Expected Future Availability and Cost of California Gasoline and California Excise Tax Revenue Projections

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California's expected gasoline demand and fuel prices for the 2000 to 2020 time frame and the expected California excise tax revenue associated with that demand are discussed. The expected effect on excise tax revenue from deploying alternative-fuel vehicles in California and the expected future effect in California of an existing excise tax subsidy for biomass-derived fuel-grade ethanol produced in the United States are also discussed. To set the context for this information, historical crude oil and gasoline supplies and prices are described.

Nonpetroleum fuels are already reducing revenue to the Highway Trust Fund by $400 million per year nationwide, and unless there are changes to the existing tax structure, the reduction could grow to $1.3 billion by 2003. Projected revenue reductions from corporate average fuel economy (CAFE) improvements and gasoline price increases are also shown.

Crude Oil Supply

California obtains the crude oil it processes into refined products from three major sources: in-state oil, Alaskan oil, and imported oil. In 1999, California's refineries processed about 1.8 billion barrels of crude oil into refined products, notably gasoline, diesel, and jet fuel (*1*). Approximately 862 million barrels of crude oil were obtained from in-state reserves, 386 million barrels from Alaska, and 529 million barrels (nearly 30 percent) from foreign sources. Over the next 20 years, both in-state and Alaskan deliveries to California refineries are expected to decrease and foreign receipts to increase. By 2012, foreign sources are expected to make up more than 50 percent of California's supplies of crude oil (*2*). However, crude oil is a global commodity and is priced accordingly. Price differences reflect quality differences [such as sulfur content and API gravity (viscosity)] and distance from refineries.

Some market observers believe that "the end of cheap oil is in sight" and that at least half of the known worldwide reserves of conventional crude oil will soon have been extracted. They base their conclusion on so-called "Hubbert curves," which attempt to portray cumulative production of major reserves. In the March 1998 edition of *Scientific American*, Campbell and Laherrere presented their view that global conventional crude oil production will peak by about 2003 and that the world will "run out of cheap oil" by 2010. They based their conclusion on use of the Hubbert curve and their experience in exploring for oil. Others believe that improved knowledge and technology will increase the volume of economically recoverable crude oil and that this will continue to offset the effect of resource extraction. Certainly, the time will come when conventional crude oil production will substantially decline, since it is a finite resource. The debate is really over how long technical innovation can offset annual production, keeping prices moderate, as well as the forms, sources, and scope of feasible alternatives and how much those will cost.

At some point, the world will have to transition away from conventional crude oil to other fuels. Several options are being explored, including coal conversion, oil sand and oil shale processing, and conversion of natural gas to liquid fuel. None of these technologies appears to be cost competitive today. However, eventually the cost of these new supplies will be less than the cost of oil, as process improvements continue to reduce their costs and as eventual depletion increases the cost of oil. Conversion of natural gas to liquid fuel has been used since 1955 in South Africa. The process is currently being developed for diesel fuel by several oil companies, including Shell, ARCO, Texaco, and Exxon.

Crude Oil Price Forecast

Figure 1 shows historical crude oil prices from 1860 to the present, in nominal (also called "as-spent") dollars and adjusted to 1997 dollars (i.e., "real" 1997 dollars), and projected crude oil prices for the time period from 2000 to 2020, also expressed in 1997 dollars. Note that after a 20 year break-in period, real historical prices fluctuated in the $10/barrel to $25/barrel range from about 1880 to 1980. Nominal prices were low and not very volatile until the early 1970s.

Beginning in the mid-1970s, crude oil prices rose dramatically and became increasingly volatile. At about that time, activities in the Middle East, especially problems related to Iran, allowed the Organization of Petroleum Exporting Countries (OPEC) to begin to control the price of crude oil. Prices rose in early 1979 when Saudi Arabia cut production. Various factors led to ever-increasing prices, peaking at about $38/barrel in 1981 (equivalent to $64.23 in 1997 dollars), when Saudi Arabia flooded the market to drive prices back down. The peak was for a relatively short time period, since the annual average price for 1981 was $56.10 per barrel. OPEC members agreed to attempt to regulate the price at $32/barrel ($54.09 in 1997 dollars), with a ceiling of $38/barrel. By 1983, oil supplies increased, conservation measures blunted demand, and OPEC retargeted oil prices to $29/barrel ($44.22 in 1997 dollars). North Sea oil production came on line by mid-1985, causing OPEC to cut prices further. By 1986, oil prices dropped dramatically and OPEC again retargeted oil prices, this time to $18/barrel ($24.91 in 1997 dollars). Non-OPEC crude oil production increased, and prices continued to decline.

Since about 1986, real (1997 dollar) oil prices have ranged from a low of $10/barrel to about $25/barrel, with values exceeding this range only for a short time in the late 1990 to early 1991 time period during the Gulf

