

Ten Years of Compressed Natural Gas (CNG) Operations at SunLine Transit Agency

April 2003 — December 2004

K. Chandler
Battelle
Columbus, Ohio

Subcontract Report
NREL/SR-540-39180
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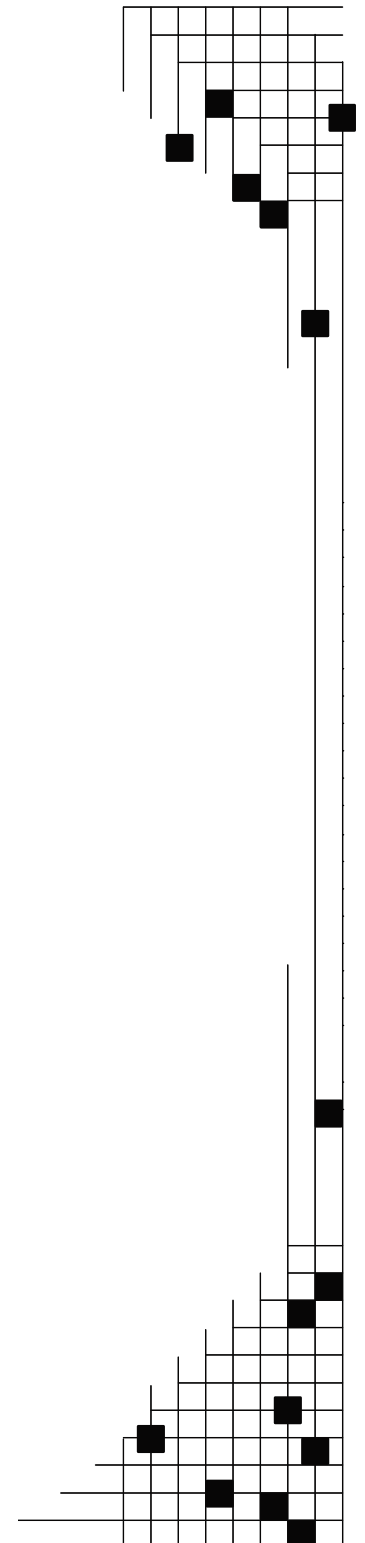
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K. Chandler
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NREL Technical Monitor: Richard Parish
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List of Acronyms and Abbreviations

ASME	American Society of Mechanical Engineers
CARB	California Air Resources Board
CNG	compressed natural gas
DDC	Detroit Diesel Corporation
DOE	U.S. Department of Energy
FTA	Federal Transit Administration
FY	fiscal year
GGE	gasoline gallon equivalent
HHICE	hydrogen hybrid internal combustion engine
hp	horsepower
LACMTA	Los Angeles County Metropolitan Transit Authority
LFL	lower flammability limit
LNG	liquefied natural gas
MPGGE	miles per gasoline gallon equivalent
NGVTF	Natural Gas Vehicle Technology Forum
NREL	National Renewable Energy Laboratory
psi	pounds per square inch
RC	roadcalls
SAE	Society of Automotive Engineers
SCAQMD	South Coast Air Quality Management District
SoCAL Gas	Southern California Gas Company

Executive Summary

This report has been produced as part of the U.S. Department of Energy's (DOE) Natural Gas Vehicle Technology Forum (NGVTF) activity, which strives to advance gaseous fuel vehicle technology and fueling infrastructure (natural gas, hydrogen, and hydrogen-natural gas blends) to displace the use of imported petroleum in the U.S. The National Renewable Energy Laboratory leads the NGVTF for DOE's FreedomCAR and Vehicle Technologies Program.

The report focuses on the SunLine Transit Agency, which started operation of compressed natural gas (CNG) transit buses in 1994 by converting its entire operating fleet to CNG, essentially overnight. Now, more than 10 years later, SunLine is still committed to CNG transit bus operations as well as testing other future technologies. The main objective of this report is to capture some of the lessons learned and experiences gained at SunLine from its last 10 years of CNG vehicle operations.

SunLine (website at www.sunline.org) started transit operations in 1977 with 22 vehicles. Its transit bus operations are located in the Palm Springs, California area and include much of the Coachella Valley (a service area reported as greater than 1,100 square miles). SunLine currently operates over 2 million miles per year at an average operational speed of around 15 miles per hour.

In 1991, SunLine discussed the possibility and then planned to convert its transit buses from diesel to CNG in order to distinguish the small transit agency as a leader for reduced emissions in heavy-duty vehicles. As part of these discussions, SunLine decided to maximize the impact by converting the entire fleet of buses and support vehicles to operate only on CNG as soon as possible. In 1991, there were only approximately 25 heavy CNG buses placed into service in the United States and another 70 heavy CNG buses on order. Therefore, SunLine's decision was risky, especially since it was made at a very early stage in CNG bus development and deployment in the United States.

The SunLine Board of Directors approved the 100% alternative fuels approach in 1992. The greatest challenge at that time with implementing full CNG operations was that it had not yet been accomplished in the United States. In order to undertake this difficult task, several activities needed to be planned and executed at the same time including:

- Collecting a group of experts and knowledge contributors
- Ordering new CNG buses
- Constructing permanent CNG fueling on-site
- Completing appropriate training for staff and mechanics
- Developing a public relations strategy
- Preparing for implementation.

In 1993, a new CNG fueling station was constructed, and new CNG buses were ordered (with the help and cooperation of Sacramento Regional Transit). Natural gas vehicle training programs were developed at the College of the Desert's Energy Technology Training Center, and the SunLine mechanics were the first "graduates" of that training. All SunLine employees received

some natural gas vehicle safety familiarization training. The nation’s first fleet to change to 100% CNG bus operations occurred in May 1994.

The current SunLine bus fleet includes 41 full size transit buses, five mid-size transit buses, and 23 paratransit vehicles. Additional support vehicles include 35 light- and medium-duty vehicles. All of these SunLine vehicles operate on CNG, and a few operate on CNG mixed with hydrogen. The analysis presented in this report focuses on the full-size and mid-size transit buses operating at SunLine (46 CNG buses in the active fleet) as shown in Table ES-1.

Table ES-1. CNG Buses at SunLine

Bus	Number of Buses	Model Year	Length	Engine	Purchase Price
Orion V	34*	1994	40 foot	Cummins L10-240G	\$225,000
EIDorado National	5	1994	29 foot	Hercules 5.6L	\$120,000
Thomas MVP	7	1995	40 foot	Cummins B5.9G	\$85,000

* Two of these buses now have Cummins C8.3G engines and one has a Deere 6081H engine. All three of these buses have prototype engines that have been used for testing.

When the CNG buses arrived and began service, normal break-in problems occurred. Some mechanics were eager to work on the new bus equipment and a few were concerned about safety. Over time, the major concern was loose fittings left by the less experienced mechanics. Learning how to troubleshoot these new buses was a challenge and was supported in a timely manner by Cummins Cal Pacific. The SunLine staff reported that the transition to CNG bus operations would have been much more difficult without Cummins’ support.

Additional information regarding the first three years of operation (1994-1996) at SunLine and Sacramento Regional Transit was also documented in a report published in 1999 by the Society of Automotive Engineers (SAE)¹. The mid-term experience (1997-1999) at SunLine was investigated in discussions with SunLine personnel. The mechanics and operators had become comfortable with the CNG buses and infrastructure by the mid-term. As new mechanics were added to the staff, familiarization training was provided both at the College of the Desert and through on-the-job training at SunLine.

This report focuses on an evaluation of the last five years of operation costs for the 46 CNG buses [fiscal year (FY) 2000 through FY 2004]. Table ES-2 provides summary results for the CNG buses at SunLine.

¹ SAE Paper 1999-01-3738, 1999, “A Three-Year Comparison of Natural Gas and Diesel Transit Buses.”

Table ES-2. Summary of Evaluation Results (FY00-FY04)

Category	Orion / Cummins L10-240G	Orion / Cummins C8.3G*	Orion / Deere 6081H*	Thomas / Cummins B5.9G	EIDorado / Cummins B5.9G	EIDorado / Hercules	Total Fleet
Number of Vehicles	31	2	1	7	4	1	46
Total Mileage	8,780,704	44,906	116,509	463,571	574,439	87,569	10,464,698
Avg. Annual Miles/Bus	56,650	44,191	23,302	13,245	28,722	21,892	--
Fuel Economy (MPGGE)	3.0	2.8	2.8	3.6	5.1	5.0	3.1
Fuel Cost (\$/Mile)	0.35	0.38	0.40	0.29	0.21	0.20	0.34
Maint. Cost (\$/Mile)	0.35	0.48	0.75	0.47	0.30	0.40	0.36
Total Cost (\$/Mile)	0.70	0.86	1.16	0.73	0.51	0.61	0.70
Miles Between RCs	13,164	5,739	4,855	4,829	9,904	3,020	11,004

* These buses had engines being rigorously tested by the manufacturer and SunLine, and the maintenance results do not reflect their commercial engine product performance.

How Did SunLine Become Successful with CNG Bus Operations? – SunLine showed pioneering leadership at a very early stage of natural gas vehicle development by converting its entire fleet. SunLine has been operating some of the least sophisticated CNG buses in the transit industry and has become very successful through persistent dedication and extensive training of maintenance personnel.

Other Projects – SunLine is a small transit agency with limited resources. SunLine, along with multiple partners, has entered into many projects over the past 10 years that have been associated with transit, natural gas, hydrogen, fuel cells, and combinations of these topics. The objectives have been to advance clean transit bus propulsion systems and to leverage project funding to afford SunLine additional and new buses and infrastructure.

Some of the recent projects at SunLine have involved the use of hydrogen. The SunLine hydrogen fueling capability has been used to demonstrate a fuel cell bus using a Ballard fuel cell in 2001 and later with the ThunderPower fuel cell bus with a UTC fuel cell in 2002-2003. SunLine has also been testing buses operating on a mixture of natural gas and hydrogen. The objective of mixing hydrogen into natural gas as a vehicle fuel is to significantly reduce oxides of nitrogen emissions from vehicles and to demonstrate a credible path to hydrogen as a transportation fuel.

What's Next? – SunLine feels the future of CNG bus operations is bright. Current plans include the imminent delivery of 15 new Orion V CNG buses with Cummins L Gas Plus engines (purchased on an existing order from Fresno Area Express transit agency) in early 2006. SunLine plans to replace the entire heavy CNG bus fleet by 2009. The newest bus in service at

SunLine is their hydrogen hybrid internal combustion engine from ISE Research and New Flyer. In November 2005, SunLine also received from ISE Research a new hybrid fuel cell bus with a Van Hool bus chassis using the Siemens hybrid electric propulsion system and a UTC fuel cell power plant.

Introduction

This report has been produced as part of the U.S. Department of Energy's (DOE) Natural Gas Vehicle Technology Forum (NGVTF) activity, which strives to advance gaseous fuel vehicle technology and fueling infrastructure (natural gas, hydrogen, and hydrogen-natural gas blends) to displace the use of imported petroleum in the U.S. The National Renewable Energy Laboratory leads the NGVTF for DOE's FreedomCAR and Vehicle Technologies Program.

This NGVTF report focuses on the SunLine Transit Agency, which started operation of compressed natural gas (CNG) transit buses in 1994 by converting its entire operating fleet essentially overnight (Figure 1). Now, more than 10 years later, SunLine is still committed to CNG transit bus operations as well as testing other future vehicle technologies. This report takes a look back at the decisions that led SunLine to a complete changeover to CNG operation and how full implementation of CNG bus operations has fared. There also is an emphasis on the last five years of operations to investigate how these early CNG technology vehicles were maintained up to nearly retirement age.

The main objective of this report is to capture some of the lessons learned and experiences gained at SunLine from its 10 years of operating only CNG-fueled vehicles. Some reports and papers have boasted extremely positive experiences at SunLine, while at the same time, some other transit agencies have reported disappointing results with CNG buses. During this same period, a number of transit agencies have experimented with CNG fuel and buses, but moved on to other technologies or back to standard diesel vehicles when they were confronted with growing pains or early operating challenges. SunLine has continued to use early natural gas vehicle and infrastructure technology, and has reported extremely positive results as demonstrated in this report.



Photo courtesy of SunLine Transit Agency

Figure 1. SunLine introduces CNG transit buses to the Coachella Valley in 1994

SunLine Transit Agency Converts to Exclusive Use of CNG

SunLine (website at www.sunline.org) started transit operations in 1977 with 22 vehicles. SunLine transit bus operations are located in the Palm Springs, California area (Figure 2) and include much of the Coachella Valley (a service area reported as greater than 1,100 square miles). SunLine is physically headquartered in Thousand Palms, California, and has nine member cities as well as one county (Riverside). Each of the following member cities and county has an appointed member on the SunLine board:

- Desert Hot Springs
- Palm Springs
- Cathedral City
- Rancho Mirage
- Palm Desert
- Indian Wells
- La Quinta
- Indio
- Coachella
- Riverside County.

The current SunLine bus fleet includes 41 full-size transit buses (40-foot), five mid-size transit buses (29-foot), and 23 paratransit vehicles. Additional support vehicles include 35 light- and medium-duty vehicles. All of these SunLine vehicles operate on CNG, and a few operate on CNG mixed with hydrogen. The analysis presented in this report is focused on the full-size and mid-size transit buses operating at SunLine (46 CNG buses in the active fleet).

Converting the Entire SunLine Fleet to CNG

The State of California has some specific and severe air quality challenges identified especially in the Los Angeles metropolitan area. The Coachella Valley, including Palm Springs, is located in Riverside County, which is one of the four counties included in the Los Angeles metropolitan area. In the 1970s, the U.S. Environmental Protection Agency and the California Air Resources Board (CARB) were considering and implementing serious emissions reductions especially for mobile sources (cars and trucks).

Starting in the late 1980s and early 1990s, CARB began to strongly encourage alternative fuels for vehicles to help with needed emissions reductions. The South Coast Air Quality Management District (SCAQMD) is the local government entity with jurisdiction on air quality issues in the Los Angeles metropolitan area including Los Angeles, Orange, Riverside, and San Bernardino counties. SCAQMD put in place several incentive programs for conversion of vehicles in the district to alternative fuels. One of the focuses of these incentive programs was on transit buses because of the large emissions impact in urban areas.

