Chapter 4

ALTERNATIVE TRANSPORTATION FUELS IN CALIFORNIA

INTRODUCTION

The introduction of alternative fuels into California's transportation market has been gradual because these fuels compete with gasoline and diesel, fuels which have been in plentiful supply at low prices. But, with an uncertain long-term future for oil supplies and prices, alternative fuels may have a more substantial and important role. As discussed in Chapter 1, a future of higher world crude oil demand and prices could occur, depending on demand growth in developing nations and future world oil production levels. In light of this possibility, conserving and diversifying energy resources remains an appropriate objective. Developing and commercializing alternative fuels is one potential means for diversifying an energy resource base for the transportation sector. Largely as a result of environmental regulations and recent energy legislation, and in spite of difficult existing market conditions, there is a potential for the entrance of an estimated one million alternative fuel vehicles (AFVs) into the California market in the next 10 years.

The appropriate role for government is to maintain the viability of alternative fuels as long-term options while allowing market forces to determine the appropriate mix of fuels for transportation use. There has been a great deal of progress in developing vehicle technology, refueling infrastructure and consumer acceptance of alternative fuels since the oil embargoes of the 1970s. In the interest of maintaining maximum flexibility to respond to changing world oil markets, the state should sustain this progress by identifying and mitigating barriers to the use of alternative fuels. This preparation will reduce the lead time necessary to respond to volatile world oil prices with rapid shifts in market shares of alternative fuel use.

This chapter discusses four major factors which affect the marketing of alternative fuels: the availability of AFVs, the cost of owning and operating AFVs, the supply of alternative fuel (primarily the number and location of fueling sites), and the price competition between alternative fuels and conventional fuels. First, there are few AFV models being offered by manufacturers. Second, those vehicles that are available can carry a high incremental price over comparable gasoline fueled vehicles. Third, most alternative fuels are available only at a small number of refueling locations. Fourth, the cost of using alternative fuels, including fuel price and operating costs, may be higher for several applications when compared to conventional fuels. Consequently, because of these four factors, demand for alternatives by consumers may be slow to materialize.

AVAILABILITY OF ALTERNATIVE FUEL VEHICLES

As a requirement of Assembly Bill 234 (Chapter 1326, Statutes of 1987), the Energy Commission regularly updates information on the availability and price of alternative transportation fuels and vehicles.

Table 4-1
CURRENT AND PROJECTED NUMBER OF AFVs IN CALIFORNIA*
(Thousands of Light Duty Vehicles)

Fuel Type	1994	2005	2015
Gasoline	21,723	24,740 - 24,754	26,797 - 26,823
Propane	40	45	51
M85	11	159 - 174	262 - 294
CNG	6	235	452
Electric	0.6**	594***	1,709***
Total AFVs	57.6	1,033 - 1,048	2,474 - 2,506

*Ranges are estimated using high and low M85 price projections. With lower M85 prices, the number of M85 vehicles may increase. At the same time, numbers of conventional vehicles and, to a lesser extent, other AFVs may decline. M85 is 85 percent methanol and 15 percent gasoline.

This number was obtained from the ***Electric Vehicle Association of the Americas Brief, Electric Vehicle Population of the United States*, March 1995. Previous estimates from Department of Motor Vehicle (DMV) data of EV use (1,200 EVs) in California appeared in the ***Calfuels Plan Report***, September 1994. These numbers are not comparable because of apparent data discrepancies with the classes of EVs in the DMV database and inclusion of non-highway EVS (i.e., golf carts and forklifts).

