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ALTERNATIVE FUEL OPTIONS AND COSTS FOR USE IN KANSAS AND SURROUNDING STATES

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16 Abstract

To meet state and federal mandates, state fleets, federal fleets, and fuel provider fleets must acquire alternatively fueled vehicles (AFVs). The Kansas House Bill 95-2161 exceeds the federal energy policy act regulations for state fleets. AFVs include vehicles fueled by ethanol, methanol, propane, natural gas, and electricity. This report includes information about who must comply with the regulations, what constitutes compliance, tax incentives and AFV options. Estimates within this report are based on 1996 dollars.

Credits can be earned, at the rate of one credit per AFV, if AFVs are acquired in excess of the minimum requirements or in advance of the requirement date. Tax incentives are also offered for qualified alternative fuel vehicle property, conversion equipment, and refueling property.

The report discusses various AFV options including Flexible Fuel Vehicles (FFVs), powered by any mixture of gasoline and alcohol fuel, and propane vehicles. In addition, public fueling stations and vehicle conversion from gas to an AFV are discussed.

The reports states that CNG vehicles currently have the lowest operating cost ($/mile), but have relatively high incremental initial cost and fueling station cost. Conceivably, for very high mileage applications, CNG vehicles could become the lowest cost option.

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PREFACE

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The contents of this report reflect the views of the authors who are responsible for the facts and accuracy of the data presented herein. The contents do not necessarily reflect the views or the policies of the State of Kansas. This report does not constitute a standard, specification or regulation.

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ALTERNATIVE FUEL OPTIONS AND COSTS FOR USE IN KANSAS AND SURROUNDING STATES

INTRODUCTION

To meet state and federal mandates, state fleets, federal fleets, and fuel provider fleets must acquire alternatively fueled vehicles (AFVs). Two pieces of legislation affect fleets in Kansas, the federal Energy Policy Act and the State House Bill 95-2161. Included in this report is information about who must comply with these regulations, what constitutes compliance, tax incentives, and AFV availability.

COMPLIANCE

State Fleets - The State of Kansas House Bill 95-2161 requires that fleets with 20 or more vehicles in the consolidated metropolitan areas (CSMA) of Wichita and Kansas City make 15% of their new vehicle purchases AFVs in the 1997 model year. These areas include the following counties: Johnson, Leavenworth, Miami, and Wyandotte for the Kansas City CSMA, and Butler, Harvey, and Sedgwick for the Wichita CSMA. This provision applies to light-duty vehicles (GVW less than 8,500 pounds).[1] State fleets are obligated as a result of HB 95-2161 to fuel their required AFVs with alternative fuels. HB 95-2161 exceeds EPACT regulations for state fleets.[2] Table 1 summarizes AFV purchase requirements for state fleets as mandated by House Bill 95-2161.

TABLE 1. PERCENTAGE OF STATE FLEET LIGHT DUTY VEHICLE PURCHASES REQUIRED BY HB95-2161.[3]

Model Year	State % AFV Purchases
1996	10%
1997	15%
1998	25%
1999	50%
2000+	75%

Federal and Fuel Provider Fleets - The Federal Energy Policy Act of 1992 (EPACT) requires that purchases made by fuel provider fleets and federal fleets with a minimum size of 50 vehicles must be comprised of 30% and 25% AFVs, respectively, during the 1997 model year. EPACT applies to light-duty vehicles (GVW less than 8,500 pounds), and to the CSMAs of Wichita and Kansas City.[4]

On December 13, 1996, President Clinton signed Executive order 1301, which calls on each

Federal agency to develop and implement was meet the alternative fuel vehicle (AFV) acquisition requirements of the Federal Policy Act (EPACT) of 1992. The executive order requires each agency to submit detailed reports within 60 days of signing of the order to the Office of Management and Budget detailing its compliance with EPACT. The order also states that each medium-duty vehicle and zero emission vehicle (ZEV) will be counted the same as two light-duty vehicles, and each dedicated alternative fuel heavy-duty vehicle will be counted as three light-duty AFV's. This Executive Order applies only to federal fleets. [4]

Table 2 summarizes EPACT purchasing requirements for fuel providers and federal fleets. EPACT imposes no regulations on municipal fleets. EPACT regulations for state fleets are exceeded by HB 95-2161.[5]

TABLE 2. NEW FLEET VEHICLES REQUIRED BY EPACT.[6]

Model Year	Federal % AFV Purchases	Fuel provider % AFV Purchases
1997	25%	30%
1998	33%	70%
1999	50%	90%
2000	75%	90%

Fuel provider fleets are required to use alternative fuels in their AFVs. These fleets can be audited by the DOE to ensure alternative fuel usage.

