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California Energy Commission

COMMISSION REPORT

Transportation Fuels Assessment

Policy Options for a Reliable Supply of Affordable and Safe Transportation Fuels in California

Gavin Newsom, Governor

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California Energy Commission

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ABSTRACT

The Transportation Fuels Assessment is a leading component of SB X1-2. This assessment identifies potential alternative methods to ensure a reliable supply of affordable and safe transportation fuels in California, evaluates the price of transportation fuels, considers supply conditions, assesses the impact of refinery closures, analyzes impacts on production from refinery maintenance and turnarounds, evaluates the feasibility of alternative methods to maintain adequate supply of fuels, and proposes solutions to mitigate impacts described elsewhere in the assessment. This report includes policy options that can help address price spikes that are unique to the California market. Each policy has an accompanying one-page summary table or set of tables with a summary of that policy.

Keywords: Transportation Fuels Assessment, SB X1-2, gasoline, price spikes, gasoline demand scenarios

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EXECUTIVE SUMMARY

Senate Bill X1-2 (SB X1-2, Skinner, Chapter 1, Statutes of 2023 First Extraordinary Session) directs the CEC to identify methods to "ensure a reliable supply of affordable and safe transportation fuels in California." This assessment does this by examining two distinct but related issues. The first is mitigating or eliminating gasoline price spikes. The second is maintaining an overall affordable, reliable, equitable, and safe supply of gasoline during the transition to zero-emission vehicles (ZEVs). This assessment also serves as a key contribution to the forthcoming Transportation Fuels Transition Plan, which is also called for by SB X1-2. Transportation fuels include gasoline, diesel, natural gas, electricity, hydrogen, and renewable combustion fuels. The scope of this assessment is primarily focused on gasoline and, to a lesser extent, on diesel and ethanol (a gasoline additive). Gasoline fuels most of the vehicle miles traveled in California, and gasoline price volatility impacts nearly all Californians through prices at the pump or through the transportation costs of products.

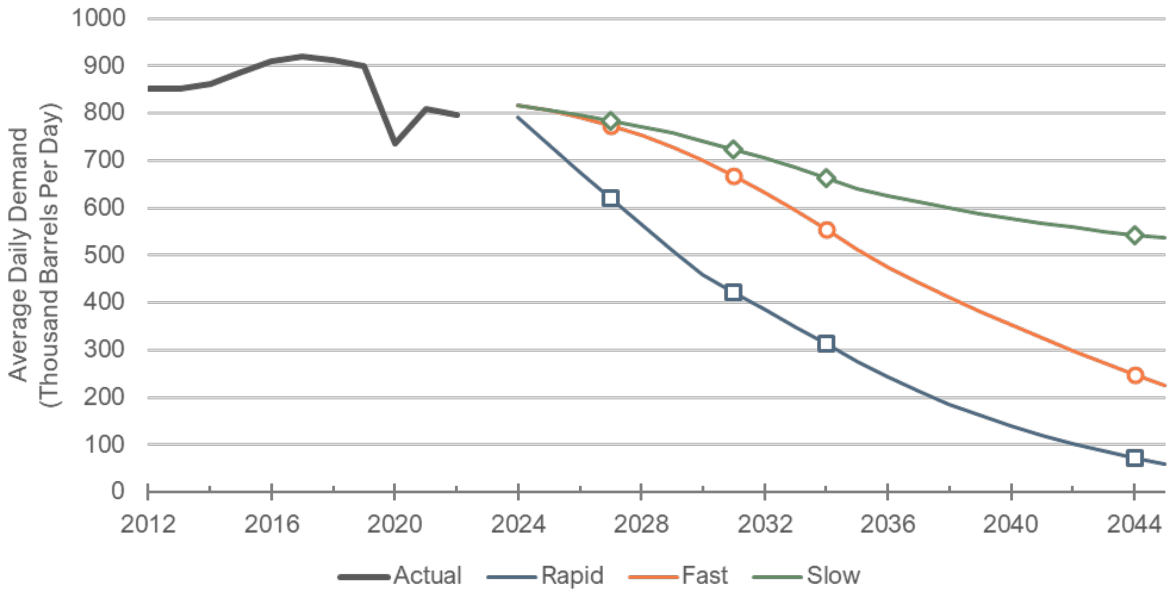
Like most product prices, gasoline prices should ideally obey the laws of supply and demand. However, supply dynamics in California's transportation fuels market differ from many other markets in the United States. Despite being directly geographically connected to other states, California's relatively isolated transportation fuels market makes it essentially a fuel island. In addition, the critical need to address the state's unique air quality challenges means that the state must require a unique fuel specification that differs from the rest of the nation. Related to the isolated market, the state's opaque spot market appears to have an outsized influence on prices in a way that does not align with supply or demand fundamentals.

These factors have led to several challenges for the stability of transportation fuel prices. For example, in the last two years (2022 and 2023), California had two gasoline price spikes in September and October. Spikes were not seen in regions outside of the western part of the United States.

Although gasoline demand peaked in 2005 and is expected to decline markedly in the next two decades, gasoline remains California's dominant transportation fuel, and demand is not especially responsive to short-term price spikes. New options, especially the state's transition away from combustion fuels in favor of ZEVs, have started to reduce drivers' dependency on gasoline, with a sharp decline expected within a decade. Figure ES- 1 shows potential demand pathways for gasoline under a rapid, fast, and a slow transition away from gasoline. Highlighted are 3-, 7-, 10-, and 20-year points for the three pathways.

Gasoline demand is expected to continue a downward trend as demand for ZEVs increases and other climate-friendly strategies unfold. However, the CEC projects that gasoline demand will remain above two hundred thousand barrels per day (TBD) at least through 2035 if not longer. Even under the most aggressive scenario transition to ZEVs, millions of petroleum-fueled vehicles are anticipated to remain on California's roads and highways beyond 2035. These vehicles will need fuel to operate, and many of the vehicles may be owned by lower income individuals and families, making it even more compelling to identify ways to ensure an affordable, reliable, equitable, and safe supply.

Figure ES- 1. Gasoline Consumption and Demand Scenarios Under Consideration for the Assessment

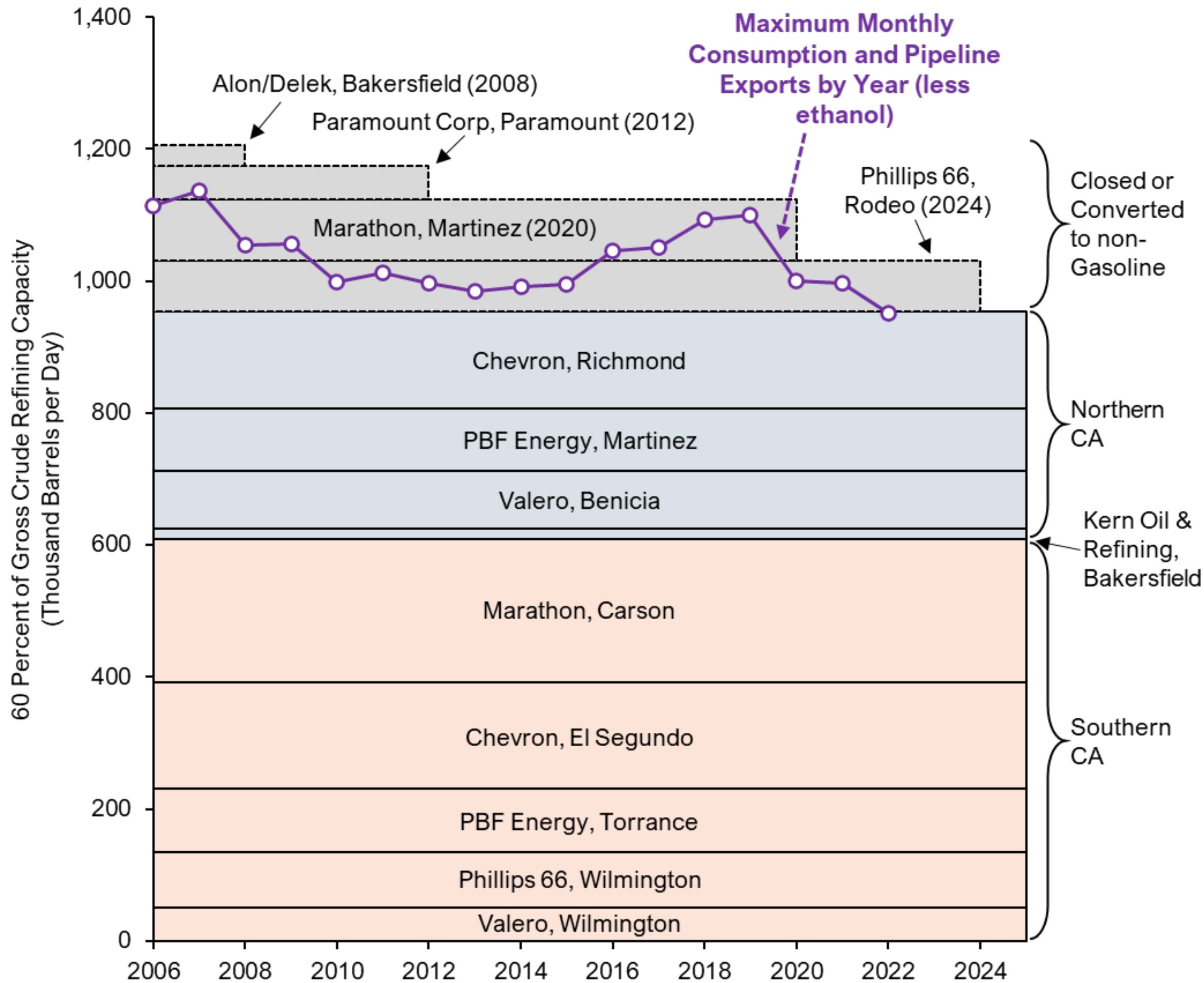


Both Supply and Demand are Key

The deployment of ZEVs and a robust mass transit system are critical for achieving the state's climate goals, reducing local air pollution, and eventually eliminating dependence on the volatile global petroleum markets. As demand for gasoline shrinks, refineries may close or convert to processing clean transportation fuels. This will lead to fewer gasoline refineries, with increased market concentration and associated market problems that often accompany it. However, some refineries will be converted to producing renewable diesel, such as the Phillips 66 Rodeo refinery, a sign of the success of clean fuel policies such as the state's Low Carbon Fuel Standard (LCFS). These converted refineries, however, will no longer be a source of gasoline.

As of March 2024, nine California refineries produce California-specific gasoline, California Reformulated Blendstocks for Oxygenate Blending (CARBOB). Moreover, supply of gasoline in the state is highly regionalized. Except for one small refinery in central California, nearly all in-state supply in the near term will come from three refineries in northern California and five refineries in Southern California. The temporary reduction of refining capacity at a single refinery in either the north or the south would represent a critical reduction of refining capacity for each respective region because the regions are not connected via pipeline, though waterborne transportation is available. Figure ES- 2 illustrates roughly estimated gasoline refining capacity (at 60% stated crude processing capacity), along with recent refinery closures, remaining capacity, and the maximum monthly demand by year.

Figure ES- 2. Approximate Peak Gasoline Refinery Capacity Compared to Maximum-Monthly Consumption



Credit: CEC Staff

In Northern California, a single refinery outage would represent up to a 45 percent reduction of regional refining capacity. In Southern California, a temporary closure of a single refinery could represent up to a 35 percent reduction of regional capacity. Intrastate movements of fuel must occur by marine cargos, so supply shocks can pose immediate challenges.

As demand for gasoline continues to decline in California, refineries will likely continue to transition from refining petroleum and may permanently close or convert to the refining of renewable feedstocks for renewable diesel or other types of bio-based fuels. A single supply shock in the north or south, be it from an unplanned maintenance event, a severe accident, a criminal act, or a natural disaster, would make it even more difficult to supply transportation fuel needs in the coming decade.

Independent of supply shocks, Californians already pay higher than the national average for gasoline, which is only partially due to state and federal mandates for improved air quality. CARBOB has been a critical tool for reducing chronically high concentrations of air toxins and meeting state and federally mandated clean and healthy air quality standards. Failing to meet federal air quality standards puts California's residents' lives and federal transportation funding at risk. By requiring CARBOB, California has enjoyed numerous benefits. For example, there has been an 80 percent reduction in cancer risk associated with exposure to gasoline-related pollutants between 1996 and 2014. Despite this and other successes, California continues to face challenging air quality management, exacerbated by climate change impacts.

With reduced demand or more flexible consumer demand, supply shocks should become less impactful. Where travelers can substitute electricity, active transportation, or other alternative travel approaches in lieu of gasoline, price spikes may be easier to manage and have less of an impact on Californians. This report presents several policy approaches that can affect gasoline demand.

Outside of crude oil dynamics, refined gasoline supply is influenced by three primary factors: production capacity, storage, and gasoline or gasoline blendstock imports. Statewide petroleum refinery capacity has declined in recent years, closely following or even exceeding the ongoing decline in demand that is due in part to more consumers adopting ZEVs. The petroleum refining industry in California appears to have sufficient infrastructure to produce, procure, and store enough gasoline to meet current levels of demand. However, as discussed, unique conditions in California make it more difficult to stabilize supply when there are acute disruptions.

Production

As discussed above, there are now nine refineries operating in California producing gasoline. In the last five years, two major refineries have converted to producing renewable diesel and stopped producing gasoline, and in-state production has fallen a result. In the face of declining refinery production, there are several short- and long-term alternatives to maintain or increase production, though each alternative presents significant potential tradeoffs.

Short-term polices may boost production and encourage a corresponding decrease in price, particularly when California is faced with acute supply disruptions. For example, in 2022 and 2023, Governor Newsom called for the California Air Resources Board (CARB) to accelerate the annual winter fuel blend transition by one month. This resulted in an increase in supply and a sharp decline in gasoline prices at the pump. However, accelerating the winter fuel blend transition presents environmental impacts. Other strategic options that may help increase supply are discussed in Chapter 3 of the assessment.

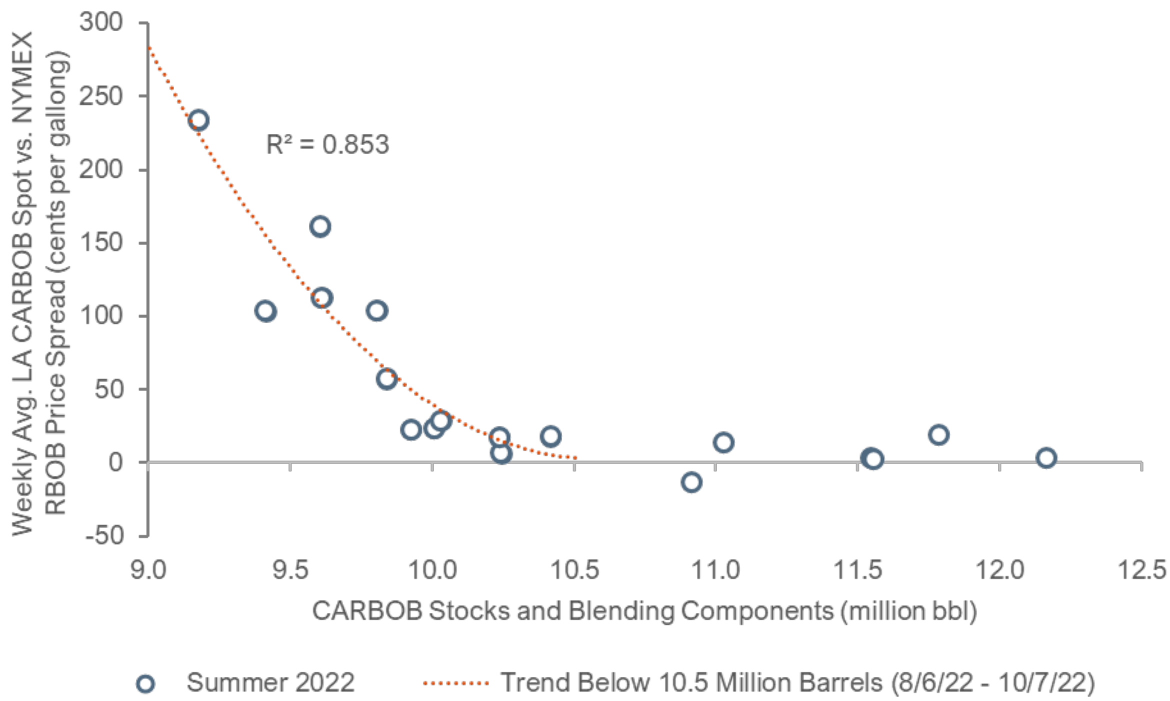
On a longer-term basis, other modifications to requirements for refined fuels may make for a more resilient supply system, but also come with potential environmental and other policy tradeoffs, all of which must be weighed carefully. For both short- and long-term approaches to production, further analysis is necessary. The Transportation Fuels Transition Plan is a related document that will be prepared jointly by the CEC and CARB for submission by the end of 2024.

Storage

Storage adds resiliency to the fuel supply system by offering a buffer that can be drawn down during supply disruptions. Statewide, gasoline storage capacity for the state represents approximately two weeks' worth of demand. Storage facilities are owned by various entities, most commonly refiners at their respective refineries, at port reception points, and by pipeline operators.

There is an observable inverse correlation between total storage levels and price spikes, though there are other important variables as well, including seasonality and demand. This broadly suggests that when storage levels of gasoline decline, the risk of price spikes increases. This was seen most dramatically in the summer of 2022. Figure ES-3 shows the correlation between storage and the 2022 price spike.

Figure ES-3. CARBOB Stocks vs. CARBOB Price Spreads: Total Weekly Stocks vs. Los Angeles Spot Market Price (July 2022 – October 2022)



As reflected in the chart, a California price spike is typically measured by the difference between the LA CARBOB spot market price and NYMEX RBOB market price, meaning that the higher prices were unique to California rather than part of a national trend. The quantities plotted on the chart include publicly available data that is reported to CEC by in-state refineries.

At petroleum refineries, storage is often used by individual refiners to blend and store products during normal operations and to provide back-up supply during periods of planned and unplanned maintenance. Requiring or incentivizing a minimum level of in-state petroleum storage could increase fuel stocks statewide and assist in mitigating or avoiding gasoline price spikes. For example, minimum petroleum storage requirements with exemptions during certain supply shock conditions may help establish a new baseline approach for storage operators. An incentive approach may also be effective and allow for more flexibility for operators. It is unclear how operators would adjust to requirements or incentives, and additional public discussion and analysis of these types of approaches is warranted.

New storage solutions are also possible. A critical tradeoff for either private or public investment in storage is the long-term expected decline in gasoline demand. There may be a case for additional storage as a matter of maintaining supply resiliency for the next two decades, but such investments do pose a stranded assets risk. More analysis is needed to determine whether the benefits of enhanced supply resiliency are worth the investment in the near term.

Imports

Currently, most of the State's consumed gasoline is refined in state, with a limited portion of the supply coming from out-of-state or overseas refineries. However, as demand continues to decline and in-state refineries convert to renewable fuels or close completely, a strategy to bolster the State's imports of gasoline will be imperative to avoid potentially systemic undersupply problems.

At present, the only practical way to import finished fuel and blending components is by marine imports. There are no pipelines for refined fuel (e.g. diesel, jet, and gasoline) going into the state, only pipelines for export out of the state (to Arizona and Nevada). Rail could theoretically be a source of imports, but so far this import approach has not been seen at any significant scale, and it would take three to five 100-car trains of gasoline or gasoline blending components to match the capacity of one ship. One typical tanker ship of gasoline represents about one third of the state's current daily demand of gasoline. Thus, routine marine imports are likely the most feasible option navigating the uncertainties arising from refineries reducing or stopping production (i.e., losing tens of thousands of barrels of daily production) while demand reduces in a much more gradual manner.

Marine imports of refined fuel from Washington state, Asia, and Europe are already a regular source of fuel, helping to balance out a sophisticated market of multiple flows in various directions. CEC data shows that imports appear to be increasing in northern California, the likely result of one large refinery conversion in 2020.

Marine imports generally tend to have higher prices compared to in-state refining, as ships can be expensive to operate compared to pipelines and present different environmental risks. However, the increased supply resiliency added by an import strategy could result in a net price benefit to consumers.

Harbor traffic is another issue to consider for any strategy relying on increased marine imports. As shown in the demand pathways above, the need for crude imports will decline with the overall decline in demand for gasoline and other fuels. This will free up some space at critical import points, but there are differences between crude import logistics and refined fuel import logistics that merit additional analysis.

The Need for Information and Oversight

The petroleum refining industry has relatively few market participants due to high fixed costs and other barriers to entry. This makes it possible for firms to exercise degrees of market power that would not be possible in perfectly competitive markets. In California, this risk of market power appears to be more pronounced than in other states. A relatively small portion of this California-specific gasoline is traded on California's local commodity markets (called "spot markets") in which a market-wide price is set. In the spot market, there are limited trades reported and fewer participants compared to a national market. Despite this characteristic of the market, the spot market price is linked through contracts to a large portion of all wholesale and thus retail gasoline sold in the state. Spot market trades can have an outsized influence on gasoline prices, with the potential susceptibility to market manipulation. With price reporting based on voluntary reports of trading, the lack of spot market transparency has contributed to incomplete information, leading to volatility in retail prices contrary to consumer interests.

In addition to price spike risk, Californians have paid consistently higher gasoline prices compared to the rest of the U.S. that cannot be fully explained by differences in fuel formulations and gasoline taxes or fees. This unexplained premium paid by California drivers has been identified by academic researchers as the California "mystery gas surcharge."

Active oversight of the increasingly concentrated petroleum and rather opaque industry is an essential component of California's transition to a low-carbon economy. Petroleum refining is a high fixed-cost industry, with costly and years-long development required for entry, thinly traded spot markets, and significant vertical integration—all of which combines in a market that is far from perfect competition. Due to the high fixed-cost structure and other barriers to entry in this industry, only a small number of firms have the resources to supply California petroleum markets. As demand for gasoline declines, the industry will become more concentrated and potentially less competitive. Economists sometimes refer to such dynamics as a type of market failure, a misalignment between producers' profit incentives and consumer welfare. In these situations, protecting consumers, and reducing incentives for market manipulation requires both robust enforcement of competition laws and potential market interventions to realign incentives. Market interventions vary widely by industry and market conditions.

Some of the challenging market dynamics in California's petroleum industry are familiar in other industries. There are many examples of highly concentrated, high fixed-cost industries such as airlines, telecommunications, and utilities—all of which are highly regulated and generally profitable. Market power in the airline industry is primarily tempered through antitrust enforcement and federal oversight. Competition among telecommunications firms is protected through antitrust enforcement and regulations requiring fair access. Finally, utilities, which bear some key similarities to energy refiners, are often highly regulated monopolies that navigate rate regulations and limits on their rates of return. These are only a few examples. Each industry and the markets they serve are unique. Enforcement of competition laws and market interventions require information about market behavior and outcomes. Therefore, an important component of petroleum market oversight should include detailed industry data collection to facilitate transparency and well-informed public policy.