***Assumes full implementation of ARB's zero emission vehicle mandate.

Results of this analysis show that progress with introducing AFVs in California's transportation energy market continues at a gradual pace, limited by a variety of market and regulatory uncertainties. In 1994, approximately 40,000 propane vehicles, 11,000 M85 flexible fuel vehicles (FFVs), 6,000 compressed natural gas (CNG) vehicles and 600 electric vehicles (EVs) were in use in the state. Collectively these AFVs amount to only a small fraction of California's total light duty motor vehicle stock of almost 22 million. However, Energy Commission staff's preliminary base case projections, developed in response to Senate Bill 1214 (Chapter 900, Statutes of 1991), indicate that within the next 10 years the number of AFVs operating in the state could potentially reach over one million (see Table 4-1).

The current forecast is much lower than previous staff forecasts which indicated 5.8 million AFVs by 2005. The current forecast reflects revisions to the assumptions in the base case due to changes that have occurred over the past two years: the price for methanol staying higher than gasoline, reduced numbers of refueling stations for alternative fuels, and fewer choices of AFV makes and models. In addition, the current base case forecast assumes for the 20-year planning horizon that staff "most likely" fuel prices, all currently planned and adopted rules and regulations, and current vehicle manufacturers' plans will be in effect.

Three factors will help determine whether the staff's current projections are realized: government regulations supporting the introduction of AFVs, the number of models being introduced by major auto manufacturers, and the application of alternative fuels in heavy duty vehicles.

Government Regulations

Significant market inroads for AFVs appear forth-coming in response to federal and state energy and air quality initiatives. The most significant of these are the National Energy Policy Act of 1992 (EPACT) and California's low-emission vehicle regulations.

EPACT: EPACT requires federal and state government fleets, energy supplier fleets, and potentially most other public and private fleets to acquire increasing percentages of AFVs as part of their total fleet composition. EPACT requires that AFVs constitute at least 75 percent of federal and state fleet purchases and 90 percent of fuel-provider fleet purchases of light duty vehicles by 2000.

California's Low-Emission Vehicle Regulations: California's low-emission vehicle regulations require auto makers to sell increasing numbers of vehicles with much lower emissions, including a sales fraction of zero emission vehicles (ZEVs). All auto manufacturers must comply with rules regarding transitional, low and ultra-low emission vehicles. The original regulations mandate that 2 percent of each of the largest manufacturer's light duty sales in California must be ZEVs by 1998, increasing to 10 percent by 2003. Smaller manufacturers are exempt from the ZEV rules and intermediate manufacturers have more time to comply. Based on this mandate, Energy Commission staff analysis indicates that the number of light duty ZEVs sold in California in 2003 may be approximately 132,000. The ZEV mandate is the major focus of the auto industry as it continues to work with California to clarify the types of vehicles which qualify for credit toward the ZEV requirement. For example, CARB staff is currently determining the feasibility of allowing manufacturers of technologies that can achieve extremely low tailpipe emissions, such as hybrid electric vehicles, to receive at least partial ZEV credit.

As a result of ongoing workshops sponsored by the California Air Resources Board (CARB), a number of amendments to the original ZEV mandate are under consideration. Although the recently proposed changes to the regulation still require that 10 percent of all vehicles offered for sale in 2003 meet the zero emission standard, the gradual phase-in (2 percent in 1998 and 5 percent by 2001) has been proposed to be modified to allow a market-driven approach that will actually result in the introduction of ZEVs as early as 1996.

Phase II Auto/Oil Study

The Auto/Oil Air Quality Improvement Research Program was established in 1989 by 14 oil companies and three domestic automakers to develop data and understanding of the influence of fuel properties on the emissions characteristics of automobiles and resulting ozone impacts in selected smog impacted urban areas in the United States. The objective of the research effort is to assist legislators and regulators to meet the nation's clean air goals. This is a large, formal program with a planned time horizon of about six years and a budget close to 40 million dollars.

The program is comprised of two phases. The main conclusion of Phase I, derived from nearly four years of testing which concluded in 1993, was "...changing fuel composition variables can alter exhaust mass emissions and help reduce ozone formation in urban areas." The data generated under the program has helped CARB establish gasoline specifications for its CARB Phase 2 reformulated gasoline (RFG) program and reactivity adjustment factors under its Low Emission Vehicle and Clean Fuels Program.

