CALIFORNIA ENERGY COMMISSION

California Energy Commission

Clean Transportation Program

**FINAL PROJECT REPORT**

# California Department of Transportation Installation Electric Vehicle Charging Stations

**Prepared for: California Energy Commission**

**Prepared by: California Department of Transportation (Caltrans)**

**Gavin Newsom, Governor**

**January 2020 | CEC-600-2020-014**

# California Energy Commission

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**Agreement Number: ARV-13-048**

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# ACKNOWLEDGEMENTS

Caltrans' Division of Equipment would like to take this opportunity to thank the California Energy Commission for providing match funding for charging stations at 22 locations throughout California. With your generosity, we have been able to gain tremendous knowledge in electric vehicle charging technology. For this electric vehicle charging station project, we have faced many challenges with the existing electrical of our aged facilities, however with determination, we were able to complete installing charging stations at all 22 locations.

As the result of this effort, in the last six months, we have displaced 1,760 gallons of fossil fuel and reduced 5,900 kg of CO2.

# PREFACE

Assembly Bill 118 (Núñez, Chapter 750, Statutes of 2007) created the Clean Transportation Program, formerly known as the Alternative and Renewable Fuel and Vehicle Technology Program. The statute authorizes the California Energy Commission (CEC) to develop and deploy alternative and renewable fuels and advanced transportation technologies to help attain the state's climate change policies. Assembly Bill 8 (Perea, Chapter 401, Statutes of 2013) reauthorizes the Clean Transportation Program through January 1, 2024, and specifies that the CEC allocate up to $20 million per year (or up to 20 percent of each fiscal year's funds) in funding for hydrogen station development until at least 100 stations are operational.

The Clean Transportation Program has an annual budget of about $100 million and provides financial support for projects that:

- Reduce California's use and dependence on petroleum transportation fuels and increase the use of alternative and renewable fuels and advanced vehicle technologies.
- Produce sustainable alternative and renewable low-carbon fuels in California.
- Expand alternative fueling infrastructure and fueling stations.
- Improve the efficiency, performance and market viability of alternative light-, medium-, and heavy-duty vehicle technologies.
- Retrofit medium- and heavy-duty on-road and nonroad vehicle fleets to alternative technologies or fuel use.
- Expand the alternative fueling infrastructure available to existing fleets, public transit, and transportation corridors.
- Establish workforce-training programs and conduct public outreach on the benefits of alternative transportation fuels and vehicle technologies.

To be eligible for funding under the Clean Transportation Program, a project must be consistent with the CEC's annual Clean Transportation Program Investment Plan Update. The CEC issued PON-13-606 to which Electric Vehicle Charging Stations was a successful award. In response to PON-13-606, the recipient submitted an application which was proposed for funding in the CEC's notice of proposed awards April 4, 2014 and the agreement was executed as ARV-13-048 on June 30, 2014.

# ABSTRACT

The objective of this Agreement was to install workplace charging stations and to accommodate future charging infrastructure demand at existing state facilities.

Before this electric vehicle charging station project began, Caltrans already launched the process of replacing its older light-duty fleet vehicles with electric vehicle to meet the Executive Order B-16-12. At that time, Caltrans owned a small number of battery electric and plug-in hybrids. Although, with a limited number of charging stations, Caltrans managed to use the combination of level 1, level 2 and publicly available chargers to charge its electric vehicle fleet.

Faced with many challenges, Caltrans achieved the goals of this agreement by providing charging stations at all 22 required locations. Of those 22 locations, Caltrans deployed 10 units of the mobile Electric Vehicle Autonomous Renewable Charger solar charging stations.

The mobile Electric Vehicle Autonomous Renewable Charger solar charging station is 100 percent renewable energy. In addition, a benefit of its use is that there is no need to dig trenches and provide electrical power lines. Once the solar charging station is delivered to the site it's ready to use.

**Keywords**: Caltrans, charging infrastructure, electric vehicle, electric vehicle autonomous renewable charger, parking facilities, solar charging station.

Please use the following citation for this report:

Nguyen, Thai. 2020. *California Department of Transportation Installation Electric Vehicle Charging Stations*. California Energy Commission. Publication Number: CEC-600-2020-014.

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# EXECUTIVE SUMMARY

The Governor's Executive Order (EO) B-18-12 (see chapter 5), requires State agencies to take actions that reduce greenhouse gas emissions. In order to comply with the EO B-18-12, Caltrans decided to meet that goal by installing more electric vehicle charging stations. These electric vehicle charging stations where specifically picked in existing employee parking facilities in order to accommodate future demand of more employees driving their electric vehicles to work.

## Early Development

The grant's requirement was to install workplace charging stations to accommodate future charging infrastructure demand at existing employee parking facilities. The grant funding supported Caltrans in its effort to install electric vehicle charging stations at 22 locations.

## Determine Charger Sites

Caltrans' management conducted assessments of several sites and they determined that 22 of those locations were suitable for development of the electric vehicle charging stations.

## Selecting Charging Station Type

A problem with the development of 10 of the electric vehicle charging stations was that existing electrical grid infrastructure could not support the increased demand of electricity to the electric vehicle charging stations. In order to make to sites feasible, Caltrans used a mix of fixed chargers and solar charger. The solar chargers provided supplemental electricity to the site during the day where demand for electricity was large since the employees park their electric vehicles there during the day. The other 12 locations did not need solar chargers, therefore only chargers were installed.

# CHAPTER 1: Technical Background

The State of California has awarded the Envision Solar International, Inc. contract #1-15-61-16 to supply EV ARC™ products to State of California Department of Transportation (Caltrans), as well as, other state and local governmental agencies or entities. The EV ARC™ delivers clean solar energy directly to an electric vehicle (EV) without any disruption or negative environmental impacts. A huge success of this project was due to convenience of electric vehicle supply equipment since they could be installed in pre-existing structures such as parking lots.

Invented and manufactured in the US, the EV ARC™ fits inside a parking space and generates enough clean, solar electricity to power 150 miles of EV driving each day. The system's solar electrical generation is enhanced by EnvisionTrak™, which enables the array to follow the sun, generating 18 to 25 percent more electricity than a fixed array. The energy is stored in the EV ARC™ Power Storage Technology, allowing EV's to charge during the day or at night. The EV ARC™ requires no trenching, foundations or installation work, allowing it to be deployed in minutes and moved to a new location with ease. "California has about 40 percent of the United States' EVs," said Desmond Wheatley, CEO of Envision Solar. EV ARC™ is the perfect solution for a State that requires a scalable, sustainable and easily deployable EV charging infrastructure that does not require trenching or foundations and can be easily moved.

# CHAPTER 2: Data on the Electric Vehicle Charging Stations

Each of the 22 locations had one of two types of chargers installed, the "EV ARC" or the "Fixed" chargers. The EV ARC had a solar array included in its installation in order to provide the supplemental electricity that was necessary to service the amount of electric vehicles that would be relying on those stations for electricity. The Fixed chargers did not have a solar array installed with these stations. The information pertaining to each of the 22 locations where the workplace electric vehicle charging stations were installed is displayed in Table 1.

