Field Operations Program
Toyota RAV4 (NiMH) Fleet Evaluation Final Report

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Published June 2000

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Prepared for the
U.S. Department of Energy
Assistant Secretary for Energy Efficiency and Renewable Energy
Under DOE Idaho Operations Office
Contract No. DE-AC07-99ID13727

1INEEL/Bechtel BWXT Idaho, LLC.
2Southern California Edison
EXECUTIVE SUMMARY

The U.S. Department of Energy’s Field Operations Program evaluates electric and other advanced technology vehicles in real-world applications and environments. Information generated by the Program is targeted to fleet managers and others considering the leasing and deployment of advanced technology vehicles. The Program subjects vehicles to several types of performance and operations tests; this report only addresses the Fleet Evaluation testing of 10 electric Toyota RAV4s by Southern California Edison (SCE). Vehicles subjected to Fleet Evaluation are driven in “normal” fleet environments. Most of the data addresses the 1-year test period (4th quarter 1998 through 3rd quarter 1999). The 10 RAV4s were picked randomly from SCE’s fleet of 245 RAV4s.

The 10 RAV4s performed well, with only one component failure. Nine hours were required to replace a motor inverter, but the vehicle was out of service for 12 days, waiting for parts. There were a total of 31 maintenance occurrences, with 16 of these relating to problems with the tires. Seven occurrences were related to preventive maintenance or installing backup alarms. The 31 problems required an average of 1.3 hours to correct, but the 31 occurrences included an average of 2.7 days of downtime. However, 21 of the 31 required less than a day of downtime.

The RAV4s were driven 68,440 miles during the test period, traveling 29 miles per charge (despite their test ranges of 76 to 100 miles), averaging 1.9 miles per AC-kWh charged. At the end of the test period, the 10 RAV4s had a total of 122,182 miles on their odometers (includes pre test-period driving), with no battery module failures.

For additional information on testing and other Program activities, visit the Program’s web site at http://ev.inel.gov/sop.
CONTENTS

1. Introduction ........................................................................................................................................ 5
2. Testing Results ................................................................................................................................ 6
3. Conclusion ....................................................................................................................................... 20

FIGURES

1. Total miles accumulated during the testing period for the 10 Toyota RAV4s. ......................... 6
2. Average miles driven per month for the 10 RAV4s........................................................................ 7
3. Vehicle component failure per 1,000 miles for the 10 RAV4s during the fourth quarter of 1998 and the first, second and third quarters of 1999 test period. ................................. 10
4. Number of hours (per 1,000 miles of operation) required for scheduled and unscheduled maintenance on the 10 RAVs........................................................................................................... 10
5. Average miles per charge event during the 4th Quarter 1998 .............................................. 14
6. Average miles per charge event during the 1st Quarter 1999 ................................................ 15
7. Average miles per charge event during the 2nd Quarter 1999.................................................. 16
8. Average miles per charge event during the 3rd Quarter 1999.................................................. 17
9. Average miles per AC kWh charged during the 4th Quarter 1998 ........................................ 17
10. Average Miles/AC kWh 1st Quarter 1999. ................................................................................. 18
11. Average Miles/AC kWh 2nd Quarter 1999................................................................................ 18
12. Average Miles/AC kWh 3rd Quarter 1999. ................................................................................ 19
TABLES

1. Maintenance performed on the 10 RAV4s during the test period. ........................................... 8

2. Monthly and total mileage accumulated for each RAV4 during the test period. .................. 11

3. Vehicle status at the conclusion of the Fleet evaluation testing. The Pomona Urban Loop was used to determine the Range as Tested................................................................. 12

4. Number of cycles, miles, and average miles per cycle placed on the 10 RAV4s and their Panasonic MHB-100 NiMH batteries at the conclusion of the testing. ................................. 13
<table>
<thead>
<tr>
<th>ACRONYMS</th>
<th>EXPLANATION</th>
</tr>
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<tbody>
<tr>
<td>AC</td>
<td>Alternating current</td>
</tr>
<tr>
<td>DOE</td>
<td>U.S. Department of Energy</td>
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<tr>
<td>ETA</td>
<td>Electric Transportation Applications</td>
</tr>
<tr>
<td>EVSE</td>
<td>Electric vehicle supply equipment</td>
</tr>
<tr>
<td>EVTC</td>
<td>Electric Vehicle Technical Center</td>
</tr>
<tr>
<td>F</td>
<td>Fahrenheit</td>
</tr>
<tr>
<td>INEEL</td>
<td>Idaho National Engineering and Environmental Laboratory</td>
</tr>
<tr>
<td>kWh</td>
<td>kilowatt-hour</td>
</tr>
<tr>
<td>mm</td>
<td>Millimeter</td>
</tr>
<tr>
<td>NEMA</td>
<td>National Electrical Manufacturers Association</td>
</tr>
<tr>
<td>NiMH</td>
<td>Nickel metal hydride (battery)</td>
</tr>
<tr>
<td>QVTs</td>
<td>Qualified Vehicle Testers</td>
</tr>
<tr>
<td>SCE</td>
<td>Southern California Edison Company</td>
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<tr>
<td>SOC</td>
<td>state-of-charge</td>
</tr>
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</table>
Field Operations Program  
Toyota RAV4 (NiMH) Fleet Evaluation  
Final Report

1. INTRODUCTION

The Field Operations Program was established by the U.S. Department of Energy (DOE) to implement electric vehicle (EV) activities dictated by the Electric and Hybrid Vehicle Research, Development, and Demonstration Act of 1976. In the ensuing years, the Program has evolved in response to new legislation, interests, and technologies. The Program’s goals include evaluating electric and other advanced technology vehicles in real-world applications and environments, developing infrastructure elements necessary to support significant advanced technology vehicle use, and increasing the awareness and acceptance of advanced technology vehicles. Personnel of the Idaho National Engineering and Environmental Laboratory (INEEL) manage the Field Operations Program. To support the field evaluation of electric vehicles, during 1996 DOE selected two Qualified Vehicle Testers (QVTs) through competitive bids. One of the QVTs is Southern California Edison Company (SCE). The other QVT is a consortium led by Electric Transportation Applications (ETA), with other members consisting of Arizona Public Service, Salt River Project, and Potomac Electric Power Company. For a more complete description of Program activities, Program reports, and test results, visit the Program’s website at http://ev.inel.gov/sop.

One of the tasks of the Program is the fleet evaluation of commercially available electric vehicles. This report summarizes the fleet evaluation of 10 nickel-metal-hydride (NiMH) equipped Toyota RAV4 EVs by the Field Operations Program and its testing partner, SCE. SCE employees operated the RAV4s in normal fleet operations.

SCE’s purpose for evaluating EVs, EV chargers, batteries, and related items is to support the safe and efficient use of EVs and to minimize potential utility system impacts. The following supports this purpose:

- As a fleet operator and an electric utility, SCE uses EVs to conduct business.
- In order to make informed decisions in the purchase of EVs, batteries, and charging equipment, SCE must evaluate them.
- SCE must determine if there are safety issues with the related equipment or their usage.
- SCE has a responsibility to educate and advise customers about efficient and safe operation of EVs.
This report summarizes the vehicles’ performance during the October 1998 to September 1999 test period. Maintenance records as well as efficiency data are used to document the vehicles’ capabilities in a large, fully operational electric utility fleet.

