

CALIFORNIA
ENERGY
COMMISSION

OPTIONS TO REDUCE PETROLEUM FUEL USE

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Introduction

In a joint report submitted to the Legislature and Governor in August 2003,ⁱ the California Energy Commission (Energy Commission) and California Air Resources Board (CARB) presented an overarching strategy to reduce California's dependence on petroleum fuels for transportation energy. Based on the use of reduction measures that were shown to be technically feasible and cost-beneficial, the agencies proposed a goal to reduce on-road petroleum fuel demand to 15 percent below 2003 levels by 2020. The key recommendations to achieve this goal were to increase new vehicle fuel economy and increase the use of non-petroleum fuels (alternative fuels). The Energy Commission incorporated this goal and key recommendations into its *2003 Integrated Energy Policy Report (Energy Report)*, which was adopted in December 2003.ⁱⁱ

Since 2003, petroleum fuel demand has continued to grow. Because of population growth and increased vehicle miles traveled, the Energy Commission projects that combined gasoline and diesel fuel demand in 2005 may increase by 3.3 percent to 5.1 percent from 2003 despite rising fuel prices.ⁱⁱⁱ

To achieve the petroleum reduction goal adopted in the *2003 Energy Report*, a combination of efficiency and alternative fuel options will be needed. While efficiency should be the first priority, federal law prevents California from establishing its own vehicle fuel economy standards. Nevertheless, in 2004, CARB adopted a landmark greenhouse gas emission (GHG) standard for cars and light trucks that also will substantially reduce petroleum consumption in new vehicles beginning in the 2009 model year. When fully implemented, the standard will result in new vehicles that consume nearly 30 percent less fuel than those built prior to 2009, while reducing GHG emissions.

Other states are now considering a similar GHG standard. However, the Energy Commission/CARB petroleum reduction strategy showed that there are cost-effective options that could double the combined fuel economy standard for cars and light trucks. The Energy Commission is initiating a multi-state collaborative to spur federal action to significantly increase the federal Corporate Average Fuel Economy standard. Given the historical reluctance of the U.S. Congress to increase fuel economy standards for new vehicles, this option faces challenges. Alternative fuels become increasingly important in the mid- to long-term as population and economic growth erode petroleum reduction benefits that come from more efficient vehicles. Even when maximized over time, improved efficiency cannot make a finite petroleum resource last indefinitely. Thus, increasing the use of alternative fuels today where they are competitive with petroleum fuels or provide benefits sufficiently valued by consumers, eases a future transition to a multi-choice and diverse transportation energy market.

Currently, ethanol^{iv} and biodiesel^v appear broadly competitive as blending ingredients in petroleum fuels. Other alternative fuels, such as electricity, liquefied

petroleum gas, and natural gas, are being successfully used in specific transportation applications; expanding their use in these applications makes sense.

Choices to improve transportation energy efficiency and increase the use of alternative fuels require public and private investments. Some choices such as improved vehicle maintenance practices will benefit from relatively modest, but sustained, investment in consumer education. The acquisition of vehicles with best-in-class fuel economy can also be accelerated by providing consumer incentives, such as, a direct incremental cost reduction, access to high-occupancy vehicle lanes or preferred parking. Until economies of scale can help reduce unit costs for alternative fuel vehicles and related fuel infrastructure, public assistance will be important for greater use of alternative fuels.

Historically, California has relied on a supply-side approach to ensure that consumers have affordable sources of transportation energy, primarily petroleum fuels; however, additional choices to give consumers equal or better transportation service and performance are being overlooked, and the state needs a more balanced approach that includes demand-side options. As we have learned in the electricity sector, choices to balance our need for new electricity supplies with demand-side measures are equally important and, in many instances, preferred over supply enhancement.

Methodology and Summary of Analytic Results

To help gauge the relative merit of various petroleum reduction options, the staff compared each option with business-as-usual choices (BAU). The results of these comparisons measure the current investment merit of alternative courses of action relative to the status quo. This merit is expressed as a present value direct net benefit. For each comparison, important monetary values of consumer costs and benefits and environmental benefits^{vi} are determined, discounted over time, and summed over an appropriate period of use. This methodology was originally used in the joint Energy Commission and CARB report, *Reducing California's Petroleum Dependence*.^{vii} Greater detail on this methodology can be found in the appendices and companion documents of the joint report.

The direct net benefit from the staff's evaluation of an option is comprised of four economic groupings. These groupings allow the staff's results to be viewed from different perspectives and can help policymakers make informed judgments on the merits of different options. These groups are:

- Direct Non-Environmental Benefit (consumer out-of-pocket expenditures and monetary savings, an indicator of market competitiveness)
- Changes in Government Revenue (state and federal fuel excise taxes typically used to provide transportation infrastructure benefits)

- Direct Environmental Net Benefit (avoided environmental and public health damages, an indicator of sustainability)
- External Cost of Petroleum Dependency (avoided military costs and economic loss due to U.S. petroleum dependence)
- Direct Net Benefit (this equals the sum of the above groups and provides a societal perspective of merit)

The staff evaluated the petroleum reduction options listed in Table 1 using this methodology. While cost and benefit comparisons can provide good insight on a product's relative competitiveness, the methodology cannot forecast market success. The latter is influenced by consumer preference and values placed on product attributes that are not always discernible or fully recognized in all market sectors. For example, if the initial hybrid electric vehicles offered for sale were compared to an equivalent gasoline vehicle, the fuel savings and avoided environmental impacts of the hybrid would not have offset its incremental cost. In a cost and benefit comparison, the early hybrid vehicle would have produced a negative benefit value. Nevertheless, this technology has exceeded market expectations, and an increasing number of vehicle models will be produced with the hybrid option.

