

file: LPGdemandsurveyrpt

October 1, 1999

***NEAR-TERM DEMAND SURVEY FOR
HEAVY-DUTY LPG POWERED TRANSIT BUSES
FINAL REPORT***

Submitted to the following:

Project Stakeholders

National Renewable Energy Laboratory, Natural Resources Canada, Propane Education and Research Council, Railroad Commission of Texas Alternative Fuels Research and Education Division, South Coast Air Quality Management District, Western Propane Gas Association

I. Background

The objective was to gauge near-term North American mass transit demand for heavy-duty LPG powered buses (30-foot or longer). A secondary goal was to further expose the viability of LPG as a mass transit fuel option. A pilot survey was first conducted in Canada. Replies from the pilot survey helped formulate the content of the final survey. Survey forms were sent to select mass transit executives in the United States, Guam, and West Indies. An addressees' list is attached (Appendix 1).

II. Methodology

A. Pilot Survey

Drawing from the American Public Transit Association's¹ (APTA) membership list, ADEPT called twelve (12) Canadian transit executives. Following these calls, survey forms were sent to eleven (11) mass transits. Nine (9) survey forms were returned. The Canadian pilot survey results helped formulate the content of the final questionnaire.

B. Full Survey

After numerous phone calls, 80 surveys were sent out. A sample survey form is attached (Appendix 2).

The population sample was intentionally selected among those mass transit properties that were thought to be inclined to reply favorably. Those surveyed were likely to be smaller mass transit fleets, mostly in smaller urban or rural areas, and not likely to have committed to a non-LPG alternative fuel. The thought was that if little demand is found among a sample population that includes such fleets, then there is little overall demand to be satisfied.

¹ All the ADEPT contacted transit properties were APTA members. APTA graciously provided ADEPT its most recent membership list.

The final survey response rate was a significant 59% (47/80). For analytical purposes, the 58 (47 + 9) respondents were arbitrarily separated into two groups: “smaller” mass transit fleets (45 or less buses) and “larger” fleets (46 or more buses). This yielded two respondent populations of similar size. Replies from two respondents who did not have 30-foot or longer buses were excluded from the database.

C. Findings (see also Appendix 3)

- About 40% of the larger fleets and 20% of the smaller fleets operate buses on alternative fuels.
- The most common alternative fuels used for mass transit vehicles are LPG and CNG. These vehicles include passenger cars, pick-up trucks, lift trucks, shuttle vehicles as well as buses.
- More than half of the respondents’ alternative fuels vehicles use LPG, yet only few operate LPG buses.
- The “pro LPG” arguments are strangely similar to the “anti LPG” arguments. The majority of both “pro” and “anti” LPG arguments deal with issues that are largely within the control of the heavy-duty engine manufacturers.
- One out of the nine Canadian respondents is currently using LPG powered buses. Another expressed interest to buy, over the next five (5) years, 75 mass transit buses powered by an ultra low emissions (ULEV) certified LPG dedicated engine.
- Over 25% of the respondent population would buy mass transit buses powered by a ULEV certified LPG dedicated engine over the next five years (totaling almost 525 buses) if such configurations were available. At 100% certainty level, among those who answered, about 105 buses per year could be sold over the next five years. Given the reported replies level of certainty, about 52 buses per year is a reasonable sales expectation among the sampled fleets’ population.

D. Data Analysis and Conclusions

- The LPG supply infrastructure is wide spread and already in use by numerous mass transits. Yet few such mass transits actually operate LPG powered buses. Mass transit decision-makers currently lack the option to order LPG powered buses.
- One of the main reasons why LPG buses are not offered by the mass transit bus OEM’s is that the choice of suitable certified LPG dedicated engines is extremely limited.
- Replies to Questions 8 and 14 required an in-depth analysis of the respondents’ comments. The objective was to define, quantify, and rank the reasons why a mass

transit decision-maker would either favor or disfavor LPG powered buses. Six phases of work were required to analyze each set of replies.²

The issues most important (from replies to Question 8) to those who are inclined toward LPG powered buses are:

- (1) Capital costs/initial costs (18 replies),
- (2) Operating costs except for fuel (15 replies),
- (3) Commitment from a reputable engine manufacturer (15 replies),
- (4) Fuel supply/availability (12 replies), and
- (5) Lower emissions (12 replies).

Engine manufacturers directly and substantially affect four (4) out of the top five (5) issues. Only one (#4) is totally within the LPG industry's control and another (#1) is partially within the LPG industry's control.

The issues most important (from replies to Question 14) to those who are not inclined towards LPG powered buses (excluding those who already made a long-lasting commitment to another low emissions solution) are:

- (1) Capital costs/initial costs (17 replies),
- (2) Lack of fuel supplies/availability (10 replies),
- (3) Operating costs except for fuel (10 replies),
- (4) Lack of infrastructure (on and off premises) (9 replies), and
- (5) Non-competitive performance versus traditional fuels (9 replies).

Engine manufacturers directly and substantially affect three (3) out of the top five (5) issues. The LPG industry controls two issues (#2 and #4) and has partial control over #1.

The “critical mass entity” in this paradigm is the medium and/or heavy-duty engine manufacturers in North America. ADEPT, based on prior efforts to entice these entities to manufacture, certify, and promote such engines, has concluded that there is little interest among North American mass transit engine manufacturers in such a venture unless sufficient demand is demonstrated.

The medium and heavy-duty engine manufacturers consider the mass transit market to account for a smaller portion of their business. This market segment is stable and has shown little growth over that last decade. It's a “nice to have” niche market but by no means “top priority” market segment. The North American engine manufacturers who currently serve this market constitute a defacto oligopoly (only two players own 96%).

It is a comfortable situation where changes are rarely initiated from within. Most mass transit engine changes are made as a reaction to outside forces.

² See attached Appendix 3 with a detailed description of these six phases of analytical work.

The mass transit engine manufacturers are one-step removed from the needs of the mass transit properties. They typically rely on bus chassis OEM's to tell them what to manufacture. In this market niche, the engine manufacturers are "order takers." As a matter of practice, the bus chassis OEM's reply to RFQ's put out by mass transit properties. Then, the bus OEM's place engine orders if and when their quotation wins. Outside competitive forces must be brought into the picture to stimulate changes within the North American market.

- By successfully addressing some of the outstanding issues listed above, the LPG industry can enhance its position with those who are ready to try LPG (and at the same time counter arguments presented by those who are "anti" LPG).
- The 1999 North American (U.S. and Canada) mass transit population of 30-foot or longer buses is estimated at 77,000 buses³. The survey respondents operate 9,092 buses (about 12% of the total 30-foot or longer buses in U.S. and Canada).

Taking into account that the sampled population was intentionally skewed towards those thought more likely to be inclined to provide pro-LPG powered bus replies, a proportional market demand projection is not applicable. A direct eventual market saturation projection would be a multiplication by a factor of 8.5 (e.g. $77,000 \div 9,092$) of the number of buses likely to be ordered by the sampled population. If a factor of 8.5 were to be used, projected annual sales would be 442 (52×8.5) buses. For reasons of conservative annual projections, a much smaller factor of 2.0 is used. *This yields a North American average annual sales projection of 104 LPG powered buses (over the next five years).*

It is reasonable to conclude that, with a proper LPG industry commitment to support sales and education efforts, approximately 100 LPG powered buses (30-foot or longer) could be sold each year over the next five years (given that a ULEV certified LPG dedicated engine is commercially available).

For more specific survey response information please see attached response tables (Appendices 4 through 6).

E. Recommendations

- The LPG industry, to achieve and to hold meaningful market penetration, must undertake a dedicated program to educate the mass transit industry executives as to:
 - (A) overcome misconceptions that LPG is not readily available,
 - (B) put the LPG safety issue in perspective and at rest, and
 - (C) stress the cost-effectiveness of LPG versus other alternative fuels.

³ APTA estimated on August 4, 1999.

This is a demand driven market. If enough mass transit decision-makers indicate to the bus OEM's that they want LPG powered buses, the engine manufacturers will make and certify LPG powered engines.

- The LPG industry should facilitate the North American entry of European heavy-duty LPG engine manufacturers. North American heavy-duty engine manufacturers typically respond to competition; they rarely initiate it.
- The LPG industry should further its involvement in hybrid vehicles, and particularly in heavy-duty applications. In the hybrid bus paradigm there are dozens of engine manufacturers who make the necessary size engines (not only three).

III. Project Management Support and Administrative Work Performed

A. Project Fundraising

Funding contracts have been completed by National Renewable Energy Laboratory (NREL), Natural Resources Canada (NRCan), Propane Education and Research Council (PERC), Railroad Commission of Texas Alternative Fuels Research and Education Division (AFRED), South Coast Air Quality Management District (SCAQMD), and Western Propane Gas Association (WPGA).

Table 1 shows total funds received to date, by respective funder.

Table 1: Total Funds Received to Date

Funder	Amount
WPGA	\$500.00
NREL	\$3,000.00
PERC	\$6,000.00
NRCan	\$6,037.20 ⁴
Total	\$15,537.20

B. Travel Associated with Effort Described

May 3, 1999, ADEPT travel to Monterey, CA, for World Truck Conference. (Background information gathered for Truck Survey.)

IV. Attachments

1. List of Survey Addressees
2. Sample Survey
3. Tabulated Results
4. Six Phase Analysis (Question 8)
5. Six Phase Analysis (Question 14)

⁴ Total is converted from CAN\$9,000 (conversion ratio of 0.6708).

V. Glossary of Acronyms

ADEPT	The ADEPT Group, Inc.
AFRED	Railroad Commission of Texas Alternative Fuels Research and Education Division
APTA	American Public Transit Association
CNG	compressed natural gas
LPG	liquefied petroleum gas (propane)
NRCan	Natural Resources Canada
NREL	National Renewable Energy Laboratory
OEM	original engine manufacturer
PERC	Propane Education and Research Council
RFQ	request for quote
SCAQMD	South Coast Air Quality Management District
ULEV	ultra low emissions vehicle
WPGA	Western Propane Gas Association

file:LPGdemandsurvey013tbl

April 6, 1999

USA LPG Mass Transit Survey

Contact/s	Phone/Fax	State	Outgoing	Follow-up	Incoming 1	Usable	Entered	#
Mr. Calhoun, Jim Maintenance Superintendent Gardena Bus Lines 15350 Van Ness Ave. Gardena, CA 90249-4100	Phn: (310) 329-3825 Fax: (310) 538-1989	CA	2/3/99		#1 2/4/99	YES	YES	1
Mr. Budlong, Bill Executive Director Mr. Navarro, Steve Service and Planning Coordinator Antelope Valley Transit Authority 1031 West Avenue L-12 Lancaster, CA 93534	Phn: (805) 726-2616 Fax: (805) 726-2615	CA	2/8/99		#6 2/12/99	YES	YES	2
Mr. Damer, Dave Superintendent, Bus Maintenance San Mateo County Transit 1250 San Carlos Ave. San Carlos, CA 94070	Phn: (650) 508-6200 Fax: (650) 871-4252	CA	2/9/99		#8 2/15/99	YES	YES	3
Mr. Mills, James R. Transit Administration Manager City of Torrance Transit Division 20500 Madrona Ave. Torrance, CA 90503	Phn: (310) 618-6266 Fax: (310) 618-6229	CA	2/9/99		#5 2/12/99	YES	YES	4

¹ The number signifies order in which received (includes USA and Canadian respondents).

<p>Mr. Anderson, Charles General Manager WESTCAT 601 Welter Avenue Pinole, CA 94564</p>	<p>Phn: (510) 724-3331 Fax: (510) 724-5551</p>	<p>CA</p>	<p>2/9/99</p>	<p>2/16, 2/18 Anita- fax today.</p>	<p>#19 2/18/99</p>	<p>YES</p>	<p>YES</p>	<p>5</p>
<p>Mr. Peck, Doug Director of Maintenance Via Metropolitan Transit 800 West Myrtle P.O. Box 12489 San Antonio, TX 78212</p>	<p>Phn: (210) 362-2465 Fax: (210) 362-2586</p>	<p>TX</p>	<p>2/9/99</p>	<p>2/16- fax today or 2/17. 2/18- msg.</p>	<p>#21 2/19/99</p>	<p>YES</p>	<p>YES</p>	<p>6</p>
<p>Ms. Soon, Cheryl Director Mr. Paul Steffens (<i>respondent</i>) City and County of Honolulu Department of Transportation Services Pacific Park Plaza, Suite 1200 711 Kapiolani Blvd., #250 Honolulu, HI 96813</p>	<p>Phn: (808) 523-4529 Fax: (808) 523-4730</p>	<p>HI</p>	<p>2/10/99</p>		<p>#13 2/16/99</p>	<p>YES</p>	<p>YES</p>	<p>7</p>
<p>Mr. Brown, Tom Transit Specialist Hawaii County Transit System 25 Aupuni Street Hilo, HI 96720</p>	<p>Phn: (808) 961-8343 Fax: (808) 961-8745</p>	<p>HI</p>	<p>2/10/99</p>	<p>2/16, 2/18 2/22, 2/23 call back.</p>				<p>8</p>
<p>Mr. Underwood, James H. General Manager Guam Mass Transit Authority 236 East O'Brien Drive Hagatña, GUAM 96910</p>	<p>Phn: (671) 475-4682 Fax: (671) 475-4600</p>	<p>Guam</p>	<p>2/10/99</p>	<p>2/23- no answer.</p>	<p>#56 3/19/99</p>	<p>YES</p>	<p>YES</p>	<p>9</p>

Mr. Cook, David Director of Project Management and Procurement Rochester-Genesee RTA 1372 E. Main Street Rochester, NY 14609	Phn: (716) 654-0200 Fax: (716) 654-0293	NY	2/10/99	2/16- msg.	#16 2/18/99	YES	YES	10
Mr. Osier, Kenny Director of Maintenance Roaring Fork Transit Agency 51 Service Center Road Aspen, CO 81611	Phn: (970) 920-1905 ext. 209 Fax: (970) 920-2864	CO	2/10/99		#9 2/15/99	YES	YES	11
Mr. Stephens, Steve Fleet Maintenance Manager Summit Stage Transit Agency P.O. Box 626 Frisco, CO 80435	Phn: (970) 668-4228 Fax: (970) 668-3592	CO	2/10/99	2/16- mailed.	#22 2/19/99	YES	YES	12
Mr. Parker, Keith T. Executive Director Clark County Public Transportation Benefit Area Authority (C-TRAN) P.O. Box 2529 Vancouver, WA 98668-2529	Phn: (360) 696-4494 Extension: #7301 Fax: (360) 696-1602	WA	2/10/99	2/16- w/ June, call back. 2/23- msg. 3/9- msg.				13
Mr. Smith, Ray Supervisor, Maintenance Polynesian Adventure Tours, Inc. 1049 Kikowaena Place Honolulu, HI 96819	Phn: (808) 833-9500 Fax: (808) 839-6808	HI	2/10/99	2/23- Robin, msg.				14