As discussed in workshops and hearings held by the CEC and in stakeholder comments, there is concern about market power abuse in the petroleum sector, and the state appears to be increasingly susceptible to price spikes as seen over the last decade. Stakeholders at CEC workshops and hearings have expressed concern about unfair market dynamics resulting from increased market power in California's petroleum industry and potential market gaming by industry participants. Moreover, stakeholders have expressed concern that harmful industry conduct will be amplified by bad actors acting anticompetitively. During this critical transition period, additional oversight is necessary to protect Californians from further market dysfunction and potential market manipulation.

SB X1-2 established the Division of Petroleum Market Oversight (DPMO). This division operates independently of the CEC's authority but is housed within and supported by the CEC for close coordination with the new data collection provisions of SB X1-2. DPMO assesses and investigates petroleum market conditions with authority to subpoena firms and refer matters for prosecution.

Californians Deserve a Strategic Transition Away from Petroleum Transportation Fuels

The Transportation Fuels Assessment is only one component of SB X1-2. The Assessment identifies methods that may help in smoothing and managing retail prices under a general framework of the transition away from petroleum fuels, with an emphasis on gasoline. It also contributes to the understanding of gasoline price spikes and identifies potential actions that can help to mitigate or eliminate them. However, a series of additional considerations with a more careful eye on environmental impacts, market dynamics at the retail level, and other issues, will be critical parts of the Transportation Fuels Transition Plan, developed by both the CEC and CARB.

California is leading the United States in a bold zero-emission, clean energy future. Moving forward also requires attention to ensure that no one is left behind. There are critical lessons to be learned in building out the state's clean energy systems, as well as those from smoothly and equitably transitioning away from the fossil fuel dominated energy systems. These lessons will be fundamental in both assisting other economies and helping to ensure that the state's residents can benefit from clean energy.

CHAPTER 1: Transportation Fuels in California

The Need for a Transportation Fuels Assessment

California's legislature directed the CEC to address transportation fuels in the context of a gasoline price spike in 2022 and the state's bold climate change vision. Senate Bill X1-2 (Stats. 2023, 1st Ex. Sess. 2023, ch. 1) requires the development of an assessment to address the key issue of ensuring a reliable supply of affordable and safe transportation fuels for combustion vehicles in California in the context of transitioning to a zero-emission future.

California's transportation fuels market is currently dominated by gasoline and diesel, the main fuels of consideration in this assessment. These two fuels have two major challenges that affect the stability of transportation fuels prices: an ongoing challenge and a long-term challenge. The ongoing challenge is that supply of these fuels is increasingly constrained with the potential for significant supply shocks, while demand is falling at a gradual pace and there is a significant segment of the population that continues to rely on gasoline (even at very high prices) for their essential transportation needs. California has only two sources of transportation fuel: in-state refining of crude and marine imports of refined fuels. While fuel storage facilities exist to provide some buffer, they are limited and can assist only with short-term fluctuations in refining or gaps in imports. Increased vehicle fuel economy, adoption of zero-emission vehicles (ZEVs), and the recent growth in telework have contributed to gasoline demand contraction since its peak in the early 2000s. Despite these factors and a likely substantial decline in demand moving forward, gasoline is likely to remain the leading transportation fuel for at least a decade, and customers are often captive to changes in prices given limited transportation alternatives.

The longer-term challenge is that ZEV adoption will lead to the most significant change in transportation since the mass production of the internal combustion engine vehicle – the complete transition away from petroleum-based vehicles to zero-emission vehicles, which will fundamentally alter the transportation fuels market.

Understanding the implications of these two challenges and potential options for addressing them is an essential first step in a near-, mid-, and long-term planning effort for the state. This chapter further explores the context that has led to this assessment.

California's Fuel Landscape

California's transportation fuels market differs from many others in the United States. Despite being directly geographically connected to other states, its relatively isolated transportation fuels market makes it essentially a fuel island. Figure 1 shows the fuel pipeline flows for California, Nevada, and Arizona. California has limited fuel connectivity with other states. Some refined fuel is exported to Arizona and Nevada via pipeline. Other refined fuels are, on occasion, exported by ship out of state. However, unlike most other states in the country, there are no gasoline pipelines for import into California, since none of the adjacent states have fuel refineries.[1] Additionally, the northern part and southern part of the state are not connected by a gasoline pipeline, making them somewhat isolated from each other. The only other way California receives significant quantities of gasoline or gasoline blending stocks is by ship.

Figure 1. Map Showing Pipeline Flows for California, Nevada, and Arizona

Credit: EIA West Coast Transportation Fuels Markets[2]

Other states in the federal Petroleum Administration for Defense District 5 (PADD 5)[3] have similar limited connectivity issues and similar long lead times for deliveries of refined fuels. However, California's unique CARBOB gasoline specification differs from all other states.[4] The CARBOB specification in the California Reformulated Gasoline (CaRFG) Regulation reduces air pollution and is an essential strategy adopted as part of California's State Implementation Plan (SIP). The SIP is a federally mandated plan to ensure that the state is on a path to significantly reduce harmful environmental pollutants that impact public health in California. Current air quality detriments contribute to billions of dollars per year in health-based

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1 The closest fuel producing refinery hubs are in Washington state, where the product is received through both a marine terminal and pipeline; Utah, where there is a pipeline through to Nevada; and New Mexico/El Paso, Texas, which has a pipeline that goes directly to Phoenix but is not connected to Southern California.

2 Adapted from U.S. Energy Information Administration Analysis & Projections of West Coast Transportation Fuels Markets. 2015. Available at: https://www.eia.gov/analysis/transportationfuels/padd5/

3 PADD 5 states include Alaska, Arizona, Hawaii, Nevada, Oregon, and Washington, in addition to California.

4 The CARBOB specification was developed to help address the state's unique air quality challenges. CARBOB is blended with 10 percent ethanol prior to distribution to retail stations. The formula changes during summer months to a specification that reduces evaporation during warmer conditions but remains distinct from other formulations used in the United States since it has lower sulfur content and much lower benzene content.

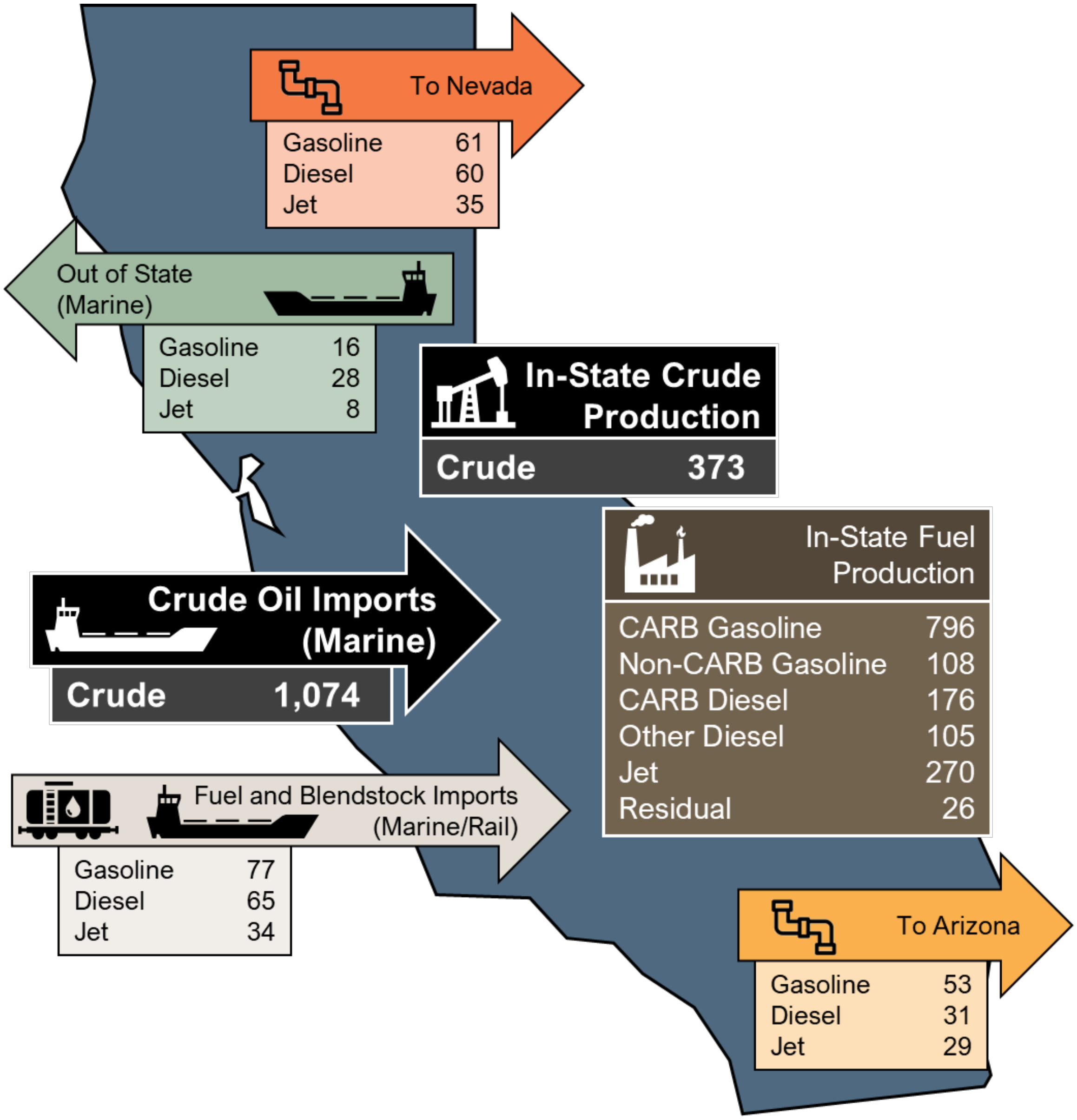
damages. Presently, out of state CARBOB production is limited to a few refineries outside of the state.

The result of this unique specification is that nearly all of California's gasoline is refined in the state, over 85 percent in 2022. Gasoline and blendstock ship cargos take three to six weeks to arrive from overseas, presenting significant challenges for unplanned events that constrict supply.

In 2022, Californians purchased 13.6 billion gallons of gasoline at the retail level, approximately 885 thousand barrels per day (TBD). Given that 10 percent of retail gasoline is ethanol, this amounts to about 800 TBD of CARBOB.

Figure 2 shows the average daily movements and processing of crude and fuel for 2022. The figure shows exports into Nevada and Arizona and to other states by marine vessels. It also shows crude imports and fuel outputs from refineries. Of note are diesel fuel movements. California imports a large amount of biodiesel and renewable diesel (RD), encouraged by the state's low-carbon fuel standard. The state also exports much more diesel fuel than gasoline as a proportion of production, again influenced by the low-carbon fuel standard's incentivization of lower-carbon imports. The figure shows the approximate breakdown of crude-to-fuel conversion: for five units of input crude, refining typically produces about three units of gasoline, one unit of diesel, and one unit of jet fuel. There is some flexibility to get a greater proportion of specific fuel proportions from input crude, but this capability is limited.

Figure 2. 2022 Daily Average California Fuel and Crude Movements and Production Volumes (Thousand Barrels per Day, TBD)

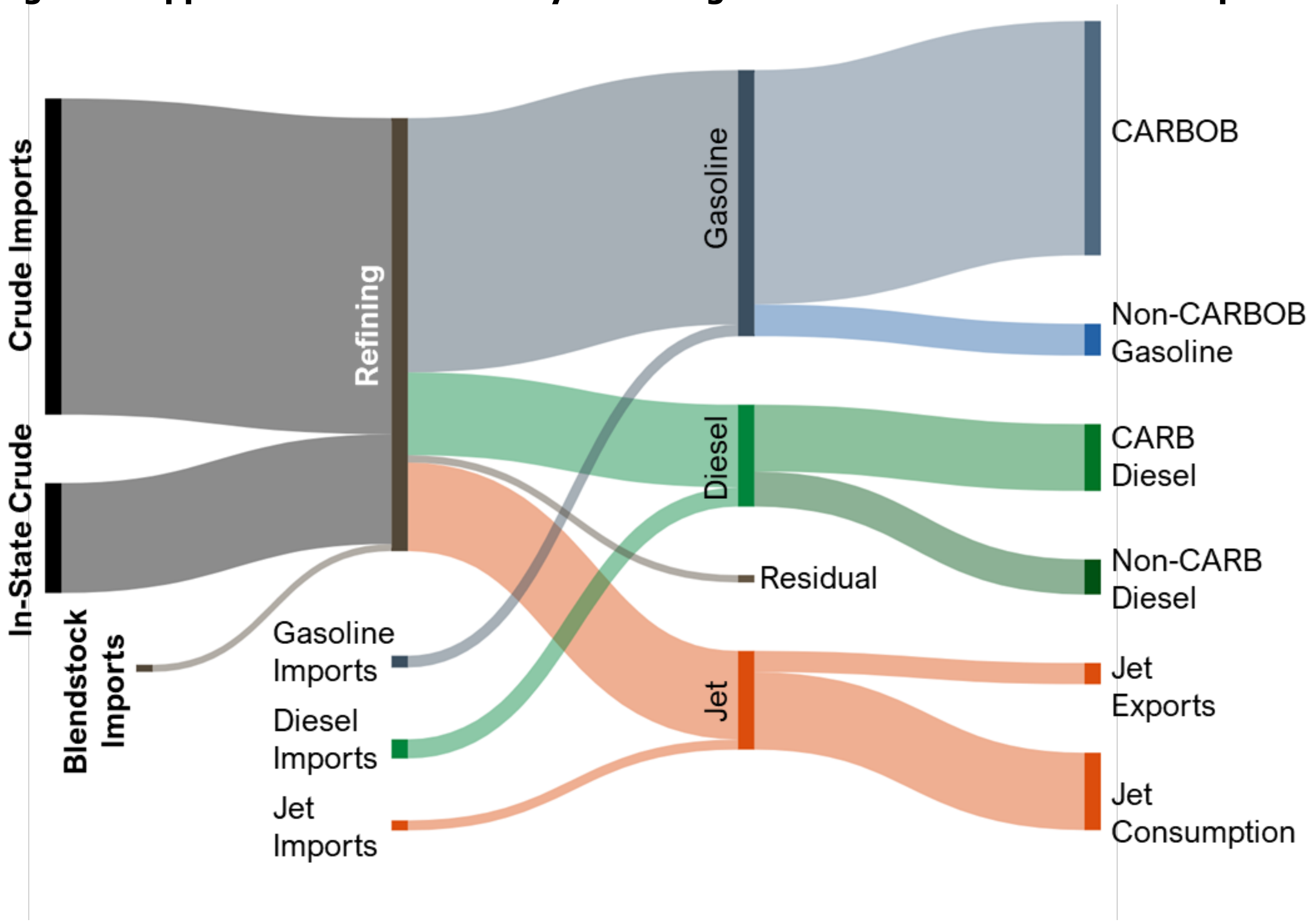


Note: Non-CARB fuel produced in-state is exported to Arizona and Nevada via pipeline, or otherwise out of state via marine vessels.

Credit: CEC Staff

Figure 3 shows the approximate magnitudes and import and export pathways described in the previous figure in the form of a Sankey diagram. On the left are in-state crude production, crude imports, and imports of gasoline and blendstocks that may be used at various stages of refining or pass through refineries into the gasoline supply. Refined gasoline, diesel, and refined jet fuel, along with imports of each, combine with production to result in a set of outputs that are either in a CARB formulation for in-state consumption or exported out of the state.

Figure 3. Approximate Fuel Pathways and Magnitudes for Crude and Other Imports



Credit: CEC Staff

The gasoline refining process is complicated, but in broad terms, California has a refining capacity comparable with its demand. Figure 4 shows the refineries responsible for in-state gasoline production, along with recently closed or converted refineries. While there are 9 CARB specification gasoline producing refineries in the state, four companies own more than one refinery within California, meaning that, of the over 1,000 TBD of California's gasoline refining capacity, five companies control over 90 percent.[5]

Figure 4 shows the approximate maximum CARBOB production capacity of each refinery based on a simple 60 percent conversion assumption of refinery crude input processing capacity:[6]

- Blue tinted bars represent northern California refineries.
- Salmon tinted bars represent southern California refineries.

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5 Staff analysis of publicly available data on California's Oil Refineries. Available at https://www.energy.ca.gov/data-reports/energy-almanac/californias-petroleum-market/californias-oil-refineries

6 This simple assumption is not intended to be precise. Detailed production data is confidential in accordance with PIIRA.

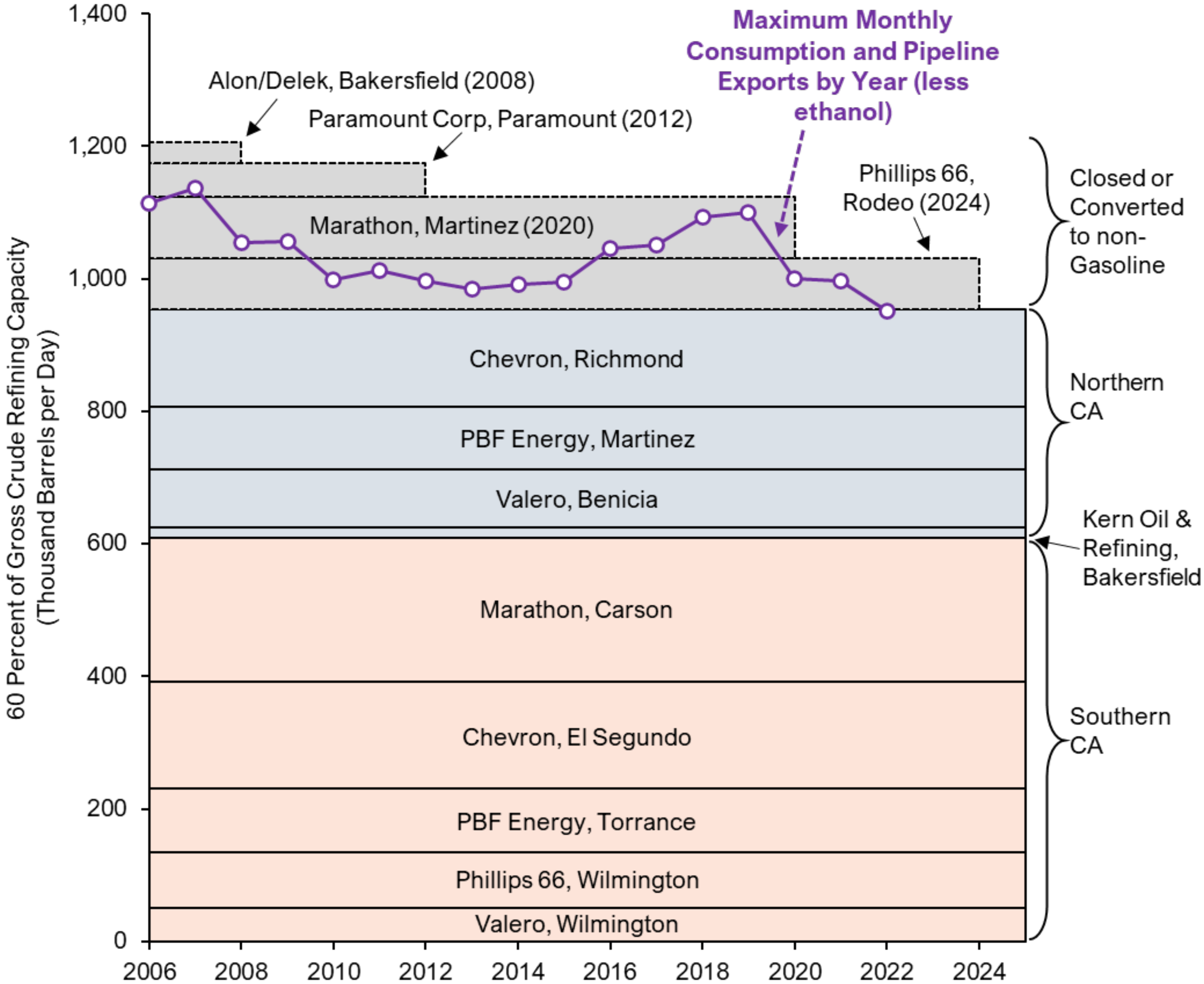
- Gray bars represent gasoline refineries that have closed or are scheduled to close by 2024.
- This figure only shows the CARB specification gasoline producing refineries. It does not include the refineries that only produce CARB specification diesel, such as the San Joaquin Refining Company's Bakersfield refinery.

As California refineries have closed or converted away from gasoline production in the last two decades, maximum gasoline refining capacity has decreased by more than 200 TBD. For example, in 2020, the Marathon Martinez refinery converted to renewable diesel production with no crude refining capacity. Similarly, the Phillips 66 Rodeo refinery ceased production of CARBOB in 2024 and converted to renewable diesel. With these conversions, statewide gasoline refining capacity decreased by nearly 200 TBD.

Refineries typically operate at their maximum stated capacity when possible. Some gasoline produced is non-CARBOB and exported out of the state, much of it on a contractual basis going to Arizona and Nevada. California refineries meet nearly all of California's gasoline demand, with imported gasoline meeting the small residual demand. In Figure 4, the purple line represents the maximum monthly consumption and pipeline exports, which shows that peak demand and supply capacity for gasoline is very tight.

When gasoline prices are high, the more costly marine imports of refined fuels and blendstocks satisfy some of the state's gasoline demand. Refineries occasionally order marine imports ahead of time to address expected supply shortages, but these imports, if any, do not typically replace the full measure of lost production. Moreover, long lead times make marine imports of refined gasoline less feasible for meeting immediate demand when California refineries experience unplanned reductions in capacity or have other supply shortages.

Figure 4. Approximate Peak Gasoline Refinery Capacity Compared to Maximum-Monthly Consumption



Credit: CEC Staff

California is essentially a fuel island. There are no pipeline inflows of refined fuel into the state, and cargo ships delivering CARBOB take three to six weeks to arrive from distant facilities capable of producing CARBOB. By contrast, many other states have a broad network of pipeline flows, multiple regular sources of marine imports, and similar fuel specifications to neighboring states, all of which help to maintain supply resiliency and hence price stability in the market. However, California's petroleum refining industry isolation is driven by several factors.

First, the state is geographically large (164 thousand square miles), topographically complex, and neighboring states are far from California's population and economic centers. The state's population and economic centers are largely clustered in Southern California and in the San Francisco Bay Area—nearly 400 miles apart. While the state is adjacent to three states, the prospect of building a pipeline distribution system, traversing mountain ranges and deserts to reach the coast or between urban centers may be economically unattractive.

Another reason for California's petroleum isolation is that the petroleum refining industry is an inherently high fixed-cost industry. When industries face extremely high costs, it is inefficient for multiple firms to compete and duplicate infrastructure, which would be prohibitively expensive. The result is increased market concentration and potential risk to consumers.

A third factor in explaining California's petroleum refining isolation is the state's CARBOB requirement. To meet federal air quality standards California phased in its reformulated gasoline requirements in 1992, 1996, and 2003. Californians have benefited from this change in terms of reduced air toxins, improved health, better environmental outcomes, transportation fuels innovation, and other benefits. For example, the California Office of Environmental Health Hazard Assessment found an 80 percent reduction in cancer risk associated with exposure to gasoline-related pollutants between 1996 and 2014.[7] Despite this and other successes, California continues to face challenging air quality management, exacerbated by climate change impacts. By adopting CARBOB, the state also faces an additional trade-off of further isolating the state's petroleum refining industry.