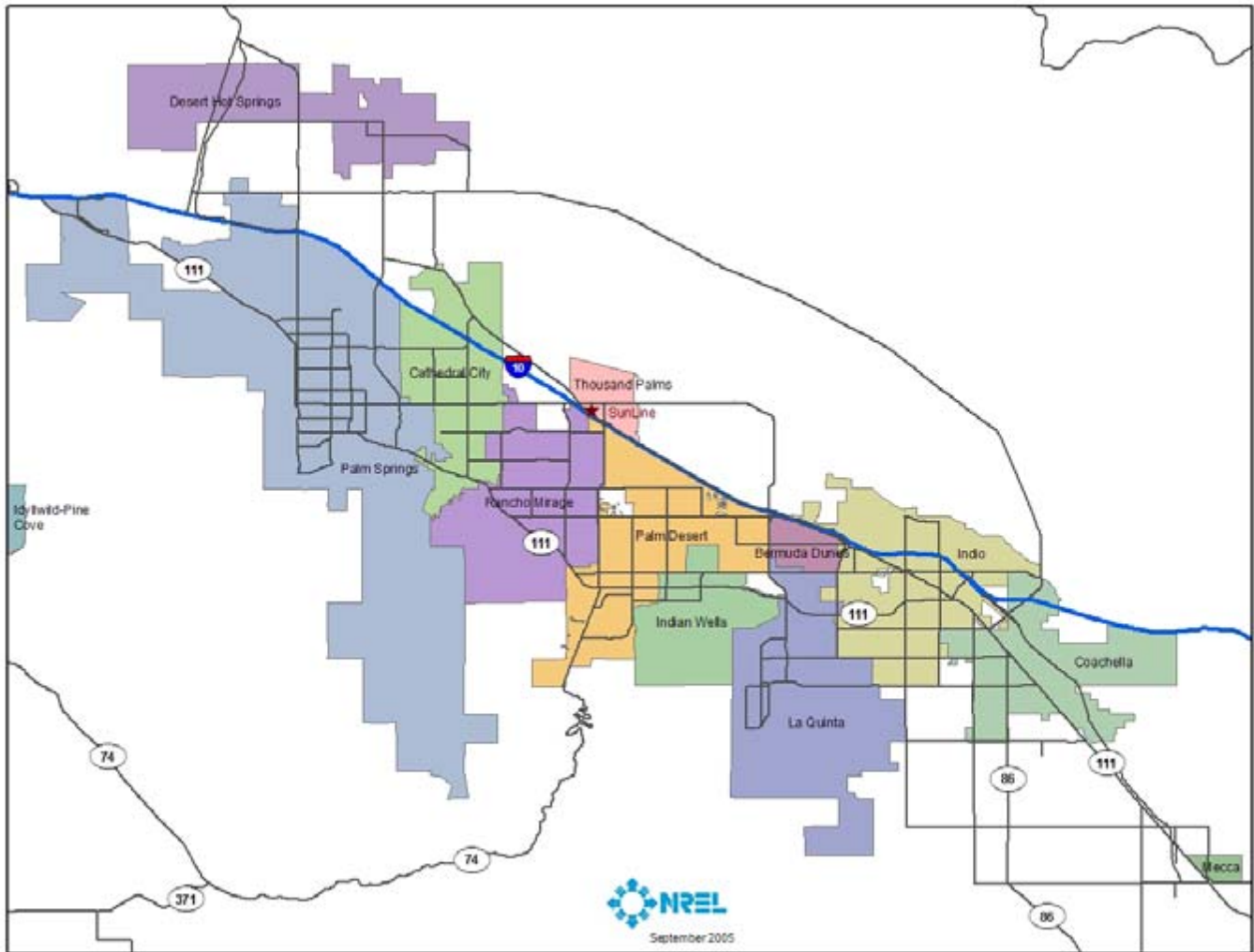


Figure 2. SunLine operating area in the Coachella Valley, California, Area

In 1991, SunLine changed general managers and was looking for a defining position on clean bus operations. Discussions and plans were made regarding a change of the transit buses to CNG. As part of these discussions, SunLine decided to maximize the impact by converting the entire fleet of buses and support vehicles to operate on CNG as soon as possible. This decision was based on economics and a desire for public recognition of the use of “clean fuels.”

This decision at SunLine was made at a very early stage in CNG bus development and deployment in the United States. In 1991 there were only approximately 25 heavy CNG buses just placed into service in the United States and another 70 heavy CNG buses on order.

The SunLine Board of Directors approved the 100% alternative fuels approach in 1992. SunLine was active the following year preparing for CNG bus operations. A new CNG fueling station was constructed with the support of the Southern California Gas Company (SoCal Gas). SunLine worked with Sacramento Regional Transit (who was also ordering a significant fleet of new CNG buses) to specify and order the new CNG buses from Orion Bus Industries (34, 40-foot transit buses) and Eldorado National (five, 29-foot buses). Natural gas vehicle training

programs were developed at the College of the Desert's Energy Technology Training Center, and the SunLine mechanics were the first "graduates" of that training. All SunLine employees received some natural gas vehicle safety familiarization training. The nation's first fleet to change to 100% CNG bus operations occurred in May 1994.

Start-Up of CNG Operations (April-May 1994)

The greatest challenge in 1993 with implementing full CNG operations was that it had not yet been accomplished in the Coachella Valley or anywhere else in the United States. In order to achieve this difficult task, several activities needed to be planned and executed at the same time including:

- Collecting a group of experts and knowledge contributors
- Ordering new CNG buses
- Constructing permanent CNG fueling on-site
- Completing appropriate training for staff and mechanics
- Developing a public relations strategy
- Preparing for implementation.

SunLine did not execute the implementation of CNG operations single-handedly. Some of the major participants in this implementation included:

- Sacramento Regional Transit (<http://www.sacrt.com/>)
- SoCal Gas (<http://www.socalgas.com/>)
- College of the Desert (<http://www.collegeofthedesert.edu/>)
- Cummins Engine Company (<http://www.cummins.com/>)
- Cummins Cal Pacific (<http://www.calpacific.cummins.com/>)
- Los Angeles County Metropolitan Transit Authority (LACMTA - <http://www.mta.net/default.asp>)
- Orion Bus Industries (<http://www.orionbus.com/orion>)
- Eldorado National (<http://www.thorindustries.com/bus/>).

LACMTA was already working with Cummins Engine Company to develop and implement heavy-duty natural gas engines and assisted SunLine with specifying and purchasing CNG buses.

The CNG fueling station at the SunLine facility in Thousand Palms was originally owned and operated by SoCal Gas, and SunLine owned 25% of the station. This later changed to a co-ownership with Clean Energy (75%) and SunLine (25%) when the gas utilities were required to divest themselves of the vehicle fueling stations. Currently, Clean Energy operates and maintains the CNG fueling station equipment at SunLine.

The training aspects of CNG vehicle operations were in their infancy when SunLine decided to convert to CNG operations. Working with several partners, including College of the Desert and Cummins, SunLine helped develop a training curriculum at the College of the Desert. All SunLine employees received natural gas familiarity and safety training. The mechanics received more intensive training, so they could maintain the heavy- and light-duty vehicles operating on

CNG at SunLine. Training information covered topics such as properties of natural gas and CNG, high pressure safety, fittings, and computer/electronic controls and sensors/calibration for the engines. Refresher training is also provided as time and resources allow. All new employees receive this familiarity and safety training for natural gas vehicles. The College of the Desert continues to provide this natural gas vehicle training for the region.

Public relations and acceptance of the “new” natural gas transit buses were important aspects of the SunLine CNG operations. SunLine was careful to include the public in its plans for implementing CNG buses. There were press releases and events at the SunLine facility in Thousand Palms. Local newspapers and television produced and continue to produce stories on the SunLine operation. Signage about clean fuels and CNG are on the buses and SunLine has continued outreach to the public including some marketing focused on children in the schools and future riders.

SunLine mechanics along with the local Cummins dealer mechanics (Cummins Cal Pacific) prepared for the implementation and support of operations. This solid relationship between SunLine and Cummins Cal Pacific continues to remain strong to this day and is considered to be one of the major reasons for success with CNG operations at SunLine. Several other groups, both local and national, were also key in supporting SunLine’s efforts over the last 10 years including DOE, the Federal Transit Administration (FTA), SCAQMD, CARB, a number of other transit agencies operating CNG buses, and the cities in the Coachella Valley.

When the CNG buses arrived and began service, normal break-in problems occurred. Some mechanics were eager to work on the new bus equipment, and a few were concerned about safety. Over time, the most common concern was loose fittings left by the less experienced mechanics. Troubleshooting was supported in a timely manner by Cummins Cal Pacific. The dealer staff was motivated, gathered information, and provided specifications and information when needed. The SunLine staff reported that the transition to CNG bus operations would have been much more difficult without their support.

SunLine's CNG Bus Fleet

The CNG buses at SunLine are summarized in Table 1 and shown in Figure 3. The original CNG bus fleet was purchased new from Orion Bus Industries and ElDorado National in 1993, and delivered in 1994. One of SunLine's older diesel buses was re-powered with a Detroit Diesel Series 50G engine for testing in revenue service. Later in 1999, seven previously owned Thomas MVP model buses were purchased and placed into transit service.

Table 1. CNG Buses at SunLine

Bus	Number of Buses	Model Year	Length	Engine	Purchase Price
Orion V	34	1994	40 foot	Cummins L10-240G	\$225,000
ElDorado National	5	1994	29 foot	Hercules 5.6L	\$120,000
Thomas MVP	7	1995	40 foot	Cummins B5.9G	\$85,000
Gillig	1	1985	40 foot	Detroit Diesel S50G	N/A



Figure 3. SunLine CNG buses (top left – El Dorado; top right – Orion; bottom – Thomas)

SunLine has participated in several demonstrations and testing of emerging natural gas technologies. This testing has provided new equipment at SunLine and allowed for high temperature environment testing for natural gas vehicle technologies. The demonstrations and testing activities have caused many changes over the years for SunLine's 47 CNG buses as summarized in Table 2.

Table 2. Engine Changes to SunLine CNG Buses

Timeframe	Bus Fleet	Change
1997	Orion V	Two buses had L10-240G engines replaced by Cummins C8.3G; in mid-2002, one of these two buses had the C engine re-powered with the C Gas Plus version; the two L10-240G engines were placed into inventory for the remaining 32 Orion buses.
1999	EIDorado	Four of the five buses had the Hercules engines replaced by Cummins B5.9G engines; two of those B engines had the 195 hp settings and two had the 230 hp settings; the remaining EIDorado bus had the Hercules engine in it until the vehicle was retired in 2004.
2000	Orion V	One bus had the Cummins L10-240G engine replaced by a John Deere 6081H engine in 2000 for testing; that engine was damaged during testing and was re-powered again in 2002 and testing continued.
2000	Gillig	The one Gillig bus with the DDC S50G engine was retired from SunLine operations and became a mobile library vehicle; this bus was only operating in FY2000 and has not been included in the summary operations analysis presented later in this report.
2003	Thomas	Four of the Thomas buses had the Cummins B5.9G engines rebuilt in chassis to the “Plus” engine package; two of those buses were prepared to operate on a mixture of hydrogen and CNG and were tested.

Each of the natural gas engine technologies used at SunLine is described below:

- **Hercules 5.6L** – In 1993 (delivery in 1994), SunLine received EIDorado National 29-foot buses equipped with the Hercules 5.6L natural gas engine. There were several chronic issues with this engine that made it unreliable (problems with valves, burning engine oil, cylinders, and pistons) in many locations that operated the engine. SunLine had problems with four of the five vehicles with this engine. Those four engines were replaced in 1999, and the fifth one was left in place until the vehicle was retired in 2003. Hercules discontinued its natural gas engine for on-road vehicles after the 1996 model year. Hercules continues to make natural gas engines for off-road applications.
- **Cummins L10-240G** – This engine was Cummins’ first commercial natural gas product for heavy vehicles. The engine had lower horsepower (240 hp versus 280 hp) and torque (750 ft-lb versus 850 ft-lb) than was expected for the typical diesel transit bus application. The engine’s fuel control system was also not as well developed as the product is now. The system has been compared to an older gasoline carbureted engine. The tune of the engine was not precise and easily fell out of adjustment. This would cause problems with emissions and sometimes backfiring. This “out of adjustment” operation of the engine would cause damage to the pistons, liners, and valves. The SunLine mechanics reported that they approached this problem by recognizing that the tune of these engines was “art” and science. The tune of one of these engines would require one mechanic, and a supervisor to check and ensure that the settings were correct. This approach has kept the engine running and in high use service for more than 10 years.
- **Detroit Diesel Corporation (DDC) Series 50G** – SunLine tested a prototype version of this engine starting in 1994. In 1997, DDC removed this prototype engine and replaced it

with a production engine. There have been no new vehicles purchased by SunLine since the initial purchase of the CNG buses in 1993, so there has been no opportunity to purchase more of the DDC product. Also, the positive relationship between the Cummins dealer (Cummins Cal Pacific) and SunLine made another purchase of DDC engines in the next CNG bus order unlikely. DDC has recently removed the S50 product from the market for diesel and natural gas because of issues with meeting the future emissions certification levels.

- **Cummins B5.9G** – SunLine has several of the B5.9G engines with the 195 hp setting and 230 hp setting. Four of the engines with the 230 hp setting have the “Plus” package on the engines. The “Plus” package includes an update of the electronics and feedback sensors for better fuel and knock control.
- **Cummins C8.3G** – SunLine has two of the C8.3G engines. One of the engines is the standard C gas engine, and one is the C Gas Plus engine for testing.
- **John Deere Power Systems** – SunLine had one Deere 6081H natural gas engine installed in an Orion V bus in 2000 for testing. The engine was damaged during testing in 2002 and was replaced with another Deere engine. This bus continues in service.

SunLine's Fueling Infrastructure

SunLine's fueling infrastructure has evolved over time. Vehicles can appropriately fill up with CNG, liquefied natural gas (LNG), hydrogen, or blends of natural gas and hydrogen. Diesel and gasoline are not available at SunLine.

As mentioned earlier, SunLine and SoCal Gas built the original CNG fast-fill station at the Thousand Palms facility with construction starting in 1993. Later in 1997, Pickens Fuel Corporation purchased the SoCal Gas portion of the fueling station and operation. Pickens later became Clean Energy in 2001. This CNG fueling station was always designed with commercial and public operations in mind. The station has a public filling station on the outside of the facility at Thousand Palms (Figure 4), and piping is run underground to SunLine's private bus filling station (Figure 5). The public and private stations provide CNG at 3600 psi or 3000 psi. The compressor station equipment is shown in Figure 6.



Figure 4. Public fueling at SunLine's Thousand Palms CNG fueling station



Figure 5. CNG fueling lane and bus wash (Thousand Palms)



Figure 6. CNG compressor station (Thousand Palms)

The CNG fueling station at Thousand Palms includes two 400 hp natural gas compressors from Wilson Technologies and provides a 10-minute CNG fill for a transit bus. The station design includes six American Society of Mechanical Engineers (ASME) tubes for a buffer to help start the fast fill.

In 1995, SunLine opened a second operating location in Indio, California, called its Clean Air Center. Twelve buses were originally operated from this location and now 15 buses are operated. A CNG fueling station was added at this location in 1995 (Figure 7). This station includes both public and private fueling, with higher-speed fueling behind the fence of the facility. One Sulzer and one IMW natural gas compressor along with three ASME tubes for a buffer were installed at Indio (Figure 8). Fueling times range from 12 minutes up to 20 minutes depending on demand. Some trucks and support vehicles are also fueled at this location from the public side of the station.



Figure 7. SunLine Clean Air Center in Indio, California



Figure 8. CNG fueling equipment (Indio)

Addition of Other Fuels

Hydrogen fueling was added to the SunLine fueling station in Thousand Palms in 2000. Hydrogen production was originally provided by an electrolyzer during 2000 to 2003 (from Stuart Energy) and later, a natural gas reformer was added on site. SunLine also added the capability to fuel with a CNG and hydrogen mix. The fueling station now has a natural gas hydrogen reformer from HyRadix for hydrogen fuel production.

The fuel station at SunLine's Thousand Palms facility had LNG fueling added in 2001 as part of the Clean Energy partnership. Waste Management uses the LNG station as a public consumer.

Experience at the SunLine Fueling Stations

SunLine personnel expressed that the CNG fueling times were acceptable at both stations. A transit agency the size of SunLine is required to have fueling equipment that can fill a transit bus in 10 minutes. Overhauls for the compressors are performed by Clean Energy every two years, so one compressor is overhauled each year while the other compressor is kept in service.

Drive-aways at the fueling dispenser have been the main type of safety issue that has occurred at the public fueling station in Thousand Palms. New drivers of light-duty vehicles at the public station have regularly ripped hoses off of the dispenser. As with public gasoline dispensers, the CNG dispenser hoses have a break-away point so that the dispenser is not damaged in the event of a drive-away. The hose pulls away from the dispenser and then can be repaired. However, one particular drive-away ripped the entire dispenser out because the hose had wrapped around the dispenser and did not have a chance to pull out at the break-away point.

The transit buses do not generally have the drive-away problem because of a starter cut-out switch at the fueling door. When that fueling door is open, the bus cannot be started. All of the SunLine vehicles have the starter cut-out switch installed (including paratransit and support vehicles).