An executive order is imminent which will require federal fleets to buy alternative fuels by either reallocating program funds or having congress appropriate more funds. Currently, federal fleets lack funding to use alternative fuels in all their AFVs.[7]

Credits: For fleets that comply with EPACT credits can be earned, at the rate of one credit per AFV, if AFV's are acquired in excess of minimum requirements or in advance of the requirement date. If a state or fuel provider Aquarius an AFV before model year 1997, DOE will allocate one credit per AFV for each year the AFV is acquired before acquisition requirements apply. Credits can also be earned for the purchase of medium and heavy duty AFV's, only after the fulfillment of light duty AFV percentage requirements for that model year. Credits earned in this manner can be used in subsequent model years. Credits may be transferred from one area to another and between any covered fleets.

AFV OPTIONS

AFVs include vehicles fueled by ethanol, methanol, propane, natural gas, and electricity. Each of these fuels has predominant advantages and disadvantages as summarized by Table 3. Depending upon the number of vehicles in a fleet and the average usage, these advantages may translate into different bottom line costs per mile. For example, the low initial cost of an E85

flexible fuel vehicle makes it less costly if it is in a low usage application, while the low cost of the natural gas fuel may make it less costly for large fleets with high usage. Tables 4.1-4.5 shows the results of three different studies comparing AFVs.

The following assumptions were used for the case studies of Table 4.

1. The costs of refueling stations for E-85, M-85, and propane are each $30, 000.
2. There is no cost for gasoline or electric fueling stations because of current availability.
3. The cost of a CNG station is $200,000.
4. The cost of a sedan is $14,000.
5. The cost of a van is $20,000.

The National Ethanol Vehicle Coalition estimates are based on 1996 dollars. Assumptions for this model are listed in Appendix C. [8]NREL findings are based on a four-year study of comments collected from drivers and service records[9]. Oak Ridge National Lab data come from spreadsheet models. Of equal importance to the costs of the vehicles is the availability of vehicles Table 5 lists vehicles which are presently available for purchase. Table 6 lists typical costs for converting vehicles to propane and natural gas.

TABLE 3. KEY ADVANTAGES AND DISADVANTAGES 0F ALTERNATIVE FUEL OPTIONS.

Vehicle type	Key advantages	Disadvantages
E-85	Low incremental vehicle cost	High fuel cost
M-85	Low incremental vehicle cost	High fuel cost and toxicity
Propane	Low fuel cost and good availability	Moderate incremental vehicle cost gas at STP[a]
CNG	Low fuel cost and home fueling capabilities	Significant sacrifice in range per fueling and cargo carrying capacity. moderate incremental vehicle cost gas at STP[a]
Electric	Quiet, zero pollution at vehicle and home fueling capabilities	High incremental vehicle cost

[a]STP is standard temperature and pressure.

Tables 4.1-4.5 show the estimated cost of alternative fuel options for a base case. Present year as well as 2010 case models are presented.

TABLE 4.1 NATIONAL ETHANOL COALITION TAX-EXEMPT ESTIMATES FOR SEDANS.

Vehicle type	Incremental initial costs ($/vehicle)	Operating costs ($/ mile)	Operating costs (3yr/ 75,000mi) ($/vehicle)	Case 1[b]. total/AFV($)	Case 2[c]. total/AFV($)
Gasoline	0	0.025	1,875	15,875	15,875
E-85	0	0.040	3,000	**18,500**	**17,600**
M-85	0	0.042	3,150	18,650	17,750
Propane	2,500	0.031	2,352	20,325	19,425
CNG	3,400	0.026	1,950	29,350	23,350

TABLE 4.2 NATIONAL ETHANOL COALITION TAX-INCLUDED ESTIMATES FOR SEDANS.

Vehicle type	Incremental initial costs ($/vehicle)	Operating costs ($/mile)	Operating costs (3yr/75,000mi) ($/vehicle)	Case 1[b]. total/AFV($)	Case 2[c]. total/AFV($)
Gasoline	0	0.04	3,000	17,000	17,000
E-85	0	0.058	4,350	**19,850**	**18,950**
M-85	0	0.067	5,025	20,525	19,625
Propane	2,500	0.042	3,150	21,150	20,250
CNG	3,400	0.036	2,700	30,100	24,100

TABLE 4.3 NATIONAL RENEWABLE ENERGY LABORATORY FINDINGS FOR SEDANS.