**Table 1: List of the 22 Workplace Charging Locations**

| Address | City | ZIP Code | County | Charger Type |
|---|---|---|---|---|
| 1993 Marina Boulevard | San Leandro | 94577 | Alameda | 1 Fixed |
| 34th Street & Stockton Blvd. | Sacramento | 95816 | Sacramento | 1 EV ARC |
| 66 Madonna Road | San Luis Obispo | 93401 | San Luis Obispo | 1 Fixed |
| 13204 Golden State Road | Sylmar | 91342 | Los Angeles | 2 Fixed |
| 1090 Bristol Street | Costa Mesa | 92626 | Orange | 2 Fixed |
| 3165 Gold Valley Drive | Rancho Cordova | 95742 | Sacramento | 1 EV ARC |
| 8502 Railroad Avenue | Santee | 92071 | San Diego | 1 Fixed |
| 7179 Opportunity Road | San Diego | 92111 | San Diego | 2 Fixed |
| 7183 Opportunity Road | San Diego | 92111 | San Diego | 1 EV ARC |
| 855 M Street | Fresno | 93721 | Fresno | 1 EV ARC |
| 4821 Adohr Lane | Camarillo | 93010 | Ventura | 1 Fixed |
| 1940 S. Workman Mill Road | Whittier | 90601 | Los Angeles | 1 EV ARC |
| 28820 The Old Road | Valencia | 91355 | Los Angeles | 1 Fixed |
| 5160 W. Imperial Highway | El Segundo | 90245 | Los Angeles | 1 Fixed |
| 1201 Baldwin Park Blvd. | Baldwin Park | 91706 | Los Angeles | 2 Fixed |
| 6641 Marine Way | Irvine | 92618 | Orange | 1 Fixed |
| 32941 Camino Capistrano | San Juan Capistrano | 92675 | Orange | 1 Fixed |

| | | | | |
|---|---|---|---|---|
| 451 West Slover Avenue | Bloomington | 92316 | San Bernardino | 1 EV ARC |
| 4050 Taylor Street | San Diego | 92110 | San Diego | 1 EV ARC |
| 1463 Broadway | El Cajon | 92021 | San Diego | 1 EV ARC |
| 1976 E. Dr. MLK Jr. Blvd. | Stockton | 95205 | San Joaquin | 1 EV ARC |
| 9087 Elkmont Way | Elk Grove | 95624 | Sacramento | 1 EV ARC |

Source: California Department of Transportation (Caltrans)

The benefits from installing these electric vehicle charging stations is that it encourages people to drive electric vehicles, which do not emit air pollutants as internal combustion engine vehicles do. To demonstrate the improvement of air quality Caltrans monitored the sites over a timeframe of 6 months for three main air pollutants: volatile organic compounds (VOCs), oxides of nitrogen (NOx), and particulate matter 10 (PM10). During the 6 months the data in Table 2 displays significant reduction of these three air pollutants emitted from the sites. Table 2 also shows the amount of fossil fuels in gallons as well as the amount of greenhouse gases (GHG) in kilograms reduced at each site due to the electric vehicle charging stations encouraging people to drive electric vehicles to work rather than internal combustion engine vehicles.

**Table 2: Summary of the Emission Data Collected from Each Location**

| Address | Count of Sessions | Sum of Energy (kWh) | Equivalent Miles | Sum of GHG Savings (kg) | Sum of fossil fuel Savings (gallons) | VOC | NOx | PM10 |
|---|---|---|---|---|---|---|---|---|
| **1090 Bristol St, Costa Mesa, CA , 92626** | | | | | | | | |
| Feb | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total** | **2** | **0** | **0** | **0** | **0** | **0** | **0** | **0** |
| **1201 Baldwin Park Blvd, Baldwin Park CA, 91706** | | | | | | | | |
| Feb | 3 | 0 | 1 | 12 | 4 | 1 | 1 | 0 |

| Address | Count of Sessions | Sum of Energy (kWh) | Equivalent Miles | Sum of GHG Savings (kg) | Sum of fossil fuel Savings (gallons) | VOC | NOx | PM10 |
|---|---|---|---|---|---|---|---|---|
| Mar | 6 | 1 | 3 | 29 | 9 | 3 | 2 | 0 |
| Apr | 35* | 1 | 5 | 46 | 14 | 5 | 4 | 0 |
| May | 18 | 2 | 5 | 47 | 14 | 6 | 4 | 0 |
| Jun | 19 | 1 | 4 | 38 | 11 | 5 | 3 | 0 |
| Jul | 6 | 1 | 2 | 19 | 6 | 2 | 1 | 0 |
| **Total** | **87** | **6** | **20** | **191** | **58** | **22** | **15** | **0** |
| **13200 Golden State, Sylmar, CA 91342** | | | | | | | | |
| Feb | 8 | 52 | 182 | 22 | 7 | 188 | 126 | 1 |
| Mar | 23 | 230 | 804 | 96 | 29 | 831 | 557 | 4 |
| Apr | 11 | 88 | 309 | 37 | 11 | 319 | 214 | 1 |
| May | 17 | 235 | 823 | 99 | 29 | 850 | 570 | 4 |
| Jun | 11 | 84 | 293 | 35 | 10 | 303 | 203 | 1 |
| Jul | 19 | 229 | 803 | 96 | 29 | 830 | 556 | 4 |
| **Total** | **89** | **918** | **3212** | **385** | **115** | **3321** | **2226** | **14** |
| **1463 Broadway, El Cajon, CA92021** | | | | | | | | |
| Feb | 20 | 173 | 604 | 72 | 22 | 625 | 419 | 3 |
| Mar | 25 | 222 | 776 | 93 | 28 | 802 | 537 | 3 |
| Apr | 18 | 168 | 589 | 71 | 21 | 609 | 408 | 3 |
| May | 21 | 203 | 710 | 85 | 25 | 734 | 492 | 3 |
| Jun | 20 | 187 | 655 | 79 | 23 | 677 | 454 | 3 |

*This number may be an outlier.