Phase II of the program expanded on Phase I efforts by exploring additional fuel property influences such as effects of very low sulfur. Phase II expanded the alternative fuel test efforts to include M85 in production FFVs, methanol in dedicated vehicles, ethanol (E85 fuel) in FFVs, and liquefied petroleum gas (LPG) and compressed natural gas (CNG) in dedicated vehicles. A major element of this phase is testing of CARB Phase 2 RFG in both old and new gasoline car fleets. While testing under this phase of the program is nearly complete, final technical and ozone modeling reports have not yet been issued. All these reports should be available by the end of 1995.

With regard to reformulated gasoline energy content, Auto/Oil testing has shown that CARB Phase 2 RFG will cause a fuel economy penalty on the order of 3 percent to 4 percent when compared to conventional gasoline without oxygenates. This implies a numerically similar increase in California gasoline demand absent other factors which may alter consumers' driving habits in 1996 when CARB Phase 2 RFG will be sold throughout the state. The gasoline in use during 1995, however, is a combination of conventional, winter oxygenated and EPA RFG. Therefore, the energy penalty compared to this combination of gasolines is expected to be less than the 3 percent to 4 percent range.

Testing has also conclusively shown that these flexible fuel vehicles will attain the energy equivalent fuel economy of conventional gasoline vehicles while operating on M85 fuel. This is 6 percent to 7 percent higher than results obtained on either industry average (current) or CARB Phase 2 RFG. Energy Commission staff analysis of the Auto/Oil data shows that CARB Phase 2 RFG in FFVs will achieve ozone benefits close to those of M85 fuel, but M85 fuel will achieve emission levels of cancer-causing pollutants 50 percent lower than CARB Phase 2 RFG.

Table 4-2
AFV MODELS AVAILABLE IN CALIFORNIA*
(1995 Model Year)

TYPE	FUEL	MANUFACTURER	MODEL	INCREMENTAL PRICE
Light Duty	M85	Ford	Taurus	$560
		Chrysler	Dodge Intrepid	$150
	CNG	Chrysler	Dodge Caravan Plymouth Voyager Dodge Ram Pickup Dodge Ram Van/Wagon Dodge Dakota Pickup	$4,500
Medium and Heavy Duty**	Methanol	DDC/TMC	Transit Bus	$40,000
		DDC/Carpenter	School Bus	$20,000
	CNG	Cummins/BIA	Transit Bus	$80,000
		DDC/Various	Buses and Trucks	$40,000
		Blue Bird/John Deere	School Bus	$12,600
		Hercules	Medium Duty Truck	Not Available
		Crane Carrier/Cummins	Refuse Truck	$49,000
	Propane	Ford	F600 & F700 Trucks	$1,000
		Caterpillar	Truck	$40,000

*This table does not include after market conversions or test vehicles.
**Except for the Ford propane truck, these incremental prices for various heavy duty AFVs can vary on a case-by-case basis due to bid specifications, number of vehicles in bid, etc.

Alternative Fuel Vehicle Models

The availability of alternative fuel models in the California new vehicle marketplace continues to be limited to a small selection of models offered by several United States manufacturers (see Table 4-2).[1] Only a few additional AFV models from these domestic manufacturers (and none from foreign manufacturers) are scheduled for upcoming model years. Conversions of some types of conventional vehicles to AFVs (typically propane or CNG) by a number of California companies offering conversion services has been an option in the past. However, new air quality regulations for such conversions impose new costs and technical requirements that may limit future AFV conversions. Thus, the narrow range of available, affordable AFV options will likely remain a major near-term obstacle to fleet operators or others seeking to employ alternative motor fuels.