SunLine has attempted to address the drive-away issue at the public station through training and retraining of public access consumers and their own employees. Labels with pictorial instructions were also added on the dispensers to help alleviate the problem. SunLine personnel reported that the small size of its fleet and staff has most likely made it easier to keep up training and awareness than it would with a larger operation.

Maintenance Facilities Upgrades and Experience

In order to support operations and maintenance of CNG buses, SunLine made some modifications and upgrades to the maintenance facility in 1995. These modifications and upgrades focused around the addition of combustible gas detectors and upgrade of some of the electrical conduit, lighting, and ventilation in the maintenance bays. The fueling station and maintenance facility upgrade costs at the Thousand Palms location were reported to be \$1.47 million in 1995. Figure 9 shows the maintenance facility at Thousand Palms. There are no additional costs for the outside bus parking areas. The Indio maintenance facility does not have combustible gas detectors; however, only minor maintenance is performed there. Any major maintenance is performed outdoors at Indio, or the bus is taken to the Thousand Palms facility.

The combustible gas sensors and alarms in the maintenance facility are required by building codes for indoor maintenance of CNG vehicles. The combustible gas detection system is designed to alarm at a 20% lower flammability limit (LFL) in air with a siren and lights, and at 40% LFL the siren and lights latch on, power in the building is turned off, and the vents are opened in the roof of the building. The proper operation of this system is tested quarterly and the combustible gas detectors are calibrated every six months.



Figure 9. Maintenance facility in Thousand Palms

SunLine's experience with the combustible gas detectors has been problematic because of false positives (alarms that are not caused by an actual natural gas release). As with other CNG equipment at SunLine, because of early implementation, the equipment used is not as sophisticated or robust as equipment purchased today. When there have been actual natural gas releases from the buses inside the maintenance garage, the mechanics report hearing the leak long before the alarm goes off in the facility. SunLine would like to upgrade this system, but has not yet identified the funding to complete the upgrade.

One significant incident occurred at SunLine in the maintenance facility in the first year of operating the CNG buses. A pressure relief device used to relieve excess pressure in the fuel

cylinders on the buses failed in the maintenance facility and caught fire. The fire department responded, and the fire was contained quickly. There was some damage to the ceiling of the maintenance facility. In fact, the scorch marks are still visible. And one big problem resulted from this experience—the fire department used a large amount of water in the maintenance facility and filled up the storm sewers. SunLine had to clean up the oil and grease that spilled out of the facility due to the excess water.

The lesson learned from this fire incident was the important need to include city, county, and local officials, especially first responders, in the CNG program from the beginning. This relationship with the officials needs to continue beyond the beginning and especially when any changes occur. Continued familiarization training for first responders is critical because of the number of people involved in a 24/7 operation and turnover of those people.

SunLine CNG Bus Operational Experience

The decision to switch to CNG buses at SunLine has already been discussed. Some additional information regarding the first three years of operation (1994-1996) at SunLine was also documented in a report published in 1999 by the Society of Automotive Engineers (SAE)². The SAE report included both SunLine and Sacramento Regional Transit and their respective experience with CNG bus operations and life-cycle cost estimates. The general conclusion from this paper was that CNG buses were expected to meet or beat the diesel bus life-cycle cost over a 12-year lifetime.

The mid-term experience (1997-1999) at SunLine was investigated in discussions with SunLine personnel. The actual operations data were not readily available from the SunLine computer system because of a change in software in 1999. The mechanics and operators had become comfortable with the CNG buses and infrastructure by the mid-term. As new mechanics were added to the staff, familiarization training was provided both at the College of the Desert and through on-the-job training at SunLine. During the 10-year period of CNG operations in this report, SunLine added or turned over 50% of the approximately 20 mechanics, so there are several mechanics that had been involved from the beginning. This has been extremely helpful for training, troubleshooting, and keeping the CNG engines in tune. Several of the staff that left mechanic positions were promoted to supervisory roles within SunLine over the years, and this has also been helpful in keeping the CNG bus fleet moving.

The rest of this section includes an evaluation of the last five years of operation costs for the 46 CNG buses [fiscal year (FY) 2000 through FY 2004]. These analyses were completed by working with SunLine staff in Thousand Palms. This data period translates into July 1999 through June 2004. Summary data for fuel consumption and maintenance costs by vehicle were collected from SunLine's computer system. More detailed summary data are provided by bus in the Appendix. The data presented in this section include costs that are not corrected for inflation.

Current SunLine Revenue Service

SunLine operates 12 fixed routes with 46 CNG transit buses (as mentioned above in Table 2, the 47th CNG bus was retired from SunLine service and operates as a mobile library from the SunLine operation in Thousand Palms). The 40-foot buses are randomly dispatched on the 12 fixed routes. The Coachella Valley has average high temperatures above 100°F during the summer months, and the low temperatures rarely drop below 40°F, even in winter. The rainfall average is 6.3 inches per year. The SunLine service area includes much of the desert floor of the Coachella Valley. The heat, low humidity, and low rainfall make this location an extreme duty cycle from an environmental perspective.

Table 3 shows by FY the total mileage, hours of operation, and average speed for all routes at SunLine (FY 1998 through FY 2004, with the fiscal year at SunLine being July through June). The general trend for the last seven years has been increasing yearly mileage (except FY2004) and hours of operation. The average speed of the buses has been decreasing slowly until the last

² SAE Paper 1999-01-3738, 1999, "A Three-Year Comparison of Natural Gas and Diesel Transit Buses."

year where it went down almost one mile per hour. The slowly decreasing average speed has been reported to be generally related to increasing congestion in the Coachella Valley. The change in the last year was in reaction to changes in service planning with removal of a higher speed suburban route called SunLink.

Table 3. Total Miles, Hours of Operation, and Average Speed by Fiscal Year

Fiscal Year	Total Miles	Total Hours of Operation	Average Speed (mph)
1998	1,722,039	108,302	15.9
1999	1,844,061	115,658	15.9
2000	2,026,680	127,276	15.9
2001	2,111,194	133,471	15.8
2002	2,261,201	146,862	15.4
2003	2,272,529	147,080	15.5
2004	2,189,697	149,540	14.6

Vehicle Usage

Vehicle usage was analyzed as an indicator of reliability and is shown in Table 4. For a full-size transit bus (40-foot), FTA’s expectation is that the bus will be used at an average rate of approximately 42,000 miles per year or at least 500,000 miles in a 12-year lifetime. The SunLine standard transit buses were used at an average rate of 56,650 miles per year each for the five-year evaluation period. This is well above the FTA benchmark. This indicates that these buses have experienced high usage and availability for service.

The Thomas and Eldorado buses are not standard 40-foot transit buses and have lower expectations for usage in transit service. The Thomas buses had about 13,200 miles per year each for the evaluation period. The Eldorado buses had approximately 28,700 miles per year each for the evaluation period. The buses equipped with Cummins C8.3G and John Deere 6081H engines had lower usage than those equipped with the Cummins L10-240G engine. This is an expected result because those three buses have been used as prototype test engines from the two manufacturers. The intent of testing these three engines has been to examine how the engines might operate and potentially fail in extreme desert conditions.

Table 4. Average Annual Miles by Bus Group

Bus	Engine	Model	Number of Buses	Five-Year Total Miles	Avg. Annual Miles/Bus
Orion	Cummins	L10-240G	31	8,780,704	56,650
Orion	Cummins	C8.3G	2	441,906	44,191
Orion	Deere	6081H	1	116,509	23,302
Thomas	Cummins	B5.9G	7	463,571	13,245
EIDorado	Cummins	B5.9G	4	574,439	28,722
EIDorado	Hercules	5.6L	1	87,569	21,892*
Total Fleet			46	10,464,698	--

* This EIDorado bus was retired at the beginning of FY2004.

Fuel Economy and Cost

The five-year average miles per gasoline gallon equivalent (MPGGE) calculations for the SunLine fleet are shown in Table 5. The Orion buses equipped with L10-240G engines had a fuel economy of 3.0 MPGGE, which equates to roughly 3.3 miles per diesel equivalent gallon. The other two Orion groups were slightly lower at 2.8 MPGGE. The Thomas buses had an average of 3.6 MPGGE, and the B5.9G-equipped EIDorado buses had an average of 5.1 MPGGE. Interestingly, the Hercules-equipped EIDorado bus had nearly the same fuel economy at 5.0 MPGGE. The fuel cost-per-mile calculations are based on actual fuel costs during the time frame in which the fuel was consumed.

Table 5. Average Miles per Gasoline Gallon Equivalent and Fuel Cost-per-Mile

Bus	Engine	Model	Number of Buses	Five-Year Avg. MPGGE	Fuel Cost (\$)/Mile
Orion	Cummins	L10-240G	31	3.0	0.35
Orion	Cummins	C8.3G*	2	2.8	0.38
Orion	Deere	6081H*	1	2.8	0.40
Thomas	Cummins	B5.9G	7	3.6	0.29
EIDorado	Cummins	B5.9G	4	5.1	0.21
EIDorado	Hercules	5.6L	1	5.0	0.20
Total Fleet			46	3.1	0.34

* Prototype test engines

Clean Energy determined CNG fuel costs based on the base natural gas price, total CNG consumed from the stations (Thousand Palms and Indio) including the public and SunLine consumption, and operations and maintenance costs for each station. SunLine purchases natural gas in a three-year block to help keep costs down. Table 6 shows a summary of total CNG consumed at the SunLine stations and average cost by fiscal year (1999 through 2004).

Table 6. CNG Consumption and Cost at SunLine Fueling Stations

Fiscal Year	Therms	Gasoline Gallon Equivalent (GGE)	Cost (\$)	Average Cost (\$)/GGE
1999	1,099,956	879,965	556,777	0.64
2000	1,267,399	1,013,920	852,674	0.84
2001	1,271,318	1,017,055	1,252,337	1.23
2002	1,365,692	1,092,554	1,166,949	1.07
2003	1,317,343	1,053,874	1,049,069	1.00
2004	1,219,578	975,662	1,071,656	1.10
Total/ Average	7,541,286/ 1,256,881	6,033,030/ 1,005,505	5,949,462/ 991,577	0.99

Figure 10 shows the average fuel economy by bus study group for each of the five years. The Hercules engine-equipped EIDorado bus was out of service for FY 2002 and that data point has been removed from the chart. The last year (FY 2004) for the Thomas buses was removed because the data were incomplete. Two of the Thomas buses used a hydrogen CNG mixture that was not accounted for in the SunLine computer system.

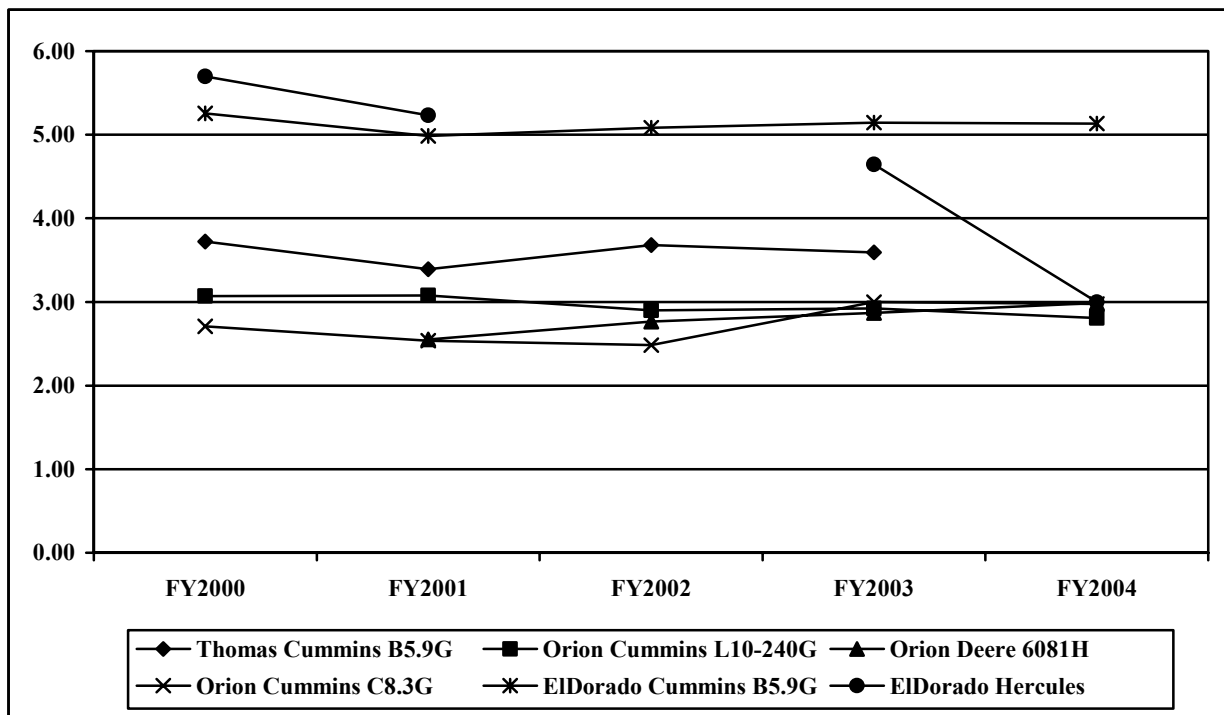


Figure 10. Average fuel economy (MPGGE) by fiscal year for each bus group

Maintenance Costs

Maintenance costs were collected by bus from SunLine’s annual summary reports. These costs included actual parts and labor costs by bus, and then these costs were summarized by bus study group as shown in Table 7. The maintenance cost-per-mile for the entire SunLine fleet was \$0.36 per mile for the five-year analysis period. This number was most influenced by the 31

Orion V buses equipped with the Cummins L10-240G engine, which had a cost-per-mile of \$0.35.

The Orion V buses with the Cummins C8.3G and Deere engines had significantly higher maintenance costs than the buses with the Cummins L10-240G engines. This occurred because of the status of the engines as a test for operation, reliability, and durability in the desert. The maintenance costs for these three buses included repairs as well as modification costs for installing these engines and equipment. These were only three buses out of 46 and had little impact on the overall cost-per-mile of the fleet.

The Thomas buses were relatively expensive to maintain. The ElDorado buses have performed below the average cost-per-mile for the rest of the fleet, except for the Hercules engine-equipped bus, which has been retired. The rest of the ElDorado study group are planned to be taken out of service at the end of the calendar year 2005.

Table 7. Total Maintenance Cost by Bus Study Group (FY 2000-FY 2004)

Bus Study Group	Mileage Base	Parts Cost (\$)	Labor Cost (\$)	Total Cost (\$)	Cost (\$)/ Mile
Orion/Cummins L10-240G	8,780,704	1,738,073.42	1,323,966.07	3,062,039.49	0.35
Orion/Cummins C8.3G*	441,906	111,463.69	99,495.35	210,959.04	0.48
Orion/Deere 6081H*	116,509	49,610.10	38,221.93	87,832.03	0.75
Thomas/Cummins B5.9G	463,571	92,946.28	123,441.03	216,387.31	0.47
ElDorado/Cummins B5.9G	574,439	80,065.40	94,826.28	174,891.68	0.30
ElDorado/Hercules	87,569	18,790.54	16,427.66	35,218.20	0.40
Total Fleet	10,464,698	2,090,949.43	1,696,378.32	3,787,327.75	0.36

* Prototype test engines

The Cummins L10-240G engine has been the workhorse of the SunLine fleet with 31 of 46 buses using this engine (67% of the buses and 84% of the total mileage of the fleet during the analysis period). This engine has been reported by other transit agencies as underpowered and difficult (if not impossible) to maintain. This natural gas engine has primitive (open-loop) electronic control compared to new natural gas engines and has had problems with the high-energy spark plugs and wires, mixer, and regulators. All of these items were specialty items for this engine and the cost for these parts reflects the low volume of engines manufactured. Cummins (and other natural gas engine manufacturers) have gone to more sophisticated electronic controls, better sensors, and coil-over-plug configurations for the spark plugs and wires, which have significantly changed maintainability and cost.

