

FINAL REPORT ON ELECTRIC VEHICLE ACTIVITIES

From
September 1991 through October 1994

Final Report

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I. INTRODUCTION

I. INTRODUCTION

This is the final report summarizing the activities of PSE&G's G-Van and TEVan operation covering the period from September 1991 to October 1994. The data and information collected for PSE&G's electric vehicle demonstration program were intended to support and enhance DOE's Electric and Hybrid Vehicle Site Operator Program. The DOE Site Operator Program is focused on the life cycle and reliability of Electric Vehicles (EVs). Of particular interest are vehicles currently available with features that are likely to be put into production or demonstrate new technology.

PSE&G acquired eight GMC Electric G-Vans in 1991, and three TEVans in 1993, and conducted a program plan to test and assess the overall performance of these electric vehicles. To accomplish the objectives of DOE's Site Operator's test program, a manual data collection system was implemented. The manual data collection system has provided energy use and mileage data.

Operating Summary

From September 1991 to October 1994 PSE&G logged 69,368 miles on eleven test vehicles. This is a total of the odometer readings on the G-Vans and TEVans. During this period, the main components such as traction motors, controllers and batteries packs were replaced on several occasions. A full size battery pack for the G-Van was kept as a spare for future replacement. PSE&G demonstrated EVs to diverse groups and associations at fifty seven various events. Section II provides additional details.

As reported in earlier quarterly reports, the cold weather had a major effect on reducing the vehicle driving range. The typical daily range for the G-Vans and TEVans in cold weather was between 20 to 30 miles, not 50 to 60 miles as originally anticipated. Overall, there was some dissatisfaction with the limited range, and some drivers were reluctant to use the vehicles.

One of the key events during 1993 was a delivery of the Chrysler TEVans. So far, PSE&G logged 7,284 miles on the TEVans, and after resolution of start-up problems, the vans were operating satisfactorily.

Section II details the operational activities concerning total mileage driven by each EV.

Section III, "Meetings and Publicity" shows fifty seven different events where PSE&G participated in meetings, workshops and demonstrations publicizing its EV program. The last two Sections IV and V titled Summary/Conclusions and Lessons Learned briefly outline PSE&G's experience with the G-Vans and TEVans.

II. OPERATIONS/ACTIVITIES

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As discussed during the Site Operators Meetings and G-Van Users Group Meetings, PSE&G curtailed its effort in collecting daily operational data for the G-Vans and TEVans during 1994. However, the total odometer mileage data for the G-Vans and TEVans are shown in Tables 1 and 2 respectively. Prior reports to the US DOE contain mileage and energy use data for the G-Vans and the TEVans. From these data the average energy usage per mile for the G-Vans and the TEVans was 1.1 kWh/mi and 1.4 kWh/mi, respectively

PSE&G initially assigned six, out of eight G-Vans, to various operating departments located throughout the State of New Jersey. The vehicles were assigned based on overall usage and need by the operating departments. At the present time, these G-Vans are primarily used for work orders, transporting material, tools, electrical equipment, meters and miscellaneous items.

The seventh G-Van was loaned to the NJ Department of Environmental Protection & Energy (DEPE) for an independent assessment. The NJ DEPE still operates this G-Van for mail delivery and other miscellaneous purposes.

The eighth G-Van was initially dedicated to PSE&G's main corporate headquarters in Newark and was used for various public shows and demonstrations. Presently this van is assigned to Linden Generating Station.

The three TEVans were initially tested at PSE&G's Research & Testing Laboratory in Maplewood, N.J. Presently, one of the TEVans is assigned to PSE&G's Edison Training Facility and two TEVans are shared by Corporate Office personnel in Newark and the Research & Testing Laboratory.

The following Tables 1 and 2 show the total mileage logged from 1991 to 1994 for the G-Vans and from 1993 to 1994, for the TEVans.