Vehicle type	Incremental initial costs ($/vehicle)	Operating costs ($/mile)	Operating costs (3yr/75,000mi) ($/vehicle)	Case 1 [b]. total/ AFV($)	Case 2 [c]. Total/ AFV($)
Gasoline	0	0.04-.06	3,000-4,500	17,000-18,500	17,000-18,500
E-85	250	0.06-0.13	4,500-9,750	**20,250-25,500**	**19,350-24,600**
M-85	250	0.06-0.17	4,500-12,750	20,250-28,500	19,350-27,600

TABLE 4.4 NATIONAL RENEWABLE ENERGY LABORATORY FINDINGS FOR VANS.

Vehicle type	Incremental initial costs ($/vehicle)	Operating costs ($/mile)	Operating costs (3yr/75,000mi) ($/vehicle)	Case 1 [b]. total/ AFV($)	Case 2 [c]. total/ AFV($)
Gasoline	0	0.07-0.17	5,250-12,750	25,250-32,750	25,250-32,750
M-85	250	0.10-0.26	7,500-19,500	29,250-41,250	**28,350-40,350**
CNG	3,500-7,500	0.04-0.14	3,000-10,500	38,500-46,000	32,500-40,000

TABLE 4.5 OAK RIDGE NATIONAL LABORATORY PREDICTIONS FOR 2010.

Vehicle type	Incremental initial costs ($/vehicle)	Operating costs ($/mile)	Operating costs (3yr/75,000mi) ($/vehicle)	Case 1 [b]. total/AFV ($)	Case 2 [c]. total/AFV($)
Gasoline	0	0.062	4,650	18,650	18,650
E-85	50	0.084	6,300	21,850	20,950
M-85	50	0.062	4,650	20,200	19,300
Propane	198	0.055	4,125	**19,820**	**18,923**
CNG	525	0.062	4,650	29,175	23,175
Electric	5,855	0.121	9,075	28,930	28,930

[b]Cost increased by $1,220 for orders after 12/31/96.
[c]Cost increased by $810 for orders after 12/31/96.

CASE 1. Cost per vehicle in a fleet of 20 AFVs for 3 years (75,000 miles) including incremental initial cost and cost of fueling site ($/vehicle)

CASE 2. Cost per vehicle in a fleet of 50 AFVs for 3 years (75,000 miles) including incremental initial cost and cost of fueling site ($/vehicle)

It should be noted that assumptions of 20 and 50 AFV fleets as well as average mileage of 25,000 miles per year do not apply to all fleets. Larger fleets and increased use of vehicles will tend to favor CNG since CNG is the least expensive fuel on an energy basis (see Figure 5 in APPENDIX A). It is possible that the total costs for using CNG will be lower than for using gasoline. Fleets can refuel in existing AFV fuel sites (Table 7) or build their own stations (Table 8). Fuel costs for some AFVs are included in Table 8.

TABLE 5. AFV'S OFFERED BY AMERICAN-AUTO MAKERS IN THE 1997 MODEL YEAR, INCLUDING NET COST OVER GASOLINE MODEL WHEN AVAILABLE.

AUTOMAKER	E-85, M-85	CNG bi-fuel	CNG DEDICATED	PROPANE	ELECTRIC
Ford.[10]	Taurus (FFV) save $345	Contour+ $3,255	Crown victoria+$3,255, f-250+$2,360[d], Econoline 250+$1,130[e], 350 club wagon+$0[e]	none	Ranger(1998)
GM[11]	None	c2,500 Pickup[d], sierra pickup[d]	None	None	EV-1(1998)
Chrysler[12 g]	None	None	None	none	EPIC(CALI)

[d]Cost increased by $1,220 for orders after 12/31/96.
[e]Cost increased by $810 for orders after 12/31/96.
[f]Pending final validation.
[g]At a press conference held during the meeting of the Governors' ethanol Coalition, Chrysler announced that beginning in 1998 all Chysler minivans would come equipped with E-85 engines at no additional costs.

TABLE 6. APPROXIMATE COST OF CONVERTING VEHICLES TO AFV'S.

Vehicle type	Conversion cost
LPG[13]	$2,500-$3,500 for trucks, $3,000-$3,700 for sedans
CNG[14]	$2,700-$5,000
E85[15]	No retrofits available
M85[16]	No retrofits available

TABLE 7: NUMBER OF REFUELING STATIONS IN KANSAS AND MISSOURI.[h, 17]

Vehicle type	KS	MO
LPG	38	83
CNG	19	11
E85	2	1
M85	0	0

[h] see attached list of refueling locations in Kansas.