Petroleum refining isolation and market concentration leave California's gasoline market vulnerable to price instability due to crude oil uncertainty, few substitution opportunities on the supply and demand side, and incentives for market manipulation by suppliers with market power. While no state is immune to the broader challenges of crude oil price instability, California faces fuel price instability even when the crude oil markets are stable. Gasoline price stability in the state is closely tied to the available refining capacity, which is highly sensitive to planned and unplanned refinery shutdowns.

A planned refinery shutdown is known well in advance by the refiner, sometimes several years in advance. A refiner with planned maintenance will sometimes build up inventories of product or schedule imports ahead of time to create a supply buffer to replace some lost production. Refiners are not compelled to store fuel, and supply buffers for planned shutdowns typically are not sufficient to prevent an unexpected tightening of statewide supply. When an unexpected refinery shutdown occurs in California, refiners have limited options to resupply quickly, especially with gasoline.

Demand for gasoline is also challenging. Although demand for gasoline peaked in 2005 and ZEV adoption makes fewer drivers dependent on gasoline, demand remains high. Californians must often drive far distances for work and other activities. During price spikes, sales may often remain high because of the difficulty many Californians have in meeting transportation needs with lower cost options. September 2022 and October 2022 gasoline sales were higher than traditional index values for each of those months, despite a price spike in September

7 California Office of Environmental Health Hazard Assessment. 2018. Gasoline-Related Air Pollutants in California. Available at https://oehha.ca.gov/media/downloads/air/report/oehhagasolinereportjanuary2018final.pdf

2022.[8] This "inelasticity" of demand means that price spikes can result in significant costs to Californians who have limited options.

Major Supply and Demand Drivers

Figure 5 plots monthly CARBOB demand against in-state CARBOB production, both actual production and an estimated maximum sustainable production.[9,10] The figure shows that CARBOB demand post-2020 is down approximately 100 TBD (11 percent) from pre-2020 levels. The market rebalanced with the conversion of one refinery in 2020.

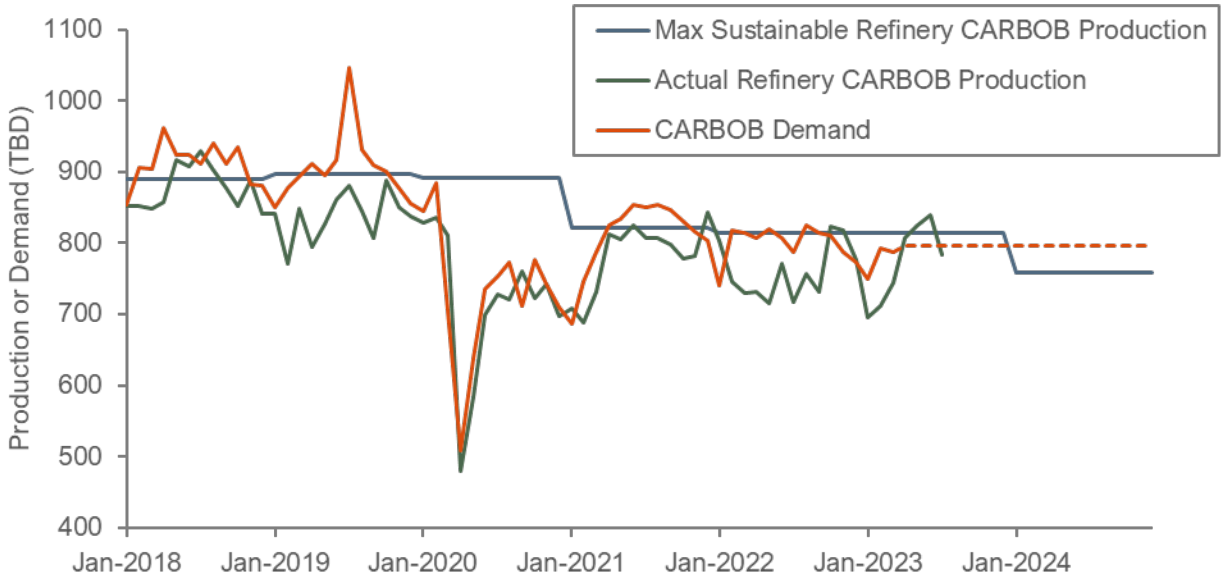
Although post-2020 maximum sustainable refinery CARBOB production remains capable of meeting current demand, actual refinery production has lagged maximum levels due in part to planned and unplanned refinery outages. Maximum sustainable refinery CARBOB production has declined further with the 2024 conversion of the Phillips 66 Rodeo refinery. The small gap between production capacity and demand increases price spike risk. Even if spikes do not occur every year, small production problems or other market effects make them more likely.

8 CEC staff analysis of gasoline sales data from the California Department of Tax and Fee Administration. Available at https://www.cdtfa.ca.gov/taxes-and-fees/spftrpts.htm

9 CARBOB lines in the chart do not include the total volume of supply and demand of gasoline, of which 10 percent is ethanol. Actual supply and demand of retail gasoline should be taken to be 10 percent larger.

10 Maximum sustainable refinery CARBOB production is estimated by taking the total operating California refinery capacity as of January 1 each year and assuming a 52 percent CARBOB yield and a 90 percent maximum sustainable capacity utilization. The maximum sustainable refinery CARBOB production is projected forward through the end of 2024, assuming the shutdown of the TBD Phillips 66 Rodeo refinery in 2024. A simple flat calculation of 57 TBD of maximum sustainable yield of CARBOB is assumed for this refinery's stated capacity of 128 TBD of crude refining capacity. Demand is projected forward from March 2023 using a flat assumption of 800 TBD.

Figure 5. Actual and Maximum Sustainable California Refinery CARBOB Production vs. CARBOB Demand, January 2018 - December 2024



Credit: ICF analysis of EIA and CEC data

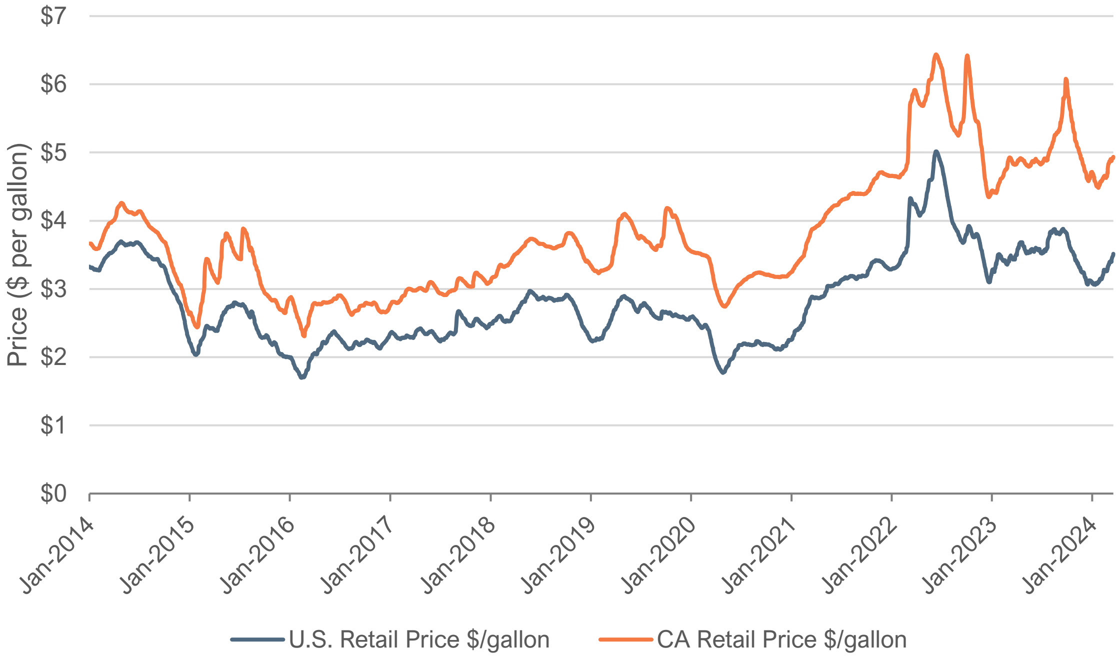
The 2022 Gasoline Price Spike

In 2022 the world faced an energy crisis triggered by Russia's invasion of Ukraine. Months after the onset of the war, September 2, 2022, California wholesale gasoline prices (also known as the CARBOB Spot market) began steadily rising, resulting in a price spike that peaked at $6.21 on October 3, 2022, $2.61 higher than the U.S. average. The spike ended shortly after Governor Newsom sent a letter to CARB on September 30, 2022, calling for an early transition to winter blend fuel specifications to increase supply, which allows refiners to produce higher gasoline volumes. Thereafter, prices began to decline for several weeks, marking one of the sharpest 4-week declines in gasoline prices in CEC records for the last 20 years. In 2022, petroleum companies reported record profits.[11] CEC is still evaluating the in-state costs and profits associated with the 2022 spike in the context of seasonal variability.

The figure below shows the average gas prices for California and the United States. In 2022, it is shown that the second price spike was only experienced in California and not the rest of the country.

11 See the Governor's January 31, 2023 press release. Available at https://www.gov.ca.gov/2023/01/31/big-oil-made-record-2022-profits-while-fleecing-california-families/

Figure 6. California and U.S. Retail Gas Prices in $/gallon[12]



Credit: EIA Data

In response to the 2022 gasoline price spike, the CEC held a hearing on November 29, 2022, to examine the factors behind this price spike.[13] The hearing discussed differences between the 2022 September-October price spike contrasted with previous price spikes. Unique to the 2022 price spike was the lack of a major unplanned shutdown event. Instead, planned maintenance at several refineries extended past their projected completion dates. Of the ten refineries that then produced CARBOB, four refinery maintenance periods overlapped. This led to a significant reduction in production beyond the decline typically occurring with maintenance. This reduction cumulatively totaled six percent, or 55 TBD, and held longer than anticipated for weeks, while inventory levels remained at decade lows. The spike ultimately pushed retail prices to $2.61 higher than the rest of the United States.

A discussion panel at the hearing identified the conversion of Marathon Martinez refinery, completed in October 2020, as a contributing factor to the low inventory levels and general supply tightness underlying the 2022 price spike. A leading cause for Marathon Martinez's early conversion was due to the COVID-19 pandemic's demand shortfalls. The hearing panel identified many other factors that contributed to the spike. Many of these factors were similar to those in previous price spikes. Some panelists stated that refineries exerted market power

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12 These values are not adjusted for inflation. That is, they are nominal values rather than inflation-adjusted "real" values.

13 See CEC's website for a transcript of the November 29, 2022, "Commissioner Hearing on California Gasoline Price Spikes, Refinery Operations, and Transitioning to a Clean Transportation Fuels Future." Available at [Commissioner Hearing on California Gasoline Price Spikes, Refinery Operations, and Transitioning to a Clean Transportation Fuels Future]

to take advantage of a shortage, while others acknowledged the general concentrated supply dynamics of the California market.

Spot Market Concerns and Manipulation Risks

The conditions surrounding the 2023 gasoline price spikes raised already heightened concerns about possible market manipulation in the petroleum refining industry. The Division of Petroleum Market Oversight (DPMO), recently established under SB X1-2, identified a potential concern in the spot market. An unusual transaction on September 15, 2023, caused the spot market price to increase by nearly $0.50 per gallon within one day.[14] Changes in the spot market directly affect contracts indexed to the reported price and also heavily influence overall market participant perceptions. This in turn impacts other wholesale and retail prices in very short order. DPMO also identified several other critical issues that may have exacerbated the price spike, including unnecessarily low inventories and inadequate imports to address backfill production shortfalls. Continued price increases throughout this price spike period were a significant cost to consumers.

The spot market is of concern because it is opaque and susceptible to manipulation. Not all transactions on the spot market are reported to price information companies such as OPIS, and in some cases, there may be an incentive for an actor to make a large high-cost purchase and report it to encourage a spike when there is no underlying supply tightness. The spot market is discussed in more detail in Chapter 2, and is an important place for policy reform, as discussed in Chapter 3.

Longer-Term Challenges with Price Stability

Although recent late summer-early fall gasoline price spikes caused undue financial strain for Californians, each was addressed relatively quickly compared to other price spikes. The spikes did, however, serve as a broader indication of potential gasoline price stability challenges as Californians transition to a low-carbon economy.

California is leading the way to a low-carbon economy, including through dramatically reduced gasoline consumption from just a few years ago. The significant changes that have occurred in commute patterns and adoption of ZEVs in the past several years have resulted in Californians consuming nearly two billion fewer gallons of gasoline in 2022 and 2023 than in 2019.[15] As noted above, this marked change in consumer demand is expected to be much more gradual going forward than it was in the wake of the Covid-19 pandemic. However, supply will likely constrict in a manner which is lumpy -- as observed in the last several years, additional refineries are likely to convert to producing other non-CARBOB fuels or discontinue operation, resulting in significant and sudden reductions in supply.

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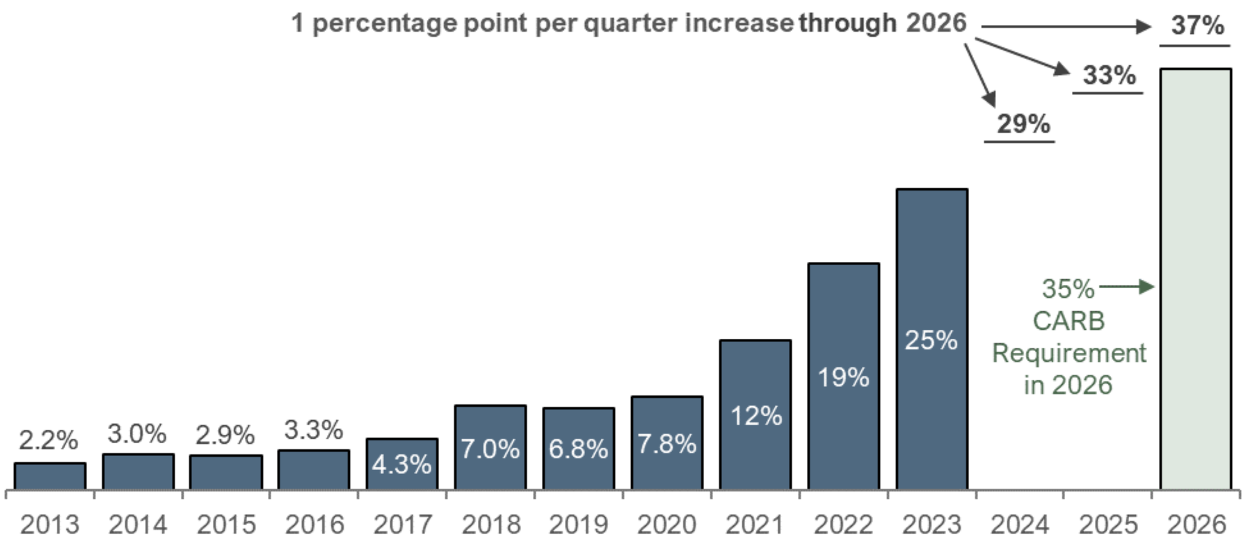
14 State Officials Provide Update on Gas Prices, Unusual Petroleum Market Transaction (ca.gov). Available at https://www.energy.ca.gov/news/2023-09/state-officials-provide-update-gas-prices-unusual-petroleum-market-transaction

15 See 2024 California Energy Commission and California Department of Tax and Fee Administration Joint Report to Legislature, at Figure 2.

Of note is the increase in new ZEV sales seen in the last few years, growing to one in four new cars in 2023. Continued growth in ZEV sales share is expected from increasing manufacturer investments as well as the CARB's Advanced Clean Cars II Regulation. This regulation increases requirements starting in 2026 for ZEVs to ultimately reach 100 percent of new light-duty vehicles sold in 2035.[16] The most recent market data from the CEC's ZEV sales dashboard suggests that vehicle manufacturers in the state are on a trajectory to exceed the regulation.[17]

Figure 7 shows the ZEV market share seen in the last decade. A conservative extension of continued market growth in ZEV sales (one percentage point per quarter) shows that ZEV sales will meet or even exceed the 2026 ZEV sales share requirement of 35 percent.

Figure 7. ZEV Market Share of New Passenger Vehicle Sales and Simple Projections



Credit: CEC ZEV Dashboard

In the medium- and heavy-duty vehicle market, ZEVs are also poised for rapid growth. New regulations by CARB will require these fleets to increase their proportion of ZEVs to improve air quality and address climate change. While this is expected to occur slightly behind the pace of the light-duty sector, technological advancements seen in the light-duty sector will likely translate into high levels of growth in this sector as well.

Increasing customer interest in ZEVs combined with new ZEV sales requirements are changing customer demand currently and may further change customer behavior. For example, with more ZEV ownership, demand elasticity for gasoline may increase. This could occur in cases where a family owns both an electric car and a gasoline-powered car. During a price spike for gasoline, the family may opt to drive the electric car more. This transportation substitution effect would be a substitution behavior that was previously more limited. Such a behavior may

16 California Air Resources Board. 2024. "Advanced Clean Cars II." Available at https://ww2.arb.ca.gov/our-work/programs/advanced-clean-cars-program/advanced-clean-cars-ii

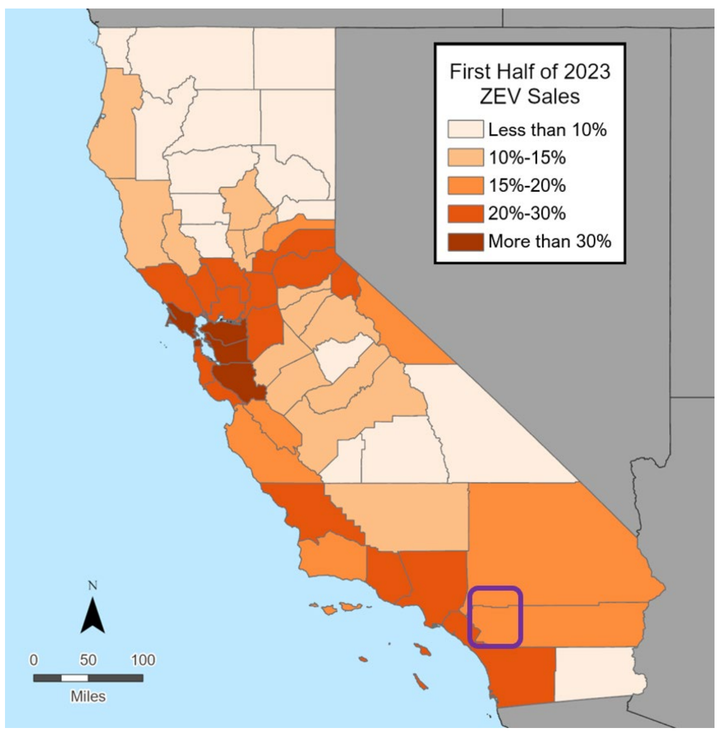
17 California Energy Commission. "New ZEV Sales in California." Available at https://www.energy.ca.gov/data-reports/energy-almanac/zero-emission-vehicle-and-infrastructure-statistics/new-zev-sales

provide enhanced demand responsiveness that could add to price stability. It should be noted, however, that lower-income families tend to have lower levels of multiple vehicle ownership. Families that only own only one car, if it is not a ZEV, would not benefit from a direct fuel substitution effect, but they may benefit from the broader price stability effects.[18]

Even with the successful implementation of CARB's Advanced Clean Cars II and other regulations with 100 percent sales requirements in 2035 and 2036, internal combustion engine (ICE) vehicles will not completely disappear in the mid-2030s. For at least one or two decades following full implementation of these regulations, ICE vehicles will remain on roads, although their presence will decline. These vehicles will need gasoline.

The distribution of ICE vehicles on the road in future decades in the state will present equity challenges. Figure 8 shows the distribution of ZEV new sales share by county. The figure indicates that rural areas of the state do not have the sales penetration that more urban areas of the state have. The purple box in the figure shows dense urban areas in the far western portions of counties that are otherwise rural — a county may look higher overall because of the dense urban areas in the western portion.

Figure 8. New ZEV Sales Share by County



Credit: CEC Staff

Given that many ICE vehicles will remain on the road and many of the owners may be in less affluent regions of the state, an equity challenge arises when thinking of ZEV deployment. A less stable gasoline price may not have any impact on an upper middle-class resident who

18 For example, CEC staff analysis for transportation forecasting shows that, for families with a household income of $80,000 per year or less, the ownership rate of more than one vehicle is 35 percent. For families with a household income of greater than $80,000, the ownership rate of more than one vehicle is 72 percent.

lives in Los Angeles and drives a ZEV. By contrast, it is likely that many or perhaps most rural and lower income residents may be most impacted by future gasoline price spikes. The state has programs that enhance ZEV access for many low-income California families. For example, the Clean Cars 4 All program allows low-income families that live in or near a disadvantaged community to receive large incentives to scrap an older, higher emitting vehicle for a clean mobility option. Under the Funding Plan for Clean Transportation Incentives, 63% of the 2023-2024 fiscal year's investment funds will go toward bolstering equitable access, resources, and support for low-income and disadvantaged communities.[19] Although these efforts to build towards an equitable transition are critical, the state must also address gasoline demand that remains.

In addition to the challenge of the long-term demand for fuel, albeit at a lower volume, as described above, there is a challenge with the supply of fuel. With only nine refineries in the state producing gasoline, permanent declines in demand will have unknown effects on the market. It is possible that more refineries will close or convert to producing renewable fuels, decreasing the resiliency of CARBOB supply to the California market. Another supply shock in these conditions could lead to price spikes, which would have the largest impact on vulnerable communities.

Future Demand Disruption

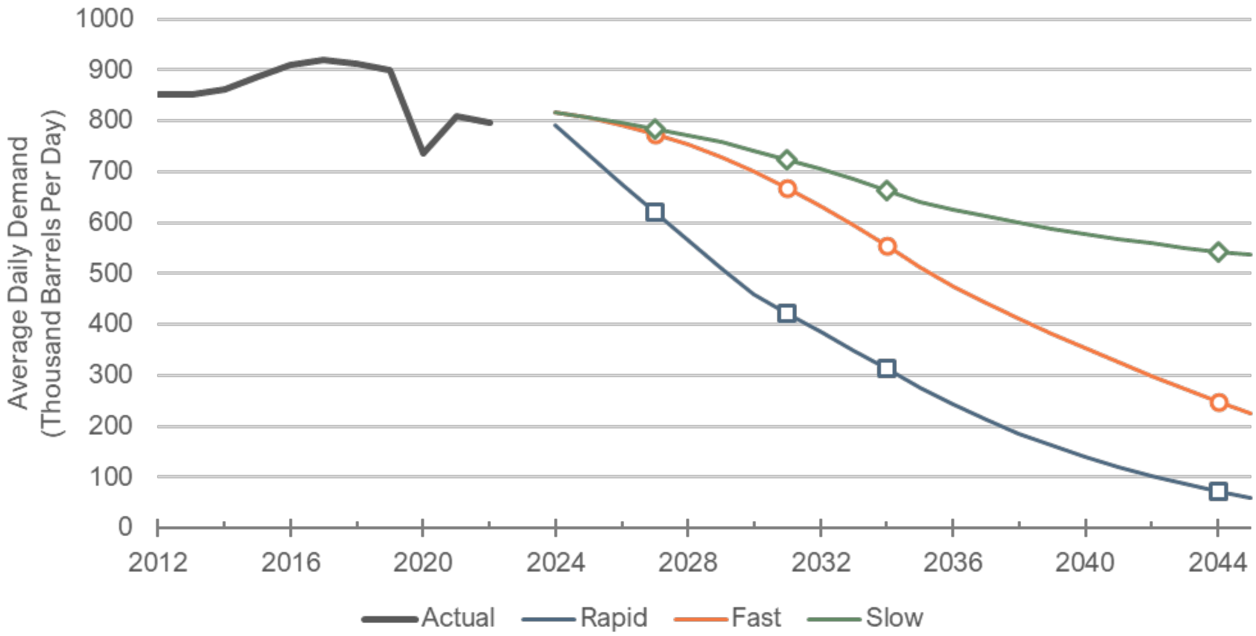
With the proliferation of zero-emission technologies, there are implications for the combustion fuels market. As demand for combustion fuels declines, refineries may close, resulting in a less resilient supply. With fewer refineries, unplanned maintenance or extension of planned maintenance at one or more remaining refineries will mean that a larger proportion of in-state supply is offline. Further, the pace of ZEV deployment still has some uncertainties. A wide variety of scenarios with different trajectories is important to envision the implications of the transition.

