Public Transit's Investment in Clean Air Technologies

RTD

Southern California Rapid Transit District

Cost Impacts of the 1990 Clean Air Act on the U.S. Transit Industry

A survey by the Southern California Rapid Transit District (SCRTD)

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ESTIMATED COSTS OF THE 1990 CLEAN AIR ACT

FOR ALTERNATIVE FUELS AND LOW EMISSIONS TECHNOLOGY

FLEET COSTS[1]:	$7.4 Billion (diesel)
	$9.3 Billion (methanol)
	$9.9 Billion (CNG)
	$8.0 Billion (particulate trap)
FUEL COSTS[2]:	$185 Million (diesel)
	$536 Million (methanol)
	$240 Million (CNG)
	$228 Million (particulate trap)
FACILITY COSTS[3]:	$12 Million (Fuel storage system)[4]
	$1.05 - $1.15 Million (methanol)[5]
	$1.5 - $3.5 Million (CNG)[6]

[1]*Total estimated cost for national fleet of 39,000 buses. Fleet replacement normally scheduled over 12 years; the Clean Air Act may accelerate replacement in some areas.*

[2]*Costs extrapolated to 1 billion miles for national fleet; data collected pre-Persian Gulf Crisis.*

[3]*Regional differences (municipal codes, environmental regulations and land acquisition requirements/prices) caused wide variances in survey results; therefore, no national conclusions were drawn for facility costs.*

[4]*Existing fuel storage systems at SCRTD will have to be either replaced or modified to meet new federal regulations for underground fuel storage tanks at a cost of $1.0 million per fuel storage system, or approximately $12.0 million for the SCRTD's 12 operating divisions.*

[5]*Added cost to construct a new methanol fueling facility at SCRTD.*

[6]*A new CNG fueling station for a large fleet operation (up to 250 buses).*

COST IMPACTS OF THE 1990 CLEAN AIR ACT

ON THE U.S. PUBLIC TRANSIT INDUSTRY

SURVEY METHODOLOGY

Eighteen of the nation's largest public transit properties responded to the SCRTD's survey. These properties represent a total of 20,645 owned buses.

The survey made inquiries into three alternate fuels/low emissions related cost categories: 1) fleet costs, 2) fuel costs, and 3) facility costs.

These estimates were then extrapolated to represent all Metropolitan Standard Areas (MSAs) with populations greater than 750,000 and a national fleet of 39,000 buses traveling an estimated 1.0 billion miles per year.

Vehicle durability and overall maintenance costs were not included since adequate data are not yet available for this purpose.

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COST IMPACTS OF THE 1990 CLEAN AIR ACT ON THE U.S. PUBLIC TRANSIT INDUSTRY

BACKGROUND

In the summer of 1990, the Southern California Rapid Transit District (SCRTD) conducted a survey of U.S. public transit properties to quantify estimated costs to convert from diesel buses to alternate fuel/low emissions buses.

The survey also evaluated the cost to purchase and operate an alternate fuel/low emission transit bus fleet. In addition to fuel and fleet costs, transit properties were asked to estimate the costs of constructing or upgrading alternate fuel fueling facilities. Code interpretations, land costs, and lack of specific design guidance resulted in a wide range of cost estimates; therefore, survey findings for this category are generalized.

The cost estimates identified in this survey are based on limited testing of new, R&D technologies. There is no mature or completely tested heavy-duty clean air transit bus technology currently available. With the exception of the SCRTD, which is operating various buses with all current technologies and has built methanol and compressed natural gas (CNG) refueling facilities, the survey results represent the best available cost estimates by various transit properties to convert their fleets based on their individual situation and local market availability of methanol, CNG and low sulfur diesel fuel. As the transit industry's experience with the new technologies increases, normal market pressure for lower costs and increased durability are anticipated.

This survey provides policymakers with the best available fleet data and cost estimates (as of summer 1990) to evaluate the impacts of the Clean Air Act on the U.S. public transit industry. The survey's findings demonstrate the urgent need for Congress to authorize and appropriate funds to comply with the federal mandates of the Act.

