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CRS Report for Congress

Impact of Highway Fuel Taxes on Alternative Fuel Vehicle Economics

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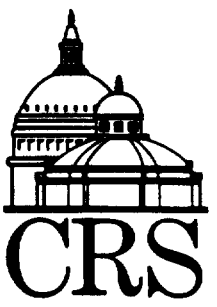

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IMPACT OF HIGHWAY FUEL TAXES ON ALTERNATIVE FUEL VEHICLE ECONOMICS

SUMMARY

The Energy Policy Act of 1992 (EPACT) sets as a national goal the replacement by 2010 of 30% of the gasoline and diesel fuel used in light duty vehicles with fuels derived from nonpetroleum sources. The Act mandates that fleet vehicles owned by Federal and State governments and alternative fuel providers lead the way, followed by those owned by private sector entities. Individual vehicle owners would then follow, once the technology and economics were sufficiently improved in experience.

The Omnibus Budget Reconciliation Act of 1993 (OBRA 93, P.L. 103-66), with its 4.3 cent per gallon deficit reduction tax on transportation fuels, has added to the economic hurdles that alternative fuels and alternative fuel vehicles must overcome in their response to EPACT. All the alternative fuels (except electricity, which currently does not pay a highway tax) have a lower energy density than gasoline, so the 4.3 cent tax increase on gasoline translates into more than 4.3 cents per gasoline equivalent gallon for the alternatives.

The purpose of this report is narrow: to roughly estimate the impact on the market potential for alternative fuels of three highway tax policy options: (1) To equalize on an energy equivalency basis the tax at a level equal to gasoline; (2) to remove the tax completely from the alternatives; and (3) to equalize at an intermediate level.

The estimates show that highway tax policy has the potential to foster penetration of AFVs more significantly than all current provisions of EPACT and other Federal policies put together. Removing the Federal highway tax altogether from the alternatives while leaving it on gasoline and diesel fuel could conceivably lead by 2010 to replacement of 10% of the gasoline which, when added to the partial replacement of gasoline by oxygenates, would bring the nation more than halfway to the 30% goal., although with a significant reduction in highway fuel tax revenue. Concurrent removal of State highway taxes from the alternative fuels could lead to an additional replacement of an equivalent percentage and bring the country close to realizing the 30% goal. Current policy will lead to replacement of less than 10% of the gasoline.

The estimates also show that equalizing the taxes to gasoline on an energy equivalent basis would not change the total number of alternative fuel vehicles from that expected from current fleet mandates but would improve the market share of propane at the expense of natural gas. Equalizing them on an energy equivalent basis at a level below that applied to gasoline would stimulate the penetration of alternative fuels significantly beyond the mandated fleet market.

The report makes a number of simplifying assumptions regarding, for example, technological progress and the time value of money, and does not address many issues which would arise were the highway tax issue to be considered, such as tax revenue neutrality, fuel and vehicle provider policy options with respect to pricing, and other economic and regulatory questions.

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INTRODUCTION

The Energy Policy Act of 1992 (EPACT) sets as a national goal the replacement by 2010 of 30% of the gasoline and diesel fuel used in light duty vehicles with fuels derived from nonpetroleum sources. The Act mandates that fleet vehicles owned by Federal and State governments and alternative fuel providers lead the way, followed by those owned by private sector entities. Individual vehicle owners would then follow, once the technology and economics were sufficiently improved through experience gained through the fleet program.

Notably, the Omnibus Budget Reconciliation Act of 1993 (OBRA 93, P.L. 103-66), with its 4.3 cent per gallon deficit reduction tax on transportation fuels, has added to the economic hurdles that alternative fuels and alternative fuel vehicles must overcome in their response to EPACT. All the alternative fuels (except electricity, which currently does not pay a highway tax) have a lower energy density than gasoline, so the 4.3 cent tax increase on gasoline translates into more than 4.3 cents per gasoline gallon equivalent for the alternatives.

Public policy advocates for alternative fuels, and the alternative fuels interests themselves seek Congressional adjustment of this complex and apparently inconsistent tax picture. Hearings are expected in the second session of the 103rd Congress. The purpose of this report is to estimate the impact on the market potential for alternative fuels of three illustrative highway tax policy options: To equalize on an energy equivalency basis the tax at a level equal to gasoline; to remove the tax completely from the alternatives; and to equalize at an intermediate level.

BACKGROUND

As matters stand today, the technologies associated with alternative fuels and alternative fuel vehicles are not as well developed as those for gasoline and diesel fuel -- not surprising given the advantages seven decades of dominance have provided to the latter. But the alternatives are close and improving rapidly. However, without credits for social benefits such as oil displacement or environmental improvement, which they basically don't get today, the economics are not attractive, except for a small number of high mileage vehicles operating on propane or compressed natural gas (CNG) for which special pricing arrangements have been made with the fuel providers.

One of the major factors affecting the economics of alternative fuel vehicles is fuel price. Two of the major alternative fuels -- methanol and ethanol -- are

more expensive than gasoline. Fuel costs would be expected to come down should production volumes reach the scale of gasoline and diesel. The gaseous fuels -- natural gas either liquified (LNG) or compressed (CNG), and propane -- are potentially less expensive.[1] All require more expensive vehicles in the short term, but the gaseous fuels, primarily because of the fuel tanks required, would continue to be more expensive than gasoline vehicles even at large production volumes. Electric vehicles are currently so expensive that the cost of electricity is not the critical factor.

Federal and State highway taxes complicate the fuel price picture. The Federal highway tax on gasoline is 18.4 cents per gallon. The average State tax on gasoline is about 20 cents per gallon. The average pump price for gasoline is about $1.15 to $1.20. Thus, highway taxes make up about one third of the sales price at the pump.[2]

Federal and State taxes on alternative fuels (methanol, ethanol, natural gas, and propane)[3] vary widely whether measured by the gallon or in terms of energy equivalence with gasoline. Full details on these disparities are set forth in CRS Report 93-330.[4] The disparities, highlighted below, mean that the alternative fuels are not competing on even tax terms whether compared to each other or to gasoline.

State highway taxes, imposed for the most part by the gallon, tend to exacerbate the disparities. For example, in Arizona (chosen at random), the State highway tax is 18 cents per gallon on gasoline and on all the alternative fuels except compressed natural gas (CNG), recently set at 1 cent per gallon of gasoline equivalent, and electricity, with no highway tax. The tax rates on the alternative fuels per gasoline gallon equivalent (GGE) are thus 36 cents for methanol, 27.2 cents for ethanol, 27.6 cents for liquified natural gas (LNG), 24.4 cents for propane, zero for electricity, 1 cent for CNG. The combined Federal and State tax on the energy in a gallon of gasoline is 36.4 cents, while on

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[1] Propane and natural gas are less expensive when they first enter the distribution system but require future economies of scale to hold distribution costs down.

