APPENDIX D2

California's Uncertain Oil Future

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INTRODUCTION

Fuel prices in California, already among the highest in the nation, face long-term upward pressures from rising demand, limited refining capacity, and high world prices for crude oil. More worrisome still, domestic production of crude oil is shrinking. Prices in California could surge in the future if the state fails to add sufficient capacity to efficiently and economically import enough crude oil and refined products to offset declining production at home and increased demand for motor fuels.

The nature of the challenge should sound familiar. For example, years of deferred investment created huge capacity deficits in transportation infrastructure and electricity generation. Freeways in the Los Angeles area are the most congested in the nation, and those in the Bay Area run a close second. Similarly, the rolling blackouts in 2001 during the electricity crisis were underpinned by peak-period electricity shortages stemming from the failure to build any new generating capacity in California during the previous two decades. Of course, the flawed rules of the state's partial deregulation of the electricity industry and unscrupulous energy companies gaming the market made the situation much worse. The construction of several large power plants since 2001 has helped sharply reduce the likelihood of an involuntary power supply interruption, but continued long-term growth in California threatens once again to push up against capacity limits.

In transportation, however, the state has been content to make do with the infrastructure legacy built by previous generations despite continued growth in demand and obvious capacity constraints. A similar story is unfolding with transportation fuels.

California's burgeoning population growth and expanding economy will create additional demand for gasoline, diesel, and aviation fuel, even with the rapid adoption of more fuel efficient vehicles, notably gas-electric hybrids. At the same time, California's traditional sources of crude oil – which the state's refineries turn into fuel – are declining steadily. With Alaskan and Californian oil fields producing less crude, the state will have to import millions of barrels of crude oil from distant sources to replace this lost output. Increasing the supply enough to match growing demand will require more and more imports.

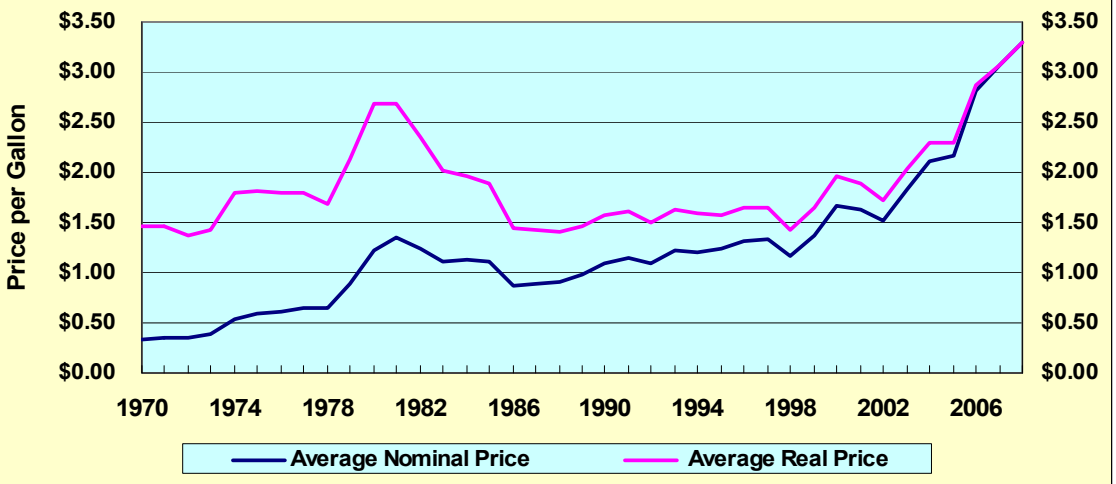
California, however, currently lacks suitable port facilities to efficiently and economically import such vast amounts of crude oil.

BACKGROUND

Rising prices at the pump are sure to produce grumbling from consumers and sensational media coverage. The complaints from consumers in vehicle-dependent California are understandable, since most people feel they have no choice but to keep buying fuel week after week. Indeed, economists describe the demand for gasoline as being extremely price inelastic, meaning that demand barely falls as the price rises.

Media reports invariably compare prices over time without adjusting for inflation, which can make it seem like gasoline prices have been increasing non-stop for decades. This is the story told by the dark blue line in Figure 1, which shows the annual average price of a gallon of gasoline in California over the past thirty-five years in nominal dollars. The pink line, which shows the inflation-adjusted annual average price, tells a different story. After spiking in 1981, the price declined and then held relatively steady from 1986 to 1998. The average annual price has been rising for the past 10 years, and passed its previous inflation-adjusted peak in 2006.

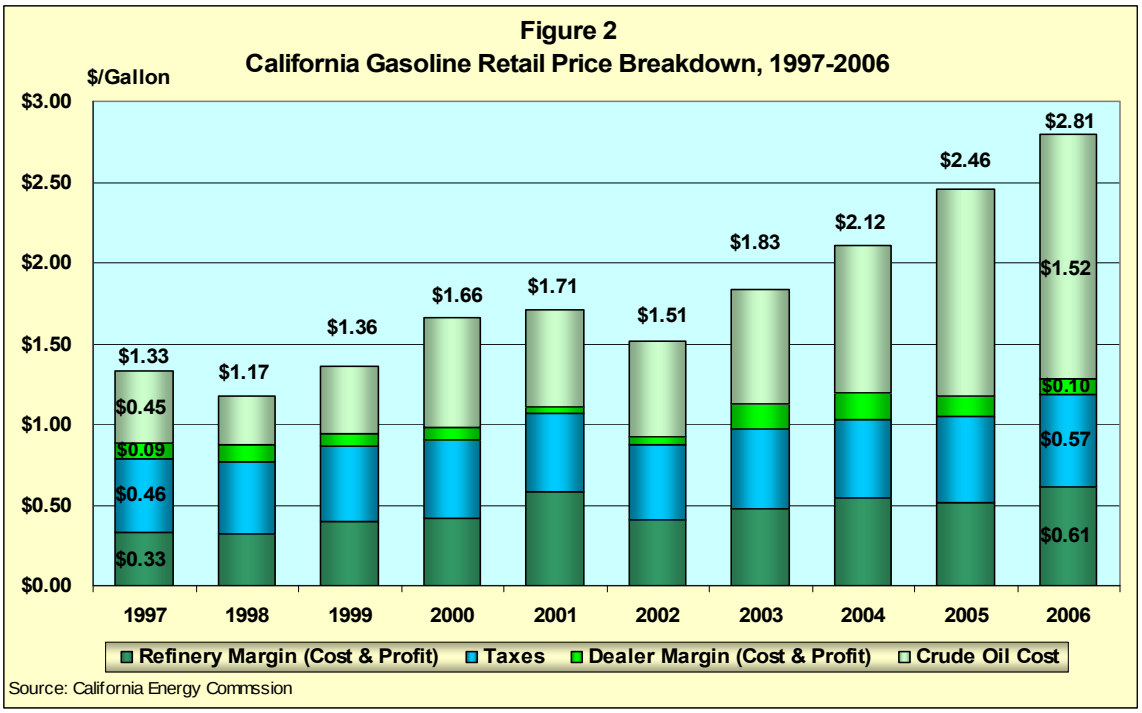
Figure 1
Historical Yearly Average California Gasoline Prices, 1970-2008



Source: California Energy Commission, Updated as of Jan 14, 2008

In 2007, the average annual price was $3.08 per gallon, but the single highest weekly price was $3.46 per gallon. As of January 14, California's average gasoline price for 2008 is $3.30 per gallon.

Components of Gas Prices: The retail price of gasoline is made up of four components: the cost of crude oil; a refinery margin; a dealer margin; and taxes. Figure 2 (on the next page) shows the relative share of these components in the annual average price of a gallon of gasoline in California since 1997.



The cost of crude oil is the largest and most volatile component of the price of gasoline, accounting for $0.30 to $1.52 per gallon. Note that if the price of crude oil is factored out, a gallon of gasoline cost only $0.42 more in the most expensive year (2006) than ten years ago (1997). During the ten-year period, the cost of crude oil has soared by $1.07 per gallon, rising from $0.45 per gallon to $1.52 per gallon in 2006. [Detailed cost components for 2007 are not yet available, but crude prices were even higher in 2007 and have continued to rise in 2008.]

