OPTION 2G
ETHANOL HI-CONTENT BLEND (E85)

Summary

This analysis examines the use of E-85 (a mixture of 85 percent ethanol and 15 percent gasoline) in flexible fuel vehicles (FFVs). Analyses of the Business-as-Usual (BAU) and Aggressive Scenarios lead to low and high petroleum displacement projections in the year 2025.

Under the BAU Scenario, FFV production ceases in 2009 and there is no significant use of E-85 for petroleum displacement through 2025. Under the Aggressive Scenario, production of FFVs continues and results in 1.0 to 1.2 billion gallons of petroleum displacement by 2025.

Background and Description

Unlike gasoline blended with ethanol, E-85 is not widely available at retail gasoline stations and fleet dispensing facilities in California.[1] One retail station exists in San Diego. Additionally, Lawrence Berkeley National Laboratory, Lawrence Livermore National Laboratory and Vandenberg Air Force Base dispense fuel to FFVs owned and operated by federal agencies. Nevertheless E-85 is a commercial fuel with growing use in other states, particularly those in the Midwest. Minnesota has the largest number of E-85 dispensing facilities, with 112 publicly accessible retail station sites, while the U.S. as a whole has 272 outlets in 28 states.[2] FFVs have been fully commercialized since 1993, with cumulative production of ethanol-compatible FFVs expected to exceed five million vehicles in 2005.

FFV Production and Cost

General Motors Corporation is offering six light truck and sport utility vehicle (SUV) FFV models in California for the first time in 2005. With anticipated sales of 45,000 General Motors vehicles in 2005, the population of FFVs in California is expected to exceed 300,000 by the end of the year.[3] The line-up of 2005 models includes 24 different sedans, station wagons, pickup trucks, minivans, and SUVs manufactured by General Motors, Ford, DaimlerChyrsler, and Nissan.[4] As in previous years, most new FFV models are priced the same as their gasoline counterparts, with a few exceptions. For 2005, the Dodge Stratus FFV costs $850 more than the gasoline version, while the Daimler Chrysler Ram pickup truck FFV is listed at $785 above the gasoline truck. The GM Sierra pickup is listed at $321 above the gasoline model. The remaining 21 FFVs are priced the same as their gasoline counterparts.

Effective October 1, 2004, the National Highway Traffic Safety Administration (NHTSA) finalized a rulemaking that extended the alternative fuel vehicle (AFV) manufacturing incentive created by the Federal Alternative Motor Fuels Act of 1988.[5] In extending the life of the incentive, NHTSA concluded the following:

" We have determined that extension of the CAFE incentive appropriately balances the Nation's need to continue to encourage investment in alternative fuel infrastructure and the risk that the Nation's alternative fuels system may never become self-sustaining. The recent proliferation of E85 refueling stations, the recent Congressional support for ethanol as an alternative fuel, and the recent expansion of public awareness and acceptance campaigns to encourage ethanol use all imply a continuing increase in E85 use and the ultimate success of the program created by Congress in AMFA, at least as far as ethanol-based fuels are concerned. The current status of the program does not support its abandonment by terminating the CAFE incentive that has sparked its development to date." [6]

FFV production trends are anticipated to continue through the 2008 model year, primarily as a result of the extension of this incentive.[7] For 2005 through 2008 models, manufacturers of FFVs and other "dual-fuel" vehicles, such as bi-fuel compressed natural gas (CNG) and propane vehicles, earn Corporate Average Fuel Economy (CAFE) credits, based on the non-petroleum content of the alternative fuel, not to exceed 0.9 miles per gallon.[8] The credit gives the manufacturer a higher CAFE value, for passenger car and light truck fleets, based on the number of AFVs manufactured as FFVs and dedicated vehicles. Dedicated AFVs (those capable of operating on only ethanol, methanol, natural gas, or propane) and electric vehicles are not subject to a CAFE credit cap. Dedicated vehicles have not, however, contributed any substantive CAFE credits to General Motors, DaimlerChrysler, and Ford Motor Company.[9] The AFV CAFE credits provide manufacturers with a CAFE compliance strategy that has a significant monetary value when large numbers of vehicles are produced.[10]

Without the FFV CAFE incentive for the 2009 model year and beyond, automakers may elect to cease production of FFVs when the $400 marginal value of the CAFE compliance credits is no longer available. For purposes of this analysis, staff assumed no FFV production for 2009 and beyond in the BAU Scenario Likewise, staff assumed that, in the Aggressive Scenario, several factors lead to increased production of FFVs in the United States. Production will grow from 1,000,000 vehicles in 2005 to 1,700,000 by 2025.

