UNITED STATES POSTAL SERVICE
ELECTRIC CARRIER ROUTE VEHICLE PROGRAM

500 VEHICLE FLEET DEPLOYMENT REPORT

M A Y 2 0 0 3

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UNITED STATES POSTAL SERVICE
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ACRONYMS	
AFV	Alternative Fuel Vehicle
AP	Accounting Period
AVUS	Automated Vehicle Utilization System
BCM	Battery Control Module
BEV	Battery Electric Vehicles
BTAP	Battery Technology Advisory Panel
CAA	Federal Clean Air Act
CAAA	Federal Clean Air Act Amendments of 1990
CPUC	California Public Utilities Commission
CAT	Customer Acceptance Testing
CFFP	Clean Fuel Fleet Program
CNG	Compressed Natural Gas
CR	Concern Report
CRV	Carrier Route Vehicle
DAIS	Data Acquisition and Interface System
DOE	US Department of Energy
DTE	Distance to Empty
ECRV	Electric Carrier Route Vehicle (Ford/Grumman)
ELLV	Electric Long Life Vehicle (GM/Grumman/US Electricar)
EOL	End of Life
EPA	US Environmental Protection Agency
EPACT	Energy Policy Act
EPM	East Penn Manufacturing
EV	Electric Vehicle
EVI	Electrical Vehicle Infrastructure, Inc.
FFV	Flex Fuel Vehicle (Ford/Grumman, Ethanol/ Gasoline)
Ford	Ford Motor Company
GWVR	Gross Vehicle Weight Rating
INEEL	US DOE Idaho National Engineering and Environmental Laboratory
ITS	University of California, Davis, Institute of Transportation Studies
LEV	Low Emission Vehicle
LLV	Long Life Vehicle (GM/Grumman)
MSA	Metropolitan Statistical Areas
MTBE	methyl tertiary-butyl ether
OEM	Original Equipment Manufacturer
PCMCIA	Personal Computer Memory Card International Association
PCS	Power Control System
PEPCO	Potomac Electric Power Company
PF	Power Factor
PG&E	Pacific Gas and Electric
RMA	Ryerson, Master & Associates, Inc.
SCE	Southern California Edison

ACRONYMS (CONTINUED)	
SOC	State of Charge
THD	Total Harmonic Distortion
USPS	United States Postal Service
VMAS	Vehicle Maintenance and Accounting System
VMF	Vehicle Maintenance Facility
ZEV	Zero Emission Vehicle

UNITS	
$	dollar (US)
$/kWh	dollar per kilowatt hour
%	percent
A	amp
amps	amperes
c	cents
c/kWh	cents per kilowatt-hour
C	degrees Celsius
^{o}C	degrees Centigrade
d	day
°F	degrees Fahrenheit
gal	gallon
GGE	gasoline gallon equivalent
GGE/month	gasoline gallon equivalent per month
kW	kilowatt
kWh	kilowatt-hour
lb	pound
m	meter
mi/kWh	miles per kilowatt hour
mpd	miles per day
mph	miles per hour
yr	year

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EXECUTIVE SUMMARY

ES.1 INTRODUCTION

In 1999, the United States Postal Service (Postal Service) contracted with the Ford Motor Company (Ford) for the purchase of 500 Electric Carrier Route Vehicles (ECRVs). The ECRVs were phased into service at 22 Post Office locations --- with 20 in California and two on the East Coast --- between February 2001 and October 2002.

This Fleet Deployment Report has been prepared by the Postal Service to document the performance of the ECRVs during the first two years of deployment. Through the implementation of the 500-vehicle ECRV program, the Postal Service has been able to assess the degree of maturity of Battery Electric Vehicle (BEV) technology and its suitability for mail delivery and collection services. The report includes information and analysis to document how well the ECRVs have performed to date. Some of the key topics addressed in the report are:

- Energy efficiency of the vehicles
- Carrier satisfaction
- Maintenance and repairs
- Availability and reliability
- Battery performance
- Infrastructure and charging system
- On-board data collection

ES.2 ECRV DEPLOYMENT AND CHARGING SYSTEMS

Prior to deployment of the ECRVs, the Postal Service conducted a detailed assessment of potential deployment locations. The evaluation process considered a wide range of siting factors, including potential impacts on mail delivery operations, local support and incentive funding for AFV programs, size of the vehicle fleet at each site, proximity to the Postal Service's Vehicle Maintenance Facility (VMF), route distance, topography and climate, degree of support available from the electric utility, and other factors. The final list of deployment sites is shown in Table ES-1.

As part of the ECRV fleet deployment, electric charging infrastructure was installed at the 22 Post Offices. Single PCS units were also installed at each of the twelve Postal Service VMFs that service vehicles for the Post Offices.

The ECRV uses an onboard conductive charger and the vehicle is connected to electric charging power via an off-board Power Control Station (PCS). The PCS is a DCS-55 Dual Charging Station manufactured by Electrical Vehicle Infrastructure, Inc. (EVI). In addition to the PCS units, the main electric infrastructure components installed at each Post Office include a new electrical service entrance with an electric meter and main circuit breakers, a new panel housing 50 amp circuit breakers for each PCS unit, a new step-down transformer when needed to supply the 208-volt current to the PCS units, a new or upgraded main transformer when needed to supply the required electrical current for the ECRVs, and a timer unit that controls the time-of-day when the vehicles are charged.

TABLE ES-1 ECRV DEPLOYMENT SITES

Post Office	Address	Number of Vehicles	Deployment Date
Alameda Main	2201 Shoreline Dr., Alameda, CA 94501-6200	20	Jan-02
Bicentennial Station	7610 Beverly Blvd., Los Angeles, CA 90048-9996	57	Feb-02
Blossom Hill Station	5706 Cahalan Ave., San Jose, CA 95123-3008	20	Oct-02
Bostonia Station	867 N. Second St., El Cajon, CA 92021-5805	20	Aug-01
Costa Mesa Main	1590 Adams Ave., Costa Mesa, CA 92628-9001	20	Jun-01
Covina Main	545 Rimsdale Ave., Covina, CA 91722-9200	20	Jan-02
Dockweiler Station	3585 S. Vermont Ave., Los Angeles, CA 90007-3977	39	Apr-01
El Monte Main	11151 Valley Blvd., El Monte, CA 91734-9000	30	Oct-01
Fountain Valley	17227 Newhope, Fountain Valley, CA 92728-9005	28	Jan-01
Glendora Main	255 S. Glendora Ave., Glendora, CA 91740-9000	20	Jan-02
Harbor City	25690 Frampton Ave., Harbor City, CA 90710-2979	5	Aug-01
Ida Jean Haxton Station	9151 Atlanta Ave., Huntington Beach, CA 92615-9000	25	May-01
Irvine Harvest Station	17192 Murphy Ave., Irvine, CA 92623-9000	24	Jun-01
La Mirada	14901 Adelfa Dr., La Mirada, CA 90638-4749	15	Aug-01
Lamond Riggs, DC	6200 N. Capital St, N.W., Washington, DC 20011-4108	14	Mar-02
Linda Vista Station	2150 Comstock St., San Diego, CA 92111-9998	22	Aug-01
Los Feliz Station	1825 N. Vermont Ave., Los Angeles, CA 90027-4212	32	Aug-01
Norwalk	14011 Clarkdale Ave., Norwalk, CA 90650-8112	26	Sep-01
Pico Rivera	6320 Passons Blvd., Pico Rivera, CA 90660-3300	16	Sep-01
Royal Oaks Station	2000 Royal Oaks Dr., Sacramento, CA 95813-9998	20	Nov-01
San Gabriel Main	120 S. Del Mar Ave., San Gabriel, CA 91778-9000	20	Dec-01
White Plains, NY	100 Fisher Avenue, White Plains, NY 10606-1919	7	Mar-02

ES.3 ECRV ENERGY USE AND EFFICIENCY

The energy efficiency of the ECRVs was measured in terms of the miles driven for each kiloWatt hour (kWh) of electricity. Table ES-2 shows the vehicle miles driven for each site and for each four-week Accounting Period (AP) since deployment, and Figure ES-1 shows the average miles per day for the fleet by AP. The total distance driven by the fleet to date exceeds two million miles with an average of 10.0 miles per vehicle per day.

The electricity use for the ECRVs at the 22 Post Office locations was obtained from the electric utilities during the period from deployment through March 2003. The eight utilities that provide service to the ECRV Post Office sites are Southern California Edison, Los Angeles Department of Water and Power, San Diego Gas and Electric, Pacific Gas and Electric, Sacramento Municipal Utility District, Alameda Power, the Potomac Electric Power Company (PEPCO), and ConEdison. Figure ES-2 shows the average electricity use per vehicle per day by month, and energy efficiency is shown in Figure ES-3 (by site) and Figure ES-4 (by month). The energy efficiency at most sites is in the range 0.8 to 1.0 miles per kWh. The average cost for electricity has averaged $0.17c per kWh, inclusive all charges. It is likely that the average electricity cost could be decreased if charging practices were optimized to minimize use of on-peak electricity.

TABLE ES-2 MILES DRIVEN AND DAYS USED

Station Name	Number of Vehicles	Days Used	Days In Shop	Miles Driven	Average Miles/Day
Alameda Main PO	20	6,205	36	72,577	11.7
Bicentennial Station PO	57	14,216	581	10,8101	7.6
Blossom Hill Station PO	20	1,659	16	20,492	12.4
Bostonia Station PO	20	9,764	242	98,015	10.0
Costa Mesa Main PO	20	9,371	8	102,183	10.9
Covina Main PO	20	6,969	26	78,942	11.3
Dockweiler Station PO	39	21,818	41	178,362	8.2
El Monte Main PO	30	12,091	207	156,906	13.0
Fountain Valley PO	28	17,194	161	199,654	11.6
Glendora Main PO	20	6,512	26	90,203	13.9
Harbor City PO	5	2,410	0	22,878	9.5
Ida Jean Haxton PO	25	12,036	241	118,662	9.9
Irvine Harvest Station PO	24	12,457	204	151,265	12.1
La Mirada PO	15	6,310	111	63,711	10.1
Lamond Riggs PO	14	3,431	69	28,244	8.2
Linda Vista Station PO	22	10,659	197	99,454	9.3
Los Feliz Station PO	32	12,753	378	80,651	6.3
Norwalk PO	26	11,686	4	105,353	9.0
Rico Rivera PO	16	6,970	57	65,346	9.4
Royal Oaks Station PO	20	6,209	92	74,104	11.9
San Gabriel Main PO	20	7,938	1	65,492	8.3
White Plains PO	7	2,097	0	19,970	9.5
Totals	**500**	**200,755**	**2,698**	**2,000,565**	**10.0**

FIGURE ES-1 AVERAGE MILES PER DAY (ALL ECRVs)

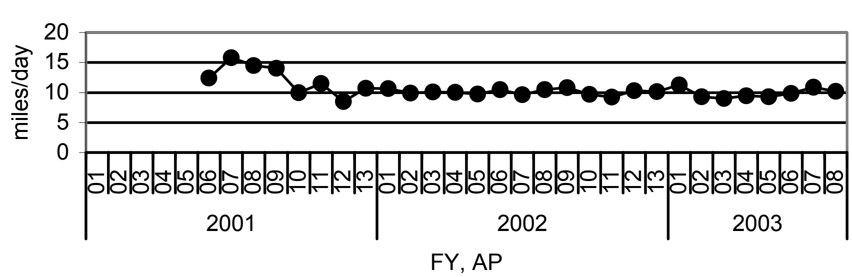


FIGURE ES-2
ECRV AVERAGE ELECTRICITY USE PER DAY

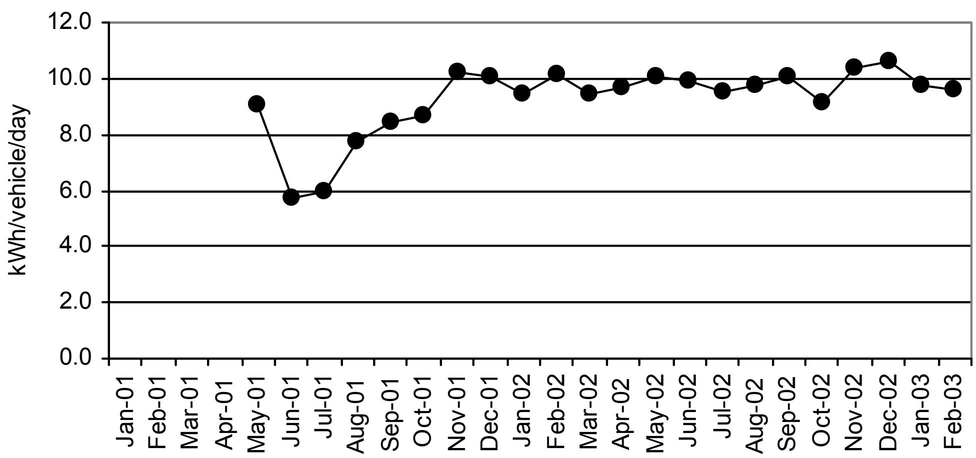


FIGURE ES 3 ECRV ENERGY EFFICIENCY

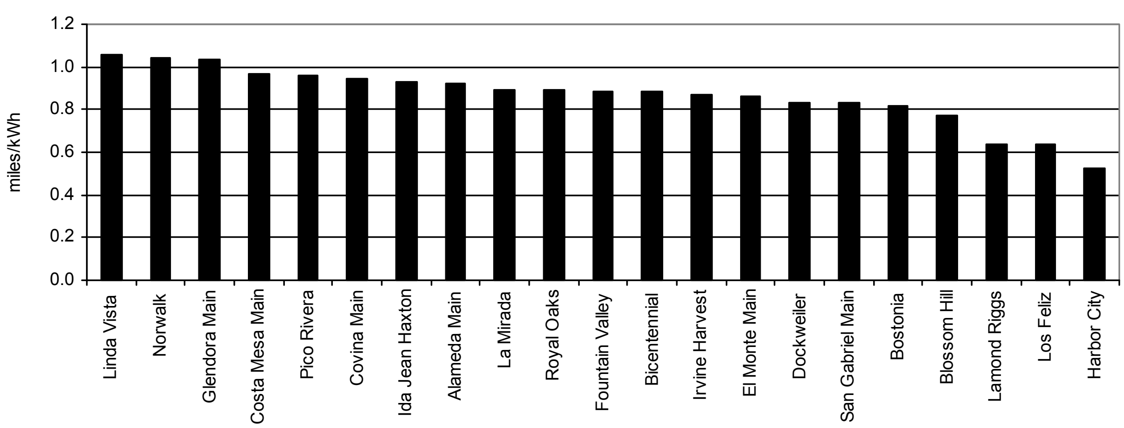
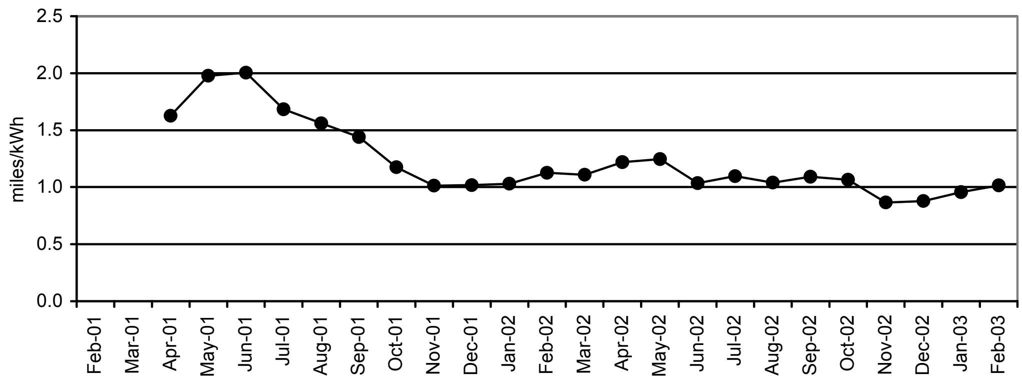


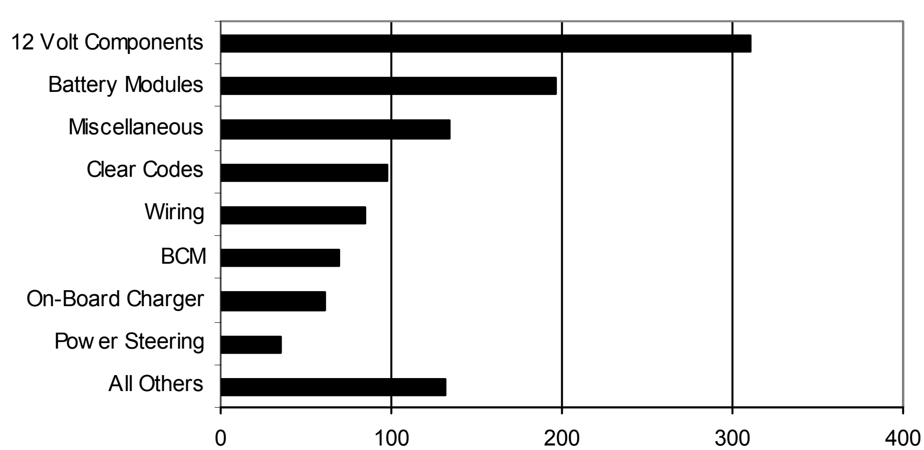
FIGURE ES-4
AVERAGE ENERGY EFFICIENCY BY MONTH
POST OFFICES IN CALIFORNIA



ES.4 MAINTENANCE, RELIABILITY AND AVAILABILITY

During the warranty period, Ford has completed many repairs on the 500-vehicle ECRV fleet. Figure ES-5 shows the number of repairs that have been made for each of the repair categories established by Ford.

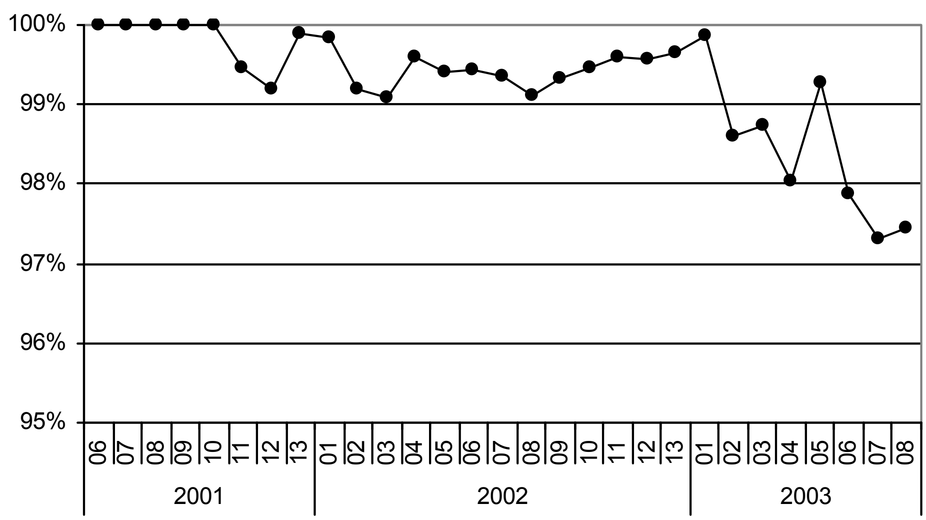
FIGURE ES-5
NUMBERS OF ECRV CONCERN REPORTS BY CATEGORY
(Excluding Pre-Delivery CRs)



In terms of reliability, component failures of most concern are those that can occur frequently, and those that result in costly repairs or extended periods of vehicle downtime. The analysis of ECRV repair data shows that the types of repairs that meet these criteria include the 12 volt components, the battery module and pack repairs and the wiring and harness repairs.

The availability of the ECRV fleet over time is shown in Figure ES-6. Availability has been consistently high (above 99%) until the last seven APs. For comparison, the availability for gasoline Carrier Route Vehicles is typically in the range from 97% to 99%.

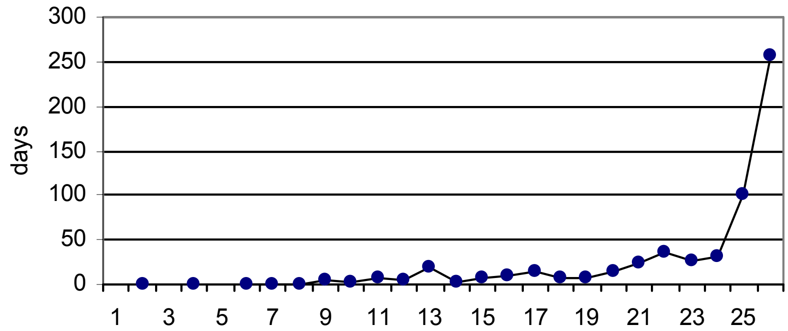
FIGURE ES-6 ECRV AVAILABILITY BY ACCOUNTING PERIOD



ES.5 BATTERIES

There is significant uncertainty in the projected battery life and the cost associated with ECRV battery pack replacements. During the most recent APs, there has been an increase in the number of battery repairs needed, with an increasing number of pack replacements. The time needed by Ford to complete the battery repairs has also increased significantly (Figure ES-7). Data from Ford regarding the costs associated with recent pack replacements indicate that the cost for a pack replacement is now on the order of $14,000. This high cost may be due to the decrease in battery pack demand following the demise of the BEV element of the California Zero Emission Vehicle mandate.

FIGURE ES-7
DAYS NEEDED TO COMPLETE BATTERY REPAIRS



ES.6 CARRIER SATISFACTION

During April and May 2003, a “structured response” type survey was sent to more than 100 Carriers and Managers, with the Carriers selected at random from all sites with ECRVs. The questions in this survey were designed to solicit information on vehicle performance. The ratings for all statements from the Carriers and the Managers were generally favorable or highly favorable. For the Carriers, the two statements that received least favorable responses were concerning the lack of power on hills, and a reluctance to use electrical equipment for fear of draining power from the traction battery. In the responses from the Managers, the two statements that received least favorable responses were on cargo capacity and the reliability of the charging system. Managers noted that the features which Carriers like best are that they do not have to go to the gasoline station and that they are quiet and clean.

ES.7 DATA COLLECTION

Twenty-five ECRVs are equipped with onboard Data Acquisition and Interface Systems (DAIS) to collect and store data on vehicle and battery performance. There are five DAIS vehicles each at the Fountain Valley, La Mirada, Linda Vista, Alameda and Royal Oaks Post Offices. The DAIS collects and records data on the flow of energy into and out of the battery pack, vehicle speed and miles driven, and temperature. Data values are recorded each second when the ECRV is being driven (in Drive files) and each minute when the ECRV is connected to the PCS for charging (in Charge files).

A DAIS database and Report Generator have been created on a Personal Computer in Microsoft Access to store and process the Postal Service ECRV data. The database was populated using approximately one year of data (where available) for each of the 25 DAIS-equipped vehicles. The Report Generator provides the capability to quickly generate reports on vehicle and energy use.

ES.8 CONCLUSIONS

With nearly two years of operating experience now available for the ECRV fleet, a substantial amount of data has been compiled on the performance of these BEVs. Over two million miles have been accumulated by the fleet, using about two million kWh of electricity. This represents a significant utilization of an alternative fuel.

In general, many of the performance issues identified during the course of operating the ECRV fleet are similar to those that may be expected for any new type of vehicle or vehicle technology. However, there is still considerable uncertainty associated with the traction battery cost and life cycle expectancy. Warranty repair and cost data from Ford indicate a relatively high number of battery module and battery pack repairs have been made, and the data indicate the costs for pack replacements have increased dramatically during the last year.

There have been external developments with BEVs at large that have resulted in a decreased demand for this type of vehicle and the batteries they depend on. Of particular relevance are the changes currently being made to the California Zero Emission Vehicle (ZEV) mandate which are expected to decrease demand for BEVs.

The ECRV Program has provided valuable experience for the Postal Service in the acquisition and operation of an AFV fleet. This experience is likely to be helpful as other advanced technologies are tested and demonstrated in the future. The lessons learned may also be helpful to other organizations involved with the operation of a fleet of light duty vehicles in similar applications. Chapter 8 of the main report includes a summary of ECRV Program accomplishments and lessons learned.

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1. INTRODUCTION

In 1999, the United States Postal Service (Postal Service) contracted with the Ford Motor Company (Ford) for the purchase of Electric Carrier Route Vehicles (ECRVs). An Initial Purchase of 500 ECRVs was called for in the contract, with Purchase Options for additional ECRVs. The first ECRVs were placed in regular service in Southern California in February 2001. By October 2002, all 500 ECRVs had been placed in service, with most vehicles in California and a small number at two locations on the East Coast.

To support the Postal Service ECRV test program and the development of the electric vehicle industry, the United States Department of Energy (DOE) entered into a testing support agreement with the Postal Service. One of the conditions of the agreement was to prepare a 500 Fleet Deployment report after all of the ECRVs were placed in service. In support of this testing agreement, the Postal Service contracted with Ryerson Master and Associates (RMA) to prepare this report.

This report has eight main chapters including this introduction. Chapter 2 includes an overview of the Postal Service carrier fleet operations and the ECRV deployment within the fleet. Chapter 3 is an evaluation of vehicle performance based on energy efficiency, repair and maintenance, reliability and battery performance. Chapter 4 discusses user (Letter Carrier) satisfaction, and Chapter 5 is a review of data collection systems. Chapter 6 covers infrastructure and the electric charging systems, and Chapter 7 discusses other ECRV program activities. Chapter 8 presents the main conclusions from this report, and Chapter 9 includes the references.

The appendices provide a list of preparers and persons contacted (Appendix A), supporting information on ECRV electricity use and mileage (Appendix B), maintenance and repair (Appendix C), battery issues (Appendix D), the Carrier satisfaction survey (Appendix E), and analysis of the ECRV Data Acquisition and Integration System data collected to date (Appendix F).

The following two sections in this introductory chapter describe the purpose and scope of this study, with a summary of some of the limitations.

1.1 PURPOSE AND SCOPE OF STUDY

The purpose of this report is to report on the performance of the ECRVs during the first two years of deployment. This is one of the largest Battery Electric Vehicle (BEV) demonstration programs ever to take place, so it presents a unique opportunity to gather detailed information of how well a BEV fleet can perform in a delivery service environment. Some of the key topics addressed in the report are:

- Energy efficiency of the vehicles
- Carrier satisfaction
- Maintenance and repairs
- Availability and reliability
- Battery performance
- Infrastructure and charging system
- On-board data collection

The period covered by this study is from initial deployment date (for each vehicle) through the beginning of calendar year 2003. Depending on when the vehicles were deployed to each site, the period of service ranges from just over one year (San Jose Station Post Office) to more than two years (Fountain Valley Station Post Office). All data are based on averages (or totals) for each deployment location, and on all deployment locations combined. The report does not include data on each individual vehicle.

Most of the data and results presented in this report were collected and analyzed in previous reports for the Postal Service. However, additional data on energy use, maintenance and repairs, and battery performance were collected to evaluate the performance of the entire fleet of 500 ECRVs. Most of this information was obtained from the Postal Service Vehicle Maintenance and Accounting System (VMAS) and directly from Ford. A limited number of site visits were made to the Postal Service Vehicle Maintenance Facilities (VMFs) in whose service areas the ECRVs are deployed, and to a few key deployment sites. A survey of Letter Carriers and Post Office Managers was also conducted to obtain feedback from the Post Offices on how well the vehicles are performing.

The Postal Service considers the 500 vehicle ECRV program to be a demonstration program with three main objectives:

- Demonstration of the maturity of electric vehicle technology
- Demonstration of cost effectiveness
- Demonstration of reliability and maintainability

This report includes information and analysis to evaluate how well the ECRVs have performed to date against the first and third of these program objectives. The report also includes some limited data on electricity and battery costs.

1.2 LIMITATIONS

Though there are now 500 ECRVs in service at 22 Post Office locations, the amount of information available for evaluating performance is still limited given the relatively short period over which the vehicles have been in service. The operating experience database (6,000 vehicle months of data per year of operation) is small when compared with the vast amount of information accumulated by the Postal Service every year for the nationwide Long Life Vehicle (LLV) fleet of gasoline vehicles (over one million vehicle-months of data for each year of operation).

While the operational data from the first two years do provide an indication of ECRV performance, they do not yet provide sufficient operational and maintenance data to determine how well the ECRVs will perform over the long term or at sites other than the deployment locations. Only a small number of the vehicles have been placed on the East Coast where cold weather could affect vehicle performance. It is expected that differences in route distances, terrain, and climate at the various deployment sites will affect the ECRV operational performance.

2. CARRIER VEHICLE MISSION AND ECRV DEPLOYMENT

This chapter includes an overview of the Postal Service Carrier Vehicle Fleet operations (including a discussion of the need for Alternative Fuel Vehicles, AFVs), a brief description of how the Electric Carrier Route Vehicle (ECRV) deployment strategy was developed, and the current status of the deployment.

2.1 OVERVIEW OF CARRIER VEHICLE FLEET OPERATIONS

The Postal Service operates a fleet of over 169,000 light-duty mail delivery vehicles called Carrier Route Vehicles (CRVs). The CRVs are used for city delivery routes and rural routes. These routes provide daily mail delivery directly to residential and business customers. The mail delivery vehicles are usually half-ton or quarter-ton gasoline vehicles, manufactured specifically for the Postal Service. In addition to the CRVs, the Postal Service also operates a large fleet of one-ton and two-ton cargo vehicles, and trucks for regional distribution.

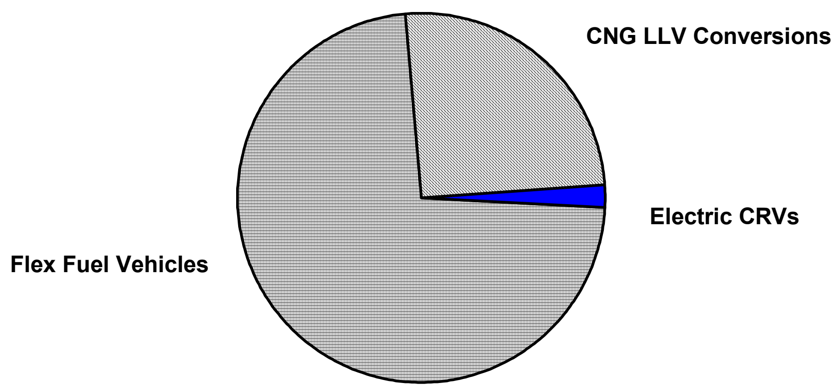
The Postal Service has an ongoing need to purchase new CRVs either to replace older CRVs or to increase the fleet to accommodate expanding services. When new vehicles are purchased or leased, the Postal Service must comply with the legislative requirements of the Energy Policy Act (EPACT), administered by the U.S. Department of Energy, and the Clean Air Act (CAA), administered by the U.S. Environmental Protection Agency. The preference for right-hand drive vehicles for mail delivery and collection means that the Postal Service often makes large acquisitions of specialized fleet vehicles directly from the vehicle manufacturers.

EPACT requires the Postal Service and other federal agencies to purchase a specified percentage of AFVs. Under EPACT mandates, 75% of light-duty vehicle purchases and leases (up to 8,500 pounds gross vehicle weight [GVW]) must be AFVs within designated Metropolitan Statistical Areas (MSAs). Allowable fuels under the EPACT mandate include natural gas, liquefied petroleum gas, alcohol fuels, hydrogen, coal, biological material derived fuels, and electricity.

The CAA, as modified by the Clean Air Act Amendments of 1990, established new mandates for fleet operators in certain MSAs designated as non-attainment for ozone (serious, severe or extreme) or carbon monoxide (design value greater than 16 parts per million). The EPA has developed a Clean Fuel Fleet Program (CFFP) which applies in the designated MSAs. The CFFP applies to all light duty vehicles up to 8,500 pounds gross vehicle weight, and heavy duty vehicles from 8,500 to 26,000 pounds gross vehicle weight. New vehicles purchased in these MSAs must meet Low Emission Vehicle (LEV) standards or better. Under the CFFP of the CAA, the fleet operators may meet the LEV emission standard using reformulated gasoline or alternative fuels.

The Postal Service voluntarily complies with the EPACT purchase percentages nationwide to avoid geographic restrictions on their assignment and usage of vehicles across the country. All new CRVs purchased by the Postal Service in recent years have been Alternative Fuel Vehicles (AFVs). The Postal Service has purchased more than 20,000 Flex Fuel Vehicles (FFVs) from Ford, designed to operate on gasoline or ethanol. Several thousand gasoline carrier vehicles (called Long Life Vehicles or LLVs) have been converted to run on Compressed Natural Gas (CNG). The composition of AFVs within the Postal Service fleet is shown in Figure 2-1.

FIGURE 2-1
POSTAL SERVICE CARRIER VEHICLE FLEET
ALTERNATIVE FUEL VEHICLES



Prior to the acquisition of the 500 ECRVs, the Postal Service conducted a test program of BEV technology for carrier vehicles in which ten LLVs were converted to Electric Long Life Vehicles (ELLVs) in collaboration with US Electricar (Chobotov et. al, 1996). For this test program, the LLVs were equipped with lead acid batteries, and five were placed in service at the Harbor City Post Office in the Los Angeles area. Subsequently, 13 Chrysler EPIC vehicles were added to the Harbor City fleet to make this the first “all-electric” postal delivery fleet in the country. These pilot programs provided valuable information for the Postal Service prior to the acquisition of a larger number of electric vehicles. A performance study of the Harbor City electric vehicles was conduced by the Postal Service Pacific Area (LeMay, 2000).

2.2 CARRIER VEHICLE ROUTES

For mail delivery, the Carrier routes are differentiated in terms of the type of route. There are three main route types at each Post Office:

1. A ***curbline or mounted route*** is one where the predominant method of Carrier delivery is to mailboxes along the curb (e.g., the driver drives from box to box and delivers the mail without leaving the vehicle).
2. A ***park and loop route*** is one where the predominant method for Carrier delivery is to park at a designated location, exit the vehicle and walk a “loop”, delivering mail to the individual homes and businesses. Frequently, multiple “loops” are designed from a single park point.
3. The ***express delivery route*** refers to expedited delivery and collection activities. The employee delivers express mail, packages and makes on-demand or scheduled pick-ups of mail, throughout the postal delivery area.

The type of route is an important consideration for AFVs, because it may affect the performance of the vehicles. For example, the miles driven for the express delivery routes are usually much higher than for the other two routes. The route types could also affect the fuel economy and vehicle maintenance costs. For the ECRVs, the ideal route is on level terrain with a distance that can be comfortably covered twice on a single charge.

In this study, a limited assessment was conducted of ECRV performance at different locations to compare performance under different operating conditions. This type of comparison can provide valuable information to fleet managers as they make decisions about future acquisitions. Prior to the large scale deployment of electric vehicles, the terrain, climate, route distance and route type at the deployment location need to be carefully considered, given the range limitations of these vehicles.

For refueling, Postal Service Carriers using gasoline vehicles typically refuel by driving to a fuel station offsite. Depending on the route distance and other local factors, the gasoline LLVs are usually refueled about once every one or two weeks. The daily use of the vehicles depends on the type of route, but the majority of vehicles used for mail delivery are on the route from late morning to late afternoon. Vehicles are usually parked at the Post Office location overnight. For electric vehicles that need to be charged daily, the ability to use off-peak electricity at night is an important factor.

2.3 ECRV SITE SELECTION AND VEHICLE DEPLOYMENT

Prior to deployment of the ECRVs, the Postal Service conducted a detailed assessment of potential deployment locations. A site selection study was performed to help develop a deployment plan for the first 500 vehicles (Ryerson, Master and Associates, Inc., January 1999). During the course of the study, over 800 Postal Service sites were screened, and more than 220 were analyzed in detail.

The prioritized list of sites was used by the Postal Service to select the sites for deployment of the 500 Initial Purchase ECRVs. A list of 22 sites was developed with the total number of vehicles at each site ranging from about 20 to 40 vehicles. The evaluation process considered a wide range of siting factors, including potential impacts on mail delivery operations, local support and incentive funding for AFV programs, size of the vehicle fleet at each site, proximity to the Postal Service's Vehicle Maintenance Facility (VMF), topography and climate, degree of support available from the electric utility, and other factors. Prior to construction, additional studies were conducted to describe the ECRV infrastructure needed for each site, and to document VMF and Fleet Information pertaining to the ECRVs.

During deployment, a few minor changes were made to the list of sites initially selected. These were due to changes in operational details and engineering constraints that were identified during the planning process. With many back-up sites identified during the site selection process, this did not result in any delays to the overall fleet deployment.

The final list of deployment sites is shown in Table 2-1. Twenty of the Post Office sites are in California with 15 in the Los Angeles area, two in San Diego, one site each in San Jose, Sacramento and Alameda. The other two sites are in New York State (White Plains Post Office), and in Washington D.C. (Lamond Riggs Post Office). Figures 2-2 through 2-5 show the deployment locations.

TABLE 2-1 ECRV DEPLOYMENT INFORMATION

Post Office	Address	VMF	Number of Vehicles	Deployment Date
Alameda Main	2201 Shoreline Dr., Alameda, CA 94501-6200	Oakland	20	Jan-02
Bicentennial Station	7610 Beverly Blvd., Los Angeles, CA 90048-9996	Los Angeles North	57	Feb-02
Blossom Hill Station	5706 Cahalan Ave., San Jose, CA 95123-3008	San Jose	20	Oct-02
Bostonia Station	867 N. Second St., El Cajon, CA 92021-5805	San Diego Midway	20	Aug-01
Costa Mesa Main	1590 Adams Ave., Costa Mesa, CA 92628-9001	Huntington Beach	20	Jun-01
Covina Main	545 Rimsdale Ave., Covina, CA 91722-9200	La Puente	20	Jan-02
Dockweiler Station	3585 S. Vermont Ave., Los Angeles, CA 90007-3977	Los Angeles Central	39	Apr-01
El Monte Main	11151 Valley Blvd., El Monte, CA 91734-9000	La Puente	30	Oct-01
Fountain Valley	17227 Newhope, Fountain Valley, CA 92728-9005	Huntington Beach	28	Jan-01
Glendora Main	255 S. Glendora Ave., Glendora, CA 91740-9000	La Puente	20	Jan-02
Harbor City	25690 Frampton Ave., Harbor City, CA 90710-2979	Torrance	5	Aug-01
Ida Jean Haxton Station	9151 Atlanta Ave., Huntington Beach, CA 92615-9000	Huntington Beach	25	May-01
Irvine Harvest Station	17192 Murphy Ave., Irvine, CA 92623-9000	Huntington Beach	24	Jun-01
La Mirada	14901 Adelfa Dr., La Mirada, CA 90638-4749	Long Beach	15	Aug-01
Lamond Riggs, DC	6200 N. Capital St, N.W., Washington, DC 20011-4108	Brightwood	14	Mar-02
Linda Vista Station	2150 Comstock St., San Diego, CA 92111-9998	San Diego Midway	22	Aug-01
Los Feliz Station	1825 N. Vermont Ave., Los Angeles, CA 90027-4212	Los Angeles North	32	Aug-01
Norwalk	14011 Clarkdale Ave., Norwalk, CA 90650-8112	Long Beach	26	Sep-01
Pico Rivera	6320 Passons Blvd., Pico Rivera, CA 90660-3300	Long Beach	16	Sep-01
Royal Oaks Station	2000 Royal Oaks Dr., Sacramento, CA 95813-9998	Sacramento Main	20	Nov-01
San Gabriel Main	120 S. Del Mar Ave., San Gabriel, CA 91778-9000	La Puente	20	Dec-01
White Plains, NY	100 Fisher Avenue, White Plains, NY 10606-1919	West Chester	7	Mar-02
Total			**500**	

FIGURE 2-2 ECRV DEPLOYMENT SITES IN CALIFORNIA

FIGURE 2-3 ECRV DEPLOYMENT SITES IN THE LOS ANGELES AREA

FIGURE 2-4 ECRV DEPLOYMENT SITE IN NEW YORK

FIGURE 2-5 ECRV DEPLOYMENT SITE IN WASHINGTON DC

3. ECRV PERFORMANCE

This chapter addresses the performance of the 500 ECRVs from deployment through March 2003. The first part provides a brief description of the physical characteristics of the ECRV and comments on the overall design. The second part addresses energy efficiency expressed in terms of the miles driven and the electricity used. The third part provides a brief discussion of vehicle reliability expressed in terms of days in service, days unused and days in shop. The third and fourth parts address maintenance and repair issues; and the fifth part discusses battery performance and cost.

The period of ECRV performance covered in this report is from initial deployment through March 2003. The data presented are generally shown as the averages or totals for each deployment location, and for all deployment locations combined. Performance data are not presented for each individual vehicle. Much of the data used in preparing this report were collected and analyzed in previous reports for the Postal Service. Applicable references are cited where this is the case.

Additional data were collected to evaluate the performance of the entire fleet of 500 ECRVs, including vehicle miles driven, electricity used, and maintenance and repair data. These data were obtained from readily available VMAS reports, from the electric utilities, and from Ford.

3.1 VEHICLE DESCRIPTION AND SPECIFICATIONS

This section includes a description of the ECRV based on the Postal Service vehicle specifications and bulletins, and on field measurements and observations taken during the time the ECRVs have been in service.

Ford selected a vehicle design for the ECRV that has been in commercial service for a number of years. The vehicle body is supplied by Grumman Allied, and is very similar to the LLV body. The chassis of the ECRV is similar to the Ford Ranger Electric Pickup Truck chassis. The Postal Service Make Model code for the ECRVs is MM 12-80.