In total, taxes have increased from $0.46 to $0.57 per gallon of gasoline. Gasoline sold in California is subject to federal and state excise taxes plus the state sales tax. The standard federal excise tax is 18.4 cents per gallon, but most gasoline sold in California contains some ethanol and thus qualifies for a tax rate reduction of several cents per gallon. California adds state excise taxes of 18.0 cents per gallon and Underground Storage Tank fees of 1.4 cents per gallon, plus state sales tax. The sales tax rate is 7.25 percent, 7.75 percent, or 8.25 percent depending on whether the taxing county has zero, one or two transportation surcharges.

The dealer margin of retail gasoline prices is the smallest component, accounting for $0.09 to $0.10 of the average price of a gallon of gasoline in California. The refining margin has almost doubled, on the other hand, rising from $0.32 to $0.61 per gallon, 1997 to 2006.

Controlling Gas Prices: California has a limited number of options as it seeks to keep gasoline prices as low as possible: reduce gasoline taxes; lower the dealer margin on gasoline; lower the refining margin; lower the price of crude oil; or minimize crude oil transportation bottlenecks and costs. Only the last option is feasible.

The state has the most control over state excise and sales taxes, yet is unlikely to reduce these major revenue sources. Meanwhile, deferred investment has created a multi-billion dollar backlog of transportation projects. Even if all future sales taxes on gasoline are dedicated to transportation projects, there will not be enough funds to pay for the state's transportation needs.

Note that gasoline taxes in California are low by developed world standards. Americans pay lower gasoline taxes than their counterparts in places such as Australia and Canada, and far less than in European countries and Japan. In fact, gasoline costs more than twice as much in most of Europe than it does in the United States, largely due to taxes.[1] Most international developed countries also make extensive use of toll roads.

The dealer margin is subject to market forces and in any event accounts for only a small fraction of the price of gasoline.

The refining margin is larger but also subject to market forces. Even if environmental regulations and community opposition were not an issue (and they are), current operators have a strong disincentive to make more than incremental additions to refining capacity in California. Building a new refinery would increase supply by a large amount, enough to drive down prices of all refined products. Further, US refiners' margins have been low for more than two decades, and it will take several more years of strong profits to spark interest in building new refineries.

California could provide incentives to encourage the construction of additional refining capacity. Given the state's ongoing budgetary woes, however, providing such a subsidy to the private sector seems an unwise and distinctly unlikely possibility. Even if there were private sector interest, a new refinery would take years to permit and build as it would face myriad environmental challenges.

The price of crude oil is subject to fluctuations in world markets caused by the vagaries of supply and demand, geopolitical factors, and actions of the OPEC cartel. None of these factors is readily influenced by California. However, crude oil is not a single product. Different oil fields produce different grades of crude oil, which vary in specific gravity (weight), acidity, and sulfur and heavy metals content. Lighter, sweeter (low sulfur) grades are easier to refine, yield more gasoline per barrel of crude, and typically cost more than heavier and sour (high sulfur) grades of crude oil.

Local crude oil prices depend on the type of crude available and regional variations in the balance between supply and demand. The local supply of crude oil may be constrained by factors other than the amount available for delivery. The capabilities of local refineries can also limit potential sources. A refinery designed to handle light crude oil, for example, may not be able to process heavy, sour grades without additional investment in processing equipment. Also, California's refineries are old and could be subject to more breakdowns in the years ahead. Infrastructure limitations can also restrict supply. Pipeline and port capacity will necessarily place an upper bound on the potential local supply of crude oil.

[1] http://www.eia.doe.gov/emeu/international/en-international-fuelprices-part2-2007.pdf

Most California refineries, designed to handle the heavy, high-sulfur "gunk" produced in the San Joaquin Valley, can refine just about any grade of crude oil with few or no modifications. An open question, however, is whether California will have sufficient capacity to import the vast quantities of crude oil needed in the future.

Crude oil transportation costs are the one component of the price of fuel in the state directly subject to actions taken (or not taken) here. California needs to construct sufficient import capacity for crude oil (1) to ensure that local supply is not constrained at a level below demand, thereby driving prices up; and (2) to keep open as many import options as possible so that California refineries pay the lowest available price for whatever grade of crude oil they consume.

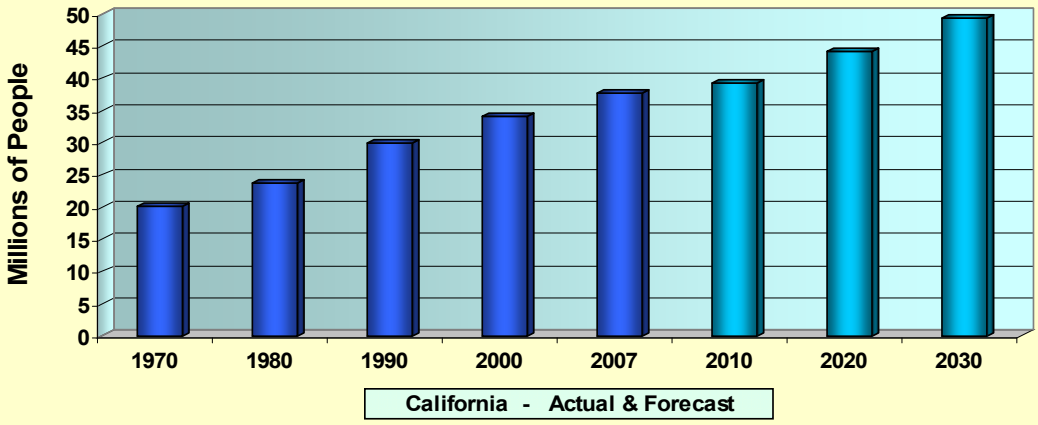
The next two sections describe the demand for crude oil in California and the sources of crude oil used in the state. The findings from these sections are then juxtaposed in a summary of supply and demand issues. Next, we describe the Pacific LA Marine Terminal for importing crude oil at the Port of Los Angeles before turning to two plausible scenarios for the future of crude oil imports in California. The final section examines the implications of changing prices for refined petroleum products.

CALIFORNIA CRUDE OIL DEMAND

This section describes four correlated factors driving crude oil demand in California: the number of people, the number of cars and light trucks, the vehicle fleet's fuel economy, and the number of vehicle miles traveled.

Population Growth: The key driver of crude oil demand, as with most other important trends in California, is population growth. Figure 3 charts the Golden State's population growth since 1970. California added over 17.8 million people, 1970-2007, raising the population by 88% from 20 million to 37.8 million residents.

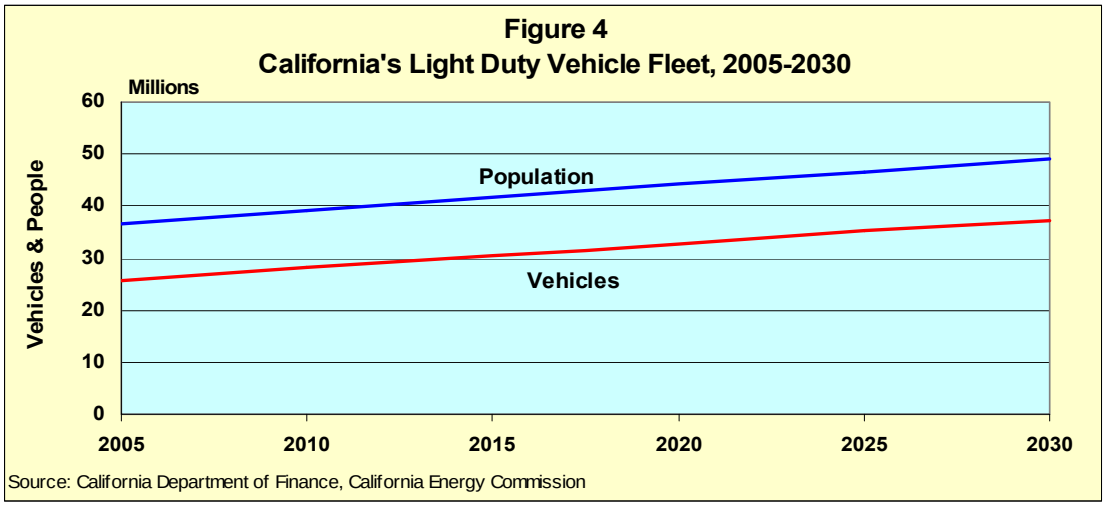
Figure 3
Population Growth in California, 1970-2030



