How-to Manual." Haas Institute for a Fair and Inclusive Society. University of California, Berkeley. https://www.racialequityalliance.org/wp-content/uploads/2016/11/GARE-Racial-Equity-Action-Plans.pdf.

Priority Beneficiaries

The CEC seeks to increase opportunities for and the participation of all Californians in CEC programs and proceedings. Aligning with Executive Order N-16-22, the CEC must take action to address existing disparities in opportunities and outcomes by designing and delivering services and programs consistent with federal and state constitutional requirements to address unequal starting points and drive equal outcomes so all Californians may reach their full potential and lead healthy and rewarding lives.

Accordingly, unless legislative mandates or other executive directives apply, the CEC will prioritize efforts to increase resources, benefits, and opportunities to, while measurably reversing existing disparities and inequities for California Native American Tribes (Tribes) and Justice Communities. The CEC intentionally differentiates "Tribes" to recognize their distinct status as sovereign nations. Siting proceedings may address issues of Environmental Justice communities more directly while grants may address Equity or Equity Justice Communities more directly. Certain mandates may require focusing efforts on other or additional segments of the population or may apply a place-based approach with a certain geographic type (for example, urban versus rural). In these situations, the terms and definitions used in the mandate should be used. For example, common categories used in legislation are "disadvantaged communities" and "low-income communities." Any term used should be defined to help ensure clarity as to who is being referenced and what the mandate requires.

California Native American Tribes (Tribes): Per Public Resources Code, § 21073: "California Native American Tribe means a Native American Tribe located in California that is on the contact list maintained by the Native American Heritage Commission." The Native American Heritage Commission maintains a list of contacts among California Native American Tribes for the purposes of Chapter 905 of the Statutes of 2004 and the California Environmental Quality Act.[179]

Justice Communities: Justice Communities is a broad umbrella term that encompasses the following designations:

- Disadvantaged Communities, pursuant to Senate Bill 535 (De León, Chapter 830, Statutes of 2012) and based on the recently updated CalEnviroScreen version 4.0,[180] which are:

179 CEC. *Tribal Consultation Policy*. November 2021. https://www.energy.ca.gov/sites/default/files/2022-02/CEC-700-2022-001.pdf.

180 CalEPA. May 2022. Final Designation of Disadvantaged Communities Pursuant to Senate Bill 535. https://calepa.ca.gov/wp-content/uploads/sites/6/2022/05/Updated-Disadvantaged-Communities-Designation-DAC-May-2022-Eng.a.hp_-1.pdf.

    - Census tracts receiving the highest 25 percent of overall scores in CalEnviroScreen 4.0
    - Census tracts lacking overall scores in CalEnviroScreen 4.0 due to data gaps, but receiving the highest 5 percent of CalEnviroScreen 4.0 cumulative pollution burden scores
    - Census tracts identified in the 2017 DAC designation, regardless of their scores in CalEnviroScreen 4.0
    - Lands under the control of federally recognized Tribes
- Low-income communities and households, pursuant to Assembly Bill 1550 (Gomez, Chapter 369, Statutes of 2016), respectively:
    - Census tracts with area median household income/state median income, less than 80 percent, and
    - Households with median household income less than 80 percent of area median income (AMI)
- Underserved community, pursuant to Assembly Bill 841 (Ting, Chapter 372, 2020):
    - A community in which at least 75 percent of public-school students in the project area are eligible to receive free or reduced-price meals under the National School Lunch Program.

Guiding Principles

These values represent guiding principles for CEC proceedings.

1) **Lead with compassion.** The CEC acknowledges that Tribes and Justice Communities have experienced a tragic legacy of unfair treatment that includes displacement and genocide for Tribes and disinvestment and redlining practices for Justice Communities, along with ongoing disproportionate environmental burdens and economic disparities. As a state agency, the CEC wants to do its part to contribute to a healthy and prosperous future for Tribes and Justice Communities. The agency should view each project and policy as an opportunity to improve a person's life.
2) **Be equal partners.** The CEC will treat all Tribes and Justice Communities with dignity and respect, being particularly deferential when it seeks their input. The agency must ensure that relevant voices of people directly affected by its programs and policies are included and heard. Let people speak for themselves and listen with intention at every level of decision-making, including needs assessment, planning, implementation, enforcement, and evaluation.
3) **Aim to do no harm.** The CEC values human health and well-being and will scrutinize trade-offs to avoid and prevent harm to Tribes and Justice Communities. Tribes and Justice Communities should not be overlooked merely for business interests or cost-effectiveness.
4) **Take action.** The CEC commits to proactively identifying and removing barriers to participation and will design policies and programs to maximize benefits, create

targeted and accessible opportunities, and customize resources for Tribes and Justice Communities.