The ECRVs are designed to operate on routes similar to gasoline-fueled Carrier route vehicles. ECRVs are designed to travel at speeds up to 60 miles per hour and to travel about 40 miles on a single electrical charge, depending on weather and road conditions. The ECRVs are right-hand drive vehicles with similar mail-carrying capacity as LLVs.

The vehicle’s gear selector has the normal options, including “P” for park, “R” for reverse, “N” for neutral, and “D” for drive, plus “E” for Economy Mode. The Economy Mode, which has a top speed of about 50 miles per hour, conserves energy and should be used for most mail delivery operations. The vehicles are equipped with regenerative braking.

The 312-volt traction battery pack includes 39 eight-volt lead acid batteries with optional heater for cold weather climates. The pack is rated at 23 kWh and weighs 2,000 pounds. The pack is located underneath the vehicle between the wheelbase and frame rails to give the vehicle a low center of gravity. The pack assembly contains the battery modules, wiring, a fan for ventilation and cooling, and a control system. The ECRV utilizes an on-board, conductive charging system. The off-board charging infrastructure is described in Chapter 6.

The ECRV has a number of unique gauges. The battery State of Charge (SOC) gauge is equivalent to a fuel gauge on a gasoline-powered vehicle. The Distance to Empty (DTE) gauge estimates the remaining distance that the vehicle can travel before requiring a battery pack recharge. The gauge reading is based on remaining energy, driving conditions, and recent vehicle usage. The Economy gauge provides information about the vehicles energy usage. Economical usage of the vehicle is indicated by the gauge reading on the plus side and maximizes the vehicle’s range.

The Motor Enabled gauge indicates the vehicle is ready to drive, and the Temperature Gauge indicates the temperature of the vehicle’s components. Unlike a conventional temperature gauge, this gauge does not start cold and move to normal. It starts normal, and moves to hot or cold when there is problem. The panel also includes a Vehicle Malfunction warning light (often referred to as a Wrench light).

The dimensions of the ECRV are shown in Table 3-1, together with selected design specifications. Compared with the Postal Service LLV, the ECRV is longer (187 inches vs. 175.5 inches), wider (79 inches vs. 76 inches), and higher (88 inches vs. 85 inches). The driver step is much higher for the ECRV (17 inches vs. 12.5 inches), as is the driver seat (46 inches vs. 38.5 inches). The top of the seatbelt latch from the floor is shorter than for the LLV (11.5 inches vs. 14.5 inches). At the rear, the height of the back door strap is 87 inches for the ECRV compared with 76 inches for the LLV; and the back bumper reach is 13.5 inches for the ECRV compared with 5 inches for the LLV. The Gross Vehicle Weight Rating (GWVR) for the ECRV is 6,250 pounds, compared with 4,450 pounds for the LLV.

3.2 ENERGY USE AND EFFICIENCY

Energy efficiency is an important performance measure for the ECRV. This is based on the miles driven for a given amount of electricity. Preliminary estimates of ECRV energy efficiency were developed by RMA during the first months of ECRV deployment. These were included in the “Life Cycle Cost and Performance Evaluation” study (RMA 2001a), and the subsequent update report (RMA, 2003). The early estimates were in the range 0.85 to 0.90 miles per kWh range. These figures were based on operational data obtained from the ECRV vehicles first deployed at the Fountain Valley, Dockweiler Station, and Ida Jean Haxton Station Post Offices.

In this study the energy efficiency estimates were updated using readily available data from all sites with ECRVs. For most sites, the vehicles were placed in service by March 2002, so there was about one year of operating data available for this study.

TABLE 3-1 ECRV VEHICLE DIMENSIONS AND DESIGN SPECIFICATIONS

External dimensions	
Length	187 inches
Width	79 inches
Height	88 inches
Cab step to ground	17 inches
Ground to top of seat cushion	46 inches
Ground to back door strap	87 inches
Back bumper horizontal "depth"	13.5 inches
Floor to top of seatbelt latch	13 inches (angle) 11.5 inches (vertical)
Curb Weight	5,000 lb
Payload Weight	1,250 lb
Gross Vehicle Weight Rating	6,250 lb
Range (approximate)	40 miles
Emission Certification	ZEV
Battery Capacity	23 kWh

Section 3.2.1 provides an overview of the ECRV energy requirements, Section 3.2.2 summarizes the approach used to obtain the fleet miles driven. Section 3.2.3 includes a summary of the approach used to obtain electricity use and cost data, and to calculate the energy efficiency for the 500 vehicle ECRV fleet.

3.2.1 ECRV Energy Requirements

In the ECRV Life Cycle and Performance Evaluation report (RMA, 2001a), it was estimated that the energy use for an ECRV over a one week period amounts to about 65-80 kWh (Table 3-2). This includes the energy required for driving the vehicle and the energy required to maintain the battery. This assumes the vehicle is driven six days a week and left parked and connected to the Power Control System (PCS) unit on the seventh day. In developing these estimates it was assumed that it takes about two hours to charge the battery (at 20 amps, 4.2 kW) and about one hour for the charge to return to 1 kW or less (assuming an average current of 6 amps).
Table 3-2, shows that, over the course of a week, the electricity needed for vehicle and battery maintenance is about 12 to 24 kWh, which is approximately 18-30% of the total energy use.

TABLE 3-2 ESTIMATED WEEKLY ENERGY REQUIREMENTS (kWh) FOR ONE ECRV

	Energy (kWh)	Energy (Percent)
On-Peak Maintenance	1.4 - 5.6	2 - 7%
Off-Peak Maintenance	10 – 18	16 - 23%
Off-Peak Charge	55	70 - 82%
Total	**67 - 79**	**100%**

The numbers presented in Table 3-2 were found to be in reasonable agreement with the energy use measured at the electricity meter for a fleet of vehicles. The daily energy use and demand for the 28 vehicles at the Fountain Valley Post Office during June 2001 was is in the range 320 to 420 kWh on the six days that the ECRVs were driven, and about 50 to 80 kWh on the one day a week when the vehicles were not driven (Figure 3-1).

The peak power demand for a single ECRV on charge was found to range from about 3.6 kW to 4.3 kW. On Sundays, when the vehicles were not driven, the maximum power demand for a site with 28 vehicles was found be about 3 kW total.

FIGURE 3-1
FOUNTAIN VALLEY P.O.
DAILY ECRV ENERGY USE
24-HOUR INCREMENTS FROM 7 a.m. to 7 a.m.

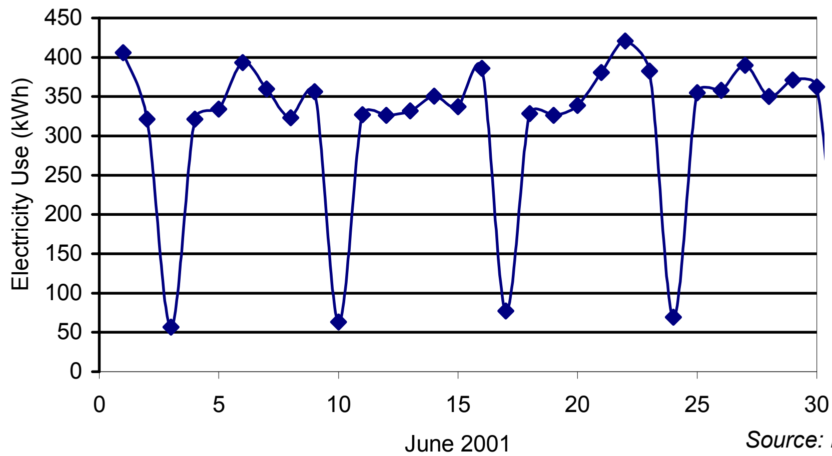


Chart 2
Source: Edison Amicos

On-peak and off-peak electricity use does not affect energy efficiency, but it can significantly affect costs. Following the charging procedure recommended by Ford, the vehicles are always connected to the PCS units (on-hook) when they are not being driven. This means that at all locations there will be at least some on-peak charging whenever they are not being driven. However, on-peak charging can also occur if the charging system timers are set incorrectly, or if the vehicle users press the “Charge-Now” feature on the PCS to activate charging at any time during on-peak hours.

Having the timers set for automatic adjustment for Daylight Savings can also help to avoid possible inadvertent on-peak charging when the clocks are set back an hour in the fall. This was an issue during the early period of vehicle deployment.

The Charge-Now button on the PCS overrides the timer so that the vehicle can be charged immediately. This feature may be used if an ECRV is brought in during the day with a low battery and the vehicle is needed for further mail deliveries or collections later the same day. However, having the Charge-Now button prominently placed on the PCS front panel makes it easy to activate this feature during the day, especially by someone who doesn’t know that it shouldn’t be used under normal circumstances.

Figure 3-2 shows the electricity demand for the Fountain Valley Post Office for three selected days during June, 2001. In Figure 3-2(a) the chart shows an "ideal charging scenario," where there is no increase in demand during the evening hours prior to when the off-peak rates begin. In Figures 3-2(b), and 3-2(c), there are distinct "shoulders" in the curve that show an increase in demand during the on-peak hours between 5:00 pm and 9:00 pm, indicative of vehicles being charged at that time.

With the present arrangement of the charging system timers at the Post Office locations, all vehicles at a site begin charging within a few minutes of each other. This results in a high power demand during the period soon after the onset of charging. The electricity use data indicate that the charging period for the site is limited to the first two or four hours after the timer activates battery pack charging. There is an opportunity to reduce the peak power demand by at least 50% by spreading the charging load over a longer period of time during the night. This is important for sites served by utilities that have a demand charge for off-peak energy use.

Based on previous studies (RMA, 2001a), some of the main observations from the ECRV program relevant to on-peak charging and minimizing electricity costs are as follows:

- The vehicle maintenance mode results in an inevitable need for electricity whenever the vehicle is on-hook. While the percentage of on-peak energy required is relatively low, it is proportionately higher at sites with short mail delivery routes.
- It is important to ensure the time clock for the charging system is set-up correctly to avoid on-peak charging. The times for on-peak and off-peak charging need to be reviewed for each utility when setting up the timer clocks.
- A relatively high on-peak demand will occur if the Charge-Now button is activated for one or more vehicles during the on-peak electricity hours. Modifying the accessibility of this feature would help to limit the amount of on-peak charging.
- For utilities that include an off-peak demand charge in the electricity bill, the demand could be significantly reduced by sequencing the chargers evenly throughout the off-peak period at night.

3.2.2 ECRV Miles Driven

To estimate the energy efficiency of the 500 vehicle ECRV fleet, vehicle miles driven were obtained for each site and for each Accounting Period (AP) from the Postal Service Vehicle Maintenance Accounting System (VMAS). The data were obtained for each site from deployment date through February, 2003. An AP is a four-week period used by the Postal Service for accounting purposes, and it is used as the basis for tracking vehicle operating and maintenance costs and utilization. The start and end dates for each AP from January 2001 through April 2003 are shown in Table 3-3.

Since the ECRVs were delivered in groups, the start dates are not exactly the same for all vehicles at each site. However, the total miles traveled, the number of vehicles, and the days used are all tracked in VMAS, so the data provide a reliable basis for estimating miles per day and average miles driven per vehicle.

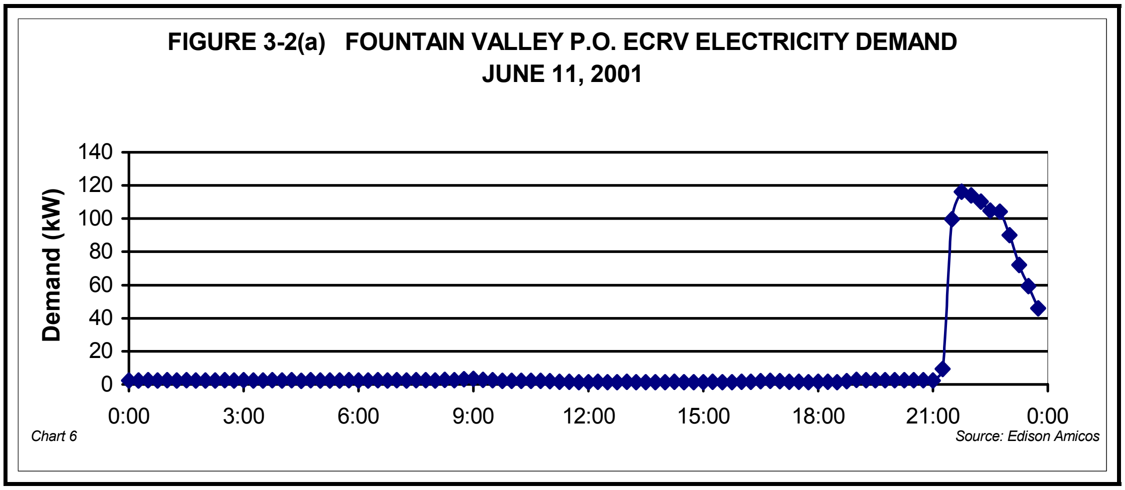


FIGURE 3-2(a) FOUNTAIN VALLEY P.O. ECRV ELECTRICITY DEMAND
JUNE 11, 2001
Demand (kW)
140
120
100
80
60
40
20
0
0:00
3:00
6:00
9:00
12:00
15:00
18:00
21:00
0:00
Chart 6
Source: Edison Amicos

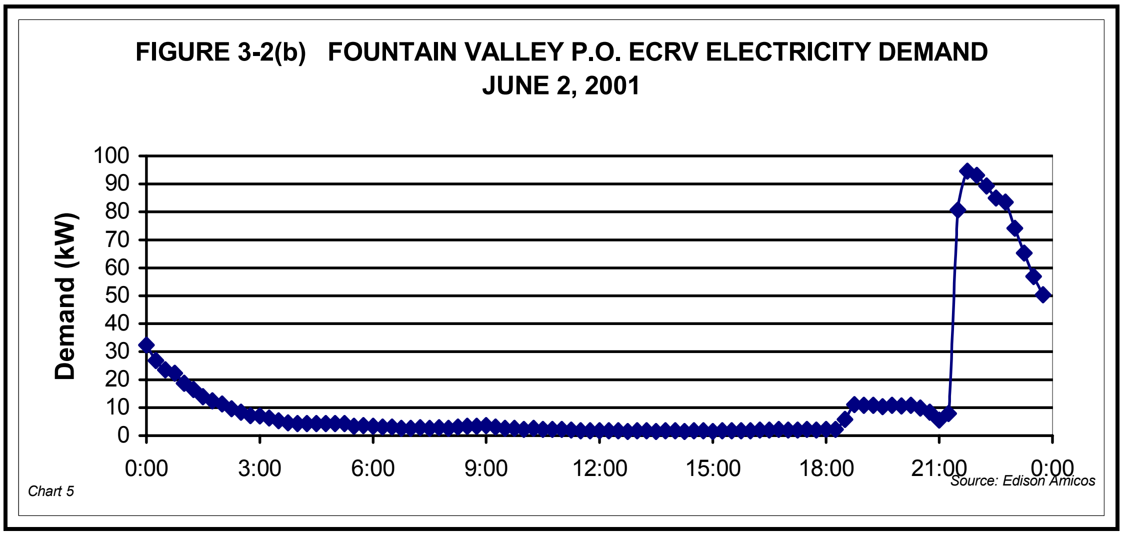


FIGURE 3-2(b) FOUNTAIN VALLEY P.O. ECRV ELECTRICITY DEMAND
JUNE 2, 2001
Demand (kW)
100
90
80
70
60
50
40
30
20
10
0
0:00
3:00
6:00
9:00
12:00
15:00
18:00
21:00
0:00
Chart 5
Source: Edison Amicos

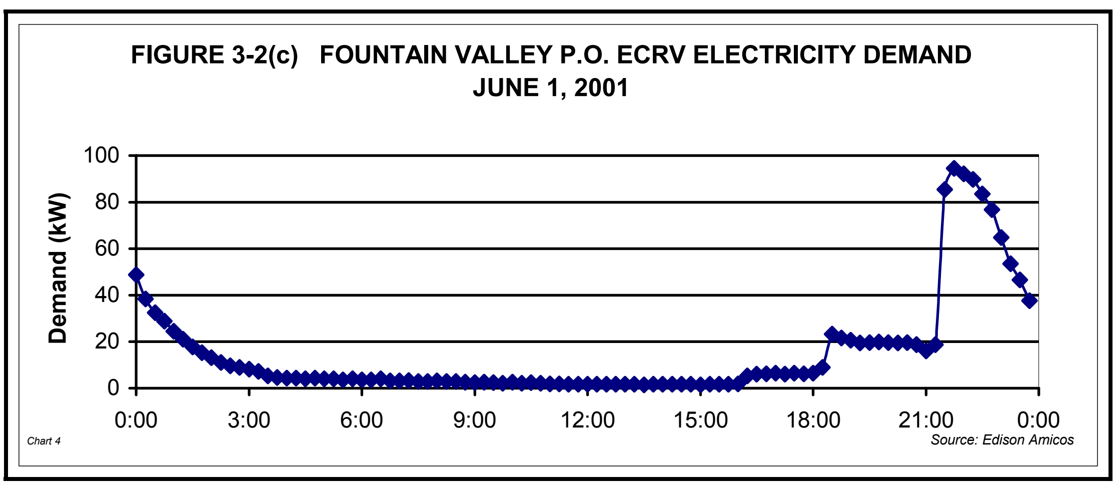


FIGURE 3-2(c) FOUNTAIN VALLEY P.O. ECRV ELECTRICITY DEMAND
JUNE 1, 2001
Demand (kW)
100
80
60
40
20
0
0:00
3:00
6:00
9:00
12:00
15:00
18:00
21:00
0:00
Chart 4
Source: Edison Amicos

TABLE 3-3 POSTAL SERVICE ACCOUNTING PERIODS

Fiscal Year	Accounting Period	Begin Date	End Date
FY01	05	12/30/00	1/26/01
	06	1/27/01	2/23/01
	07	2/24/01	3/23/01
	08	3/24/01	4/20/01
	09	4/21/01	5/18/01
	10	5/19/01	6/15/01
	11	6/16/01	7/13/01
	12	7/14/01	8/10/01
	13	8/11/01	9/7/01
FY02	01	9/8/01	10/5/01
	02	10/6/01	11/2/01
	03	11/3/01	11/30/01
	04	12/1/01	12/28/01
	05	12/29/01	1/25/02
	06	1/26/02	2/22/02
	07	2/23/02	3/22/02
	08	3/23/02	4/19/02
	09	4/20/02	5/17/02
	10	5/18/02	6/14/02
	11	6/15/02	7/12/02
	12	7/13/02	8/9/02
	13	8/10/02	9/6/02
FY03	01	9/7/02	10/4/02
	02	10/5/02	11/1/02
	03	11/2/02	11/29/02
	04	11/30/02	12/27/02
	05	12/28/02	1/24/03
	06	1/25/03	2/21/03
	07	2/22/03	3/21/03
	08	03/22/03	04/18/03
	09	4/19/03	5/16/03

The miles driven and days used for each Post Office are included in Section B.1 of Appendix B (Section B.1). The totals are summarized by site in Table 3-4, and by AP in Table 3-5. Average miles per day for the fleet are shown by site in Figure 3-3, and by AP in Figure 3-4.

TABLE 3-4 MILES DRIVEN AND DAYS USED – POST OFFICE TOTALS DEPLOYMENT THROUGH FY03, AP08

Station Name	Number of Vehicles	Sum of Days Assigned	Sum of Days Not Used	Sum of Days Used	Sum of Days In Shop	Sum of Miles Driven	Avg Miles/Day
Alameda Main PO	20	7,460	1,219	6,205	36	72,577	11.7
Bicentennial Station PO	57	18,914	4,303	14,216	581	10,8101	7.6
Blossom Hill Station PO	20	2,365	688	1,659	16	20,492	12.4
Bostonia Station PO	20	10,700	708	9,764	242	98,015	10.0
Costa Mesa Main PO	20	11,448	2,069	9,371	8	102,183	10.9
Covina Main PO	20	7,924	933	6,969	26	78,942	11.3
Dockweiler Station PO	39	24,492	2,633	21,818	41	178,362	8.2
El Monte Main PO	30	14,245	1,947	12,091	207	156,906	13.0
Fountain Valley PO	28	19,672	2,321	17,194	161	199,654	11.6
Glendora Main PO	20	8,420	1,882	6,512	26	90,203	13.9
Harbor City PO	5	2,555	145	2,410	0	22,878	9.5
Ida Jean Haxton PO	25	14,895	2,618	12,036	241	118,662	9.9
Irvine Harvest Station PO	24	13,968	1,309	12,457	204	151,265	12.1
La Mirada PO	15	7,665	1,244	6,310	111	63,711	10.1
Lamond Riggs PO	14	4,204	704	3,431	69	28,244	8.2
Linda Vista Station PO	22	11,650	794	10,659	197	99,454	9.3
Los Feliz Station PO	32	15,526	2,425	12,753	378	80,651	6.3
Norwalk PO	26	12,662	972	11,686	4	105,353	9.0
Rico Rivera PO	16	7,792	765	6,970	57	65,346	9.4
Royal Oaks Station PO	20	7,084	783	6,209	92	74,104	11.9
San Gabriel Main PO	20	8,860	921	7,938	1	65,492	8.3
White Plains PO	7	2,590	493	2,097	0	19,970	9.5
Totals	**500**	**235,091**	**31,876**	**200,755**	**2,698**	**2,000,565**	**10.0**

From a review of these figures and tables, it can be seen that the total distance driven by the fleet to date exceeds two million miles. The average miles per day (mpd) varies from a low of 6.3 mpd at Los Feliz to a high of 13.9 mpd at Glendora. The average for the 500-vehicle fleet is 10.0 mpd. From Figure 3-4, it can be seen that the average distance driven per day for the 500-vehicle fleet has been consistently between 9 mpd and 11 mpd since the end of Fiscal Year 2001. Prior to that, the miles per day average was higher. During the early period when the ECRVs were being deployed, the sample size was less. Also, the VMAS data (Appendix B.1) show that ECRVs are typically driven for longer distances during the first one or two months in service.

3.2.3 ECRV Electricity Use and Energy Efficiency

The electricity use for the ECRVs at the 22 Post Office locations was obtained from the electricity utilities during the period from deployment through March 2003. There are six utilities in California that have ECRVs in their service areas, and two utilities on the East Coast. The utilities and the list of ECRV sites served by each utility are shown in Table 3-6.

TABLE 3-5 MILES DRIVEN AND DAYS USED – ALL SITES

FY	AP	Number of Vehicles	Sum of Days Assigned	Sum of Days Not Used	Sum of Days Used	Sum of Days In Shop	Sum of Miles Driven	Average Miles/Day
2001	01	2	48	48	0	0	0	
	02	4	96	49	47	0	1,320	
	03	2	48	21	27	0	1,968	
	04	2	48	2	46	0	2	
	05	22	528	526	2	0	2	
	06	27	648	522	126	0	1,564	12.4
	07	30	856	369	487	0	7,687	15.8
	08	67	1,608	1,151	457	0	6,624	14.5
	09	82	1,968	961	1,007	0	14,134	14.0
	10	128	3,005	1,300	1,705	0	17,046	10.0
	11	136	3,182	1,098	1,870	214	21,512	11.5
	12	173	4,152	1,145	2,983	24	25,290	8.5
	13	198	4,616	897	3,715	4	39,760	10.7
2002	01	285	6,840	2,073	4,759	8	50,813	10.7
	02	301	6,984	1,499	5,441	44	54,078	9.9
	03	323	7,182	1,154	5,973	59	60,340	10.1
	04	343	7,930	1,125	6,777	28	68,120	10.1
	05	374	8,306	1,775	6,492	39	63,122	9.7
	06	397	9,139	1,530	7,567	42	79,486	10.5
	07	448	10,756	2,232	8,469	55	81,570	9.6
	08	454	10,900	1,722	9,096	82	95,489	10.5
	09	482	11,572	1,331	9,627	614	104,007	10.8
	10	478	11,006	1,164	9,789	53	95,046	9.7
	11	478	10,959	809	10,109	45	93,515	9.3
	12	478	11,426	622	10,753	47	105,971	10.0
	13	478	10,948	413	10,499	36	101,698	9.8
2003	01	478	11,472	384	11,073	15	115,319	10.6
	02	478	10,994	409	10,627	68	98,986	9.3
	03	478	10,516	323	10,141	132	91,562	9.0
	04	478	10,996	225	10,558	211	99,624	9.4
	05	498	10,956	300	10,576	80	98,157	9.3
	06	498	11,454	1,379	9,861	222	97,099	9.8
	07	498	11,952	1,494	10,181	315	108,577	10.8
	08	500	12,000	1,824	9,915	261	101,077	10.2
		500	**235,091**	**31,876**	**200,755**	**2,698**	**2,000,565**	**10.0**

FIGURE 3-3 ECRV AVERAGE DAILY MILES DRIVEN

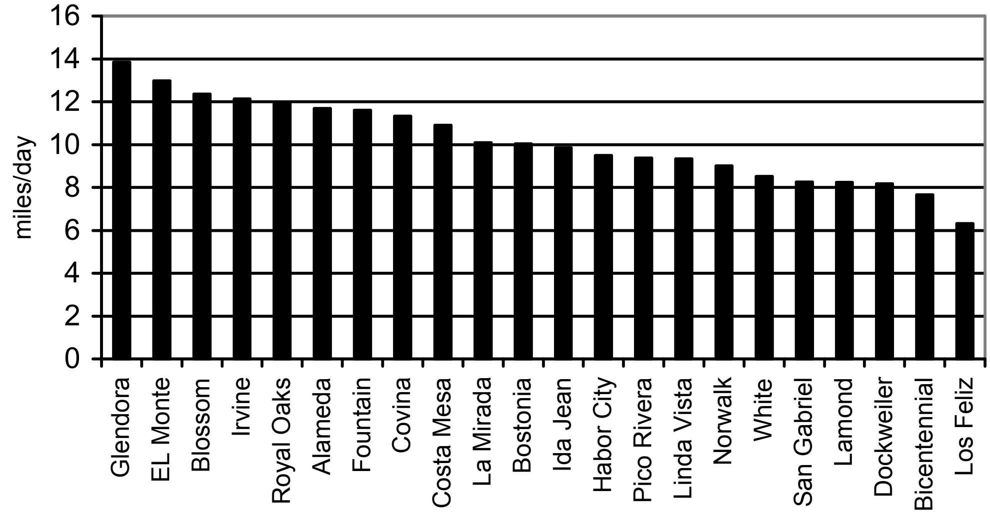


FIGURE 3-4 AVERAGE MILES PER DAY (ALL ECRVs)

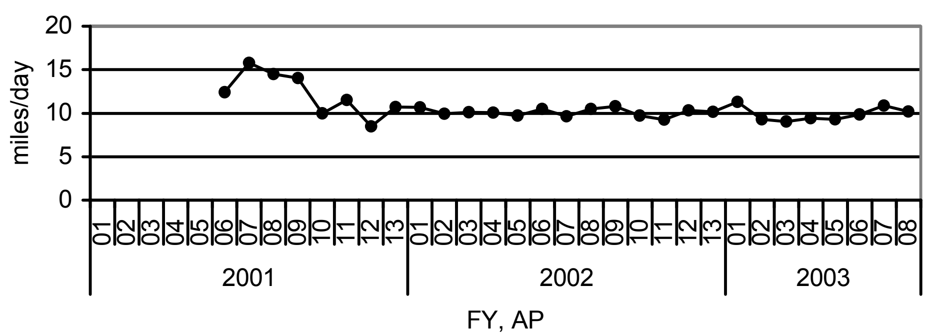


TABLE 3-6 LIST OF ELECTRIC UTILITIES FOR RESPECTIVE ECRV DEPLOYMENT LOCATIONS (AS OF APRIL 2003)

CALIFORNIA

Southern California Edison
- Costa Mesa Main P.O.
- Covina Main P.O.
- El Monte Main P.O.
- Fountain Valley P.O.
- Glendora Main P.O.
- Ida Jean Haxton Station P.O.
- Irvine Harvest Station P.O.
- La Mirada P.O.
- Norwalk P.O.
- Pico Rivera P.O.
- San Gabriel Main P.O.

Sacramento Municipal Utility District
- Royal Oaks Station P.O.

Los Angeles Department of Water and Power
- Bicentennial Station P.O.
- Dockweiler Station P.O.
- Harbor City P.O.
- Los Feliz Station P.O.

San Diego Gas and Electric
- Bostonia Station P.O.
- Linda Vista Station P.O.

Pacific Gas and Electric
- Blossom Hill Station P.O.

City of Alameda
- Alameda Main P.O.

WASHINGTON DC

Potomac Electric Power Company (PEPCO)
- Lamond Riggs P.O.

NEW YORK STATE

Consolidated Edison Company of New York (ConEdison)
- White Plains P.O.

The eight utilities were contacted and requested to provide monthly electricity use and cost data for the ECRV sites from deployment through February 2003. Electricity use data were available by month for all ECRV sites in California. For the Lamond Riggs Post Office, electricity data were not available by month. For the White Plains Post Office, no reliable electricity use data were available. Tables summarizing the electricity use data are included in Appendix B (Section B.2).

The cost data include facility charges, meter charges, demand charges, energy use charges, and any special energy cost charges. This was done to assure that the energy efficiency calculations accounted for all costs rather than just the electricity unit costs.

The electricity use totals are summarized for each site in Table 3-7, and by month in Table 3-8. In both these tables, the data are for the 20 sites in California and Lamond Riggs. The daily average electricity use (kiloWatt hours, kWh) is shown for the entire fleet in Figure 3-5. The average electricity use per vehicle per day is shown by month in Figure 3-6 and by site in Figure 3-7.

It should be noted that all daily average electricity use data presented in this report were calculated by dividing electricity use (kWh) by the number of days in the billing period, and then adjusting the result by a factor of 7/6 to account for the 6-day work week.

Figure 3-5 shows that, over the period from February 2001 through May 2002, the electricity use gradually increased as more ECRVs were placed in service. For most of the last year (March 2002 through February 2003), the average daily electricity use for the fleet was in the range 4,000-5,300 kWh. This equates to between 9 and 10.5 kWh per vehicle per day. For all California vehicles, the average daily use is 9.2 kWh per vehicle (Table 3-7).

TABLE 3-7 ELECTRICITY USE TOTALS FOR EACH POST OFFICE (FROM DEPLOYMENT THROUGH FEBRUARY 2003)

Post Office	Days	Total kWh	Daily Avg kWh	Bill $ Amount	Average Cost ($/kWh)	Number of Vehicles	KWh/day/ Vehicle
Alameda Main PO	422	78,360	217	$11,616	$0.15	20	10.8
Bicentennial Station PO	365	122,560	392	$16,119	$0.13	57	6.9
Blossom Hill Station PO	116	26,400	266	$3,909	$0.15	20	13.3
Bostonia Station PO	609	119,960	230	$23,587	$0.20	20	11.5
Costa Mesa Main PO	640	105,695	193	$23,638	$0.22	20	9.6
Covina Main PO	459	83,276	212	$11,332	$0.14	20	10.6
Dockweiler Station PO	810	213,920	308	$32,417	$0.15	39	7.9
El Monte Main PO	526	181,571	403	$31,423	$0.17	30	13.4
Fountain Valley PO	965	225,238	272	$39,708	$0.18	28	9.7
Glendora Main PO	497	87,197	205	$22,479	$0.26	20	10.2
Harbor City PO [1]	122	9,520	91	$2,695	$0.28	5	18.2
Ida Jean Haxton PO	703	127,112	211	$21,041	$0.17	25	8.4
Irvine Harvest Station PO	738	173,682	275	$26,510	$0.15	24	11.4
La Mirada PO	581	71,202	143	$12,783	$0.18	15	9.5
Lamond Riggs PO	246	44,320	210	$4,297	$0.10	14	10.5
Linda Vista Station PO	610	94,080	180	$20,746	$0.22	22	8.2
Los Feliz Station PO	599	126,480	246	$12,482	$0.10	32	7.7
Norwalk PO	549	100,865	214	$18,066	$0.18	26	8.2
Rico Rivera PO	568	68,141	140	$9,687	$0.14	16	8.7
Royal Oaks Station PO	419	83,240	232	$13,906	$0.17	20	11.6
San Gabriel Main PO	491	78,565	187	$19,179	$0.24	20	9.3
All Sites - Total		**2,221,384**	**235**	**$371,615**	**$0.17**	**500**	**9.5**

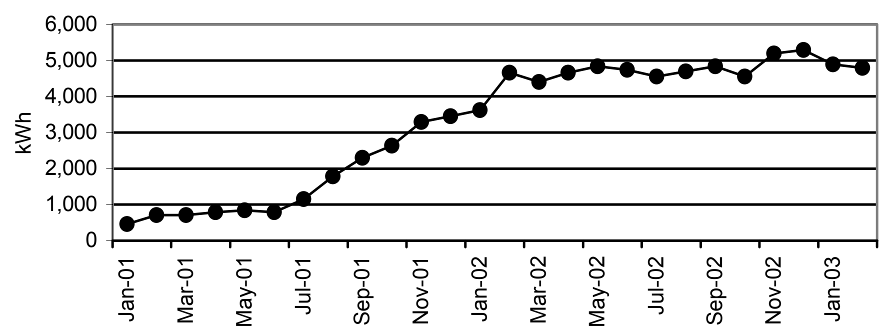
Note: No data were available for White Plains.

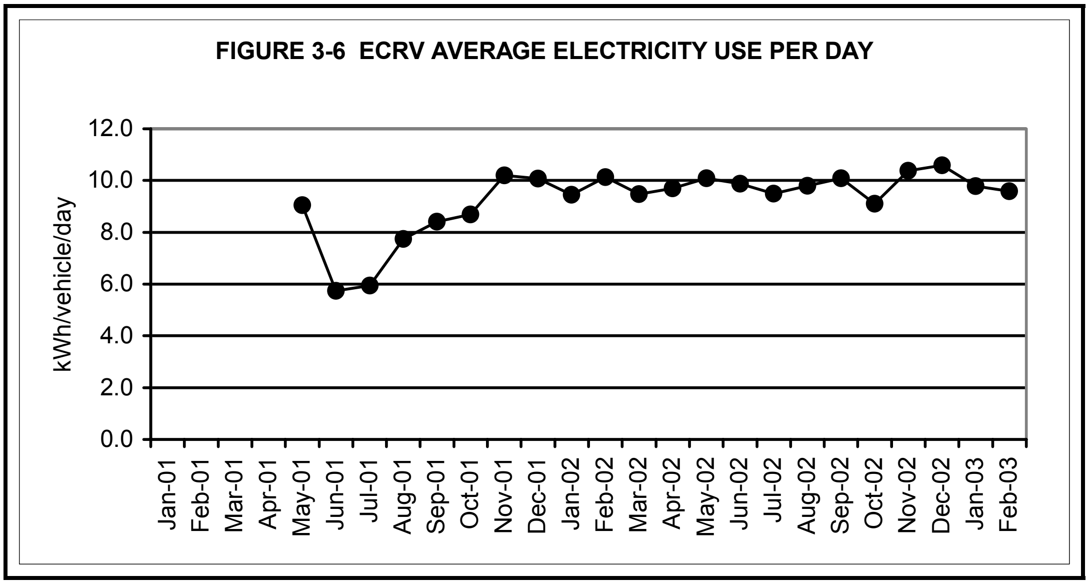
[1] For Harbor City, the kWh/day/vehicle total is for the last four billing periods. (Prior to that, electricity use includes that for the 12 Chrysler EPIC electric vehicles also.

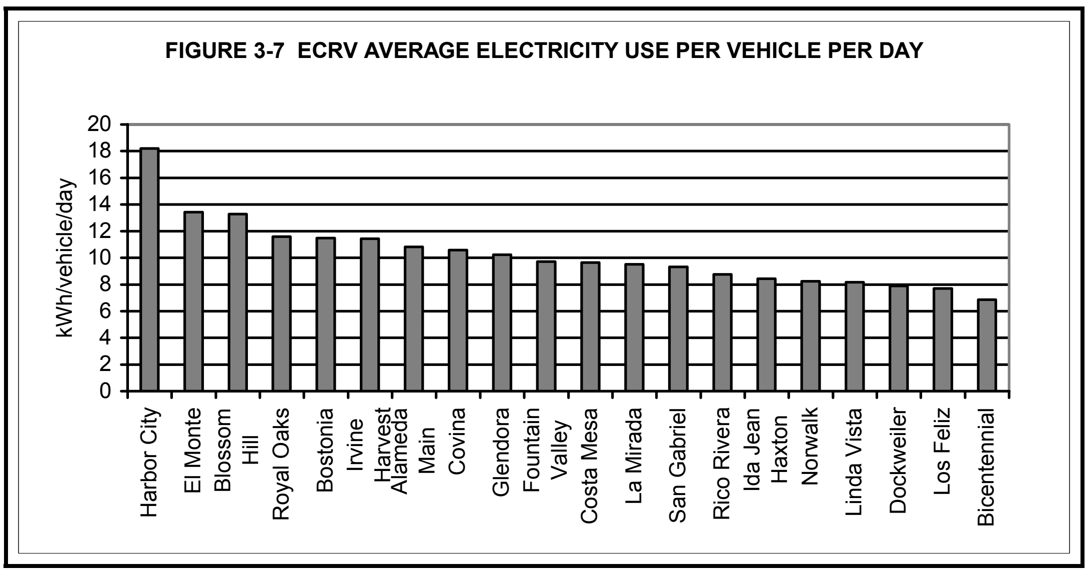
TABLE 3-8 ELECTRICITY USE TOTALS BY MONTH (JANUARY 2001 THROUGH FEBRUARY 2003)

Month	Days	Total kWh	Daily Avg kWh	Bill $ Amount	Average Cost ($/kWh)	Vehicles Deployed	kWh/day /Vehicle
Jan-01	31	12278	462	$1,785	$0.15	28	
Feb-01	28	16972	707	$2,476	$0.15	28	
Mar-01	31	18943	713	$2,763	$0.15	28	
Apr-01	30	20310	790	$3,011	$0.15	68	
May-01	31	22346	841	$3,274	$0.15	93	9.0
Jun-01	30	20212	786	$4,515	$0.22	137	5.7
Jul-01	31	30620	1152	$6,108	$0.20	194	5.9
Aug-01	31	47514	1788	$9,569	$0.20	231	7.7
Sep-01	30	59049	2296	$11,777	$0.20	273	8.4
Oct-01	31	69934	2632	$11,190	$0.16	303	8.7
Nov-01	30	84694	3294	$12,610	$0.15	323	10.2
Dec-01	31	91792	3455	$14,110	$0.15	343	10.1
Jan-02	31	96216	3621	$15,419	$0.16	383	9.5
Feb-02	28	111873	4661	$22,474	$0.17	460	10.1
Mar-02	31	117086	4406	$19,650	$0.16	465	9.5
Apr-02	30	119755	4657	$17,660	$0.16	480	9.7
May-02	31	128633	4841	$25,121	$0.21	480	10.1
Jun-02	30	121862	4739	$22,644	$0.19	480	9.9
Jul-02	31	120990	4553	$23,239	$0.19	480	9.5
Aug-02	31	124872	4699	$23,930	$0.19	480	9.8
Sep-02	30	124436	4839	$22,624	$0.18	480	10.1
Oct-02	31	120919	4551	$19,177	$0.16	500	9.1
Nov-02	30	133482	5191	$19,260	$0.14	500	10.4
Dec-02	31	140570	5290	$20,492	$0.15	500	10.6
Jan-03	31	129905	4889	$19,761	$0.15	500	9.8
Feb-03	31	127425	4796	$19,656	$0.15	500	9.6

FIGURE 3-5
ECRV DAILY AVERAGE ELECTRICITY USE
ALL VEHICLES, ALL SITES







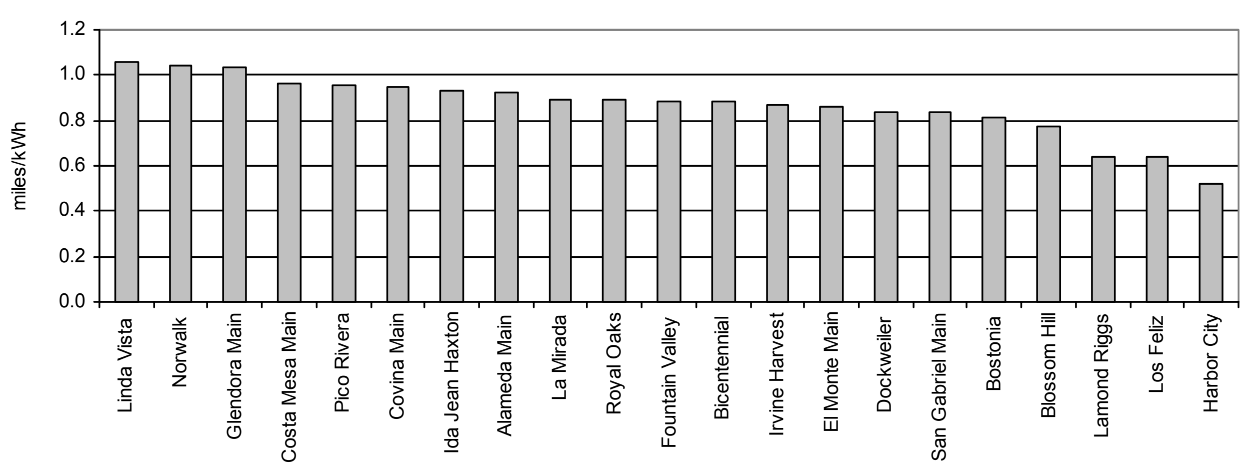
Using the data presented above for vehicle miles driven and electricity used, estimates of energy efficiency were developed (miles per kWh). The results are shown in Table 3-9, and Figure 3-8 (by site) and Figure 3-9 (by month). With the exception of Lamond Riggs, Los Feliz and Harbor City, all sites show energy efficiency in the range 0.8 miles per kWh to just over 1.0 miles per kWh, with an average of 0.85 miles/kWh for the fleet. This compares with an estimate of 0.87 miles per kWh which was derived in the performance evaluation using the first few months of data at three sites (RMA, 2001a). Plotting the average energy efficiency data against average miles per day for each site suggests that energy efficiency improves by about 10-15% as the distance driven increases from 7 to 14 miles per day (Figure 3-10).