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COST IMPACTS OF THE 1990 CLEAN AIR ACT ON THE U.S. PUBLIC TRANSIT INDUSTRY

DESCRIPTION OF FLEET COSTS

Transit fleet costs are usually associated with a 12-year bus life and replacement cycle. This means that the typical annual cash flow to replace a transit bus fleet could be the cost to replace 1/12 of the owned fleet each year. Under the clean air regulations that SCRTD operates under, these costs would be accelerated as we are obligated to achieve a goal of 100 percent conversion to low emission buses by the year 2000. As such, it will be necessary to increase bus capital spending to replace a given fleet in less than 12 years here at SCRTD. Local laws and conditions will affect these schedules on a national basis.

Based on the results of the survey, the estimated cost to replace a bus for each technology (1990 prices) would be: $190,000 for diesel, $238,000 for methanol, $254,000 for CNG and $204,000 for particulate traps. The total estimated costs for a national fleet of 39,000 buses would be $7.4 billion for diesel, $9.3 billion for methanol, $9.9 billion for CNG and $8.0 billion for particulate traps.

Based on SCRTD's experience with such technology, the estimated cost range for each alternate fuel bus is slightly lower than the survey except for particulate traps. Therefore, the following ranges of prices are estimated: a) methanol - the range is between $215,000 and $230,000 per bus, b) CNG - the range is between $230,000 and $240,000 per bus, and c) particulate traps - the range is between $200,000 and $211,000 per bus.

DESCRIPTION OF FUEL COSTS

Fuel cost data in this report were collected before the Persian Gulf Crisis. They represent annual operating budget expenditures at the SCRTD. When extrapolated to an estimated 1.0 billion miles for the national fleet, the survey results yield a total estimated fuel cost of $185 million for diesel, $536 million for methanol, $240 million for CNG and $228 million for particulate traps. These estimates will be refined as more experience is gained and may also be influenced by market conditions and public policy decisions.

COST IMPACTS OF THE 1990 CLEAN AIR ACT

ON THE U.S. PUBLIC TRANSIT INDUSTRY

DESCRIPTION OF FACILITY COSTS

The survey estimates for new fueling facilities vary widely depending on municipal codes, environmental regulations and land acquisition requirements and prices. No national conclusions were drawn due to the variance of the survey results and the regional nature of the situation. However, new federal regulations for underground fuel storage tanks will require significant expenditure of capital funds over the next eight years for all transit properties.

Existing fuel storage systems at SCRTD will have to be either replaced or modified to meet these new fuel tank regulations. These costs are estimated to be $1.0 million per system or approximately $12.0 million for the SCRTD's 12 operating divisions. It should be noted that when the fuel storage and dispensing systems have been upgraded to be in full compliance with the new regulations, they will be essentially compatible with methanol with minor modifications.

The cost increment to construct a new methanol fueling facility ranges between five and fifteen percent added cost over the same size diesel fuel facility or approximately $1.05 to $1.15 million per new methanol facility at SCRTD. The cost differential covers additional vapor recovery piping and upgraded material required in portions of the methanol systems. Based on experience at the SCRTD to date, other required facility changes relating to the use of methanol are minor.

The use of CNG fuel in transit buses requires a completely new fuel storage and dispensing system. The costs for a new CNG fueling station for a large fleet operation (up to 250 buses) will be in the rage of $1.5 to $3.5 million, depending on the fueling time requirements of the transit property (fast fuel is costly and slow fuel is relatively inexpensive).

Although the changes to the maintenance facility areas at SCRTD test divisions have been minor relative to CNG fueling, it is possible that regulatory agencies may require significant changes and improvement to ventilation and fire safety systems, a should a large number of buses by converted to CNG. This will be of major significance in colder climates where refueling and maintenance activities are typically performed indoors. These expenditures would be in areas such as explosion proof fixtures and special ventilation systems.

DESCRIPTION OF FACILITY COSTS ....continued

The use of CNG fuel will not obviate the need to expand capital funds for other underground tank improvements. This is due to the fact that a number of other products are stored in underground tanks at transit operating facilities including motor oil, transmission oil, antifreeze, waste oil, and waste fuel. A portion of the estimated $12.0 million for fuel station improvements at SCRTD is for soil clean up that would be required even if the facilities were closed. This cost will obviously vary depending on code regulations, work environment and specific conditions encountered at each location.

OTHER POTENTIAL COSTS

It was noted earlier that the cost figures in this study do not reflect durability of equipment, "weight penalties" or losses in passenger capacity associated with operating transit buses on alternate fuels.