5) **Value community expertise.** The CEC recognizes the depth and breadth of experience of Tribes and Justice Communities as experts in what is happening on their land, in their homes and neighborhoods, with their families, friends, and co-workers, and in knowing the solutions they want to see. The CEC will seek input to inform and improve decisions and programs.
6) **Welcome participation.** The CEC seeks to inform and enable Tribes and Justice Communities to participate in all aspects of policy design, implementation, and evaluation. Due diligence is required to ensure that proceedings are applicable, and that the Tribes' and Justice Communities' interests and needs are represented. The CEC should ensure proceedings are accessible by offering language services, ADA accommodations, and culturally relevant material.
7) **Be responsive.** The CEC will respond and be accountable to concerns shared by Tribes and Justice Communities. The CEC will be transparent about its capacity to act and its limitations.
8) **Attempt interdisciplinary approach.** The CEC will aim to break down silos between divisions and peer agencies to find interdisciplinary approaches to advance more robust and comprehensive energy solutions that creatively address the multiple crises Californians are facing.

Best Practices to Embed an Equity and Environmental Justice Lens

These practices are intended to help staff implement the guiding principles.

1) **Embed equity into all programs, policies, and projects.** As of September 13, 2022, state agencies must embed equity into all efforts. If a program, policy, or project does not embed equity, staff must provide a statement explaining why equity is not embedded. To assess a program, policy, or project through an equity lens, consider using the assessment tool at the end of the JAEDI Framework.
2) **Engage with Tribes early, often, and meaningfully.** The CEC recognizes Tribes have sovereignty over their territories and members and acknowledge that Tribes and tribal communities possess distinct cultural, spiritual, environmental, economic and public health interests, and unique traditional cultural knowledge about California resources. The CEC defines effective consultation as open, inclusive, regular, collaborative, and implemented in a manner that is respectful, shares responsibility, and provides the free exchange of information concerning regulations, rules, policies, programs, projects, plans, property decisions, and activities. Additionally, the Legislature passed Assembly Bill 52 (Gatto, Chapter 532, Statutes of 2014), which amended portions of the Public Resources Code, in recognition of California Native American tribal sovereignty, Native Americans' knowledge of tribal cultural resources, and the unique relationship of California local governments and public agencies with California Native American tribal governments. Thus, engagement with Tribes should include seeking insight, guidance, direction, and feedback on policies, programs, operations, and projects before plans are moving forward. Meaningful

engagement means ensuring decisions and actions are informed by, and when possible, led by Tribes. Consider asking for their priorities and what gaps have they identified along with opportunities. Whenever any feedback is sought from Tribes, staff should aim to report back how that feedback was considered and what impact it made.

Before engaging with tribes, reach out to the CEC's Tribal Liaison and review the CEC's tribal consultation policy for guidance. The Governor's Executive Order B-10-11 and the CNRA Tribal Consultation Policy require tribal consultation to be initiated when state agencies engage in legislation, regulation, rules, policy, programs, projects, plans, property decisions, and activities that may affect Tribes. In addition, CEQA requires tribal consultation for discretionary actions.[181] (For more information, review "Culture Card: A Guide to Build Cultural Awareness"[182] and Technical Advisory AB 52 And Tribal Cultural Resources in CEQA.[183]) Talk with the CEC's Tribal Liaison to help determine if peer agencies are working on similar topics and should be included in CEC-led engagement or consultation with tribes to avoid overwhelming, overburdening or confusing Justice Communities.

3) **Engage with Justice Communities early, often, and meaningfully.** This engagement should include seeking insight, guidance, direction, and feedback on policies, programs, operations, and projects before plans are moving forward. Meaningful community engagement means ensuring decisions and actions are informed by, and when possible, led by Justice Communities. Consider asking for their priorities and what gaps have they identified along with opportunities. Whenever any feedback is sought from Justice Communities, staff should aim to report back how that feedback was considered and what impact it made. Before engaging with Justice Communities, reach out to the CEC's Public Advisor. The Public Advisor can help tailor contact lists for extensive outreach using the CEC's customer relationship management tool. Talk to the Public Advisor about options to engage with the Disadvantaged Communities Advisory Group (DACAG), the CEC's key external advisory body on justice matters.[184] Consider talking with peer agencies

181 CEC. *Tribal Consultation Policy*. November 2021. https://www.energy.ca.gov/sites/default/files/2022-02/CEC-700-2022-001.pdf.

