DOCKETED	
Docket Number:	22-IEPR-01
Project Title:	2022 Integrated Energy Policy Report Update
TN #:	248734
Document Title:	Final 2022 Integrated Energy Policy Report Update - Track Changes Version
Description:	***THIS DOCUMENT SUPERSEDES TN 248668***
Filer:	Raquel Kravitz
Organization:	California Energy Commission
Submitter Role:	Commission Staff
Submission Date:	2/10/2023 11:11:23 AM
Docketed Date:	2/10/2023

CALIFORNIA ENERGY COMMISSION

CALIFORNIA NATURAL RESOURCES AGENCY

California Energy Commission

COMMISSION REPORT

(bst) ~~Draft~~ (est) (bbu) Final (ebu) 2022 Integrated Energy Policy Report Update

Please Note: Proposed language appears in bold underline **(example)** and proposed deletions appear in strikethrough (example). To effectively include access to the marked-up language for all users, please refer to the following key codes:

- "(bbu)" means begin bold underline text.
- "(ebu)" means end bold underline text.
- "(bst)" means begin strikethrough text.
- "(est)" means end strikethrough text

Gavin Newsom, Governor

(bst) ~~November 2022~~ (est) February 2023 | CEC-100-2022-001-CMD

California Energy Commission

David Hochschild, Chair
Siva Gunda, Vice Chair
Commissioners

J. Andrew McAllister, Ph.D.
Patty Monahan
Kourtney Vaccaro

Stephanie Bailey
Jane Berner
David Erne
Noemí Gallardo
Quentin Gee
Akruti Gupta
Heidi Javanbakht
Hilary Poore
John Reid
Kristen Widdifield
Primary Authors

Raquel Kravitz
Project Manager

Heather Raitt
IEPR Director

Drew Bohan
Executive Director

DISCLAIMER – APPLICABLE TO DRAFT ONLY

DISCLAIMER TO BE DELETED IN FINAL REPORT ADOPTED BY THE CEC

ACKNOWLEDGEMENTS

Rizaldo Aldas
Grace Anderson
Mona Badie
Aniss Bahreinian
Linda Barrera
Amanda Bourdet
Erica Brand
Jennifer Campagna
Peter Chen
Ethan Cooper
Denise Costa
Bart Croes
Hank Crook
Miki Crowell
Lisa DeCarlo
Maggie Deng
Kristen Driskell
Tom Flynn
Nick Fugate
Ben Finkelor
Jesse Gage
Cary Garcia
Liz Gill
Elena Giyenko
Aleecia Gutierrez
Miina Holloway
Mark Hesters
Elizabeth Huber
Nick Janusch
Katrina Leni-Konig
Erik Lyon
Mark Kootstra
Alex Lonsdale
Lynn Marshall
Bob McBride
Chris McLean
Ingrid Neumann
Mark Palmere
Elizabeth Pham
Peter Puglia
Ken Rider
Harrison Reynolds
Carol Robinson
Katerina Robinson
Gordon Schremp
Linda Spiegel
Kevin Uy
Reneé Webster-Hawkins
Terra Weeks
Ysbrand van der Werf
Chie Hong Yee Yang

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

Please use the following citation for this report:

Bailey, Stephanie, Jane Berner, David Erne, Noemí Gallardo, Quentin Gee, Akruti Gupta, Heidi Javanbakht, Hilary Poore, John Reid, and Kristen Widdifield. (bst) ~~2022. *Draft* (est)~~ *(bbu)* **2023. *Final* *2022*** (ebu) *Integrated Energy Policy Report*. California Energy Commission. Publication Number: CEC-100-2022-001-CMD.

TABLE OF CONTENTS

Page

Page

LIST OF FIGURES

Page

LIST OF TABLES

Page

EXECUTIVE SUMMARY

(bst) ~~The state~~ (est) (bbu) **California** (ebu) is transforming its energy system away from fossil fuels to achieve a reliable, clean, affordable energy future that benefits *all* Californians. (bst) ~~California~~ (est) (bbu) **The state** (ebu) is an international leader in energy policy, and in September 2022, Governor Gavin Newsom signed (bst) ~~a suite of bills passed by the Legislature to~~ (est) (bbu) **several laws that will** (ebu) accelerate California's bold commitment to reduce greenhouse gas (GHG) emissions through world-leading climate action. This package of (bst) ~~bills is called~~ (est) (bbu) l**aws,-** (ebu) the *California Climate Commitment*, (bst) ~~which includes putting in statute a requirement~~ (est) (bbu) **requires specified agencies to take action to ensure** (ebu) that California (bst) ~~reach~~ (est) (bbu) **reaches** (ebu) net-zero GHG emissions by 2045 (Assembly Bill 1279, Muratsuchi, Chapter 337, Statutes of 2022~~)~~ (bst) ~~and mandating~~) (est). (bbu) **It also requires** (ebu) 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). (bbu) **Further,** (ebu) Governor Newsom bst) ~~also~~ (est) 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 (bst) ~~State's~~ (est) (bbu) **state's** (ebu) 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 (bst) ~~to~~ (est)each (bbu) **to** (ebu) 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 (bst) ~~further~~ (est) ~~-~~embed equity and environmental justice (bbu) **further** (ebu) in CEC efforts. Workshop participants and others confirmed the CEC should have a framework to enable the public to (bbu) **monitor** (ebu) more easily (bst) ~~monitor~~ (est) ~~-~~the CEC's commitment and approach to equity and environmental justice. (bst) ~~Additionally~~ (est) (bbu) **Moreover** (ebu), 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 (bst) ~~its~~ (est) (bbu) **the** (ebu) 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, (bst) ~~to~~ (est) update the relevant data sets accordingly, and (bst) ~~to~~ (est) test the new inputs and outputs.

Making Information Readily Available: California Energy Planning Library

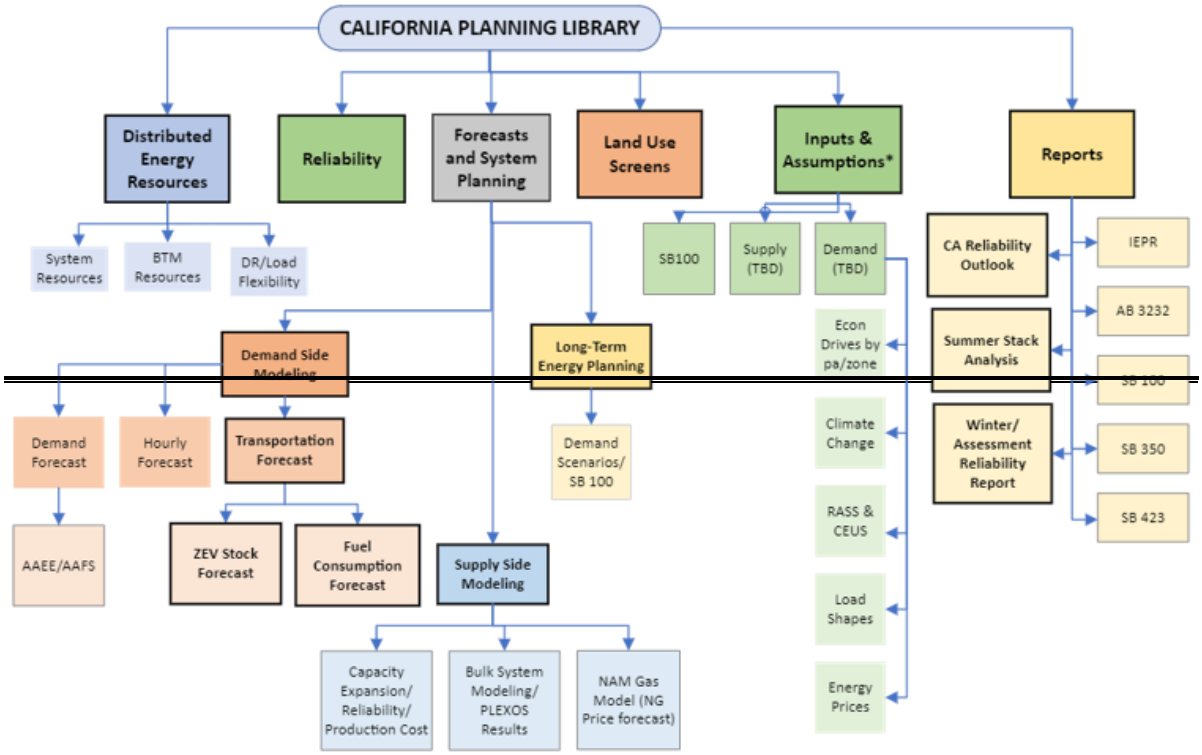
Information is foundational to building the policies and tools necessary to equitably achieve carbon neutrality by 2045. The CEC is working to make its data and analytics more easily available to all, from peer agencies engaged in energy planning to novices who want to learn more. Aims include:

- 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.

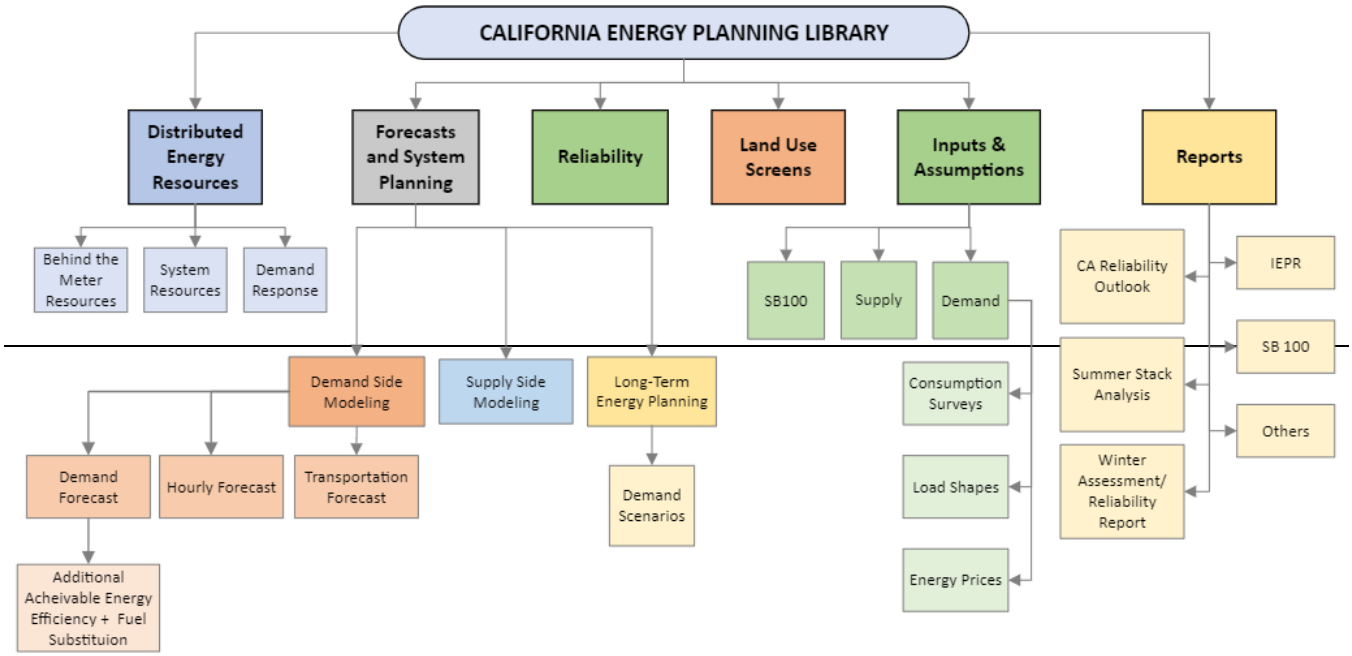
The CEC is launching the California Energy Planning Library in early 2023~~—~~, an online platform available from the CEC's webpage. For the initial rollout, it will house commonly requested analytics developed for electricity planning (Figure ES-1), such as energy reliability and the energy demand forecast (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 [begin image delete]



[end image delete] [begin image insert]



[end image insert] 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 (bst) ~~is updating~~ (est) (bbu) **updated** (ebu) 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*. (bst) ~~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*.~~ (est)

(bbu) **Updated electricity demand forecasts show that electricity consumption in California is increasing at an accelerating rate, fueled in part by California's efforts to decarbonize the transportation and building sectors by switching from fossil fuels to electricity. Statewide electricity sales were more than 290,000 gigawatt-hours (GWh) in 2021 and are forecasted to be just under 302,000 GWh in 2035 in the planning forecast. These values incorporate the projected impacts of customer generation, additional achievable energy efficiency, fuel substitution, and transportation electrification. The California Energy Demand Update 2022** Planning **Forecast peak demand for the California Independent System Operator (California ISO) — which manages roughly 80 percent of California's load — reaches 55,117 megawatts (MW) by 2035. By 2035, this managed forecast is 5.1 percent higher than projected by the comparable California Energy Demand 2021 scenario. The increase can be attributed mostly to the increased levels of transportation electrification resulting from the inclusion of recent and proposed regulations. CARB's Advanced Clean Cars II regulation (requires that all new passenger cars, trucks, and sports utility vehicles sold in California be zero-emission by 2035) and the proposed Advanced Clean Fleets regulations (to achieve a medium- and heavy-duty zero-emission truck and bus fleet in California by 2045 and earlier in specific market segments) are reflected in the forecast.** (ebu)

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

(bbu) **Energy reliability in California and nationally is increasingly impacted by highly variable and unusual weather events and emergencies brought on by climate change. A vast majority of the time, California's energy system runs reliably without issue, and utilities hold backup assets to provide energy during emergencies and avoid outages. The state's greatest energy reliability concerns are driven by a small number of hours during increasingly historic heat event and cold snaps when demand for energy skyrockets to unprecedented levels. If these types of weather events coincide with another climate-driven emergency, like drought or fire, the state's energy system can be strained beyond the usual reliability contingencies. As California regulators and utilities address these new uncertainties, it will be critical to weigh the risk of potential and temporary outages with the relative cost increase in energy rates for consumers. Ultimately, increases in electricity and gas rates can create a form of reliability concern, as the cost of power may become increasingly unaffordable for low-income and fixed-income Californians. It will be critical to address procurement for these emergency needs at least cost to ratepayers and advisable to identify opportunities to invest in assets that provide benefit to the grid year-round.** (ebu)

Since the heat event in August 2020 that led to rotating power outages, the CEC, California Public Utilities Commission (CPUC), and California (bst) ~~Independent System Operator (California ISO)~~ (est) (bbu) **ISO** (ebu) have been working diligently to better prepare the state for the accelerated impacts of climate change. (bst) ~~Despite the~~ (est) (bbu) **Since this** (ebu) focused effort to address energy reliability in 2021, (bbu) **climate** (ebu) risks persisted (bst) ~~in 2022~~ (est). 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 (bst)* ~~(hours when energy demand minus wind and solar generation is largest).~~ (est) The net peak occurs after the highest demand (gross peak) when solar generation rapidly declines at the end of the day~~,~~ and extends (bbu) **the** (ebu) concern for meeting electricity demand (bst) ~~until~~ (est) from 4:00 p.m. to 9:00 p.m. (bbu) **Extreme weather caused by climate change drives California's net peak far above normal energy consumption levels on a small number of days a year, creating extreme outliers of reliability concerns.** (ebu)

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 (bst) ~~(shown illustratively~~ (est) (bbu) **to address these outliers (illustrated** (ebu) 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:

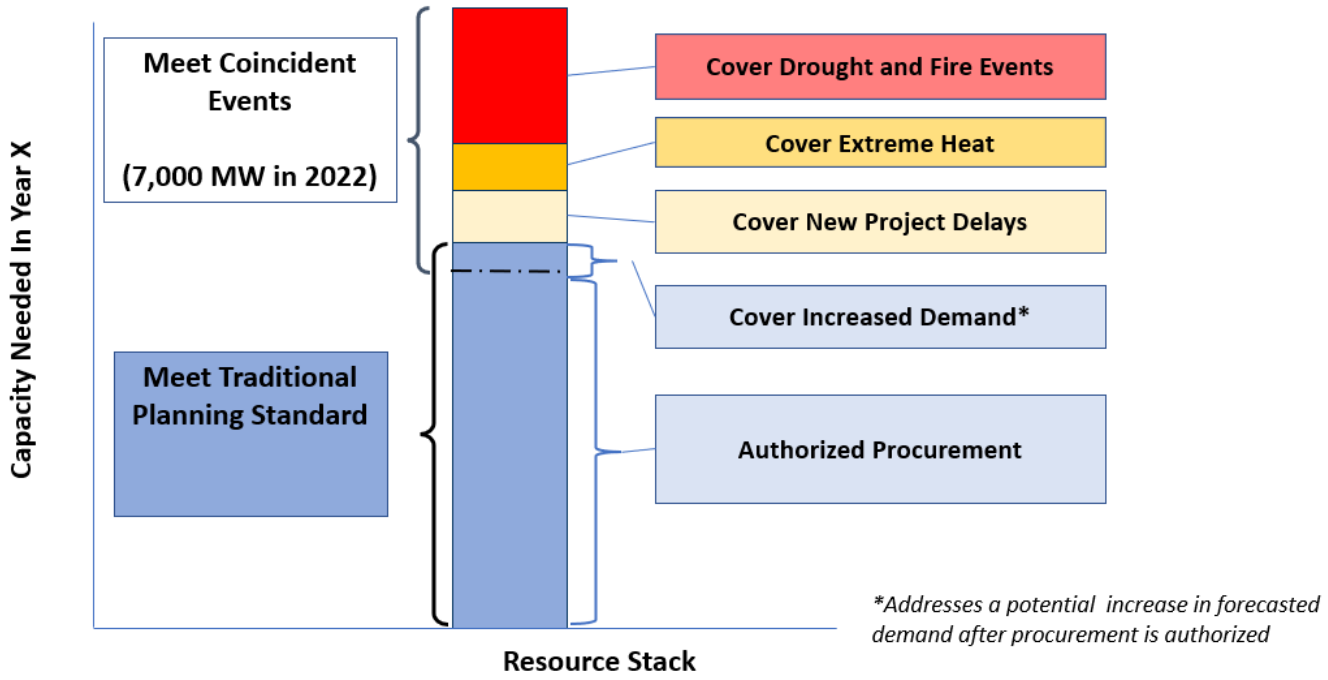
- Demand increases that may occur, due to economic or climate factors changing, after procurement is ordered (identified as a potential lag).
- Delays in on-line dates of authorized procurement under development due to issues such as supply chain problems.
- Extreme heat similar to August 2020.

- Drought (that reduces hydroelectric availability) and (bst) ~~fire events~~ (est) (bbu) **fires** (ebu) (that threaten electricity infrastructure).

Assuming all these (bst) ~~factors are realized~~ (est) (bbu) **things happen simultaneously** (ebu), the (bst) ~~analysis anticipated~~ (est) (bbu) **state could experience** (ebu) a (bst) ~~potential~~ (est) shortfall of 7,000 (bst) ~~megawatts (~~MW~~)~~ (est) 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 (bst) ~~Strategy~~ (est) (bst) **Strategic** (ebu) 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 (bst) ~~to~~ (est) provide additional emergency resources during extreme events.

The extreme heat event over the (bst) ~~ten~~ (est) (bbu) **10** (ebu)-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 (bst) ~~multiple~~ (est) (bbu) **several** (ebu) initiatives to be deployed, including those authorized by AB 205. While the AB 205 programs are in (bst) their (est) infancy, (bbu) **having been passed into law only months before the heat wave,** (ebu) they (bst) ~~helped~~ (est) (bbu) **were able to provide additional electricity to help** (ebu) meet the record demand experienced in September 2022. Californians also met the challenge and reduced their (bst) ~~load~~ (est) (bbu) **energy demand** (ebu) during the critical net peak hours (bst) ~~(between 4 p.m. and 9 p.m.)~~ (est) in response to FlexAlerts and a wireless emergency alert. All these efforts and more helped keep the power flowing and the lights on. (bst) ~~A~~ (est) (bbu) **On November 2, 2022, the California ISO published a** (ebu) detailed analysis of the (bst) ~~crises is underway.~~(est) (bbu) **impacts of the heat event.** (ebu)

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



Source: CEC staff

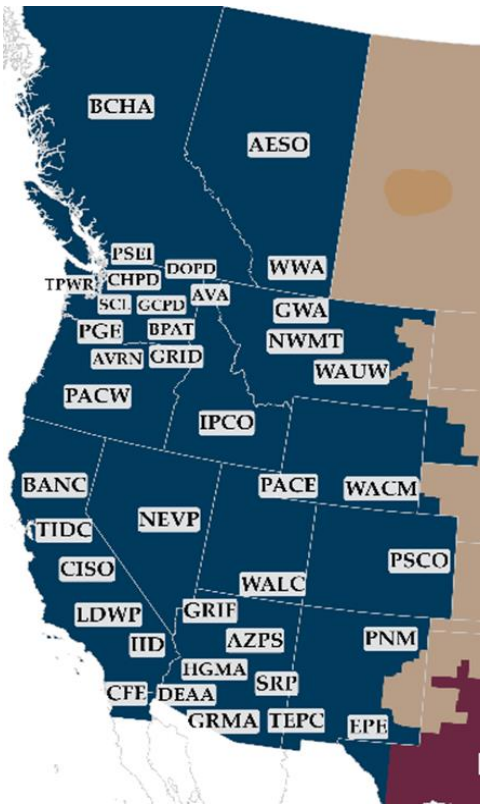
Given concerns about energy reliability, Senate Bill 846 (Dodd, Chapter 239, Statutes of 2022) preserves the option to extend operation of the Diablo Canyon nuclear power plant, which serves about 6 percent of California's electricity, for five years beyond the 2025 retirement date. The statute also 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 (bst) ~~much~~ (est) larger whole — the Western Interconnection. The Western Interconnection includes electricity infrastructure in 11 western states, two Canadian provinces, and portions of Mexico (bst)~~and~~ (est) (bbu) **operated as** (ebu) 34 independent balancing authorities (bst) ~~that are~~ (est) governed by (bbu) **the** (ebu) 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 (bst) ~~as realized by~~ (est) (bbu)**. A recent example of the benefits of regional collaboration is the California ISO's formation of** (ebu) the Western Energy Imbalance Market (WEIM), a forum for real-time energy trading to balance energy supply and demand (bbu) **regionally** (ebu). Since (bst) ~~its~~ (est) (bbu) **the** (ebu) inception (bbu) **of this market** (ebu) in 2014, California ISO analysis shows that the WEIM has created (bst) ~~more than $2~~ (est) (bbu) **$3.4** (ebu) billion in gross benefits and saved (bst) ~~700~~(est) (bbu) **more than 790** (ebu),000 metric tons of GHG emissions. Building on the success of the WEIM, the (bbu) **California ISO will implement an** (ebu) Extended Day-Ahead Market, or EDAM, (bst) ~~is a proposal~~ (est) 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: (bst) ~~Western Electricity Coordinating Council~~ (est) (bbu)**WECC** (ebu)

(bst)~~There is also a growing interest in coordinating reliability efforts and resource adequacy planning, given~~ (est) (bbu) **Coordination across** (ebu) the (bst) ~~weather extremes of a rapidly changing climate and changes in the resource mix to shift away from fossil fuels. Further, westwide coordination~~ (est) (bbu) **West** (ebu) is key to (bbu) **reducing the cost of adapting to climate change while decarbonizing the energy sector. Coordination may also aid in** (ebu) developing (bst) ~~the~~ (est) transmission lines needed for California to access (bst) ~~renewable~~ (est) clean resources in other states (bst) ~~and within California~~ (est) (bbu) **when needed and export abundant clean energy resources, like offshore wind once fully developed, to other western states**. (ebu) The California ISO's *20-Year Transmission Outlook* anticipates that new transmission, beyond current planned projects, is needed to connect about 4,000 (bst) ~~megawatts~~ (est) (bbu) **MW** (ebu) of out-of-state wind capacity into California.

The Role of Hydrogen in California's Clean Energy Future

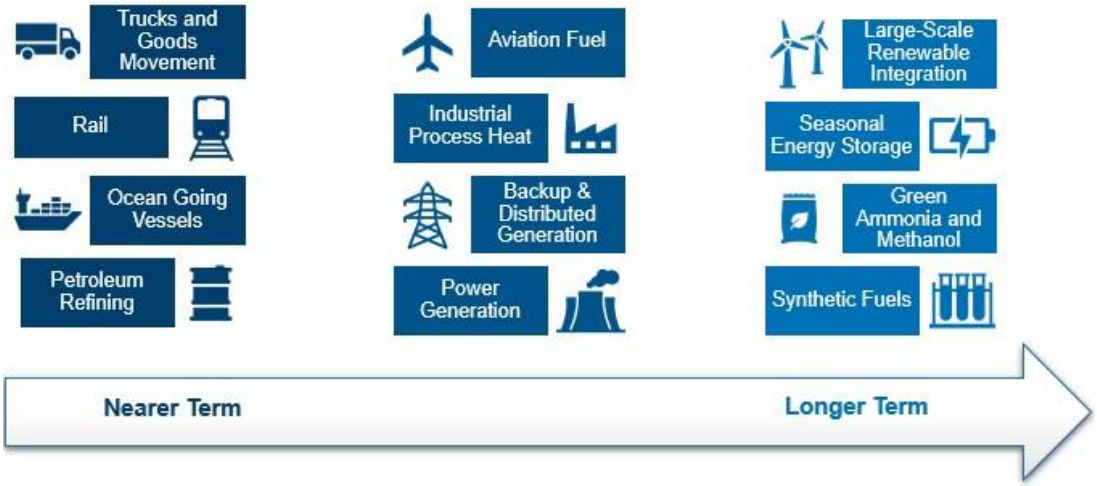
(bst) ~~Hydrogen holds promise in playing important roles~~ (est) (bbu) **The CEC continues to explore the role hydrogen can play** (ebu) in California's clean energy future. Already, hydrogen (bbu) **derived from fossil fuels** (ebu) is widely used in California and around the world in petroleum refining~~,~~ 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) (bst) ~~*Draft* (est)~~ *2022 Scoping Plan Update* envisions a scenario in which (bst) ~~a new industry producing~~ (est) low-carbon hydrogen will help decarbonize the transportation~~,~~ (bst) ~~buildings,~~ (est) and industrial sectors. In this scenario, (bst)~~production~~ (est) (bbu) **the supply** (ebu) of low-carbon hydrogen would (bst) ~~potentially~~ (est) (bbu) **need to** (ebu) increase by (bst) ~~60~~ (est) (bbu) **1,700** (ebu) -fold and (bst) ~~exceed by 70 percent that~~ (est) (bbu) **almost double what is** (ebu) produced today using fossil fuels, primarily for petroleum refining. Barriers include~~-~~ higher production costs (bbu) **of producing hydrogen from clean resources** (ebu) and~~-~~ the need to (bst)~~quickly~~ (est) develop large-scale hydrogen production plants quickly in coordination with new renewable energy resources for use in production.~~-~~ Further, the state would need to (bst) ~~address limits to~~ (est) (bbu) **develop rules for** (ebu) the (bbu) **amount of** (ebu) hydrogen (bst) ~~concentration~~ (est) that can be blended in existing gas pipelines or (bst) ~~the need for~~ (est) (bbu) **suppo**rt (ebu) dedicated hydrogen pipelines and other distribution and storage infrastructure. ~~Hydrogen is a climate pollutant~~ (est) (bbu) **Also, hydrogen can extend the lifetime of several greenhouse gases if leaked into the atmosphere** (ebu), has a higher (bst) ~~diffusivity~~ (est) (bbu) **potential for leakage** (ebu) than (bst) ~~fossil gas~~ (est) (bbu) **methane** (ebu), and causes steel (bst) ~~brittleness, so~~ (est) (bbu) **to become brittle. So,** (ebu) it will be important to minimize leakage for climate, safety, and economic reasons. (bst) ~~Also,~~ (est) (bbu) **Lastly, it will be important to control** (ebu) emissions of oxides of nitrogen from hydrogen combustion (bst) ~~need~~ (est) to (bst) ~~be controlled~~ (est) (bbu) **protect public health**. (ebu)

Today, hydrogen is almost exclusively produced from fossil fuels through steam methane reformation (bst) ~~(SMR),~~ (est), 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 (bst) ~~requires production~~ (est) (bbu) **will require hydrogen to be produced from renewable resources. For example, hydrogen could be produced** (ebu) using biomethane instead of fossil-based methane in (bst) ~~SMR or~~ (est) steam methane reformation, using renewable electricity to split hydrogen from water molecules (electrolysis), (bst) ~~resulting in low~~ (est) (bbu) **or using waste biomass from forests** (ebu) or (bst) ~~zero~~ (est) (bbu) **agriculture to produce hydrogen and** (ebu) carbon (bst) ~~hydrogen.~~ (est) (bbu) **through advanced pyrolysis.** (ebu) The (bst) ~~*Draft*~~ (est) *2022 Scoping Plan Update* also identifies pairing (bst) ~~SMR~~ (est) (bbu)**steam methane reformation** (ebu) with carbon capture, utilization, and storage (bst) ~~(CCUS)~~ (est) as another potential near-term tool for reducing emissions until hydrogen production using electrolysis with renewables or other low-carbon processes can meet demand. (bst) ~~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.~~ (est)

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 (bbu) **low-carbon** (ebu) chemicals such as (bbu) **green** (ebu) 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 (bst) ~~through electrolysis of water or reformation of biofuels using renewable energy.~~ (est). Further, California is competing in the (bst) ~~$6–7 billion~~ (est) 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," (bbu) **with up to $7 billion in funding for 6 to 10 hubs in the United States**. (ebu)

Transparency and accountability in public hydrogen investment could be (bst) ~~furthered~~ (est) (bbu) **advanced** (ebu) by clear policy that sets milestones for scaling up production of (bst) ~~a~~ (est) 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. 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 (bst) ~~to develop a path forward for hydrogen development~~ (est) (bbu)**, including policy recommendations and strategies for decarbonization,** (ebu) by June 1, 2024.

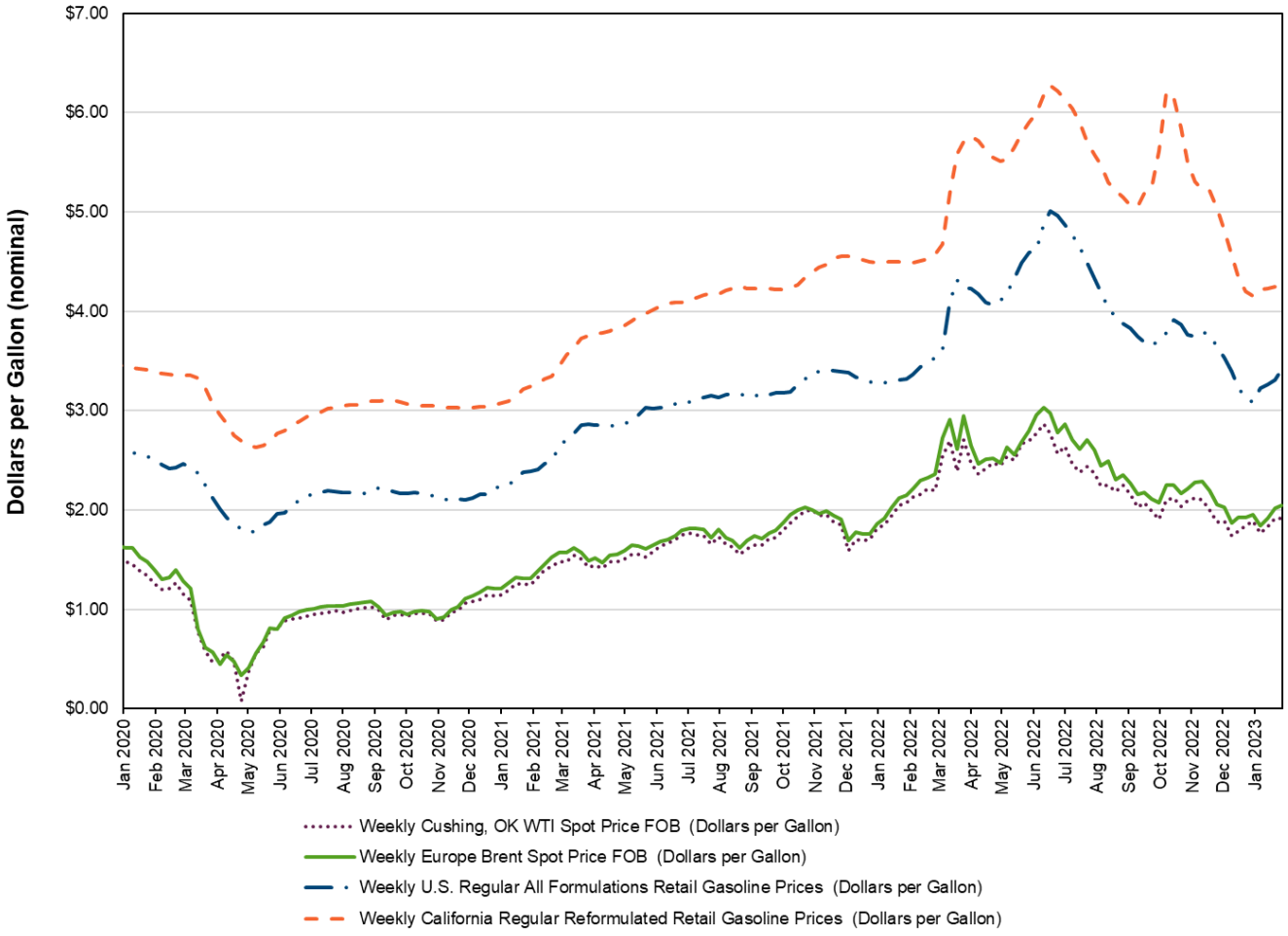
High Gasoline Prices

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.
- (bst) ~~Dependence~~ (est) (bbu) **Higher dependence** (ebu) 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 [begin image insert]



[end image insert] 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. (bst) ~~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.~~ (est)

(bbu) **The CEC held an informational hearing November 29, 2022, to better understand why gasoline prices spiked in 2022 and identify solutions for avoiding future price spikes. At the hearing, key takeaways included acknowledgement that demand for finished gasoline is declining but will persist as California transitions away from petroleum, and, therefore, a managed transition will be critical to avoiding oil price spikes as demand declines. The need for additional data about refinery operations was also identified as necessary to better understand the impact of planned and unplanned refinery outages and inventory levels on gasoline prices.**

SB 1322 and proposed legislation, introduced by the Governor in a special session December 5, 2022, are aimed at protecting consumers from fuel price gouging and shed greater transparency on refiner maintenance schedules, supply contracts, and inventory. Also, the CEC is starting work in 2023 on a Transportation Fuels Transition Study to plan for and track progress on the state's transition away from petroleum fuels and toward a reliable, safe, equitable, and affordable transportation fuels future.

The CEC will continue to support the Governor's Office and Legislature with expert analysis into the gasoline market. (ebu)

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. (bbu)
Managing the transition away from fossil gas will be critical to minimizing price spikes like those California is experiencing with oil prices. (ebu)

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, (bbu) **and** (ebu) reliable~~,~~ and ensures(bst) ~~our~~ (est) (bbu) **California's** (ebu) 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 (bst) ~~our~~ (est) (bbu) **the state's** (ebu) energy system.

This chapter (bst) ~~includes a summary of~~ (est) (bbu) **summarizes** (ebu) 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, (bst) ~~to~~ (est) developing solutions to ensure a better future. As Silvia Paz, (bst) ~~Executive Director~~ (est) (bbu) **executive director** (ebu) at Alianza — a

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.

community-based organization in the Salton Sea region — 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 (bst) ~~number~~ (est) 2021-0050, the State Water Resources Control Board noted:

---

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,

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.