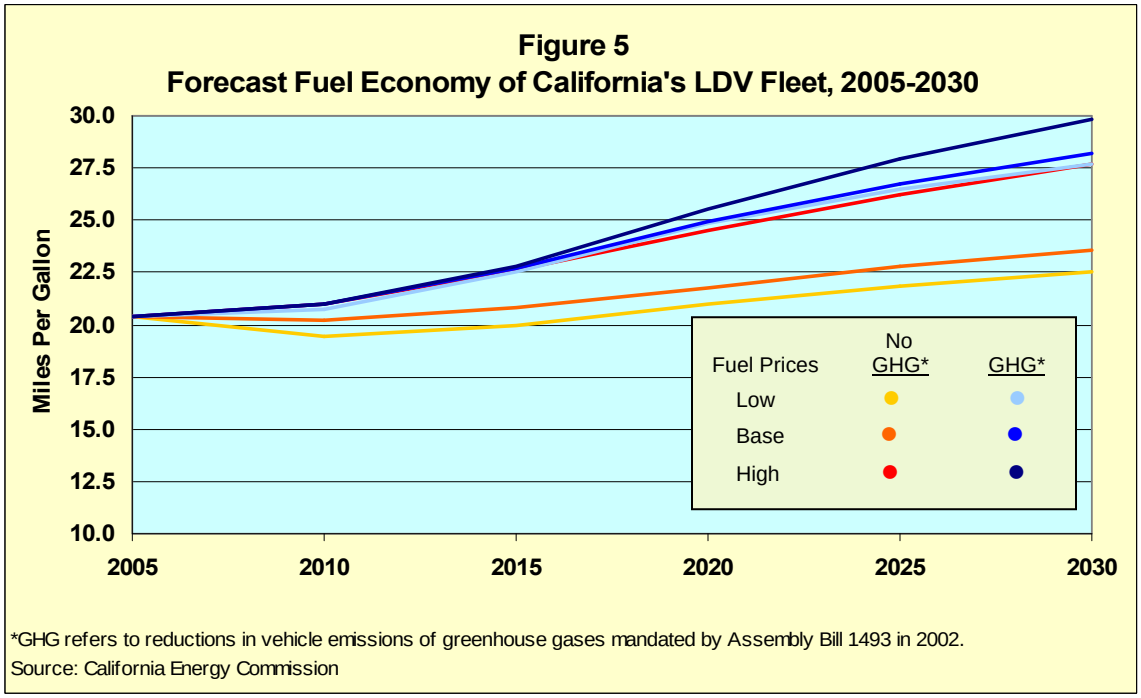
Source: California Department of Finance

The California Department of Finance expects the compound average rate of growth to slow from 1.7% (the historical average, 1970 to 2007) to 1.2% per year through 2030. A combination of internal growth (residents having children) plus net domestic and international migration will push California's population up by 30% (roughly 11.5 million people) to 49.2 million people by 2030.

Vehicle Fleet Size: As the population rises, so will the number of light duty vehicles (LDVs) – cars, light trucks, and sport utility vehicles – on the roads in California. Figure 4 (on the next page) shows the California Energy Commission (CEC) long-term LDV fleet forecast. The number of LDVs is expected to rise from 25.6 million in 2005 to 37.2 million in 2030, a 45% increase. The average number of LDVs per person statewide will increase slightly, rising from 0.70 to 0.76 per person.



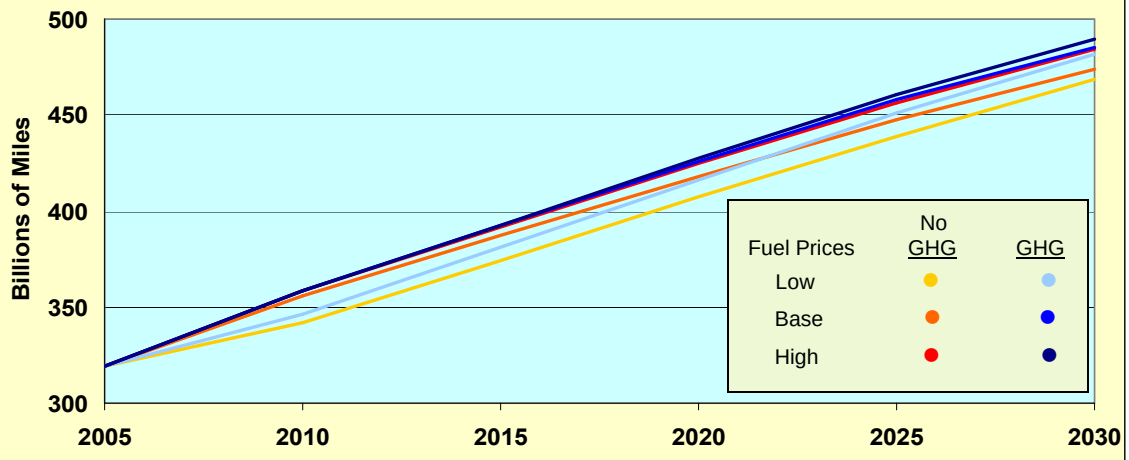
Fleet Fuel Economy: All else equal, more vehicles will mean a greater demand for fuel. Yet, the average fuel economy of all light duty vehicles on the road in California is changing, as shown in Figure 5. The CEC estimates vary depending on the price of fuel and the strictness of regulations restricting greenhouse gas emissions. Consumers respond to higher fuel prices by purchasing more fuel efficient vehicles; manufacturers respond to regulatory rules as well as consumer demand. In all scenarios, the CEC expects fuel economy to improve by 2030 as more consumers select hybrids, diesels, and more efficient gasoline-powered vehicles. In the worst-case scenario, average fuel economy falls until 2010 (due to a fleet mix that includes numerous light trucks and SUVs). In the best-case scenario, Californians will travel almost 50 percent further on every gallon of gasoline in 25 years.



Note: The CEC projections assume the California Air Resources Board's targets for zero- and ultra-low emission vehicles are met, an assumption many observers believe is overly optimistic. Fuel consumption may well be higher (and average fuel economy lower) than projected.

Vehicle Miles Traveled: Even if Californians drive more fuel efficient vehicles, they will travel many more miles. In part, the vehicle miles traveled (VMT) in the state is a simple reflection of the population increase: more people times more cars equal more miles. This formula saw the VMT in the state nearly double in 25 years despite anemic growth in the number of new freeway lane miles. Californians covered 320 billion miles in 2004 on roughly the same roads that carried 162 billion vehicle miles in 1980, a fact that explains much of the state's legendary traffic congestion. Figure 6 suggests traffic congestion will worsen without major capacity improvements, since VMT will continue to increase.