182 U.S, Department of Health & Human Services, Substance Abuse and Mental Health Services Administration. January 2009. "Culture Card: A Guide to Build Cultural Awareness." https://store.samhsa.gov/sites/default/files/d7/priv/sma08-4354.pdf.

183 Governor's Office of Planning and Research. June 2017. *Technical Advisory: AB 52 and Tribal Cultural Resources in CEQA*. https://opr.ca.gov/ceqa/docs/20200224-AB_52_Technical_Advisory_Feb_2020.pdf.

184 DACAG webpage, https://www.energy.ca.gov/about/campaigns/equity-and-diversity/disadvantaged-communities-advisory-group.

who are working on similar topics to determine if engagement can be done together to avoid overwhelming, overburdening or confusing Justice Communities.

4) **Set aside a percentage of program funds for grant investments for Tribes and Justice Community projects.** Many CEC grant programs already dedicate a significant portion of investments, with most spending at least 15 percent on projects located in and benefitting disadvantaged communities with some programs requiring at least 50 percent and others achieving over 70 percent spending of its fund on projects located in disadvantaged communities. Communicate investment and funding opportunities through extensive outreach, including through the Empower Innovation[185] platform.
5) **Include technical assistance and customized resources.** An array of reasons exist that prevent many Tribes and Justice Communities from participating in programs and projects, including limited capacity, inexperience in complex state proceedings, distance from state events, among others. Offering customized technical assistant and other resources, when feasible, can be the key to enabling meaningful participation., to ensure Tribes and Justice Communities can participate, engage, and implement grants, programs, and projects.
6) **Track qualitative and quantitative data that can help evaluate programs, policies, and projects with an equity lens.** Unless it is confidential, this data should be shared with Tribes and Justice Communities and the public, to enable them to assess our work and inform their efforts. Policies should direct more data to be collected and research to be conducted that can lead to increased understanding of the needs of communities and how to effectively deliver solutions. Non-energy benefits and social costs should also be considered in analyses.
    - **Nonenergy benefits** represent the array of diverse impacts of energy programs and projects beyond the generation, conservation, and transportation of energy. Nonenergy benefits exist in three overarching categories: participant nonenergy benefits, utility nonenergy benefits, and societal nonenergy benefits. Incorporating nonenergy benefits may produce greater benefits to all Californians by increasing the societal benefits produced by public funds. Incorporating and tracking these benefits supports investments essential to California's transition to a clean energy economy. Specific categories of nonenergy benefits to consider:
        - **Participant nonenergy benefits** accrue to the program participants, including, but not limited to, reduced building or home operating costs, lower energy burden, increased property value, improved health, safety, and comfort,

185 Empower Innovation webpage, https://www.empowerinnovation.net/.

educational opportunities, increased energy reliability and household resilience, asset ownership, and beneficial fuel switching.

- **Utility nonenergy benefits** accrue as indirect costs or savings to the utility, including, but not limited to, bill payment improvements and reduced arrearages, reduced bad debt, infrastructure savings, improved fire safety, system resilience, and increased reliability for customers.
- **Societal nonenergy benefits** represent indirect program effects beyond those realized by ratepayers, the utility, or participants, and they accrue to society at large, including, but not limited to, quality local job creation, economic development, growth of tax receipts, increased community resilience, increased labor productivity, lower energy costs, increased property values, neighborhood stability, reduced emissions of greenhouse gases, improved air quality and other environmental benefits, avoided short- and long-term displacement, improved fire safety, development of and access to new technologies, improved public health and reduced health care costs, meaningful community engagement, community pride, ratepayer satisfaction through thoughtful equity and inclusion, reduced water use, and reduced reliance on fossil fuels.