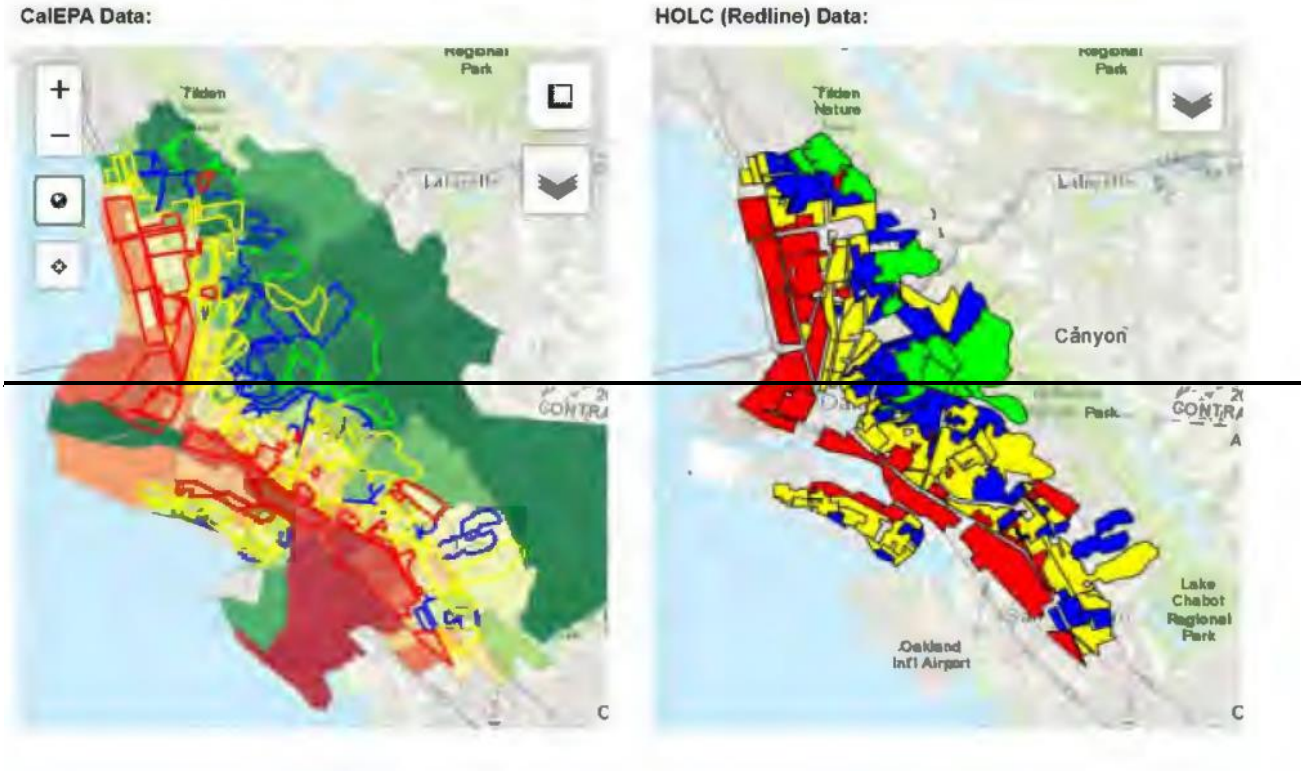
10 Presentation by Kevin Olp, Jennifer McGovern, and Jaimie Huynh, "Pollution and Prejudice," at the August 31, 2022, IEPR workshop on Centering Equity and Environmental Justice Throughout CEC Efforts. https://efiling.energy.ca.gov/GetDocument.aspx?tn=245728.

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.

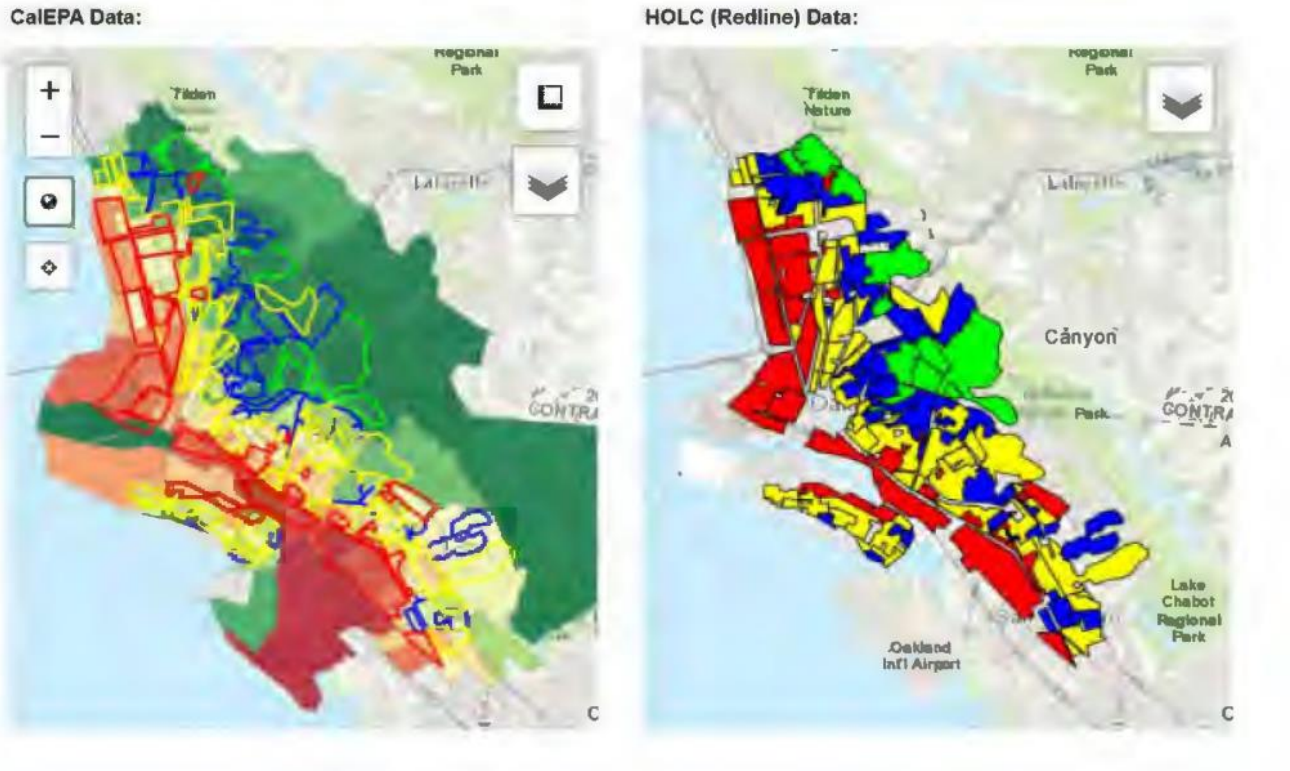
the top 10 percent most polluted neighborhoods in California have 90 percent people of color.[13]

Figure 1: Comparison of CalEnviroScreen Scores to Redline Maps [begin images delete]



[end images delete] [begin image insert]

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.)



[end image insert]

Source: 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]

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,

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

2022, IEPR workshop, promotores[15] who served as panelists shared that a crisis like the pandemic makes people realize the importance of energy and (bst) ~~how~~ (est)(bbu) **ways** (ebu) it can be taken for granted. During the pandemic, promotores were in demand, but they had difficulty reaching the community (bst) ~~due to~~ (est) (bbu) **because of** (ebu) 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 (bst)~~; when~~ (est). (bbu) **When** (ebu) a state agency goes to a community to address one issue, the community informs (bst) ~~them~~ (est) (bbu) **it** (ebu) of many other problems that need solving.

At the June 29, 2022, IEPR workshop, Dr. Manuel Pastor suggested that the crises (bst)~~we~~ (est) (bbu) **Californians** (ebu) 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 individualistic and competitive values.[17] *Solidarity Economics* has three basic premises (bst) ~~(1) mutuality~~ (est):

---

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.

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.

- (bbu) **Mutuality** (ebu) is key to prosperity — it is *our* economy, not *the* economy(bst)~~,~~ ~~(2) we~~ (est)
- (bbu) **We** (ebu) actually do better when we work and act together, especially against the climate threat that is common to all of us (bst)~~, and (3) because~~ (est)
- (bbu) **Because** (ebu) some people do benefit from current arrangements, social movements are crucial to generate change. This change will require difficult conversations, but (bst) ~~we~~ (est) (bbu) **the CEC** (ebu) 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 (bbu) **advance equity** (ebu) more effectively (bst) ~~advance equity~~ (est). 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

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.

Jobs Act (IIJA) opportunities(bst) ~~and~~ (est). (bbu) **The CEC must also** (ebu) 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. (bbu) **This package is** (ebu) 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 Edmund G. Brown Jr.'s Executive Order B-10-11, emphasizing engagement and

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.

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 (bst) ~~for~~ (est) 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 (bbu) **development of the** (ebu) 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

---

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

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.

has been vital in providing input on an array of policies and programs and created an equity framework[28] that staff ~~have~~has used to assess benefits being generated by programs such as the Electric Program Investment Charge (EPIC (bst)~~) program.~~) (est). The (bst) ~~DACAG has pressed both agencies to consider adopting its equity~~ DACAG's framework ~~but neither has adopted it in full; instead, each agency has decided to create its own framework informed by~~ (est) (bbu) **also served as a model and resource for** (ebu) the (bst) ~~DACAG's~~ (est) (bbu) **CEC's and CPUC's individual** (ebu) equity frameworks.

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~~,~~ (bbu) **(CBOs),** (ebu) 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 (bst) ~~over~~ (est) (bbu) **more than** (ebu) 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 (bst) ~~efforts~~ (est). 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

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

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/.

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 (bst) ~~located~~ (est) in disadvantaged communities throughout the state.[32]

One of the CEC's most robust grant programs is (bst) ~~the~~ (est) EPIC (bst) ~~program~~ (est). 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 (bst) ~~; however~~ (est). (bbu) **However** (ebu), as of 2021, the CEC is investing 67 percent in these communities, far exceeding its goals.[34] Equity considerations are integrated into the EPIC (bst) ~~program's~~ (est) 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, (bst) ~~to~~ (est) quantify benefits beyond

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.

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.

where a project is located, and (bst) ~~to~~ (est) 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.

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 (bst) ~~in~~ (est) (bbu) **within** (ebu) 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 (bbu) **members** (ebu) feel supported(bst) ~~and~~ (est), 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 the CEC's efforts.
- Revisiting the CEC's Energy Equity Indicators to obtain input and conduct a literature review to determine the future of the tool.

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

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.)

Figure 2: IEPR Workshop and Regional Engagement Map

(bst) ~~Credit~~ (est) (bbu) **Source (ebu)**: 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

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.

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.

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:

---

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.

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.

> "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]

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 (bbu) **in Kern County)** (ebu) 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, or *high-road,* clean energy jobs for a California workforce at all technical and training levels.[41]
- 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 (bst) facilities (est) (bbu) **centers** (ebu), government agencies, community organizations, employers, community colleges, trainees/apprentices, and others.

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_CizvyXIckwDpRBNC-xNHsf8Bo.ccHoK6lVi8NchDjR.

(bbu) **41 UCLA Labor Center. The High Road in Workforce Development. https://cwdb.ca.gov/wp-content/uploads/sites/43/2020/08/OneSheet_HRTP_ACCESSIBLE.pdf.** (ebu)

- 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 (bbu) **in Ventura County)** (ebu) 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."[42] 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 (bst) ~~one~~ (est) (bbu) **1** (ebu) percent for a utility, and in all general rate cases.[43] 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~~,~~ (bbu) **(CBOs),** (ebu) 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 an Energy Tech Hub concept for tribal, rural, disadvantaged, and hard-to-reach communities that could increase engagement in (bst) ~~policymaking~~ (est) (bbu) **policy making** (ebu) and program design, provide effective technical assistance, and support education and jobs for just

42 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.

43 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.

energy transitions.[44] 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 (bst) ~~also~~ (est) serving broader community energy needs and enhancing local partnerships and energy initiatives.

At all three regional IEPR workshops, (bst) ~~and~~ (est) especially during the Oxnard workshop, the CEC received considerable feedback on the continued need for (bst)~~community~~ (est) direct engagement (bbu) **with local government, tribes, and communities** (ebu) on policy and funding decisions. (bst) ~~In~~ (est) (bbu) **During visits with local government entities, community residents, local leaders, and tribes; in** (ebu) 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.
- **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.
- (bst) ~~**Communities**~~ (est) (bbu)**Tribes and communities** (ebu) **know best** — (bst) ~~Communities~~ (est) (bbu) **Tribes and communities** (ebu) are best situated to determine their needs and wants. (bst) ~~Communities~~ (est) (bbu) **Tribes and communities** (ebu) are interested in energy and nonenergy benefits from CEC programs and policies such as energy resiliency, (bbu) **reliable and affordable energy sources,** (ebu) lower utility bills, quality jobs, clean energy infrastructure, and more. Consider leveraging (bst)~~learnings~~ (est) (bbu) **lessons** (ebu) from other outreach efforts and codeveloped policies so as not to burden tribes and 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,

44 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.

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** — (bst) ~~California's~~ (est) (bbu) **Tribes and** (ebu) communities (bbu) **throughout the state** (ebu) have unique, distinct, and diverse needs and capacities. Uniform statewide funding and other programs do not always reach (bst) ~~their~~ (est) (bbu) **the** (ebu) intended beneficiaries. Many tribes, community-based organizations, and advocates (bst) ~~that raise and represent community interests~~ (est) (bbu) **working to find solutions** (ebu) are (bst) ~~under-resourced~~ (est) (bbu) **underresourced,** (ebu) which (bst) ~~impacts~~ (est) (bbu) **affects** (ebu) their ability to(bst) ~~both~~ (est) 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. (bst) ~~Communities~~ (est) (bbu) **Tribes and communities** (ebu) 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 (bst) ~~effectively~~ (est) represent community interests (bbu) **effectively** (ebu) at the state level, tribes, community-based organizations, advocates, and their partners note that long-term, sustained, system--level funding is needed. (bst) ~~Communities~~ (est) (bbu) **Tribes and communities** (ebu) have the desire to create change from within — sometimes transformational changes for (bst) ~~their communities.~~ (est) (bbu) **the people they represent**. (ebu) Advocates asked the CEC to target funding programs to (bst) ~~under-resourced~~ (est) (bbu) l**ocal government, tribes, and underresourced** (ebu) community needs (bst) ~~and~~ (est) (bbu) s**o they can be addressed more directly and asked that funding. Advocates** (ebu) also asked that (bst) ~~funding and~~ (est) 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 (bst) ~~confirms~~ (est) (bbu) **confirm** (ebu) 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 (bst) ~~Executive Order~~ (est) (bbu) **executive order** (ebu) 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 ((bst) ~~see~~ (est) Appendix A) takes this a step further.

(bbu) **The framework** (ebu) 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 (bst) ~~also~~ (est) be included in their work. The considerations can be used to evaluate the work completed (bst) ~~and~~ (est), 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,[45] the California Environmental Justice Alliance (CEJA) Environmental Justice Principles,[46] and the Disadvantaged Community Advisory Group (DACAG) Equity Framework.[47] It also incorporates the values, principles, and practices CEC staff has learned from internal experience, (ebu) **from** (ebu) 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

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

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

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

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.[48] 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 "(bst) ~~energy equity indicators~~ (est) (bbu) **Energy Equity Indicators.** (ebu)" 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 (bst) ~~has~~ (est) (bbu) **have** (ebu) not been updated since (bst) ~~its~~ (est) (bbu) **the** (ebu) 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:

48 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.

- 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 (bbu) **weather** (ebu) events (bbu) **such as severe heat waves and floods (ebu).**

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(bst) ~~the following topics:~~ (est) 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*,[49] 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.

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

49 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.

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

		Energy	Environmental	Health	Socioeconomic	Disadvantaged Communities and Tribes
Tools	**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

(bst) ~~Credit~~ (est) (bbu) **Source** (ebu): CEC

Based on this literature review, CEC staff determined (bst) ~~that~~ (est) 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[50] 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 (bst) ~~helps~~ (est):

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

- (bbu) **Helps** (ebu) enable and empower individuals and communities to retrieve, understand, and use their data (bst)~~, supports~~ (est)
- (bbu) **Supports** (ebu) communities pursuing strategies and investments to aid in a clean energy transition (bst)~~, addresses~~ (est)
- (bbu) **Addresses** (ebu) gaps and creates opportunities to direct resources to the communities that need it the most (bst)~~, and increases~~ (est)
- (bbu) **Increases** (ebu) 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."[51] 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,[52] Silvia Paz and Dr. Benner emphasized the importance of bringing their work back to the communities to gather more information, refine (bbu) **the process** (ebu), 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."[53] 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.

---

51 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.

52 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.

53 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.[54]
- Publication.

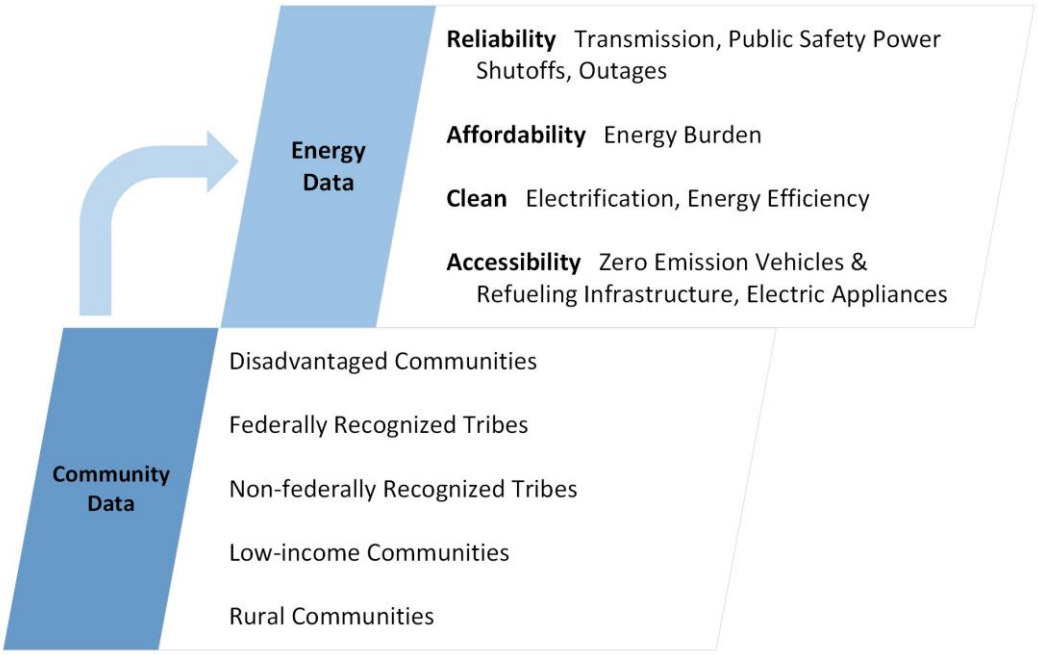
Each phase of the Energy Equity Indicators will follow this process.

The Future of Energy Equity Indicators

CEC staff (bst) ~~are~~ (est) (bbu) **is** (ebu) 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.

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

Figure 3: Energy Equity Indicators Phase One



Source: CEC

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 explore more easily (bst) ~~explore~~ (est) frequently requested CEC (bst) ~~deliverables~~ (est) (bbu) **products** (ebu) and analysis that directly affect their work. As part of this effort, the CEC plans to include a timeline for deliverables (bbu) **developed by the CEC and** (ebu) 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*,[55] (bbu) **and Appendix C)** (ebu), the energy demand forecast (Chapter 3), energy reliability assessments (Chapter 4), and information about gasoline prices (Chapter 4). (bbu) **The California Energy Planning Library will initially include static data, but the CEC plans to make dynamic data available in the coming years. The California Energy Planning Library will evolve and support the CEC's vision to provide the foundational information needed to achieve California's zero-carbon goals.** (ebu)

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 (bst) ~~timeframe~~ (est) (bbu) **time frame** (ebu). 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 (bbu) **CEC's** (ebu) Energy Assessments Division. In later phases, the aim is

55 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*. CEC. Publication Number: CEC-700-2022-006-SD.

to use this approach as a template for making analytics readily available from other divisions in the CEC.

Background Information

CEC as Energy Data Repository

The CEC serves as the state's energy data repository[56] 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~~.~~(bbu) **in its role as a planning entity for the state**. (ebu) Availability of data is key to an equitable energy transition and (bst) ~~to~~ (est) bringing clean, reliable, and affordable energy to all Californians. The California Energy Planning Library is part of a larger and ongoing effort to

56 Public Resources Code Section 25216.5(d) requires the CEC to (bst) ~~"Serve~~ (est) "(bbu) **[s]erve** (ebu) 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."

make the CEC's data and analytical products publicly available and understandable and present them in modern ways. Energy Insights[57] and Energy Equity Indicators[58] (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 (bst) ~~also~~ (est) 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

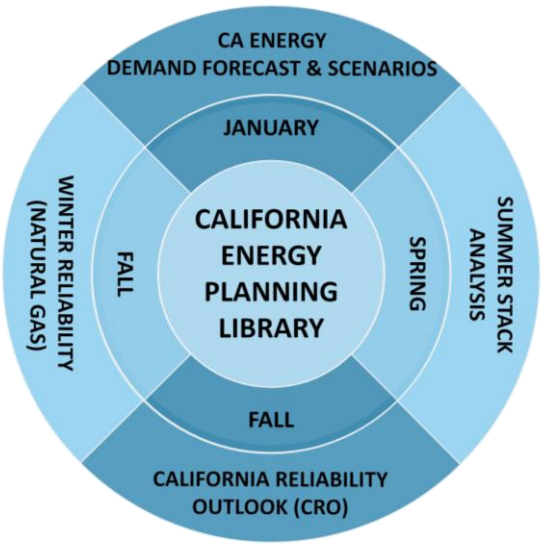
To ensure transparency and communicate the expected timeline of analyses, the California Energy Planning Library will include a calendar (bst)~~. The calendar~~ (est) (bbu) **graphic, which** (ebu) will identify and highlight the release or update of major planning products and links to products that have been adopted. Prioritized for inclusion in the first phase is the CEC's update to land-use screens~~,~~[59] the California Energy Demand Update 2022, and reliability analyses, including Summer Stack Analysis, California Reliability Outlook, and Winter Reliability.

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

58 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.

59 *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



(bst)~~Credit~~ (est) (bbu) **Source** (ebu): CEC staff

Public Input and Next Steps

CEC staff sought input from stakeholders at the April 27, 2022, Integrated Energy Policy Report workshop.[60] Staff's takeaways from the workshop included (bbu) **the following** (ebu):

- 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.

This invaluable feedback is driving the launch of the California Energy Planning Library. As one (bst) ~~of the panel participants~~ (est) (bbu) **panelist** (ebu) commented at the IEPR workshop,

60 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.

"I think the planning library for existing information is going to make our lives a lot easier and more organized."[61]

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.

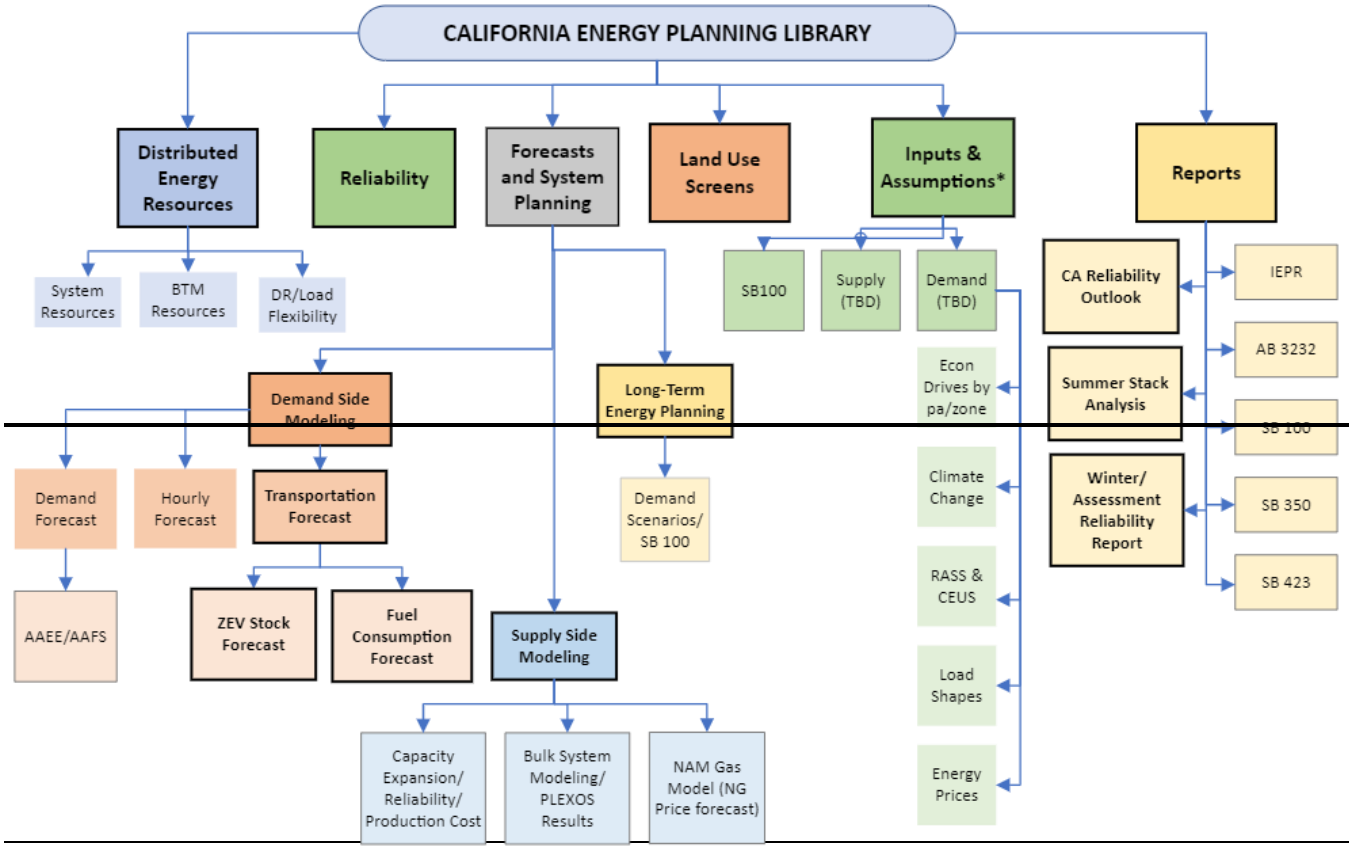
After completion of the first phase, the CEC will solicit feedback from sister agencies and other stakeholders during an "open feedback window." Feedback garnered during this period will influence the data and analytical products incorporated into the library, guide data modernization, and drive other improvements to the platform. (bst) ~~Ongoing~~ (est) (bbu) **The California Energy Planning Library strives to make the CEC's data and data products more accessible, available, and understandable but cannot entirely eliminate the formal data request process. While new data and data products will continue to be posted as developed by the CEC, the California Energy Planning Library will not manipulate the data and disperse customized data sets. However, ongoing** (ebu) stakeholder engagement and user feedback are vital to the success of the California Energy Planning Library, and the CEC will provide opportunities for feedback (bst) ~~on an ongoing, annual basis.~~ (est)

(bbu) **annually.** (ebu) 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.

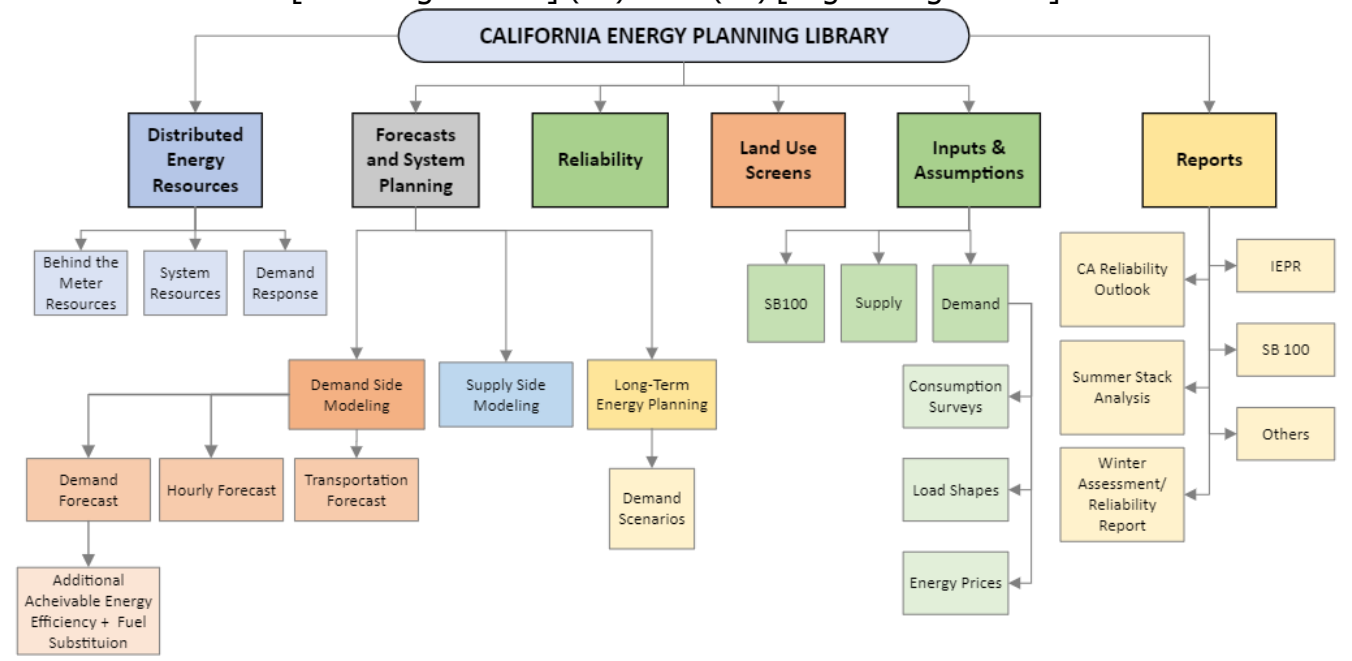
Subsequent and ongoing phases will focus on the modernization of data and analytical tools, as well as expanding data products (bst) ~~and~~ (est), incorporating links to data partners (bbu) **, and exploring possible future collaboration with outside entities** (ebu). Also in subsequent phases, the 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.

61 Ibid.

Figure 5: Future Site Map [begin image delete]

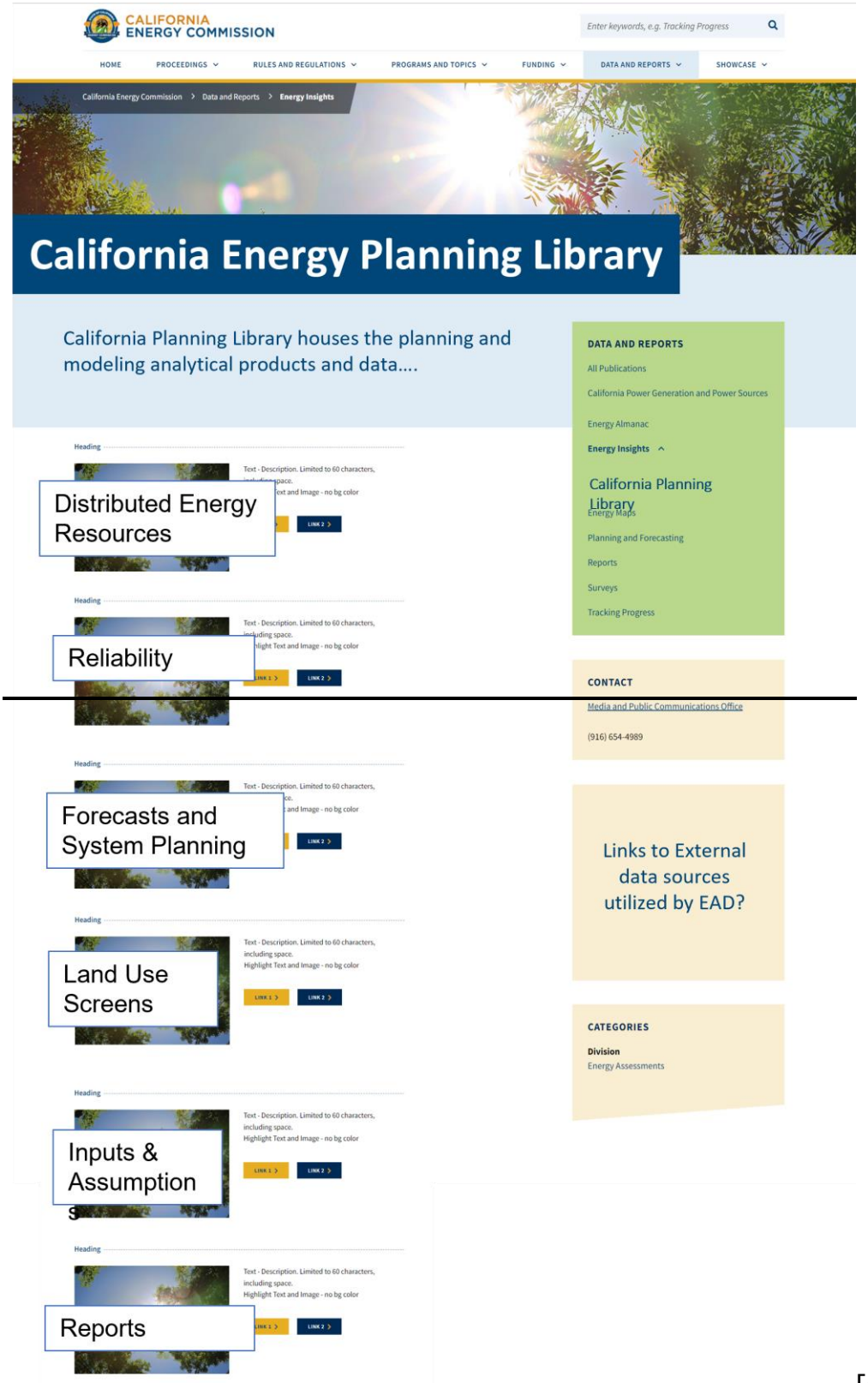


[end image delete] (bst) ~~Credit~~ (est) [begin image insert]



[end image insert] **(bbu) Source (ebu):** CEC staff

Figure 6: California Energy Planning Library Landing Page [begin image delete]



[end image delete]

[begin image insert]

(bst) ~~Credit~~ (est)

[end image insert]

(bbu) **<u>Source</u>** (ebu): 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).[62] 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 (bst) ~~will~~ (est) ~~be~~ (bst) (bbu) **were** (ebu) presented (bst) ~~in a workshop in~~ (est) (bbu) **at the** (ebu) December (bbu) **7 and 16, 2022, workshops on Updates to the CED 2022-2035 Forecast[63]** (ebu) and included in the final *2022 Integrated Energy Policy Report Update (2022 IEPR Update)*.

62 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."

(bbu) **63 December 7, 2022, IEPR workshop on Updates to the CED 2022-2-35 Forecast, Part 1. https://www.energy.ca.gov/event/workshop/2022-12/iepr-commissioner-workshop-updates-california-energy-demand-2022-2035.**

December 16, 2022 IEPR workshop on Updates to the CED 2022-2-35 Forecast, Part 2. https://www.energy.ca.gov/event/workshop/2022-12/iepr-commissioner-workshop-updates-california-energy-demand-2022-2035-0. (ebu)

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 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 (bst) ~~their~~ (est) (bbu) **its** (ebu) first round of demand scenarios.[64] 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 (bst) ~~analyzed~~ (est) (bbu) **conducted** (ebu). 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.[65] (bbu) **Both the California ISO and the CPUC agreed to use the Additional Transportation Electrification scenario for these planning processes.** (ebu) The Additional Transportation Electrification scenario

64 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.