| Address | Count of Sessions | Sum of Energy (kWh) | Equivalent Miles | Sum of GHG Savings (kg) | Sum of fossil fuel Savings (gallons) | VOC | NOx | PM10 |
|---|---|---|---|---|---|---|---|---|
| Jul | 21 | 170 | 596 | 71 | 21 | 616 | 413 | 3 |
| **Total** | **125** | **1122** | **3928** | **471** | **141** | **4061** | **2722** | **17** |
| **1940 S. Workman Mill Rd, Whittier, CA90601** | | | | | | | | |
| **Jul** | 21 | 85 | 297 | 36 | 11 | 307 | 206 | 1 |
| **Total** | **21** | **85** | **297** | **36** | **11** | **307** | **206** | **1** |
| **1976 E. D r MLK Jr Blvd, Stockton, CA95205** | | | | | | | | |
| Feb | 15 | 186 | 649 | 78 | 23 | 671 | 450 | 3 |
| Mar | 13 | 169 | 593 | 71 | 21 | 613 | 411 | 3 |
| Apr | 15 | 188 | 659 | 79 | 24 | 681 | 456 | 3 |
| May | 22 | 333 | 1167 | 140 | 42 | 1207 | 809 | 5 |
| Jun | 17 | 233 | 816 | 98 | 29 | 844 | 566 | 4 |
| Jul | 17 | 121 | 424 | 51 | 15 | 438 | 294 | 2 |
| **Total** | **99** | **1231** | **4308** | **517** | **154** | **4454** | **2986** | **20** |
| **1993 Marina Blvd, San Leandro, CA 94577** | | | | | | | | |
| Feb | 45 | 490 | 1715 | 206 | 62 | 1774 | 1189 | 8 |
| Mar | 8 | 116 | 406 | 49 | 15 | 420 | 281 | 2 |
| May | 4 | 82 | 288 | 35 | 10 | 298 | 200 | 1 |
| Jun | 4 | 32 | 112 | 13 | 4 | 115 | 77 | 0 |
| Jul | 3 | 47 | 166 | 20 | 6 | 172 | 115 | 1 |

| Address | Count of Sessions | Sum of Energy (kWh) | Equivalent Miles | Sum of GHG Savings (kg) | Sum of fossil fuel Savings (gallons) | VOC | NOx | PM10 |
|---|---|---|---|---|---|---|---|---|
| **Total** | **64** | **768** | **2687** | **322** | **96** | **2778** | **1862** | **12** |
| **28820 The Old Rd, Valencia, CA91355** | | | | | | | | |
| Jun | 1 | 4 | 13 | 2 | 0 | 13 | 9 | 0 |
| **Total** | **1** | **4** | **13** | **2** | **0** | **13** | **9** | **0** |
| **3165 Gold Valley Drive, Rancho Cordova, CA95742** | | | | | | | | |
| Feb | 23 | 202 | 708 | 85 | 25 | 732 | 490 | 3 |
| Mar | 12 | 133 | 466 | 56 | 17 | 482 | 323 | 2 |
| Apr | 20 | 194 | 681 | 82 | 24 | 704 | 472 | 3 |
| May | 19 | 174 | 607 | 73 | 22 | 628 | 421 | 3 |
| Jun | 20 | 213 | 744 | 89 | 27 | 769 | 516 | 3 |
| Jul | 12 | 132 | 463 | 56 | 17 | 479 | 321 | 2 |
| **Total** | **106** | **1048** | **3669** | **440** | **132** | **3794** | **2542** | **16** |
| **32941 Camino Capistrano, San Juan Capistrano, CA , 92675** | | | | | | | | |
| Feb | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Mar | 2 | 11 | 40 | 5 | 1 | 41 | 28 | 0 |
| May | 3 | 9 | 30 | 4 | 1 | 31 | 21 | 0 |
| Jun | 1 | 2 | 7 | 1 | 0 | 7 | 5 | 0 |
| **Total** | **7** | **22** | **77** | **9** | **3** | **80** | **53** | **0** |

| Address | Count of Sessions | Sum of Energy (kWh) | Equivalent Miles | Sum of GHG Savings (kg) | Sum of fossil fuel Savings (gallons) | VOC | NOx | PM10 |
|---|---|---|---|---|---|---|---|---|
| **34th Street, Sacramento, CA 95816** | | | | | | | | |
| Feb | 36 | 218 | 761 | 91 | 27 | 787 | 528 | 3 |
| Mar | 21 | 134 | 467 | 56 | 17 | 483 | 324 | 2 |
| Apr | 53 | 307 | 1074 | 129 | 39 | 1111 | 745 | 5 |
| May | 27 | 222 | 776 | 93 | 28 | 803 | 538 | 3 |
| Jun | 40 | 249 | 871 | 105 | 31 | 901 | 604 | 4 |
| Jul | 32 | 176 | 614 | 74 | 22 | 635 | 426 | 3 |
| **Total** | **209** | **1306** | **4563** | **548** | **164** | **4720** | **3165** | **20** |
| **4050 Taylor St, San Diego, CA 92110** | | | | | | | | |
| Feb | 45 | 222 | 779 | 93 | 28 | 805 | 540 | 3 |
| Mar | 49 | 225 | 787 | 94 | 28 | 814 | 546 | 3 |
| Apr | 52 | 236 | 825 | 99 | 30 | 853 | 571 | 4 |
| May | 6 | 22 | 78 | 9 | 3 | 81 | 54 | 0 |
| Jun | 45 | 302 | 1057 | 127 | 38 | 1093 | 732 | 5 |
| Jul | 41 | 332 | 1161 | 139 | 42 | 1200 | 804 | 5 |
| **Total** | **238** | **1339** | **4686** | **562** | **168** | **4846** | **3248** | **21** |
| **451 Slover Ave, Bloomington, CA 92316** | | | | | | | | |
| Feb | 14 | 48 | 168 | 20 | 6 | 174 | 116 | 1 |
| Apr | 19 | 49 | 171 | 21 | 6 | 177 | 119 | 1 |
| May | 3 | 45 | 157 | 19 | 6 | 162 | 109 | 1 |
| Jun | 10 | 118 | 412 | 49 | 15 | 426 | 285 | 2 |

| Address | Count of Sessions | Sum of Energy (kWh) | Equivalent Miles | Sum of GHG Savings (kg) | Sum of fossil fuel Savings (gallons) | VOC | NOx | PM10 |
|---|---|---|---|---|---|---|---|---|
| **Total** | **46** | **259** | **908** | **109** | **33** | **939** | **629** | **4** |
| **4821 Adohr Ln, Camarillo, CA 93012** | | | | | | | | |
| Mar | 1 | 17 | 59 | 7 | 2 | 61 | 41 | 0 |
| Jul | 3 | 44 | 155 | 19 | 6 | 161 | 108 | 1 |
| **Total** | **4** | **61** | **215** | **26** | **8** | **222** | **149** | **1** |
| **5160 W Imperial Hwy, El Segundo, CA 90045** | | | | | | | | |
| Apr | 3 | 48 | 167 | 20 | 6 | 172 | 115 | 1 |
| May | 8 | 137 | 480 | 58 | 17 | 497 | 333 | 2 |
| Jun | 8 | 106 | 370 | 44 | 13 | 383 | 257 | 2 |
| Jul | 8 | 133 | 467 | 56 | 17 | 483 | 324 | 2 |
| **Total** | **27** | **424** | **1484** | **178** | **53** | **1535** | **1029** | **7** |
| **66 Madonna Rd, San Luis Obispo, CA 93401** | | | | | | | | |
| Feb | 9 | 120 | 419 | 50 | 15 | 433 | 290 | 2 |
| Mar | 16 | 117 | 409 | 49 | 15 | 423 | 283 | 2 |
| Apr | 38 | 391 | 1370 | 164 | 49 | 1416 | 949 | 6 |
| May | 33 | 443 | 1549 | 186 | 55 | 1601 | 1073 | 7 |
| Jun | 34 | 417 | 1460 | 175 | 52 | 1509 | 1011 | 6 |
| Jul | 27 | 316 | 1105 | 133 | 40 | 1142 | 765 | 5 |
| **Total** | **157** | **1803** | **6310** | **758** | **226** | **6525** | **4373** | **28** |