SunLine has attempted to address the high parts costs mentioned above by finding other parts sources. The spark plug wires from Cummins cost approximately \$100 each and SunLine has found a vendor that supplies essentially the same part for \$50 each. The spark plugs have traditionally cost approximately \$20 each from Cummins, and SunLine has found the same spark plugs for around \$10 each.

More cost savings at SunLine have resulted from its experience with the engines and their tune-ups. Cummins recommends tune-ups at 18,000 miles, 36,000 miles, and 72,000 miles. SunLine has extended those tune-ups to 24,000 miles, 48,000 miles, and 96,000 miles for each engine (or at least twice per year). However, the activities are “by the book.” A tune-up consists of changing the spark plugs and air filter, checking the oxygen sensor (including using an exhaust analyzer), and checking the Woodward controller settings. SunLine also has the mechanics inspect the operation of the CNG buses every day. At the 48,000 mile tune-up, the SunLine mechanics also replace the fuel system O-rings, valve cover tubes, and adjust the valves.

All of the Cummins’ natural gas engines use a special low ash content engine oil, and the L10-240G engines are no different. The original oil change interval recommendation from Cummins is every 6,000 miles. SunLine tested extending this oil change interval all the way to 24,000 miles using oil analysis at every 6,000 miles. They found that the engine oil was acceptable up to 18,000 miles except during the summer months. SunLine decided on an oil change interval

every 12,000 miles to keep the oil changes standardized during the year. However, the engine oil for all of the buses is still analyzed every 6,000 miles to make sure there are no problems. The engine oil change intervals and practices have been in place since 1999 with no known issues.

SunLine also reports cost savings for the CNG buses compared to their previous experience with diesel engine equipped buses. The reported savings come from a reduced quantity of hazardous waste collected from cleaning the engines and used engine oil.

SunLine has determined that the best time to start rebuilding all of the Cummins L10-240G engines is at about 500,000 miles, which is the same as it would have been with diesel engines. Most experience with early natural gas engine technology has been reported as much lower vehicle usage before an engine rebuild was required. SunLine has had excellent experience with the need for rebuilding the Cummins L10-240G engines. Some Cummins L10-240G engines at SunLine have been used well beyond 500,000 miles before rebuilding (the average mileage of the Cummins L10-240G engine equipped buses was 541,000 miles at the end of the evaluation period, with only 12 of the 31 buses having the rebuild). The engine rebuild cost is typically between \$13,000 and \$15,000 for each engine. Table 8 shows the engine rebuilds that have been completed and several significant engine repairs with the date and odometer of those repairs. The table also shows the odometer reading for each of these Orion V buses at the end of the operations analysis period (June 2004).

SunLine has kept the three Cummins L10-240G engines that were removed from the Orion buses, which now have Cummins C8.3G and Deere 6081H engines. These three L10 engines are used as “swing” engines during the rebuild process. When a bus comes in for the 500,000 mile engine rebuild, that engine is removed, and one of the three spare L10 engines is used as a replacement.

Table 8. Engine Rebuilds for Orion V Buses with Cummins L10-240G Engines

Bus	Rebuild Date	Rebuild Mileage	Notes	Odometer at End of Data Period (June 2004)
501	2/24/2004	602,772		623,860
502				560,237
503				585,780
504	6/1/2002	405,210		525,754
505				567,389
506				557,980
507	12/30/2004	594,680	Installed rebuilt cylinder head	568,052
508	8/27/2003	496,317		541,238
509				559,974
510	12/7/2004	584,307		556,667
511	10/30/2003	530,391	Replaced two piston liners and heads	568,037
512				556,016
513				579,642
514	10/14/2000	332,408		533,083
515	8/15/2002	168,145	Replaced one piston liner and head	529,429
516	10/19/2004	631,435		614,359
517	4/9/2002	428,784		548,881
520				529,281
521				530,996
522				523,661
523				395,290
524				542,782
525	6/19/2002	N/A	Replaced one piston liner and head	576,450
526	4/3/2003	481,387	Replaced six piston liners and heads	522,488
527				558,412
528	8/31/2004	562,392		562,386
529	6/29/2004	526,656		526,656
530	5/1/2003	490,747		555,357
533	1/11/2004	532,467		556,264
534				307,677
535	2/25/2003	444,898		506,921

N/A: Not available.

Roadcalls

A roadcall (RC) is defined as an on-road failure of an in-service bus if it requires the bus to be taken out of service or replaced on route. RCs are a direct indicator of reliability for transit buses. Many problems that can cause an RC do not involve the engine or drivetrain. These non-engine and drivetrain problems typically involve the door systems, because when a door is open, the bus cannot move. Other issues that might cause an RC include inoperability of the air conditioning or wheelchair lift.

Table 9 shows results of miles between RCs for each of the study bus groups over the analysis period. SunLine did not have a complete record of the cause of these RCs, so only the miles between all RCs are presented in the table. The Orion buses with Cummins L10-240G engines had the highest average miles between RCs of the bus study groups.

Table 9. Total Roadcalls by Bus Study Group (FY 2000 - FY 2004)

Bus	Engine	Model	Mileage Base	Total RCs	Miles Between RCs
Orion	Cummins	L10-240G	8,780,704	667	13,164
Orion	Cummins	C8.3G*	441,906	77	5,739
Orion	Deere	6081H*	116,509	24	4,855
Thomas	Cummins	B5.9G	463,571	96	4,829
ElDorado	Cummins	B5.9G	574,439	58	9,904
ElDorado	Hercules	5.6L	87,579	29	3,020
Total Fleet			10,464,698	951	11,004

* Prototype test engines

Total Fuel and Maintenance Cost-per-Mile

Table 10 presents total fuel and maintenance cost-per-mile for each of the bus study groups. The ElDorado buses had the lowest total cost-per-mile. The Orion buses with Cummins L10-240G engines had the next lowest total cost-per-mile with the Thomas buses only slightly higher. The Orion bus with the Deere engine had the highest total cost-per-mile, and the Orion buses with the Cummins C8.3G engines had the next highest total cost-per-mile. These higher costs were caused by higher maintenance costs for the testing activities for these engines.

Table 10. Summary of Fuel and Maintenance Cost-per-Mile by Bus Study Group (FY 2000-FY 2004)

Bus	Engine	Model	Fuel Cost (\$)/ Mile	Maintenance Cost (\$)/ Mile	Total Cost (\$)/ Mile
Orion	Cummins	L10-240G	0.35	0.35	0.70
Orion	Cummins	C8.3G*	0.38	0.48	0.86
Orion	Deere	6081H*	0.40	0.75	1.16
Thomas	Cummins	B5.9G	0.29	0.47	0.73
ElDorado	Cummins	B5.9G	0.21	0.30	0.51
ElDorado	Hercules	5.6L	0.21	0.40	0.61
Total Fleet			0.34	0.36	0.70

* Prototype test engines

Other Projects at SunLine

SunLine is a small transit agency with limited resources. Along with multiple partners, SunLine has entered into many projects over the past 10 years that have been associated with transit, natural gas, hydrogen, fuel cells, and combinations of these fuels and technologies. The objectives have been to advance clean transit bus propulsion systems and to leverage project funding, so SunLine can afford additional and new buses and infrastructure.

The novelty of a small transit agency, such as SunLine, to convert completely to natural gas for all vehicles and the additional projects with advanced propulsion and infrastructure has developed great interest in the transit industry, within California, across the United States, and worldwide. SunLine has hosted many visitors to view its operation and the equipment used. The number of visitors gradually increased over time, and SunLine eventually decided to develop training materials and an on-site tour so that visitors could learn about its projects and processes. From this, the Clean Fuels Mall was born. The Clean Fuels Mall tour at SunLine includes 10 stations:

1. An energy sustainability model
2. Fuel cell vehicle garage
3. Teledyne electrolyzer
4. Solar collectors
5. Stuart Energy electrolyzer
6. Mini hydrogen station
7. Hydrogen storage system
8. Trace Technologies inverter
9. Hyradix reformer
10. Fueling mall (compressed and liquefied natural gas, hydrogen, and a mixture of hydrogen and compressed natural gas).

The hydrogen fueling capability at this station has been used to demonstrate a fuel cell bus using a Ballard fuel cell in 2001, as well as a ThunderPower fuel cell bus with a UTC fuel cell in 2002 through 2003. Both buses are shown in Figure 11.



Figure 11. Fuel cell buses tested in operation at SunLine (left – ThunderPower bus with a UTC fuel cell power plant; right – P4 Ballard fuel cell-powered bus)

SunLine has also been testing buses operating on a mixture of natural gas and hydrogen. The objective of mixing hydrogen into natural gas as a vehicle fuel is to significantly reduce oxides of nitrogen emissions from vehicles.

Future Bus Operations at SunLine

SunLine feels the future of CNG bus operations is bright. Current plans include the imminent delivery of 15 new Orion V CNG buses with Cummins L Gas Plus engines (purchased on an existing order from the Fresno Area Express transit agency) in early 2006. SunLine plans to replace the entire heavy CNG bus fleet by 2009. SunLine is also looking for opportunities to expand its bus service so that the Orion buses with rebuilt Cummins L10-240G engines can continue to be used. These buses are capable of several more years of service because the desert does not promote rust and deterioration of the bus body and frame.

The newest bus in service at SunLine is their hydrogen hybrid internal combustion engine bus (Figure 12). The bus model is from New Flyer, the engine is a Ford V10 H₂, and the hybrid electric propulsion system is from Siemens. ISE Research provided the integration of the system and the Siemens hybrid electric propulsion system.

The next new bus from ISE Research is a hybrid fuel cell bus with a Van Hool chassis using the Siemens hybrid electric propulsion system and a UTC fuel cell power plant. This fuel cell bus was purchased with three others for AC Transit in Oakland, California. These four fuel cell buses are essentially identical and the SunLine fuel cell bus from ISE and Van Hool is shown in Figure 13. This bus was delivered to SunLine in November 2005.



Figure 12. Hydrogen hybrid internal combustion engine bus



Figure 13. SunLine ISE/Van Hool/UTC fuel cell bus

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Appendix A: List of Buses

Vehicle	VIN	Make/Model	Year	Start at SunLine	Used	Length	Width	Fuel	Engine Make/Model	Notes
801	1T75T2F28S1130061	Thomas MVP	1995	6/1/1999	Yes	40	96	CNG	Cummins B5.9G+ 230 hp	In chassis rebuild to Plus version; HCNG
802	1T75T2F25S1130065	Thomas MVP	1995	6/1/1999	Yes	40	96	CNG	Cummins B5.9G+ 230 hp	In chassis rebuild to Plus version
803	1T75T2F29S1130067	Thomas MVP	1995	6/1/1999	Yes	40	96	CNG	Cummins B5.9G+ 230 hp	In chassis rebuild to Plus version; HCNG
804	1T75T2F24S1130073	Thomas MVP	1995	6/1/1999	Yes	40	96	CNG	Cummins B5.9G+ 230 hp	In chassis rebuild to Plus version
805	1T75T2F26S1130074	Thomas MVP	1995	6/1/1999	Yes	40	96	CNG	Cummins B5.9G 195 hp	
806	1T75T2F2XS1130076	Thomas MVP	1995	6/1/1999	Yes	40	96	CNG	Cummins B5.9G 195 hp	
807	1T75T2F21S1130077	Thomas MVP	1995	6/1/1999	Yes	40	96	CNG	Cummins B5.9G 195 hp	
501	2B1569K71R6031839	Orion V	1994	3/31/1994	No	40	102	CNG	Cummins L10-240G	
502	2B1569K70R6031864	Orion V	1994	3/31/1994	No	40	102	CNG	Cummins L10-240G	
503	2B1569K76R6031867	Orion V	1994	4/4/1994	No	40	102	CNG	Cummins L10-240G	
504	2B1569K73R6031874	Orion V	1994	3/30/1994	No	40	102	CNG	Cummins L10-240G	
505	2B1569K79B6031877	Orion V	1994	4/1/1994	No	40	102	CNG	Cummins L10-240G	
506	2B1569K70R6031881	Orion V	1994	4/5/1994	No	40	102	CNG	Cummins L10-240G	
507	2B1569K76R6031884	Orion V	1994	4/9/1994	No	40	102	CNG	Cummins L10-240G	
508	2B1569K73R6031888	Orion V	1994	4/5/1994	No	40	102	CNG	Cummins L10-240G	
509	2B1569K79R6031894	Orion V	1994	4/6/1994	No	40	102	CNG	Cummins L10-240G	
510	2B1569K76R6031898	Orion V	1994	4/20/1994	No	40	102	CNG	Cummins L10-240G	
511	2B1569K72R6031901	Orion V	1994	4/14/1994	No	40	102	CNG	Cummins L10-240G	
512	2B1569K7XR6031905	Orion V	1994	4/14/1994	No	40	102	CNG	Cummins L10-240G	
513	2B1569K75R6031908	Orion V	1994	4/16/1994	No	40	102	CNG	Cummins L10-240G	
514	2B1569K75R6031911	Orion V	1994	4/20/1994	No	40	102	CNG	Cummins L10-240G	
515	2B1569K77R6031912	Orion V	1994	4/23/1994	No	40	102	CNG	Cummins L10-240G	
516	2B1569K79R6031913	Orion V	1994	4/30/1994	No	40	102	CNG	Cummins L10-240G	
517	2B1569K70R6031914	Orion V	1994	4/18/1994	No	40	102	CNG	Cummins L10-240G	
518	2B1569K72R6031915	Orion V	1994	4/16/1994	No	40	102	CNG	John Deere 6081H	Repowered from L10 in 2000 then again in 2002
520	2B1569K76R6031917	Orion V	1994	4/21/1994	No	40	102	CNG	Cummins L10-240G	
521	2B1569K78R6031918	Orion V	1994	4/22/1994	No	40	102	CNG	Cummins L10-240G	
522	2B1569K7XR6031919	Orion V	1994	4/24/1994	No	40	102	CNG	Cummins L10-240G	
523	2B1569K78R6031921	Orion V	1994	5/6/1994	No	40	102	CNG	Cummins L10-240G	
524	2B1569K7XR6031922	Orion V	1994	5/12/1994	No	40	102	CNG	Cummins L10-240G	
525	2B1569K71R6031923	Orion V	1994	5/7/1994	No	40	102	CNG	Cummins L10-240G	
526	2B1569K73R6031924	Orion V	1994	5/14/1994	No	40	102	CNG	Cummins L10-240G	
527	2B1569K75R6031925	Orion V	1994	5/15/1994	No	40	102	CNG	Cummins L10-240G	
528	2B1569K79R6031927	Orion V	1994	5/24/1994	No	40	102	CNG	Cummins L10-240G	
529	2B1569K79R6031930	Orion V	1994	5/25/1994	No	40	102	CNG	Cummins L10-240G	
530	2B1569K74R6031933	Orion V	1994	5/30/1994	No	40	102	CNG	Cummins L10-240G	
533	2B1569K73R6031941	Orion V	1994	6/7/1994	No	40	102	CNG	Cummins L10-240G	
534	2B1569K70R6031945	Orion V	1994	6/7/1994	No	40	102	CNG	Cummins L10-240G	
535	2B1569K74R6031916	Orion V	1994	4/22/1994	No	40	102	CNG	Cummins L10-240G	
603	1N9EBAH63RC084015	EIDorado MO	1994	4/18/1994	No	29		CNG	Hercules NG engine	out of service in FY04
1477	81063	Gillig	1985	1/1/1985	No	40	102	CNG	DDC Series 50G	out of service in FY00; now a library bus
531	2B1569K7XR6031936	Orion V	1994	5/29/1994	No	40	102	CNG	Cummins C8.3G+	Repowered from L10 in 1997
532	2B1569K73R6031938	Orion V	1994	6/6/1994	No	40	102	CNG	Cummins C8.3G	Repowered from L10 in 1997
601	1N9EBAH68RC084012	EIDorado MO	1994	4/6/1994	No	29		CNG	Cummins B5.9G 195 hp	Repowered from Hercules in 1999
602	1N9EBAHxxRC084xxx	EIDorado MO	1994	4/18/1994	No	29		CNG	Cummins B5.9G 230 hp	Repowered from Hercules in 1999
604	1N9EBAH6XR084013	EIDorado MO	1994	4/18/1994	No	29		CNG	Cummins B5.9G 230 hp	Repowered from Hercules in 1999
605	1N9EBAH65RC084016	EIDorado MO	1994	4/19/1994	No	29		CNG	Cummins B5.9G 195 hp	Repowered from Hercules in 1999