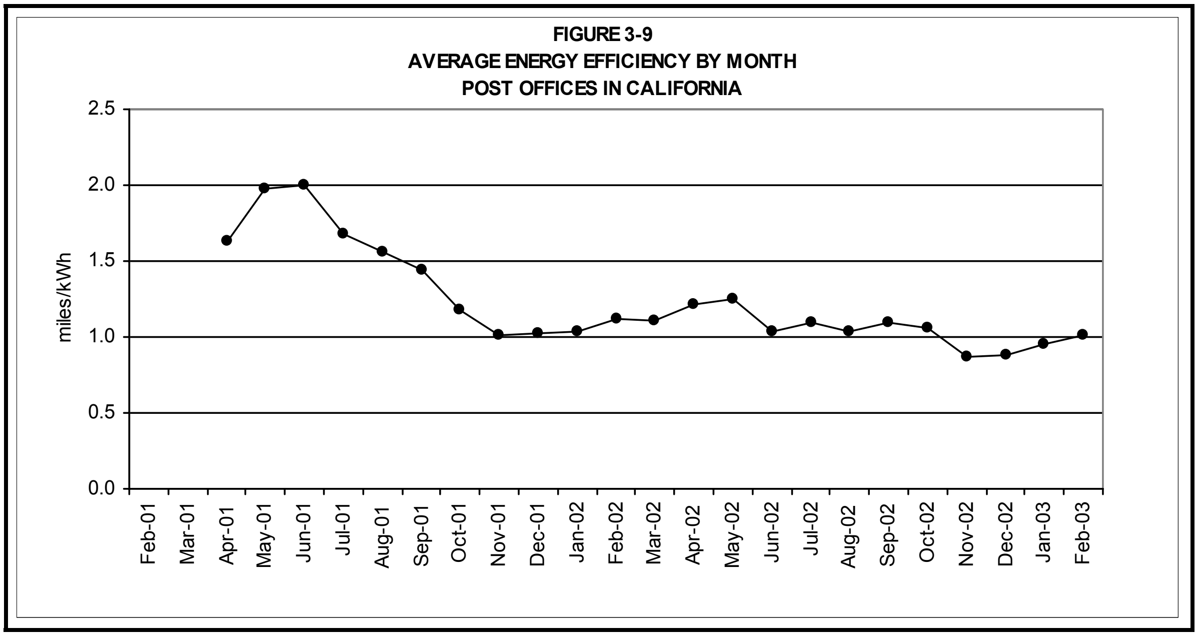
TABLE 3-9 ECRV ENERGY EFFICIENCY

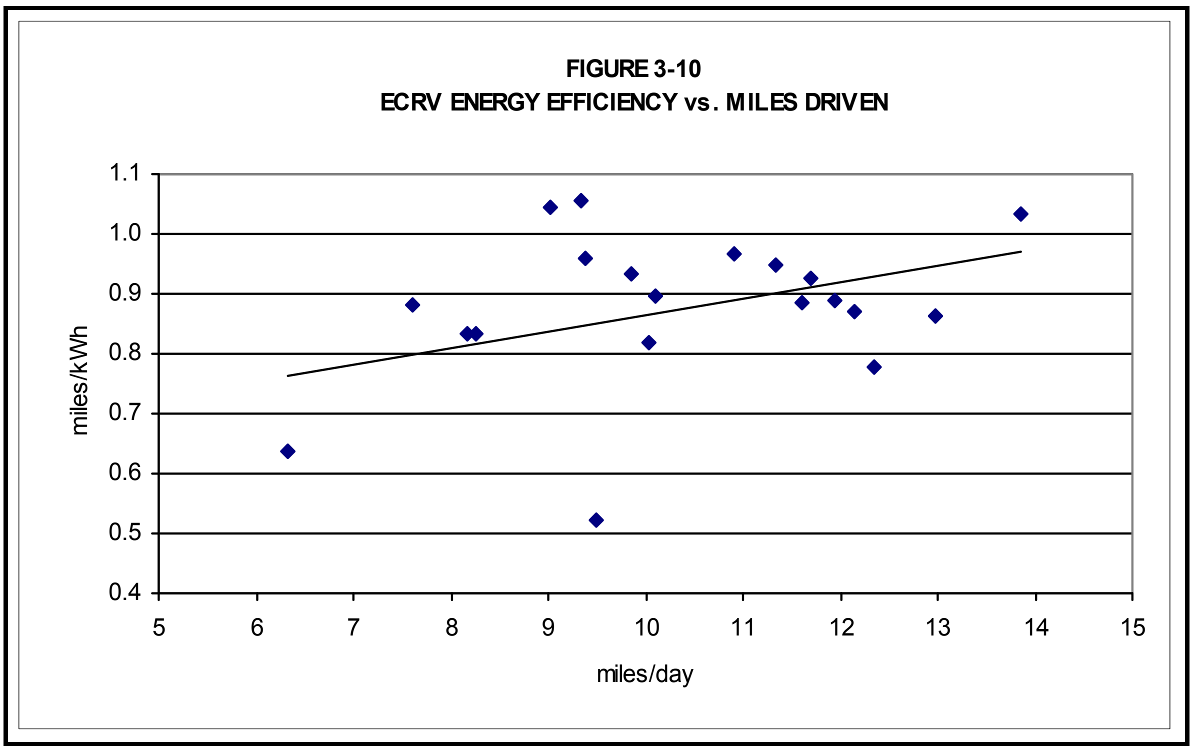
Read Date	Number of Vehicles	Vehicle Days Used	Sum of Miles Driven	Total kWh	Miles/kWh	Miles/Day
Alameda Main	20	6,205	72,577	78,360	0.93	11.7
Bicentennial Station	57	14,216	108,101	122,560	0.88	7.6
Blossom Hill Station	20	1,659	20,492	26,400	0.78	12.4
Bostonia Station	20	9,764	98,015	119,960	0.82	10.0
Costa Mesa Main	20	9,371	102,183	105,695	0.97	10.9
Covina Main	20	6,969	78,942	83,276	0.95	11.3
Dockweiler Station	39	21,818	178,362	213,920	0.83	8.2
El Monte Main	30	12,091	156,906	181,571	0.86	13.0
Fountain Valley	28	17,194	199,654	225,238	0.89	11.6
Glendora Main	20	6,512	90,203	87,197	1.03	13.9
Harbor City [1]	5	517	4,867	9,520	0.52	9.4
Ida Jean Haxton Station	25	12,036	118,662	127,112	0.93	9.9
Irvine Harvest Station	24	12,457	151,265	173,682	0.87	12.1
Lamond Riggs	14	3,431	28,244	44,320	0.64	8.2
La Mirada	15	6,310	63,711	71,202	0.89	10.1
Linda Vista Station	22	10,659	99,454	94,080	1.06	9.3
Los Feliz Station	32	12,753	80,651	126,480	0.64	6.3
Norwalk	26	11,686	105,353	100,865	1.04	9.0
Pico Rivera	16	6,970	65,346	68,141	0.96	9.4
Royal Oaks Station	20	6,209	74,104	83,240	0.89	11.9
San Gabriel Main	20	7,938	65,492	78,565	0.83	8.3
All Sites - Total	**493**	**196,765**	**1,962,584**	**2,221,384**	**0.88**	**10.0**

[1] Data for Harbor City are for December 2002 through March 2003.

FIGURE 3-8 ECRV ENERGY EFFICIENCY







The average cost of electricity ($/kWh) for each site is shown in Figure 3-11. The data shown in this figure and in Table 3-7 indicate that the average cost of electricity for sites in California ranges from less than $0.15c per kWh to more than $0.25c per kWh. This wide range is likely due to the availability of favorable utility rates at some sites (low cost per kWh), and a relatively high use of on-peak electricity at other sites (high cost per kWh). Further analysis of the data would be needed to provide a more explicit explanation of the differences. The average for all sites and all vehicles is $0.17c per kWh (Table 3-7). (For the Life Cycle cost analysis, a value of $0.14 per kWh was used for the electricity cost (RMA, 2001a)). It is likely that the average electricity cost could be decreased if the charging practices were optimized at all sites to minimize use of on-peak electricity.

The monthly cost for electricity at all sites in California is shown in Figure 3-12. This figure shows that, with all vehicles in operation (April 2002 through February 2003), the monthly cost of electricity for all sites in California (479 vehicles) was on the order of $20,000 to $25,000. From this limited duration of data, there is some indication of an increase in the monthly electricity cost in summer, which would be expected given that most of the utilities have higher rates during the summer months, especially for on-peak electricity use. Insufficient data were available for the Lamond Riggs and White Plains Post Offices to evaluate whether the colder ambient temperatures have any adverse affect on the ECRV energy efficiency at those sites.

FIGURE 3-11
AVERAGE COST OF ELECTRICITY - POST OFFICES IN CALIFORNIA

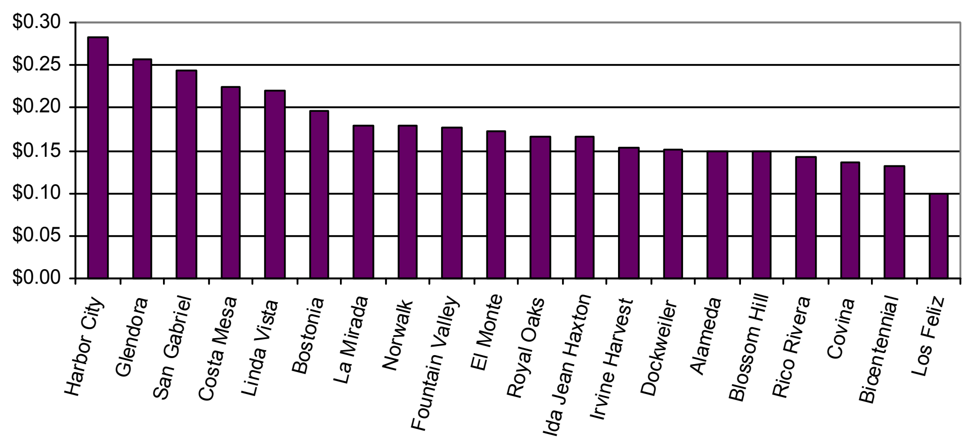
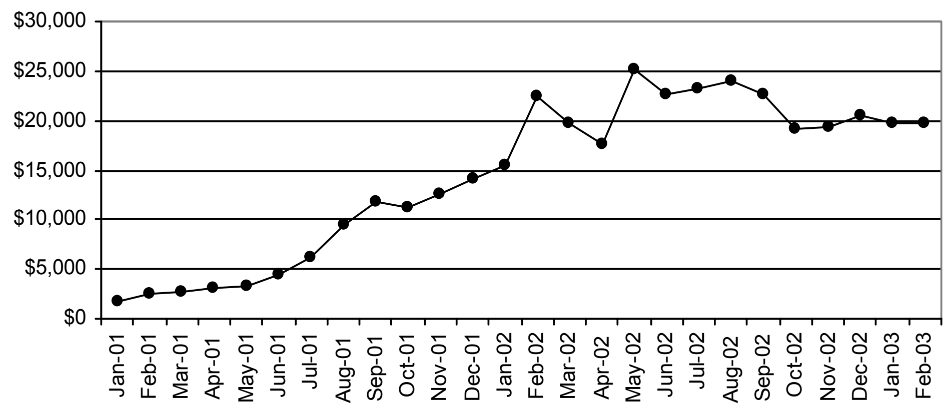


FIGURE 3-12
MONTHLY COST FOR ELECTRICITY - CALIFORNIA POST OFFICES



3.2.4 Air Emission Reductions

Estimates of air emission reductions for the ECRV deployment were developed by assuming the ECRVs are Zero Emission Vehicles, and the level of emission reductions would be based on the emissions of the vehicles being displaced. Though there were some Carrier Route Vehicle transfers at the Post Offices to accommodate the ECRVs, the vehicles which were retired from service were the Postal Service AMG Jeeps with Model Year 1978-1983. The emission estimates were not adjusted to account for any power plant emissions associated with electricity generation.

Emissions associated with the AMG Jeeps were estimated using the EMFAC2002 program available from the California Air Resources Board. Details of this program are available in the EMFAC Users Guide (CARB, 2003a). A 1983 vehicle model year was assumed, with emission factors for the South Coast Air Quality Management District. Emission Factors were obtained for running emissions, cold starts, hot starts, hot soak, diurnal evaporation and running losses (Table 3-10). An average vehicle speed of 20 mph was used, and it was assumed there would be 10 hot starts, and 1 cold start each day.

TABLE 3-10 EMISSIONS FACTORS USED FOR 1983 AMG JEEP

Running Emissions	Carbon Monoxide(CO)	25.668 g/mi
	Reactive Organic Compounds (ROC)	0.982 g/mi
	Oxides of Nitrogen ($NO_{x)}$)	2.832 g/mi
Cold Start Emissions	CO	45.148 g/trip
	ROC	3.426 g/trip
	NO_x	1.383 g/trip
Hot Start Emissions	CO	4.263 g/trip
	ROC	0.313 g/trip
	NO_x	0.351 g/trip
Hot Soak Emissions	ROC	0.582 g/trip
Diurnal Evaporation Emissions [1]	ROC	1.38 g/day
Running Losses [2]	ROC	6.84 g/day

Source: California Air Resources Board, EMFAC2002
Notes: [1] Assumes 12 hours of diurnal losses; [2] Assumes one hour of driving per day.

Total emission reductions for the period from deployment to date were estimated using the total vehicle miles and days used for each Air District. The emissions were also pro-rated by calendar year based on the number of miles driven in each Air District each year. The results are presented in Table 3-11.

TABLE 3-11 ESTIMATE OF EMISSION REDUCTIONS

		BAAQMD	SCAQMD	SDCAPCD	SMAQMD	Other	Total
Number of Vehicles		40	377	42	20	21	500
Miles Driven		108,257	1,587,709	197,469	74,104	69,827	2,037,366
Days Used		8,304	160,731	20,423	6,209	5,530	201,197
Total Emission Reductions (pounds)	CO	7,733	120,950	15,127	5,395	5,022	154,226
	ROC	516	8,879	1,119	371	338	11,223
	NO_x	765	11,647	1,453	530	496	14,891
2001 Emission Reductions (pounds)	CO	0	29,369	3,782	635	0	33,930
	ROC	0	2,156	280	44	0	2,469
	NOX	0	2,828	363	62	0	3,276
2002 Emission Reductions (pounds)	CO	5,422	73,147	9,076	3,808	3,863	95,620
	ROC	361	5,370	671	262	260	6,958
	NOX	537	7,044	872	374	381	9,232
2003 Emission Reductions (pounds)	CO	2,311	18,434	2,269	952	1,159	24,676
	ROC	154	1,353	168	65	78	1,796
	NOX	229	1,775	218	93	114	2,383

Notes
Vehicle miles driven and days used obtained from Postal Service VMAS data.
BAAQMD = Bay Area Air Quality Management District
SCAQMD = South Coast Air Quality Management District
SDCAPCD = San Diego County Air Pollution Control District
SMAQMD = Sacramento Metropolitan Air Quality Management District
Other = Lamond Riggs and White Plains Post Offices

3.3 MAINTENANCE AND REPAIR

During the time the ECRVs have been in service, over a thousand warranty repairs have been completed by Ford. While the Postal Service Vehicle Maintenance Facilities (VMFs) have conducted some repairs on the ECRVs, these have mostly been body and cab repairs, tire and wheel repairs, and for lighting (changing bulbs). The repairs have been made by the VMFs when needed to keep vehicles in service (personnel communication with Gerard Koontz, Huntington Beach VMF, May 2, 2003).

Most of the information in this section is based on analysis of the ECRV Concern Reports (CRs) that Ford has been using to document ECRV incidents and repairs. A detailed listing of the CRs was obtained from Ford in the form of a log (see Appendix C). Ford also provided the actual Concern Reports for battery module and pack repairs. Additional information and explanation of the data on warranty repairs was provided directly by Ford staff involved in maintaining the ECRVs in the field (personal communication with Ken Stwertnik, April 25, 2003).

Figure 3-13 presents a summary of the ECRV warranty repairs showing the incident categories used by Ford and the number of Concern Reports issued for each type of repair. An explanation of the repair categories is included in Table 3-12. It can be seen that, apart from clear codes and miscellaneous non-electrical repairs, the categories that have occurred most frequently are the 12-volt components (28 %) and battery modules (18 %). These two repair categories have considerably more incidents than the remaining categories. Incidents in the battery module category include battery module and pack replacements.

FIGURE 3-13
NUMBERS OF ECRV CONCERN REPORTS BY CATEGORY
(Excluding Pre-Delivery CRs)

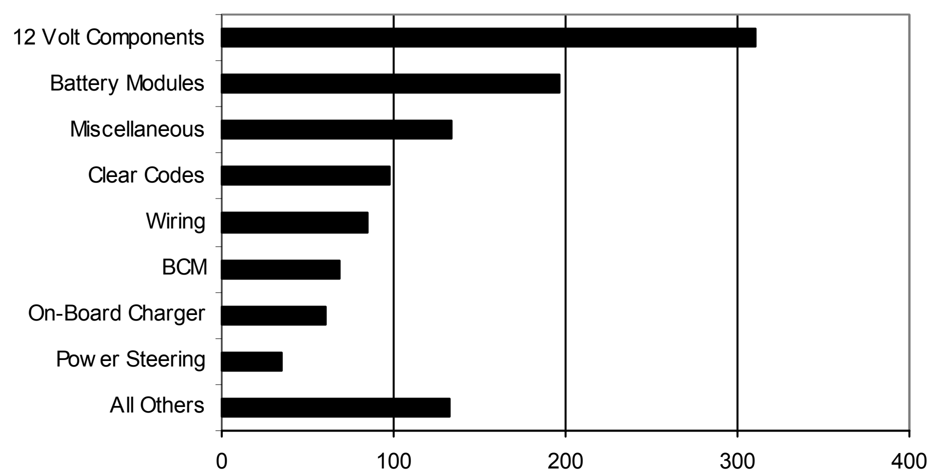


TABLE 3-12 EXPLANATION OF CONCERN REPORT CATEGORIES (FORD MOTOR COMPANY)

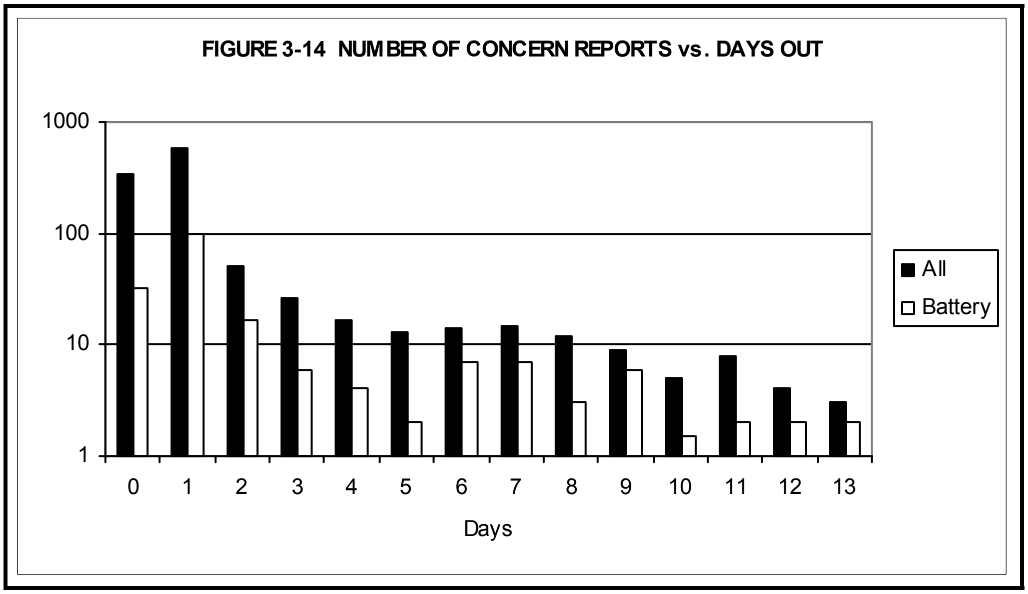
- **Clear Codes:** Clear codes are used when the technician could not identify a specific vehicle problem. This call is usually in response to the vehicle malfunction (wrench) warning light being on, or that the vehicle did not recharge.
- **Auxiliary Battery:** The auxiliary battery is a 12-volt battery that provides power for the network system on the vehicle and normal automotive functions. It is charged via the DC to DC converter. The EV puts a greater usage on this battery than a typical gasoline vehicle so it is more prone to failure. When voltage is below 11.5 volts the vehicle will not charge or start.
- **BCM:** The Battery Control Module (BCM) manages the battery pack and charging process. Problems with the BCM are related to vehicle range and charging. The driver is notified of a problem when warning light(s) are on.
- **Battery Modules:** There are 39 battery modules in the battery pack. Failure of just one module will reduce range and/or not allow the vehicle to be driven. As more miles are accumulated on the modules, the greater the potential for range reduction. Most repairs are related to decreased vehicle range caused by worn module(s).
- **On-Board Charger:** This component charges the battery pack as directed by the BCM. Failure results in the vehicle not being recharged.
- **Contactor Box:** This component is controlled by the BCM and opens and closes various high voltage circuits. Failure results in the wrench (malfunction) warning light turning on and/or the loss of power steering, charging, heater, and/or vehicle operation.
- **Charger Inlet:** This component provides the connector for the Power Control System (PCS) and supplies wall current to the On-Board Charger. Failure results in loss of charging.

TABLE 3-12 EXPLANATION OF CONCERN REPORT CATEGORIES (FORD MOTOR COMPANY) (CONTINUED)

- **Heater Components:** This category covers the Heater Switching Module and the heater core resistors. Failure may be indicated by warning light(s) being on and/or loss of power steering, charging and heater function.
- **12-Volt Components:** Most failures have been with the side brake lights, horn contact "clock-spring", headlamp switch, and ignition switch.
- **Power Steering:** The power steering unit is unique to this vehicle. Failure results in loss of power steering and possible failure of the contactor box.
- **TIM/Motor/Transaxle:** The Traction Inverter Module (TIM) and Motor/Transaxle assembly are connected and together provide power to the rear wheels. Failure of these components may result in turning on warning light(s), and/or a loss of power.
- **Wiring Harness/Misc:** This category covers blown fuses, connector pin problems, and/or wiring defects. Most of the failures are blown fuses related to vehicle complexity.
- **Vacuum Pump:** This component supplies vacuum for the power brake booster and for the climate control system. Most replacements are due to a noisy pump.
- **Non Electrical/Misc:** This category covers all other systems steering and brakes. The majority of failures have been broken guide pins in the parking brake handle.

One reason why the number of incidents for 12-volt components is high is that this category includes the water pump, a component that has experienced recurring problems. In April 2003, Ford committed to replacing all ECRV water pumps (Ken Stwertnik, April 25, 2003). Ford indicated that a number of 12-volt failures were due to the higher usage of parts (such as the ignition switch) on an electric vehicle than compared with a comparable internal combustion engine vehicle.

Figure 3-14 is a histogram showing the number of incidents and the time taken to complete the repairs ("days out"). (Note that a logarithmic scale is used in this figure.) The data for "all CRs" are included in this figure together with the battery module data. While the overall profile shows a tail distribution with the number of incidents decreasing with time needed for repair, the battery module profile shows a bimodal distribution with a peak at one day, and a secondary peak at 6-8 days. The two peaks are likely associated with the module repairs and the pack replacements Not shown in this figure are the 15 CRs that took longer than 14 days or more, including seven for battery repairs, and four for 12-volt component repairs.



Note: logarithmic scale on y axis

The number of CR incidents per month from February 2001 through March 2003 is shown in Figure 3-15. The total number per month increased through 2002 as all ECRVs were phased into service. The number of CR incidents per vehicle per month is shown in Figure 3-16. Based on this data, it appears that the frequency of incidents increased through late 2002, with an average repair frequency for the ECRV fleet to date of 0.12 per vehicle per month (1.47 repairs per vehicle per year).

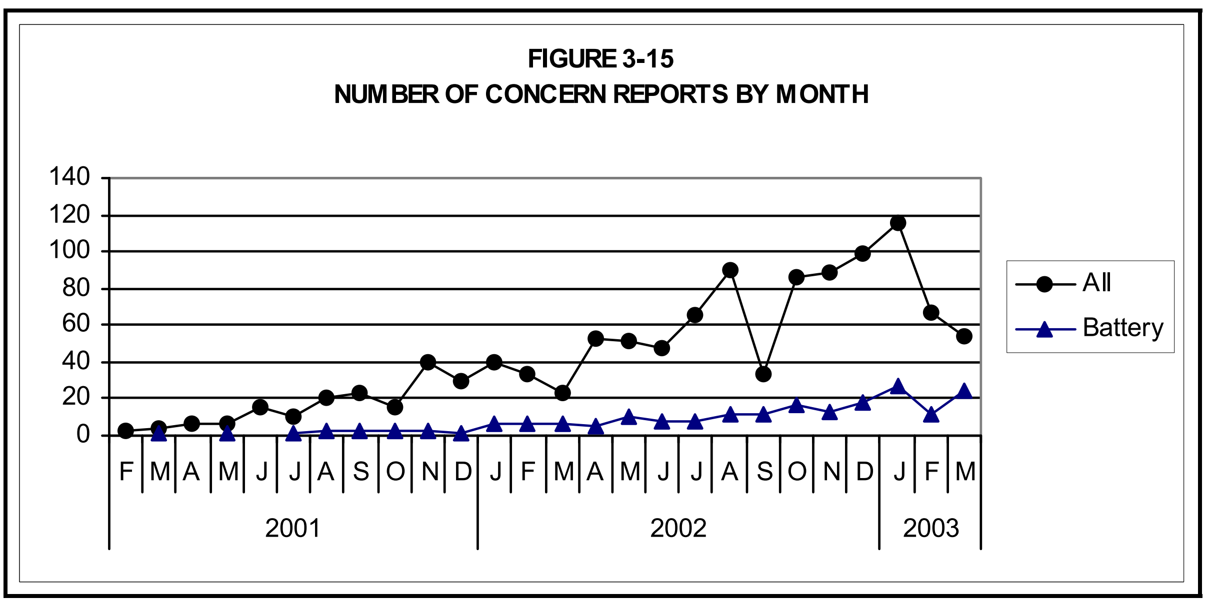
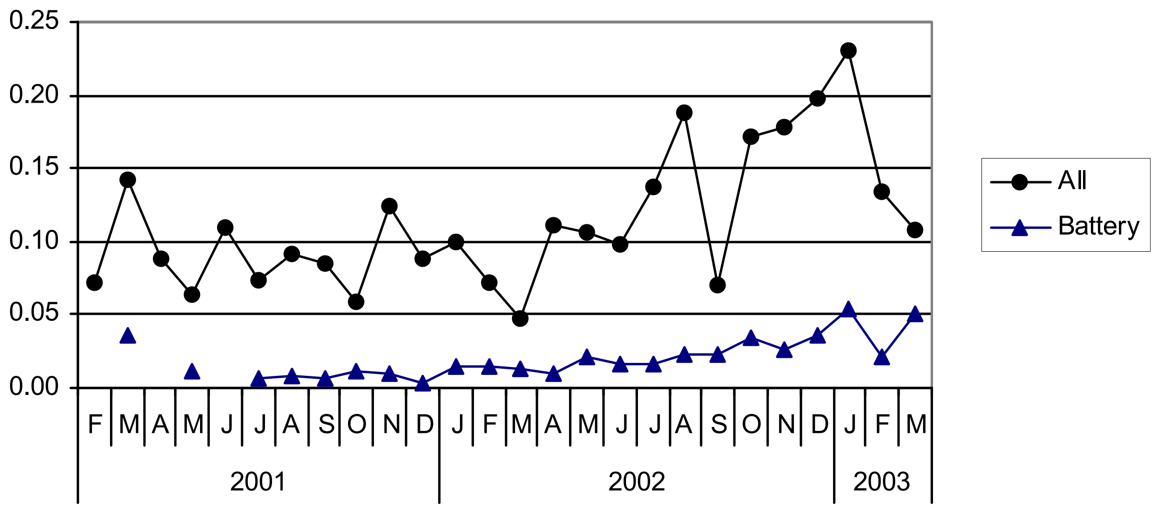


FIGURE 3-16
NUMBER OF CONCERN REPORTS PER VEHICLE PER MONTH



Based upon the information included in the CR logs and from discussions with Ford personnel, RMA developed independent estimates of the time taken (labor hours) to complete each type of repair. In most cases, it was assumed that the actual time to accomplish the repair would be on the order of an hour or less. However, it was assumed that a service technician would need time to travel to the ECRV in the field and/or to bring the ECRV into the shop, so even for the simplest kinds of repair the minimum labor time required was assumed to be three (3) hours.

The two repair categories that have consistently needed more time to complete are the battery module repairs, and some of the wiring harness repairs. For a technician to investigate battery module incidents, it is often necessary to completely discharge the battery prior to diagnosis, and this may require the vehicle to be driven for several hours. For these types of repair, the CR data indicate that the time between the initiation of the repair and the date of completion is often many days (three days on average, with 12% taking more than a week). In the case of extended repairs, for at least some of this time, the service technician could be waiting for parts or a replacement battery. For this analysis it was assumed that battery module repairs take 10 hours of technician time and battery pack repairs 24 hours.

Some of the wiring harness repairs have been especially challenging because of the complexity of the wiring system in the ECRV. Engineering assistance is frequently needed, and it may take many hours of mechanic time to complete this type of repair (personal communication, Ken Stwertnik with Ivor John. April 25, 2003). It was assumed that the labor time for wiring harness repairs would be 14 hours on average, based on information from Ford.

Using the above assumptions, estimates were developed for the total labor hours and the total labor hours per month per vehicle to complete the ECRV repairs. The calculations were made for all repair categories, and for battery modules separately as this category has dominated the need for technician repair time. The monthly labor totals and the labor totals per vehicle per month are shown in Figures 3-17 and 3-18, respectively. These figures show that, since mid-2001, the time needed for maintenance has increased steadily. The average labor time for all repairs has increased from about 0.3 to over 1.1 hours per vehicle per month, and the average labor time for battery repairs has increased from 0.1 to more than 0.6 hours per vehicle per month during the same period. The average time spent for all repairs was about 0.7 hours per vehicle per month.

FIGURE 3-17
TOTAL LABOR TIME FOR REPAIRS

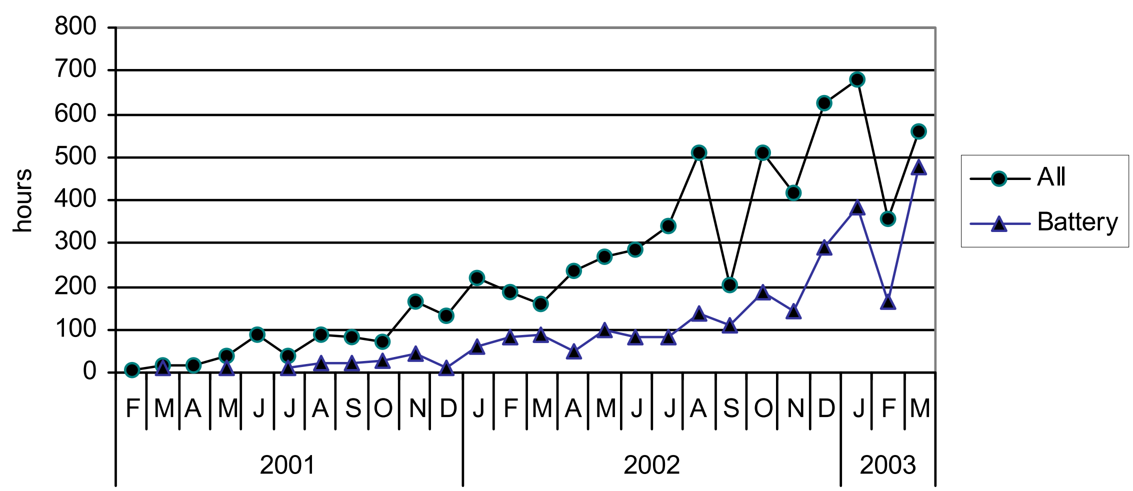
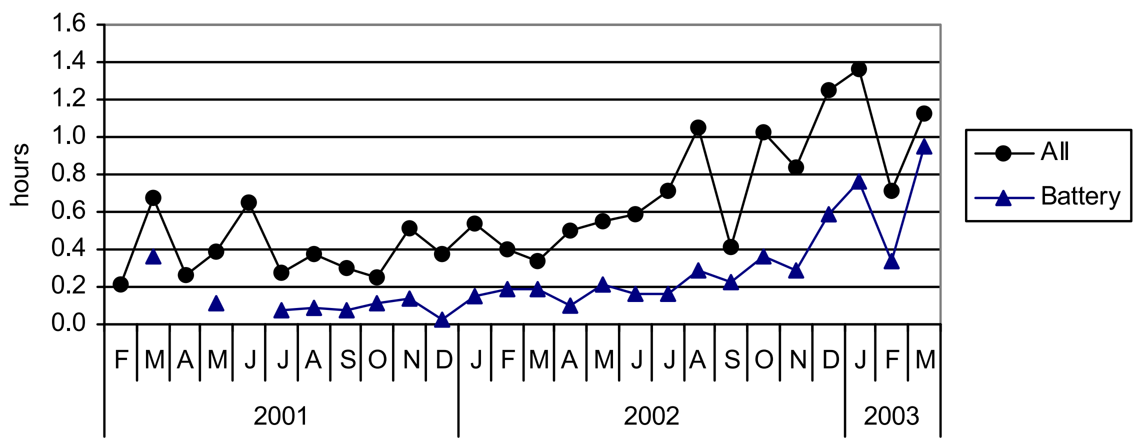


FIGURE 3-18
AVERAGE LABOR TIME FOR REPAIRS PER VEHICLE



It is important to emphasize that these estimates are based on information provided by Ford for warranty repairs. At the end of the warranty, the time taken by Postal Service mechanics and the types of repairs may well vary from these estimates. Also, this analysis provides no information on the cost of parts needed to complete these repairs.

In addition to the Ford Concern Reports, the Postal Service VMAS data for the ECRVs were obtained to investigate the types of repairs the Postal Service mechanics have been involved with, and the typical costs incurred through the warranty period to date. This was done for a sample of the ECRVs at the eight Post Offices served by the Huntington Beach and La Puente VMFs. Brief phone interviews were also conducted with a small number of VMF personnel. The results are presented in Table 3-13. The data in this table confirm that, apart from the “all others” component category, very little time has been spent by the VMFs on the ECRVs, and this has been mostly for work on cab and body repairs (12.2%), tire repairs and replacements (8.6%), wheels (2.4%) and lighting (2.5%). All VMF repairs (including the “all other” category) have incurred an average cost (for parts and labor) of approximately $400 per vehicle since deployment (or about $200 per vehicle per year).

TABLE 3-13 SUMMARY OF VMAS DATA COMPONENT COSTS FOR ECRVS (HUNTINGTON BEACH AND LA PUENTE VMFs)

Component Category	Total Cost (Parts and Labor	Percent
Heating	$680	0.9%
Cab Body	$9,233	12.2%
Instrument Gauges	$48	0.1%
Brakes	$577	0.8%
Suspension	$379	0.5%
Tires	$6,499	8.6%
Wheels	$1,847	2.4%
Front axle	$92	0.1%
Rear axle	$32	0.04%
Transmission	$38	0.1%
Charging System	$30	0.0%
Cranking System	$352	0.5%
Ignition System	$364	0.5%
Lighting System	$1,855	2.5%
Cooling System	$58	0.1%
Exhaust System	$90	0.1%
Fuel System		
Engine	$35	0.05%
Trailer		
All Others	$53,396	70.6%
Total	**$75,604**	**100.0%**

Source: VMAS AEL302P9, FY01 through FY03, Q02. Total of 187 ECRVs.

The main conclusions from this analysis on ECRV maintenance and repair are as follows:

- A high number of warranty repair issues has been addressed by Ford. The trend is upward in recent months.
- The battery module repair category has been one of the most prevalent and time consuming problems. These failures require extended service time to diagnose and repair. (Refer to Section 3.5 for further discussion on this item.)
- The wiring harness repair category has also required extended service time. Because of the extensive wiring on the ECRV, the repairs are often very complex. Ford Engineering has often been needed to help diagnose and repair these problems.
- The 12-volt component category is the category with the highest number of incidents. Many of the vehicle systems that are mechanical on a gasoline vehicle are electrical on the ECRV (e.g., the water pump). This places a higher demand on the ECRV 12-volt system. The 12-volt component repairs have not been as time-consuming or complicated as those for battery modules and wiring harnesses.
- Problems have occurred with the water pumps (categorized as a 12-volt component) and the power steering units in many of the ECRVs. Ford has addressed these problems by replacing many of the components and establishing improved quality standards with suppliers. Water pumps may have exacerbated battery performance problems because failures may have resulted in overheating of the battery pack.
- On-road failures have occurred, and some vehicles have been towed in for repairs (mainly by Ford). However, results from the Carrier survey (Chapter 4) indicate this issues has not been pervasive.
- Postal Service has been involved to a minimal extent in service and repairs through the warranty period to date. Repairs conducted by the Postal Service have been mostly for the body and cab, tires, wheels, and lighting systems.

Reliability and battery performance are discussed in more detail in the next two sections.

3.4 RELIABILITY AND AVAILABILITY

3.4.1 Vehicle Reliability and Availability

Due to the limited period that the ECRVs have been operating, it is difficult to predict long-term reliability and availability with confidence. However, the available data do give a preliminary indication of the overall trend during the first two years since vehicles were first deployed.

Two approaches were used to develop an indication of the ECRV availability. The first approach was to use the Postal Service VMAS data to derive a percentage of lost time for the fleet to date. The second approach was to estimate the lost time from an assessment of the Ford Concern Reports, previously discussed

Applicable data from the VMAS AEL302P9 reports (summarized in Appendix B, Section B.1) were used to provide availability index values for the ECRV fleet by subtracting the “days in shop" from the "days assigned" and dividing by the "days assigned". The availability to date for each Post Office is shown in Figure 3-19. Overall the availability index value for the ECRV fleet using this approach is on the order of 98.8%, with most sites above 98%. Availability over time is shown in Figure 3-20. This figure indicates that availability to date has been high (above 99%), but there has been a deterioration in the last seven APs. This methodology does not account for ECRV "days not used", but when those days are included, a similar trend is observed.

For comparison, the availability index values for Postal Service gasoline LLVs is typically in the range from 98% to 99% for the newer LLVs (vehicle age of 6 or 7 years), and from 97% to 98% for older vehicles (RMA, 2001a).