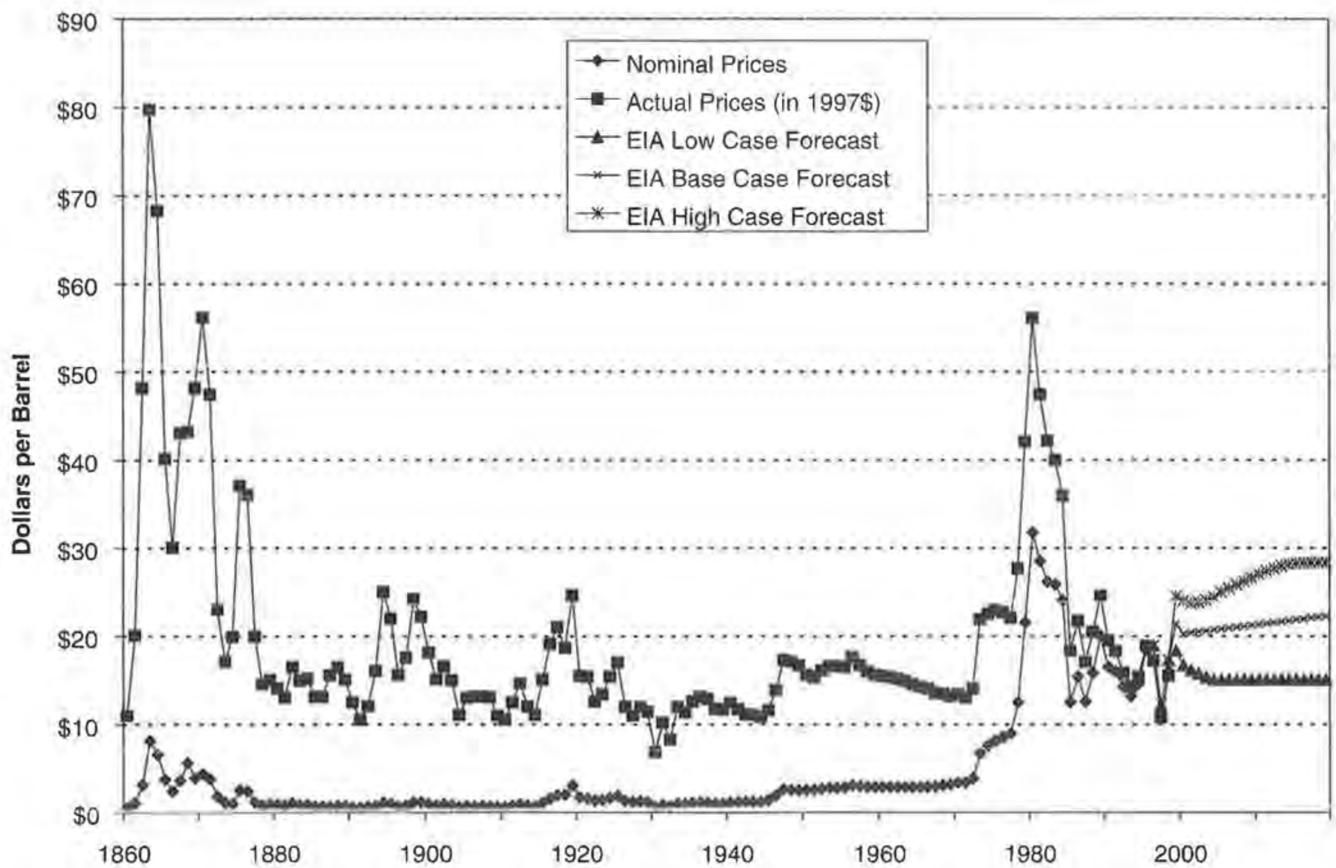

FIGURE 1 U.S. crude oil prices.

War and again in spring and summer 2000. Prices got so low by late 1998 that OPEC members agreed to cut production in an attempt to regain control over the price. In late 1999, the U.S. Department of Commerce dismissed a petition from domestic crude oil producers that alleged that several countries sold crude oil to the United States at artificially low prices to drive them out of business. By spring 2000, prices had risen to the $32/barrel range as OPEC again attempted to regulate the price by limiting production. Saudi Arabia currently asserts that it will regulate its production sufficiently to maintain the price of crude oil at $25/barrel. Saudi Arabia naturally wishes to receive the maximum revenue possible, but it and some other OPEC members believe that prices higher than $25/barrel could lead to a worldwide economic decline. Also, as noted above, OPEC oil ministers are aware that sustained high prices will lead to additional non-OPEC supplies and that alternative fuels and energy efficiency measures may become economic and enter the market, reducing the demand for OPEC crude oil.

Saudi Arabia, Kuwait, and Algeria are the only OPEC countries operating below 90 percent production capacity, and they are probably the only OPEC countries that could increase production sufficiently to reduce the current price of $30 per barrel. The ability of Saudi Arabia (which has very low incremental production costs and the bulk of the world's known oil reserves), or others for that matter, to sustain oil prices at targeted levels remains to be seen, but clearly OPEC and its major members have the potential to significantly influence prices.

Figure 1 also includes the crude oil price forecast from the Energy Information Administration's (EIA's) high, base case, and low price forecasts in its *Annual Energy Outlook 2000* (3). The California Energy Commission currently uses a flat price forecast of $20.40/barrel (1997dollars) with an uncertainty range of ±$2.50/barrel. This is very close to the EIA base case. Notice how both of these projections fit with historical data. Neither the California Energy Commission nor EIA expect a return to the high prices of the 1980 to 1985 time period. However, both expect prices to remain rather high relative to historical prices (excluding the period of the 1980s when very high prices occurred). Crude oil price forecasters tend to have a fairly poor track record, since political instability in the Middle East and the result of OPEC decision making are factors that forecasters do not appear to be able to include in their crude oil price forecasts.

HISTORICAL AND FORECAST CALIFORNIA GASOLINE DEMAND

Figure 2 shows California's historical and projected gasoline demand in billions of gallons annually (upper

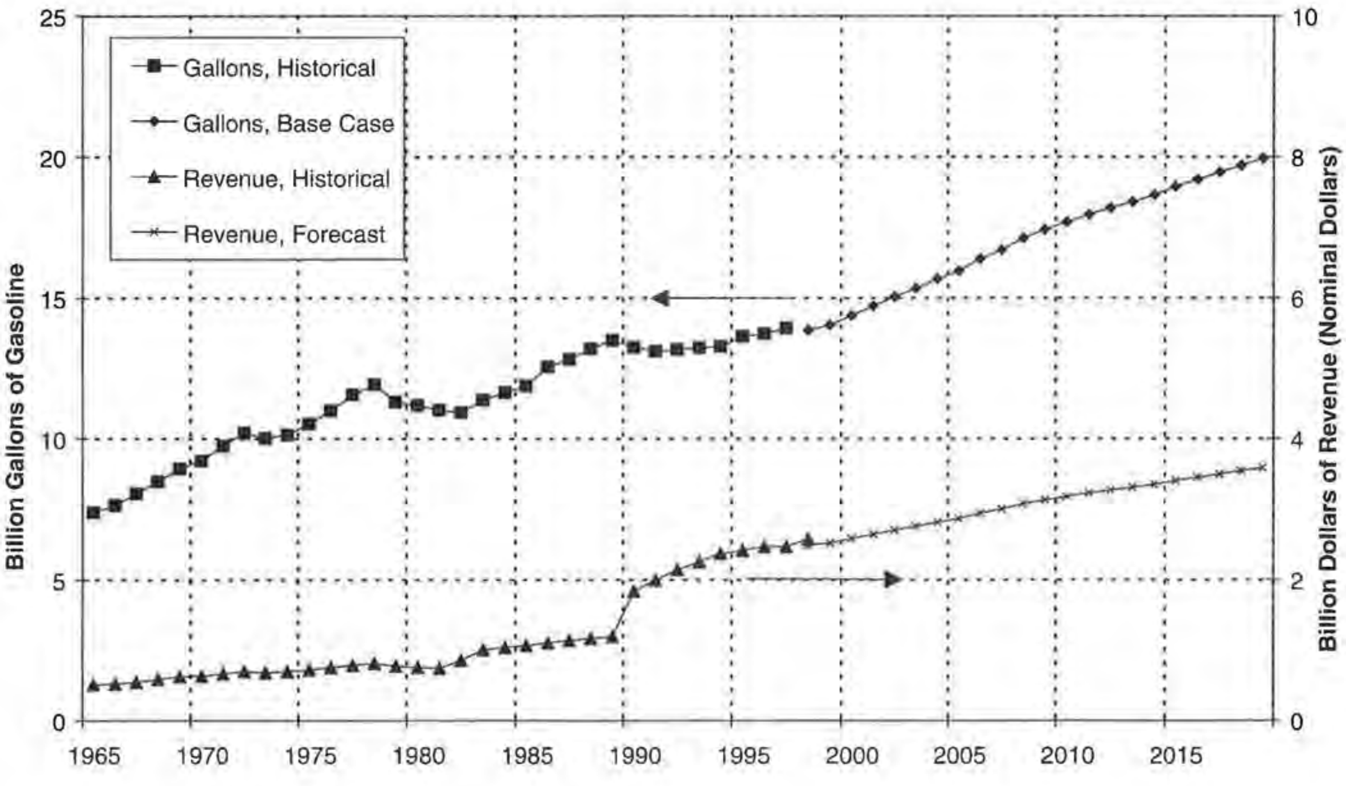

FIGURE 2 Historical and forecast California gasoline consumption and state excise taxes.

lines and left vertical axis). Demand has risen steadily since 1966, with the exception of three relatively modest dips in demand. The first dip occurred in the early 1970s, caused by the first crude oil price rise. The second dip was in the late 1970s, caused by the dramatic crude oil price rise of that time period. The third dip occurred in the early 1990s, probably caused more by the economic downturn of that time than the Gulf War. Overall, gasoline consumption has increased from 7.4 billion gallons in 1966 to 14.2 billion gallons in 1999, averaging about 2 percent per year. More recently, California's gasoline consumption growth rate slowed to about 0.24 percent per year from 1991 to 1999.