Meeting Future Emissions Requirements

The emissions certification process for FFVs is more complex than for gasoline only or dedicated AFVs, because FFVs must be certified on both gasoline and E-85. California's emissions standards and testing procedures are different from those at

the federal level and usually require manufacturers to meet more stringent standards and procedures.

All automakers producing FFVs have been able to achieve California Low Emission Vehicle (LEV) I or LEV 2 tailpipe and evaporative emissions standards. LEV II regulations became effective in 2004 and automakers have the flexibility to choose LEV 1 or LEV 2 regulations to emissions-certify their vehicles for several more years.[11] However, in the future, automakers will have to certify under the LEV 2 regulation and meet zero emission vehicle (ZEV) requirements through the certification of a mix of partial zero emission vehicles (PZEVs), advanced technology – partial zero emission vehicle (AT-PZEV) and a small fraction of ZEVs.[12]

According to automakers, achieving the PZEV standard in an FFV will be challenging.[13] Staff's review of literature from industry suppliers indicates promising available technology that may help automakers achieve PZEV evaporative emissions requirements. Of particular note is the availability of new materials and fabrication techniques that minimize permeation emissions.[14] In addition, developments in fuel systems materials to meet 15–year, 150,000 mile emissions durability requirements appear possible. These materials have undergone long-term exposure testing with a range of ethanol/gasoline, methanol/gasoline and other gasoline and fuel additives, including peroxides.[15]

Staff believes that automakers will weigh the costs of achieving emissions requirements in FFVs against the development costs associated with other alternative fuel and advanced technologies. Emissions, performance, reliability, customer satisfaction, and internal cost goals for various alternative fuel product offerings will be established. Over the years, incremental costs associated with FFVs have remained low relative to other options.[16] Staff believes that there is room for automakers to incur additional emissions control costs, if such costs are required to overcome the unique issues associated with emissions certification of FFVs on E-85 and gasoline under LEV 2 regulations.[17]

Ethanol Supply and Price Trends

Ethanol Supply

A combination of in-state production and imports from Midwest states and foreign sources could provide adequate supplies of ethanol for the combination of high level (E-10) ethanol blending in California gasoline and E-85 use in FFVs. Energy Commission and the California Air Resources Board (CARB) staff project that an adequate supply of ethanol could be made available from California, Midwest states, and foreign sources providing 4.6 billion gallons of ethanol in 2030.[18]

This supply would support about four million FFVs using an E-40 fuel (or half time use of E-85), while the rest of the fleet operated on E-10.[19] The analysis indicated

that California ethanol demand would be 20 percent or less of projected U.S. ethanol supply through 2030.[20] The analysis presented here envisions California ethanol demand at levels lower than those in the AB 2076 analysis. Under the Aggressive Scenario in this analysis, 1.0 to1.2 billion gallons of petroleum displacement is envisioned in 2025.

A Renewable Fuel Standard (RFS) introduced as part of new energy legislation by Congress in 2005, includes proposals for six to eight billion gallons of renewable fuel use by the year 2012. This is likely to foster a continuation of ethanol plant construction in the U.S. should the RFS become law.[21]

There appears to be excess supply of domestic ethanol in 2005 that is likely to carry into 2006, based on plants scheduled to come on line and new ethanol plant development projects.[22] Since it is anticipated that California will be the highest value market for ethanol for the foreseeable future, it will likely attract all the ethanol it needs for a combination of ethanol blending in gasoline and E-85 use in FFVs.[23]

Ethanol Price

Should the long-term trend of higher California gasoline prices (relative to other states) persist, as predicted under Energy Commission transportation fuel price scenarios for the Integrated Energy Policy Report, then California will remain the highest value market for ethanol whether it is blended into gasoline or used to formulate E-85 for use in FFVs, or used for blending with diesel.

Even under a nationwide Methyl Tertiary Butyl Ether (MTBE) ban scenario, and incentives for ethanol production and use in other states, California's ability to "bid away" ethanol supplies is likely because of the 15 to 35 cent higher retail cost of the state's gasoline relative to gasoline markets in other states.[24]

Cost of Blending E-85 in California in 2005

Given the lower cost of ethanol relative to the higher price of gasoline in California, an E-85 market could emerge based on these blending economics when compared to opportunities for higher level ethanol blending in gasoline.[25] With April 2005, ethanol spot prices in northern and southern California at around $1.25 per gallon, or $0.76 per gallon net (of federal tax incentive) basis, E-85 could be formulated by an ethanol blender at a cost of $0.93 per gallon.[26] On a gasoline gallon equivalent (gge) energy basis, this cost is $1.30 per gge or 60 cents lower than the current wholesale cost of gasoline.