Life cycle cost durability information related to vehicle life cannot be made at this time due to relatively low mileage on test fleets. It is estimated that another 3-5 years operational experience is needed before data on engine overhaul requirements, etc., can be determined with accuracy. As more experience is gained, engine durability forecasts will be attempted based on tear down measurements, oil analysis results and detailed investigations of engine failures.

A 1990-technology methanol bus weighs approximately 1600 lbs. more than a comparably equipped standard diesel bus while a CNG bus weighs approximately 2,800 lbs. more than the standard diesel bus. These buses have the same range as a diesel counterpart. However, the impact of added weight of the various alternate fuel transit bus technologies is being assessed. It is known that this weight increase adversely affects brake service, tire and transmission life and reduces passenger carrying capacities due to axle load limitations. Federal and state laws limit the total operating weight of a vehicle; therefore, if the weight of fuel increases, the passenger capacity must be reduced by a like weight value. A CNG fleet could require the purchase of up to 10 percent more vehicles in order to achieve passenger carrying capacity equal to a diesel fleet.

The vehicle weight increase associated with CNG will stress the importance of testing liquified natural gas (LNG) technology. This option is being explored by The Metropolitan Transit Authority of Harris County in Houston, Texas. LNG refueling rates and bus weight are attractive as compared to CNG so that a cost comparison between the two systems will eventually be necessary since achieving a fast fuel CNG capability is very expensive as well as the previously mentioned operational problems associated with weight.

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OTHER POTENTIAL COSTS ....continued

During the final edits of this report, the Clean Air Act of 1990 was passed. The 1995 issue of having all rebuilt engines brought up to the new emission standards was not addressed, but will add significant costs to implementation of the act by the transit industry. Current experiments with retrofit technology - methanol/Avocet, CNG and particulate traps are just beginning, with cost to retrofit vehicles in the $20,000 to $40,000 per bus range. No durability or life cycle data yet exists.

ATTACHMENT 1

AGENCY NAME	CITY, STATE
Metropolitan Atlanta Rapid Transit Authority	Atlanta, GA
San Mateo County Transit District	Burlingame, CA
Chicago Transit Authority	Chicago, IL
Greater Cleveland Regional Transit Authority	Cleveland, OH
Dallas Area Rapid Transit	Dallas, TX
Orange County Transit District	Garden Grove, CA
Southern California Rapid Transit District	Los Angeles, CA
Milwaukee County Transit System	Milwaukee, WI
New York City Transit Authority	New York, NY
New Jersey Transit	Newark, NJ
Alameda-Contra Costa Transit District	Oakland, CA
Southeastern Pennsylvania Transportation Authority	Philadelphia, PA
Sacramento Regional Transit District	Sacramento, CA
Utah Transit Authority	Salt Lake City, UT
Santa Clara County Transportation Agency	Santa Clara, CA
Municipality of Metropolitan Seattle	Seattle, WA
BI-State Development Agency	St. Louis, MO
Washington Metropolitan Area Transit Authority	Washington, DC

ESTIMATED COST ANALYSIS FOR FLEET PURCHASE
(BASED ON 1990 PRICES)