| Address | Count of Sessions | Sum of Energy (kWh) | Equivalent Miles | Sum of GHG Savings (kg) | Sum of fossil fuel Savings (gallons) | VOC | NOx | PM10 |
|---|---|---|---|---|---|---|---|---|
| **6681 Marine Way, Irvine, CA 92618** | | | | | | | | |
| Jun | 4 | 28 | 96 | 12 | 3 | 100 | 67 | 0 |
| Jul | 19 | 235 | 822 | 99 | 29 | 850 | 570 | 4 |
| **Total** | **23** | **263** | **918** | **111** | **32** | **950** | **637** | **4** |
| **7179 Opportunity Rd, San Diego, CA 92111** | | | | | | | | |
| Mar | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| May | 3 | 13 | 45 | 5 | 2 | 47 | 31 | 0 |
| Jun | 1 | 1 | 4 | 1 | 0 | 4 | 3 | 0 |
| **Total** | **5** | **14** | **49** | **6** | **2** | **51** | **34** | **0** |
| **7183 Opportunity Rd, San Diego, CA 92111** | | | | | | | | |
| Feb | 17 | 152 | 534 | 64 | 19 | 552 | 370 | 2 |
| Mar | 22 | 197 | 690 | 83 | 25 | 714 | 478 | 3 |
| Apr | 15 | 114 | 399 | 48 | 14 | 412 | 276 | 2 |
| May | 24 | 220 | 769 | 92 | 28 | 795 | 533 | 3 |
| Jun | 15 | 127 | 445 | 53 | 16 | 461 | 309 | 2 |
| Jul | 19 | 231 | 809 | 97 | 29 | 836 | 561 | 4 |
| **Total** | **112** | **1041** | **3646** | **437** | **131** | **3770** | **2527** | **16** |
| **8502 Railroad** | | | | | | | | |

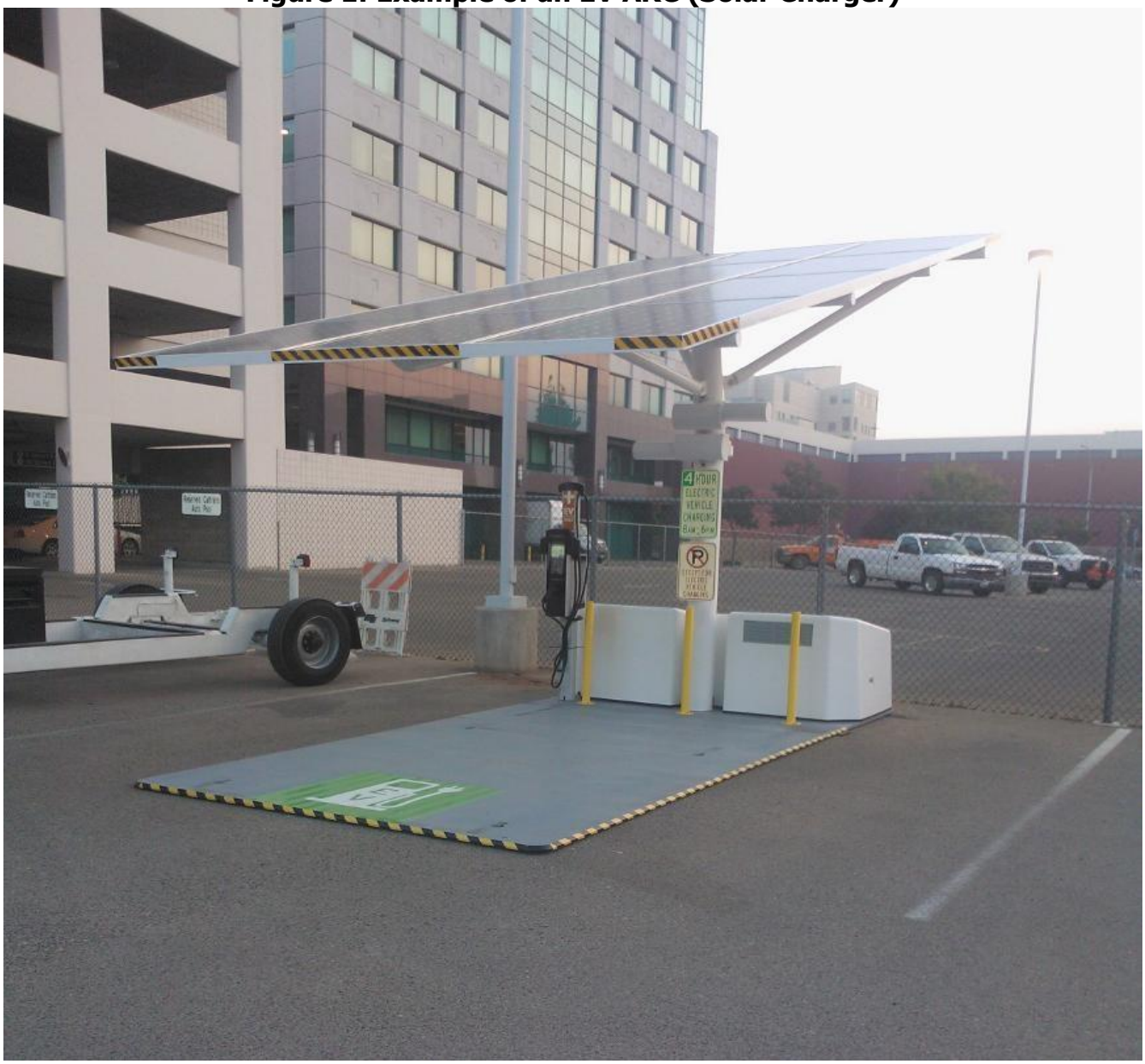
| Address | Count of Sessions | Sum of Energy (kWh) | Equivalent Miles | Sum of GHG Savings (kg) | Sum of fossil fuel Savings (gallons) | VOC | NOx | PM10 |
|---|---|---|---|---|---|---|---|---|
| **Ave, Santee, CA , 92071** | | | | | | | | |
| Feb | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Jul | 1 | 19 | 66 | 8 | 2 | 68 | 46 | 0 |
| **Total** | **2** | **19** | **66** | **8** | **2** | **68** | **46** | **0** |
| **855 M St, Fresno, CA 93721** | | | | | | | | |
| Feb | 38 | 225 | 787 | 94 | 28 | 813 | 545 | 3 |
| Mar | 29 | 188 | 657 | 79 | 24 | 679 | 455 | 3 |
| Apr | 55 | 321 | 1123 | 135 | 40 | 1161 | 778 | 5 |
| May | 69 | 351 | 1227 | 147 | 44 | 1269 | 851 | 5 |
| Jun | 74 | 350 | 1225 | 147 | 44 | 1266 | 849 | 5 |
| Jul | 58 | 319 | 1115 | 134 | 40 | 1153 | 773 | 5 |
| **Total** | **323** | **1754** | **6134** | **736** | **220** | **6341** | **4251** | **26** |
| **9087 Elkmont Way, Elk Grove, CA 95624** | | | | | | | | |
| Feb | 10 | 50 | 174 | 21 | 6 | 180 | 120 | 1 |
| Mar | 7 | 46 | 160 | 19 | 6 | 165 | 111 | 1 |
| Apr | 1 | 6 | 22 | 3 | 1 | 23 | 15 | 0 |
| May | 2 | 13 | 46 | 6 | 2 | 48 | 32 | 0 |
| **Total** | **20** | **115** | **402** | **49** | **15** | **416** | **278** | **2** |
| **Grand Total** | **1767** | **13602** | **47592** | **5903** | **1763** | **49212** | **32987** | **209** |