With these wide price differentials favoring ethanol over reformulated gasoline and gasoline blending components, staff believes market conditions are right for establishing near-term E-85 dispensing facilities, in California. Important changes in

tax law will benefit blenders of E-85 as well in 2005 and allow collection of the full value of the federal ethanol blenders' incentive for the first time in 2005.[27]

E-85 Supply Infrastructure and Outlets

As described in the companion analysis titled "Ethanol Blend (E10)", California's petroleum infrastructure currently has all the storage and equipment needed to blend reformulated gasoline at terminals and transport it to retail stations and fleet clients. This infrastructure can provide E-10 blending as well as blending for an emerging E-85 market, but will require some expansion and capital investment not yet evaluated by staff.

What is lacking in California today is significant E-85 dispensing capability for retail and fleet fueling. Currently, four fleet entities and one retail facility have been granted research and development status by the CARB to install and operate an E-85 dispenser.[28] Significant expansion of E-85 fueling in California can only occur when one or more of these facilities receive CARB certification of a vapor recovery system under the Enhanced Vapor Recovery (EVR) program adopted by the CARB in 2000.[29] With manufacturers focused on retail gasoline outlet vapor recovery certification, required in over 9,000 retail gasoline stations, a special effort to certify one E-85 system will likely be required.[30] Vandenberg Air Force Base is pursuing certification as required by CARB, however, staff is not aware of the extent of certification activities being pursued by the four fleet operators that have been granted research and development status.[31]

Fostering E-85 Availability in California

Progress in establishing E-85 dispensing facilities at fleet and retail locations in California could commence once EVR-certified E-85 dispensers and associated vapor recovery equipment are available. With the current focus on upgrading gasoline dispensing facilities by 2010, several years will be required to establish E-85 fueling on any significant scale. Staff believes that 10 to 20 percent of retail gasoline locations would need to offer E-85 to foster large scale consumer acceptance of E-85. This would mean E-85 availability at between 900 and 1,800 retail locations. 2015 might be a reasonable target date for this number of E-85 locations.

Existence of successful business approaches to foster E-85 availability in the Midwest could serve to guide stakeholders in establishing E-85 availability at retail and fleet-fueling facilities in California.[32] Approaches employed in Minnesota illustrate the kind of progress that can be achieved with state incentives and major participation from stakeholders in planning and implementation Minnesota has achieved the greatest progress both in educating the public about E-85 and fostering E-85 availability for businesses, local jurisdictions and state agencies. Several of the

12 co-operatively owned Minnesota ethanol plants are blenders/wholesalers of E-85 and provide fuel to surrounding communities as well as to the larger Twin Cities metropolitan area.[33]

E-85 is accessible in Minnesota at 112 retail outlets with 12 additional sites in process to dispense E-85 this year.[34] Many stakeholders have contributed to the progress in establishing this network of E-85 stations.[35]

Key Assumptions

In this analysis, the key assumptions driving increased levels of E-85 use in FFVs for the BAU and Aggressive Scenarios include the following:

- The price of E-85 remains competitive with gasoline on a gge price basis through 2025 and the fuel substitution ratio (E-85 gallons to replace one gasoline gallon) in an FFV is 1.34.[36]

- The federal 51 cent per gallon incentive for blending of ethanol is extended and retained through 2025.[37]

- Increased production of ethanol in California and the Midwest meets new ethanol fuel market demand for high ethanol content blending.[38]

- Regulatory issues with regard to emissions in FFVs, including certification to PZEV standards and evaporative emissions concerns are resolved, possibly at some additional cost to automobile manufacturers.[39]

- The certification of one or more EVR systems for E-85 at service stations is achieved by 2006, making deployment of E-85 dispensing facilities possible in retail and fleet fueling operations.[40]

- Creation of a coalition of stakeholders to educate consumers and fleet owners about FFVs and E-85 fuel use, as well as establishing necessary procedures to create a E-85 network.[41]

- Growth in the FFV population under a BAU Scenario that continues through the 2008 model year, but ceases in 2009, as the “sunset” clause for dual-fuel vehicle CAFE credits takes effect. As a result, the FFV population gradually decreases through 2025 as FFVs are retired from the fleet of California vehicles.[42]

- Growth in the FFV population under an Aggressive Scenario that assumes production of FFVs through 2025 resulting from extension of CAFE credits for dual fuel vehicles, market forces, or other incentives.[43] FFVs represent 15 percent of new vehicle sales for the period 2013 through 2025.