	FLEET SIZE	DIESEL BUS PURCHASE	REPLACEMENT DIESEL FLEET PURCHASE	METHANOL BUS PURCHASE	METHANOL FLEET PURCHASE	MEOH % INC	CNG BUS PURCHASE	CNG FLEET PURCHASE	CNG % INC	PART TRAP BUS PURCHASE	PART TRAP FLEET PURCHASE	TRAP % INC
WMATA	1704	$200,000	$340,800,000	$230,000	$391,920,000	15%	$290,000	$494,160,000	45%	$215,000	$366,360,000	8%
Milwaukee	535	$200,000	$107,000,000	$250,000	$133,750,000	25%	$250,000	$133,750,000	25%	$225,000	$120,375,000	13%
SEPTA	1441	$170,000	$244,970,000	$204,000	$293,964,000	20%	$212,500	$306,212,500	25%	$175,000	$252,175,000	3%
Bi-State	655	$200,000	$131,000,000	$240,000	$157,200,000	20%	$275,000	$180,125,000	38%	$240,000	$157,200,000	20%
Chicago	2172	$202,000	$438,744,000	$226,000	$490,872,000	12%	$262,000	$569,064,000	30%	$216,000	$469,152,000	7%
AC Transit	862	$179,000	$154,298,000	$230,000	$198,260,000	28%	$245,000	$211,190,000	37%	$205,000	$176,710,000	15%
Cleveland	741	$225,000	$166,725,000	$270,000	$200,070,000	20%	$250,000	$185,250,000	11%	$230,000	$170,430,000	2%
Utah TA	440	$180,000	$79,200,000	$230,000	$101,200,000	28%	$257,000	$113,080,000	43%	$190,000	$83,600,000	6%
Santa Clara	515	$210,000	$108,150,000	$290,000	$149,350,000	38%	$290,000	$149,350,000	38%	$250,000	$128,750,000	19%
Seattle	1060	$190,000	$201,400,000	$230,000	$243,800,000	21%	$245,000	$259,700,000	29%	$205,000	$217,300,000	8%
Atlanta RTA	683	$166,000	$113,378,000	$226,000	$154,358,000	36%	$241,000	$164,603,000	45%	$191,000	$130,453,000	15%
NYCTA	3730	$200,000	$746,000,000	$250,000	$932,500,000	25%	$250,000	$932,500,000	25%	$200,000	$746,000,000	0%
NJT	2000	$156,174	$312,348,000	$255,000	$510,000,000	63%	$266,174	$532,348,000	70%	$170,174	$340,348,000	9%
Dallas	650	$190,000	$123,500,000	$230,000	$149,500,000	21%	$250,000	$162,500,000	32%	$230,000	$149,500,000	21%
Samtrans	257	$180,000	$46,260,000	$210,000	$53,970,000	17%	$210,000	$53,970,000	17%	$190,000	$48,830,000	6%
Sacrame	200	$200,000	$40,000,000	$240,000	$48,000,000	20%	$270,000	$54,000,000	35%	$220,000	$44,000,000	10%
OCTD	500	$200,000	$100,000,000	$240,000	$120,000,000	20%	$250,000	$125,000,000	25%	$210,000	$105,000,000	5%
SCRTD *	2500	$190,000	$475,000,000	$230,000	$575,000,000	21%	$245,000	$612,500,000	29%	$205,000	$512,500,000	8%
TOTAL	20645		$3,928,773,000		$4,903,714,000	25%		$5,239,302,500	33%		$4,218,683,000	7%
COST PER BUS			$190,301		$237,526			$253,781			$204,344	
COST OVER DIESEL PER BUS			$0		$47,224			$63,479			$14,043	
NATIONAL FLEET (39,000 BUSES)			$7,421,755,728		$9,263,494,599			$9,897,447,203			$7,969,418,116	
COST OVER DIESEL NATIONAL FLEET			$0		$1,841,738,871			$2,475,691,475			$547,662,388	

* actual costs

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ESTIMATED COST ANALYSIS FOR FUEL (1990)