Source: Caltrans

# CHAPTER 3: Figures Displaying the Electric Vehicle Charging Stations

Figure 1 displays one of the EV ARC (solar charger) that was installed at the parking lot at 855 M Street, Fresno, CA.

**Figure 1: Example of an EV ARC (Solar Charger)**




Source: Caltrans

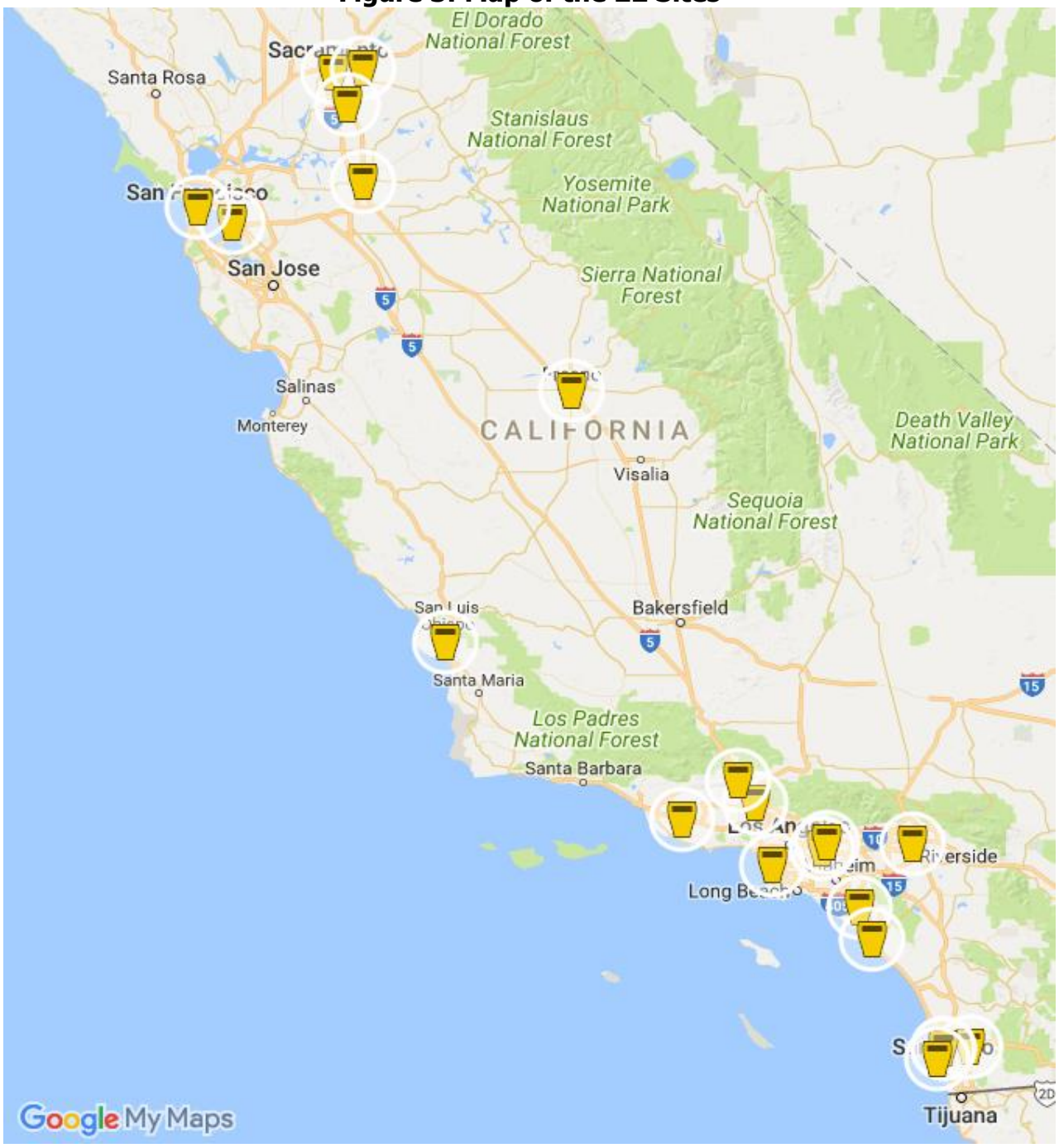
Figure 2 displays one of the fixed chargers that was installed in a parking facility at 8502 Railroad Avenue, Santee, CA.

**Figure 2: Example of a Fixed Charger**


Source: Caltrans

Figure 3 is a map that displays all the 22 locations electric vehicle charging stations were developed throughout the State of California.