2. TESTING RESULTS

Southern California Edison’s (SCE) Fleet of 245 Toyota RAV4 EVs may be the world’s largest fleet of RAV4s. Out of the 245, 10 RAV4s were randomly selected to be fleet tested as part of DOE’s Field Operations Program. They were operated in coastal, urban, and desert areas to provide data under a variety of climactic conditions. In the 12-month test period, the vehicles logged 68,440 miles (Figure 1) in meter reading applications. (The variance in total miles is due to the different meter reading routes the vehicles were assigned to). This equates to a per vehicle average of 6,844 miles of fleet use during the test year.

![Figure 1](image1.png)

**Figure 1.** Total miles accumulated during the testing period for the 10 Toyota RAV4s.

Most months, each vehicle was driven between 300 and 900 miles, averaging 570 miles (Figure 2). The highest miles driven for a single vehicle was during December, when vehicle 23761 was driven 1,135 miles. The lowest monthly total was for vehicle number 23760, when it was driven 67 miles. During December, Vehicle 23760 was out of service for 12 days for a controller/power control unit problem. The 12 days were likely spent waiting for parts, as the actual repair only required 9 hours (Table 1). The hours per incident required to correct most problems was fairly low. An average of 1.3 hours was required to fix the 31 incidents. While most (21 of 31) of the incidents involved downtime of a day or less, the average downtime per incident was 2.7 days.

An important part of evaluating an electric vehicle is feedback from the vehicle operators. Surprisingly, the most outstanding concern the drivers had was not range, but
tire performance. As seen in some of the driver questionnaires (see Appendix 1), the low-rolling-resistance tires did not provide the desired traction. Additionally, tire life is another issue that deserves attention, as it was the most troublesome vehicle component (Figure 3); tire repair or replacement was the most frequently performed service on the RAV4s. The rubber compound, softer sidewalls, and higher inflation pressure may all contribute to the shorter tread life and perhaps make them more susceptible to punctures. The need to repair the tires adversely impacted the number of servicing hours required to maintain the RAV4s (Figure 4).

![Average Miles Driven per Month](image)

**Figure 2.** Average miles driven per month for the 10 RAV4s.

Tire-related issues accounted for 16 of the 31 maintenance items reported (Table 1). Seven items were for either preventive maintenance or installing backup alarms; five were for things like burned-out light bulbs, a windshield crack, and a misadjusted door. One occurrence involved recharging the air conditioner and one involved the ABB kWh meter installed by SCE to monitor the energy use. The final occurrence involved Vehicle 23760’s power control unit (PCU), which required the previously mentioned twelve days to repair. The PCU problem could arguably be considered the only EV-specific component that required maintenance. While the ABB kWh meter is EV-specific, it was added by SCE for testing purposes only.
Table 1. Maintenance performed on the 10 RAV4s during the test period.

<table>
<thead>
<tr>
<th>Veh. No.</th>
<th>Component Name</th>
<th>Odometer Reading</th>
<th>Reported Problem</th>
<th>Date Reported</th>
<th>Date Repaired</th>
<th>Downtime (Days)*</th>
<th>Hours</th>
<th>Corrective Action</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

**4th Quarter 1998**

<table>
<thead>
<tr>
<th>Veh. No.</th>
<th>Component Name</th>
<th>Odometer Reading</th>
<th>Reported Problem</th>
<th>Date Reported</th>
<th>Date Repaired</th>
<th>Downtime (Days)*</th>
<th>Hours</th>
<th>Corrective Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>23751</td>
<td>Tires / wheels</td>
<td>4,576</td>
<td>Front tires need to be replaced</td>
<td>10/29/98</td>
<td>10/29/98</td>
<td>0</td>
<td>1</td>
<td>R&amp;R front tires</td>
</tr>
<tr>
<td>23773</td>
<td>Tires / wheels</td>
<td>NA</td>
<td>Right front tire flat</td>
<td>11/16/98</td>
<td>11/20/98</td>
<td>4</td>
<td>1</td>
<td>R&amp;R tire</td>
</tr>
</tbody>
</table>

**1st Quarter 1999**

<table>
<thead>
<tr>
<th>Veh. No.</th>
<th>Component Name</th>
<th>Odometer Reading</th>
<th>Reported Problem</th>
<th>Date Reported</th>
<th>Date Repaired</th>
<th>Downtime (Days)*</th>
<th>Hours</th>
<th>Corrective Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>23751</td>
<td>Tire</td>
<td>6,233</td>
<td>Nail in left front tire</td>
<td>03/04/99</td>
<td>03/05/99</td>
<td>1</td>
<td>0.5</td>
<td>Repaired tire</td>
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<tr>
<td>23760</td>
<td>ABB meter</td>
<td>N/A</td>
<td>ABB meter bad</td>
<td>01/11/99</td>
<td>01/12/99</td>
<td>1</td>
<td>1.5</td>
<td>R&amp;R ABB meter</td>
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<tr>
<td>23760</td>
<td>Controller/ PCU</td>
<td>8,521</td>
<td>Vehicle quit on road</td>
<td>01/13/99</td>
<td>01/29/99</td>
<td>12</td>
<td>9</td>
<td>R&amp;R motor inverter</td>
</tr>
<tr>
<td>23761</td>
<td>Tire</td>
<td>11,345</td>
<td>Nail in left front tire</td>
<td>01/04/99</td>
<td>01/05/99</td>
<td>1</td>
<td>0.5</td>
<td>Repaired tire</td>
</tr>
<tr>
<td>23761</td>
<td>Tire</td>
<td>12,601</td>
<td>Right front tire flat</td>
<td>02/03/99</td>
<td>02/08/99</td>
<td>3</td>
<td>1.5</td>
<td>R&amp;R tire</td>
</tr>
<tr>
<td>23761</td>
<td>Tire</td>
<td>13,755</td>
<td>Rear tires flat</td>
<td>03/15/99</td>
<td>03/17/99</td>
<td>2</td>
<td>1</td>
<td>Repaired rear tires</td>
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<tr>
<td>23763</td>
<td>Tire</td>
<td>11,291</td>
<td>Right front tire has a slow leak</td>
<td>02/01/99</td>
<td>02/08/99</td>
<td>5</td>
<td>1.25</td>
<td>Repaired tire</td>
</tr>
</tbody>
</table>