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

incorporates the California Air Resources Board's (CARB's) Advanced Clean Cars II[66] regulation and proposed Advanced Clean Fleets (bst) ~~[67] regulation and is the scenario that the California ISO and CPUC agreed to use for the TPP and IRP.~~ (est) (bbu) **regulation. Advanced Clean Cars II requires that all new passenger cars, trucks, and sports utility vehicles sold in California be zero-emission by 2035. The proposed Advanced Clean Fleets[68] regulation aims to achieve a medium- and heavy-duty zero-emission truck and bus fleet everywhere feasible in California by 2045, with earlier targets in specific market segments.** (ebu) 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.

Forecast Process

The CEC seeks input into its forecast development through various venues including public workshops and the public Demand Analysis Working Group (DAWG)[69] 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 (bst) ~~will present~~ (est) (bbu) **presented** (ebu) a preview of the (bst) ~~forecast~~ (est) (bbu) **transportation and additional achievable fuel substitution** (ebu) results at a DAWG meeting (bst) ~~in mid~~ (est) November (bbu) **15, 2022**. (ebu)

(bst) ~~A final workshop will be~~ (est) (bbu) **Workshops were** (ebu) held December 7 (bbu) **and December 16** (ebu), 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

---

66 CARB. "(bst)~~Proposed~~ (est) (bbu) **Advanced Clean Cars II Regulations: All New Passenger Vehicles Sold in California to be Zero Emissions by 2035** (ebu)." 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.

(bst) ~~67 CARB. Advanced Clean Fleets webpage, https://ww2.arb.ca.gov/our-work/programs/advanced-clean-fleets. Expected to be adopted in October 2022.~~(est)

(bbu) **68 CARB. Advanced Clean Fleets webpage, https://ww2.arb.ca.gov/our-work/programs/advanced-clean-fleets. Expected to be adopted in October 2022.** (ebu)

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

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 (bst) ~~will update~~ (est) (bbu) **updated** (ebu) 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 (bbu) **photovoltaic** (ebu) (PV) system adoption and storage adoption data, and updating the hourly and peak demand forecast.

No updates (bst) ~~will be~~ (est) (bbu) **were** (ebu) made to the additional achievable energy efficiency (AAEE) (bst) ~~or~~ (est) (bbu) **component. The additional achievable** (ebu) fuel substitution (AAFS) (bst) ~~components. The CEC will review~~ (est) (bbu) **component was updated to layer** (ebu) the (bst) ~~single-forecast-set language with~~ (est) (bbu) **impacts of** (ebu) the (bst) ~~California ISO, CPUC, and~~ (est) CARB (bst) ~~and update the language to reflect the scenarios that will be used~~ (est) (bbu) **State Implementation Plan strategy** (ebu) for (bst) ~~planning and procurement. The single-forecast-set language will be included in the final *2022 IEPR Update.*~~ (est) (bbu) **zero-emission space and water heater sales on top of Scenario 4.** (ebu)

Revised Forecast Framework

For the California Energy Demand Update (CEDU) 2022, the CEC (bst) ~~will revise~~ (est) (bbu) **revised** (ebu) the standard forecasting framework to create a more transparent forecasting process, more clearly describe 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) (bst) ~~will be~~ (est) (bbu) **were** (ebu) reduced to one primary set of baseline assumptions, and more attention (bst) ~~will be~~ (est) (bbu) **was** (ebu) 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 (bst) ~~will shift~~ (est) (bbu) **shifted** (ebu) 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 (bst) ~~will streamline~~ (est) (bbu) **streamlined** (ebu) the forecast framework by eliminating the unused high and low baseline forecasts and (bst) ~~will~~ (est) instead (bst) ~~prepare~~ (est) (bbu) **prepared** (ebu) one baseline demand forecast modeled after the previous mid demand case and (bst) ~~pair~~ (est) (bbu) **paired** (ebu) that with assumptions for AAEE, AAFS,[70] 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.

(bst)~~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,[71] and now additional achievable transportation electrification (AATE). The proposed set of 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.~~ (est)

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 • (bbu) **California ISO TPP economic, policy, and bulk**	• California ISO TPP (bbu) **local area reliability studies** (ebu) • Local (bst) ~~Studies~~ (est) (bbu) **capacity technical**

70 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.

(bst)~~71 Ibid.~~(est)

		system studies (ebu)	**studies** (ebu)
Economic, Demographic, and Price Scenarios	Baseline (Mid)	Baseline (Mid)	Baseline (Mid)
AAEE Scenario	-	(bst) ~~Mid (~~(est) Scenario 3~~)~~	(bst) ~~Low (~~ (est) Scenario 2~~)~~
AAFS Scenario	-	(bst) ~~Mid (~~(est) Scenario 3~~)~~	(bst) ~~High (~~(est) Scenario 4~~)~~ (bbu) **plus SIP** (ebu)
AATE Scenario	-	(bst) ~~Mid (~~ (est) Scenario 3~~)~~	(bst) ~~Mid (~~ (est) Scenario 3~~)~~

(bst) ~~Credit~~ (est) (bbu) **Source** (ebu): CEC

(bbu) Additional Achievable Fuel Substitution Updates

Load modifiers such as AAEE and AAFS are generally only updated in odd-numbered forecast IEPR years (such as the 2021 and 2023 forecasts). This IEPR is an exception because of recent and potentially impactful adoption of the *2022 State Strategy for the State Implementation Plan* (2022 State SIP Strategy) by the California Air Resources Board (CARB) on September 22, 2022. The 2022 State SIP Strategy includes the requirement that by 2030 all space and water heaters sold in California for either new or existing residential and commercial buildings must comply with a statewide zero-emission GHG standard.[72] This zero-emission standard will have criteria pollutant cobenefits such as NOx emissions reductions. CARB plans to begin the rulemaking process for the zero-emission space and water heater measure is expected to begin in 2023 and conclude in 2025. Through the rulemaking process, this zero-emission standard may potentially be expanded to include other end uses. Further, the Bay Area Air Quality Management District (BAAQMD) is proposing zero-emission NOx standards for space and water heating

(bbu) **72 CARB. September 2022. 2022 State Strategy for the State Implementation Plan. Page 101-103. https://ww2.arb.ca.gov/sites/default/files/2022-08/2022_State_SIP_Strategy.pdf.**

to go into effect in 2029 (one year earlier than in the 2022 State SIP Strategy), pursuant to their development of Rules 9-4 and 9-6.[73]

The Local Reliability Scenario, as indicated by Table 2, includes the energy impacts from CARB's zero-emission space and water heaters measure as part of the 2022 State SIP Strategy. The fuel substitution impacts from this measure have been developed as incremental to those already characterized in the AAFS Scenario 4 programmatic fuel substitution impacts developed in 2021.[74]

CEC staff used the Fuel Substitution Scenario and Analysis Tool (FSSAT) to model the energy impacts of the 2022 State SIP Strategy incremental to the programmatic impacts modeled by AAEE and AAFS. FSSAT has previously been used for the Assembly Bill 3232 (Friedman, Chapter 373, Statutes of 2018) California Building Decarbonization Assessment and the Demand Scenarios Project, which provides long-term projections that reflect potential economywide impacts of electrification and decarbonization strategies.[75] Staff consulted with CARB staff regarding the underlying technology and adoption rate assumptions that should be used to characterize in FSSAT the fuel substitution that will likely occur from the 2022 State SIP Strategy. Guided by the *CARB 2022 Scoping Plan*, CEC staff assumed beginning in 2026 that there would be a natural ramp up of fuel substitution prior to the 2030 zero-emissions regulation going into effect.[76] As such, the impacts of the 2022 State SIP Strategy characterized in FSSAT for new and existing residential and commercial buildings begin in 2026, are incremental to AAFS Scenario 4 impacts, and exclusively examine the fuel substitution of space-

---

73 BAAQMD. May 2022. Notice of Preparation of an Environmental Impact Report and Notice of Public Scoping Meeting for the Proposed Amendments to Rules 9-4 and 9-6. https://www.baaqmd.gov/rules-and-compliance/rule-development/building-appliances.

74 Javanbakht, Heidi, Cary Garcia, Ingrid Neumann, Anitha Rednam, Stephanie Bailey, and Quentin Gee. 2022. *Final 2021 Integrated Energy Policy Report, Volume IV: California Energy Demand Forecast*. California Energy Commission. Publication Number: CEC-100-2021-001-V4. pp. 33-49 and Appendix A. https://efiling.energy.ca.gov/GetDocument.aspx?tn=241581.

75 Michael Kenney, Nicholas Janusch, Ingrid Neumann, Mike Jaske. August 2021. *California Building Decarbonization Assessment*. CEC. Publication Number: CEC-400-2021-006-CMF. https://www.energy.ca.gov/publications/2021/california-building-decarbonization-assessment.

"Adoption of Demand Scenarios, Resolution No: 22-0524-5." Docket 21-IEPR-03. May 24, 2022. https://efiling.energy.ca.gov/GetDocument.aspx?tn=243270&DocumentContentId=76953.

76 CARB. *2022 Scoping Plan for Achieving Carbon Neutrality*. November 16, 2022. https://ww2.arb.ca.gov/sites/default/files/2022-12/2022-sp.pdf.

and water-heating appliances. Staff presented these results at the December 7, 2022, IEPR Commissioner Workshop.[77] (ebu)

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~~,~~ (bbu) **(demand-side modeling),**(ebu) but it is not designed to capture (bst) ~~rapid~~ (est) (bbu) **supply-side** (ebu) policy (bst) ~~and consumer preference~~ (est) shifts~~.~~ (bbu) **such as Advanced Clean Cars II**. (ebu) As new ZEV sales grow (bbu) **in line with regulations** (ebu), 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 (bbu) **scenarios** (ebu) 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 (bst) ~~forecast~~ (est) (bbu) **assign** (ebu) 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 (bst) ~~scenario~~ (est) (bbu) **forecast** (ebu), which is nearly identical to the mid case forecast in the previous IEPR. In the baseline (bbu) **forecast,** (ebu) economic and demographic inputs, coupled with vehicle choice models and vehicle travel models, determine total vehicle stock and (bbu) **transportation** (ebu) energy demand for light-duty (LD) and medium- and heavy-duty (MDHD) sectors. Key inputs and assumptions for the baseline (bst) ~~scenario~~ (est) (bbu) **forecast** (ebu) include vehicle attributes such as price, range, refueling time, acceleration, and model availability. They also

---

77 December 7, 2022, IEPR Commissioner Workshop on Updates to the California Energy Demand 2022–2035 Forecast webpage. https://www.energy.ca.gov/event/workshop/2022-12/iepr-commissioner-workshop-updates-california-energy-demand-2022-2035. (ebu)

include incentives for ZEVs, such as federal tax credits, state rebates and rewards, and high-occupancy vehicle access incentives. (bbu) **One specific incentive modification to highlight is staff integration of the new federal ZEV incentives resulting from the 2022 Inflation Reduction Act.** (ebu) The other major category of model inputs is consumer preferences for ZEVs (bbu) **derived from CEC survey data and updated to market conditions through the first half of 2022**. (ebu)

Policies are included in the baseline (bst) ~~scenario~~ (est) (bbu) **forecast** (ebu) 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 (bst) ~~model~~ (est) (bbu) **models** (ebu), such as CARB's supply-side Advanced Clean Cars II regulation, are not included in the baseline.

Following the baseline (bst) ~~scenario~~ (est) (bbu) **forecast** (ebu) are (bst) ~~three~~ (est) additional scenarios, each of which has additional electricity demand during each of the forecast years. (bst) ~~Scenario 1 has more aggressive vehicle attributes, incentives, and preferences that increase~~ (est) (bbu) **Because of a higher-than-expected** (ebu) ZEV adoption rate seen in the (bst) ~~vehicle choice models.~~ (est) (bbu) **baseline forecast, staff did not conduct Scenario 1.** (ebu) Scenario 2 involves a direct, (bst) ~~post-process~~ (est) postprocess alignment of LD vehicle sales that captures delayed compliance or some exemptions with CARB's policies, in particular CARB's Advanced Clean Cars II (bst) ~~regulation and its proposed Advanced Clean Fleets regulation.~~ (est). (bbu) **For MDHD, Scenario 2 uses lower prices for battery-electric trucks to capture increased electrification.** (ebu) Scenario 3 represents full compliance with all regulations (bst) ~~again~~ (est) (bbu)**, including CARB's Advanced Clean Fleets Regulation,** (ebu) with a (bst) ~~post-process~~ (est) (bbu) **postprocess** (ebu) 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

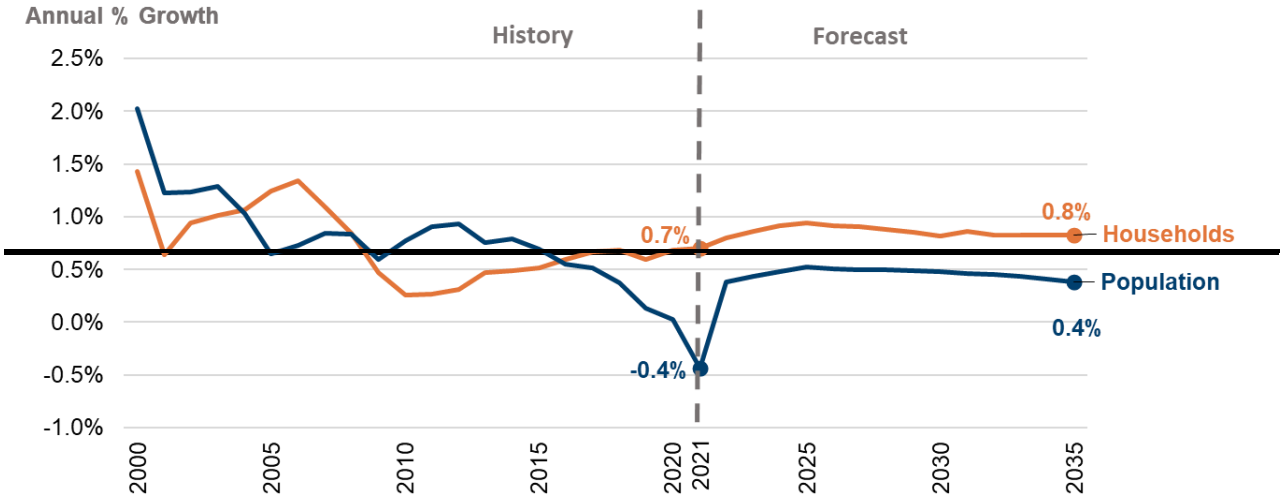
Statewide population for CEDU 2022 continues to grow 0.5 percent annually from 2022 to 2035, as with the previous population projections from the California Department of Finance (DOF). The 2022 total population estimate is 39.5 million and is projected to reach roughly 42 million by 2035 (6. (bst) ~~35~~4 (est) 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 (bst) ~~Baby Boomers~~ (est) (bbu) **baby boomers** (ebu) 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).

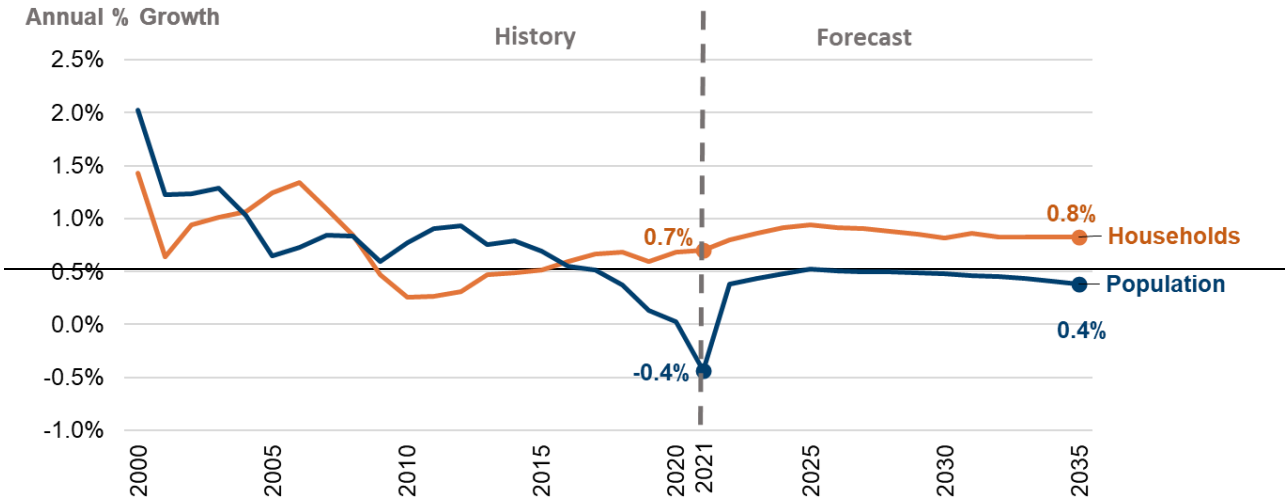
Figure 7: Statewide Population and Household Growth, CEDU 2022

[begin image delete]



[end image delete]

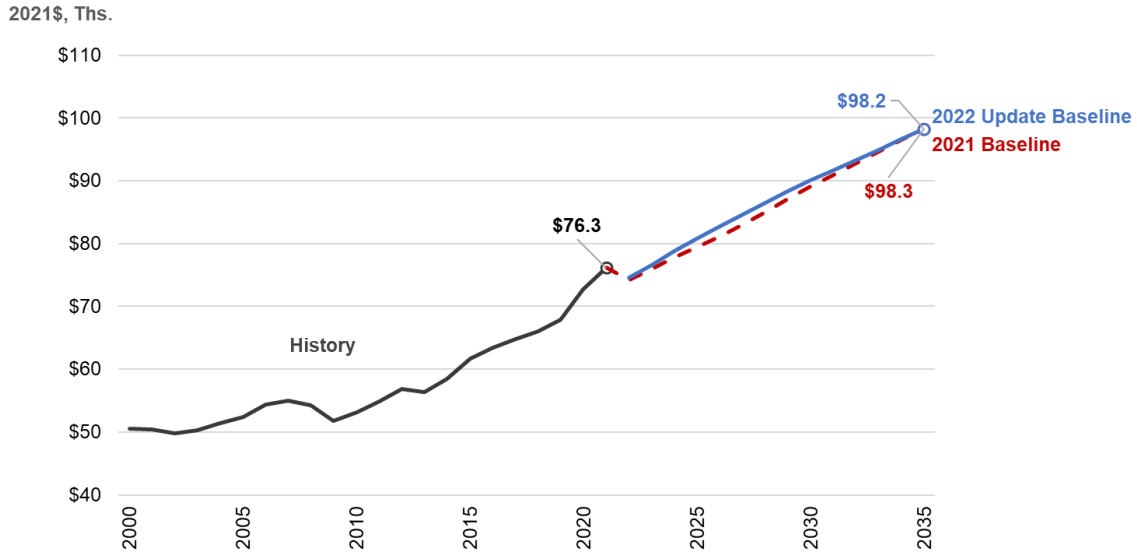
(bst)~~Credit~~ (est) [begin image insert]



[end image insert] (bbu) **Source (ebu)**: 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

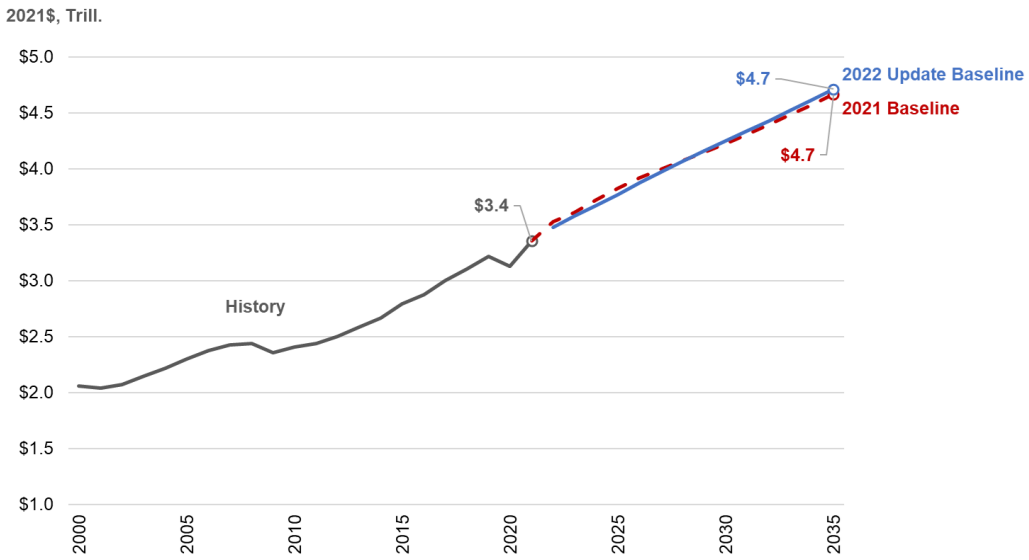


(bst) ~~Credit~~ (est) (bbu) **Source** (ebu): CEC using data from Moody's Analytics and DOF

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."[78]

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

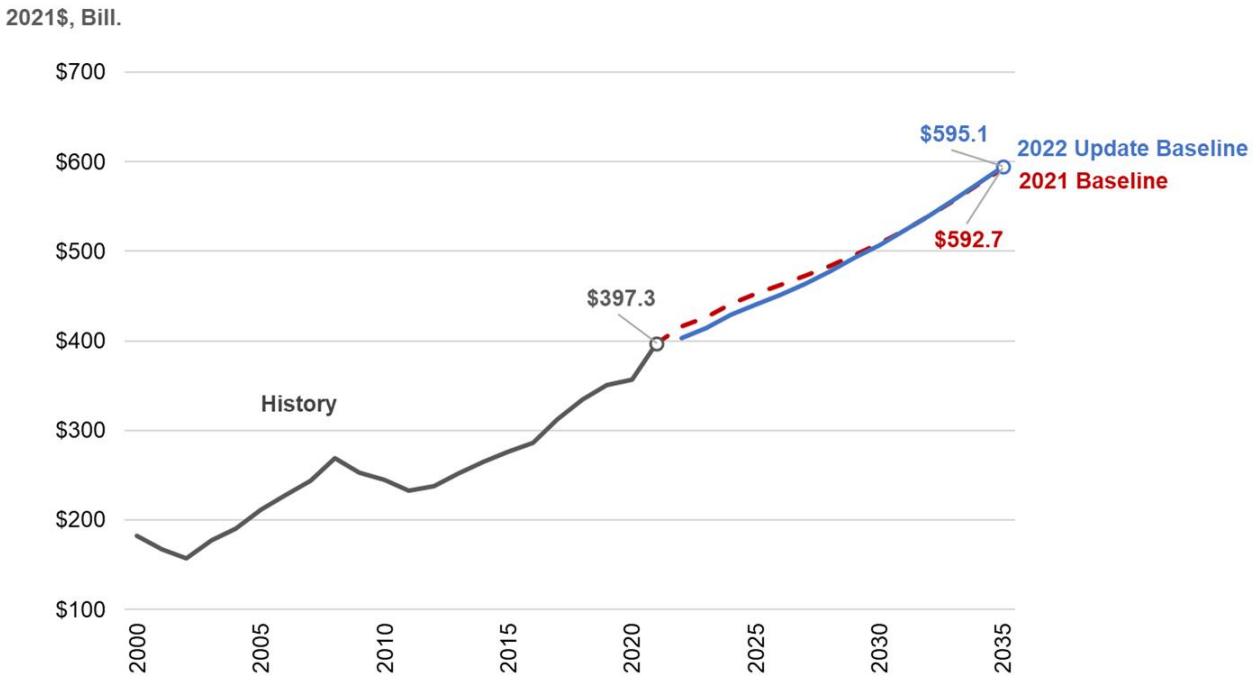
Figure 9: Gross State Product Comparison, CEDU 2022



(bst) ~~Credit~~ (est) (bbu) **Source** (ebu): 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.

Figure 10: Gross Manufacturing Output Comparison, CEDU 2022



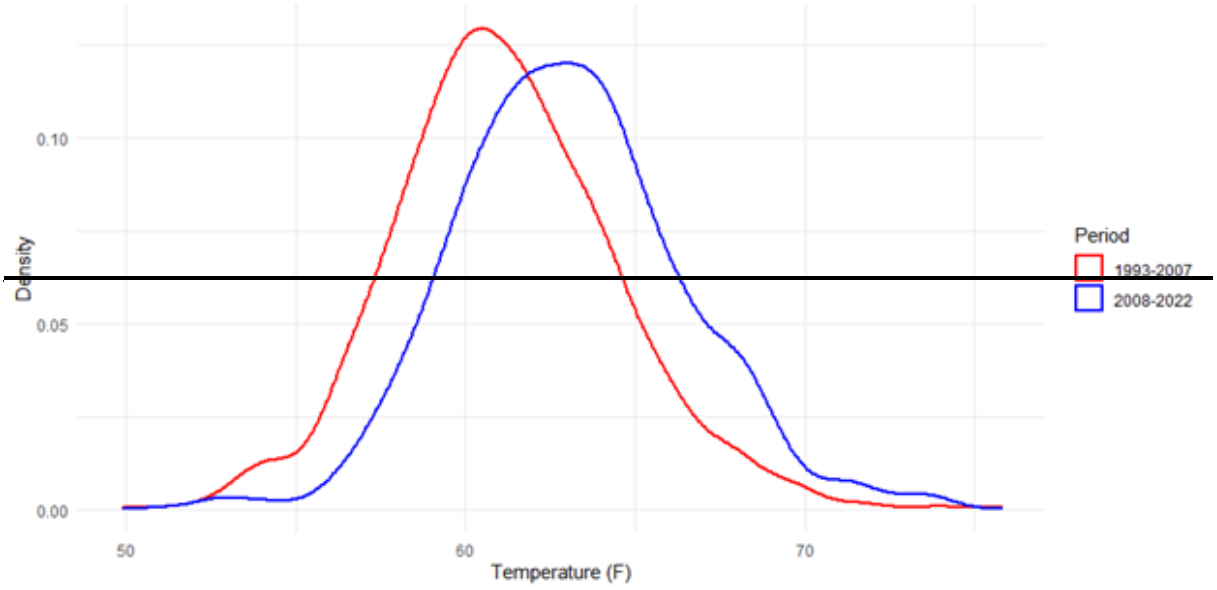
(bst) ~~Credit~~ (est) (bbu) **Source** (ebu): CEC using data from Moody's Analytics from May 2021 and May 2022

Climate Trends

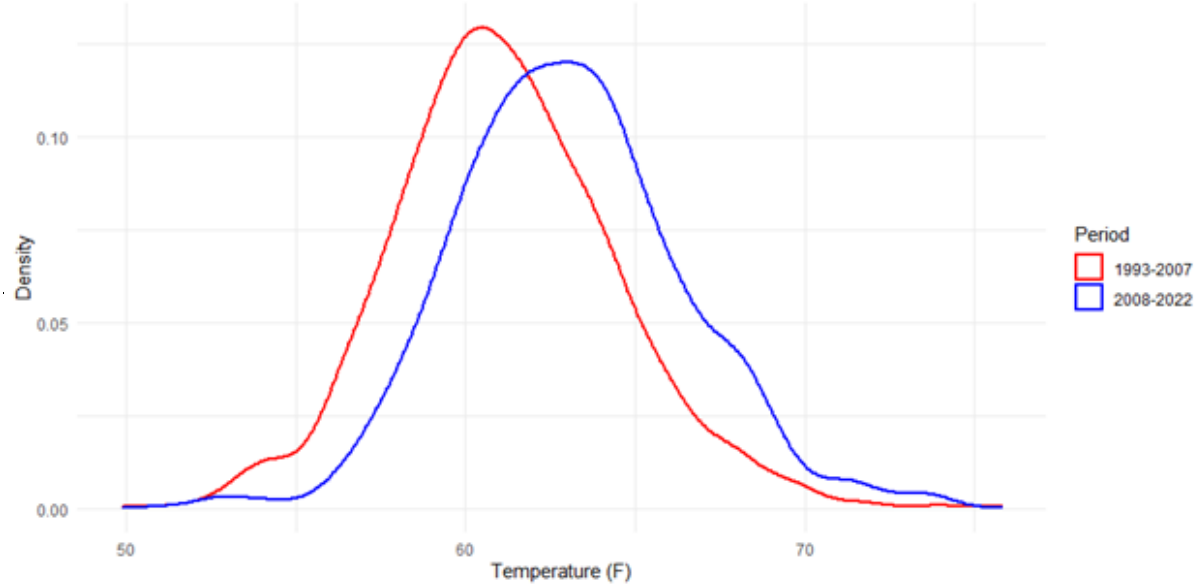
Rising temperatures are an important factor affecting the CEC's demand forecasts, particularly forecasts of peak electricity demand, which is highly sensitive to temperature. The CEC's peak forecast must consider demand under normal peak conditions as well as for the types of extreme temperatures that would be expected only once in (bst) ~~five, ten~~ (est) (bbu) **5, 10** (ebu), 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 [begin image delete]



[end image delete] [begin image insert]



[end image insert]

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, (bst) ~~extreme~~ (est) heat event (bst) ~~which~~ (est) (bbu) **that** (ebu) 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 (bst) ~~their~~ (est) 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[79] 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 (bst) ~~both~~ (est) for the purchase of ZEVs and (bst) ~~for~~ (est) 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 (bst) ~~executive order~~ (est) (bbu) **Executive Order N-79-20 to transition**(bbu) to zero (bst) ~~out emissions from~~ (est) (bbu) **emission** (bbu) 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[80] introduces new changes to ZEV incentives, primarily through vehicle tax credits. CEC staff(bst) ~~is accounting~~ (est) (bbu) **has accounted** (ebu) for these new federal incentives in modeling transportation energy demand for the (bbu) **baseline forecast of the** (ebu) *2022 IEPR Update* (bst) ~~in the two scenarios that evaluate consumer preferences~~ (est).

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

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

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

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 (bst) ~~(Friedman, Chapter 373, Statutes of 2018)~~ (est) California Decarbonization Assessment.[81] In July 2022, the CPUC opened a proceeding (R. 22-07-005) that seeks to (bst) ~~(1) reform~~ (est) (bbu) **do achieve three goals:**

1. **Reform** (ebu) fixed charges consistent with AB 205 (bst) ~~, (2) consider~~ (est). (bbu)
2. **Consider** (ebu) policies to enable widespread demand flexibility through retail rate reform in support of the state's electrification initiatives (bst)~~, and (3) ease~~ (est). (bbu)
3. **Ease** (ebu) IOU compliance with updates to Load Management Standards[82] 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.[83]

Behind-the-Meter PV and Storage Trends

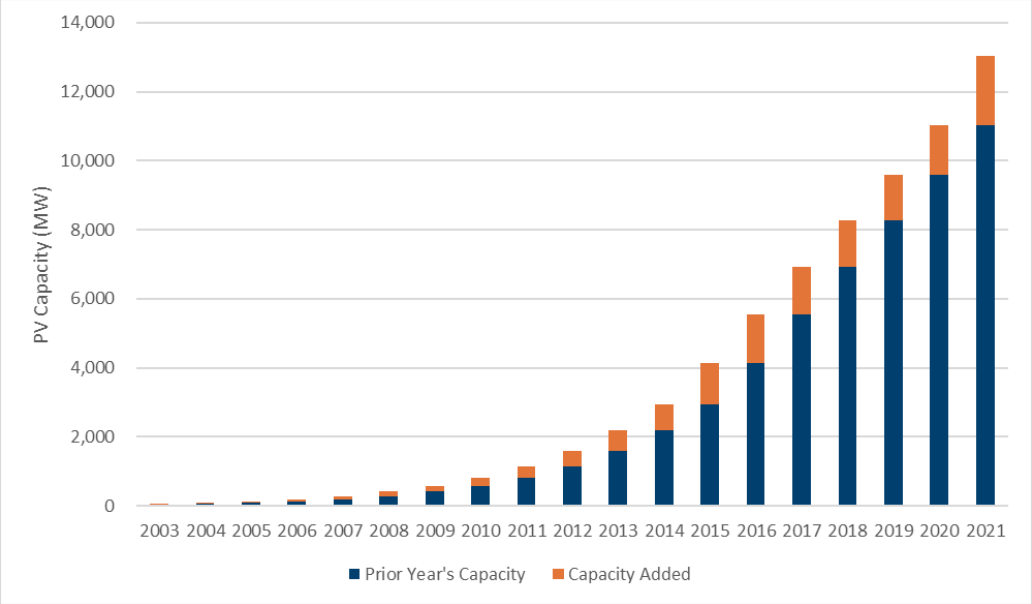
Since 2017, California has added about 1,400 to 2,000 megawatts (MW) of new behind-the-meter (BTM) PV capacity annually. By the end of 2021, there were roughly 13,000 MW of installed BTM PV capacity in California, as shown in Figure 12. The CEC estimates that more than 22,000 gigawatt--hours (GWh) of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

(bbu) **81 Michael Kenney, Nicholas Janusch, Ingrid Neumann, Mike Jaske. August 2021. California Building Decarbonization Assessment. CEC. Publication Number: CEC-400-2021-006-CMF. https://www.energy.ca.gov/publications/2021/california-building-decarbonization-assessment.** (bbu)

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

83 (bst) ~~California Air Resources Board. *2022 State Strategy for the State Implementation Plan.*~~ (est) (bbu) **California Air Resources Board. 2022. *2022 State Strategy for the State Implementation Plan.*** (ebu) https://ww2.arb.ca.gov/resources/documents/2022-state-strategy-state-implementation-plan-2022-state-sip-strategy.

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

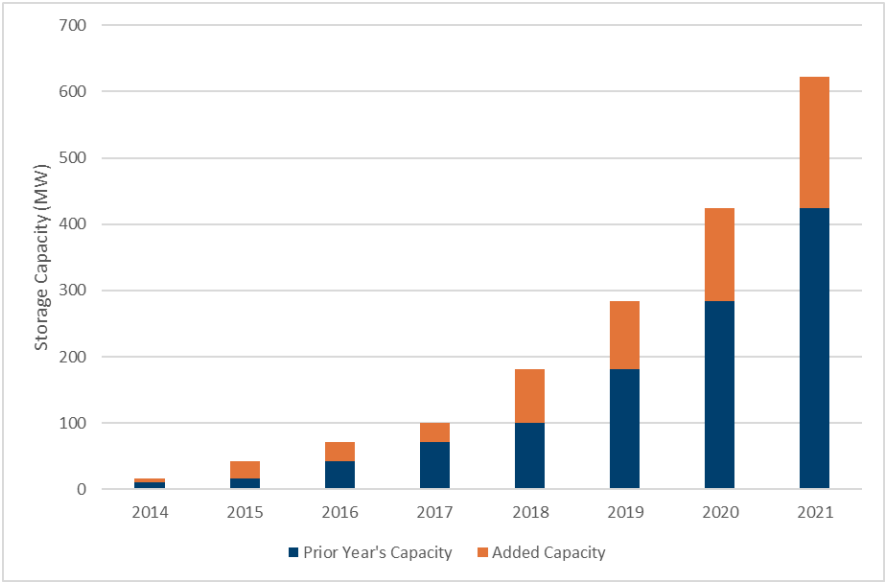


(bst) ~~Credit~~ (est) (bbu) **Source**(bbu): CEC

BTM storage adoption in California continues to increase (bst) ~~at a rapid pace~~ (est) (bbu) **rapidly**, (bbu) 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



(bst) ~~Credit~~ (est) Source: 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 (bst) ~~due to~~ (est) (bbu) **because of** (ebu) 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 (bbu) **VMT** (ebu) data are not yet available, but highway (bbu) **VMT** (ebu) 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 (bst) ~~show~~ (est) (bbu) **shows** (ebu) nearly 840,000 LD ZEVs registered in the state for 2021.[84] LD ZEV sales increased markedly from 2020 to 2021 and continued to grow in the first half of 2022. Through the end of (bst) ~~June~~ (est) (bbu) **October** (ebu) 2022, ZEVs represent (bst) ~~16.5~~ (est) (bbu) **17.7** (ebu) 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 (bst) ~~partially~~ (est) ease (bst) ~~by the end of 2022~~ (est) (bbu) **throughout 2023** (ebu), so continued growth in the ZEV market is likely. (bbu) **However, some uncertainties remain, as the new vehicle market is now affected by recent increases in interest rates.** (ebu) Similar supply chain challenges exist in the MDHD ZEV market as well, with similar supply chain issues expected to become less severe (bst) ~~toward the end of the year.~~ (est) (bbu) **throughout 2023.** (ebu) Current DMV registration data (bst) ~~shows~~ (est) (bbu) **show** (ebu) about 2,000 MDHD ZEVs as of mid-2022.[85]

(bbu) California Energy Demand Forecast, 2023–2035

CEC staff presented draft forecast results at IEPR workshops December 7 and December 16, 2022. Table 3 presents the final forecast results. Statewide electricity consumption was more than 280,000 GWh in 2021 and is forecasted to

84 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.