7) **Include an educational component in all programs.** Have a mindset that the state wants everyone to be able to understand the impact and benefit of clean energy, including the technologies, job opportunities, and investments. This foundational education is vital to help ensure communities can prepare for and protect against climate threats. Material shared with the community should be culturally relevant and sensitive; include the experiences and appreciation of diverse cultural perspectives and be translated into other languages for participants who do not speak English or have limited English proficiency.
8) **Shape programs to improve health and safety.** Policies and programs should prioritize human and public health and improved quality of life. Aim to identify impacts and utilize findings to optimize the health and well-being of California's most vulnerable communities. Programs can include health interventions, provide educational material explaining health impacts, and can aim to quantify health benefits and impacts, such as climate related illnesses, injuries, and deaths; and reduce related healthcare costs.
9) **Consider how to create financial benefits or cost relief.** All investments in clean energy technologies, energy efficiency, and other environmental and energy investments, should consider benefitting communities directly through financial investment, incentives, rebates, and cost savings while also considering affordability and rate impacts.
10) **Identify pathways to increase supplier diversity and economic development.** Some programs may have inherent procurement opportunities that can be promoted to owners of small businesses, tribal enterprises, and other diverse business enterprises and contractors. Consider involving the Public Advisor in your efforts to expand outreach about programs to supplier diversity groups, through the CEC's customer relationship management tool, and the EmpowerInnovation.net platform.
11) **Create opportunities for workforce and career development.** A trained and ready workforce prepared to accelerate the implementation of clean energy infrastructure

and bring technologies to market is vital to achieving a clean energy future. Consider the following in planning processes:

- Promote and fund workforce development pathways to high-quality careers in clean energy industries, including pre-apprenticeship and other training programs
- Set and track hiring targets for Tribes and Justice communities, including women, reentry populations, and people living with disabilities into clean energy industries
- Ensure that energy-related careers are high-road, with a career-ladder, family-sustaining wages, and benefits
- Train the next generation of climate leaders, entrepreneurs, and workers for the clean energy economy

12) **Develop guardrails for consumer protection.** Bad actors may seek ways to exploit vulnerable populations for financial gain through scams, fraudulent marketing, and predatory practices. Staff should proactively consider potential issues customers or consumers may face and learn from the mistakes and solutions of other industries. Programs must have adequate consumer protection measures, disclosures, and accountability mechanisms to help ensure that Californians are not taken advantage of or otherwise compromised.

13) **Implement metrics for program and policy evaluation to ensure accountability.** Programs should develop and track metrics that help determine the success of a program, gaps in access or delivery, or need for course correction. The CEC should be responsive and accountable to community concerns, following up to provide data, findings, and continuing discussions about issues. The CEC should be diligent about working on an issue and communicate progress to the community.

14) **Consider ways to engage with and outreach to local government.** Local government may be a trusted source or partner of Tribes and Justice Communities to help expand outreach and will likely know which mediums to use, which languages are spoken by the residents, and which forums are best suited to promote**.**

15) **Avoid using "stakeholder(s)" and aim to describe participants more accurately.** Stakeholder is the blanket term used to describe an individual, group, or organization that stands to be impacted by the outcome of a project. But, because it may be used indiscriminately, there is a potential to offend. Aim to use more specific descriptions. When there is a need to describe a wider segment of the public, instead of stakeholder, consider using "interested member of the public" or "active participant". Do not describe tribes as stakeholders because they are sovereign entities who hold rights rather than solely stakes or interests.

Considerations for Embedding Equity and Environmental Justice

This list of considerations may be used in the design phase of a program, policy, or project and can also be used at the end to evaluate success and determine ways to course correct.

Participation: Will Tribes and Justice Communities be able to participate meaningfully and with sufficient support? Considerations include, but are not limited to, the following:

- Determine options for venues that are convenient, accessible, and have appropriate amenities
    - Is anyone who lives in a remote area trying to attend (for example, rural, mountainous, unincorporated areas)?
    - What is the proximity to public transportation?
    - Can the event be scheduled outside of customary hours?
    - Can there be multiple sessions or opportunities to participate?
    - Provide a clear and transparent timeline of plans
- Determine feasibility and preferred formats (for example, in-person, virtual, or hybrid). Some Tribes and Justice Communities may not have adequate broadband to use virtual platforms.
- Use engaging and diverse modes of communication including visuals, sounds, and mechanisms to provide written comments (such as Zoom chat or virtual whiteboards).
- Provide advance notification (at least 10 days but preferably more) of meeting times and locations to Tribes and Justice Communities, local leaders and other groups.
- Provide relevant and clear information and materials to sufficiently evaluate the proposed initiative, program, or policy.
- Determine if financial support is allowed to Tribes and Justice Communities and other advocates to defray the cost of participation when invited by staff and leadership (such as a stipend or technical assistance).
- Check to see whether language services are needed, including interpretation and accurate translations in preferred language(s).
- Determine if Americans with Disabilities Act or other accommodations are needed.