The California Energy Commission forecasts gasoline and alternative-fuel vehicle demand using a nested multinominal logit structure computer model (called CALCARS) to evaluate the effect of "preference data" for conventional and alternative-fuel vehicles. The commission's base case gasoline demand forecast assumes continued penetration of less fuel-efficient light trucks and sport utility vehicles, leading to a growth rate of about 1.8 percent per year for the 1999 to 2020 time period.

Historical and Forecast Revenue from California Excise Taxes

Figure 2 also shows historical and projected state excise tax revenue from collection of California excise taxes (lower lines and right vertical axis). It assumes no change in the state excise tax rate and no effect of the biomass-derived ethanol subsidy for oxygenated fuels (details are given later).

Figure 3 shows the historical California excise revenue data from Figure 2, plotted with more vertical resolution. The "bumps" in the historical line are due to tax rate increases, as indicated in the figure. The growth rate in California state excise tax revenue for the 1966 to 1999 time period is about 5.0 percent,

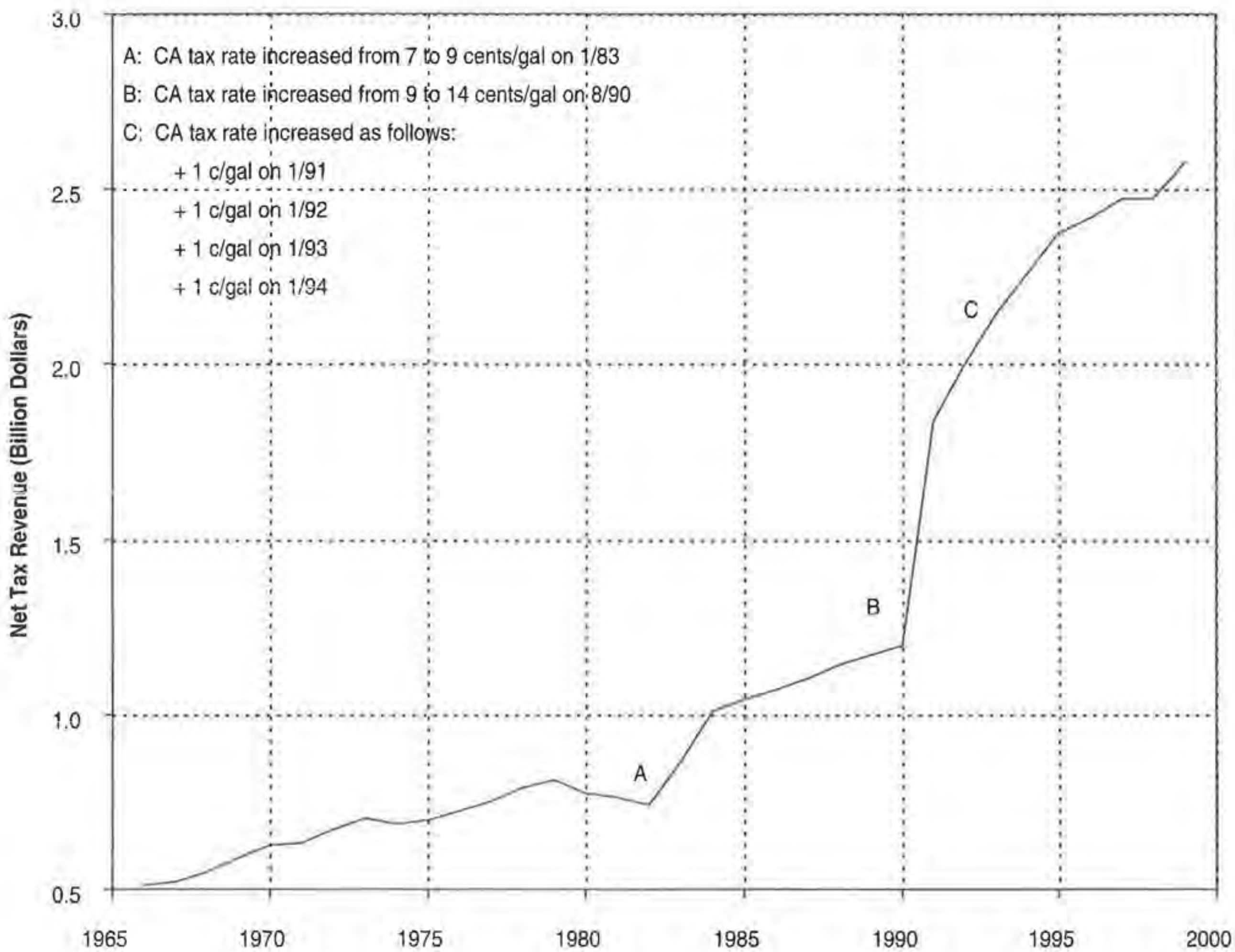

FIGURE 3 California excise tax revenue (California gasoline use only; nominal dollars).

compared with the 2 percent growth rate for gasoline consumption. This increased excise tax growth rate is attributable to the tax rate increases. The historical data are from the California Board of Equalization and represent all taxable gasoline sales.

Gasoline Price Forecast

Long-term gasoline prices correlate well with crude oil prices. Regression correlation of 74 percent (R^2) has been found using 26-week smoothed crude oil and gasoline prices to remove short-term variability (*4*). Thus, a good estimate of long-term, market-equilibrium gasoline prices can be made from crude oil price forecasts, to the degree that the crude oil price forecasts are reliable.

Figure 4 shows retail branded gasoline prices for the 1996 to 2000 (through July 17) time period broken down to reflect crude oil cost, wholesaler's gross margin, retailer's gross margin, and taxes (federal and state excise taxes and sales taxes). For the most part, recent annual average price changes in California are due to changing crude oil prices, which ranged from a low of $0.30/gal in 1998 to a high of $0.64/gal in 2000. Next in importance in affecting price changes is refinery gross margin, which ranged from a low of $0.30 in 1996 to a high of $0.37 in 2000. If the crude oil price is maintained at $25/barrel, the corresponding crude oil cost component is about $0.60/gal of gasoline. This corresponds closely to the price for 2000 (through June 19) of $0.64/gal.

Figures 5 (branded gasoline) and 6 (unbranded gasoline) show the same data for 2000, resolved into weekly values to show short-term market dynamics. These figures show how the refinery gross margin (see thick line) tends to increase as fuel supplies become less available (see March 2000 and July 2000) and to decrease as supplies become more available (see January 2000). Note that both branded and unbranded retailers tend to have lower margins when wholesale margins increase and increasing margins when wholesale margins decline.