- E-85 fuel utilization by FFV owners increases over a ten year period, beginning in 2005, then remains constant through 2025.

- Existing California petroleum infrastructure that can accommodate an increase in ethanol movement through the system (excluding the common carrier pipeline) and ethanol blending in California Blendstock of Oxygenate Blending (CARBOB) and E-85 for delivery by truck to outlets, without significant additional per gallon blending costs through 2025.

- Delivery of Midwest ethanol by rail and incremental supplies of foreign ethanol meeting most of California's ethanol demand.

- 200 to 400 million gallons per year of in-state ethanol by 2015.[44]

Results

Tables 1 and 2 summarize the Aggressive Scenario results for petroleum reduction and benefits of E-85 FFV use for a 5 percent and 12 percent discount rate, respectively.

Table 1. Petroleum Reduction and Benefits for E-85 FFVs at 5 Percent Discount Rate

Alternative Fuel Option	Displacement in 2025, billion gallon/yr gasoline equivalent	Reduction from Base Case Demand, percent	Highest Cumulative Benefit or Change, 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 Benefits
Low Fuel Price	1.2	5.7	0	(1.4)	0.2	0.6	(0.6)
Highest Fuel Price	1.0	4.7	0	(0.7)	0.6	0.6	0.5

Table 2. Petroleum Reduction and Benefits for E-85 FFVs at 12 Percent Discount Rate

Alternative Fuel Option	in 2025, billion gallon/yr gasoline equivalent	from Base Case Demand, percent	Highest Cumulative Benefit or Change, Present Value, 2005-2025, 12% 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 Benefits
Low Fuel Price	1.2	5.7	0	(0.5)	0.1	0.2	(0.3)
Highest Fuel Price	1.0	4.7	0	(0.3)	0.3	0.3	0.3

Results for the BAU Scenario are not included in the Costs and Benefits Analysis since FFV production is assumed to cease in 2009. Staff assumed that in this scenario, investments in making E-85 available for 600,000 FFVs would not be economically attractive to blenders and suppliers. In this situation, staff assumed that fuel use is limited to no more than five percent of the FFV fleet at a 50 percent utilization rate. This would imply an E-85 demand of about 14 million gallons per year and ethanol demand of 12 million gallons per year. This quantity of ethanol is just over one percent of California's 2004 ethanol demand.[45]

Under the Aggressive Scenario, petroleum reduction of 1.0 to1.2 billion gallons per year is achieved in 2025 due to the FFV population growth and increase in E-85 utilization rate. This range can be compared with the ethanol blending in gasoline option of 0.48 to 0.50 billion gallons petroleum displacement in 2025.

Key Drivers and Uncertainties

Several remaining issues and uncertainties could limit the growth of E-85 use and the FFV population in California in the 2005 to 2025 time period.

- Margins on E-85 under low gasoline prices and/or competition from higher value discretionary ethanol/gasoline blending markets in the U.S. could hamper the development of an E-85 market in California.

  Comment: Assuming a low gasoline price scenario at $1.80 per gallon, ethanol wholesale price in California would need to be $1.36 per gallon or 85 cents per gallon (net of fuel excise tax incentive) to compete with gasoline on an energy equivalent basis. In 2004, California spot railcar ethanol averaged about $1.64 per gallon or $1.12 net of tax incentive.[46]

- Loss of the federal subsidy for ethanol after 2010 could affect development of ethanol production and availability for E-85 use in FFVs.

  Comment: Commercial scale, low cost cellulosic ethanol will not be available for many years as the technology is just approaching the first phase of

commercial demonstration. Thus, corn-based or imported ethanol would be diverted to higher value gasoline blending markets after 2010.

- FFV product offerings could cease as CAFE credits expire at the end of the 2008 model year and PZEV emission requirements could move manufacturers to develop other advanced technology options to comply with California LEV 2 emission requirements.

- Without consumer education and an aggressive approach to establishing E-85 fueling facilities, little use of ethanol as E-85 relative to that for gasoline blending will occur before 2015.