FIGURE 3-19 ECRV AVAILABILITY BY POST OFFICE

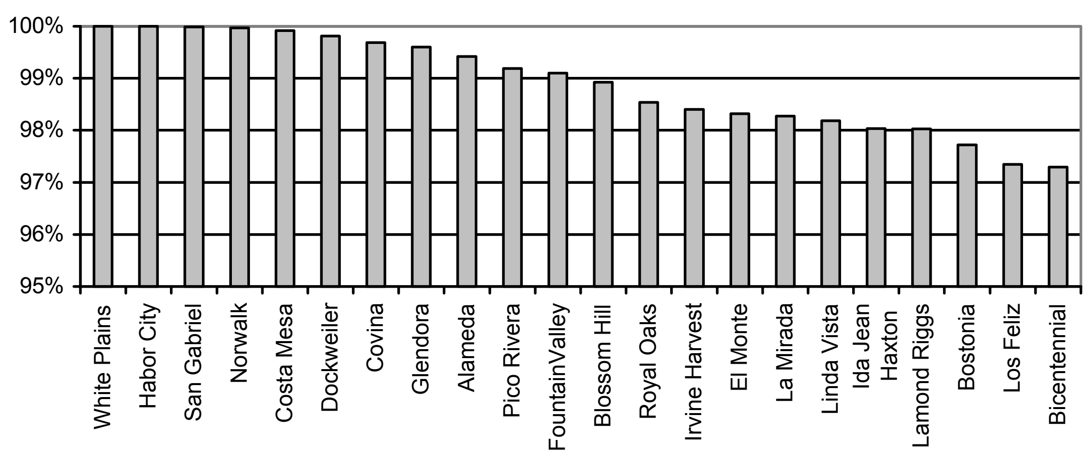
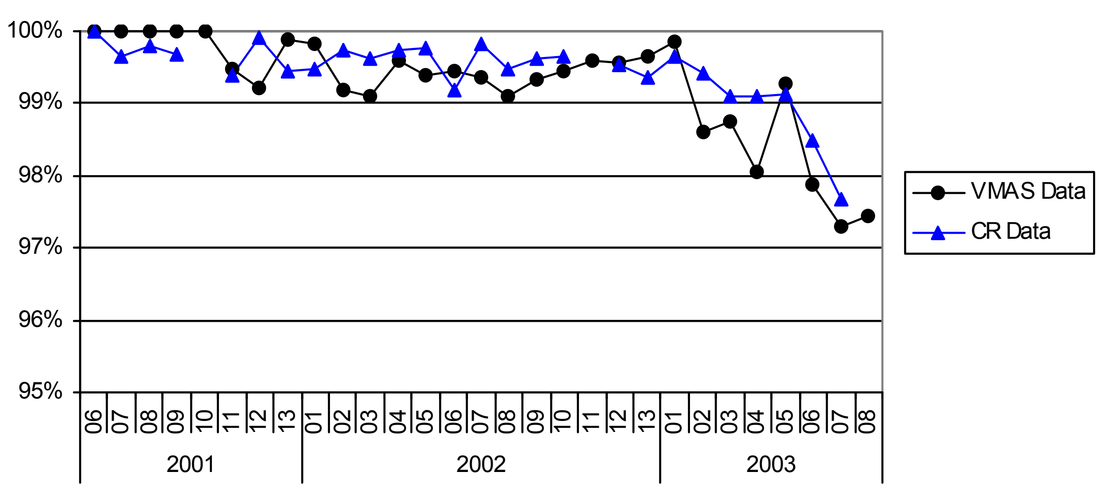


FIGURE 3-20 ECRV AVAILABILITY BY AP

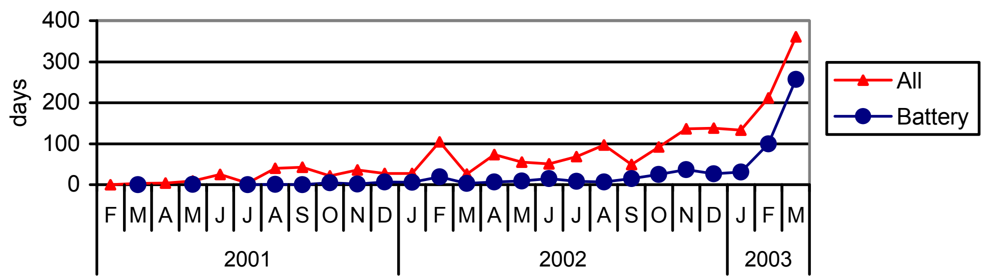


In the second approach, Concern Reports (CRs) were reviewed to develop a separate availability index. This estimate was based on the CRs provided by Ford covering the period from February 2001 through April 2003. The time elapsed between the report date and the repair completion date was used as an estimate of vehicle lost days, similar to “days in shop” in the previous approach. This assumes the vehicles are not available for operations during the time the CR remains open.

The availability index in this case was estimated by calculating the total number of vehicle-days by month), and using the CRs to estimate total time the ECRVs were unavailable. This provided an average value of 99.3% for the ECRV fleet. This figure compares reasonably well with the estimate from the first approach using VMAS data, and the overall trend also shows the downward trend in the last few months (also shown Figure 3-20).

The downward trend in the availability index during the last few months coincides with the increased need for repairs during the same period (Figure 3-17). Figure 3-21 shows that repairs during the last five months took longer to complete than those previously. Again, this is consistent with the need for more complex battery repairs often involving pack replacements. This trend may indicate that batteries are approaching their end of life, and the need for pack replacements.

FIGURE 3-21 REPAIR DAYS BY MONTH



In summary, the Postal Service has experienced considerable reliability problems with the ECRV fleet during recent months. These have mostly been due to battery pack replacements. In addition to these battery performance issues, the warranty repair data show that there have also been high failure levels with water pumps, wiring harnesses and other 12-volt components.

It appears that the availability of the ECRV fleet to date has been comparable with that for the Postal Service gasoline LLVs, but the data suggest that reliability and availability have been deteriorating during the last few months, mainly because of battery problems. Battery performance is discussed further in Section 3.5.

3.4.2 Reliability of the Electricity Supply

During the late 1990s, power supply problems in California raised concerns about the reliability of electricity supply and the potential for cost increases. In the summers of 1999 and 2000, there were periodic disruptions to the supply, and users throughout the state faced uncertainty about electricity prices and supply reliability.

For electric vehicles that rely on wall current for charging, it is critical that electricity supply be reliable and cost-effective. While the power supply problems during that period did impact cost and reliability of the supply, most of the problems were related to peak demand periods during the day. Since EVs tend to be charged during the off-peak period, they are sheltered to some degree from power supply disruptions. However, the off-peak rates have been subject to cost increases as a result of California's power supply problems. During the last few years, the price per kiloWatt for off-peak electricity in the Southern California Edison service area has increased from $0.06c/kWh (without taxes and other facility/service charges) to $0.09c/kWh in 2003.

Since the year 2000, the State of California has made progress in stabilizing the electricity supply, providing additional supply during times of peak demand. New plants have been built to assist the state in overcoming the shortfalls.

Many of the ECRV deployment sites are served by the municipal utilities, including the Los Angeles Department of Water and Power. The municipal utilities have not been subject to the power supply and cost instability problems to the same extent as the publicly owned utilities.

Since 1999, the publicly owned utilities have been approved to increase rates to cover the higher wholesale power supply costs, however, the increases have remained moderate to date. The ongoing working sessions with the Governor, the power suppliers and the utilities are attempting to stabilize both the supply and the costs of the power. They are focusing on the use of long-term supply contracts, establishment of a State Power Authority, reducing demand through conservation, and other measures. To date, there has been considerable progress on these issues.

3.5 BATTERY PERFORMANCE AND COST

3.5.1 Battery Performance

As the first ECRVs were placed in service, the uncertainties associated with battery performance, battery life, and battery replacement cost were known to be significant concerns. Some of the contributing factors to this are summarized below:

- Ford experienced a "battery power reduction without warning" on some of the early ECRVs going through end of production line range testing. This was a result of battery module voltage drop-out which was later attributed to poor acid diffusion.
- The two ECRVs tested by Southern California Edison (SCE) in the Accelerated Reliability Testing program both experienced battery problems, and the battery packs in both vehicles were replaced before the end of the test program.

- Uncertainties over battery life and cost in an incipient BEV market were singled out as one of the main issues in the ECRV Life Cycle Cost and Performance Evaluation (RMA, 2001a).

A significant concern was raised with the battery pack in 2001 when several ECRVs going through the end of production line range testing experienced “module voltage dropout”. After a detailed investigation, Ford attributed this to poor acid diffusion in the battery because of plate pore size and porosity (Taenaku, 2001). Ford concluded this problem would not adversely affect the Postal Service because the vehicles operate at shallow depth of discharge and they are in warm climates.

In late 2001-early 2002, Ford and East Penn Manufacturing Company, Inc. (EPM) – the ECRV battery pack manufacturer – jointly identified battery modules delivered to Ford that were outside the production control specification. Ford and EPM have subsequently taken steps to ensure that production controls are implemented as designed. They have also changed to cast-metal plate electrodes in the battery in place of the original expanded-metal plates. Ford has not seen any evidence of the voltage dropout problem reappearing.

Prior to full-scale deployment of the ECRVs, two vehicles went through an Accelerated Reliability testing program with SCE (SCE EVTC, December 2001). For Vehicle 124001, the battery pack was replaced at 8,818 miles, 10,069 miles and 11,323 miles. For Vehicle 124002, the pack replacement occurred at 16,293 miles. However, it is unclear if these battery packs had served their full useful life before being replaced, and whether or not the second and third replacements on Vehicle 124001 were completely new packs. This early experience (especially with Vehicle 124001) served to raise awareness about potential problems with the batteries for vehicles deployed in Postal Service operations.

To date, the ECRV fleet has experienced a high number of battery-related incidents requiring lengthy and costly repairs. The battery module repair category has been one of the most prevalent and time consuming problems. These failures require extended service time to diagnose and repair, they lead to a relatively high degree of vehicle lost time, and in some cases they have affected the drivers’ confidence about vehicle range and reliability.

From deployment through April 2003, there were 243 CRs involving battery modules out of a total of 1,215. About 63 of these were termed “pre-delivery”, so there have been 180 battery repairs for vehicles in the field. These have involved 122 vehicles (24% of the fleet). Many vehicles have needed battery repairs more than once. For 41 vehicles, there has been a need to replace the entire battery pack (8% of fleet), and this has been needed more than once for five vehicles. These numbers are based on data available through the end of March 2003, which represents a weighted average of 1.5 years for the fleet.

The CRs for the battery module incidents, provided by Ford, were carefully reviewed to develop a better understanding of the implications of these numbers. Appendix D includes a limited sample of battery repair CRs for the 25 most recent repairs, and the incidents associated with the vehicles equipped with Data Acquisition and Interface Systems (DAIS).

Figure 3-22 shows the number of battery module and pack repairs by month since deployment. This figure shows there has been a growing number of repairs over time. While some of this increase may be attributable to the steady increase in vehicles deployed between 2001 and

2002, the figure shows a large increase in the number of pack replacements in recent months. Figure 3-23, also derived from the CR data, shows that the number of defective modules per repair has also increased steadily over time, and nearly all module repairs (excluding pack replacements) involved five or less modules.

FIGURE 3-22
NUMBER OF MODULE AND PACK REPLACEMENTS OVER TIME

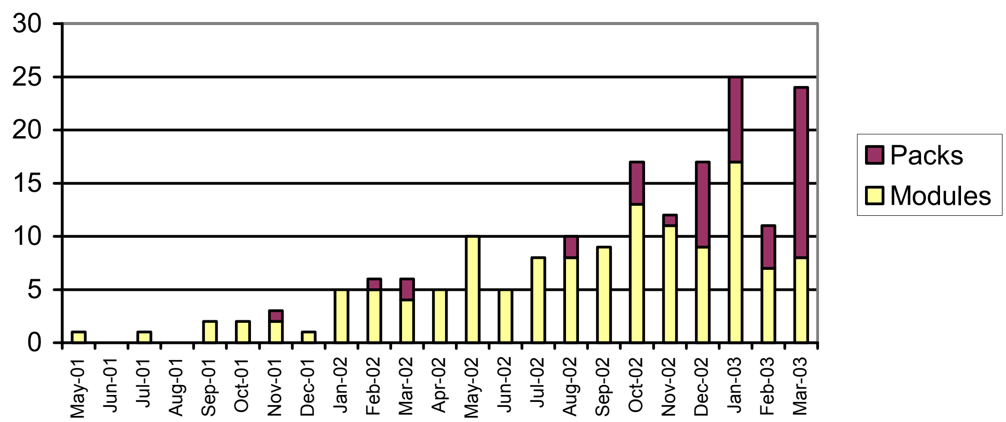
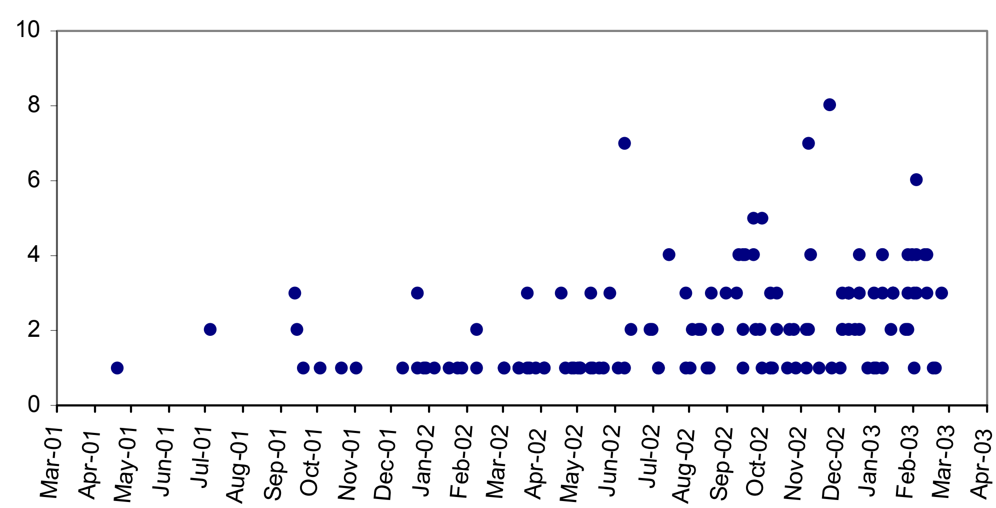


FIGURE 3-23 NUMBER OF MODULES REPLACED

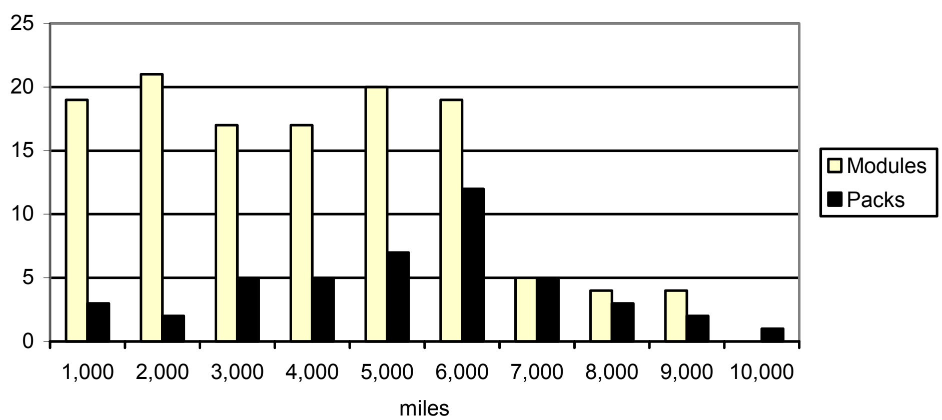


The Postal Service contract with Ford was not specific in defining how the battery condition would be evaluated over time, nor what conditions would constitute the need for an entire pack replacement. However, Ford has developed the following criteria for deciding when a battery needs to be repaired, rebuilt or replaced. All battery pack modules are first checked for open circuit voltage, SOC, and capacity (the latter two calculated by the battery control module). If there is a significant deviation of any of these values from normal ranges, those modules are flagged for replacement. The entire pack is replaced either (1) if replacements are needed and the amp-hour throughput exceeds a certain value (generally 8,000 kWh); or (2) if there are more than five modules that need to be replaced. Ford's standard service does not generally attempt to rejuvenate modules that vary significantly from the rest of the pack.

Figure 3-14 (included in Section 3.3.3), showed the number of battery CRs plotted as a function of "days out". (This is the difference between the date when the incident was first reported and the date when the repair was completed.) Most of the battery repairs were completed in two days or less, but there is a secondary cluster of repairs that took about 6-7 days. Also, of the 15 repairs that took 14 days or more to complete, seven were for batteries. The average times to complete the module and pack repairs were 2.0 and 6.1 days, respectively, and 3.0 days combined. These figures compare with an average of 1.4 days for all other repairs.

Examination of battery repairs against odometer reading (Figure 3-24) shows that the repairs in each 1,000 mile increment up to 6,000 miles has been consistently between 17 and 21. However, the number of pack replacements has increased steadily by odometer reading. Since the average vehicle odometer reading at the time of this study was only about 4,000 miles, the number of battery repairs and replacements for odometer readings greater than 4,000 miles is expected to increase over time. The fleet would have to travel many more miles to ascertain where the median point (in miles) would be for battery pack replacements, thereby indicating the battery pack life expressed in terms of vehicle miles driven.

FIGURE 3-24 BATTERY REPAIRS BY ODOMETER READING



For the ECRVs that have been in service the longest, the battery performance has been mixed. The 28 vehicles at Fountain Valley have traveled more than 7,000 miles on average, and there have been no pack replacements to date. However, at Dockweiler and Ida Jean Haxton, the packs have been replaced on eleven out of 65 vehicles (17% of the vehicles), and at Irvine Harvest, there have been seven pack replacements out of 24 (29%). These results highlight the relatively high frequency of battery replacements to date in the oldest vehicles, and also the significant differences in battery longevity from site to site.

Ford has indicated that the warranty data gathered to date indicate that the battery life is about 30 months. However, these data do not reflect the efforts made by the Postal Service to re-deploy vehicles with low range into routes that require a limited drive range. Also, some vehicles that experienced low range after a period of time have been kept on their original route as long as the vehicle met the required range for that route. These practices may have raised the apparent battery life artificially. Ford has not attempted to predict the battery life in the absence of these actions. The data in Figure 3-24 suggest there is likely to be a wide spread in the battery life across the fleet.

Obtaining early detection of impending battery problems has been a challenge. Detecting battery deterioration as early as possible is important to help minimize serious battery damage. Ford Engineering considers the SOC change rate and the DTE gauges as early warning indicators for encroaching battery problems, particularly for vehicles that are driven to the limits of the battery capacity (low states of charge).

From the CRs, it is clear that the initial indicators of battery problems are almost always the Malfunction Indicator (Wrench) Lamp coming on (84 CRs) or Low Range (71 CRs). However, in practice, it is usually the operator's observances of less-than-expected DTE that is the initial cause for requests for service. The ability to provide service at the most opportune time is dependent on having all ECRV drivers aware of this and the need to report unusual observations. The DAIS data for these vehicles were also reviewed, where available, for the times when battery problems occurred. However, no clear indicators of battery deterioration were apparent. (Refer to Section 5.3 of the report for further details).

In the Carrier satisfaction survey conducted in April, 2003, the Carriers' feedback on battery performance was mostly favorable (Chapter 4). There was no indication in the responses that suggested a major concern about battery performance or reliability. One related statement that received a less favorable response was that the Carriers are concerned about using the electrical ancillary equipment for fear of draining the battery. In the performance data collected for this report, there is no evidence that there have been weather-related energy efficiency or availability issues.

The Battery Control Module (BCM) software code was modified in late 2002 to accommodate both the expanded-metal plate battery modules and the cast metal plate electrodes. The code change consisted of an adjustment to the voltage limit temperature compensation applied during a charge. During the validation of this change it was also seen that the new algorithm reduced charge time and improved charge acceptance for the existing expanded-metal battery modules. Also, gassing was reduced which is expected to help reduce battery failures due to electrolyte dry-out.

3.5.2 Battery Costs

From the outset of the ECRV Demonstration Program, battery costs were recognized as being a significant contributor to the life cycle cost for electric vehicles. The life cycle costs are impacted by the battery cost (manufacturing and installation) and battery life.

Over time, there has been a considerable range in the cost estimates for repairing and replacing the battery packs. In the initial contract between Ford and the Postal Service, the estimated cost for a battery pack replacement provided by Ford was $4,700, though it is unclear whether this amount included installation. During the initial production phase, Ford indicated that the cost to replace a battery pack could be on the order of $9,600, including the cost for the battery from the manufacturer, Original Equipment Manufacturer (OEM) mark-up and installation cost (email from Jeffrey Stroven to Judy Beigbeder, September 21, 2001).

The uncertainty surrounding battery replacement cost was highlighted in the ECRV Life Cycle Cost and Performance Evaluation study (RMA, 2001a). In that study, a base case scenario was developed using a battery replacement cost of $5,238. It was also assumed there would be two battery replacements – one after four years, and the other after eight years. After discounting, the total present value cost for the two replacements was $7,900. The present value battery replacement cost was estimated to be $3,922 for one replacement, and $11,983 for three replacements. However, using the $9,600 figure provided by Ford, it was estimated the present value cost for three replacements could be as high as $21,798. Since that time, Ford has stated their actual cost for replacing battery packs in 2003 was $14,000 (email from David Wagner to Jacqueline Johnson, April 29, 2003)

The ECRV Life Cycle Cost and Performance Evaluation included a review of a wide range of data sources on battery costs (RMA, 2001a). One of the main sources referenced in this report was the Battery Technology Advisory Panel (BTAP) report for the California Air Resources Board (CARB, 2000). An addendum to this report was recently released which indicates there has been no significant change in the specific energy, cost or life for lead acid battery technology during the last three years. The following conclusions are included in the update. *"Lead acid battery life is still limited to about 600-800 cycles at 70% depth of discharge which, depending on the usage profile, is equivalent to a service life of 2-5 years at best. . . . There is no fundamental change in the cost projections published in the 2000 BTAP report – i.e. $150 to $200 per kWh at moderate production volumes. This is equivalent to about $4,500-$6,000 for a 30 kWh pack."* (Anderman, 2003).

3.5.3 Recent Developments

During the latter part of 2002, the Postal Service received notice from Ford that they would be ending their Ranger EV program and canceling the "Think City" BEV program. Ford's program decisions mirrored the recent industry and regulatory shifts away from development of dedicated battery electric technology and a shift toward hybrid electric vehicles and fuel cell technology. At the same time, Ford notified the Postal Service that EPM – the ECRV battery pack manufacturer – was making a business decision to end production of the Postal Service ECRV battery packs. Price increases could thus be expected for interim battery pack orders. No suitable replacement batteries were located, and no alternative supplier was found.

In 2003, the California Zero Emission Vehicle mandate is also expected to be changed in a way that places far less demand on the OEMs to produce BEVs (CARB, 2003). As this change is implemented, the future demand for BEVs and BEV batteries is uncertain. While in the past it was possible to predict that battery costs would go down because of increased demand related to the ZEV mandate, it is difficult to determine how BEV technology and battery performance will change without the BEV provisions in the ZEV mandate, and as hybrid electric vehicles start to place a higher demand for different kinds of batteries.

Coupled with the deteriorating battery performance of the ECRV fleet and the high failure levels of many ECRV components, these developments in the industry and in Ford's position on BEV technology presented a significant challenge to the Postal Service. Clearly, it would be increasingly difficult to maintain and support the ECRV fleet in the face of a deteriorating ECRV support structure at Ford and in the industry. To the extent that Postal Service relied upon receiving maintenance support for the ECRVs from authorized Ford dealerships, cancellation of the Ranger EV program means that those dealerships could be less able to provide the needed support over time.

With these prospects, the Postal Service determined that the risks and costs of attempting to operate the ECRV fleet through a normal delivery vehicle's life cycle would be excessive. An agreement was negotiated with Ford to end the ECRV Program with a Ford buy-out of the ECRV contract. Under the terms of the new agreement, the 500 ECRVs will be replaced by 500 Windstars which are operationally viable ULEV-certified vehicles. The ECRVs will be dismantled and returned to Ford for disassembly.

4. CARRIER SATISFACTION

Mail Carrier satisfaction is an important measure of vehicle performance. When vehicle users respond favorably to the vehicles they drive, they are more supportive of the initiatives to improve them and more tolerant when there is a need to make repairs or modifications. If a Postal Service vehicle presents frequent troublesome problems it can lead to a source of frustration to the carrier, especially if it limits their ability to carry out the work in an efficient and reliable manner. Reliable mail delivery is a paramount necessity, and the vehicles need to be capable of meeting this demanding objective.

In many cases, Carriers make judgments on the ECRV in comparison to other available vehicles. The most prevalent vehicle used for mail delivery and collection is the gasoline LLV, so this creates an obvious frame of reference for the Carriers.

As they are asked to use Alternative Fuel Vehicles, it is also important that the Carriers are given the training necessary to operate the vehicles safely and efficiently. In the case of electric vehicles, some of the issues that Carriers need to be aware of are the gauges, the correct actions to take when a potential problem presents itself, and the right procedure for refueling (charging) the vehicle.

Several formal and informal surveys were conducted to evaluate Carrier satisfaction prior to and following the first vehicle deployments. These include the Customer Acceptance Test, the Accelerated Reliability Testing, and other informal discussion held between Headquarters personnel and the Carriers. The main conclusions from the Customer Acceptance Test are summarized in Section 4.1 below. This early feedback made it clear that ergonomic issues were the main concerns expressed with the vehicles during the pilot testing.

To provide additional information for this report, an update survey was conducted in April 2003. By the time this present study was initiated, the ergonomic issues had been well-documented and addressed to the extent feasible. As such, the update survey targeted feedback on vehicle performance rather than ergonomics. The methodology used for this survey and the results from the survey are presented in Section 4.2.

4.1 CUSTOMER ACCEPTANCE AND ACCELERATED RELIABILITY TESTING

To obtain early information on the performance of the ECRVs, a Customer Acceptance Test was conducted at the Fountain Valley Post Office using two pilot ECRVs. This was conducted from July 11 through August 16, 2000. During this time, eighteen Carriers drove the ECRVs on their normal mail delivery routes for a period of two days each. Prior to driving the vehicles, the Carriers received training on the operation of the Electric Carrier Route Vehicles and participated in a short practice drive with an experienced electric vehicle operator. The Carriers then provided information pertaining to the vehicle's performance during this period. The results of the Customer Acceptance Test were documented in a report, which identified 15 concerns pertaining to ECRV design and performance (RMA, 2000).

Postal Service Carriers interviewed during the Customer Acceptance Test, indicated their satisfaction with vehicle handling and performance was quite high. Some significant initial problems were experienced with the pilot test ECRVs that were corrected. A number of ergonomic problems were also identified during the Customer Acceptance Test. To date, some of these problems have been remedied.

In this series of tests, three complaints were expressed frequently by the Carriers:

1. The first complaint was that the ECRV body was too high off the ground. The stepwell of the ECRV is four inches higher than the LLV. Carriers expressed concern with injury from stepping down from the vehicle because of the added height. Some Carriers said that to get back into the vehicle, they had to pull themselves up using the steering wheel.
2. The second frequent complaint was in relation to the delivery of mail from the vehicle on a mounted route. In the ECRV, the driver is higher off the ground, and the lower edge of the window is also higher. Carriers said it was sometimes difficult to reach down to place mail into mailboxes, depending on the height of the mailbox.
3. The third frequent complaint relates to the height of the rear cargo door. It is higher than the LLV door, and reaching the door strap to close the door is sometimes difficult without climbing onto the rear bumper. Also, many of the shorter Carriers said that they could not physically climb into the cargo area from the rear. They would either access mail trays from the front door, or use some type of pole extension device to reach mail trays. Carriers were concerned with muscle strains from reaching for mail.

Other issues raised by the Carriers in these interviews were as follows:

- The rear bumper of the ECRV is higher than that for the LLV and it extends farther out from the vehicle, making it hard to reach mail in the vehicle.
- The ECRV parking brake is hard to set and release.
- The Postal Service procedure is to curb the wheel when parking, and the ECRV wheels are hard to uncurb.
- The seat belt-shoulder clasp is high and catches the driver in the neck rather than diagonally across the center of the shoulders.
- The brake pedal needs to be applied harder than the LLV (although the brakes perform well).

As a component of the Southern California Edison (SCE) Accelerated Reliability Testing, road handling of the ECRV was tested. Driver satisfaction with the road handling of the vehicle appeared to be quite high, with the driver indicating that the vehicle felt stable, acceleration was adequate, and the steering and braking were responsive. The drivers concluded the vehicle performance was comparable to a gasoline vehicle. The SCE employees who drove the ECRVs during the Accelerated Reliability Testing program were generally satisfied.

4.2 CARRIER SATISFACTION SURVEY – APRIL 2003

A survey on Carrier satisfaction was conducted during April and May 2003. A structured response type survey was sent to more than 100 Carriers and Managers, with the Carriers selected at random from all sites with ECRVs. The questions in this survey were designed to solicit information on vehicle performance, rather than ergonomics, safety and comfort.

An explanation of how the survey was conducted is included in Appendix E together with copies of the completed forms and the analysis that was conducted on the data. About 45% of the Carrier forms and 60% of the Manager forms were completed and returned within the requested timeframe.

The results from the survey are presented in the figures and tables at the end of this section. The responses are shown graphically in Figures 4-1 and 4-2 (for Carriers and Managers, respectively), and tabulated in Tables 4-1 and 4-2, along with the respective questionnaire statements that were used. Data in each cell of Tables 4-1 and 4-2 show the percentage of respondents that rated the corresponding statement in the respective category. For example, a response which strongly disagrees with a negative statement - such as “The ECRV is sometimes difficult to get started” - would be rated as a highly favorable response. Disagreeing with a positive statement – such as “The vehicle provides adequate heating capability at all times of the year” would be rated as a favorable response. Processing the data in this way provides an effective way to view the results of the survey in summary format.

In general, the ratings from the Carriers and the Managers are dominated by favorable or highly favorable responses (Figures 4-1 and 4-2). For the Carriers, the two statements that received less favorable responses were #7, concerning the loss of power on hills, and #17 which indicates some reluctance to use electrical equipment for fear of draining power from the traction battery. Specific statements were included to solicit feedback on the frequency of ECRV component failures compared with gasoline vehicles (#18 and #9). The responses to these questions were predominantly favorable, as they were for towing (#16), range (#8), and Carriers’ confidence in the State of Charge gauge for providing a reliable indication of range (#12). Specific comments provided by the Carriers are included in Appendix E.

In the responses from the Managers, the two statements that received the most critical feedback were on cargo capacity (#3) and the reliability of the charging system (#8). The statements with the most favorable responses were on adequate operational capability (#2) and adequate range (#5).

In the comment section of the questionnaire, the Post Office Managers reported that the Carriers’ main complaints with the ECRV were battery limitations (three out of twelve) and problems with the chargers (two out of twelve). These were the only two complaints specific to performance. One manager stated that the main complaint was that Carriers are upset that they may be losing their ECRVs, and another reported that Carriers were satisfied with the ECRVs and they had no complaints. Managers noted that the features which Carriers like best are that they do not have to go to the gasoline station (four out of twelve), and that they are quiet and clean (four out of twelve). Only three of the Managers had received feedback from Post Office customers. At two of the locations, the customers had expressed surprise that the Postal Service was using electric vehicles, and at the third, the customers liked the quietness and benefit to the environment.

There were no battery performance complaints expressed by the Managers at the colder climate East Coast sites (Lamond Riggs and White Plains Post Offices), though they did express a desire for increased heat output in winter.

Concerns about vehicle height and other ergonomic issues were again raised by several Managers and many Carriers.

4.3 SUMMARY

During the early deployment period, most of the carrier comments were directed at the ergonomics and safety aspects of the ECRV. The most recent survey --- focusing on vehicle performance --- provides a favorable response from the Carriers. In this last survey, responses were received from more than 40 of the 100 Carriers who were sent surveys and from 12 of the 22 Post Office Managers. Relatively few adverse comments were made about the batteries and the electrical drivetrain.

FIGURE 4-1 SUMMARY OF CARRIER QUESTIONNAIRE RESPONSES

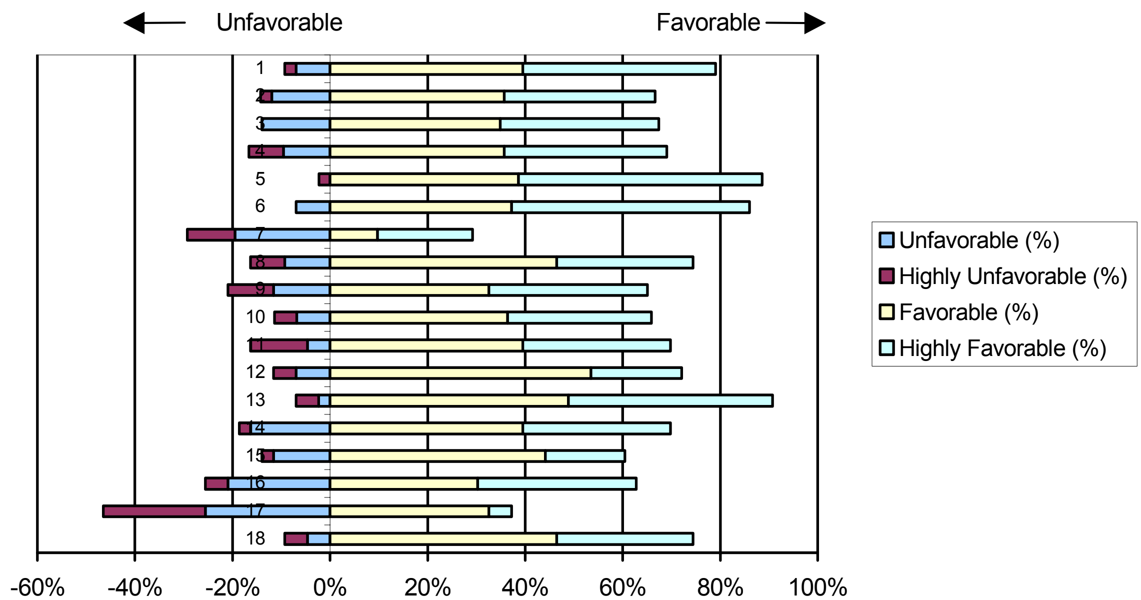


FIGURE 4-2 SUMMARY OF MANAGER QUESTIONNAIRE RESPONSES

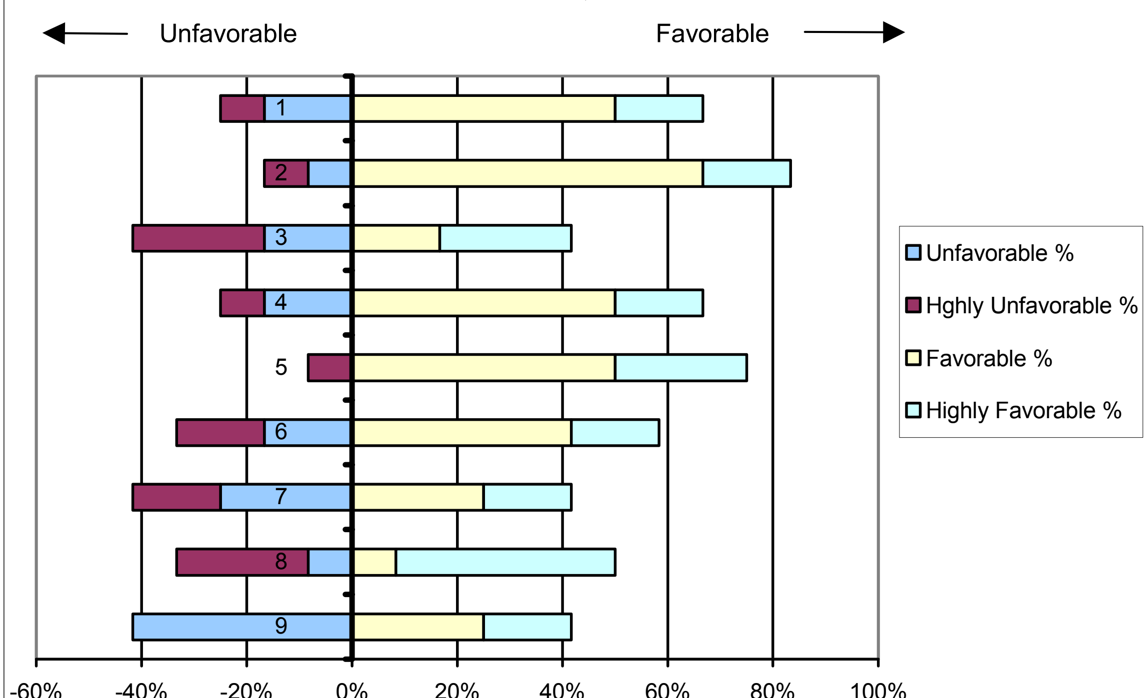


TABLE 4-1 SUMMARY OF CARRIER QUESTIONNAIRE RESPONSES

Carrier Questionnaire Statement	Highly Unfavorable (%)	Unfavorable (%)	Neutral (%)	Favorable (%)	Highly Favorable (%)
1. The ECRV has always had ample acceleration.	3%	9%	15%	33%	39%
2. The ECRV acceleration has deteriorated during the time I have been driving this vehicle.	3%	16%	25%	25%	31%
3. Acceleration deteriorates during the day as I proceed with my route.	0%	18%	24%	24%	33%
4. The top speed of the ECRV is less than adequate.	6%	9%	22%	31%	31%
5. The ECRV brakes perform just as well as those on a gasoline vehicle.	0%	0%	15%	42%	42%
6. The ECRV road handling (including steering and cornering) is good.	0%	3%	13%	41%	44%
7. The ECRV lacks power on steep hills.	6%	26%	48%	3%	16%
8. Under normal use, the ECRV provides adequate range.	9%	13%	9%	44%	25%
9. The ECRV I drive has been out of service for repairs more often than the gasoline vehicles at this Post Office.	13%	6%	13%	38%	31%
10. The charging system always works well and provides complete recharge of the battery each day.	3%	9%	22%	41%	25%
11. The vehicle provides adequate heating capability at all times of the year.	13%	3%	19%	31%	34%
12. I am confident that the State of Charge SOC indicator (fuel gauge) provides a reliable indication of remaining range.	6%	9%	16%	47%	22%
13. The ECRV has adequate cargo capacity for normal delivery operations.	6%	3%	3%	47%	41%
14. Sometimes the ECRV is difficult to get started.	0%	23%	13%	35%	29%
15. The ECRV performance deteriorates in cold weather.	3%	9%	31%	38%	19%
16. I have never needed to call for a tow while on route with an ECRV.	3%	22%	13%	25%	38%
17. I am reluctant to use electrical equipment (such as wipers, headlights, heater) because this could reduce vehicle range.	22%	31%	19%	22%	6%
18. The component parts on the ECRV are as reliable as for any other new vehicle.	6%	3%	22%	41%	28%

Refer to the text in Section 4.2 for an explanation of the data in this table.

TABLE 4-2 SUMMARY OF MANAGER QUESTIONNAIRE RESPONSES

Manager Questionnaire Statement	Highly Unfavorable (%)	Unfavorable (%)	Neutral (%)	Favorable (%)	Highly Favorable (%)
1. Carriers at this Post Office are satisfied with the ECRV's performance capabilities.	9%	18%	9%	45%	18%
2. The ECRVs at this Post Office provide adequate operational capability for their assigned routes.	9%	9%	0%	64%	18%
3. The ECRV cargo capacity sometimes limits our ability to deliver mail efficiently.	27%	9%	18%	18%	27%
4. The ECRVs always start each day without difficulty.	9%	18%	0%	55%	18%
5. Under normal use, the ECRVs provide adequate range.	9%	0%	18%	45%	27%
6. The ECRVs need to be towed in from a route more frequently than a comparable gasoline vehicle.	9%	18%	9%	45%	18%
7. The ECRVs are out of service for repairs more often than the other types of vehicle at this Post Office.	9%	27%	18%	27%	18%
8. The charging system at this Post Office works well, and provides adequate recharging of the vehicle batteries each day.	27%	9%	18%	0%	45%
9. Some Carriers are reluctant to use electrical equipment (such as wipers, headlights, and heater) because this could reduce vehicle range.	0%	45%	9%	27%	18%

Refer to the text in Section 4.2 for an explanation of the data in this table.

5. DATA COLLECTION

Twenty-five of the ECRVs are equipped with onboard Data Acquisition and Interface Systems (DAIS) to collect and store data on vehicle and battery performance. The DAIS units installed in the ECRVs include a data logger designed and assembled by Ford, together with proprietary software. Some of the many potential uses of the DAIS data include:

- Evaluating vehicle electricity usage and charging patterns.
- Conducting detailed analysis of individual vehicle performance.
- Diagnosing component failures.
- Analyzing parasitic loads and system component efficiencies.
- Establishing predictive maintenance programs based on component failure data.
- Analyzing and diagnosing components for future design changes.

Soon after deployment of the first ECRVs, the Postal Services contracted with Ryerson, Master and Associates, Inc. (RMA) to conduct an evaluation of the DAIS system, and a preliminary review of the data collected by the DAIS system (RMA, 2001b). This work included the preparation of a preliminary database format, data user interface, and report generator using Microsoft Access. RMA subsequently assisted Postal Service with the collection of DAIS data from the twenty five DAIS vehicles during the first year of operation.

This chapter provides a brief description of the Data Acquisition and Integration System. The system is described in Section 5.1, and a summary of the data collection effort is presented in Section 5.2. Section 5.3 includes a limited analysis of the DAIS data. These discussions are based on the information included in the previous report prepared by RMA (RMA, 2001b). Results are based on the data collected during the last one year period.

5.1 DATA ACQUISITION AND INTEGRATION SYSTEM

The Ford-designed DAIS collects and records data on the following parameters:

- Date and Time
- Wall Current (amps supplied to the vehicle by the off-board Power Control Station)
- Battery Pack Temperature (^{o}C)
- Battery Pack Voltage (volts)
- Battery Pack Current (amps flowing into or out of the battery pack)
- Vehicle Speed (mph)
- Ambient Temperature (^{o}C)

In addition to the above parameters, the DAIS derives and records data on the following parameters:

- Battery Pack Power (kW)
- Cumulative Battery Pack Current (Ahr)
- Cumulative Battery Pack Energy (kWhr into or out of the battery pack)
- Cumulative Wall Energy (kWhr supplied to the vehicle by the off-board Power Control Station)
- Miles Driven (miles)
- Estimate of Cumulative Charger Energy (kWhr)

Data values are recorded each second when the ECRV is being driven and each minute when the ECRV is connected to the off-board Power Control System (PCS). No data are collected when the ignition is off and the vehicle is not connected to the off-board PCS. The Personal Computer Memory Card International Association (PCMCIA) Data Cards (128 MB capacity) are installed in the onboard data logger units to record the DAIS data. The data are stored in files on the PCMCIA Data Cards. The data logger creates a “drive file” the first time the vehicle is started on each calendar day. As the vehicle is driven, data are appended to this drive file. A new drive file is created by the data logger when the vehicle is restarted on the next calendar day. This data storage protocol usually results in one drive file for each day the vehicle is driven.