Fuel Demand Scenarios Considered

Figure 9 shows historical consumption and three demand scenarios of gasoline associated with potential ZEV adoption and customer behavior changes. The scenarios are drawn from CARB's 2022 Scoping Plan and CEC's Integrated Energy Policy Report (IEPR) forecast and includes a rapid development, a fast development, and a slow development of ZEV adoption (and associated gasoline demand decline). Refinery dynamics are likely to differ in each scenario but may reveal important patterns and sensitivities. Markers for each scenario are applied at 3-year, 7-year, 10-year, and 20-year intervals from 2024 for reference.

19 CARB Press Release: CARB approves incentive funding plan that invests in equitable transition to zero-emission future. Available at https://ww2.arb.ca.gov/news/carb-approves-incentive-funding-plan-invests-equitable-transition-zero-emission-future

Figure 9. CARBOB Consumption and Demand Scenarios Under Consideration for the Assessment



Credit: CEC Staff, CARB Scoping Plan Data [20]

The rapid development shows a sharp decline in gasoline demand in early years and continued decline through 2045. This development is based on CARB's 2022 Plan Update for Achieving Carbon Neutrality (Scoping Plan). Driving the decline in demand is a rapid market expansion of ZEVs and a marked decline in per capita passenger vehicle miles traveled (VMT). The Scoping Plan scenario includes a 25 percent reduction in per capita VMT by 2030 compared to 2019, growing to 30 percent by 2045. The Scoping Plan discusses a series of strategies for achieving this goal, but there are no statutory or regulatory mandates that require VMT to decline. One such strategy to reduce VMT is to foster more compact, transportation-efficient development in infill, urban areas.

The fast development shows a gradual decline in gasoline demand through 2028, with a transition to a steep descent through around 2037. Remaining ICE vehicles and other sources of demand slow the decline of demand through 2045. This scenario is an extension of the CEC's 2022 transportation energy demand forecast scenario called Additional Achievable Transportation Electrification Scenario 3. This scenario through 2035 is a regular component of the CEC's IEPR. The scenario incorporates ZEV adoption as required with CARB regulations, such as Advanced Clean Cars II and Advanced Clean Fleets. The extension of fuel demand past 2035 is somewhat limited in the CEC's transportation energy modeling framework, but it does present a distinct picture from the CARB scenario. The difference between this scenario

20 Actual demand for 2023 will be available in mid-2024.

and the rapid scenario primarily results from a difference in per capita VMT. The fast development does not assume a decline in per capita VMT.

The slow development shows a noticeable decline through 2035 but then only slightly declines in demand post 2035. This scenario is an extension of the IEPR transportation forecast baseline forecast, which has lower ZEV adoption than the fast development. This scenario is not driven by the CARB regulations in the fast development scenario. Rather, the slow development scenario is driven primarily by 2022 market trends and existing and projected consumer preferences for ZEVs. This type of scenario could occur if federal preemption or judicial decisions were to limit the ability of CARB to enforce its vehicle regulations.

Fuel Supplier Pathways in Response to Demand Scenarios

As gasoline demand declines in the coming years (consistent with the demand scenarios above), refiners and suppliers will need to determine how to modify their operations as CARBOB demand declines. These actions may differ among refiners due to each having different perceived market risks as demand profiles decline. Below are two general response pathways. The actual response pathway may represent a combination of different responses from each refiner and within Northern California or Southern California.

One possible pathway is that refining declines as demand declines and California has adequate supplies to meet demand, resulting in refinery closures. Another pathway is for refiners to pivot towards exports of refined fuels or blendstocks. However, if refineries close, or if export strategies result in lower CARBOB production capacity, demand could quickly outpace supply and price spike risk will increase. The purpose of this report is to explore different future scenarios and identify how the state might intervene to assure an affordable, reliable, equitable, and safe supply of gasoline for consumers who need it.

Pathway One: Reduced Gasoline Production

In pathway one, penetration of ZEVs and the associated decline in gasoline demand will drive a reduction in CARBOB production in the state.[21] In this scenario, refiners would reduce crude refining runs to lower the production of gasoline. Eventually, declining refinery operations will lead to refinery closures or conversions to non-gasoline biofuels.

Although there is some flexibility with refining crude oil into different fuels besides gasoline, this capability is limited. Petroleum diesel is an unlikely alternative, as renewable diesel penetration has grown to more than half of all diesel consumed in the state as of 2022.[22] The limitation of gasoline production shifting to diesel production is also suggested by the recent increase in diesel marine exports as a proportion of total marine exports. Diesel production will also decline as renewable diesel production or imports into California continue to grow. Shifting some gasoline production to jet fuel production is more likely, but the ability to do so is limited for each refinery.

21 This assumes that Nevada and Arizona demands are stable.

22 California Air Resources Board. "Low Carbon Fuel Standard Reporting Tool Quarterly Summaries." Available at https://ww2.arb.ca.gov/resources/documents/low-carbon-fuel-standard-reporting-tool-quarterly-summaries

The specific refineries that would shut down under this pathway are uncertain, but the in-state capacity for refining would not be a smooth decline like the demand scenarios. Rather, the supply response will be "lumpy" in the sense that a typical refinery is capable of supplying about 10 to 20 percent of overall state demand. Should one refinery close or convert (to renewable diesel), a large portion of in-state CARBOB supply essentially vanishes. The position of other refineries will be temporarily bolstered, resulting in an increase in market concentration. However, suppliers could choose to secure additional CARBOB supply from other domestic or foreign refiners if it is economically viable.

Declining demand may make it more difficult for smaller refiners to remain in the market. This could result in only the larger refiners remaining in each of the northern and southern parts of the state and consolidating the market, reducing competition. Although the northern and southern parts of the state are somewhat isolated, intrastate shipping from one part of the state to another could become a more common practice (See Appendix A on Marine Imports Evaluation). It may be that in one part of the state the last remaining large refinery completely shuts down and the state becomes reliant entirely on imports or intrastate movements. Under these conditions of lower supply, shipping capacity at reception ports should be relatively feasible, as intrastate movement was quite common in previous years.

The specific assets that would shut down under this scenario are highly dependent on the refiners' strategies as they see how their current sales mix may or may not optimize their business.[23] Exports to Arizona and Nevada may also play a role, given that demand in these states may remain strong.

23 For instance, the refiner's sales mix of dealer tankwagon sales, branded or unbranded sales, bulk sales, etc., would impact the decision to shut down operations. Dealer tankwagon sales are delivered sales of branded fuel by a refiner or supplier to a service station. These sales prices are typically higher than Branded rack sales since they include the cost of delivery to the service station.

Table 1 lays out some possible pathways of refineries that could continue to produce gasoline under declining demand. Conceivably under the rapid development scenario, California could be down to one or no refineries by 2044, due to the decreased demand for gasoline in the State.

Table 1. Possible Gasoline Refineries Remaining Under Each Demand Scenario Under Pathway One

Year	Rapid Scenario	Fast Scenario	Slow Scenario
2027 **3 years**	620 TBD Demand 3 Northern refineries 4 Southern refineries	780 TBD Demand 4 Northern refineries 5 Southern refineries	785 TBD Demand 4 Northern refineries 5 Southern refineries
2031 **7 years**	420 TBD Demand 2 Northern refineries 3 Southern refineries	670 TBD Demand 4 Northern refineries 4 Southern refineries	720 TBD Demand 4 Northern refineries 4 Southern refineries
2034 **10 years**	310 TBD Demand 1 Northern refinery 2 Southern refineries	555 TBD Demand 3 Northern refineries 3 Southern refineries	660 TBD Demand 4 Northern refineries 4 Southern refineries
2044 **20 years**	70 TBD Demand Extremely low demand, possibly no refineries	250 TBD Demand 1 Northern refinery 1 Southern refinery	540 TBD Demand 3 Northern refineries 3 Southern refineries

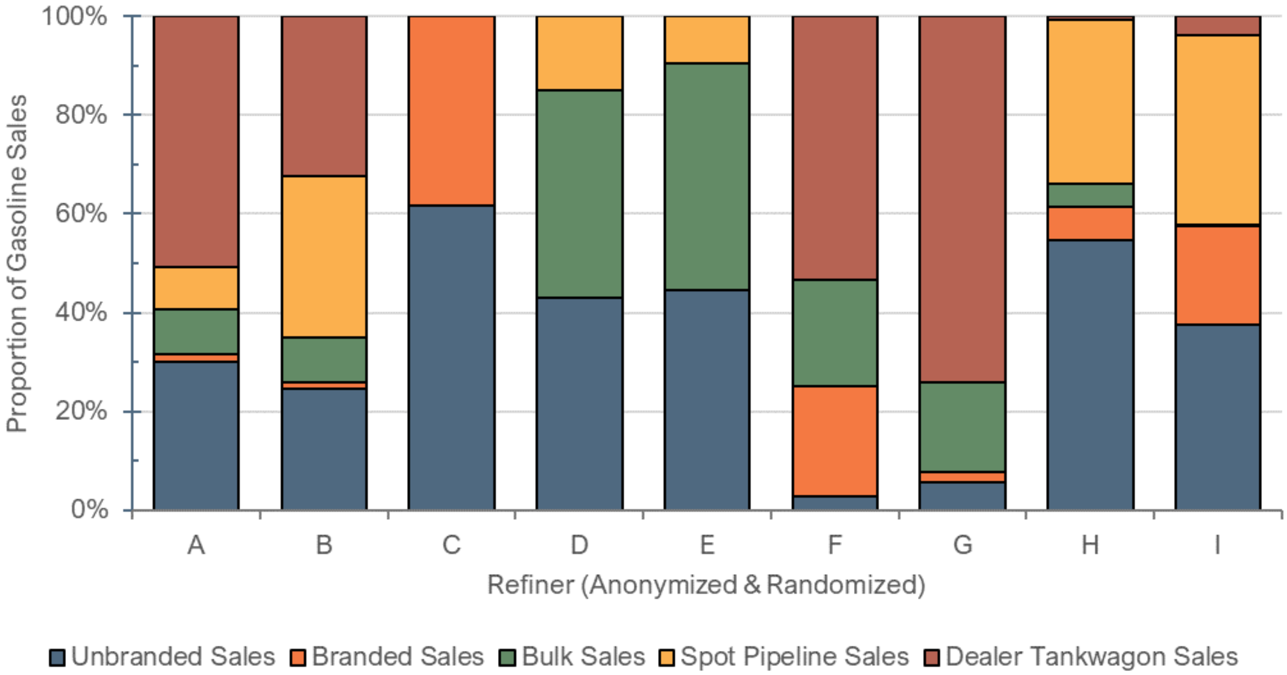
There are significant logistical issues that need to be resolved during the demand decline and supply phase down, which will be a primary component of the Transportation Fuels Transition Plan established in SB X1-2. The remaining refineries will need to be suited for access to their associated market. The response by infrastructure owners (i.e., terminals and pipelines) with much lower volumes is uncertain. Addressing other petroleum needs (e.g., lubrication products) may become challenging if the only refinery on the west coast capable of producing them closes. Jet fuel imports would need to increase substantially even with moderate penetration of reasonable substitute aviation services (e.g., sustainable aviation fuel, hydrogen, or electric aviation).

The precise response under the refinery closure pathway is also dependent on other factors besides refinery capacity, so the Pathway One supply responses in

Table 1 remain merely possible and not at the confidence level of a forecast. For example, individual refiner gasoline marketing and production optimization strategies are very diverse. For example, anonymized refiner data for July 2023 shows very diverse sales strategies (see

Figure 10) for CARBOB in California. Some refiners sell significant delivered dealer tank wagon (DTW) volumes, others a high percentage of unbranded fuel, and others spot market sales or bulk sales. It is uncertain which sellers would tend to leave the market first or how shifts in their sales strategies will unfold in response to declining demand.

Figure 10. Refinery Gasoline Sales Type, July 2023 by Refiner



Credit: CEC Staff

In addition to the uncertainties associated with supply reactions to declining demand, the associated gasoline price consequences are even more challenging. As mentioned above, increasing ZEV penetration may increase the elasticity of demand for gasoline in addition to the general demand for gasoline. Increased elasticity means that supply disruptions may be less problematic. However, general market concentration factors and the lumpiness of the decline suggest that higher prices and price spike risk may continue to be challenging, especially for lower-income California families. This speaks to the importance of policies to mitigate price spikes, discussed in Chapter 3.

While Pathway One shows a future where the refineries will gradually close over time as the demand for CARBOB declines, the CEC notes that refiners could continue to process crude and export product to domestic and foreign markets, extending the effective life of some refineries at least.

Pathway Two: Maintain Crude Runs and Export Non-CARBOB Gasoline

In light of declining demand for CARBOB, it is possible that some refiners may maintain crude processing and export gasoline or gasoline blendstocks to other states or foreign countries.[24]

24 The study assumes that the Phillips' Rodeo refinery will close as planned in 2024.

The likely main export markets would be to foreign countries via marine cargos. Pipeline exports to Nevada have stabilized in recent years, and most of the state's gasoline comes from California. While pipeline exports to Arizona have increased in recent years, representing only about half the state's consumption, other imports into Arizona are competitive. Both Nevada and Arizona have low levels of ZEV adoption compared to California, but they are experiencing exponential growth in ZEV registrations.[25] Although demand for gasoline may not decline on the same pathway as California, it is not likely that demand will increase significantly in the near term, and ZEV penetration within those states by the end of the decade may mean a decline in demand. Other nearby states such as Oregon and Washington have adoption rates that are closer to California.

The reason for pivoting to export is that each refinery has fixed costs (labor, maintenance, etc.) that do not decrease when crude refining runs decrease, so they have a financial incentive to keep their crude input high. One challenge for this strategy is that export products, either gasoline or diesel, must compete with fuel provided by export refineries in Korea, Singapore, India and other Asian markets. The "netback" to California refiners after accounting for freight will lower the margin for those export barrels. However, the California refiners may be competitive into Latin America, so there may be some export potential.

Each refinery conducts detailed planning for its operations and the products it manufactures. There are several questions that demonstrate the areas of complexity in this pathway:

1. Do potentially lower export profits erode refinery margins so much that California refineries continue to close or convert to renewable diesel?
2. Since California crude production is going to decline (fracking and conventional production), does it make economic sense to import crude with much of it going to refined exports?
3. What are reasonable market limits on the volumes of fuel that can be exported to domestic and global markets? How much surplus gasoline and diesel are economic to export?
4. Does this "run and export" scenario provide a cushion during gasoline shortfalls in the transition by sustaining refinery operating capacity to produce more CARBOB if needed?
5. What are the impacts to fence line communities as California demand drops and some refiners utilize exports to stay in business and balance their production?
6. Would there be adequate shipping available to export required volumes to foreign markets, or pipeline capacity to export more to Nevada or Arizona?

It would be surprising if California refiners did not attempt to continue to operate their refineries to produce fuel and find export markets for their products, although the extent to which this is feasible is uncertain. Viable export markets in Mexico or Latin America may be reasonable to expect but could be limited. Refiners who import crude from the Persian Gulf and then seek to export to the Far East may find that the marginal cost of the foreign crude

25 For ZEV registrations by state, see: TransAtlas

and the low net returns to move the products into the Far East may not be economic. This could drive crude run reductions or further refinery conversions to renewable diesel.

During the August 17, 2023, workshop on the Transportation Fuels Assessment, participants noted that there would be additional supply resiliency against outages at remaining refineries by sustaining some CARBOB production capacity in California above statewide demand.

While CARBOB demand falls under the rapid, fast, and slow scenarios, refiners will have to decide whether to compete for shrinking CARBOB demand or to find export markets (domestic or foreign) for their product. The ability of refiners to maintain crude refining runs as demand for CARBOB and diesel fuel declines will become very challenging due to port constraints, limited market outlets, and weakened refinery economics.

CHAPTER 2: Petroleum Basics

The CEC's experience with petroleum issues goes back to the inception of the agency in 1975, spurred by energy crises at the time, some of them involving petroleum. This Chapter provides a broad overview of refining, explores a suite of petroleum issues, and provides context for the CEC's role in understanding petroleum.

The Petroleum Industry Information Reporting Act of 1980

Enacted in 1980, the Petroleum Industry Information Reporting Act of 1980 (PIIRA) (Public Resources Code § 25350 *et seq.*) enables the CEC to require data from various petroleum industry participants, including refiners and marketers. The business and product information from industry participants are collected as reports at weekly, monthly, and annual frequencies. The CEC holds confidential information collected under PIIRA as confidential at the individual company level but publishes aggregated data.

Senate Bill 1322 (Allen, Chapter 374, Statutes of 2022), enacted in September 2022, establishes new reporting requirements under PIIRA on the gross margin of gasoline sold in California by refineries. The bill requires refiners that produce gasoline meeting California specifications to report the following: volume-weighted average gross gasoline refining margin, volume of crude oil purchased, price of crude oil purchased, volumes and prices by type of sale, and estimated LCFS and Cap and Trade compliance costs of gasoline sold in California. The data provided in the reports allows for a gross margin to be calculated at various types of petroleum wholesale distribution: branded, unbranded, bulk, and dealer tank wagon (DTW). The CEC publishes margin information from these reports on its website in an aggregated and anonymized format, per PIIRA provisions, 45 days after reports are due.

Senate Bill X1-2 requires additional information from refiners, traders, importers, and other market participants. Refineries are required to report additional information regarding their refining margins such as refined gasoline purchases, operational costs, and a net gasoline refining margin. SB X1-2 also introduced maintenance reporting, including the requirement that maintenance plans be submitted to the CEC 120 days before work commences, daily spot market transaction reporting, and marine imports reporting with a minimum of 96-hour ahead notice. This expanded information improves monitoring of maintenance, provides better insights into the operations and profits of gasoline refiners, and increases visibility into the spot market and petroleum product imports. With the additional data, the CEC can determine if a maximum gross gasoline refining margin should be applied, what the maximum value should be, and potentially a penalty for exceeding that value.

A Primer on Petroleum

The purpose of this section is to provide readers with a base of knowledge for understanding SBX 1-2. This section is a simple narrative explanation of the process that crude oil takes to become gasoline fuel into a customer's tank in California. This narrative introduces terms and concepts in common use within the petroleum industry.

Crude Oil Basics

Crude oil, or petroleum, is composed of hydrocarbons and other organic materials found in the Earth's crust. Crude oil is refined primarily to provide energy through transportation fuels, such as gasoline and diesel, and to produce petrochemicals used in various products like fertilizers and plastics.

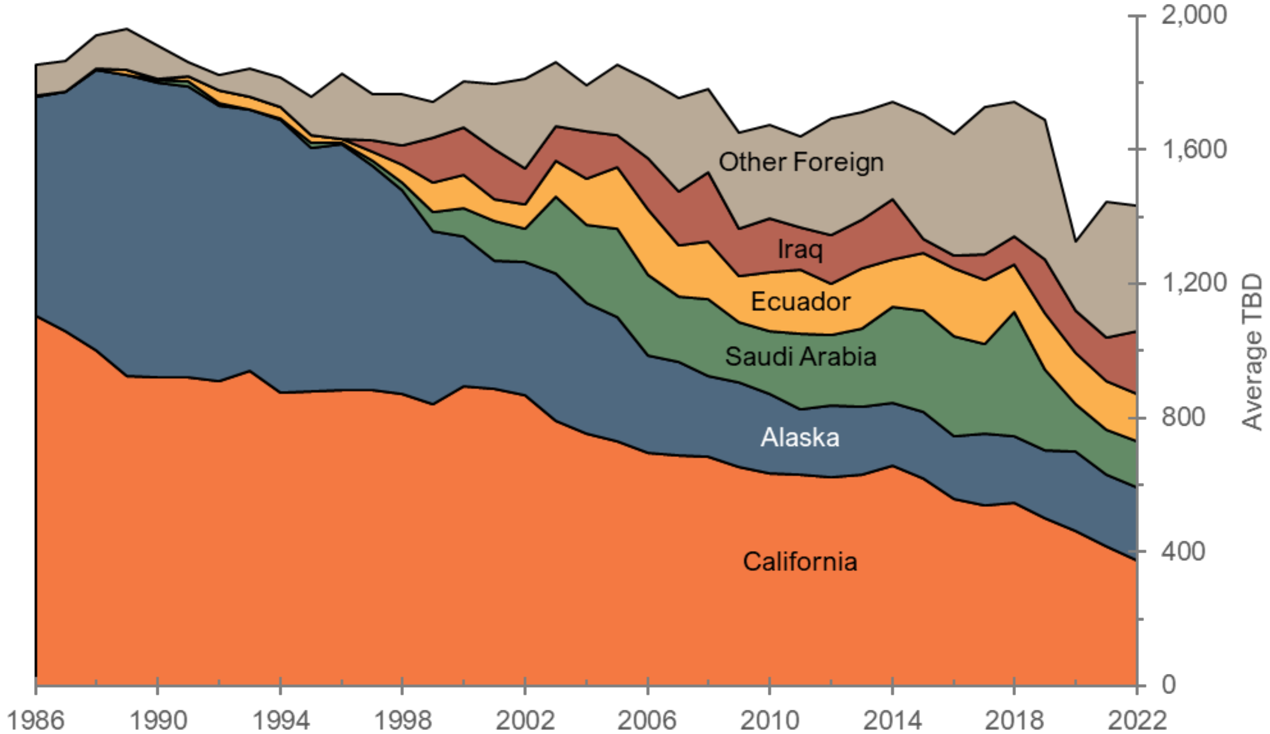
Crude oil is graded mostly by its density and sulfur content. Light crudes are less dense than water, while heavy crudes tend to be denser than water. More technically, in California, crude less than 20 API gravity[26] is referred to as "heavy crude."[27] A sweet crude has a sulfur concentration below 0.5 percent and a sour crude has a sulfur concentration above 0.5 percent. These properties of crude oil determine its market value. Crude oil that is light and sweet is usually more expensive than crude that is heavy and sour.