TABLE 8. APPROXIMATE COST TO BUILD VARIOUS AFV REFUELING STATIONS.

Vehicle type	Refueling station costs
LPG[18]	$15,000-$30,000 for 2,000 gallon tank
CNG[19]	$200,000
E85[20] [i]	$40,000 for new site, $1,000 to convert gasoline site
M85[21]	$20,000 for 2,000 gallon tank

[i] see section below about FFVs

TAX INCENTIVES

Section 6 of HB 95-2161 creates an income tax credit for taxpayer expenditures for qualified alternative fuels vehicle property, conversion equipment, and refueling property made after January 1, 1996. A qualified taxpayer is defined in this section as *any person, association, partnership, limited liability company, limited partnership, or corporation who owns and operates a fleet of 10 or more vehicles and the average fuel consumption for such a fleet of motor vehicles is equal to or greater than 2,000 gallons per year.* Between 1/1/96 and 12/31/96, the taxpayer may receive a tax credit of 50% of the total amount expended, not to exceed $2,500 per vehicle. After 1/1/99, the tax credit drops to 40% with a $2,000 per vehicle limit.

Any taxpayer that purchases a factory-equipped AFV and does not determine the exact basis attributable to such property shall be allowed a credit not exceeding the lesser of 5% of the cost of the vehicle or $750. This applies only if the 50% tax credit has not been taken, and only to the first owner. If the tax credit exceeds the taxpayer's liability, the amount that exceeds the liability may be carried over for deduction the following year or years until the total amount of the tax credit has been deducted from tax liability, except that no such tax credit shall be carried over for deduction after the third taxable year.[22]

TABLE 9.1 EPACT TAX INCENTIVES PER AFV PURCHASED BY GROSS WEIGHT (GVW).[23]

Tax Incentives	By GROSS vehicle WEIGHT (GVW) of AFV		Special AFVs	Per Fueling Site
	Up to 10,000 lb		10,001 to 26,000 lb	Over 26,000 lb
CREDIT				
DEDUCTION	Up to $2,000 per AFV		Up to $5,000 per AFV	Up to $50,000 per AFV

TABLE 9.2 EPACT TAX INCENTIVES PER AFV PURCHASED FOR SPECIAL AFV'S.[23]

SPECIAL AFV's	Buses seating 20 or more	Electric vehicles	Per fueling site
CREDIT		**10% up to $4,000 per EV**	
DEDUCTION	**Up to $50,000 per bus**		**Up to $100,000 per site**

Appendix A

FLEXIBLE FUEL OPTIONS

Flexible Fuel Vehicles (FFVs) are vehicles with a single tank and powered by any mixture of gasoline and alcohol fuel. The only FFV available for the 1997 model year is the Ford Taurus.[24] Taurus comes in an E-85 and an M-85 version. These cars are designed to burn a mixture of gasoline and 85% ethanol or 85% methanol. The difference in FFVs and normal gasoline engines are in the engines' control systems, and not in the engine itself. FFVs monitor the oxygen content of the fuels entering the engine and adjust the fuel to air ratio to enhance efficiency. The Taurus E-85 and M-85 differ only in this control system. The only difference in the E-85 and M-85 vehicles lies in a replaceable electronic component called the chip that controls engine settings to minimize exhaust pollutants. Conversion can be achieved by replacing the chip. FFVs also have specially lined tanks and hoses to avoid corrosion and o-rings, gaskets, and seals constructed with special polymers.[25] Gasoline vehicles cannot be converted to FFVs.[26]

The Ethanol Vehicle Coalition provides a "Forgivable Loan" to public fueling stations. This entails the coalition paying for the E-85 infrastructure in return for the stations agreeing to sell E-85 for four years.[27]

Based on the findings reported in Tables 4.1-4.5, the E-85 FFV is the current lowest cost option. It can conceivably be viewed as an even lower cost option by taking advantage of the Forgivable Loan from the Ethanol Vehicle Coalition and by using gasoline as the fuel for fleets in which use of alternative fuel is not mandated. The ethanol AFVs should remain the lowest cost options as long as current ethanol production tax incentives are in place. Without these producer based tax incentives, methanol would be the lower cost option.