Figure 6
Forecast Light-Duty Vehicle Miles Traveled in California, 2005-2030



*GHG refers to reductions in vehicle emissions of greenhouse gases mandated by AB 1493 in 2002.
Source: California Energy Commission

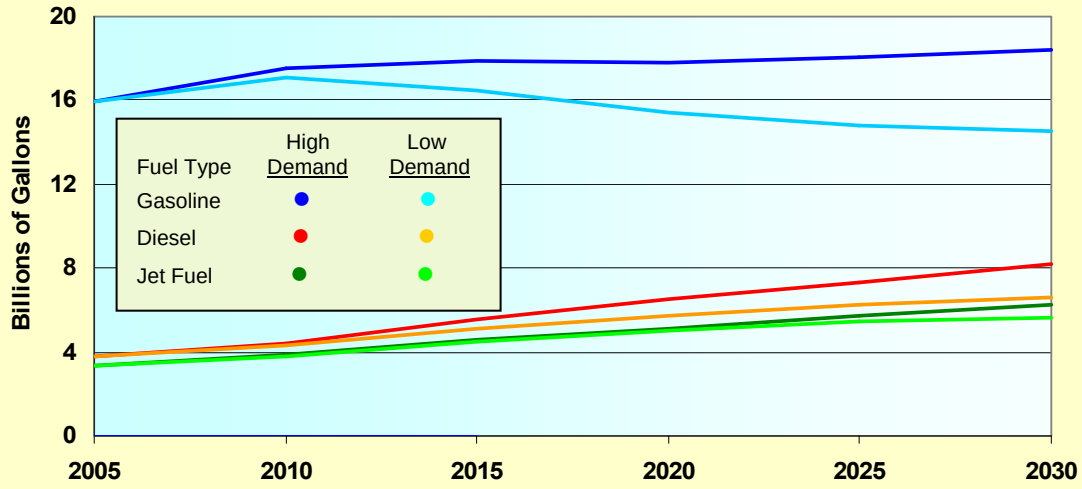
The number of VMT in California is expected to rise about 50 percent, 2005-2030, from 320 billion to 480 billion miles. Unfortunately for Golden State motorists, the average speed at which those miles are traveled will almost certainly decline. [Counter-intuitively, the forecast for the largest number of VMT corresponds to high fuel prices and strict greenhouse gas emissions regulations. Consumers react to such conditions by purchasing more efficient cars, which lowers their cost per mile traveled, and so they travel more.]

Demand Summary: The picture for California's future statewide demand for gasoline and diesel is straightforward. From 2005 to 2030, the state's population will increase by 34 percent; the number of LDVs will increase by 45 percent; and total vehicle miles traveled in California will rise by 50 percent. In combination with a healthy economy, these trends all point to higher demand for fuel.

However, the gradual increase in the average fuel economy of California's vehicle fleet will keep the demand for gasoline and diesel from rising as quickly as the number of vehicle miles traveled. The CEC's best case scenario – low fuel prices combined with strong fuel efficiency growth – even suggests gasoline demand may fall in the coming decades. The growing popularity of gasoline-electric hybrid vehicles may not be sufficient, however, to offset the combined increase in the number of vehicles and VMT.

Figure 7 breaks out the projected demand for gasoline and diesel fuel in California, and adds the third major use of crude oil refined in the state: aviation fuel.

Figure 7
Forecast California Transportation Fuel Demand, 2005-2030



Source: California Energy Commission

Californians are among the lowest per-capita consumers of gasoline in the United States, partially due to the high market penetration of fuel-efficient imports and to gasoline prices that are consistently higher than the national average. The CEC estimates statewide demand for gasoline could rise or fall in the next 25 years, depending on fuel prices and legislation. Diesel consumption will definitely increase, rising from 3.7 billion to about 7.3 billion gallons per year during the same period. Aviation fuel consumption will grow from 3.3 billion to about 6.1 billion gallons annually. Total demand for transportation fuel – gasoline, diesel, and aviation fuel – will rise from 23.0 billion gallons to about 29.5 billion gallons per year.

The bulk of the California's transportation fuels are produced by in-state refineries. [California imports a small percentage of its refined petroleum products.] As demand for transportation fuels grows over the next 20 years, so will refinery demand for the raw material – crude oil.

CALIFORNIA SOURCES OF CRUDE OIL[2]

The crude oil used in California comes from three sources: oilfields located within the state; Alaska's North Slope; and assorted foreign suppliers, primarily in the Middle East, West Africa, and Latin America, with some imports from the Pacific Rim and Canada.

Production from two of these sources (Alaska's North Slope and California oilfields) is declining steadily. The production of crude oil at Alaska's North Slope (ANS) is expected to decline by an average of approximately 3 percent per year through 2019. [Potential production from the Alaska National Wildlife Reserve will not change the long-term trend, and will have no effect during the forecast horizon.] The production of California crude oil is conservatively forecast to decline by 3.5 percent per year through 2019.

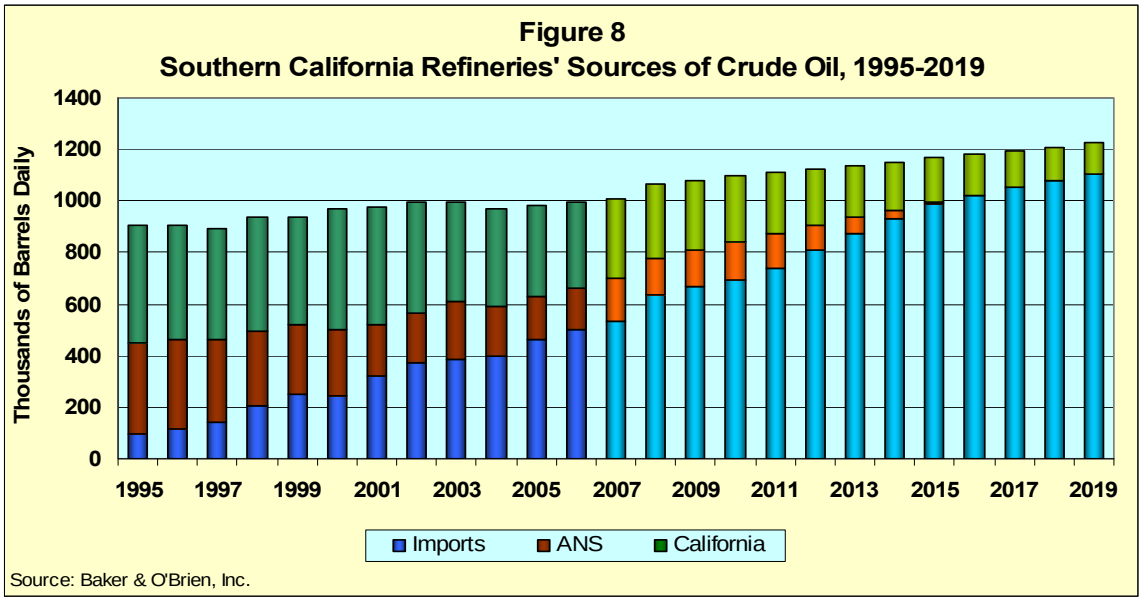
The problem for California, as described by Baker and O'Brien Inc., is that Southern California refineries are last in the queue for both ANS and (Central) California crude oil. Due to limited supply alternatives for the recipients (and the small volume involved in Hawaii), ANS oil is preferentially supplied to Alaska, Hawaii and the Pacific Northwest. Thus, *ANS crude will no longer be used in California refineries by 2018*. California crude oil is preferentially supplied to refineries in Bakersfield and Santa Maria, due to their lack of seaports.

Declining domestic supplies will force California to rely ever more heavily on imported supplies of crude oil. Crude oil is supplied in response to market forces, and the final demand in California is for refined products – primarily gasoline, diesel, and aviation fuel. Refining capacity, however, depends on two constraints. First, decades of low returns on capital and a difficult regulatory environment have dampened the industry's enthusiasm to invest in additional capacity. Indeed, the California Energy Commission expects the incremental increases in capacity at the state's refineries will be insufficient to keep pace with rising demand, necessitating increased imports of refined products. Second, the state's refining capacity also depends on the availability of crude oil. If the supply of in-state crude decreases without replacement, then current refining capacity will decline as well.

The charts that follow portray the future sources of crude oil flowing to refineries in Southern, Northern, and Central California. The increases in crude oil supplied to California reflect modest expected growth in refining capacity in the state. Baker and O'Brien, Inc. projects incremental "capacity creep" at California refineries of 1.25 percent per year, and also include some small projects that will increase capacity by 50,000 barrels per day statewide by 2012.