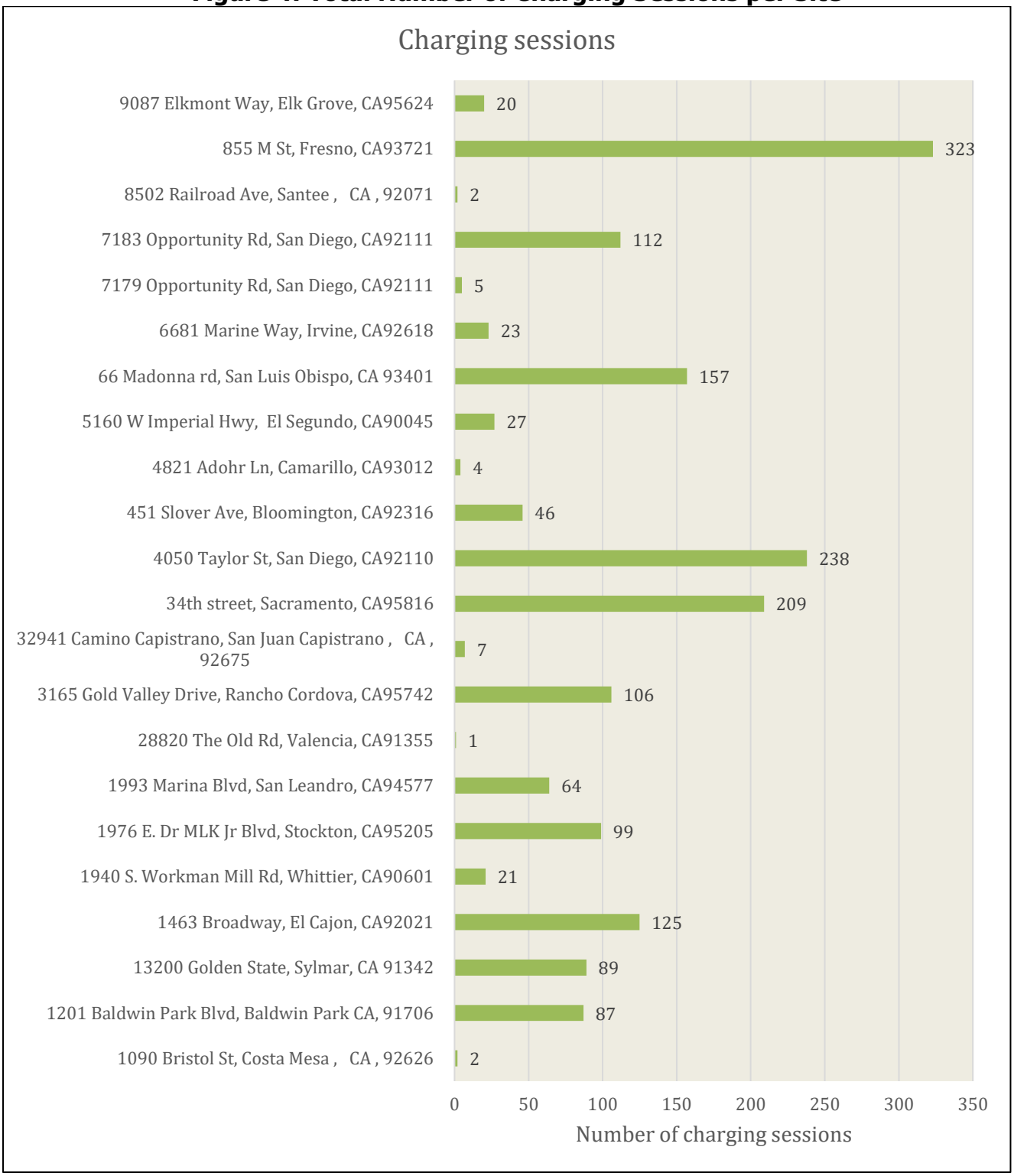
**Figure 3: Map of the 22 Sites**




Source: Caltrans

Figure 4 displays the total charging sessions data for each of the 22 locations. The vertical axis lists the locations and the horizontal axis is the total number of charging sessions at each site over the six month timeframe Caltrans was monitoring the electric vehicle charging stations (February 2018 to July 2018).

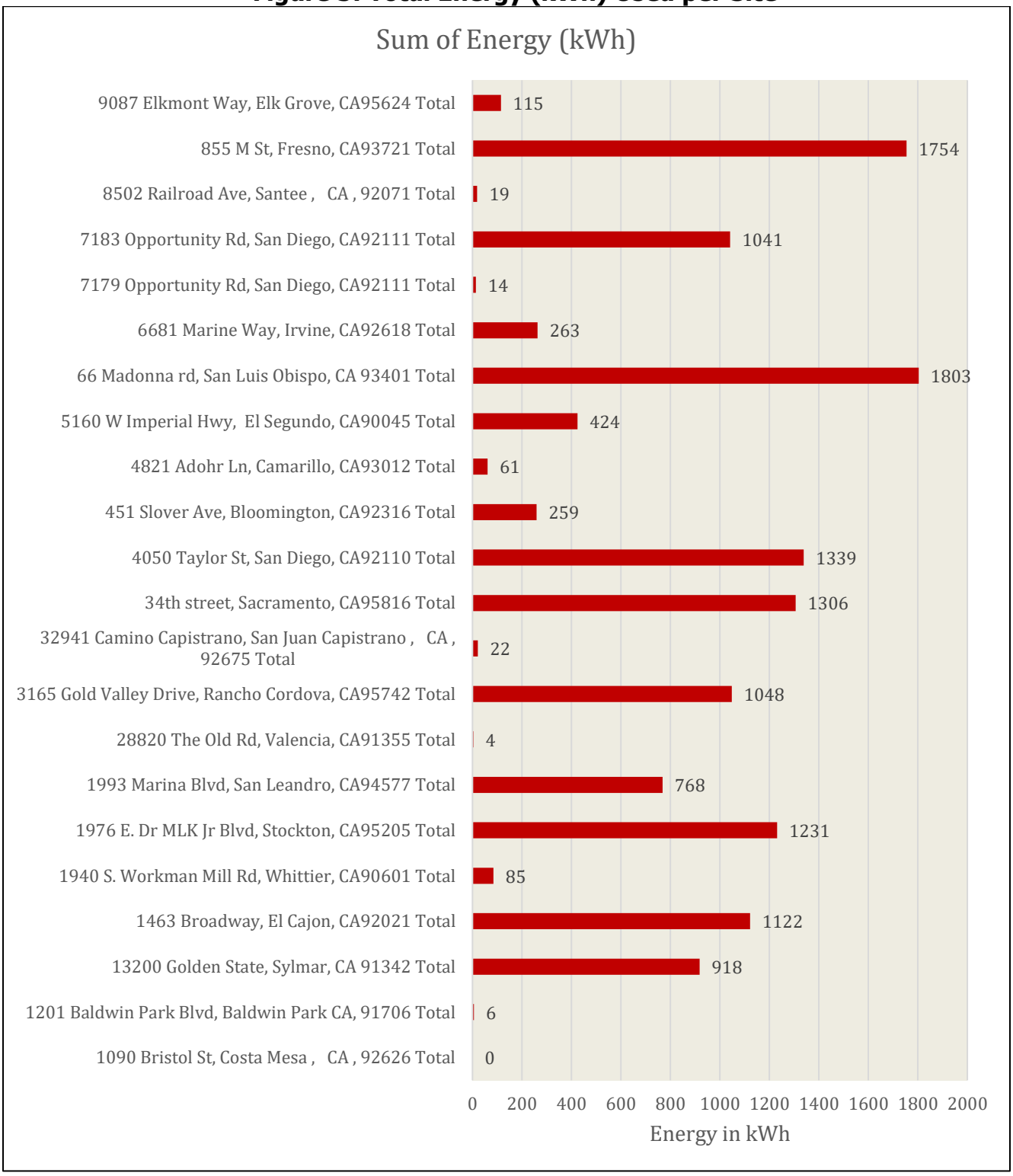
**Figure 4: Total Number of Charging Sessions per Site**




Source: Caltrans

Figure 5 displays the total energy (kWh) used for each of the 22 locations. The vertical axis lists the locations and the horizontal axis is the total energy (in kilowatt hours (kWh)) used at each site over the six month timeframe Caltrans was monitoring the electric vehicle charging stations (February 2018 to July 2018).