Continuing progress in reducing new gasoline vehicle emissions is having an important effect on auto industry development and marketing of AFVs. The use of cleaner-burning alternative fuels such as M85 and CNG is not receiving as much emphasis in light-duty vehicle emission-reducing strategies as previously expected. The combination of gasoline reformulation and advances in automotive emission control technology appears to be making the exhaust emission levels required by California's low-emission vehicle standards achievable without relying on the use of alternative fuels.

For example, for the 1995 model year, 12 different domestic and foreign auto makers have a total of 23 gasoline light-duty vehicle models certified as meeting the state's "Transitional Low-Emission Vehicle" standard. Testing of several advanced pre-production vehicle models is also demonstrating the ability to comply with the more stringent "Low-Emission Vehicle" and "Ultra-Low Emission Vehicle" standards using CARB Phase 2 reformulated gasoline.

One promising new approach that may improve the picture for near-term AFV model availability is a practice being instituted by Ford Motor Company referred to as their "Qualified Vehicle Modifier" program. Ford is working with selected aftermarket conversion companies to offer certain AFV models, converted by the QVM, with full corporate involvement and support. This may help bridge the gap between assembly-line produced AFVs and traditional AFV conversions by allowing customers to purchase a "new converted" AFV that has the benefit of the auto maker's technical, sales, service and warranty support. Ford will introduce the QVM option in California in the 1996 model year with three natural gas models and one electric model. Initial regulatory and marketplace results of Ford's QVM venture are likely to determine the extent of further auto industry interest in this approach.

Other than Ford's QVM plans, auto maker announcements of new AFV model availability in California have not been forthcoming. General Motors, which previously offered both M85 and CNG models, has yet to formally re-establish its AFV production plans. Chrysler will also discontinue its M85 vehicle model offering in 1996, but will maintain availability of its current CNG models.

Heavy-Duty Vehicles

Heavy-duty engine and vehicle manufacturers may be facing a more difficult emission control challenge with diesel-fueled engines, and are therefore devoting more development effort to alternative fuel options. Besides the currently available heavy-duty AFV models, additional alternative fuel heavy-duty engines are under development by Caterpillar (methanol, CNG, LNG and propane), Ford (methanol and CNG), Mack (CNG and LNG), Navistar (methanol), Cummins (methanol, CNG and LNG) and John Deere (CNG).

AFV COSTS

Prospective AFV owners in California, primarily fleet operators seeking options for compliance with the requirements of EPACT, do not yet have a wide array of new vehicle market choices. Considerable incremental prices continue to be charged for most of the AFV models, while most incentives that have been available to help offset these extra purchase costs are expiring. Converting gasoline vehicles to alternative fuel (CNG or propane) use may still be a feasible option for some fleets, although the cost of such conversions may exceed that of new AFV models because of emission certification requirements.

Expected fuel cost savings from using some alternative fuels should at least partially offset additional AFV purchase costs, but full cost recovery appears achievable only in cases of extremely high vehicle operating mileage. Clearly, in the absence of stronger regulation or other incentives, a more complete range of AFV models combined with lower incremental purchase prices and/or lower fueling costs will be needed for alternative fuels to be more widely used in the fleet sector and ultimately by the public.

M85: M85 FFVs have been a primary option for EPACT compliance by federal government fleets, the first to face the AFV acquisition requirements of the Act. Further reliance on this option for fleet compliance will be more difficult since the Ford Taurus is the only remaining FFV model available, and the incremental price of this model is scheduled to increase to $1,200 for the 1996 model year. With M85 currently priced higher than gasoline (on an energy-equivalent basis), owning and operating this vehicle would cost a fleet operator between 10 and 15 percent more than the gasoline model, or about three cents more per mile on average. Of course, the operator can avoid the additional operating cost by electing to refuel FFVs with gasoline.