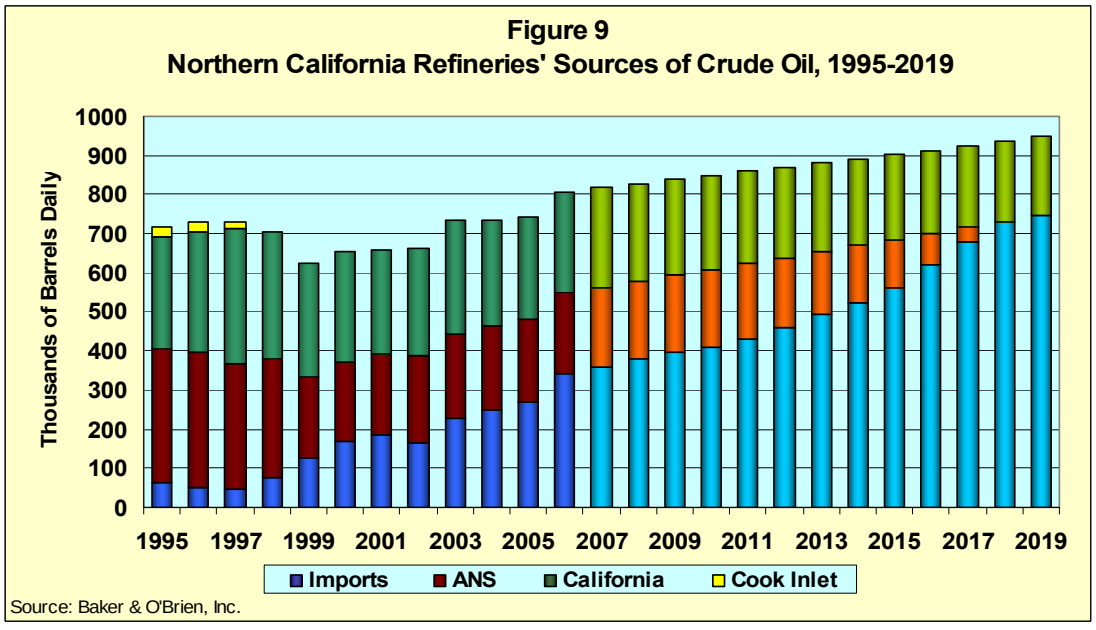
[2] This section summarizes the most recent available findings reported by Baker & O'Brien, Inc. Southern California numbers come from "Update of Southern California Crude Oil Supply and Demand," prepared for Plains All American Pipeline, L.P., May 2007. Northern California numbers come from "Outlook or Crude Oil Imports into California," prepared for Pacific Energy Group, LLC, April 2005.

Figure 8 shows the sources of crude used in Southern California refineries, actual for 1995-2006 and forecast for 2007 to 2019.



Southern California refineries' runs of ANS crude oil will decline from 134,000 barrels per day (bpd) in 2006 to zero by 2015. Their use of crude oil from California wells is projected to decline by roughly two-thirds, 2006-2019. Imports of crude oil, on the other hand, will more than double during the same time period. From 506,000 bpd in 2006 (about 52 percent of the current total), imports of crude oil will surge to 1.1 million bpd and will account for over 90 percent of total crude oil used in Southern California refineries in 2019.

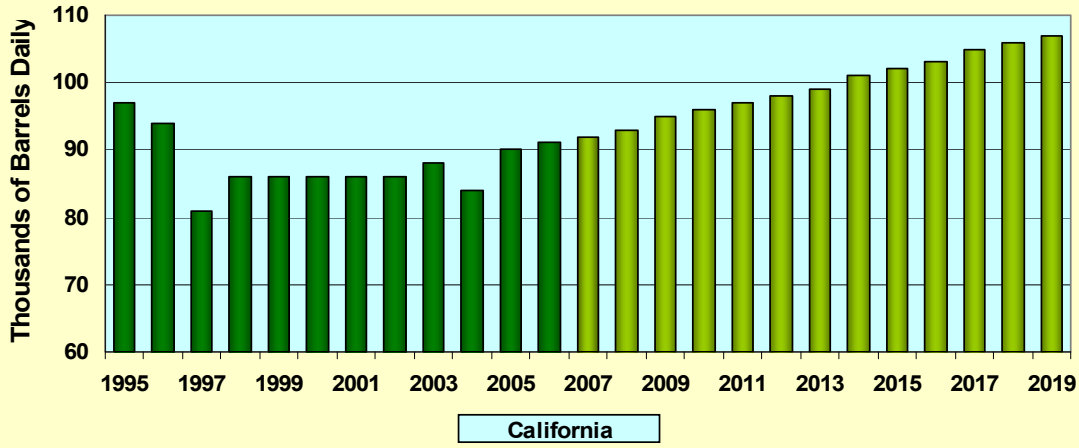
Figure 9 shows the sources of crude used in Northern California refineries, actual for 1995-2004 and forecast for 2005 to 2019.



The use of ANS crude oil will decline more slowly in Northern California than in Southern California, remaining relatively steady at about 200,000 bpd through 2011 before declining to zero by 2018. Northern California refineries' use of oil from in-state wells also will remain strong, falling from about 275,000 to 200,000 bpd. Imports, though, will surge from just over 249,000 bpd (representing about 34 percent of total crude refining runs) to 748,000 bpd (representing 79 percent of total runs).

Figure 10 shows the sources of crude used in Central California refineries, actual for 1995-2004 and forecast for 2005 to 2019.

Figure 10
Central California Refineries' Sources of Crude Oil, 1995-2019



Source: Baker & O'Brien, Inc.

Central California refineries rely exclusively on crude oil from in-state wells. The increase from 2004 to 2005 represents a one-time addition to refinery capacity; the growth from 2005-2019 reflects incremental capacity creep of 1.25 percent per year.

SUPPLY & DEMAND – SUMMARY AND ISSUES

Demand

The demand for refined products in California will increase, based on a growing population, more vehicles on the road, and additional vehicle miles traveled. From 2007 to 2030, the state will add 11.5 million people, and 11.6 million light duty vehicles. The number of vehicle miles traveled annually in the state will increase by 161 billion miles, 2005-2030.

The adoption of hybrids, diesels, and more efficient gasoline-powered vehicles will boost the average fuel economy in the state, but will not be sufficient to offset the combined increase in the number of vehicles and VMT. From 2005 to 2030, annual gasoline consumption statewide may increase by as much as 2.5 billion gallons or decrease by as much as 1.4 billion gallons; annual diesel consumption will increase by some amount between 2.8 and 4.4 billion gallons; and annual aviation fuel consumption will increase by 2.4 to 3.0 billion gallons. Thus, even with the impact of greenhouse gas regulations factored in, statewide demand for products refined from crude oil is expected to increase.

Supply

The total supply of refined products to the market is expected to grow at a moderate rate. The supply of crude oil to refineries will change significantly.

From 2005 to 2019, the consumption of crude oil by California refineries is expected to increase from 1.8 million bpd to 2.3 million bpd. The sources of this oil will shift markedly:

- ANS crude oil used in CA will decline from 374,000 bpd to zero;
- Crude oil pumped in-state will decline from 696,000 bpd to 423,000 bpd; and
- The state's reliance on imports will rise from 737,000 bpd to 1.87 million bpd.

The decline of in-state production is particularly important because it means California will have to import an additional 273,000 bpd *even if demand were to stay the same* (and demand is rising).

Issue #1: Will refinery capacity in California be sufficient to meet product demand?

The estimates of California's crude oil supplies are really a projection of crude oil consumption by the state's refineries. The supply of refined petroleum products is already tight in California (as it is throughout the country). What will happen if burgeoning demand—driven by population and economic growth and the resulting rise in vehicle miles traveled—outpaces the capacity creep projected at California refineries? *Tight supplies will translate into higher prices for gasoline, diesel, and jet fuel.* California will have to import more refined products (in addition to importing more crude oil).