As shown in Table 1, not all of the options could be evaluated quantitatively because good information on their potential was not always usable in the staff's methodology or required such gross assumptions that predicted results would not be meaningful. Nevertheless, some of the options that were less rigorously evaluated appear to be worthwhile pathways to maintain movement of goods and people or reduce the long-term demand for transportation energy. These options include fuel-efficient replacement tires, land use planning, and public transit.

Table 1. Selected Options to Reduce Petroleum Fuel Use

Efficiency Option	Description
1A. Improved Vehicle Fuel Economy	Scenarios comparing improved fuel economy in new light-duty vehicles are evaluated
1B. Fuel Efficient Replacement Tires ¹	The Energy Commission's tire testing program, expected results, and possible actions are described
1C. Fuel Efficient Fleets ¹	Information needs and possible actions are described to evaluate public and private fleet opportunities to reduce fuel use
1D. Vehicle Maintenance Practices	Scenarios of reduced fuel consumption from performing vehicle maintenance practices: oil changes, air and oil filter changes, and monitoring tire air pressure
1E. More Efficient On-road Diesel Medium- and Heavy-Duty Trucks	Scenarios comparing improved fuel economy in new medium and heavy-duty trucks are evaluated
1F. Light-Duty Diesel Vehicles	Scenarios comparing increased use of diesel engines in light-duty vehicles are evaluated
1G. Reduced Vehicle Day-Lighting ¹	Qualitative assessment of fuel consumption impact from reduced use of vehicle lights during daytime periods
1H. Truck-Stop Electrification	Scenarios of using auxiliary power units on heavy-duty trucks are evaluated
1I. Low Viscosity Lubricating Oil ¹	Qualitative assessment of fuel use impact from low viscosity motor oils
Alternative Fuel Option	
2A. Hydrogen ¹	Qualitative assessment of hydrogen-based applications in vehicles
2B. Electric Battery Technologies	Scenarios of using neighborhood electric vehicles (EVs) and city EVs are evaluated
2C. Grid-Connected Hybrid Electric Vehicles	Scenarios of using grid-connected hybrid EVs are evaluated
2D. CNG for Light-duty Vehicles	Scenarios of using compressed natural gas light-duty vehicles are evaluated
2E. Liquefied Petroleum Gas ¹	Qualitative assessment of using liquefied petroleum gas vehicles
2F. Ethanol Blend (E10)	Scenarios of increased use of ethanol blended with gasoline and diesel fuel are evaluated
2G. Ethanol Hi-Content Blend (E85)	Scenarios of increased use of ethanol blended with gasoline and diesel fuel are evaluated
2H. LNG and CNG for Medium and Heavy-duty Vehicles	Scenarios of using liquefied and compressed natural gas in medium and heavy-duty vehicles are evaluated
2I. Gas-to-Liquid (GTL) and Coal-to-Liquid (CTL) Fuels	Scenarios of using gas-to-liquid and coal-to-liquid fuel are evaluated
2J. Renewable Diesel (biodiesel and other biogas-to-liquid fuels)	Scenarios of using renewable diesel fuel are evaluated
2K. Heavy-Duty Hybrid Electric Vehicles	Scenarios of using hybrid electric technology in heavy-duty vehicles are evaluated
2L. Ethanol in Diesel Fuel	
2M. Non-Road Options	
Other Fuel Demand Reduction Option	
3A. Public Transit ¹	Status of public transit usage

¹This option is discussed qualitatively without a cost and benefit evaluation. Sufficient information was not readily available or in a usable form at this time to establish a meaningful and predictable cost and benefit relationship for this option.

The options with the highest overall merit are those with positive direct net benefit while producing a relatively large petroleum reduction. Estimated amounts of petroleum fuel reduction resulting from individual efficiency and alternative fuel options are displayed in Tables 2 and 3, respectively. In comparing the options by net benefit result and volume of petroleum fuel reduction, one can see that some options with positive net benefit produce relatively small fuel reduction and others produce relatively large fuel reduction but with small or negative net benefit. Qualitatively, the overall merit of our options is a combination of their net benefit values along with their petroleum reduction volumes.

Table 2.

Petroleum Reduction and Benefits for Selected Efficiency Scenarios							
Efficiency Option or Scenario	Displacement in 2025, billion gallon gasoline equivalent	Reduction from Base Case Demand,² percent	Highest Cumulative Benefit or Change,¹ Present Value, 2005-2025, 5% discount rate, Billion \$2005				
			A	B	C	D	A+B+C+D
			Direct Non-Environmental Benefit	Change in Government Revenue	Direct Environmental Net Benefit	External Cost of Petroleum Dependency	Direct Net Benefit
Improved Vehicle Fuel Economy, CARB Mild Hybrid Scenario	2.29	10.99	7.20	(3.37)	2.01	1.15	6.99
Improved Vehicle Fuel Economy, CARB Full Hybrid Scenario	3.03	14.55	(2.80)	(4.36)	2.60	1.48	(3.08)
Improved Maintenance Practices (30% with Information Program)	0.63	3.00	7.18	(1.00)	1.46	0.78	8.42
More Efficient On-road Diesel Medium- and Heavy-Duty Trucks (Aggressive Case)	2.30	11.04	9.46	(1.43)	1.93	1.04	11.00
Light-Duty Diesel Vehicles	1.30	6.24	1.30	(1.70)	1.40	0.90	1.90
Truck-Stop Electrification (Aggressive Case)	0.34	1.63	2.40	(0.28)	0.26	0.14	2.53

¹Values in parentheses are negative; ²Base Case is combined on-road gasoline and diesel demand

Table 3.