Appendix B: Summary Data by Bus Group

Summary Data by Bus Group

Thomas Buses/Cummins B5.9G Engines (801-807)

Data Item	FY2000	FY2001	FY2002	FY2003	FY2004	Total
Mileage	67,212	64,268	86,705	92,400	152,986	463,571
Roadcalls	11	9	26	20	30	96
Miles Between RCs	6,110	7,141	3,335	4,620	5,100	4,829
Fuel Amount	18,063	18,944	23,564	25,715	28,936	115,222
Fuel Cost (\$)	15,173	23,301	25,213	25,715	31,830	121,232
Fuel Cost (\$)/Gal	0.84	1.23	1.07	1.00	1.10	1.04
MPG	3.72	3.39	3.68	3.59		3.60
Fuel Cost (\$)/Mile	0.226	0.363	0.291	0.278	0.208	0.288
Parts Cost (\$)	9,835	15,892	20,485	19,767	26,967	92,946
Labor Cost (\$)	16,551	14,432	17,251	25,318	49,889	123,441
Maintenance Cost (\$)/Mile	0.393	0.472	0.435	0.488	0.502	0.467
Total Cost (\$)/Mile	0.618	0.834	0.726	0.766	0.710	0.728
Min Hubodometer	34,002	45,112	55,911	69,440	75,953	
Max Hubodometer	65,547	74,266	89,765	105,400	128,341	

Orion Buses/Cummins L10-240G Engines (501-517; 520-530; 533-535)

Data Item	FY2000	FY2001	FY2002	FY2003	FY2004	Total
Mileage	1,759,876	1,778,284	1,870,528	1,750,797	1,621,219	8,780,704
Roadcalls	125	159	125	142	116	667
Miles Between RCs	14,079	11,184	14,964	12,330	13,976	13,164
Fuel Amount	573,038	577,841	645,535	598,898	577,286	2,972,598
Fuel Cost (\$)	481,352	710,744	690,722	598,898	635,015	3,116,731
Fuel Cost (\$)/Gal	0.84	1.23	1.07	1.00	1.10	1.05
MPG	3.07	3.08	2.90	2.92	2.81	2.95
Fuel Cost (\$)/Mile	0.274	0.400	0.369	0.342	0.392	0.355
Parts Cost (\$)	237,889	367,846	454,763	338,651	338,925	1,738,073
Labor Cost (\$)	194,233	238,092	264,450	291,410	335,782	1,323,966
Maintenance Cost (\$)/Mile	0.246	0.341	0.384	0.360	0.416	0.349
Total Cost (\$)/Mile	0.519	0.740	0.754	0.702	0.808	0.704
Min Hubodometer	100,799	151,409	205,591	256,799	307,677	
Max Hubodometer	390,490	444,325	509,683	566,644	623,860	

Orion Bus/Deere 6081H Engine (518)

Data Item	FY2000	FY2001	FY2002	FY2003	FY2004	Total
Mileage	599	39,458	24,109	38,879	13,464	116,509
Roadcalls	0	11	1	11	1	24
Miles Between RCs		3,587	24,109	3,534	13,464	4,855
Fuel Amount	104	15,464	8,724	13,555	4,506	42,353
Fuel Cost (\$)	87	19,021	9,335	13,555	4,957	46,954
Fuel Cost (\$)/Gal	0.84	1.23	1.07	1.00	1.10	1.11
MPG		2.55	2.76	2.87	2.99	2.75
Fuel Cost (\$)/Mile	0.146	0.482	0.387	0.349	0.368	0.403
Parts Cost (\$)	9,105	13,306	11,111	13,437	2,653	49,610
Labor Cost (\$)	8,261	8,710	6,685	9,480	5,086	38,222
Maintenance Cost (\$)/Mile	28.992	0.558	0.738	0.589	0.575	0.754
Total Cost (\$)/Mile	29.137	1.040	1.125	0.938	0.943	1.157
Hubodometer	259,747	299,205	323,314	362,193	375,657	

Orion Buses/Cummins C8.3G Engines (531-532)

Data Item	FY2000	FY2001	FY2002	FY2003	FY2004	Total
Mileage	73,026	80,030	82,334	108,849	97,667	441,906
Roadcalls	23	15	7	11	21	77
Miles Between RCs	3,175	5,335	11,762	9,895	4,651	5,739
Fuel Amount	26,971	31,530	33,174	36,310	32,829	160,814
Fuel Cost (\$)	22,656	38,782	35,496	36,310	36,112	169,356
Fuel Cost (\$)/Gal	0.84	1.23	1.07	1.00	1.10	1.05
MPG	2.71	2.54	2.48	3.00	2.98	2.75
Fuel Cost (\$)/Mile	0.310	0.485	0.431	0.334	0.370	0.383
Parts Cost (\$)	16,304	24,246	26,168	24,527	20,219	111,464
Labor Cost (\$)	13,828	18,486	18,348	19,991	28,842	99,495
Maintenance Cost (\$)/Mile	0.413	0.534	0.541	0.409	0.502	0.477
Total Cost (\$)/Mile	0.723	1.019	0.972	0.743	0.872	0.861
Min Hubodometer	155,927	201,601	246,609	326,937	390,748	
Max Hubodometer	270,826	305,182	342,508	371,029	404,885	

Eldorado Buses/Cummins B5.9G Engines (601, 602, 604, 605)

Data Item	FY2000	FY2001	FY2002	FY2003	FY2004	Total
Mileage	93,015	100,833	98,138	110,046	172,407	574,439
Roadcalls	13	7	8	13	17	58
Miles Between RCs	7,155	14,405	12,267	8,465	10,142	9,904
Fuel Amount	17,698	20,225	19,304	21,382	33,589	112,198
Fuel Cost (\$)	14,866	24,877	20,655	21,382	36,948	118,728
Fuel Cost (\$)/Gal	0.84	1.23	1.07	1.00	1.10	1.06
MPG	5.26	4.99	5.08	5.15	5.13	5.12
Fuel Cost (\$)/Mile	0.160	0.247	0.210	0.194	0.214	0.207
Parts Cost (\$)	11,842	14,083	18,252	15,438	20,451	80,065
Labor Cost (\$)	11,918	12,061	16,348	22,925	31,575	94,826
Maintenance Cost (\$)/Mile	0.255	0.259	0.353	0.349	0.302	0.304
Total Cost (\$)/Mile	0.415	0.506	0.563	0.543	0.516	0.511
Min Hubodometer	103,885	88,275	88,300	96,586	145,427	
Max Hubodometer	188,106	222,128	263,036	304,047	347,656	

Eldorado Bus/Hercules Engine (603)

Data Item	FY2000	FY2001	FY2002	FY2003	FY2004	Total
Mileage	21,281	24,668	0	41,320	300	87,569
Roadcalls	3	14	0	12	0	29
Miles Between RCs	7,094	1,762		3,443		3,020
Fuel Amount	3,735	4,714	0	8,896	100	17,445
Fuel Cost (\$)	3,137	5,798	0	8,896	110	17,942
Fuel Cost (\$)/Gal	0.84	1.23		1.00	1.10	1.03
MPG	5.70	5.23		4.64	3.00	5.02
Fuel Cost (\$)/Mile	0.147	0.235		0.215	0.367	0.205
Parts Cost (\$)	2,887	3,533	0	12,016	354	18,791
Labor Cost (\$)	3,097	3,284	0	9,523	523	16,428
Maintenance Cost (\$)/Mile	0.281	0.276		0.521	2.923	0.402
Total Cost (\$)/Mile	0.429	0.511		0.737	3.290	0.607
Hubodometer	127,174	151,842	151,842	193,162	193,462	

Appendix C: SunLine Fleet Fuel and Maintenance Costs

SunLine Fleet Fuel and Maintenance Costs

Summary Entire Fleet

Data Item	FY2000	FY2001	FY2002	FY2003	FY2004	Total
Mileage	2,015,009	2,087,541	2,161,814	2,142,291	2,058,043	10,464,698
Roadcalls	175	215	167	209	185	951
Miles Between RCs	11,514	9,709	12,945	10,250	11,125	11,004
Fuel Amount	639,609	668,718	730,301	704,756	677,246	3,420,630
Fuel Cost (\$)	537,272	822,523	781,422	704,756	744,971	3,590,943
Fuel Cost (\$)/Gal	0.84	1.23	1.07	1.00	1.10	1.05
MPG	3.15	3.12	2.96	3.04	3.04	3.06
Fuel Cost (\$)/Mile	0.267	0.394	0.361	0.329	0.362	0.343
Parts Cost (\$)	287,861	438,905	530,779	423,836	409,568	2,090,949
Labor Cost (\$)	247,889	295,064	323,083	378,647	451,695	1,696,378
Maintenance Cost (\$)/Mile	0.266	0.352	0.395	0.375	0.418	0.362
Total Cost (\$)/Mile	0.533	0.746	0.756	0.704	0.780	0.705

Bus 501

Data Item	FY2000	FY2001	FY2002	FY2003	FY2004	Total
Mileage	58,325	53,835	65,358	56,463	57,714	291,695
Roadcalls	4	10	3	4	2	23
Miles Between RCs	14,581	5,384	21,786	14,116	28,857	12,682
Fuel Amount	18,280	17,751	22,560	20,025	20,569	99,185
Fuel Cost (\$)	15,355	21,834	24,139	20,025	22,626	103,979
Fuel Cost (\$)/Gal	0.84	1.23	1.07	1.00	1.10	1.05
MPG	3.19	3.03	2.90	2.82	2.81	2.94
Fuel Cost (\$)/Mile	0.263	0.406	0.369	0.355	0.392	0.356
Parts Cost (\$)	13,608	12,890	10,413	11,856	11,396	60,163
Labor Cost (\$)	6,827	8,230	7,890	9,188	11,124	43,258
Maintenance Cost (\$)/Mile	0.350	0.392	0.280	0.373	0.390	0.355
Total Cost (\$)/Mile	0.614	0.798	0.649	0.727	0.782	0.711
Hubodometer	390,490	444,325	509,683	566,146	623,860	

Bus 502

Data Item	FY2000	FY2001	FY2002	FY2003	FY2004	Total
Mileage	63,451	44,304	61,323	61,373	60,595	291,046
Roadcalls	5	1	11	6	5	28
Miles Between RCs	12,690	44,304	5,575	10,229	12,119	10,395
Fuel Amount	21,603	14,047	20,681	20,264	21,282	97,877
Fuel Cost (\$)	18,147	17,278	22,129	20,264	23,410	101,227
Fuel Cost (\$)/Gal	0.84	1.23	1.07	1.00	1.10	1.03
MPG	2.94	3.15	2.97	3.03	2.85	2.97
Fuel Cost (\$)/Mile	0.286	0.390	0.361	0.330	0.386	0.348
Parts Cost (\$)	7,591	21,400	14,479	13,685	11,396	68,550
Labor Cost (\$)	6,639	7,585	9,347	11,241	11,124	45,935
Maintenance Cost (\$)/Mile	0.224	0.654	0.389	0.406	0.372	0.393
Total Cost (\$)/Mile	0.510	1.044	0.749	0.736	0.758	0.741
Hubodometer	332,642	376,946	438,269	499,642	560,237	

Bus 503

Data Item	FY2000	FY2001	FY2002	FY2003	FY2004	Total
Mileage	65,529	49,950	62,495	76,677	79,356	334,007
Roadcalls	9	8	5	7	6	35
Miles Between RCs	7,281	6,244	12,499	10,954	13,226	9,543
Fuel Amount	23,023	16,019	21,080	24,621	25,886	110,629
Fuel Cost (\$)	19,339	19,703	22,556	24,621	28,475	114,694
Fuel Cost (\$)/Gal	0.84	1.23	1.07	1.00	1.10	1.04
MPG	2.85	3.12	2.96	3.11	3.07	3.02
Fuel Cost (\$)/Mile	0.295	0.394	0.361	0.321	0.359	0.343
Parts Cost (\$)	7,131	12,407	10,665	13,306	9,116	52,625
Labor Cost (\$)	7,374	8,316	9,059	10,947	14,171	49,867
Maintenance Cost (\$)/Mile	0.221	0.415	0.316	0.316	0.293	0.307
Total Cost (\$)/Mile	0.516	0.809	0.677	0.637	0.652	0.650
Hubodometer	317,302	367,252	429,747	506,424	585,780	

Bus 504

Data Item	FY2000	FY2001	FY2002	FY2003	FY2004	Total
Mileage	64,163	57,647	49,897	61,738	58,716	292,161
Roadcalls	5	6	8	6	5	30
Miles Between RCs	12,833	9,608	6,237	10,290	11,743	9,739
Fuel Amount	20,979	18,821	17,023	21,014	20,430	98,267
Fuel Cost (\$)	17,622	23,150	18,215	21,014	22,473	102,474
Fuel Cost (\$)/Gal	0.84	1.23	1.07	1.00	1.10	1.04
MPG	3.06	3.06	2.93	2.94	2.87	2.97
Fuel Cost (\$)/Mile	0.275	0.402	0.365	0.340	0.383	0.351
Parts Cost (\$)	12,553	9,384	22,316	13,131	9,482	66,867
Labor Cost (\$)	6,773	8,283	7,866	8,911	10,219	42,051
Maintenance Cost (\$)/Mile	0.301	0.306	0.605	0.357	0.336	0.373
Total Cost (\$)/Mile	0.576	0.708	0.970	0.697	0.718	0.724
Hubodometer	297,756	355,403	405,300	467,038	525,754	

Bus 505

Data Item	FY2000	FY2001	FY2002	FY2003	FY2004	Total
Mileage	60,410	58,346	61,861	61,319	56,142	298,078
Roadcalls	2	8	4	1	2	17
Miles Between RCs	30,205	7,293	15,465	61,319	28,071	17,534
Fuel Amount	18,904	19,389	20,932	20,612	19,188	99,025
Fuel Cost (\$)	15,879	23,848	22,397	20,612	21,107	103,844
Fuel Cost (\$)/Gal	0.84	1.23	1.07	1.00	1.10	1.05
MPG	3.20	3.01	2.96	2.97	2.93	3.01
Fuel Cost (\$)/Mile	0.263	0.409	0.362	0.336	0.376	0.348
Parts Cost (\$)	8,715	12,271	10,040	10,727	9,939	51,692
Labor Cost (\$)	6,802	8,528	9,652	9,905	11,652	46,539
Maintenance Cost (\$)/Mile	0.257	0.356	0.318	0.336	0.385	0.330
Total Cost (\$)/Mile	0.520	0.765	0.680	0.673	0.761	0.678
Hubodometer	329,721	388,067	449,928	511,247	567,389	