  Comment: Numerous Minnesota stakeholders have achieved success in establishing an E-85 program and network of dispensing facilities for the state's 100,000 FFVs. California can likely apply approaches taken and lessons learned in Minnesota.

- The number of FFVs in California fleets, and a strategy to target those vehicles for E-85 fueling, has not been established.

  Comment: Such an undertaking might be the most expedient way to bring visibility to E-85 and establish sites for eventual acceptance and use by consumers.

- Lack of co-ordination among current E-85 site operators under ARB Research and Development status may impede the enhanced vapor recovery certification process of E-85 dispensing systems.

End Notes:

[1] Ethanol in the form of E-85 (85 percent ethanol and 15 percent gasoline) is designed for use in ethanol compatible flexible-fuel vehicles (E-FFVs). Unlike "dedicated" alternative fuel vehicles that are designed for the exclusive use of E-85, M-85, propane or natural gas, FFVs can operate on gasoline, alcohol, or any mixture of gasoline alcohol.

[2] See www.eere.energy.gov/afdc/infrastructure/station_counts.html E-85 station count adjusted for new Minnesota stations and current as of May 9, 2005. For a separate listing of existing and planned Minnesota E-85 stations see www.cleanairchoice.org/outdoor/E85InCounty.asp?City=City

[3] According to data in the California Department of Motor Vehicles Registration Database, about 234,000 FFVs were registered in California as of October 22, 2004. FFVs have been owned and operated by California consumers and fleet operators since 1989. About fifteen thousand methanol compatible FFVs (M-FFVs) were sold through the 1997 model year, primarily Ford Taurus and General Motors Lumina models. A shift to E-85 compatible FFVs (E-FFVs) occurred first in 1996 when Ford offered 3300 ethanol and 2000 methanol compatible FFVs (M-FFVs). Large commercial sales of FFVs began in 1998 with Chrysler Corporation's E-FFV "Caravan" (minivan). Over 147,000 FFV Caravans were manufactured in the 1998 model year. Ford Motor Company built and sold 190,000 E-FFVs Ranger pickups in 1999. General Motors followed suit in the 2000 model year with 98,000 E- FFV Chevy S-10 and GM Sonoma pickups. General Motors, Ford and DaimlerChrysler together produced 672,000 FFVs in 2000 and over one million FFVs in 2003. Over four million E-85 compatible FFVs are on U.S. highways in 2005. California's share of FFVs is lower than its market share of gasoline vehicles (12 percent) because most FFV models have been offered in other states before being offered in California consumers and fleet operators.

[4] The full listing of 2005 model year FFVs as well as prior model year offerings is available at www.E85Fuel.com

[5] See www.nhtsa.dot.gov/cars/rules/CAFE/Rulemaking/AMFAFinalRule2004.htm

[6] Ibid., Section IX, Conclusion.

[7] The Alternative Motor Fuels Act (AMFA) of 1988 created manufacturing incentives in the form of "CAFE credits" to encourage production of vehicles dedicated to or capable of operating on alternative fuels for reasons of national energy security and over dependence on foreign sources of petroleum. The Program became effective with the 1993 model year for methanol, ethanol, natural gas, and propane dedicated and "dual-fuel" vehicles, as well as electric vehicles. Dual-fuel vehicles, those capable of operating on gasoline and alternative fuel, include flexible fuel vehicles (FFVs) as well as bi-fuel natural gas and propane vehicles.

[8] Dual-fuel vehicles, those capable of operating on gasoline and alternative fuel, include fuel flexible vehicles (FFVs). Dual Fuel vehicles are limited to a CAFE credit "cap" of 1.2 miles per gallon through the 2004 model year, and a 0.9 miles per gallon cap for 2005 -2008 model years. Dedicated alternative fuel vehicles are subject to neither cap nor sunset clause in AMFA, thus, hypothetically, a manufacturer could produce only dedicated E-85 vehicles and achieve a CAFE rating for passenger cars under AMFA of 15 MPG/ (0.15) = 100 MPG (this number is roughly comparable to the EPA combined city/highway fuel economy for the 2005 Ford Explorer, Chevy Tahoe and GM Yukon when operating on E-85). For comparison, if a hypothetical fleet of ethanol FFVs were manufactured instead, half-time use of gasoline is assumed and for purposes of calculating the CAFE fuel economy. The resultant CAFE value is calculated as a harmonic average using the fuel economy values associated with 1) gasoline, and 2) E-85. While achieving 15 MPG with E-85 in combined city and highway driving as measured in the federal EPA cycles (Title 40-CFR), these same vehicles achieve 19.5 MPG when using gasoline. Thus, the hypothetical FFV fleet would be rated at 32.6 MPG, however, for purposes of compliance with CAFE regulations, the FFV fleet would revert to a CAFE

rating of 16.9 MPG after the 2008 model year, unless the credit cap was extended or restored in the 2009 model year by Congress.