**2nd Quarter 1999**

<table>
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<th>Veh. No.</th>
<th>Component Name</th>
<th>Odometer Reading</th>
<th>Reported Problem</th>
<th>Date Reported</th>
<th>Date Repaired</th>
<th>Downtime (Days)*</th>
<th>Hours</th>
<th>Corrective Action</th>
</tr>
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<tbody>
<tr>
<td>23751</td>
<td>Tire</td>
<td>7,075</td>
<td>Front tire worn</td>
<td>05/03/99</td>
<td>05/03/99</td>
<td>1</td>
<td>0.75</td>
<td>R&amp;R front tires (2)</td>
</tr>
<tr>
<td>23751</td>
<td>Backup alarm</td>
<td>7,111</td>
<td>Install backup alarm</td>
<td>05/05/99</td>
<td>05/05/99</td>
<td>1</td>
<td>0.75</td>
<td>Installed backup alarm</td>
</tr>
<tr>
<td>23751</td>
<td>Tire</td>
<td>7,734</td>
<td>Right front tire flat</td>
<td>06/14/99</td>
<td>06/14/99</td>
<td>1</td>
<td>0.5</td>
<td>R&amp;R tire</td>
</tr>
<tr>
<td>23751</td>
<td>Preventive maintenance</td>
<td>7,734</td>
<td>Service due</td>
<td>06/14/99</td>
<td>06/14/99</td>
<td>1</td>
<td>1.5</td>
<td>Service completed</td>
</tr>
<tr>
<td>23752</td>
<td>Backup alarm</td>
<td>4,564</td>
<td>Install backup alarm</td>
<td>05/05/99</td>
<td>05/05/99</td>
<td>1</td>
<td>2</td>
<td>Installed backup alarm</td>
</tr>
<tr>
<td>23752</td>
<td>A/C system</td>
<td>5,065</td>
<td>A/C not cold enough</td>
<td>06/18/99</td>
<td>06/18/99</td>
<td>1</td>
<td>1.5</td>
<td>Recharged by vendor</td>
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<tr>
<td>Veh. No.</td>
<td>Component Name</td>
<td>Odometer Reading</td>
<td>Reported Problem</td>
<td>Date Reported</td>
<td>Date Repaired</td>
<td>Downtime (Days)*</td>
<td>Hours</td>
<td>Corrective Action</td>
</tr>
<tr>
<td>---------</td>
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<tr>
<td>23753</td>
<td>Tire</td>
<td>12,896</td>
<td>Front tires wearing out</td>
<td>04/19/99</td>
<td>04/23/99</td>
<td>5</td>
<td>2</td>
<td>R&amp;R front tires (2)</td>
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<tr>
<td>23753</td>
<td>Backup alarm</td>
<td>13,517</td>
<td>Install backup alarm</td>
<td>05/13/99</td>
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<td>1.5</td>
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<td>23760</td>
<td>Tire</td>
<td>12,091</td>
<td>Nail in left rear tire</td>
<td>06/17/99</td>
<td>06/19/99</td>
<td>3</td>
<td>1</td>
<td>Repaired tire</td>
</tr>
<tr>
<td>23764</td>
<td>Backup alarm</td>
<td>5,969</td>
<td>Install backup alarm</td>
<td>05/06/99</td>
<td>05/06/99</td>
<td>1</td>
<td>0.75</td>
<td>Installed backup alarm</td>
</tr>
<tr>
<td>23773</td>
<td>Tire</td>
<td>8,477</td>
<td>Right front and right rear tires flat</td>
<td>04/06/99</td>
<td>04/14/99</td>
<td>7</td>
<td>1.75</td>
<td>Repaired both tires</td>
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<tr>
<td>23773</td>
<td>Non EV related</td>
<td>9,548</td>
<td>Right rear brake light burned out</td>
<td>06/24/99</td>
<td>06/24/99</td>
<td>1</td>
<td>2.5</td>
<td>R&amp;R brake light bulb</td>
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3rd Quarter 1999

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<tr>
<th>Veh. No.</th>
<th>Component Name</th>
<th>Odometer Reading</th>
<th>Reported Problem</th>
<th>Date Reported</th>
<th>Date Repaired</th>
<th>Downtime (Days)*</th>
<th>Hours</th>
<th>Corrective Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>23751</td>
<td>Non EV related</td>
<td>7,734</td>
<td>Right front turn lens damaged</td>
<td>06/21/99</td>
<td>07/01/99</td>
<td>9</td>
<td>1</td>
<td>R&amp;R right front turn lens</td>
</tr>
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<td>23751</td>
<td>Tire</td>
<td>9,424</td>
<td>Left front tire worn</td>
<td>09/02/99</td>
<td>09/02/99</td>
<td>1</td>
<td>0.5</td>
<td>R&amp;R tire</td>
</tr>
<tr>
<td>23760</td>
<td>Tire</td>
<td>12,561</td>
<td>Left front tire flat</td>
<td>07/06/99</td>
<td>07/06/99</td>
<td>1</td>
<td>0.5</td>
<td>Repaired tire</td>
</tr>
<tr>
<td>23761</td>
<td>Tire</td>
<td>14,162</td>
<td>Flat tire</td>
<td>07/02/99</td>
<td>07/02/99</td>
<td>1</td>
<td>1</td>
<td>Repaired tire</td>
</tr>
<tr>
<td>23763</td>
<td>Brakes</td>
<td>16,308</td>
<td>Left brake light out</td>
<td>08/26/99</td>
<td>08/26/99</td>
<td>1</td>
<td>0.5</td>
<td>R&amp;R brake light bulb</td>
</tr>
<tr>
<td>23764</td>
<td>Preventive maintenance</td>
<td>9,263</td>
<td>Service due</td>
<td>07/28/99</td>
<td>08/27/99</td>
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<td>1</td>
<td>Service completed</td>
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<tr>
<td>23764</td>
<td>Non EV related</td>
<td>9,263</td>
<td>Crack in windshield</td>
<td>09/10/99</td>
<td>09/29/99</td>
<td>14</td>
<td>1</td>
<td>R&amp;R windshield</td>
</tr>
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<td>23770</td>
<td>Preventive maintenance</td>
<td>8,240</td>
<td>Service due</td>
<td>07/28/99</td>
<td>08/27/99</td>
<td>1</td>
<td>1</td>
<td>Service completed</td>
</tr>
<tr>
<td>23773</td>
<td>Tire</td>
<td>10,098</td>
<td>Nail in right rear tire</td>
<td>08/04/99</td>
<td>08/04/99</td>
<td>1</td>
<td>N/A</td>
<td>R&amp;R tire by parkhouse</td>
</tr>
<tr>
<td>23826</td>
<td>Non EV related</td>
<td>9,168</td>
<td>Fuel door bent\ out of adjustment</td>
<td>08/16/99</td>
<td>08/16/99</td>
<td>1</td>
<td>1</td>
<td>Repaired</td>
</tr>
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</table>
Figure 3. Vehicle component failure per 1,000 miles for the 10 RAV4s during the fourth quarter of 1998 and the first, second and third quarters of 1999 test period.

Figure 4. Number of hours (per 1,000 miles of operation) required for scheduled and unscheduled maintenance on the 10 RAVs.
The Toyota RAV4s accumulated 68,440 miles (Table 2) during the fleet evaluation testing period and each had previously accumulated an average of 5,400 miles before the start of testing. Thus, at the conclusion of the testing, they had accumulated a total of 122,182 miles (Table 3). All of the RAV4s were equipped with Panasonic NiMH batteries and conductive connectors for charging.