Crude oil is priced by the barrel (bbl), equal to 42 gallons. Crude oil markets use marketable crude named grades for pricing. The price of Brent North Sea (Brent), a sweet and light crude, reflects the price of crude from Europe, and many other foreign grades use this price as a benchmark, asking above or below the Brent price depending on crude quality. The CEC uses this price to estimate the price of foreign crude coming into California. West Texas Intermediate (WTI), also sweet and light (but heavier than Brent), reflects the price of crude oil from the United States. California's own grade San Joaquin Valley (SJV), being heavy and sour, prices below WTI most of the time, but the CEC uses WTI as an estimate of domestic crude oil prices.

In general, light and sweet crudes are less energy-intensive to refine than heavy and sour crudes. California refineries favor heavy and sour types of crude oil, as this matches the properties of California's crude that these refineries were originally built to run. Refiners in California mix many types of crude oil from both foreign and domestic sources to target a crude mix that allows their refinery to operate at an optimum economic level based on market conditions. Figure 11 shows California crude oil sources and trends since 1986.

26 The American Petroleum Institute (API) adopted the API gravity (°API) as a measure of the crude oil density.
27 Penn State College of Earth and Mineral Sciences. Petroleum Processing. FSC 432 Petroleum Processing: API Gravity.

Figure 11. Crude Oil Supply Sources to California Refineries, 1986 – 2022



Credit: CEC analysis of EIA data

Key numbers on crude oil supply in California in 2022, in terms of average TBD, are as follows:

- Refineries based within California received an average of 1,446 TBD of crude.
- California oil fields are still the largest single source for refinery inputs, about 372 TBD of crude for California refineries (25.8 percent).
- The next largest source is Alaska, or an average of 219 TBD (15.2 percent).
- Other states supplied a minimal amount of crude (less than 0.01 percent).
- Iraq is the third largest source and largest foreign supplier, averaging 187 TBD (12.9 percent).
- Foreign crude from Iraq and all other countries, including Saudi Arabia and Ecuador, averaged 853 TBD (59.0 percent, from multiple sources).

Refining Crude Oil

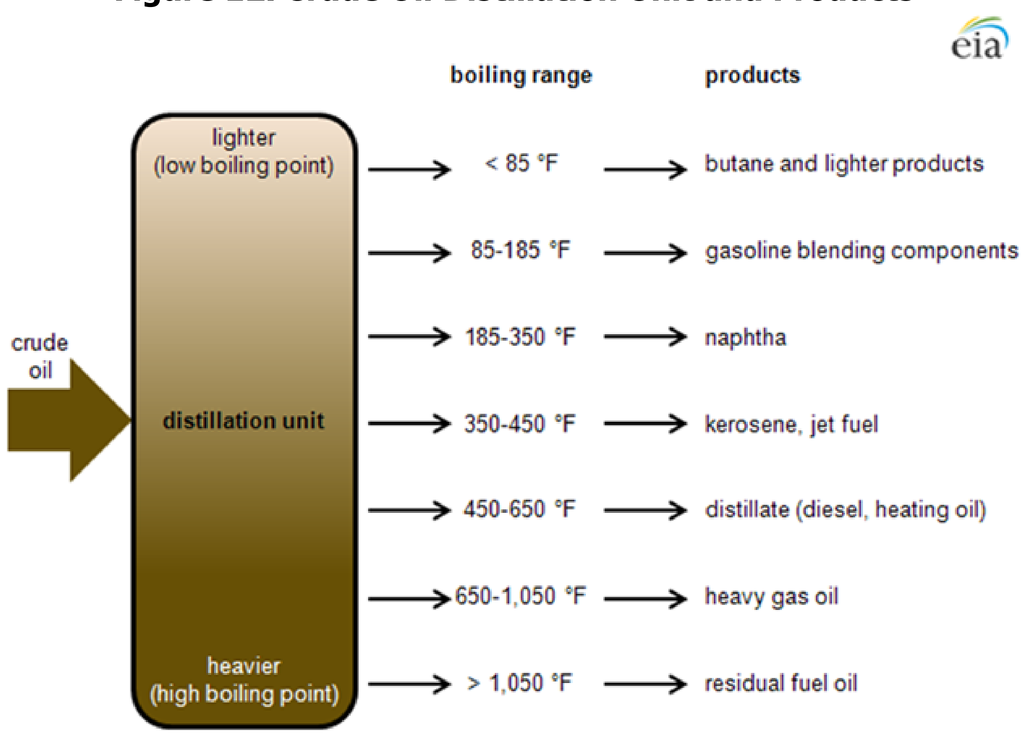
Oil refineries convert the mixture of hydrocarbon molecules that is crude oil into refined products that people use, such as gasoline and diesel. Refineries primarily sort these hydrocarbons from lightest to heaviest using large processing units with four major functions: cleaning, distillation, cracking, and reconfiguration.

Cleaning and Distillation

Cleaning or scrubbing units remove sulfur, metals, salts, and other non-hydrocarbons out of the crude oil mixture and out of finished products. Sulfur forms compounds in hydrocarbons that are corrosive, explosive, and dangerous in downstream units. Sulfur also creates acid rain in the Earth’s atmosphere when burned in fuel, so removal is critical. Sulfur cleaning is usually the first stage for crude oil at California's fuel producing refineries. In California, most refineries perform additional sulfur cleaning at many stages along the refining process with hydro-desulfurization units. Hydro-desulfurization units, or hydrotreaters, use hydrogen and pressure to bond hydrogen to sulfur and remove it from the feedstock. These units are used to clean feedstock like gas oil headed to downstream units or to clean gasoline, diesel, and jet fuel, before sale.

Distillation, performed by a crude distillation unit, or crude unit, is the primary refinery unit and the centerpiece of most refineries. A distillation unit will boil the crude using a very large still tower and boiler, leaving the bottom of the still with heavy oils called gas oils. Boiling crude oil separates it into light and heavy hydrocarbon portions called a cut. Each cut refers to the temperature that it took for the product to boil out of the crude. A secondary distillation unit, the vacuum distillation unit, takes the gas oils and remaining material, commonly referred to as the bottoms, or bottom cut, from crude units and boils them again at lower pressures to further sort these gas oils to extract further cuts. The amount produced from each distillation cut depends on the composition of the crude oil put in. Figure 12 shows various fuel products and their distillation temperature ranges.

Figure 12. Crude Oil Distillation Unit and Products



Credit: EIA

Cracking and Reconfiguration

All other units after the distillation stage of the refining process are called downstream units. These units specialize in handling a specific range and combination of the distilled cuts from crude oil. Downstream units allow refiners greater control of final products from just distillation alone.

Cracking units, a broad category of processes, crack very heavy cuts into lighter ones. Thermal cracking uses extreme heat. Catalytic cracking uses chemical catalysts to speed up the process. California refineries use three types of cracking processes: hydrocracking, catalytic cracking, and coking.

Hydrocracking units take gas oils, add hydrogen and a metal catalyst at high temperature and pressure. This is like the hydrotreater cleaning process but goes further to break gas oils into diesel and jet fuel-sized molecules. As a bonus, hydrogen attaches to sulfur, allowing input of dirtier gas oils while producing cleaner outputs.

Fluid catalytic cracking units, or cat crackers, use specialized catalysts to break gas oils into mainly gasoline and lighter molecules with higher octane ratings for gasoline. This unit is fed only low sulfur inputs.

Coking, often considered its own process, is a thermal cracking process. Coking units use the higher temperatures that the distillation units avoid, because the carbon coke fouls the distillation units. In a coker, this carbon is formed by design, the heaviest oils are baked at high temperatures in drums until carbon, called coke, forms inside the drum. The resulting vapor becomes more gas oil to feed downstream cracking units. The coke in the drum is cleaned out and sold as fuel or as precursor for steel and aluminum industries.

Reconfiguration, another broad category of units that are focused on converting small, light, gaseous molecules such as propylene or butylene into a heavier molecule in the gasoline cut. At California refineries, alkylation units, or alky units, are an example. Alkylation units process using an acid catalyst which allows a wide range of light molecules to combine into gasoline-sized ones. Other types in this category reshape simple line-shaped molecules into branched snowflake-shaped molecules. These molecules add desirable qualities like high octane ratings to gasoline. In California, many refineries have catalytic reforming units that are an example of this type of reconfiguration unit.

Blending

The last task the refinery performs is blending. Blending is done in batches, where a fixed volume of components mix into a final finished product for later shipment. Petroleum products are a mixture of cuts, some portion coming directly from the distillation unit. Gasoline, for example, will contain portions from an alkylation unit that combines gases. It may also come from a catalytic cracking unit that processes heavy gas oils from the bottom cuts of the atmospheric distillation unit. The combined blendstocks form the refinery's product "slate," or marketable products the refinery can produce.[28] The refiner will mix combinations of distillation cuts with downstream cuts together as blendstocks to match a blend specification.

Figure 13 shows the combined refinery slate by product type and percentage from 2018 to 2022.

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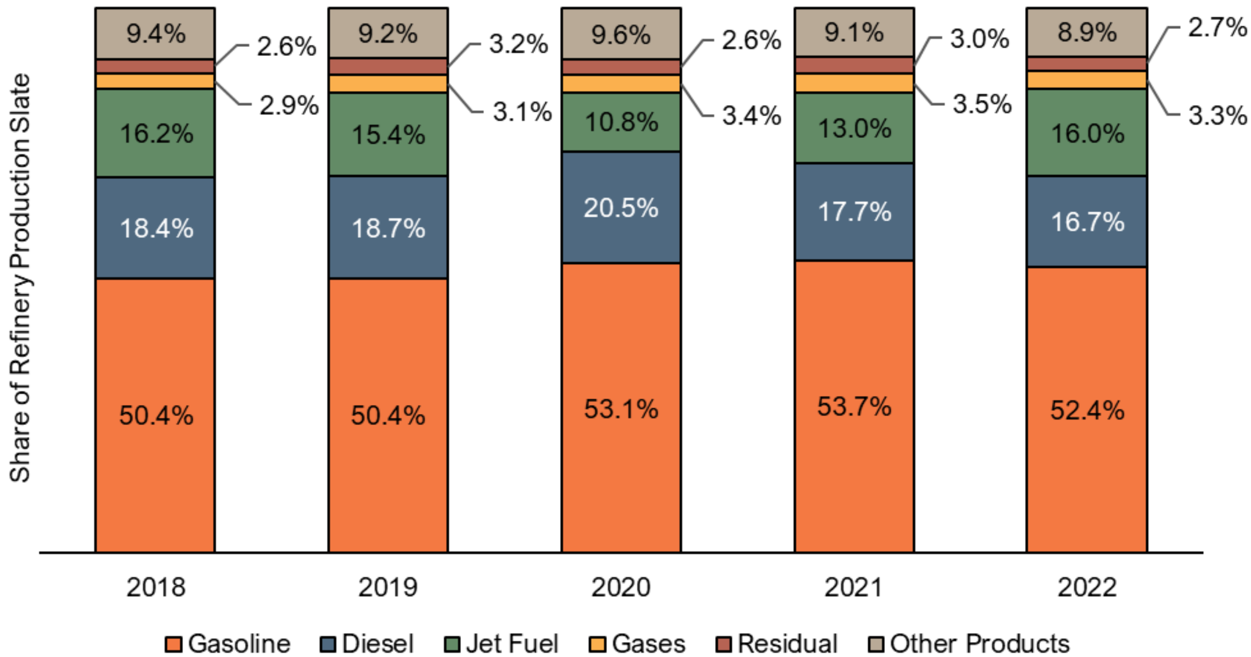
28 Reference units for refinery product slate are energy units, commonly expressed as either barrel of oil equivalent (BOE) or megajoules (MJ). One BOE is equal to about 6,118 MJ.

Figure 13. California Refinery Product Slate 2018 to 2022



Credit: CEC analysis of EIA data

Key numbers for refineries in California are as follows:

- There are eleven fuel producing refineries in California, totaling 1,723 TBD of crude input capacity.
- Nine of the eleven can produce CARBOB: three in the San Francisco Bay area, five in Los Angeles County, one small refinery in Kern County.
- These refineries input an average of 1,412 TBD of crude oil during 2022.
- Gasoline production made up 52.4 percent of the production slate in 2022 including out-of-state specifications.[29]
- Diesel fuel made up 16.7 percent of the production slate in 2022.
- Jet fuel made up 16.0 percent of the production slate in 2022.

Overall, gasoline, diesel and jet fuel combine for 85.1 percent of all marketable production from the refineries in California during 2022. The remainder of the refinery slate includes

29 The reference units for this chart are energy units (MJ or BOE). Thus, gasoline production represents 52.4 percent of the total energy of the product slate. The product slate and percentage are distinct metrics from the assumed 60 percent crude-to-gasoline production assumption discussed in

Figure 13 above, which is a volumetric conversion assumption (thousand barrels of crude converting to thousand barrels of gasoline).

products such as: bunker oils for ships, lubricating oils, petroleum coke, propane, and industrial inputs like acetylene.

California Gasoline

In California, the blend of raw gasoline is referred to as California Reformulated Blendstocks for Oxygenate Blending (CARBOB). Reformulated, instead of conventional blendstock (CBOB), refers to the blend's lower Reid Vapor Pressure (RVP), a measure of vapor pressure that relates to evaporation rate, that all reformulated blendstock specifications (RBOB) in the United States adjust for.[30] Oxygenate blending is the process of adding ethanol (an oxygenate), so CARBOB, CBOB, and RBOB are all intended to be blended with ethanol. The CARBOB formula changes during summer months to a specification that reduces evaporation and production of organic compounds that lead to ozone formation during warmer conditions but remains distinct from other formulations used in the United States since it has lower sulfur content and much lower benzene content.

All California fuel refineries sell gasoline in CARBOB form, specifically for transportation within California.[31]

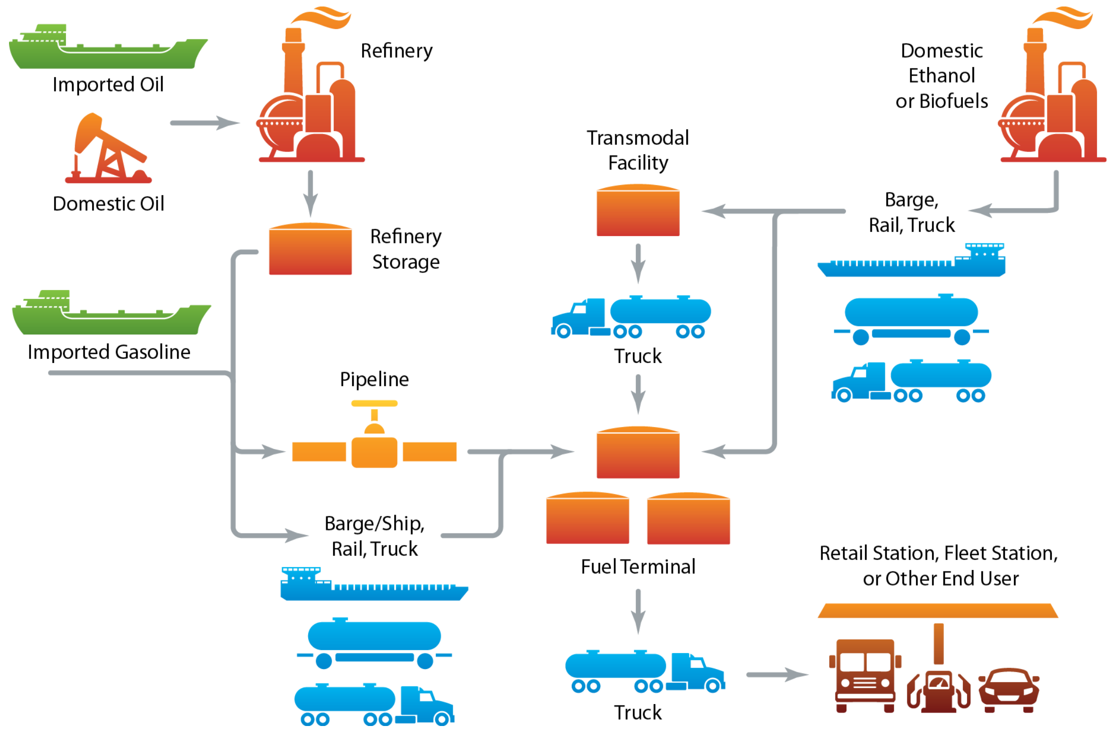
Moving Product

Figure 14 shows the process of product movement from crude oil to retail stations. After the refinery has blended fuel to the correct specification, the fuel needs to be moved to product storage terminals that are closer to gas stations and customers. The largest terminals in California are connected through pipelines. Pipelines allow petroleum products to move quickly and affordably. Pipeline companies often will combine different refineries' deliveries together to utilize the pipeline system's capacity efficiently. At terminals CARBOB gasoline is blended with ethanol and ready to be pumped for use. This finished gasoline is called California Reformulated Gasoline (CaRFG).

30 US EPA. Gasoline Standards. 1999. "Phase II Reformulated Gasoline." Available at https://nepis.epa.gov/Exe/ZyPDF.cgi/00000FG5.PDF?Dockey=00000FG5.pdf

31 Refineries may also sell gasoline in other forms for export purposes to NV, AZ, or out of the state.

Figure 14. Gasoline Supply and Transportation



Credit: Dean Armstrong, National Renewable Energy Laboratory

Pipeline Specifications

Refiners blend to standard specifications like CARBOB making it possible to easily transport products on a pipeline system. Pipeline companies and all the refineries served agree to the pipeline's own fuel specifications beforehand. This makes the products "fungible", allowing products from various refiners to be comingled together. The pipeline standard specifications are often stricter versions of the government fuel standards.

The stricter pipeline specification gives refiners flexibility on meeting the actual specification and ensures that contamination from another refinery's product is less of a problem. For example, if a small contamination of CARBOB gasoline occurs at a storage terminal in California, simply adding more pipeline standard product will dilute the contamination. The contaminated gasoline will never enter the pipeline system again but since it meets the overall CARBOB standard the gasoline can still be sold at stations near the terminal.

Pipeline Operations

Multiple types of refined products are pumped through the same pipeline via a sequencing system known as batching.[32] Batching keeps a steady pressure within the pipeline and lessens the mixing of products. Using one pipeline saves on the cost of building separate pipelines for each product. A pipeline operator, such as Kinder Morgan in California, earns revenue by how much volume is moved through the pipeline and by the distance to the destination terminals. This financial incentive encourages the pipeline operator to maximize the throughput on the

32 US Department of Energy

pipeline. However, the pipeline company only offers use of pipeline time and capacity. Shippers, usually marketer/refiners, nominate the product to move on the pipeline from refineries or commercial storage facilities.

Pipeline schedules follow a defined process, with pipelines requiring qualified shippers to nominate batch sizes and destinations in advance of each pipeline cycle. Kinder Morgan has 48 pipeline cycles per year (about every 7 days). Shippers who have been historical shippers are prioritized over parties who may only ship periodically. When pipelines are nominated at maximum throughput or higher, the pipeline "allocates" shipments based on the shippers' pipeline history. Refineries and other shippers are certified to inject their fuel into the pipeline only after they've tested their fuel to ensure quality and for substances that might taint the pipeline sequence or damage the pipeline.

For example, ethanol is not transported via refined product pipelines because it is corrosive and causes damage. Once scheduling is done and the refinery's testing certifications are up to date, the batch is loaded into the pipeline per the pipeline schedule towards distribution terminals located all along the pipeline system. Distribution terminals receive refined products from several suppliers that are held together in community storage tanks for like types of fuel. This is another reason why fuel standards are enforced, as lower quality products could contaminate other deliveries held in storage.

Kinder Morgan operates the only common carrier pipeline network within California. All the other product pipelines are exclusively owned by a company for its own purposes such as moving products from marine port terminals to refineries. Kinder Morgan runs multiple pipelines within California, serving two major refining sources with the West and North lines. The West line collects products from Los Angeles refineries and ends in San Diego in the south, and Las Vegas and Phoenix to the east. The North line, which collects products from the San Francisco Bay area, runs through to Chico, CA in the north, Fresno, CA southward and to Reno, Nevada eastward. There is no pipeline connection between the West and North lines and therefore no pipeline connection between Northern and Southern California refining centers. Figure 15 shows the California and Nevada portions of Kinder Morgan's Pacific pipeline system.

Figure 15. Product Pipeline Systems in California

Credit: CEC Staff

Spot Markets

Spot markets are so-called "physical" markets where contracts for physical delivery of gasoline, diesel, and jet fuel are bought and sold. The contracts traded on spot markets can require delivery within 30 days of the deal or can be on a "prompt" basis – meaning delivery in the next several days. Spot market transactions allow refiners, wholesalers, and traders to sell CARBOB that may be surplus or buy product if needed. As noted in the January 31, 2024 letter from the Division of Petroleum Market Oversight to Governor Newsom, only a fraction of all the cleaner-burning CARBOB gasoline consumed in California every day is traded on the spot market, but it plays an important role in setting prices across the state. The spot market can be a first trading stop as gasoline flows from refineries, cargo ships, and pipelines to the "racks" where gasoline trucks are loaded and on to retail gasoline stations.

Traders in the spot market include some California refiners, large wholesalers and retailers, and international trading firms who buy and sell relatively large quantities of gasoline, often tens of thousands of barrels. The function of the gasoline spot market is to provide buyers and sellers the opportunity to trade large quantities of gasoline for near-term delivery in California.

The spot market in California is currently an unregulated, over-the-counter market. Spot market deals are negotiated directly between buyers and sellers or mediated by brokers. California has two spot markets: one for Los Angeles (LA) and one for the San Francisco Bay Area. Other U.S. spot market locations include the Pacific Northwest (Portland), Houston, Chicago, and New York. The LA spot market is more active than the San Francisco market and the LA spot price impacts the largest portion of retail gasoline prices across the state.

Spot market transactions and average prices for the LA market are published by price reporting agencies ("PRAs"). PRAs have an outsized influence on market dynamics through their assessment of current market prices. Buyers and sellers negotiate the contract price for individual deals, but only some of those deals are voluntarily (or selectively) reported to the PRA. The PRA then publishes what it assesses to be the current market price for California gasoline. The Oil Price Information Service ("OPIS"), a for-profit company, is the industry-leading PRA in California and on the West Coast.

A common way that spot contracts are priced is an "exchange of futures for physical" or "EFP" trade, which are contracts that are priced relative to the New York Mercantile Exchange ("NYMEX") futures RBOB contract at the close of a specific day. RBOB is a common benchmark for gasoline sold in other parts of the United States. In an EFP transaction, the spot market parties agree to a differential to the NYMEX RBOB price. This differential is the measure of the difference between the L.A. spot market and the NYMEX. This differential is a key benchmark for observers to determine if the L.A. market is experiencing supply/demand issues.

Spot market prices are the biggest driver of statewide gasoline prices, even though they represent a small portion of gasoline sales each day. According to OPIS: "Nearly every gallon of gasoline, diesel and jet fuel sold on the West Coast references OPIS spot prices."[33] That is because many other spot, bulk, rack, and marine cargo transactions, including high-volume transactions between refiners and distributors or retailers under long-term contracts, set their pricing by reference to the OPIS-assessed spot market price that can change daily. As a result, the prices for relatively small trades (compared to statewide volumes) on the spot market have a magnified or exaggerated effect on retail gasoline prices across the state.