85 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.

be 358,738 GWh in 2035. The CEDU 2022 baseline sales forecast represents the amount of electricity load-serving entities will need to provide to their customers and is derived by subtracting projected customer generation from the updated consumption forecast. Baseline statewide sales were more than 245,000 GWh in 2021, which is about 2 percent higher than the 2021 CED forecast and grows to more than 290,000 GWh in 2035. The managed statewide sales incorporate the projected impacts of AAEE, AAFS, and AATE. For the Planning Forecast, managed statewide sales grow to just fewer than 302,000 GWh in 2035.

Table 3: Summary of Statewide Forecast Results in 2035

	Planning Forecast (Annual GWh)	**Local Reliability Scenario (Annual GWh)**
Baseline Consumption	358,738	358,738
Behind-the-Meter Distributed Generation and Storage	68,256	68,256
Baseline Sales **(Baseline Consumption - BTM DG and Storage)**	290,483	290,483
AAEE	19,156	12,200
AAFS	6,613	31,154
AATE	24,011	24,011
Managed Sales **(Baseline Sales – AAEE + AAFS + AATE)**	301,951	333,447

Source: CEC

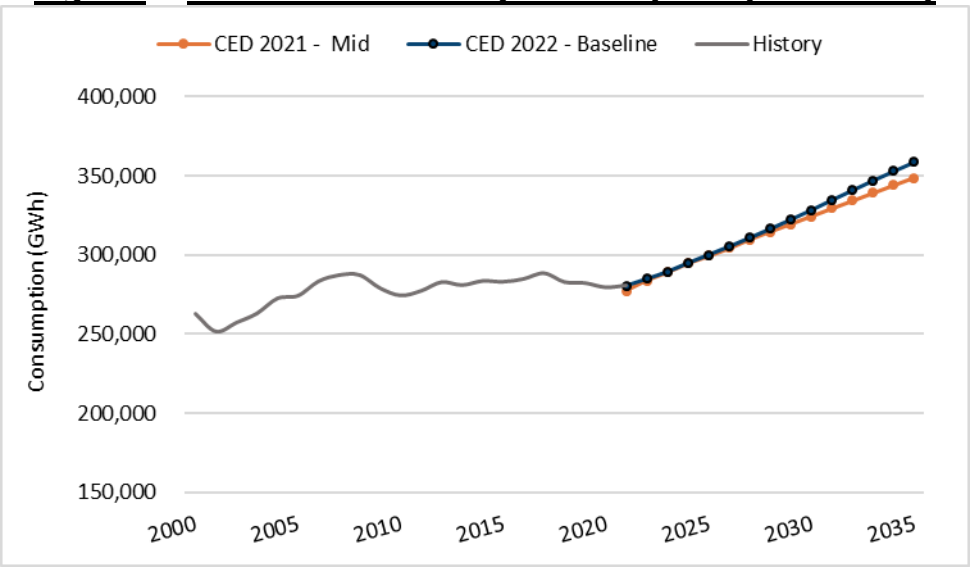
The peak demand forecast is derived from the annual consumption forecast by applying hourly load profiles to projected annual consumption. Peak forecasts are developed for balancing authorities, rather than for the state. The CEDU 2022 Planning Scenario peak forecast for the California ISO — which manages roughly 80 percent of California's load — reaches 55,117 MW by 2035.

Annual Electricity Consumption Forecast

Forecasted baseline electricity consumption grows at a rate of about 1.8 percent annually through 2035 as the economy recovers and transportation electrification

adds to electricity demand. By 2035, CEDU 2022 baseline consumption is about 3 percent higher than the CEDU 2021 mid case and reaches more than 358,000 GWh.

Figure 14: Baseline Electricity Consumption (Statewide)

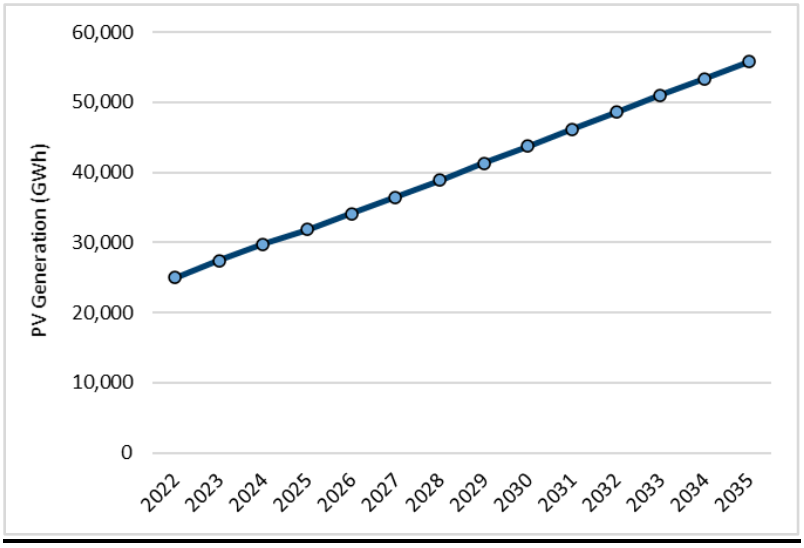


Source: CEC analysis

Electricity Sales Forecast

The CEDU 2022 sales forecast represents the amount of electricity load-serving entities will need to provide to their customers and is derived by subtracting projected customer generation from the consumption forecast. As such, the statewide sales forecast reflects many of the same characteristics as the consumption forecast, but the substantial amounts of incremental PV generation added each year reduce annual growth relative to consumption. Between 2022 and 2035, behind-the-meter PV generation grows on average by about 6 percent. By 2035, annual PV generation reaches 55,740 GWh. (See Figure 15.) The CEC's PV generation forecast was developed based on policies in place in early 2022. Any significant policy changes since then will be considered in the 2023 IEPR forecast.

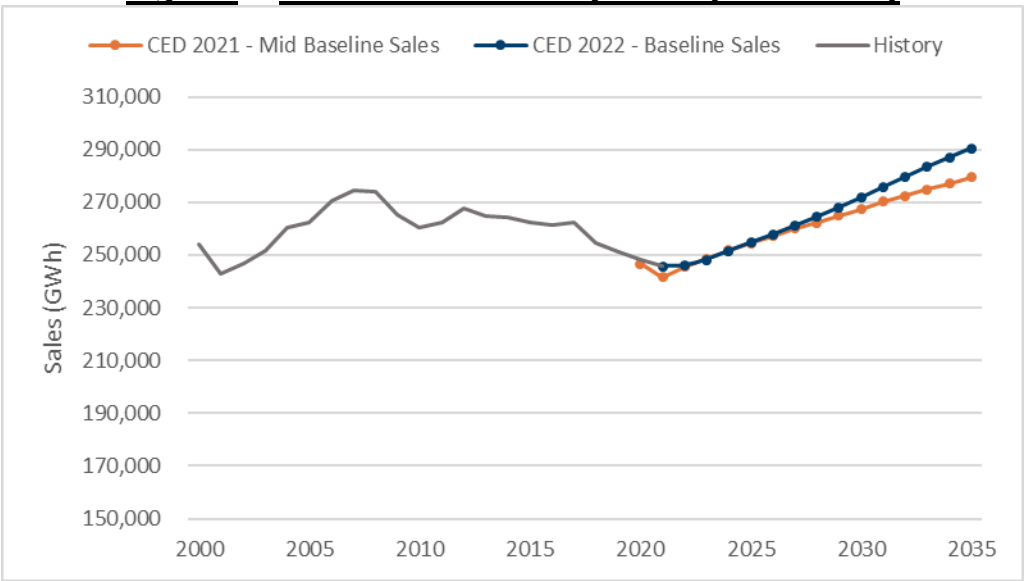
Figure 15: Annual Behind-the-Meter PV Generation



Source: CEC analysis

Between 2022 and 2035, annual growth in the baseline sales averages about 1 percent. By 2035, baseline sales are 4 percent higher than CED 2021 mid case and reach more than 290,000 GWh. (See Figure 16.)

Figure 16: Baseline Electricity Sales (Statewide)



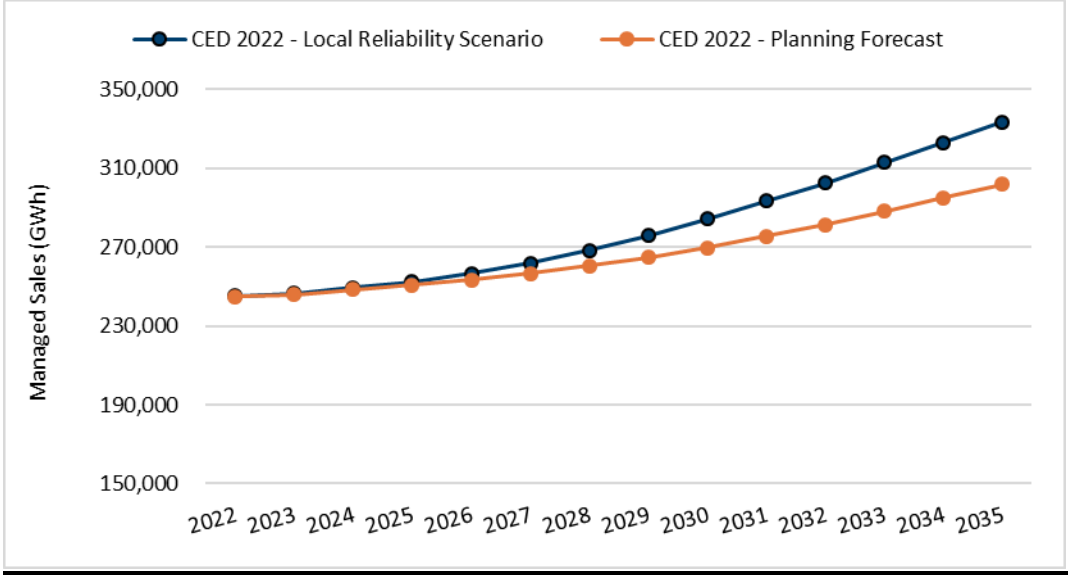
Source: CEC analysis

Managed Sales Forecasts

The CEDU 2022 sales forecast — combined with AAEE, AAFS, and AATE scenarios — creates a managed sales forecast. The Planning Forecast is a managed forecast that is a combination of the sales forecast, AAEE Scenario 3, AAFS Scenario 3, and AATE Scenario 3. The Local Reliability Scenario is a managed forecast that is a combination of the sales forecast, AAEE Scenario 2, AAFS Scenario 4 and the 2022

State SIP Strategy, and AATE Scenario 3. By 2035, the Planning Forecast reaches 301,951 GWh, and the Local Reliability Scenario reaches 333,447 GWh. (See Figure 17.)

Figure 17: Managed Electricity Sales (Statewide)



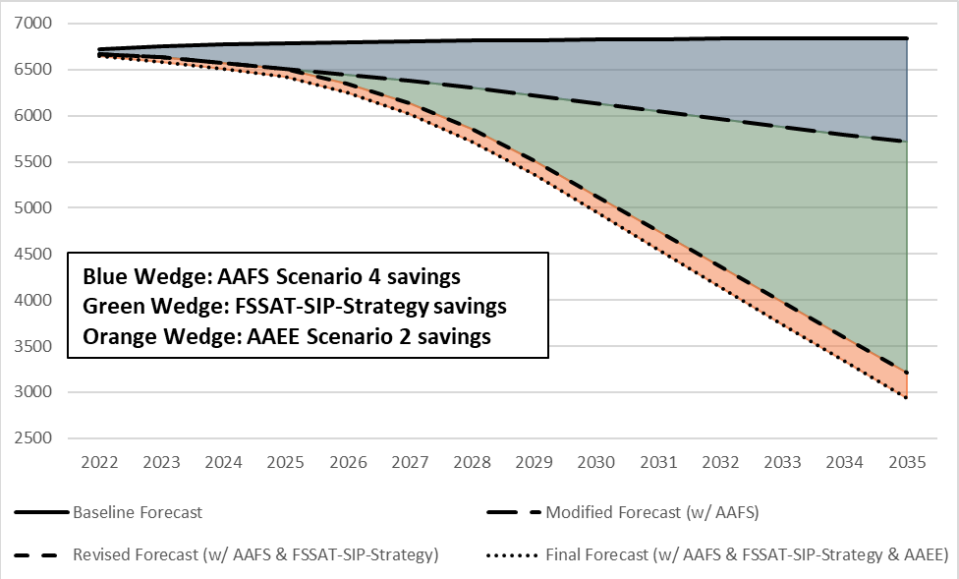
Source: CEC analysis

Results for the AAEE, AAFS, and AATE are described below.

Additional Achievable Energy Efficiency and Fuel Substitution Electricity Impacts

The model structure of FSSAT can clearly show the impacts from the 2022 State SIP Strategy while avoiding any double counting or overlap of programmatic AAEE and AAFS savings already modeled in 2021. Figure 18 shows the combined gas demand impacts contributed from AAEE Scenario 2, AAFS Scenario 4, and the State 2022 SIP Strategy included in the Local Reliability Scenario. The top solid line represents the baseline 2021 IEPR gas demand forecast. The line below the baseline forecast represents the "modified" forecast in FSSAT, which accounts for the savings from AAFS Scenario 4 (represented as blue-shaded region) and includes the expected programmatic fuel substitution from several end uses. Based on the "modified" forecast that includes the programmatic fuel substitution savings, FSSAT then models the expected impacts from the 2022 State SIP Strategy (represented as the green shaded region) and results in the next line below, the "revised" forecast. The expected savings from AAEE Scenario 2 (represented as the orange-shaded region) are then applied to the "revised" forecast, resulting in the bottom dashed line as the "final" forecast, which includes the combined impacts from the programmatic AAEE and AAFS scenarios and the 2022 State SIP Strategy.

Figure 18: Gas Demand Forecast Reductions From the Local Reliability Scenario (MM Therms)



Source: CEC analysis

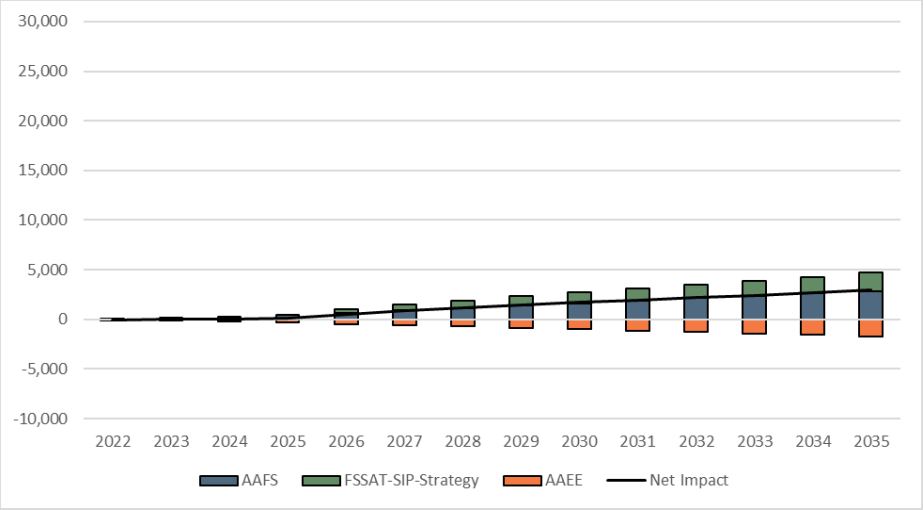
As shown in the blue wedge in Figure 18, the forecast reflects the assumption that the 2022 State SIP Strategy begins to impact gas demand in 2026.[86] The results show that the 2022 State SIP Strategy contributes larger gas savings than the programmatic savings of AAEE Scenario 2 and AAFS Scenario 4. In 2030, expected gas savings from AAEE, AAFS, and the 2022 State SIP strategy are 177 MM therms, 687 MM therms, and 1,006 MM therms, respectively, contributing to total gas savings of 1,870 MM therms. In 2035, the expected savings grow to a total of 3,904 MM therms. The 2035 savings are 274, 1,119, 2,511 MM therms for AAEE, AAFS, and the 2022 State SIP Strategy, respectively. The 2022 State SIP Strategy savings are exclusively from space and water heating, while the programmatic AAEE and AAFS savings stem from several end uses.

Figure 19 and Figure 20 illustrate the added electricity net impacts from AAEE 2, AAFS 4, and the 2022 State SIP Strategy included in the Local Reliability Scenario.

(bbu) **86 This reflects the timeline in the draft SIP that new buildings would be all-electric starting in 2026. In December 2022, CARB changed the SIP requirement to go into effect in 2030 after CEC staff had completed this analysis and incorporated it into the forecast. The CEC will collaborate closely with CARB to update modeling of the SIP for the 2023 energy demand forecast.** (ebu)

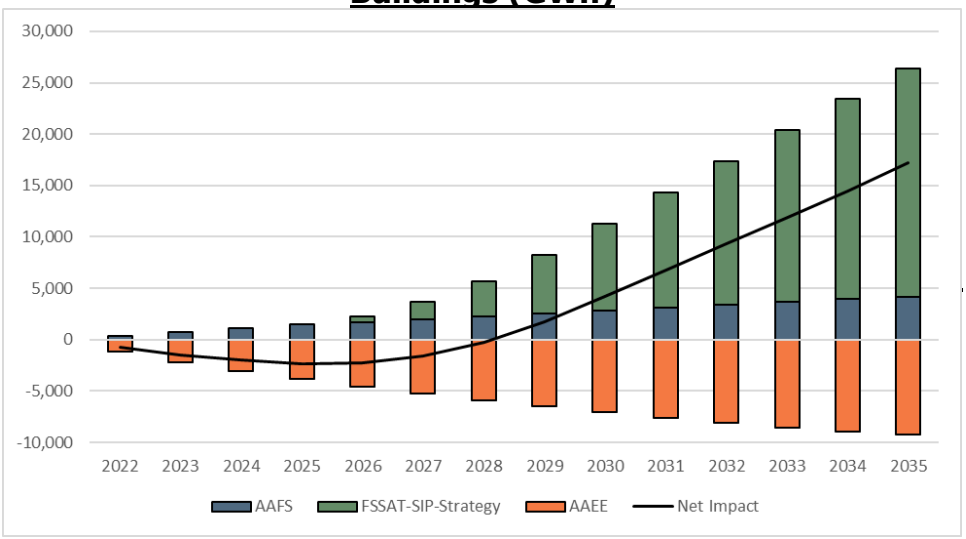
As seen in both figures, the electricity savings from AAEE Scenario 2 reduces but does not eliminate the added electricity from all fuel substitution activities. Figure 19 shows the impacts for new homes and commercial buildings. The net impacts from existing buildings reported in Figure 20 are noticeably larger. This difference can be explained by there being more replacements expected to occur in existing buildings and the fact that only the most efficient heat pump technologies are assumed to be installed in new buildings. New construction is required to comply with Title 24 Building Standards, whereas the SIP plan permits a wider range of technologies to be sold in the state and thus available for replacement of appliances in existing buildings.

Figure 19: Saved/Added Electricity From the Local Reliability Scenario in New Construction Buildings (GWh)



Source: CEC analysis

Figure 20: Saved/Added Electricity From the Local Reliability Scenario in Existing Buildings (GWh)



Source: CEC analysis

The resulting decarbonization of existing buildings from the 2022 State SIP Strategy will have the greatest impact on added electricity load relative to the programmatic AAFS impacts. In 2030, AAFS accounts for about 4,452 GWh of the added electricity from new and existing buildings, while the 2022 State SIP Strategy accounts for more than double that amount, 9,551 GWh of added electricity. Similarly, in 2035, the 2022 State SIP Strategy accounts for 24,122 GWh of added electric load from new and existing buildings, which is more than three times compared to the 7,020 GWh of added electricity expected from AAFS Scenario 4. This difference in added electric load between AAFS and the 2022 State SIP Strategy occurs from the wide range of replacement technologies, including electric resistance technologies (in contrast to electric heat pumps), with varying efficiencies being installed in existing buildings for the 2022 State SIP Strategy.

For the 2022 State SIP Strategy, the FSSAT estimates that roughly 2.67 million heat pumps for space and water heating and 1 million electric resistant technologies, primarily for water heating, are expected to be installed in the residential sector by 2030. These installations are additional to the 3.68 million residential heat pumps expected to be installed by 2030 from AAFS Scenario 4 programmatic activities. The combination of these AAFS programmatic activities as well as the ramp up fuel substitution assumed for the 2022 State SIP Strategy aims for the state to achieve installation of six million heat pumps by 2030. This goal was originally recommended in the *2021 IEPR* and discussed in the Governor's July letter to CARB.[87] However, as suggested by the added electricity impacts results depicted in Figure 19 and Figure 20, a continued focus on efficient decarbonization by using the most efficient heat pump technologies along with traditional energy efficiency is needed to address the potential grid reliability impacts of added electricity as the state decarbonizes the buildings sector.

(bbu) 87 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. P. 4. https://www.energy.ca.gov/data-reports/reports/integrated-energy-policy-report/2021-integrated-energy-policy-report.

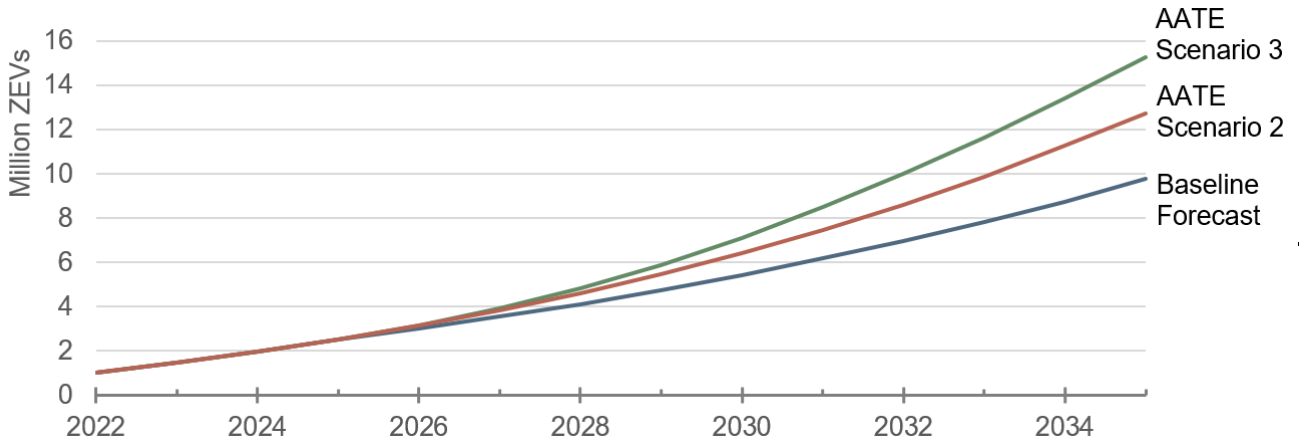
Newsom, Gavin. July 22, 2022. Letter from Governor Newsom to CARB Chair Liane Randolph. https://www.gov.ca.gov/wp-content/uploads/2022/07/07.22.2022-Governors-Letter-to-CARB.pdf. (ebu)

For the *2023 IEPR*, CEC staff intends to consult with CARB and CPUC staff to improve the characterization and assumptions used to model the 2022 SIP State Strategy. Staff will seek to improve the characterization of the technologies available, the share of adoption of various competing technologies, and the modeling of low-income households.

Additional Achievable Transportation Electrification Impacts

By postprocessing the baseline forecast, AATE Scenario 3 accounts for much of the general choice model aspect of the forecast while aligning new vehicle sales to CARB's ZEV regulations. For instance, with LD vehicle sales, consumer preferences for sport utility vehicles or pickup trucks over smaller sedans can be maintained, but Advanced Clean Cars II sales requirements for new ZEV sales can also be integrated. Similar to LD, freight demand by vehicle class is maintained, but fuel types of newly added vehicles are modified in the freight model baseline forecast. (Freight is the largest component of the MDHD population.) The results show that significantly more ZEVs are part of the population under AATE 3 compared to the baseline forecast. For example, in 2030, the baseline forecast shows 5.4 million ZEVs, while AATE Scenario 3 shows 7.1 million ZEVs. Figure 21 below shows the ZEV population results for LD vehicles.

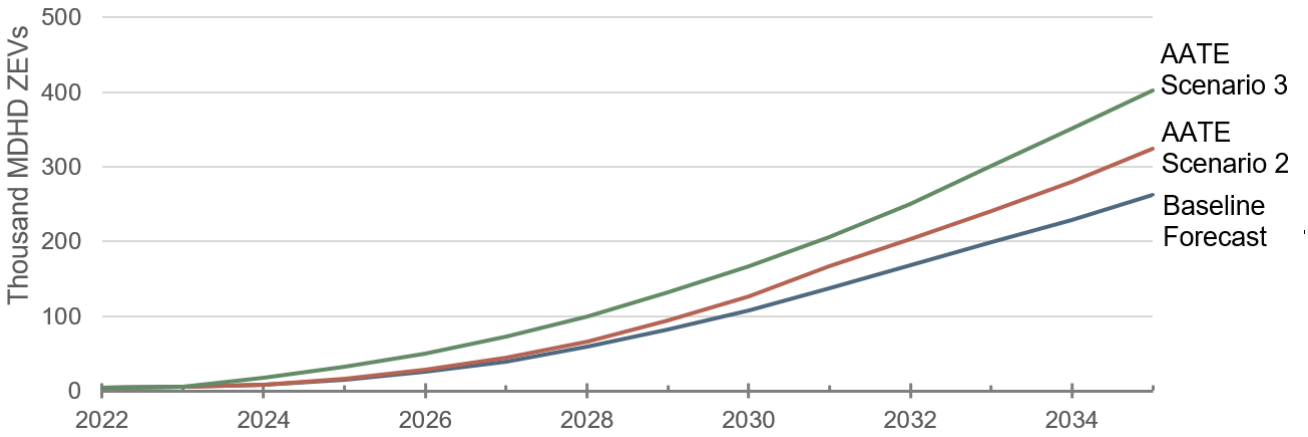
Figure 21: AATE Light-Duty ZEV Populations



Source: CEC analysis

The relationship seen for LD ZEV adoption is also seen in MDHD when accounting for the anticipated Advanced Clean Fleets regulation. Figure 22 below shows the MDHD ZEV population increasing to about 167,000 ZEVs in 2030 for AATE Scenario 3.

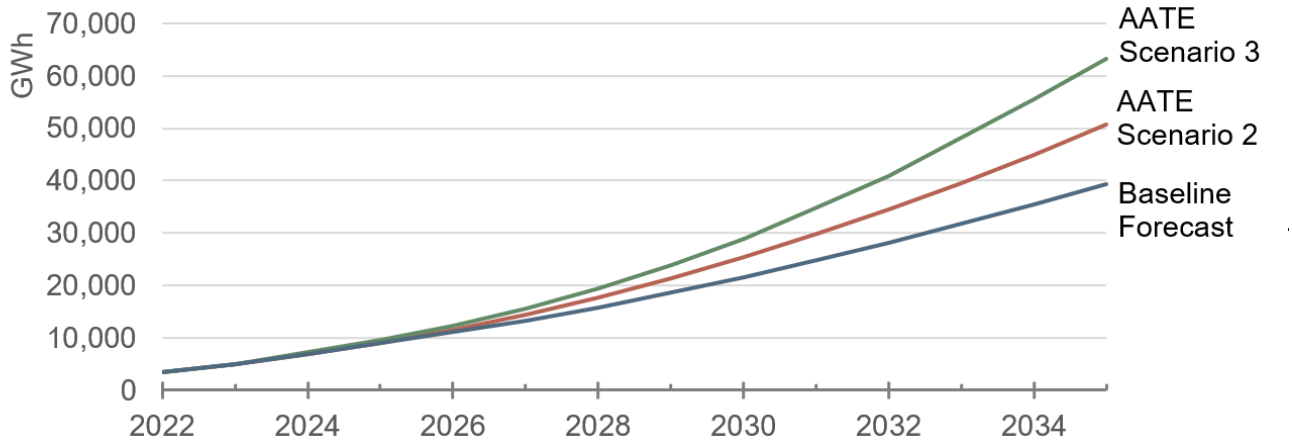
Figure 22: AATE Medium- and Heavy-Duty ZEV Populations



Source: CEC analysis

Similar to the vehicle adoption rates, electricity demand from increasing EV adoption also increases over the forecast period. Although light-duty EV adoption for AATE Scenario 3 is larger than in the previous "Additional Transportation Electrification" scenario adopted in 2022, total electricity demand for AATE 3 is somewhat lower. This finding is because the updated baseline forecast and AATE scenarios have improved fuel economy inputs, improvements to the vehicle travel models for ZEVs, and an improvement to the plug-in hybrid fuel consumption component of the forecasting model. Figure 23 below shows the transportation electricity demand from on-road vehicles.

Figure 23: Transportation Electricity Demand (Light-, Medium-, and Heavy-Duty Vehicles)



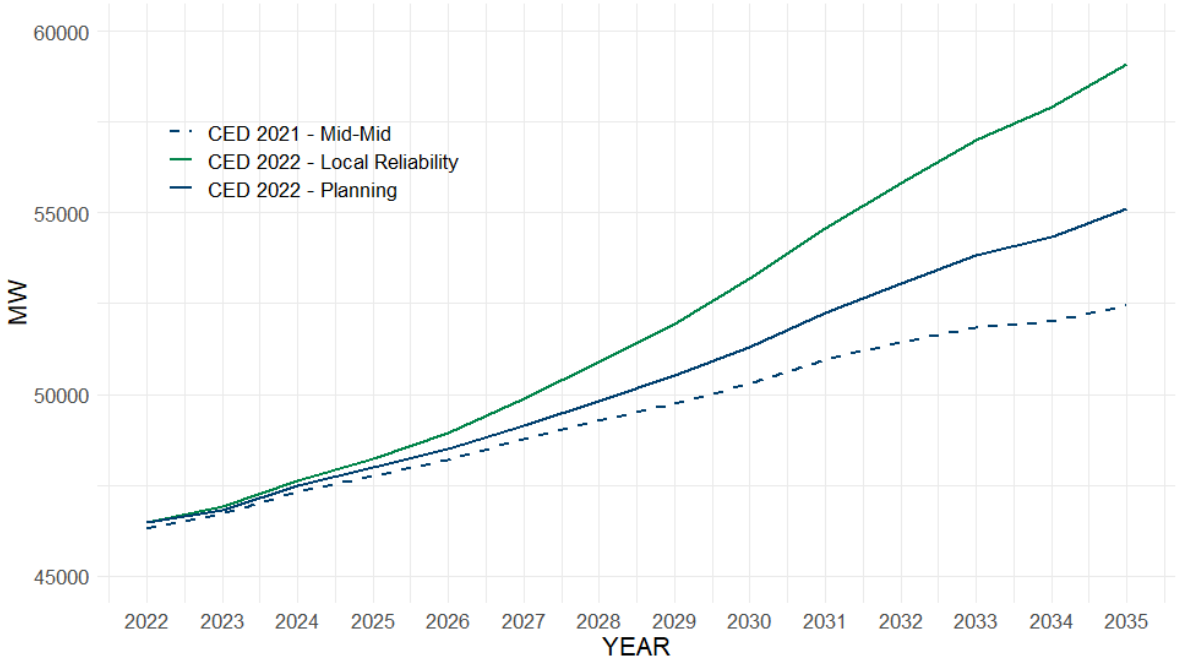
Source: CEC analysis

Staff presented load shapes associated with amount of electricity demand displayed above at the December 16, 2022, IEPR workshop. A more complete, systemwide integration of hourly and peak demand that incorporates transportation electrification is presented in the next section.

Peak Demand

The peak demand forecast update is derived from the annual consumption forecast by applying hourly system load profiles to projected annual consumption. CEC staff benchmarks the peak forecast to weather-normalized peaks from the most recent historical year — from summer 2022, in this case. The baseline peak forecast updates can be combined with the AAEE, AAFS, and AATE scenarios to create managed forecasts for use in planning studies. The CEDU 2022 baseline forecast — combined with the AAEE Scenario 3, AAFS Scenario 3, and AATE Scenario 3 — creates a managed peak forecast for the California ISO control area that grows at a rate of 1.3 percent annually, reaching 55,117 MW by 2035. By 2035, this managed forecast is 5.1 percent higher than projected by the CED 2021 mid-mid scenario. The increase can be attributed mostly to the increased levels of transportation electrification resulting from the inclusion of CARB's Advanced Clean Cars II and Advanced Clean Fleets regulations. Additional details regarding AAEE, AAFS, and AATE scenarios are described above.

Figure 24: Managed System Peak Demand (California ISO)



Source: CEC analysis

Choice of a Single Managed Forecast Set for Electricity Planning

The baseline electricity demand, when combined with six AAEE savings scenarios, five AAFS scenarios and the CARB 2022 State SIP Strategy space and water heating measure,[88] and two AATE scenarios adopted as part of this *IEPR*, create managed electricity forecasts that constitute options for a "single forecast set" to be used for planning in CEC, CPUC, and California ISO (the joint agencies and California ISO) proceedings. The lead staff of the joint agencies and California ISO guiding the processes listed below have agreed that specific elements of this forecast set will be used for planning and procurement in the California ISO's TPP and the CPUC's IRP, resource adequacy, and other planning processes as outlined below. The details of this agreement will be adapted through time as the needs of planning and procurement evolve. This agreement was also documented in a joint Memorandum of Understanding in December 2022.[89]

The term "single forecast set" is intended to clarify that what has commonly been called a "single forecast" is not a single number but actually a set of forecast numbers adopted as part of the *IEPR*. This set includes managed forecast scenarios that combine baseline forecasts using alternative weather variants; AAEE, AAFS, and AATE scenarios; and hourly load forecasts for transmission access charge (TAC) areas.[90] Agreement on a single forecast set includes specification on the use for each component of the set.

The single forecast set consists of components of the IEPR demand forecast:

- **A baseline forecast of annual energy and peak demand, with three peak event weather variants (*for example*, 1-in-2, 1-in-5, and 1-in-10)**

(bbu) 88 The concept as adopted in the 2022 State SIP Strategy is a new sales requirement such that new space and water heaters purchased starting in 2030 would be required to be zero-emission. CARB will be kicking off a formal rulemaking in early 2023 and plans to take a proposed regulation to the board for consideration no later than 2025 with implementation beginning in 2030. The proposed sales requirement was layered on top of AAFS Scenario 4.

89 Memorandum of Understanding Between The California Public Utilities Commission (CPUC) And The California Energy Commission (CEC) and The California Independent System Operator (ISO) Regarding Transmission and Resource Planning and Implementation. December 2022. https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/news-and-outreach/documents/news-office/mous/cpuc-cec-caiso-mou-december-2022.pdf

90 A TAC area denotes a portion of the California ISO balancing authority area that has been placed in the California ISO's operational control through an agreement with an electric utility or other entity operating a transmission system component. A TAC area typically consists of an IOU and several publicly owned utilities using the transmission system owned by the IOU. (ebu)

- **Hourly loads for the baseline forecast for each of three IOU TAC areas**
- **Six scenarios of AAEE described by annual energy and hourly load impacts**
- **Five scenarios of AAFS described by annual energy and hourly load impacts. One scenario — Scenario 4 — includes the 2022 State SIP Strategy zero-emission space and water heater sales requirement**
- **Two scenarios of AATE described by annual energy and hourly load impacts**

The combination of the CEDU 2022 baseline forecast using a specific weather variant plus an AAEE, AAFS, and AATE scenario depends on the use. The practices and procedures used in electricity local capacity studies address uncertainty about the location-specific impacts of various assumptions by systematically using adverse assumptions about weather-induced peak load, and conservative load modifiers to base loads. For energy efficiency savings, AAEE Scenario 2 is used for local capacity studies because it is more conservative than Scenario 3 that is used in most planning studies. For fuel substitution, AAFS Scenario 4 is used rather than Scenario 3 that is used in most planning studies. For transportation electrification, Scenario 3 is used for local capacity studies and planning studies.