Mr. Butters, Pat Maintenance Manager City of Santa Monica Big Blue Bus 1620 Sixth Street Santa Monica, CA 90401	Phn: (310) 458-1975 ext: 250 Fax: (310) 260-3274	CA	2/10/99 & 2/18/99	2/18-resent.	#31 2/23/99	YES	YES	15
Mr. Varga, Peter Executive Director Grand Rapids Area Transit Authority 333 Wealth Street S.W. Grand Rapids, MI 49503	Phn: (616) 456-7514 Fax: (616) 456-1941	MI	2/11/99		#11 2/16/99	YES	YES	16
Mr. Warren, Steven Assistant General Manager, Maintenance CTTRANSIT 100 Leibert Road Hartford, CT 06141	Phn: (860) 522-8101 Fax: (860) 247-1810	CT	2/11/99		#7 2/15/99	YES	YES	17
Mr. Post, Ben Fleet Manager, "The Trolley" E NOA Corporation 1141 Waimanu Street Honolulu, HI 96814	Phn: (808) 591-9066 Fax: (808) 591-9065	HI	2/12/99	2/18 Jim, msg. 2/23 Adam, msg.				18
Mr. Gaites, Carl L. Transit Division Manager Manatee County Area Transit 1108 26 th Avenue East Bradenton, FL 34208	Phn: (941) 747-8621 Fax: (941) 742-5992	FL	2/12/99		#17 2/18/99	YES	YES	19

Mr. Sweeney, Roger Executive Director Pinellas Suncoast Transit Authority 14840 49 th Street North Clearwater, FL 33762-2893	Phn: (727) 530-9921 Fax: (727) 535-5580	FL	2/12/99	2/23- Mary, msg. 3/5- Larel, msg.				20
Mr. Tibone, David Manager Transportation Services University of Delaware 403 Wyoming Road Newark, DE 19716	Phn: (302) 831-1187 Fax: (302) 831-4872	DE	2/12/99	2/23- will review. 3/5- msg.				21
Mr. Ascher, Michael President MTA Bridges and Tunnels Triborough Station Box 35 New York, NY 10035	Phn: (212) 360-3100 Fax: (212) 360-1569	NY	2/12/99	2/23- resent. 3/5- msg. Jerad Potsowcheck				22
Mr. Norwisch, William Vice President of Operations Pete Schultz MTA Long Island Bus 700 Commercial Avenue Garden City, NY 11530	Phn: (516) 542-0100 ext: 4328, 4334 ext: 4430 Fax: (516) 228-6549	NY	2/12/99	2/23- will fax today. 3/10- dbl checking delegation.				23
Mr. Yaeger, Terry Director of Maintenance Hillsborough Area Regional Transit Authority 4305 East 21 st Avenue Tampa, FL 33605	Phn: (813) 623-5835 Fax: (813) 664-1119	FL	2/12/99		#32 2/23/99	YES	YES	24

Mr. McCulloch, Dave Superintendent Maintenance UMass Transit Service University of Massachusetts University Bus Garage P.O. Box 31110 Amherst, MA 01003-1110	Phn: (413) 545-0056 Fax: (413) 545-1930	MA	2/12/99		#12 2/16/99	YES	YES	25
Mr. Cannistraci, Steve Senior Heavy-Duty Equipment Mechanic Los Angeles Department of Transportation 221 N. Figueroa Street, Ste. 400 Los Angeles, CA 90012	Phn: (213) 580-5406 Fax: (213) 580-5458	CA	2/12/99	2/23- msg.	#36 2/25/99	YES	YES	26
Mr. Blondin, Michael General Manager Merrimack Valley Regional Transit Authority 85 Railroad Avenue Haverhill, MA 01835	Phn: (978) 373-1184 Fax: (978) 521-5956	MA	2/16/99	3/3- msg.				27
Mr. Winders, Randy Director of Maintenance Intercity Transit P.O. Box 659 Olympia, WA 98507-0659	Phn: (360) 705-5883 Fax: (360) 786-5074	WA	2/16/99		#14 2/16/99	YES	YES	28
Mr. Farley, Brandon Interim Transit Manager City Transit 955 Morro Street San Louis Obispo, CA 93401	Phn: (805) 781-7121 Fax: (805) 781-7198	CA	2/16/99	3/3- msg.				29

Mr. Ogren, Martin Director of Transportation Services University of Notre Dame 115 Maintenance Avenue Notre Dame, IN 46556	Phn: (219) 631-6467 Fax: (219) 631-9654	IN	2/16/99	3/3- no longer involved with compressed gas program.				30
Mr. Westbrook, Kenneth P. Resident Manager Escambia County Area Transit 1515 West Fairfield Drive Pensacola, FL 32501	Phn: (850) 595-3228 ext: 13 Fax: (850) 595-3222	FL	2/16/99		#28 2/22/99	YES	YES	31
Mr. Scott, Kirk A. General Manager Waco Transit System (WTS) 421 Columbus Avenue Waco, TX 76701	Phn: (254) 753-0113 Fax: (254) 753-8878	TX	2/17/99		#15 2/18/99	YES	YES	32
Mr. Scott, Terry Lee Acting Director El Paso Mass Transit Department (Sun Metro) 700 A San Francisco Street El Paso, TX 79901-1060	Phn: (915) 533-3333 Fax: (915) 541-6405	TX	2/17/99	3/3- dbl checking delegation.				33
Mr. Kraatz, Ken General Manager Citylink-Abilene Transit System 1189 South 2 nd Street Abilene, TX 79602	Phn: (915) 676-6423 Fax: (915) 676-6407	TX	2/17/99		#27 2/22/99	YES	YES	34

<p>Ms. Fon, Lori General Manager Tyler Transit 412 W. Locus Street Tyler, TX 75703</p>	<p>Phn: (903) 533-8057 Fax: (903) 531-9418</p>	TX	2/18/99	3/3- Patricia, msg.				35
<p>Mr. Ghirardi, Kevin J. Public Transit Administrator Terrebonne Parish Consolidated Transit Government P.O. Box 6097 Houma, LA 70361</p>	<p>Phn: (504) 873-6565 Fax: (504) 873-6439</p>	LA	2/18/99		#18 2/18/99	YES	YES	36
<p>Mr. Pritchard, Mark I. CEO & General Manager Metropolitan Tulsa Transit Authority 510 South Rockford P.O. Box 52488 Tulsa, OK 74152-0488</p>	<p>Phn: (918) 699-0224 Fax: (918) 582-5209</p>	OK	2/18/99	3/3- msg.				37
<p>Ms. Garza, Elida Assistant Director of Transit Lower Rio Grande Valley Development Council – RIO TRANSIT 311 North 15th Street McAllen, TX 78501-4705</p>	<p>Phn: (800) 574-8322 Fax: (956) 969-8176</p>	TX	2/18/99	3/3- try to finish today.	#53 3/10/99	YES	YES	38
<p>Mr. Hume, Randall Administrator Central Oklahoma Transportation & Parking Authority (COTPA) 300 SW 7th Street Oklahoma City, OK 73109</p>	<p>Phn: (405) 297-2529 Fax: (405) 297-2111</p>	OK	2/18/99	3/3- try by Friday.				39

Mr. Murphy, Roger General Manager Humboldt Transit Authority 133 V Street Eureka, CA 95501	Phn: (707) 443-0826 Fax: (707) 443-2032	CA	2/18/99	3/3- no answer. 3/5- msg.				40
Ms. Krieg, Jeanne General Manager Eastern Contra Costa Transit Authority (Tri Delta Transit) 801 Wilbur Avenue Antioch, CA 94509	Phn: (925) 754-6622 Fax: (925) 757-2530	CA	2/18/99		#24 2/19/99	YES	YES	41
Mr. Luis Fernandez Maintenance Manager National City Transit 522 West 8 th Street P.O. Box U National City, CA 91950-1004	Phn: (619) 474-7505 Fax: (619) 474-2058	CA	2/18/99	3/3- Noey Valdez, msg.				42
Mr. Webster, Jeffrey D. General Manager Fresno County Rural Transit Agency 2100 Tulare Street, Suite 619 Fresno, CA 93721	Phn: (559) 233-6789 Fax: (559) 233-9645	CA	2/19/99		#25 2/19/99	YES	YES	43
Mr. Kilcoyne, Ronald J. Transportation Manager Santa Clarita Transit 25663 Avenue Stanford Santa Clarita, CA	Phn: (661) 294-2500 Fax: (661) 294-2517	CA	2/19/99	3/3- no anwer. 3/5- sally, msg.	#47 3/5/99	YES	YES	44

Mr. Kestranek, Tom Transportation Director Port Arthur Transit (PAT) P.O. Box 1089 Port Arthur, TX 77640	Phn: (409) 983-8767 Fax: (409) 983-8609	TX	2/19/99		#26 2/22/99	YES	YES	45
Mr. Liesenfelt, Jim Transit Director Space Coast Area Transit 401 South Varr Avenue Cocoa, FL 32922	Phn: (407) 633-1878 Fax: (407) 633-1905	FL	2/19/99	3/3- msg.				46
Mr. Dunn, Ed Maintenance Manager Broward County Division of Mass Transit 3201 West Copans Road Pompano Beach, FL 33069-5199	Phn: (954) 357-8300 Fax: (954) 357-8350	FL	2/19/99	3/3- Tony, msg.				47
Mr. Brown, Noel E. Transit Planning Administrator Taltran – City of Tallahassee 555 Appleyard Drive Tallahassee, FL 32304	Phn: (850) 891-5200 Fax: (850) 891-5385	FL	2/19/99	3/3- will send out today	#45 3/3/99	YES	YES	48
Mr. Watt, Lawrence A. Deputy Director of Public Works County of San Diego San Diego County Transit System Department of Public Works 5469 Kearny Villa Road Suite 204 San Diego, CA 92123-1159	Phn: (619) 874-4098 Fax: (619) 874-4028	CA	2/22/99	3/3- msg.				49

Mr. Bunce, Kevin Director of Maintence Corpus Christi Regional Transportation Authority 5657 Bear Lane Corpus Christi, TX 78405	Phn: (512) 289-2712 Fax: (512) 289-2552	TX	2/22/99	3/3- msg.				50
Mr. Harbeson, Raymond Mr. Overture, Steve (<i>respondent</i>) Delaware Transit Corporation Blue Hen Corporate Center 455 Bay Road Suite 4B Dover, DE 19901	Phn: (302) 739-3278 Fax: (302) 739-3104	DE	2/22/99	3/3- msg.	#49 3/9/99	YES	YES	51
Mr. Lutz, James L. Executive Director Red Rose Transit Authority 45 Erick Road Lancaster, PA 17601-3111	Phn: (717) 397-5613 Fax: (717) 397-4761	PA	2/22/99		#30 2/23/99	YES	YES	52
Mr. Sanjeev, Malhortra Chief of Transportation Loudoun County Transportation Division 3 rd Floor 1 Harrison Street SE Lees Burg, VA 20177	Phn: (703) 771-2527 (sent by mail)	VA	2/22/99	3/3- waiting.				53
Mr. Seither, Michael President and General Manager Louisiana Transit Company, Inc. 8265 Jefferson Highway P.O. Box 23247 Harahan, LA 70361	Phn: (504) 737-9611 Fax: (504) 737-4589	LA	2/22/99	3/3- Shantel, msg.				54

Mr. Vlacich, Bronco Maintenance Manager Montgomery County Transit Services 18604 Thornberry Lane Olney, MD 20832-1819	Phn: (301) 217-2184 Fax: (301) 217-4687	MD	2/22/99	3/9- Sally, msg.	#57 3/26/99	YES	YES	55
Ms. Canby, Anne P. Secretary Delaware Department of Transportation P.O. Box 778 Dover, Delaware 19903	Phn: (302) 739-4303 Fax: (302) 739-4329	DE	2/22/99	3/9- Dolan, msg.				56
Mr. Ambrose, Raymond Transit Administrator Corridor Transportation Corporation 312 Marshall Avenue #114 Laurel, MD 20707	Phn: (301) 725-4000 Fax: (301) 725-0776	MD	2/22/99		#43 3/2/99	YES	YES	57
Ms. John, Jearlean Chief Executive Officer Mr. Bartholemew, David (Respondent) Public Transport Service Corporation Railway Building South Quay, Port of Spain TRINIDAD, WEST INDIES	Phn: (868) 623-2344 (868) 623-2341 Fax: (868) 625-6502	Trinid ad	2/23/99	3/10- Marleen, msg.	#58 4/6/99	YES	YES	58
Mr. Rivera, George President and General Manager Metropolitan Bus Authority P.O. Box 195349 San Juan, PR 00919-5349	Phn: (787) 751-7979 Fax: (787) 751-0527	PR	2/24/99	3/9- no answer.				59

Mr. Johnson, Robert C. Transit Director Waukesha Metro Transit 2311 Badger Drive Waukesha, WI 53188-5932	Phn: (414) 524-3636 Fax: (414) 524-3646	WI	2/24/99	3/9- try to finish this week.				60
Mr. Meindel, Alan Transit Manager Fond du Lac Area Transit P.O. Box 150 Fond du Lac, WI 54936-0150	Phn: (920) 929-2935 Fax: (920) 929-7572	WI	2/24/99	3/9- refax.				61
Mr. Shrum, James Director Eagle County Regional Transportation Authority P.O. Box 1564 Avon, CO 81620	Phn: (970) 748-0702 Fax: (970) 748-0710	CO	2/24/99	3/9- declined.				62
Mr. Kelley, Thomas Manager Kelley Transit 30 Railroad Square Torrington, CT 06790	Phn: (860) 489-9243 Fax: (860) 496-4090	CT	2/24/99	3/9- refax.	#54 3/15/99	YES	YES	63
Mr. McCarthy, Joseph Executive Director Department of Transportation City of Kenosha 3735 65 th Street Kenosha, WI 53142	Phn: (414) 653-4290 Fax: (414) 653-4295	WI	2/24/99		#34 2/24/99	YES	YES	64

Mr. Abegg, Mike Planner Minnesota Valley Transit Authority 100 East Highway 13 Burnsville, MN 55337	Phn: (612) 882-7500 Fax: (612) 882-7600	MN	2/24/99		#35 2/24/99	YES	YES	65
Mr. Berkshire, Ron Fleet Service Manager Lane Transit District P.O.Box 7070 Eugene, OR 97401-0470	Phn: (541) 741-6100 Fax: (541) 682-6177	OR	2/24/99		#37 2/25/99	YES	YES	66
Mr. Puderbaugh, Alan Transit Services Manager Salem Area Mass Transit District 3140 Del Webb Avenue NE Salem, OR 97303-4165	Phn: (503) 588-2424 Fax: (503) 588-0209	OR	2/24/99		#44 3/2/99	YES	YES	67
Mr. Bryant, Tony Director of Bus Maintenance Tri-County Metropolitan Transit District of Oregon (Tri-Met) 4012 Southeast 17 th Avenue Portland, OR 97202-3993	Phn: (503) 238-7515 Fax: (503) 239-6451	OR	2/24/99		\$40 2/26/99	YES	YES	68
Mr. Bobbett, Gary Fleet Manager City of Bowling Green 611 Raven Street Bowling Green, KY 42101	Phn: (502) 843-5506 Fax: (502) 843-5543	KY	2/25/99		#42 3/2/99	YES	YES	69