Figure 7 shows historical U.S. regular grade gasoline prices in real 1997 dollars and in nominal dollars. The California Energy Commission currently uses a gasoline price range of $1.39/gal to $1.65/gal to forecast gasoline demand, as indicated by the horizontal dark lines. Also

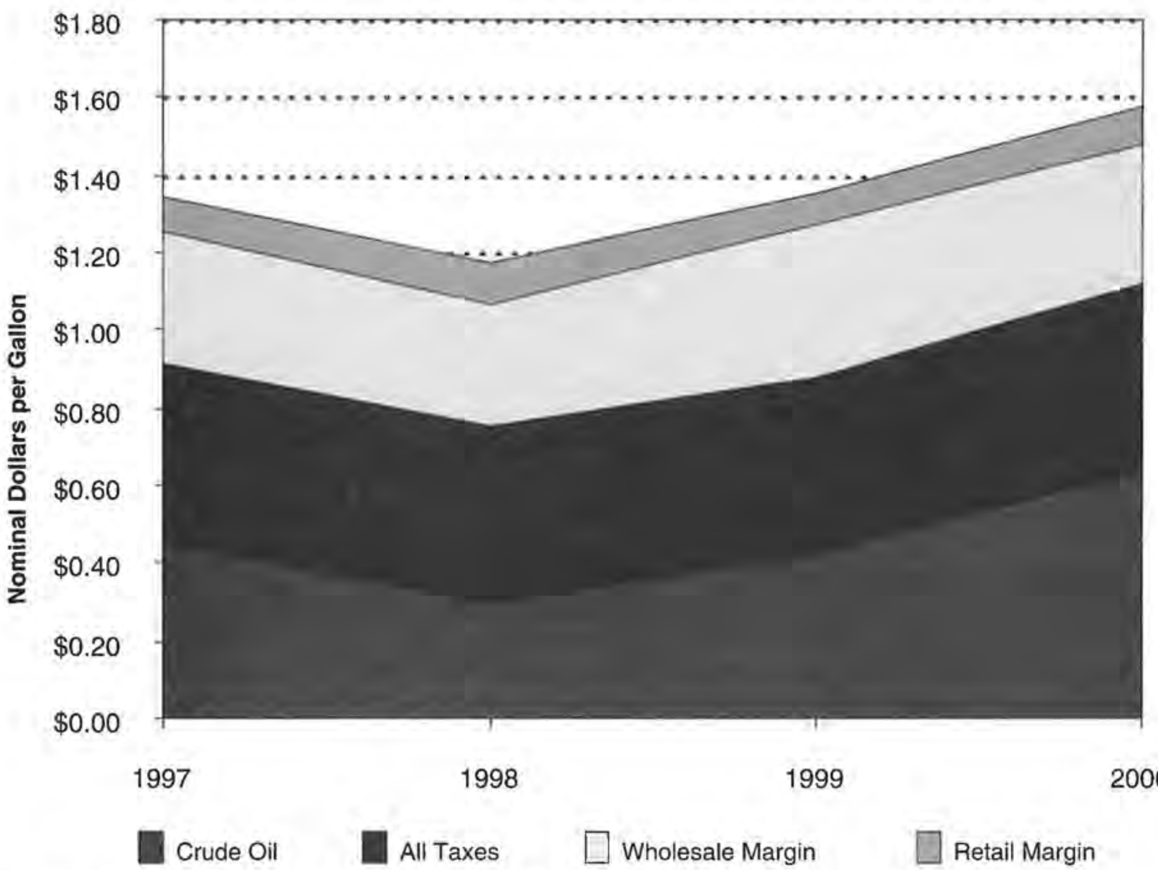

FIGURE 4 California branded gasoline retail price components.

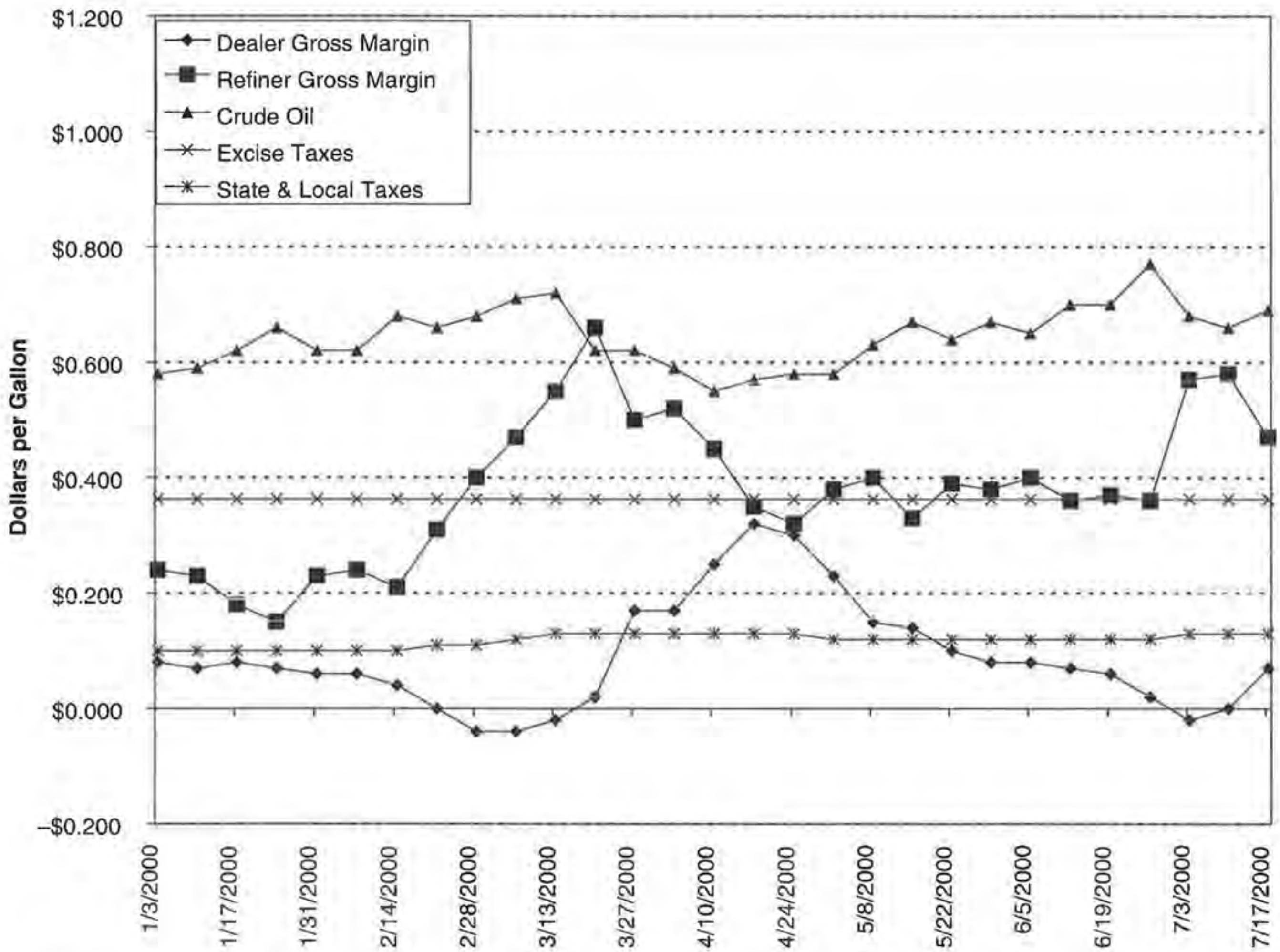

FIGURE 5 Recent branded gasoline price components.