CNG: CNG vehicles have also been acquired in increasing numbers recently by the federal government and other fleet operators. The prevailing incremental prices of CNG models (e.g., $4,500 for Chrysler's models) dominates the economics of owning and operating these vehicles. Even with natural gas priced below gasoline, less than one-half of the incremental purchase cost would be paid back in fuel savings over 100,000 miles of operating a typical vehicle (assuming a fuel economy equivalent to 20 mpg). If the price advantage of natural gas diminishes as forecasted, overall CNG vehicle economics will look even less attractive, unless the incremental vehicle purchase prices are reduced substantially. The high cost of CNG refueling installations poses a further economic obstacle to the use of CNG by fleets that cannot rely on the commercial network of fueling stations.

Propane: Propane vehicles continue to be used by some fleets, although the lack of new vehicle availability and questions over the continued viability of vehicle conversions clouds the future of propane as an EPACT compliance option. In the past, fleet operators who could obtain conversions at reasonable cost (or even perform their own in-house conversions), and who could obtain propane fuel supplies at one-fourth to one-third less than gasoline, realized a payback on their vehicle conversion investment within five years or less. A number of fleet operators elected to use propane based strictly on their own economic decisions, apart from any EPACT or other regulatory influence. The forecast shows a continued price advantage for propane over gasoline indicating that this alternative fuel option will continue to be selected by some fleets if vehicle availability is adequate.

Electricity: Although certain electric vehicles such as the General Motors Impact, Ford Ecostar, Honda Civic, Chrysler TE Van and others are currently being demonstrated, production run prices remain uncertain. Due to recent modifications to the ZEV regulations, some automobile manufacturers will actually be making their initial offering of ZEV models as early as 1996.

A number of smaller companies offer converted EVs, some of which are being operated in the state, primarily in electric utility company fleets. Prices of these converted vehicles, however, are not reliable indicators of future prices of auto industry-produced EVs. Thus, while forecasted electricity prices show an expected energy operating cost savings over gasoline -- over a 50 percent savings in utility service areas with the lowest rates -- determining the overall comparative costs of EV ownership and operation requires actual EV sales prices.

AVAILABILITY OF ALTERNATIVE FUELS

Fuel supply is not expected to be a major constraint to the near-term growth of motor fuel markets for any of the major alternative fuels. Availability at an adequate network of refueling sites to allow unrestricted AFV travel in the state is, however, likely to remain a constraint.

M85: M85 is now available at 55 public refueling stations in California, concentrated in urban regions where fleets with M85 vehicles are headquartered. Prospects for substantially expanding this limited M85 fuel station network remain uncertain. However, a "fuel station trigger" contained in state air quality regulations could require gasoline suppliers to make M85 available at more locations in the South Coast Air Basin, and other areas that "opt in" to the program, once cumulative sales of certified low-emission M85 vehicles in California reach the 20,000 level. Individual fleet operators with M85 vehicles may find it advantageous to install their own on-site M85 fueling facilities. A number of these installations are already in place. The flexible fuel M85 vehicles currently produced are also capable of using gasoline and thus are not dependent on M85 refueling stations.

CNG: California natural gas utilities are expanding the state network of CNG vehicle refueling stations. By the end of 1995, about 100 public access stations and 75 additional fleet installations are expected to be in operation. Further expansion of the CNG refueling network is contingent, in part, on the California Public Utilities Commission authorizing utility funding for this type of investment. Most CNG vehicles placed in service are dedicated (CNG only) vehicles, and are therefore dependent on adequate access to refueling stations.

Propane: Propane is reportedly available for vehicle refueling at more than 1,000 locations in California, making it the most widely-available alternative to gasoline and diesel fuel. It is unknown how many of these locations are equipped to refuel a significant number of motor vehicles and, most importantly, how many offer competitive motor fuel prices. Fleets with propane vehicles typically have motor fuel arrangements with propane suppliers for on-site refueling installations and/or access to designated supplier-operated stations.