The data logger creates a charge file the first time the vehicle is connected to the off-board PCS each calendar day. As the vehicle is charged, the data are appended to this charge file. If the vehicle is reconnected to the off-board PCS during the same calendar day, then the charge data are appended to the same charge file. The data logger only creates a new charge file when the vehicle is disconnected from the off-board PCS and then reconnected on the next calendar day. The charge file typically includes charge data past midnight, as a new charge file is not created by the Ford system until the connection to the off-board PCS is terminated and then reestablished. On a weekend, the charge file typically includes two or three days of data, as the ECRV is usually not disconnected from the PCS during this time.

On average, twelve data files are created by Ford’s system each week for each vehicle. Six of these files are for when the vehicle is being driven, and six files are for when the vehicle is connected to the PCS. A substantial amount of information is collected by the DAIS when it is working properly and the vehicles are used regularly. For each vehicle, as much as 30 megabytes of data per month may be collected. This equates to several gigabytes of data per year for the 25 DAIS vehicles.

The Ford data logger assigns a new filename each time a file is created. The convention for the file name is as follows:

<table>
<tr><td>Drive File</td><td>D DD MM YY</td></tr>
<tr><td>Charge File</td><td>C DD MM YY</td></tr>
<tr><td colspan="2">Where:
C stands for charge
D for drive,
DD for day of the month (two digits) on which the data file was created,
MM for month (two digits),
and YY for year (two digits).</td></tr>
</table>

The drive file and the charge file both have the same column structure. It is important to note that the Ford DAIS records no vehicle identification number. This information is tracked by hand by writing the vehicle identification number on the outside of the Data Card. Table 5-1 shows an example DAIS Drive File, and Table 5-2 shows an example DAIS Charge File. Table 5-3 presents a DAIS "data dictionary" that explains how each value in the database is measured or calculated by the Ford data logger.

Further details of the DAIS system are included in the DAIS report prepared by RMA for the Postal Service (RMA, 2001b).

5.2 DAIS DATA COLLECTION

Microsoft Access was used to create a DAIS database and report generator (RMA, 2001). The database format allows new data to be uploaded from the PCMCIA Data Cards and appended to the database. Because of the large volume of data accumulated by the DAIS system, daily summary tables are included in the database. Creating daily summary tables enables the report generator to run more quickly, without the need to access and process the large amount of raw data contained within the database.

The Access database was initially developed and tested by RMA using data collected by the DAIS units installed on the two pilot vehicles used for the Customer Acceptance Tests at the Fountain Valley Post Office (USPS vehicle numbers 1240005 and 1240006). The data were collected during the period July-November, 2000. Subsequently, the database was populated using approximately one year of data (where available) for each of the 25 DAIS-equipped vehicles. The locations of these units and vehicle numbers are shown in Table 5-4.

To import data into the database, the raw data are transferred from the PCMCIA Data Cards into temporary folders on the host computer, and then prepared for importing to Access. The major steps for creating the database are as follows:

1. Transfer the records from the Data Cards into a temporary data file.
2. Add the vehicle identification number and the data type (charge or drive data).
3. Screen the data records for format errors.
4. Screen the data records for out-of-range errors.
5. Generate the Daily Summary Tables.

During the development of the database, several problems were encountered with the data generated by the DAIS units. First, the DAIS data files stored on the Data Cards do not include an identifier for the vehicle from which the data were collected. This information must be hand entered when the data files are transferred to the database. Second, while the type of data (Charge or Drive data) is specified in the file name (with a C or a D), a manual step was needed to include this with each record in the database. Data quality issues were also identified during the data import process.

TABLE 5-1 EXAMPLE OF DAIS DATA IN A CHARGE FILE

Time	Wall Current	Wall kWhrs	Pack Voltage	Pack Current	Pack kW	Pack Ahrs	Pack kWhrs	Pack Temp C	Vehicle Speed	Miles Driven	Ambient Temp C	Est. wall kWhrs
7/17/2000 15:51	0.54	0	327	-0.01	-0.003	0	0	27	0	0	26	0
7/17/2000 15:52	20.37	0.07	334	10.47	3.502	0.114	0.038	27	0	0	26	0.047
7/17/2000 15:53	20.05	0.139	337	10.4	3.507	0.288	0.097	27	0	0	26	0.114
7/17/2000 15:54	20.02	0.208	339	10.36	3.508	0.461	0.156	27	0	0	26	0.182
7/17/2000 15:55	19.97	0.277	339	10.31	3.499	0.633	0.215	27	0	0	26	0.249
7/17/2000 15:56	19.98	0.346	340	10.28	3.494	0.805	0.273	27	0	0	26	0.317
7/17/2000 15:57	19.91	0.415	340	10.25	3.488	0.976	0.332	27	0	0	26	0.384
7/17/2000 15:58	19.93	0.483	341	10.25	3.489	1.146	0.39	27	0	0	26	0.451
7/17/2000 15:59	19.85	0.552	341	10.23	3.486	1.314	0.448	27	0	0	26	0.517
7/17/2000 16:00	19.81	0.62	341	10.21	3.482	1.484	0.506	27	0	0	26	0.584
7/17/2000 16:01	19.77	0.688	341	10.2	3.48	1.655	0.565	27	0	0	26	0.651
7/17/2000 16:02	19.77	0.757	341	10.19	3.479	1.824	0.623	27	0	0	26	0.718
7/17/2000 16:03	19.77	0.825	341	10.18	3.476	1.994	0.681	27	0	0	26	0.785
7/17/2000 16:04	19.89	0.893	342	10.17	3.473	2.164	0.739	27	0	0	26	0.852
7/17/2000 16:05	19.77	0.962	342	10.16	3.472	2.333	0.797	27	0	0	26	0.918
7/17/2000 16:06	19.77	1.03	342	10.15	3.469	2.502	0.855	27	0	0	26	0.985
7/17/2000 16:07	19.77	1.098	342	10.13	3.464	2.671	0.913	27	0	0	26	1.052
7/17/2000 16:08	19.77	1.166	342	10.13	3.464	2.84	0.971	27	0	0	26	1.119
7/17/2000 16:09	19.77	1.235	342	10.12	3.461	3.009	1.029	27	0	0	26	1.185
7/17/2000 16:10	19.77	1.303	342	10.08	3.45	3.177	1.087	27	0	0	26	1.252
7/17/2000 16:11	19.77	1.371	342	10.08	3.452	3.345	1.145	27	0	0	26	1.319
7/17/2000 16:12	19.77	1.439	343	10.06	3.446	3.513	1.203	27	0	0	26	1.385
7/17/2000 16:13	19.77	1.507	343	10.05	3.444	3.68	1.261	27	0	0	26	1.452
7/17/2000 16:14	19.77	1.576	343	10.03	3.436	3.845	1.317	27	0	0	26	1.516
7/17/2000 16:15	19.77	1.644	343	10.02	3.435	4.012	1.376	28	0	0	26	1.584

TABLE 5-2 EXAMPLE OF DAIS DATA IN A DRIVE FILE

Time	Wall Current	Wall kWhrs	Pack Voltage	Pack Current	Pack kW	Pack Ahrs	Pack kWhrs	Pack Temp C	Vehicle Speed	Miles Driven	Ambient Temp C	Est. Wall kWhrs
7/17/2000 10:24	0	0	332	-3.7	-1.227	0	0	24	1	0	21	0
7/17/2000 10:24	0	0	332	-3.7	-1.227	0	0	24	1	0.0002	21	0
7/17/2000 10:24	0	0	332	-3.89	-1.294	0.001	0	24	1	0.0004	21	0
7/17/2000 10:24	0	0	332	-4.24	-1.406	0.003	0.001	24	2	0.0009	21	0
7/17/2000 10:24	0	0	331	-5.67	-1.878	0.005	0.002	24	2	0.0015	21	0
7/17/2000 10:24	0	0	331	-5.67	-1.874	0.008	0.003	24	2	0.0019	21	0
7/17/2000 10:24	0	0	330	-5.9	-1.95	0.009	0.003	24	2	0.0024	21	0
7/17/2000 10:24	0	0	331	-6.34	-2.097	0.011	0.004	24	2	0.0029	21	0
7/17/2000 10:24	0	0	330	-6.96	-2.293	0.014	0.005	24	1	0.0033	21	0
7/17/2000 10:24	0	0	329	-7.27	-2.396	0.017	0.006	24	1	0.0035	21	0
7/17/2000 10:24	0	0	330	-7.53	-2.482	0.019	0.006	24	1	0.0037	21	0
7/17/2000 10:24	0	0	329	-7.73	-2.547	0.021	0.007	24	0	0.0038	21	0
7/17/2000 10:24	0	0	329	-7.83	-2.575	0.023	0.008	24	1	0.004	21	0
7/17/2000 10:24	0	0	330	-7.92	-2.616	0.025	0.008	24	5	0.0053	21	0
7/17/2000 10:24	0	0	329	-8	-2.633	0.027	0.009	24	6	0.0069	21	0
7/17/2000 10:24	0	0	328	-8.31	-2.725	0.031	0.01	24	6	0.0088	21	0
7/17/2000 10:24	0	0	328	-9.1	-2.98	0.034	0.011	24	8	0.0109	21	0
7/17/2000 10:24	0	0	327	-9.9	-3.24	0.039	0.013	24	8	0.0132	21	0
7/17/2000 10:24	0	0	326	-10.54	-3.438	0.043	0.014	24	8	0.0156	21	0
7/17/2000 10:24	0	0	326	-10.49	-3.419	0.046	0.015	24	8	0.0179	21	0
7/17/2000 10:24	0	0	328	-10.81	-3.541	0.049	0.016	24	9	0.0203	21	0
7/17/2000 10:24	0	0	326	-11.46	-3.736	0.053	0.017	24	9	0.0229	21	0
7/17/2000 10:24	0	0	326	-12.54	-4.083	0.058	0.019	24	10	0.0255	21	0
7/17/2000 10:24	0	0	325	-13.67	-4.443	0.063	0.02	24	10	0.0285	21	0
7/17/2000 10:24	0	0	325	-14.48	-4.7	0.068	0.022	24	9	0.031	21	0
7/17/2000 10:24	0	0	324	-14.3	-4.638	0.071	0.023	24	9	0.0336	21	0
7/17/2000 10:24	0	0	326	-14.12	-4.604	0.074	0.024	24	9	0.0362	21	0
7/17/2000 10:24	0	0	326	-13.3	-4.331	0.076	0.025	24	9	0.0387	21	0

TABLE 5-3 DATA DICTIONARY FOR DAIS PARAMETERS [1]

Col #	Parameter (Label)	Units	Measured or Derived [2]	Instantaneous/ Cumulative [3]	Comments
1	Date and Time (Time)	Date time	Measured (data logger internal clock)	Instantaneous	Field is formatted as a daily time stamp. It includes the date and the time (24-hour clock).
2	Wall Current (Wall Current)	amps	Measured (current meter)	Instantaneous	Device is a current meter physically located in the vehicle. There may be some loss of power in the cable from the wall-mounted Power Control System (PCS) to the vehicle, but this is minimal (relatively short cable, no load). The current meter is the first device the current passes through in the vehicle.
3	Cumulative Wall Energy (Wall KWhrs)	kWhr	Derived: (Col2*207/(60*1000)) + kWhr in previous record	Cumulative	Voltage is not measured. The data logger assumes the voltage is a constant 207V (nominal 208V service). Since this is a cumulative parameter, the power used on the last time increment (1 minute) is added to the total in the previous record.
4	Battery Pack Voltage (Pack voltage)	volts	Measured (variable control module)	Instantaneous	Device is placed directly on pack terminals.
5	Battery Pack Current (Pack Current)	amps	Measured (current meter)	Instantaneous	Device is very close to battery. Measures net current going into or out of the pack - positive (in); negative (out).
6	Battery Pack Power (Pack KW)	kW	Derived: Col3*Col4/1000	Instantaneous	Instantaneous indication of pack power.
7	Cumulative Battery Pack Current (Pack Ahrs)	Ahr	Derived: Col5/60 + Ahr from previous record	Cumulative	Product of current (amps) and time increment (1 minute) with factor to adjust from minutes to hours, added to total in previous record.
8	Cumulative Battery Pack Energy (Pack KWhrs)	kWhr	Derived: Col4*Col7	Cumulative	Product of Pack Ahr and Pack voltage
9	Battery Pack Temperature (Pack Temp C)	^{o}C	Measured (thermocouple)	Instantaneous	Sensor is physically located inside the pack at a location considered to be the hottest place.

TABLE 5-3 DATA DICTIONARY FOR DAIS PARAMETERS [1]

Col #	Parameter (Label)	Units	Measured or Derived [2]	Instantaneous/ Cumulative [3]	Comments
10	Vehicle Speed (Vehicle Speed)	mph	Measured: device on transaxle	Instantaneous	Device is coupled to transaxle.
11	Miles Driven (Miles Driven)	miles	Derived: (Col10/3600)	Cumulative	DAIS value for miles driven is derived from speed indicator on transaxle. Formula here assumes time interval is 1 sec. This is not the same as the odometer reading in the car, which is a mechanical device that cannot be read by the data logger.
12	Ambient Temperature (Ambient Temp C)	degree Cent.	Measured	Instantaneous	Sensor on outside of vehicle.
13	Estimate of Cumulative Charger Energy (Est. wall kWhrs [4])	kWhr	Derived.	Cumulative	Ford has included this field to allow them to evaluate efficiency factors and parasitic losses.

Notes
[1] Data dictionary developed by Ryerson, Master and Associates, Inc., using input from Ford Motor Company.
[2] For measured data, this column includes the measuring device. For derived data, the column includes the formula.
[3] All cumulative data should begin at zero when a new daily data file is created.
[4] This value uses the pack kW-hrs to back-calculate the wall power assuming certain efficiencies and losses for the system. For example, if there is 10A at the pack, and the charging system has an 80% efficiency with no auxiliary load, the wall current would be about 12A. Efficiency factors are not constant. They depend on current. In making the comparisons, it is important to note that the pack voltage is different than the wall voltage, so power is a better parameter to use than current for this type of comparison.

TABLE 5-4 SUMMARY OF POST OFFICE SITES AND VEHICLES WITH DAIS UNITS

Fountain Valley	Linda Vista	La Mirada	Royal Oaks	Alameda
016	198	233	357	362
029	210	236	358	378
030	232	245	402	383
031	312	306	407	396
033	314	308	412	416

Only a limited amount of time was available to conduct quality control efforts on the initial data from the ECRVs. Additional quality control efforts are needed to establish a permanent database for the ECRVs. The screening steps for importing data discussed above and a data value verification step (to confirm each parameter is within expected range) are important steps in the needed quality control effort.

Preliminary “Out-of-Range” values were identified for each parameter using available data on the DAIS. These out-of-range values are listed in Table 5-5.

TABLE 5-5 PRELIMINARY OUT-OF-RANGE VALUES FOR DATA PARAMETERS

Parameter	Charge File Min. Value	Charge File Max. Value	Drive File Min. Value	Drive File Max. Value
Wall Current (amps)	0	50	0	0
Cumulative Wall Energy (kWhr)	0	60	0	0
Battery Pack Voltage (volts)	0	400	0	400
Battery Pack Current (amps)	-75	50	-600	200
Battery Pack Power (kW)	-25	20	200	100
Cumulative Battery Pack Current (Ahr)	-150	100	-1200	400
Cumulative Battery Pack Energy (kWhr)	-30	50	0	50
Battery Pack Temperature (deg. C)	0	100	0	100
Vehicle Speed (mph)	0	0	0	100
Miles Driven (miles)	0	0	0	100
Ambient Temperature (^{o}C)	-50	50	-50	50

Once the data were screened and incorporated into the initial database, an Access Query was written to produce daily summary tables. The parameters included in the daily summary tables are shown in Table 5-6. The daily summaries allow the report generator to run more quickly, without the need to access and process the raw data every time a report is prepared.

The report generator constructed by RMA provides the user with an option to generate three types of reports for each parameter. These is a **detailed report** that shows the daily data, a **monthly report** that shows monthly averages and/or totals, and a **summary** report that shows the total and/or average for the entire time period selected. The user has the option to select one or more vehicles for each report, and reports may be generated for any range of days for which data are available. The reports also have options for charting the data.

Whenever a report query is run, the report generator produces the report, together with an error report that summarizes the import errors and the screening errors applicable to the data used. The system is capable of generating the following reports:

- Vehicle daily usage level (e.g. operating hours per day)
- Vehicle monthly usage level (e.g. operating days per month)
- Vehicle miles driven (e.g. miles per day)
- Vehicle energy use over time (e.g. kW-hr per day or per month)

- Vehicle energy use over distance (e.g. kW-hr per mile)
- Vehicle charge time (e.g. hours to reach full charge)
- Battery pack energy flow (e.g. kW-hr into pack, kW-hr out of pack)
- Battery pack temperature

TABLE 5.6 PARAMETERS INCLUDED IN THE DATABASE DAILY SUMMARY TABLES

<table>
<tr><td rowspan="2">Miles Driven</td><td>Miles driven</td><td rowspan="2">Vehicle Energy Use</td><td>Wall kW hours</td></tr>
<tr><td>Days driven</td><td>Miles driven</td></tr>
<tr><td rowspan="3">Drive Charge Time</td><td>Drive minutes</td><td rowspan="8">Temperature Ranges Ambient</td><td>-50 - 0 ºC</td></tr>
<tr><td>Charge Minutes</td><td>0 - 15 ºC</td></tr>
<tr><td>Not Used Minutes</td><td>15 - 30 ºC</td></tr>
<tr><td rowspan="5">Pack Energy</td><td>Drive kW positive</td><td>30 - 50 ºC</td></tr>
<tr><td>Drive kW negative</td><td>Max. Ambient</td></tr>
<tr><td>Drive kW net</td><td>Min. Ambient</td></tr>
<tr><td>Pack Charge kW</td><td rowspan="2">Avg. Ambient</td></tr>
<tr><td>Pack kWhrs</td></tr>
<tr><td rowspan="5">Charge Profile</td><td>Low charge</td><td rowspan="6">Temperature Ranges Pack</td><td>0 - 25 ºC</td></tr>
<tr><td>High charge</td><td>25 - 50 ºC</td></tr>
<tr><td>Morning charge</td><td>50 - 100 ºC</td></tr>
<tr><td>Day charge</td><td>Min. Pack</td></tr>
<tr><td>Night charge</td><td>Max. Pack</td></tr>
<tr><td>Wall Energy</td><td>Wall kW hours</td><td>Avg. Pack</td></tr>
</table>

5.3 Analysis of the DAIS Data

The Report Generator was run to prepare a range of reports using the available DAIS data. The data span used for the DAIS reports is from vehicle deployment date to the end of 2002. In most cases this represents more than one year since the DAIS units were placed in operation. Reports were generated for a range of variables derived from the DAIS data. The reports are included in Appendix F.

A comparison of the DAIS data for the five sites is presented in Table 5-7. This table includes miles and days driven, electricity delivered to the pack (pack electricity), and the average daily hours driven and hours on charge for each of the five sites. The trends in miles per day and energy efficiency for all 25 DAIS vehicles are shown in Figures 5-1 and 5-2 respectively. There was considerable variability in the trend of energy efficiency for the five sites. This is not unexpected given that there were gaps in the data.

The energy efficiency data presented in Table 5-1 and in Figure 5-2 are derived using a measure of electricity flowing into the battery pack. This results in a higher value (1.55 miles per kWh) than previously estimated for the fleet using odometer readings and electricity totals for these five sites (0.92 miles/kWh) (Table 3.9). This is because the losses from the meter to the vehicle battery pack are not accounted for in the DAIS data. The large difference between these figures suggests there is a considerable efficiency penalty due to parasitic loads and system losses.

TABLE 5-7 SUMMARY OF DAIS DRIVE DATA

Post Office Location	Miles	Days Driven	Pack Electricity (kWh)	Average miles/day	Pack Energy Efficiency (miles/kWh)	Hours Driven per Day	Hours on Charge per Day	Average Speed (mph)
Alameda	8,867	827	5,831	10.7	1.52	1.17	14.9	9.2
Royal Oaks	8,882	831	5,183	10.7	1.71	0.58	15.8	18.4
Fountain Valley	6,555	702	4,528	9.3	1.45	0.47	15.1	19.9
Linda Vista	6,815	884	3,638	7.7	1.87	0.55	17.5	14.0
La Mirada	6,349	860	5,052	7.4	1.26	0.43	17.0	17.2
All	**37,468**	**4,104**	**24,231**	**9.1**	**1.55**	**0.64**	**16.14**	**14.3**

The range in the average route lengths for the DAIS vehicles was between 7.4 miles per day (average for La Mirada) and 10.7 miles per day (average for Alameda and Royal Oaks). The average energy efficiency for the five DAIS sites shows some correlation with the miles driven, but, again, there is considerable variability in the data.

The Ford Concern Report (CR) data included eleven CRs applicable to battery problems with the DAIS vehicles (Table 5-8). Of these eleven, six were pre-delivery and one was a "clear code". For the four remaining, there was no data for two of the four (CRs 815, 941). For the two remaining CRs (892 and 0125), the vehicle DAIS data were reviewed for the week prior to the repair work, in order to determine whether any indicators of impending battery problems could be identified.

FIGURE 5-1 DAIS VEHICLES - MILES PER DAY

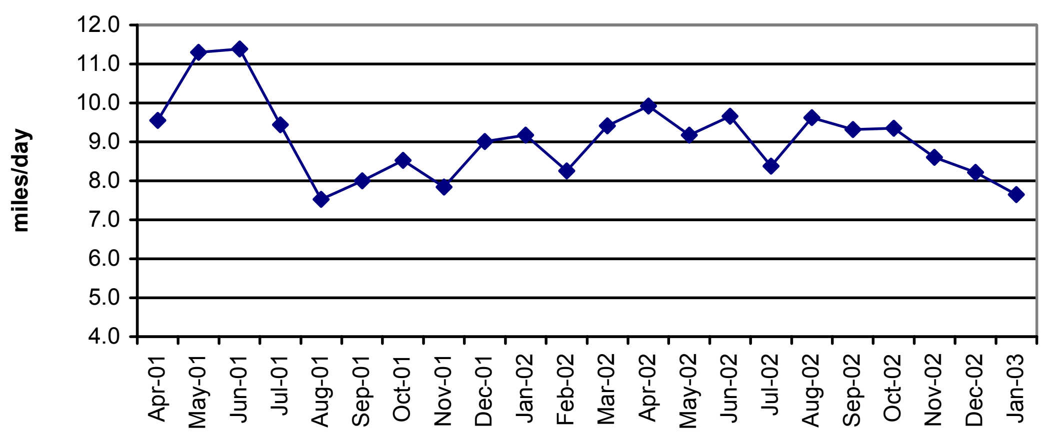


FIGURE 5-2 DAIS VEHICLES - ENERGY EFFICIENCY

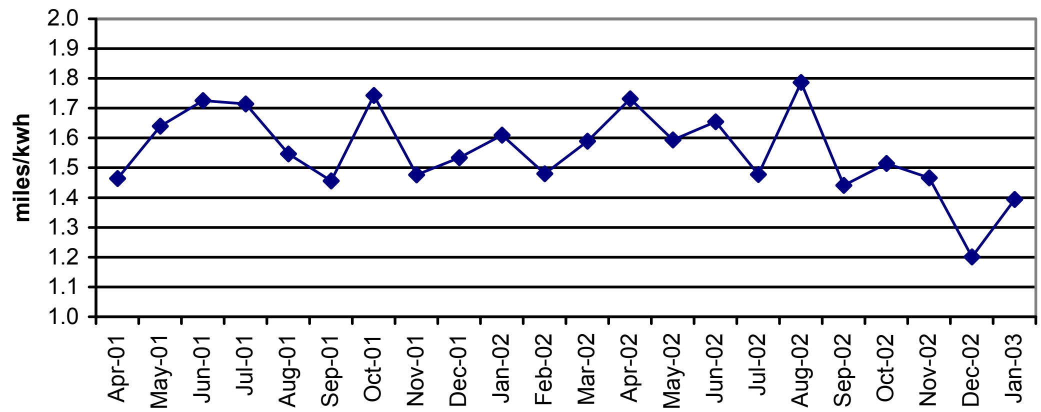


TABLE 5-8 SUMMARY OF FORD CONCERN REPORTS FOR THE DAIS VEHICLES

CR #	ECRV ID#	Date of Call	Odometer	Indicator	# Modules Defective	Replace Modules/Pack	Days Out	
627	016	21-Aug-02	1525	Wrench Light	N/A	N/A	1	Clear Codes
815	029	13-Dec-02	7,158	Low Range	2	Modules	1	
008	029	21-Mar-01	416	Low Range	1	Modules	1	Pre-delivery
892	233	19-Dec-02	4353	Wrench Light	3	Modules	1	
941	314	10-Jan-03	2644	Elec. Circuit Prob.	?	Pack	1	
9031	357	9-Jan-02	118	Wrench Light	1	Modules	33	Pre-delivery
9038	358	26-Mar-02	61	Low Range	1	Modules	32	Pre-delivery
9025	378	17-Dec-01	70	Wrench Light	?	Pack	0	Pre-delivery
9033	402	15-Jan-02	83	Wrench Light	1	Modules	42	Pre-delivery
9125	416	2-Dec-02	3,985	Low Pack Capacity	8	Modules	11	
9022	416	20-Dec-01	52	Low Range	?	Pack (Swap)	41	Pre-delivery

In this review, the only possible indicator of an issue was the pack current early in the program compared with the pack current immediately prior to the event for Vehicle #416 (Figure 5-1). From this figure, it can be seen there was a decline in the pack current from 12 amps soon after deployment (Dec. 21, 2001) down to 10 amps immediately prior to the battery work (Nov. 27, 2002). No other obvious indicators of battery problems were evident in the DAIS data for these two vehicles.

FIGURE 5-3 (a)
DAIS CHARGE DATA, VEHICLE 416
DECEMBER 21, 2001

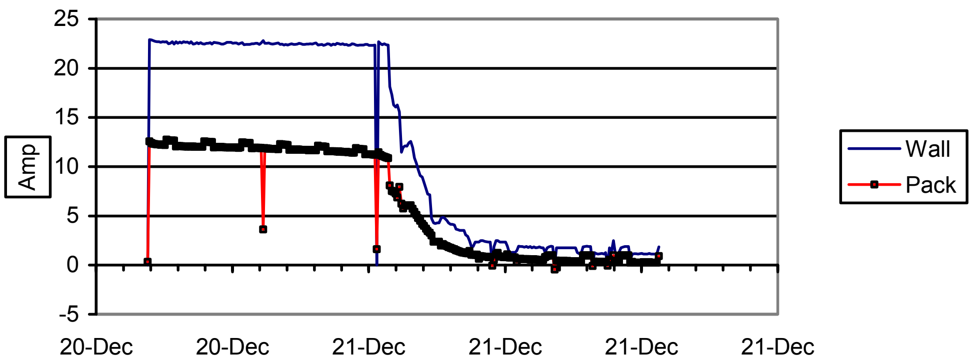
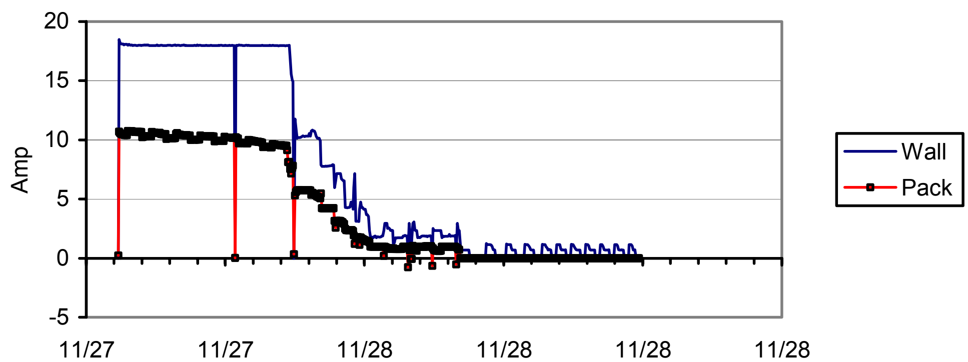


FIGURE 5-3 (b)
DAIS CHARGE DATA, VEHICLE 416
NOVEMBER 27, 2002



6. VEHICLE CHARGING INFRASTRUCTURE

This chapter includes a brief description of a typical ECRV charging demand profile (Section 6.1), the ECRV charging system and equipment (Section 6.2), and a summary of charging system performance and reliability (Section 6.3).

6.1 ECRV CHARGING DEMAND PROFILE

The ECRV charging system at each ECRV deployment site is designed to allow the ECRV traction batteries to be charged daily during the off-peak period designated by the utility. When the ECRV drivers return from their delivery routes in the late afternoon, they connect the ECRVs to the Power Control Station (PCS). Between the time the ECRV is placed “on-hook” and the time when the traction battery charge current is activated by the timer at night, the vehicle draws a low-level of current (called maintenance current) to provide energy for the parasitic loads associated with vehicle accessories and battery pack temperature control. The current supplied to the vehicle cycles on and off during this maintenance mode. Additional parasitic loads occur during the charging of the traction battery for the battery pack temperature control devices (cooling fan and heater). For vehicles with DAIS units, there is an additional parasitic load to operate the data processing and storage hardware.

A typical demand profile during maintenance mode, obtained from the DAIS data, is shown in Figure 6-1. Note that during the maintenance mode, there is no current flowing to the traction battery pack.

As soon as the timer activates power to charge the traction battery pack, the current to each vehicle increases to approximately 20 amps (equivalent to about 4.2 kW at the electricity meter). A typical demand profile during the charging period is shown in Figure 6-2. The demand shown in this figure, obtained from DAIS data, is based on a measurement of current as it flows to the vehicle (“wall current”) and a measurement of current as it reaches the battery pack (“pack current”). Figure 6-3 shows an example of the demand cycle at a single Post Office as the charging system comes on each night (except Sundays).

After the battery pack is charged, the current decreases as the charge cycle is completed. As soon as the charging is complete the battery control module turns off the charge current, and the charging system reverts to maintenance mode. The vehicles are kept on-hook whenever they are not being used. This is the procedure recommended by Ford in the Postal Service ECRV Operator Training Manual.

Based on a review of data obtained from the DAIS units installed on ECRVs at the Fountain Valley Post Office (between February and June, 2001), it appears that the full charge current (about 20 amps, 4.2 kW) is supplied for about two to four hours each evening, depending on the miles driven that day. Charging is completed after about one to two more hours as the power decreases to less than 1 kW. After the battery charging is complete, the system reverts to the maintenance mode. The maintenance mode continues to provide power as needed until the vehicle is taken off-hook.

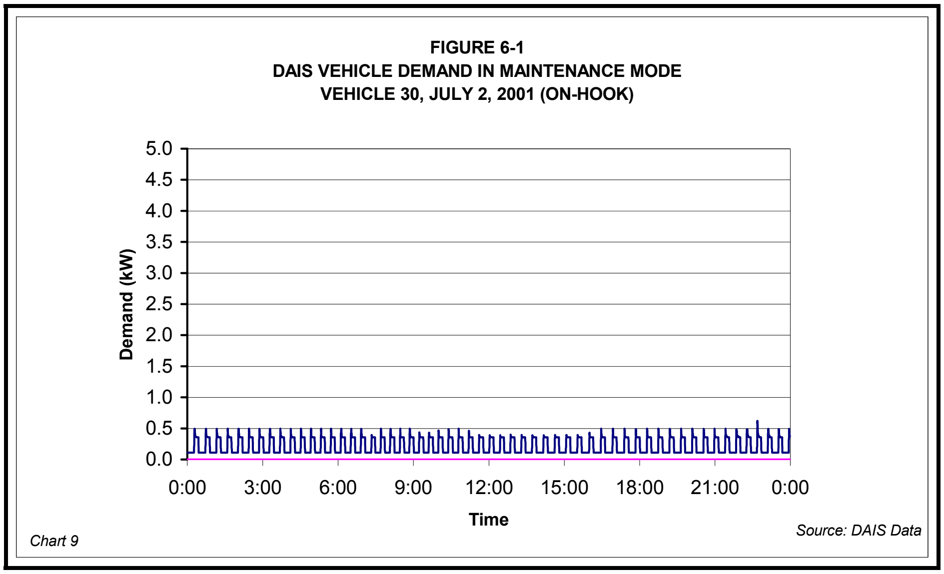


FIGURE 6-1
DAIS VEHICLE DEMAND IN MAINTENANCE MODE
VEHICLE 30, JULY 2, 2001 (ON-HOOK)
Demand (kW)
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0:00
3:00
6:00
9:00
12:00
15:00
18:00
21:00
0:00
Time
Chart 9
Source: DAIS Data

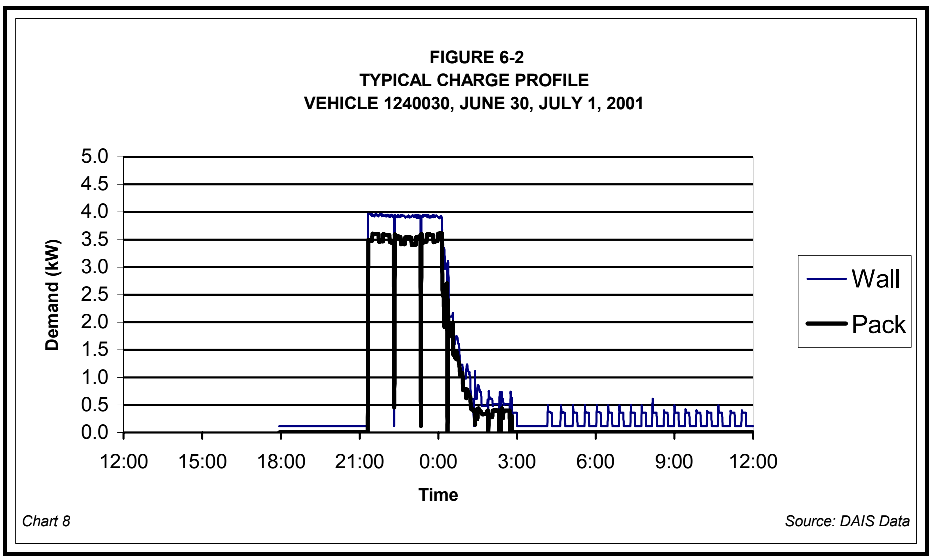


FIGURE 6-2
TYPICAL CHARGE PROFILE
VEHICLE 1240030, JUNE 30, JULY 1, 2001
Demand (kW)
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
12:00
15:00
18:00
21:00
0:00
3:00
6:00
9:00
12:00
Time
Wall
Pack
Chart 8
Source: DAIS Data

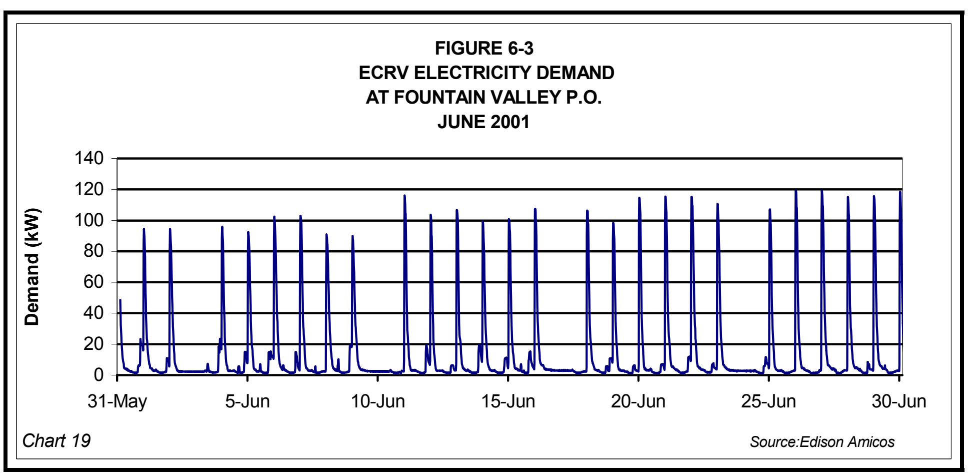


FIGURE 6-3
ECRV ELECTRICITY DEMAND
AT FOUNTAIN VALLEY P.O.
JUNE 2001
Demand (kW)
140
120
100
80
60
40
20
0
31-May
5-Jun
10-Jun
15-Jun
20-Jun
25-Jun
30-Jun
Chart 19
Source:Edison Amicos

6.2 POWER CONTROL SYSTEMS

The Ford ECRV uses an onboard conductive charger. The vehicle is connected to electric charging power via an offboard PCS. The PCS is a DCS-55 Dual Charging Station manufactured by Electrical Vehicle Infrastructure, Inc. (EVI). Each PCS has two charging cables for connection to two vehicles.

For the 500 vehicle ECRV fleet, Ford Motor Company (Ford) installed the PCS units and associated electrical equipment at each of the 22 Post Offices. The PCS units are used to supply electrical current to the ECRV's onboard battery charger when the ECRV is parked at the Post Office. The PCS units also supply power to the ECRV auxiliary systems, such as the battery pack temperature control system, when the vehicle is parked at the Post Office.

Single PCS units were also installed at each of the twelve Postal Service Vehicle Maintenance Facilities (VMFs) that service vehicles for the Post Offices. Table 6-1 presents a list of Post Offices and Vehicle Maintenance Facilities that have charging systems installed. At the time the systems were installed, each Station Manager and Vehicle Maintenance Manager at these facilities was provided an ECRV Program Overview, which provided a general description of the vehicle and the charging system.

The Model DCS-55 Dual Charging Station, manufactured by Electrical Vehicle Infrastructure, Inc. (EVI) of Auburn, California, was selected by Ford. As a cost saving measure requested by the Postal Service (Postal Service Charger Specification 3.2.1), EVI developed the DCS-55 to enable two vehicles to be charged from one charging station.

Each Power Control Station (PCS) supplies electrical current to two ECRVs. A maximum of 20 amps of current, at 208 volts single phase, is supplied to each vehicle by the PCS units. The PCS units are mounted on a pedestal or mounted to an existing wall.

In addition to the PCS units, the main electric infrastructure components installed at each Post Office include the following:

- A new electrical service entrance section housing an electric meter and main circuit breakers.
- A new electrical panel housing 50 amp circuit breakers for each PCS unit.
- A new step-down transformer, when needed to supply the 208-volt current to the PCS units.
- A new or upgraded main transformer, when needed to supply the required electrical current for the ECRVs.
- A timer unit that controls the time-of-day when the vehicles are charged.

The major electrical components installed at each Post Office and Vehicle Maintenance Facility are shown in Table 6-1 on the following page. Photographs showing the electrical infrastructure and charging systems are included in Figure 6-4.