TABLE - 1
G-VAN MILEAGE
 From September 1991 to October 1994

Location	Total Miles
Linden 3555	10710
Trenton 3559	8920
NJDEP 3554	8858
Linden 3558	8622
Essex 3560	7649
Essex 3556	7361
Salem 3561	5067
Hudson 3557	4897
Total	62084

TABLE - 2
TEVAN MILEAGE
 From April 1993 to October 1994

Edison 5055 Ni-Fe	3010
Maplewood 5056 Ni-Cd	2415
Edison 5057 Ni-Cd	1859
TOTAL	7284

III. MEETINGS/PUBLICITY

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From October 1993 - December 1993

Fourth Quarter

1. Meetings/Workshop/Demonstrations

- 1.1 On October 11, 1993, PSE&G and Chrysler displayed the TEVan to CNBC TV network. This program was aired on October 18, 1993.
- 1.2 On October 12, 1993, PSE&G attended the Eastern Region Electric Transportation Task Force meeting discussing and exchanging EV related issues.
- 1.3 On October 16, 1993, the TEVan was displayed at the Capital Science Circus in Trenton, NJ. 2,000 attendees visited this event.
- 1.4 On October 18, 1993, the TEVan was demonstrated at New Jersey Institute of Technology. Fifty students and faculty members attended the display.
- 1.5 On October 22, 1993, the TEVan was demonstrated at the Montclair Society of Engineering, meeting in Montclair, NJ. Forty-five people attended the display.
- 1.6 On November 19, 1993, the TEVan was displayed to the Japan Institute of Office Automation Group in Newark, NJ. Twenty-five people attended this demonstration.

III. MEETINGS/PUBLICITY

From July 1993 - September 1993

Third Quarter

2. Meetings/Workshop/Demonstrations

- 2.1 On August 7, 1993 PSE&G participated in the G-Van and TEVan Users Group meeting in Dallas, Texas discussing various issues with G-Vans and TEVans.
- 2.2 Rutgers Cooperate Extension of Essex County sponsored a county fair on August 8, 1993 in Brookdale Park, Bloomfield, N.J. PSE&G displayed the G-Van at this fair where the theme was "Remembering Our Roots in Environmental Education" This was one of the most popular Essex County fairs, with six thousand visitors.
- 2.3 On August 24, 1993 PSE&G displayed the TEVan to ARI a vehicle leasing company. The G-Van and TEVan demonstrations were conducted at PSE&G's Maplewood, R&T Laboratory. Seventeen attendees participated in the demonstration.
- 2.4 On September 8 and 9, 1993 PSE&G hosted the TEVan Training Seminar in Edison, NJ. Thirty one (31) representatives from utilities and Chrysler dealers attended the session.
- 2.5 On August 11 thru 14 and September 21 and 22, 1993 PSE&G, in conjunction with other site operators, participated in preparing, specifying and detailing EV programs for 1994.
- 2.6 On September 15, 1993 PSE&G demonstrated the G-Van at Kean College in Union, NJ, approximately twenty students attended this display.

III. MEETINGS/PUBLICITY

From January 1993 - June 1993
Second and First Quarter

3. Meetings/Workshop/Demonstrations

- 3.1 On April 14, 1993 the G-Van was presented at the Bergen Generating Station ground breaking ceremony. PSE&G employees, customers, contractors and the Commissioner of the Department of Environmental Protection and Energy of State of New Jersey attended the ceremony.

- 3.2 On June 16, 1993 the G-Van was demonstrated to students of Camden Vocational High School.

III. MEETINGS/PUBLICITY

From October 1992 - December 1992

Fourth Quarter

4. Meetings/Workshop/Demonstrations

- 4.1 On October 13, 1992 PSE&G demonstrated the G-Van at the 16th Annual New Jersey Science Convention at the Garden State Exhibition.
- 4.2 On October 19 thru 21, 1992 PSE&G presented the G-Van at the NJ Environmental Exposition at the Garden State Convention & Exhibit Center.
- 4.3 On October 28 thru 30, 1992 PSE&G displayed the G-Van at the NJ School Board's Annual Meeting in Atlantic City, N.J.
- 4.4 On November 10, 1992 PSE&G demonstrated the G-Van at the NJ Chapter of National Association of Fleet Administration in Morristown, N.J.
- 4.5 On November 19, 1992 PSE&G demonstrated the G-Van to the League of Municipalities at the Conference Center in Atlantic City.
- 4.6 On December 8-9, 1992 PSE&G in conjunction with other site operators participated in the Task Force Meeting in Book Hill, S.C.