Petroleum Reduction and Benefits for Selected Alternative Fuel Scenarios							
Alternative Fuel Option or Scenario	Displacement in 2025, billion gallon gasoline equivalent	Reduction from Base Case Demand,² percent	Highest Cumulative Benefit or Change,¹ Present Value, 2005-2025, 5% discount rate, Billion \$2005				
			A	B	C	D	A+B+C+D
			Direct Non-Environmental Benefit	Change in Government Revenue	Direct Environmental Net Benefit	External Cost of Petroleum Dependency	Direct Net Benefit
Electric Battery Technologies (NEV and CEV)	0.10	0.48	1.11	(0.11)	0.06	0.03	1.09
Grid-connected Hybrid Electric Vehicles (HEV20)	0.55	2.64	0.62	(0.11)	0.13	0.08	0.72
Grid-connected Hybrid Electric Vehicles (HEV60)	0.73	3.50	(0.40)	(0.36)	0.40	0.21	(0.16)
CNG for Light-duty Vehicles (Honda Case)	0.03	0.16	(0.31)	(0.03)	0.003	0.02	(0.32)
CNG for Light-duty Vehicles (Honda and GM Case)	0.08	0.40	(0.51)	(0.05)	(0.004)	0.03	(0.53)
Ethanol Blend (E10 reduced price case)	0.48	2.30	0.00	(2.50)	2.00	0.60	0.10
Ethanol Hi-Content Blend (E85)	1.0	4.8	0.0	(0.7)	0.6	0.6	0.5
LNG and CNG for Medium- and Heavy-duty Vehicles (Aggressive Case)	1.72	8.26	2.65	(2.48)	0.36	1.24	1.77
Gas-to-Liquid (GTL) and Coal-to-Liquid (CTL) Fuels	1.64	7.87	0.00	(0.20)	0.13	0.97	0.90
Renewable Diesel (B20)	0.99	4.75	0.00	(0.80)	0.28	0.25	(0.28)
Heavy-duty Hybrid Electric Vehicles (Aggressive Case)	0.05	0.22	(0.06)	(0.03)	0.03	0.01	(0.04)

¹Values in parentheses are negative; ²Base Case is combined on-road gasoline and diesel demand

A summary of the direct net benefit for efficiency and alternative fuel options are displayed in Figures 1 and 2, respectively. The range of values shown for each option reflects the variation in petroleum fuel prices used in the comparisons. The break-even point or point of neutrality for an option is shown by the vertical line centered over zero present value. As the benefit value increases in the positive direction, the investment merit increases and vice versa. Options that do not pass the break-even point generally have consumer costs that are not offset by fuel savings or a combination of benefit values; these options produce a negative benefit value.