Issue #2: Will California be able to handle the surge in crude oil imports?

Declining production from domestic oil wells in California and on Alaska's North Slope will dramatically increase the state's reliance on imports. Table 1 below compares the amount of waterborne crude oil (imported plus ANS) used by California refineries in 2005 with the total forecast for 2019. In 2005, waterborne crude oil includes all foreign imports, plus crude oil from ANS. In 2019, the total includes only foreign imports, since by then California refiners will no longer use ANS crude oil.

Table 1
Waterborne Crude Oil used by California Refineries[3]
(Thousands of barrels per day)

	2005	2019	Increase
Northern California	479	748	269
Southern California	632	1,123	491
Total	1,111	1,871	760

Source: Baker & O'Brien, Inc.

Waterborne crude oil used by refineries in Northern California will increase by 269,000 bpd. In Southern California, the increase will be 476,000 bpd. Thus, statewide use of crude oil transported by ship will increase 67 percent.

Will California crude oil terminals and pipelines be able to receive and distribute 760,000 additional barrels per day? *If they cannot, this will artificially restrict the supply of crude oil in California which will translate into higher prices.* Imports will be crucial to the state's future fuel supply. Even assuming that refining capacity in the state did not increase in response to the rising demand for petroleum products, California would still have to import additional crude oil to replace declining supplies from ANS and in-state oilfields.

[3] Southern California numbers come from "Update of Southern California Crude Oil Supply and Demand," prepared for Plains All American Pipeline, L.P., May 2007. Northern California numbers come from "Outlook or Crude Oil Imports into California," prepared for Pacific Energy Group, LLC, April 2005.

TWO SCENARIOS FOR CRUDE OIL IMPORTS IN CALIFORNIA

By 2019, California will need to bring in an additional 760,000 bpd of crude oil by ship, 491,000 bpd in Southern California alone. In light of this need, we believe there are three likely scenarios for the importing of crude oil in California.

Scenario #1 – No or Limited Infrastructure to Handle Future Imports

In this scenario, California ignores the looming problem of how to handle the rising need for crude oil imports. Production from the state's current domestic sources of crude oil declines while demand for refined products grows. Yet, the state fails to add sufficient capacity, attempting to make do with existing crude oil terminals. Imports rise but not by enough to replace declining domestic sources. Lacking sufficient capacity, crude oil terminals become the weak link in California's energy supply. Scarcity caused by refineries not receiving enough crude oil leads to sharply rising prices for refined products and a public outcry over "price gouging".

Scenario #2 – Infrastructure Added to Handle Future Imports

In this scenario, crude oil terminal capacity in the state keeps up with the growing need for imported oil. The state adds capacity and the surge of crude oil is handled by a combination of existing facilities (which ramp up their throughput) plus new crude oil terminals. California avoids a bottleneck in the import of crude oil and keeps prices from spiking due to scarcity.

- If the capacity is added at shallow water berths, then the crude will arrive on smaller ships in direct point-to-point service and via lightering operations. [In lightering, crude oil is transferred from very large ships to smaller ones offshore, and then the smaller ones take the oil into port.] Lightering is more efficient than using a small ship for the entire journey, but still more expensive than point-to-point service with a very large ship.

- If the added capacity includes deep water berths, California is able to take advantage of the economies of scale offered by the point-to-point use of very large ships. Lower transportation costs make more sources of crude oil (especially distant ones) cost-competitive in California. Additional competitive (and hence realistic) potential sources of crude oil reduce the state's vulnerability to supply disruptions, which is always a concern when relying on just a few suppliers. Moreover, improved, cost-effective access to more of the world's oil producers helps California oil consumers. All else equal, additional competition among sellers favors buyers.

PLAINS ALL AMERICAN CRUDE OIL IMPORT TERMINAL

Plains All American Pipeline, L.P. is developing a deep water crude oil marine terminal at the Port of Los Angeles. Located at Pier 400, the Pacific L.A. Marine Terminal will feature 81-foot water depth at its primary berth. The deep water berth will lower the transportation cost of imported crude oil, making more sources of oil cost-effective. The facility will be capable of handling in excess of 350,000 bpd of crude oil and intermediate refinery feedstock and will have storage facilities for 4 million barrels of petroleum. The additional capacity is critical to meeting Southern California's need to import an additional 491,000 bpd by 2019.

Deep-Water Terminal: The deep water berth will allow the terminal to receive some of the largest crude oil carriers in the world, appropriately referred to as Very Large Crude Carriers (VLCCs). The four most common classes of crude oil tankers are Aframax, (so named because they were originally designed to maximize rates under the Average Freight Rate Assessment scale); Suezmax (the largest vessel that can transit the Suez Canal fully loaded); Very Large Crude Carrier (VLCC); and Ultra Large Crude Carrier (ULCC).

Aframax tankers have an average capacity of 750,000 barrels; Suezmax tankers can carry about 1 million barrels; VLCC ships can carry about 2 million barrels; and ULCC ships can carry up to 4 million barrels of crude.

Existing oil terminals in California have comparatively shallow berths or, in the case of the San Francisco Bay ports, can only be reached by transiting shallow water. This is not a problem for the smaller Aframax and Suezmax ships, which typically have drafts of 49 feet and 56 feet respectively. Most of the oil tankers calling at terminals in California are from these two classes.

Typical VLCCs have a draft of up to 70 feet, which prevents them from using many existing berths. As a result, VLCC vessels account for only a small share of all crude oil tanker traffic in San Pedro Bay. [The VLCC share of tanker traffic arriving in Southern California *waters* is higher. The VLCCs are met offshore and their crude oil is transferred to Aframax and Suezmax vessels in an operation known as lightering. The smaller ships then carry the crude oil into port.]

ULCC vessels, which often exceed 1,200 feet in length and can have a draft of 80 feet, do not call on the West Coast at all. Indeed, there are only 5 of these ships in service. On rare occasions when they do visit the U.S., it is to discharge crude oil at a facility off the coast of Louisiana.

Because it will be able to accommodate VLCCs, the Plains All American terminal has the potential to substantially reduce the transportation cost component of crude oil reaching the Southern California market.

Larger ships provide economies of scale, reducing the cost per barrel of oil delivered. The total cost of chartering a VLCC is higher than for smaller Aframax and Suezmax tankers, but the additional carrying capacity more than makes up the difference. And the crew costs are roughly similar for all three classes of tanker.

The savings from using larger vessels can be substantial, and they increase with distance, as shown in Table 2.

Table 2
Transportation Cost of Shipping Crude to Los Angeles
(Delivery Cost Per Barrel of Crude Oil)

	Ship Size					
	AFRAMAX		**SUEZMAX**		**VLCC**	
Origin	2008	2019	2008	2019	2008	2019
Mexico	$0.81	$0.94	$0.67	$0.78	$0.50	$0.57
Ecuador	$1.23	$1.43	$1.03	$1.20	$0.74	$0.86
Saudi Arabia	$3.74	$4.33	$3.20	$3.73	$2.26	$2.60
West Africa	$4.01	$4.65	$3.30	$3.84	$2.42	$2.78

Source: Distribution Consulting Services, Inc.

The transportation cost per barrel of crude oil delivered varies with distance and ship size. For the 13,000 nautical mile trip from Saudi Arabia to Los Angeles, for example, the transportation cost per barrel in 2008 is expected to be $2.26 on a VLCC, $3.20 on a Suezmax ship, and $3.74 on an Aframax tanker. The transportation cost per barrel using a VLCC with lightering [not shown in the table] is forecast to be $2.93 per barrel.

The savings from using larger ships are consistent with common sense: a larger ship is more costly to operate, but the extra expense is still lower than the cost of making multiple trips with a smaller vessel. Over the course of a year these savings add up to a substantial amount, as can be seen by comparing the transportation costs shown in Table 3.