Electricity: Electricity for EV charging can be made available anywhere there is electric service, a suitable charger (sometimes incorporated in the vehicle) and adaptable plug-in. However, special provisions are necessary to obtain electricity priced for EV charging at rates considerably lower than standard electric rates. As of June 1995, there were approximately 34 public access EV charging stations (166 outlets) and 79 private stations (194 outlets) located throughout the state.[2] While some utilities are installing a limited number of public EV charging facilities, most charging is expected to be accomplished during "off-peak" (late night, early morning) hours at the vehicle's base location. This typically requires installing proper wiring circuitry, separate meter and a charger, if the latter is not part of the vehicle equipment.

TRANSPORTATION FUEL PRICE PROJECTIONS

Table 4-3 shows Energy Commission staff estimates of retail (delivered, fully taxed) fuel prices for the years 1994, 2005 and 2015. Once the introduction of reformulated gasoline is complete, the long-term prices of petroleum-based transportation fuels should be relatively stable over the next 20 years. As shown in the table, petroleum prices are projected for two oil and natural gas price scenarios, termed the "base case" and "low case." While the fuels price forecasts do not specify a high fuel price scenario, the Energy Commission recognizes higher prices as a possible outcome that would dampen transportation demand accordingly. For the base case, crude oil prices are projected to grow at about 2 percent per year in real dollars. For the low case, crude oil prices remain level in real terms for about 10 years, then rise about 1 percent per year for the next 10.

This translates into petroleum product prices that are relatively level for the base case and declining in the low case (after the period of introducing reformulated fuels), assuming that excise tax levels remain fixed.

Assuming that fuel taxes remain at present levels, the staff fuel price forecasts project little change in the current price relationships between most alternative fuels and petroleum fuels. This would make it difficult for alternative fuels to improve their marketplace competitiveness. Following is a brief summary of the forecasted fuel price trends for the major alternative fuels compared with petroleum fuels. A more detailed fuel price forecast discussion is provided in a staff report entitled ***1995 Transportation Fuel Price Analysis*** .

CNG: CNG prices for the two cases were based on projections of core commercial gas rates consistent with oil prices for each case, plus a margin to reflect the costs of refueling station equipment, the cost of compression, and state and federal taxes. This cost-based calculation was assumed to represent prices as they will be when California makes the transition from current subsidized rates to a competitive regime, around the year 2000. In the period prior to 2000, prices are expected to rise. Once the transition is complete, real CNG prices are projected to decline in both the base and low cases. Without an increase in its taxation, CNG would still be less costly than gasoline in the 2000 to 2005 time period, but lose any price advantage over diesel.

M85: Due to the extreme volatility of the methanol market experienced in the last two years, staff projected a range of M85 prices for both the base and low cases. In each case, this is represented by a band ranging from about 10 cents (real) per gasoline equivalent gallon lower than reformulated gasoline to about 30 cents higher for the long term. In the short to mid-term, M85 is expected to be somewhat higher priced than gasoline for both cases, until the market for methanol stabilizes. From its 1994 retail price position of about 43 percent more costly than gasoline, M85 is projected to be between 8 percent less costly and 26 percent more costly than gasoline in California by the year 2005.

Propane: Propane is expected to maintain its slight historical price advantage over gasoline, at least for customers (e.g., fleets) able to take advantage of competitive motor fuel supply pricing (vs. small-volume pricing to recreational vehicle and other markets). However, propane appears unlikely to become much less costly than diesel.

Table 4-3
COMPARATIVE FUEL PRICES*
(1993 $/Gasoline Equivalent Gallon)[3]

FUEL	BASE CASE 1994	BASE CASE 2005	BASE CASE 2015	LOW CASE 1994	LOW CASE 2005	LOW CASE 2015
RFG	1.15	1.42	1.45	1.15	1.32	1.28
CNG	0.80	1.17	1.16	0.80	1.08	1.02
M85	1.64	1.33 - 1.77	1.37 - 1.83	1.64	1.22 - 1.66	1.20 - 1.66
Diesel	1.19	1.18	1.20	1.19	1.08	1.04
Propane	0.97	1.15	1.15	0.97	1.08	1.04
Electricity** (cents/kwh)	4.7 - 10.4	4.9 - 10.6	5.0 - 10.9	4.7 - 10.4	4.9 - 10.6	5.0 - 10.9