shown in Figure 7 are EIA's low, base case, and high price forecasts from *Annual Energy Outlook 2000*. The EIA forecasts are consistent with the commission's range but lower in magnitude. The difference ranges from $0.36/gal in the low case to $0.22/gal in the high case. The EIA low price forecast assumes increased oil rig drilling, slower Pacific Rim economic growth, and increased non-OPEC production. The EIA high price forecast assumes a greater economic recovery for Asia and agreement by OPEC and non-OPEC countries to cut oil production.

Figure 8 shows actual weekly price differentials between California and national average prices. Notice the variability of this price difference, ranging from –$0.063/gal to +$0.484/gal. (The commission estimates that a sustained price increase of about $0.15/gal is needed to stimulate market-based imports to flow to California.) The following section discusses some of the reasons why California's gasoline prices tend to be higher and more volatile than the national average.

Price Differences

California has historically been a relatively isolated gasoline market. The state usually produces about 10 percent more gasoline than it consumes, exporting the excess as conventional gasoline to Nevada and Arizona. Pipelines connect California refineries to Reno, Las Vegas, and Phoenix. Phoenix is also supplied by pipeline from El Paso, Texas, and that line will soon extend to the Gulf Coast. Before the advent of California's unique reformulated gasoline (Ca-RFG), when California refineries had production problems they could import replacement supplies in the form of gasoline or blend stocks via marine tanker from the state of Washington. Now, California suppliers can do that only to replace production of the conventional fuel made for export to adjacent states.

For the more common problem of production lost from a refinery making Ca-RFG, imports must come through the Panama Canal, originating in the Gulf

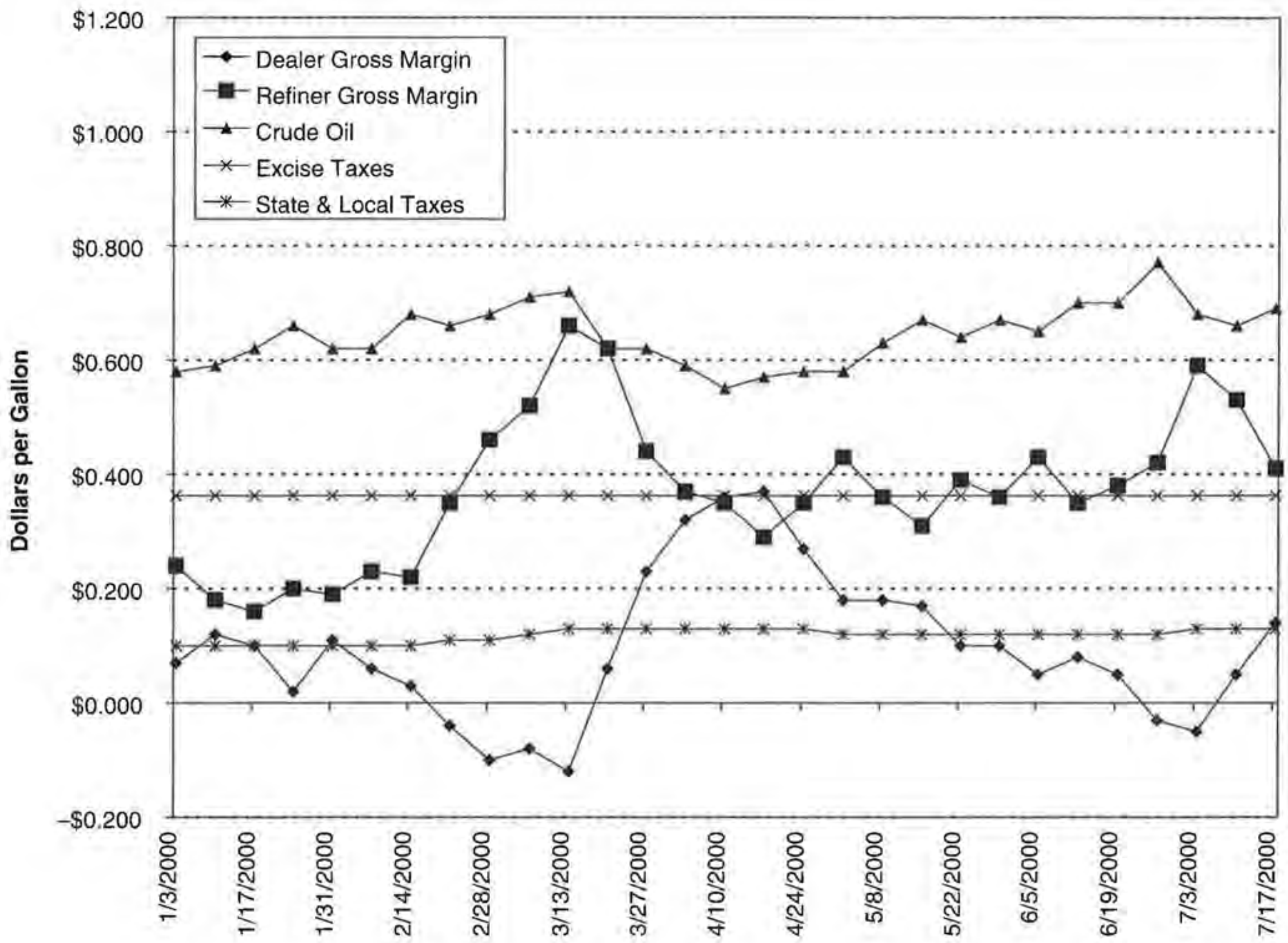

FIGURE 6 Recent unbranded gasoline price components.

Coast refineries, the Caribbean, or even Finland. These sources can produce relatively small quantities of Ca-RFG, not having made the capital investments needed to produce large quantities. Thus, when a Ca-RFG refinery loses production, sustained high prices are needed to attract and deliver replacement supplies.

Furthermore, California's refinery population has decreased from 44 in 1982 to only 13 today. Correspondingly, refinery utilization has increased from 71 percent to nearly 100 percent today. Refinery upgrades costing up to $4 billion in 1996 were needed to make Phase 2 Ca-RFG, which went into production in April 1996. Estimates completed before that time placed the wholesale production cost increase at $0.05/gal to $0.15/gal compared with conventional gasoline. Actual price differences since that time are difficult to pin down because of the frequency of production problems both within California and in nearby states, but the lower end of the price range seems closer to actual pump price differences than the high end.