Bus 506

Data Item	FY2000	FY2001	FY2002	FY2003	FY2004	Total
Mileage	61,718	56,639	62,849	52,262	53,316	286,784
Roadcalls	7	3	7	6	4	27
Miles Between RCs	8,817	18,880	8,978	8,710	13,329	10,622
Fuel Amount	20,745	19,170	22,265	18,437	20,096	100,713
Fuel Cost (\$)	17,426	23,579	23,824	18,437	22,106	105,371
Fuel Cost (\$)/Gal	0.84	1.23	1.07	1.00	1.10	1.05
MPG	2.98	2.95	2.82	2.83	2.65	2.85
Fuel Cost (\$)/Mile	0.282	0.416	0.379	0.353	0.415	0.367
Parts Cost (\$)	5,418	14,456	14,656	12,046	10,264	56,840
Labor Cost (\$)	6,164	8,162	8,863	9,962	10,385	43,536
Maintenance Cost (\$)/Mile	0.188	0.399	0.374	0.421	0.387	0.350
Total Cost (\$)/Mile	0.470	0.816	0.753	0.774	0.802	0.717
Hubodometer	332,914	389,553	452,402	504,664	557,980	

Bus 507

Data Item	FY2000	FY2001	FY2002	FY2003	FY2004	Total
Mileage	60,615	67,881	66,598	60,177	51,933	307,204
Roadcalls	0	4	5	3	6	18
Miles Between RCs		16,970	13,320	20,059	8,656	17,067
Fuel Amount	18,452	18,666	23,748	21,049	18,211	100,126
Fuel Cost (\$)	15,500	22,959	25,410	21,049	20,032	104,950
Fuel Cost (\$)/Gal	0.84	1.23	1.07	1.00	1.10	1.05
MPG	3.29	3.64	2.80	2.86	2.85	3.07
Fuel Cost (\$)/Mile	0.256	0.338	0.382	0.350	0.386	0.342
Parts Cost (\$)	5,522	12,671	12,016	15,443	7,607	53,259
Labor Cost (\$)	4,788	7,850	7,906	9,613	10,809	40,966
Maintenance Cost (\$)/Mile	0.170	0.302	0.299	0.416	0.355	0.307
Total Cost (\$)/Mile	0.426	0.641	0.681	0.766	0.740	0.648
Hubodometer	321,463	389,344	455,942	516,119	568,052	

Bus 508

Data Item	FY2000	FY2001	FY2002	FY2003	FY2004	Total
Mileage	56,074	50,914	56,945	68,086	51,641	283,660
Roadcalls	3	12	5	1	6	27
Miles Between RCs	18,691	4,243	11,389	68,086	8,607	10,506
Fuel Amount	18,281	17,086	24,393	20,908	19,604	100,272
Fuel Cost (\$)	15,356	21,016	26,101	20,908	21,564	104,945
Fuel Cost (\$)/Gal	0.84	1.23	1.07	1.00	1.10	1.05
MPG	3.07	2.98	2.33	3.26	2.63	2.83
Fuel Cost (\$)/Mile	0.274	0.413	0.458	0.307	0.418	0.370
Parts Cost (\$)	10,670	14,436	14,706	16,989	13,015	69,815
Labor Cost (\$)	7,783	8,398	8,970	10,502	10,813	46,466
Maintenance Cost (\$)/Mile	0.329	0.448	0.416	0.404	0.461	0.410
Total Cost (\$)/Mile	0.603	0.861	0.874	0.711	0.879	0.780
Hubodometer	313,652	364,566	421,511	489,597	541,238	

Bus 509

Data Item	FY2000	FY2001	FY2002	FY2003	FY2004	Total
Mileage	59,555	53,254	64,915	62,521	57,597	297,842
Roadcalls	2	3	5	10	2	22
Miles Between RCs	29,778	17,751	12,983	6,252	28,799	13,538
Fuel Amount	18,712	17,033	21,070	19,777	20,034	96,626
Fuel Cost (\$)	15,718	20,951	22,545	19,777	22,037	101,028
Fuel Cost (\$)/Gal	0.84	1.23	1.07	1.00	1.10	1.05
MPG	3.18	3.13	3.08	3.16	2.87	3.08
Fuel Cost (\$)/Mile	0.264	0.393	0.347	0.316	0.383	0.339
Parts Cost (\$)	7,990	10,138	10,835	12,280	10,300	51,544
Labor Cost (\$)	6,874	7,995	9,146	9,832	9,551	43,398
Maintenance Cost (\$)/Mile	0.250	0.341	0.308	0.354	0.345	0.319
Total Cost (\$)/Mile	0.514	0.734	0.655	0.670	0.727	0.658
Hubodometer	321,687	374,941	439,856	502,377	559,974	

Bus 510

Data Item	FY2000	FY2001	FY2002	FY2003	FY2004	Total
Mileage	56,381	57,805	65,380	56,546	66,221	302,333
Roadcalls	3	4	4	2	4	17
Miles Between RCs	18,794	14,451	16,345	28,273	16,555	17,784
Fuel Amount	18,519	18,145	22,537	19,030	21,728	99,959
Fuel Cost (\$)	15,556	22,318	24,115	19,030	23,901	104,920
Fuel Cost (\$)/Gal	0.84	1.23	1.07	1.00	1.10	1.05
MPG	3.04	3.19	2.90	2.97	3.05	3.02
Fuel Cost (\$)/Mile	0.276	0.386	0.369	0.337	0.361	0.347
Parts Cost (\$)	10,339	10,874	10,428	12,974	11,470	56,086
Labor Cost (\$)	6,702	7,735	7,957	8,810	14,346	45,550
Maintenance Cost (\$)/Mile	0.302	0.322	0.281	0.385	0.390	0.336
Total Cost (\$)/Mile	0.578	0.708	0.650	0.722	0.751	0.683
Hubodometer	310,715	368,520	433,900	490,446	556,667	

Bus 511

Data Item	FY2000	FY2001	FY2002	FY2003	FY2004	Total
Mileage	58,607	63,637	68,397	58,170	52,913	301,724
Roadcalls	3	4	4	2	3	16
Miles Between RCs	19,536	15,909	17,099	29,085	17,638	18,858
Fuel Amount	20,552	22,429	19,606	19,553	18,433	100,573
Fuel Cost (\$)	17,264	27,588	20,978	19,553	20,276	105,659
Fuel Cost (\$)/Gal	0.84	1.23	1.07	1.00	1.10	1.05
MPG	2.85	2.84	3.49	2.97	2.87	3.00
Fuel Cost (\$)/Mile	0.295	0.434	0.307	0.336	0.383	0.350
Parts Cost (\$)	6,945	8,179	11,380	19,602	10,761	56,867
Labor Cost (\$)	7,170	7,630	8,952	9,676	11,411	44,839
Maintenance Cost (\$)/Mile	0.241	0.248	0.297	0.503	0.419	0.337
Total Cost (\$)/Mile	0.535	0.682	0.604	0.839	0.802	0.687
Hubodometer	324,920	388,557	456,954	515,124	568,037	

Bus 512

Data Item	FY2000	FY2001	FY2002	FY2003	FY2004	Total
Mileage	60,635	55,664	62,253	57,787	51,233	287,572
Roadcalls	4	2	1	2	3	12
Miles Between RCs	15,159	27,832	62,253	28,894	17,078	23,964
Fuel Amount	19,553	20,629	22,932	21,614	19,918	104,646
Fuel Cost (\$)	16,425	25,374	24,537	21,614	21,910	109,859
Fuel Cost (\$)/Gal	0.84	1.23	1.07	1.00	1.10	1.05
MPG	3.10	2.70	2.71	2.67	2.57	2.75
Fuel Cost (\$)/Mile	0.271	0.456	0.394	0.374	0.428	0.382
Parts Cost (\$)	9,440	13,482	16,739	11,260	7,567	58,487
Labor Cost (\$)	5,507	7,027	8,147	9,444	10,826	40,951
Maintenance Cost (\$)/Mile	0.247	0.368	0.400	0.358	0.359	0.346
Total Cost (\$)/Mile	0.517	0.824	0.794	0.732	0.787	0.728
Hubodometer	329,079	384,743	446,996	504,783	556,016	

Bus 513

Data Item	FY2000	FY2001	FY2002	FY2003	FY2004	Total
Mileage	60,286	60,113	67,888	56,337	52,443	297,067
Roadcalls	13	4	2	7	3	29
Miles Between RCs	4,637	15,028	33,944	8,048	17,481	10,244
Fuel Amount	19,375	19,189	22,071	18,646	18,528	97,809
Fuel Cost (\$)	16,275	23,602	23,616	18,646	20,381	102,520
Fuel Cost (\$)/Gal	0.84	1.23	1.07	1.00	1.10	1.05
MPG	3.11	3.13	3.08	3.02	2.83	3.04
Fuel Cost (\$)/Mile	0.270	0.393	0.348	0.331	0.389	0.345
Parts Cost (\$)	6,137	8,873	13,225	7,628	17,212	53,075
Labor Cost (\$)	6,279	7,675	8,611	7,939	14,711	45,217
Maintenance Cost (\$)/Mile	0.206	0.275	0.322	0.276	0.609	0.331
Total Cost (\$)/Mile	0.476	0.668	0.670	0.607	0.997	0.676
Hubodometer	342,861	402,974	470,862	527,199	579,642	

Bus 514

Data Item	FY2000	FY2001	FY2002	FY2003	FY2004	Total
Mileage	60,553	50,320	61,950	56,256	41,226	270,305
Roadcalls	4	10	5	1	5	25
Miles Between RCs	15,138	5,032	12,390	56,256	8,245	10,812
Fuel Amount	17,827	15,640	20,928	18,566	14,052	87,013
Fuel Cost (\$)	14,975	19,237	22,393	18,566	15,457	90,628
Fuel Cost (\$)/Gal	0.84	1.23	1.07	1.00	1.10	1.04
MPG	3.40	3.22	2.96	3.03	2.93	3.11
Fuel Cost (\$)/Mile	0.247	0.382	0.361	0.330	0.375	0.335
Parts Cost (\$)	8,238	15,783	11,013	10,662	8,214	53,909
Labor Cost (\$)	6,200	9,082	8,653	8,899	10,903	43,737
Maintenance Cost (\$)/Mile	0.238	0.494	0.317	0.348	0.464	0.361
Total Cost (\$)/Mile	0.486	0.876	0.679	0.678	0.839	0.697
Hubodometer	323,331	373,651	435,601	491,857	533,083	

Bus 515

Data Item	FY2000	FY2001	FY2002	FY2003	FY2004	Total
Mileage	57,529	49,767	60,409	51,506	59,117	278,328
Roadcalls	1	7	5	12	4	29
Miles Between RCs	57,529	7,110	12,082	4,292	14,779	9,598
Fuel Amount	17,744	16,417	20,747	18,136	20,177	93,221
Fuel Cost (\$)	14,905	20,193	22,199	18,136	22,195	97,628
Fuel Cost (\$)/Gal	0.84	1.23	1.07	1.00	1.10	1.05
MPG	3.24	3.03	2.91	2.84	2.93	2.99
Fuel Cost (\$)/Mile	0.259	0.406	0.367	0.352	0.375	0.351
Parts Cost (\$)	5,682	17,910	21,439	10,629	8,451	64,112
Labor Cost (\$)	5,372	8,931	9,718	8,853	9,787	42,662
Maintenance Cost (\$)/Mile	0.192	0.539	0.516	0.378	0.309	0.384
Total Cost (\$)/Mile	0.451	0.945	0.883	0.730	0.684	0.734
Hubodometer	308,630	358,397	418,806	470,312	529,429	

Bus 516

Data Item	FY2000	FY2001	FY2002	FY2003	FY2004	Total
Mileage	62,301	63,216	66,874	58,696	47,715	298,802
Roadcalls	2	4	1	1	3	11
Miles Between RCs	31,151	15,804	66,874	58,696	15,905	27,164
Fuel Amount	20,170	21,016	23,101	20,791	18,006	103,084
Fuel Cost (\$)	16,943	25,850	24,718	20,791	19,807	108,108
Fuel Cost (\$)/Gal	0.84	1.23	1.07	1.00	1.10	1.05
MPG	3.09	3.01	2.89	2.82	2.65	2.90
Fuel Cost (\$)/Mile	0.272	0.409	0.370	0.354	0.415	0.362
Parts Cost (\$)	4,705	12,870	10,737	8,311	9,075	45,698
Labor Cost (\$)	5,861	6,762	8,023	8,294	11,049	39,989
Maintenance Cost (\$)/Mile	0.170	0.311	0.281	0.283	0.422	0.287
Total Cost (\$)/Mile	0.442	0.719	0.650	0.637	0.837	0.649
Hubodometer	377,858	441,074	507,948	566,644	614,359	

Bus 517

Data Item	FY2000	FY2001	FY2002	FY2003	FY2004	Total
Mileage	51,785	61,414	60,582	55,703	52,328	281,812
Roadcalls	5	2	2	7	2	18
Miles Between RCs	10,357	30,707	30,291	7,958	26,164	15,656
Fuel Amount	17,317	20,315	21,432	20,431	18,330	97,825
Fuel Cost (\$)	14,546	24,987	22,932	20,431	20,163	103,060
Fuel Cost (\$)/Gal	0.84	1.23	1.07	1.00	1.10	1.05
MPG	2.99	3.02	2.83	2.73	2.85	2.88
Fuel Cost (\$)/Mile	0.281	0.407	0.379	0.367	0.385	0.366
Parts Cost (\$)	9,761	8,739	20,902	10,179	7,204	56,784
Labor Cost (\$)	7,194	9,369	8,774	9,242	8,625	43,204
Maintenance Cost (\$)/Mile	0.327	0.295	0.490	0.349	0.303	0.355
Total Cost (\$)/Mile	0.608	0.702	0.868	0.715	0.688	0.721
Hubodometer	318,854	380,268	440,850	496,553	548,881	

Bus 518

Data Item	FY2000	FY2001	FY2002	FY2003	FY2004	Total
Mileage	599	39,458	24,109	38,879	13,464	116,509
Roadcalls	0	11	1	11	1	24
Miles Between RCs		3,587	24,109	3,534	13,464	4,855
Fuel Amount	104	15,464	8,724	13,555	4,506	42,353
Fuel Cost (\$)	87	19,021	9,335	13,555	4,957	46,954
Fuel Cost (\$)/Gal	0.84	1.23	1.07	1.00	1.10	1.11
MPG	5.76	2.55	2.76	2.87	2.99	2.75
Fuel Cost (\$)/Mile	0.146	0.482	0.387	0.349	0.368	0.403
Parts Cost (\$)	9,105	13,306	11,111	13,437	2,653	49,610
Labor Cost (\$)	8,261	8,710	6,685	9,480	5,086	38,222
Maintenance Cost (\$)/Mile	28.992	0.558	0.738	0.589	0.575	0.754
Total Cost (\$)/Mile	29.137	1.040	1.125	0.938	0.943	1.157
Hubodometer	259,747	299,205	323,314	362,193	375,657	

Bus 520

Data Item	FY2000	FY2001	FY2002	FY2003	FY2004	Total
Mileage	58,909	56,348	63,399	58,336	51,406	288,398
Roadcalls	8	7	0	4	7	26
Miles Between RCs	7,364	8,050		14,584	7,344	11,092
Fuel Amount	18,553	17,485	21,558	19,949	19,438	96,983
Fuel Cost (\$)	15,585	21,507	23,067	19,949	21,382	101,489
Fuel Cost (\$)/Gal	0.84	1.23	1.07	1.00	1.10	1.05
MPG	3.18	3.22	2.94	2.92	2.64	2.97
Fuel Cost (\$)/Mile	0.265	0.382	0.364	0.342	0.416	0.352
Parts Cost (\$)	9,461	12,750	21,201	9,016	6,236	58,665
Labor Cost (\$)	5,932	8,975	9,023	8,422	10,614	42,966
Maintenance Cost (\$)/Mile	0.261	0.386	0.477	0.299	0.328	0.352
Total Cost (\$)/Mile	0.526	0.767	0.841	0.641	0.744	0.704
Hubodometer	299,792	356,140	419,539	477,875	529,281	