PROPANE VEHICLES

Propane vehicles, which are also known as liquid petroleum gas (LPG) vehicles, are not offered by any of the three major US automakers in the 1997 model year. Gasoline vehicles can be converted to propane. In Table 9 are some of the vendors that perform conversions and a cost estimate for converting. Attached is a list of propane refueling stations in Kansas. The range for propane vehicles is almost equivalent to that of a comparable gasoline vehicle. The power, acceleration, payload, and cruise speed are comparable with those of an equivalent internal-combustion engine.[28]

As shown in Table 4.5, the Oak Ridge National Lab (ORNL) predictions for 2010 report that propane will be the lowest cost option. This ORNL estimate is based on ethanol cost projections, which are considerably higher than projections, by the National Renewable Energy Laboratory (NREL). If NREL projections are used, ethanol would be the lowest cost AFV option.

CNG vehicles can be obtained by either purchasing those offered by Ford or GM or by converting gasoline vehicles. CNG conversions are less common than propane conversions. In Table 9 are some of the vendors in Kansas that perform conversions and a cost estimate for converting. Attached is a list of CNG refueling sites in Kansas. The range of CNG vehicles is at least one-half that of comparable gasoline-fueled vehicles. The power, acceleration, payload, and cruise speed are comparable to those of equivalent internal combustion engines.[29]

Tables 4.1-4.5 show that the operating costs for CNG vehicles is lower than for other AFV options. Therefore, for very high mileage applications, CNG vehicles could potentially be the lowest cost option.

SUMMARY OF LOW COST OPTIONS

The findings in Tables 4.1-4.3 show that the E-85 FFV is the lowest cost option for fleets. It is an even better cost option when the Ethanol Vehicle Coalition's Forgivable Loan program is applied, and when gasoline is used for fleets not mandated to use alternative fuels. The drawback of FFVs is their limited availability--the Ford Taurus is currently the only model available.

CNG vehicles currently have the lowest operating cost ($/mile), but have relatively high incremental initial cost and fueling station cost. Conceivably, for very high mileage applications, CNG vehicles could become the lowest cost option.

Table 4.5 shows that in 2010, propane vehicles are predicted to be the lowest cost option; however, supplier-controlled price fluctuations of propane ultimately leave the economics of propane utilization in the hands of the fuel suppliers.

FUEL PRICE TRENDS

Trends in prices for the last few years are summarized by Figures 1 through 5. As seen by these trends, the price of propane and natural gas can vary considerably. Prices of natural gas and propane reached its peak in 1997.

Ethanol prices and price trends have been relatively stable (except for the past year, which has now been corrected). Due to advances in converting wood, grass, and municipal waste into ethanol, the prices for ethanol are expected to remain stable or decrease slightly over the long run

With the exception of 1995, methanol prices have also been relatively stable. Price increases at this time were due to supply shortage due to a major production facility being off line for several months. If higher volumes of methanol were used, these types of supply shortages would not occur and methanol would potentially line out at prices less than ethanol even with ethanol tax incentives. These stable, low prices are a good back-up option to use of ethanol vehicles since ethanol vehicles can be readily converted to methanol vehicles.

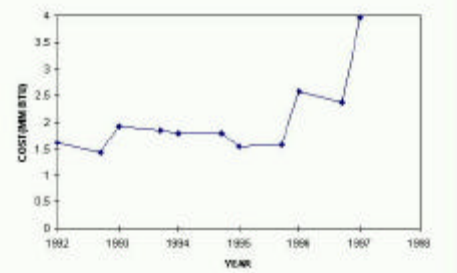

Fig 1. Price trends for Natural Gas (Oil and Gas Journal)

Fig 2. Price trends for propane (Oil and Gas Journal)

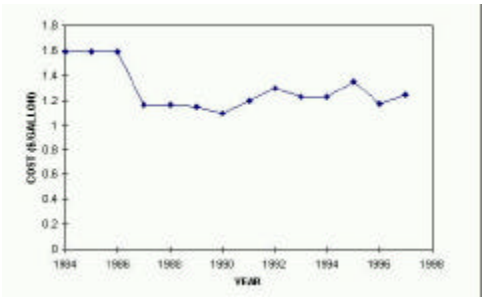

Fig 3. Price trends for ethanol (Chemical Marketing Reporter)

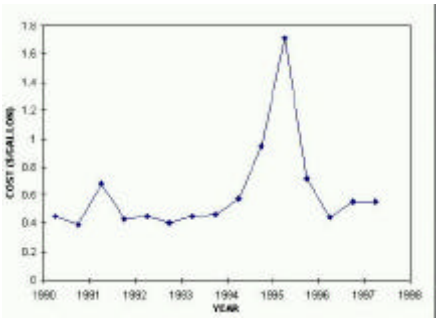

Fig 4. Price trends for methanol (Chemical Marketing Reporter)

Figure 5 clearly indicates the prices of various alternative fuels and gasoline. The prices here have been converted to gasoline equivalent. The gasoline equivalents are obtained by multiplying the cost of the fuel by the ratio of per gallon energy content of gasoline to that of the particular fuel. The prices were taken on a tax-free basis.