Mr. Mark Donaghy General Manager Transit Authority of Northern Kentucky 3375 Madison Pike Fort Wright, KY 41017	Phn: (606) 578-6943 ext: 3020 Fax: (606) 578-6952	KY	2/25/99		#51 3/9/99	YES	YES	70
Major Brown, Desmon Operations Manager Metropolitan Management Transport Holdings Limited (MMTH) PJC Resource Center, 4 th Floor 36 Trafalgar Road KINGSTON 6 JAMAICA WEST INDIES	Phn: (876) 926-7968 Fax: (876) 926-7973	JAM AICA	2/25/99	3/10- Beverly, may respond.	#55 3/15/99	YES	YES	71
Mr. Carter, Taylor Operations Manager TTA P.O. Box 7965 Huntington, WV 25779	Phn: (304) 529-6094 Fax: (304) 529-7300	WV	2/25/99	3/9- Eddie, msg.	#50 3/9/99	YES	YES	72
Ms. Rhoads, Bonnie Manager Mr. Wilson, Paul Director of Maintenance Owensboro Transit System P.O. Box 10003 Owensboro, KY 42302	Phn: (502) 687-8570 Fax: (502) 687-8573	KY	2/25/99		#41 3/1/99	YES	YES	73

Mr. Cure, Irving General Manager Cambria County Transit Authority 726 Central Avenue Johnstown, PA 15902-2996	Phn: (877) 879-2282 Fax: (814) 536-5951	PA	2/25/99		#48 3/5/99	YES	YES	74
Mr. Basden, Herman Director Public Transportation Board P.O. Box HM 443 Hamilton, HM BX BERMUDA	Phn: (441) 292-3854 Fax: (441) 292-9996	BER MUD A	2/25/99	3/10- Sheila, msg.				75
Mr. DeVlieger, Bert General Manager Albany Transit System 712 Flint Avenue Albany, GA 31701-2416	Phn: (912) 430-5182 Fax: (912) 430-5160	GA	2/25/99		#38 2/26/99	YES	YES	76
Ms. Shogaolu, Benedict Executive Director Coastal Rapid Public Transit Authority 1418 Third Avenue Conway, SC 29526	Phn: (843) 246-7277 Fax: (843) 248-8980	SC	2/25/99	3/10- wrong #.				77
Mr. Foster, Roger Transportation Superintendent Grand Forks City Bus 867 South 48 th Street P.O. Box 5200 Grand Forks, ND 58206-5200	Phn: (701) 746-2590 Fax: (701) 746-4872	ND	2/25/99	3/10- call back 3/11.				78

Mr. Earle, Steve General Manager Missoula Urban Transportation District 1221 Shakespeare Street Missoula, MT 59802	Phn: (406) 721-3333 Fax: (406) 543-8387	MT	2/25/99		#39 2/26/99	YES	YES	79
Mr. Reynolds, Mark General Manager Carson City Community Transportation 2621 Northgate Lane, Suite 10 Carson City, NV 89706	Phn: (775) 887-2323 Fax: (775) 887-2324	NV	2/25/99	3/10- next week.				80

<p>Ms. Sheaffer, Cory General Manager Fleet Operations University of Wyoming P.O. Box 3261 University Station, WY 82071</p>	<p>Phn: (307) 766-3229 Fax: (307) 766-3413</p>	<p>WY</p>	<p>2/26/99</p>	<p>3/10- next week</p>				<p>81</p>
<p>Ms. Fox, Nancy Transportation and Parking Manager Mr. Bingel, Jeff (<i>respondent</i>) University Transportation and Parking Services – Hornet Express California State University Sacramento 6000 J Street Sacramento, CA 95819-6076</p>	<p>Phn: (916) 278-7275 Fax: (916) 278-5078</p>	<p>CA</p>	<p>3/1/99</p>		<p>#52 3/9/99</p>	<p>YES</p>	<p>YES</p>	<p>82</p>
<p>Mr. Brandrup, Len Transit Director Ozark Regional Transit 2423 East Robinson Springdale, AK 72764</p>	<p>Phn: (501) 756-9109 ext: 247 Fax: (501) 756-2901</p>	<p>AK</p>	<p>3/30/99</p>		<p>#59 4/13/99</p>	<p>NO NOTE: L.B. wants survey!</p>	<p>NO</p>	<p>83</p>

file: LPGdemandsurvey001tmp

TRANSMISSION VIA FACSIMILE: <FAX NUMBER>

<DATE>

Mr./Ms. <NAME>

<TITLE>

<ADDRESS>

Subject: Near-Term Demand Survey for LPG (Propane) Buses.

Dear Mr./Ms. <LAST NAME>:

This survey is faxed to you because you are in a privileged position of having pertinent technical knowledge, hands-on management expertise as well as decision-making power. Further, your mass transit agency may benefit from LPG powered buses because it is in an area where these conditions converge. These conditions are:

1. Favorable economic conditions (i.e. most favorable difference between the cost of a useful unit of energy of diesel and LPG, existing federal/state/provincial/regional incentives, large stocks of LPG available throughout the year, availability of long-term stable price LPG contracts, etc.),
2. Acuteness of local requirements to reduce air pollution, and
3. Available and supportive local infrastructure.

Your input will help decide if millions of dollars should be spent over the next two years to develop, test and certify a dedicated LPG engine for the mass transit industry.

As an alternative fuel, LPG offers several apparent advantages:

1. Operates closest to gasoline and/or diesel overall performance;
2. Refueling sites are easier to find than CNG, LNG, ethanol or methanol;
3. If needed, LPG refueling sites are affordable to build;
4. LPG refueling stations can operate when there are power outages;
5. Domestically produced LPG is abundant;
6. LPG provides longer driving range than other alternative fuels;
7. LPG is cost effective for fleet operations;
8. Storage of LPG requires less space (on board and on the ground); and,
9. There is a long-standing general familiarity with LPG as a fuel.

Some apparent disadvantages of LPG versus diesel and/or gasoline are:

1. Lower energy density;
2. Usually requires spark ignition required¹ (which incurs a 10 to 15% efficiency loss);
3. Less know-how in mass transit engine design than with diesel or gasoline engines;
4. Less know-how in mass transit vehicle design than with diesel or gasoline;
5. Most mass transit have extensive experience with diesel powered vehicles (vs. little or no experience with propane powered vehicles);
6. On-going safety and training is required.

For most mass transit agencies, (who have yet to make an alternate fuel commitment), LPG is likely to be the most cost-effective option to comply with increasingly stringent air pollution regulations. This is emphasized by the recent California Air Resources Board (ARB) finding that diesel particulate matter emissions are toxic (see enclosed). Lastly, on 01/28/99, the ARB reached an agreement with environmental groups that virtually outlaws the sale of diesel powered transit buses in California (see enclosed).

It should take 20 minutes or less to complete and return the enclosed survey. Please fax back your reply to (310) 478-5658.

We know you are busy and appreciate the time that you are taking to reply. Thank you for your cooperation.

If there are any questions, please call Ms. Alina Kulikowski-Tan at (310) 478-8448.

Sincerely,

Alex Spataru
President

P.S. If you want a copy of this survey results, please fill out the last question information.

Enclosures

¹ Only versus diesel.

File: LPGdemandsurvey001.doc

Date: February 10, 1999

MASS TRANSIT DECISION-MAKERS SURVEY
NEAR-TERM DEMAND FOR HEAVY-DUTY LPG¹
POWERED BUSES

After careful analysis, you were selected to participate in this survey. Your answers and comments are important.

Survey Purpose Statement

This survey is to:

- (1) Assess alternative fuels penetration into the mass transit market;
- (2) Assess attitudes towards and familiarity with LPG fuel among mass transit decision-makers;
- (3) Assess penetration of hybrid vehicles into the mass transit market;
- (4) Gauge likelihood of the purchase of LPG powered buses over the next five (5) years.

Your input will determine if funds will be allocated in 1999 to develop, test and certify a LPG dedicated heavy-duty engine for mass transit buses.

Please answer each question that pertains to your mass transit operation.

Thank you.

¹ LPG (Liquefied Petroleum Gas) is also commonly known as "Propane."

QUESTIONNAIRE

1. How many buses (30 feet or longer) are now in your fleet? (Please write in the number.) : _____ buses.

2. Currently, are there any vehicles in your fleet that operate on an alternative fuel?
(see list of applicable alternative fuels in Question # 3 below)

Yes No

If you answered “No” to Question # 2 above, please skip to Question # 5.

3. If you answered “Yes” to Question # 2 above, what alternative fuels are now used in your fleet (please check all applicable fuels)?

<u>Alternative Fuel</u>	<input type="checkbox"/>	<u>Vehicle Type</u> ²	<u>Number of Vehicles</u> (includes buses, vans, sedans, forklifts, shuttles, etc)
a. CNG ³	<input type="checkbox"/>	_____	_____
b. Electricity	<input type="checkbox"/>	_____	_____
c. Ethanol	<input type="checkbox"/>	_____	_____
d. LNG ⁴	<input type="checkbox"/>	_____	_____
e. Methanol	<input type="checkbox"/>	_____	_____
f. LPG	<input type="checkbox"/>	_____	_____
g. Bi-fuel ⁵	<input type="checkbox"/>	_____	_____
Fuel/s: _____		_____	_____
h. Other ⁶	<input type="checkbox"/>	_____	_____
Fuel: _____		_____	_____

² For example: Shuttle, Sedan, Bus, Paratransit, Forklift, etc.

³ CNG – Compressed Natural Gas.

⁴ LNG – Liquefied Natural Gas.

⁵ Please specify fuel/s.

⁶ Please specify fuel/s.

4. How many buses 30' or longer are now running on alternative fuels in your fleet?

	<u>Alternative Fuel Used</u>	<u>Number of Buses Only Running on that Alternative Fuel</u>
a.	CNG	_____
b.	Electricity	_____
c.	Ethanol	_____
d.	LNG	_____
e.	Methanol	_____
f.	LPG	_____
g.	Bi-fuel	_____
h.	Other	_____

5. Are there now any hybrid vehicles in your fleet?

Yes No

6. If you answered “Yes” to Question # 5 above, please list what type they are and what fuel/s the hybrid vehicles operate/s on?

<u>Vehicle Type</u>	<u>Fuels</u>
_____	_____
_____	_____

7. If you answered “No” to Question #5, do you plan to include any hybrid vehicles in your fleet over the next five (5) years?

Yes No

8. Given that a suitable LPG powered engine were available, what issues/considerations may play a major favorable role over the next five (5) years in your decision to shift all or part of your fleet to LPG dedicated buses?

Reason #1: _____

Reason #2: _____

Reason #3: _____

9. Given that a suitable LPG powered engine were commercially available, is your transit agency likely to buy over the next five (5) years mass transit buses powered by an ultra low emissions⁷ certified LPG dedicated engine?

Yes

No

If you answered “**No**” to Question # 9 above, please skip to Question # 14.

10. If you answered “**Yes**” to Question # 9 above, what size engine would you prefer? Please select one horsepower range that is most likely to fit your requirements.

- | | | |
|----|--------------|--------------------------|
| a. | 225 – 250 hp | <input type="checkbox"/> |
| b. | 251 – 275 hp | <input type="checkbox"/> |
| c. | 276 – 300 hp | <input type="checkbox"/> |
| d. | 301 – 325 hp | <input type="checkbox"/> |
| e. | 326 – 350 hp | <input type="checkbox"/> |
| f. | 351 – 375 hp | <input type="checkbox"/> |
| g. | 376 – 400 hp | <input type="checkbox"/> |

11. If you answered “**Yes**” to Question # 9 above, please indicate the torque (in ft-lb.) that is most likely to fit your requirements: _____

⁷ ARB and EPA certifications.

12. Given that a suitable ultra low emissions heavy-duty engine were commercially available, how many buses altogether do you anticipate your mass transit agency may purchase over the next five (5) years (with LPG engines that fit the power and torque requirements you selected in Questions # **10** and **11**)?

Total number of LPG buses that are likely to be bought by your mass transit over the next five (5) years: _____ (addition of five numbers below)

- Number of LPG buses to be bought in Year 2000: _____
- Number of LPG buses to be bought in Year 2001: _____
- Number of LPG buses to be bought in Year 2002: _____
- Number of LPG buses to be bought in Year 2003: _____
- Number of LPG buses to be bought in Year 2004: _____

13. What is the confidence level of the predicted bus purchase(s) indicated in Question # **12** above?

- a. 81 - 100% sure of my prediction (almost certain)
- b. 61 - 80% sure of my prediction (very sure)
- c. 41 - 60% sure of my prediction (quite sure)
- d. 21 - 40% sure of my prediction (not so sure)
- e. 01 - 20% sure of my prediction (little better than a wild guess)

14. If you answered “**No**” to Question # **9**, please list the two (2) main reasons why LPG powered buses are **not** likely to be considered by your mass transit agency.

Reason # 1:

Reason # 2:

15. Do you wish to receive a compilation of this survey's results?

Yes

No

If you answered "Yes" to Question #15, please fill out the following:

Name: _____ Company: _____

Address: _____

City: _____ State: _____

Fax #: _____

PLEASE FAX COMPLETED SURVEY TO: (310) 478-5658

TABLE OF QUESTIONS AND REPLIES TO NEAR-TERM DEMAND SURVEY FOR HEAVY-DUTY LPG POWERED BUSES IN MASS TRANSITS

Question 1. How many buses (30-foot or larger) are now in your fleet?