III. MEETINGS/PUBLICITY

From July 1992 - September 1992

Third Quarter

5. Meetings/Workshop/Demonstrations

- 5.1 On July 14, 1992 PSE&G demonstrated the G-Van at a seminar for teachers in Hackensack, NJ, titled, "Energy in the 21st Century."
- 5.2 On July 14, 1992 PSE&G presented the G-Van at "The NJ Teachers Workshop on Energy and Environment" in Newark, at New Jersey Institute of Technology.
- 5.3 On July 28 and 29, 1992 PSE&G attended a CONEG seminar in Philadelphia, PA. This seminar was arranged by Coalition of Northeastern Governors. The State of New Jersey Department of Environmental Protection and Energy (DEPE) displayed the G-Van at the exhibition.
- 5.4 On August 1, 1992 PSE&G displayed the G-Van at Madison Community Club, Madison, NJ.
- 5.5 On August 4, 1992 PSE&G participated in the G-Van Users group meeting detailing motor failure and brake line corrosion problems at the Pennsylvania Power and Light facility in Allentown, PA.
- 5.6 On September 8 and 9, 1992 PSE&G in conjunction with other site operators participated in demonstrating PSE&G's EV program to the US Department of Energy and the staff of various congressmen from Kansas, Texas, California, Florida and New Jersey.
- 5.7 On September 12 and 13, 1992 PSE&G demonstrated the G-Van at Hoboken Environmental City Fair, approximately one thousand (1000) persons reviewed the G-Van.
- 5.8 On September 29, 1992 PSE&G presented a technical paper in Atlantic City, New Jersey on Electric Vehicles.

III. MEETINGS/PUBLICITY

From April 1992 - June 1992 Second Quarter

6. Meetings/Workshop/Demonstrations
 - 6.1 On April 3, 1992 PSE&G participated in an EV demonstration at the Engineering Week, Rutgers University in Newark, NJ.
 - 6.2 On April 12, 1992 a non-profit T.V. network presented a half hour talk show on EVs and Natural Gas Vehicles.
 - 6.3 On April 21, 1992 PSE&G demonstrated the G-Van at PSE&G's Annual Stockholders Meeting in Newark, New Jersey.
 - 6.4 On April 22, 1992 PSE&G demonstrated the G-Van at Hoffman La Roche in Nutley, New Jersey.
 - 6.5 On April 25, 1992 PSE&G demonstrated the G-Van at the Ridgefield, New Jersey Centennial celebration. The Mayor, council members, policemen, firemen, teachers and general public attended the Centennial programs.
 - 6.6 From April 21 to 24, 1992, PSE&G in conjunction with the US DOE and other site operators participated in the DOE site operator's meeting in Phoenix, AZ.
 - 6.7 On April 29, 1992 PSE&G demonstrated the G-Van at the Hackensack New Jersey High School.
 - 6.8 On May 2, 1992 PSE&G demonstrated the G-Van at an Earthday celebration in Brookdale Park, Bloomfield, New Jersey to the local TV media, the town environmental committee and approximately 300 visitors.
 - 6.9 On June 16, 1992 PSE&G's Marketing Department attended a briefing and presentation of the G-Van.
 - 6.10 On June 17, 1992, 150 PSE&G retirees attended an Electric Vehicle presentation and demonstration.
 - 6.11 On June 18, 1992 PSE&G participated in the advance training provided by the G-Van user group.
 - 6.12 On June 18, 1992 the G-Van was presented to supervisors of PSE&G's auto-mechanics.