To account for unforeseen uncertainties, variations of IEPR CEDU outputs that diverge from the single forecast set may be used in CPUC IRP modeling under specific circumstances with consensus from joint agency and California ISO leadership.[91] However, lead CPUC staff agrees to ensure that adopted IRP portfolios will not deviate from the single forecast set.

The following list describes the current agreement among the lead staff of the joint agencies and California ISO:

- **CPUC IRP Reference System Plan, Preferred System Plan, and California ISO TPP economic studies:[92]**
  - **Baseline annual energy and annual peak demand**

(bbu) 91 In May 2022, leadership of the joint agencies and California ISO decided to use a new scenario that reflected CARB's proposed regulations for zero-emission vehicles given the long lead time for the types of system upgrades that could be required to support implementation of these regulations. This scenario, called the Additional Transportation Electrification scenario, was used by the California ISO for the TPP.

92 In consultation with the CEC and California ISO, the CPUC may authorize procurement using an alternative weather variant. (ebu)

- **AAEE Scenario 3 annual energy and peak demand**
- **AAFS Scenario 3 annual energy and peak demand**
- **AATE Scenario 3 annual energy and peak demand**
- **1-year-in-2 peak event weather conditions**

- **California ISO TPP policy studies and bulk system studies:**
  - **Baseline annual energy and annual peak demand**
  - **AAEE Scenario 3 annual energy and peak demand**
  - **AAFS Scenario 3 annual energy and peak demand**
  - **AATE Scenario 3 annual energy and peak demand**
  - **1-year-in-5 peak event weather conditions**
  - **Planning Forecast hourly loads**
  - **CEC staff allocations of AAEE, AAFS, and AATE to load buses used in transmission studies**
- **California ISO TPP local area reliability studies and local capacity technical studies:**
  - **Baseline annual energy and annual peak demand**
  - **AAEE Scenario 2 annual energy and peak demand**
  - **AAFS Scenario 4 annual energy and peak demand**
  - **AATE Scenario 3 annual energy and peak demand**
  - **1-year-in-10 peak event weather conditions**
  - **CEC staff allocations of AAEE, AAFS, and AATE to load buses used in transmission studies**
- **California ISO Maximum Import Capability allocation for CPUC's system resource adequacy requirements for load-serving entities (LSEs)**
  - **Monthly peak demand derived from the Planning Forecast managed sales hourly loads**
- **CPUC resource adequacy LSE system requirements[93]**
  - **Monthly peak demand derived from Planning Forecast managed sales hourly loads**

(bbu) 93 In consultation with the CEC and California ISO, the CPUC may authorize procurement using an alternative weather variant. (ebu)

- **AAEE Scenario 3 annual and monthly peak demand**
- **AAFS Scenario 3 annual and monthly peak demand**
- **AATE Scenario 3 annual and monthly peak demand**
- **1-year-in-2 peak event weather conditions**

- **CPUC IOU distribution planning requirements**
  - **Baseline peak demand (also known as the IEPR demand forecast) and AAEE and AAFS scenarios (also known as "distributed energy resource growth forecasts")**
  - **Weather variants and AAEE, AAFS, and AATE scenario variants that may differ by IOU as per CPUC D. 18-02-004[94]**
- **California ISO flexible capacity studies for resource adequacy:[95]**
  - **Baseline mid-case hourly loads by California ISO area**
  - **AAEE Scenario 3 hourly loads by California ISO area**
  - **AAFS Scenario 3 hourly loads by California ISO area**
  - **AATE Scenario 3 annual and monthly peak demand**
  - **1-year-in-2 peak event weather conditions**

Lead staff of the joint agencies and California ISO have developed a process by which the CPUC or California ISO can make a formal request to the CEC for a desired demand forecast variant or combination that is not yet produced. If the CEC does not have the resources to develop such a variant, then lead staff from the requesting agency may consider deviating from this agreement to independently develop and use such a variant for the period until the CEC is able to develop it. (bb)Such requests should also be made and approved using appropriate

---

(bbu) 94 Following a May 11, 2020, CPUC Distribution Resources Plan Ruling (R.14-08-013), the same IEPR datasets are used by each IOU. The IOUs meet and confer to establish which IEPR datasets to use and present a listing of the selected datasets to CPUC staff for approval. In all cases, IEPR datasets are used where feasible for disaggregation and forecasting, and the IOUs clearly state in their filings which datasets were used.

95 The method for assessing flexible capacity using the hourly CEC forecast was first used for flexible capacity resource adequacy planning for Year 2020. The joint agencies and California ISO are collaborating to evaluate this use case into the overall CEC demand forecasting work flow and the California ISO's flexible capacity projection method. The joint agencies and California ISO are evaluating and potentially modifying the flexible capacity analysis going forward. Until finalization of evaluation and potential changes are made, the California ISO will continue to use the CEC's hourly forecast. (ebu)

procedures of the requesting agency to ensure all interested stakeholders are aware of such a deviation. (ebu)

Forecast Updates for 2023

Staff (bst) ~~plan~~ (est) (bbu) **plans** (ebu) to expand and update the forecast to improve how climate change is incorporated into forecasted demand and (bst) ~~to~~ (est) 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 (bst) ~~and commercial~~ (est) sector end-use (bst) ~~models~~ (est) model to incorporate the latest Residential Appliance Saturation (bst) ~~Survey and Commercial End Use~~ (est) 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 (bst) ~~travelled~~ (est) (bbu) **traveled** (ebu) by different travel modes.
- ~~(bst) Expanding the pipeline gas demand forecast to assess monthly demand and peak winter day demand.~~(est)
- Ensuring scenarios capture a range of possibilities and are useful and relevant to stakeholders.

Shifts in Energy-Use Patterns

Electrification of buildings and transportation will change energy-use patterns, and there are numerous uncertainties around (bst) ~~this~~ (est) (bbu) **electrification** (ebu) that will need to be considered and monitored as (bst) ~~electrification~~ (est) it becomes more prevalent. The uncertainties include (bbu) **(1)** (ebu) the rate of adoption of electric vehicles and heat pumps, (bbu) **(2)** (ebu) EV charging patterns and *vehicle-to-building*[96] charging and discharging, (bbu) **(3)** (ebu) the amount of electricity needed for (bst) ~~instate~~ (est) (bbu) **in-state** (ebu)

96 *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.

production of hydrogen for use in fuel cell electric vehicles, (bbu) **(4)** (ebu) battery storage charging and discharging, and **(5)** load flexibility and demand response (bst)~~, and ways that~~ (est). (bbu) **There is uncertainty around how** (ebu) 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.

(bbu) **Additional challenges remain for forecasting load with more geographic specificity. For example, MDHD load is expected to be relatively small compared to LD load but will likely be more concentrated in fewer areas of the state, with the potential for much higher loads in such pockets. CEC staff is coordinating with other state agencies to consider new ways of enhancing the forecast to address these challenges.** (ebu)

Long-Term Energy Demand Scenarios to Support SB 100 Assessments

The impacts of climate change and decarbonization policies have created a need for a routinely produced set of long-term energy demand scenarios to (bst) ~~be used for~~ (est) (bbu) **inform** (ebu) planning (bst) ~~purposes~~ (est). 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.[97] 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. (bbu) **The scenarios will include assessments of the potential role of hydrogen in meeting decarbonization goals and the SB 100 targets.** (ebu)

97 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[98] and a second on distributed energy resources.[99] 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 on May 20, 2022.[100] A joint analysis conducted by the CEC and California ISO focused on summer 2022 but also evaluated reliability through 2025. The analysis identified four broad categories of

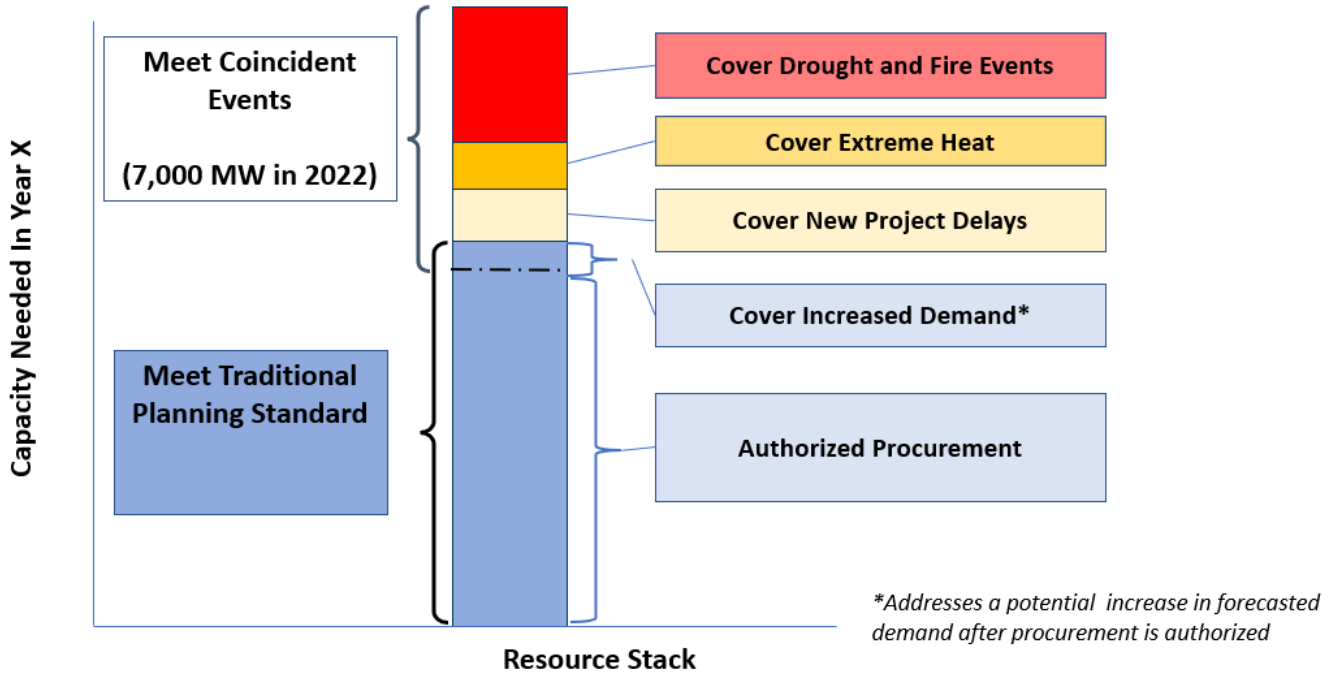
98 Order Instituting Informational Proceeding on Gas Decarbonization (22-OII-02), https://www.energy.ca.gov/proceedings/energy-commission-proceedings/order-instituting-informational-proceeding-gas.

99 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.

100 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.

capacity needed to address coinciding extreme events, as illustrated in Figure (bst) ~~14.~~ (est) (bbu) **25.** (ebu)

Figure 25: Reliability Impacts



Source: CEC staff

The first category reflects capacity needed to meet traditional grid reliability planning, shown in dark blue in Figure (bst) ~~14~~ (est) (bbu) **25** (ebu). 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.[101] The CEC's 2021 CED forecast, adopted in January 2022, projects a greater demand through 2026 than was anticipated in the 2020 CEDU. The (bst) ~~2020 CEDU was~~ (est) (bbu) **CPUC** (ebu) used (bst) ~~by~~ (est) the (bst) ~~CPUC~~ (est) (bbu) **2020 CEDU** (ebu) to develop the procurement order for 2022 and beyond. The peak demand in the 2021 CED increased compared to the 2020 CEDU in part (bst) ~~due to~~ (est) (bbu) **because of** (ebu) an

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

update to the weather normalization (bst) ~~methodology~~ (est) method to (bst) ~~more heavily~~ (est) weight recent years (bbu) **more heavily** (ebu) to better capture climate change impacts.[102] 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 (bst) ~~14~~ (est)(bbu) **25)** (ebu) 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 (bst) ~~have experienced supply chain issues.~~ (est) (bbu) e**xperienced supply chain challenges from COVID-19 over the past three years. These challenges were compounded in 2022 continued supply chain impacts of the COVID-19 pandemic and tariffs on solar.[103]** (ebu)

The third category consists of capacity resources to address conditions not incorporated in the traditional planning standard. These (bbu) **conditions** (ebu) include extreme (bbu) **and unanticipated weather** (ebu) events (bbu) **that have increased in frequency due to climate change,** (ebu) such as the westwide heat (bst) ~~wave~~ (est) (bbu) **event** (ebu) experienced in August 2020, which led to (bst) ~~multiple~~ (est) incidents of load curtailment, and the September 2022 extreme heat event.

The fourth category consists of resources to address (bst) ~~coincident~~ (est) (bbu) **emergencies that occur during an** (ebu) extreme (bst) ~~events~~ (est) (bbu) **weather event** (ebu), such as (bbu) **a wildfire that occurs during an** (ebu) extreme drought (bst) ~~and wildfires.~~ (est). For example, the Bootleg Fire in Oregon (bbu) **unexpectedly** (ebu) reduced imports to the California ISO footprint by 3,000 MW in 2021 during an extreme drought year. (Shown in red in Figure (bst) ~~14.)~~ (est) 25.)

---

102 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.

(bbu) **103 Federal Register. April 1, 2022. Volume 87, No. 63. https://www.govinfo.gov/content/pkg/FR-2022-04-01/pdf/2022-06827.pdf.** (ebu)

Table 4: 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.

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 (bst) ~~a~~ (est) coinciding (bst) ~~event~~ (est) (bbu) **events.** (ebu) 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 (bbu) **if several of these coincidental events occur at once.** (ebu)

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*,[104] 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 (bst) ~~prior to~~ (est) (bbu) **before** (ebu) 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*.[105]

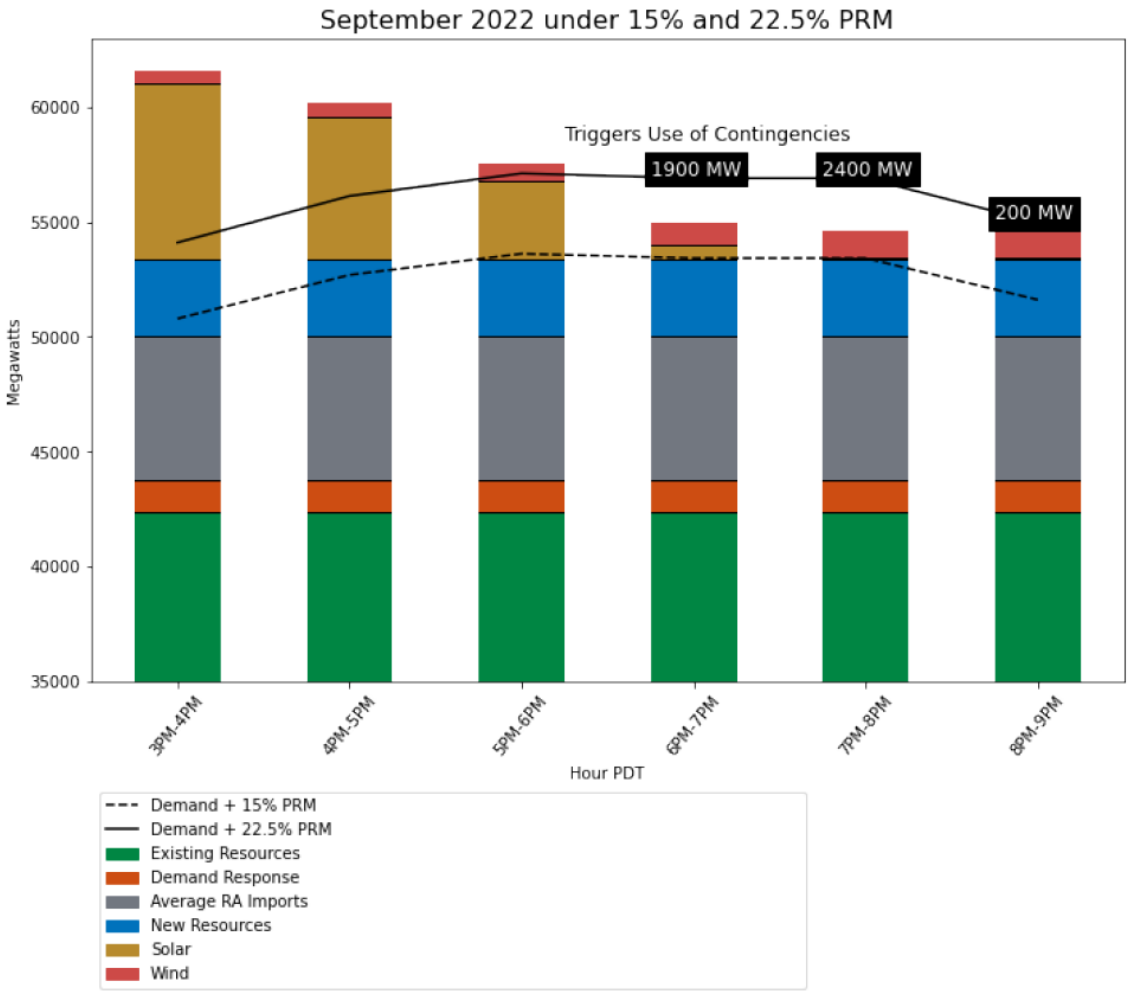
The updated analysis identified better summer net peak conditions for summer 2022 than were originally projected, in part because of the procurement ordered by the CPUC. For July and August 2022, resources were projected to be sufficient to address an (bst) ~~average and an~~ (est) extreme heat event. 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 (bst) ~~15~~ (est) 26.) *PRM* is a metric used to (bbu) **calculate supply relative to the forecasted demand. A PRM target is set to** (ebu) ensure there is sufficient supply (bst) ~~to meet the demand~~ (est) 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 (bbu) **the potential for an** (ebu) 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.

104 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.

105 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.

Figure 26: 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 (bst) ~~to~~ (est) provide additional emergency resources during (bbu) **coincidental** (ebu) 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[106] to support the SRRF. This (bbu) **extension** (ebu) 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 (bst) ~~Power Safety Power Shutoffs~~ (est) (bbu) **public safety power shutoffs.** (ebu)
3. Decrease emissions from backup generation.
4. Minimize air pollution.
5. Avoid impacts to disadvantaged communities.

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

106 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.

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 (bst) ~~(1) make~~ (est):

- (bbu) **Make** (ebu) available to the public a cost comparison of other potential resource portfolios as alternatives to the Diablo Canyon extension (bst)~~, (2) reevaluate~~ (est)
- (bbu) **Reevaluate** (ebu) the cost-effectiveness of extending operations of the Diablo Canyon power plant if costs exceed the loan value (bst)~~, (3) make~~ (est)
- Make a determination in a public process of the need for the Diablo Canyon extension (bst)~~, and (4) in~~ (est)
- (bbu) **In** (ebu) 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 (bbu) **Reliability** (ebu) Investment Plan and a goal for load shifting. The Clean Energy (bbu) **Reliability** (ebu) 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 (bst) ~~ten~~ (est) (bbu) **10** (ebu) -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 (bst) ~~the~~ (est) (bbu) **a** (ebu) 22.5 percent PRM. On August 31, the Governor issued an emergency proclamation that enabled (bst) ~~multiple~~ (est) (bbu) **several** (ebu) initiatives to be deployed, including those authorized by AB 205. While the programs are in infancy, (bst) ~~they helped~~ (est) (bbu) **the CEC was able to establish the programs quickly enough to help provide new electricity resources to** (ebu) meet the record demand experienced in September 2022. (bbu) **The growth of grid-connected energy storage, including 3,500 MW in California ISO territory since the 2020 outages, also provided critical net peak support. Energy storage also demonstrated strong performance as** (ebu) Californians (bst) ~~also~~ (est) ~~-~~met the challenge and reduced their load during the critical net peak hours (between 4:00 p.m. and 9:00 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. (bst) ~~A detailed~~ (est) (bbu) **The California ISO published an** (ebu) analysis(bbu) **in November 2022** (ebu) of the (bst) ~~crises is underway~~

~~and will be available by the end~~ (est) (bbu) **effects** (ebu) of the (bst) ~~year.~~ (est) (bbu) **heat event in a summer market performance report.[107]** (ebu)

(bbu) **The CEC, in collaboration with CARB and the CPUC, is conducting further analysis of energy reliability and the heat event of summer 2022. AB 205 required the CEC to summarize summer 2022 reliability for the state and provide an overview of reliability for 2023−2026. The analysis includes additional detail on the extreme heat event and the state's response to maintain grid reliability in summer 2022. Although the state was able to deploy several new clean resources and demand response to meet the needs during the heat event, the state did ultimately need to deploy additional fossil fuel emergency generators and nonspecified power purchases from the western grid through the strategic reserve at DWR to avoid power outages. The CEC is working with CARB to estimate the emissions associated with these resources. Since the reporting requirements of AB 205 overlap with the reliability analysis required by SB 846 (next section), the CEC is combining the results, including the emission analysis, into one report expected to be issued to the Legislature in February 2023.** (ebu)

Reliability Planning Assessment

(bst) ~~As required by~~ (est) SB 846~~,~~ (bbu) **requires** (ebu) the CEC and CPUC (bst) ~~are developing~~ (est) (bbu) **to develop** a (bbu) **quarterly** (ebu) Reliability Planning Assessment to estimate the balance of electricity supply and demand for 5 and 10 years forward (bst)~~. The analysis includes high-, medium-, and low-risk scenarios and will be completed by December 15, 2022~~ (est), (bbu) **provide an overview of new project development, and provide recommendations for improving grid reliability. The first report, expected to be submitted to the Legislature in February 2023 (and will address the reporting requirements of AB 205 as noted above), will include analysis of existing and proposed generation resources over the 10-year time frame. The analysis will also include several scenarios that may impact grid reliability, including heat events like the state experienced in 2020 and 2022 and potential delays in new project development, such as from supply chain issues.** (ebu)

(bbu) **107 California ISO. November 2, 2022. *Summer Market Performance Report*. http://www.caiso.com/Documents/SummerMarketPerformanceReportforSeptember2022.pdf.** (ebu)

Western Electricity Integration

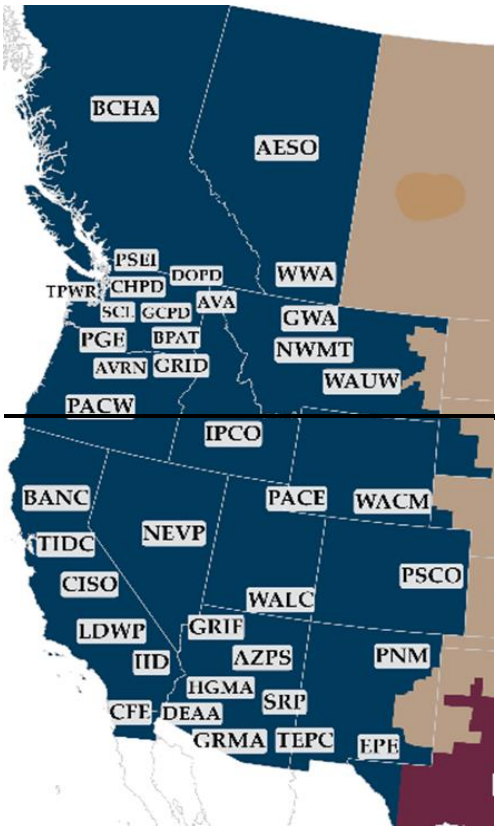
Introduction

California's electricity system is an integral part of a (bst) ~~much~~ (est) 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 (bst) ~~16~~ (est) (bbu) **27.)** (ebu) To maintain stability, the interconnected system of balancing authorities must adhere to strict federal and provincial reliability standards, grid codes, and operating practices. (est) ~~This complex system continues to evolve through coordination efforts to address market development, resource adequacy, and transmission development.~~ (est)

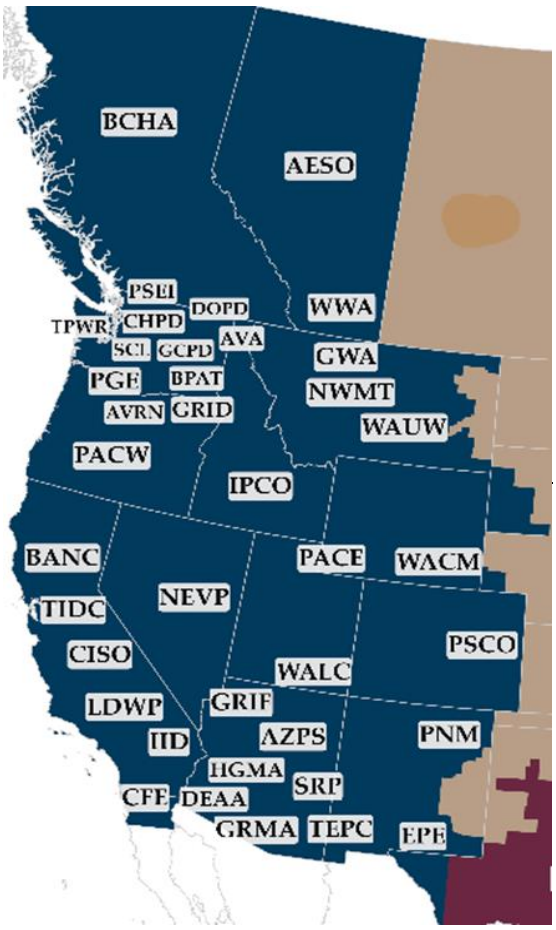
(bbu) **The WI is in the midst of a progression not seen before. Forces driving this extraordinary, rapid change are improved economics for new fuel and generation technologies, emergence of regional markets and resource adequacy programs, and unexpected weather events that bring extraordinary precipitation and temperatures outside the range of what states have planned for based on historical weather records. Magnifying the implications of these disruptive, dynamic forces is the nearly unified push across the West to reduce combustion of fossil fuels for electricity generation while decarbonizing buildings and transportation through electrification.**

Planning and operating under these conditions would be a tall order for any electric system. Indeed, it is particularly daunting for the West, which remains fragmented into 34 balancing areas without centralized energy dispatch, planning, or governance. Integrating system operation and planning across the West could significantly decrease the ratepayer impact of adapting to climate change while decarbonizing and bring considerable economic and environmental benefits by harnessing diversity in loads, weather, and clean resources across the West. (ebu)

Figure 27: WI Balancing Authorities [begin image delete]



[end image delete] [begin image insert]



[end image insert]

Source: (bst) ~~Western Electricity Coordinating Council~~ (est) (bbu) **WECC** (ebu)

Western Market Implementation and Enhancement

Electricity markets in the (bst) ~~west~~ (est) West continue to evolve and increase in complexity and capability. Two major market (bst) ~~developments~~ (est) (bbu) initiatives (ebu) in the (bst) ~~west~~ (est) (bbu) West (ebu) include the (bbu) **development of the** (ebu) 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 (bst) ~~multiple~~ (est) ~~-~~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 (bbu) **will grow to 22 participants by 2023 and** (ebu) includes representatives serving nearly 80 percent of the (bst) ~~Western Electricity Coordinating Council's~~ (est) (bbu) **WECC's WI** (ebu) load (bst) ~~and~~ (est). It provides a platform for participants to buy and sell power in increments of 5 to 15 minutes ~~from~~a (bbu) **head of** (ebu) 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. (bst) ~~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.[108]~~

~~Most recently, the~~ (est) (bbu) **The** (ebu) California ISO and stakeholders (bst) ~~are working to create~~ (est) (bbu) **developed** (ebu) 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 (bst) ~~Revised Straw~~ (est) Final Proposal published in (bst) ~~August~~ (est) (bbu) **December 2022 and approved on February 1, 2023.[109]** (ebu)

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 (bst) ~~used~~ (est) in WEIM) unit commitment and enabling resource scheduling across a geographic area larger than the California ISO footprint.[110] The EDAM (bst) ~~proposal would~~ (est) will extend participation to WEIM entities. The (bst) ~~proposal~~ (est) (bbu) **initiative** (ebu) 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 (bst) ~~product~~ (est) (bbu) **products** (ebu) designed to cover (bst) ~~both~~ (est) 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 45.

(bst) ~~108 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).~~ (est)

109 California ISO. EDAM webpage, (bst) ~~https://stakeholdercenter.caiso.com/StakeholderInitiatives/Extended-day-ahead-market.~~ (est) (bbu) **https://stakeholdercenter.caiso.com/StakeholderInitiatives/Extended-day-ahead-market.**

California ISO press release. "Western Day-Ahead Market Enhancements Approved." February 2, 2023. http://www.caiso.com/Documents/Western-day-ahead-market-enhancements-approved.pdf.

110 *Unit commitment* refers to the process of positioning electric generators to meet the expected needs of the grid for the following day while attempting to minimize system operating costs. (ebu)

Table 5: 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

(bst) ~~Credit~~ (est) (bbu)**Source** (ebu): California ISO

The California ISO (bst) ~~is proposing initially~~ (est) proposes to (bst) ~~use a~~ (est) extend the GHG accounting system (bst) ~~that is effectively an extension of that~~ (est) used in the WEIM~~.~~ (bbu) **and include enhancements designed to limit secondary dispatch while allowing for several GHG pricing regions.** (ebu) This approach has the benefit of being well-defined and requiring relatively few design changes. The California ISO (bst) ~~proposes~~ (est) (bbu) **commits** (ebu) to (bst) ~~continue evaluating alternate~~ (est) (bbu) **evolving** (ebu) approaches (bst) ~~for~~ (est) (bbu) **to GHG** (ebu) accounting (bst) ~~for GHGs.~~ (est)

(bst) ~~The~~ (est) in EDAM (bst) ~~proposal process targets publishing a draft~~ (est) (bbu) **as operational experience is gained and varying regulatory programs develop across western states.**

Following the release of the (ebu) final proposal (bst) ~~by late October 2022 and a final proposal by early December 2022.~~ (est), (bbu) **the first WEIM participant PacifiCorp announced its intention to join the EDAM, a promising first step in the launch of the EDAM.** (ebu) California ISO staff (bst) ~~would bring~~ (est) (bbu) **brought** (ebu) the final proposal before a joint session of the California ISO Board of Governors and the WEIM Governing Body (bst) ~~for approval December 14, 2022.~~ (est) (bbu) **that was approved unanimously on February 1, 2023.** (ebu)

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)[111] 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 (bst)~~,~~ ~~as~~ (est). SPP (bst) ~~works toward publishing a~~ (est) (bbu) **published the final** (ebu) service offering for Markets+ in late November 2022. SPP identified (bst) ~~March~~ (est) (bbu) **the months leading up to June** (ebu) 2023 as (bst) ~~a~~ (est) (bbu) **the** (ebu) 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 (bst)~~Emergence~~ (est) (bbu)Implementation (ebu)

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 (bst) ~~resource~~ (est) (bbu) **investment in energy** (ebu) infrastructure (bst) ~~investment~~ (est) (bbu) **such as generation, storage, and transmission.** (ebu)

Western Power Pool

The Western Power Pool[112] (formerly the Northwest Power Pool), Powerex, and other major western utilities/states (bst) ~~are developing~~ (est) (bbu) **have developed and filed a tariff at the Federal Energy Regulatory Commission (FERC) for** (ebu) the Western Resource

(bbu) **111 Bonneville Power Administration is a federal agency located in the Pacific Northwest that delivers hydropower in the Columbia River Basin. https://www.bpa.gov/about.**

112 The Western Power Pool is a nonprofit corporation promoting voluntary association among its membership consisting of major generating utilities serving the western United States, British Columbia, and Alberta. https://www.westernpowerpool.org/. (ebu)

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. (bst)~~The~~ (est) Western Power Pool staff emphasized the need to build flexibility into the program design so that WRAP can integrate with emerging electricity market designs. (bbu) **This program integration need has been recognized by both the California ISO EDAM and SPP Markets+ development teams. Both market development groups have expressed willingness to support WRAP integration into their day-ahead market designs.** (ebu)

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 (bst) ~~an~~ (est) August (bbu) **and December** (ebu) 2022 (bst) ~~filing~~ (est) (bbu) **filings** (ebu) to the Federal Energy Regulatory Commission (FERC), the Western Power Pool requested a WRAP implementation effective date of January 1, 2023.[113] (bbu) **In early December 2022, 11 WRAP members, featuring several WEIM participants including PacifiCorp, committed to full participation in the program. A decision from FERC on the WRAP filing is expected in the first half of 2023.** (ebu)

(bbu) ~~Western Electricity Coordinating Council (~~ (ebu) WECC (bst)~~ Facilitation~~ (est) (bbu) Assessments (ebu) of Resource Adequacy (bst) ~~Discussions~~(est) (bbu) Discussion (ebu)

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.[114] Through WECC stakeholder initiatives, like the Western Assessment of Resource Adequacy, analysis and information on resource adequacy are

113 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.

114 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.

provided to stakeholders and decision makers. The WECC resource adequacy work supports broader 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.

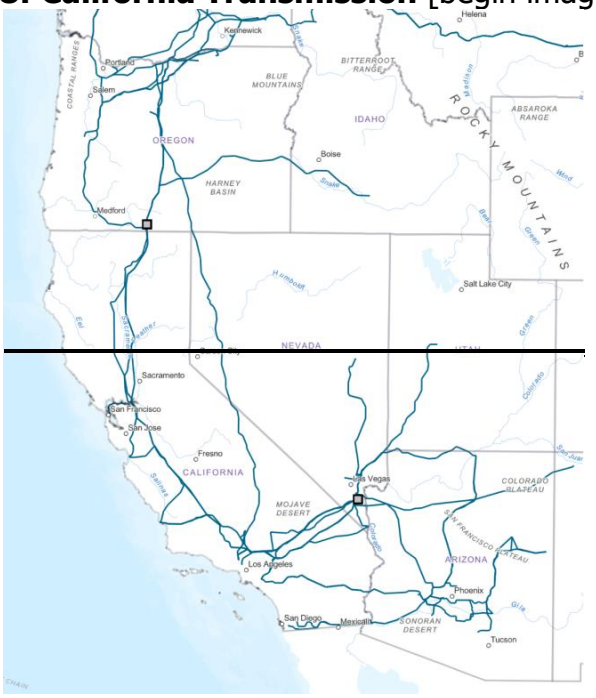
In mid-summer 2022, WECC (bst) ~~also began hosting~~ (est) (bbu) **initiated** (ebu) a resource adequacy discussion series to explore current and emerging issues with stakeholders. By sharing challenges and reviewing analytical approaches, the WECC staff is gathering stakeholder input on resource adequacy analytics. (bbu) **The discussion series is planned to resume in early 2023 to promote further dialogue on this key element of western integration.** (ebu)

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,[115] and this number is expected to grow (bst) ~~as California relies on new resources, primarily wind, in other parts of the West to attain its climate goals. Figure 17~~ (est). (bbu) **Figure 28** (ebu) shows the major transmission lines in California and connections to other states.

115 (bst) ~~CEC Energy Almanac. California Electrical Generation - Imports and Exports.~~ (est) (bbu) **CEC Energy Almanac. "California Electrical Generation — Imports and Exports."** (ebu) https://www.energy.ca.gov/data-reports/energy-almanac/california-electricity-data/california-electrical-energy-generation.