As ordered by California Governor Gray Davis (Executive Order D-5-99) on March 25, 1999, California will begin using Phase 3 Ca-RFG by the end of 2002. This fuel will not use methyl tertiary butyl ether (MTBE) because it has been found to be a threat to California's drinking water due to its current use in Phase 2 Ca-RFG. Additional capital expenditures of approximately $1 billion are required. In addition, the fuel may have to use ethanol as an oxygenate to replace MTBE. These changes are expected to increase the cost of producing Phase 3 Ca-RFG by $0.034 to $0.064/gal. Compared with Phase 2 Ca-RFG, Phase 3 Ca-RFG will have lower sulfur and benzene levels and increased distillation temperature flexibility, and it will have no MTBE.

The wholesale price of Phase 2 Ca-RFG has fluctuated from $0.55/gal to nearly $1.30/gal, depending on the availability of refining capacity. California has requested an exemption from the federal Clean Air Act (CAA) mandate to use an oxygenate in reformulated gasoline. The basis for this request is that California

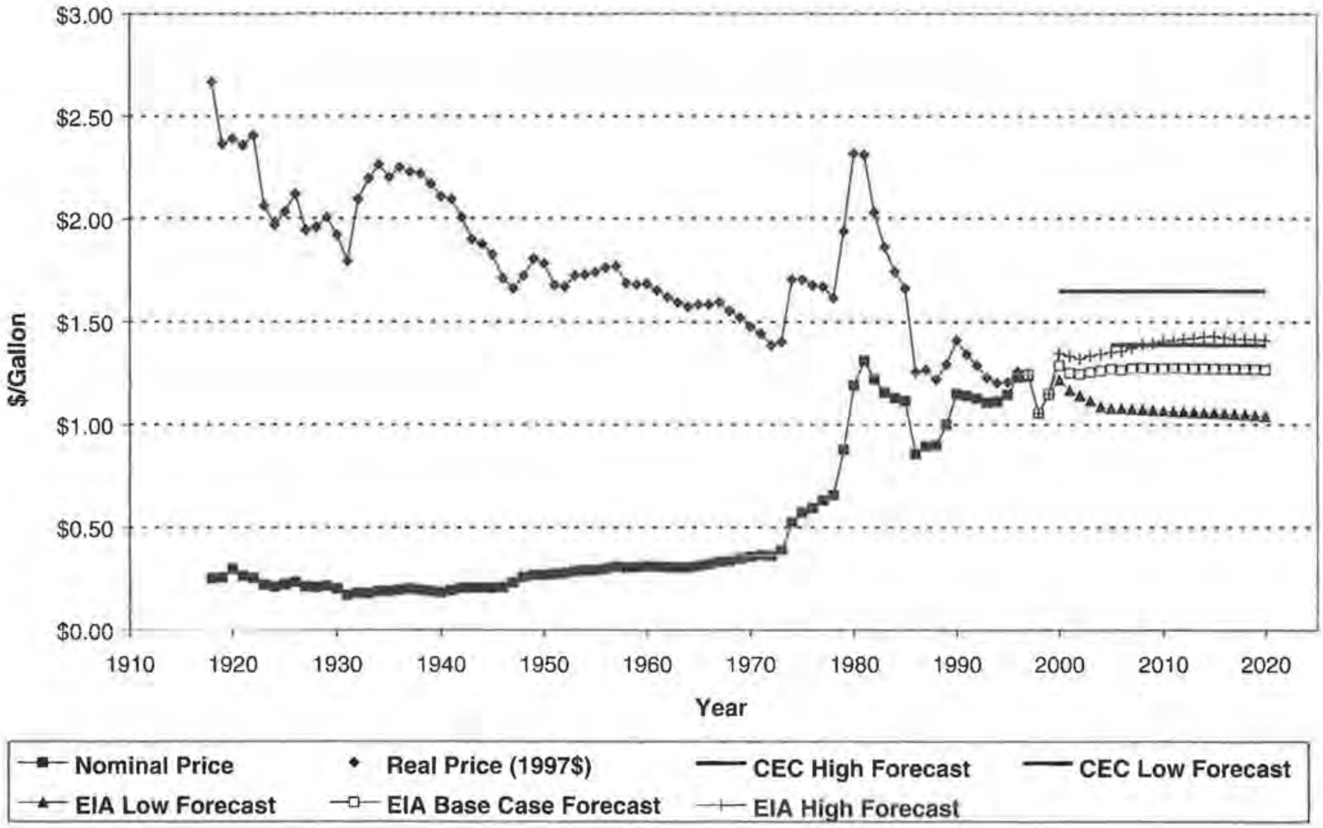

FIGURE 7 U.S. gasoline prices since 1918.

has demonstrated that its refiners can make a cleaner-burning fuel without the use of any oxygenates and that requiring oxygenate in the fuel adds to production costs while not improving air quality. If the waiver is granted, the commission expects a reduction in production cost of \$0.016/gal to \$0.031/gal, assuming that the cost of obtaining ethanol reflects adequate supplies. This may not be the case, as explained more fully below. In the case of a nationwide ban on MTBE and a shortage of ethanol, the waiver could save much more than indicated. This is because a nationwide ban may lead to such high ethanol prices that the incremental cost of producing Phase 3 Ca-RFG is well above the estimated \$0.034 to \$0.064/gal.

Even with the requested waiver from the CAA requirement to use an oxygenate, it is estimated that California will need 54,000 barrels per day of ethanol for Ca-RFG to meet octane and volume requirements under a "free market" scenario. This will increase nationwide demand for fuel-grade ethanol from the current production level of 107,000 barrels per day, about a 50 percent increase. This increase will require use of all the production capacity that is currently idle, under construction, and planned for the near future. If the waiver is not granted, it is estimated that California will need 85,000 barrels per day of ethanol. Whether or not the waiver is granted, there could be a shortage of fuel-grade ethanol. The ethanol volume would replace the 115,000 barrels per day of MTBE currently used.

The Clinton administration has also mounted an effort to eliminate use of MTBE nationwide. In the event of a nationwide MTBE ban, ethanol is likely to be the only oxygenate used to make reformulated gasoline. Other potential oxygenates have many of the same undesirable characteristics as MTBE and are not likely to be used, especially in California where all such additives must undergo a multimedia environmental assessment. So far ethanol is the only constituent that has passed this evaluation, and other additives are not likely to be successful. To the degree that California continues to set the pace of this change, the federal government and other states are not likely to accept another oxygenate. Since the demand for ethanol just from conversion from MTBE to ethanol in California will use all spare and planned capacity, it is quite likely that there will be problems supplying sufficient fuel-grade ethanol