[2] This estimate is only approximate. Premium gasoline sells for more than this average price; regular gasoline sells for less. Further, some States and municipalities have sales and other taxes on top of the highway taxes. The point is that highway taxes make up a significant fraction of the ultimate sales price.

[3] Electricity is not yet taxed as a highway fuel, although some States are considering imposing such a tax. Taxing electricity as a highway fuel is complicated by the difficulty of defining an "equivalent gallon."

[4] This report, originally issued March 12, 1993, has been revised to reflect the changes incorporated in the Omnibus Budget Reconciliation Act of 1993. Reissue date is December 17, 1993.

methanol it is 59 cents, on ethanol 46.9 cents, on LNG 55.8 cents, on propane 49.3 cents, on CNG 6.6 cents, and on electricity zero. These numbers are summarized in table 1.

Table 1. Effect of Tax Policy and Energy Density on Total Federal and State Highway Tax, Using Arizona As An Example (Cents per Gasoline Gallon Equivalent)

Fuel	Federal Tax	State Tax	Total
Gasoline	18.4	18	36.4
Methanol	23.0	36	59.0
Ethanol	19.7	27.2	46.9
LNG	28.2	27.6	55.8
Propane	24.9	24.4	49.3
CNG	5.6	1.0	6.6

Sources: U.S. Tax Code and Arizona Department of Commerce, adjusted for energy content by CRS

What is true in Arizona concerning disparities in tax treatment is also true in general in the other States. The details are different, with special consideration given by various States to one or another fuel by one or another tax mechanism. Withall, it is clear that alternative fuels as a class are not treated equally among themselves or compared to gasoline or diesel fuel.

CAVEATS

The analysis in this report has a narrow purpose -- to roughly estimate the impact of selected changes in taxation of alternative fuels on market penetration of those fuels. It does not take into account factors such as fuel provider flexibility in pricing policies (although the marketing aggressiveness of CNG interests is noted), technical development efforts, and educational programs; vehicle buyer attitudes toward new social goals, new purchase options, and buyer attitudes toward unfamiliar fuels and technologies; relative abilities of the alternative fuels to meet future emission requirements; possible development of emission credit trading and other market price adjustments; or local officials regulatory approaches to real or perceived hazards such as toxicity, flammability, or ecological impacts; and probably many other factors. And it assumes that owners of flexibly fueled vehicles (FFVs) or dual fueled vehicles use the alternative fuel all the time.

The analysis assumes no quantum changes in automotive and fuel technology. These factors could have significant effects, in either direction for

each fuel and possibly in opposite directions among the fuels. There will of course be improvements over the next 15 years, but breakthroughs sufficient to throw these calculations seriously awry, though they may occur, are most unlikely to affect the market significantly in this time frame.

The analysis shows that the size and distribution of highway taxes at either or both the Federal and State levels can make a great deal of difference in the cost competitiveness of alternative fuels. Different assumptions about fuel and vehicle economics would change the mix and total number of vehicles and fuels but would not change the conclusion about the significance of the taxes.

ALTERNATIVE POLICY OPTIONS

To bracket the range of potential policy choices facing the Congress, three alternatives are presented and analyzed below. One is equalizing the Federal highway tax at the energy equivalent of the current gasoline tax of 18.4 cents per gallon; the second is complete removal of the Federal highway tax from all the alternative fuels; the third is an equalization of the Federal highway tax among the alternative fuels on an energy equivalency basis and then setting the equalized tax at 12 cents per gasoline gallon equivalent (a reduction in effective tax rate of about one third).[5] Table 2 shows the Federal highway tax rates for these options.

Table 2. Alternative Highway Tax Scenarios

Fuel	Tax Under Current Policy		Energy Equivalence (18.4 c/GGE*)	Modest Incentive (12 c/GGE)	No Tax on ATFs
	Cents/Gal(Actual)	Cents/GGE	Cents/Gal	Cents/Gal	
Gasoline	18.4	18.4	18.4	18.4	18.4
Methanol	11.4	23.0	9.2	6.0	0
Ethanol	13.0	19.7	12.2	8.0	0
LNG	18.3	28.2	12.0	7.8	0
Propane	18.3	24.9	13.6	8.9	0
CNG	5.6	5.6	18.4	12.0	0

* GGE = gasoline gallon equivalent

[5] The choice of 12 cents per gallon is rather arbitrary. Any intermediate price would be as useful as an example.

IMPACT OF CURRENT POLICY

CRS has estimated[6] that, under current law and Executive Branch programs, some 2.6 million alternative fuel vehicles will be on the road by 2010, displacing about 120,000 barrels per day of gasoline and diesel fuel. About 200,000 of these vehicles would be in the Federal fleet, 350,000 in State and local fleets, about 650,000 in fuel provider fleets, and about 1.4 million in private fleets. Recent estimates by Department of Energy are higher.[7] Industry estimates of market share of the major alternative fuels vary widely. In the absence of evidence to the contrary, it seems reasonable to assume that natural gas and propane will garner about 40% each, with methanol FFVs taking up the remaining 20%. This assumption is based respectively on aggressive promotion of CNG by the natural gas utilities and the natural gas vehicle (NGV) industry, on the relatively attractive combination of propane vehicle and propane fuel prices, and on the lower required capital investment for the methanol vehicles. Also assumed for this base case is the lack of success of ethanol vehicles because of the very high fuel price and electric vehicles (despite the California mandate) because of the very high vehicle cost.

Most of these 2.6 million vehicles will not be economically attractive to the owner-operators, but will be on the road because of the Clean Air Act, EPACT, and State mandates. The ones that will be economic will benefit from one or more of several possible factors: (1) they will be fueled by CNG or propane and will be driven at least twice as many miles per year as the average nonfleet vehicle; (2) the fuel providers will offer special fuel prices not in themselves high enough to return profits at the rate normally sought; (3) the refueling infrastructure providers will not seek to fully recover their costs through the fuel price alone, or (4) the vehicle makers will absorb some or all of the manufacturing cost increment or make it up through higher prices on conventional vehicles.

Since few nonfleet vehicle owners will be able to meet any of these conditions, the number of vehicle owners not under EPACT mandate switching to alternative fuels is assumed to be negligible.