*For purposes of this table, staff assumed that RFG (in 2005 and 2015) and all alternative fuels achieve equal vehicle fuel economy when compared to conventional gasoline (RFG in 1994) on an energy consumption basis. Caution should be exercised in using these prices to compare gasoline with AFV per mile fuel costs. Actual engine thermal efficiencies (and therefore energy consumption, fuel economy and fuel cost per mile) may be higher or lower than comparable gasoline vehicles depending on the maturity of the AFV technology.

**Electricity fuel prices cannot be put in terms of gasoline equivalent gallons. Although electricity fuel prices appear to be orders of magnitude higher than the price of other fuels, the high fuel efficiency of EVs makes actual fuel costs comparable to or lower than other fuels.

Table 4-4
TAXES APPLIED TO SALES OF
HIGHWAY MOTOR FUELS IN CALIFORNIA
(Dollars as of mid-1995)

FUEL	Federal Excise Tax*	State Excise Tax*	State/Local Sales (Average Percent)
M85	0.1140	0.09	7.9
CNG**	0.0485	0.07	none
Propane/LNG**	0.183	0.06	7.9
Electricity***	--	--	--
Gasoline	0.184	0.18	7.9
Diesel	0.244	0.18	7.9

*All charges are per gallon except CNG which is charged per therm.
**In lieu of annual per vehicle "tax stamp" purchase.
***The Energy Commission recognizes that as alternative fuels become commercialized, the tax issue could have an impact on the Highway Fund.

Electricity: Because of regulatory uncertainties, only one electricity price for EVs was developed. This is based on the municipal utilities' EV rates and the investor-owned utilities' proposed EV rates before the California Public Utilities Commission Low Emission Vehicle proceedings. Electricity prices were based on the proposed rates, the utilities' assumed vehicle recharging profiles for their various on- and off-peak rates, and the utilities' service charges for time of use meters. These prices varied between utilities, ranging from 5 to 10 cents per kwh, primarily due to differences in their assumed recharging profiles. Assumed growth rates of these electricity prices were obtained for specific utilities from the Energy Commission's ***1994 Electricity Report***. By and large, these growth rates are nearly flat in real terms over the next 20 years.

Electricity rates for EV charging are expected to remain relatively stable during the next 10 years. Assuming that no taxes are applied, electricity for EVs will continue to be less than half as costly as gasoline in some utility company service areas and only slightly less costly than gasoline in other areas. However, the major EV costs are likely to be associated with initial and replacement battery costs.

Taxes

As shown in Table 4-4, taxation plays an important part in the comparative retail prices of fuels, with M85 and propane taxed roughly on an energy-based par with gasoline and diesel. Taxes comprise from 27 to 35 percent of the retail prices of these fuels. CNG

is currently taxed at a much lower rate, about 14 percent of the retail price, and electricity is currently untaxed. Since any future revisions to this tax structure remain uncertain, the current tax levels were assumed to apply for all forecast years. Potential changes to these fuel tax rates could alter the comparative outlook for retail fuel prices. For example, federal or state action to tax all alternative fuels at the same rate could diminish the price advantage of CNG and electricity. Conversely, action to differentially raise tax rates on gasoline and/or diesel could improve the price competitiveness of all the alternative fuels. Staff examined how three differing transportation fuel tax structures could affect the future price of fuels. These results are presented in a staff report, ***1995 Transportation Fuel Tax Analysis*** .