	FLEET MILEAGE	DIESEL FUEL $/MI	DIESEL TOTAL FUEL COSTS	MEOH FUEL $/MI	METHANOL TOTAL FUEL COSTS	MEOH % INC	CNG FUEL $/MI	CNG TOTAL FUEL COSTS	CNG % INC	TRAP FUEL $/MI	PART TRAP TOTAL FUEL COSTS	TRAP % INC
WMATA	52,830,694	$0.180	$9,509,525	$1.210	$63,925,140	572%	$0.510	$26,943,654	183%	$0.230	$12,151,060	28%
Milwaukee	20,134,612	$0.170	$3,422,884	$0.640	$12,886,152	276%	$0.140	$2,818,846	-18%	$0.180	$3,624,230	6%
SEPTA	41,000,000	$0.194	$7,954,000	$0.581	$23,821,000	199%	$0.219	$8,979,000	13%	$0.230	$9,430,000	19%
Bi-State	24,000,000	$0.127	$3,048,000	$0.280	$6,720,000	120%	$0.146	$3,504,000	15%	$0.139	$3,336,000	9%
Chicago	75,000,000	$0.180	$13,500,000	$0.280	$21,000,000	56%	$0.103	$7,725,000	-43%	$0.220	$16,500,000	22%
AC Transit	26,000,000	$0.193	$5,018,000	$0.879	$22,854,000	355%	$0.204	$5,304,000	6%	$0.403	$10,478,000	109%
Cleveland	24,744,160	$0.190	$4,701,390	$2.190	$54,189,710	1053%	$0.330	$8,165,573	74%	$0.290	$7,175,806	53%
Utah TA	14,957,000	$0.136	$2,034,152	$0.284	$4,247,788	109%	$0.236	$3,529,852	74%	$0.174	$2,602,518	28%
Santa Clara	23,700,000	$0.190	$4,503,000	$0.700	$16,590,000	268%	$0.270	$6,399,000	42%	$0.240	$5,688,000	26%
Seattle	36,000,000	$0.134	$4,824,000	$0.441	$15,876,000	229%	$0.195	$7,020,000	46%	$0.169	$6,084,000	26%
Atlanta RTA	28,702,099	$0.186	$5,338,590	$0.314	$9,012,459	69%	$0.223	$6,400,568	20%	$0.256	$7,347,737	38%
NYCTA	104,100,000	$0.249	$25,920,900	$0.587	$61,106,700	136%	$0.260	$27,066,000	4%	$0.274	$28,523,400	10%
NJT	73,953,464	$0.140	$10,353,485	$0.280	$20,706,970	100%	$0.230	$17,009,297	64%	$0.180	$13,311,624	29%
Dallas	21,400,000	$0.230	$4,922,000	$0.630	$13,482,000	174%	$0.160	$3,424,000	-30%	$0.250	$5,350,000	9%
Samtrans	7,372,747	$0.150	$1,105,912	$0.900	$6,635,472	500%	$0.290	$2,138,097	93%	$0.200	$1,474,549	33%
Sacrame	8,611,000	$0.220	$1,894,420	$0.320	$2,755,520	45%	$0.190	$1,636,090	-14%	$0.280	$2,411,080	27%
OCTD	21,000,000	$0.250	$5,250,000	$0.299	$6,279,000	20%	$0.286	$6,006,000	14%	$0.275	$5,775,000	10%
SCRTD *	105,000,000	$0.170	$17,850,000	$0.370	$38,850,000	118%	$0.250	$26,250,000	47%	$0.190	$19,950,000	12%
TOTALS	708,505,776		$131,150,259		$400,937,911	347%		$170,318,976	30%		$161,213,004	23%
COST PER MILE			$0.1851		$0.5659			$0.2404			$0.2275	
COST OVER DIESEL PER MILE			$0.0000		$0.3808			$0.0553			$0.0424	
NATIONAL FLEET (est. 1.0 Billion Miles)			$185,108,242		$565,892,227			$240,391,796			$227,539,436	
COST OVER DIESEL NATIONAL FLEET			$0		$380,783,984			$55,283,554			$42,431,193	

* actual costs - Fuel cost based on July 1990 pre-Middle East crisis costs. LA (OCT 90) price is now $1.12/gal for diesel #2.
Methanol is currently @ $0.51/gal, therefore methanol cost per mile is now close to diesel cost per mile.

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ESTIMATED COST ANALYSIS FOR FUELING FACILITIES (1990)