[9] Large numbers of alternative fuel vehicles are required to generate significant CAFE credits. As of 2005, only FFVs have been produced in sufficient volume to generate credits approaching exceeding the CAFE credit "cap" of 1.2 MPG (2003 and earlier) 0.9 MPG (2004-2008). (See the National Highway Safety Traffic Administration [NHTSA] rulemaking document "Availability of Alternative Fuel Vehicles", 2000, www.nhtsa.dot.gov/cars/rules/rulings/CAFE/alternativefuels/availability1.htm)

[10] The marginal value of avoided CAFE fines calculated by Rubin and Leiby (1998) is about $600 for FFVs and around $1200 for dedicated alternative fuel vehicles. Since FFVs can be manufactured at an incremental cost to gasoline vehicles of around $200 to 400, a business case can be made for production volumes of FFVs up to the 0.9 MPG credit cap available through the 2008 model year.

[11] All General Motors 2005 FFVs achieve California ULEV emissions: http://www.gm.com/automotive/innovations/altfuel/emissions/ Ford Motor Company FFVs achieve California LEV and ULEV standards: https://www.fleet.ford.com/showroom/emissions_certificates/EmissionsReport.asp?VehicleType=All&ModelYear=2005&FuelType=Ethanol%20Flex%20Fuel&Model1=All&EngineSize=All

[12] PZEV is a partial-zero emission vehicle and is characterized by having very low or near "zero" evaporative emissions in addition to SULEV certified tailpipe emissions. An AT-PZEV is an advanced technology PZEV and is characterized by SULEV emissions and other features of a ZEV. http://www.arb.ca.gov/msprog/zevprog/factsheets/calemissions.pdf

[13] "E85 Alternative Fuel and Flexible Fuel Vehicles in California" Presentation by Gary Herwick and Phil Lampert, California Energy Commission Stakeholders Workshop, October 12, 2004.

[14] For example, blow molded plastic tanks can be constructed to greatly lengthen the path that permeation emissions would have to take to escape through the walls of a fuel tank: http://www.inergyautomotive.com/publi/inerg_contlib.php?maPage=26@maRub=3

[15] "Fuel Trends and Technology" Update Newsletter, Dupont Automotive and Dupont Dow Elastomers, Winter 2003.

[16] Personal communication with Gary Herwick (General Motors, retired) April 21, 2005.

[17] Staff believes that the marginal value of CAFE credits for FFVs ($600 – See footnote 10) provides manufacturers a cushion to engineer and implement the necessary technology for emissions control under LEV II standards. While the marginal value of CAFE credits can be $1000 and more for dedicated alternative fuel vehicles (AFVs), dedicated AFV volumes have not been large enough to contribute to CAFE compliance strategy, whereas FFVs (because of volume production) have.

[18] See "Attachment C - Ethanol Supply Demand Analysis", Appendix C Petroleum Reduction Options, Reducing California's Petroleum Dependence , CEC Report # 600-03-005, August 2003. www.energy.ca.gov/fuels/petroleum_dependence/documents/600-03-005A3_ATTACHMENT_C.PDF

[19] Ibid., page C-3

[20] Ibid., Table C-1, page C-2

[21] U.S. Senator Lugar of Indiana Press release, March 17, 2005: U.S. Sen. Dick Lugar and 18 other Senators introduced the Fuels Security Act of 2005 that included provisions that would more than double the production and use of domestic renewable fuels including ethanol, biodiesel, and fuels produced from cellulosic biomass. http://lugar.senate.gov/pressapp/record.cfm?id=233735

[22] There are 17 plants under construction in April 2005 and many more in the planning stages. See BBI International and the Renewable Fuels Organization (RFA) websites www.bbiethanol.com/ and http://www.ethanolrfa.org/. An indicator of excess supply can be seen in the voluntary (discretionary) ethanol blending market. In 2004, following California and east coast phase-out of MTBE, ethanol used for discretionary blending was about 1.05 billion gallons or 29 percent of all use. Projections for 2005 indicate mandated ethanol blending market volumes unchanged from 2004, however, new supplies will increase ethanol available for voluntary blending to about 1.5 billion gallons or 38 percent of all 2005 ethanol use. Information from RFA and VeraSun Energy.