Figure 1
Petroleum Reduction and Benefit for Selected Efficiency Scenarios

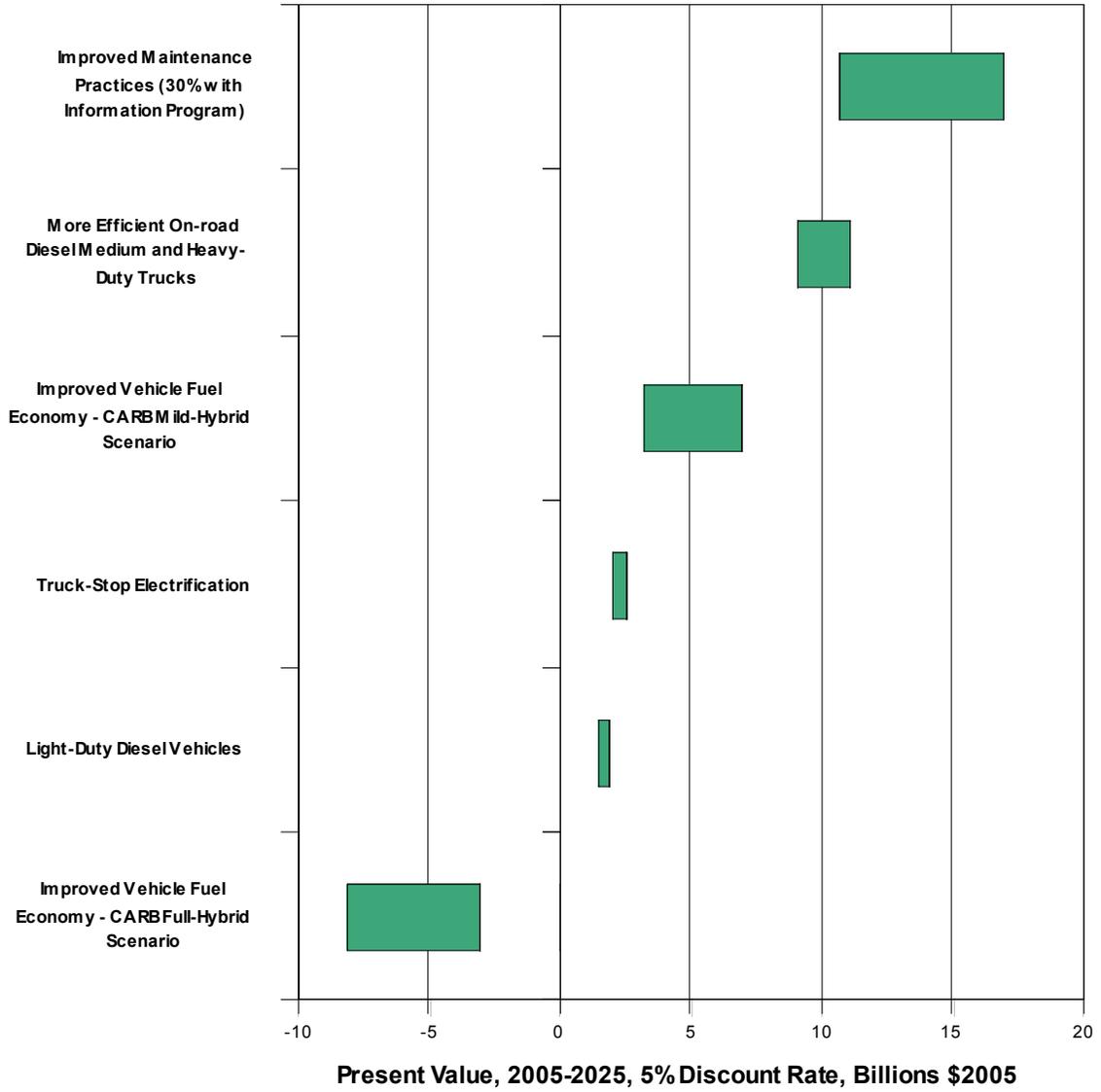
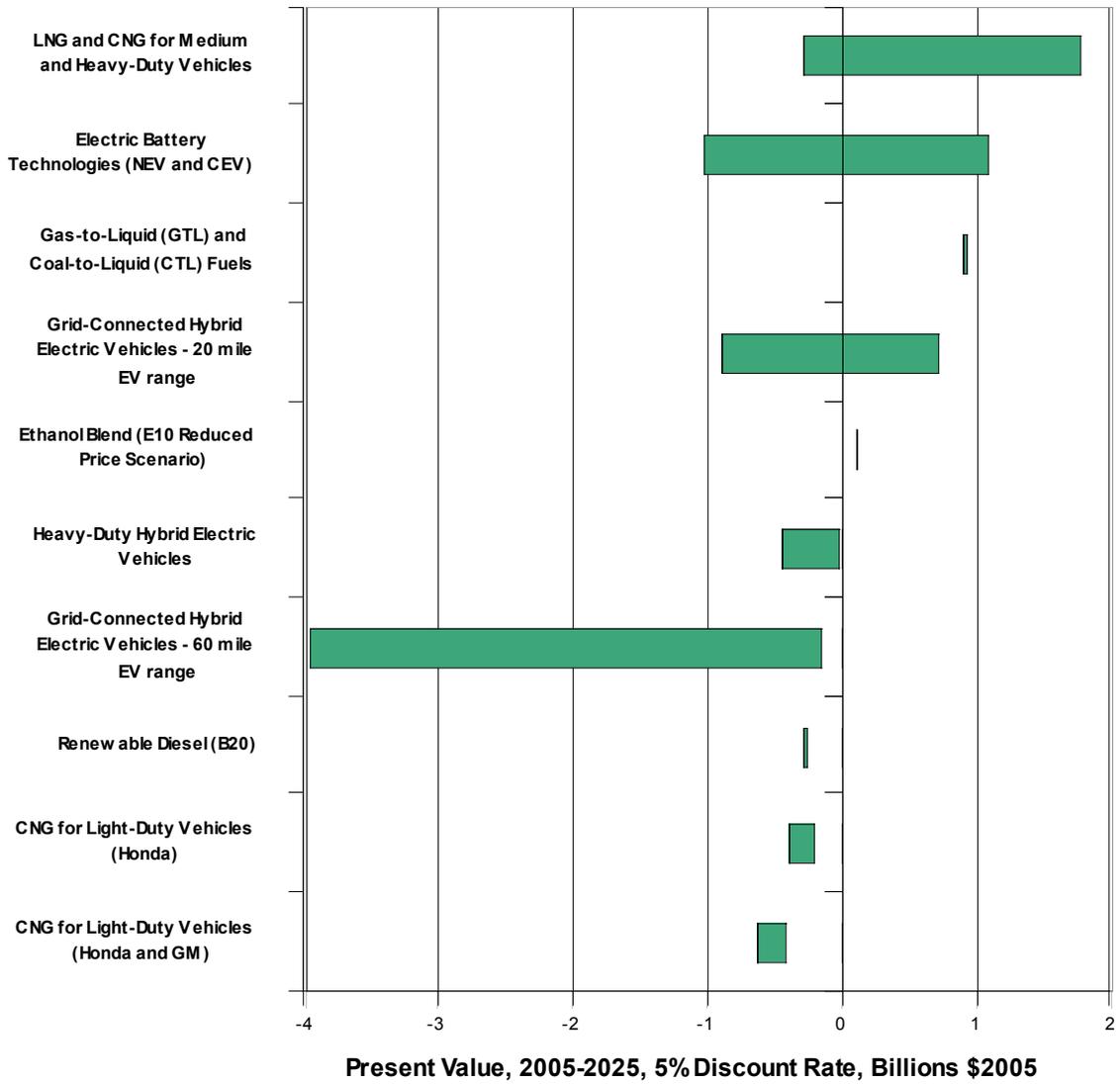