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[6] "Alternative Fuels: Oil Import and Highway Tax Issues." Issue Brief 93009, by David E. Gushee. Continually Updated.

[7] The Energy Information Administration of Department of Energy has estimated in Annual Energy Outlook 1994 that, as a result of federal and State mandates and incentives, alternative fuel vehicle sales in 2010 will comprise about 11% of new light duty vehicle sales, 30% being electric or hybrid electric. Total AFV population would be around 10 million vehicles. This is a very optimistic estimate compared to the CRS estimate of about 2.6 million vehicles.

IMPACT OF REMOVAL OF FEDERAL HIGHWAY TAX

Removing the Federal highway tax from alternative fuels would be of significant economic benefit to all the alternative fuels. Since the fuels are taxed differently, removing the tax would benefit the fuels differently and would thus change the relative economics among them.

Natural Gas Vehicles

Natural gas fueled cars cost about $2500[8] more than their gasoline counterparts,[9] give or take a few hundred dollars.[10] Owners seek to make up this incremental cost from the lower fuel price. If one assumes that gas arrives at an urban area at $3.25 per thousand cubic feet[11] and if one assumes that the gas can be delivered to a service station, compressed, and put into the car for 30 cents per gallon,[12] and that the State highway tax is the same for gasoline and

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[8] These estimates, and those which follow later in this report, are CRS's judgments based on a range of published studies plus anecdotal evidence of recent cost trends.

[9] EPACT provides in the year of purchase, for purposes of income tax calculation, a deduction to adjusted gross income of up to $2000 per vehicle for a dedicated alternative fuel vehicle purchase. However, for a fleet owner already depreciating the vehicle, the benefit of accelerated depreciation is worth only a few percent. In the interest of simpler mathematics, this benefit will therefore not be taken into account in the calculations which follow which relate to fleet vehicles. It will be included for cases where individual vehicle owners are being discussed.

[10] Heavier vehicles cost more to convert and use more fuel per mile. Large scale production is expected to reduce incremental costs of alternative fuel vehicles significantly but, except for a dedicated methanol vehicle, not to zero.

[11] $3.25 per MCF (37 cents per gasoline equivalent gallon) is a reasonable estimate for a city some distance from the gas wells, with a wellhead price of around $2.00 per MCF. The price will vary with distance from the wellhead and the price at the wellhead, among other factors.

[12] This cost includes transport through the local distribution company network, energy cost for compression to 4,000 psi or so for fast-fill delivery into the vehicle tank at 3,000 to 3,600 psi, capital cost for the compression, storage, and delivery equipment, and retailer profit. For the cost per gallon to be this low, the service station must be operating at close to capacity or, alternatively, the capital cost could be incorporated into the distribution company's ratebase and paid by all gas users rather than just NGV users. Either or both of these requirements are being met at some locations.

CNG, then CNG would be about 25 cents per gasoline gallon equivalent cheaper than gasoline.[13]

As a simple example of the fleet vehicle buyer's view, neglecting the time value of money and other complicating factors, if CNG at the pump costs 25 cents less per gallon than gasoline, the vehicle must burn 10,000 gasoline-equivalent gallons of CNG to recover the $2500 incremental cost. At a fuel economy of 20 miles per gallon (the average car on the road today), the vehicle must go 200,000 miles. For a three-year payback,[14] the vehicle must go about 67,000 miles per year. At 20 miles per gallon, fuel consumption of 3350 gallons per year would be involved. Far less than 1% of fleet passenger cars consume that much per year (see figure 1). If the vehicle gets about 13 miles per gallon (the average heavy light duty truck [LDT] fuel economy) and cost $4000 to convert, it would need to consume 16,000 gallons while going about 208,000 miles; less than 1% of light duty trucks in fleets are driven that much.

For the private vehicle buyer, the economics are only slightly different. EPACT provides a deduction from Federal adjusted gross income of $2000.[15] For a buyer in the 31% tax bracket, this deduction is worth about $600, leaving him with $1900 to recover from the lower CNG price. Some 7600 gallons (150,000 miles) would be needed, at a price difference of 25 cents per gallon. So few light duty vehicle go anywhere near 50,000 miles per year that both CRS and DoE assume that EPACT will not cause significant numbers of private vehicle owners to buy CNG vehicles.[16]

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[13] CNG at stations nearer to the gas source than the 25 cents per GGE of this scenario would have a larger price advantage. Should the gas supplier or those in the delivery infrastructure be able to recover some of their costs through payers other than vehicle owners, this too would increase the price advantage. Currently, both of these circumstances are occurring.

[14] If one assumes a longer payback period, the number of miles per year that must be driven is lower. Three years was chosen because many fleet owners depreciate their vehicles over that time period. Similarly, if one assumes a lower fuel economy than 20 mpg, the number of miles driven per year for payback would be lower than in this example.

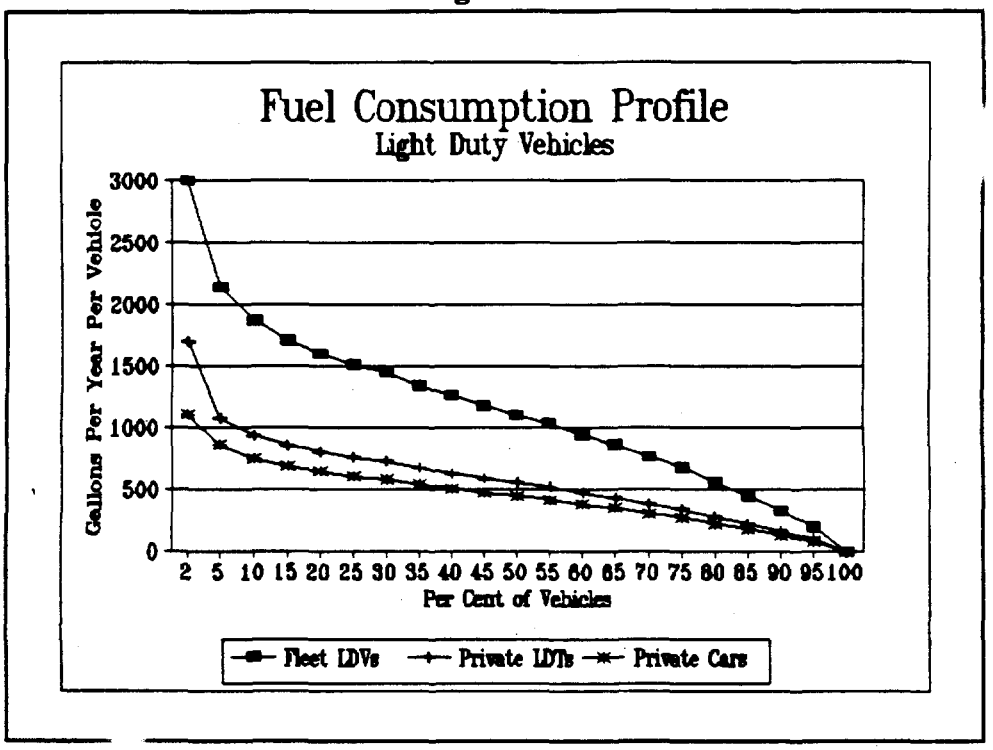
[15] EPACT distinguishes between a dedicated alternative fuel vehicle and a dual fueled vehicle. For CNG, this is currently a distinction without a difference, because both the incremental cost of the vehicle and the total cost of "qualified" equipment (engine, fuel delivery system, and exhaust system) are greater than the maximum allowable deduction.