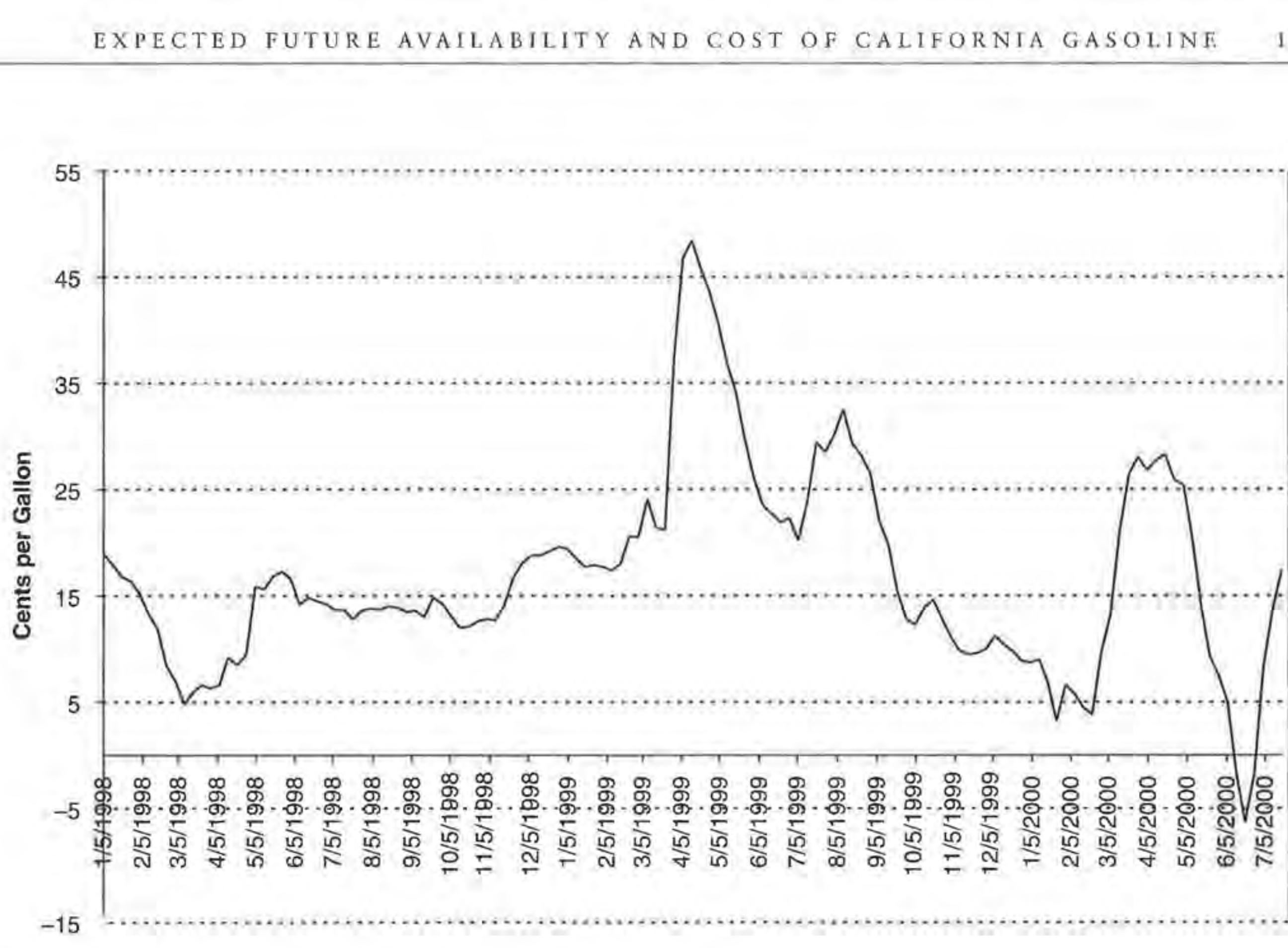

FIGURE 8 California minus national average regular gasoline price.

to meet nationwide demand, and prices could become very high. In that event, the incremental prices cited above would considerably underestimate the cost increases associated with producing Phase 3 Ca-RFG, since ethanol is a major cost component of Ca-RFG.

Ethanol Tax Subsidy

Producers who use ethanol made from renewable sources, such as corn, receive a federal excise tax subsidy of \$0.54 for every gallon of ethanol used in transportation fuel. This subsidy directly reduces federal excise tax revenues. According to the General Accounting Office (GAO), this provision reduced federal fuel excise revenue for the 1979 to 1995 time period by approximately \$7.2 billion (in 1997 dollars) (*5*). In the 1995 federal fiscal year, federal fuel excise tax revenue was reduced by \$617 million. In a letter dated November 1, 1999, the Comptroller General of the United States indicated in a letter to the Chairman of the U.S. Senate Committee on the Budget that continuation of the fuel-grade ethanol excise tax subsidy would reduce federal excise tax revenues by \$2.4 billion over the next 5 years. A more recent GAO report estimates that the subsidy would reduce tax revenue by \$400 million in FY 2001 and \$600 million per year during FY 2002 through FY 2005 (*6*, Appendix III, p. 306). This tax subsidy is scheduled to expire in 2000, but most observers believe Congress will extend it.

The earlier GAO report also indicates that ethanol used as an oxygenate in gasoline accounted for 701 million gallons of gasoline equivalent (gge) in 1992, increasing to 914 million gge in 1996. Not all oxygenated gasoline uses ethanol. In California the most widely used oxygenate is MTBE, which does not receive an excise tax subsidy. Corresponding MTBE use as a fuel oxygenate was 1,175 million gge in 1992 and 3,330 million gge in 1996. Expressed in gallons of each commodity, in 1995 the United States "gasoline pool" contained 110.8 billion gallons of gasoline, 4.7 billion gallons of MTBE, and 1.2 billion gallons of ethanol (*5*, p. 46).

The GAO revenue effects cited above were estimated before the announced nationwide MTBE ban. It is possible that the 4.7 billion gallons of MTBE used nationwide in reformulated gasoline could be replaced with ethanol and that the ethanol tax subsidy would remain in place. If so, it would take approximately 2.35 billion gallons of ethanol to replace the MTBE, since ethanol has approximately twice as much oxygen content per gallon. Assuming $0.54 excise tax credit per gallon of ethanol, this equates to about $1.5 billion per year by 2003, approximately tripling the current excise tax revenue reduction associated with the tax subsidy. For comparison, nationwide road excise tax refunds, credits, and transfers were $1.3 billion in federal FY 1999 (7, p. 18). This could occur as early as 2003. This result assumes that there will be sufficient biomass-derived ethanol to meet oxygenate requirements under a nationwide MTBE ban, which is problematic.

Figure 9 shows the state and federal excise tax revenue estimated from historical gasoline consumption for the 1965 to 1999 time period (dark line). This revenue trajectory was estimated by assuming the tax rate appropriate for each year and includes increases in tax rates as appropriate. It is not based on actual receipts or allocations to California. Per-gallon tax rate changes during this time period are the reason for the "stepped" nature of the historical revenue trajectory.

Figure 9 also shows the expected federal and state revenue flowing to California on the basis of a continuation of existing federal and state tax rates per gallon, under a base case CALCARS model forecast of gasoline consumption with gasoline priced at $1.50/gal (line with solid boxes). For illustrative purposes, it was assumed that 100 percent of the federal taxes collected from gasoline sold in California returned to the state, which is not totally correct, since only about 95 percent of the dollars California drivers pay gets returned (see FHWA's Table FE221 at www.fhwa.dot.gov/ohim, Products and Publications) (cumulative from the mid-1950s).[1] FHWA estimates the amount of ethanol used in gasoline at each of three percentage ranges, 5.7 to 7.0 percent by volume, 7.7 to less than 10 percent, and 10 percent. FHWA calls this fuel "gasohol." Excise tax revenue is reduced in proportion to the amount of gasohol sold in each category, with the intent of estimating the revenue reduction effect of the $0.54/gal of renewable-source ethanol producer's tax credit (personal communication, R. Erickson, FHWA, July 31, 2000).