Table 4-5 PRELIMINARY BASE CASE TRANSPORTATION FUEL DEMAND FORECAST* (Millions of Fuel Specific Units)				
FUEL	**UNITS**	**1994**	**2005**	**2015**
Gasoline**	Gallons	12,785	12,718 - 12,728	12,694 - 12,708
Electric	KWH	425	2,659	4,601
CNG	Therms	8	150	210
Methanol***	Gallons	11	19 - 36	26 - 50
Propane	Gallons	62	69	78
Diesel	Gallons	2,226	2,794	3,211
Aviation	Gallons	3,116	3,334	3,451

*Ranges are estimated using high and low methanol price projections. Higher methanol demand displaces gasoline use.
**Reformulated gasoline starting in 1996.
***Combination of M100 for transit buses and M85 for light duty vehicles.

DEMAND FOR ALTERNATIVE FUELS

Energy Commission staff prepared transportation fuel demand forecasts in response to the requirements of Senate Bill 1214 (Chapter 900, Statutes of 1991). This legislation directs the Energy Commission to forecast statewide and regional transportation demand under a variety of possible futures or scenarios, and to evaluate policies and programs to achieve a "least environmental and economic cost" transportation energy system.

The combination of availability and cost of AFVs, number of refueling sites, and relative costs when compared to conventional fuels has resulted in projections for a gradual increase in the near-term demand for alternative fuels. Table 4-5 compares the base case aggregate demand forecast through

Table 4-6 PROJECTED LIGHT DUTY VEHICLE GASOLINE DISPLACEMENT BY ALTERNATIVE TRANSPORTATION FUELS* (Millions of Gasoline Equivalent Gallons)		
FUEL	**2005**	**2015**
Electricity	312	644
CNG	163	232
M85**	7 - 17	12 - 26
Propane	31	33
Total Alternative Fuels	513 - 523	921 - 935
Light Duty Vehicle Gasoline Demand With Alternative Fuels	12,571 - 12,581	12,603 - 12,617
Light Duty Vehicle Gasoline Demand Without Alternative Fuels	13,084 - 13,094	13,524 - 13,538

*Assumes no change in travel demand or fuel prices between the two cases (gasoline only vs. alternative fuel availability).
**Ranges are estimated using high and low methanol price projections.

2015 for all transportation sectors. This forecast includes present transit uses of alternative fuels, but does not include any of the potential growth in additional uses of alternative fuels in medium and heavy duty trucks or transit vehicles.

Total gasoline demand in California is expected to remain relatively constant due to increases in alternative fuel use, fuel economy increases primarily from technology advances, and switching from gasoline to diesel for movement of goods. Both electricity and natural gas use in transportation in California are expected to grow over the next 20 years, based on current regulations and anticipated commercial availability of alternative fuel vehicles. The demand for methanol, propane, diesel and commercial aviation fuel is expected to increase slightly, in contrast to a relatively flat demand for gasoline.

Table 4-6 indicates the amount of gasoline displaced by alternative fuels used in light duty vehicles for the base case forecast. The total amount of gasoline displaced by AFVs is approximately 7 percent in the year 2015.

ENDNOTES

1. This table was compiled by Energy Commission staff from a variety of industry sources.

2. California Energy Commission, ***Resource Guide -- Infrastructure for Alternative Fuel Vehicles***, June 1995, p. 12, publication no. P500-95-004.

3. The gasoline-equivalent basis allows comparison among various transportation fuels based on their respective energy content. Due to the lower energy content of reformulated gasoline beginning in 1996, two sets of conversion rates were used to account for the amount of fuel that would be required to displace one gallon of gasoline. The 1994 equivalencies are: 1.154 therms of CNG, 2.03 gallons of M100, 1.76 gallons of M85, 1.26 gallons of propane, 0.90 gallons of diesel, and 0.90 gallons of aviation fuel. The 2005 and 2015 equivalencies are: 1.11 therms of CNG, 1.95 gallons of M100, 1.71 gallons of M85, 1.21 gallons of propane, 0.86 gallons of diesel, and 0.87 gallons of aviation fuel.