[16] If one assumes a longer payback period, the number of miles driven per year to recover the incremental cost is lower. For a five year payback, for example, one need only consume 1500 gallons per year, or 30,000 miles (assuming a 20 mpg vehicle). As shown in figure 1, about 1% of all private cars consume that much fuel per year.

Removal of the Federal highway tax would relieve CNG of 5.6 cents per gallon of tax. If the full 5.6 cents reduction were passed through to the vehicle driver, it would, in the early years and at a fuel price difference of 25 cents per gasoline gallon equivalent, reduce car breakeven fuel consumption from 10,000 to 8150 gallons and mileage from 200,000 to 163,000 and light truck breakeven fuel consumption from 16,000 gallons to 13,000 gallons and mileage from 200,000 to 169,000 miles.

With this reduced breakeven mileage, the share of fleet cars or fleet light duty trucks driven that much is still not more than 1%, so the option would shift less than 1% of fleet LDVs, either cars or trucks, from uneconomic to economic. Since the EPACT fleet mandates start out at 20% of new vehicle purchases, most mandated AFV purchases in the early years would be uneconomic whether or not the highway tax on CNG were removed. These small improvements reflect the minimal leverage that this option would have on CNG vehicle economics because of its already favorable tax position.

Figure 1[17]



It is worthy of note that, given sufficient scale of production for CNG-powered vehicles, the incremental production cost is projected to decline by at least half and perhaps by two thirds. At an estimated $800 incremental cost for a mass-produced CNG car and $1200 for a light truck (assuming the cost reductions would be passed on to buyers), breakeven fuel consumption would be

[17] Source: Department of Transportation

about 3200 gallons for the car (some 21,000 miles per year for a three-year payback) and 4800 gallons for the truck (also 21,000 miles per year for three years). CNG would be economically attractive for perhaps 50% of fleet cars and 20% of fleet trucks. It would be economically attractive to 2 or 3% of private car owners and perhaps 5% of private LDT owners.

However, even after large-scale production economics took over, many vehicles under EPACT mandate would still not be economic under this scenario. EPACT mandates that 90% of fuel provider fleet vehicles and 70% of private fleet vehicles be AFVs. Therefore, absent some additional driving force, it is unlikely that CNG vehicles will be produced in large enough volume for the economies of scale to be realized.

From this analysis, under this option, it would appear that CNG vehicles will penetrate the mandated fleet market to the extent that the CNG interests succeed in enticing them in and that they will not penetrate the private fleet market. The Federal highway tax lever is already working in favor of CNG almost as much as removing the Federal highway tax would.

For liquefied natural gas (LNG), removing the Federal highway tax would reduce retail fuel price by 18.3 cents per gallon of LNG or about 28 cents per gasoline gallon equivalent (GGE). Reducing the pump price of LNG by 28 cents per GGE would bring LNG close to gasoline or diesel fuel on average, and would possibly make it less expensive in some specific geographic locations, such as near LNG import terminals. Such site-specific opportunities, coupled with the special handling requirements associated with the very low temperatures involved, would probably lead to a market too small to attract vehicle manufacturers to produce the specially-designed vehicles necessary, except possibly for specialized uses such as urban transit buses, a small market for fuels even though important environmentally.

Propane

Propane-fueled cars currently cost about $1200 more than their gasoline counterparts; for light trucks the increment is about $2000. Propane has historically had a price advantage of 20 to 30 cents per gallon over gasoline at the production facility. Distribution costs per gallon for propane are about the same as for gasoline.[18] However, the energy content is about 25% less than that of gasoline, reducing the price advantage (excluding taxes) to, at a minimum, about 13 cents per gasoline equivalent gallon.

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[18] Propane retail prices to the home heating market have historically been marked up much more than vehicle fuel. This analysis assumes that propane as a vehicle fuel would be priced in a manner similar to gasoline.

The Federal highway tax on propane is the same per gallon as on gasoline.[19] Given the difference in energy content, the tax penalizes propane by 6.6 cents per gallon, reducing its price advantage to about 6.4 cents per gallon (not counting State taxes). Breakeven fuel consumption would be about 18,000 gallons, or about 360,000 miles, for a car and 31,000 gallons, or about 400,000 miles, for an LDT. For convenience in collecting the money, a number of States, particularly gas-producing states, have historically substituted an annual fee for the highway tax. The fee has been set to recover about as much money as the highway tax paid by the average vehicle, averaging $100.[20] For vehicles driven more than the average, the effective highway tax rate is thus lower, so for a vehicle driven some 20,000 miles per year, the tax rate per gallon would be about half that for gasoline. Adding in the impact of the 35% lower energy density for propane, this approach has meant at least an additional 7 cents per gasoline equivalent gallon cost advantage,[21] and more as the vehicle's annual mileage increased. This helps explain why propane already has a fuel market of about 300,000 vehicles.

Removing the Federal highway tax of 18.3 cents per gallon (24.9 cents per GGE) would increase propane's price advantage from 6.4 cents (not counting the impact of State-to-State differences) to about 31 cents per gasoline equivalent gallon. Breakeven fuel consumption in the early years for a car would be reduced to about 3900 gallons.[22] For a three year payback, fuel consumption would be about 1300 gallons per year; around 40% of fleet cars consume that much. For a truck, breakeven fuel consumption would be about 6500 gallons, or 2200 per year. About 10% of all fleet LDTs use that much fuel.

Economics this attractive would presumably drive a significant share of fleet owners under EPACT mandate to choose propane as their alternative fuel.

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[19] Actually, the highway tax per gallon is 18.3 cents for propane, which is not subject to the Underground Storage Tank tax. Given the uncertainties involved in this analysis, the difference between 18.4 and 18.3 will be ignored.