**Table 2.** Monthly and total mileage accumulated for each RAV4 during the test period.

<table>
<thead>
<tr>
<th>Vehicle No.</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
<th>Sep</th>
<th>Totals</th>
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<td>23751</td>
<td>622</td>
<td>420</td>
<td>394</td>
<td>227</td>
<td>395</td>
<td>478</td>
<td>449</td>
<td>399</td>
<td>639</td>
<td>517</td>
<td>794</td>
<td>608</td>
<td>5,942</td>
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<td>323</td>
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<td>1,135</td>
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<td>900</td>
<td>883</td>
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<td>509</td>
<td>449</td>
<td>535</td>
<td>429</td>
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<td>431</td>
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<td>570</td>
<td>501</td>
<td>654</td>
<td>328</td>
<td>6,073</td>
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<td>23773</td>
<td>515</td>
<td>430</td>
<td>584</td>
<td>707</td>
<td>486</td>
<td>532</td>
<td>533</td>
<td>461</td>
<td>260</td>
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<td>482</td>
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<td>565</td>
<td>460</td>
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<td>6,695</td>
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<td>5,296</td>
<td>6,462</td>
<td>6,337</td>
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<td>5,624</td>
<td>5,046</td>
<td>5,651</td>
<td>5,497</td>
<td>68,440</td>
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</table>
Table 3. Vehicle status at the conclusion of the Fleet evaluation testing. The Pomona Urban Loop was used to determine the Range as Tested.

<table>
<thead>
<tr>
<th>SCE Vehicle #</th>
<th>Range as Tested (Date)</th>
<th>Delivery Date</th>
<th>Assigned Garage</th>
<th>Assigned Application</th>
<th>Status</th>
<th>Odometer as of 09/30/99</th>
</tr>
</thead>
<tbody>
<tr>
<td>23751</td>
<td>90 (01/98)</td>
<td>12/97</td>
<td>Arrowhead</td>
<td>Meter Reading</td>
<td>In Use</td>
<td>10,032</td>
</tr>
<tr>
<td>23752</td>
<td>93 (12/97)</td>
<td>12/97</td>
<td>Santa Monica</td>
<td>Meter Reading</td>
<td>In Use</td>
<td>6,422</td>
</tr>
<tr>
<td>23753</td>
<td>86 (12/97)</td>
<td>12/97</td>
<td>Santa Monica</td>
<td>Meter Reading</td>
<td>In Use</td>
<td>14,975</td>
</tr>
<tr>
<td>23760</td>
<td>88 (12/97)</td>
<td>12/97</td>
<td>Covina</td>
<td>Meter Reading</td>
<td>In Use</td>
<td>14,720</td>
</tr>
<tr>
<td>23761</td>
<td>76 (12/97)</td>
<td>12/97</td>
<td>Covina</td>
<td>Meter Reading</td>
<td>In Use</td>
<td>17,859</td>
</tr>
<tr>
<td>23763</td>
<td>95 (12/97)</td>
<td>12/97</td>
<td>Covina</td>
<td>Meter Reading</td>
<td>In Use</td>
<td>17,318</td>
</tr>
<tr>
<td>23764</td>
<td>100 (12/97)</td>
<td>12/97</td>
<td>San Jacinto</td>
<td>Meter Reading</td>
<td>In Use</td>
<td>9,768</td>
</tr>
<tr>
<td>23770</td>
<td>98 (12/97)</td>
<td>12/97</td>
<td>San Jacinto</td>
<td>Meter Reading</td>
<td>In Pomona for preventive maintenance</td>
<td>8,639</td>
</tr>
<tr>
<td>23773</td>
<td>84 (01/98)</td>
<td>12/97</td>
<td>Montebello</td>
<td>Meter Reading</td>
<td>In Use</td>
<td>10,893</td>
</tr>
<tr>
<td>23826</td>
<td>80 (12/97)</td>
<td>12/97</td>
<td>Montebello</td>
<td>Meter Reading</td>
<td>In Use</td>
<td>11,556</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>122,182</td>
</tr>
</tbody>
</table>

Table 4 shows the total number of miles driven and charge cycles for the 122,182 miles driven before and during the test cycle. The average miles driven per charge cycle in Table 4 is only 20 miles, while during the test period the vehicles averaged 29 miles per charge cycle (Figures 5 – 8). (While an organizational theorist might be able to explain the influence of being tested on the drivers’ behaviors, this report will limit itself to simply identifying the average miles driven per charge cycle). The RAV4s averaged a cumulative 1.9 miles per AC-kWh charged (Figures 9 – 12) during the test period.
Table 4. Number of cycles, miles, and average miles per cycle placed on the 10 RAV4s and their Panasonic MHB-100 NiMH batteries at the conclusion of the testing. The manufacturer rated capacity is 100 Amp-hour at C/3. All of the RAV4s were placed in service during December 1997. The data includes miles accumulated before and during the test period. The data reflects the test fleet status as of September 31 1999.

<table>
<thead>
<tr>
<th>Vehicle No.</th>
<th>Total number of charge cycles</th>
<th>Total miles</th>
<th>Battery modules replaced</th>
<th>Average miles per charge cycle</th>
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<tbody>
<tr>
<td>23751</td>
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<td>0</td>
<td>20.00</td>
</tr>
<tr>
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<td>17,318</td>
<td>0</td>
<td>20.00</td>
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<td>0</td>
<td>20.02</td>
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<td>8,639</td>
<td>0</td>
<td>20.00</td>
</tr>
<tr>
<td>23773</td>
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<td>0</td>
<td>19.99</td>
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<td>23826</td>
<td>578</td>
<td>11,556</td>
<td>0</td>
<td>19.99</td>
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<tr>
<td>Totals</td>
<td>6,109</td>
<td>122,182</td>
<td>0</td>
<td>20.00</td>
</tr>
</tbody>
</table>
Figure 5. Average miles per charge event during the 4th Quarter 1998. (*Problems with the ABB meter programming led to missed or incorrect data).
Figure 6. Average miles per charge event during the 1st Quarter 1999. (*Problems with ABB meter programming led to missed or incorrect data).
Figure 7. Average miles per charge event during the 2nd Quarter 1999.
Figure 8. Average miles per charge event during the 3rd Quarter 1999.

Figure 9. Average miles per AC kWh charged during the 4th Quarter 1998. (*Problems with ABB meter programming led to missed or incorrect data.)
Figure 10. Average Miles/AC kWh 1st Quarter 1999. (*Problems with ABB meter programming led to missed or incorrect data.)

Figure 11. Average Miles/AC kWh 2nd Quarter 1999.
Figure 12. Average Miles/AC kWh 3rd Quarter 1999.
3. CONCLUSION

While a vehicle’s appeal will vary from person to person, the majority of the RAV4 drivers surveyed preferred electric vehicles to internal combustion engine (ICE) vehicles in their job applications. SCE’s fleet of 245 RAV4s has an approval rating of over 70% amongst drivers.

There are environmental as well as financial benefits when incorporating electric vehicles into a fleet. 16,426 pounds of pollutants were reduced while driving the RAV4s instead of driving 10 ICE vehicles for the same amount of time. Thirteen oil changes were avoided, saving 65 quarts of oil, nor did the vehicles have to undergo smog checks every 2 years. 34,220 kWh of electricity were consumed, saving 2,738 gallons of gasoline, netting savings of over $1,700 in fuel costs.

The RAV4s were leased for 3 years at a cost of $16,000 per vehicle. The lease includes a 3-year bumper to bumper warranty, which covers all necessary repairs not resulting from driver negligence or abuse. In addition, subsidizing funds exist in California, which lowers the lease cost of an electric vehicle, making it comparable to an ICE vehicle. EVs have 10 times fewer moving parts than an ICE vehicle, which results in fewer component failures.