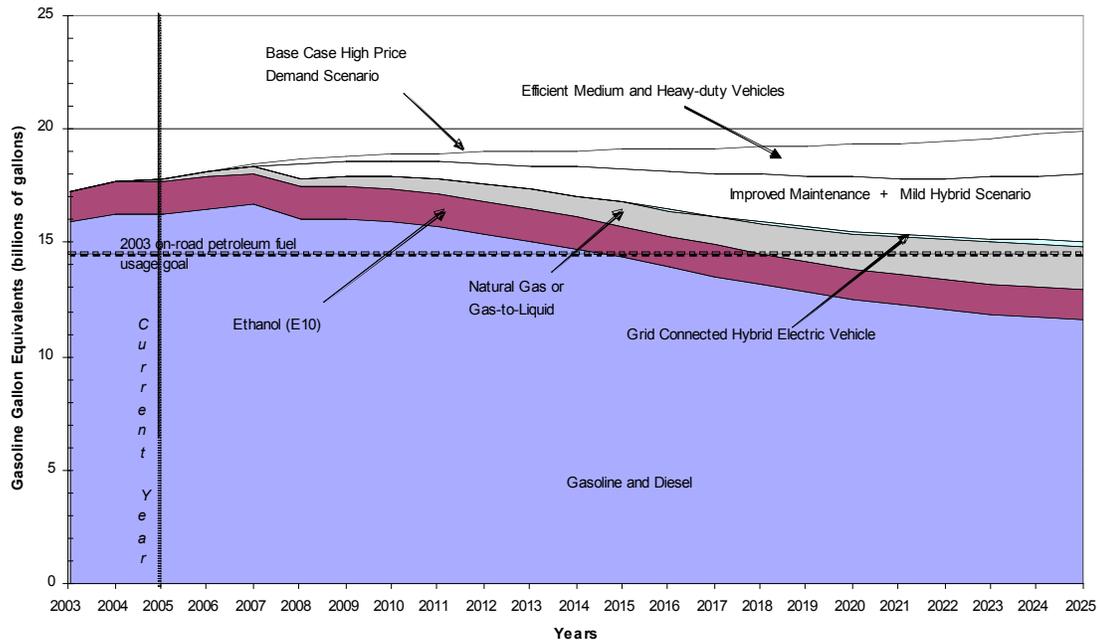
Figure 2
Petroleum Reduction and Benefits for Selected Alternative Fuel
Scenarios



In earlier analysis performed by the Energy Commission and CARB for the report, *Reducing California's Petroleum Dependence*,^{viii} the agencies elected to combine options with significant net benefit and petroleum reduction values to determine a maximum petroleum reduction potential. A similar process to build examples of a petroleum reduction portfolio produces the transportation energy demand profile shown in Figures 3 and 4. The on-road petroleum fuel goal adopted by the Energy Commission and CARB is displayed as a reference point. The uppermost line labeled as Base Case High Price Demand Scenario is the projected on-road gasoline and diesel demand forecast for the very high fuel price scenario. This curve also reflects the impact of California's GHG emission standards for light-duty vehicles.

The options used in the Figure 3 scenario reduce on-road gasoline and diesel demand to about 11.6 billion gasoline gallon equivalent (gge) in 2025, about 42 percent reduction from the base case demand forecast. The largest reductions in this scenario result from new vehicle fuel economy improvements for future light-duty vehicles and in medium and heavy-duty trucks.

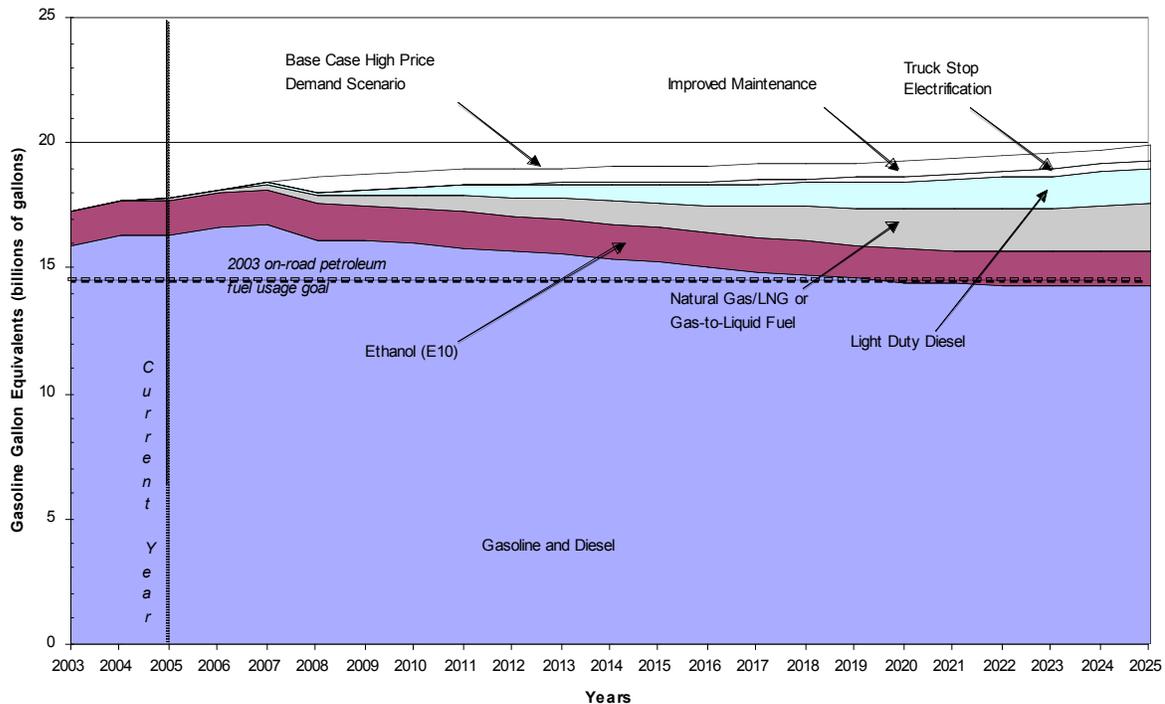
Figure 3
Base Case Petroleum Fuel Demand and Petroleum Reduction Scenario #1