[23] As of mid April 2005, California wholesale gasoline is at 30 cent premium to NYMEX futures. *Platts OPR Extra,* Monday, April 18, 2005, www.platts.com . California retail gasoline price trends in 2005 on average are 20 cents per gallon higher than the rest of the United States based on recent EIA/DOE gasoline price data, thus, at least in the short term, the California gasoline market will attract sellers of gasoline blending components and ethanol because of the likely higher gasoline margins in this market.

[24] Platt's OPR Extra; CaRFG differential to NYMEX gasoline in January 2004 - April 2005.

[25] The ARB Predictive Model for California Phase 3 reformulated gasoline currently limits increasing the oxygen content(ethanol content) in gasoline with the possible exception of limited blending at 7.7 volume percent ethanol by a few refiners. Staff believes that this practice is likely to be limited to a few refiners that can produce CARBOB for ethanol blending at 7.7 percent and distribution from their refinery rack only. The practice would require additional segregated storage as well. Supposing ten percent of CaRFG can be distributed and sold this way before 2010, new demand in shifting from 5.7 to 7.7 percent blending would amount to 20 million gallons per year, a 2 percent incremental demand above California's 900 million gallons of ethanol use in 2004.

[26] Assumes gasoline spot or rack price at $1.90 per gallon and the full value of the federal tax incentive (51 cents per gallon) applied to the ethanol portion of E-85.

[27] Prior to 2004, potential marketers of E-85 could not take full advantage of the blenders tax credit because of federal tax rules limiting the blenders ability to collect the tax credit when ethanol exceeds ten percent in gasoline. The imposed Income tax refund mechanism effectively limited the value of the tax credit to between 60 and 80 percent of what a blender could receive through direct blending of ethanol into gasoline at 10 volume percent or less. With the passage of the Volumetric Ethanol Excise Tax Credit (VEETC) in the American Jobs Creation Act of 2004 (H.R. 4520), the full value of the excise tax credit will apply equally to all ethanol blending levels up to 85 percent ethanol. The Act also extended the ethanol tax incentive to December 31, 2010 at 51 cents per gallon and extended eligibility for the small producers tax credit to co-operatively owned ethanol plants. http://www.e85fuel.com/front_page/veetc/veetc_implementation121404.pdf

[28] The four fleets involve three federal operations and one municipal utility (Sacramento Municipal Utility District) fleet in Sacramento. Vandenberg Air Force Base, Lawrence Berkeley National Laboratory, and Lawrence Livermore National Laboratory have all installed above ground E-85 storage tanks for fleet vehicle use only. One publicly accessible E-85 dispenser can be found at the San Diego Regional Transit Center.

[29] The Air Resource Board Enhanced Vapor Recovery (EVR) Program requires significant upgrades to all gasoline vapor recovery components and systems at all gasoline service stations in California over a ten year period that began in 2000. The regulatory program is staged in seven specific elements culminating with the installation of In -Station Diagnostics no later than June 2010. E-85 fuel meets the definition of "gasoline" for purposes of the EVR regulation and thus E-85 dispensing systems are subject to requirements applicable to gasoline.

[30] Personal communication with Mr. Rodriquez of Emco Wheaton, October 12, 2205. Mr. Rodriquez indicated that because of the complexity and time required (180 days minimum) to satisfy regulatory requirements for certification of a system, few manufacturers if any could commit time to certifying an E-85 system. Gasoline vapor recovery systems certification activities are currently top priority for the industry. Staff concludes that that certification process for an E-85 system may require one year or longer to complete, once industry participants/stakeholders are committed to the process.

[31] Personal Communication between Mike McCormack (CEC) and Jose Guerrero (ARB), Enhanced Vapor Recovery Program staff on October 15, 2004.

[32] As an example, VeraSun Energy has partnered with Get-N-Go station to make E-85 available in Sioux City, South Dakota. VeraSun, owner/operator of the largest U.S. dry mill ethanol plant located in Aurora, South Dakota has introduced an E-85 fuel named "VE85" through the Get-N-Go station chain. By May 5, 2005, 35 stations had been converted to dispense the fuel, and six stations offered the fuel to consumers that day. See www.verasun.com press release dated May 6, 2005. Holiday Stationstores, CENEX, Ashland Marathon, ConocoPhillips, and others have applied successful approaches in establishing E-85 dispensing capability in Minnesota and other Midwest states as well.