#	RESPONDENT	STATE	COUNTRY	RESPONSE
41	Owensboro Transit System	KY	USA	0 (5 Chance 25' & 3 Orion 25')
42	City of Bowling Green	KY	USA	0 (3 Ford 13 passenger buses)
56	Guam Mass Transit Authority	Guam	US Protectorate	3
25	Fresno County Rural Transit Agency	CA	USA	5
18	Terrebonne Parish Consolidated Transit	LA	USA	8
53	RIO TRANSIT	TX	USA	8
39	Missoula Urban Transportation District	MT	USA	9
26	Port Arthur Transit	TX	USA	10
15	Waco Transit System	TX	USA	13
38	Albany Transit System	GA	USA	13
54	Kelley Transit	CT	USA	13
17	Manatee County Area Transit	FL	USA	16
27	Citylink-Abilene Transit System	TX	USA	17
43	Corridor Transportation Corporation	MD	USA	18
52	CSUSac – Hornet Express	CA	USA	23
22	Summit Stage Transit Agency	CO	USA	29
48	Cambria County Transit Authority	PA	USA	30
50	TTA	WV	USA	31
19	WESTCAT	CA	USA	32
30	Red Rose Transit Authority	PA	USA	35
28	Escambia County Area Transit	FL	USA	38
12	UMass Transit Service	MA	USA	39

24	Tri Delta Transit	CA	USA	40
6	Antelope Valley Transit Authority	CA	USA	45
34	Kenosha Department of Transportation	WI	USA	47
14	Intercity Transit	WA	USA	48
47	Santa Clarita Transit	CA	USA	53
1	Gardena Bus Lines	CA	USA	55
5	City of Torrance Transit Division	CA	USA	55
45	Taltran – City of Tallahassee	FL	USA	56
44	Salem Area Mass Transit District	OR	USA	58
9	Roaring Fork Transit Agency	CO	USA	65
11	Grand Rapids Area Transit Authority	MI	USA	79
35	Minnesota Valley Transit Authority	MN	USA	98
51	Transit Authority of Northern Kentucky	KY	USA	99
37	Lane Transit District	OR	USA	125
8	San Mateo County Transit	CA	USA	127
49	Blue Hen Corporate Center	DE	USA	147
32	Hillsborough Area Regional Transit Authority	FL	USA	160
31	City of Santa Monica Big Blue Bus	CA	USA	170
36	LADoT	CA	USA	200
57	Montgomery County Transit Services	MD	USA	226
16	Rochester-Genesee RTA	NY	USA	244
7	CT Transit	CT	USA	375
21	Via Metropolitan Transit	TX	USA	449
13	Honolulu Department of Transportation	HI	USA	525
40	Tri-Met	OR	USA	629
3	Keylown City Hall	BC	CANADA	36
33	Saskatoon Transit	SK	CANADA	109

	Services			
46	Hertz Northern Bus	SK	CANADA	117
29	Brampton Transit	ON	CANADA	120
4	Halifax Regional Municipality	NS	CANADA	178
2	BC Transit	BC	CANADA	475
20	Laidlaw Canadian Coach Operations	AB	CANADA	562
10	Ottawa-Carleton Regional Transit Commission	ON	CANADA	800
23	Montréal Urban Community Transit Corporation	QC	CANADA	1,600
55	Metropolitan Management Transport Holdings Limited		JAMAICA	410
58	Public Transport Service Corporation	Trinidad	WEST INDIES	120

Summary of Answers to Question 1

Of the U.S. respondents, there are 22 fleets with 45 or less buses and 23 fleets with 46 or more buses.

Of the Canadian respondents, there is 1 fleet with 45 or less buses and 8 fleets with 46 or more buses.

The Jamaican and Trinidad and Tobago respondents have 2 fleets with 46 or more buses.

Two of the respondents had fleets that did not include 30' or larger buses. Their replies were not included in the database.

Note:

The survey was intentionally skewed towards smaller transits. The survey designers were aware that CNG had already made significant inroads among major transits. Out of 8,310 buses on order in January 1999, (based on APTA's survey of about 75% of the U.S. buses and trolley buses) 1,201 were for CNG and LNG. Also, out of 4,225 buses built in 1998, 924 were CNG and LNG. The large majority of CNG and LNG buses are operated and/or ordered by the largest mass transits.

Question 2. Currently, are there any vehicles in your fleet that operate on an alternative fuel?

Results from Fleets with 45 or Less Buses:

REFERENCE #	STATE	COUNTRY	YES	NO
25	CA	USA	✓	
19	CA	USA	✓	
52	CA	USA	✓	
26	TX	USA	✓	
24	CA	USA		✓
6	CA	USA		✓
22	CO	USA		✓
54	CT	USA		✓
17	FL	USA		✓
28	FL	USA		✓
38	GA	USA		✓
56	Guam	US Protectorate		✓
18	LA	USA		✓
12	MA	USA		✓
43	MD	USA		✓
39	MT	USA		✓
30	PA	USA		✓
48	PA	USA		✓
15	TX	USA		✓
27	TX	USA		✓
53	TX	USA		✓
50	WV	USA		✓
3	BC	CANADA		✓

Question 2 (Continued)

Results from Fleets with 46 or More Buses:

REFERENCE #	STATE	COUNTRY	YES	NO
5	CA	USA	✓	
31	CA	USA	✓	
36	CA	USA	✓	
32	FL	USA	✓	
57	MD	USA	✓	
40	OR	USA	✓	
44	OR	USA	✓	
21	TX	USA	✓	
34	WI	USA	✓	
1	CA	USA		✓
8	CA	USA		✓
47	CA	USA		✓
9	CO	USA		✓
7	CT	USA		✓
49	DE	USA		✓
45	FL	USA		✓
13	HI	USA		✓
51	KY	USA		✓
11	MI	USA		✓
35	MN	USA		✓
16	NY	USA		✓
37	OR	USA		✓
14	WA	USA		✓
46	SK	CANADA	✓	
20	AB	CANADA		✓
2	BC	CANADA		✓
4	NS	CANADA		✓
29	ON	CANADA		✓
10	ON	CANADA		✓
23	QC	CANADA		✓
33	SK	CANADA		✓
55		JAMAICA		✓
58	Trinidad and Tobago	WEST INDIES		✓

Summary of Answers to Question 2

- **Smaller Fleets (45 or less buses)**

18% of the U.S. small fleet respondents have vehicles that run on an alternative fuel.

The Canadian small fleet respondent has no vehicles that run on alternative fuels.

- **Larger Fleets (46 or more buses)**

39% of the U.S. respondents have vehicles that run on an alternative fuel.

13% of the Canadian respondents have vehicles that run on an alternative fuel.

The Caribbean respondents have no vehicles that run on alternative fuels.

FINDINGS:

(1) Larger fleets are more likely to have converted to an alternative fuel.

(2) In the international mass transit sectors covered by this survey, the thrust towards alternative fuels is furthest along in the U.S.

Question 3. If you answered “YES” to Question #2, what alternative fuels are now used in your fleet?

Results from Fleets with 45 or Less Buses:

#	STATE	COUNTRY	RESPONSE		
			Alternative Fuel	Vehicle Type/s	Number of Vehicles
19	CA	USA	• LPG	Transit Bus LPG Paratransit	6 8
25	CA	USA	• CNG • Electricity • LPG • Unleaded Gasoline	Vans Buses Bus Trolley Vans Vans	16 17 1 1 21 3
52	CA	USA	• CNG	Shuttle	1
26	TX	USA	• LPG	Sedan Pick-up	1 1

Results from Fleets with 46 or More Buses:

#	STATE	COUNTRY	RESPONSE		
			Alternative Fuel	Vehicle Type/s	Number of Vehicles
5	CA	USA	• Electricity	Vans, Sedans, Pick-ups, Carts Bus	30 1
31	CA	USA	• Electricity	26' Bus	1
36	CA	USA	• CNG • Electricity • LPG	30' Buses 30' Buses 30' Buses	57 8 50
32	FL	USA	• CNG	Small Buses	7
57	MD	USA	• CNG • LNG	Bus Bus	7 4
40	OR	USA	• CNG • LNG	Flatbed Truck Buses	1 10
44	OR	USA	• CNG • LPG	Bus Forklift	8 1
21	TX	USA	• LPG	Paratransit, Sedans, F700, Pick-ups, Forklifts	182
34	WI	USA	• Electricity • CNG	40' Buses - RTS II Streetcars	12 5

46	SK	CANADA	• LPG	School bus	5
----	----	--------	--------------	------------	---

Summary of Answers to Question 3

- **Smaller Fleets**

49% of the U.S. respondents who had alternative fueled vehicles, have vehicles running on LPG. Only 12% had buses running on LPG.

- **Larger Fleets**

61% of the U.S. respondents who had alternative fueled vehicles, have vehicles running on LPG. Only 14% had buses running on LPG.

100% of the Canadian respondents who had alternative fueled vehicles, have vehicles running on LPG. All vehicles were buses.

FINDING:

Although LPG is used by an apparent majority of those fleets that have made an effort to shift to alternative fuels (49% for smaller fleets and 61% for larger fleets), only 23-25% of these fleets operate buses on LPG.

The fueling infrastructure is often already in place. What is apparently missing is/are the bus engine/s.

Question 4. How many buses 30’ or larger are now running on alternative fuels in your fleet?

Results from Fleets with 45 or Less Buses:

#	STATE	COUNTRY	RESPONSE	
			<i>Alternative Fuel Used</i>	<i>Number of Buses Running on that Fuel</i>
19	CA	USA	• LPG	6
25	CA	USA	• CNG	5
52	CA	USA	• CNG	1

Results from Fleets with 46 or More Buses:

#	STATE	COUNTRY	RESPONSE	
			<i>Alternative Fuel Used</i>	<i>Number of Buses Running on that Fuel</i>
5	CA	USA	• Electricity	1
31	CA	USA	• Electricity	3
36	CA	USA	• CNG	57
			• LPG	50
57	MD	USA	• CNG	7
40	OR	USA	• LNG	10
44	OR	USA	• CNG	8
21	TX	USA	• LPG	66
34	WI	USA	• CNG	12
46	SK	CANADA	• LPG	5

Summary of Answers to Question 4

- **Smaller Fleets**
The U.S. respondents operate 12 alternative fueled buses (30’ or larger). Six (6) are running on LPG (one fleet) and six (6) are running on natural gas. The CNG powered bus population was distributed among two fleets.
- **Larger Fleets**
The U.S. respondents operate 219 alternative fueled buses (30’ or larger). 121 are running on LPG (in three fleets), 104 are running on natural gas (CNG and LNG) (in six fleets), and four are running on electricity (in two fleets).

FINDING:

The surprise of this “snap shot” survey is that among the sampled population there are still more LPG buses in use than buses running on CNG. As the old LPG engines or conversions run out their life cycle, this is likely to shift towards CNG/LNG unless another suitable and certified LPG dedicated engine is certified.

Question 5. Are there now any hybrid vehicles in your fleet?

Results from Fleets with 45 or Less Buses:

REFERENCE #	STATE	COUNTRY	YES	NO
6	CA	USA		✓
19	CA	USA		✓
24	CA	USA		✓
25	CA	USA		✓
52	CA	USA		✓
22	CO	USA		✓
54	CT	USA		✓
17	FL	USA		✓
28	FL	USA		✓
38	GA	USA		✓
56	Guam	US Protectorate		✓
18	LA	USA		✓
12	MA	USA		✓
43	MD	USA		✓
39	MT	USA		✓
30	PA	USA		✓
48	PA	USA		✓
15	TX	USA		✓
26	TX	USA		✓
27	TX	USA		✓
53	TX	USA		✓
50	WV	USA		✓
3	BC	CANADA		✓

Question 5 (Continued)

Results from Fleets with 46 or More Buses:

REFERENCE #	STATE	COUNTRY	YES	NO
36	CA	USA	✓	
1	CA	USA		✓
5	CA	USA		✓
8	CA	USA		✓
31	CA	USA		✓
47	CA	USA		✓
9	CO	USA		✓
7	CT	USA		✓
49	DE	USA		✓
32	FL	USA		✓
45	FL	USA		✓
13	HI	USA		✓
51	KY	USA		✓
57	MD	USA		✓
11	MI	USA		✓
35	MN	USA		✓
16	NY	USA		✓
37	OR	USA		✓
40	OR	USA		✓
44	OR	USA		✓
21	TX	USA		✓
14	WA	USA		✓
34	WI	USA		✓
20	AB	CANADA		✓
2	BC	CANADA		✓
4	NS	CANADA		✓
10	ON	CANADA		✓
29	ON	CANADA		✓
23	QC	CANADA		✓
33	SK	CANADA		✓
46	SK	CANADA		✓
55		JAMAICA		✓
58	Trinidad and Tobago	WEST INDIES		✓

Summary of Answers to Question 5

- **Smaller Fleets**
None of the respondents have hybrid vehicles.

- **Larger Fleets**
One U.S. respondent has hybrid vehicles.

The non-U.S. respondents have no hybrid vehicles.

FINDINGS:

Only one (1) out of 56 respondents has any experience with hybrid buses. This may be due to the initial sample population skew towards smaller fleets. This ties in with historical evidence that larger mass transits are typically more inclined to experiment with new technologies (due to larger resources and more prone to political pressure).

It is interesting to note that the hybrid vehicles operated in California run on LPG.

Question 6. *If you answered “YES” to Question #5, please list what type they are and what fuel/s the hybrid vehicles operate/s on?*

Results from Fleets with 45 or Less Buses:

#	STATE	COUNTRY	RESPONSE	
			<i>Vehicle Type</i>	<i>Fuel/s</i>
NONE				

Results from Fleets with 46 or More Buses:

#	STATE	COUNTRY	RESPONSE	
			<i>Vehicle Type</i>	<i>Fuel/s</i>
36	CA	USA	<ul style="list-style-type: none"> • APS-Hughes – El Dorado • ISE Research – El Dorado 	LPG LPG

Summary of Answers to Question 6

- **Larger Fleets**
LPG fuel the only hybrid vehicles used by the respondent.

Question 7. If you answered “NO” to Question #5, do you plan to include any hybrid vehicles in your fleet over the next five (5) years?

Results from Fleets with 45 or Less Buses:

REFERENCE #	STATE	COUNTRY	YES	NO
56	Guam	US Protectorate	✓	
30	PA	USA	✓	
48	PA	USA	✓	
19	CA	USA	Uncertain	
25	CA	USA	Uncertain	
28	FL	USA	Uncertain	
6	CA	USA		✓
24	CA	USA		✓
52	CA	USA		✓
22	CO	USA		✓
54	CT	USA		✓
17	FL	USA		✓
38	GA	USA		✓
18	LA	USA		✓
12	MA	USA		✓
43	MD	USA		✓
39	MT	USA		✓
15	TX	USA		✓
26	TX	USA		✓
27	TX	USA		✓
53	TX	USA		✓
50	WV	USA		✓
3	BC	CANADA		✓

Question 7 (Continued)

Results from Fleets with 46 or More Buses:

REFERENCE #	STATE	COUNTRY	YES	NO
5	CA	USA	✓	
31	CA	USA	✓	
7	CT	USA	✓	
32	FL	USA	✓	
57	MD	USA	✓	
11	MI	USA	✓	
37	OR	USA	✓	
40	OR	USA	✓	
36	CA	USA		Uncertain
9	CO	USA		Uncertain
14	WA	USA		Uncertain
34	WI	USA		Uncertain
1	CA	USA		✓
8	CA	USA		✓
47	CA	USA		✓
49	DE	USA		✓
45	FL	USA		✓
13	HI	USA		✓
51	KY	USA		✓
35	MN	USA		✓
16	NY	USA		✓
44	OR	USA		✓
21	TX	USA		✓
20	AB	CANADA		✓
2	BC	CANADA		✓
4	NS	CANADA		✓
10	ON	CANADA		✓
29	ON	CANADA		✓
23	QC	CANADA		✓
33	SK	CANADA		✓
46	SK	CANADA		✓
55		JAMAICA		✓
58	Trinidad and Tobago	WEST INDIES	✓	

Summary of Answers to Question 7

- **Smaller Fleets**

14% of the U.S. respondents plan to include hybrid vehicles in their fleet over the next five years (14% were uncertain).

The Canadian respondent does not plan to include hybrid vehicles in his fleet over the next five years.

- **Larger Fleets**

36% of the U.S. respondents plan to include hybrid vehicles in their fleet over the next five years (14% were uncertain).

The Canadian and Jamaican respondents do not plan to include hybrid vehicles in their fleet over the next five years.

The Trinidad and Tobago respondent plans to include hybrid vehicles in his fleet over the next five years.