Figure 28: California Transmission [begin image delete]



[end image delete] [begin image insert]

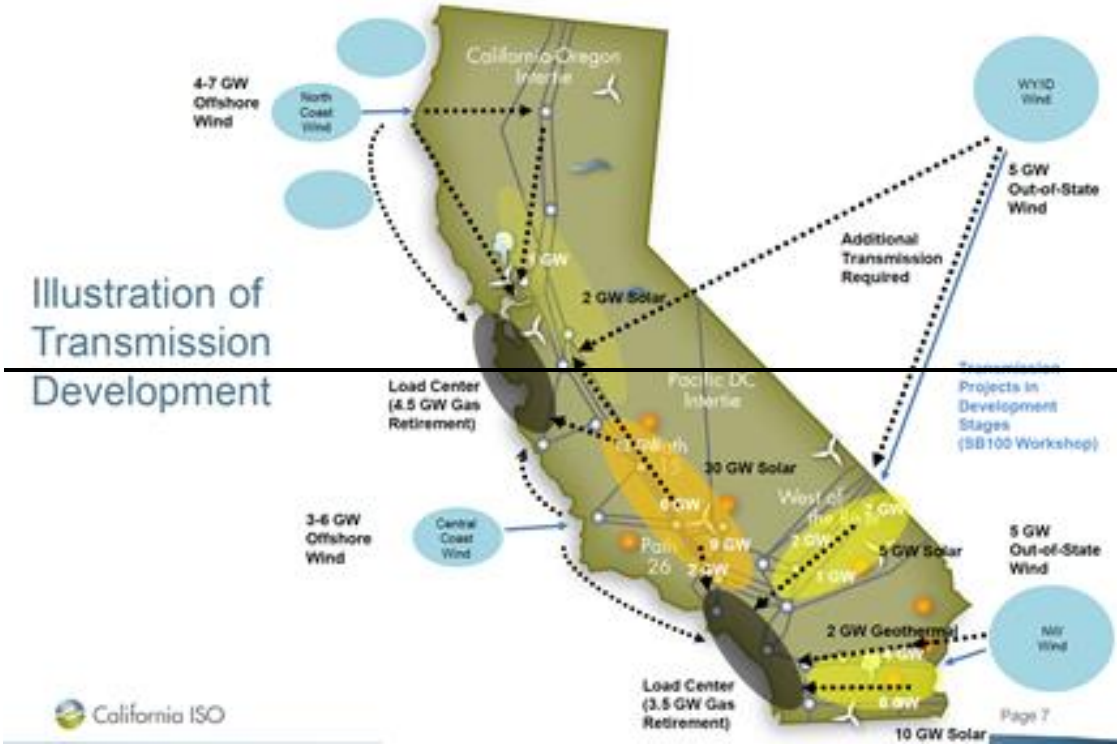
[end image insert]

Source: Homeland Infrastructure Foundation Level Database, CEC staff

Transmission Proposals in the Western Region

The California ISO's *20-Year Transmission Outlook*116 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 (bst) ~~18~~ (est) 29 is the California ISO's illustrative look at resource areas and the associated transmission identified in its *20-Year Transmission Outlook.*

Figure 29: California ISO's Illustrative Transmission Needs From California ISO 20-Year Outlook



116 California ISO (bst) , ~~20-Year Transmission Outlook.~~ (est). May 2022. (bbu) ***20-Year Transmission Outlook,*** (ebu) http://www.caiso.com/InitiativeDocuments/20-YearTransmissionOutlook-May2022.pdf.

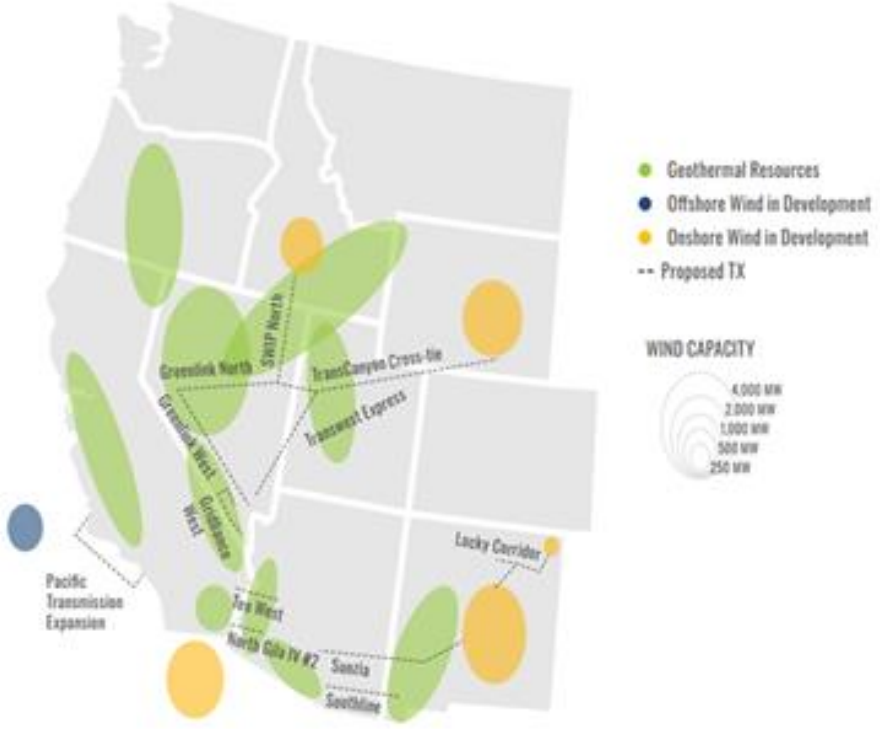
~~Credit~~

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

(bst) ~~With regard to~~ (est) Regarding 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~~30 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. (bbu) **The SPTO model may prove attractive to transmission developers as California advances its offshore wind resources and further integrates its abundant renewable energy portfolio into the system operations and planning efforts of the WI.** (ebu)

Figure 30: Resources Areas and Proposed Transmission Projects



(bst) ~~Credit~~ (est) (bbu) **Source** (ebu): Resolving interconnection Queue Logjams, Grid Strategies LLC for the California ISO, October 2021, Figure 9.

Transmission Summary

California will require significant investment in (bst) ~~both~~ (est) 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.

(bbu) **Engaging Western Leaders on the Three Pillars of System Integration: Markets, Resource Adequacy, and Transmission**

The CEC hosted a workshop on western electricity market integration December 2, 2022. The workshop was attended by all CPUC and CEC commissioners, the CEO of the California ISO, chair of CARB, and leaders of several other western states. The discussion explored the three pillars of electricity system integration — markets, resource adequacy, and transmission. The workshop also included an update on the California Legislature's request for the California ISO to provide a summary of recent studies on the impacts of expanded regional cooperation. Highlights of the workshop, including key takeaways warranting consideration in 2023, are summarized below.

Pillar 1: Essential Role of Markets

Discussion of this first pillar illuminated the benefits and status of existing and emerging western markets, laying a foundation describing various types of markets, including services and common categories of benefits that derive from market options (Table 6). Many facets warrant further consideration, but a key takeaway is that incremental, voluntary energy imbalance market approaches have proven successful in achieving participation and saving $3.4 billion cumulative over eight years.[117] Expansion of existing markets to offer day-ahead services could save up to $1.2 billion per year more; a full western RTO could offer further benefits in the range of $1.4 billion to $2 billion. An analysis by the consulting firm Energy Strategies[118] concludes that WECC-wide day-ahead markets could achieve 78 percent of the operational efficiencies of a full RTO. These valuable operational efficiencies have also saved more than 790,000 metric tons of GHG emissions.[119]

Table 6: Energy Market Services From Varied Approaches to Organized Markets

Market Service	Bilateral Market	Real-Time Market	Day-Ahead Market	RTO
Centrally Optimized Dispatch	No central optimization.	Real-time dispatch is centrally optimized, day-ahead is not.	Real-time AND day-ahead dispatch are centrally optimized.	Same as for day-ahead market.
Transmission Available to Market	Transmission rights required for all transactions.	Some or all capacity could be available depending on market design.	Same as for real-time market.	Transmission capacity available up to reliability limit.
Transmission Planning	Local planning by transmission providers. Regional planning and interregional	Same as bilateral market.	Same as bilateral market.	Transmission planning by RTO, some lower voltage transmission

(bbu) **117 California ISO. January 31, 2023. Western Energy Imbalance Market Benefits Fourth Quarter 2022. https://www.westerneim.com/Documents/iso-western-energy-imbalance-market-benefits-report-q4-2022.pdf.**

118 Keegan Moyer. Essential Role of Markets. Presentation on December 2, 2022. https://efiling.energy.ca.gov/GetDocument.aspx?tn=247865.

119 California ISO. January 31, 2023. Western Energy Imbalance Market Benefits Fourth Quarter 2022. https://www.westerneim.com/Documents/iso-western-energy-imbalance-market-benefits-report-q4-2022.pdf.

Market Service	Bilateral Market	Real-Time Market	Day-Ahead Market	RTO
	coordination under Order 1000 remain.			planning remains at the local level.
Reliability Obligations & Balancing Authority Boundaries	Balancing authorities are retained and have primary reliability obligations.	Same as bilateral market.	Same as bilateral market.	RTO has primary reliability obligations. Balancing authorities are consolidated.
Resource Adequacy	Addressed by individual regulators, no market requirement.	Market addresses intra-hour resource sufficiency, does not impact long-term resource adequacy.	Market addresses day-ahead resource adequacy. Could impact long-term resource adequacy planning.	Market can include its own longer-term resource adequacy requirements.
Transparent Access to Information	Very little access to information.	Transparent access to pricing information for real time transactions and transmission.	Same as real-time market + access to information on day-ahead transactions.	Same as day-ahead market.

Note: The green shading indicates services that have been realized as of the end of 2022. Yellow shading indicates services that have partially been realized for that market structure as of the end of 2022.

Source: CEC staff modification of figure presented by Keegan Moyer from Energy Strategies at the December 2, 2022, IEPR Commissioner Workshop on Western Electricity System Integration. page 5. https://efiling.energy.ca.gov/GetDocument.aspx?tn=247865.

The EDAM, being developed by the California ISO, builds upon the proven ability of WEIM to increase regional coordination, support state policy goals, and meet demand cost-effectively. The design will also support the rapidly evolving western resource adequacy landscape. Benefit estimates for EDAM, *incremental to WEIM*, suggest potential savings for California of more than $300 million *annually* and more than $880 million *annually* for the larger West. EDAM is planned to go live in late 2024, which will be closely coordinated with entities indicating their intent to participate in that time frame. With consensus on a hybrid governance approach of

shared authority, PacifiCorp, on behalf of its subsidiary utilities in six western states, announced it is joining EDAM.[120]

While governance has been addressed for EDAM, panelist Spencer Grey with the Northwest & Intermountain Power Producers Coalition emphasized that moving to more extensive engagement at ISO or RTO levels will require governance changes.[121] The CEC concurs that a thoughtful revisiting of a range of governance approaches that could require legislative intervention will be warranted if western states and utilities propose to join a broader regional organization. Also, as EDAM moves forward, it is prudent to continue to assess the impacts of EDAM on various jurisdictions, customer segments, and communities as suggested by the Los Angeles Department of Water and Power.[122] CEC staff can collaborate on such work if led by affected utilities.

On the eastern side of the interconnection, a non-WI entity – Southwest Power Pool (SPP) – has implemented the Western Energy Imbalance Service (WEIS) Markets+. SPP has 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 Powerex and some Arizona and Nevada utilities. If substantial financial commitments are received, market development will proceed to two phases with launch estimated in 2026. SPP's aggressive business development strategy reflects a broad vision of integration over the West. In this vision, WEIM and WEIS would be replaced by Markets+ and "SPP West" an RTO that would include a consolidated

---

120 PacifiCorp. December 8, 2022. "PacifiCorp to Build on Success of Real-Time Energy Market Innovation as First to Sign on to New Western Day-Ahead Market," https://www.pacificorp.com/about/newsroom/news-releases/EDAM-innovative-efforts.html.

California ISO. December 8, 2022. "California ISO Welcomes PacifiCorp's Announcement to Participate in the Extended Day-Ahead Market," http://www.caiso.com/Documents/california-iso-welcomes-pacificorps-announcement-to-participate-in-the-extended-day-ahead-market.pdf.

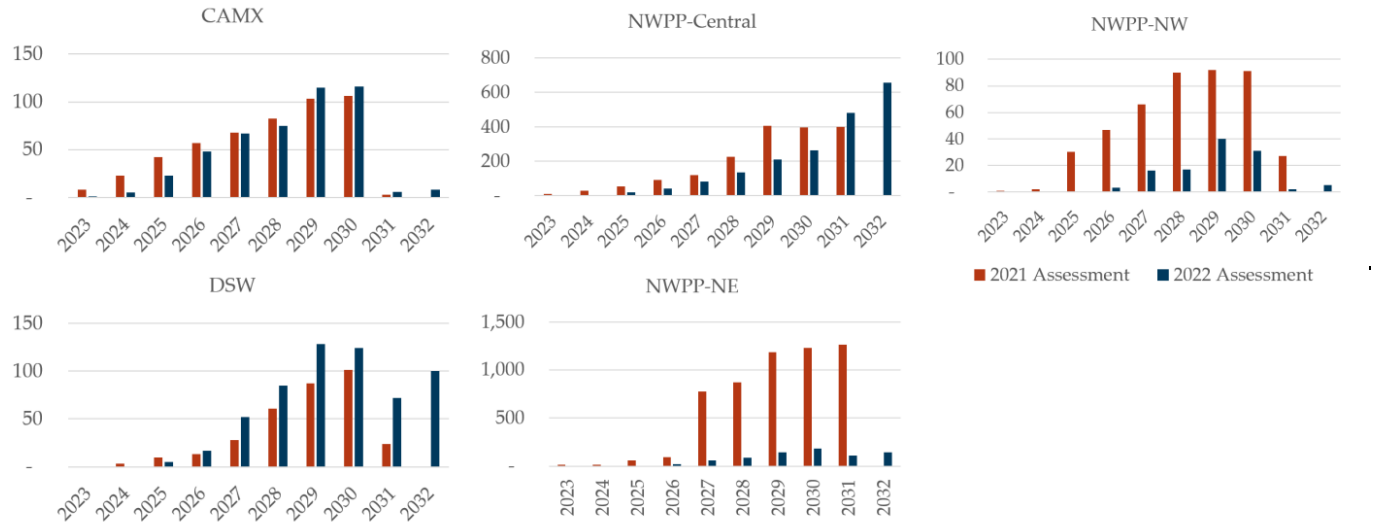
121 Remarks by Spencer Grey with Northwest & Intermountain Power Producers Coalition at the December 2, 2022, IEPR Commissioner Workshop on Western Electricity System Integration. https://energy.zoom.us/rec/share/7dpGPKSe1T47OIqTQwgtuz3GTTtvna9EA8K0rgHVldknSp8EguowT_NqfHN2A5jU.71GPcHu1jRT5jC1n.

122 LADWP. Simon Zewdu. December 23, 2022. Comments from the Los Angeles Department of Water and Power to the California Energy Commission on the December 2, 2022, IEPR Commissioner Workshop on Western Electricity System Integration. https://efiling.energy.ca.gov/GetDocument.aspx?tn=248221.

BA, regional planning, and unit commitment/dispatch. Nine entities on the east side of the WI are SPP West prospective members.

Pillar 2: Resource Adequacy as the Foundation
Discussion of the second pillar of integration, resource adequacy, revealed that western subregions must add large increments of resources of a magnitude and at a rate never experienced in history. The interconnection is underresourced and faces continuing risk of unserved load. To maintain traditional levels of reliability, 40 GW is needed this decade and as much as 100 GW if full electrification of transport and buildings is to be implemented. WECC's 2022 Western Assessment of Resource Adequacy (WARA) raised additional concerns about the increased variability associated with changing loads and an increase in resource types. The combination of these two factors is increasing the uncertainty and range of planning outcomes, resulting in many hours of potential "demand at risk" in the WI. The WARA projects that the number of hours at risk of unserved load will grow through 2030 (Figure 31).

Figure 31: Challenges in the West: Subregional Demand-at-Risk Results



Note: The scales of figures for subregions vary. Shown are the demand risk indicators, in total hours at risk, for the following subregions of the WARA: California-Mexico (CAMX); Desert Southwest (DSW); and Northwest Power Pool Central (NWPP-Central), Northwest (NWPP-NW), and Northeast (NWPP-NE).

Source: Branden Sudduth. Presentation at the December 2, 2022, IEPR Commissioner Workshop on Western Electricity System Integration. "Western Assessment of Resource Adequacy and NERC Winter Reliability Assessment." Slide number 6. https://efiling.energy.ca.gov/GetDocument.aspx?tn=247876.

Western Power Pool CEO Sarah Edmonds noted that WRAP will help address the interconnection adequacy challenge by increasing collaboration, taking advantage of operating efficiencies, and sharing resources.

WRAP has attracted dozens of participants. It will require entities making a forward showing to demonstrate that they own or have acquired rights to adequate resources to meet their expected loads plus a planning reserve. The WRAP program operator then directs and oversees sharing among WRAP participants in shortages and times of system stress (caused by extreme weather, outages, or underperformance of variable resources like solar and wind). Recognizing the changing regional landscape, WRAP will arm participants and the region with guidance and modeling to ensure the transition can be made while maintaining reliability standards. The diversity and dispatch efficiencies of the large footprint will enable economic savings and a lower planning reserve margin when planned collectively, than if done stand-alone. One implication could be that those not part of WRAP may have less access to resources historically available to be shared.

A final critical takeaway for adequacy is that new firm,[123] low-carbon resources will be necessary to support reliability as states move away from fossil generation. California will still need more than 30 GW of firm capacity to maintain resource adequacy even after adding hundreds of GW of wind, solar, and batteries. Five candidates for clean firm capacity were (1) enhanced geothermal, (2) small modular nuclear reactors, (3) fossil generation with carbon capture and sequestration, (4) very long-duration energy storage, and (5) clean fuels such as renewable gas (including hydrogen).[124] Energy+Environmental Economics (E3) analysis showed it could be twice as expensive to achieve carbon reduction goals unless clean, firm resource investment is made and technologies deployed (Figure 32).[125]

---

123 Firm energy resources are those that can run at any time.

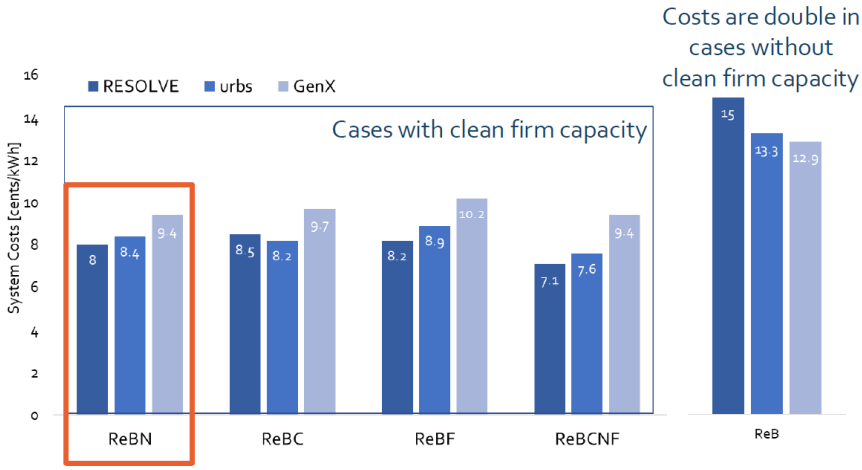
124 *Enhanced geothermal resources* generate electricity without the need for the natural convective hydrothermal resources typical of traditional geothermal resources. *Carbon capture and sequestration technologies* attempt to remove carbon dioxide after combustion of fuels used by certain electric generators before the GHG enters the atmosphere; this removed carbon is then stored. *Renewable gas* is a type of synthetic gas (or substitute gas) which has been produced primarily by anaerobic digestion or thermal gasification processes applied to organic matter.

125 Olson, Arne. Presentation December 2, 2022. "Maintaining Resource Adequacy on a Changing Electricity System," https://efiling.energy.ca.gov/GetDocument.aspx?tn=247875.

Figure 32: The Pressing Need for "Clean Firm" Resources

+ Any single clean firm resource (nuclear, gas w/ CCS, hydrogen) can play this role

+ Clean firm resources also complement each other and can achieve the most cost savings when existing in a system together



Study funded by Environmental Defense Fund and Clean Air Task Force with analysis by E3, Stanford and Princeton
https://www.ethree.com/e3-contributes-to-new-study-showing-clean-firm-power-is-key-to-decarbonized-california/

Note: RESOLVE, urbs and Genx refer to the electricity systems analysis software tools respectively from Energy+Environmental Economics, Stanford University and Princeton University. The study scenario naming conventions utilized for the bar chart groupings is as follows: Re - renewable energy, B - battery, N - nuclear, C - combustion with carbon capture, F - clean fuel. For example, the grouping labled ReBCNF represents the inclusion of all available clean firm technologies in the modeling of that scenario.

Source: Arne Olson. Presentation at the December 2, 2022, IEPR Commissioner Workshop on Western Electricity System Integration. "Maintaining Resource Adequacy on a Changing Electricity System." https://efiling.energy.ca.gov/GetDocument.aspx?tn=247875. Slide 9.

Study funded by Environmental Defense Fund and Clean Air Task Force with analysis by E3, Stanford, and Princeton, https://www.ethree.com/e3-contributes-to-new-study-showing-clean-firm-power-is-key-to-decarbonized-california/.

Pillar 3: Transmission the Enabler

Workshop discussion of this third pillar of integration highlighted the pressing need for new WI transmission, the essential ingredient to achieving maximum benefit from other integration pillars. Several presenters noted the need to build transmission to take advantage of resilience through reliance on diversity — resources, loads, weather, time zones, and geography. Interregional transmission planning must be coordinated with resource planning. Related to this is the remarkable diurnal complementarity of wind resources in the SPP region with solar in the southwest portion of the WI. If accessed through a new DC tie across the interconnection boundary, net peak challenges could be reduced. New transmission can achieve this, independent of creation of markets or an RTO.

California Legislature's ACR 188

The workshop agenda also included a report on the California Legislature's request that the California ISO provide the most recent information on organized energy markets and regional transmission organization efforts in California and the West. This information would be used to assess what can be done to realize potential

benefits. The California ISO has engaged the National Renewable Energy Laboratory (NREL) to author the report summarizing relevant studies to be delivered to the California Legislature on February 28, 2023. A California ISO webpage "Exploring Regional Solutions"[126] will ease continuing stakeholder engagement on ACR 188 and other western integration topics.

Concluding Observations and Next Steps

The West has already come far on the integration journey, and initiatives continue to evolve to enhance coordination. The growth in clean energy resource development, initiated by the states and being expanded by the federal Inflation Reduction Act, is resulting in a sea change for the development of clean energy and climate action. The 10-year extension of tax credits for clean energy, storage, and other technologies is crucial. The authority given to federal agencies to partner with states and utilities to build new transmission lines can be relied on to transform western grid options. Continuing rollout of western markets will best succeed when existing frameworks are used as the foundation. With intent to collaborate and attention to consensus, a voluntary day-ahead market will be functioning in early 2024, with a second potentially in 2026, and WRAP will be implemented.

The energy transitions the nation is undertaking require out-of-the-box and beyond-the-boundaries thinking not previously envisioned in the West. By engaging in passionate, focused, and intentional dialogue, the West can achieve far more together than would be possible if each state or utility acted on its own. The *three C's* — coordination, collaboration, consensus — can be the basis for exploring and selecting next steps on western integration. Options to be pursued in concert with leadership of all western states, California ISO, SPP, and interested utilities include:

- **Enhance collaboration among western states with a goal of cooperatively identifying potential "western next steps" on integration. Increase staffing at all levels (technical and policy) and support options for other states to build technical capability.**
- **Focus on understanding the implications of boundaries among markets and adequacy programs and identify solutions to the challenges revealed.**
- **In partnership with interested states, propose and seek funding for a seminar series hosted by an existing independent forum to further explore the three**

---

126 California ISO webpage. http://www.caiso.com/informed/Pages/RegionalSolutions.aspx. (ebu)

pillars of integration. These pillars would serve the purpose of seeking more depth and breadth of understanding of technical, policy, and planning questions.

- **Establish a partnership for United States Department of Energy (U.S. DOE) and state research and development investment, with the objective of bringing two clean, firm generation technology/fuels into commercial deployment by 2030–2035, to enhance reliability across the interconnection and implement policy goals at lower cost.**
- **Pursue detailed review of U.S. DOE and other congressional incentive/funding alternatives to achieve integration benefits; develop project grant proposals co-led by interested western states, including a focus on western transmission coordination and investment.**
- **Continue support for incremental, voluntary day-ahead market approaches that build on initiatives already well into implementation, such as energy imbalance markets and WRAP.**
- **Build on the content of the ACR 188 report to better understand longer-term paths forward and pursue collaborative conversations with interested western states.**
- **Support evaluation of potential opportunity costs of not joining regional wholesale markets.**
- **Monitor and engage in discussions of the Western Energy Industry Leaders and the Western Markets Exploration Group at appropriate times.** (ebu)

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(bbu) **for California** (ebu), including pursuit of a California Hydrogen Hub (bst)~~, that will shape~~ (est). (bbu) **Hydrogen is a quickly evolving topic, and this section intends to reflect** (ebu) the (bst) ~~state's~~ (est) (bbu) **current state of play in terms of CEC activities supporting the**

use of hydrogen ~~future.~~**in decarbonization[127] and the role of hydrogen in the scoping plan scenario of the *2022 Scoping Plan Update*.** (ebu)

Hydrogen Use in California and the United States (bbu)~~is~~ (ebu) 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 (bst) ~~U.S.~~ (est) United States is estimated at around 10 million metric tons per year (MMT/yr), with variance depending on the source and inclusion of by-product hydrogen.[128] California is estimated to produce 1.05 MMT/yr of hydrogen,[129] or about 10.5 percent of the national capacity, at a combination of petroleum refineries and merchant hydrogen production plants. (bbu) **Almost all this hydrogen production uses**

(bbu) **127 *Decarbonization* refers to the reduction of carbon dioxide emissions from a process like generating energy.** (ebu)

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

129 (bst) ~~CEC staff calculation. Used Documentation of California's 2000-2019 GHG Inventory~~ (est) (bbu) **CEC staff calculation. Used Documentation of California's 2000–2019 GHG Inventory,** (ebu) 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 (bst) ~~natural~~ (est) (bbu) **fossil** (ebu) 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.

fossil fuels as a feedstock, as discussed below, and is referred to as *fossil* hydrogen in this report.[130] (ebu)

Most (bbu) **fossil** (ebu) 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.[131] 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.[132] California largely imports ammonia fertilizer and has an insignificant amount of in-state ammonia production, as shown in Figure (bst) ~~20~~ (est) 33, 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 California was on average dispensing nearly 7 tons of hydrogen per day, which translates to 2, (bst) ~~500~~ (est) 600 tons per year or about 0.2 percent of total in-state production.[133]

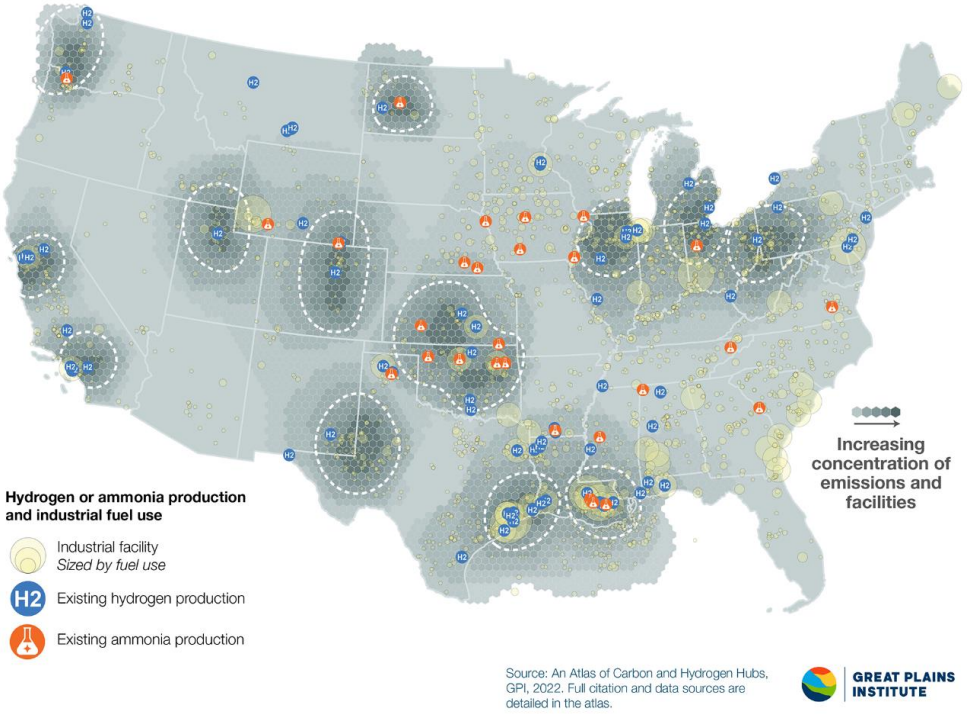
(bbu) **130 For this IEPR, the term *fossil* hydrogen refers to hydrogen produced from fossil fuels as a feedstock, which is the vast majority of production to date. *Low-carbon* hydrogen refers to hydrogen produced from non-fossil fuel feedstocks. References simply to *hydrogen* are nonspecific.** (ebu)

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

132 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.

133 (bst) ~~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).~~ (est) (bbu) **Berner, Jane, Miki Crowell, and Andrew Martinez. 2022. *Joint Agency Staff Report on Assembly Bill 8: 2022 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-600-2022-064. Dispensing data presented in Figure 5, page 16. https://www.energy.ca.gov/sites/default/files/2022-12/CEC-600-2022-064.pdf.** (ebu)

Figure (bbu) 33: 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 (bbu) **is nearly entirely fossil fuel-based and** (ebu) results in 10.4 MMT carbon dioxide equivalent ($MMTCO_2e$) of in-state emissions annually, about 2. (bst) ~~5~~ (est) (bbu) **6** (ebu) percent of California's total GHG emissions.[134] Emissions from fossil gas production and transmission to support hydrogen

134 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 (bst) ~~, Product-Based Benchmarks in the Cap-and-Trade Regulation (March 2014),~~(est). (bbu) **Appendix A: Additions and Amendments to Product-Based Benchmarks in the Cap-and-Trade Regulation (March 2014).** (ebu) https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2013/capandtrade13/2appabenchmarks.pdf.

Using (bst) ~~total~~ (est) the average of (bst) ~~418.2 $MMTCO_2e$ for~~ (est) California's total GHG emissions of 410.6 $MMTCO_2e$ in 2017, 411.0 $MMTCO_2e$ in 2018, and 404.5 $MMTCO_2e$ in 2019, from California Air Resources Board. (bst) ~~2000-2019 GHG Inventory (2021~~ (est) (bbu) **2000–2020 GHG Emissions Trends Report Data (2022**

production in California (about 1.2 MMTCO_2e/yr[135]) and emissions associated with imported ammonia fertilizer produced from hydrogen ((bst) ~~about~~ (est) at least 2 MMTCO_2e/yr[136]) 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. (bst) ~~The~~ (est) (bbu) **Today, the** (ebu) source of methane is almost exclusively from fossil gas. Emission reductions can be achieved by directly producing low-carbon hydrogen from biomethane using SMR, (bbu) **using biomass gasification** (ebu)or (bst) ~~by~~ (est) (bbu) **pyrolysis, or** (ebu) using renewable or zero-carbon electricity to make (bbu) **low-carbon** (ebu) hydrogen using electrolysis that (bst) ~~result~~ (est) results in zero or minimal fossil GHG emissions. Emissions reductions are also possible by capturing and sequestering carbon emissions.

In passing Assembly Bill 1279 (bst) ~~(Muratsuchi, Chapter 337, Statutes of 2022)~~ (est) in August 2022, the California Legislature set targets to achieve statewide carbon neutrality no later than 2045 and (bst) ~~to~~ (est) ensure anthropogenic (bbu) **, or human-made,** (ebu) 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

---

Edition). https://ww2.arb.ca.gov/sites/default/files/classic/cc/inventory/2000-2020 (ebu)_ghg-_inventory (bst)~~-data~~(est) (bbu)_**trends_figures.xlsx**. (ebu)

135 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 (bst) ~~CARB GHG Global Warming Potentials,~~ (est) (bbu) **"CARB GHG Global Warming Potentials,"** (ebu) https://ww2.arb.ca.gov/ghg-gwps.

136 Using 589,524 MT N/yr total fertilizer use in California for 2017 from (bst) ~~CARB Emission Inventory Methodology for Soil Nitrogen Oxides.~~ (est) (bbu) **"CARB Emission Inventory Methodology for Soil Nitrogen Oxides."** (ebu) 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. (bst) "~~Life Cycle Energy Use and Greenhouse Gas Emissions of Ammonia Production From Renewable Resources and Industrial By-Products~~" (est) 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.

(bbu) **Emissions associated with out-of-state methane and hydrogen leakage, and ammonia transport not included.** (ebu)

359, Statutes of 2022) in August 2022, giving CARB significant authority to establish a (bst) ~~Carbon Capture, Removal, Utilization, and Storage Program~~ (est) (bbu) **carbon capture, removal, utilization, and storage program.** (ebu)

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 ((bst) ~~Table 5)~~ (est) (bbu) **for example, "green hydrogen" and "gray hydrogen")** (ebu) but has limitations. There is a lack of consistent understanding in — and use of — colors to describe hydrogen. For instance, (bst) ~~another color chart lists black hydrogen in the same category as gray hydrogen[137] and~~ (est) green hydrogen can (bbu) **mean hydrogen produced via electrolysis using renewable hydrogen, but it can also** (ebu) encompass more than (bst) ~~just electrolysis of renewables~~ (est) that, as is the case in the (bst) ~~draft~~ (est) *2022 Scoping Plan Update.*[138] (bst) ~~Established production methods, such as using biomass as feedstock in SMR and gasification, are missing from~~ (est) An internet search of "the colors (bst) ~~shown, while other methods not very relevant to California, such as production using coal as~~ (est) (bbu) **of hydrogen" returns** (ebu) a (bst) ~~feedstock, are represented in the~~ (est) (bbu) **variety of color charts, some with more colors than others, and many not including all production pathways.** (ebu) The color scheme provides only a high-level insight into the relative benefits of using one color of hydrogen over another.

(bst) ~~137 North American Council for Freight Efficiency. December 2020. "Hydrogen Color Spectrum." https://nacfe.org/news/nacfe-december-2020-newsletter/.~~ (est)

138 (bst) ~~California Air Resources Board. May 10~~ (est) CARB. November 16, 2022. (bst) ~~*Draft 2022 Scoping Plan Update.*~~ (est) (bbu) ***2022 Scoping Plan for Achieving Carbon Neutrality.*** **"**(ebu) Green hydrogen**,** (bbu) **" for the purposes of the Scoping Plan, is** (ebu) defined (bst) ~~in Executive Summary,~~ (est) (bbu) **on** (ebu) page (bst) ~~i.~~ (est) **26 as interchangeable with "renewable hydrogen" and not limited to only electrolytic hydrogen produced from renewables. https://ww2.arb.ca.gov/sites/default/files/2022-** (ebu) (bst) ~~05~~ (est) (bbu) **12** (ebu) /2022-(bst) ~~draft~~ (est)sp.pdf.

(bst)~~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.~~ (est)

Several solutions could clarify hydrogen terminology. (bst) ~~The colors~~ (est) A standard color scheme could (bst) ~~be further defined~~ (est) (bbu) **identify all pathways and include information on GHG emissions** (ebu) to enable consistency and transparency in accounting for GHG reductions. (bst) ~~For instance, the 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."[139]~~ (est) 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

~~139 Green Hydrogen Coalition. "Green Hydrogen." https://www.ghcoalition.org/green-hydrogen.~~

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.[140]

Given the competing definitions and variety of naming conventions for hydrogen, CEC staff (bst) ~~continue~~ (est) (bbu) **continues** (ebu) 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.