Unfortunately, California has been experiencing more frequent and extreme price spikes that seem to be driven by price swings in the spot market. More than twenty years ago, the Attorney General's Office produced a Report on Gasoline Pricing in California, which examined the unique volatility of the state's gasoline market.[34] In the years since that initial appraisal, the market has seen gasoline price spikes in 2012, 2015, 2019, 2022, and 2023. It appears that price spikes have become more common over time, with gasoline price spikes occurring in three of the last five years, with the exceptions being during the COVID pandemic. These spikes have been generally driven by periodic episodes of undersupply of gasoline (in the form of reduced refinery production, lower inventories of stored gasoline, or both) that are exacerbated by the dynamics of trading and reporting on the spot market. DPMO's initial analysis of the most recent gasoline price spikes in California noted that spot market volatility, illiquidity, and lack of transparency may all be contributing to and exacerbating price spikes during periods of undersupply.

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33 OPIS West Coast Spot Market Report website. Available at https://www.opisnet.com/product/pricing/spot/west-coast-spot-market-report

34 Office of the California Attorney General. Report on Gasoline Pricing in California. May 2000. https://oag.ca.gov/sites/all/files/agweb/pdfs/antitrust/gasstudy/gasstudy2.pdf

Product Racks

Distribution terminals utilize truck loading "racks" to load tanker trucks. Racks are also located where the last blending stages for finished gasoline take place. Ethanol, additives, and detergents are added at the rack either by in-line rack blending or the less precise "splash" blending. A tanker truck at the rack is loaded with CARBOB, additives, and detergent packages, and simultaneously blended with ethanol to produce E10 gasoline. This blended product, California Reformulated Gasoline (CA RFG), is what is sent to service stations.

Retail marketers, or distributors for service stations, buy product from refiners at the distribution rack. There are three main ways these terminal sales are separated: branded rack sales, unbranded rack sales, and dealer tank wagon (DTW) sales.

- Branded rack sales are sales of branded fuel that has branded additives and detergents. These are ultimately sold by a branded service station such as Chevron or Shell. Branded service stations generally have priority through the branded rack, as well as DTW sales.
- Unbranded sales have generic additive and detergent packages. They are sold by unbranded service stations such as Costco or local convenience store chains. These customers can shop around for the best unbranded rack price offered at the closest distribution terminals.
- DTW sales are a delivery sale, where delivery is included in the price for branded service stations. DTW sales include a wholesale price (usually higher than rack) plus the cost of delivery to the station, mostly the cost of the tanker truck service. Most common customers for DTW sales are company owned and operated.

Branded Gasoline and Fuel Additives

Several brands of gasoline contain fuel additives, generally understood as TOP TIER® certified gasoline. These are offered by companies such as Chevron, Shell, Exxon, 76, Valero, Costco, and ARCO. There is some evidence that these fuels offer improved performance over standard gasoline available in the United States broadly.[35] However, these fuels do not appear to provide superior performance above and beyond the stringent standards required by CARBOB. These standards include a reduction in some standard gasoline constituents such as sulfur and the addition of special detergents to burn cleaner. In 2019, the CEC asked fuel providers for evidence of superiority, but the CEC did not receive any evidence. Additionally, CEC staff independently searched for studies that could substantiate the superiority and were unable to find any evidence.[36]

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35 For example, the American Automobile Association conducted a 2016 study in which it found that Top Tier fuel did provide benefits and improved fuel economy. However, the fuels tested, both Top Tier certified and non-Top Tier certified, were from Texas, which does not use CARBOB. See AAA FUEL QUALITY RESEARCH: Proprietary research into the effectiveness of fuel additive packages in commercially-available gasoline

36 See Additional Analysis on Gasoline Prices in California for more information.

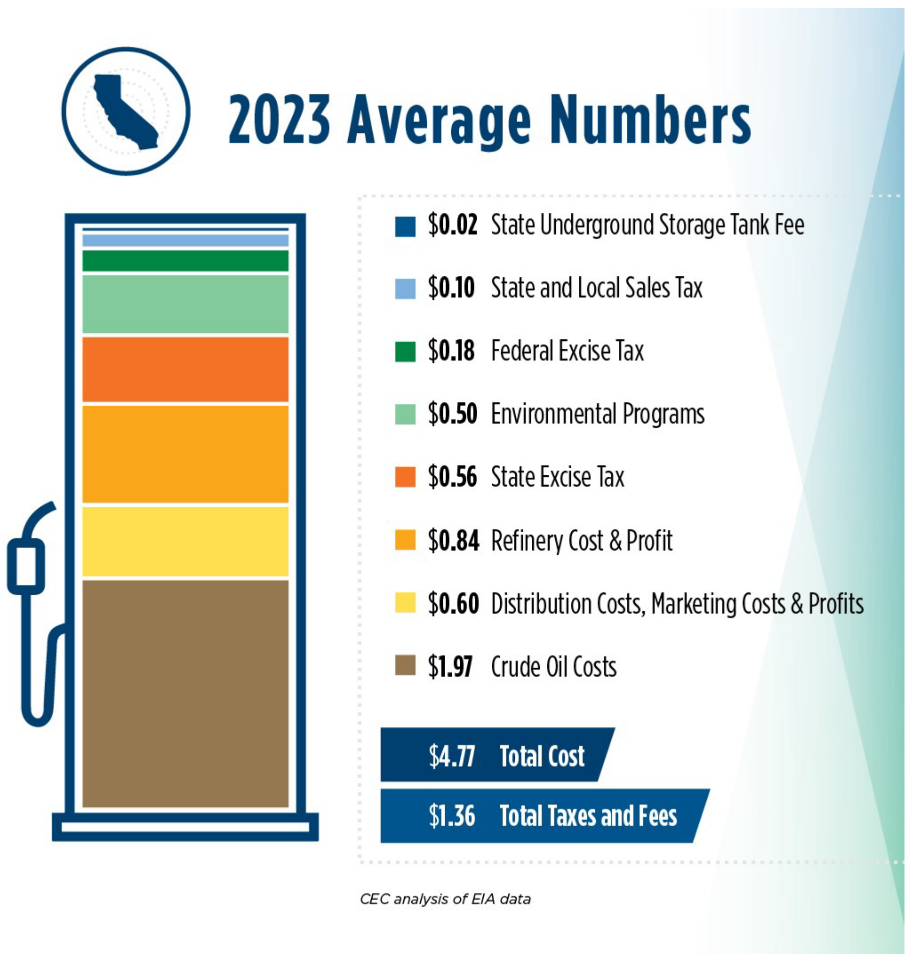
Margin Basics

Rack and DTW sales are an important point to measure prices in relation to each other. These sales mark the critical point where products are no longer counted as inventory but as sold, making it easier to classify sales after the rack as retail and before the rack as wholesale. This is helpful in categorizing sales to calculate margins.

A margin is an estimate of net revenues per unit sold by subtracting the cost of inputs from the price of product produced. For refineries, the gross gasoline refining margin is calculated by subtracting the cost of crude oil from the price of product at the rack and DTW. There's remaining margin to account for as prices at the gas pump are usually higher. This retail margin is calculated by subtracting the price of product at the rack from the prices at the pump. Margins that only subtract input costs are called gross margins, as they do not account for any operating costs. A net margin will subtract both operating and input costs.

For gasoline retail margins that the CEC calculates, the CEC subtracts taxes and fees from the average retail price, giving an average gross margin after taxes. Figure 16 shows California's 2023 year-to-date average components of the retail price of gasoline.

Figure 16. Breakdown of California 2023 Average Retail Price Components, through 2023



Credit: CEC Staff Analysis of EIA Data on for 2023

In 2023, the cost of crude accounted for the largest portion, $1.97, or 41.3 percent of California's retail gasoline price. Combined refiner and retail margins (referred to in the figure as "Refinery Cost & Profit" and "Distribution Costs, Marketing Costs & Profits") total the next largest portion, $1.44 or 30.2 percent, while all taxes and fees combine as the remaining $1.36 or 28.5 percent of the retail price.

Refinery Outages

As mentioned above, refineries' planned maintenance may involve going partially or completely offline. Some refiners use storage and increase imports to help address supply as part of their plans and to meet their contractual obligation to retail entities. However, unplanned refinery outages can occur at any time, and planned maintenance does not always align with the anticipated timeline. The impact of either of these events can be compounded if other refiners are already undergoing planned turnarounds for maintenance work. The unplanned outage or extension of maintenance of one large refinery can be extremely disruptive, especially if statewide refinery capacity is lower in the future. When unplanned outages occur, even the impacted refiner may not know the longer-term impact of the outage for several days, and other refiners may not be aware of the incident (although refinery fires and extended flaring[37] are obvious). The uncertainty on event duration can lead to delays on refiners making decisions on purchasing marine cargos for replenishment.

Through SB X1-2, the CEC has more insight into planned and unplanned maintenance outages. For planned maintenance, refineries are required to report their planned maintenance event at least 120 days prior to the event. If a planned event is scheduled less than 120 days in advance, refiners must report within 48 hours of identifying the need for maintenance. For unplanned maintenance events lasting more than 24 hours, refineries are required to file a report within 48 hours of the unplanned maintenance. In their report, refineries are required to provide CEC information about the expected inventory impacts, expected length of the maintenance, and if the refinery intends to backfill the lost supply with imports.

An illustrative example of the complicated dynamics is the Torrance Refinery shutdown of 2015. The extent of the shutdown was initially unknown, which led to delays in arranging imports from other countries. The Torrance shutdown was one of the largest supply disruptions California has faced, and the uncertainty that followed resulted in an extended period of supply shortages and higher prices for California. During that incident, a significant amount of replenishment fuel was shipped from Northern California to Southern California by marine vessel (much more than was imported). This was helpful in sustaining supply to Southern California, although the "relief" may not have been possible if Chevron's Richmond refinery was undergoing a turnaround or had its own unplanned event. Moreover, with Marathon Martinez conversion and Phillips Rodeo having converted in 2024, the Bay area will no longer be in surplus of gasoline to ship to Southern California in the future. In cases of coincident multiple refineries shutting down, perhaps due to a major localized catastrophic

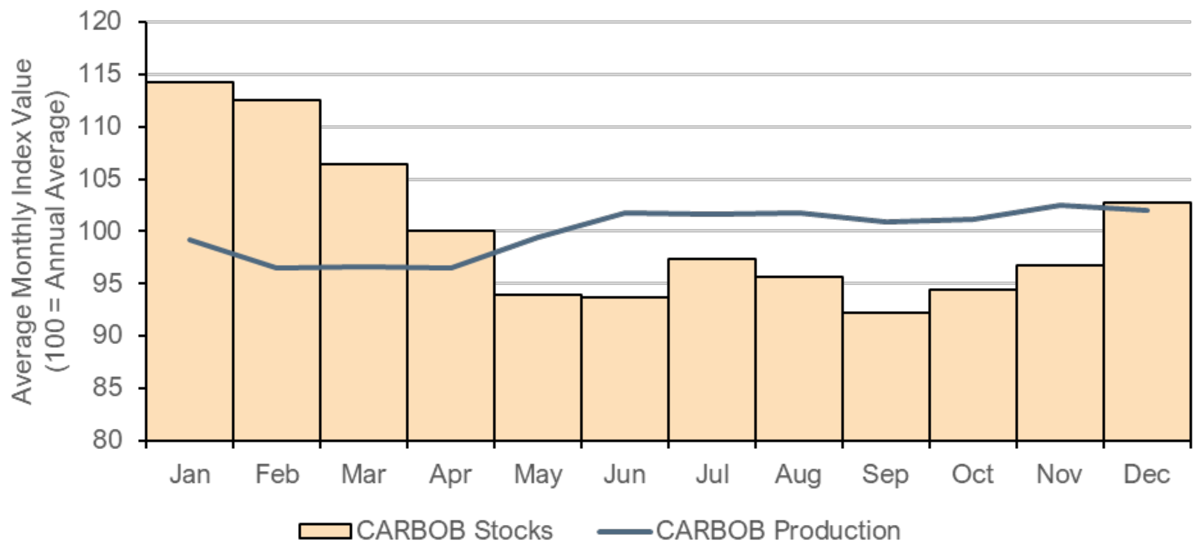
37 Flaring occurs when a refiner must burn flammable gases that are released to prevent pressure buildup in equipment. Flaring can be planned or unplanned.

event, the supply response may require significant cargo transport and perhaps measures to conserve fuel and allow non-CARB gasoline to be secured.

Seasonal Dynamics

Demand for CARBOB declines in the early part of typical years, while demand peaks in the summer. Figure 17 shows an index of CARBOB stocks (or storage) and CARBOB production at refineries from 2006 to 2022. CARBOB production partially tracks the consumption, but a drawdown of stocks built from previous months also helps satisfy some demand without production. However, as stocks draw down and demand remains high, additional risk from supply disruptions may occur. Although production declines very slightly in September, stocks tend to be at the lowest levels of the year, an indication of low resiliency.

Figure 17. Average Monthly CARBOB Production Index and CARBOB Stock Index (2006-2022)



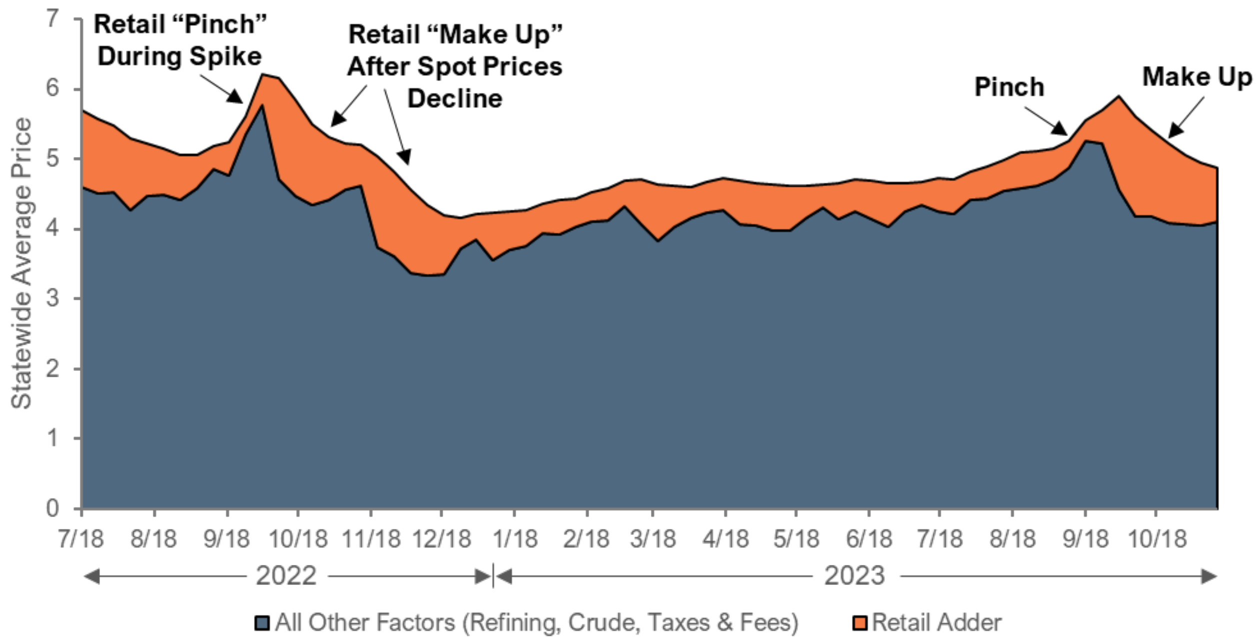
Credit: CEC Staff

Retail Dynamics

A common pattern observed in the gasoline market is that retail prices can rapidly increase with the spot market, but they are slower to decline even as the underlying spot prices go down quickly. This dynamic of "up like a rocket, down like a feather" in retail prices can be seen from CEC's analysis of the slopes of price increases and declines.[38] Figure 18 highlights the retail adder components in orange (delivery to station, retail marketing, station profits) on top of other standard existing cost adders, such as taxes and fees, crude oil prices, and refining prices, in blue.

38 For more information on gasoline prices, see Estimated Gasoline Price Breakdown and Margins

Figure 18. Retail Margins Compared with Other Price Components Combined July 2022 - October 2023



Credit: CEC Staff analysis of OPIS and EIA data

Spikes in the spot market and crude market can increase rapidly and flow into retail prices somewhat quickly, creating a close "pinch" that keeps the retail adder fairly consistent until the spike abates. After the spot market price spikes abates, there is an observable delay in retail prices declining. Retail prices remain somewhat high, the result of retailers attempting to make up for potential losses or tight margins during the spike. This phenomenon can be seen for the 2023 spike as well. Overall, the slow decline allows retailers to realize sustained, high retail margins.

CEC does not currently have the ability to analyze retail issues at a more geographically refined level given the structure of tax reporting to the California Department of Tax and Fee Administration.[39] For example, although the CEC collects sales data at stations, this reporting is only at the annual level, which is not temporally detailed enough to evaluate patterns associated with price spikes.

During the November 29, 2022 gasoline price hearing[40], Dr. Severin Borenstein cited a phenomenon he has termed the "mystery gasoline surcharge." Gasoline prices in California are higher than those in other U.S. States, but even when accounting for well-established factors,

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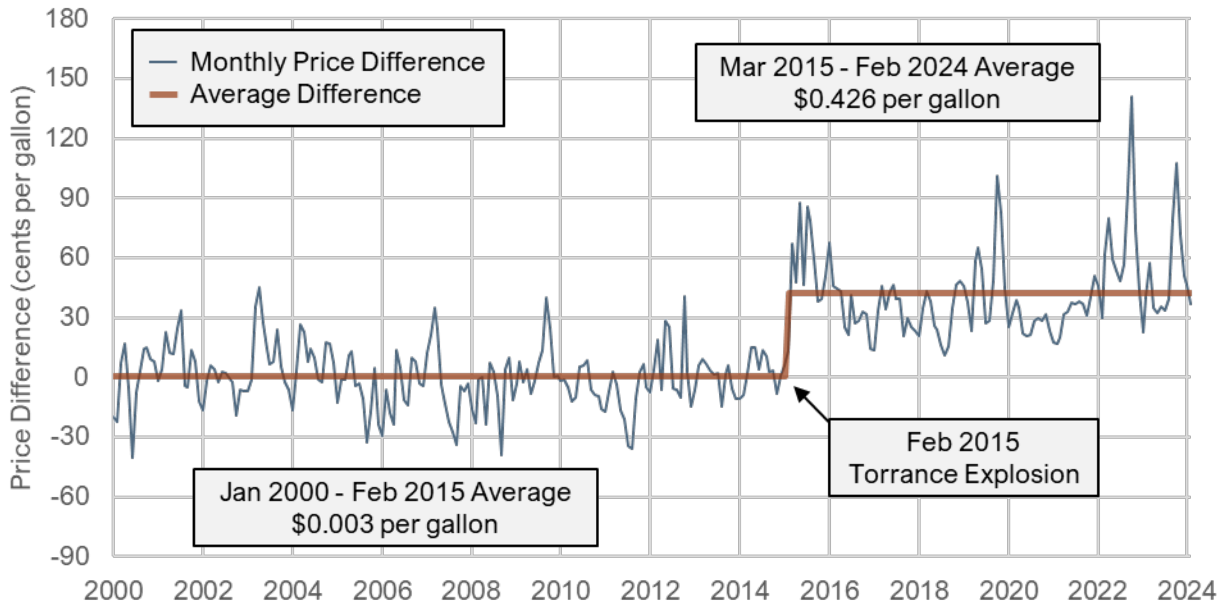
39 The California Department of Tax and Fee Administration collects excise taxes from fuel suppliers before delivery at retail stations, so taxes are only available at a very aggregate level. Available at [Fuel Tax and Fee Guides]

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

a distinct pattern has emerged since the Torrance refinery explosion in early 2015. Prior to 2015, after accounting for known contributors to higher gasoline prices in California such as the underground tank storage fee, environmental fees, slightly higher state excise taxes, and the cost of producing CARBOB gasoline, the price of non-California gasoline was essentially identical to California retail gasoline. However, after the 2015 Torrance explosion, the price difference emerged, and it continues to persist as of the most recent data collection period (February 2024). Borenstein estimates that this surcharge represents more than $40 billion dollars that Californians have borne since 2015.

Figure 19. The Mystery Gasoline Surcharge: California Gasoline Price Premium After Removing Differences in Taxes and Fees and California Specification Gasoline Production Costs (2024 dollars)



Credit: Severin Borenstein, University of California, Berkeley.

Borenstein has cited several potential reasons for the mystery gasoline surcharge, but he does not intend for them to explain everything.[41] Refiners own downstream retail outlets (e.g., Chevron is a major refiner and operates many Chevron branded gasoline stations) and have an influence on other downstream brands.[42] Less gasoline is sold as off-brand gasoline compared to the rest of the U.S. There is also a marked difference in off-brand prices compared to branded prices when looking at California compared to the rest of the U.S.

41 For instance, see Borenstein's June 30, 2022, testimony to the California Select Committee on Gasoline Supply and Pricing. Available at https://www.assembly.ca.gov/sites/assembly.ca.gov/files/borensteingasolinetestimony220630.pdf

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

Borenstein believes that these factors show that there is less competition at the retail level. The ultimate set of causes is still uncertain.

Ethanol

California is a reformulated gasoline market, blending 10 percent ethanol by volume (E10) into CARBOB. Blends with higher ethanol content, such as E15 (15 percent ethanol by volume), have been used in other states. At the federal level, EPA has issued waivers allowing year-round use of E15 starting in 2022.[43,44] More recently in February 2024, EPA issued a final rule to approve the permanent waiver for eight Midwest states, effective April 28, 2025.[45] California does not currently allow the sale of E15. E15 fuel evaluation is required to determine whether it would create any significant new environmental or public health impacts.[46]

As part of an evaluation process from CARB, recent research on E15 indicates that it may represent a lower environmental harm compared to E10. Researchers at the University of California at Riverside performed emissions testing on a fleet of 20 Tier 3 light-duty vehicles using a baseline CaRFG and a splash-blended CaRFG with fuel-grade denatured ethanol creating E15 for testing.[47] Each vehicle and fuel combination was tested using the Federal Test Procedure on a chassis dynamometer. Major results were as follows:

- No statistically significant fuel effect on nitrogen oxide (NOx) emissions for E15.
- Particulate matter showed statistically significant reductions of 18 percent for E15 compared to E10. Solid particle number emissions were a statistically significant 12 percent lower for E15 than E10.
- Total hydrocarbons, non-methane hydrocarbons, and carbon monoxide showed either marginally or statistically significant reductions for E15.
- Statistically significant increase of 32% in acetaldehyde.

The researchers reported that the study only found a 1 percent reduction in fuel economy. Strictly relying on the energy content difference between E10 and E15 suggests that an E15 blend should result in about a 3 percent reduction in fuel economy.

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43 Regan, Michael. 2022. *RE: May 1, 2022 E15 Reid Vapor Pressure Fuel Waiver.* United States Environmental Protection Agency. Available at https://www.epa.gov/system/files/documents/2022-04/nationwide-fuel-waiver-allowing-e15-gasoline.pdf

44 EPA Fuel Waivers. United States Environmental Protection Agency. Available at https://www.epa.gov/enforcement/fuel-waivers

45 Request From States for Removal of Gasoline Volatility Waiver. United States Federal Registrar. Available at https://www.govinfo.gov/content/pkg/FR-2024-02-29/pdf/2024-04023.pdf

46 The California Health and Safety Code (CHSC) requires that a multimedia evaluation be conducted and reviewed by the California Environmental Policy Council (CEPC) before specifications for new motor fuels can be adopted by the California Air Resources Board (CARB).