Assuming a 1-year lease cost of $5,333, an energy cost of 8.2 cents per kWh, an average of 3,422 kWh per vehicle year, and an average of 6,844 miles driven per year, the cost to operate the RAV4s averaged 82 cents per mile.

Southern California Edison has made a strong commitment to incorporate electric vehicles into its fleet. Original equipment manufacturers continue to advance EV technology, in turn increasing the applications that electric vehicles could be assigned for. This report shows that EVs are not only capable of being matched to a mission successfully, they also have the ability to reduce the overall cost of operating a utility fleet.
Appendix A
Driver Questionnaires
SCE Electric Vehicle Driver Questionnaire

DRIVER NAME: Ron Price  
LOCATION: Arrowhead  
VEHICLE #: 23751  
VEHICLE MAKE & MODEL: Toyota RAV4  
VEHICLE APPLICATION: Meter Reading  
DATE: 5/24/99

### Driveability
1. The vehicle feels stable and safe  
   - SA  A  NS  D  SD  NA  
   - X
2. The vehicle steering is responsive  
   - SA  A  NS  D  SD  NA  
   - X
3. The vehicle acceleration is adequate  
   - SA  A  NS  D  SD  NA  
   - X
4. The vehicle braking is responsive and safe  
   - SA  A  NS  D  SD  NA  
   - X

### Driving Controls and Gauges
1. The cabin temperature controls are easy to operate  
   - SA  A  NS  D  SD  NA  
   - X
2. The "state-of-charge" gauge is helpful and easy to read  
   - SA  A  NS  D  SD  NA  
   - X
3. The "range remaining" gauge is helpful and easy to read  
   - SA  A  NS  D  SD  NA  
   - X

### Charging Controls and Gauges
1. The charging controls are easy to operate  
   - SA  A  NS  D  SD  NA  
   - X
2. The charging connector (plug) is easy to use  
   - SA  A  NS  D  SD  NA  
   - X
3. The charging cord is easy to manage  
   - SA  A  NS  D  SD  NA  
   - X
4. The vehicle charges adequately (full in the morning)  
   - SA  A  NS  D  SD  NA  
   - X
5. The charger is reasonably quiet  
   - SA  A  NS  D  SD  NA  
   - X
6. Do you know the differences between Inductive and Conductive charging?  
   - Yes  No
   - Yes
   - If yes, which do you prefer?  Inductive
   - No preference

7. Did you have any problems charging?  Yes  No  
   - Yes
8. If yes, please describe*  
   - (
   - thing
   - kind
   - what
   - how
   - why
   - also
   - take
   - note
   - fix
   - recall
   - report
   - call
   - pay
   - fix
   - it
   - fix
   - it
   - fix
   - it
   - fix
   - it
   - fix
   - it
   - fix
   - it
   - fix
   - it
   - fix
   - it
   - fix
   - it
   - fix
   - it

### Interior
1. The heater provides adequate heat  
   - SA  A  NS  D  SD  NA  
   - X
2. The air conditioner provides adequate cooling  
   - SA  A  NS  D  SD  NA  
   - X
3. The vehicle is quiet  
   - SA  A  NS  D  SD  NA  
   - X
4. Did you use electronic equipment (cell phone, radio, etc.) inside the EV?  Yes  No  
   - Yes
   - If yes, please list equipment(s) and describe any problems encountered*  
   - Radio: it would drain battery.  
   - until plug back in to the key

### General
1. The vehicle has adequate payload  
   - SA  A  NS  D  SD  NA  
   - X
2. The vehicle has adequate range  
   - SA  A  NS  D  SD  NA  
   - X
3. The vehicle is easy to operate  
   - SA  A  NS  D  SD  NA  
   - X
4. The vehicle is suited for your job application  
   - SA  A  NS  D  SD  NA  
   - X
5. The vehicle meets your expectations  
   - SA  A  NS  D  SD  NA  
   - X
6. If you had to choose between this vehicle or a similar gasoline vehicle for use in your work, which one would you select?  
   - Electric Vehicle  
   - Gasoline Vehicle  
   - Either

**COMMENTS:**

What did you like best?  
The vehicle is comfortable, easy to drive, easy to set in out of place.

What did you like least?  
The range is not good because if you run heater, lights, 

*SA: Strongly Agree; A: Agree; NS: Not Sure; D: Disagree; SD: Strongly Disagree; NA: Not Applicable*
**Electric Vehicle Driver Questionnaire**

**Participant**

**DRIVER NAME:** MARK RODRIGUEZ  **LOCATION:** SANTA MONICA

**VEHICLE NUMBER:** 23752  **VEHICLE MAKE & MODEL:** TOYOTA EV LAW

**VEHICLE APPLICATION:** METER READING  **DATE:** 3/20/99

### DRIVEABILITY

1. The vehicle feels stable and safe  
   - [ ] Strongly Agree  
   - [ ] Agree  
   - [ ] Not Sure  
   - [ ] Disagree  
   - [ ] Strongly Disagree  
   - [ ] Not Applicable

2. The vehicle steering is responsive
   - [ ] Strongly Agree
   - [ ] Agree
   - [ ] Not Sure
   - [ ] Disagree
   - [ ] Strongly Disagree
   - [ ] Not Applicable

3. The vehicle acceleration is adequate
   - [ ] Strongly Agree
   - [ ] Agree
   - [ ] Not Sure
   - [ ] Disagree
   - [ ] Strongly Disagree
   - [ ] Not Applicable

4. The vehicle braking is responsive and safe
   - [ ] Strongly Agree
   - [ ] Agree
   - [ ] Not Sure
   - [ ] Disagree
   - [ ] Strongly Disagree
   - [ ] Not Applicable

### DRIVING CONTROLS AND GAUGES

1. The cabin temperature controls are easy to operate
   - [ ] Strongly Agree
   - [ ] Agree
   - [ ] Not Sure
   - [ ] Disagree
   - [ ] Strongly Disagree
   - [ ] Not Applicable

2. The “state-of-charge” gauge is helpful and easy to read
   - [ ] Strongly Agree
   - [ ] Agree
   - [ ] Not Sure
   - [ ] Disagree
   - [ ] Strongly Disagree
   - [ ] Not Applicable

3. The “range remaining” gauge is helpful and easy to read
   - [ ] Strongly Agree
   - [ ] Agree
   - [ ] Not Sure
   - [ ] Disagree
   - [ ] Strongly Disagree
   - [ ] Not Applicable

### CHARGING CONTROLS AND GAUGES

1. The charging controls are easy to operate
   - [ ] Strongly Agree
   - [ ] Agree
   - [ ] Not Sure
   - [ ] Disagree
   - [ ] Strongly Disagree
   - [ ] Not Applicable

2. The charging connector (plug) is easy to use
   - [ ] Strongly Agree
   - [ ] Agree
   - [ ] Not Sure
   - [ ] Disagree
   - [ ] Strongly Disagree
   - [ ] Not Applicable

3. The charging cord is easy to manage
   - [ ] Strongly Agree
   - [ ] Agree
   - [ ] Not Sure
   - [ ] Disagree
   - [ ] Strongly Disagree
   - [ ] Not Applicable

4. The vehicle charges adequately (full in the morning)
   - [ ] Strongly Agree
   - [ ] Agree
   - [ ] Not Sure
   - [ ] Disagree
   - [ ] Strongly Disagree
   - [ ] Not Applicable