[20] $100 for an average consumption of 500 gallons per year, or 10,000 miles per year at 20 miles per gallon, is 20 cents per gallon, the average State highway tax.

[21] For a vehicle driven 20,000 miles per year when the average vehicle goes 10,000 miles per yea.

[22] For convenience, gasoline equivalent gallons will be used in the propane and methanol analyses, since the impact on vehicle owners is by miles driven, determined by fuel economy measured in miles per gasoline equivalent gallons. The actual number of propane gallons consumed would be 35% higher and of methanol gallons twice as high. Since CNG "gallons" are measured on a basis of energy equivalence to gasoline, this point did not arise.

For 10% of the fleet LDTs and 40% of the fleet cars, it would be economic.[23] For the rest of the fleets under mandate, it would be less expensive than CNG but must compete against CNGs aggressive marketing. Thus, propane would also probably capture some of the rest of the mandated fleet market, at the expense of natural gas which, for a given annual fuel consumption, would be less economic than propane absent the special arrangements CNG providers will make.

Given the marketing power of CNG and its special advantages for heavier light duty trucks, CNG would be expected to retain a significant penetration in the fleet market under this option. Thus, propane's share would increase from the base case of 40% to a guesstimated 60%, or about 1.5 million vehicles, at the expense of CNG, whose share would drop to 20% or about 500,000 vehicles.

Would a propane price differential of 31 cents per gallon attract the nonfleet vehicle owner? That person would benefit more from the EPACT tax advantage than the fleet owner would. For an owner in the 31% federal tax bracket considering a dedicated propane car with a $1200 incremental cost, the $2000 deduction from adjusted gross income[24] would reduce his tax by about $600, leaving him with only $600 to recover from fuel savings. Only 1900 gasoline equivalent gallons of propane would be needed for breakeven. About one third of all car owners use that much gasoline in three years.

For an owner considering a dual fuel propane vehicle, the benefit applies only to the incremental cost of the fuel delivery system, the engine, and the emission control system. Thus, his deduction from AGI would be the $1200 he spent in incremental cost, or a tax reduction of $360, leaving him with $840 to make up from fuel savings. About 2700 gallons would be needed, or about 900 gallons per year, a volume consumed by about 5% of all car owners.

For the nonfleet LDT owner, the EPACT credit would leave $1400 to be recovered, whether from a dedicated propane LDT or from a dual-fuel one. Breakeven fuel consumptions would be about 1500 gallons per year. About 5% of all LDTs consume that much fuel per year.

A potential market of one third of all car owners (for a dedicated propane vehicle) and 5% of all LDT owners represents about 45 million and 2 million vehicles respectively, or enough for mass production economies of scale to begin to be realized. In mass production, these vehicles would have significantly lower

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[23] Propane price has historically been subject to price spikes, particularly during cold spells in winter. The propane suppliers seeking to penetrate the vehicle fuel market are taking steps to assure stable prices for vehicle fuel.

[24] For a dedicated alternative fuel vehicle, the EPACT tax adjustment to Federal adjusted gross income is up to $2000 for the cost of the fuel delivery system, the engine, and the exhaust system. These components cost more than $2000, so the full benefit is available, even though, for a car, the incremental cost will be less than $2000.

incremental costs. The cost increment for a propane vehicle would be less than the $1200/$2000 estimated for the early years. A reasonable estimate is $500 for a car, $700 for a truck.

For the nonfleet owner considering a dedicated propane car, the tax benefit from EPACT would be the same $600 as before, so the propane car would be available at no extra net cost. For the dual fueled version, the tax benefit would be worth $150, leaving $350 to be made up from the lower fuel price. At the fuel price advantage of 31 cents per gallon of gasoline equivalent this option would generate, the mass-produced dedicated propane car would be a real bargain. The dual fueled car would require consumption of about 1200 equivalent gallons to generate breakeven. For a dedicated light truck, with a $600 EPACT tax credit, the $100 difference in net price would be made up in less than a year. For the dual fuel version, the credit of $210 would leave a net cost increment of $490, requiring 1600 gallons or 550 gallons per year. About two thirds of LDTs are driven that much.

On the other hand, domestic propane production, currently about 14 billion gallons per year, cannot be expanded to meet the potential demands of the transportation market without extensive additional processing of gas, natural gas liquids, or oil. Price would rise with demand increases of this magnitude, so the transportation market would probably be self-limiting at about 10 billion gallons of domestic propane per year.[25] This volume could supply 9 to 10 million vehicles (about 7% of the light duty vehicle fleet), bought in the short term at higher incremental vehicle costs and paid for by significantly lower fuel prices and bought in the longer term on the basis of a lower initial incremental vehicle cost penalty and a somewhat lower incremental fuel cost benefit.

Methanol

Currently, because of cold-start problems in spark-ignition engines, the auto industry offers only methanol-gasoline dual fueled light duty vehicles, called flexibly fueled vehicles (FFVs) because only one fuel tank is required. The methanol FFV currently costs several hundred dollars more than its gasoline counterpart. However, the automakers have been planning to price the FFV the same as the gasoline car, to stimulate FFV sales.

To achieve a normal industrial rate of return, methanol's costs at current plant scale require a sales price of about 45 cents per gallon, or about 90 cents per GGE. Adding distribution costs of about 20 cents per gallon and federal and State taxes makes it about 50 cents per GGE more expensive than gasoline at the pump, if the full price is charged, which wouldn't necessarily be the case in the early years. In a small number of States, including California, which have

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[25] Price increases of the magnitude contemplated could draw imports, probably from areas such as Russia, the Middle East, South America, and the Pacific Rim. However, competition from CNG would limit the amount the price could rise and therefore limit the amount that could be economically imported for the vehicle market.

adjusted their State highway taxes to Btu equivalency or close thereto, the methanol price at the pump can be competitive with premium grade gasoline, particularly once reformulated gasoline, with its added cost of several cents per gallon, enters the market.

Removing the Federal highway tax of 11.4 cents per gallon (23 cents per gasoline equivalent gallon) would bring methanol's pump price below that of premium gasoline in those States which adjust their highway taxes on methanol and would bring it close to parity in the other States. For fleet vehicles, this cost advantage is probably of very limited value, since most fleets operate on economics, not specialized performance, and thus use regular gasoline. Therefore, this option would probably not affect the market share of methanol in fleet vehicles, assumed earlier to be about 20% (about 500,000 vehicles) on the basis of low mileage users minimizing capital expenditure.