(bbu) **While the best descriptor to use (green, clean, renewable, and so forth) for low-carbon hydrogen remains uncertain, public comments submitted on the *Draft 2022 IEPR Update* suggest broad consensus on discarding the color scheme and instead focusing on carbon intensity.[141] Using carbon intensity would entail tracking the GHG emissions throughout the entire life cycle of the hydrogen, from production through consumption.** (ebu) Further, there is a need to better(bst) ~~track and~~ (est) understand (bst) ~~direct emissions of hydrogen (for example, due to leaks), their global warming impact, and mitigation measures to assess more accurately the~~ (est) (bbu) **hydrogen leakage (which can undermine its climate benefits) and the** (ebu) potential (bst) ~~environmental, health, and safety~~ (est) for air quality impacts (bst) ~~of~~ (est) from some hydrogen (bst) ~~use. Hydrogen released~~ (est)(bbu) **production pathways and hydrogen combustion.**

Being such a small and light molecule, hydrogen can escape (ebu) into the atmosphere, either through leaks during storage and transport or unburned in a power plant (bst) ~~) is~~ (est) (bbu) **. Fugitive hydrogen molecules are** (ebu) 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

140 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.

(bbu) **141 Comments received from Air Products, SoCalGas, Green Hydrogen Coalition, California Hydrogen Coalition, and California Hydrogen Business Council (on the Draft 2022 IEPR Update) were supportive of a life-cycle carbon intensity approach. https://www.energy.ca.gov/data-reports/reports/integrated-energy-policy-report/2022-integrated-energy-policy-report-update-1.** (ebu)

(both potent greenhouse gases) and stratospheric cooling (also contributing to global warming).[142]

(bst) ~~The 20-year~~ (est) (bbu) **A multi-institution study using a state-of-the-art global numerical model calculated the 100-year** (ebu) global warming potential (GWP) for hydrogen (bst) ~~is estimated~~ (est) ~~at~~ (bst) ~~about 33~~ (est) 12.8 ± 5.2 and the (bst) ~~100~~ (est) 20-year GWP at (bst) ~~11.~~ (est) (bbu) **40.1 ± 24.1. (The climate impact of hydrogen is indirect and subject to larger uncertainties than direct impacts from other greenhouse gases.)** (bbu)[143] 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 miles of hydrogen-dedicated pipeline in 2021 (bst) ~~144~~ (est) and transporting hydrogen from production sites near renewable solar, wind, and biowaste (bst) ~~sources~~ (est) (bbu) **resources** (ebu) will require additional pipelines or transport via trucks or trains. While investing in (bbu) **low-carbon** (ebu) hydrogen production, storage, and transport infrastructure, the state must appropriately measure (bst) ~~and~~ (est), monitor (bbu)**, and reduce** (ebu) 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 (bbu) **(classification)** (ebu) 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 low-carbon hydrogen is provided here, (bst) ~~SB~~ (est) (bbu) **Senate Bill** (ebu) 1075 (Skinner, Chapter 363, Statutes of 2022) requires CARB, in consultation with the CEC and

142 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.

143 (bst) ~~Ibid.~~(est) (bbu) **Hauglustaine, D., F. Paulot, W. Collins, R. Derwent, M. Sand, and O. Boucher. 2022. "Climate Benefit of a Future Hydrogen Economy." *Communications Earth & Environment*, 3:295. https://doi.org/10.1038/s43247-022-00626-z.** (ebu)

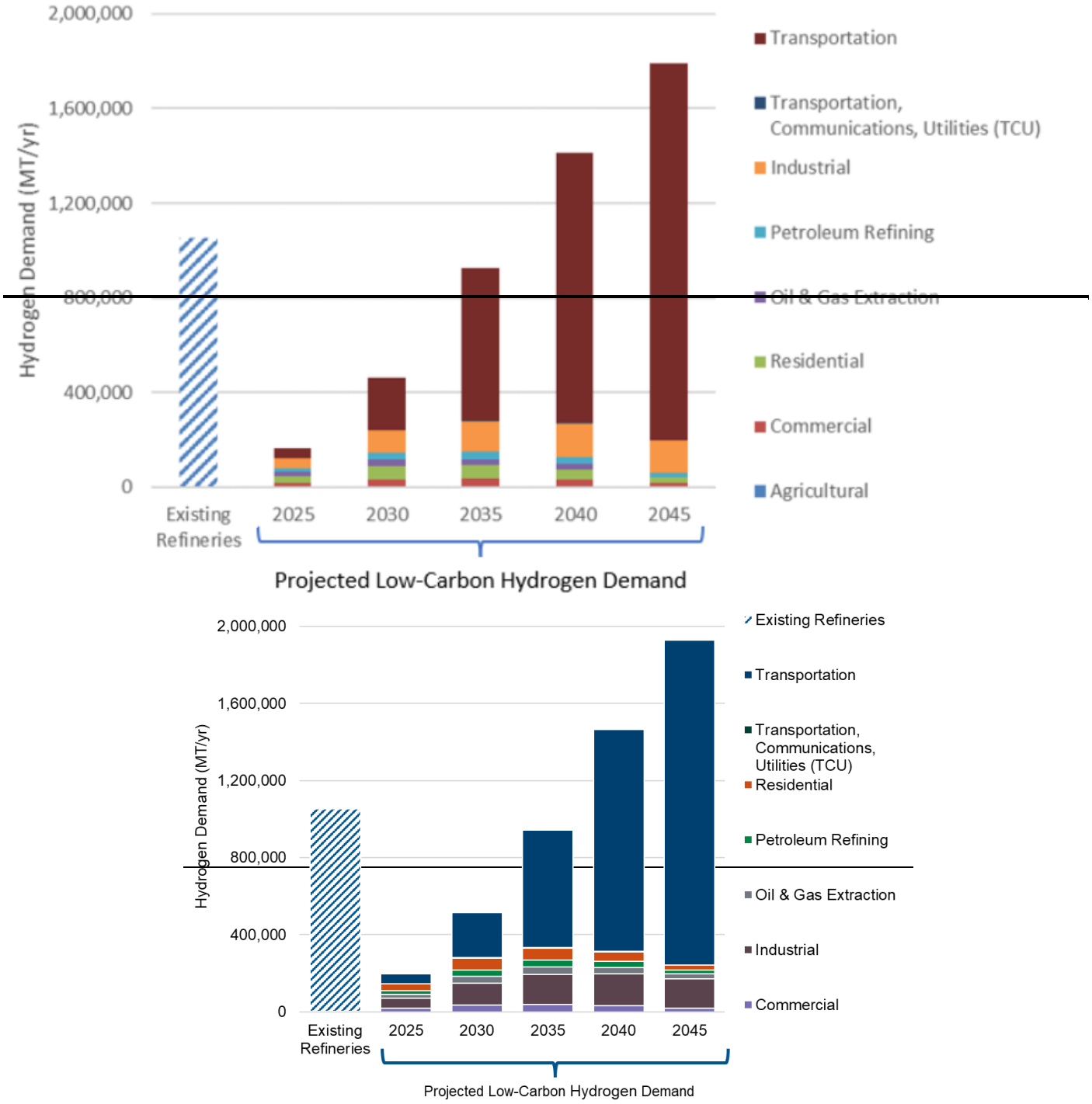
(bst) ~~144 Pipeline and Hazardous Materials Safety Administration (PHMSA), "Gas Distribution, Gas Gathering, Gas Transmission, Hazardous Liquids, Liquefied Natural Gas (LNG), and Underground Natural Gas Storage (UNGS) Annual Report Data," Form 7100.2-1 Part H operator filings database, 2021 (as of October 3, 2022), https://www.phmsa.dot.gov/data-and-statistics/pipeline/gas-distribution-gas-gathering-gas-transmission-hazardous-liquids.~~ (est)

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 (bst) ~~its~~ (est) (bbu) **the** (ebu) role (bbu) **of hydrogen** (ebu) in decarbonizing the electrical and transportation sectors as part of the 2023 and 2025 IEPRs.

As part of its (bst) ~~*Draft*~~ (est) *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 (bst) ~~70 percent more than~~ (est) (bbu) **two times the** (ebu) current levels of fossil (bst) ~~fuel-based~~ (est) hydrogen (Figure 34) — or a (bst) ~~60~~ (est) 1,700-fold increase in existing low-carbon (bst) ~~production in California (Figure 21).~~ (est) (bbu) **supply. (bbu)** [145] Cleaning up the SMR-produced (bbu) **, fossil** (ebu) hydrogen used today at refineries can have a large emissions reduction impact in the near- term (bst) ~~due to~~ (est) (bbu) **because of** (ebu) the scale of established demand. Emerging end uses will take time to scale- up, but beyond 2035, they may dominate statewide hydrogen demand.

145 (bst) ~~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.~~ (est) (bbu) **California Air Resources Board. November 16, 2022. *2022 Scoping Plan for Achieving Carbon Neutrality,* p. 9. https://ww2.arb.ca.gov/sites/default/files/2022-12/2022-sp.pdf.** (ebu)

Figure 34: 2022 Draft Scoping Plan Proposed Scenario — Modeled Hydrogen Demand Growth by Sector



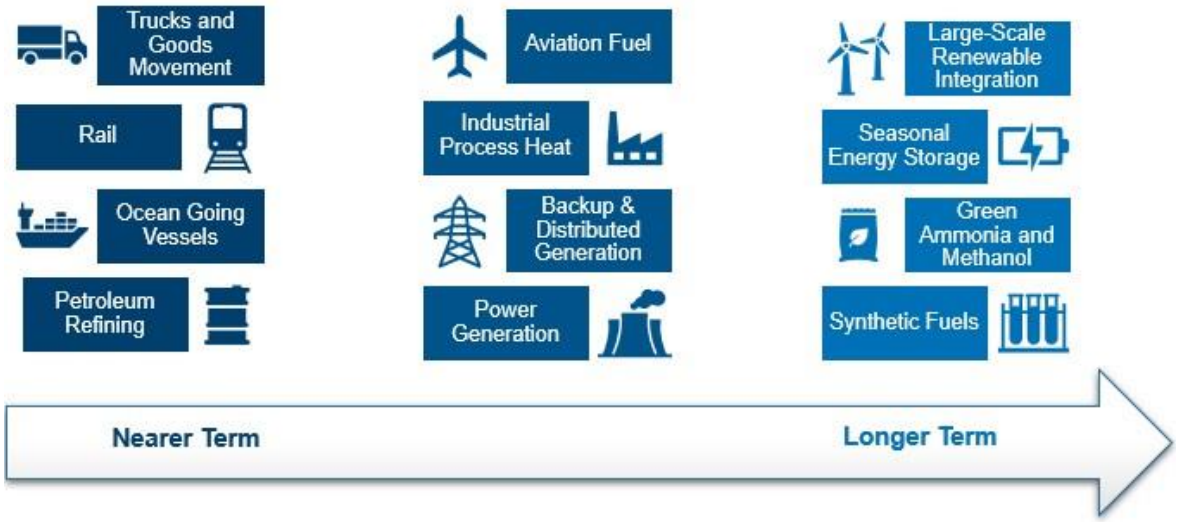
Note: Staff assumed 1.05 MMT/yr demand at existing refineries, met by fossil-derived hydrogen, based on a calculation of annual hydrogen production in California (2017-2019), almost all of which is used in refineries.

(bst) ~~Credit~~ (est) Source: CEC staff using data from the (bst) ~~draft *2022Scoping*~~ (est) (bbu) ***2022 Scoping*** (ebu)*Plan Update* – (bst) ~~AB 32 GHG Inventory Sectors Modeling Data Spreadsheet~~ (est) (bbu) **AB 32 GHG Inventory Sectors Modeling Data Spreadsheet,**

https://ww2.arb.ca.gov/sites/default/files/2022-11/2022-sp-PATHWAYS-data-E3.xlsx, Energy Demand worksheet, (ebu) for (bst) ~~2025-2045 low-carbon~~ (est) hydrogen (bst) ~~demand~~ (est) by sector in the (bst) ~~Proposed~~ (est) (bbu) **Scoping Plan** (ebu) Scenario.

Hard-to-electrify transportation and industrial processes and grid reliability are key areas with a high potential for increased (bbu) **use of low-carbon** (ebu) hydrogen (bst) ~~use~~ (est), which is broadly consistent with hydrogen growth modeled in the ~~draft~~ *2022 Scoping Plan Update*.[146] These and other opportunities are shown in Figure (bst) ~~22~~ (est) 35.

Figure 35 (ebu): Simplified Representation of Nearer and Longer-Term Opportunities for Hydrogen Decarbonization



(bst) ~~Credit~~ (est) (bbu) **Source** (ebu): 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 (bst)~~cells,~~ (est) (bbu) **cell electric vehicles (FCEVs),** (ebu) including transit buses and long-haul trucks.

146 In the (bst) ~~draft~~ (est) *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.

(bst) ~~Hydrogen fuel cell electric vehicles (FCEVs)~~ (est) (bbu) **FCEVs** (ebu) 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 (bst) ~~rare-earth~~ (est) (bbu) **precious** (ebu) metals like platinum used in production, they do not have the same reliance on cobalt,(bbu) **nickel,** (ebu) and lithium that are challenges in battery production, and they (est) ~~also~~ (bst) have fewer challenges in disposal and recycling.[147] On the other hand, BEVs have certain advantages over FCEVs. BEVs are the least expensive ZEVs available in terms of unsubsidized costs~~.~~ (bbu)**, although this could change over time.** (ebu) While refueling takes longer, recharging infrastructure can be more convenient (bbu) **(for example, at home)** (ebu) than hydrogen refueling stations. (bst) ~~Using electricity to power vehicles using a battery is a more efficient process than converting energy first to hydrogen~~ (est) (bbu) **These relative advantages** (ebu) and (bst) ~~then to electricity.~~ (est) 9bbu) **disadvantages reflect the complexity of determining the "best" zero-emission technology for each transportation use case.** (ebu)

(bst) ~~A comparison of making~~ (est) (bbu) **Using electricity to power vehicles using a battery is generally a more efficient process than converting energy first to hydrogen and then to electricity, although this efficiency varies when considering other factors such as ambient temperature (for example, fuel cells maintain charge better than batteries in cold conditions). All other factors being equal, a comparison of making low-carbon** (ebu) hydrogen from electrolysis and using it in an FCEV with using electricity to charge a battery in a BEV found the BEV to be (bst) ~~approximately~~ (est) (bbu) **about** (ebu) 2.3 times more energy~~--~~efficient as of 2020, with hydrogen efficiency improving but still about half the efficiency of batteries by 2050.[148] Also, BEV technology has matured and scaled faster than FCEV technology, resulting in many more makes and models of BEVs available in the market. (bst) ~~These competing factors reflect the complexity of determining the "best" zero-emission technology for each transportation use case.~~ (est) (bbu) **FCEVs could still grow in a similar trajectory to that of BEVs, given BEV development had a head start and the ZEV market is still relatively small. Public investment in both ZEV technologies will enable customers to take**

147 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.

148 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/.

advantage of the respective strengths of each technology in particular use cases. (ebu)

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.[149] 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.[150] (bst) ~~Further,~~ (est) (bbu) **California is a leader on the international stage for FCEV support, along with China, Japan, South Korea, and Germany. On a per capita basis, California ranks second after South Korea in terms of total FCEV deployments and third after Japan and South Korea in terms of government funding for public** (ebu) hydrogen (bst) ~~and~~ (est) (bbu) **refueling stations.[151]**

Low-carbon hydrogen and low-carbon (ebu) hydrogen carriers have the potential to power (bbu) **other harder-to-electrify** (ebu) 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.[152]

149 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.

150 (bst) ~~California Energy Commission.~~ (est) CEC. "Zero Emission Vehicle and Infrastructure Statistics." https://www.energy.ca.gov/data-reports/energy-almanac/zero-emission-vehicle-and-infrastructure-statistics.

(bbu) **151 Berner, Jane, Miki Crowell, and Andrew Martinez. 2022. *Joint Agency Staff Report on Assembly Bill 8: 2022 Annual Assessment of Time and Cost Needed to Attain 100 Hydrogen Refueling Stations in California*. CEC and CARB. Publication Number: CEC-600-2022-064. https://www.energy.ca.gov/sites/default/files/2022-12/CEC-600-2022-064.pdf. Pages 44-47.** (ebu)

152 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,[153] and many industrial end-use applications are hard to convert from fossil gas usage to electricity.[154] Heavy industrial processes that use fossil fuels for high-temperature heat could be candidates for the use of (bbu) **low-carbon** (ebu) hydrogen as a replacement, zero-carbon energy source. Such opportunities were discussed in the *2021 IEPR*.[155]

Grid Reliability

(bst) ~~Hydrogen from renewable resources~~ (est) (bbu) **Low-carbon hydrogen** (ebu) 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~~.~~ (bbu) **through repowering targeted ramping resources running off fossil gas with low-carbon hydrogen made from renewable resources.** (ebu) (See prior section of this chapter for more information about reliability.)

A study by (bst) ~~Energy + Environmental Economics (~~(est) E3 (bst~~)~~ (est) found that (bst) ~~by 2050,~~ (est) gas power plants will need to stay on-line (bbu) **at least through 2050** (ebu) 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 (bbu) **low-carbon** (ebu) hydrogen — assuming cost reductions are achieved as predicted by 2050 — would enable expanded repowering with hydrogen.

---

153 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.

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

155 Kenney, Michael, Jacob Wahlgren, Kristina Duloglo, Tiffany Mateo, Danuta Drozdowicz, and Stephanie Bailey. 2022. (bst) ~~Final 2021 Integrated Energy Policy Report, Volume I: Building Decarbonization. California Energy Commission.~~ (est) (bbu) ***Final 2021 Integrated Energy Policy Report, Volume I: Building Decarbonization*. CEC.** (ebu) Publication Number: CEC-100-2021-001-V1. (bbu) **https://efiling.energy.ca.gov/GetDocument.aspx?tn=241599.** (ebu)

Given technology development trends, new engines and turbines will have the ability (bst) ~~for~~ (est) (bbu) **to process** (ebu) higher blends of hydrogen, thus filling the need for dispatchable zero-carbon resources.[156] (bst) ~~Projects~~ (est) (bbu) **Some utilities** (ebu) are already (bst) ~~exploring~~ (est) upgrading gas turbines for hydrogen combustion, including the Los Angeles Department of Water and Power's Intermountain Power Plant project in Utah[157] and the Northern California Power Agency's Northern California Pacific H_2ub project at the Lodi Energy Center (bbu)**, in which the combustion turbine has been fully upgraded to incorporate hydrogen blending capability** (bbu).[158]

Hydrogen can also provide an alternative to batteries to support grid reliability or in fuel cell resources to provide long-duration or seasonal storage. (bbu) **Fuel cells are an opportunity for backup power under the Distributed Electricity Backup Assets Program that the CEC is implementing in accordance with AB 205.** (ebu) 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.[159]

Other Opportunities

Refineries

Low-carbon hydrogen produced from renewable resources and pathways such as electrolysis can be used to displace fossil (bst) ~~derived~~ (est) hydrogen already in use at California refineries. Executive Order N-79-20 calls on state agencies to support the transition of fuel production (bst) ~~facilities~~ (est) (bbu) **plants** (ebu) 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.

---

156 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.

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

158 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.

159 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.

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 (bbu) **low-carbon** (ebu) 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.[160] A third of German refiners are moving toward electrolytic hydrogen production, with 100 MW-scale projects planned for mid-decade operation.[161] While the Shell Rhineland electrolyzer is one of the largest operating in the world, (bst) ~~its~~ (est) 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 (bst) ~~further~~ (est) 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 (bst) ~~derived~~ (est) hydrogen used by refineries with electrolytic hydrogen produced from renewable electricity.[162] 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 low-carbon hydrogen from biomethane using SMR, gasification, or other novel methods of production, as well as employment of CCUS technology (bbu) **coupled with fossil hydrogen** (ebu), 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"[163] derived

160 (bst) ~~Shell. "Hydrogen — What Is It? | Hydrogen Fuel & Projects | Shell Global~~ (est) (bbu) **Shell. "Hydrogen — What Is It? | Hydrogen Fuel & Projects | Shell Global** (ebu)." 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.

161 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.

162 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.

(bbu) **163 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.** (ebu)

from biogas or electricity.[164] However, there have been no applications for LCFS renewable hydrogen refinery credits to date.[165] Despite the opportunity for near-term and large-scale carbon reductions, investments in low- (bst) ~~GHG~~ (est) (bbu) **carbon** (ebu) 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," (bst) ~~166~~ (est) 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[167] and at least 40 percent renewable content across all stations in the company's network registered in the LCFS.[168] 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).[169] 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 Chemicals

Other opportunities include green chemicals (such as ammonia and methanol) and synthetic fuels. (bst) ~~Renewable~~ (est) (bbu) **Low-carbon** (ebu) 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 (bst) ~~20~~) (est) 33), as fossil gas constitutes

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

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

(bst)~~166 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.~~(est)

(bbu) **167 A *joule* is a unit of energy equal to the amount of work done when a force oof 1 newton displaces a mass through the distance of 1 meter in the direction of the force applied. A *megajoule* is the equivalent of 1 million joules.** (ebu)

168 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.

169 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*. (bst) ~~California Energy Commission and California Air Resources Board.~~(est) (bbu) **CEC and CARB.** (ebu) Publication Number: CEC-600-2021-040. https://www.energy.ca.gov/sites/default/files/2021-12/CEC-600-2021-040.pdf. p 21.

about 80 percent of the cost of producing ammonia.[170] Green ammonia produced from (bbu) **low-carbon** (ebu) hydrogen (bst) ~~made from renewable sources~~ (est) 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.[171]

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 (bst) ~~based~~ (est) 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 (bst) ~~carbon capture/storage and utilization.~~ (est) (bbu) **CCUS systems.** (ebu) Further, the state would need to (bst) ~~address leakage and limits to the~~ (est) (bbu) **develop rules for the amount of low-carbon** (ebu) hydrogen (bst) ~~concentration~~ (est) that can be blended in existing gas pipelines or (bst) ~~the need for~~ (est) (bbu) **support** (ebu) dedicated hydrogen pipelines and other distribution and storage infrastructure. (bst) ~~(Leakage is discussed further below in respect~~ (est) (bbu) **Also, hydrogen can extend the lifetime of several greenhouse gases if leaked into the atmosphere, has a higher potential for leakage than methane, and causes steel to become brittle, so it will be important** (ebu) to (bst) ~~the need to standardize the measure of~~ (est) minimize leakage for climate (bst) ~~benefits.) Also, the state will need~~ (est) (bbu)**, safety, and economic reasons. Lastly, it will be important** (ebu) to control (bst) ~~the~~ e (est) missions of oxides of nitrogen from (bst) ~~combusting~~ (est) hydrogen (bbu) **combustion to protect public health** (ebu). Some of these barriers can be addressed by the new (bbu) **low-carbon** (ebu) hydrogen (bbu) **production projects and** (ebu) funding opportunities described below.

New Hydrogen Production Projects

In the past few years, public and private investment has spurred new (bbu) **low-carbon** (ebu) 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

---

170 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.

171 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.

FCEVs. The CEC's Gas Research and Development Program has invested $4 million in hydrogen production research on emerging technologies and pilot-scale demonstrations.[172] Further, the CEC's Clean Transportation Program has invested nearly $17 million in four new (bst) ~~renewable~~ (est) (bbu) **low-carbon** (ebu) hydrogen production plants and an upgrade to an existing plant, with a combined 8,760 metric tons per year of capacity directed toward transportation.[173] Examples of projects to expand (bbu) **low-carbon** (ebu) 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.[174] 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 (bbu) **low-carbon** (ebu) 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.[175] The facility will use two alkaline water 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 (bbu) **low-carbon** (ebu) hydrogen requires investment in the development of the technologies and infrastructure needed for

---

172 (bst) ~~California Energy Commission.~~ (est) (bbu) **CEC.** (ebu) "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.

173 Brecht, Patrick. 2022. *2022–2023 Investment Plan Update for the Clean Transportation Program*. (bst) ~~California Energy Commission.~~ (est) (bbu) **CEC.** (ebu) 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. (bbu) **The Investment Plan Update and the grant funding opportunities for these production plans use "renewable hydrogen" in describing these projects.** (ebu)

174 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.

175 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.

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.[176]

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 low-carbon hydrogen technology development and commercialization.

California is competing for a federal hydrogen RDD&D funding opportunity administered by the U.S. (bst) ~~Department of Energy (U.S.~~ (est) DOE (bst) ~~).~~ (est). The "Regional Clean Hydrogen Hubs" program (bbu) **(also known as *H2Hub*)** (ebu) is offering up to $6– (bbu) **billion–$** (ebu) 7 billion to (bst) ~~six~~ (est) 6 to (bst) ~~ten~~ (est) 10 qualifying applicants (with additional $1– (bbu) **billion–$** (ebu) 2 billion potentially reserved for future H2Hub launches or other supporting activities)[177] and "will create networks of hydrogen producers, consumers, and local connective infrastructure to accelerate the use of hydrogen as a clean energy carrier."[178] The

176 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*. (bst) ~~California Energy Commission and California Air Resources Board.~~ (est) (bbu) **CEC and CARB.** (ebu) 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.

177 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.

178 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.

Governor's Office of Business and Economic Development (GO-Biz) is preparing a competitive application to establish a renewable hydrogen hub in California.[179] 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.[180]

Gasoline Cost Factors and Price Spikes

In 2022, global crude oil prices spiked, resulting in gasoline (bst) ~~prices~~ (est) (bbu) **price** (ebu) 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 (bst) ~~was comprised~~ (est) consisted of six factors, including refinery practices, fees for environmental programs, taxes, oil prices, production costs, and distribution costs. (bst) ~~It is important to note~~ (est) (bbu) **Staff emphasizes** (ebu) that these cost estimates are (bst) ~~only~~ (est) applicable (bbu) **only** (ebu) for (bst) ~~the month of~~ (est) 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 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

179 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. (bst) ~~"California Launches Statewide Alliance to Establish Federally Co-Funded Hydrogen Hub~~ (est) (bbu) **"California Launches Statewide Alliance to Establish Federally Co-Funded Hydrogen Hub California Formally Announces Intention to Create a Renewable Hydrogen Hub."** (ebu) Accessed October 19, 2022. https://business.ca.gov/california-formally-announces-intention-to-create-a-renewable-hydrogen-hub/.

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

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:[181]

- 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.)[182]
- 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).[183]
- 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).

181 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~~ (est) (bbu) **Program** (ebu) were calculated from daily values published by the Oil Price Information Service for (bst) ~~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 (bst) ~~that~~ (est) (bbu)**. The CEC cost estimates** (ebu) are published on the CEC's "Estimated Gasoline Price Breakdown and Margins" website.

182 An approximation of potential impacts from unplanned refinery outages in the California fuels market was calculated by comparing (bst) ~~southern~~ (est) (bbu) **Southern** (ebu) 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.

183 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 (bst) ~~work~~ (est) and staff presentations related to the Petroleum Market Advisory Committee activities.

- Higher distribution costs and retail margins (bst) ~~are another~~ (est), relatively smaller (bst) ~~factor~~ (est) (bbu) **factors** (ebu) (costing an extra 1.7 cents cpg in March 2022).

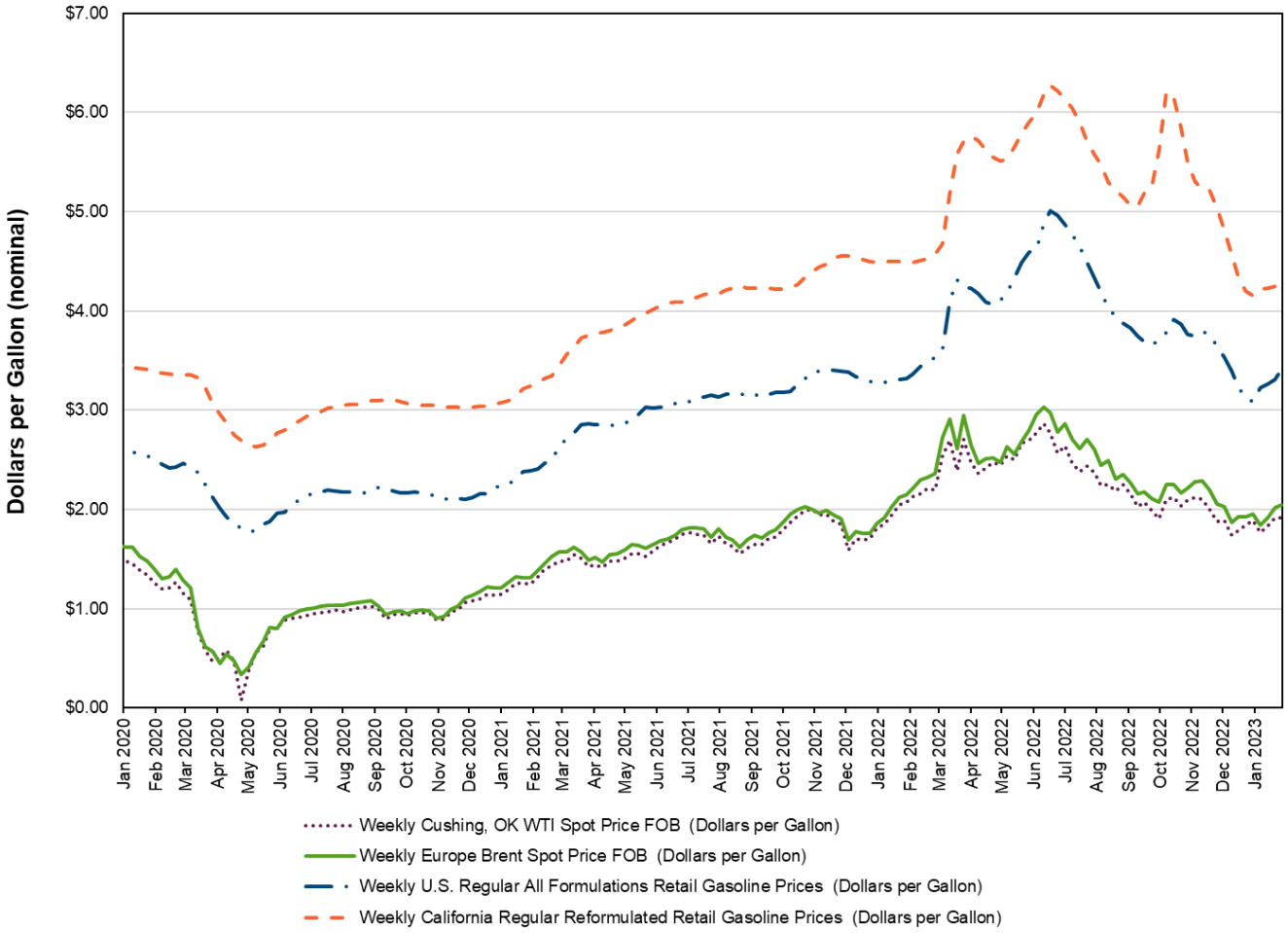
Other Factors That Influence Gasoline Prices

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 (bst) ~~due to~~ (est) (bbu) **because of** (ebu):

- 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 (bst) ~~23~~ (est) (bbu) **36** (ebu) 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 36: California and U.S. Oil and Gasoline Prices [begin image insert]



[end image insert]

(bst) ~~Data~~ (est) 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 (bst) ~~due to~~ (est) (bbu) **because of** (ebu) 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 (bst) ~~is expected to~~ (est) (bbu) **will** (ebu) potentially exacerbate price spikes associated with future significant unplanned refinery outages.

Gasoline Price Spikes

Economists[184] 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[185] 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."

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[186] 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 (bst) ~~which~~ (est) that 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.

---

184 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.

185 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.

186 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.

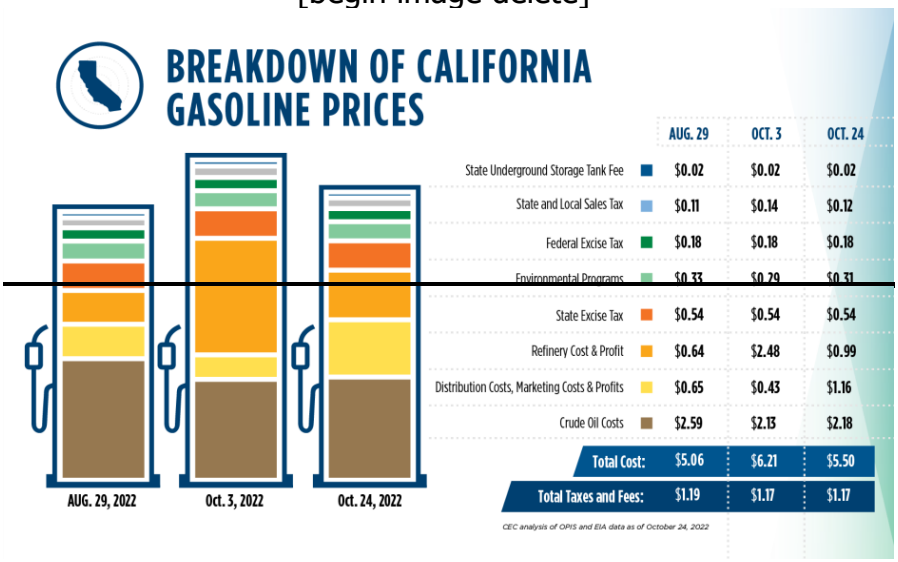
Summer 2022 Gasoline Price Spikes

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.

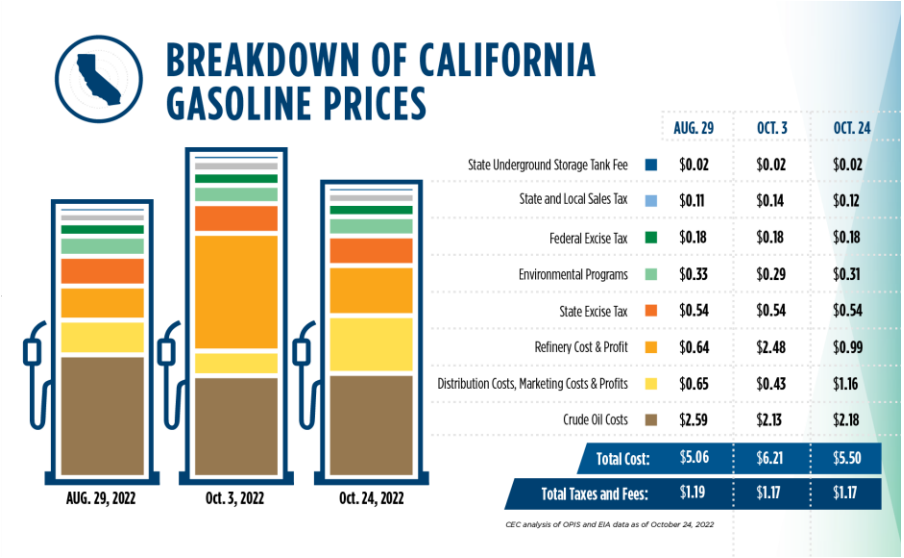
In September and October 2022, California gasoline prices continued to rise, and California experienced the highest absolute prices for gasoline in history, along with the highest price differential compared to the rest of the United States. The differential peaked on October 4, 2022, with gasoline costing $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 (bst) ~~their~~ (est) the 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 (bst) ~~24~~ (est) (bbu) **37** (ebu) shows a snapshot comparison of the breakdown of gasoline costs in California on a day in August 2022 and two days in October 2022.

Figure 37: Gasoline Prices on August 29, October 10, and October 24, 2022

[begin image delete]



[end image delete] [begin image insert]



[end image insert] 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.[187] Third quarter profits of the refiner Valero Energy Corporation were $2.82 billion in 2022, up from $463 million the previous year.[188] 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. (bst) ~~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.~~ (est)

187 Kumar, Arunia (bst) ~~Kumar~~ (est). 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.

188 Kumar, Arunia (bst) ~~Kumar~~ (est). 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.

(ebu) **Informational Hearing on 2022 Gasoline Price Spikes**

The CEC held a hearing November 29, 2022, to seek answers about gasoline price spikes in 2022 as the oil industry recorded record profits.[189] The spikes happened despite decreasing crude oil prices, minimal unplanned outages for maintenance, and no new state taxes or fees on gas at the pump.