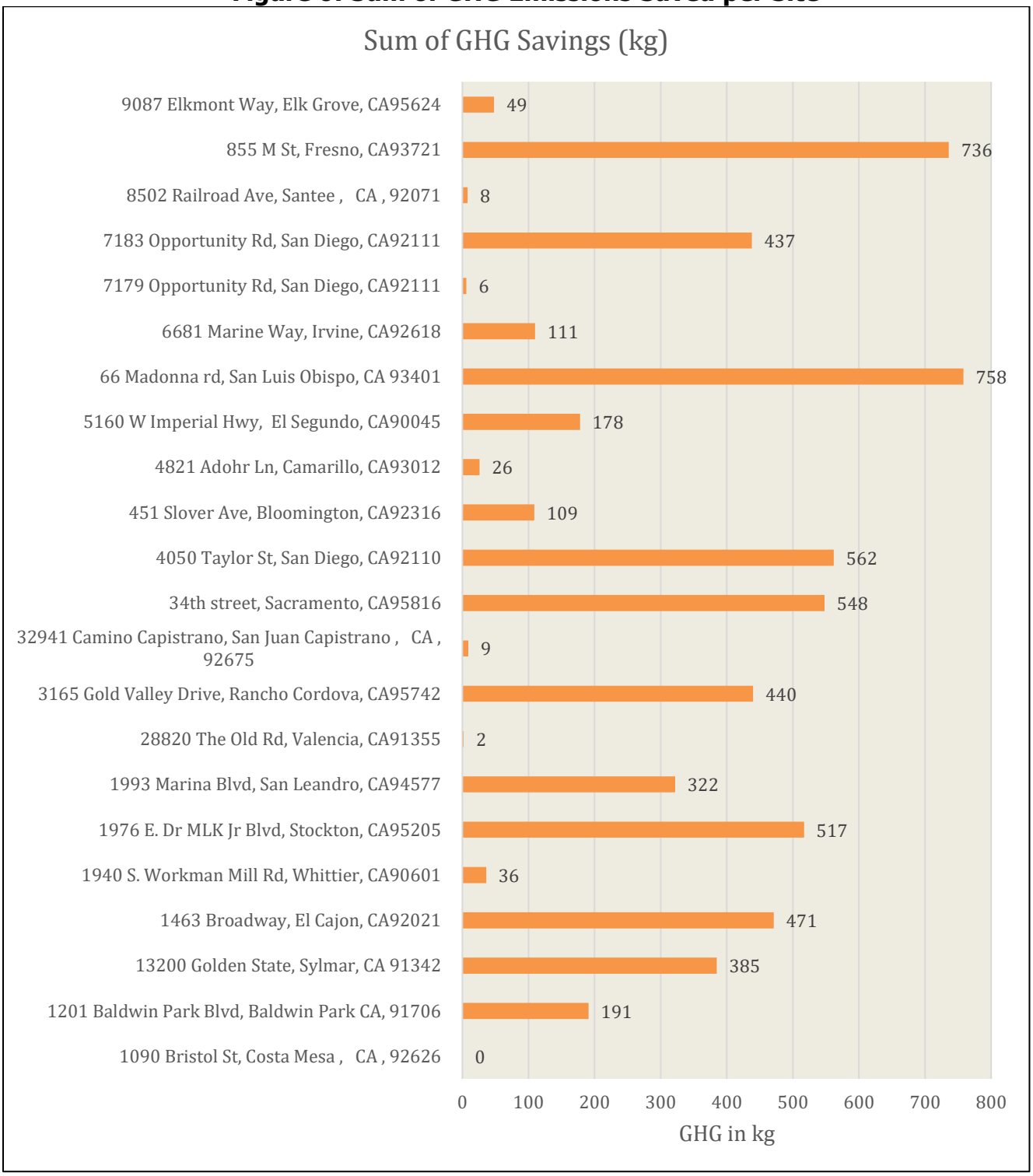
**Figure 5: Total Energy (kWh) Used per Site**




Source: Caltrans

Figure 6 displays the sum of the GHG emissions saved for each of the 22 locations. The vertical axis lists the locations and the horizontal axis is the sum of GHG emissions in kilograms that were saved by people driving electric vehicles at each site over the six month timeframe Caltrans was monitoring the electric vehicle charging stations (February 2018 to July 2018).

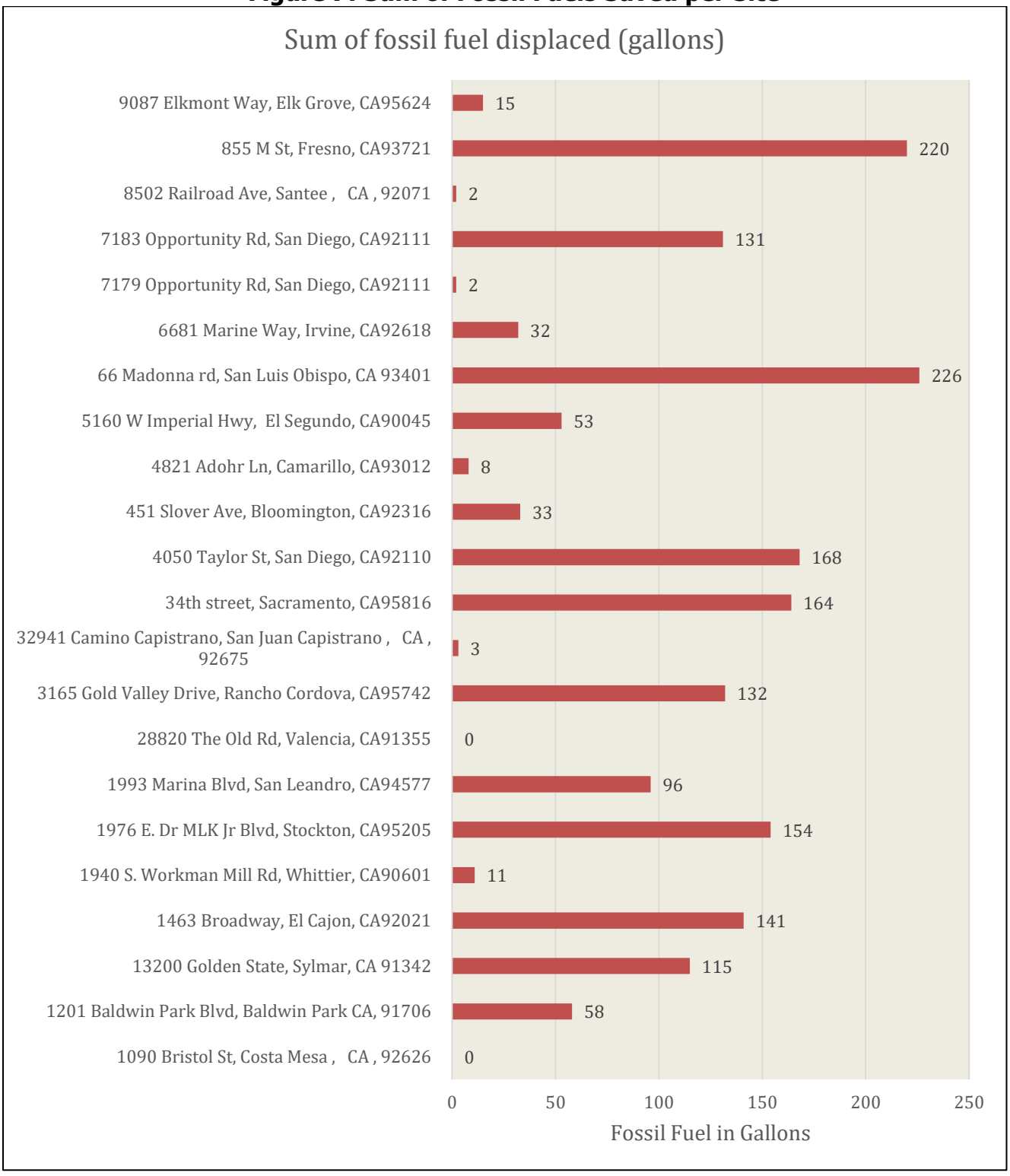
**Figure 6: Sum of GHG Emissions Saved per Site**