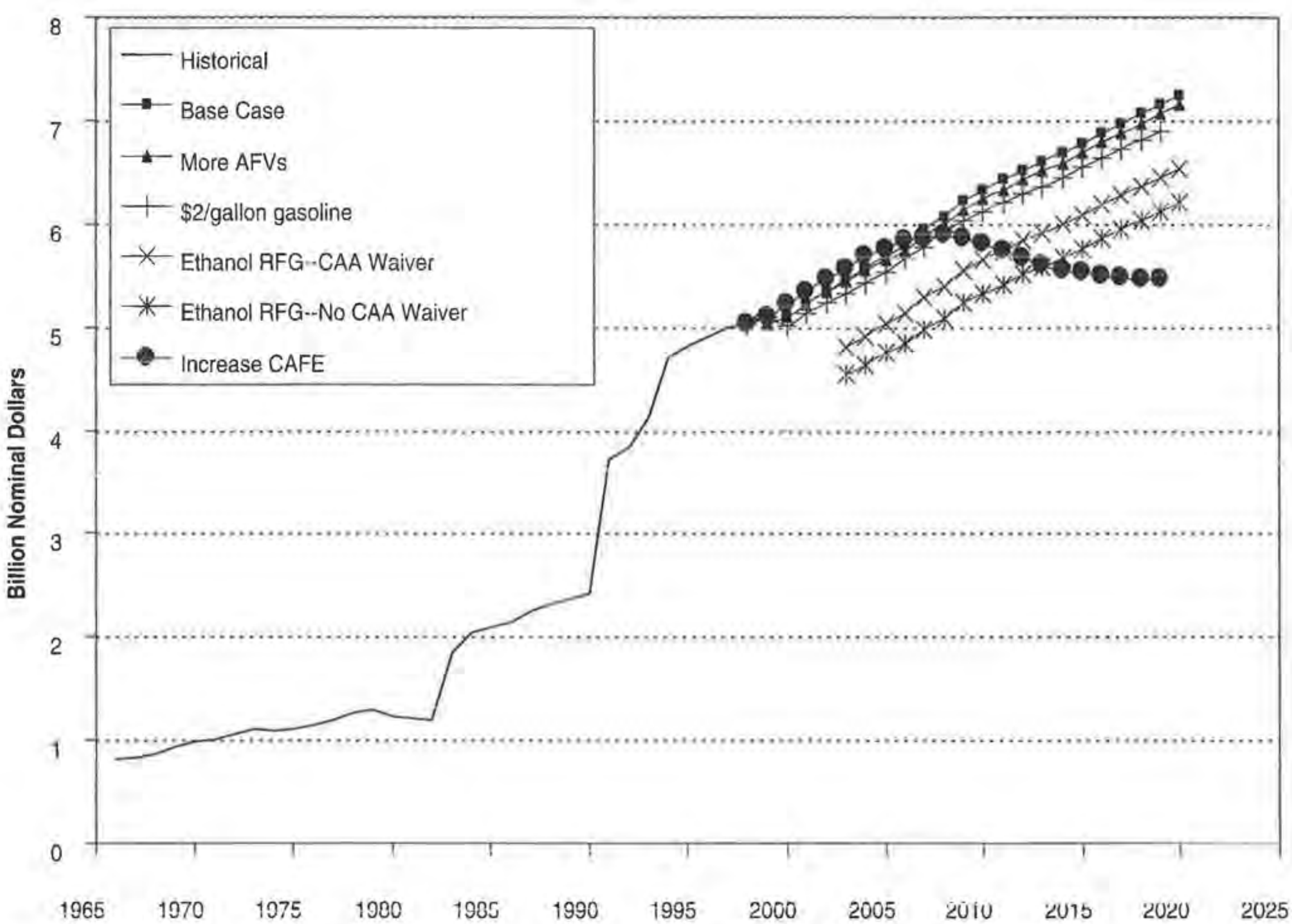

FIGURE 9 Historical state and federal excise tax revenue generation and effect of maximum alternative-fuel vehicle penetration and ethanol subsidy.

At the present time, \$0.031/gal of the \$0.0184/gal federal excise tax on gasoline goes to the general fund, not the Highway Trust Fund, if the gasoline contains 10 percent ethanol. Correspondingly, \$0.025/gal of the federal excise tax revenue goes to the general fund if the gasoline contains 5.7 to less than 10 percent ethanol.

Figure 9 also shows the estimated state and federal excise tax revenue under several alternatives that reduce gasoline demand and thus excise tax revenue. First, and least significant in terms of revenue reduction, is the scenario labeled "more AFVs." This scenario represents remaining gasoline demand under an aggressive program to implement alternative-fuel vehicle use in California (line with solid triangles). Next is the effect of long-term gasoline prices at \$2/gal, which reduces gasoline demand. Next is the effect of a waiver from the federal requirement to use an oxygenate in Ca-RFG, as described above. Next is the effect if the waiver is not granted, and finally, and probably the most significant, is the case where CAFE standards are increased by about 45 percent (line with solid circles).

RECOMMENDATIONS

Because of uncertainties in crude oil supplies and refined product fuel price projections, it would be prudent to evolve federal and state road excise taxes to a point where they are fuel neutral. Then excise tax revenue would be indifferent to the type of fuel used to transport goods and people on roadways. Also, it would not be necessary for excise tax revenue proponents to enter the debate over when to develop nonpetroleum fuels. The author's belief is that on-road fuels should be taxed on a Btu basis rather than on a volumetric basis. This would encourage use of more fuel-efficient technologies and vehicles, reducing transportation's contribution to global warming gas emissions. Furthermore, if taxes are needed to provide incentives to new technologies, they should be offset by increases in taxes for others, so that the highway fund remains indifferent to this effort.

The California Energy Commission endorses options that improve fuel use efficiency. Improved fuel use efficiency would reduce the demand for gasoline production from California refineries, which too often have difficulty keeping pace with demand. Also, more fuel-efficient vehicles would reduce California's global warming gas emissions. However, as noted above, increasing fuel use efficiency could significantly reduce excise tax revenue. One way to offset this effect is to index excise taxes to inflation. This approach has been suggested for alcohol and tobacco sales (6, Appendix III, p. 310) and should be considered in conjunction with road fuel excise taxes specified on a Btu basis.

CONCLUSIONS

Alternative-fuel vehicles are not expected to substantially reduce excise tax revenue, at least not in the 2000 to 2020 time frame. On the other hand, an existing ethanol producers' tax subsidy will have an increasingly larger effect beginning as early as 2003. Furthermore, improved CAFE standards could also have a significant effect.

NOTE

1. TEA-21 establishes annual funding levels for each of several categories. This disconnects excise tax collection from Highway Trust Fund distributions, which in turn makes all states absorb the effect of the ethanol tax subsidy, not just those using gasoline that contains renewable sources of ethanol.

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