FINDINGS:

- (1) There is now a very small number of hybrid buses in use.**
- (2) Although there is little available information on actual costs and field performance of hybrid buses, the respondents expressed a clear interest to include hybrid buses in their future fleets. The “hybrid concept” has apparently seduced the imagination of many mass transit fleet operators.**

Question 8. *Given that a suitable LPG powered engine were available, what issues/ considerations may play a major favorable role over the next five (5) years in your decision to shift all or part of your fleet to LPG dedicated buses?*

Results from Fleets with 45 or Less Buses:

#	STATE	COUNTRY	RESPONSE
19	CA	USA	<ul style="list-style-type: none"> Existing onsite infrastructure, good fuel availability Environmental-regulatory issues Availability of reliable, adequately powered engine
25	CA	USA	<ul style="list-style-type: none"> CARB certified engine or conversion kit for new vehicles (vans and buses) Continued favorable emissions results to prove to others that LPG is a clean fuel Recognition that LPG is indeed classified as an alternative clean fuel for vehicle purchase
52	CA	USA	<ul style="list-style-type: none"> Location of refueling Reliability Range
6	CA	USA	NONE
24	CA	USA	NONE
22	CO	USA	NONE
54	CT	USA	<ul style="list-style-type: none"> Cost of fuel Reduce pollution
17	FL	USA	<ul style="list-style-type: none"> If air pollution made this a non-attainment area If our country-government (not just transit system) decided to make a change to an alternative fuel If the vehicle cost remain the same as diesel If adequately trained maintenance employees can be found If vendor support for alternative engines was adequate
28	FL	USA	<ul style="list-style-type: none"> Cost effective Funding availability
38	GA	USA	<ul style="list-style-type: none"> Cost of fueling station Cost of training mechanic Local government seeing a need
56	Guam	US Protectorate	<ul style="list-style-type: none"> LPG dedicated buses are cost effective to operate and to maintain They are fuel efficient Environmentally friendly – producing less environmental pollution

18	LA	USA	<ul style="list-style-type: none"> • Technical knowledge of maintenance crew • Quality and availability of fuel • Dependency upon one or few vendors and/or manufacturers • Small systems have difficulty adapting to new tech.
12	MA	USA	<ul style="list-style-type: none"> • Cost and available funding
43	MD	USA	<ul style="list-style-type: none"> • Refueling station locations • Parts availability • Mechanic training
39	MT	USA	<ul style="list-style-type: none"> • Funding for the expense of facility conversion • Lower maintenance cost
30	PA	USA	<ul style="list-style-type: none"> • Electric hybrid available • Fueling station cost • Fuel availability
48	PA	USA	<ul style="list-style-type: none"> • Availability of fuel • Cost of fuel site • Added cost of technology to engine
15	TX	USA	<ul style="list-style-type: none"> • Cost for operating vehicles • Capital cost requirements • Local interest by elected officials in alternative fuels
27	TX	USA	<ul style="list-style-type: none"> • Fueling
53	TX	USA	<ul style="list-style-type: none"> • Better environment • Government mandate
26	TX	USA	NONE
50	WV	USA	<ul style="list-style-type: none"> • The cost of using LPG would need to be close to my present operating cost • I'm concerned about the hidden cost <ul style="list-style-type: none"> (a) Installing pumps/tanks (b) Supply/price of LPG • Safety of using LPG would/could be an issue
3	BC	CANADA	<ul style="list-style-type: none"> • Cost of addition/conversion

Question 8 (Continued)

Results from Fleets with 46 or More Buses:

#	STATE	COUNTRY	RESPONSE
1	CA	USA	<ul style="list-style-type: none"> • FTA Grants • Construction of new shop equipped for gas/fire protection certification • Demonstration project
5	CA	USA	<ul style="list-style-type: none"> • Would consider a hybrid on LPG
36	CA	USA	<ul style="list-style-type: none"> • True commitment on the part of the OEM to develop the technology an support the product
47	CA	USA	<ul style="list-style-type: none"> • Price of engine and fuel • Availability of fueling station and price of installation • Warranty backing from OEM
9	CO	USA	<ul style="list-style-type: none"> • Proven technology by DDC or Cummins • More cost effective than LNG/CNG • Proven hybrid technology from small bus manufacturers (less than 30')
7	CT	USA	<ul style="list-style-type: none"> • Would not due to large infrastructure cost required
49	DE	USA	<ul style="list-style-type: none"> • Fuel handling characteristics • Capability of facility to accommodate servicing of vehicles • Serviceability and maintainability of engines
13	HI	USA	<ul style="list-style-type: none"> • Availability and cost of LPG fuel
51	KY	USA	<ul style="list-style-type: none"> • Required to do it • Performance advantage proven over other alternative fuels • Economics
57	MD	USA	<ul style="list-style-type: none"> • None, we are fond of CNG
35	MN	USA	<ul style="list-style-type: none"> • Already have committed to CNG, will not be revisiting the question
16	NY	USA	<ul style="list-style-type: none"> • Capital funds to pay for the incremented cost of LPG buses and to pay for infrastructure modification to our facilities • To accommodate the fueling, maintenance, and storage of these buses
37	OR	USA	<ul style="list-style-type: none"> • Availability of fuel • Reliable source of fuel • Favorable cost
40	OR	USA	<ul style="list-style-type: none"> • Decreased capital/operating cost • Decreased emissions • Competitive environment for fuel

21	TX	USA	<ul style="list-style-type: none"> • If life cycle cost of alternative fuel bus is within 10% of a life diesel bus • Availability of engine and bus manufacturing is our only hold back (had the Series 50 come through we would have had 217, 40' buses on LPG) • We already have infrastructure (we will be pumping 10,000 gallons LPG per day by October 1999)
14	WA	USA	<ul style="list-style-type: none"> • Vehicle reliability • Operating and maintenance cost • Safety
34	WI	USA	<ul style="list-style-type: none"> • Lower infrastructure than CNG • Lower operating pressure than CNG
8	CA	USA	NONE
31	CA	USA	NONE
45	FL	USA	NONE
32	FL	USA	NONE – gas of any hydrocarbon nature is considered a transitional type fuel
11	MI	USA	NONE
44	OR	USA	NONE
20	AB	CANADA	<ul style="list-style-type: none"> • Air quality for vehicle performing charter work
4	NS	CANADA	<ul style="list-style-type: none"> • Cost effectiveness • Debugging of current fuel technology
23	QC	CANADA	<ul style="list-style-type: none"> • Air pollution regulation • Government
33	SK	CANADA	<ul style="list-style-type: none"> • Facilities • Safety • Staff acceptance
46	SK	CANADA	<ul style="list-style-type: none"> • Proven reliability in our northern climate • Reduction in fuel cost • Lower emissions
2	BC	CANADA	NONE
10	ON	CANADA	NONE
29	ON	CANADA	NONE
55		JAMAICA	<ul style="list-style-type: none"> • Safety • Availability of fuel • Operational characteristics of propane unit vs. diesel
58	Trinidad and Tobago	WEST INDIES	<ul style="list-style-type: none"> • Reduction and cost of fuel • Cleaner environment • Availability and adaptability to change alternative fuel

Summary of Answers to Question 8

The collection, interpretation and analysis of these replies required considerable effort, experience with mass transit operation, familiarity with alternative fuel issues in the mass transit environment, familiarity with LPG issues, as well as a tenacious follow-up.

There were six (6) phases to this process:

Phase I. Translation of replies into LPG industry and air quality terminology.

Phase II. Tabulation of interpreted replies into categories covering 23 issues for both small and large fleets.

Phase III. Re-formatting the 23 issues into seven (7) more general groups for small and large fleets. All issues within a group shared some common element/s.

Phase IV. Totaled work done under Phase II for both small and large fleets.

Phase V. Totaled work done under Phase III for both small and large fleets.

Phase VI. Extracted [for the possible benefit of the LPG industry] those issues that the industry is thought to be able to address within the short-term.

See Appendix 5 for worksheets and results of Phases II through VI.

FINDINGS:

Among the decision-making group, the five most important “pro” issues for LPG dedicated powered buses are:

- (1) Capital costs/initial costs (18 replies),**
- (2) Operating costs except for fuel (15 replies),**
- (3) Commitment from a reputable engine manufacturer (15 replies),**
- (4) Fuel supply/availability (12 replies), and**
- (5) Lower emissions (12 replies).**

**The only issue within full control of the LPG industry is #4 (fuel supply/availability).
The issue #1 is only within partial control of the LPG industry.**

Most “pro” issues are within the engine manufacturers’ control.

Question 9. *Given that a suitable LPG powered engine were commercially available, is your transit agency likely to buy over the next five (5) years mass transit buses powered by an ultra low emissions certified LPG dedicated engine?*

Results from Fleets with 45 or Less Buses:

#	STATE	COUNTRY	YES	NO
19	CA	USA	✓	
25	CA	USA	✓	
52	CA	USA	✓	
54	CT	USA	✓	
56	Guam	US Protectorate	✓	
18	LA	USA	✓	
48	PA	USA	✓	
53	TX	USA	✓	
28	FL	USA	Uncertain	
6	CA	USA		✓
24	CA	USA		✓
22	CO	USA		✓
17	FL	USA		✓
38	GA	USA		✓
12	MA	USA		✓
43	MD	USA		✓
39	MT	USA		✓
30	PA	USA		✓
15	TX	USA		✓
26	TX	USA		✓
27	TX	USA		✓
50	WV	USA		✓
3	BC	CANADA		✓

Question 9 (Continued)

Results from Fleets with 46 or More Buses:

#	STATE	COUNTRY	YES	NO
36	CA	USA	✓	
47	CA	USA	✓	
21	TX	USA	✓	
34	WI	USA	✓	
1	CA	USA		✓
5	CA	USA		✓
8	CA	USA		✓
31	CA	USA		✓
9	CO	USA		✓
7	CT	USA		✓
49	DE	USA		✓
32	FL	USA		✓
45	FL	USA		✓
13	HI	USA		✓
51	KY	USA		✓
57	MD	USA		✓
11	MI	USA		✓
35	MN	USA		✓
16	NY	USA		✓
37	OR	USA		✓
40	OR	USA		✓
44	OR	USA		✓
14	WA	USA		✓
23	QC	CANADA	✓	
20	AB	CANADA		✓
2	BC	CANADA		✓
4	NS	CANADA		✓
10	ON	CANADA		✓
29	ON	CANADA		✓
33	SK	CANADA		✓
46	SK	CANADA		✓
55		JAMAICA	✓	
58	Trinidad and Tobago	WEST INDIES	✓	

Summary of Answers to Question 9

- **Smaller Fleets**
36% of the U.S. respondents would buy over the next five years mass transit buses powered by an ultra low emissions certified LPG dedicated engine. These respondents now operate eight (8) fleets totaling 122 buses.

The Canadian respondent does not plan to buy over the next five years mass transit buses powered by an ultra low emissions certified LPG dedicated engine.

One U.S. respondent was uncertain. Upon further follow-up it was determined that he might be convinced if some of the issues listed under Question 8 were resolved. For reasons of conservative estimates, his fleet was not counted among those inclined to purchase LPG powered buses.

- **Larger Fleets**

17% of the U.S. respondents would buy over the next five years mass transit buses powered by an ultra low emissions certified LPG dedicated engine. These respondents operate four (4) fleets totaling 749 buses.

13% of the Canadian respondents would buy over the next five years mass transit buses powered by an ultra low emissions certified LPG dedicated engine. He operates one fleet with 1,600 buses.

Both Caribbean respondents would buy over the next five years mass transit buses powered by an ultra low emissions certified LPG dedicated engine. They operate two (2) fleets totaling 530 buses.

FINDINGS:

(1) The below table indicates that smaller fleets are likely to be more receptive to shift to LPG powered buses than larger fleets.

Sampled Population	Stated that it is possible to be convinced to shift to LPG.	Stated that they will not shift to LPG.	Rough Ratio
Smaller Fleets	8 (plus one “uncertain”)	14	1:2
Larger Fleets	7	26	1:4

(2) Given these replies, an estimate (although rough) could be made of the potential U.S. mass transit market saturation level for LPG powered buses.

It was estimated by APTA that there are about 70,000 mass transit buses (30-foot or larger) in the U.S. The U.S. sampled population operates 4,562* buses. Out of this population, twelve (12) fleets operating 868 buses expressed the possibility to shift to LPG. Thus, about 19% (868/4,562) of the U.S. mass transit market could eventually convert to LPG. In this optimistic line of thinking, it can be projected that the eventual market saturation level would be over 13,000 buses (30-foot or larger). It is unrealistic to expect such market penetration within the short and medium term unless the majority of the issues identified in the analysis of the replies to Questions 8 and 14 are timely and successfully addressed.

*For conservative estimate reasons, Guam, Jamaica and the West Indies were excluded.

Question 10. *If you answered “YES” to Question #9, what size engine would you prefer? Please select a horsepower range that is most likely to fit your requirements.*

Results from Fleets with 45 or Less Buses:

#	STATE	COUNTRY	HORSEPOWER RANGE
19	CA	USA	276-325 HP
25	CA	USA	225-250 HP
52	CA	USA	225-250 HP
54	CT	USA	276-300 HP
28	FL	USA	251-275 HP
18	LA	USA	225-250 HP
48	PA	USA	276-300 HP
53	TX	USA	351-400 HP
56	Guam	US Protectorate	276-300 HP

Results from Fleets with 46 or More Buses:

#	STATE	COUNTRY	HORSEPOWER RANGE
36	CA	USA	251-275 HP
47	CA	USA	276-300 HP – Transit 376-400 HP – Commuter
21	TX	USA	276-300 HP
34	WI	USA	276-300 HP
23	QC	CANADA	225-250 HP
55		JAMAICA	225-250 HP
58	Trinidad and Tobago	WEST INDIES	225-250 HP

Summary of Answers to Question 10

- **Smaller Fleets**
45% of the U.S. respondents prefer the 276-300 HP range and 33% prefer the 225-250 HP range.

There were no Canadian responses to this question.

- **Larger Fleets**
The U.S. respondents prefer the 276-300 HP range.

The Canadian and Caribbean respondents prefer the 225-250 HP range.