III. MEETINGS/PUBLICITY

From January 1992 - March 1992

First Quarter

7. Meetings/Workshop/Demonstrations
 - 7.1 On January 20-21, 1992 PSE&G participated in EPRI's Electric Transportation Task Force Meeting in San Francisco, CA.
 - 7.2 On February 4, 5, and 6, 1992 PSE&G participated in a three day session at York Technical College establishing a technical curriculum for EV repair and maintenance. The details of the meeting were published in the local news media.
 - 7.3 PSE&G, on February 19, 1992, demonstrated the G-Van to the AT&T Company.
 - 7.4 On February 20, 1992 PSE&G made a presentation on its EV program at the Northeast States Coordinated Air Use Management (NESCAUM) association one day workshop in Northampton, Massachusetts.
 - 7.5 On February 21, 1992, a local non-profit TV Network, WNJN Trenton, presented a documentary which included special features of PSE&G's EV program. This show covered EV testing and assessment.
 - 7.6 On February 27, 1992, PSE&G gave a demonstration of the G-Van at the Research and Testing Laboratory for Air Conditioning Research Institute members.
 - 7.7 On March 18, 1992 PSE&G made a presentation on EV's to the Third Annual US Hydrogen Meeting in Washington, DC.
 - 7.8 On March 24-26, 1992 PSE&G participated in EPRI's Infrastructure Working Group Activities in Los Angeles, CA.

III. MEETINGS/PUBLICITY

From October 1991 - December 1991

Fourth Quarter

8. Meetings/Workshop/Demonstrations

- 8.1 On November 19, 1991 PSE&G in conjunction with the Electric Vehicle Development Corporation (EVDC) and other regional utilities organized and hosted a one day symposium in Teaneck, New Jersey. About 100 representatives from utilities auto makers, local and state government agencies and universities attended the symposium.
- 8.2 On September 18, 1991, PSE&G displayed the G-Van at The Clean Air and Transportation Awareness Day in conjunction with the Department of Transportation of New Jersey.
- 8.3 On October 7-10, 1991, PSE&G displayed the G-Van for Bellcore Energy Awareness Week, at several locations.
- 8.4 On October 15-18, 1991, PSE&G demonstrated the G-Van the Johnson & Johnson (J&J), Energy Awareness Week, at several J&J locations.
- 8.5 On October 21, 1991, PSE&G demonstrated the G-Van at the 8th Annual New Jersey Environmental Exposition, at Raritan Center, in Edison, New Jersey.
- 8.6 On October 26, 1991, PSE&G displayed the G-Van in the parade of the Town of Kearny, in Kearny NJ.
- 8.7 On October 28, 1991, PSE&G presented the G-Van to Mr. Rick Sinding and Ms. Nancy Wittenberg of New Jersey Environmental Protection and Energy of New Jersey.
- 8.8 On November 1, 1991, PSE&G displayed the G-Van at the Rally of Alternative Fuel Vehicles, sponsored by the State of New Jersey Department of Environmental Protection.
- 8.9 On November 20, 1991, PSR&G displayed the G-Van at The League of Municipalities Conference, in Atlantic City, New Jersey.

IV. SUMMARY/CONCLUSIONS

IV. Summary/Conclusions

The attached chart shows the total miles accumulated since the inception of the program for each EV. The total miles recorded were 69,368 miles. The G-Vans logged 62,084 miles, whereas the TEVans logged 7,284 miles.

During the reporting period, of September 1991-October 1994, PSE&G had several successful public demonstrations of the G-Vans and TEVans as detailed in Section III. The vehicles were used as part of PSE&G's normal fleet applications, however, during the cold weather period the service of the vehicles was limited due to a severe reduction in range.

In addition to the regular maintenance, four failed traction motors were replaced and three new battery packs were also installed in the G-Vans. On average the energy use was about 1.1 kWh/mile.