	# FUEL FAC.	NEW DIESEL FACILITY PURCHASE	DIESEL TOTAL PURCHASE	METHANOL FACILITY PURCHASE	METHANOL TOTAL PURCHASE	MEOH % INC	CNG FACILITY PURCHASE	CNG TOTAL PURCHASE	CNG % INC	PART TRAP FACILITY PURCHASE	PART TRAP TOTAL PURCHASE
WMATA	10	$10,000,000	$100,000,000	$10,000,000	$100,000,000	0%	$6,500,000	$65,000,000	-35%	$10,000,000	$100,000,000
Milwaukee	3										
SEPTA	9	$4,750,000	$42,750,000	$5,400,000	$48,600,000	14%	$7,550,000	$67,950,000	59%	$4,750,000	$42,750,000
Bi-State	3	$250,000	$750,000	$2,000,000	$6,000,000	700%	$5,000,000	$15,000,000	1900%	$250,000	$750,000
Chicago	9	$2,500,000	$22,500,000	$9,637,500	$86,737,500	286%	$6,425,000	$57,825,000	157%	$2,500,000	$22,500,000
AC Transit	5	$750,000	$3,750,000	$750,000	$3,750,000	0%	$750,000	$3,750,000	0%	$750,000	$3,750,000
Cleveland	5	$200,000	$1,000,000	$230,000	$1,150,000	15%	$2,500,000	$12,500,000	1150%	$200,000	$1,000,000
Utah TA	4										
Santa Clara	4	$1,500,000	$6,000,000	$2,400,000	$9,600,000	60%	$4,600,000	$18,400,000	207%	$1,500,000	$6,000,000
Seattle	6	$750,000	$4,500,000	$865,000	$5,190,000	15%	$3,250,000	$19,500,000	333%	$750,000	$4,500,000
Atlanta RTA	3	$150,000	$450,000	$160,000	$480,000	7%	$100,000	$300,000	-33%	$150,000	$450,000
NYCTA	19	$600,000	$11,400,000	$18,515,738	$351,799,022	2986%	$2,500,000	$47,500,000	317%	$600,000	$11,400,000
NJT	18	$750,000	$13,500,000	$2,500,000	$45,000,000	233%	$4,650,000	$83,700,000	520%	$750,000	$13,500,000
Dallas	4	$250,000	$1,000,000	$400,000	$1,600,000	60%	$1,000,000	$4,000,000	300%	$250,000	$1,000,000
Samtrans	2	$1,200,000	$2,400,000	$2,500,000	$5,000,000	108%	$2,500,000	$5,000,000	108%	$1,200,000	$2,400,000
Sacramento	1	$2,300,000	$2,300,000	$3,900,000	$3,900,000	70%	$7,500,000	$7,500,000	226%	$23,000,000	$23,000,000
OCTD	3	$500,000	$1,500,000	$750,000	$2,250,000	50%	$4,000,000	$12,000,000	700%	$500,000	$1,500,000
SCRTD *	14	$800,000	$11,200,000	$920,000	$12,880,000	15%	$3,300,000	$46,200,000	313%	$800,000	$11,200,000
TOTALS	115		$225,000,000		$683,936,522	204%		$466,125,000	107%		$245,700,000
COST PER FACILITY			$1,956,522		$5,947,274			$4,053,261			$2,136,522

* actual costs

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ATTACHMENT 3

ALTERNATE FUELS/LOW EMISSIONS TECHNOLOGY COST ANALYSIS WORK SHEET

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT

ALTERNATE FUELS SECTION

JULY 1990

RTD

COMPANY:_____________________

NAME:_________________________

TITLE:_________________________

PHONE:_______________________

ALTERNATE FUELS/LOW EMISSIONS TECHNOLOGY
COST ANALYSIS WORK SHEET

Introduction

The attached work sheet is designed to assist in deriving the range of cost incurred by purchasing and operating buses that utilize clean fuels, including; "clean diesel" (particulate trap technology), methanol and compressed natural gas. The work sheet also addresses the costs to convert existing capital stock to the above clean fuels.

The work sheet provides a methodology and includes certain cost factors, based on the Southern California Rapid Transit District's experience. However, much of the actual cost information will be specific to the individual operator's situation and is therefore left for each operator to address. These variations include regional differences in fuel costs, cold weather fueling requirements and availability of land for fueling and tank storage.

The total cost for an operator to comply with the provisions of the Clean Air Act will depend upon the operator's fleet replacement needs, as well as the final provisions of the legislation concerning the phase-in schedule and requirements concerning conversion of the existing fleet. The work sheet package includes tables to derive a very rough total cost range. These cost estimates will require fine tuning by the operator once the final provisions of the Clean Air Act are known.

Instructions

1. Steps 1 through 20 (pages 1-5) of the Alternative Fuels/Low Emissions Technologies Work Sheet are self explanatory.

2. Table A, "Clean Emissions Impact on Transit Buses" summarizes the results of the calculations in Steps 1 through 20 of the work sheet. The numbers and letters in parentheses reference the location within the work sheet where the information is derived.

3. Tables B-E are rough estimates of the total cost of replacing and operating a fleet utilizing each respective fuel type; Table B is baseline diesel, Table C is diesel with a particulate trap, Table D is compressed natural gas and Table E is Methanol.

4. Complete the title sheet, including a phone number for a contact person.

Questions

If you have any questions regarding the questionnaire, please contact Vince Pellegrin, at (213) 972-5844, or David Meyers, at (213) 972-5866, in SCRTD's Alternative Fuels Section.