FINDINGS:

- (1) The U.S. market prefers the larger size engine.**
- (2) There seem to be two separate engine max. power needs:**
 - (A) a 276-300 HP engine (3 fleets, totaling 549 buses),**
 - (B) a 225-250 HP engine (3 fleets, totaling 2,130 buses).**

Using fleet size of the respondents as a market size need indicator, the smaller, 225-250 HP engine would take first priority (heavily weighted on the single Canadian fleet with 1,600 buses). If the Canadian fleet is set aside, there is a similar need for each of the engine sizes (549 engines for the 276-300 HP size and 530 engines for the 225-250 HP size).
- (3) There is a general trend in U.S. mass transits toward lighter buses. This may mitigate the perceived need for larger engines. The main six bus manufacturers in North America should be surveyed to answer this critical question.**

Question 11. *If you answered “YES” to Question #9, please indicate the torque (in ft-lb.) that is most likely to fit your requirements.*

Results from Fleets with 45 or Less Buses:

#	STATE	COUNTRY	RESPONSE
19	CA	USA	850-900 ft-lb
25	CA	USA	Comparable to existing standard specification for an unleaded fueled 15 passenger domestic van. (1) To power 15 passenger domestic van (2) Whatever it takes to power a 31 passenger Blue Bird type bus (3) Whatever it takes to power a 24 passenger Blue Bird type bus
52	CA	USA	806 ft-lb +
54	CT	USA	-
28	FL	USA	735-900 ft-lb
56	Guam	US Protectorate	900 ft-lb (1220 N-m) @ 1300 rpm
18	LA	USA	-
48	PA	USA	2000-2200 ft-lb
53	TX	USA	814 ft-lb

Results from Fleets with 46 or More Buses:

#	STATE	COUNTRY	RESPONSE
36	CA	USA	-
47	CA	USA	800 ft-lb – Transit 1500 ft-lb – Commuter
21	TX	USA	-
34	WI	USA	-
23	QC	CANADA	750 ft-lb
55		JAMAICA	383 ft-lb + (520 Nm +)
58	Trinidad and Tobago	WEST INDIES	420 ft-lb

Summary of Answers to Question 11

FINDINGS:

- (1) There were not enough replies to formulate conclusive findings, but there again seems to be a preference for higher torques in the U.S. (versus outside the U.S.).
- (2) A torque in the range of 800-900 ft-lb is likely to be a good starting point.

Question 12. *Given that a suitable ultra low emissions heavy-duty engine were commercially available, how many buses altogether do you anticipate your mass transit agency may purchase over the next five (5) years (with LPG engines that fit the power and torque requirements you selected in Question #10 and 11)?*

What is the total number of LPG buses that are likely to be bought by your mass transit over the next five (5) years?

Results from Fleets with 45 or Less Buses:

#	STATE	COUNTRY	RESPONSE
19	CA	USA	<ul style="list-style-type: none"> • Number to be bought in 2000: 7 • Number to be bought in 2001: 0 • Number to be bought in 2002: 0 • Number to be bought in 2003: 2 • Number to be bought in 2004: 10
25	CA	USA	<ul style="list-style-type: none"> • Number to be bought in 2000: 0 • Number to be bought in 2001: 2 • Number to be bought in 2002: 3 • Number to be bought in 2003: 15 • Number to be bought in 2004: 0
52	CA	USA	<ul style="list-style-type: none"> • Number to be bought in 2000: 1 • Number to be bought in 2001: 1 • Number to be bought in 2002: 1 • Number to be bought in 2003: ? • Number to be bought in 2004: ?
54	CT	USA	<ul style="list-style-type: none"> • Number to be bought in 2000: 0 • Number to be bought in 2001: 0 • Number to be bought in 2002: 0 • Number to be bought in 2003: 4 • Number to be bought in 2004: 0
28	FL	USA	<ul style="list-style-type: none"> • Number to be bought in 2000: 0 • Number to be bought in 2001: 4 • Number to be bought in 2002: 0 • Number to be bought in 2003: 0 • Number to be bought in 2004: 0
56	Guam	US Protectorate	<ul style="list-style-type: none"> • Number to be bought in 2000: 0 • Number to be bought in 2001: 0 • Number to be bought in 2002: 0 • Number to be bought in 2003: 12 • Number to be bought in 2004: 0

18	LA	USA	<ul style="list-style-type: none"> • Number to be bought in 2000: 0 • Number to be bought in 2001: 0 • Number to be bought in 2002: 0 • Number to be bought in 2003: 3 • Number to be bought in 2004: 3
48	PA	USA	<ul style="list-style-type: none"> • Number to be bought in 2000: 0 • Number to be bought in 2001: 0 • Number to be bought in 2002: 0 • Number to be bought in 2003: 5 • Number to be bought in 2004: 2
53	TX	USA	<ul style="list-style-type: none"> • Number to be bought in 2000: 0 • Number to be bought in 2001: 0 • Number to be bought in 2002: 0 • Number to be bought in 2003: 5 • Number to be bought in 2004: 0

Question 12 (Continued)

Results from Fleets with 46 or More Buses:

#	STATE	COUNTRY	RESPONSE
36	CA	USA	<ul style="list-style-type: none"> • Number to be bought in 1999: 50-80 • Number to be bought in 2000: 0 • Number to be bought in 2001: 0 • Number to be bought in 2002: 0 • Number to be bought in 2003: 0 • Number to be bought in 2004: 45-100
47	CA	USA	<ul style="list-style-type: none"> • Number to be bought in 2000: 0 • Number to be bought in 2001: 20 • Number to be bought in 2002: 0 • Number to be bought in 2003: 16 • Number to be bought in 2004: 9-19
21	TX	USA	<ul style="list-style-type: none"> • Number to be bought in 1999: 80 • Number to be bought in 2000: 40 • Number to be bought in 2001: 40 • Number to be bought in 2002: 57 • Number to be bought in 2003: 43 • Number to be bought in 2004: N/A
34	WI	USA	<ul style="list-style-type: none"> • Number to be bought in 2000: 0 • Number to be bought in 2001: 5 • Number to be bought in 2002: 9 • Number to be bought in 2003: 5 • Number to be bought in 2004: 5

23	QC	CANADA	<ul style="list-style-type: none"> • Number to be bought in 2000: 0 • Number to be bought in 2001: 0 • Number to be bought in 2002: 0 • Number to be bought in 2003: 25 • Number to be bought in 2004: 50
55		JAMAICA	<ul style="list-style-type: none"> • Number to be bought in 2000: 0 • Number to be bought in 2001: 0 • Number to be bought in 2002: 25 • Number to be bought in 2003: 25 • Number to be bought in 2004: 25

Summary of Answers to Question 12

• **Smaller Fleets**

Total number of LPG buses that are likely to be bought over the next five years by U.S. respondents:

- *Number to be bought in 2000: 8*
- *Number to be bought in 2001: 7*
- *Number to be bought in 2002: 4*
- *Number to be bought in 2003: 46*
- *Number to be bought in 2004: 15*

There were no Canadian responses.

• **Larger Fleets**

Total number of LPG buses that are likely to be bought over the next five years by U.S. respondents:

- *(Number to be bought in 1999: 130)**
- *Number to be bought in 2000: 40*
- *Number to be bought in 2001: 65*
- *Number to be bought in 2002: 66*
- *Number to be bought in 2003: 64*
- *Number to be bought in 2004: 59*

Total number of LPG buses that are likely to be bought over the next five years by Canadian and Caribbean respondents:

- *Number to be bought in 2000: 0*
- *Number to be bought in 2001: 0*
- *Number to be bought in 2002: 25*
- *Number to be bought in 2003: 50*
- *Number to be bought in 2004: 75*

*1999 was not included in the questionnaire. However, the reported sales projection should be noted (but was not counted in the statistical analysis).

FINDINGS:

(1) The total “bus buy” projection for the next five years for the sampled mass transit is 524 LPG powered buses.

Total Survey Population Orders Projection	
(1999)	(130)
2000	48
2001	72
2002	95
2003	160
2004	149
Five Year Total	524 (not including 1999)

(2) Annual “bus buy” projection grows over the years (except for 2004).

Question 13. What is the confidence level of the predicted bus purchase(s) indicated in Question #12.

Results from Fleets with 45 or Less Buses:

#	STATE	COUNTRY	RESPONSE
19	CA	USA	61-80% ~70%
25	CA	USA	21-40% (“no guarantee that you will have a certified engine for me to buy”) ~30%
52	CA	USA	41-60% ~50%
54	CT	USA	41-60% ~50%
28	FL	USA	41-60% ~50%
56	Guam	US Protectorate	41-60% ~50%
18	LA	USA	41-60% ~50%
48	PA	USA	41-60% ~50%
53	TX	USA	21-40% ~30%

Results from Fleets with 46 or More Buses:

#	STATE	COUNTRY	RESPONSE
36	CA	USA	61-80% ~70%
47	CA	USA	21-40% ~30%
21	TX	USA	81-100% ~90%
34	WI	USA	81-100% ~90%
23	QC	CANADA	21-40% ~30%
55		JAMAICA	41-61% ~50%

Summary of Answers to Question 13

- **Smaller Fleets**

Of the U.S. respondents, the average confidence level of the predicted bus purchase(s) indicated in Question #12 is 50%.

There were no Canadian responses to this question.

- **Larger Fleets**

Of the U.S. respondents, the average confidence level of the predicted bus purchase(s) indicated in Question #12 is 70%.

The non-U.S. respondents’ average confidence level is 40%.

FINDING:

On the whole, those who replied to this survey felt that their bus buy prediction had about one in two chances to become reality.

Question 14. *If you answered “NO” to Question #9, please list the two (2) main reasons why LPG powered buses are not likely to be considered by your mass transit agency.*

Results from Fleets with 45 or Less Buses:

#	STATE	COUNTRY	RESPONSE
6	CA	USA	<ul style="list-style-type: none"> We lack fueling capability for LPG on our leased facility lot Safety history of LPG is a concern to me
24	CA	USA	<ul style="list-style-type: none"> Facility modifications required Technology not reliable/proven
22	CO	USA	<ul style="list-style-type: none"> Difficult to run efficiently at this altitude, 9,000+ feet Poor performance during cold winter months, -20°F
17	FL	USA	<ul style="list-style-type: none"> Ethanol and methanol are more readily available Since we are a unit of county government, the decision to change would involve all county diesel vehicles, not just transit buses
38	GA	USA	<ul style="list-style-type: none"> We are now installing a new diesel fueling station; we cannot justify another fueling station Money and manpower to train mechanics
12	MA	USA	<ul style="list-style-type: none"> Cost of converting fleet Oldest buses are 1993
43	MD	USA	<ul style="list-style-type: none"> Amount of time required to reach fueling sites Subcontractors ability to maintain the equipment
39	MT	USA	<ul style="list-style-type: none"> Cost of fill stations and facility conversion Operating and maintenance costs overruns for a small operation
30	PA	USA	<ul style="list-style-type: none"> Anticipate moving to hybrid electric powered by diesel Transition actions are less than introducing a new fuel into the equation
15	TX	USA	<ul style="list-style-type: none"> We are not replacing most of our fleet until six years from now Our current infrastructure is for diesel fuel
26	TX	USA	<ul style="list-style-type: none"> No fueling site Insufficient FTA funds for capital procurement
27	TX	USA	<ul style="list-style-type: none"> We are replacing our bus fleet with diesel powered twelve-year buses
50	WV	USA	<ul style="list-style-type: none"> We are satisfied and like diesel High operating cost

3	BC	CANADA	<ul style="list-style-type: none"> BC Transit is the provincial corporation, which we purchase our buses through. They seem to be set on the low sulfur diesel fuel we currently use.
---	----	--------	--

Question 14 (Continued)

Results from Fleets with 46 or More Buses:

#	STATE	COUNTRY	RESPONSE
1	CA	USA	<ul style="list-style-type: none"> Shop not certified for repair/service for LPG fuel vehicles Must have funds identified for project (FTA, CALTRANS, etc.)
5	CA	USA	<ul style="list-style-type: none"> Control valve “freezes up.” Fuel collects in valves, gets gummy and makes sludge Never proven to work in heavy-duty use. Only previous history has been in light-duty work and that has had problems
8	CA	USA	<ul style="list-style-type: none"> No data to support cost effectiveness – cost comparison to clean diesel etc. No data to support dependability – longevity versus clean diesel.
31	CA	USA	<ul style="list-style-type: none"> We do not want to go through the development process to get this engine available for service There is no heavy-duty engine manufacturer that I am aware of that is working on an LPG application for one industry
9	CO	USA	<ul style="list-style-type: none"> No proven technology being offered by major bus manufacturers in US (especially at high altitudes)
7	CT	USA	<ul style="list-style-type: none"> Infrastructure costs are too high Higher costs of buying LPG buses
49	DE	USA	<ul style="list-style-type: none"> Facility limitations and cost associated with upgrading Unproven technology
32	FL	USA	<ul style="list-style-type: none"> Transitional fuel – we would rather place our resources in the fuel cell technology
45	FL	USA	<ul style="list-style-type: none"> If we went to gas it would be CNG because Tallahassee supplies natural gas
13	HI	USA	<ul style="list-style-type: none"> Availability and cost of LPG fuel Our buses run on diesel and are relatively new. It would not be feasible to have buses run on diesel and on LPG
51	KY	USA	<ul style="list-style-type: none"> Because we have not determined how we will comply with the regulations You only allowed a yes or no answer
57	MD	USA	<ul style="list-style-type: none"> We have made the decision for CNG Infrastructure for CNG is in place

11	MI	USA	<ul style="list-style-type: none"> • Fueling investment • Storage
35	MN	USA	<ul style="list-style-type: none"> • Already have committed CNG, will not be revisiting question
16	NY	USA	<ul style="list-style-type: none"> • Our preferred alternative fuel is CNG
37	OR	USA	<ul style="list-style-type: none"> • LPG did not prove successful at Tri-Met in Portland, OR • No readily available source of LPG
40	OR	USA	<ul style="list-style-type: none"> • OEMs don't offer • Increase capital, operating cost with little emissions reductions over clean diesel
44	OR	USA	<ul style="list-style-type: none"> • Are converting fleet to CNG
14	WA	USA	<ul style="list-style-type: none"> • High operating and maintenance cost • Vehicle reliability
20	AB	CANADA	<ul style="list-style-type: none"> • The current diesel engines are very clean burning, thus very little noticeable pollution • There is currently no shortage of diesel fuel, and the cost of installing LPG station is very expensive
2	BC	CANADA	<ul style="list-style-type: none"> • No bus for engine manufacturers have proposed or offered LPG • The latest "clean diesel" buses are meeting expectation and there is greater local interest in CNG or fuel cells than LPG as alternative fuel
4	NS	CANADA	<ul style="list-style-type: none"> • Limited funding for bus purchases • Lack of industry support on the construction of long life vehicles both in transit operators and OEMs
10	ON	CANADA	<ul style="list-style-type: none"> • Bad technology • Fuel safety hazards
29	ON	CANADA	<ul style="list-style-type: none"> • There have been few successful demonstrations of this technology • Initial costs are very high, station, storage, etc.
33	SK	CANADA	<ul style="list-style-type: none"> • Maintenance costs • Facilities improvements required
46	SK	CANADA	<ul style="list-style-type: none"> • Problems with cold weather application • Lack of operating knowledge

Summary of Answers to Question 14

The collection, interpretation and analysis of these replies required considerable effort, experience with mass transit operation, familiarity with alternative fuel issues in the mass transit environment, familiarity with LPG issues, as well as a tenacious follow-up.

There were six (6) phases to this process:

Phase I. Translation of replies into LPG industry and air quality terminology.

Phase II. Tabulation of interpreted replies into categories covering 23 issues for both small and large fleets.

Phase III. Re-formatting the 23 issues into seven (7) more general groups for small and large fleets. All issues within a group shared some common element/s.

Phase IV. Totaled work done under Phase II for both small and large fleets.

Phase V. Totaled work done under Phase III for both small and large fleets.

Phase VI. Extracted [for the possible benefit of the LPG industry] those issues that the industry is thought to be able to address within the short-term.

See Appendix 5 for worksheets and results of Phases II through VI.