[33] See Chippewa Valley Ethanol Company LLC. website: www.cvec.com, May 2005 Newsletter.

[34] http://www.cleanairchoice.org/outdoor/E85Fuel.asp and http://www.cleanairchoice.org/outdoor/ E-85 is largely distributed in the Midwest by multi-state convenience store operators, and several major refiners through branded stations. For example, CENEX and franchisees operate 34 stations and Holiday Stationstores has 21 outlets offering E-85 in Minnesota and adjoining states.

[35] Stakeholders include the American Lung Association of Minnesota, the Twin Cities Clean Cities Coalition, U.S. DOE Clean Cities, the National Ethanol Vehicle Coalition, five Minnesota state agencies, Minnesota Corn Growers Association, Ford, DaimlerChrysler, General Motors, four cities including St. Paul and Minneapolis, and additional entities.

[36] The fuel substitution ratio of 1.34 represents the gasoline to E-85 fuel economy ratio of all 2005 new FFVs as derived from EPA 2005 model year certification data. The number also happens to be very close to the volumetric energy content ratio of gasoline to E-85.

[37] If cellulosic ethanol is aggressively pursued, ethanol production costs could be lowered dramatically once the technology matures. The federal tax incentive should decrease over time in this scenario, thus restoring revenue to the U.S. Treasury currently forgiven as a means to support ethanol production in the U.S.

[38] It is assumed that California gasoline prices remain higher than those in the rest of the U.S. through 2025. Thus, California remains the highest value market for petroleum and gasoline blending components including ethanol, and competing alternative fuels such as E-85. It is further assumed that even with occasional spikes in spot ethanol prices, California will always attract adequate supplies of ethanol even if many other states elect to incentivize ethanol (e.g. reduction of fuel excise taxes). Staff assumes that California gasoline price differential relative to the Gulf and East Coasts in general, will be higher than the "bid away" price of ethanol from these other states.

[39] Because FFVs are commercial today, competition and antitrust considerations make it difficult to ascertain exact plans of the automakers regarding upcoming new FFV products, engineering strategies and associated costs to achieve compliance with California new car emissions requirements.

[40] In discussions with CARB staff, Commission staff concludes that enhanced vapor recovery certification of E-85 dispensing systems is possible, and that one or more stakeholders will take the initiative to certify one or more systems in 2005 or 2006.

[41] This could be an expansion of California's current ethanol working group providing stakeholder input for the 2005 Integrated Energy Policy report proceeding.

[42] Production of FFVs is likely to occur after 2009 even if CAFE credits fail to be retained in the longer term because of the broad support for FFV technology and ethanol based fuels in Midwest states. Staff has not attempted to estimate the impact that other states might have on future FFV production by General Motors, Ford, DaimlerChrysler, Nissan and other manufacturers of FFVs.

[43] A more aggressive approach involving the use of tax incentives, such as that employed in Brazil to incentivize FFV production over standard Brazilian "gasohol" vehicles, could double or quadruple this number. See Szwarc, (2005) "Flex Fuel Vehicles in Brazil", power point presentation, Arlington, Virginia. February.

[44] Alfalfa and sugar beet growers in the Imperial Valley have been pursuing the development of a sugar cane to ethanol industry for about four years and could provide significant ethanol supplies. Project proponents have estimated ethanol volumes in excess of 400 million gallons from Imperial Valley alone. Not included in this estimate is cellulosic based ethanol that could be produced from California's vast biomass and municipal waste resources.

[45] If a very aggressive E-85 consumer education program was instituted and half of FFV owners purchased E-85 fifty percent of the time (assuming an unknown but adequate number of convenient E-85 outlets), then E-85 demand would jump to 140 million gallons per year with corresponding ethanol demand of 120 million gallons, or 13 percent of California's 2004 ethanol demand for gasoline blending. Beyond 2008, E-85 use would gradually decline as older FFVs were retired from the fleet.

[46] On the other hand, $1.36 per gallon with an allowance of 15 cents for transportation indicates a Midwest ethanol plant gate price of $1.21 per gallon. Thus, even under the low gasoline price scenario lasting 10 years in the price range of $1.75 to $1.80, a new 40 million gallon per year dry mill in the Midwest) stands to be profitable. If gasoline prices followed the high ($2.10 per gallon) or very high price scenario ($2.20 per gallon and higher), ethanol producer profitability approaches historical highs.