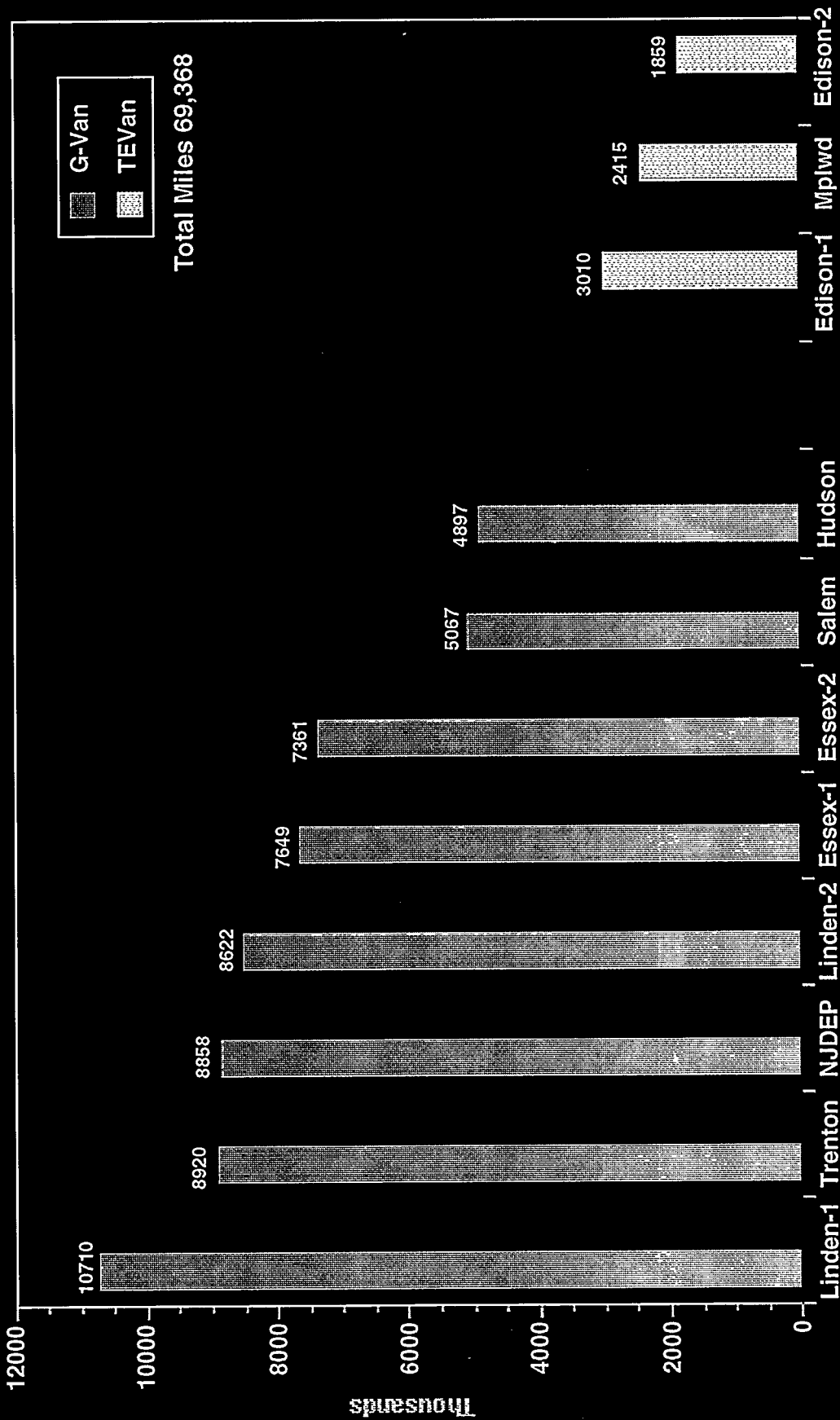
Initially the TEVans did not operate satisfactorily and start-up problems with the gear shifter, controller and watering had to be resolved with help from Chrysler. However, some problems with the gear shifter, controller and battery still exist. Chrysler is making an effort to improve the TEVan performance and respond to user's problems. In general TEVans, during cold weather averaged about 35 miles per charge. On average, the energy use was about 1.4 kWh/mile.

Three new controllers, two vacuum pumps and part of a battery pack were replaced in the TEVans during 1993-1994.



US DOE ELECTRIC & HYBRID VEHICLE SITE OPERATORS PROGRAM

TOTAL MILES UP TO OCTOBER 1994



V. LESSONS LEARNED

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In general, testing the G-Vans and the TEVans PSE&G learned the following :

1. Operation:

- 1.1 During the cold weather, G-Van and TEVan mileage range dropped from 50-60 miles to 20 to 30 miles per charge for a 30-50% reduction in vehicle range.
- 1.2 On average the kWh per mile was 1.1 kWh/mi for the G-Vans and 1.4 kWh/mi for the TEVans.
- 1.3 The off-board charging system for the G-Vans is bulky and cumbersome. This system needed major modification for easier operation and maintenance.
- 1.4 An accurate "fuel gauge" is one of the key components required for operating EVs.