FINDINGS:

Among the decision-making group, the five most important “anti” issues for LPG dedicated powered buses are:

- (1) Capital costs/initial costs (17 replies),**
- (2) Lack of fuel supplies/availability (10 replies),**
- (3) Operating costs except for fuel (10 replies),**
- (4) Lack of infrastructure (on and off premises) (9 replies), and**
- (5) Non-competitive performance versus traditional fuels (9 replies).**

Only two (2) issues (#2 and #4) can be directly addressed by the LPG industry. The LPG industry also has partial control over issue #1.

The bulk of the above listed issues are within the engine manufacturers’ control.

Question 15. Do you wish to receive a compilation of this survey's results?

#	RESPONDENT	STATE	COUNTRY	YES	NO
1	Gardena Bus Lines	CA	USA	✓	
5	City of Torrance Transit Division	CA	USA	✓	
8	San Mateo County Transit	CA	USA	✓	
19	WESTCAT	CA	USA	✓	
25	Fresno County Rural Transit Agency	CA	USA	✓	
31	City of Santa Monica Big Blue Bus	CA	USA	✓	
36	LADoT	CA	USA	✓	
47	Santa Clarita Transit	CA	USA	✓	
52	CSUSac – Hornet Express	CA	USA	✓	
22	Summit Stage Transit Agency	CO	USA	✓	
7	CT Transit	CT	USA	✓	
54	Kelley Transit	CT	USA	✓	
49	Blue Hen Corporate Center	DE	USA	✓	
17	Manatee County Area Transit	FL	USA	✓	
28	Escambia County Area Transit	FL	USA	✓	
45	Taltran – City of Tallahassee	FL	USA	✓	
38	Albany Transit System	GA	USA	✓	
56	Guam Mass Transit Authority	Guam	US Protectorate	✓	
13	Honolulu Department of Transportation	HI	USA	✓	
41	Owensboro Transit System	KY	USA	✓	
18	Terrebonne Parish Consolidated Transit	LA	USA	✓	
12	UMass Transit Service	MA	USA	✓	
43	Corridor Transportation Corporation	MD	USA	✓	
57	Montgomery County Transit Services	MD	USA	✓	
11	Grand Rapids Area Transit Authority	MI	USA	✓	
39	Missoula Urban Transportation District	MT	USA	✓	
16	Rochester-Genesee RTA	NY	USA	✓	
37	Lane Transit District	OR	USA	✓	
40	Tri-Met	OR	USA	✓	
48	Cambria County Transit Authority	PA	USA	✓	
21	Via Metropolitan Transit	TX	USA	✓	
26	Port Arthur Transit	TX	USA	✓	
27	Citylink-Abilene Transit System	TX	USA	✓	

53	RIO TRANSIT	TX	USA	✓	
14	Intercity Transit	WA	USA	✓	
34	Kenosha Department of Transportation	WI	USA	✓	
50	TTA	WV	USA	✓	
6	Antelope Valley Transit Authority	CA	USA		✓
24	Tri Delta Transit	CA	USA		✓
9	Roaring Fork Transit Agency	CO	USA		✓
32	Hillsborough Area Regional Transit Authority	FL	USA		✓
42	City of Bowling Green	KY	USA		✓
51	Transit Authority of Nothern Kentucky	KY	USA		✓
35	Minnesota Valley Transit Authority	MN	USA		✓
44	Salem Area Mass Transit District	OR	USA		✓
30	Red Rose Transit Authority	PA	USA		✓
15	Waco Transit System	TX	USA		✓
20	Laidlaw Canadian Coach Operations	AB	CANADA	✓	
4	Halifax Regional Municipality	NS	CANADA	✓	
33	Saskatoon Transit Services	SK	CANADA	✓	
46	Hertz Northern Bus	SK	CANADA	✓	
2	BC Transit	BC	CANADA		✓
3	Keylown City Hall	BC	CANADA		✓
10	Ottawa-Carleton Regional Transit Commission	ON	CANADA		✓
29	Brampton Transit	ON	CANADA		✓
23	Montréal Urban Community Transit Corporation	QC	CANADA		✓
55	Metropolitan Management Transport Holdings Limited		JAMAICA	✓	
58	Public Transport Service Corporation	Trinidad & Tobago	WEST INDIES	✓	

FINDING:

Most respondents want to receive the survey's results.

PHASE II
QUESTION 8 ANALYSIS (SMALLER FLEETS)

(1) Fuel Supply / Availability	7
(2) Capital Costs / Initial Costs (i.e. Shop Conversion Costs, Higher Engine Price, Higher Cost For On-Board Fueling System, Higher Bus Costs, etc.)	9
(3) Operating Costs (e.g. Maintenance) Except For Fuel	10
(4) Fuel Costs	3
(5) Availability Of Long-Term Fuel Contracts	2
(6) Financial Government Support (i.e. Grants, Subsidies, Tax Relief, etc.)	4
(7) Transition Process From Current Traditional Fuel (i.e. Via Demonstration Project, “Hassle Factor”)	1
(8) If On Hybrid Vehicle	1
(9) Reputable Engine Manufacturer Commitment (i.e. Ongoing Product Development, Warranty, Fast Troubleshooting, etc.)	10
(10) Presence Of Infrastructure (On And Off Premises)	6
(11) More Cost Effective Than LNG/CNG / Cost Advantage Over Other AF’s	3
(12) Better Performing Than Other AF’s	2
(13) Government Mandates	9
(14) Lower Emissions Than Traditional Fuels	7
(15) Overall Cycle Life Cost vs. Traditional Fuel Option	2
(16) Reputable Bus Manufacturer Commitment	4
(17) Safety (Relative Safety Of LPG vs. Other AF’s and/or Traditional Fuels)	1
(18) Training And Education	3

File: LPGdemsurvey_8S.doc

(19) Improved Performance In Cold Weather 2

(20) Fuel Quality 2

PHASE III
QUESTION 8 ANALYSIS (SMALLER FLEETS)

I. COST ISSUES

Operating Costs (e.g. Maintenance) Except For Fuel	10
Capital Costs / Initial Costs (i.e. Shop Conversion Costs, Higher Engine Price, Higher Cost For On-Board Fueling System, Higher Bus Costs, etc.)	9
<i>Financial Government Support (i.e. Grants, Subsidies, Tax Relief, etc.)*</i>	4
<i>Fuel Costs*</i>	3
<i>More Cost Effective Than LNG/CNG / Cost Advantage Over Other AF's*</i>	3
Overall Cycle Life Cost vs. Traditional Fuel Option	2
TOTAL	31

II. FUEL SUPPLY ISSUES

<i>Fuel Supply / Availability*</i>	7
<i>Presence Of Infrastructure (On And Off Premises)*</i>	6
<i>Availability Of Long-Term Fuel Contracts*</i>	2
Fuel Quality	2
TOTAL	17

III. COMMITMENTS FROM KEY PLAYERS

Reputable Engine Manufacturer Commitment (i.e. Ongoing Product Warranty, Fast Troubleshooting, etc.)	Development, 10
Reputable Bus Manufacturer Commitment	4
TOTAL	14

* It is thought that the LPG industry can take short-term action on the italicized issues.

IV. EMISSIONS ISSUES

<i>Government Mandates*</i>	9
Lower Emissions Than Traditional Fuels	7
TOTAL	16

V. IMAGE/TRAINING

<i>Training And Education*</i>	3
<i>Safety (Relative Safety Of LPG vs. Other AF's and/or Traditional Fuels)*</i>	1
TOTAL	4

VI. PERFORMANCE ISSUES

Better Performing Than Other AF's	2
Improved Performance In Cold Weather	2
TOTAL	4

VII. OTHER

<i>Transition Process From Current Traditional Fuel (i.e. Via Demonstration Project, "Hassle Factor")*</i>	1
<i>If On Hybrid Vehicle*</i>	1
TOTAL	2

* It is thought that the LPG industry can take short-term action on the italicized issues.

**PHASE II
QUESTION 8 ANALYSIS (LARGER FLEETS)**

(1) Fuel Supply / Availability	5
(2) Capital Costs / Initial Costs (i.e. Shop Conversion Costs, Higher Engine Price, Higher Cost For On-Board Fueling System, Higher Bus Costs, etc.)	9
(3) Operating Costs (e.g. Maintenance) Except For Fuel	5
(4) Fuel Costs	6
(5) Availability Of Long-Term Fuel Contracts	4
(6) Financial Government Support (i.e. Grants, Subsidies, Tax Relief, etc.)	2
(7) Transition Process From Current Traditional Fuel (i.e. Via Demonstration Project, "Hassle Factor")	2
(8) If On Hybrid Vehicle	2
(9) Reputable Engine Manufacturer Commitment (i.e. Ongoing Product Development, Warranty, Fast Troubleshooting, etc.)	5
(10) Presence Of Infrastructure (On And Off Premises)	1
(11) More Cost Effective Than LNG/CNG / Cost Advantage Over Other AF's	2
(12) Friendlier To Use Than Other AF's	1
(13) Better Performing Than Other AF's	1
(14) Government Mandates	2
(15) Lower Emissions Than Traditional Fuels	5
(16) Overall Cycle Life Cost vs. Traditional Fuel Option	1
(17) Reputable Bus Manufacturer Commitment	3
(18) Safety (Relative Safety Of LPG vs. Other AF's and/or Traditional Fuels)	4
(19) Relative State Of Technology Advancement (Fear Of "Guinea Pig" Effects)	1

File: LPGdemsurvey_8L.doc

(20) Training And Education	2
(21) Improved Performance In Cold Weather	1
(22) Improved Performance vs. Traditional Fuels	1

**PHASE III
QUESTION 8 ANALYSIS (LARGER FLEETS)**

I. COST ISSUES

Capital Costs / Initial Costs (i.e. Shop Conversion Costs, Higher Engine Price, Higher Cost For On-Board Fueling System, Higher Bus Costs, etc.)	9
<i>Fuel Costs</i> *	6
Operating Costs (e.g. Maintenance) Except For Fuel	5
<i>Financial Government Support (i.e. Grants, Subsidies, Tax Relief, etc.)</i> *	2
<i>More Cost Effective Than LNG/CNG / Cost Advantage Over Other AF's</i> *	2
Overall Cycle Life Cost vs. Traditional Fuel Option	1
TOTAL	25

II. FUEL SUPPLY ISSUES

<i>Fuel Supply / Availability</i> *	5
<i>Availability Of Long-Term Fuel Contracts</i> *	4
<i>Presence Of Infrastructure (On And Off Premises)</i> *	1
TOTAL	10

III. COMMITMENTS FROM KEY PLAYERS

Reputable Engine Manufacturer Commitment (i.e. Ongoing Product Warranty, Fast Troubleshooting, etc.)	Development, 5
Reputable Bus Manufacturer Commitment	3
Relative State Of Technology Advancement (Fear Of “Guinea Pig” Effects)	1
TOTAL	9

* It is thought that the LPG industry can take short-term action on the italicized issues.

IV. EMISSIONS ISSUES

Lower Emissions Than Traditional Fuels	5
<i>Government Mandates*</i>	2
TOTAL	7

V. IMAGE/TRAINING

<i>Safety (Relative Safety Of LPG vs. Other AF's and/or Traditional Fuels)*</i>	4
<i>Training And Education*</i>	2
TOTAL	6

VI. PERFORMANCE ISSUES

Better Performing Than Other AF's	1
Friendlier To Use Than Other AF's	1
Improved Performance In Cold Weather	1
Improved Performance vs. Traditional Fuels	1
TOTAL	4

VII. OTHER

<i>Transition Process From Current Traditional Fuel (i.e. Via Demonstration Project, "Hassle Factor")*</i>	2
<i>If On Hybrid Vehicle*</i>	2
TOTAL	4

* It is thought that the LPG industry can take short-term action on the italicized issues.

**PHASE IV
QUESTION 8 ANALYSIS (COMBINED)**

(1) Fuel Supply / Availability	12
(2) Capital Costs / Initial Costs (i.e. Shop Conversion Costs, Higher Engine Price, Higher Cost For On-Board Fueling System, Higher Bus Costs, etc.)	18
(3) Operating Costs (e.g. Maintenance) Except For Fuel	15
(4) Fuel Costs	9
(5) Availability Of Long-Term Fuel Contracts	6
(6) Financial Government Support (i.e. Grants, Subsidies, Tax Relief, etc.)	6
(7) Transition Process From Current Traditional Fuel (i.e. Via Demonstration Project, "Hassle Factor")	3
(8) If On Hybrid Vehicle	3
(9) Reputable Engine Manufacturer Commitment (i.e. Ongoing Product Development, Warranty, Fast Troubleshooting, etc.)	15
(10) Presence Of Infrastructure (On And Off Premises)	7
(11) More Cost Effective Than LNG/CNG / Cost Advantage Over Other AF's	5
(12) Better Performing Than Other AF's	3
(13) Friendlier To Use Than Other AF's	1
(14) Government Mandates	11
(15) Lower Emissions Than Traditional Fuels	12
(16) Overall Cycle Life Cost vs. Traditional Fuel Option	3
(17) Reputable Bus Manufacturer Commitment	7
(18) Safety (Relative Safety Of LPG vs. Other AF's and/or Traditional Fuels)	5

File: LPGdemsurvey_8comb.doc

(19) Training And Education	5
(20) Relative State Of Technology Advancement (Fear Of “Guinea Pig” Effects)	1
(21) Improved Performance In Cold Weather	3
(22) Improved Performance vs. Traditional Fuels	1
(23) Fuel Quality	2

PHASE V
QUESTION 8 ANALYSIS (COMBINED)

I. COST ISSUES

(A) Capital Costs / Initial Costs (i.e. Shop Conversion Costs, Higher Engine Price, Higher Cost For On-Board Fueling System, Higher Bus Costs, etc.)	18
(B) Operating Costs (e.g. Maintenance) Except For Fuel	15
(C) <i>Fuel Costs</i> *	9
(D) <i>Financial Government Support (i.e. Grants, Subsidies, Tax Relief, etc.)</i> *	6
(E) <i>More Cost Effective Than LNG/CNG / Cost Advantage Over Other AF's</i> *	5
(F) Overall Cycle Life Cost vs. Traditional Fuel Option	3
TOTAL	56

II. FUEL SUPPLY ISSUES

(A) <i>Fuel Supply / Availability</i> *	12
(B) <i>Presence Of Infrastructure (On And Off Premises)</i> *	7
(C) <i>Availability Of Long-Term Fuel Contracts</i> *	6
(D) Fuel Quality	2
TOTAL	27

III. COMMITMENTS FROM KEY PLAYERS

(A) Reputable Engine Manufacturer Commitment (i.e. Ongoing Product Development, Warranty, Fast Troubleshooting, etc.)	15
(B) Reputable Bus Manufacturer Commitment	7

* It is thought that the LPG industry can take short-term action on the italicized issues.