What impact would reducing the price by 23 cents per GGE have on the nonfleet vehicle market? Premium has about 25% of the gasoline market, implying an initial potential methanol FFV market among nonfleet vehicles of up to perhaps 15 million cars and light trucks in those States adjusting their methanol highway tax. Further, given close-to-comparable pricing for premium gasoline in most of the country, it is possible that the claims of improved performance for the methanol car might create a modest-sized national market for performance buffs. That market might be 5%, or 7 million cars.

As described earlier, EPACT treats FFVs differently from dedicated AFVs, in that only the incremental cost of the "qualified property" (fuel and exhaust systems and engine) is eligible for the tax incentive. Since the methanol FFV is to be offered at no incremental price difference compared to the equivalent gasoline-fueled vehicle, the difference in EPACT tax treatment "costs" the methanol FFV buyer some $600 in tax benefits that would be available were the provision to treat dedicated and dual-fueled vehicles the same.[26]

The Environmental Protection Agency (EPA) and California Energy Commission (CEC) have both commissioned studies which show that methanol production costs would go down at production volumes associated with motor fuel use (billions of gallons per year compared to the hundreds of millions of gallons per year associated with chemical demand). Should these reductions be realized, then the methanol could be price competitive with regular gasoline even without the benefit of this option. With this option, methanol would have up to the full 11 cents per equivalent gallon reduction in tax as a price advantage with no increment in vehicle price. This would make the methanol car a viable option for all vehicle buyers -- fleet or private, car or truck. However, it requires investment in large scale methanol plants with access to low cost natural gas, so the fuel economics would be realized gradually, not immediately as the propane vehicle would offer.

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[26] The primary argument in the EPACT conference deliberations in favor of the provision as enacted pointed out that a dual-fueled vehicle would not necessarily use the alternative fuel while the dedicated vehicle would.

Therefore, in the absence of a general adjustment of state highway taxes on methanol to energy equivalence, the potential for action on highway taxes at the Federal level to make much of an impact on methanol's penetration into the marketplace appears to be rather limited, particularly over the near and mid terms. On the basis of the estimates just made, the full potential might be 20 million vehicles, primarily in those States which have adjusted their State tax, plus performance buffs. Given that the incentives are modest, a penetration of about 25% of the potential market (about 5 million cars) seems reasonable.

Electric Vehicles

There would be no effect from this policy option, since there is no Federal highway tax on electricity for vehicles.

Net Effect on Fleet Composition

Under current policy, as indicated earlier, the total number of AFVs in 2010 may be perhaps 2.6 million vehicles, divided 40% CNG (about 1 million vehicles), 40% propane (1 million vehicles), and 20% methanol (500,000 vehicles), with a scattering of ethanol and electric vehicles (perhaps tens of thousands of vehicles). Among fleets under mandate, removal of the Federal highway tax from the alternative fuels would reduce the number of CNG vehicles, since fleet owners would more frequently have a more-economic choice in propane. It would increase the number of propane vehicles accordingly, but probably would not change significantly the number of methanol vehicles, since that choice would still be made primarily by fleet owners of vehicles traveling only a few thousand miles per year, since most fleet owners do not buy vehicles requiring premium gasoline. To put some numbers on these qualitative trends, the mix might change from 40/40/20 to 20/60/20 (500,000 CNG vehicles, 1.5 million propane vehicles, and 500,000 methanol vehicles).

At the same time, some vehicle owners not under mandate would find untaxed propane and methanol economically attractive, while few would find CNG or LNG to be economic. From the estimates made earlier, there might be as many as 10 million propane vehicles and 20 million methanol vehicles. There would be significant overlap in the two markets, so the combined potential might be perhaps 12 or 13 million vehicles, with the propane being favored by the high mileage drivers and the methanol favored by the drivers seeking a bit of extra performance. Assuming that there are half again as many high mileage drivers as performance buffs, the split would be 7.5 million vehicles on propane and 5 million on methanol.

The overall result of removing the Federal highway tax on vehicle fuels other than gasoline by 2010 would be 500,000 natural gas vehicles, 9 million propane vehicles, and 5.5 million methanol vehicles, again with a smattering of ethanol and electric vehicles. The Highway Trust Fund would lose some $2.6 billion in highway fuel tax revenue.

IMPACT OF TAXING AT ENERGY EQUIVALENCE

Equalizing the Federal highway tax to 18.4 cents per gallon of gasoline equivalent would reduce the tax on methanol by 4.6 cents per equivalent gallon, on ethanol by 1.3 cents per equivalent gallon, on LNG by 9.8 cents per equivalent gallon, and on propane by 6.6 cents per equivalent gallon. The tax on CNG would increase by 12.8 cents per gallon.

The changes in AFV economics fostered by this proposed policy would be beneficial but marginal and thus of little impact for all the fuels but CNG. Ethanol is much more expensive than gasoline, even with the tax subsidy available to it. Methanol is currently up to 50 cents more costly than gasoline on the average, but the change would improve the chances for methanol in some States to be less expensive than premium gasoline. However, since this would not be a national advantage, its appeal as a sales factor for methanol FFVs would be limited. Since propane is already economic for high mileage vehicles, it would become slightly more so, but probably not enough to make a major difference in the face of other factors making greater differences in vehicle or fuel prices. For CNG, however, this policy would make that fuel's uphill economic climb significantly steeper.

The major net change, therefore, would be for propane to capture some of the market in fleets under mandate that CNG will take under current policy. This shift would be significant, because propane's relative price would improve by 19.4 cents per gasoline equivalent gallon. CNG's share of the nongovernmental mandated fleet vehicle market[27] would decline sharply. Because all AFV economics would remain basically unattractive, it is unlikely that any significant number of vehicle owners not under EPACT mandate would opt for AFVs, so the total number of AFVs would not increase significantly, if at all. Propane could appeal to a few more high mileage drivers not under fleet mandate and not economic under current policy where the Federal tax is about 35% higher on an energy basis. This number of drivers would not be large; there aren't that many nonfleet high mileage drivers.

The overall effect of equalizing the Federal highway tax for all fuels at gasoline energy equivalence (18.4 cents per gasoline equivalent gallon) would be to maintain the AFV population essentially unchanged but to increase the share of propane vehicles and decrease the share of CNG vehicles. The mix would shift from the assumed 40/40/20 mix resulting from the current tax structure to perhaps 30/50/20, or 750,000 CNG vehicles, 1.3 million propane vehicles, and 500,000 methanol cars. Highway Trust Fund revenue would increase modestly under this scenario, because the CNG vehicles would be paying 18.4 cents per gasoline equivalent gallon instead of the current 5.6 cents and somewhat more than compensate for the reduced amount the propane and methanol vehicles would pay.