ALTERNATE FUELS/LOW EMISSIONS TECHNOLOGIES
WORK SHEET

1. Please estimate the cost to build an average size fueling facility for your fleet operating on each of the following fuels.

   a. Diesel ______________________________

   b. Methanol ______________________________

   c. Compressed Natural Gas (CNG) ______________________________

   d. Propane ______________________________

   e. Other ______________________________

2. How many bus fueling facilities do you operate? ______________

3. What is the underground storage capacity (gallons) of your average diesel fueling facility?

   ____

4. What is your average diesel bus mileage between refuelings?

   ____

5. Please estimate the initial purchase price for buses at your property using each of the following technologies.

   a. Diesel ______________________________

   b. Diesel w/Particulate Trap ______________________________

   c. Methanol ______________________________

   d. Compressed Natural Gas (CNG) ______________________________

   e. Propane ______________________________

   f. Methanol w/Ignition Improver ______________________________

   g. Other ______________________________

FUELS/LOW EMISSIONS TECHNOLOGIES
WORK SHEET

6. Please estimate your total costs to convert an existing diesel bus to each of the following technologies. Include costs for both material and labor.

   a. Diesel w/Particulate Trap ____________________

   b. Methanol ____________________

   c. Compressed Natural Gas (CNG) ____________________

   d. Propane ____________________

   e. Methanol w/Ignition Improver ____________________

   f. Other ____________________

7. Please estimate the price each of the following fuels would cost you per gallon [per therm (100,000 Btu) for CNG}. Include the cost of delivery.

   a. Diesel ____________________

   b. Low Sulfur Diesel (<500 ppm) ____________________

   c. Methanol ____________________

   d. Compressed Natural Gas (CNG) ____________________

   e. Propane ____________________

   f. Other ____________________

8. Please estimate the impacts on the overall maintenance costs to your bus fleet (Decrease, Same, Slight Increase, Large Increase) operating each of the following technologies compared to the maintenance of your existing diesel fleet.

   a. Diesel w/Particulate Trap ____________________

   b. Methanol ____________________

   c. Methanol w/Ignition Improver ____________________

   d. Compressed Natural Gas (CNG) ____________________

   e. Propane ____________________

   f. Other ____________________

9. Please estimate the cost impacts on the overall durability of your bus fleet (Increase, Same, Slight Decrease, Large Decrease) operating on each of the following technologies compared to the durability of your existing fleet.

a. Diesel w/Particulate Trap ______________________

b. Methanol ______________________

c. Methanol w/Ignition Improver ______________________

d. Compressed Natural Gas (CNG) ______________________

e. Propane ______________________

f. Other ______________________

10. How much do you spend on tires and brakes per year? __________

11. How many buses are in your fleet (Include spares)? __________

12. How many total miles does your fleet accumulate per year?

____

13. What is your fleet average diesel bus fuel economy (mpg)?

____

14. What is the on-board diesel storage capacity (gallons) of your bus?

____

15. What is the tare weight of your diesel bus (Include full load of fuel)?

____

ALTERNATE FUELS/LOW EMISSIONS TECHNOLOGIES
WORK SHEET

16. How many passengers does one of your diesel buses carry? (Include standees.)

____

17. Calculate bus weights for each of the following technologies (numbers in parentheses denote references within the work sheet to be used in the blanks).

    a. Diesel = ________ lb.
    (15)

    b. Particulate Trap = ________ lb. + 350 lb. = _______ lb.
    (15)

    c. CNG = ________ lb. + (18 X ________) lb. = ________ lb.
    (15) (14)

    d. Methanol = ________ lb. + (10.7 X _______) lb. = _______ lb.
    (15) (14)

18. Calculate bus passenger loading for each of the following technologies using the appropriate numbers shown.

    a. Diesel = ________ passengers
    (16)

    b. Part. Trap = ______ - [(________ - _______)/150] = ______
    (16) (17b) (17a)

    c. CNG = ______ - [(_______ - _______)/150] = ______
    (16) (17c) (17a)

    d. Methanol = ______ - [(_______ - _______)/150] = ______
    (16) (17d) (17a)