47 Comparison of Exhaust Emissions Between E10 CaRFG and Splash Blended E15 (available online here). The research was funded by CARB, Renewable Fuels Association, Growth Energy, National Corn Growers Association, and the United States Council for Automotive Research (USCAR). Available at https://ww2.arb.ca.gov/resources/documents/comparison-exhaust-emissions-between-e10-carfg-and-splash-blended-e15

This research suggests that E15 would likely not introduce additional harms. The testing results show the use of E15 versus E10 will reduce the tailpipe emissions of most pollutants with no statistically significant impact on evaporative emissions.

CHAPTER 3: Policy Options to Mitigate Price Spikes

Addressing the Supply Challenge

As discussed in detail in Chapter 1, California faces a significant supply challenge, with price spikes of particular concern. The state's fuel supply market is already somewhat concentrated at the wholesale level. Other supply factors such as market isolation and a unique fuel blend add to price spike risk. As demand declines over the next 20 years, due to California's increasing adoption of ZEVs, refineries may close or convert to renewable fuels, and as a result, the supply conditions may increase baseline prices and add to price spike risk. Price spike risk is especially concerning, as demand reduction is expected to be on a relatively smooth trajectory, while supply declines from refinery closures or conversions will result in steep, sudden declines in gasoline production capacity. Immediate declines in CARBOB production will have uncertain effects on the market, especially if an unplanned outage occurs shortly after a refinery closure.

There are some potential mitigating factors in the market independent of targeted fuel price spike mitigation policies. One example is a family that owns one ZEV and one ICE vehicle, who drives the ZEV during price spikes. Across millions of families, such behavior could increase the elasticity of demand and reduce price spike risk for all drivers. Another possibility is that some refineries may maintain their crude refining for some period and pivot to export refined products. With higher overall supply capacity in the state, CARBOB supply could be more resilient during a supply shock.

Despite some potential mitigating factors—including extensive programs designed to make ZEVs more affordable for lower-income families—there is still risk to lower-income communities as market concentration increases, especially if capacity declines as well. This chapter presents a suite of policy options that state government could take to help reduce price spike pressure on Californians, the leading issue for ensuring a reliable supply of affordable and safe transportation fuels.

Equity Challenges and Tradeoffs

While various policy options to mitigate gasoline price spikes could result in various environmental impacts, it is crucial to acknowledge and carefully consider the potential environmental justice (EJ) and equity implications associated with each of these options. Currently, it is challenging to quantify these impacts definitively, as they depend on numerous variables, including the extent of policy adoption, the duration of implementation, and the specific pathways through which these policies would be enacted. Nevertheless, this section aims to provide a qualitative evaluation, highlighting the potential EJ and equity consequences that may emerge from the adoption and implementation of these policy measures. It is also noteworthy that the Transportation Fuels Transition Plan will serve as a crucial instrument for thoroughly assessing the equity implications of fuel prices and ZEV accessibility for communities in California.

While it is not desirable to put a financial burden on drivers in EJ communities, it is possible that sustained lower fuel prices can generally incentivize more driving and make driving gasoline-powered vehicles more economically attractive in comparison to ZEVs. As a result, the prolonged operation of gasoline vehicles on California's roadways could lead to continued pollution from both refineries and vehicles.

These EJ issues are particularly challenging. As highlighted in Chapter 1, lower income communities often have limited access to ZEVs or other dependable and affordable alternative modes of transportation. It is therefore critical to develop policy options that both safeguard vulnerable communities from volatile fuel prices and actively work to reduce their exposure to pollution and transition them towards safer transportation fuels. The State, however, through various vehicle purchase incentive programs, is working to make ZEVs more accessible to those who are low-income and living in disadvantaged communities. Incentive programs such as Clean Cars 4 All and the Clean Vehicle Assistance Program provide point-of-sale incentives for these consumers to afford these vehicles more easily. Additionally, the Clean Vehicle Assistance Program, through its partner banks, provides lower interest loans for its participants, which can sometimes be a barrier to vehicle ownership. Through October 22, 2023, both programs have issued more than 17,814 vehicle grants.[48]

Some of the options examined in this report could have adverse impacts on the environment and result in adverse health impacts and higher health costs, challenges to ensuring a safe supply of transportation fuels. While policy impacts are intended to control dramatic increases in spot market prices that are quickly passed on to consumers, potential health risks cannot be ignored. In the long term, the shift towards higher adoption of ZEVs could result in a reduction of refineries operating in the state, as well as a decrease in tailpipe emissions. It is crucial that the implementation of EV infrastructure and access to cost-effective EVs lead the transition, accompanied by a corresponding decrease in refinery capacity. Furthermore, increased EV adoption will enable more dual vehicle households to own both an EV and a gasoline vehicle, potentially increasing the elasticity of gasoline demand in response to price fluctuations.

The following subsections delve deeper, providing a more detailed qualitative analysis of the EJ impacts associated with various policy options, specifically focusing on emissions originating from refineries and vehicles.

Impacts of Continued Refinery Operations

Refineries are often near marginalized and disadvantaged communities, leading to disproportionate impacts on air quality and, consequently, the health of these populations. Although there are regulations that restrict the amount of pollution that refineries can emit, the California Office of Environmental Health Hazard Assessment identifies some levels of toxic air contaminants from refineries, including various Proposition 65-listed chemicals in petroleum products, pose significant health risks.[49] These risks range from various types of cancers, such as leukemia, lung cancer, and cancers of the nose, throat, and sinuses, to developmental and

48 Data from Insights on CA Light-Duty ZEV Incentive Programs.

49 California Office of Environmental Health Hazard Assessment. "Toxic Air Contaminants". https://oehha.ca.gov/air/toxic-air-contaminants

reproductive harm, particularly during pregnancy. Notable chemicals contributing to these risks include benzene, 1,3-Butadiene, carbon monoxide, lead, and sulfur dioxide, among others. Exposure to these chemicals and the resulting health impacts can vary across different refinery regions.

The communities near refineries frequently comprise low-income families and people of color, who bear the brunt of the air pollution from refinery operations. Additional health risks of compromised air quality can lead to a higher incidence of respiratory issues, cardiovascular diseases, and other health problems. These communities often lack the resources and political influence to advocate for a safer fuel supply and stricter regulatory oversight, perpetuating a cycle of environmental injustice. While the impact of short-term policies to address price spikes on the longevity of refinery operations remains uncertain, it is imperative to acknowledge and consider the public health and safety risk of prolonged refinery activity and increased production.

Emissions from Policy Impacts on Driving

Short-term price spikes have a limited effect on demand, but long-term lower fuel costs can lead to an increase in vehicle travel, also known as the rebound effect. While enhanced gasoline price stability is beneficial in terms of economic predictability, it carries the potential risk of increasing gasoline-powered vehicle activity and, consequently, pollution. Increased ZEV adoption is expected to mitigate air quality, but air quality standards are not static, and the state must continue to improve air quality. Continued or otherwise delayed reductions in pollution from gasoline combustion is expected to be more pronounced in low-income areas, which tend to have a higher concentration of older, less environmentally friendly vehicles. This could exacerbate local air quality issues and public health challenges, further compounding the environmental injustices faced by these populations.

Although policies that keep average prices low may encourage more driving in the long-term, it is important to note that, due to relatively low elasticity, price spike mitigation policies are not likely to significantly increase driving. Therefore, policies that reduce price spike risk will not necessarily contribute to more pollution. Policies that keep average prices low may result in more driving, and hence, more pollution. This is an important trade-off for considering longer term issues with the Transportation Fuels Transition Plan.

Emissions due to Changes in Fuel Composition

Switching from California’s unique gasoline composition to U.S. reformulated gasoline (RFG) or providing short-term allowances for it could have noticeable impacts on air pollution levels. California's gasoline blend is specifically designed to address the state’s unique air quality challenges, with stricter standards for volatility and content of certain compounds that reduce emissions of ozone precursors, particulate matter, and toxic air contaminants. According to a 2005 United States Government Accountability Office's (GAO) report,[50] the U.S. Environmental Protection Agency (EPA) has analyzed various gasoline blends’ impacts on emissions, finding

50 Special Gasoline Blends Reduce Emissions and Improve Air Quality, but Complicate Supply and Contribute to Higher Prices

that California's unique blend significantly reduces volatile organic compounds (VOCs) by 25 percent to 29 percent, NOx by about 6 percent, and reduces emissions of toxic chemicals. This is contrasted with a commonly used blend in the Gulf Coast region, which offers lesser reductions in VOCs (12 percent to 16 percent) and NOx (less than 1 percent). These estimates are somewhat uncertain, as they are based partially on data from older vehicles and may not be fully applicable to newer vehicles with advanced emissions controls. While adding oxygenates to gasoline has been shown to reduce emissions from older vehicles, newer vehicles automatically reduce certain pollutants, potentially reducing or eliminating the benefits of oxygenates. Despite these complexities, experts and the EPA agree that special gasoline blends have contributed to air quality improvements in some regions, although comprehensive studies isolating their specific impact are limited.

Understanding the dose-response relationship of modifying fuel composition is a complex task, particularly for short-term changes, as their proportional impact on air quality and emissions might not be immediately noticeable. For instance, introducing 50 TBD of Nevada specification fuel into an existing demand of 800 TBD would constitute a 6 percent alteration in the gasoline mix. However, the impact on vehicle or evaporative emissions would not be instantaneous, as it takes time for the new fuel blend to diffuse into the myriad gas tanks across the region. Moreover, if such a policy adjustment is only temporary, lasting a mere couple of weeks, discerning its effects becomes even more challenging. Despite these complexities, it is crucial to acknowledge and analyze these potential impacts, particularly on air quality and public health, to ensure informed and responsible policy making. This consideration is especially pertinent in low-income and disadvantaged communities, where older vehicles equipped with less advanced emissions control systems are more prevalent. In these areas, the impact of changes to fuel composition could be more pronounced, necessitating careful attention and mitigation strategies to protect vulnerable populations.

Enhanced Mobility

Despite the various environmental justice issues outlined above, it is important to highlight the improvement in mobility that stable and inexpensive gasoline prices bring, particularly in low-income and disadvantaged communities. For many residents in these areas, dependable and affordable transportation is crucial for accessing employment, education, and essential services. Policy initiatives aimed at stabilizing gasoline prices contribute significantly to these goals, making daily transportation more predictable and financially manageable. This enhanced mobility can lead to improved economic opportunities and quality of life, helping to alleviate some of the burdens faced by these communities.

It is also important to note that there are other policy approaches that could improve mobility that are not directly related to stable gasoline pricing. For instance, building denser housing or mixed-use developments, increasing alternative mobility options, and reducing headways for public transit[51] could all improve mobility and reduce the impacts of price spikes on lower-

51 For example, reduced headways could involve more frequent public transit or additional stops along transit corridors.

income families without directly addressing gasoline price spikes. This approach is explored below as well.

Additional Policy Options to Mitigate Price Spikes

Based on initial comments from CEC workshops and CEC staff review, this section lists several options which may mitigate price spikes in California gasoline, along with brief one-page summary tables. The list is broken out into various categories of policy types, including the following:

- Policies that Address Gasoline Demand
- Policies that Address Gasoline Supply
- Policies that would Involve Highly Complex Implementation (supply or demand)
- Policies that Intend to Address Unique Emergency Circumstances

Some policies may have more of a benefit in terms of mitigating short-term price increases, while others may intend to reduce fuel prices overall. Nearly all these options require additional and extensive analysis to better understand their potential market impacts and may require statutory modifications and commensurate state funding to sufficiently implement. The following bullets characterize the key components of the policy option tables listed.

- **Statement of Initiative.** A broad characterization of the policy option.
- **Scope.** The likely or potential extent of the policy impact, in TBD, thousand barrels per day, or reference to other methods with approximate quantitative values. Where a TBD or other quantitative estimate is not readily estimable, the scope will highlight.
- **Pros.** Why will the initiative help? What benefits does it have?
- **Cons.** What are the possible roadblocks? What are the drawbacks of the policy?
- **Issues to Resolve.** Important matters that are not necessarily a pro or con but should be considered on further analysis.
- **Other.** Where applicable, potential questions or considerations outside of issues that need to be addressed.

Every policy option involves trade-offs. Additional supply may come at the cost of environmental impacts or costs to the State. These will need to be weighed by policymakers.

The CEC does not take a formal position on whether these policies should be adopted or not. Rather, these options are simply analyses of proposals the CEC has received throughout its proceedings and that staff have identified as policy options. Some policies appear to be more effective, but critical trade-offs exist for them all. Some policies are either inconsistent with each other or somewhat duplicative in some ways with each other, so adoption of all these policy options are not feasible.

Shortcut for Framing the Policy Scope

CARBOB demand currently runs between 750 and 850 TBD. Bearing in mind this level will help to broadly compared some policy options with reasonably estimable impact that can mitigate supply losses in the event of an unexpected supply shock.

One way to categorize the supply policy options involves the distinction between storage, production, and imports. Generally, storage options include stock minimums for refiners and terminals, utilization of existing non-operating storage, and state-run product reserves. These policy options would likely require large investments or other spending for infrastructure construction or leasing but may have a minimal impact on the environment. Increasing the available storage for refiners could help reduce supply and inventory shortages that contribute heavily to price spikes, but there are some unknowns that merit further exploration.

Production strategies focus on changes to the CARBOB specification, increasing the ethanol content in finished fuels, and allowing refiners to temporarily use non-CARBOB fuel for gasoline retail stations in the State. Certain changes to the CARBOB specification could have a negative impact on the environment and public health, with potential risk of non-attainment of Federal air quality standards. These are, however, the most likely strategies to cost the State and refiners less money to implement, resulting in a higher direct financial savings to consumers, but with uncertain long-term health detriments.

Import strategy options focus on increasing imports of finished fuel into the State. Maintaining the supply of finished fuel via imports can alleviate inventory shortages attributed to planned maintenance, which may contribute to gasoline price stability. Depending on the timing and the policy, there could be a benefit in cases of unplanned maintenance. Import strategies can be implemented over both the short-term and long-term. It is possible that an effective import strategy could have little to no net environmental impact because the imports would supply existing demand. The cost of policies for importing finished fuel tends to be high, as there is a cost associated with shipping the fuel.[52]

There are many other policy options not captured on the supply side. For example, policy options that target demand of gasoline lead to reduced consumption of gasoline and to increased demand elasticity reducing the impact of price spikes. These policy options decrease reliance on gasoline-fueled ICE vehicles by increasing availability of mobility options to support the overall transition away from petroleum-fueled ICE vehicles to zero-emission vehicles (ZEVs). The associated tables discuss these policy options in more detail.

Short descriptive tables and individual matrix assignments are presented per policy option or specific strategy of a given policy option. Utilizing all options or strategies would be infeasible, and the goal would be to select options that can effect changes in supply and markets, with the least environmental or cost tradeoffs.

Some options also may be considered during a major disaster such as an earthquake, major pipeline outage, a catastrophic fire like that of the 2015 Torrance Refinery outage, or some other acute event. There may be limitations on these options if needed assets are damaged. See the next section on Emergency Response actions.

52 At the same time, reducing shipping of crude could have potential beneficial impacts as well. The precise impact is uncertain.

List Summary of Additional Policy Options

Policy Options Targeting the Demand of Gasoline

1. Enhanced ZEV Access
2. VMT Reduction Strategies
3. Fuel Conservation

Policy Options Targeting the Supply of Gasoline

4. Storage Strategies
5. Production Enhancement Strategies
6. Alignment of Gasoline Specifications for Western States
7. Import Strategies

Highly Complex Implementation Policies

8. Gas Price Stabilization Fund
9. Cost of Service Model
10. State-Owned Refineries
11. Retail Margin Management

Emergency Implementation Policies

12. Railcar Replenishment

Policy Options Targeting the Demand of Gasoline

1. Enhanced ZEV Access

Table 2. Overview of Enhanced ZEV Access

Topic	Description
Statement of Initiative	Accelerate ZEV adoption by offering additional incentives for zero-emission vehicles, with an emphasis on equity. The equity-focused programs, Clean Cars 4 All and the Clean Vehicle Assistance Program, have had large impacts in encouraging ZEV adoption.
Scope	Uncertain scope of impact and dependent on resource investment. By encouraging and incentivizing ZEV adoption, fuel consumption will be reduced.
Pros	▪ Potential increase in demand elasticity, reducing the impact of supply shocks. ▪ More ZEVs on the road will lead to less gasoline consumption. ▪ ZEVs have no tailpipe emissions and higher adoption will lead to higher usage of a safer fuel supply.
Cons	▪ Programs can become over-subscribed if they do not continue to receive an infusion of appropriated state funding, which means they may have an uncertain impact on gasoline demand year over year. ▪ ZEV adoption does not reduce VMT, which may have negative impacts on congestion.
Issues to Resolve	▪ Clean Cars 4 All and the Clean Vehicle Assistance Program will need a continued source of state funding.

2. VMT Reduction Strategies

Table 3. Overview of VMT Reduction Strategies

Topic	Description
Statement of Initiative	Develop and implement statewide policies to accelerate infill and mixed-use development in existing transportation-efficient places, deploy strategic resources to create more transportation-efficient locations, and build a statewide transportation demand management (TDM) framework with VMT mitigation requirements for large employers and large developments.
Scope	In terms on accelerating infill and mixed-use development, notwithstanding the recent passage of laws that expand property owners' ability to create multiple units on single-family lots and limit local governments' ability to block new housing in certain circumstances,[53] many barriers to infill development remain in place, discouraging this important development type in ways that need to be addressed. If barriers can be overcome, infill development will lead to less VMT, prompt shorter transit headways, and eventually reduce gasoline usage in those areas. The goal of TDM is to provide people with information, incentives, and other support programs that help them utilize sustainable transportation options such as remote work, alternative work schedules, transit, ridesharing, bicycling, and walking and rely less on cars. A strategic point of focus for TDM program implementation could be large employers (more than 100 employees), who often incentivize driving alone by offering free parking, gas stipends, and similar perks, and do not offer similar levels of support to employees to take transit, ride their bicycle, or walk.
Pros	▪ Infill and mixed-use development may promote VMT reduction and in turn reduce gasoline consumption in favor of safer fuels. ▪ Potential increase in demand elasticity, reducing the impact of supply shocks.
Cons	▪ Unclear total impact in terms of reducing demand in response to supply shocks. ▪ Some areas are not amenable to high density, so price spikes may continue to affect some regions. ▪ High transit usage is historically only seen in dense communities. ▪ May not be feasible for less dense and more rural communities.
Issues to Resolve	▪ Would require high levels of coordination and cooperation at the local municipal level who are the lead on land-use policies.

53 California Department of Housing and Community Development. See Accessory Dwelling Units

3. Implementation of Fuel Conservation Measures

Table 4. Overview of Fuel Conservation Measures

Topic	**Description**
Statement of Initiative	Develop and implement tools to encourage fuel conservation by using the media to alert the public to potential shortages of fuel or enact direct consumption policies to increase conservation, increase availability and affordability of alternatives to light-duty vehicles (e.g., bikes, e-bikes, scooters), prioritizing needs of underserved communities, and authorizing and implementing roadway pricing strategies, such as toll roads and high occupancy toll lanes.
Scope	Develop a State Marketing, Education, and Outreach (ME&O) strategy to encourage demand reduction during months that have high gasoline demand (July-October). Additionally, the State and local governments could increase access to active transportation modes, which may result in a reduction of light-duty vehicle travel, which would in turn result in lower fuel consumption. Likewise, authorizing transportation pricing strategies is essential to promote more efficient use of vehicles and to further transit and active transportation improvements. Pricing strategies present an opportunity to fund the transportation system in a more equitable and fiscally sustainable way than current funding sources, promote more efficient functioning of existing infrastructure, and fund new transportation options.
Pros	▪ The ME&O strategy is a low-cost option to call for voluntary conservation to reduce gasoline consumption. ▪ Potential increase in demand elasticity, reducing the impact of supply shocks.
Cons	▪ Could spur panic buying, increasing demand and exacerbating the price spike. This does not tend to occur in the case of electric power conservation alerts but could be more likely in the case of gasoline, where fuel can be purchased in advance. ▪ Unclear total impact in terms of reducing demand in response to supply shocks. Consumer responsivity to electricity alerts is likely not analogous to responsivity to gasoline alerts. ▪ May not be feasible for less dense and more rural communities.
Issues to Resolve	▪ What measures should be prioritized? ▪ What measures are the most productive? ▪ This would require support from multiple State agencies.
Other	▪ Will need to develop "messaging" that stimulates conservation but not panic.

Policy Options Targeting the Supply of Gasoline

4. Storage Strategies

The listed storage strategies will help maintain an adequate buffer supply that, upon the release of the stored supply, can allow for a short-term boost to overall supply and mitigate in cases of supply shock.

A. Storage Strategy: Stock Minimums for Refiners and Terminals

Table 5. Storage Strategy: Stock Minimums for Refiners and Terminals

Topic	Description
Statement of Initiative	Require refiners and terminals to maintain contingency reserves of gasoline fuel in refineries and terminals. During supply shocks, temporary release of minimum requirements to supply the market.
Scope	Variable scope of impact but could create an effective reserve of several hundred thousand barrels.
Pros	▪ The requirement could mitigate short-term price spikes. ▪ Maintaining minimum stocks will provide a quickly available reserve. ▪ Additional stored gasoline would be distributed in Northern and Southern California at key locations, like refineries.
Cons	▪ If the refiners withhold stocks to maintain the minimum, it may artificially create shortages in downstream markets (refiners may need to hold back a shipment to sustain the legal minimum stocks, which could cause a terminal to run lower than expected). ▪ Could increase average prices for refiners to maintain additional storage. ▪ The pipeline cycle process requires terminals to always be low on stocks before a batch is delivered, so this may be best applied at refineries and/or pipeline storage. ▪ A process or program will need to be developed to orchestrate the use of the volumes held in reserve.
Issues to Resolve	▪ What volume should be held in reserve and what would be the basis? ▪ Can it be held as finished CARBOB or as blendstocks? ▪ Downstream impacts could impact spot market prices in uncertain ways, although a market equilibrium may likely emerge at a higher price level. ▪ What is the cost to the refiner, and will this be passed to consumers?
Other	▪ Potential exists for the state to be criticized for requiring refiners to withhold fuel from the market.

B. Storage Strategy: Existing Non-Operating Storage

Table 6. Storage Strategy: Utilization of Existing Non-Operating Storage

Topic	**Description**
Statement of Initiative	Lease tankage at closed refineries to hold gasoline in reserve in the event of supply shortages.
Scope	Variable scope of impact depending on existing capacity, up to several hundred thousand barrels.
Pros	▪ No need to build tanks for a reserve, reducing stranded asset risk. ▪ Existing storage has existing logistical pathways for rapid distribution. ▪ Can start sooner with agreed protocols.
Cons	▪ Limited locations. Some refiners have indicated their "at refinery" storage is fully utilized. ▪ Current possibilities at Martinez and Rodeo refineries in Northern CA may not be available if they plan to import or use for renewable fuel purposes.
Issues to Resolve	▪ How large should the reserve target be? ▪ What capacity is available? ▪ How would seasonal RVP changes be managed? The fuel will need to be sold to dispose of high RVP stocks in the Spring and summer RVP purchased, and the converse in the Fall. ▪ Should it be the state leasing the storage and owning the fuel? Or use a private partner to lease and operate it? ▪ How would the reserves be utilized?
Other	▪ It might be difficult to see a refiner agreeing to use their tanks for this purpose. ▪ It may make sense for each refiner/supplier to be required to store a certain volume to use at their discretion.