Table 3
Projected Annual Cost of Shipping Crude Oil to Southern California in 2019
(Millions of Dollars)

	Annual Volume	***Total Volume Shipped in…***		
Origin	**(millions bbl)**	**AFRAMAX**	**SUEZMAX**	**VLCC**
Mexico	43.4	$40.8	$33.9	$24.8
Ecuador	43.4	$62.1	$53.0	$37.4
West Africa	53.0	$246.1	$206.4	$147.1
Saudi Arabia	202.9	$878.7	$757.0	$527.6

Source: Distribution Consulting Services, Inc.

The projected costs for 2019 should be treated as illustrative; vessel charter rates are notoriously volatile, making them difficult to predict years in advance. While the magnitude of the costs may change, it is the comparative advantage of using larger ships that will matter in California. Using Suezmax instead of VLCC tankers between Saudi Arabia and Southern California, for example, would add 43 percent (almost $230 million per year) to the transportation cost. Using VLCC tankers with lightering [not shown] would add 32 percent (about $168 million per year).

Additional Capacity: Declining production at domestic oil fields that supply California refineries today means the state will have to import a lot more oil *even if demand, which is growing, stayed the same.* The projected increase in imports in Southern California, 2006 to 2019 is shown in Table 4.

Table 4
Incremental Change in Southern California Oil Imports Since 2006

	Thousands of Additional Barrels per Day													
	Base	Forecast												
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Middle East	-	11	65	78	67	93	136	174	209	246	260	270	280	290
Latin America	-	11	24	35	17	25	36	46	55	65	71	77	83	88
West Africa	-	10	46	56	43	50	57	65	71	78	85	91	98	104
Canada	-	0	0	0	66	74	81	88	95	102	108	115	121	127
Pacific Rim	-	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	-	32	135	169	193	242	310	373	430	491	524	553	582	609

Thus, the need to replace declining output at current domestic sources and an increase in demand will see Southern California imports of crude oil rise steadily through 2019. The 609,000 bpd *increase* by 2019 more than *doubles* the 2006 imports of 498,000 bpd.

Yet, crude oil import facilities in Southern California are already at capacity. [Capacity could be increased by lightering the oil into much smaller vessels. Such a strategy would greatly increase transportation and environmental costs because of the need to run multiple ships simultaneously instead of just one.] Indeed, import capacity at the San Pedro Bay Ports has declined over the past 30 years as facilities have been taken out of service, as shown in Table 5.

Table 5
LA/LB Petroleum (Crude Oil and Products) Terminals, 1976-2005

Current	No Longer in Service
ExxonMobil, 1 Marine Terminal (Berths 237-240C)	Union Oil Company of CA (Berths 45-47)
ExxonMobil, 2 Marine Terminal	Navy DFSC (Berths 37-39)
Shell Oil Co. Marine Terminal (Berths 167-169)	Chevron, USA (Berth 259)
ConocoPhillips (Berths 148-151)	Chevron, USA (Berths 100 & 101)
Kinder Morgan Harbor Terminal (Berths 118 & 119)	Kinder Morgan Terminal
Shore Terminals	Amerigas (Berth 120)
Vopak Petroleum Product/Chemical (Berths S-101)	Atlantic Richfield, Co. (Berth 71)
Valero (Berths 162-164)	Mobil Oil Corp. (Berth 260)
Chemoil (Berths F210 & F211)	Bray Terminal
BP Terminal (Berth 121)	GATX (Berths 171-173)
BP Terminal 2 (Berths 76-78)	Gulf Oil Corp. (Berth 215)
BP Terminal 3 (Berths 56 & 57)	Pacific Oasis (Berth J242)
Pacific Long Beach Terminal	
Tesoro Marine Terminal (Berths 84-87)	
World Oil Marine Terminal	

Source: SPEC Services, Inc.

Ten facilities have closed since 1975. And among the 15 active facilities, the Valero berths face an uncertain future. This context underscores the need for the 350,000+ bpd capacity at the proposed Pacific L.A. Marine Terminal.

THE IMPACT OF CHANGING PRICES FOR REFINED PETROLEUM PRODUCTS

Gasoline prices in the U.S. have been rising because of increasing crude oil costs. The need for special blends that reduce the impact on air quality and limited refinery capacity have pushed California's prices higher still. Additional upward pressure on prices will be introduced in the next few years if the state does not add sufficient capacity to handle the demand for waterborne crude oil. Moreover, the state needs crude oil terminals with deep water berths if it is to enjoy the economies of scale offered by direct service from distant sources using very large crude carriers.

Higher energy costs don't bode well for California. Even small fluctuations in prices for refined products can have a noticeable impact on California consumers, businesses, and the economy as a whole.

Consumer and Business Impact

Table 6 shows the impact of a 10-cent change (up or down) in the price of gasoline.

Table 6
Annual Household Spending on Gasoline in California*

Number of Households	12.5 million
Average VMT per Household	20,049 miles
Gasoline Consumption per Household	954 gallons
Gasoline Spending per Household*	$2,992
Household Cost/Savings per 10¢ Change in the Price per gal. of Gasoline	$95
Statewide Cost/Savings per 10¢ Change in the Price per gal. of Gasoline	$1.2 billion

*Based on 2002 household consumption, 2007 household number, and an average price of $3.14/gallon on July 9, 2007.
Sources: U.S. Department of Energy; California Department of Finance; LAEDC.

The average California household consists of 3.0 people, travels 20,049 miles per year, and consumes 954 gallons of gasoline at an average annual cost of $2,992. [Some of the vehicle miles are covered in diesel-powered vehicles; the average household spending on diesel fuel was not available.] For every 10-cent change in price of a gallon of gasoline, therefore, the average household can expect to pay or save an extra $95 per year. The actual cost will vary widely depending on vehicle fuel efficiency and driving patterns. With 12.5 million households in the state, the aggregate cost/savings of a $0.10 per gallon increase/decrease in the price of gasoline is $1.2 billion.

If the price of gasoline falls, the savings are redeployed to other household purchases. If the price rises, households will compensate for the increased cost of gasoline mostly by cutting their expenditures on other items. [Consumers tend to change their gasoline usage significantly only in response to large, sustained increases in prices.]

California consumers will also feel the pinch from the rising cost of refined petroleum products when the state's businesses raise prices to compensate for their higher fuel costs. Some of the price hikes will be explicitly linked to rising fuel prices, such as the surcharges

that have appeared recently in California for pizza delivery and airport shuttle services. Other price changes will be less visible but will occur nonetheless. Businesses in the transportation industry (such as airlines and delivery companies) and firms with service fleets (such as utilities and gardeners) will need to recoup their rising costs. Table 7 describes spending for gasoline and diesel by California businesses.

Table 7
Annual Business Spending on Gasoline and Diesel in California

Number of Businesses	841,774	
Average VMT per Business	66,929 miles	
	Gasoline	*Diesel*
Fuel Consumption per Business	3,220 gallons	2,419 gallons
Fuel Spending per Business*	$10,098	$7,806
Business Cost/Savings per 10¢ Change in the Price/gal. of Fuel	$322	$242
Aggregate Cost/Savings to Businesses	$271 million	$204 million

*Based on 2002 business consumption, 2004 business number, and an average price of $3.14/gallon for gasoline and $3.23/gallon for diesel on July 9, 2007.
Sources: U.S. Department of Energy; US Census Bureau; LAEDC.

California's 841,774 businesses operate vehicles that travel 56 billion miles per year in total for an average of 66,929 miles per business. Gasoline consumption per business averages 3,220 gallons, at a cost of $10,098; diesel consumption averages 2,419 gallons and costs $7,806. Since the average number of miles covered per business is high, the annual impact of a modest $0.10/gallon change in the price of gasoline or diesel is also high: $322 for gasoline and $242 for diesel. Using statewide averages masks the great variation between businesses in the number of miles actually traveled. For firms whose primary business is transportation or whose primary business requires traveling to customers, the number of miles traveled and thus the cost or savings of the fuel price change will be significantly greater.