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[27] The nongovernmental fleet market is specified here because governmental vehicles do not pay highway taxes.

IMPACT OF MODEST REDUCTION IN FEDERAL HIGHWAY TAX AND ENERGY EQUIVALENCE WITH GASOLINE

Reduction of the Federal highway tax on alternative fuels by about one third of the gasoline rate (to 12 cents per gasoline equivalent gallon)[28] would not appear to offer the opportunity to stimulate the penetration of alternative fuels without an associated loss of highway tax revenue. This option would not have equal impacts on the alternative fuels. It would hurt natural gas less than taxation at the gasoline energy equivalent rate but would still be damaging to it relative to current policy (under which CNG pays about one third the gasoline equivalent rate). Within the mandated fleets, propane's share would rise at the expense of CNG, but not as far as it would with no tax on the alternatives (where it would be much more economic than CNG) nor as far as it would with the tax at energy equivalence (where none would be economic and the marketing effort available to CNG would have a greater relative effect). The resultant shares would probably approach 35/45/20 (850,000 CNG vehicles, 1.15 million propane vehicles, and 500,000 methanol vehicles. Methanol would not be helped significantly in the fleet market, again because its appeal to fleet owners is at the low mileage end of the utilization spectrum where fuel price differences are not the critical cost factor.

In the nonfleet market, propane would be helped some, compared to the base case or the equivalence to gasoline case. Its price advantage over gasoline would become about 12.8 cents per gasoline equivalent gallon (6.4 cents from the tax and 6.4 cents in pretax price). Breakeven would be at about 4700 gallons for the dedicated propane vehicle ($600 net incremental price/12.8 cents per gallon) and 6600 gallons for the dual fuel version. About 1 to 2% of all cars would be candidates for conversion; if about half converted, about 2 million cars might be involved. The response would be less than one third the response from taking the highway tax off the alternatives. This less-than-proportional response follows from the shape of the frequency distribution of vehicles vs. miles driven per year at the high end, where so few vehicles are clustered compared to the distribution closer to the average, where so many are clustered. The impacts of all three options on the number and distribution of AFVs are summarized in Table 3.

POTENTIAL ROLE OF STATE HIGHWAY TAXES

State highway taxes are, in most States, higher than the Federal highway tax. In most States, they are applied on a per gallon basis not taking into account the fuels' energy contents, although this is changing as more State officials direct their attention to the role of alternative fuels as factors in energy, environmental and economic policy. Thus, in most States, the lower the fuel

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[28] A one third reduction was chosen to soften the impact on the Highway Trust Fund revenues compared to larger reductions.

energy content per gallon, the more disadvantaged the fuel is compared to gasoline or diesel fuel. Methanol, with the lowest energy content among the liquid fuels, is disadvantaged the most. CNG, because it is not a liquid fuel, has been given more specific policy attention and thus tends to be taxed on an energy equivalent basis.

Were State highway taxes on the alternatives reduced to zero, in concert with the Federal tax removal option for the alternatives, fuel pump prices would be reduced by about one third compared to the present situation. Propane would be a real bargain, natural gas would be attractive to large numbers of heavier light duty trucks, and methanol would become competitive in most parts of the country provided the vehicle makers continued their policy of equal vehicle pricing and fuel providers realized the production economies expected

Table 3. Impact of Highway Tax Options on Numbers of AFVs in 2010

Option	Status Quo	Tax Equal to Gasoline on Energy Content	No Federal Highway Tax	12 Cents per Gallon of Gasoline Equivalent
Fleets (Total)	**2.6 million**	**2.6 million**	**2.6 million**	**2.6 million**
CNG	1 million	750,000	500,000	850,000
Propane	1 million	1.25 million	1.5 million	1.15 million
Methanol	500,000	500,000	500,000	500,000
Non-Fleets (Total)	**Negligible**	**Negligible**	**12.5 million**	**3.5 million**
CNG	Negligible	Negligible	Negligible	Negligible
Propane	Negligible	Negligible	7.5 million	2 million
Methanol	Negligible	Negligible	5 million	1.5 million
Total	**2.6 million**	**2.6 million**	**15.1 million**	**6.1 million**

from the larger scale of operation. Electric vehicles and ethanol fuel would remain too expensive in this time frame, absent a decisive technological breakthrough beyond those forecast from current developmental programs.

Experience in Canada and The Netherlands is that, when the propane price is set at about one third less than the gasoline price, propane vehicles capture about 15 to 20% of the market. The estimate of about 6.5% for propane vehicle penetration under the Federal tax removal (propane price of one sixth less than gasoline price) in this paper, although independently arrived at, is consistent with that experience.

Experience in New Zealand, Canada, and elsewhere shows that when CNG price is about one third lower than the competing gasoline price, CNG vehicle penetration is less than that of propane vehicles when propane has the same relative price advantage. The analysis given above explains this: The CNG vehicle is more expensive than the propane vehicle, so more miles are needed for economic breakeven or, on the fuel side, a larger increment (a lower relative fuel price) is needed for breakeven at the same number of miles driven.

IMPACTS ON HIGHWAY TRUST FUND REVENUES

The Status Quo

Because of their low current level of consumption, alternative fuels currently generate about $40 million per year, most of which is from propane. This will increase in 1994 to perhaps $50 million from the highway tax increase in OBRA 93 and the increasing presence of AFVs. CNG vehicles have in the past paid no Federal highway tax. As of October 1, 1993, CNG is taxed, but CNG vehicles pay 12.8 cents per gallon less than gasoline. Assuming that there are about 20,000 CNG vehicles currently on the road and that they are all paying the highway tax,[29] using 2,000 gallons per year each (CNG is more attractive to high mileage heavy light duty truck owners, because they use a lot of fuel and the tankage makes less relative difference in vehicle weight and payload), revenue in 1994 will be about $2.2 million, compared to the $3.7 million that would be generated by tax parity on an energy content basis. The 5,000 or so methanol vehicles will displace about 2.5 million gallons (assuming that they are in relatively low mileage use) and use 5 million gallons of methanol, for a tax obligation of about $550,000.