C. Storage Strategy: State-Owned Product Reserve

Table 7. Storage Strategy: State-Owned Product Reserve

Topic	**Description**
Statement of Initiative	Establish state-owned product reserves in the North and South Regions to allow rapid deployment of fuel when needed.
Scope	Variable scope of impact, up to several hundred thousand barrels. Potential to build to size for Northern and Southern California needs.
Pros	▪ Having fuel available in state-owned reserves would provide quick access to fuel in the event of refinery outages. ▪ The state may be able to control the use of the fuel so that industry does not use it as a crutch to lower stocks. In other words, the state would only use the reserve for situations where events may cause significant price spikes.
Cons	▪ Industry may lower their stock levels if the reserves are released by the State every time there is a price spike. ▪ Risk of stranded assets if the state builds the reserve system. ▪ Price spikes are typically short-lived, while a state-managed storage system would require sustained operation, opening the question about the benefit-cost. ▪ Rotation of fuel for RVP purposes may increase regular costs slightly.
Issues to Resolve	▪ Must identify locations in the north and south. ▪ Protection against industry gaming of the inflow/outflow system. ▪ How would the fuel integrate with the existing system? ▪ How would seasonal RVP changes be managed? ▪ There may need to be several variations of this option evaluated. ▪ Existing spare storage in the KM system is minimal, but new build tanks for modest reserves in key locations may be possible. ▪ How would the reserves be utilized? Open bidding once CEC indicates the situation calls for use of the reserve? Who conducts the sale? Who is allowed to bid? Can the SPR model be used?
Other	▪ It will be important to get the product from the reserve into the system quickly. ▪ Will need to review the 2002 study in the context of the current market and infrastructure. ▪ The DOE product reserves have only been utilized once – for hurricane Sandy – and that was diesel fuel for electric generator usage.

5. Production Enhancement Strategies

Production enhancement covers several distinct approaches that have different features but are categorized as attempting to increase the supply of gasoline by modifications to standards outside of any sort of interstate agreement.

A. Production Enhancement Strategy: E15

Table 8. Production Enhancement Strategy: E15

Topic	Description
Statement of Initiative	Allow increased blending of ethanol with CARBOB from 10 percent (E10) to 15 percent (E15), effectively augmenting the existing CARBOB supply.
Scope	Could increase supply up to 40 TBD (5 percent), or about 17 additional unit trains (100-car trains) of ethanol per month from the Midwest.
Pros	▪ Likely to lower the price of CA fuel due to additional supply. ▪ Fewer environmental harms than E10, with a 1 percent loss of fuel economy.[54,55] ▪ E15 is allowed by the EPA and currently sold in 31 states.[56] ▪ The U.S. already exports about 60 TBD ethanol.
Cons	▪ Refineries may rebalance production for higher ethanol blends, potentially limiting the long-term ability for this strategy to reduce costs. ▪ E15 fuel specifications have not been adopted in California, and it could take years to conduct proper regulatory processes. ▪ Ethanol price may increase with higher demand.
Issues to Resolve	▪ Additional analysis is necessary to understand the pollution impacts of E15. ▪ Some equipment may not be capable of dispensing E15 and require upgrades, although this appears to be limited.[57] ▪ Blending processes and procedures will need to be in place.

54 Karavalakis, et. al., 2022. Comparison of Exhaust Emissions Between E10 CaRFG and Splash Blended E15. Prepared for CARB. Available online at: Comparison of Exhaust Emissions Between E10 CaRFG and Splash Blended E15.

55 Tang, et. Al., 2023. Expanding the ethanol blend wall in California: Emissions comparison between E10 and E15. Fuel (350). Available online at: Expanding the ethanol blend wall in California: Emissions comparison between E10 and E15.

56 Of the 31 states approved for E15 sales, 12 have 10 or fewer stations in operation. See New EPA ruling expands sale of 15 percent ethanol blended motor gasoline.

57 A recent report of multimedia evaluation submitted to CARB indicates that some gaps of E15 compatibility for some equipment. "Some equipment currently in use in California is… listed [by Underwriters Laboratories] only to E10. Equipment with a UL listing of E10 could be considered compatible with E15 with a manufacturer's statement of compatibility, however research and previous requests show that not all manufacturers will provide this document for blends above E10." See CARB's Multimedia Evaluation Report, page 31. Available at https://ww2.arb.ca.gov/sites/default/files/2022-07/E15_Tier_I_Report_June_2020.pdf

B. Production Enhancement Strategy: RVP Modification

Table 9. Production Enhancement Strategy: RVP Modification

Topic	**Description**
Statement of Initiative	Consider various modifications to RVP requirements to address tight supply conditions. Examples include early allowance for winter grade RVP, shifting the time period of winter RVP, or a permanent modification of summer RVP specification.
Scope	Timing of mitigation needs may limit implementation effectiveness. Staff estimate a potential of up to 90 TBD of added supply during early allowance periods, an approximate 10 percent supply increase. Longer-term shift of summer blend RVP could increase supply by about 4 percent.
Pros	▪ Increase in supplies during high-risk periods. ▪ Evidence of contributing to a significant ramping down during the 2022 and 2023 price spikes.
Cons	▪ Increased risk of violation of federal air quality attainment standards and related sanctions or litigation. ▪ RVP and other gasoline specifications are included in the federally required State Implementation Plan for air quality and cannot be weakened without identifying substitute emission reductions. ▪ Could increase evaporative emissions and ozone levels for at least those two months, with potential persisting effects for several months. ▪ Permanently shifting the RVP time period may result in shifting when price spikes occur instead of mitigating them. ▪ RVP shifting options only available during certain months of the year.
Issues to Resolve	▪ Will require CARB input on air quality risks on community safety. ▪ What market conditions would trigger implementing some actions? ▪ Timing of implementation. ▪ Vapor lock risk.

C. Production Enhancement Strategy: Non-CARBOB Fee-Based Allowance

Table 10. Production Enhancement Strategy: Non-CARBOB Fee-Based Allowance

Topic	Description
Statement of Initiative	Create a fee-based non-CARBOB allowance program that can be activated during a price spike or in response to a reasonable expectation of one.[58] Revenue from fees would be used for air quality improvement strategies in non-attainment regions or other EJ communities.
Scope	On average, there are 1,200 thousand barrels (24 days at 50 TBD) of non-CARBOB gasoline in CA refineries and 100-130 TBD non-CARBOB production. Using a small portion of these resources or allowing the importation of non-CARBOB gasoline could mitigate a price spike without jeopardizing supply to Nevada or Arizona. For nearby imports, a cargo size of 250-300 thousand barrels per ship. One ship per week is approximately 40-50 TBD.
Pros	▪ Widespread access to non-CARBOB gasoline in stock or in nearby locations during critical periods could be used to reduce the spot market price during a supply shock. ▪ In-state supply could be rapidly available for pipeline batches. Out-of-state non-CARBOB supply could be more quickly secured than CARBOB. ▪ May minimize the intensity of a price spike with the lowest volume of CARBOB substitution. ▪ Direct support of communities most impacted generally by air quality impacts.
Cons	▪ Introducing non-CARBOB gasoline could impose a negative pollution effect and potential risk to federal air quality attainment standards. ▪ RVP and other gasoline specifications are included in the federally required State Implementation Plan for air quality and cannot be weakened without identifying substitute emission reductions.
Issues to Resolve	▪ Deeper analysis and public deliberation on policy implementation, economic underpinnings, and environmental impacts. ▪ The state will need an authority to activate the policy quickly and have an effective fee structure in place prior to a spike. ▪ Uncertainty on potential gaming behavior during spike periods. ▪ When to activate and deactivate an allowance period. ▪ How to set fees to address the spike and minimize non-CARBOB used.

58 This policy approach is discussed in broader terms as part of 2015 the Petroleum Market Advisory Committee docket (Borenstein, Bushnell, and Lewis, 2004. "Market Power in California's Gasoline Market"). See MARKET POWER IN CALIFORNIA'S GASOLINE MARKET for more information.

Other	▪ May impact NV and AZ supply, but those markets (except Reno) can be partially supplied from the East.

D. Production Enhancement Strategy: CARBOB for Reno

Table 11. Production Enhancement Strategy: CARBOB for Reno

Topic	Description
Statement of Initiative	Supply CARBOB gasoline and diesel into Reno market terminals long-term. This will make more storage available for CARBOB product or blendstocks in northern California refineries and large storage terminals.
Scope	Would require Bay area refiners to produce 5 percent more CARBOB instead of Nevada gasoline in exchange for more supply flexibility.
Pros	▪ More effective storage for CARBOB product due to elimination of a need to hold Reno-specification gasoline in refineries and the terminal storage-pipeline system. ▪ Relatively easy to implement with refiner capability. ▪ Air quality improvements for Reno residents.
Cons	▪ Refiners in Northern CA will have to regularly make more CARBOB based on demand in Reno (about 20 TBD CARBOB). ▪ Potential price impacts in Reno.
Issues to Resolve	▪ What would be the process to implement? Who is involved? ▪ Would pipeline operators see advantages on costs and potentially impact tariffs? ▪ Interstate relations impacts. ▪ Ability to make more CARBOB with declining refinery capacity.

6. Alignment of Gasoline Specifications for Western States

Table 12. Overview of Alignment of Gasoline Specifications for Western States

Topic	Description
Statement of Initiative	Establish a unified gasoline specification for several states in the West. (Note: RVP would remain the same as current).
Scope	Unknown direct impact from the policy, but a market shift that could expand the market coverage and increase competition for fuel via marine cargos.
Pros	▪ If gasoline products have identical specifications in all three states, shorter associated import timelines could reduce supply shock effects in California. ▪ If CARBOB were to be the agreed upon specification, there would be positive air pollution impacts in all regionalized states. ▪ Import and export flexibility could be enhanced for all three states. ▪ Increased competition could decrease prices and reduce price spike risk.
Cons	▪ The states must agree on common specifications. Legislative or at least regulatory changes would be necessary in all states. ▪ With CARBOB being the most difficult to produce, it is possible that the agreed specification could lead to a less stringent emissions standard for California. Cost and benefit impacts of such alignment must be assessed. ▪ RVP and other gasoline specifications are included in the federally required State Implementation Plan for air quality and cannot be weakened without identifying substitute emission reductions. ▪ Refiners may use the fungible fuel as a rationale to lower stocks and/or storage, potentially increasing price spike risk.
Issues to Resolve	▪ Concurrence among multiple state entities in all states, which may not be feasible.
Other	▪ Northeast states were able to better manage heating oil and diesel stock levels and demand surges when both products were aligned on sulfur specifications.

7. Import Strategies

Import strategies intend to increase supply directly or indirectly by bringing in fuel from refineries outside of the state. Across all strategies listed, timing is a critical challenge.

A. Import Strategy: Resupply Compensation

Table 13. Import Strategy: Resupply Compensation

Topic	**Description**
Statement of Initiative	If companies or traders are reluctant to purchase gasoline during a price spike or supply shortage,[59] a program could provide compensation to those parties to stimulate transport of CARBOB fuel to California.
Scope	Cargo size is 250-300 thousand barrels per ship. Limited supply sources for CARBOB may make this a one-to-two ship per week option, approximately 40 to 80 TBD, or about 5 percent to 10 percent.
Pros	▪ Incentives to stimulate shipments may result in additional CARBOB fuel arriving in California. ▪ CARBOB consumption would remain approximately similar to existing expectations.
Cons	▪ Timing of resupply may occur too late due to logistical timelines. Identification of refiner, manufacture of CARBOB, and vessel movement to CA could take up to six weeks. ▪ Refiners or blenders who can produce CARBOB fuel are limited. At best one-to-two ships per week (5 percent to 10 percent of demand) for planning purposes. ▪ Could be very expensive if freight and price risk are "covered" for the importer by the designated authority or program. ▪ Policy may also cause refiners to "wait and see" what the state may do before they act, which would be counterproductive.
Issues to Resolve	▪ Program development will require additional work. A bidding system or reverse auction may be useful in this process. ▪ Would this option allow compensation for purchases of key blendstocks (e.g., alkylate), or only CARBOB? ▪ Who is allowed to compete for the incentives and how will the program control who gets the incentive? ▪ Could this create a market distortion?
Other	▪ Any program will need an ongoing authority to manage this process, including timing and scope. ▪ Will the program be perceived as picking winners and losers? Will the program be perceived as aiding Big Oil? ▪ While the program itself may become a short-term response mechanism, delineating all the issues here may make take time.

59 During the Commissioner hearing on California Gas Price Spikes on November 29, 2022, CEC staff pointed out that importers may be reluctant to purchase ships due to the expectation that in-state refinery capacity may recover. This was evidenced in an attempted refinery restart during the 2015 Torrance refinery outage.

B. Import Strategy: Short-Term Imports

Table 14. Import Strategy: Short-Term Imports

Topic	**Description**
Statement of Initiative	The state creates a program or hires a trading company that takes on a series of regular delivery contracts during critical risk periods to augment gasoline supply via imports for a defined period.
Scope	Cargo size 250-300 thousand barrels per ship; one ship per week amounts to about 35-50 TBD, about 5 percent of CA supply.
Pros	▪ Provides security during times of increased supply shock risk. ▪ Increasing total supply could decrease spot prices. ▪ May be a good buffer for longer-term larger shortages that arise during the defined period.
Cons	▪ Potential high cost to the state. Because marine cargos are more expensive, gasoline brought to the spot market will likely be sold at a loss. ▪ CARBOB refiners outside of California are limited. ▪ Highly uncertain market reactivity to the program, depending on the extent the program's actions are known and market actors understand how to optimize their behavior to the supply increase. ▪ State actions in the spot market may result in objections of unfair competition or "dumping."
Issues to Resolve	▪ How many cargo ships can be deployed to California ports? ▪ Does the pipeline have enough capacity to handle an increase in marine imports? ▪ Is there enough storage to handle the product imported? ▪ How will the state negotiate with the Kinder Morgan pipeline system to move fuel? ▪ How well known will the contracts, volumes, and spot market additions be to other market participants? ▪ How will costs from likely losses in the spot market be paid for?
Other	▪ If put in place, the state must establish an authority or program to manage the entire process, as well as a contractor to manage the logistical aspects of all stages of the program (e.g., purchase, shipping, offloading, selling on the market, etc.).

C. Import Strategy: Reliable Imports

Table 15. Import Strategy: Reliable Imports

Topic	**Description**

Statement of Initiative	As the transition unfolds, California may wish to consider developing a relationship with a supplier and refiner or marketer to bring CARBOB into California via regular ship loads so consumers are assured a reliable import supply.
Scope	Based on refinery gasoline production vs demand, a strategy may establish 5 percent to 10 percent greater supply than planned refinery production to preserve a baseline supply above expected demand.
Pros	▪ Having a CARBOB term contract with a major refiner (Reliance, Korea, or a country in the Middle East) to provide (for example) 50 TBD – one-to-two cargo ships per week. This would provide a cushion as State CARBOB demand declines and refiners' behavior remains uncertain.
Cons	▪ It may be difficult to make appropriate financial and logistical arrangements, such as import location and other logistics (how the fuel is stored and sold, etc.). ▪ CARBOB refinery capacity outside of California is limited, although a term commitment may better ensure reliable supply. ▪ The State would be actively engaging in the market as a mechanism to control supply, which may cause other market participants to disengage or engage in other market gaming strategies.
Issues to Resolve	▪ Will depend on where the ZEV transition impacts gasoline demand the most and how refiners choose to operate their business in that environment. That is, the option may need to react to how the refining business changes with decreased demand.
Other	▪ This is a transition-focused option and may not be something California can direct. It is like Hawaii's approach, which is heavily dependent on imports but managed by industry stakeholders.

D. Import Strategy: Jones Act Vessels

Table 16. Import Strategy: Jones Act Vessels

Topic	Description
Statement of Initiative	State-leased or state-owned (i.e., state-managed) Jones Act tankers[60] may provide resiliency if the right refineries can produce the necessary gasoline for the state's needs in a timely fashion.
Scope	Standard ship capacity. Provide California with an available ship to move fuel between domestic ports.
Pros	▪ Would provide prompt marine capacity to load and discharge gasoline or blendstocks.
Cons	▪ Placing a vessel under lease on a "stand-by" basis will be extremely expensive, with unknown vessel management challenges (e.g., crew, maintenance, etc.). ▪ Standby location must be near port capable of rapid production shift capacity to CARBOB, with associated uncertainties. ▪ While there is some CARBOB production capability in the Pacific Northwest, it may still take time to produce a batch suitable to load a vessel. ▪ There would need to be a commercial arrangement with a refiner to supply the fuel to load the vessel.
Issues to Resolve	▪ Leasing capability and costs, terms of use and fuel acquisition assurance. ▪ How would the state direct the ship operation and market the gasoline after loading on the vessel? ▪ What would be the procedure for utilizing the vessel and discharging the gasoline?
Other	▪ Should the State be in the business of buying and selling fuel?

60 The Jones Act requires that any cargo traveling by sea between two U.S. must be built in the United States and be crewed by mostly U.S. citizens.

Highly Complex Implementation Policies

8. Gas Price Stabilization Fund

Table 17. Overview of Gas Price Stabilization Fund

Topic	Description
Statement of Initiative	During times of lower gas prices, fees would be levied in a variable manner to then allow for stabilization initiatives during California-specific price spikes.
Scope	A means-tested fund disbursement program for middle- and low-income gasoline vehicle owners would provide an offset to California-specific gasoline price spikes.
Pros	▪ Financial assistance provides some insulation against price spikes for middle-to-low income Californians. ▪ Fungibility of disbursement funds may also encourage conservation.
Cons	▪ Gas prices may remain consistently high throughout the year and the difference between the average price in California and the average price in the U.S. may widen. ▪ Public perceptions of the fund's purpose may present a communications challenge, as funds would not be disbursed for national price spikes (e.g., when California spot markets prices are in alignment with NYMEX RBOB prices). ▪ It may be difficult to adopt a means-tested benefit program.
Issues to Resolve	▪ How to optimize fees during lower gas price periods? ▪ Mitigating potential shortfalls in the fee offset fund?

9. Cost of Service Model

Table 18. Overview of Cost-of-Service Model

Topic	Description
Statement of Initiative	California would actively regulate the operating rules, prices, and rate of return of petroleum fuel market operators similar to the current structure used to manage private electric and fossil natural gas utilities as natural monopolies.
Scope	California sellers would be required to have prices approved by the designated State authority and spending would have to be approved for cost recovery in prices.
Pros	▪ The state would have more control over the margins.
Cons	▪ Current market operators do not have natural or logistical monopolies like standard private electric and fossil natural gas utilities. ▪ Challenging to optimize operations and yields due to stricter regulatory environment. ▪ Unclear how this would control trading parties.
Issues to Resolve	▪ Is there concern about regulating fuels by California that are destined for other states? ▪ Would permission need to be granted to change crude oil processing and refinery product slate (refiners may produce 30 or more products at a given refinery – not just one product such as electric utilities)?
Other	▪ Are there other countries that utilize a model like this?

10. State-Owned Refineries

Table 19. Overview of State-Owned Refineries

Topic	Description
Statement of Initiative	The State of California would purchase and own refineries in the State to manage the supply and price of gasoline.
Scope	Could range from one refinery to all refineries in the state.
Pros	▪ The State would operate a market independent source of production which would eliminate potential market manipulation
Cons	▪ It is very expensive to purchase or compensate for refinery infrastructure and will raise questions of liability and cost effectiveness when the projected demand of gasoline will decline in the State over time. ▪ There are complex industrial processes that the State has no experience in managing. ▪ Significant legal issues would need to be addressed.
Issues to Resolve	▪ What does the State procurement process look like for such a transaction? ▪ How would the state purchase crude, blendstocks, etc., and sell the diverse products from one or more refineries? ▪ What would drive how the State managed the refinery? Profit? Maximize production? Minimize production?
Other	▪ As demand for fossil fuel declines, will the presence of State-owned refineries inhibit an orderly phase out of refinery capacity?

11. Retail Margin Management

Table 20. Overview of Retail Margin Management

Topic	**Description**
Statement of Initiative	Measure, publicize, and potentially manage retail margins.
Scope	Assure that all gasoline that is sold at retail stations in California is not sold at excessive retail margins.
Pros	▪ Linking allowable retail dealer margins to a ceiling can reduce the lag in restoration of retail prices after a spike. ▪ Transparency may foster faster responses to spot market changes. This will likely mean prices increase faster, but the retailers will need to lower prices faster as well, which will benefit consumers more based on chronic lags in retail price declines.
Cons	▪ Retail associations may object to publishing retail margins based on actual data or limiting retail margins. ▪ Price caps do not have a history of effective implementation. ▪ It may be difficult to determine "reasonable" retail margins based on varying costs of rent, land, labor at different stations or regions of CA. ▪ Burden for dealers to report their weekly fuels delivered costs vs the average price for their sales (less taxes) to the administering body.
Issues to Resolve	▪ As gasoline demand declines, increasing margin allowances may help keep dealers in business and minimize job losses.
Other	▪ Evidence presented to CEC indicates that retail prices increase with the spot market but lag when the spot market declines. ▪ Historical evidence also shows that while refinery margins have gone up and down, retail margins have consistently grown over time.

Emergency Implementation Policies

Emergency Implementation Policies reflect potential actions the State may need to consider in severe emergencies where physical supply of fuel is paramount. These types of events could include earthquakes and other events, including major pipeline failures, extensive port dock damage, broad power outages that close multiple refineries for multiple days. These policies may have effects on fuel pricing, but their focus is more directed to managing emergency supply shocks than addressing prices.

12. Railcar Replenishment

Table 21. Overview of Railcar Replenishment

Topic	**Description**
Statement of Initiative	Use railcars to provide CARBOB or Conventional BOB to California.
Scope	A unit train (100 railcars) of refined gasoline hold 70 thousand barrels of fuel – 3 million gallons. One unit train per day would cover about 8 percent of California demand.
Pros	▪ Option for additional supply of finished fuel or blendstocks. ▪ May be faster than marine movements from the Gulf Coast.
Cons	▪ Limited locations to load unit trains of gasoline or blendstocks at Gulf Coast refineries. ▪ Limited locations in CA to offload – which could be impacted by the event, but this could be mitigated to an extent if transloaded from rail cars into trucks. ▪ Timing concerns of loading and unloading may limit the effectiveness. ▪ Likely will not be effective if CARBOB is the required fuel (few non-California refiners can produce it).
Issues to Resolve	▪ Will need to confirm that rail receiving facilities in California are operational for both gasoline and ethanol. ▪ Should develop a catalogue of all terminals in California and their rail and truck loading and receiving capability (or lack of). ▪ Are there adequate railcars available?
Other	▪ Further study of this approach may indicate that there are potential private sector pathways for a more commercial approach. ▪ The volume of demand that needs to be covered may be less than normal if earthquakes impact roads and ability to commute.