If national standards are not adopted to achieve the efficiency results shown in Figure 3, an alternative scenario is displayed in Figure 4. The Figure 4 scenario does not rely upon increases in national fuel economy standards but uses petroleum fuel reduction options that might be deployed through state policies. The projected on-road gasoline and diesel demand in 2025 is about 14.4 billion gge, about 28 percent reduction from the base case demand forecast.

Figure 4

Base Case Petroleum Fuel Demand and Petroleum Reduction Scenario #2



Although additional petroleum reduction portfolios can be created from the various options that produced positive benefits, not all of them can be combined in a simple additive manner. If the reduction options compete within the same market sector, their reduction outcomes would not necessarily be additive.

Options Involving Technologies for Improved Energy Efficiency

The options of improving new light-duty vehicle fuel economy and more efficient medium and heavy-duty trucks have the largest direct net benefit values and significant fuel demand reduction. Because federal law preempts California from establishing its own vehicle fuel economy standards, the state is in the initial phase of building a multi-state collaborative to influence federal action in this regard. However, given the historical reluctance of the U.S. Congress to increase the fuel economy standards for new vehicles, these options face challenges.

Notwithstanding the significant petroleum demand reduction expected as a side benefit of California's GHG emission standards, additional gasoline fuel savings appears cost-effective with greater application of hybrid vehicle technology. This projection comes from using incremental vehicle costs estimated by CARB in the

mild hybrid case for improved vehicle fuel economy. For the "very high gasoline price" series used in the Energy Commission staff's analysis, the CARB mild hybrid scenario produced a positive net benefit and a fuel demand reduction of about 11 percent from the base case demand.

Another efficiency option with a relatively large gasoline demand reduction is light-duty diesel (LDD) vehicles. Although vehicle and engine manufacturers are demonstrating a limited number of engines that may fully satisfy federal and state emission standards, uncertainty remains on the required cost and certification performance of LDD emission control technology. If this uncertainty is successfully resolved by manufacturers, the proportion of LDD vehicles sales in California will likely increase over time, and sales could approach the level experienced in Western Europe.^{ix}

While gasoline demand is reduced through greater market penetration of LDD vehicles, the demand for diesel fuel increases, eroding a large fraction of the petroleum fuel demand reduction. In the staff's aggressive market penetration scenario for LDD vehicles, gasoline demand in 2025 is reduced by about 16 percent from the base case.^x However, diesel demand increases by about 20 percent and the net petroleum fuel reduction is about 7 percent.^{xi} Nevertheless, in the staff's analysis a swing toward greater diesel production in California's refineries could improve petroleum throughput efficiency, producing an increase in the volume of usable fuel per unit of input crude oil.^{xii} This latter benefit would occur for all of the options that might result in greater diesel fuel demand compared to the base case forecast.

Medium- and heavy-duty vehicles using diesel fuel are two market sectors that can also effectively reduce petroleum fuel demand with more efficient engine and vehicle technologies. The staff's analysis of an aggressive regulatory scenario for these vehicles shows an on-road petroleum fuel demand reduction of about 11 percent in 2025. However, as in the case for improved light-duty fuel economy, the state must rely on federal action for this scenario to be realized.

Options Involving the Use of Alternative Non-Petroleum Fuels

Alternative fuels that can be easily combined (blended) with conventional gasoline and diesel fuel, such as ethanol and biodiesel, respectively, have the easiest pathway to greater use. While some differences exist between these fuels and petroleum fuels, ethanol and biodiesel at blend levels of 10 percent and 20 percent, respectively, can be used in conventional petroleum fuel systems with little or no change throughout the petroleum fuel cycle, from production through end-use. The commercial standing of these two fuels also benefits from federal taxation policy that provides tax credits when these fuels are blended with petroleum fuels.^{xiii}

Grid-connected hybrid electric vehicles continue to show promise, but manufacturers have not promoted this technology because they perceive a lack of consumer preference for a vehicle with limited electric range. The staff's analysis for the HEV20 scenario, a grid-connected hybrid with 20 mile battery range, shows a positive direct net benefit.

Liquefied natural gas (LNG) and compressed natural gas (CNG) have found successful applications in certain medium- and heavy-duty vehicle market segments. The staff's analyses project a positive merit for LNG and CNG in these market segments. In the highest petroleum fuel price scenario, the aggressive LNG and CNG option reduced on-road gasoline and diesel demand by about 8 percent in 2025. However, natural gas engine models are limited and more expensive unit costs for appropriate engine and vehicle combinations restrict market growth. The emission advantage of these technologies is also being reduced by advances in emission controls for diesel technology. To maintain the market potential of these and other alternatives, policies must be adopted to create added consumer value to use these fuels.