By 2010, there would be about 2.6 million AFVs, mandated by EPACT.[30] Using the 40/40/20 split estimated in Table 3, 1 million CNG vehicles using 2 billion gasoline equivalent gallons of CNG would pay about $112 million; one million propane vehicles displacing 2 billion gallons of gasoline would use 2.7 billion gallons of propane and pay about $500 million; 500,000 methanol vehicles displacing 250 million gallons of gasoline[31] would use 500 million gallons of methanol and pay about $55 million in highway taxes. Total tax income would be $667 million. Gasoline tax foregone on the 4.25 billion gallons of gasoline displaced would be about $782 million.

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[29] Not likely, given the fact that many are in government fleets and many others are experimental.

[30] IB 93009. Op. cit.

[31] Assuming that methanol FFVs would be selected by those seeking minimal first cost because they didn't drive enough miles to repay the incremental gaseous-fueled vehicle cost through lower fuel prices.

Energy Equivalent Tax at The Gasoline Rate

Under this option, the total number of AFVs in 2010 would still be about 2.6 million, as indicated in Table 3. The CNG vehicles would displace about 1.5 billion gallons of gasoline and would pay 275 million; the 1.25 million propane vehicles would displace 2.5 billion gallons of gasoline and pay $460 million; the 500,000 methanol vehicles would displace 250 million gallons of gasoline and pay $46 million for a total of $782 million. There would be no loss of Highway Trust Fund revenue.

No Federal Highway Tax on Alternative Fuels

Should the highway tax be temporarily waived for alternative fuels, AFVs would begin to penetrate the parts of the market not under mandate. From the estimates made earlier in this report, some 7.5 million nonfleet vehicles would become economic on propane, some 5 million on methanol. The same 500,000 CNG vehicles would be on the road as in the base case.

Assuming that each nonfleet propane vehicle would displace 1,000 gallons of gasoline per year, 7.5 billion gallons of gasoline would be displaced. If each nonfleet methanol vehicle consumes 500 gallons per year, as the methanol fleet vehicles are assumed to do, another 2.5 billion gallons of gasoline would be displaced. The 10 billion gallons of gasoline displaced would cost the Highway Trust Fund $1.84 billion.

Adding the fleet tax loss of $782 million and the nonfleet tax loss of $1.84 billion, total revenue foregone would be $2.6 billion.

12 Cents Tax per Gasoline Gallon Equivalent on Alternative Fuels

Assuming the fleet distribution of AFVs as in Table 3, and mileage driven as calculated for this option, the fleet CNG vehicles would displace 1.7 billion gallons, the fleet propane vehicles 2.3 billion gallons, and the fleet methanol vehicles 250 million gallons. Total tax revenue would be $510 million.

On the nonfleet side, the propane vehicles would displace 2 billion gallons and the methanol vehicles 750 million gallons, for a total revenue of $240 million and $90 million respectively. Net revenue foregone would be $448 million. These estimates are summarized in Table 4.

Under the status quo, there would be a net revenue loss to the Highway Trust Fund of $115 million in 2010 because of the increase in CNG vehicles resulting from the EPACT mandates. There would be no net loss for the all fuels tax equal to gasoline option, a $2.6 billion loss for the option of removing the tax from the alternative fuels, and a revenue loss of $448 million for the intermediate option. The costs per gallon of gasoline displaced would be $0.03 ($1.14 per barrel), zero, $0.18 ($7.66 per barrel), and $0.064 ($2.70 per barrel) for the intermediate option.

Assuming that the EPACT mandate should get credit for the first 4.25 billion gallons, equal taxation on an energy basis would have no economic or energy impact, removing the tax from the alternative fuels would displace 10 billion gallons of gasoline for $2.6 billion, or $0.26 per gallon of gasoline displaced ($11 per barrel), and the intermediate option would displace 2.75 billion gallons of gasoline for $448 million, or $0.16 per gallon of gasoline displaced ($6.84 per barrel).

Table 4. Impact of Highway Tax Options on Highway Trust Fund Revenues in 2010 (Millions of Dollars)

Option	Status Quo	Tax Equal to Gasoline on Energy Content	No Federal Highway Tax	12 Cents per Gallon of Gasoline Equivalent
Fleets (Total Tax Revenue)	**667**	**782**	**0**	**510**
CNG	112	276	0	204
Propane	500	460	0	276
Methanol	55	46	0	30
Non-Fleets (Total Tax Revenue)	**0**	**0**	**0**	**330**
CNG	0	0	0	0
Propane	0	0	0	240
Methanol	0	0	0	90
Total Highway Tax Revenue from Alternative Fuels	**667**	**782**	**0**	**840**
Gasoline Tax Foregone	**782**	**782**	**2600**	**1288**
Gasoline Gallons Displaced	**4.25 billion**	**4.25 billion**	**14.25 billion**	**7 billion**

CONCLUSIONS

Since the different fuels have different economics and different current tax rates per gasoline gallon equivalent, setting the tax on each at a rate that is equivalent on an energy basis would favor propane most, methanol some, and natural gas least. Should the States follow on the same basis, all would benefit, while methanol would gain the most relative to the other fuels, because it is taxed per gallon in most States.

The estimates show that highway tax policy has the potential to foster penetration of AFVs more significantly than all of the provisions of EPACT and other Federal policies put together. Removing the Federal highway tax altogether from the alternatives could conceivably lead by 2010 to replacement of 10% of the gasoline which, when added to the gasoline backout of the oxygenates in gasoline, would bring the nation more than halfway to the 30% goal. Concurrent removal of State highway taxes from the alternative fuels could lead to a 20% replacement and bring the country close to realizing the 30% goal. Current policy will lead to replacement of less than 10% of the gasoline[32] and will not lead to significant penetration of alternative fuels into markets not under mandate.

The study options in this report are not designed to be "revenue neutral" to either the Federal government or the States. Since the economics of both the fuels and the vehicles would improve with increasing scale, perhaps a reduced highway excise tax on alternative fuels need not be permanent but could be phased out in a manner similar to that currently in EPACT for the vehicles and the fuel delivery infrastructure. Thus, a temporary waiver of the excise tax, followed by reimposition on an energy equivalent basis, would stimulate penetration of alternative fuels into market segments beyond those fleets mandated by EPACT. The "no Federal highway tax" option would represent in 2010 about 2.5 cents per gallon of gasoline estimated to be consumed in that year and would be very small in the early years of the policy as the numbers of AFVs increased from its current very small base.

This report assumes from the beginning that electric vehicles and ethanol fuel would not become economically competitive between now and 2010 as a result of changes in highway tax policies. That assumption simplifies the calculations and comparisons. Should some sort of tax parity be considered, electricity and ethanol should be included, as they are technically and environmentally viable as alternative fuel options, and the assumptions about them in this report may well be wrong.

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[32] IB 93009, Op. cit.