The hearing focused on getting information from oil companies regarding inventory management practices and other factors cited as the reasons for the recent price spikes, as well as discussing increased transparency to protect Californians from price shocks in the future. The refiners declined to participate in the discussion and instead were represented by the Western States Petroleum Association.

The agenda featured a panel of petroleum industry experts and public advocates who discussed current challenges and offered ideas on what additional safeguards and transparency measures could be put in place to ensure a successful transition away from fossil fuels.

Most of the public comments submitted in response to the hearing focused on the proposed windfall tax and price gouging penalty, opposing the Governor's proposed legislation to set a penalty for oil companies making excessive profits. Other comments were in support of a penalty on excessive oil refiner profits, California's environmental policies, and CEC's authority to gather data and develop the proposed Transportation Fuels Transition Study. Two members of the petroleum industry, PBF Energy and the Western States Petroleum Association, published comments addressing California's gasoline prices, policy implications to prices and supply, and recommendations on potential solutions and how to approach the transition study.

On December 5, 2022, the Governor held a special legislative session to propose a bill to address California's high gasoline prices.[190] The legislation proposes to impose a penalty on refiners making excessive profits and collect additional data from refiners regarding pricing, supply contracts, inventory levels, and maintenance schedules. It also establishes an advisory committee to provide the CEC with independent advice and insights on the fuels market and plan for and

189 November 29, 2022. Commissioner Hearing on California Gasoline Price Spikes, Refinery Operations, and Transitioning to a Clean Transportation Fuels Future, https://www.energy.ca.gov/event/workshop/2022-11/commissioner-hearing-california-gasoline-price-spikes-refinery-operations.

190 Senate Bill 2. December 5, 2022. https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=202320241SB2.

monitor progress toward a reliable, safe, equitable, and affordable transition away from petroleum fuels. Details of the bill are still to be determined. (ebu)

Transitioning Away (bst) ~~from~~ (est) (bbu)From (ebu) 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.[191] 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~~,~~ (bbu) **(Santa Barbara County)**, (ebu) operated by Phillips 66, will permanently close in early 2023.[192] 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.[193] 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 (bst) ~~event~~ (est) (bbu) **wave** (ebu) (discussed in the "Reliability" section above), a concentrated effort is needed to protect Californians from gasoline price spikes. This (bbu) **effort** (ebu) will include assessing:

- Factors that drive gasoline price spikes, including refinery dynamics and fuel inventory management.
- Tools available or that can be acquired to better predict price spikes, such as enhanced analytics through expanded data collection.

---

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

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

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

- Policy levers the state should consider (bst) ~~to reduce~~ (est) (bbu) **for reducing** (ebu) price spikes, including a potential strategic fuels reserve.

The CEC is initiating a study to understand the impact of climate goals (bbu)**, federal programs, and general market trends toward increasing ZEV adoption** (ebu) on the demand, reliability, safety, and affordability of petroleum fuels under a variety of scenarios. The study will consider market impacts associated with decreased demand for gasoline given the dynamics of (bst) ~~ZEV adoption.~~ (est) (bbu**) California's isolated gasoline market. Key areas of the study will include equitable approaches to managing the transition away from petroleum fuels and strategies to reduce market volatility resulting from lower statewide refinery capacity.** (ebu) Plans for the Transportation Fuels Transition Study (bst) ~~will be~~ (est) were discussed at the November 29, 2022, informational hearing (bbu) **, and the study is referenced in the Governor's proposed legislation, introduced at the December 5, 2022, special session.** (ebu)

Fossil Gas Transition

Introduction

(bst) ~~The~~ (est) (bbu) **In 2020, the** (ebu) combustion of fossil gas (bst) ~~accounts~~ (est) (bbu) **accounted** (ebu) for about (bst) ~~110~~ (est) (bbu) **102** (ebu) million tons (MMT) of carbon dioxide equivalent (CO_2e) emissions (bst) ~~per year~~ (est) in California, or about (bst) ~~26~~ (est) (bbu) **27** (ebu) percent of statewide emissions.[194] Further, leaked fossil gas from California's transmission, distribution, and storage systems accounts for (bst) ~~approximately~~ (est) (bbu) **about** (ebu) 5 MMT of CO_2e annually.[195] CARB's (bst) ~~2019~~ (est) (bbu) **2020** (ebu) estimate of out-of-state GHG emissions (on a 20- (bst) ~~yr~~ (est) (bbu) **year** (ebu) global warming

194 CARB. "GHG Inventory Query Tool (2000–(bst) ~~2019~~ (est)(bbu) **2020)** (ebu)," Emissions from Fuel Combustion, Natural Gas. Accessed ~~April 18~~ (bbu) **December 28** (ebu), 2022. https://ww2.arb.ca.gov/applications/greenhouse-gas-emission-inventory-0.

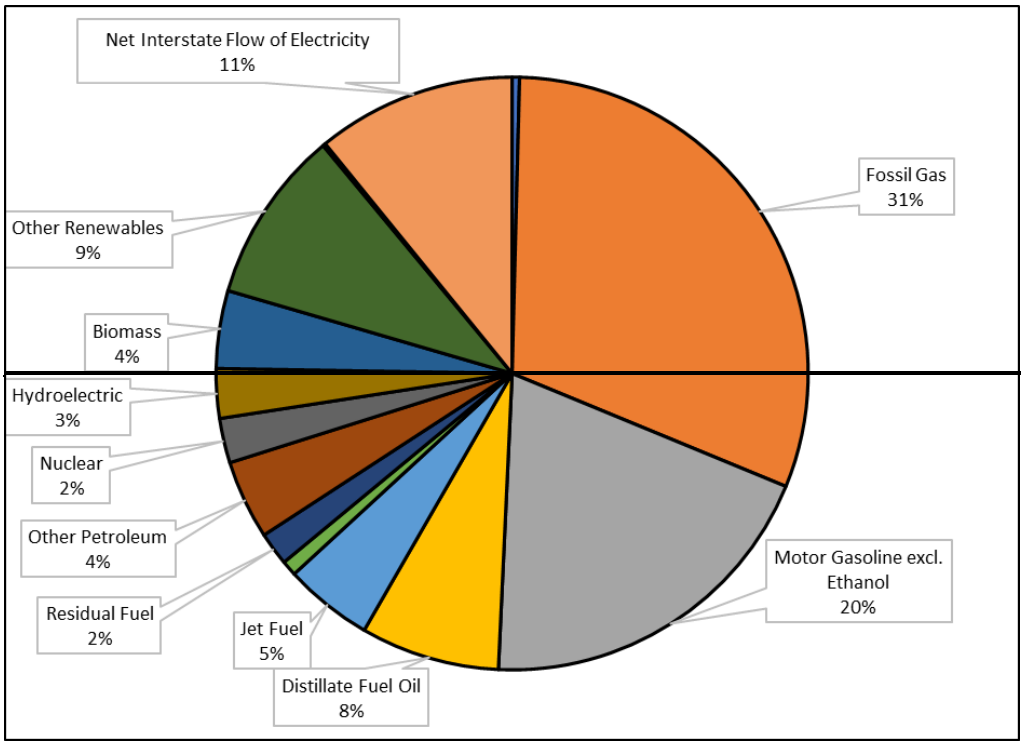
195 CARB. GHG Emissions Inventory Summary (2000- (bst) ~~2019~~ (est) (bbu) **2020**) (ebu), Updated (bst) ~~9/20/2021~~ (est) (bbu) **12/28/2022** (ebu). https://ww2.arb.ca.gov/applications/greenhouse-gas-emission-inventory-0.

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.

potential time horizon) are (bst) ~~25.9~~ (est) 24.8 $MMTCO_2e$ for gas imported to California.[196] Fossil gas is the most consumed fuel in the state, making up about 31 percent of total energy consumption in California in 2020 (Figure (bst) ~~25~~ (est) (bbu) **38)** (ebu).[197] 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.

Figure 38: Gas Accounts for 31 Percent of California's Energy Consumption (2020)

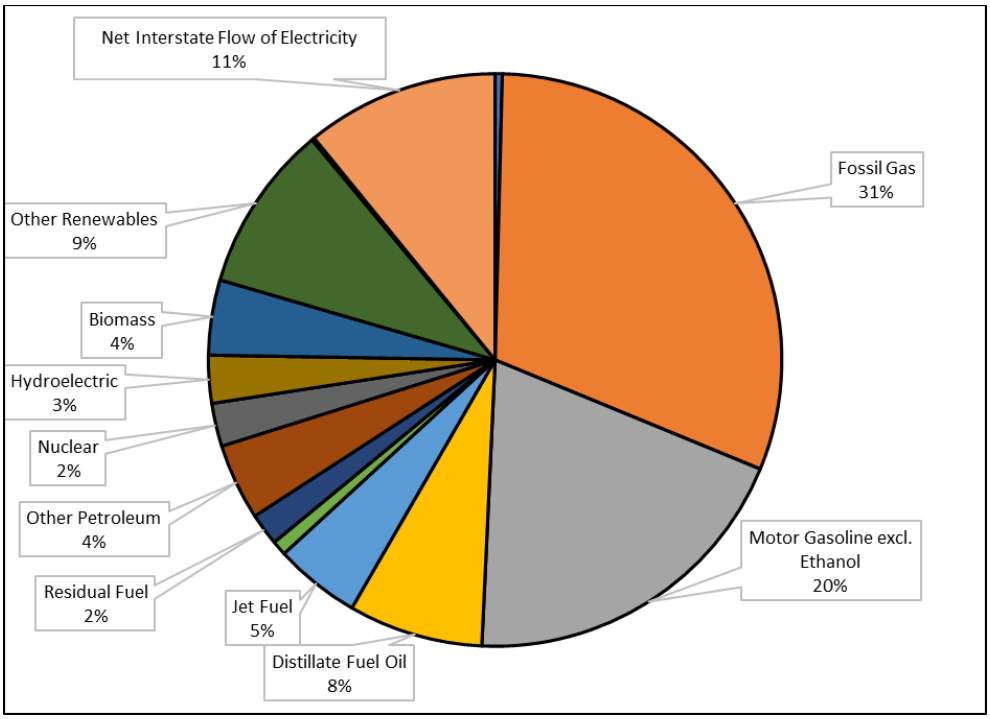
[begin image delete]



196 (bst) ~~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.~~ (est) (bbu) **CARB. December 19, 2022. *Out of State Greenhouse Gas Emissions from Loss, Release, and Flaring of Natural Gas Imported to California: 2018-2020.* https://ww3.arb.ca.gov/cc/inventory/pubs/reports/2000_2019/ab_2195_out_of_state_natural_gas_emissions.pdf https://ww2.arb.ca.gov/sites/default/files/classic/cc/inventory/AB%202195%20Out-of-State%20Natural%20Gas%20Emissions%20Report_2018-2020.pdf.** (ebu)

197 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 (bbu) **decline** (ebu) is largely because gasoline and hydroelectric power consumption were down in 2020 (hydroelectric was down 50 percent from 2019).

[end image delete] [begin image insert]



[end image insert] 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~~/~~ and utilization (bst) ~~and~~ (est) or storage).
- (bst) ~~How to ensure that the gas system remains safe and reliable.~~ (est) 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

(bbu) **Fossil gas will continue to play an important role in providing energy to Californians while the state implements strategies for decarbonizing the gas system.** (ebu) The CEC, CPUC, and CARB (bbu) **each** (ebu) have initiatives (bst) ~~underway~~ (est) to address (bst) ~~the~~ (est) (bbu) **these** (ebu) complex challenges (bst) ~~associated~~ (est) (bbu) **and are coordinating their efforts to better align the gas system** (ebu) with the (bst) ~~gas~~ (est) (bbu) **state's climate targets. The CEC supports an interagency, coordinated approach to the** (ebu) transition (bbu) **away from fossil gas,** (ebu) and (bst) ~~decarbonization strategies. The~~ (est) the agencies~~.~~ are (bst) ~~also coordinating~~(est) (bbu) **working** (ebu) to (bbu) **coordinate across efforts,** (ebu) identify any issues not covered by ongoing efforts, and (bst) ~~if new initiatives are~~ (est) (bbu) **assess** (ebu) needed (bbu) **actions to better align the gas system with the state's climate targets.** (ebu)

CEC

The CEC established the Gas Decarbonization Order to Institute Informational Proceeding (Gas Decarb OIIP) at its business meeting March 9, 2022.[198] 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.[199] 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.[200] 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.[201] 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 (bst) ~~is developing~~ (est) (bbu) **adopted** (ebu) a new site-specific approval process for large gas infrastructure projects.

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

199 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.

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

201 CPUC. 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),[202] 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 (bbu) **north of Los Angeles** (ebu) while maintaining energy reliability for the Los Angeles region.[203] 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 (bbu) **and reduction in gas demand** (ebu) to (bst) ~~obviate~~ (est) (bbu) **eliminate** (ebu) the need for Aliso Canyon.[204] The CPUC concurrently issued a ruling finding that Aliso Canyon is (bst) ~~currently~~ (est) needed for SoCalGas to (bst) ~~reliably~~ (est) meet energy demand (bbu) **reliably** (ebu) in the Los Angeles basin; therefore, sufficient replacement resources must be available for the eventual elimination of (bbu) **the use of** (ebu) Aliso Canyon's (bst) ~~use~~ (est). 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 (bst) ~~two~~ (est) 2 percent of electric capacity or (bst) ~~four~~ (est) (bbu) **4** (ebu) percent of forecast peak gas demand.

Related initiatives include the CPUC's proceeding to support decarbonizing buildings in California (R.19-01-011),[205] which (bst) ~~on September 15, 2022,~~ (est) eliminated gas line extension subsidies for(bst) ~~residential and nonresidential~~ (est) new gas hookups to homes

---

202 (bst) ~~Senate Bill 380~~ (est) (bbu**) Senate Bill 380** (ebu) (Pavley, Chapter 14, Statutes of 2016). (bst) ~~https://~~ (est) (bbu) **http://www.leginfo.** (ebu) (bst) ~~legislature.~~ (est) ca.gov/ (bst) ~~faces/billCompareClient.xhtml?bill_id=20152016OSB380&showamends=false.~~ (est) (bbu) **pub/15-16/bill/sen/sb_0351-0400/sb_380_bill_20160330_amended_asm_v95.pdf.** (ebu)

203 CPUC. February 9, 2017. (bbu) **I.17-02-002.** (ebu) Order Instituting Investigation pursuant to Senate Bill 380 to determine the feasibility of minimizing or eliminating the use of the Aliso Canyon (bst) ~~natural~~ (est) (bbu) **fossil** (ebu) gas storage facility located in the County of Los Angeles while still maintaining energy and electric reliability for the region. (bbu) **For general information, see Aliso Canyon Well Failure at https://www.cpuc.ca.gov/regulatory-services/safety/gas-safety-and-reliability-branch/aliso-canyon-well-failure.** (ebu)

204 (bbu) **CPUC.** (ebu) September 23, 2022~~,~~. Assigned Commissioner Ruling Entering Into The Record Energy Division Proposal and Ordering Testimony. I.17-02-002.

205 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.

and commercial buildings (bbu)**, effective July 1, 2023** (ebu).[206] Also, the CPUC's multiphased Renewable Gas Rulemaking (R.13-02-008) establishes policy related to the production, procurement, and interconnection of renewable gas, including renewable hydrogen and biomethane.[207]

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(bst) ~~released a draft of~~ (est) (bbu) **adopted** (ebu) its most recent update, the(bst) ~~*Draft*~~ (est) (bbu) **final** (ebu) *2022 Scoping Plan Update*, (bst) ~~in May~~ (est) (bbu) **on December 15,** (ebu) 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* (bst) ~~, expected to be released in November 2022 for Board consideration in December, will address~~ (est) (bbu) **also addresses** (ebu) 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 (bst) ~~natural~~ (est) (bbu) **fossil** (ebu)gas plants to meet (bst) ~~our~~ (est) (bbu) **California's** (ebu) long-term energy goals. Decarbonization of the buildings and industrial sectors is achieved in part by blending (bst) ~~renewable natural~~ (est) (bbu) **fossil** (ebu) gas and (bst) ~~renewable~~ (est) (bbu) **low-carbon** (ebu) hydrogen in (bst) ~~natural~~ (est) (bbu) **fossil** (ebu) gas pipelines.

206 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.

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

Distributed Energy Resources

Introduction

California has embraced the adoption of distributed energy resources (DERs)[208] as an important strategy to meet its commitments to increase renewable and zero-carbon resources and support transportation and building electrification. Building on the *2019 IEPR*,[209] 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 (bst) ~~can also help~~ (est) (bbu) **have the potential to** (ebu) manage grid constraints and the need for distribution and transmission upgrades.

Californians from all customer classes are adopting onsite DERs. (bst) ~~They are motivated~~ (est) (bbu) **Rates designed** (ebu) to (bst) ~~a great extent by retail rates~~ (est) (bbu) **support DERs** (ebu) and incentive programs (bbu) **have eased the adoption of onsite DERs.** (ebu) 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, (bst) ~~making DERs more attractive. These factors mean adoption by customers will likely accelerate and exceed analysts' best predictions, like forecasts of rooftop solar adoption.~~ which can make investment in DERs attractive. (est)

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:

---

208 *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.

209 (bst) ~~California Energy Commission~~ (est) (bbu) **CEC** (ebu) staff. 2020. *Final 2019 Integrated Energy Policy Report*. (bst) ~~California Energy Commission.~~ (est) (bbu) **CEC** (ebu). Publication Number: CEC-100-2019-001-CMF. https://efiling.energy.ca.gov/getdocument.aspx?tn=232922.

- (bst) ~~How can the state harness customers' private DER investment decisions to provide benefits to the grid and to society at large?~~ (est) (bbu) **What is the optimal balance of the roles of DER and grid assets to make the energy transition?** (ebu)
- How can the state ensure that policies that promote DER adoption do not result in additional costs and rate increases for nonparticipating households?
- ~~(bst) How can the state equitably wind down prior DER incentive structures to align DER incentives with grid needs, rate stability, and promote electrification efforts?~~ (est)
- What rate designs (bbu) **or demand flexibility options** (ebu) are needed to encourage customers to install and manage DERs in ways that support the state's affordability, reliability, and electrification goals?
- ~~(bst) 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?~~ (est)
- How can DER owners and operators be fairly compensated when they are able to provide value to the grid (bst)~~, such as avoided infrastructure costs~~ (est)?
- How must the state encourage DER deployment and (bst) ~~capturing~~ (est) (bbu) **capture** (ebu) potential DER value, while (bst) ~~ensuring the~~ (est) managing potential costs (bst) ~~associate with~~ (est) (bbu)**, such as distribution system upgrades needed to accommodate** (ebu) DER deployment (bst) ~~is not shifted to non-DER customers?~~ ? (est)
- How could DERs supply a (bst) ~~major~~ (est) (bbu) **significant** (ebu) 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?[210]
- What policies could rapidly bring (bbu) **climate** (ebu) 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?

---

210 (bst) ~~AB~~ (est) (bbu) **Assembly Bill** (ebu) 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.

- (bbu) **What are the roles that DERs should play to facilitate California's transition to a decarbonized society?**
- **What are the best methods to maximize the value that DERs can provide the grid, local communities, and other ratepayers?**
- **What is the most efficient method to cost-effectively procure DERs?**
- **How can DERs best be included in the grid planning process?**
- **What is the role of interconnection and how can reform increase the pace of DER deployment in a way that is calibrated to grid needs?** (ebu)

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.

CEC DER Informational Proceeding

The CEC proceeding is focused on the potential benefits of DER[211] 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.

211 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.

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 (bst) ~~methodology~~(bst) (bbu) **method** (ebu) 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, 2022.[212] 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 (bst) ~~methodology~~ (est) (bbu) **method** (ebu) 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

(bbu) **212 CPUC. June 24, 2022. *Decision Adopting Local Capacity Obligations for 2023-2025, Flexible Capacity Obligations for 2023, and Reform Track Framework.* https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M488/K540/488540633.PDF.** (ebu)

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.

(bst) ~~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.~~ (est) (bbu) **The working group began its work on a durable solution following the decision. Since CPUC Decision 22-06-050 gave the working group a deadline of February 1, 2023, the working group developed a workplan and timeline that would produce a final report for CEC adoption in January 2023.**

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** (bst) ~~**order instituting**~~ (est) (bbu) **an** (ebu) **informational proceeding** (bst) ~~**(OIIP)**~~ (est) **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 (bbu) **order instituting informational proceeding** (ebu) (OIIP~~.~~). This (bst) ~~OIIP~~ (est) (bbu) **proceeding** (ebu) 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 (bbu)**, development of nonenergy benefits and social costs,** (ebu) 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 (bst) ~~be set up to~~ (est) (bbu) **apply best practices for community engagement, provide language services, and** (ebu) include listening and learning (bst) ~~from~~ (est) (bbu) **sessions with** (ebu) tribes, local government, community leaders, residents, and others. The summits should be in varying regions and include site visits and engagement sessions. (bst) ~~A possible topic would be~~ (est) (bbu) **Possible topics** (ebu) to (bbu) **address during the summit could be:**

- **To conduct an** (ebu) update, across all state agencies, of language and terms describing tribes and communities. (bst) ~~To continue uplifting tribes and communities, state leadership should consider~~ (est) (bbu) **The agencies could discuss creating a webpage where a glossary of terms could reside or other type of centralized hub to consolidate existing definitions used by agencies and help align the agencies on using the same terms to reduce confusion.**
- **To draft** (ebu) 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 (bst) ~~towards~~ (est) (bbu) **toward** (ebu) using more nuanced language that is customized to people and areas they are prioritizing.
- (bbu) **To develop nonenergy benefits and social costs for analysis related to climate change solutions and clean energy infrastructure.** (ebu)

- **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 (bbu)**, or at least increasing,** (ebu) 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 and education 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 (bst) ~~and~~ (est) (bbu)**, printing costs,** (ebu) childcare (bbu)**, and transportation** (ebu) 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 members 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 and work more consistently with local government**. 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. (bbu) **The CEC should connect with local government entities and associations to develop a deeper relationship that enables consistent communication and interaction to ensure state policies are developed to improve local impact.** (ebu)
- **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 (bbu) **-owned** (ebu) 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 (bst)~~to improve~~ (est) (bbu)improving (ebu) the new platform.** This engagement and feedback can be accomplished (bst)~~ both~~ (est) 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.
- (bbu) **The state should provide adequate and consistent funding to support further development and ongoing data updates for the California Energy Planning Library. While initial phases of implementation will target the reorganization of existing data, subsequent and future phases will focus on the modernization of data and analytical tools, as well as expanding data products, incorporating links to data partners, and possibly collaborating with outside entities. The California Energy Planning Library will evolve over**

time, and the CEC will embrace opportunities to make it more dynamic after the foundational phase of incorporating data and data products. (ebu)

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 (bst) ~~improve how~~ (est) better incorporate the realities of climate change (bst) ~~is incorporated into it~~ (est) 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 and the CPUC 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 life-cycle carbon intensity will be critical. The CEC staff recommends developing methods to measure climate benefits of hydrogen that are consistent (bst) ~~and~~ (est), standardized, and clear as to the actual renewable content of the hydrogen molecules to compare objectively (bst) ~~compare~~ (est) 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 (bbu) ~~directly produced~~ (ebu) 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 producing low-carbon 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 (bbu) ~~Senate Bill 100~~ (ebu) analysis of hydrogen (bbu) supply adequacy and hydrogen demand for electricity**. **(ebu)** 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 ((bst) ~~de~~ (est) 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~~.~~, as well as for new economic opportunities such as green ammonia production to support California agriculture. This type of evaluation can, in turn, guide appropriate and equitable state investment in hydrogen. (bst) ~~Other types of analyses to continue and expand relate to hydrogen availability for transportation fuel and other hard-to-electrify industries.~~ (est)

- **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, (bbu) **use, and trade,** (ebu) to California.

(bbu) **Distributed Energy Resources**

- **Examine how to balance the roles of DER and grid assets in making the energy transition away from fossil fuels. There are many challenges that must be addressed to make the energy transition in a way that optimizes the roles of both DER and grid assets in California's energy future. The CEC should include this topic in the scope of its DER informational proceeding.**
- **Examine the role of interconnection and how utility process reform can increase the pace of DER deployment. Interconnection of DER is a challenge that should be addressed to make the energy transition in a way that optimizes the role of DER in California's energy future. While the application process has been streamlined, actual interconnection can be dependent on other utility construction processes. Current levels of interconnection staffing and utility process integration may not support anticipated increases in the pace of DER deployment. The CEC should include this topic in the scope of its DER informational proceeding.** (ebu)

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.

(bbu) ***Building electrification*** **is the replacement of fossil fuel equipment with electric equipment. An example is the replacement of natural gas heating equipment with electric heating equipment.** (ebu)

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 (bst) ~~natural~~ (est) (bbu) **fossil** (ebu) gas
- the transportation of oil by pipeline

It also reviews proposals to build interstate (bst) ~~natural~~ (est) (bbu) **fossil** (ebu) gas pipelines, (bst) ~~natural~~ (est) (bbu) **fossil** (ebu) gas storage projects, and liquefied (bst) ~~natural~~ (est) (bbu) **fossil** (ebu) 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.

(bbu) **A *load shape* is the hourly profile of electricity demand as a percentage of the total demand.** (ebu)

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.

(bbu) ***Transportation electrification* is the replacement of petroleum-fueled vehicles with electric or hydrogen fueled vehicles.** (ebu)

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.

(bbu) ~~The **Western Electricity Coordinating Council**~~ **(ebu)** The **WECC** promotes bulk electric system reliability for the entire Western Interconnection system. The North American Electricity Reliability Corporation delegated authority to the (bst) ~~Western Electricity Coordinating Council~~ (est) (bbu) **WECC** (ebu) 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

(bbu) **NOx** **oxides of nitrogen** (ebu)

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
(bbu) **WEIM**	**Western Energy Imbalance Market–**(ebu)
WI	Western Interconnection
WRAP	Western Resource Adequacy Program
ZEV	zero-emission vehicle

Appendix A:
(bst) ~~Draft~~ (est) 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),[213] Jemez Principles for Democratic Organizing,[214] Disadvantaged

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

214 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,[215] California Environmental Justice Alliance (CEJA) Environmental Justice Principles,[216] The Greenlining Institute's Make Equity Real,[217] (bbu) **the Building Energy, Equity and Power Coalition,[218]** (ebu) The Energy Justice Workbook,[219] and Energy Equity Project Report.[220]

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."[221]

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.

---

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

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

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

(bbu) **218 Energy Justice Statement https://docs.google.com/document/d/1iSN-_TSSjKd9-9yXi7xNkvYgEC0-XDs4heDXTEmQs30/edit; https://ww2.arb.ca.gov/sites/default/files/2022-03/BEEP%20Letter%20and%20Report_Equitable%20Decarb%20March%202022.pdf** (ebu)

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

220 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.

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

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.

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.[222]

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.

---

222 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.

The CEC recognizes that "equity" has been used more commonly at the CEC and other state agencies.

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 (bst)~~. Siting~~ (est) (bbu) **instead of squeezing them into the "community" category.**

There may be situations in which the focus may either be equity or environmental justice and thus prefer or need to use certain lexicon. For example, siting (ebu) 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.[223]

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

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,[224] which are:
    - 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.
- (bbu) **People living with disabilities as defined by American Disabilities Act (ADA):**
    - **An individual with a disability is defined by the ADA as a person who has a physical or mental impairment that substantially limits one or more major life activities, a person who has a history or record of such an impairment, or a person who is perceived by others as having such an impairment.** (ebu)

224 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.

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~~.~~ (bbu) **that lead to detrimental health impacts.** (ebu) As a state agency, the CEC wants to do its part to contribute to a (bst) ~~healthy~~ (est) (bbu) **dignified** (ebu) 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.[225] (For more information, review "Culture Card: A

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

Guide to Build Cultural Awareness"[226] and Technical Advisory AB 52 And Tribal Cultural Resources in CEQA.[227]) 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.[228] Consider talking with peer agencies 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 (bbu) **of their funding** (ebu) 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[229] platform.

---

226 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.

227 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.

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

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

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. (bst) ~~Non-energy~~(est) (bbu) **Nonenergy** (ebu) 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, 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 (bst) ~~the~~ (est) (bbu) **tribes and** (ebu) 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 (bbu) **tribes and** (ebu) most vulnerable communities~~.~~ (bbu)**, such as people living with disabilities.** (ebu) Programs (bst) ~~can~~ (est) (bbu) **should** (ebu) include (bbu) **considerations for** (ebu) health interventions, (bst) ~~provide~~ (est) educational material explaining health impacts, (bst) ~~and can~~ (est) (bbu) **housing needs for people living in non-single family homes (such as mobile homes, farmworker houses, or renters); and programs should** (ebu) 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 (bbu) **tribes and** (ebu) communities directly through financial investment, incentives, rebates, and cost savings while also considering affordability and rate impacts. (bbu) **Consider the impact of policies on residents' energy, housing, and other costs, especially in the context that many low-income households are currently using less energy than needed to live safe and healthy lives.** (ebu)

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~~mobility, family-sustaining wages, and benefits

- (bst) ~~Train~~ (est) (bbu) **Provide pay for training** (ebu) the next generation of climate leaders, entrepreneurs, and workers for the clean energy economy (bbu) **and include transferable skills to ensure versatility**
- **Determine opportunities for union jobs and labor agreements.** (ebu)

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.

(bst) ~~**Restoration**~~ (est) (bbu) **Remedies** (ebu)**:** 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:

- (bst) ~~Investments reflect~~ (est) (bbu) **Reflect** (ebu)_ the priorities of Tribes and Justice Communities
- (bst) ~~Investments aim~~ (est) (bbu) **Aim** (ebu)_ to be community-driven
- (bst)~~Investments aim to address~~ (est) (bbu) **Address directly** (ebu)_ the needs of Tribes and Justice Communities
- (bst) ~~Investments deliver~~ (est) (bbu) **Deliver** (ebu)_ direct benefits to Tribes and Justice Communities
- (bst) ~~Investments aim to avoid~~ (est) (bbu) **Avoid** (ebu) creating or exacerbating burdens
- (bst) ~~Investments are~~ (est) (bbu) **Create** (ebu)_ multisectoral programs to achieve transformation
- (bst) ~~Investments operationalize~~ (est) (bbu) **Support energy democracy through community-scale distributed energy resources**
- **Support community resilience to climate change**
- **Operationalize** (ebu)_ 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.[230] 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.

Table A-1: Example Benefit Metrics

Policy Priorities	Benefit Metric and Units

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

Invest in energy justice communities	Dollars spent [$] by CEC programs
Decrease energy burden	Dollars saved [$] in energy expenditures (bst) ~~due to~~ (est) (bbu) **because of** (ebu) technology adoption
(bbu) **Decrease energy burden** (ebu)	Energy saved [MWh or MMBTU] or reduction in fuel [GGe]
Decrease environmental exposure and burdens	Avoided air pollutants
(bbu) **Decrease environmental exposure and burdens** (ebu)	Remediation impacts on surface water, groundwater, soil
(bbu) **Decrease environmental exposure and burdens** (ebu)	Reduction of legacy contaminated waste
Increase clean energy jobs, job pipeline, job training	Dollars spent [$] and/or number of participants in job training programs, apprenticeship programs, STEM education, tuition, scholarships and recruitment
(bbu) **Increase clean energy jobs, job pipeline, job training** (ebu)	Number of hires resulting from CEC training
(bbu) **Increase clean energy jobs, job pipeline, job training** (ebu)	Number of jobs created
(bbu) **Increase clean energy jobs, job pipeline, job training** (ebu)	Number of and/or dollar value [$] 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 [$] awarded to diverse businesses
Increase energy democracy	Number of stakeholder events, participants, and/or dollars spent to engage with organizations and residents, including participation and notification of how input was used
(bbu) **Increase energy democracy** (ebu)	Dollars spent [$] or number of hours spent on technical assistance
(bbu) **Increase energy democracy** (ebu)	Dollar value [$] and number or clean energy assets owned resulting from investments

Increase access to low-cost capital	Dollars spent [$] by source and purpose and location
(bbu) **Increase access to low-cost capital** (ebu)	Leverage ratio of private to public dollars [%]
(bbu) **Increase access to low-cost capital** (ebu)	Loan performance impact through dollar value [$] 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
(bbu) **Increase reliability, resilience, and infrastructure to support reliability and resilience** (ebu)	Number and size (MWh) of community resilience infrastructure deployed

(bst) ~~Credit~~ (est) (bbu) **Source** (ebu): 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

(bst) ~~Credit~~ (est) (bbu) **Source** (ebu): 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 (bst) ~~Zero Nox~~ (est) ZeroNox 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

(bst) ~~Credit~~ (est) (bbu) **Source** (ebu): 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

(bst) ~~Credit~~ (est) (bbu) **Source** (ebu): CEC

(bbu) Appendix C: Land-Use Screens

For the *2022 Integrated Energy Policy Report (IEPR) Update*, the California Energy Commission (CEC) started a process to revise the land-use screens[231] used in state electricity planning processes. Since 2008, the CEC, the California Public Utilities Commission, and the California Independent System Operator have used spatial environmental and land-use data to guide their relevant energy resource planning. Over time, the methods and data used have evolved, reflecting the availability of new information, new planning initiatives, and new policies related to biodiversity conservation, agricultural resource protection, and renewable resource development. The land-use screens had not been updated since 2018. During the *2022 IEPR Update*, the CEC sought input from state and federal agencies and the public about data sources and proposed methodological updates.

The *Scoping Order for the 2022 Integrated Energy Policy Report Update* [232] noted that land-use screens would be enhanced and integrated into a California Energy Planning Library. The CEC staff sought input on the California Energy Planning Library at the April 27, 2022, IEPR workshop.[233] The workshop included a panel of expert data users and discussion of the most widely requested CEC analytical products.

Following the April 2022 workshop, the CEC considered public comments and coordinated with state and federal agencies to revise the relevant datasets and propose modifications to the existing land-use screening methods.

(bbu) **231 *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.**

232 Scoping Order for the 2022 Integrated Energy Policy Report Update. https://efiling.energy.ca.gov/GetDocument.aspx?tn=242747&DocumentContentId=76300.

233 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.

The CEC held an October 10, 2022, IEPR Workshop,[234] to present a draft staff report[235] documenting proposed data and methodological updates and receive additional stakeholder comments. The CEC staff takeaways, included:

- **Additional public process steps needed before finalizing data and method modifications.**
- **Additional datasets representing protected areas that preclude energy development are needed (such as a National Scenic Areas).**
- **Additional discussion needed about solar resource potential in Critically Overdrafted Basins, as defined by the Sustainable Groundwater Management Act.[236]**
- **Additional land use evaluation exploring land-use-related nonenergy benefits of distributed energy resources needed in the next Senate Bill 100 report.**

This invaluable feedback is shaping the final updates to data sources and methods, which will be documented in a final staff report expected in the second quarter of 2023. The updates to the land-use screens will be further refined and finalized through an iterative public engagement process that will extend beyond the *2022 IEPR Update*. When complete, the final staff report will be available from the California Energy Planning Library. (See Chapter 2.) (ebu)

---

234 October 10, 2022, IEPR Commissioner Workshop on Land Use Screens. https://www.energy.ca.gov/event/workshop/2022-10/iepr-commissioner-workshop-land-use-screens.

235 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. https://efiling.energy.ca.gov/GetDocument.aspx?tn=246353.

236 The Sustainable Groundwater Management Act is comprised from a three-bill legislative package and subsequent statewide regulations.
Assembly Bill 1739 (Dickinson, Chapter 347, Statues of 2014). https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201320140AB1739.
Senate Bill 1168 (Pavley, Chapter 346, Statues of 2014). https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201320140SB1168.
Senate Bill 1319 (Pavley, Chapter 348, Statues of 2014). https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201320140SB1319. (ebu)