There is great interest and significant support to develop hydrogen fuel as a long-term replacement for petroleum fuels. However, market projections for this option would require significant advancements in technological performance and cost reductions before credible results can be projected. Nevertheless, California is joined by major automotive manufacturers, energy providers, and the federal government to implement a phased blueprint plan,^{xiv} resolving uncertainties and preparing for deployment of hydrogen-based transportation technologies over the next decade. As this effort unfolds, its results will allow more meaningful evaluations to be performed on hydrogen's contribution to reduced petroleum fuel demand.

Non-road and off-road applications have potential to reduce petroleum fuel use by switching to alternative fuels. By shifting to alternative fuels, these applications may reduce gasoline and diesel fuel demand by 22 million to 1.1 billion gallons gge. At the higher displacement range, this volume is about 5 percent of the on-road gasoline and diesel fuel demand forecast (very high price scenario). However, the staff is not able to quantify the incremental costs and benefits for such a shift at this time.

Options Involving Public Information Programs

In lieu of improved technology, near-term options to reduce petroleum fuel demand can be implemented with improved consumer information and resultant changes in behavior. The leading candidates in the public information program area are improved vehicle maintenance practices and energy labeling of replacement tires for vehicles.

The staff presents estimates of a range of cost-effective fuel savings for performing routine changes of air and oil filters, oil changes, and monitoring of proper tire air pressure. In the staff's best scenario, fuel demand is reduced by 4.3 percent in 2025. This scenario uses an annual information campaign to convince a fraction of light-duty vehicle owners to perform these practices. For any given year, the staff assumed that vehicles no older than six years were already being maintained properly due to warranty requirements. Thus, the targeted vehicle owners for the improved maintenance practices were those with vehicles older than six years. Based upon results from other information campaigns, the staff assumed that a maximum of 30 percent of the targeted population could be influenced to perform the desired maintenance practices. Although the value of fuel saved can offset all or a portion of the maintenance expense, this benefit is generally considered a bonus for the consumer since desired engine and vehicle drivability, engine life, and vehicle safety are the primary benefits of these practices.

The Energy Commission's tire testing program initiated in 2005 is designed to quantify tire performance (such as traction, wear rates, and cost) as a function of rolling resistance.^{xv} This work may lead to energy efficiency standards and efficiency labels for replacement tires. With such information, consumers will be able to use an energy criterion in selecting new replacement tires.

Informing the public about the transportation energy implications of their land use and growth decisions can result in less vehicle miles traveled (VMT) and less fuel use. The Energy Commission recognizes the link between transportation demand and placement of future community features such as residential housing, business centers, shopping, and recreational facilities. Although specific results can differ among communities, the staff presents a land use case study where the preferred growth plan projected a VMT per household reduction of about 16 percent compared to the base case scenario.^{xvi} If duplicated statewide, the example presented can alter the current VMT trend and lessen the state's embedded demand for transportation energy.

Public transit in California provides an important mode of mobility and social service for many citizens. Where population density and travel corridors produce sufficient levels of ridership to make transit an efficient energy choice, reason exists to maintain these investments. The ridership review conducted by the staff is an initial attempt to bound the cost and benefit relationship between increased transit ridership, reduced passenger car trips, and investment cost.^{xvii} However, case specific analyses would be required to determine where increased investment would produce a cost-effective reduction in transportation energy demand. Nevertheless, information to promote transit ridership as part of a larger public information program will help maintain ridership levels and limit growth in passenger car VMT.

Challenges to Reducing Petroleum Fuel Use

While implementation of the petroleum reduction options that produce clear societal net benefits appears sensible, the rate of government revenue from the collection of fuel excise taxes will decline as less petroleum fuel is used. For example, because a more efficient vehicle uses less fuel per mile of travel, less fuel excise tax will be collected per mile of travel. Since fuel excise taxes are the primary investment resource for the state's roads and highways, the long-term result of a reduced rate of fuel excise tax collection must be examined. However, even with the most aggressive strategy to slow the rate of growth in on-road transportation fuel demand, overall collection of fuel excise taxes will increase at least through 2010.

To achieve the petroleum and alternative fuel goals adopted in the *2003 Integrated Energy Policy Report*,^{xviii} a combination of efficiency and alternative fuel options will be needed. Although choices exist to reduce petroleum fuel use while resulting in net benefits, most options have an initial cost that is greater than the BAU choice. Consumers must be convinced that these initial costs can be defrayed over time before reductions in fuel use can be achieved. Alternatively, consumers may need improved information on the overall merit of these transportation choices before making their next purchasing decision.

Staff Findings and Options for Policy

The staff finds efficiency measures provide the greatest benefit for a given investment. However, the efficiency option with the largest projected benefit and petroleum fuel reduction, improving new vehicle fuel economy standards, cannot be implemented by California and requires federal action. Although initial contact with other states to form a fuel economy collaborative to influence federal action in this regard has been positive, there is no certainty of success in this endeavor. Other efficiency options such as improved vehicle maintenance practices, truck stop electrification, more efficient medium- and heavy-duty diesel engines, and increased use of diesel engines in light-duty vehicles appear to have positive merit in a petroleum reduction strategy. Where additional consumer information can spur greater use of efficiency options, benefits are projected to exceed investment cost.