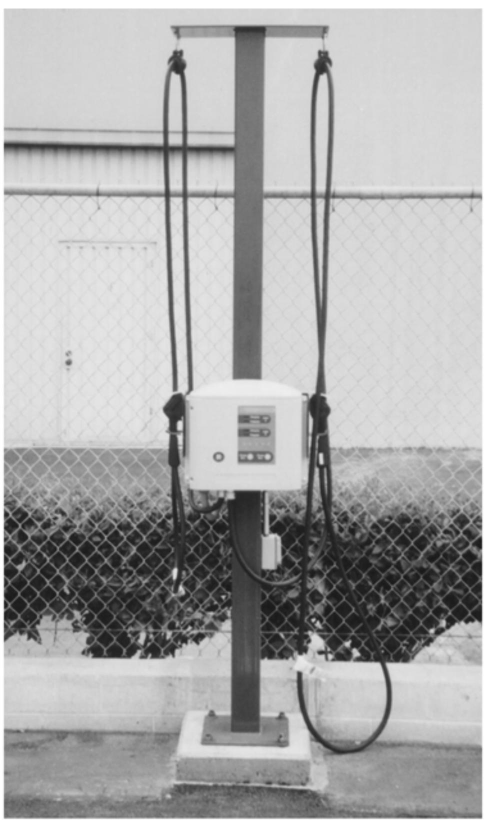
TABLE 6-1 MAJOR ELECTRICAL COMPONENTS INSTALLED AT EACH POST OFFICE AND VEHICLE MAINTENANCE FACILITY

Site Name	# of Vehicles	Infrastructure Components Installed				
		Service Entrance Section	Main Trans. Pad	Step-Down Trans.	EV Panel	# of PCS Units
Huntington Beach VMF	0	- -	- -	- -	- -	1
Fountain Valley P.O. (DAIS)	28	X	- -	X	X	14
Ida Jean Haxton Station P.O.	25	X	- -	- -	X	13
Irvine Harvest Station P.O.	24	X	- -	X	X	12
Costa Mesa Main P.O. (Leased)	20	X	X	- -	X	10
Los Angeles Central VMF	0	- -	- -	- -	- -	1
Dockweiler Station P.O. (Leased)	40	X	X	X	X	20
Alameda Station P.O.	24	X	- -	X	X	12
Los Angeles North VMF (Leased)	0	- -	- -	- -	- -	1
Los Feliz Station P.O.	32	X	X	X	X	16
Bicentennial Station P.O.	33	X	X	X	X	17
San Diego Midway VMF	0	- -	- -	- -	- -	1
Bostonia Station P.O. (Leased)	20	X	- -	- -	X	10
Linda Vista Station P.O. (DAIS)	22	X	- -	- -	X	11
La Puente VMF (Leased)	0	- -	- -	- -	- -	1
El Monte Main P.O.	30	X	- -	X	X	15
San Gabriel Main P.O.	20	X	- -	X	X	10
Glendora Main P.O.	20	X	- -	- -	X	10
Covina Main P.O. (Leased)	20	X	X	X	X	10
Long Beach VMF	0	- -	- -	X	- -	1
La Mirada P.O. (Leased) (DAIS)	15	X	- -	- -	X	8
Pico Rivera P.O. (Leased)	16	X	X	- -	X	8
Norwalk P.O.	26	X	X	- -	X	13
Torrance VMF (Leased)	0	- -	- -	- -	- -	1
Harbor City P.O.	5	- -	- -	- -	- -	3
San Jose VMF	0	- -	- -	- -	- -	1
Blossom Hill Station P.O.	20	X	X	- -	X	10
Oakland VMF (Leased)	0	- -	- -	- -	X	1
Alameda Main P.O. (Leased) (DAIS)	20	X	X	- -	X	10
Sacramento Main VMF	0	- -	- -	X	- -	1
Royal Oaks Station P.O. (DAIS)	20	X	X	X	X	10
West Chester VMF	0	- -	- -	- -	- -	1
White Plains P.O.	5	N/A	N/A	N/A	N/A	3
Brightwood VMF	0	- -	- -	- -	- -	1
Lamond Riggs Station P.O.	14	X			X	7
USPS Engineering Merrifield	1	- -	- -	- -	- -	0
Total	**500**	- -	- -	- -	- -	**264**

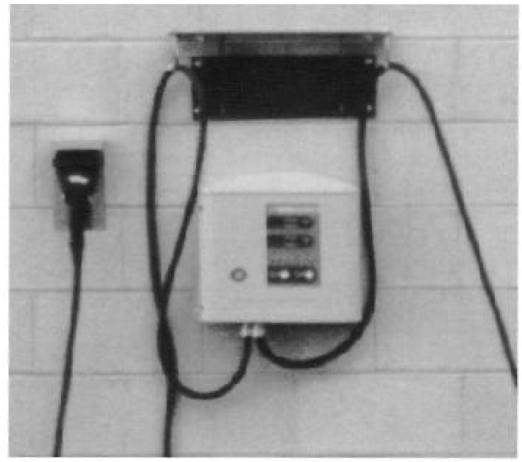
Notes
X = Installed with initial purchase
Initial Purchase of 500 vehicles

FIGURE 6-4 ELECTRICAL INFRASTRUCTURE AND CHARGING SYSTEMS

ECRV with Power Cord Attached



Pedestal-Mounted
Power Control Station (PCS)
Charges Two ECRVs



Wall-Mounted Power Control Station
Charges Two ECRVs

New Service Entrance Section with Meter

New Electrical Panel, Timer Control
and Step-Down Transformer

During the installation of the electric infrastructure, certain electrical components were sized to enable all the Carrier Route Vehicles at the Post Office to be replaced with ECRVs in the future. Specifically, the Postal Service Charger Specification 3.2.3.2 required new transformer pads, service entrance sections, buried conduit, and conduit placed in walls, to be sized to accommodate the total number of Carrier Route Vehicles located at each Post Office. This requirement was implemented to reduce future costs associated with deployment of additional ECRVs at these Post Offices. This requirement also reduced the potential that newly installed electrical components would need to be replaced to accommodate additional ECRVs at these Post Offices.

6.3 CHARGING SYSTEM PERFORMANCE AND RELIABILITY

In the ECRV Baseline Performance Testing conducted by Southern California Edison (SCE), the charging system performance specifications for total power factor (PF) and total harmonic distortion (THD) were easily satisfied by these units. Vehicles were successfully and fully charged in under 8 hours as required, with the “bulk” of the charge occurring in the first 5 hours.

Also in the Baseline Performance Assessment, SCE determined the power conversion efficiency of the on-board charger. For the two vehicles they evaluated, the efficiency factors were 85.1% and 86.9% at maximum power, and 81.6% to 82.0% over the full charge cycle (SCE, October 2000, page 16). These values do not account for any parasitic losses during the maintenance mode.

There have been some reports that the charging connector does not release easily from the ECRV. This concern was raised by Carriers at Fountain Valley and at Dockweiler. Ford has been replacing or repairing equipment, as necessary.

In the Satisfaction Survey conducted in April, 2003, there were a high number of unfavorable responses from the Post Offices Managers regarding the charging systems (refer to Chapter 4). Further inquiry is needed to understand the reasons for this, but some possible explanations could be the faulty release discussed above, or it may be a perception gained when the batteries fail to hold charge for an adequate length of time.

7. OTHER PROGRAM ACTIVITIES

During the time since the ECRV Program was conceived, the Postal Service has sponsored and commissioned many studies to help with the process of vehicle acquisition, site selection, vehicle acceptance testing, data collection and monitoring performance. Details of the site selection studies were discussed in Chapter 2 of this report; Customer Acceptance Testing was discussed in Chapter 4; and the Data Acquisition and Integration System (DAIS) was described in Chapter 5.

This chapter includes a brief summary of the work conducted by Southern California Edison (SCE) on Baseline Performance Testing and Accelerated Reliability Testing prior to the full-scale fleet deployment (Section 7.1). This information is based on a review of the formal reports issued by SCE covering these topics. Also included is a review of the ECRV Life Cycle Cost and Performance Evaluation study conducted by Ryerson, Master and Associates, Inc., in 2001 (Section 7.2).

7.1 ECRV BASELINE PERFORMANCE AND ACCELERATED RELIABILITY TESTING

Between July and December 2000, Southern California Edison (SCE) conducted Baseline Performance tests on two of the first ECRVs produced by Ford, and in December 2000, SCE began testing two other ECRVs for the Accelerated Reliability Test. The Accelerated Reliability Test will continue for a one year period, and SCE is expected to drive each vehicle over 20,000 miles in the one-year period. Results from the Baseline Performance Test and the Accelerated Reliability Test are discussed in Chapter 7.

The Baseline Performance Test was conducted on two ECRVs by SCE during the latter part of Year 2000. Results are documented in SCE's quarterly reports for October and December 2000 (SCE, 2000). SCE reported that, on the USPS Pomona delivery route that "duplicates the stop-and-go driving style of a house-to-house delivery route," the vehicles achieved a range of approximately 31 miles. During the tests, the vehicles were loaded to their maximum weight limit. (The maximum payload is 1,250 pounds.) On a more typical urban driving range, and also at maximum weight, the vehicles achieved 43 miles. The range of each vehicle was tested periodically as the vehicles accumulated miles. After reaching 10,000 miles, results revealed little loss of range. On the urban loop, range remained at about 40 miles.

The vehicles satisfied the minimum requirements set by the USPS for acceleration and braking. Acceleration did diminish somewhat as batteries lost power; however, the minimum performance requirements were still satisfied.

In the SCE road-handling test, the vehicles performed comparably to equivalent gas-powered vehicles. After each test run, the driver filled out a survey regarding the performance of the EV.

The results were as follows:

1. The vehicle feels safe and stable.	Agree
2. The vehicle steering is responsive.	Agree
3. The vehicle acceleration is adequate.	Strongly agree
4. The vehicle braking is safe and responsive.	Strongly agree

The driver reported that "both electric and gasoline vehicles performed equally with regard to handling and safety."

7.2 ECRV LIFE CYCLE COST AND PERFORMANCE EVALUATION

Shortly after the ECRVs were deployed at the first three sites, the Postal Service commissioned a study by RMA to evaluate the Life Cycle Cost and Performance of the ECRVs based on information available at the time (RMA, 2001a). The main purpose of the study was to provide information to the Postal Service to help them make decisions concerning additional vehicle purchases under the existing contract with Ford. This involved data collection for the ECRVs and for other Carrier Route Vehicles used by the Postal Service for comparison purposes.

Although there had been only a short period of time for the Postal Service to gain operating experience with the ECRVs, the contract with Ford required the Postal Service to make a decision on the First Purchase Option for 1,000 additional ECRVs before 75% of the Initial Purchase ECRVs were delivered. This was necessary for Ford to avoid the need to temporarily discontinue the vehicle production process.

Intensive ECRV data collection and analysis was performed at the Fountain Valley Post Office, the Ida Jean Haxton Post Office, and the Dockweiler Station Post Office. At these three sites, there were a total of 93 ECRVs. Five of the ECRVs delivered to the Fountain Valley Post Office contained Data Acquisition and Interface Systems, which provided more performance data for these vehicles.

Comparison data were also collected on the costs and performance of the gasoline Long Life Vehicles (LLVs), the ethanol/gasoline Flex Fuel Vehicles (FFVs), and the Chrysler EPIC Electric Vehicles that were being operated at the Harbor City Post Office in Los Angeles.

Even though the available ECRV data spanned only a short period of time, quality data were obtained for a number of important cost and operating parameters. Valuable data were obtained on electricity use patterns, electricity costs, infrastructure costs, vehicle operator satisfaction, and early vehicle repair requirements.

Due to the short operating history of the ECRVs, insufficient data were available to reliably predict the life cycle repair and maintenance costs, battery replacement costs, and other long-term cost factors for the vehicle. To help address these important consideration, repair and maintenance data available for other electric vehicles were reviewed.

Using the available data, life cycle cost estimates were developed for each vehicle type, and the performance of the ECRVs to date was compared with that for the LLV. The final report included a number of recommendations for enhancing the ECRV program. One of the most significant conclusions was that there is considerable uncertainty in the battery cost and performance. A number of recommendations were included to help the Postal Service find ways to minimize the risk associated with this factor.

During 2003, the operating costs (for electricity) were updated using more extensive data for the same three Post Office locations (RMA, 2003). It was found that the energy efficiency of the ECRVs at the same three Post Offices over a longer time span (just under one year) was substantially the same as first reported. The update report also reviewed the extent to which the ECRV fleet and the associated infrastructure could be used as a “stepping stone” for other advancing vehicle technologies such as gasoline-battery hybrids and fuel cell vehicles.

8. CONCLUSIONS

This chapter summarizes some of the main conclusions on the experience gained by the Postal Service from implementing the ECRV Program. Section 8.1 presents some of the main ECRV Program accomplishments, Section 8.2 summarizes the Postal Service experience with the ECRV batteries and other vehicle limitations, and Section 8.3 includes a discussion on "lessons learned" during the implementation of this program. The final section presents an overall summary of the program including the current status.

8.1 ECRV PROGRAM ACCOMPLISHMENTS

Some of the more significant program accomplishments are presented below:

- The Postal Service has operated the 500 ECRVs for nearly two years. Over two million miles have been accumulated by the fleet, using about two million kWh of electricity. This represents a significant utilization of alternative fuel.

- The ECRV Program has yielded significant technology and data that are useful to the industry and program stakeholders. The vehicles have yielded tangible benefits to air quality during their deployment period.

- To enable the ECRV Program to proceed, the Postal Service – together with Ford and other stakeholders – succeeded in securing financial subsidies from a wide range of government agencies and electric utilities. With this funding, Ford was able to offer the Postal Service the new ECRVs at a purchase price competitive with gasoline vehicles, and the subsidies also helped to offset the costs of installing charging infrastructure.

- In collaboration with contractors, the Postal Service implemented a cost-saving measure that enables two vehicles to be charged from one charging station. The charging stations are easy to use and very convenient for the Carriers. The infrastructure also includes a separate electricity meter for the ECRVs at each Post Office, so that electricity use and costs can be tracked separately from other electrical usage at the Post Office.

- Mail Carrier satisfaction with the ECRVs has been favorable. Carriers have commented that they like not having to visit off-site refueling stations, and they like the clean, quiet characteristics of the ECRV.

- The Accelerated Reliability Testing conducted by Southern California Edison found the ECRV road-handling characteristics to be good, including adequate acceleration, good vehicle stability, and responsive braking and steering. A number of performance problems identified during pilot vehicle testing have been corrected. Many ergonomic concerns with the ECRV have also been resolved.

- The Data Acquisition and Interface Systems installed on 25 of the vehicles have accumulated detailed information on energy flow to and from the vehicle batteries, and other vehicle performance characteristics from deployment to the present.

- Vehicle availability to date for the ECRVs has been comparable with similar gasoline Long Life Vehicles used by the Postal Service for mail delivery.

8.2 ECRV LIMITATIONS

Some of the performance and cost issues associated with the ECRV batteries and other vehicle limitations are presented below:

- There remains significant uncertainty in the projected battery life and the cost associated with ECRV battery pack replacements. For a BEV, the frequency and cost of battery pack replacement have a significant impact on the life cycle cost. During the last three years, the costs for lead acid BEV batteries have not decreased as many anticipated. Data from Ford regarding the costs associated with recent ECRV pack replacements suggest that battery pack replacement costs have increased considerably.

- A considerable percentage of warranty repair work has been devoted to battery repairs. Battery modules have been repaired on 122 vehicles and battery packs have been replaced on 41. These data indicate that the ECRV battery pack life may be less than three years, as used for life cycle cost estimates.

- A high number of warranty repairs has been made by Ford on the ECRV fleet to date. In addition to the battery module repairs and replacements, other component categories with high numbers of repairs include 12-volt components (including water pumps) and wiring and harnesses.

- The relatively high production cost for the vehicle has been a key concern. This is not unusual for a new vehicle involving a new technology. Established production models have demonstrated that, if demand and production levels increase, the unit costs can be reduced to competitive levels over time (Sperling, 1995). However, increased demand for BEVs has not materialized, and there has been no reduction in BEV production cost.

8.3 LESSONS LEARNED FROM THE ECRV PROGRAM

Some lessons learned from the implementation of the ECRV Program are presented below:

- With the operation of any fleet that utilizes electrical charging systems, detailed planning is in order to avoid regular charging during the daytime and evening hours when electricity rates are the highest. This planning effort should include developing strategies for electrical load management, ensuring that charging system time clocks are adjusted properly, and using the best available electricity rate structures. Training for personnel and subsequent program audits are also important elements for maximizing efficiency.

- Precise guidelines have been lacking for deciding when a replacement pack is needed. This has led to uncertainty that makes it hard to make sound decisions about additional commitments to this technology. Defining the performance measures that trigger the need for battery pack replacements in vehicle acquisition contract documents could be a significant advantage.

- As new technologies utilizing alternative fuels are implemented, enhancements may be needed to the traditional databases used for tracking costs and performance metrics. New or revised management systems may be needed for capturing operating and maintenance data specific to the new technology during the early phases of a demonstration program.

- When Data Acquisition Systems are being installed on some (or all) vehicles within the fleet, there is a need to establish a database management system that defines how the data will be collected and processed, what quality control procedures will be used, and who will be responsible for maintaining the database system.

- Manufacturer warranty support has been critical for keeping the ECRV fleet operational to date. Such support is likely to be essential for any new technology vehicles that are brought into delivery fleet operations in large numbers.

- Emerging technologies that may replace or augment the vehicle being acquired should be considered to ensure that program investments on infrastructure, training, and maintenance practices are not lost as the newer technologies gain ground.

- Cost projections for new vehicles and new vehicle components can vary significantly during the years when a new technology is being demonstrated. At the time of ECRV deployment, there was an expectation that BEV production costs would decrease as California and other state Zero Emission Vehicle programs called for a higher level of BEV sales. Subsequently, this growth scenario has not materialized. Based on current information from Ford, the anticipated costs for maintaining the ECRV fleet through a normal vehicle life cycle far exceed the early estimates.

- The warranty agreements for new technology vehicles could benefit from a different emphasis than those for gasoline vehicles. With a conventional vehicle, the drive train has extremely high reliability, and the warranty provides the buyer with assurance that they will not have to change this major component under normal circumstances. With Alternative Fuel Vehicles, components are often unproven, and normal degradation may be expected (such as with the battery packs on the ECRVs).

8.4 PROGRAM SUMMARY AND CURRENT STATUS

With nearly two years of operating experience now available for the Postal Service 500-vehicle Electric Carrier Route Vehicle (ECRV) fleet, a substantial amount of data has been compiled on the performance of these BEVs. The program has provided valuable experience for the Postal Service, and this experience is likely to be helpful as other advanced technologies are tested and demonstrated in the future. The lessons learned may also be helpful to other organizations involved with the operation of a fleet of light duty vehicles in similar applications.

Many of the performance issues identified during the course of operating the ECRV fleet are similar to those that may be expected for any new type of vehicle or vehicle technology. Over time many of those issues could be adequately addressed with changes in the design, production or operation of the vehicles. As an example, problems with the ECRV power steering and water pump have been addressed by improving the quality in the supply chain. Costs for electricity have been similar if not less than for gasoline, and a number of opportunities were identified for improving the efficiency and cost-effectiveness of the program.

On the other hand, limitations with the traction batteries have been a pervasive problem. There has been considerable uncertainty associated with battery cost, performance and reliability. Considerable effort has been invested by the Postal Service, Ford, and other program stakeholders to gather more data on battery performance, and to identify ways to address the cost and performance challenges. These efforts have not been successful, however, and the decision has now been made to terminate the ECRV Program.

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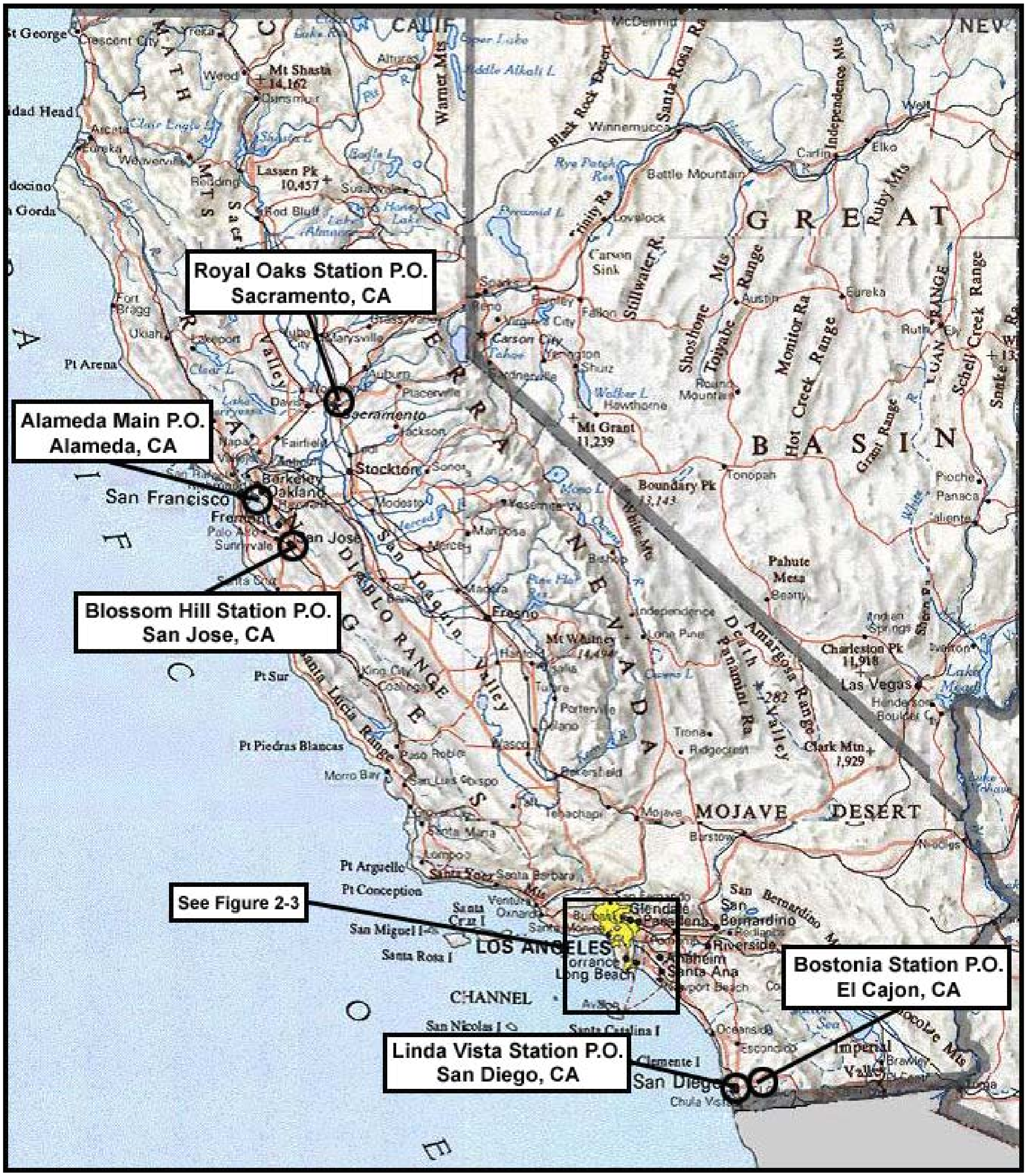

FIGURE 2-2 ECRV DEPLOYMENT SITES IN CALIFORNIA

FIGURE 2-3 ECRV DEPLOYMENT SITES IN THE LOS ANGELES AREA

FIGURE 2-4 ECRV DEPLOYMENT SITE IN NEW YORK

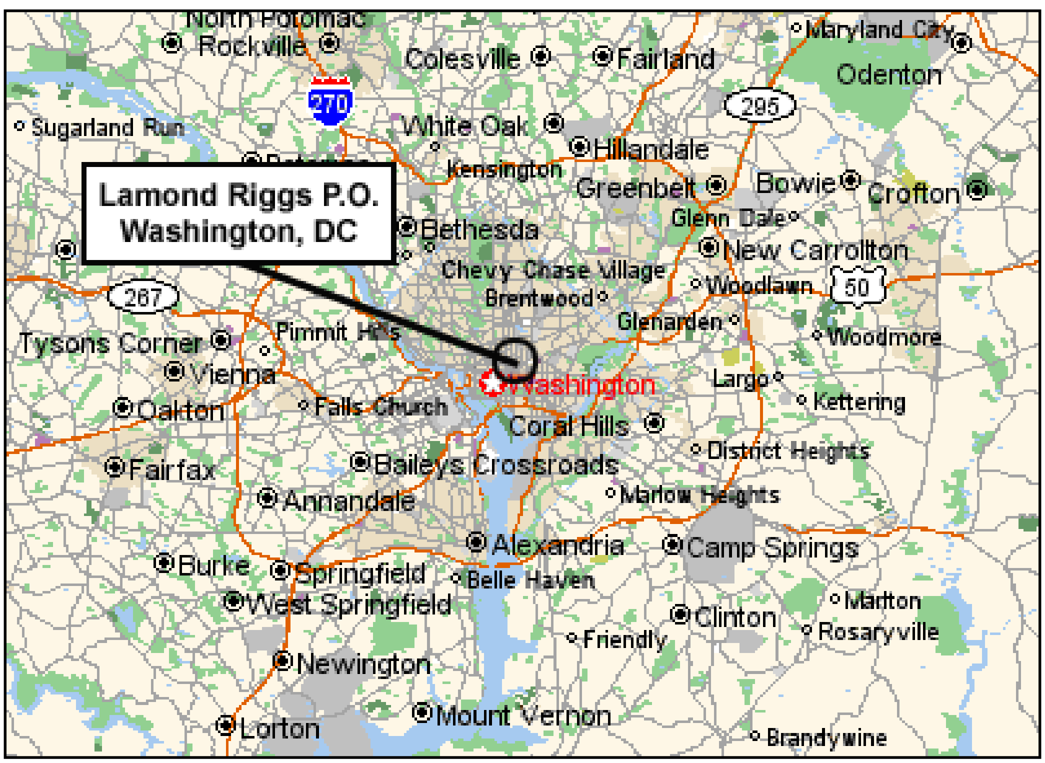

FIGURE 2-5 ECRV DEPLOYMENT SITE IN WASHINGTON DC

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E.1 SURVEY OBJECTIVES AND METHODOLOGY

In April 2003, a questionnaire was designed and distributed to the Post Office Managers and Letter Carriers at the 22 sites with Electric Carrier Route Vehicles (ECRVs). More than 100 Carriers were randomly selected (out a total of 500). The questionnaires were distributed with a Self Addressed Envelope (SAE) so the Carriers could return the completed questionnaires directly to Ryerson, Master and Associates, Inc. This approach was used to ensure the Carriers had the opportunity to provide candid comments on the performance of the ECRVs without being concerned about having statements and remarks attributed directly to them.

The questionnaires for the Managers and the Carriers included a list of statements relevant to the vehicle performance. Respondents were asked to circle the number that best indicates the extent to which they agreed or disagreed with each statement using the following guide:

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5

The statements were intentionally designed to solicit feedback on vehicle performance (operational and maintenance) rather than to request opinions about the ergonomics. This was intentional, because Carriers have expressed concerns about the vehicle height (driver platform and rear cargo bay) in previous interviews and surveys, including the Customer Acceptance Test.

Post Office Managers were also asked to provide additional feedback on the features of the vehicle that they liked and disliked, and on the types of comments made by customers about the ECRVs.

Responses were obtained from 12 Managers and 44 Carriers. Section E.2 provides a complete list of the comments received from the Carriers (E.2.1) and the Managers (E.2.2). Section E.3 provides a summary of the questionnaire ratings for the Carriers (E.3.1) and the Managers (E.3.2). To analyze the results, the number of responses in each rating category (1-5) were totaled for each statement. To provide a consistent way of interpreting the average ratings, the ratings for “negatively” phrased questions were reversed and an “adjusted score”. Results were then expressed as percentages with favorable and unfavorable responses.

Observations and conclusions concerning the survey are included in Section 4.3 of the main report.

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E.2 SURVEY COMMENTS

E.2.1 CARRIER COMMENTS

The following is a list of comments provided by the Carriers in their questionnaire responses:

“The ECRV is too high for a drive rte., lacks power going up hill, and is a safety hazard. It is too quiet, people walking can't hear you coming and walk out in front of you. There is no need for a window in the back compartment (anti-theft device?).”

“It's not a good vehicle for delivering mail. It's too high and is not good for a mail truck.

“Vehicle sits too high. Cannot step up into rear cargo area. Distance with charge is horrible. I cannot complete a collection on full charge, which is 1-1/2 hours straight with approximately 30 stop and starts.”

“For the two years I've driven the vehicle, the only problem I've had was with the brake booster going bad and that was after having it for about two years”

“ECRV need some type of sound when turn on so people around you can know you are moving. I think this is extremely important to add to this vehicle. I've had some incidents when taller people cross my path and I start moving. It would be very hard to see a toddler from an ECRV because it is so high. Battery for ECRV needs more improvement for longer routes.”

“Defroster doesn't work very well in cold rainy weather. You end up having to wipe windows to see. Rear bumper makes it difficult to access cargo from rear door.”

“No hills.”

“For customer safety I think a back up noise should be made to let customers know that vehicle is on. Vehicle is very quiet and most people outside the vehicle do not know that vehicle is on.”

“I have had no problems with my ECRV. I like the ECRV much better than gas. I like the bigger size and better shocks. The ECRV is also much easier to drive with more visibility (back window).”

“Only one tow needed in 5,600 miles. I prefer the ECRV over gas types. Very positive reaction by the public. Only drawback is the step down height.”

“The "distance to empty" gage says 60 miles, but I don't think it can go for 60 miles without needed charging.”

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"My personal opinion I would not buy or use this type of vehicle."

"In the winter times, this vehicle is not good."

"Re #15-#18: During the winter months, the use of heat, even for a short period of time, causes the vehicle's performance to deteriorate faster than normal. This is a problem because of low temperatures and the way the battery works."

"Re #14, sometimes you think it's running but it's not. You have to put in park and start again."

"Because the ECRV is very quiet, I would like to install back up warning horn. It would help on residential streets."

"Heater runs the batteries down very quickly! Sometimes worry about making it back!"

"I really enjoy driving the ECRV, knowing the USPS is not polluting the air."

"Better than gas powered heat."

"Whoever ordered these vehicles, has no idea what they're doing!"

"This vehicle is the best thing to hit the P.O. since the Pony Express. I love it."

"Best postal vehicle since I been in the Post Office 30 years."

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E.2.2 POSTMASTER / STATION MANAGER / OIC COMMENTS

The following is a list of comments provided by the Managers in their questionnaire responses. The comments are grouped under each of the four questions included in the Manager questionnaire.

What are the main complaints, if any, you get from your Carriers about the ECRV?

“No complaints. Carriers are satisfied with electric vehicles.”

“The cargo area is too high, difficult to load and unload heavy and big parcels on winter and raining the battery dies at the end of the route.”

“Battery packs don't stay charged for long periods of time.”

“Carriers worry about using them on their routes and then calling”

“Difficult to determine when charging connection is properly attached. Visibility of rear is not as good.”

“Break down too often.”

“Battery life too short”

“Charge.”

“Dismount delivery more difficult because of vehicle height, in and out of rear of vehicle, seat belt is difficult, no adjustable tray.”

“Carriers are upset that they might loose [sic] their vehicles (ECRV)”

“Increase heat output during winter period.”

What aspects of the ECRV do your Carriers most like?

“The side window.”

“No noise, no gas smell, cargo area is big.”

“The speed, cleanliness and size.”

“Don't have to go to gasoline station as gasoline LLVs”

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“No fueling time/cost”

“Engine tune.”

“Not having to refuel.”

“Not having to put gas and it being quiet.”

“Smooth handling, quiet - lower noise level.”

What kind of feedback, if any, do you get from your Post Office customers about the ECRVs?

Some postal customers are surprised that we have electric vehicles.”

“Surprise to see electric vehicle.”

“None.”

“They don't like the height of the vehicle - ground to cargo bed.”

“None”

“None”

“N/A”

“Very quiet while running. Great for the environment. Positive image for the Postal Service.”

Other Comments

“We can not use vehicle on long route. Battery did not last.”

“Overall the carriers love the ECRVs when they work. They are out of service too much and when they fix them, the same problems resurface.”

“The height of the vehicle presents a potential safety hazard for shorter people.”

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E.3 SUMMARY OF SURVEY RESULTS

E.3.1 CARRIER RATINGS

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F.1 INTRODUCTION

This appendix includes the results from running the DAIS data Report Generator to analyze the DAIS data collected by the 25 ECRVs with DAIS units. The DAIS system and the Report Generator are described in Chapter 5 of this report. The data span for the DAIS reports is from vehicle deployment date to the end of 2002. In most cases this represents more than one year since the DAIS units were placed in operation. The DAIS vehicles located at each of the five sites are as follows:

Fountain Valley	Linda Vista	La Mirada	Royal Oaks	Alameda
016	198	233	357	362
029	210	236	358	378
030	232	245	402	383
031	312	306	407	396
033	314	308	412	416

Reports were generated for a range of variables derived from the DAIS data. Observations and conclusions from these reports are included in Chapters 3 and 5 of the main report. An explanation for each type of report is included in the pages immediately following this introduction. The following reports were generated:

All 5 sites (25 DAIS Vehicles):

- Miles Driven – days used and miles driven per day
- Drive/Charge Time – average hours driven and hours on charge per day
- Wall Energy – energy flow to the vehicle from the off-board charger
- Charge Profile – duration and time of charging (maintenance current and full charge)
- Pack Energy – energy flow in and out of the battery
- Vehicle Energy Use – pack energy used per mile driven
- Ambient Temperature Ranges – average hours in specified ranges
- Pack Temperature Ranges – average hours in specified ranges
- Ambient Temperatures – minimum, maximum and average temperatures (C)
- Pack Temperatures – minimum, maximum and average temperatures (C)

Site Averages (Fountain Valley, Linda Vista, La Mirada, Royal Oaks Station, Alameda Main):

- Miles Driven – days used and miles driven per day
- Drive/Charge Time – average hours driven and hours on charge per day
- Charge Profile – duration and time of charging (maintenance current and full charge)
- Pack Energy – energy flow in and out of the battery
- Vehicle Energy Use – pack energy used per mile driven
- Pack Temperature Ranges – average hours in specified ranges
- Pack Temperatures – minimum, maximum and average temperatures (C)

Report Title	Miles driven
Information Provided	Total miles, number of days driven in the period selected, average miles/day
Notes:	A drive file is created by the DAIS on any day when the vehicle is driven. No drive file is created if the vehicle is not used. Data are recorded to the drive file whenever the vehicle is turned on, but not when the vehicle ignition is off. The monthly report gives the number of days driven for each calendar month included in the data range selected.

Report Title	Drive/Charge Time
Information Provided	Number of hours each day the vehicle was "on-hook" (connected to the Power Control Station), being driven, or not used.
Notes:	Number of hours not used is estimated by subtracting the hours driven and the hours on-hook from 24 hours. If there is an error in the DAIS data files such that records were generated for the same time steps in the charge and drive files, then the value for hours not used could become negative, indicating a problem with the data recorded for that day.

Report Title	Pack Energy
Information Provided	Total kWhr delivered to battery by regeneration while being driven (positive drive kWhr), total kWhr supplied by the battery while being driven (negative kWh), the net energy demand (net drive kWhr), and the total energy delivered to the battery while being charged (charge kWhr). Dividing the charge kWhr in this report by the wall energy in the Wall Energy report will provide an indication of charger efficiency.
Notes:	In this table a zero value indicates a very small value, which has been rounded to zero. Days with no values in the database are shown as blanks (null values). Because all data are analyzed using a 24-hour clock (midnight to midnight), the charge energy and the drive energy are not expected to be correlated on a daily basis. However, there will be a correlation in the monthly data and the summary data for the entire period.

Report Title	Charge profile
Information Provided	Number of hours when the wall current is greater than 19 Amps, and number of hours between the wall current is between 1 Amp and 19 Amps. Number of hours when the wall current is greater than 1 Amp at specified time ranges through the day.
Notes:	Report indicates how long the vehicle was on charge in any particular day. Note that the time “on-hook” (see Drive/Charge Time report) may be greater than the sum of times in this report because on-hook will include times when wall current is less than 1 Amp. The time ranges can be used to provide an indication of whether the charging occurred during on-peak or off-peak times. The time periods in the database were based on midnight to 8 am, 8 am to 8 pm, and 8 pm to midnight. Note that these ranges may need to be adjusted for different utility rate structures.

Report Title	Wall energy
Information Provided	Total and daily average of wall energy (kWhr)
Notes:	Days with no charging are shown as null values, as they are not used in the averaging. This ensures that the averages provide data only for days when charging occurred.

Report Title	Vehicle energy use
Information Provided	Average energy use (kWhr/mile).
Notes:	The vehicle energy use is calculated by dividing the wall energy by the miles driven over the selected period. There is no detailed report available for this parameter because the daily charge and drive data are not correlated (since the database uses a 24-hour clock to develop the daily data).

Report Title	Ambient temperature ranges
Information Provided	Number of hours and percent of time that temperatures were within pre-established ranges.
Notes:	Report includes temperature data for each vehicle and for charge and drive files separately. The reports sometimes show days with temperatures of zero. Often these appear to be incorrect because there is no data for the next range. The zero values are not rejected in the error screening because zero could be a legitimate temperature value.

Report Title	Pack temperature ranges
Information Provided	Number of hours and percent of time that temperatures were within pre-established ranges.
Notes:	Report includes temperature data for each vehicle and for charge and drive files separately. The reports sometimes show days with temperatures of zero. These appear to be based on incorrect data records, because there is usually no data for the next data range in the record. The zero values are not rejected in the error screening because zero could be a legitimate temperature value.

Report Title	Ambient temperatures
Information Provided	Minimum, maximum and average temperatures.
Notes:	Report includes temperature data for each vehicle and for charge and drive files separately. The reports sometimes show days with temperatures of zero. These appear to be based on incorrect data records, because there is usually no data for the next data range in the record. The zero values are not rejected in the error screening because zero could be a legitimate temperature value.

Report Title	Pack temperatures
Information Provided	Minimum, maximum and average temperatures.
Notes:	Report includes temperature data for each vehicle and for charge and drive files separately. The reports sometimes show days with temperatures of zero. These appear to be based on incorrect data records, because there is usually no data for the next data range in the record. The zero values are not rejected in the error screening because zero could be a legitimate temperature value.

APPENDIX B - ANALYSIS OF ENERGY EFFICIENCY

ECRV DAYS USED AND MILES DRIVEN

Station Name	FY	AP	Number of Vehicles	Sum of Days Assigned	Sum of Days Not Used	Sum of Days Used	Sum of Days In Shop	Sum of Miles Driven	Avg Miles/Day
Costa Mesa Main PO	**2001**	10	12	288	288	0	0	0	
		11	20	480	466	14	0	34	2.4
		12	20	480	**48**	**432**	0	2909	6.7
		13	20	460	0	460	0	4820	10.5
	2002	01	20	480	0	480	0	4560	9.5
		02	20	460	0	460	0	4462	9.7
		03	20	440	60	380	0	4059	10.7
		04	20	460	60	400	0	5045	12.6
		05	20	440	97	343	0	3250	9.5
		06	20	460	200	260	0	4462	17.2
		07	20	480	175	305	0	5628	18.5
		08	20	480	160	320	0	4360	13.6
		09	20	480	160	320	0	4577	14.3
		10	20	460	95	365	0	4163	11.4
		11	20	460	0	460	0	4654	10.1
		12	20	480	0	480	0	5376	11.2
		13	20	460	**0**	**460**	0	3441	7.5
	2003	01	20	480	0	480	0	3719	7.7
		02	20	460	0	460	0	5184	11.3
		03	20	440	0	440	0	3531	8.0
		04	20	460	0	460	0	6174	13.4
		05	20	440	**0**	**440**	0	**4587**	10.4
		06	20	460	88	372	0	**4587**	12.3
		07	20	480	92	380	8	4259	11.2
		08	20	480	80	400	0	4342	10.9
Totals			**20**	**11448**	**2069**	**9371**	**8**	**102183**	**10.9**

Note: For an explanation of the items in bold and any blank cell refer to the last page of appendix B.1.

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APPENDIX B - ANALYSIS OF ENERGY EFFICIENCY

ECRV DAYS USED AND MILES DRIVEN

Station Name	FY	AP	Number of Vehicles	Sum of Days Assigned	Sum of Days Not Used	Sum of Days Used	Sum of Days In Shop	Sum of Miles Driven	Avg Miles/Day
Covina Main PO	**2002**	05	20	456	456	0	0	0	
		06	20	456	173	283	0	4429	15.7
		07	20	484	4	480	0	5347	11.1
		08	20	484	4	480	0	5319	11.1
		09	20	484	5	476	3	5130	10.8
		10	20	460	18	440	2	4748	10.8
		11	20	460	2	446	16	5341	12.0
		12	20	480	0	475	5	5183	10.9
		13	20	460	0	460	0	4987	10.8
	2003	01	20	480	0	480	0	5200	10.8
		02	20	460	20	440	0	4687	10.7
		03	20	440	0	440	0	4601	10.5
		04	20	460	1	459	0	4900	10.7
		05	20	440	**0**	**440**	0	**4731**	10.8
		06	20	460	87	373	0	**4731**	12.7
		07	20	480	81	399	0	4721	11.8
		08	20	480	82	398	0	4887	12.3
Totals			**20**	**7924**	**933**	**6969**	**26**	**78942**	**11.3**

Note: For an explanation of the items in bold and any blank cell refer to the last page of appendix B.1.

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APPENDIX B - ANALYSIS OF ENERGY EFFICIENCY

ECRV DAYS USED AND MILES DRIVEN

Station Name	FY	AP	Number of Vehicles	Sum of Days Assigned	Sum of Days Not Used	Sum of Days Used	Sum of Days In Shop	Sum of Miles Driven	Avg Miles/Day
El Monte Main PO	**2002**	01	12	288	288	0	0	0	
		02	30	720	676	44	0	844	19.2
		03	30	696	206	490	0	6956	14.2
		04	30	691	20	671	0	8667	12.9
		05	30	660	17	643	0	8145	12.7
		06	30	690	10	680	0	8434	12.4
		07	30	720	10	710	0	8824	12.4
		08	30	720	39	675	6	8657	12.8
		09	30	720	53	654	13	8798	13.5
		10	30	690	48	642	0	8328	13.0
		11	30	690	50	640	0	8405	13.1
		12	30	720	72	610	38	8321	13.6
		13	30	690	77	607	6	8087	13.3
	2003	01	30	720	50	668	2	8682	13.0
		02	30	690	40	622	28	8351	13.4
		03	30	660	47	605	8	7394	12.2
		04	30	690	14	640	36	8267	12.9
		05	30	660	**20**	**640**	0	**7794**	12.2
		06	30	690	60	624	6	**7794**	12.5
		07	30	720	78	608	34	7936	13.1
		08	30	720	72	618	30	8222	13.3
Totals			**30**	**14245**	**1947**	**12091**	**207**	**156906**	**13.0**

Note: For an explanation of the items in bold and any blank cell refer to the last page of appendix B.1.