Restoration: Does the initiative, policy, or project aim to remedy prior and present harms faced by Tribes and Justice Communities who have been negatively impacted by the energy system?

Decision-making: Does the initiative, policy or program consider the input of Tribes and Justice Communities during the decision-making process? Considerations include whether Tribes and Justice Communities can help codevelop the initiative, policy, or program or provide input in other ways.

Benefits: Does the initiative, policy, or program include economic, social, health or other benefits for Tribes and Justice Communities? Considerations include, but are not limited to, the following:

- Whether the policy considers benefits and harms in nonenergy areas (for example, gentrification and displacement), including for future generations.
- Whether the benefits are direct or indirect; assured or risky; meaningful or symbolic. Some examples of direct energy benefits relate to increased reliability and resiliency (such as the generation, conservation, transmission, and storage of energy). Examples

of indirect or cobenefits include improved health (for example, reduction in asthma rates over time) and local job opportunities.

Access: Does the initiative, policy, or program in some way make clean energy or transportation more accessible or affordable to Tribes and Justice Communities?

Considerations for Embedding Equity into Investments

This list provides some considerations for making investments with a justice lens:

- Investments reflect the priorities of Tribes and Justice Communities
- Investments aim to be community-driven
- Investments aim to address the needs of Tribes and Justice Communities
- Investments deliver direct benefits to Tribes and Justice Communities
- Investments aim to avoid creating or exacerbating burdens
- Investments are multisectoral to achieve transformation
- Investments operationalize equity by:
    - If applicable, embedding equity in the mission, vision, and values of investment programs.
    - Ensuring equity into the program's process.
    - Ensuring equity outcomes via implementation.
    - Measuring and analyzing for equity.

Considerations for Benefits Metrics

In alignment with the Department of Energy General Guidance for Justice40 Implementation, Table A-1 provides examples of metrics CEC can use to measure and analyze equity benefits to justice communities for projects and programs and are not intended to be all inclusive.[186] Program level benefits should be identified through a public engagement process and use consistent analysis methods and tools to allow for aggregation of data. Any additional project level benefits should be developed by the recipient in conjunction with community input.

186 Final DOE Justice40 General Guidance. https://www.energy.gov/sites/default/files/2022-07/Final%20DOE%20Justice40%20General%20Guidance%20072522.pdf.

Table A-1: Example Benefit Metrics

Policy Priorities	Benefit Metric and Units
Invest in energy justice communities	Dollars spent [$] by CEC programs
Decrease energy burden	Dollars saved [$] in energy expenditures due to technology adoption
	Energy saved [MWh or MMBTU] or reduction in fuel [GGe]
Decrease environmental exposure and burdens	Avoided air pollutants
	Remediation impacts on surface water, groundwater, soil
	Reduction of legacy contaminated waste
Increase clean energy jobs, job pipeline, job training	Dollars spent [$] and/or number of participants in job training programs, apprenticeship programs, STEM education, tuition, scholarships and recruitment
	Number of hires resulting from CEC training
	Number of jobs created
	Number of and/or dollar value [$] of partnerships, contracts, or training with minority serving institutions
Increase clean energy enterprise creation and contracting for minority or disadvantaged businesses in energy justice communities	Number of contracts and/or dollar value [$] awarded to diverse businesses
Increase energy democracy	Number of stakeholder events, participants, and/or dollars spent to engage with organizations and residents, including participation and notification of how input was used
	Dollars spent [$] or number of hours spent on technical assistance
	Dollar value [$] and number or clean energy assets owned resulting from investments
Increase access to low-cost capital	Dollars spent [$] by source and purpose and location
	Leverage ratio of private to public dollars [%]
	Loan performance impact through dollar value [$] of current loans and of delinquent loans (30-day or 90-day) and/or number of loans (30-day delinquent or 90-day default)
Increase parity in clean energy technology access and adoption	Clean energy resource [MWh] adopted
Increase reliability, resilience, and infrastructure to support reliability and resilience	Increase in community resilience hubs
	Number and size (MWh) of community resilience infrastructure deployed

Credit: CEC

Appendix B:
Regional and Community Engagement Efforts for 2022 Integrated Energy Policy Report Workshops Centering Equity and Environmental Justice

The CEC conducted engagement with tribes, governmental entities, and communities in the three different regions where IEPR workshops on equity and environmental justice took place. The tables below summarize the engagement for each region: Salton Sea, San Joaquin Valley, and Central Coast.