Bus 521

Data Item	FY2000	FY2001	FY2002	FY2003	FY2004	Total
Mileage	60,623	61,104	55,154	59,821	28,440	265,142
Roadcalls	2	4	4	11	2	23
Miles Between RCs	30,312	15,276	13,789	5,438	14,220	11,528
Fuel Amount	18,767	19,753	18,377	20,823	11,272	88,992
Fuel Cost (\$)	15,764	24,296	19,663	20,823	12,399	92,946
Fuel Cost (\$)/Gal	0.84	1.23	1.07	1.00	1.10	1.04
MPG	3.23	3.09	3.00	2.87	2.52	2.98
Fuel Cost (\$)/Mile	0.260	0.398	0.357	0.348	0.436	0.351
Parts Cost (\$)	5,374	8,365	21,948	7,695	8,220	51,600
Labor Cost (\$)	5,399	7,270	8,752	9,047	6,837	37,305
Maintenance Cost (\$)/Mile	0.178	0.256	0.557	0.280	0.529	0.335
Total Cost (\$)/Mile	0.438	0.653	0.913	0.628	0.965	0.686
Hubodometer	326,477	387,581	442,735	502,556	530,996	

Bus 522

Data Item	FY2000	FY2001	FY2002	FY2003	FY2004	Total
Mileage	56,083	57,693	58,967	56,610	53,761	283,114
Roadcalls	4	5	4	1	2	16
Miles Between RCs	14,021	11,539	14,742	56,610	26,881	17,695
Fuel Amount	18,143	18,330	20,963	18,851	18,949	95,236
Fuel Cost (\$)	15,240	22,546	22,430	18,851	20,844	99,911
Fuel Cost (\$)/Gal	0.84	1.23	1.07	1.00	1.10	1.05
MPG	3.09	3.15	2.81	3.00	2.84	2.97
Fuel Cost (\$)/Mile	0.272	0.391	0.380	0.333	0.388	0.353
Parts Cost (\$)	9,145	8,920	13,423	6,908	7,576	45,972
Labor Cost (\$)	6,730	7,707	8,007	7,647	9,005	39,096
Maintenance Cost (\$)/Mile	0.283	0.288	0.363	0.257	0.308	0.300
Total Cost (\$)/Mile	0.555	0.679	0.744	0.590	0.696	0.653
Hubodometer	296,630	354,323	413,290	469,900	523,661	

Bus 523

Data Item	FY2000	FY2001	FY2002	FY2003	FY2004	Total
Mileage	52,818	58,102	55,381	53,407	53,830	273,538
Roadcalls	5	3	4	3	3	18
Miles Between RCs	10,564	19,367	13,845	17,802	17,943	15,197
Fuel Amount	17,726	18,850	19,904	18,163	19,668	94,311
Fuel Cost (\$)	14,890	23,186	21,297	18,163	21,635	99,170
Fuel Cost (\$)/Gal	0.84	1.23	1.07	1.00	1.10	1.05
MPG	2.98	3.08	2.78	2.94	2.74	2.90
Fuel Cost (\$)/Mile	0.282	0.399	0.385	0.340	0.402	0.363
Parts Cost (\$)	6,986	11,916	13,530	9,389	15,343	57,163
Labor Cost (\$)	7,649	7,034	7,726	8,752	9,925	41,086
Maintenance Cost (\$)/Mile	0.277	0.326	0.384	0.340	0.469	0.359
Total Cost (\$)/Mile	0.559	0.725	0.768	0.680	0.871	0.722
Hubodometer	174,570	232,672	288,053	341,460	395,290	

Bus 524

Data Item	FY2000	FY2001	FY2002	FY2003	FY2004	Total
Mileage	49,762	61,991	45,068	60,520	50,339	267,680
Roadcalls	5	4	7	6	3	25
Miles Between RCs	9,952	15,498	6,438	10,087	16,780	10,707
Fuel Amount	16,399	19,704	15,502	20,042	17,040	88,687
Fuel Cost (\$)	13,775	24,236	16,587	20,042	18,744	93,384
Fuel Cost (\$)/Gal	0.84	1.23	1.07	1.00	1.10	1.05
MPG	3.03	3.15	2.91	3.02	2.95	3.02
Fuel Cost (\$)/Mile	0.277	0.391	0.368	0.331	0.372	0.349
Parts Cost (\$)	6,043	14,567	23,771	5,763	7,361	57,505
Labor Cost (\$)	4,764	7,333	8,431	9,561	12,631	42,720
Maintenance Cost (\$)/Mile	0.217	0.353	0.715	0.253	0.397	0.374
Total Cost (\$)/Mile	0.494	0.744	1.083	0.584	0.770	0.723
Hubodometer	324,864	386,855	431,923	492,443	542,782	

Bus 525

Data Item	FY2000	FY2001	FY2002	FY2003	FY2004	Total
Mileage	57,069	66,363	58,789	57,119	51,990	291,330
Roadcalls	6	6	4	7	3	26
Miles Between RCs	9,512	11,061	14,697	8,160	17,330	11,205
Fuel Amount	18,579	20,218	19,841	20,607	19,364	98,609
Fuel Cost (\$)	15,606	24,868	21,230	20,607	21,300	103,612
Fuel Cost (\$)/Gal	0.84	1.23	1.07	1.00	1.10	1.05
MPG	3.07	3.28	2.96	2.77	2.68	2.95
Fuel Cost (\$)/Mile	0.273	0.375	0.361	0.361	0.410	0.356
Parts Cost (\$)	5,279	7,360	20,639	5,794	7,359	46,431
Labor Cost (\$)	6,950	6,428	9,344	8,375	11,034	42,131
Maintenance Cost (\$)/Mile	0.214	0.208	0.510	0.248	0.354	0.304
Total Cost (\$)/Mile	0.488	0.582	0.871	0.609	0.763	0.660
Hubodometer	342,189	408,552	467,341	524,460	576,450	

Bus 526

Data Item	FY2000	FY2001	FY2002	FY2003	FY2004	Total
Mileage	53,408	61,403	60,863	42,604	33,683	251,961
Roadcalls	1	2	5	5	1	14
Miles Between RCs	53,408	30,702	12,173	8,521	33,683	17,997
Fuel Amount	17,479	19,269	20,376	14,905	12,176	84,205
Fuel Cost (\$)	14,682	23,701	21,802	14,905	13,394	88,484
Fuel Cost (\$)/Gal	0.84	1.23	1.07	1.00	1.10	1.05
MPG	3.06	3.19	2.99	2.86	2.77	2.99
Fuel Cost (\$)/Mile	0.275	0.386	0.358	0.350	0.398	0.351
Parts Cost (\$)	5,425	8,451	14,468	17,190	7,101	52,636
Labor Cost (\$)	6,213	6,375	8,348	12,537	8,200	41,673
Maintenance Cost (\$)/Mile	0.218	0.241	0.375	0.698	0.454	0.374
Total Cost (\$)/Mile	0.493	0.627	0.733	1.048	0.852	0.725
Hubodometer	323,935	385,338	446,201	488,805	522,488	

Bus 527

Data Item	FY2000	FY2001	FY2002	FY2003	FY2004	Total
Mileage	55,111	58,027	62,095	55,310	51,094	281,637
Roadcalls	4	6	3	9	3	25
Miles Between RCs	13,778	9,671	20,698	6,146	17,031	11,265
Fuel Amount	18,300	18,488	21,545	19,129	17,956	95,418
Fuel Cost (\$)	15,372	22,740	23,053	19,129	19,752	100,046
Fuel Cost (\$)/Gal	0.84	1.23	1.07	1.00	1.10	1.05
MPG	3.01	3.14	2.88	2.89	2.85	2.95
Fuel Cost (\$)/Mile	0.279	0.392	0.371	0.346	0.387	0.355
Parts Cost (\$)	8,484	14,655	7,778	10,278	11,559	52,753
Labor Cost (\$)	5,818	8,422	8,557	9,744	11,777	44,319
Maintenance Cost (\$)/Mile	0.260	0.398	0.263	0.362	0.457	0.345
Total Cost (\$)/Mile	0.538	0.790	0.634	0.708	0.843	0.700
Hubodometer	331,886	389,913	452,008	507,318	558,412	

Bus 528

Data Item	FY2000	FY2001	FY2002	FY2003	FY2004	Total
Mileage	51,164	59,094	62,241	53,662	42,549	268,710
Roadcalls	4	7	3	1	2	17
Miles Between RCs	12,791	8,442	20,747	53,662	21,275	15,806
Fuel Amount	17,858	19,357	21,503	17,935	15,440	92,093
Fuel Cost (\$)	15,001	23,809	23,008	17,935	16,984	96,737
Fuel Cost (\$)/Gal	0.84	1.23	1.07	1.00	1.10	1.05
MPG	2.87	3.05	2.89	2.99	2.76	2.92
Fuel Cost (\$)/Mile	0.293	0.403	0.370	0.334	0.399	0.360
Parts Cost (\$)	10,150	9,281	10,236	17,228	9,252	56,148
Labor Cost (\$)	6,250	7,265	8,918	9,330	10,312	42,076
Maintenance Cost (\$)/Mile	0.321	0.280	0.308	0.495	0.460	0.366
Total Cost (\$)/Mile	0.614	0.683	0.677	0.829	0.859	0.726
Hubodometer	344,840	403,934	466,175	519,837	562,386	

Bus 529

Data Item	FY2000	FY2001	FY2002	FY2003	FY2004	Total
Mileage	44,633	59,500	56,926	36,580	51,985	249,624
Roadcalls	2	8	0	2	9	21
Miles Between RCs	22,317	7,438		18,290	5,776	11,887
Fuel Amount	14,877	20,153	19,955	12,894	18,634	86,513
Fuel Cost (\$)	12,497	24,788	21,352	12,894	20,497	92,028
Fuel Cost (\$)/Gal	0.84	1.23	1.07	1.00	1.10	1.06
MPG	3.00	2.95	2.85	2.84	2.79	2.89
Fuel Cost (\$)/Mile	0.280	0.417	0.375	0.352	0.394	0.369
Parts Cost (\$)	5,677	13,173	22,326	6,537	33,673	81,386
Labor Cost (\$)	5,855	7,653	8,069	12,479	12,171	46,228
Maintenance Cost (\$)/Mile	0.258	0.350	0.534	0.520	0.882	0.511
Total Cost (\$)/Mile	0.538	0.767	0.909	0.872	1.276	0.880
Hubodometer	321,665	381,165	438,091	474,671	526,656	

Bus 530

Data Item	FY2000	FY2001	FY2002	FY2003	FY2004	Total
Mileage	47,517	59,045	54,067	52,999	56,011	269,639
Roadcalls	9	6	2	4	2	23
Miles Between RCs	5,280	9,841	27,034	13,250	28,006	11,723
Fuel Amount	15,854	18,804	19,447	18,104	19,231	91,440
Fuel Cost (\$)	13,317	23,129	20,808	18,104	21,154	96,513
Fuel Cost (\$)/Gal	0.84	1.23	1.07	1.00	1.10	1.06
MPG	3.00	3.14	2.78	2.93	2.91	2.95
Fuel Cost (\$)/Mile	0.280	0.392	0.385	0.342	0.378	0.358
Parts Cost (\$)	7,672	10,659	9,607	9,302	8,759	45,999
Labor Cost (\$)	6,675	6,485	7,982	10,308	9,845	41,295
Maintenance Cost (\$)/Mile	0.302	0.290	0.325	0.370	0.332	0.324
Total Cost (\$)/Mile	0.582	0.682	0.710	0.712	0.710	0.682
Hubodometer	333,235	392,280	446,347	499,346	555,357	

Bus 531

Data Item	FY2000	FY2001	FY2002	FY2003	FY2004	Total
Mileage	38,645	45,674	45,008	80,328	63,811	273,466
Roadcalls	9	8	4	8	4	33
Miles Between RCs	4,294	5,709	11,252	10,041	15,953	8,287
Fuel Amount	14,164	18,586	17,485	24,861	20,923	96,019
Fuel Cost (\$)	11,898	22,861	18,709	24,861	23,015	101,344
Fuel Cost (\$)/Gal	0.84	1.23	1.07	1.00	1.10	1.06
MPG	2.73	2.46	2.57	3.23	3.05	2.85
Fuel Cost (\$)/Mile	0.308	0.501	0.416	0.309	0.361	0.371
Parts Cost (\$)	8,054	13,900	12,517	10,295	6,791	51,557
Labor Cost (\$)	6,670	10,188	9,776	10,893	15,545	53,073
Maintenance Cost (\$)/Mile	0.381	0.527	0.495	0.264	0.350	0.383
Total Cost (\$)/Mile	0.689	1.028	0.911	0.573	0.711	0.753
Hubodometer	155,927	201,601	246,609	326,937	390,748	

Bus 532

Data Item	FY2000	FY2001	FY2002	FY2003	FY2004	Total
Mileage	34,381	34,356	37,326	28,521	33,856	168,440
Roadcalls	14	7	3	3	17	44
Miles Between RCs	2,456	4,908	12,442	9,507	1,992	3,828
Fuel Amount	12,807	12,944	15,689	11,449	11,906	64,795
Fuel Cost (\$)	10,758	15,921	16,787	11,449	13,097	68,012
Fuel Cost (\$)/Gal	0.84	1.23	1.07	1.00	1.10	1.05
MPG	2.68	2.65	2.38	2.49	2.84	2.60
Fuel Cost (\$)/Mile	0.313	0.463	0.450	0.401	0.387	0.404
Parts Cost (\$)	8,250	10,345	13,651	14,232	13,428	59,907
Labor Cost (\$)	7,158	8,298	8,572	9,099	13,297	46,423
Maintenance Cost (\$)/Mile	0.448	0.543	0.595	0.818	0.789	0.631
Total Cost (\$)/Mile	0.761	1.006	1.045	1.219	1.176	1.035
Hubodometer	270,826	305,182	342,508	371,029	404,885	

Bus 533

Data Item	FY2000	FY2001	FY2002	FY2003	FY2004	Total
Mileage	55,226	56,843	58,334	52,064	51,432	273,899
Roadcalls	0	3	7	3	6	19
Miles Between RCs		18,948	8,333	17,355	8,572	14,416
Fuel Amount	18,383	19,778	20,839	18,851	18,577	96,428
Fuel Cost (\$)	15,442	24,327	22,298	18,851	20,435	101,352
Fuel Cost (\$)/Gal	0.84	1.23	1.07	1.00	1.10	1.05
MPG	3.00	2.87	2.80	2.76	2.77	2.84
Fuel Cost (\$)/Mile	0.280	0.428	0.382	0.362	0.397	0.370
Parts Cost (\$)	8,218	10,110	19,049	6,719	28,458	72,555
Labor Cost (\$)	5,221	6,588	9,773	7,807	10,324	39,713
Maintenance Cost (\$)/Mile	0.243	0.294	0.494	0.279	0.754	0.410
Total Cost (\$)/Mile	0.523	0.722	0.876	0.641	1.151	0.780
Hubodometer	337,591	394,434	452,768	504,832	556,264	

Bus 534

Data Item	FY2000	FY2001	FY2002	FY2003	FY2004	Total
Mileage	45,303	50,610	54,182	51,208	50,878	252,181
Roadcalls	1	4	2	5	2	14
Miles Between RCs	45,303	12,653	27,091	10,242	25,439	18,013
Fuel Amount	14,897	17,323	18,475	17,458	17,931	86,084
Fuel Cost (\$)	12,513	21,307	19,768	17,458	19,724	90,771
Fuel Cost (\$)/Gal	0.84	1.23	1.07	1.00	1.10	1.05
MPG	3.04	2.92	2.93	2.93	2.84	2.93
Fuel Cost (\$)/Mile	0.276	0.421	0.365	0.341	0.388	0.360
Parts Cost (\$)	3,825	9,256	7,147	5,155	6,841	32,224
Labor Cost (\$)	4,893	6,593	6,730	6,591	9,447	34,254
Maintenance Cost (\$)/Mile	0.192	0.313	0.256	0.229	0.320	0.264
Total Cost (\$)/Mile	0.469	0.734	0.621	0.570	0.708	0.624
Hubodometer	100,799	151,409	205,591	256,799	307,677	