APPENDIX B - ANALYSIS OF ENERGY EFFICIENCY

ECRV DAYS USED AND MILES DRIVEN

Station Name	FY	AP	Number of Vehicles	Sum of Days Assigned	Sum of Days Not Used	Sum of Days Used	Sum of Days In Shop	Sum of Miles Driven	Avg Miles/Day
Fountain Valley PO	**2001**	01	2	48	48	0	0	0	
		02	4	96	49	47	0	1320	
		03	2	48	21	27	0	1968	
		04	2	48	2	46	0	2	
		05	22	528	526	2	0	2	
		06	27	648	522	126	0	1564	12.4
		07	28	672	233	439	0	5615	12.8
		08	28	672	215	457	0	6624	14.5
		09	28	672	29	643	0	7982	12.4
		10	28	644	39	605	0	7560	12.5
		11	28	644	61	583	0	7686	13.2
		12	28	672	116	556	0	7695	13.8
		13	28	644	29	615	0	6870	11.2
	2002	01	28	672	0	672	0	7652	11.4
		02	28	644	0	634	10	6976	11.0
		03	28	616	2	594	24	6625	11.2
		04	28	644	30	590	24	7010	11.9
		05	28	616	39	553	24	6646	12.0
		06	28	644	1	619	24	7191	11.6
		07	28	672	3	645	24	6916	10.7
		08	28	672	12	641	19	7193	11.2
		09	28	672	12	658	2	7063	10.7
		10	28	644	5	635	4	6983	11.0
		11	28	644	3	636	5	6608	10.4
		12	28	672	39	632	1	6859	10.9
		13	28	644	25	619	0	6746	10.9
	2003	01	28	672	42	630	0	7207	11.4
		02	28	644	0	644	0	6824	10.6
		03	28	616	20	596	0	6673	11.2
		04	28	644	7	637	0	7035	11.0
		05	28	616	**0**	**616**	0	**6481**	10.5
		06	28	644	70	574	0	**6481**	11.3
		07	28	672	62	610	0	7014	11.5
		08	28	672	59	613	0	6583	10.7
Totals			**28**	**19672**	**2321**	**17194**	**161**	**199654**	**11.6**

Note: For an explanation of the items in bold and any blank cell refer to the last page of appendix B.1.

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APPENDIX B - ANALYSIS OF ENERGY EFFICIENCY

ECRV DAYS USED AND MILES DRIVEN

Station Name	FY	AP	Number of Vehicles	Sum of Days Assigned	Sum of Days Not Used	Sum of Days Used	Sum of Days In Shop	Sum of Miles Driven	Avg Miles/Day
Glendora Main PO	**2002**	04	20	480	480	0	0	0	
		05	20	480	415	65	0	2259	
		06	20	460	76	384	0	5218	13.6
		07	20	480	101	376	3	5461	14.5
		08	20	480	117	363	0	5620	15.5
		09	20	480	8	472	0	7172	15.2
		10	20	460	21	439	0	5917	13.5
		11	20	460	31	429	0	4522	10.5
		12	20	480	0	480	0	5585	11.6
		13	20	460	39	421	0	5727	13.6
	2003	01	20	480	29	451	0	5181	11.5
		02	20	460	55	405	0	4868	12.0
		03	20	440	56	384	0	5498	14.3
		04	20	460	46	414	0	5372	13.0
		05	20	440	**26**	**414**	0	**4539**	11.0
		06	20	460	59	378	23	**4539**	12.0
		07	20	480	150	330	0	7247	22.0
		08	20	480	173	307	0	5478	17.8
Totals			**20**	**8420**	**1882**	**6512**	**26**	**90203**	**13.9**

Note: For an explanation of the items in bold and any blank cell refer to the last page of appendix B.1.

APPENDIX B - ANALYSIS OF ENERGY EFFICIENCY

ECRV DAYS USED AND MILES DRIVEN

Station Name	FY	AP	Number of Vehicles	Sum of Days Assigned	Sum of Days Not Used	Sum of Days Used	Sum of Days In Shop	Sum of Miles Driven	Avg Miles/Day
Ida Jean Haxton Station PO	**2001**	09	15	360	360	0	0	0	
		10	25	600	240	360	0	1104	3.1
		11	25	585	187	193	205	3404	17.6
		12	25	600	41	559	0	3403	6.1
		13	25	575	217	358	0	3060	8.5
	2002	01	25	600	127	470	3	4529	9.6
		02	25	575	101	454	20	4416	9.7
		03	25	550	53	485	12	4581	9.4
		04	25	575	16	559	0	5724	10.2
		05	25	550	191	359	0	4872	13.6
		06	25	575	67	508	0	5173	10.2
		07	25	600	62	538	0	5250	9.8
		08	25	600	114	486	0	4998	10.3
		09	25	600	79	521	0	5181	9.9
		10	25	575	77	498	0	4800	9.6
		11	25	575	112	463	0	4563	9.9
		12	25	600	49	551	0	4998	9.1
		13	25	575	49	526	0	5393	10.3
	2003	01	25	600	22	578	0	5541	9.6
		02	25	575	0	575	0	5335	9.3
		03	25	550	21	529	0	5195	9.8
		04	25	575	46	529	0	5720	10.8
		05	25	550	**21**	**529**	0	**5175**	9.8
		06	25	575	103	471	1	**5175**	11.0
		07	25	600	132	468	0	5628	12.0
		08	25	600	131	469	0	5444	11.6
Totals			**25**	**14895**	**2618**	**12036**	**241**	**118662**	**9.9**

Note: For an explanation of the items in bold and any blank cell refer to the last page of appendix B.1.

APPENDIX B - ANALYSIS OF ENERGY EFFICIENCY

ECRV DAYS USED AND MILES DRIVEN

Station Name	FY	AP	Number of Vehicles	Sum of Days Assigned	Sum of Days Not Used	Sum of Days Used	Sum of Days In Shop	Sum of Miles Driven	Avg Miles/Day
Irvine Harvest Station PO	**2001**	10	24	576	576	0	0	0	
		11	24	576	365	202	9	3077	15.2
		12	24	576	52	500	24	6254	12.5
		13	24	552	49	499	4	6259	12.5
	2002	01	24	576	14	559	3	6641	11.9
		02	24	552	20	528	4	6564	12.4
		03	24	528	14	502	12	6133	12.2
		04	24	552	25	525	2	6470	12.3
		05	24	528	16	504	8	6057	12.0
		06	24	552	29	522	1	6325	12.1
		07	24	576	16	557	3	6723	12.1
		08	24	576	26	528	22	6532	12.4
		09	24	576	71	501	4	6239	12.5
		10	24	552	0	552	0	6269	11.4
		11	24	552	0	552	0	6384	11.6
		12	24	576	0	576	0	6943	12.1
		13	24	552	0	552	0	6591	11.9
	2003	01	24	576	0	576	0	6622	11.5
		02	24	552	0	552	0	6505	11.8
		03	24	528	0	528	0	6224	11.8
		04	24	552	0	552	0	6866	12.4
		05	24	528	**0**	**528**	0	**6149**	11.6
		06	24	552	21	499	32	**6149**	12.3
		07	24	576	1	530	47	6680	12.6
		08	24	576	14	533	29	6609	12.4
Totals			**24**	**13968**	**1309**	**12457**	**204**	**151265**	**12.1**

Note: For an explanation of the items in bold and any blank cell refer to the last page of appendix B.1.

APPENDIX B - ANALYSIS OF ENERGY EFFICIENCY

ECRV DAYS USED AND MILES DRIVEN

Station Name	FY	AP	Number of Vehicles	Sum of Days Assigned	Sum of Days Not Used	Sum of Days Used	Sum of Days In Shop	Sum of Miles Driven	Avg Miles/Day
La Mirada PO	**2001**	13	15	360	234	126	0	1389	11.0
	2002	01	15	360	90	270	0	3237	12.0
		02	15	345	46	294	5	3007	10.2
		03	15	330	37	293	0	2857	9.8
		04	15	345	37	308	0	3329	10.8
		05	15	330	56	274	0	2795	10.2
		06	15	345	52	293	0	2940	10.0
		07	15	360	66	294	0	2949	10.0
		08	15	360	94	266	0	2813	10.6
		09	15	360	40	320	0	3623	11.3
		10	15	345	48	297	0	3004	10.1
		11	15	345	73	272	0	2776	10.2
		12	15	360	35	325	0	3296	10.1
		13	15	345	67	278	0	2852	10.3
	2003	01	15	360	38	322	0	3234	10.0
		02	15	345	49	296	0	2847	9.6
		03	15	330	27	281	22	2839	10.1
		04	15	345	21	295	29	2884	9.8
		05	15	330	0	330	0	2794	8.5
		06	15	345	32	312	1	2780	8.9
		07	15	360	59	283	18	2890	10.2
		08	15	360	43	281	36	2576	9.2
Totals			**15**	**7665**	**1244**	**6310**	**111**	**63711**	**10.1**

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APPENDIX B - ANALYSIS OF ENERGY EFFICIENCY

ECRV DAYS USED AND MILES DRIVEN

Station Name	FY	AP	Number of Vehicles	Sum of Days Assigned	Sum of Days Not Used	Sum of Days Used	Sum of Days In Shop	Sum of Miles Driven	Avg Miles/Day
Norwalk PO	**2002**	01	26	624	417	207	0	3092	14.9
		02	26	598	140	458	0	4484	9.8
		03	26	572	82	490	0	4812	9.8
		04	26	598	54	544	0	5395	9.9
		05	26	572	2	570	0	5000	8.8
		06	26	598	147	451	0	5310	11.8
		07	26	624	0	624	0	5325	8.5
		08	26	624	0	624	0	5513	8.8
		09	26	624	0	624	0	5535	8.9
		10	26	598	0	598	0	5048	8.4
		11	26	598	0	598	0	4770	8.0
		12	26	624	0	624	0	5198	8.3
		13	26	598	0	598	0	5337	8.9
	2003	01	26	624	0	624	0	4949	7.9
		02	26	598	0	598	0	5224	8.7
		03	26	572	0	572	0	4694	8.2
		04	26	598	0	598	0	5135	8.6
		05	26	572	0	572	0	5527	9.7
		06	26	598	50	548	0	4687	8.6
		07	26	624	37	583	4	5189	8.9
		08	26	624	43	581	0	5129	8.8
Totals			**26**	**12662**	**972**	**11686**	**4**	**105353**	**9.0**

Note: For an explanation of the items in bold and any blank cell refer to the last page of appendix B.1.

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APPENDIX B - ANALYSIS OF ENERGY EFFICIENCY

ECRV DAYS USED AND MILES DRIVEN

Station Name	FY	AP	Number of Vehicles	Sum of Days Assigned	Sum of Days Not Used	Sum of Days Used	Sum of Days In Shop	Sum of Miles Driven	Avg Miles/Day
Pico Rivera PO	**2002**	01	16	384	270	114	0	2977	26.1
		02	16	368	71	297	0	2190	7.4
		03	16	352	7	345	0	4076	11.8
		04	16	368	19	349	0	2089	6.0
		05	16	352	42	310	0	1760	5.7
		06	16	368	64	304	0	1588	5.2
		07	16	384	32	352	0	**1732**	4.9
		08	16	384	0	384	0	4142	10.8
		09	16	384	22	362	0	3924	10.8
		10	16	368	44	324	0	3287	10.1
		11	16	368	56	312	0	3147	10.1
		12	16	384	5	379	0	2640	7.0
		13	16	368	0	368	0	4819	13.1
	2003	01	16	384	0	384	0	3051	7.9
		02	16	368	0	368	0	3675	10.0
		03	16	352	0	330	22	2842	8.6
		04	16	368	0	345	23	3461	10.0
		05	16	352	1	351	0	3700	10.5
		06	16	368	37	331	0	3191	9.6
		07	16	384	52	320	12	3463	10.8
		08	16	384	43	341	0	3592	10.5
Totals			**16**	**7792**	**765**	**6970**	**57**	**65346**	**9.4**

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APPENDIX B - ANALYSIS OF ENERGY EFFICIENCY

ECRV DAYS USED AND MILES DRIVEN

Station Name	FY	AP	Number of Vehicles	Sum of Days Assigned	Sum of Days Not Used	Sum of Days Used	Sum of Days In Shop	Sum of Miles Driven	Avg Miles/Day
San Gabriel Main PO	**2002**	03	20	480	480	0	0	0	
		04	20	480	277	203	0	2866	14.1
		05	20	440	0	440	0	3592	8.2
		06	20	460	1	459	0	3748	8.2
		07	20	480	0	480	0	3862	8.0
		08	20	480	1	479	0	3993	8.3
		09	20	480	20	460	0	3831	8.3
		10	20	460	0	460	0	3590	7.8
		11	20	460	20	440	0	3604	8.2
		12	20	480	21	459	0	3817	8.3
		13	20	460	0	460	0	3715	8.1
	2003	01	20	480	4	476	0	3608	7.6
		02	20	460	40	420	0	3720	8.9
		03	20	440	0	440	0	3477	7.9
		04	20	460	0	460	0	3675	8.0
		05	20	440	**0**	**440**	0	**3494**	7.9
		06	20	460	5	455	0	**3494**	7.7
		07	20	480	26	453	1	3644	8.0
		08	20	480	26	454	0	3762	8.3
Totals			**20**	**8860**	**921**	**7938**	**1**	**65492**	**8.3**

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APPENDIX B - ANALYSIS OF ENERGY EFFICIENCY

ECRV DAYS USED AND MILES DRIVEN

Station Name	FY	AP	Number of Vehicles	Sum of Days Assigned	Sum of Days Not Used	Sum of Days Used	Sum of Days In Shop	Sum of Miles Driven	Avg Miles/Day
Bicentennial Station PO	**2002**	05	10	240	240	0	0	0	
		06	11	264	114	150	0	10	
		07	43	1032	816	216	0	9	
		08	43	1032	751	281	0	2493	8.9
		09	42	1008	30	426	552	2455	5.8
		10	54	1254	388	852	14	6876	8.1
		11	55	1276	364	912	0	5812	6.4
		12	55	1320	279	1041	0	10365	10.0
		13	55	1265	78	1186	1	8624	7.3
	2003	01	55	1320	0	1320	0	22164	16.8
		02	55	1265	53	1312	6	6913	5.3
		03	55	1210	40	1250	0	6855	5.5
		04	55	1265	26	1233	6	6993	5.7
		05	55	1210	35	1175	0	6484	5.5
		06	55	1265	294	971	0	6024	6.2
		07	55	1320	356	964	0	9756	10.1
		08	57	1368	439	927	2	6268	6.8
Totals			**57**	**18914**	**4303**	**14216**	**581**	**108101**	**7.6**

Note: For an explanation of the items in bold and any blank cell refer to the last page of appendix B.1.

APPENDIX B - ANALYSIS OF ENERGY EFFICIENCY

ECRV DAYS USED AND MILES DRIVEN

Station Name	FY	AP	Number of Vehicles	Sum of Days Assigned	Sum of Days Not Used	Sum of Days Used	Sum of Days In Shop	Sum of Miles Driven	Avg Miles/Day
Dockweiler Station PO	**2001**	08	39	936	936	0	0	0	
		09	39	936	572	364	0	6152	16.9
		10	39	897	157	740	0	8382	11.3
		11	39	897	19	878	0	7311	8.3
		12	39	936	0	936	0	5029	5.4
		13	39	897	1	896	0	9444	10.5
	2002	01	39	936	21	915	0	7846	8.6
		02	39	897	0	897	0	6283	7.0
		03	39	858	39	819	0	6305	7.7
		04	39	897	17	880	0	6297	7.2
		05	39	858	60	798	0	5862	7.3
		06	39	897	13	870	14	6914	7.9
		07	39	936	66	870	0	6361	7.3
		08	39	936	21	915	0	7332	8.0
		09	39	936	23	913	0	6668	7.3
		10	39	897	39	840	18	6610	7.9
		11	39	897	44	853	0	5327	6.2
		12	39	936	46	890	0	8464	9.5
		13	39	897	0	897	0	6518	7.3
	2003	01	39	936	60	876	0	6999	8.0
		02	39	897	50	847	0	6857	8.1
		03	39	858	30	828	0	6676	8.1
		04	39	897	8	889	0	5499	6.2
		05	39	858	5	853	0	6681	7.8
		06	39	897	58	839	0	7737	9.2
		07	39	936	126	807	3	7886	9.8
		08	39	936	222	708	6	6922	9.8
Totals			**39**	**24492**	**2633**	**21818**	**41**	**178362**	**8.2**

Note: For an explanation of the items in bold and any blank cell refer to the last page of appendix B.1.

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APPENDIX B - ANALYSIS OF ENERGY EFFICIENCY

ECRV DAYS USED AND MILES DRIVEN

Station Name	FY	AP	Number of Vehicles	Sum of Days Assigned	Sum of Days Not Used	Sum of Days Used	Sum of Days In Shop	Sum of Miles Driven	Avg Miles/Day
Harbor City PO	**2001**	13	5	120	5	115		1381	12.0
	2002	01	5	120	3	117		1012	8.6
		02	5	115		115		1030	9.0
		03	5	110	21	89		**1024**	11.5
		04	5	115		115		**1025**	8.9
		05	5	110		110		988	9.0
		06	5	115	2	113		1033	9.1
		07	5	120	2	118		1124	9.5
		08	5	120	4	116		1072	9.2
		09	5	120	3	117		1104	9.4
		10	5	115	2	113		1027	9.1
		11	5	115	2	113		1020	9.0
		12	5	120	14	106		1072	10.1
		13	5	115	3	112		1029	9.2
	2003	01	5	120	12	108		952	8.8
		02	5	115	1	114		1065	9.3
		03	5	110	8	102		1053	10.3
		04	5	115	**8**	**107**		**1053**	9.8
		05	5	110	8	102		**976**	9.6
		06	5	115	8	107		881	8.2
		07	5	120	26	94		961	10.2
		08	5	120	13	107		996	9.3
Totals			**5**	**2555**	**145**	**2410**	**0**	**22878**	**9.5**
Total - Last 5 Accounting Periods			**5**	**580**	**63**	**517**	**0**	**4867**	**9.4**

Note: For an explanation of the items in bold and any blank cell refer to the last page of appendix B.1.

APPENDIX B - ANALYSIS OF ENERGY EFFICIENCY

ECRV DAYS USED AND MILES DRIVEN

Station Name	FY	AP	Number of Vehicles	Sum of Days Assigned	Sum of Days Not Used	Sum of Days Used	Sum of Days In Shop	Sum of Miles Driven	Avg Miles/Day
Los Feliz Station PO	**2002**	01	31	744	744	0	0	0	
		02	31	744	444	300	0	4761	15.9
		03	31	682	110	561	11	4984	8.9
		04	31	713	76	637	0	3695	5.8
		05	32	706	112	589	5	3402	5.8
		06	32	737	108	627	2	5306	8.5
		07	32	768	158	592	18	3250	5.5
		08	32	768	148	620	0	3570	5.8
		09	32	768	124	644	0	4053	6.3
		10	32	736	83	639	14	3939	6.2
		11	32	736	35	701	0	4066	5.8
		12	32	768	33	734	1	4312	5.9
		13	32	736	40	680	16	4051	6.0
	2003	01	32	768	57	705	6	4073	5.8
		02	32	736	51	679	6	3888	5.7
		03	32	704	18	666	20	3827	5.7
		04	32	736	18	694	24	4058	5.8
		05	32	704	39	665	0	3635	5.5
		06	32	736	4	681	59	3635	5.3
		07	32	768	11	684	95	4211	6.2
		08	32	768	12	655	101	3935	6.0
Totals			**32**	**15526**	**2425**	**12753**	**378**	**80651**	**6.3**

Note: For an explanation of the items in bold and any blank cell refer to the last page of appendix B.1.

APPENDIX B - ANALYSIS OF ENERGY EFFICIENCY

ECRV DAYS USED AND MILES DRIVEN

Station Name	FY	AP	Number of Vehicles	Sum of Days Assigned	Sum of Days Not Used	Sum of Days Used	Sum of Days In Shop	Sum of Miles Driven	Avg Miles/Day
Bostonia Station PO	**2001**	12	20	480	480	0	0	0	
		13	20	480	69	411	0	4043	9.8
	2002	01	20	480	2	476	2	4323	9.1
		02	20	460	1	457	2	4458	9.8
		03	20	440	1	439	0	4235	9.6
		04	20	460	1	457	2	4441	9.7
		05	20	440	2	438	0	4381	10.0
		06	20	460	1	458	1	4533	9.9
		07	20	480	0	480	0	4442	9.3
		08	20	480	4	441	35	4999	11.3
		09	20	480	2	478	0	4233	8.9
		10	20	460	0	460	0	4665	10.1
		11	20	460	0	448	12	4507	10.1
		12	20	480	24	454	2	4556	10.0
		13	20	460	0	458	2	5105	11.1
	2003	01	20	480	3	475	2	4858	10.2
		02	20	460	21	438	1	4643	10.6
		03	20	440	9	420	11	4267	10.2
		04	20	460	3	447	10	4375	9.8
		05	20	440	20	401	19	4161	10.4
		06	20	460	7	410	43	4238	10.3
		07	20	480	7	438	49	4428	10.1
		08	20	480	51	380	49	4124	10.9
Totals			**20**	**10700**	**708**	**9764**	**242**	**98015**	**10.0**

Note: For an explanation of the items in bold and any blank cell refer to the last page of appendix B.1.

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APPENDIX B - ANALYSIS OF ENERGY EFFICIENCY

ECRV DAYS USED AND MILES DRIVEN

Station Name	FY	AP	Number of Vehicles	Sum of Days Assigned	Sum of Days Not Used	Sum of Days Used	Sum of Days In Shop	Sum of Miles Driven	Avg Miles/Day
Linda Vista Station PO	**2001**	12	17	408	408	0	0	0	
		13	22	528	293	235	0	2494	10.6
	2002	01	22	528	49	479	0	4944	10.3
		02	22	506	0	503	3	4603	9.2
		03	22	484	0	484	0	4371	9.0
		04	22	506	0	506	0	4460	8.8
		05	22	484	0	482	2	4029	8.4
		06	22	506	0	506	0	4721	9.3
		07	22	528	0	521	7	4873	9.4
		08	22	528	0	528	0	4859	9.2
		09	22	528	0	527	1	5041	9.6
		10	22	506	0	506	0	4627	9.1
		11	22	506	0	503	3	5135	10.2
		12	22	528	0	528	0	4702	8.9
		13	22	506	0	495	11	4612	9.3
	2003	01	22	528	0	528	0	4881	9.2
		02	22	506	1	491	14	4636	9.4
		03	22	484	-2	462	24	4147	9.0
		04	22	506	0	486	20	4225	8.7
		05	22	484	-2	444	42	4358	9.8
		06	22	506	47	413	46	4332	10.5
		07	22	528	0	512	16	4742	9.3
		08	22	528	0	520	8	4662	9.0
Totals			**22**	**11650**	**794**	**10659**	**197**	**99454**	**9.3**

Note: For an explanation of the items in bold and any blank cell refer to the last page of appendix B.1.

APPENDIX B - ANALYSIS OF ENERGY EFFICIENCY

ECRV DAYS USED AND MILES DRIVEN

Station Name	FY	AP	Number of Vehicles	Sum of Days Assigned	Sum of Days Not Used	Sum of Days Used	Sum of Days In Shop	Sum of Miles Driven	Avg Miles/Day
Blossom Hill Station PO	**2002**	09	20	480	480				
		10	1	25	23				
		11							
		12							
		13							
	2003	01							
		02							
		03							
		04							
		05	20	440		427	13	6100	14.3
		06	20	460	97	363		4957	13.7
		07	20	480	59	418	3	4600	11.0
		08	20	480	29	451		4835	10.7
Totals			**20**	**2365**	**688**	**1659**	**16**	**20492**	**12.4**

Note: For an explanation of the items in bold and any blank cell refer to the last page of appendix B.1.

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APPENDIX B - ANALYSIS OF ENERGY EFFICIENCY

ECRV DAYS USED AND MILES DRIVEN

Station Name	FY	AP	Number of Vehicles	Sum of Days Assigned	Sum of Days Not Used	Sum of Days Used	Sum of Days In Shop	Sum of Miles Driven	Avg Miles/Day
Royal Oaks Station PO	**2002**	03	2	44	42	2		22	
		04	2	46	13	33		907	
		05	2	44	30	14		84	
		06	2	46	33	13		145	
		07	16	384	336	48		1243	25.9
		08	20	480	34	446		3210	7.2
		09	20	480		441	39	9030	20.5
		10	20	460	20	439	1	4616	10.5
		11	20	460		451	9	5015	11.1
		12	20	480		480		5602	11.7
		13	20	460	9	451		4735	10.5
	2003	01	20	480	26	454		5501	12.1
		02	20	460		447	13	4979	11.1
		03	20	440	21	403	16	4317	10.7
		04	20	460	22	436	2	4535	10.4
		05	20	440	21	417	2	4558	10.9
		06	20	460	50	400	10	4682	11.7
		07	20	480	103	377		**5397**	14.3
		08	20	480	23	457		5526	12.1
Totals			**20**	**7084**	**783**	**6209**	**92**	**74104**	**11.9**

Note: For an explanation of the items in bold and any blank cell refer to the last page of appendix B.1.

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APPENDIX B - ANALYSIS OF ENERGY EFFICIENCY

ECRV DAYS USED AND MILES DRIVEN

Station Name	FY	AP	Number of Vehicles	Sum of Days Assigned	Sum of Days Not Used	Sum of Days Used	Sum of Days In Shop	Sum of Miles Driven	Avg Miles/Day
Alameda Main PO	**2002**	06	20	460	393	67		2006	29.9
		07	20	480	337	143		935	6.5
		08	20	480	144	336		6638	19.8
		09	20	480	4	476		8632	18.1
		10	20	460		460		4595	10.0
		11	20	460		460		4691	10.2
		12	20	480		480		5165	10.8
		13	20	460	26	434		4873	11.2
	2003	01	20	480	28	452		5375	11.9
		02	20	460	26	434		5041	11.6
		03	20	440	28	412		4631	11.2
		04	20	460	1	426	33	4539	10.7
		05	20	440	53	386	1	3517	9.1
		06	20	460	104	355	1	3403	9.6
		07	20	480	34	445	1	4678	10.5
		08	20	480	41	439		3858	8.8
Totals			**20**	**7460**	**1219**	**6205**	**36**	**72577**	**11.7**

Note: For an explanation of the items in bold and any blank cell refer to the last page of appendix B.1.

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APPENDIX B - ANALYSIS OF ENERGY EFFICIENCY

ECRV DAYS USED AND MILES DRIVEN

Station Name	FY	AP	Number of Vehicles	Sum of Days Assigned	Sum of Days Not Used	Sum of Days Used	Sum of Days In Shop	Sum of Miles Driven	Avg Miles/Day
Lamond Riggs PO	**2002**	08	2	48	1	47		681	
		09	11	264	147	117		617	5.3
		10	14	322	207	115		730	6.3
		11	14	322	17	305		1969	6.5
		12	14	336	5	331		2362	7.1
		13	14	322		322		3064	9.5
	2003	01	14	336	13	318	5	2454	7.7
		02	14	322		322		2238	7.0
		03	14	308		299	9	1997	6.7
		04	14	322		294	28	4071	13.8
		05	14	308	2	303	3	1940	6.4
		06	14	322	98	224		2892	12.9
		07	14	336		312	24	1578	5.1
		08	14	336	214	122		1651	13.5
Totals			**14**	**4204**	**704**	**3431**	**69**	**28244**	**8.2**

Note: For an explanation of the items in bold and any blank cell refer to the last page of appendix B.1.

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APPENDIX B - ANALYSIS OF ENERGY EFFICIENCY

ECRV DAYS USED AND MILES DRIVEN

Station Name	FY	AP	Number of Vehicles	Sum of Days Assigned	Sum of Days Not Used	Sum of Days Used	Sum of Days In Shop	Sum of Miles Driven	Avg Miles/Day
White Plains PO	**2001**	07	2	184	136	48		2072	
		08							
		09							
		10							
		11							
		12							
		13							
	2002	01	2	48	48				
		02							
		03							
		04							
		05							
		06	2	46	46				
		07	7	168	48	120		1316	11.0
		08	7	168	48	120		1495	12.5
		09	7	168	48	120		1101	9.2
		10	7	161	46	115		1224	10.6
		11	7	115		115		1199	10.4
		12	7	120		120		**1155**	**9.6**
		13	7	115		115		**1392**	**12.1**
	2003	01	7	168		168		**3140**	**18.7**
		02	7	**163**	2	**161**		1506	9.4
		03	7	154		154		824	5.4
		04	7	161	4	157		787	5.0
		05	7	154	51	103		776	7.5
		06	7	161		161		710	4.4
		07	7	168	2	166		**1669**	10.1
		08	7	168	14	154		1676	10.9
Totals			**7**	**2590**	**493**	**2097**	**0**	**19970**	**9.5**

Note: For an explanation of the items in bold and any blank cell refer to the last page of appendix B.1.

APPENDIX B - ANALYSIS OF ENERGY EFFICIENCY

ECRV DAYS USED AND MILES DRIVEN

Station Name	FY	AP	Number of Vehicles	Sum of Days Assigned	Sum of Days Not Used	Sum of Days Used	Sum of Days In Shop	Sum of Miles Driven	Avg Miles/Day
All Sites	**2001**	01	2	48	48	0	0	0	
		02	4	96	49	47	0	1320	
		03	2	48	21	27	0	1968	
		04	2	48	2	46	0	2	
		05	22	528	526	2	0	2	
		06	27	648	522	126	0	1564	12.4
		07	30	856	369	487	0	7687	15.8
		08	67	1608	1151	457	0	6624	14.5
		09	82	1968	961	1007	0	14134	14.0
		10	128	3005	1300	1705	0	17046	10.0
		11	136	3182	1098	1870	214	21512	11.5
		12	173	4152	1145	2983	24	25290	8.5
		13	198	4616	897	3715	4	39760	10.7
	2002	01	285	6840	2073	4759	8	50813	10.7
		02	301	6984	1499	5441	44	54078	9.9
		03	323	7182	1154	5973	59	60340	10.1
		04	343	7930	1125	6777	28	68120	10.1
		05	374	8306	1775	6492	39	63122	9.7
		06	397	9139	1530	7567	42	79486	10.5
		07	448	10756	2232	8469	55	81570	9.6
		08	454	10900	1722	9096	82	95489	10.5
		09	482	11572	1331	9627	614	104007	10.8
		10	478	11006	1164	9789	53	95046	9.7
		11	478	10959	809	10109	45	93515	9.3
		12	478	11426	622	10753	47	105971	10.0
		13	478	10948	413	10499	36	101698	9.8
	2003	01	478	11472	384	11073	15	115319	10.6
		02	478	10994	409	10627	68	98986	9.3
		03	478	10516	323	10141	132	91562	9.0
		04	478	10996	225	10558	211	99624	9.4
		05	498	10956	300	10576	80	98157	9.3
		06	498	11454	1379	9861	222	97099	9.8
		07	498	11952	1494	10181	315	108577	10.8
		08	500	12000	1824	9915	261	101077	10.2
Total All Sites, All APs			**500**	**235091**	**31876**	**200755**	**2698**	**2000565**	**10.0**

Note: For an explanation of the items in bold and any blank cell refer to the last page of appendix B.1.

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APPENDIX B - ANALYSIS OF ENERGY EFFICIENCY

ECRV DAYS USED AND MILES DRIVEN

Station Name	FY	AP	Number of Vehicles	Sum of Days Assigned	Sum of Days Not Used	Sum of Days Used	Sum of Days In Shop	Sum of Miles Driven	Avg Miles/Day
Site Totals - Deployment Through FY03, AP08									
Alameda Main PO			20	7460	1219	6205	36	72577	11.7
Bicentennial Station PO			57	18914	4303	14216	581	108101	7.6
Blossom Hill Station PO			20	2365	688	1659	16	20492	12.4
Bostonia Station PO			20	10700	708	9764	242	98015	10.0
CostaMesa Main PO			20	11448	2069	9371	8	102183	10.9
Covina Main PO			20	7924	933	6969	26	78942	11.3
Dockweiler Station PO			39	24492	2633	21818	41	178362	8.2
El Monte Main PO			30	14245	1947	12091	207	156906	13.0
FountainValley PO			28	19672	2321	17194	161	199654	11.6
Glendora Main PO			20	8420	1882	6512	26	90203	13.9
Harbor City PO			5	2555	145	2410	0	22878	9.5
Ida Jean Haxton PO			25	14895	2618	12036	241	118662	9.9
Irvine Harvest Station PO			24	13968	1309	12457	204	151265	12.1
La Mirada PO			15	7665	1244	6310	111	63711	10.1
Lamond Riggs PO			14	4204	704	3431	69	28244	8.2
Linda Vista Station PO			22	11650	794	10659	197	99454	9.3
Los Feliz Station PO			32	15526	2425	12753	378	80651	6.3
Norwalk PO			26	12662	972	11686	4	105353	9.0
Rico Rivera PO			16	7792	765	6970	57	65346	9.4
RoyalOaks Station PO			20	7084	783	6209	92	74104	11.9
SanGabriel Main PO			20	8860	921	7938	1	65492	8.3
White Plains PO			7	2590	493	2097	0	19970	9.5
Totals			**500**	**235091**	**31876**	**200755**	**2698**	**2000565**	**10.0**

Note: For an explanation of the items in bold and any blank cell refer to the last page of appendix B.1.

APPENDIX B - ANALYSIS OF ENERGY EFFICIENCY

ECRV DAYS USED AND MILES DRIVEN

Station Name	FY	AP	Number of Vehicles	Sum of Days Assigned	Sum of Days Not Used	Sum of Days Used	Sum of Days In Shop	Sum of Miles Driven	Avg Miles/Day

Notes for Appendix B.1 - Days Used and Miles Driven

1. A limited procedure for Quality Control was implemented. Data were changed only when it was clear that there were arithmetic inaccuracies.
2. Items noted in bold are values, which were corrected during the Quality Control review, or represent a total.
3. Spaces left blank in columns 5 through 8 (days) indicate that no data were available from the Postal Service.
4. Spaces left blank in column 10 indicate that the data in previous columns was inadequate to calculate a reliable estimate of the miles per day.
5. The table for Harbor City has a second total for last five APs only. For this period, there were no EPICs onsite.
6. The mileage table for White Plains includes a separate total for the miles during 2003 only.

Note: For an explanation of the items in bold and any blank cell refer to the last page of appendix B.1.

APPENDIX B - ANALYSIS OF ENERGY EFFICIENCY

ECRV ELECTRICITY USE AND COST

Costa Mesa Main PO
Utility:SCE
Vehicles: 20

Read Date	Days	Total kWh	Daily Avg kWh	Bill $ Amount	Average Cost ($/kWh)	kWh/day/ Vehicle
22-Mar-03	29	5075	204	$818	$0.16	10.2
21-Feb-03	30	5041	196	$810	$0.16	9.8
22-Jan-03	33	5701	202	$898	$0.16	10.1
20-Dec-02	30	5506	214	$868	$0.16	10.7
20-Nov-02	30	5319	207	$840	$0.16	10.3
21-Oct-02	32	5234	191	$1,455	$0.28	9.5
19-Sep-02	31	5388	203	$2,017	$0.37	10.1
19-Aug-02	31	5216	196	$1,818	$0.35	9.8
19-Jul-02	29	4731	190	$1,846	$0.39	9.5
20-Jun-02	31	5180	195	$1,461	$0.28	9.7
20-May-02	31	5089	192	$827	$0.16	9.6
19-Apr-02	28	5016	209	$863	$0.17	10.5
22-Mar-02	29	5167	208	$1,223	$0.24	10.4
21-Feb-02	30	5707	222	$1,286	$0.23	11.1
22-Jan-02	33	5919	209	$1,007	$0.17	10.5
20-Dec-01	31	6172	232	$969	$0.16	11.6
19-Nov-01	31	5076	191	$616	$0.12	9.6
19-Oct-01	31	5190	195	$1,187	$0.23	9.8
18-Sep-01	29	4964	200	$1,398	$0.28	10.0
20-Aug-01	32	4636	169	$1,316	$0.28	8.5
19-Jul-01	29	368	15	$115	$0.31	0.7
Totals	**640**	**105695**	**193**	**$23,638**	**$0.22**	**9.6**

Note: Electricity data obtained from electrical utility. Column 7 data was calculated from previous columns' data.

APPENDIX B - ANALYSIS OF ENERGY EFFICIENCY

ECRV ELECTRICITY USE AND COST

Covina Main PO
Utility: SCE
Vehicles: 20

Read Date	Days	Total kWh	Daily Avg kWh	Bill $ Amount	Average Cost ($/kWh)	kWh/day/ Vehicle
05-Mar-03	29	6033	243	$721	$0.12	12.1
04-Feb-03	32	6103	223	$737	$0.12	11.1
03-Jan-03	30	6573	256	$784	$0.12	12.8
04-Dec-02	33	6542	231	$778	$0.12	11.6
01-Nov-02	31	5910	222	$726	$0.12	11.1
01-Oct-02	32	6526	238	$883	$0.14	11.9
30-Aug-02	29	6200	249	$775	$0.13	12.5
01-Aug-02	29	5965	240	$896	$0.15	12.0
03-Jul-02	30	6210	242	$902	$0.15	12.1
03-Jun-02	32	6428	234	$764	$0.12	11.7
02-May-02	28	5898	246	$713	$0.12	12.3
04-Apr-02	30	6688	260	$807	$0.12	13.0
05-Mar-02	32	6480	236	$1,326	$0.20	11.8
01-Feb-02	29	1080	43	$354	$0.33	2.2
03-Jan-02	33	640	23	$166	$0.26	1.1
Totals	**459**	**83276**	**212**	**$11,332**	**$0.14**	**10.6**

Note: Electricity data obtained from electrical utility. Column 7 data was calculated from previous columns' data.

APPENDIX B - ANALYSIS OF ENERGY EFFICIENCY

ECRV ELECTRICITY USE AND COST

El Monte Main PO
Utility: SCE
Vehicles: 30

Read Date	Days	Total kWh	Daily Avg kWh	Bill $ Amount	Average Cost ($/kWh)	kWh/day/ Vehicle
26-Mar-03	29	9888	398	$1,735	$0.18	13.3
25-Feb-03	32	10857	396	$1,846	$0.17	13.2
24-Jan-03	29	9749	392	$1,737	$0.18	13.1
26-Dec-02	33	11456	405	$1,894	$0.17	13.5
23-Nov-02	31	10876	409	$1,856	$0.17	13.6
23-Oct-02	29	10041	404	$1,830	$0.18	13.5
24-Sep-02	32	11567	422	$2,105	$0.18	14.1
23-Aug-02	30	11045	430	$1,989	$0.18	14.3
24-Jul-02	29	10350	416	$2,019	$0.20	13.9
25-Jun-02	32	11400	416	$1,995	$0.18	13.9
24-May-02	30	10869	423	$1,813	$0.17	14.1
24-Apr-02	28	9631	401	$1,712	$0.18	13.4
27-Mar-02	29	10686	430	$1,822	$0.17	14.3
26-Feb-02	32	12077	440	$2,005	$0.17	14.7
25-Jan-02	30	11278	439	$1,893	$0.17	14.6
26-Dec-01	28	11161	465	$1,884	$0.17	15.5
28-Nov-01	43	8640	234	$1,288	$0.15	7.8
Totals	**526**	**181571**	**403**	**$31,423**	**$0.17**	**13.4**

Note: Electricity data obtained from electrical utility. Column 7 data was calculated from previous columns' data.

APPENDIX B - ANALYSIS OF ENERGY EFFICIENCY

ECRV ELECTRICITY USE AND COST

Fountain Valley PO
Utility: SCE
Vehicles: 28

Read Date	Days	Total kWh	Daily Avg kWh	Bill $ Amount	Average Cost ($/kWh)	kWh/day/ Vehicle
06-Mar-03	30	8494	330	$1,399	$0.16	11.8
04-Feb-03	29	7803	314	$1,308	$0.17	11.2
06-Jan-03	33	9607	340	$1,498	$0.16	12.1
04-Dec-02	33	9513	336	$1,409	$0.15	12.0
01-Nov-02	31	8724	328	$1,357	$0.16	11.7
01-Oct-02	28	7778	324	$1,420	$0.18	11.6
03-Sep-02	32	8616	314	$1,575	$0.18	11.2
02-Aug-02	30	7948	309	$1,376	$0.17	11.0
03-Jul-02	29	7812	314	$1,587	$0.20	11.2
04-Jun-02	33	9155	324	$1,438	$0.16	11.6
02-May-02	28	7917	330	$1,338	$0.17	11.8
04-Apr-02	29	8404	338	$1,499	$0.18	12.1
06-Mar-02	30	8722	339	$1,506	$0.17	12.1
04-Feb-02	31	9440	355	$1,660	$0.18	12.7
04-Jan-02	31	10041	378	$1,728	$0.17	13.5
04-Dec-01	33	9783	346	$1,669	$0.17	12.4
01-Nov-01	30	8741	340	$1,658	$0.19	12.1
02-Oct-01	32	9138	333	$1,921	$0.21	11.9
31-Aug-01	29	8688	350	$1,923	$0.22	12.5
02-Aug-01	30	9059	352	$2,008	$0.22	12.6
03-Jul-01	29	9107	366	$2,036	$0.22	13.1
04-Jun-01	32	9344	341	$1,309	$0.14	12.2
03-May-01	29	8404	338	$1,253	$0.15	12.1
04-Apr-01	29	7597	306	$1,211	$0.16	10.9
06-Mar-01	33	5786	205	$920	$0.16	7.3
01-Feb-01	28	1012	42	$207	$0.20	1.5
04-Jan-01	31	1101	41	$176	$0.16	1.5
04-Dec-00	33	1489	53	$225	$0.15	1.9
01-Nov-00	30	1642	64	$227	$0.14	2.3
02-Oct-00	33	1934	68	$338	$0.17	2.4
30-Aug-00	29	1429	57	$387	$0.27	2.1
01-Aug-00	18	1010	65	$142	$0.14	2.3
Totals	**965**	**225238**	**272**	**$39,708**	**$0.18**	**9.7**

Note: Electricity data obtained from electrical utility. Column 7 data was calculated from previous columns' data.