2. Maintenance

- 2.1 Battery maintenance was the major portion of total EV maintenance even though automatic watering was used.
- 2.2 A thermal management system and a battery monitoring system could be very useful and effective in operating and maintaining EVs.

3. Public Reaction:

- 3.1 In general, the public reaction during various demonstrations and displays was very favorable and encouraging.

4. Driver's Acceptance:

- 4.1 Energy usage per mile is considerably higher than expected for electric vehicles and needs to be reduced.
- 4.2 Charging time of four to eight hours is still considerably "long". Opportunity charging, reduced to 15 to 30 minutes should be an option.
- 4.3 Overall availability of the TEVans was not as reliable as expected since the vehicles were specifically equipped with the advanced battery and the most recent components

4.4 The new TEVans in general were comfortable and easy to drive after the startup problems were resolved. Acceleration and interior design received favorable comments from various groups when they test drove this EV.

5. Infrastructure:

5.1 The infrastructure for charging EVs at various public, commercial and residential facilities must be considered prior to the successful commercialization of EVs.

6. Commercialization:

6.1 Near term commercialization of EVs is heavily dependent on capital cost, total vehicle weight, on-board power source and the convenience of charging EVs at various locations.

5. PSE&G Urban Environment Field Testing

Since PSE&G's service area primarily covers the central corridor of New Jersey extending from New York to Philadelphia, it provided a unique metropolitan value added feature in testing and assessing EV's in an EPA non-attainment urban environment.

6. PSE&G Previous Experience in Assessing Batteries

PSE&G, in the early eighties, completed an assessment of large advanced batteries for DOE. The assessment also included the balance of plant equipment and the overall economics of the battery plant operating in conjunction with the utility grid network. Final reports detailing design, engineering, installation, operation and economics were published in a DOE report.

7. EV Inspection and Examinations

PSE&G maintains a maintenance shop where the vehicles routinely go through inspection prior to acceptance. These tests and inspections are completed to verify and confirm reliable operations of the vehicles. The PSE&G's Research and Testing (R&T) Laboratory Lab performs the conventional inspections and examinations for the State of New Jersey.

VI. VALUE ADDED FEATURES

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PSE&G continued to provide additional value-added features to enhance its EV program. PSE&G offered the following items as value-added features:

1. PSE&G Participation in United States Advanced Battery Consortium

The battery development and its timely commercialization could significantly impact overall EV market penetration. At present, the battery appears to be the key issue which could dominate EV range, weight, and cost. Therefore, to further support the research and development of the battery manufacturing industry and accelerate the market potential of electric vehicles, PSE&G signed a tailored collaboration agreement with the Electric Power Research Institute for over one million and six hundred thousand dollars (\$1,600,000). These funds were targeted to directly support the United States Advanced Battery Consortium (USABC).

2. PSE&G Participation in Electric Vehicle Association of the Americas (EVAA)

EVAA participation fostered PSE&G's background in, and awareness of, state-of-the-art development related to EVs. PSE&G has invested about \$25,000 annually since 1989 and currently maintains active membership in EVAA. This contribution exhibits a dedication to actively participate and to encourage EV related activities in USA.

3. Electric Power Research Institute (EPRI) Task Force Membership

PSE&G was an advisor assigned to the Electric Transportation Task Force at EPRI, providing valuable resources in selecting and guiding key technologies for future transportation activities related to EVs. EPRI is a consortium of almost 700 member utilities. PSE&G has been an active participant since the inception of EPRI and has invested several million dollars fostering innovative technologies including EVs.

4. Eastern Region Electric Transportation Task Force (ETTF)

PSE&G participated in this regional activity. The organization is comprised of representatives from four northeast states (NJ, NY, PA, CN) with the primary goal to combine resources to enhance the strategic deployment of electric vehicles. Active participation in this organization provides PSE&G with the opportunity for periodic communications and meetings with the participants which strengthens mutual objectives.