Table B-1: June 29, 2022, IEPR Workshop Inland Empire/Salton Sea Regional Engagement

Date	Description	Location
6/28/2022	Hike at Mecca Canyon with Alianza Coachella Valley to view Salton Sea Landscape and learn about Salton Sea restoration	Coachella, CA
6/28/2022	Community tour with Leadership Council to get to know the community and understand extent of economic disparity, view geothermal power plants, visit new developments, Polancos, mobile home parks, community park, and speak with residents.	Coachella, Thermal, and North Shore, CA
6/28/2022	Imperial Irrigation District ECGS Battery Storage Facility	El Centro, CA
6/28/2022	Dinner with Comite Civico and local community leaders	El Centro, CA
6/30/2022	Visit to Obsidian Butte with Kwaaymii Laguna Band of Mission Indians, Fort Yuma Quechan Indian Tribe, and Native American Land Conservancy	Calipatria, CA
6/30/2022	Visit with Torres Martinez Desert Cahuilla Indians	Thermal, CA

Credit: CEC

Table B-2: July 20, 2022, IEPR Workshop San Joaquin Valley Regional Engagement

Date	Description	Location
7/19/2022	Visit with North Fork Rancheria of Mono Indians Tribal Council	North Fork, CA
7/19/2022	Visit with the City of Arvin and partners to learn about their clean energy and transportation projects, and new Arvin campus of Kern Community College District	Arvin, CA
7/19/2022	Dinner with Chancellor of the Kern Community College District	Bakersfield, CA
7/21/2022	Transportation Workforce Development Tour of the Kern County Electrical Training Center, IBEW Apprenticeship Hall, Bakersfield College 21st Century Energy Center with Kern Community College District	Bakersfield, CA
7/21/2022	Tour of WattEV 21st Century Truck Stop funded by CEC (EPC-21-006; ARV-21-025) that includes a public charging truck stop and distributed energy resource (DER) package composed of solar, battery energy storage system, and an AC/DC distribution control system	Bakersfield, CA
7/21/2022	Tour of Green Power Motor Company manufacturing facility for electric buses	Porterville, CA
7/21/2022	Tour of Zero Nox which specializes in the development, manufacture, and sale of electric powertrain technology and its integration into electric vehicles.	Porterville, CA
7/21/2022	Meeting with Senator Grove	Bakersfield, CA
7/22/2022	Visit Every Neighborhood Partnership to learn about CEC-funded project, *Building Healthier and More Energy-Efficient Communities in Fresno and the Central Valley* (EPC-17-035)	Fresno, CA

Credit: CEC

Table B-3: August 31, 2022, IEPR Workshop Central Coast Regional Engagement

Date	Description	Location
8/29/2022	CPUC Southern California Region Tribal Consultation with CEC and CARB	Pala, CA
8/30/2022	Tour of Limoneira agribusiness facilities to learn about their solar project and sustainability practices.	Santa Paula, CA
8/30/2022	Environmental Justice Tour, organized by CAUSE, of multiple sites including the Port of Hueneme, Halaco Superfund Site & New-Indy Containerboard Factory, Ormond Beach Generating Station, ABA Energy Corporation Drilling Site, Anterra Oil Wastewater Facility, SoCalGas Compressor Station	Oxnard, CA
9/1/2022	Tour Port of Hueneme, an EV Blueprint Grant recipient, and learn about their community outreach program that incorporates community education on topics such as green energy and local air quality	Port Hueneme, CA
9/1/2022	Tour of Wiggins Lift, an Oxnard-based business manufacturing the first commercially available zero emission fully electric large capacity forklift	Oxnard, CA
9/1/2022	Tour of the Arevon/Tesla 100 megawatt/400 megawatt-hour Saticoy battery storage system that features 142 Tesla Megapacks, Tesla's utility-scale battery storage product.	Oxnard, CA
9/2/2022	Visit with Clean Power Alliance (CPA) to tour energy reliability Power Ready locations and learn about their partnership with the Ventura County Electrical Joint Apprenticeship Training Committee (VCEJATC) to provide funding for the Western Electric Cybersecurity Apprenticeship Training (WECAT) for Smart Buildings & Smart Cities.	Oxnard, CA

Credit: CEC