5. The charger is reasonably quiet
   - [ ] Strongly Agree
   - [ ] Agree
   - [ ] Not Sure
   - [ ] Disagree
   - [ ] Strongly Disagree
   - [ ] Not Applicable

6. Do you know the differences between Inductive and Conductive charging?  
   - [ ] Yes
   - [ ] No
   - [ ] No preference
   - [ ] Not Applicable

   If yes, which do you prefer?  
   - [ ] Inductive
   - [ ] Conductive
   - [ ] No preference

7. Did you have any problems charging?  
   - [ ] Yes
   - [ ] No
   - [ ] Not Applicable

   If yes, please describe*

### INTERIOR

1. The heater provides adequate heat
   - [ ] Strongly Agree
   - [ ] Agree
   - [ ] Not Sure
   - [ ] Disagree
   - [ ] Strongly Disagree
   - [ ] Not Applicable

2. The air conditioner provides adequate cooling
   - [ ] Strongly Agree
   - [ ] Agree
   - [ ] Not Sure
   - [ ] Disagree
   - [ ] Strongly Disagree
   - [ ] Not Applicable

3. The vehicle is quiet
   - [ ] Strongly Agree
   - [ ] Agree
   - [ ] Not Sure
   - [ ] Disagree
   - [ ] Strongly Disagree
   - [ ] Not Applicable

4. Did you use electronic equipment (cell phone, radio, etc.) inside the EV?  
   - [ ] Yes
   - [ ] No
   - [ ] No problems.
   - [ ] Not Applicable

   If yes, please list equipment(s) and describe any problems encountered*

### GENERAL

1. The vehicle has adequate payload
   - [ ] Strongly Agree
   - [ ] Agree
   - [ ] Not Sure
   - [ ] Disagree
   - [ ] Strongly Disagree
   - [ ] Not Applicable

2. The vehicle has adequate range
   - [ ] Strongly Agree
   - [ ] Agree
   - [ ] Not Sure
   - [ ] Disagree
   - [ ] Strongly Disagree
   - [ ] Not Applicable

3. The vehicle is easy to operate
   - [ ] Strongly Agree
   - [ ] Agree
   - [ ] Not Sure
   - [ ] Disagree
   - [ ] Strongly Disagree
   - [ ] Not Applicable

4. The vehicle is suited for your job application
   - [ ] Strongly Agree
   - [ ] Agree
   - [ ] Not Sure
   - [ ] Disagree
   - [ ] Strongly Disagree
   - [ ] Not Applicable

5. The vehicle meets your expectations
   - [ ] Strongly Agree
   - [ ] Agree
   - [ ] Not Sure
   - [ ] Disagree
   - [ ] Strongly Disagree
   - [ ] Not Applicable

6. If you had to choose between this vehicle or a similar gasoline vehicle for use in your work, which one would you select?  
   - [ ] Electric Vehicle
   - [ ] Gasoline Vehicle
   - [ ] Either

### COMMENTS*

What did you like best?  
- [ ] CLEAN - NO EMISSIONS.

What did you like least?  
- [ ] MILAGE ON A CHARGE

---

**SA:** Strongly Agree;  **A:** Agree;  **NS:** Not Sure;  **D:** Disagree;  **SD:** Strongly Disagree;  **NA:** Not Applicable
**Electric Vehicle Driver Questionnaire**

**Participant**: 

**Driver Name**: LEVI HENRY  
**Location**:  
**Vehicle Number**: 23753  
**Vehicle Make & Model**: 10407A E3 RAV  
**Vehicle Application**: HEATER/REF  
**Date**: 3/20/97

### Driveability

| 1. The vehicle feels stable and safe | A | NS | D | SD | NA |
| 2. The vehicle steering is responsive | | | | | | |
| 3. The vehicle acceleration is adequate | | | | | |
| 4. The vehicle braking is responsive and safe | | | | | | |

### Driving Controls and Gauges

| 1. The cabin temperature controls are easy to operate | | | | | | |
| 2. The “state-of-charge” gauge is helpful and easy to read | | | | | | |
| 3. The “range remaining” gauge is helpful and easy to read | | | | | | |

### Charging Controls and Gauges

| 1. The charging controls are easy to operate | | | | | | |
| 2. The charging connector (plug) is easy to use | | | | |
| 3. The charging cord is easy to manage | | | | |
| 4. The vehicle charges adequately (full in the morning) | | | | | | |
| 5. The charger is reasonably quiet | | | | | | |
| 6. Do you know the differences between Inductive and Conductive charging?  | Yes | No |
| If yes, which do you prefer?  | Inductive | Conductive | No preference |
| 7. Did you have any problems charging?  | Yes | No |

If yes, please describe:

### Interior

| 1. The heater provides adequate heat | | | | | | |
| 2. The air conditioner provides adequate cooling | | | | | |
| 3. The vehicle is quiet | | | | |
| 4. Did you use electronic equipment (cell phone, radio, etc.) inside the EV?  | Yes | No |

If yes, please list equipment(s) and describe any problems encountered:

### General

| 1. The vehicle has adequate payload | | | | | | |
| 2. The vehicle has adequate range | | | | | | |
| 3. The vehicle is easy to operate | | | | | | |
| 4. The vehicle is suited for your job application | | | | | | |
| 5. The vehicle meets your expectations | | | | | | |
| 6. If you had to choose between this vehicle or a similar gasoline vehicle for use in your work, which one would you select?  | Electric Vehicle | Gasoline Vehicle | Either |

### Comments:

- What did you like best? _quiet, smooth_
- What did you like least? _breaking over speed bumps - got tire_
# SCE Electric Vehicle Driver Questionnaire

**DRIVER NAME:** Bayram  
**LOCATION:** Calpino  
**VEHICLE #:** 23760  
**VEHICLE MAKE & MODEL:** F-4  
**DATE:** 5-14-99

## Driveability
- The vehicle feels stable and safe - **SA**
- The vehicle steering is responsive - **A**
- The vehicle acceleration is adequate - **D**
- The vehicle braking is responsive and safe - **SD**

## Driving Controls and Gauges
1. The cabin temperature controls are easy to operate - **A**
2. The "state-of-charge" gauge is helpful and easy to read - **A**
3. The "range remaining" gauge is helpful and easy to read - **A**

## Charging Controls and Gauges
1. The charging controls are easy to operate - **A**
2. The charging connector (plug) is easy to use - **A**
3. The charging cord is easy to manage - **A**
4. The vehicle charges adequately (full in the morning) - **A**
5. The charger is reasonably quiet - **A**
6. Do you know the differences between Inductive and Conductive charging? — **Yes**
   - If yes, which do you prefer? — **Inductive**
   - No preference

## Conductive Charging

## Interior
1. The heater provides adequate heat - **A**
2. The air conditioner provides adequate cooling - **NA**
3. The vehicle is quiet - **A**
4. Did you use electronic equipment (cell phone, radio, etc.) inside the EV? — **Yes**
   - If yes, please list equipment(s) and describe any problems encountered:
     - *(Radio) No problems*

## General
1. The vehicle has adequate payload - **A**
2. The vehicle has adequate range - **A**
3. The vehicle is easy to operate - **A**
4. The vehicle is suited for your job application - **A**
5. The vehicle meets your expectations - **A**
6. If you had to choose between this vehicle or a similar gasoline vehicle for use in your work, which one would you select? — **Electric Vehicle**

## Comments
- What did you like best? — Something different than gasoline.
- What did you like least? — The brakes for some reason always "squeak".