19. Calculate brake/tire wear increase over diesel bus wear rate for each of the following technologies using the appropriate numbers shown. (Multiply results by 100).

    a. Diesel = Base

    b. Part. Trap = (_______ - _______)/______ = ______ % increase
    (17b) (17a) (17a)

    c. CNG = (_______ - _______)/______ = ______ % increase
    (17c) (17a) (17a)

19. (Continued)

d. Methanol = (______ - ______)/______ = ______% increase
(17d) (17a) (17a)

20. Calculate fuel consumption rates for each of the following technologies using the appropriate numbers shown.

a. Diesel = ______ / ______ = ______ $ per mile
(7a) (13)

b. Low S Diesel = ______ / ______ = ______ $ per mile
(7b) (13)

c. Part. Trap = ______ X 1.1 = ______ $ per mile
(20b)

d. Methanol = ______ /(______/2.5) = ______ $ per mile
(7c) (13)

e. CNG = ______ X 1.3/(______) +.03 = ______ $ per mile
(7d) (13)

f. Methanol w/Ignit. Imp.=(.97 X ______+.49)/(______/2.5)
(7c) (13)

= ______ $ per mile

TABLE A

CLEAN EMISSIONS IMPACT ON TRANSIT BUSES

	DIESEL	CLEAN DIESEL W/PART. TRAP	CNG	METHANOL	CONVERSIONS METH/ AVOCET	CONVERSIONS CNG	CONVERSIONS PART TRAP
FUEL FACILITIES	(1a)	(1a)	(1c)	(1b)	(1b)	(1c)	(1a)
PASS. LOADING	(18a)	(18b)	(18c)	(18d)	(18d)	(18c)	(18b)
FUEL COSTS	(20a)	(20c)	(20e)	(20d)	(20f)	(20e)	(20c)
MAINTENANCE	Base	(8a)	(8d)	(8b)	(8c)	(8d)	(8a)
BRAKE/TIRES	(19a)	(19b)	(19c)	(19d)	(19d)	(19c)	(19b)
INITIAL COST	(5a)	(5b)	(5d)	(5c)	(6e)	(6c)	(6a)
DURABILITY	Base	(9a)	(9d)	(9b)	(9c)	(9d)	(9a)
BUS WEIGHT	(17a)	(17b)	(17c)	(17d)	(17d)	(17c)	(17b)

TABLE B

PROJECTED COSTS WORK SHEET

BASELINE DIESEL

CAPITAL COSTS

Vehicle =	_______ (5a) X _______ (11)	=	_______
Facility =	_______ (1a) X _______ (2)	=	_______
Total		=	_______

ANNUAL OPERATING COSTS

Fuel =	_______ (20a) X _______ (12)	=	_______
Brakes/Tires =	_______ (10)	=	_______
Total		=	_______

TABLE C

PROJECTED COSTS WORK SHEET

O. E. M. PARTICULATE TRAP

CAPITAL COSTS

Vehicle = ________ (5b) X ________ (11) = ________

Facility = ________ (1a) X ________ (2) = ________

Total = ________

ANNUAL OPERATING COSTS

Fuel = ________ (20c) X ________ (12) = ________

Brakes/Tires = ________ (10) X (1 + ________ (19b)) = ________

Total = ________

+ ________ (8a) Maintenance

TABLE D

PROJECTED COSTS WORK SHEET

O. E. M. COMPRESSED NATURAL GAS (CNG)

<u>CAPITAL COSTS</u>

Vehicle = ________ X ________ = ________
(5d) (11)

Facility = ________ X ________ = ________
(1c) (2)

Total = ________

<u>ANNUAL OPERATING COSTS</u>

Fuel = ________ X ________ = ________
(20e) (12)

Brakes/Tires = ________ X (1 + ________) = ________
(10) (19c)

Total = ________

\+ ________ Maintenance
(8d)

TABLE E

PROJECTED COSTS WORK SHEET

O. E. M. METHANOL

CAPITAL COSTS

Vehicle = ________ X ________ = ________
(5c) (11)

Facility = ________ X ________ = ________
(1b) (2)

Total = ________

ANNUAL OPERATING COSTS

Fuel = ________ X ________ = ________
(20d) (12)

Brakes/Tires = ________ X (1 + ________) = ________
(10) (19d)

Total = ________

\+ ________ Maintenance
(8b)