Increased use of alternative fuel options requires different degrees of continued public support and development. For options that can be integrated with conventional petroleum fuels, such as ethanol blended with gasoline (E10) and biodiesel blended with petroleum diesel (B2 and B20), consumer benefits appear neutral or slightly positive as long as federal tax credits are maintained. Other alternatives, such as, CNG and LNG in light- and heavy-duty applications, need help to overcome incremental acquisition costs and more convenient availability and access to fueling facilities. A detailed discussion of key actions to accelerate market acceptance of seven alternative fuels being considered is presented in the staff's *Alternative Fuels Commercialization* report.^{xix}

All of the petroleum fuel reduction options focusing on gasoline use are compared to a new benchmark, vehicles designed to meet California's GHG emission standards. When fully deployed in 2016, these vehicles will consume about 30 percent less fuel than the average gasoline vehicle manufactured in 2008. This represents a significant step toward the petroleum reduction goal adopted in the *2003 Energy Report*. Since a good portion of the benefit of a petroleum reduction option related to light-duty vehicles is the value of gasoline saved, the California's GHG standard raises the bar for all other petroleum reduction options. As staff's analyses show, however, there are cost-effective options that take the state even further toward meeting the petroleum reduction goal.

Establishing a greater number of efficiency and alternative fuel choices to help maintain acceptable stability between supply and demand in our transportation energy market is vital to the state's economic health. If the state relies solely on petroleum supply-side actions triggered by increasing fuel prices, our economy becomes less competitive than those that use a combination of supply and demand-side measures to temper upward spikes in fuel prices. State support and investments in demand-side measures can produce positive benefits for consumers and our environment.

Endnotes

- ⁱ California Energy Commission, *Reducing California's Petroleum Dependence*, August 2003, P600-03-005F; http://www.energy.ca.gov/fuels/petroleum_dependence/documents/index.html.
- ⁱⁱ California Energy Commission, *2003 Integrated Energy Policy Report*, December 2003, Pub. No. 100-03-019F http://www.energy.ca.gov/2003_energypolicy/index.html.
- ⁱⁱⁱ California Energy Commission, *Forecasts of California Transportation Fuel Demand 2005-2025*, May 2003, 600-2005-008. The range of fuel demand increase is calculated from the projected demand in 2003 and 2005 based upon a range of fuel price scenarios in the Energy Commission's CALCARS demand model.
- ^{iv} Ethanol's economic standing as a chosen ingredient in the production of California's reformulated gasoline is greatly influenced by a federal tax credit. The tax credit reduces a blender's tax liability by \$.51 for each gallon of ethanol used. This credit was recently adjusted in federal law, PL 108-357.
- ^v Biodiesels economic standing as a possible ingredient in diesel fuel is greatly influenced by a federal tax credit that reduces a fuel blender's tax liability by \$.01 per percentage point of biodiesel blended in a gallon of fuel, up to maximum of 20 percent. For certain sources of biodiesel, the federal tax credit provides a maximum benefit of \$1.00 per gallon of biodiesel used. This credit was recently adopted in federal law, PL 108-357.
- ^{vi} In the comparisons evaluated, incremental consumer costs (e.g., expenditures for vehicles, fuel, and maintenance) and benefits (e.g., fuel savings) and incremental environmental benefits (e.g., reduced fuel cycle emissions of criteria pollutants, GHG reductions, and avoided cost related to petroleum dependency) were used to calculate net benefits.
- ^{vii} California Energy Commission, *Reducing California's Petroleum Dependence*, August 2003, Pub. No. 600-03-005F. http://www.energy.ca.gov/fuels/petroleum_dependence/documents/index.html.
- ^{viii} Ibid.
- ^{ix} Belinda Chen, Dan Sperling, *CASE STUDY OF LIGHT-DUTY VEHICLES IN EUROPE*, UCD-ITS-RR-04-14, <http://www.its.ucdavis.edu/publications/2004/UCD-ITS-RR-04-14.pdf>; Light-duty diesel vehicle sales in Western European countries (Germany, France, Belgium, Netherlands, Luxembourg, Austria, Switzerland, Ireland, United Kingdom, Denmark, Norway, Sweden, Iceland, Greece, Italy, Portugal, and Spain) equaled 41 percent of all light-duty vehicle sales in 2002.
- ^x From the Option 1F paper in the Addenda, the 2025 gasoline displacement at the highest fuel price scenario is about 2.5 billion gallons and the net gasoline-diesel reduction is about 1.4 billion gallons gasoline equivalent. The base case gasoline demand for this scenario is about 15.328 billion gallons and the diesel demand is about 5.508 billion gallons gasoline equivalent (see endnote 2).
- ^{xi} Ibid.
- ^{xii} See Addenda, Option 1F.
- ^{xiii} American Jobs Creation Act of 2004, P.L. 108-357; ethanol tax credit of \$.51 per gallon through 2010; biodiesel tax credit of up to \$1.00 per gallon of virgin oil and up to \$.50 for non-virgin oil; <http://thomas.loc.gov/cgi-bin/bdquery/z?d108:HR04520:@@D&summ2=m&>.
- ^{xiv} California Environmental Protection Agency, California Hydrogen Highway, Blueprint Plan and Topic Team Reports, <http://www.hydrogenhighway.ca.gov/plan/plan.htm>.
- ^{xv} California Energy Commission, Contract Agreement 600-04-017, April 5, 2005.
- ^{xvi} California Energy Commission, Effect of Land Use Choices on Transportation Fuel Demand, May 2005, CEC 600-2005-010. The daily per household VMT in the base case was 41.7 miles and the preferred case produced 34.9 miles.
- ^{xvii} See Addenda, Option 3A.
- ^{xviii} California Energy Commission, *2003 Integrated Energy Policy Report*, December 2003, Pub. No. 100-03-019F http://www.energy.ca.gov/2003_energypolicy/index.html.
- ^{xix} California Energy Commission, Alternative Fuels Commercialization, May 2005, CEC 600-2005-020.