Bus 535

Data Item	FY2000	FY2001	FY2002	FY2003	FY2004	Total
Mileage	54,333	57,455	59,088	48,940	43,615	263,431
Roadcalls	2	2	3	3	6	16
Miles Between RCs	27,167	28,728	19,696	16,313	7,269	16,464
Fuel Amount	17,187	18,567	20,144	17,713	17,138	90,749
Fuel Cost (\$)	14,437	22,837	21,554	17,713	18,852	95,393
Fuel Cost (\$)/Gal	0.84	1.23	1.07	1.00	1.10	1.05
MPG	3.16	3.09	2.93	2.76	2.54	2.90
Fuel Cost (\$)/Mile	0.266	0.397	0.365	0.362	0.432	0.362
Parts Cost (\$)	5,705	11,621	13,650	10,969	8,718	50,663
Labor Cost (\$)	5,575	6,403	7,257	9,553	12,155	40,942
Maintenance Cost (\$)/Mile	0.208	0.314	0.354	0.419	0.479	0.348
Total Cost (\$)/Mile	0.473	0.711	0.719	0.781	0.911	0.710
Hubodometer	297,823	355,278	414,366	463,306	506,921	

Bus 601

Data Item	FY2000	FY2001	FY2002	FY2003	FY2004	Total
Mileage	34,800	39,143	33,761	25,471	36,829	170,004
Roadcalls	3	2	3	4	5	17
Miles Between RCs	11,600	19,572	11,254	6,368	7,366	10,000
Fuel Amount	6,853	8,195	6,849	5,155	7,865	34,917
Fuel Cost (\$)	5,757	10,080	7,328	5,155	8,652	36,971
Fuel Cost (\$)/Gal	0.84	1.23	1.07	1.00	1.10	1.06
MPG	5.08	4.78	4.93	4.94	4.68	4.87
Fuel Cost (\$)/Mile	0.165	0.258	0.217	0.202	0.235	0.217
Parts Cost (\$)	2,337	2,701	7,097	5,153	7,163	24,450
Labor Cost (\$)	3,430	2,637	5,514	8,042	7,937	27,560
Maintenance Cost (\$)/Mile	0.166	0.136	0.374	0.518	0.410	0.306
Total Cost (\$)/Mile	0.331	0.394	0.591	0.720	0.645	0.523
Hubodometer	147,710	186,853	220,614	246,085	282,914	

Bus 602

Data Item	FY2000	FY2001	FY2002	FY2003	FY2004	Total
Mileage	33,120	34,022	40,908	41,011	43,609	192,670
Roadcalls	4	2	2	4	5	17
Miles Between RCs	8,280	17,011	20,454	10,253	8,722	11,334
Fuel Amount	6,125	7,014	7,448	7,720	8,100	36,407
Fuel Cost (\$)	5,145	8,627	7,969	7,720	8,910	38,372
Fuel Cost (\$)/Gal	0.84	1.23	1.07	1.00	1.10	1.05
MPG	5.41	4.85	5.49	5.31	5.38	5.29
Fuel Cost (\$)/Mile	0.155	0.254	0.195	0.188	0.204	0.199
Parts Cost (\$)	5,366	3,171	5,129	1,849	4,214	19,728
Labor Cost (\$)	4,205	3,833	4,540	4,371	7,182	24,131
Maintenance Cost (\$)/Mile	0.289	0.206	0.236	0.152	0.261	0.228
Total Cost (\$)/Mile	0.444	0.459	0.431	0.340	0.466	0.427
Hubodometer	188,106	222,128	263,036	304,047	347,656	

Bus 603

Data Item	FY2000	FY2001	FY2002	FY2003	FY2004	Total
Mileage	21,281	24,668	0	41,320	300	87,569
Roadcalls	3	14	0	12	0	29
Miles Between RCs	7,094	1,762		3,443		3,020
Fuel Amount	3,735	4,714	0	8,896	100	17,445
Fuel Cost (\$)	3,137	5,798	0	8,896	110	17,942
Fuel Cost (\$)/Gal	0.84	1.23	1.07	1.00	1.10	1.03
MPG	5.70	5.23		4.64	3.00	5.02
Fuel Cost (\$)/Mile	0.147	0.235		0.215	0.367	0.205
Parts Cost (\$)	2,887	3,533	0	12,016	354	18,791
Labor Cost (\$)	3,097	3,284	0	9,523	523	16,428
Maintenance Cost (\$)/Mile	0.281	0.276		0.521	2.92	0.402
Total Cost (\$)/Mile	0.429	0.511		0.737	3.290	0.607
Hubodometer	127,174	151,842	151,842	193,162	193,462	

Bus 604

Data Item	FY2000	FY2001	FY2002	FY2003	FY2004	Total
Mileage	25,095	22,309	23,444	35,278	43,128	149,254
Roadcalls	6	3	3	4	1	17
Miles Between RCs	4,183	7,436	7,815	8,820	43,128	8,780
Fuel Amount	4,720	4,687	4,993	6,760	8,245	29,405
Fuel Cost (\$)	3,965	5,765	5,343	6,760	9,070	30,902
Fuel Cost (\$)/Gal	0.84	1.23	1.07	1.00	1.10	1.05
MPG	5.32	4.76	4.70	5.22	5.23	5.08
Fuel Cost (\$)/Mile	0.158	0.258	0.228	0.192	0.210	0.207
Parts Cost (\$)	4,139	6,132	4,180	3,371	4,021	21,844
Labor Cost (\$)	4,283	3,567	2,911	5,555	9,015	25,331
Maintenance Cost (\$)/Mile	0.336	0.435	0.302	0.253	0.302	0.316
Total Cost (\$)/Mile	0.494	0.693	0.530	0.445	0.513	0.523
Hubodometer	103,885	126,194	149,638	184,916	228,044	

Bus 605

Data Item	FY2000	FY2001	FY2002	FY2003	FY2004	Total
Mileage		5,359	25	8,286	48,841	62,511
Roadcalls		0	0	1	6	7
Miles Between RCs				8,286	8,140	8,930
Fuel Amount		329	14	1,747	9,379	11,469
Fuel Cost (\$)	0	405	15	1,747	10,317	12,484
Fuel Cost (\$)/Gal	0.84	1.23	1.07	1.00	1.10	1.09
MPG		16.29	1.79	4.74	5.21	5.45
Fuel Cost (\$)/Mile		0.076	0.599	0.211	0.211	0.200
Parts Cost (\$)		2,078	1,845	5,066	5,054	14,043
Labor Cost (\$)		2,024	3,383	4,958	7,441	17,805
Maintenance Cost (\$)/Mile		0.765	209	1.210	0.256	0.509
Total Cost (\$)/Mile		0.841	210	1.421	0.467	0.709
Hubodometer		88,275	88,300	96,586	145,427	

Bus 801

Data Item	FY2000	FY2001	FY2002	FY2003	FY2004	Total
Mileage	2,409	10,627	14,595	20,051	30,000	77,682
Roadcalls	0	3	6	3	2	14
Miles Between RCs		3,542	2,433	6,684	15,000	5,549
Fuel Amount	750	2,978	3,580	5,487	421	13,216
Fuel Cost (\$)	630	3,663	3,831	5,487	463	14,074
Fuel Cost (\$)/Gal	0.84	1.23	1.07	1.00	1.10	1.06
MPG	3.21	3.57	4.08	3.65	71	5.88
Fuel Cost (\$)/Mile	0.262	0.345	0.262	0.274	0.015	0.181
Parts Cost (\$)	1,779	4,143	3,063	2,795	4,483	16,263
Labor Cost (\$)	2,383	2,421	2,140	3,910	10,390	21,243
Maintenance Cost (\$)/Mile	1.728	0.618	0.356	0.334	0.496	0.483
Total Cost (\$)/Mile	1.989	0.962	0.619	0.608	0.511	0.664
Hubodometer	53,068	63,695	78,290	98,341	128,341	

Bus 802

Data Item	FY2000	FY2001	FY2002	FY2003	FY2004	Total
Mileage	12,096	11,422	10,283	5,674	39,747	79,222
Roadcalls	0	0	4	4	7	15
Miles Between RCs			2,571	1,419	5,678	5,281
Fuel Amount	3,262	3,243	3,116	1,707	11,860	23,188
Fuel Cost (\$)	2,740	3,989	3,334	1,707	13,046	24,816
Fuel Cost (\$)/Gal	0.84	1.23	1.07	1.00	1.10	1.07
MPG	3.71	3.52	3.30	3.32	3.35	3.42
Fuel Cost (\$)/Mile	0.227	0.349	0.324	0.301	0.328	0.313
Parts Cost (\$)	478	2,233	1,356	3,935	7,348	15,350
Labor Cost (\$)	1,871	2,591	1,893	2,505	11,201	20,061
Maintenance Cost (\$)/Mile	0.194	0.422	0.316	1.135	0.467	0.447
Total Cost (\$)/Mile	0.421	0.772	0.640	1.436	0.795	0.760
Hubodometer	59,533	70,955	81,238	86,912	126,659	

Bus 803

Data Item	FY2000	FY2001	FY2002	FY2003	FY2004	Total
Mileage	9,067	8,125	15,303	5,926	26,649	65,070
Roadcalls	1	0	5	1	11	18
Miles Between RCs	9,067		3,061	5,926	2,423	3,615
Fuel Amount	2,629	2,554	4,193	1,783	469	11,628
Fuel Cost (\$)	2,208	3,141	4,487	1,783	516	12,135
Fuel Cost (\$)/Gal	0.84	1.23	1.07	1.00	1.10	1.04
MPG	3.45	3.18	3.65	3.32	57	5.60
Fuel Cost (\$)/Mile	0.244	0.387	0.293	0.301	0.019	0.186
Parts Cost (\$)	2,968	2,957	4,370	2,423	6,416	19,135
Labor Cost (\$)	2,378	2,058	2,423	3,465	11,507	21,832
Maintenance Cost (\$)/Mile	0.590	0.617	0.444	0.994	0.673	0.630
Total Cost (\$)/Mile	0.833	1.004	0.737	1.295	0.692	0.816
Hubodometer	41,306	49,431	64,734	70,660	97,309	

Bus 804

Data Item	FY2000	FY2001	FY2002	FY2003	FY2004	Total
Mileage	11,573	11,110	12,756	11,572	35,986	82,997
Roadcalls	5	3	2	2	4	16
Miles Between RCs	2,315	3,703	6,378	5,786	8,997	5,187
Fuel Amount	2,932	3,239	3,442	3,311	9,531	22,455
Fuel Cost (\$)	2,463	3,984	3,683	3,311	10,484	23,925
Fuel Cost (\$)/Gal	0.84	1.23	1.07	1.00	1.10	1.07
MPG	3.95	3.43	3.71	3.50	3.78	3.70
Fuel Cost (\$)/Mile	0.213	0.359	0.289	0.286	0.291	0.288
Parts Cost (\$)	2,375	1,973	3,687	2,774	4,469	15,278
Labor Cost (\$)	2,710	1,738	2,992	3,774	9,949	21,163
Maintenance Cost (\$)/Mile	0.439	0.334	0.524	0.566	0.401	0.439
Total Cost (\$)/Mile	0.652	0.693	0.812	0.852	0.692	0.727
Hubodometer	34,002	45,112	57,868	69,440	105,426	

Bus 805

Data Item	FY2000	FY2001	FY2002	FY2003	FY2004	Total
Mileage	11,081	8,000	11,022	18,499	5,270	53,872
Roadcalls	3	1	5	0	0	9
Miles Between RCs	3,694	8,000	2,204			5,986
Fuel Amount	2,938	2,402	3,018	5,016	1,851	15,225
Fuel Cost (\$)	2,468	2,954	3,229	5,016	2,036	15,704
Fuel Cost (\$)/Gal	0.84	1.23	1.07	1.00	1.10	1.03
MPG	3.77	3.33	3.65	3.69	2.85	3.54
Fuel Cost (\$)/Mile	0.223	0.369	0.293	0.271	0.386	0.292
Parts Cost (\$)	876	1,945	2,860	2,236	1,880	9,797
Labor Cost (\$)	2,687	1,884	2,781	3,245	2,200	12,798
Maintenance Cost (\$)/Mile	0.322	0.479	0.512	0.296	0.774	0.419
Total Cost (\$)/Mile	0.544	0.848	0.805	0.567	1.161	0.711
Hubodometer	60,983	68,983	80,005	98,504	103,774	

Bus 806

Data Item	FY2000	FY2001	FY2002	FY2003	FY2004	Total
Mileage	10,802	6,265	7,247	15,043	4,999	44,356
Roadcalls	1	1	0	1	1	4
Miles Between RCs	10,802	6,265		15,043	4,999	11,089
Fuel Amount	2,875	1,908	2,124	3,926	1,631	12,464
Fuel Cost (\$)	2,415	2,347	2,273	3,926	1,794	12,755
Fuel Cost (\$)/Gal	0.84	1.23	1.07	1.00	1.10	1.02
MPG	3.76	3.28	3.41	3.83	3.06	3.56
Fuel Cost (\$)/Mile	0.224	0.375	0.314	0.261	0.359	0.288
Parts Cost (\$)	745	1,006	3,179	3,483	780	9,194
Labor Cost (\$)	2,112	1,904	1,847	4,283	1,875	12,020
Maintenance Cost (\$)/Mile	0.265	0.464	0.694	0.516	0.531	0.478
Total Cost (\$)/Mile	0.488	0.839	1.007	0.777	0.890	0.766
Hubodometer	42,399	48,664	55,911	70,954	75,953	

Bus 807

Data Item	FY2000	FY2001	FY2002	FY2003	FY2004	Total
Mileage	10,184	8,719	15,499	15,635	10,335	60,372
Roadcalls	1	1	4	9	5	20
Miles Between RCs	10,184	8,719	3,875	1,737	2,067	3,019
Fuel Amount	2,677	2,620	4,091	4,485	3,173	17,046
Fuel Cost (\$)	2,249	3,223	4,377	4,485	3,490	17,824
Fuel Cost (\$)/Gal	0.84	1.23	1.07	1.00	1.10	1.05
MPG	3.80	3.33	3.79	3.49	3.26	3.54
Fuel Cost (\$)/Mile	0.221	0.370	0.282	0.287	0.338	0.295
Parts Cost (\$)	613	1,636	1,970	2,121	1,590	7,930
Labor Cost (\$)	2,409	1,836	3,175	4,135	2,768	14,324
Maintenance Cost (\$)/Mile	0.297	0.398	0.332	0.400	0.422	0.369
Total Cost (\$)/Mile	0.518	0.768	0.614	0.687	0.759	0.664
Hubodometer	65,547	74,266	89,765	105,400	115,735	

Bus 1477

Data Item	FY2000	FY2001	FY2002	FY2003	FY2004	Total
Mileage	6,240					6,240
Roadcalls	0					0
Miles Between RCs						
Fuel Amount	1,696					1,696
Fuel Cost (\$)	1,425	0	0	0	0	1,425
Fuel Cost (\$)/Gal	0.84	1.23	1.07	1.00	1.10	0.84
MPG	3.68					3.68
Fuel Cost (\$)/Mile	0.228					0.228
Parts Cost (\$)	943					943
Labor Cost (\$)	1,472					1,472
Maintenance Cost (\$)/Mile	0.387					0.387
Total Cost (\$)/Mile	0.615					0.615
Hubodometer	21,737					

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