APPENDIX B - ANALYSIS OF ENERGY EFFICIENCY

ECRV ELECTRICITY USE AND COST

Glendora Main PO
Utility: SCE
Vehicles: 20

Read Date	Days	Total kWh	Daily Avg kWh	Bill $ Amount	Average Cost ($/kWh)	kWh/day/ Vehicle
07-Mar-03	30	5931	231	$1,202	$0.20	11.5
05-Feb-03	29	5687	229	$1,188	$0.21	11.4
07-Jan-03	32	6601	241	$1,157	$0.18	12.0
06-Dec-02	32	6413	234	$1,293	$0.20	11.7
04-Nov-02	32	6633	242	$1,432	$0.22	12.1
03-Oct-02	28	5922	247	$2,209	$0.37	12.3
05-Sep-02	31	6452	243	$2,291	$0.36	12.1
05-Aug-02	28	6284	262	$2,307	$0.37	13.1
08-Jul-02	33	6964	246	$2,625	$0.38	12.3
05-Jun-02	30	6338	246	$1,457	$0.23	12.3
06-May-02	28	5868	245	$1,283	$0.22	12.2
08-Apr-02	32	6727	245	$1,420	$0.21	12.3
07-Mar-02	30	6290	245	$1,364	$0.22	12.2
05-Feb-02	28	5047	210	$1,198	$0.24	10.5
08-Jan-02	33	0		$17		
06-Dec-01	41	40	1	$36	$0.90	0.1
Totals	**497**	**87197**	**205**	**$22,479**	**$0.26**	**10.2**

Note: Electricity data obtained from electrical utility. Column 7 data was calculated from previous columns' data.

APPENDIX B - ANALYSIS OF ENERGY EFFICIENCY

ECRV ELECTRICITY USE AND COST

Ida Jean Haxton Station PO
Utility: SCE
Vehicles: 25

Read Date	Days	Total kWh	Daily Avg kWh	Bill $ Amount	Average Cost ($/kWh)	kWh/day/ Vehicle
10-Mar-03	31	6738	254	$1,044	$0.15	10.1
07-Feb-03	29	6462	260	$903	$0.14	10.4
09-Jan-03	31	7523	283	$1,104	$0.15	11.3
09-Dec-02	33	7133	252	$942	$0.13	10.1
06-Nov-02	30	6299	245	$895	$0.14	9.8
07-Oct-02	31	6154	232	$955	$0.16	9.3
06-Sep-02	30	5751	224	$907	$0.16	8.9
07-Aug-02	29	5430	218	$910	$0.17	8.7
09-Jul-02	33	5724	202	$914	$0.16	8.1
06-Jun-02	30	5835	227	$839	$0.14	9.1
07-May-02	28	5685	237	$952	$0.17	9.5
09-Apr-02	31	6655	250	$1,059	$0.16	10.0
09-Mar-02	30	6633	258	$1,061	$0.16	10.3
07-Feb-02	30	7248	282	$1,174	$0.16	11.3
08-Jan-02	32	8063	294	$1,254	$0.16	11.8
07-Dec-01	32	6993	255	$1,115	$0.16	10.2
05-Nov-01	32	5754	210	$677	$0.12	8.4
04-Oct-01	28	4810	200	$649	$0.13	8.0
06-Sep-01	31	3743	141	$1,453	$0.39	5.6
06-Aug-01	28	3784	158	$627	$0.17	6.3
09-Jul-01	32	3679	134	$1,164	$0.32	5.4
07-Jun-01	30	1016	40	$280	$0.28	1.6
08-May-01	32	0	0	$163		
Totals	**703**	**127112**	**211**	**$21,041**	**$0.17**	**8.4**

Note: Electricity data obtained from electrical utility. Column 7 data was calculated from previous columns' data.

APPENDIX B - ANALYSIS OF ENERGY EFFICIENCY

ECRV ELECTRICITY USE AND COST

Irvine Harvest Station PO
Utility: SCE
Vehicles: 24

Read Date	Days	Total kWh	Daily Avg kWh	Bill $ Amount	Average Cost ($/kWh)	kWh/day/ Vehicle
24-Mar-03	32	8341	304	$1,156	$0.14	12.7
20-Feb-03	29	7363	296	$1,074	$0.15	12.3
22-Jan-03	33	8763	310	$1,224	$0.14	12.9
20-Dec-02	30	8275	322	$1,038	$0.13	13.4
20-Nov-02	33	9142	323	$1,164	$0.13	13.5
18-Oct-02	29	8125	327	$1,160	$0.14	13.6
19-Sep-02	31	8584	323	$1,374	$0.16	13.5
19-Aug-02	31	9033	340	$1,231	$0.14	14.2
19-Jul-02	30	8282	322	$1,209	$0.15	13.4
19-Jun-02	29	7624	307	$1,081	$0.14	12.8
21-May-02	29	7587	305	$995	$0.13	12.7
22-Apr-02	31	8455	318	$1,208	$0.14	13.3
22-Mar-02	29	8272	333	$1,239	$0.15	13.9
21-Feb-02	30	8756	341	$1,236	$0.14	14.2
22-Jan-02	33	9124	323	$1,302	$0.14	13.4
20-Dec-01	31	9027	340	$1,302	$0.14	14.2
19-Nov-01	31	8292	312	$980	$0.12	13.0
19-Oct-01	30	8126	316	$1,022	$0.13	13.2
19-Sep-01	30	8045	313	$1,620	$0.20	13.0
20-Aug-01	31	8643	325	$1,669	$0.19	13.6
20-Jul-01	30	5583	217	$1,820	$0.33	9.0
20-Jun-01	69	240	4	$335	$1.40	0.2
12-Apr-01	27	0	0	$71		
Totals	**738**	**173682**	**275**	**$26,510**	**$0.15**	**11.4**

Note: Electricity data obtained from electrical utility. Column 7 data was calculated from previous columns' data.

APPENDIX B - ANALYSIS OF ENERGY EFFICIENCY

ECRV ELECTRICITY USE AND COST

La Mirada PO
Utility: SCE
Vehicles: 15

Read Date	Days	Total kWh	Daily Avg kWh	Bill $ Amount	Average Cost ($/kWh)	kWh/day/ Vehicle
18-Mar-03	32	3711	135	$477	$0.13	9.0
14-Feb-03	30	3534	137	$451	$0.13	9.2
15-Jan-03	30	3841	149	$496	$0.13	10.0
16-Dec-02	33	4250	150	$527	$0.12	10.0
13-Nov-02	29	3567	144	$452	$0.13	9.6
15-Oct-02	33	4313	152	$680	$0.16	10.2
12-Sep-02	30	3624	141	$688	$0.19	9.4
13-Aug-02	28	3788	158	$1,173	$0.31	10.5
16-Jul-02	32	3619	132	$749	$0.21	8.8
14-Jun-02	30	3708	144	$615	$0.17	9.6
15-May-02	29	4159	167	$577	$0.14	11.2
16-Apr-02	29	3539	142	$535	$0.15	9.5
18-Mar-02	33	4173	148	$630	$0.15	9.8
13-Feb-02	28	3822	159	$571	$0.15	10.6
16-Jan-02	33	4859	172	$698	$0.14	11.5
14-Dec-01	28	3946	164	$587	$0.15	11.0
16-Nov-01	32	3989	145	$576	$0.14	9.7
15-Oct-01	31	3812	143	$1,217	$0.32	9.6
14-Sep-01	31	948	36	$1,084	$1.14	2.4
Totals	**581**	**71202**	**143**	**$12,783**	**$0.18**	**9.5**

Note: Electricity data obtained from electrical utility. Column 7 data was calculated from previous columns' data.

APPENDIX B - ANALYSIS OF ENERGY EFFICIENCY

ECRV ELECTRICITY USE AND COST

Norwalk PO
Utility: SCE
Vehicles: 26

Read Date	Days	Total kWh	Daily Avg kWh	Bill $ Amount	Average Cost ($/kWh)	kWh/day/ Vehicle
13-Mar-03	31	6176	232	$924	$0.15	8.9
10-Feb-03	28	5180	216	$803	$0.16	8.3
13-Jan-03	33	6527	231	$960	$0.15	8.9
11-Dec-02	33	5987	212	$894	$0.15	8.1
08-Nov-02	30	5579	217	$852	$0.15	8.3
09-Oct-02	29	5266	212	$1,205	$0.23	8.1
10-Sep-02	33	5842	207	$1,320	$0.23	7.9
08-Aug-02	29	5359	216	$1,409	$0.26	8.3
10-Jul-02	29	5291	213	$1,346	$0.25	8.2
11-Jun-02	32	5873	214	$966	$0.16	8.2
10-May-02	30	6017	234	$947	$0.16	9.0
10-Apr-02	28	5948	248	$953	$0.16	9.5
13-Mar-02	33	6704	237	$1,015	$0.15	9.1
08-Feb-02	28	6274	261	$1,112	$0.18	10.1
11-Jan-02	30	6778	264	$1,200	$0.18	10.1
12-Dec-01	33	6757	239	$1,135	$0.17	9.2
09-Nov-01	31	5187	195	$826	$0.16	7.5
09-Oct-01	29	120	5	$199	$1.66	0.2
Totals	**549**	**100865**	**214**	**$18,066**	**$0.18**	**8.2**

Note: Electricity data obtained from electrical utility. Column 7 data was calculated from previous columns' data.

UNITED STATES POSTAL SERVICE
ELECTRIC CARRIER ROUTE VEHICLE PROGRAM
500 VEHICLE FLEET DEPLOYMENT REPORT

APPENDIX B - ANALYSIS OF ENERGY EFFICIENCY

ECRV ELECTRICITY USE AND COST

Rico Rivera PO
Utility: SCE
Vehicles: 16

Read Date	Days	Total kWh	Daily Avg kWh	Bill $ Amount	Average Cost ($/kWh)	kWh/day/ Vehicle
04-Mar-03	32	4102	150	$530	$0.13	9.3
31-Jan-03	29	3396	137	$470	$0.14	8.5
02-Jan-03	30	3725	145	$508	$0.14	9.1
03-Dec-02	33	3776	133	$504	$0.13	8.3
31-Oct-02	31	3373	127	$424	$0.13	7.9
30-Sep-02	32	3587	131	$514	$0.14	8.2
29-Aug-02	28	3329	139	$498	$0.15	8.7
01-Aug-02	30	3862	150	$566	$0.15	9.4
02-Jul-02	29	3949	159	$576	$0.15	9.9
03-Jun-02	33	4327	153	$558	$0.13	9.6
01-May-02	29	4123	166	$548	$0.13	10.4
02-Apr-02	29	4311	173	$511	$0.12	10.8
04-Mar-02	31	4198	158	$500	$0.12	9.9
01-Feb-02	29	4303	173	$569	$0.13	10.8
03-Jan-02	31	4080	154	$550	$0.13	9.6
03-Dec-01	33	4400	156	$553	$0.13	9.7
31-Oct-01	30	3920	152	$471	$0.12	9.5
01-Oct-01	32	1380	50	$791	$0.57	3.1
30-Aug-01	17	0	0	$46		0.0
Totals	**568**	**68141**	**140**	**$9,687**	**$0.14**	**8.7**

Note: Electricity data obtained from electrical utility. Column 7 data was calculated from previous columns' data.

APPENDIX B - ANALYSIS OF ENERGY EFFICIENCY

ECRV ELECTRICITY USE AND COST

San Gabriel Main PO
Utility: SCE
Vehicles: 20

Read Date	Days	Total kWh	Daily Avg kWh	Bill $ Amount	Average Cost ($/kWh)	kWh/day/ Vehicle
07-Mar-03	30	5236	204	$773	$0.15	10.2
05-Feb-03	30	4900	191	$765	$0.16	9.5
06-Jan-03	32	5847	213	$792	$0.14	10.7
05-Dec-02	31	5174	195	$723	$0.14	9.7
04-Nov-02	12	2008	195	$410	$0.20	9.8
23-Oct-02	21	3200	178	$819	$0.26	8.9
02-Oct-02	28	4440	185	$1,669	$0.38	9.3
04-Sep-02	30	4840	188	$1,717	$0.35	9.4
05-Aug-02	31	5040	190	$1,740	$0.35	9.5
05-Jul-02	31	4920	185	$1,726	$0.35	9.3
04-Jun-02	29	4640	187	$1,168	$0.25	9.3
06-May-02	32	5440	198	$1,229	$0.23	9.9
04-Apr-02	154	22880	173	$5,648	$0.25	8.7
Totals	**491**	**78565**	**187**	**$19,179**	**$0.24**	**9.3**

Note: Electricity data obtained from electrical utility. Column 7 data was calculated from previous columns' data.

APPENDIX B - ANALYSIS OF ENERGY EFFICIENCY

ECRV ELECTRICITY USE AND COST

Bicentennial Station PO
Utility: LADWP
Vehicles: 57

Read Date	Days	Total kWh	Daily Avg kWh	Bill $ Amount	Average Cost ($/kWh)	kWh/day/ Vehicle
09-Apr-03	29	10880	438	$1,341	$0.12	7.7
03/11/03	29	11440	460	$1,495	$0.13	8.1
02/10/03	31	12160	458	$1,408	$0.12	8.0
01/10/03	32	13280	484	$1,596	$0.12	8.5
09-Dec-02	33	12320	436	$1,470	$0.12	7.6
06-Nov-02	30	12320	479	$1,478	$0.12	8.4
10/07/02	31	11120	418	$1,717	$0.15	7.3
09/06/02	30	10560	411	$1,899	$0.18	7.2
08/07/02	29	8480	341	$1,043	$0.12	6.0
07/09/02	32	8880	324	$1,008	$0.11	5.7
06/07/02	30	5280	205	$848	$0.16	3.6
08-May-02	29	3360	135	$430	$0.13	2.4
09-Apr-02		2480		$385		
Totals	**365**	**122560**	**392**	**$16,119**	**$0.13**	**6.9**

Note: Electricity data obtained from electrical utility. Column 7 data was calculated from previous columns' data.

APPENDIX B - ANALYSIS OF ENERGY EFFICIENCY

ECRV ELECTRICITY USE AND COST

Dockweiler Station PO
Utility: LADWP
Vehicles: 39

Read Date	Days	Total kWh	Daily Avg kWh	Bill $ Amount	Average Cost ($/kWh)	kWh/day/ Vehicle
03/31/03	28	9360	390	$1,511	$0.16	10.0
03/03/03	31	8800	331	$1,494	$0.17	8.5
01/31/03	31	9120	343	$1,656	$0.18	8.8
12/31/02	34	10720	368	$1,748	$0.16	9.4
11/27/02	30	8960	348	$1,595	$0.18	8.9
10/28/02	32	9120	333	$1,661	$0.18	8.5
09/26/02	30	9360	364	$1,521	$0.16	9.3
08/27/02	29	7920	319	$1,572	$0.20	8.2
07/29/02	32	10000	365	$1,576	$0.16	9.3
06/27/02	29	8400	338	$1,418	$0.17	8.7
05/29/02	504	122160	283	$16,663	$0.14	7.3
01/10/01						
Totals	**810**	**213920**	**308**	**$32,417**	**$0.15**	**7.9**

Note: Electricity data obtained from electrical utility. Column 7 data was calculated from previous columns' data.

APPENDIX B - ANALYSIS OF ENERGY EFFICIENCY

ECRV ELECTRICITY USE AND COST

Harbor City PO
Utility: LADWP
Vehicles: 5

Read Date	Days	Total kWh	Daily Avg kWh	Bill $ Amount	Average Cost ($/kWh)	kWh/day/ Vehicle
04/08/03	29	2400	97	$1,226	$0.51	19.3
03/10/03	30	2640	103	$508	$0.19	20.5
02/08/03	30	2320	90	$485	$0.21	18.0
01/09/03	33	2160	76	$476	$0.22	15.3
12/07/02	33	4040	143	$546	$0.14	28.6
11/04/02	31	4040	152	$546	$0.14	30.4
10/04/02	29	6560	264	$752	$0.11	52.8
09/05/02	30	5440	212	$604	$0.11	42.3
08/06/02	29	6080	245	$672	$0.11	48.9
07/08/02	32	6160	225	$685	$0.11	44.9
06/06/02	32	5520	201	$631	$0.11	40.3
05/07/02	30	5360	208	$651	$0.12	41.7
04/08/02	31	4560	172	$549	$0.12	34.3
03/08/02	29	6080	245	$635	$0.10	48.9
02/07/02	62	17520	330	$2,111	$0.12	65.9
12/07/01	64	5840	106	$814	$0.14	21.3
10/04/01	29	6400	257	$765	$0.12	51.5
09/05/01	30	4800	187	$616	$0.13	37.3
08/06/01	31	4640	175	$558	$0.12	34.9
07/06/01	60	4800	93	$634	$0.13	18.7
05/07/01	31	4720	178	$615	$0.13	35.5
04/06/01	29	4160	167	$572	$0.14	33.5
03/08/01	29	4000	161	$576	$0.14	32.2
02/07/01	29	4080	164	$598	$0.15	32.8
01/09/01		4640		$613		
Totals	**822**	**128960**	**183**	**$17,438**	**$0.14**	**36.6**
Total (last 4)	**122**	**9520**	**91**	**$2,695**	**$0.28**	**18.2**

Note: Electricity data obtained from electrical utility. Column 7 data was calculated from previous columns' data.

APPENDIX B - ANALYSIS OF ENERGY EFFICIENCY

ECRV ELECTRICITY USE AND COST

Los Feliz Station PO
Utility: LADWP
Vehicles: 32

Read Date	Days	Total kWh	Daily Avg kWh	Bill $ Amount	Average Cost ($/kWh)	kWh/day/ Vehicle
04/01/03	28	6560	273	$862	$0.13	8.5
03/04/03	29	7120	286	$883	$0.12	9.0
02/03/03	32	7280	265	$872	$0.12	8.3
01/02/03	31	8640	325	$909	$0.11	10.2
12/02/02	96	21120	257	$2,649	$0.13	8.0
08/28/02	29	7120	286	$981	$0.14	9.0
07/30/02	32	7360	268	$865	$0.12	8.4
06/28/02	29	6400	257	$894	$0.14	8.0
05/30/02	293	54880	219	$3,567	$0.06	6.8
08/10/01		0				
Totals	**599**	**126480**	**246**	**$12,482**	**$0.10**	**7.7**

Note: Electricity data obtained from electrical utility. Column 7 data was calculated from previous columns' data.

APPENDIX B - ANALYSIS OF ENERGY EFFICIENCY

ECRV ELECTRICITY USE AND COST

Bostonia Station PO
Utility: SDG&E
Vehicles: 20

Read Date	Days	Total kWh	Daily Avg kWh	Bill $ Amount	Average Cost ($/kWh)	kWh/day/ Vehicle
02-Apr-03	28	5440	227	$1,149	$0.21	11.3
05-Mar-03	30	6480	252	$1,311	$0.20	12.6
03-Feb-03	31	6360	239	$1,254	$0.20	12.0
03-Jan-03	31	6320	238	$1,239	$0.20	11.9
03-Dec-02	32	6360	232	$1,311	$0.21	11.6
01-Nov-02	30	5560	216	$1,085	$0.20	10.8
02-Oct-02	29	6040	243	$1,191	$0.20	12.1
03-Sep-02	32	6880	251	$1,295	$0.19	12.5
02-Aug-02	31	6280	236	$1,207	$0.19	11.8
02-Jul-02	29	5640	227	$1,105	$0.20	11.3
03-Jun-02	32	5680	207	$1,084	$0.19	10.4
02-May-02	29	5640	227	$1,095	$0.19	11.3
03-Apr-02	29	6000	241	$1,150	$0.19	12.1
05-Mar-02	32	6240	228	$1,175	$0.19	11.4
01-Feb-02	29	6600	266	$1,195	$0.18	13.3
03-Jan-02	31	6840	257	$1,187	$0.17	12.9
03-Dec-01	33	6480	229	$1,487	$0.23	11.5
31-Oct-01	29	5680	229	$1,082	$0.19	11.4
02-Oct-01	33	5960	211	$1,056	$0.18	10.5
30-Aug-01	29	3480	140	$931	$0.27	7.0
Totals	**609**	**119960**	**230**	**$23,587**	**$0.20**	**11.5**

Note: Electricity data obtained from electrical utility. Column 7 data was calculated from previous columns' data.

APPENDIX B - ANALYSIS OF ENERGY EFFICIENCY

ECRV ELECTRICITY USE AND COST

Linda Vista Station PO
Utility: SDG&E
Vehicles: 22

Read Date	Days	Total kWh	Daily Avg kWh	Bill $ Amount	Average Cost ($/kWh)	kWh/day/ Vehicle
27-Mar-03	29	4800	193	$1,207	$0.25	8.8
26-Feb-03	30	4960	193	$1,160	$0.23	8.8
27-Jan-03	32	5040	184	$1,175	$0.23	8.4
26-Dec-02	31	5040	190	$1,087	$0.22	8.6
25-Nov-02	31	5040	190	$1,089	$0.22	8.6
25-Oct-02	30	4640	180	$1,047	$0.23	8.2
25-Sep-02	30	4560	177	$1,042	$0.23	8.1
26-Aug-02	31	4800	181	$1,059	$0.22	8.2
26-Jul-02	31	4720	178	$1,064	$0.23	8.1
25-Jun-02	32	4880	178	$1,034	$0.21	8.1
24-May-02	29	4720	190	$1,040	$0.22	8.6
25-Apr-02	29	5120	206	$1,099	$0.21	9.4
27-Mar-02	29	5280	212	$1,096	$0.21	9.7
26-Feb-02	32	5840	213	$1,206	$0.21	9.7
25-Jan-02	30	4960	193	$1,033	$0.21	8.8
26-Dec-01	30	5920	230	$1,159	$0.20	10.5
26-Nov-01	33	5120	181	$1,048	$0.20	8.2
24-Oct-01	29	4400	177	$943	$0.21	8.0
25-Sep-01	33	4000	141	$918	$0.23	6.4
23-Aug-01	29	240	10	$239	$1.00	0.4
Totals	**610**	**94080**	**180**	**$20,746**	**$0.22**	**8.2**

Note: Electricity data obtained from electrical utility. Column 7 data was calculated from previous columns' data.

APPENDIX B - ANALYSIS OF ENERGY EFFICIENCY

ECRV ELECTRICITY USE AND COST

Blossom Hill Station PO
Utility: PG&E
Vehicles: 20

Read Date	Days	Total kWh	Daily Avg kWh	Bill $ Amount	Average Cost ($/kWh)	kWh/day/ Vehicle
18-Mar-03	32	6240	228	$946	$0.15	11.4
13-Feb-03	25	5920	276	$894	$0.15	13.8
14-Jan-03	28	7200	300	$1,042	$0.14	15.0
15-Dec-02	31	7040	265	$1,027	$0.15	13.2
15-Nov-02						
Totals	**116**	**26400**	**266**	**$3,909**	**$0.15**	**13.3**

Note: Electricity data obtained from electrical utility. Column 7 data was calculated from previous columns' data.

APPENDIX B - ANALYSIS OF ENERGY EFFICIENCY

ECRV ELECTRICITY USE AND COST

Royal Oaks Station PO
Utility: SMUD
Vehicles: 20

Read Date	Days	Total kWh	Daily Avg kWh	Bill $ Amount	Average Cost ($/kWh)	kWh/day/ Vehicle
04-Mar-03	29	6320	254	$1,027	$0.16	12.7
31-Jan-03	32	7600	277	$1,132	$0.15	13.9
31-Dec-02	31	7440	280	$1,120	$0.15	14.0
27-Nov-02	34	8560	294	$1,200	$0.14	14.7
29-Oct-02	29	6080	245	$1,003	$0.17	12.2
28-Sep-02	31	6400	241	$1,090	$0.17	12.0
29-Aug-02	30	6160	240	$1,066	$0.17	12.0
31-Jul-02	29	6240	251	$1,074	$0.17	12.6
29-Jun-02	32	6720	245	$1,123	$0.17	12.3
01-Jun-02	28	5840	243	$1,012	$0.17	12.2
01-May-02	31	6440	242	$1,070	$0.17	12.1
07-Feb-02	83	9440	133	$1,989	$0.21	6.6
Totals	**419**	**83240**	**232**	**$13,906**	**$0.17**	**11.6**

Note: Electricity data obtained from electrical utility. Column 7 data was calculated from previous columns' data.

APPENDIX B - ANALYSIS OF ENERGY EFFICIENCY

ECRV ELECTRICITY USE AND COST

Alameda Main PO
Utility: Alameda
Vehicles: 20

Read Date	Days	Total kWh	Daily Avg kWh	Bill $ Amount	Average Cost ($/kWh)	kWh/day/ Vehicle
18-Apr-03	28	4440	185	$90	$0.49	9.3
21-Mar-03	30	4800	187	$130	$0.70	9.3
19-Feb-03	33	5400	191	$198	$1.04	9.5
17-Jan-03	29	5400	217	$198	$0.91	10.9
19-Dec-02	30	6120	238	$284	$1.19	11.9
18-Nov-02	31	5880	221	$252	$1.14	11.1
18-Oct-02	33	5760	204	$238	$1.17	10.2
18-Sep-02	33	6360	225	$306	$1.36	11.2
16-Aug-02	29	5400	217	$618	$2.84	10.9
18-Jul-02	27	4920	213	$564	$2.65	10.6
21-Jun-02	32	5880	214	$667	$3.11	10.7
20-May-02	31	5880	221	$672	$3.04	11.1
19-Apr-02	31	6240	235	$713	$3.03	11.7
19-Mar-02	25	4920	230	$564	$2.46	11.5
22-Feb-02		960		$117		
Totals	**422**	**78360**	**217**	**$5,611**	**$0.07**	**10.8**

Note: Electricity data obtained from electrical utility. Column 7 data was calculated from previous columns' data.

APPENDIX B - ANALYSIS OF ENERGY EFFICIENCY

ECRV ELECTRICITY USE AND COST

Lamond Riggs PO
Utility: ConEdison
Vehicles: 14

Read Date	Days	Total kWh	Daily Avg kWh	Bill $ Amount	Average Cost ($/kWh)	kWh/day/ Vehicle
NO DATA BY						
MONTH						
Totals	**246**	**44320**	**210**	**$4,297**	**$0.10**	**15.0**

Note: Electricity data obtained from electrical utility. Column 7 data was calculated from previous columns' data.

APPENDIX B - ANALYSIS OF ENERGY EFFICIENCY

ECRV ELECTRICITY USE AND COST

White Plains PO
Utility: PEPCO
Vehicles: 7

Read Date	Days	Total kWh	Daily Avg kWh	Bill $ Amount	Average Cost ($/kWh)	kWh/day/ Vehicle
NO DATA AVAILABLE						

Note: Electricity data obtained from electrical utility. Column 7 data was calculated from previous columns' data.

UNITED STATES POSTAL SERVICE
ELECTRIC CARRIER ROUTE VEHICLE PROGRAM
500 VEHICLE FLEET DEPLOYMENT REPORT

APPENDIX B - ANALYSIS OF ENERGY EFFICIENCY

ECRV ELECTRICITY USE AND COST

All Sites

Post Office	Days	Total kWh	Daily Avg kWh	Bill $ Amount	Average Cost ($/kWh)	Number of Vehicles	kWh/day/ Vehicle
Alameda Main PO	422	78360	217	$5,611	$0.15	20	10.8
Bicentennial Station PO	365	122560	392	$16,119	$0.13	57	6.9
Blossom Hill Station PO	116	26400	266	$3,909	$0.15	20	13.3
Bostonia Station PO	609	119960	230	$23,587	$0.20	20	11.5
CostaMesa Main PO	640	105695	193	$23,638	$0.22	20	9.6
Covina Main PO	459	83276	212	$11,332	$0.14	20	10.6
Dockweiler Station PO	810	213920	308	$32,417	$0.15	39	7.9
El Monte Main PO	526	181571	403	$31,423	$0.17	30	13.4
FountainValley PO	965	225238	272	$39,708	$0.18	28	9.7
Glendora Main PO	497	87197	205	$22,479	$0.26	20	10.2
Harbor City PO	122	9520	91	$2,695	$0.28	5	18.2
Ida Jean Haxton PO	703	127112	211	$21,041	$0.17	25	8.4
Irvine Harvest Station PO	738	173682	275	$26,510	$0.15	24	11.4
La Mirada PO	581	71202	143	$12,783	$0.18	15	9.5
Lamond Riggs PO	246	44320	210	$4,297	$0.10	14	15.0
Linda Vista Station PO	610	94080	180	$20,746	$0.22	22	8.2
Los Feliz Station PO	599	126480	246	$12,482	$0.10	32	7.7
Norwalk PO	549	100865	214	$18,066	$0.18	26	8.2
Rico Rivera PO	568	68141	140	$9,687	$0.14	16	8.7
RoyalOaks Station PO	419	83240	232	$13,906	$0.17	20	11.6
SanGabriel Main PO	491	78565	187	$19,179	$0.24	20	9.3
All Sites - Total		**2221384**	**4825**	**$371,615**	**$0.17**	**493**	**9.8**

(excluding White Plains Post Office)

Note: Electricity data obtained from electrical utility. Column 7 data was calculated from previous columns' data.

APPENDIX B - ANALYSIS OF ENERGY EFFICIENCY

ECRV ELECTRICITY USE AND COST

Total Electricity Use by Month

Month	Days	Total kWh	Daily Avg kWh	Bill $ Amount	Average Cost ($/kWh)	Vehicles Deployed	kWh/day /Vehicle
Jan-01	31	12278	462	$1,785	$0.15	28	
Feb-01	28	16972	707	$2,476	$0.15	28	
Mar-01	31	18943	713	$2,763	$0.15	28	
Apr-01	30	20310	790	$3,011	$0.15	68	
May-01	31	22346	841	$3,274	$0.15	93	9.0
Jun-01	30	20212	786	$4,515	$0.22	137	5.7
Jul-01	31	30620	1152	$6,108	$0.20	194	5.9
Aug-01	31	47514	1788	$9,569	$0.20	231	7.7
Sep-01	30	59049	2296	$11,777	$0.20	273	8.4
Oct-01	31	69934	2632	$11,190	$0.16	303	8.7
Nov-01	30	84694	3294	$12,610	$0.15	323	10.2
Dec-01	31	91792	3455	$14,110	$0.15	343	10.1
Jan-02	31	96216	3621	$15,419	$0.16	383	9.5
Feb-02	28	111873	4661	$22,474	$0.17	460	10.1
Mar-02	31	117086	4406	$19,650	$0.16	465	9.5
Apr-02	30	119755	4657	$17,660	$0.16	480	9.7
May-02	31	128633	4841	$25,121	$0.21	480	10.1
Jun-02	30	121862	4739	$22,644	$0.19	480	9.9
Jul-02	31	120990	4553	$23,239	$0.19	480	9.5
Aug-02	31	124872	4699	$23,930	$0.19	480	9.8
Sep-02	30	124436	4839	$22,624	$0.18	480	10.1
Oct-02	31	120919	4551	$19,177	$0.16	500	9.1
Nov-02	30	133482	5191	$19,260	$0.14	500	10.4
Dec-02	31	140570	5290	$20,492	$0.15	500	10.6
Jan-03	31	129905	4889	$19,761	$0.15	500	9.8
Feb-03	31	127425	4796	$19,656	$0.15	500	9.6

Note: Electricity data obtained from electrical utility. Column 7 data was calculated from previous columns' data.

APPENDIX B - ANALYSIS OF ENERGY EFFICIENCY

ECRV ELECTRICITY USE AND COST

Notes for Appendix B.2 - ECRV Electricity Use and Cost

1. Daily average energy use (kWh/day) is the Total kWh divided by the billing days, adjused by a factor of 7/6 to account for the 6-day work week.

2. In the final table of total electricity use by month the totals included only to derive an average electricity use per day calculation. Given that the meter reading takes place at different days, this was considered to be the best way to derive the trend of the average daily electricity use per vehicle.

Note: Electricity data obtained from electrical utility. Column 7 data was calculated from previous columns' data.

APPENDIX C - MAINTENANCE AND REPAIR DATA

C.2 POSTAL SERVICE VMAS DATA

VMAS Data Listing Maintenance and Repair Work Orders for ECRV Tires at Santa Ana VMF

Vehicle ID	Work Order No.	Work Order Note	Quantity	Cost	Odometer	Date
1240018	03004720	12400018 R/R TIRE	1	$63	6481	21-Feb-03
1240156	02001013	gave part to voma	1	$102	1129	18-Oct-01
1240098	01007229	give part to VOMA	1	$99	243	13-Jul-01
1240130	01007762	give part to VOMA	1	$102	54	09-Aug-01
1240008	03002086	mount and balance one tire; r/r rt rear tire - flat	1	$63	5124	19-Dec-02
1240086	01007699	mount, bal tire	1	$102	252	09-Aug-01
1240143	03006079	pmi 3/10	3	$51	6570	11-Apr-03
1240148	03006080	pmi 3/10	2	$51	5171	11-Apr-03
1240009	02006828	pmi 6/24	2	$102	5198	03-Jul-02
1240026	02006887	pmi 6/24	1	$102	4114	27-Jun-02
1240170	02007043	pmi 7/1	1	$102	4390	03-Jul-02
1240086	01007677	pull tires and parts	2	$102	252	09-Aug-01
1240139	03006109	r/r 1 tire	1	$51	8161	18-Apr-03
1240088	03006010	r/r 2 front tires; clear pmi	2	$51	7390	10-Apr-03
1240138	03006111	r/r 2 tires	2	$51	6227	18-Apr-03
1240150	03001165	r/r left front tire - flat	1	$102	4299	31-Oct-02
1240127	03004495	r/r left front tire - flat	1	$63	5531	12-Feb-03
1240155	02006986	r/r left rear tire	1	$102	3837	01-Jul-02
1240029	02008423	r/r left rear tire - flat	1	$102	6027	06-Sep-02
1240164	03001599	R/R LEFT REAR TIRE - FLAT	1	$102	3060	01-Nov-02
1240139	03006078	r/r lf tire	1	$51	8142	11-Apr-03
1240156	03001006	r/r r/r tire	1	$102	6365	15-Oct-02
1240011	03004431	r/r rt front tire	1	$63	7858	07-Feb-03
1240008	02004636	r/r rt front tire - flat	1	$102	3290	22-Mar-02
1240130	03000169	r/r rt front tire - flat	1	$102	5946	17-Sep-02

Note: Data Used to Compile these tables were obtained from Santa Ana VMF, VMAS System.

APPENDIX C - MAINTENANCE AND REPAIR DATA

C.2 POSTAL SERVICE VMAS DATA

Vehicle ID	Work Order No.	Work Order Note	Quantity	Cost	Odometer	Date
1240105	03004549	r/r rt rear tire	1	$63	3289	12-Feb-03
1240014	02004809	r/r rt rear tire - flat	1	$102	4233	03-Apr-02
1240096	03002987	r/r rt rear tire - flat	1	$63	6603	27-Dec-02
1240161	03006442	r/r rt rear tire - flat	1	$51	5728	29-Apr-03
1240022	03002677	r/r rt rear tire - slow leak	1	$63	4335	20-Dec-02
1240145	02008178	r/r rt rear tire; mount and balance one tire	1	$102	3380	26-Aug-02
1240007	02001153	R/R TIRE	1	$102	2321	01-Nov-01
1240016	02002284	R/R TIRE	1	$102	2781	13-Dec-01
1240140	02003942	R/R TIRE	1	$102	1328	21-Feb-02
1240017	02006100	R/R TIRE	1	$102	6195	29-May-02
1240164	03000293	R/R TIRE	1	$102	2803	24-Sep-02
1240011	03001316	R/R TIRE	1	$102	6712	25-Oct-02
1240156	03003095	r/r tire	1	$63	5275	27-Dec-02
1240033	03003634	R/R TIRE	1	$63	5654	11-Jan-03
1240154	03004000	r/r tire	1	$63	7716	24-Jan-03
1240143	03004048	R/R TIRE	1	$63	5663	24-Jan-03
1240135	03004590	r/r tire	1	$63	4394	12-Feb-03
1240017	03005596	R/R TIRE	1	$51	9562	11-Apr-03
1240132	02001717	R/R TIRE/RIM	1	$102	720	16-Nov-01
1240023	01008006	remove rt rear tire - flat; mount and balance tire; installed by Fo	1	$102	1547	09-Aug-01
1240104	03002471	replaced tire	1	$63	3915	19-Dec-02
1240104	03002741	replaced tire	1	$63	3915	10-Feb-03
1240104	03002741	replaced tire	-1	-$63	3915	10-Feb-03
1240012	028005F1	tire not charged on work order fy 01	1	$102	2152	30-Nov-01

Note: Data Used to Compile these tables were obtained from Santa Ana VMF, VMAS System.

APPENDIX D - BATTERY DATA

D.1 CONCERN REPORTS FOR SELECTED BATTERY INCIDENTS

(b) CONCERN REPORTS FOR ALL DAIS VEHICLE BATTERY MODULE INCIDENTS

CR Date	Concern Report #	ECRV ID#	Number of Defective Modules	Modules Replaced (or Pack)	Notes	Odometer Miles
3/22/2001	8	29	1	# 16		416
3/22/2001	9	416	1	# 34		227
12/17/2001	9025	378	?	Battery Pack	Swapped w/ USPS 411	70
12/20/2001	9022	416	?	Battery Pack	Swapped w/ USPS 414	52
1/9/2002	9031	357	1	# 34		118
1/15/2002	9033	402	1	# 7		83
2/8/2002	9038	358	1	# 26		61
9/23/2002	627	16	0	na	Clear Code	1525
12/2/2002	9125	416	8	# 23, 17, 20, 21, 26, 39, 18, 19	Five discharge tests each revealing 1 or 2 bad modules	3,985
12/13/2002	815	29	2	# 3, 4		7,158
12/19/2002	892	233	3	# 6, 10, 12		4,353
1/10/2003	941	314	?	Battery Pack		2,644

Note: Selected Concern Reports were provided by Ford Motor Company.

APPENDIX E
ECRV CARRIER SATISFACTION SURVEY

SUMMARY OF SURVEY RESULTS - MANAGER RATINGS

Manager Ratings	1	2	3	4	5	6	7	8	9	10	11	12
1. Carriers at this Post Office are satisfied with the ECRV's performance capabilities.	5	4	4	2	3	2	4	1	4	4	5	4
2. The ECRVs at this Post Office provide adequate operational capability for their assigned routes.	5	4	4	4	4	4	4	1	4	2	5	4
3. The ECRV cargo capacity sometimes limits our ability to deliver mail efficiently.	5	5	1	1	3	2	4	5	4	2	1	3
4. The ECRVs always start each day without difficulty.	4	5	1	4	2	4	3	4	4	2	5	4
5. Under normal use, the ECRVs provide adequate range.	5	5	3	4	3	4	4	1	4	4	5	4
6. The ECRVs need to be towed in from a route more frequently than a comparable gasoline vehicle.	1	1	2	5	2	4	5	4	3	2	2	2
7. The ECRVs are out of service for repairs more often than the other types of vehicle at this Post Office.	1	2	4	5	3	4	5	4	2	2	3	1
8. The charging system at this Post Office works well, and provides adequate recharging of the vehicle batteries each day.	5	5	1	1	3	2	4	5	1	3	5	5
9. Some Carriers are reluctant to use electrical equipment (such as wipers, headlights, and heater) because this could reduce vehicle range.	2	2	4	4	3	1	3	4	4	4	1	2

UNITED STATES POSTAL SERVICE
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APPENDIX E
ECRV CARRIER SATISFACTION SURVEY

SUMMARY OF SURVEY RESULTS - MANAGER RATINGS

Analysis of Ratings	# of 1	# of 2	# of 3	# of 4	# of 5	#>5	Total Count	Adjusted Average	Favorable (%)	Unfavorable (%)	Highly Favorable (%)	Highly Unfavorable (%)
1. Carriers at this Post Office are satisfied with the ECRV's performance capabilities.	1	2	1	6	2	0	12	3.5	67%	25%	17%	8%
2. The ECRVs at this Post Office provide adequate operational capability for their assigned routes.	1	1	0	8	2	0	12	3.8	83%	17%	17%	8%
3. The ECRV cargo capacity sometimes limits our ability to deliver mail efficiently.	3	2	2	2	3	0	12	3.0	42%	42%	25%	25%
4. The ECRVs always start each day without difficulty.	1	2	1	6	2	0	12	3.5	67%	25%	17%	8%
5. Under normal use, the ECRVs provide adequate range.	1	0	2	6	3	0	12	3.8	75%	8%	25%	8%
6. The ECRVs need to be towed in from a route more frequently than a comparable gasoline vehicle.	2	5	1	2	2	0	12	3.3	58%	33%	17%	17%
7. The ECRVs are out of service for repairs more often than the other types of vehicle at this Post Office.	2	3	2	3	2	0	12	3.0	42%	42%	17%	17%
8. The charging system at this Post Office works well, and provides adequate recharging of the vehicle batteries each day.	3	1	2	1	5	0	12	3.3	50%	33%	42%	25%
9. Some Carriers are reluctant to use electrical equipment (such as wipers, headlights, and heater) because this could reduce vehicle range.	2	3	2	5	0	0	12	3.2	42%	42%	17%	0%

Note: Refer to the introduction to Section E.1 of this appendix for an explanation of the column headings.

Percentage values in the "Favorable" column include Favorable and Highly Favorable percentages combined.

Percentage values in the "Unfavorable" column include Unfavorable and Highly Unfavorable percentages combined.