(C) Relative State Of Technology Advancement (Fear Of “Guinea Pig” Effects) 1

TOTAL 23

IV. EMISSIONS ISSUES

(A) Lower Emissions Than Traditional Fuels 12

(B) *Government Mandates** 11

TOTAL 23

V. IMAGE/TRAINING

(A) *Training And Education** 5

(B) *Safety (Relative Safety Of LPG vs. Other AF’s and/or Traditional Fuels)** 5

TOTAL 10

VI. PERFORMANCE ISSUES

(A) Better Performing Than Other AF’s 3

(B) Improved Performance In Cold Weather 3

(C) Friendlier To Use Than Other AF’s 1

(D) Improved Performance vs. Traditional Fuels 1

TOTAL 8

VII. OTHER

(A) *Transition Process From Current Traditional Fuel (i.e. Via Demonstration Project, “Hassle Factor”)** 3

(B) *If On Hybrid Vehicle** 3

TOTAL 6

* It is thought that the LPG industry can take short-term action on the italicized issues.

PHASE VI
QUESTION 8 ANALYSIS (COMBINED)
EXTRACT OF THOSE ISSUES OVER WHICH IT IS THOUGHT THAT THE LPG
INDUSTRY HAS SHORT-TERM CONTROL

I. COST ISSUES

<i>(C) Fuel Costs</i> *	9
<i>(D) Financial Government Support (i.e. Grants, Subsidies, Tax Relief, etc.)</i> *	6
<i>(E) More Cost Effective Than LNG/CNG / Cost Advantage Over Other AF's</i> *	5
TOTAL	20

II. FUEL SUPPLY ISSUES

<i>(A) Fuel Supply / Availability</i> *	12
<i>(B) Presence Of Infrastructure (On And Off Premises)</i> *	7
<i>(C) Availability Of Long-Term Fuel Contracts</i> *	6
TOTAL	25

IV. EMISSIONS ISSUES

<i>(B) Government Mandates</i> *	11
TOTAL	11

V. IMAGE/TRAINING

<i>(A) Training And Education</i> *	5
<i>(B) Safety (Relative Safety Of LPG vs. Other AF's and/or Traditional Fuels)</i> *	5
TOTAL	10

* It is thought that the LPG industry can take short-term action on the italicized issues.

VII. OTHER

(A) <i>Transition Process From Current Traditional Fuel (i.e. Via Demonstration Project, "Hassle Factor")*</i>	3
(B) <i>If On Hybrid Vehicle*</i>	3
TOTAL	6

PHASE II
QUESTION 14 ANALYSIS (SMALLER FLEETS)

(1) Lack of Fuel Supply / Availability	6
(2) Capital Costs / Initial Costs (i.e. Shop Conversion Costs, Higher Engine Price, Higher Cost For On-Board Fueling System, Higher Bus Costs, etc.)	6
(3) Operating Costs (e.g. Maintenance) Except For Fuel	4
(4) High Fuel Costs	1
(5) Current Fleet Relatively New	2
(6) No Availability Of Long-Term Fuel Contracts	2
(7) Lack of Financial Government Support (i.e. Grants, Subsidies, Tax Relief, etc.)	1
(8) Transition Process From Current Traditional Fuel (i.e. Via Demonstration Project, “Hassle Factor”)	3
(9) Use / Plan To Use Other AF / Hybrid Vehicles	2
(10) No Reputable Engine Manufacturer Commitment (i.e. Ongoing Product Development, Warranty, Fast Troubleshooting, etc.)	1
(11) Lack Of Infrastructure (On And Off Premises)	5
(12) Less Cost Effective Than LNG/CNG / Cost Disadvantage Over Other AF’s	1
(13) Overall Cycle Life Cost vs. Traditional Fuel Option	1
(14) No Reputable Bus Manufacturer Commitment	1
(15) Safety (Relative Safety Of LPG vs. Other AF’s and/or Traditional Fuels)	1
(16) Lack of Training And Education	1
(17) Relative State Of Technology Advancement (Fear Of “Guinea Pig” Effects)	1
(18) Decreased Performance In Cold Weather / High Altitudes	2
(19) Non-Competitive Performance vs. Traditional Fuels	2

PHASE III
QUESTION 14 ANALYSIS (SMALLER FLEETS)

I. COST ISSUES

Capital Costs / Initial Costs (i.e. Shop Conversion Costs, Higher Engine Price, Higher Cost For On-Board Fueling System, Higher Bus Costs, etc.)	6
Operating Costs (e.g. Maintenance) Except For Fuel	4
Current Fleet Relatively New	2
<i>High Fuel Costs</i> *	1
<i>Lack of Financial Government Support (i.e. Grants, Subsidies, Tax Relief, etc.)</i> *	1
<i>Less Cost Effective Than LNG/CNG / Cost Disadvantage Over Other AF's</i> *	1
Overall Cycle Life Cost vs. Traditional Fuel Option	1
TOTAL	16

II. FUEL SUPPLY ISSUES

<i>Lack of Fuel Supply / Availability</i> *	6
<i>Lack Of Infrastructure (On And Off Premises)</i> *	5
<i>No Availability Of Long-Term Fuel Contracts</i> *	2
TOTAL	13

III. COMMITMENTS FROM KEY PLAYERS

No Reputable Engine Manufacturer Commitment (i.e. Ongoing Product Development, Warranty, Fast Troubleshooting, etc.)	1
No Reputable Bus Manufacturer Commitment	1

* It is thought that the LPG industry can take short-term action on the italicized issues.

Relative State of Technology Advancement (Fear of “Guinea Pig” Effects)	1
TOTAL	3

IV. IMAGE/TRAINING

<i>Lack of Training And Education</i> *	1
<i>Safety (Relative Safety Of LPG vs. Other AF’s and/or Traditional Fuels)</i> *	1
TOTAL	2

V. PERFORMANCE ISSUES

Decreased Performance In Cold Weather / High Altitudes	2
Non-Competitive Performance vs. Traditional Fuels	2
TOTAL	4

VI. OTHER

<i>Transition Process From Current Traditional Fuel (i.e. Via Demonstration Project, “Hassle Factor”)</i> *	3
Use / Plan To Use Other AF / Hybrid Vehicles*	2
TOTAL	5

PHASE II
QUESTION 14 ANALYSIS (LARGER FLEETS)

(1) Lack of Fuel Supply / Availability	4
(2) Capital Costs / Initial Costs (i.e. Shop Conversion Costs, Higher Engine Price, Higher Cost For On-Board Fueling System, Higher Bus Costs, etc.)	11
(3) Operating Costs (e.g. Maintenance) Except For Fuel	6
(4) High Fuel Costs	3
(5) Current Fleet Relatively New	1
(6) No Availability Of Long-Term Fuel Contracts	4
(7) Lack of Financial Government Support (i.e. Grants, Subsidies, Tax Relief, etc.)	2
(8) Transition Process From Current Traditional Fuel (i.e. Via Demonstration Project, "Hassle Factor")	4
(9) Use / Plan To Use Other AF / Hybrid Vehicles	6
(10) No Reputable Engine Manufacturer Commitment (i.e. Ongoing Product Development, Warranty, Fast Troubleshooting, etc.)	5
(11) Lack Of Infrastructure (On And Off Premises)	4
(12) Less Cost Effective Than LNG/CNG / Cost Disadvantage Over Other AF's	7
(13) Overall Cycle Life Cost vs. Traditional Fuel Option	2
(14) No Reputable Bus Manufacturer Commitment	4
(15) Safety (Relative Safety Of LPG vs. Other AF's and/or Traditional Fuels)	1
(16) Lack of Training And Education	3
(17) Relative State Of Technology Advancement (Fear Of "Guinea Pig" Effects)	7
(18) Decreased Performance In Cold Weather / High Altitudes	2
(19) Non-Competitive Performance vs. Traditional Fuels	7

(20) Decrease In Fuel Quality	1
(21) Insignificant Emissions Decrease Relative To Traditional Fuels	3

**PHASE III
QUESTION 14 ANALYSIS (LARGER FLEETS)**

I. COST ISSUES

Capital Costs / Initial Costs (i.e. Shop Conversion Costs, Higher Engine Price, Higher Cost For On-Board Fueling System, Higher Bus Costs, etc.)	11
<i>Less Cost Effective Than LNG/CNG / Cost Disadvantage Over Other AF's*</i>	7
Operating Costs (e.g. Maintenance) Except For Fuel	6
<i>High Fuel Costs*</i>	3
<i>Lack of Financial Government Support (i.e. Grants, Subsidies, Tax Relief, etc.)*</i>	2
Overall Cycle Life Cost vs. Traditional Fuel Option	2
Current Fleet Relatively New	1
TOTAL	21

II. FUEL SUPPLY ISSUES

<i>Lack of Fuel Supply / Availability*</i>	4
<i>Lack Of Infrastructure (On And Off Premises)*</i>	4
<i>No Availability Of Long-Term Fuel Contracts*</i>	4
Decrease In Fuel Quality	1
TOTAL	13

III. COMMITMENTS FROM KEY PLAYERS

Relative State of Technology Advancement (Fear of “Guinea Pig” Effects)	7
No Reputable Engine Manufacturer Commitment (i.e. Ongoing Product Development, Warranty, Fast Troubleshooting, etc.)	5

* It is thought that the LPG industry can take short-term action on the italicized issues.

No Reputable Bus Manufacturer Commitment 4

TOTAL 16

IV. EMMISSIONS ISSUES

Insignificant Emissions Decrease Relative To Traditional Fuels 3

TOTAL 3

V. IMAGE/TRAINING

Lack of Training And Education * 3

Safety (Relative Safety Of LPG vs. Other AF's and/or Traditional Fuels) * 1

TOTAL 4

VI. PERFORMANCE ISSUES

Non-Competitive Performance vs. Traditional Fuels 7

Decreased Performance In Cold Weather / High Altitudes 2

TOTAL 9

VII. OTHER

Use / Plan To Use Other AF / Hybrid Vehicles* 6

Transition Process From Current Traditional Fuel (i.e. Via Demonstration Project, "Hassle Factor") * 4

TOTAL 10

**PHASE IV
QUESTION 14 ANALYSIS (COMBINED)**

(1) Lack of Fuel Supply / Availability	10
(2) Capital Costs / Initial Costs (i.e. Shop Conversion Costs, Higher Engine Price, Higher Cost For On-Board Fueling System, Higher Bus Costs, etc.)	17
(3) Operating Costs (e.g. Maintenance) Except For Fuel	10
(4) High Fuel Costs	4
(5) Current Fleet Relatively New	3
(6) No Availability Of Long-Term Fuel Contracts	6
(7) Lack of Financial Government Support (i.e. Grants, Subsidies, Tax Relief, etc.)	3
(8) Transition Process From Current Traditional Fuel (i.e. Via Demonstration Project, “Hassle Factor”)	7
(9) Use / Plan To Use Other AF / Hybrid Vehicles	8
(10) No Reputable Engine Manufacturer Commitment (i.e. Ongoing Product Development, Warranty, Fast Troubleshooting, etc.)	6
(11) Lack Of Infrastructure (On And Off Premises)	9
(12) Less Cost Effective Than LNG/CNG / Cost Disadvantage Over Other AF’s	8
(13) Overall Cycle Life Cost vs. Traditional Fuel Option	3
(14) No Reputable Bus Manufacturer Commitment	5
(15) Safety (Relative Safety Of LPG vs. Other AF’s and/or Traditional Fuels)	2
(16) Lack of Training And Education	4
(17) Relative State Of Technology Advancement (Fear Of “Guinea Pig” Effects)	8
(18) Decreased Performance In Cold Weather / High Altitudes	4
(19) Non-Competitive Performance vs. Traditional Fuels	9

(20) Decrease In Fuel Quality	1
(21) Insignificant Emissions Decrease Relative To Traditional Fuels	3

PHASE V
QUESTION 14 ANALYSIS (COMBINED)

I. COST ISSUES

(A) Capital Costs / Initial Costs (i.e. Shop Conversion Costs, Higher Engine Price, Higher Cost For On-Board Fueling System, Higher Bus Costs, etc.)	17
(B) Operating Costs (e.g. Maintenance) Except For Fuel	10
(C) <i>Less Cost Effective Than LNG/CNG / Cost Disadvantage Over Other AF's*</i>	8
(D) <i>High Fuel Costs*</i>	4
(E) <i>Lack of Financial Government Support (i.e. Grants, Subsidies, Tax Relief, etc.)*</i>	3
(F) Overall Cycle Life Cost vs. Traditional Fuel Option	3
(G) Current Fleet Relatively New	3
TOTAL	48

II. FUEL SUPPLY ISSUES

(A) <i>Lack of Fuel Supply / Availability*</i>	10
(B) <i>Lack Of Infrastructure (On And Off Premises)*</i>	9
(C) <i>No Availability Of Long-Term Fuel Contracts*</i>	6
(D) Decrease In Fuel Quality	1
TOTAL	26

III. COMMITMENTS FROM KEY PLAYERS

(A) Relative State Of Technology Advancement (Fear Of “Guinea Pig” Effects)	8
(B) No Reputable Engine Manufacturer Commitment (i.e. Ongoing Product Development, Warranty, Fast Troubleshooting, etc.)	6

* It is thought that the LPG industry can take short-term action on the italicized issues.

(C) No Reputable Bus Manufacturer Commitment 5

TOTAL 19

IV. EMISSIONS ISSUES

(A) Insignificant Emissions Decrease Relative To Traditional Fuels 3

TOTAL 3

V. IMAGE/TRAINING

(A) *Lack of Training And Education** 4

(B) *Safety (Relative Safety Of LPG vs. Other AF's and/or Traditional Fuels)** 2

TOTAL 6

VI. PERFORMANCE ISSUES

(A) Non-Competitive Performance vs. Traditional Fuels 9

(B) Decreased Performance In Cold Weather / High Altitudes 4

TOTAL 13

VII. OTHER

(A) Use / Plan To Use Other AF / Hybrid Vehicles 8

(B) *Transition Process From Current Traditional Fuel (i.e. Via Demonstration Project, "Hassle Factor")** 7

TOTAL 15

PHASE VI
QUESTION 14 ANALYSIS (COMBINED)
EXTRACT OF THOSE ISSUES OVER WHICH IT IS THOUGHT THAT THE LPG
INDUSTRY HAS SHORT-TERM CONTROL

I. COST ISSUES

<i>(C) Less Cost Effective Than LNG/CNG / Cost Disadvantage Over Other AF's*</i>	8
<i>(D) High Fuel Costs*</i>	4
<i>(E) Lack of Financial Government Support (i.e. Grants, Subsidies, Tax Relief, etc.)*</i>	3
TOTAL	15

II. FUEL SUPPLY ISSUES

<i>(A) Lack of Fuel Supply / Availability*</i>	10
<i>(B) Lack Of Infrastructure (On And Off Premises)*</i>	9
<i>(C) No Availability Of Long-Term Fuel Contracts*</i>	6
TOTAL	25

V. IMAGE/TRAINING

<i>(A) Lack of Training And Education*</i>	4
<i>(B) Safety (Relative Safety Of LPG vs. Other AF's and/or Traditional Fuels)*</i>	2
TOTAL	6

VII. OTHER

<i>(A) Transition Process From Current Traditional Fuel (i.e. Via Demonstration Project, "Hassle Factor")*</i>	7
TOTAL	7

* It is thought that the LPG industry can take short-term action on the italicized issues.