---

**SA:** Strongly Agree; **A:** Agree; **NS:** Not Sure; **D:** Disagree; **SD:** Strongly Disagree; **NA:** Not Applicable
**SCE Electric Vehicle Driver Questionnaire**

**DRIVER NAME:** JUSTIN VAN TASSEL  
**LOCATION:** COVINA  
**VEHICLE #:** 23761  
**VEHICLE MAKE & MODEL:** TOYOTA RAV 4  
**VEHICLE APPLICATION:**  
**DATE:** 5/13/99

### DRIVEABILITY
1. The vehicle feels stable and safe  
2. The vehicle steering is responsive  
3. The vehicle acceleration is adequate  
4. The vehicle braking is responsive and safe

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### DRIVING CONTROLS AND GAUGES
1. The cabin temperature controls are easy to operate  
2. The “state-of-charge” gauge is helpful and easy to read  
3. The “range remaining” gauge is helpful and easy to read

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### CHARGING CONTROLS AND GAUGES
1. The charging controls are easy to operate  
2. The charging connector (plug) is easy to use  
3. The charging cord is easy to manage  
4. The vehicle charges adequately (full in the morning)  
5. The charger is reasonably quiet  
6. Do you know the differences between Inductive and Conductive charging? Yes □ No □  
   If yes, which do you prefer? □ Inductive □

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<tr>
<th>Conductive</th>
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7. Did you have any problems charging? Yes □ No □  
   If yes, please describe*

**INTERIOR**

1. The heater provides adequate heat  
2. The air conditioner provides adequate cooling  
3. The vehicle is quiet  
4. Did you use electronic equipment (cell phone, radio, etc.) inside the EV? Yes □ No □  
   If yes, please list equipment(s) and describe any problems encountered*

**GENERAL**

1. The vehicle has adequate payload  
2. The vehicle has adequate range  
3. The vehicle is easy to operate  
4. The vehicle is suited for your job application  
5. The vehicle meets your expectations  
6. If you had to choose between this vehicle or a similar gasoline vehicle for use in your work, which one would you select? (Circle One) Electric Vehicle □ Gasoline Vehicle □ Either

### COMMENTS*

What did you like best? **MOTOR QUIET AND COMFORTABLE**

What did you like least? **THE HEATER DOESN'T WORK WELL**

*SA: Strongly Agree; A: Agree; NS: Not Sure; D: Disagree; SD: Strongly Disagree; NA: Not Applicable*
SCE Electric Vehicle Driver Questionnaire

DRIVER NAME: Tyrone Chambers  LOCATION: Covina
VEHICLE #: 23763  VEHICLE MAKE & MODEL: Toyota Rav 4 EV

VEHICLE APPLICATION:  DATE: 5/13/99

DRIVEABILITY
1. The vehicle feels stable and safe   SA  A  NS  D  SD  NA
2. The vehicle steering is responsive  __________  __________  __________  __________  __________  __________
3. The vehicle acceleration is adequate ____________________________
4. The vehicle braking is responsive and safe ____________________________

DRIVING CONTROLS AND GAUGES
1. The cabin temperature controls are easy to operate ____________________________
2. The "state-of-charge" gauge is helpful and easy to read __________  __________  __________  __________  __________  __________
3. The "range remaining" gauge is helpful and easy to read ____________________________

CHARGING CONTROLS AND GAUGES
1. The charging controls are easy to operate ____________________________
2. The charging connector (plug) is easy to use ____________________________
3. The charging cord is easy to manage ____________________________
4. The vehicle charges adequately (full in the morning) ____________________________
5. The charger is reasonably quiet ____________________________
6. Do you know the differences between Inductive and Conductive charging? ___Yes ___No
   If yes, which do you prefer? ___Inductive ___

Conductive ___No preference

7. Did you have any problems charging? ___Yes ___No
   If yes, please describe*

INTERIOR
1. The heater provides adequate heat ____________________________
2. The air conditioner provides adequate cooling __________  __________  __________  __________  __________  __________
3. The vehicle is quiet ____________________________
4. Did you use electronic equipment (cell phone, radio, etc.) inside the EV? ___Yes ___No
   If yes, please list equipment(s) and describe any problems encountered* Radio No Problems

GENERAL
1. The vehicle has adequate payload ____________________________
2. The vehicle has adequate range ____________________________
3. The vehicle is easy to operate ____________________________
4. The vehicle is suited for your job application ____________________________
5. The vehicle meets your expectations ____________________________
6. If you had to choose between this vehicle or a similar gasoline vehicle for use in your work, which one
   would you select? (Circle One) Electric Vehicle Gasoline Vehicle Either

COMMENTS*
What did you like best? Car has good power for E.V.

What did you like least? The breaks squeaks loud. Ride a little unstable
on freeways.

SA: Strongly Agree; A: Agree; NS: Not Sure; D: Disagree; SD: Strongly Disagree; NA: Not Applicable
# Electric Vehicle Driver Questionnaire

**Participant**

**DRIVER NAME:**

**LOCATION:** San Jacinto

**VEHICLE NUMBER:** 23764

**VEHICLE MAKE & MODEL:** TOYOTA RAV4

**VEHICLE APPLICATION:** Metering

**DATE:**

## Driveability

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<td>4. The vehicle braking is responsive and safe</td>
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## Driving Controls and Gauges

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<td>1. The cabin temperature controls are easy to operate</td>
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<td>2. The “state-of-charge” gauge is helpful and easy to read</td>
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<td>3. The “range remaining” gauge is helpful and easy to read</td>
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## Charging Controls and Gauges

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<td>2. The charging connector (plug) is easy to use</td>
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<td>3. The charging cord is easy to manage</td>
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<td>4. The vehicle charges adequately (full in the morning)</td>
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<td>5. The charger is reasonably quiet</td>
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<td>6. Do you know the differences between Inductive and Conductive charging?</td>
<td>Yes</td>
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<td>If yes, which do you prefer?</td>
<td>Inductive</td>
<td>Conductive</td>
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## Interior

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<td>2. The air conditioner provides adequate cooling</td>
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<td>3. The vehicle is quiet</td>
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<td>4. Did you use electronic equipment (cell phone, radio, etc.) inside the EV?</td>
<td>Yes</td>
<td>No</td>
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## General

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<td>2. The vehicle has adequate range</td>
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<td>3. The vehicle is easy to operate</td>
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<td>4. The vehicle is suited for your job application</td>
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<td>5. The vehicle meets your expectations</td>
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<td>6. If you had to choose between this vehicle or a similar gasoline vehicle for use in your work, which one would you select? (Circle One) Electric Vehicle</td>
<td>Gasoline Vehicle</td>
<td>Either</td>
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## Comments

**What did you like best?** Not Sure. But people like to talk about it.

**What did you like least?** Wind moves it around too much and don't feel it would be safe in an accident.

SA: Strongly Agree; A: Agree; NS: Not Sure; D: Disagree; SD: Strongly Disagree; NA: Not Applicable
Electric Vehicle Driver Questionnaire