Industry Impact

Oil accounts for a smaller share of U.S. (and California) gross domestic product today than it did during the oil shocks of the 1970s. While this makes the overall economy less vulnerable to rising fuel prices, some industries remain heavily dependent on oil. The tables on the next three pages present the most oil-intensive industries (Table 8); rank the top 20 oil-intensive industries by California annual receipts, a measure of their importance to the state's economy (Table 9); and rank the top 20 oil-intensive industries by their California employment, another measure of their importance to the state (Table 10).

A direct requirements coefficient reflects the value of products produced by the petroleum refining industry per dollar of production by the using industry. For example, the table shows that the air transportation industry (in bold), spends 8.42 cents on refined petroleum products (primarily aviation fuel) per dollar of industry revenues.

Table 8
Oil-Intensive Industries

Consuming Industry Description	Industry NAICS	Direct Requirements Coefficient
Asphalt paving mixture and block manufacturing	324121	$0.3303
Petroleum lubricating oil and grease manufacturing	324191	$0.2482
State and local government passenger transit	S00201	$0.2434
All other petroleum and coal products manufacturing	324199	$0.1776
Asphalt shingle and coating materials manufacturing	324122	$0.1612
Pipeline transportation	486000	$0.1365
Petrochemical manufacturing	325110	$0.1176
Air transportation	**481000**	**$0.0842**
Petroleum refineries	324110	$0.0761
Surface active agent manufacturing	325613	$0.0631
Printing ink manufacturing	325910	$0.0454
Couriers and messengers	492000	$0.0438
Other basic organic chemical manufacturing	325190	$0.0420
Truck transportation	484000	$0.0399
Waste management and remediation services	562000	$0.0384
Sand, gravel, clay, and refractory mining	212320	$0.0378
Adhesive manufacturing	325520	$0.0373
Maintenance and repair of hwys, streets, bridges, and tunnels	230330	$0.0366
Gold, silver, and other metal ore mining	2122A0	$0.0354
Stone mining and quarrying	212310	$0.0330
Highway, street, bridge, and tunnel construction	230230	$0.0323
Other miscellaneous chemical product manufacturing	325998	$0.0319
Drilling oil and gas wells	213111	$0.0315
Federal electric utilities	S00101	$0.0290
Transit and ground passenger transportation	485000	$0.0282
Copper, nickel, lead, and zinc mining	212230	$0.0247
Metal heat treating	332811	$0.0241
Support activities for other mining	21311A	$0.0229
Other nonmetallic mineral mining	212390	$0.0218
Nitrogenous fertilizer manufacturing	325311	$0.0204

Source: Bureau of Economic Analysis, *1997 Benchmark U.S. Input-Output Accounts*

Not surprisingly, transportation industries (such as transit and couriers and messengers) and oil-related industries (such as asphalt and petrochemical manufacturing) figure prominently among the most oil-dependent industries. The list also highlights some oil-dependent industries that might be easily overlooked, notably waste management, utilities, and road construction.

Table 9 looks at the role played in the California economy by the most oil-dependent industries, ranking them by annual receipts in the state.

Table 9
Top 20 Oil-Intensive Industries Ranked By Annual Receipts in California

Rank	Consuming Industry Description	Industry NAICS	California Receipts (millions)
1	Petroleum refineries	324110	$19,296
2	Truck transportation	484000	$11,372
3	Couriers and messengers	492000	$5,278
4	Highway, street, bridge, and tunnel construction (& M&R)	237310	$5,138
5	Waste management and remediation services	562000	$4,774
6	Air transportation	481000	$4,404
7	Pipeline transportation	486000	$3,158
8	Transit and ground passenger transportation	485000	$1,495
9	Other basic organic chemical manufacturing	325190	$1,096
10	Other miscellaneous chemical product manufacturing	325998	$729
11	Other nonmetallic mineral mining	212390	$629
12	Sand, gravel, clay, and refractory mining	212320	$585
13	Asphalt shingle and coating materials manufacturing	324122	$543
14	Asphalt paving mixture and block manufacturing	324121	$498
15	Adhesive manufacturing	325520	$486
16	Petroleum lubricating oil and grease manufacturing	324191	$469
17	Gold, Silver and other metal ore mining	2122A0	$386
18	Printing ink manufacturing	325910	$333
19	Stone mining and quarrying	212310	$299
20	Metal heat treating	332811	$214

Sources: Bureau of Economic Analysis, *1997 Benchmark U.S. Input-Output Accounts*, 1997 Economic Census

Among oil-intensive industries, petroleum refineries ($19.3 billion), truck transportation ($11.4 billion), couriers and messengers ($5.3 billion), and road construction ($5.1 billion) have the largest presence in California's economy. Five other oil-intensive industries – waste management, air transportation, pipeline transportation, transit and ground passenger transportation, and "other basic organic chemical manufacturing" – have annual receipts in California of $1 billion or more.

Table 10 ranks the top twenty oil-intensive industries in California by statewide industry employment. Transportation-related industries—for people, goods and refuse—plus road construction and refining top the list, with each industry employing at least 13,000 people in California.

Table 10
Top 20 Oil-Intensive Industries Ranked By Employment in California

Rank	Consuming Industry Description	California Employment	California Payrolls (millions)	California Average Wages
1	Truck transportation	109,281	$3,962	$36,253
2	Couriers and messengers	69,941	$2,388	$34,136
3	Air transportation	53,828	$2,828	$52,545
4	Waste management and remediation services	35,435	$1,597	$45,064
5	Transit and ground passenger transportation	34,488	$828	$24,006
6	Hwy, street, bridge, and tunnel construction, M&R	28,102	$1,688	$60,064
7	Rail transportation	13,797	$863	$62,562
8	Petroleum refineries	13,149	$1,172	$89,157
9	Sand, gravel, clay, and refractory mining	3,091	$185	$59,914
10	Other miscellaneous chemical product manufacturing	2,913	$145	$49,625
11	Other basic organic chemical manufacturing	2,717	$193	$71,094
12	Adhesive manufacturing	2,650	$150	$56,595
13	Pipeline transportation	2,377	$174	$73,349
14	Drilling oil and gas wells	1,679	$101	$59,937
15	Stone mining and quarrying	1,497	$77	$51,392
16	Other nonmetallic mineral mining	1,377	$80	$57,781
17	Asphalt shingle and coating materials manufacturing	1,043	$57	$54,308
18	Printing ink manufacturing	1,020	$51	$49,890
19	Nitrogenous fertilizer manufacturing	834	$30	$35,420
20	Petroleum lubricating oil and grease manufacturing	823	$45	$54,179
	Total (Oil-Intensive Industries)	380,042	$16,612	$43,711

*Sources: 1997 Benchmark U.S. Input-Output Accounts,
California Labor Market Information Division, QCEW report: 2003,
Association of American Railroads, *Railroad Service in California: 2003*.

Statewide, all California industries employ 12.45 million people. The top twenty oil-intensive industries collectively employ 380,042 workers, representing 3.1 percent of the statewide total.

Economic Development Impact

California is a high-cost location, and rising fuel prices simply add to the litany of reasons firms find it so expensive to do business in the Golden State. High personal and corporate state taxes; high land costs and scarce workforce housing; expensive worker compensation rates; chronic traffic congestion; high utility rates, particularly for electricity; and a complex, uncertain regulatory environment all add to the cost of doing business in California. Any one of these factors, like rising fuel prices, would be insufficient *alone* to drive an existing business out of the state or keep a new firm from locating here. The *combined* impact, however, could be dramatic.

Bain & Company reported in a study for the California Business Roundtable that nearly 40 percent of companies in California plan to move jobs out of the state. *Half* of the businesses interviewed (ranging from the very small to the very large) had explicit policies not to add additional workers in California.

California's enormous market, enviable climate and highly trained workforce will continue to lure firms into the state. Businesses that offer services that can only be provided locally have no choice but to remain in the state. For all firms that can serve the California market from outside the state—notably manufacturing, film production, and any service that can be provided by phone or over the internet—the state's poor business climate already offers a powerful incentive to leave. California can ill afford to allow the price of refined oil products to rise even further than it already has relative to other U.S. states.