Source: Caltrans

Figure 7 displays the sum of fossil fuels saved for each of the 22 locations. The vertical axis lists the locations and the horizontal axis is the sum of fossil fuels in gallons that were saved by people driving electric vehicles at each site over the six month timeframe Caltrans was monitoring the electric vehicle charging stations (February 2018 to July 2018).

**Figure 7: Sum of Fossil Fuels Saved per Site**




Source: Caltrans

# CHAPTER 4: Conclusion

Most of Caltrans' facilities were built more than 50 years ago. Their electrical capacity was not designed to accommodate the extra power load for installing these conventional chargers. This problem typically occurs for those locations that required more than one dual-charger. To accommodate chargers at locations where the cost of upgrading the existing electrical panel to meet demand well over our budget, Caltrans placed a solar charger (EV ARC) in replace of the traditional/conventional charger.

EV ARC worked well where either electricity was not available or the cost of installing an adequate power system at the site was enormous. Another major challenge was selecting locations for the charging stations within each facility. Most of Caltrans' facilities were designed to service and maintenance heavy equipment and are required to keep the area clear for large vehicles. As a result of this constraint, employee parking stalls are often located away from the buildings and the main electrical panel.

Within Caltrans' 22 charging locations, there are facilities where the EV usage is very low to nearly zero. Currently, there is no EV assigned to those locations because Caltrans' EV range of 100 eMile or less does not meet the duty cycle need. Caltrans is planning to purchase longer range EV. In the meantime, plug-in hybrids will serve these locations.

For those locations where charger use is in high demand, Caltrans addressed this situation by rotating the charging of its EV fleet with employee charging. There are locations where a charging sign-in sheet was created for Caltrans employees, which assigned time slots for charging personal EVs, while prioritizing the State's EV charging needs first.

Since Caltrans' new EV charging policy allows employees to use the chargers, the department has seen an increase in the number of new EV ownership among its employees. At the Caltrans Sacramento facility, two years ago, there was only two employees with EVs. As of July 2018 it has a total of nine employees with EVs.

# CHAPTER 5: References

1. Executive Order B-16-12[1]
2. Executive Order B-18-12[2]
3. Assembly Bill 118[3]

1 Executive Order B-16-12 (https://www.ca.gov/archive/gov39/2012/03/23/news17472/index.htm)

2 Executive Order B-18-12 (https://www.ca.gov/archive/gov39/2012/04/25/news17508/index.html)

3 Assembly Bill 118 (https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=200720080AB118)

# GLOSSARY

CALIFORNIA ENERGY COMMISSION (CEC) – The state agency established by the Warren-Alquist State Energy Resources Conservation and Development Act in 1974 (Public Resources Code, Sections 25000 et seq.) responsible for energy policy. The Energy Commission's five major areas of responsibilities are:

- Forecasting future statewide energy needs
- Licensing power plants sufficient to meet those needs
- Promoting energy conservation and efficiency measures
- Developing renewable and alternative energy resources, including providing assistance to develop clean transportation fuels
- Planning for and directing state response to energy emergencies

Funding for the Commission's activities comes from the Energy Resources Program Account, Federal Petroleum Violation Escrow Account and other sources.

CALIFORNIA DEPARTMENT OF TRANSPORTATION (Caltrans) - is responsible for the design, construction, maintenance, and operation of the California State Highway System, as well as that portion of the Interstate Highway System within the state's boundaries.

CARBON DIOXIDE ($CO_2$) - A colorless, odorless, non-poisonous gas that is a normal part of the air. Carbon dioxide is exhaled by humans and animals and is absorbed by green growing things and by the sea. CO2 is the greenhouse gas whose concentration is being most affected directly by human activities. CO2 also serves as the reference to compare all other greenhouse gases (see carbon dioxide equivalent).

ELECTRIC VEHICLES (EV) – A broad category that includes all vehicles that are fully powered by electricity or an electric motor.

GREENHOUSE GASES (GHG) – Any gas that absorbs infra-red radiation in the atmosphere. Greenhouse gases include water vapor, carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), halogenated fluorocarbons (HCFCs), ozone (O3), perfluorinated carbons (PFCs), and hydrofluorocarbons (HFCs).

KILOGRAM (kg) - The base unit of mass in the International System of Units that is equal to the mass of a prototype agreed upon by international convention and that is nearly equal to the mass of 1000 cubic centimeters of water at the temperature of its maximum density.

KILOWATT-HOUR (kWh) - The most commonly-used unit of measure telling the amount of electricity consumed over time. It means one kilowatt of electricity supplied for one hour. In 1989, a typical California household consumes 534 kWh in an average month.

NOx - Oxides of nitrogen that are a chief component of air pollution that can be produced by the burning of fossil fuels. Also called nitrogen oxides.

PARTICULATE MATTER (PM) - Unburned fuel particles that form smoke or soot and stick to lung tissue when inhaled. A chief component of exhaust emissions from heavy-duty diesel engines.

VOLATILE ORGANIC COMPOUNDS (VOCs) - Carbon-containing compounds that evaporate into the air (with a few exceptions). VOCs contribute to the formation of smog and/or may themselves be toxic. VOCs often have an odor and some examples include gasoline, alcohol and the solvents used in paints.