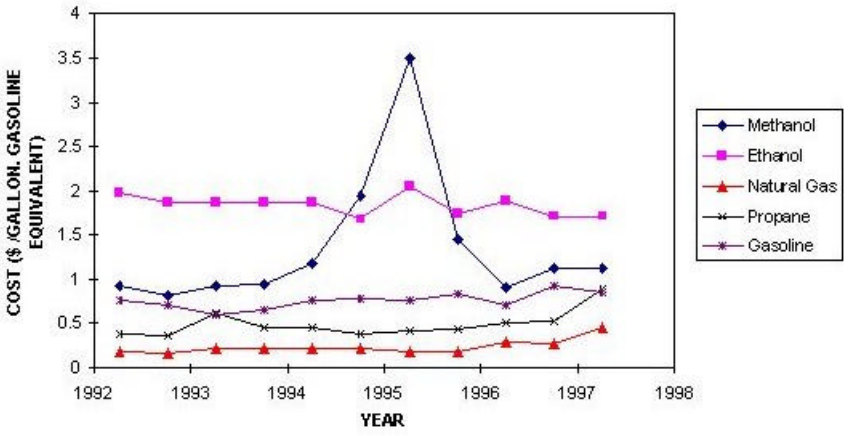

Fig 5. Comparative price trends in gasoline equivalent.

Appendix B

LPG

State Avenue Goodyear Kansas City, KS
913-788-7272

Dee's Auto & Truck Repair
Arkansas City
316-442-2781

Lovett's Auto
Junction City
913-762-5160

Payne Oil Co.
Salina
913-823-2287

Carson's Mechanical Service
Great Bend
316-793-5353

Ten Penny's
Nortonville
913-886-3333

Yosemitie Sam's
Topeka
913-246-2083

CNG

State Avenue Goodyear Kansas City, KS
913-788-7272

Dee's Auto & Truck Repair Arkansas City
316-442-2781

APPENDIX C

Assumptions made by Ethanol Vehicle Coalition for making cost estimations:

1. All vehicles are mid-size vehicles, such as Chevrolet Lumina or Ford Taurus. For the purpose of this comparison, it is also assumed that the fuel economy remains constant and that the vehicles are driven under identical conditions of climate and elevation, to identical destinations, by identical drivers.
2. 25 miles per gallon (all around usage) for gasoline vehicles.
3. 18 miles per gallon (all around usage) for E-85 vehicles.
4. 12.5 miles per gallon (all around usage) for M-85 vehicles.
5. 21.25 miles per therm (all around usage) for CNG vehicles.
6. 20.2 miles per gallon (all around usage) for propane vehicles.
7. $0.62 per gallon of gasoline (tax-exempt purchased by Midwest state).
8. $1.00 per gallon of gasoline (approximate current retail price).
9. $0.72 per gallon of E-85 (tax-exempt purchased by Midwest state with alcohol fuels tax credit applied).
10. $1.04 per gallon of E-85 (approximate retail pump price with alcohol fuels tax credit applied).
11. $0.52 per gallon of M-85 fuel (tax exempt).
12. $0.84 per gallon of M-85 fuel (approximate retail market price).
13. Cost of 1 therm natural gas = $0.55 (tax exempt).
14. Cost of 1 therm natural gas = $0.776 (appropriate retail price for use as motor fuel.
15. Propane cost = $0.63 per gallon (tax exempt).
16. Propane cost = $0.85 per gallon (approximate retail price).
17. One gallon of gasoline = 114,000 BTUs.
18. 14 therms of natural gas = 1 gallon of gasoline.
19. 1.24 gallons of propane = one gallon of gasoline.
20. Cost of natural gas conversion kit = $4500 per vehicle.
21. Cost of Propane conversion kit = $2500 per vehicle
22. Cost of M-85 OEM option = $1000 per vehicle.
23. Cost of E-85 OEM option = $1000 per vehicle.
24. Assume all other repair and maintenance costs are identical.