DRIVER NAME: ______________ LOCATION: SAN JACINTO

VEHICLE NUMBER: 23720 VEHICLE MAKE & MODEL: TOYOTA RAV4

VEHICLE APPLICATION: MEASURING DATE: ______________

**DRIVEABILITY**

1. The vehicle feels stable and safe ___ A ___ NS ___ D ___ SD ___ NA __
2. The vehicle steering is responsive ___ A ___ NS ___ D ___ SD ___ NA __
3. The vehicle acceleration is adequate ___ A ___ NS ___ D ___ SD ___ NA __
4. The vehicle braking is responsive and safe ___ A ___ NS ___ D ___ SD ___ NA __

**DRIVING CONTROLS AND GAUGES**

1. The cabin temperature controls are easy to operate ___ A ___ NS ___ D ___ SD ___ NA __
2. The “state-of-charge” gauge is helpful and easy to read ___ A ___ NS ___ D ___ SD ___ NA __
3. The “range remaining” gauge is helpful and easy to read ___ A ___ NS ___ D ___ SD ___ NA __

**CHARGING CONTROLS AND GAUGES**

1. The charging controls are easy to operate ___ A ___ NS ___ D ___ SD ___ NA __
2. The charging connector (plug) is easy to use ___ A ___ NS ___ D ___ SD ___ NA __
3. The charging cord is easy to manage ___ A ___ NS ___ D ___ SD ___ NA __
4. The vehicle charges adequately (full in the morning) ___ A ___ NS ___ D ___ SD ___ NA __
5. The charger is reasonably quiet ___ A ___ NS ___ D ___ SD ___ NA __
6. Do you know the differences between Inductive and Conductive charging? ___ Yes ___ No
   If yes, which do you prefer? ___ Inductive ___ Conductive ___ No preference
7. Did you have any problems charging? ___ Yes ___ No
   If yes, please describe: ____________________________

**INTERIOR**

1. The heater provides adequate heat ___ A ___ NS ___ D ___ SD ___ NA __
2. The air conditioner provides adequate cooling ___ A ___ NS ___ D ___ SD ___ NA __
3. The vehicle is quiet ___ A ___ NS ___ D ___ SD ___ NA __
4. Did you use electronic equipment (cell phone, radio, etc.) inside the EV? ___ Yes ___ No
   If yes, please list equipment(s) and describe any problems encountered: ____________________________

**GENERAL**

1. The vehicle has adequate payload ___ A ___ NS ___ D ___ SD ___ NA __
2. The vehicle has adequate range ___ A ___ NS ___ D ___ SD ___ NA __
3. The vehicle is easy to operate ___ A ___ NS ___ D ___ SD ___ NA __
4. The vehicle is suited for your job application ___ A ___ NS ___ D ___ SD ___ NA __
5. The vehicle meets your expectations ___ A ___ NS ___ D ___ SD ___ NA __
6. If you had to choose between this vehicle or a similar gasoline vehicle for use in your work, which one would you select? (Circle One) Electric Vehicle __________ Gasoline Vehicle __________ Either __________

**COMMENTS:**

What did you like best? __________________________

What did you like least? __________________________

SA: Strongly Agree; A: Agree; NS: Not Sure; D: Disagree; SD: Strongly Disagree; NA: Not Applicable
SCE Electric Vehicle Driver Questionnaire

DRIVER NAME: CARLOS MUNQUA LOCATION: MONTEBELLO
VEHICLE #: 23273 VEHICLE MAKE & MODEL: TOYOTA PRIUS
VEHICLE APPLICATION: METRO TRANS DATE: 5/3/16

**DRIVEABILITY**
1. The vehicle feels stable and safe  
2. The vehicle steering is responsive  
3. The vehicle acceleration is adequate  
4. The vehicle braking is responsive and safe

**DRIVING CONTROLS AND GAUGES**
1. The cabin temperature controls are easy to operate
2. The “state-of-charge” gauge is helpful and easy to read
3. The “range remaining” gauge is helpful and easy to read

**CHARGING CONTROLS AND GAUGES**
1. The charging controls are easy to operate
2. The charging connector (plug) is easy to use
3. The charging cord is easy to manage
4. The vehicle charges adequately (full in the morning)
5. The charger is reasonably quiet
6. Do you know the differences between Inductive and Conductive charging? Yes  No
   If yes, which do you prefer? Inductive
   Conductive  No preference
7. Did you have any problems charging? Yes  No
   If yes, please describe

**INTERIOR**
1. The heater provides adequate heat
2. The air conditioner provides adequate cooling
3. The vehicle is quiet
4. Did you use electronic equipment (cell phone, radio, etc.) inside the EV? Yes  No
   If yes, please list equipment(s) and describe any problems encountered

**GENERAL**
1. The vehicle has adequate payload
2. The vehicle has adequate range
3. The vehicle is easy to operate
4. The vehicle is suited for your job application
5. The vehicle meets your expectations.
6. If you had to choose between this vehicle or a similar gasoline vehicle for use in your work, which one would you select? (Circle One) Electric Vehicle Gasoline Vehicle Either

**COMMENTS**
What did you like best? I like the quietness and smoothness of the gear.
What did you like least? I didn’t like driving uphill in this.

SA: Strongly Agree; A: Agree; NS: Not Sure; D: Disagree; SD: Strongly Disagree; NA: Not Applicable
# SCE Electric Vehicle Driver Questionnaire

**DRIVER NAME:** Michael Yupe  
**LOCATION:** Montebello  
**VEHICLE #:** 2582G  
**VEHICLE MAKE & MODEL:** RAV Toyota  
**VEHICLE APPLICATION:** Pro R-V  
**DATE:** 5/1/99

## Driveability
1. The vehicle feels stable and safe  
2. The vehicle steering is responsive  
3. The vehicle acceleration is adequate  
4. The vehicle braking is responsive and safe

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## Driving Controls and Gauges
1. The cabin temperature controls are easy to operate  
2. The "state-of-charge" gauge is helpful and easy to read  
3. The "range remaining" gauge is helpful and easy to read

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## Charging Controls and Gauges
1. The charging controls are easy to operate  
2. The charging connector (plug) is easy to use  
3. The charging cord is easy to manage  
4. The vehicle charges adequately (full in the morning)  
5. The charger is reasonably quiet  
6. Do you know the differences between Inductive and Conductive charging?  
   - Yes  
   - No

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<th>Conductive</th>
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## Interior
1. The heater provides adequate heat  
2. The air conditioner provides adequate cooling  
3. The vehicle is quiet  
4. Did you use electronic equipment (cell phone, radio, etc.) inside the EV?
   - Yes  
   - No

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## General
1. The vehicle has adequate payload  
2. The vehicle has adequate range  
3. The vehicle is easy to operate  
4. The vehicle is suited for your job application  
5. The vehicle meets your expectations  
6. If you had to choose between this vehicle or a similar gasoline vehicle for use in your work, which one would you select? (Circle One)  
   - Electric Vehicle  
   - Gasoline Vehicle  
   - Either

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## Comments:
**What did you like best?** It's quiet I like driving it  
**What did you like least?** Brake system along with the slick tires I don't like.