

# Environmental Benefits from Plug-in Electric Vehicle Deployment in the Region

December 2013

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SUBMITTED TO:

San Joaquin Valley Air Pollution Control District

SUBMITTED BY:

California Center for Sustainable Energy





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## I. Background

The San Joaquin Valley Air Basin is one of only two areas in the nation designated as “extreme nonattainment” for the federal ozone standard.<sup>1,2</sup> Ground level ozone pollution, commonly known as smog, forms when sunlight reacts with air containing hydrocarbons and nitrogen oxides (NOx), both of which are emitted by the combustion of fossil fuels.

Diesel trucks and mobile agriculture equipment are the single largest source of NOx emissions as the San Joaquin Valley is dominated by interstate trucks and other through traffic.<sup>3</sup> Heavy-duty vehicles contribute 6% of particulate matter (PM) and 46% of NOx in the Valley. Such emissions lead to hazardous health conditions and negative effects on agriculture.

## II. Smog Forming Emissions – Plug-in Electrics vs. Gasoline

Research into the well-to-wheel smog forming emissions of different fuel types has shown that current gasoline vehicles emit seven times more pollutants than an electric vehicle and more than twice as much as a plug-in hybrid electric vehicle (PHEV).<sup>4</sup> Even as gasoline vehicles become more efficient and use less fuel per mile, plug-in electric vehicles (PEVs) will still emit considerably fewer smog-forming pollutants. Projections for 2020 show, despite advances in vehicle technology, gasoline vehicles will still emit more than five times the smog-forming pollutants as all-electric vehicles and nearly twice as much as a PHEV.

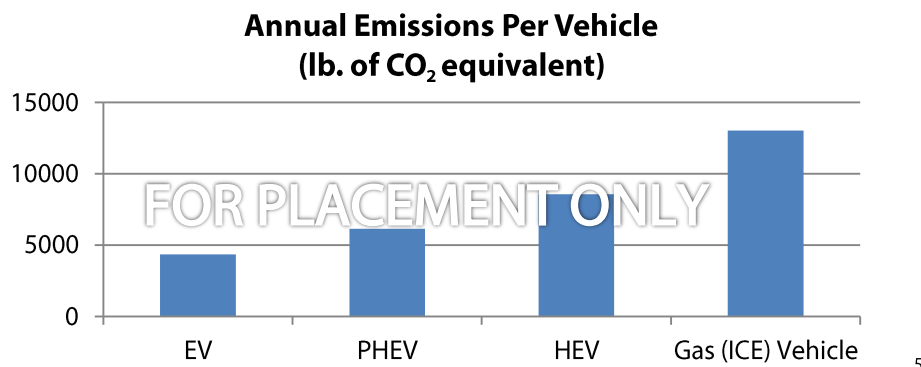
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<sup>1</sup> CARB Vision for Clean Air Public Review Draft, June 27, 2012

<sup>2</sup> On Nov 14, 2013 the SJVAPCD announced that they had zero violations of the hourly ozone standard and have submitted a formal request to the federal Environmental Protection Agency to declare the Valley in attainment.

<sup>3</sup> CARB, “Vision for Clean Air: A Framework for Air Quality and Climate Planning” – Public Review Draft, June 27, 2012. <http://www.arb.ca.gov/planning/vision/vision.htm>

<sup>4</sup> California Air Resources Board, “Advanced Clean Cars Summary”, [www.arb.ca.gov/msprog/clean\\_cars/acc%20summary-final.pdf](http://www.arb.ca.gov/msprog/clean_cars/acc%20summary-final.pdf)



While much of these avoided emissions come from the fuel cycle – the extraction, transportation, refining and manufacture or generation of a specific fuel – whose reductions would not have large immediate environmental benefits for the Valley, the reduction in emissions attributed to vehicle use would directly impact the Valley’s air quality.

### III. Why is this Important?

One of the primary environmental benefits of increased PEV adoption is the reduction of adverse health impacts of ground level ozone pollution. Although progress has been made, all eight counties in the San Joaquin Valley Air Basin received failing ozone pollution grades from the American Lung Association in 2013.<sup>6</sup> In fact, the cities of Visalia, Bakersfield, Fresno and Hanford are among the five most ozone polluted cities in the country. The cities of Modesto and Merced are among the top 25.<sup>7</sup>

Increased exposure to ozone puts adults and children at risk of adverse health effects. Each year there are an estimated 812 PM-related deaths in the San Joaquin Valley.<sup>8</sup>

<sup>5</sup> [http://www.afdc.energy.gov/vehicles/electric\\_emissions.php](http://www.afdc.energy.gov/vehicles/electric_emissions.php)

<sup>6</sup> American Lung Association, “State of the Air 2013”

<sup>7</sup> Ibid.

<sup>8</sup> Hall, Jane & Victor Brajer. The Benefits of Meeting Federal Clean Air Standards in South Cost and San Joaquin Valley Air Basins. Cal State University – Fullerton.



## a. Impact of Pollutants on Children's Health

High levels of ground level ozone pose the greatest health risks to children and can lead to asthma, impaired lung functioning and increased risk of lung infection.<sup>9</sup> These effects can impact the local economy by increasing school absences, visits to doctors and emergency rooms and hospital admissions.

Children breathe in more air per pound of body weight than the average adult does, and because children's respiratory systems are still developing, they are often more susceptible to pollutants than adults. Several studies have shown that exposure to PM and nitrogen dioxide (NO<sub>2</sub>) leads to higher probability of infant death, and the cumulative effect of PM and NO<sub>2</sub> exposure seems to be fatal for young children as well. Further, air pollution exposure during pregnancy can lead to premature births, low birth weights or birth defects.<sup>10</sup>

## b. Impact of Pollution on Agriculture

Agriculture is a major part of the San Joaquin Valley's economy. In 2010, California produced \$37.5 billion in agricultural products, of which the Valley represented 56% of the total.<sup>11</sup> Rising levels of ozone in the air has shown to be harmful for crops and other vegetation. Research has found that agricultural crops may suffer from a decline in nutrients and reduced growth as a result of increased ozone. Ultimately, the poor air quality may inhibit the Valley's robust agricultural sector from producing at its maximum capacity.

## IV. Conclusion

The air pollution in the San Joaquin Valley has led to detrimental health effects, which in turn, negatively affect the local economy. Lost workdays, nonfatal heart attacks, asthma attacks and emergency room visits culminate to losses in productivity and increased spending for health treatments. By reaching federal attainment levels for both ozone and PM, residents in the San Joaquin

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<sup>9</sup> <http://www.epa.gov/glo/health.html>

<sup>10</sup> <http://www.environment.ucla.edu/reportcard/article.asp?parentid=1700>

<sup>11</sup> California Partnership for the San Joaquin Valley. San Joaquin Valley Regional Economic Summit: Issues, Opportunities and Recommendations. March 2012.



Valley Air Basin could reap annual benefits of \$5.73 billion.<sup>12</sup> Additionally, Valley residents can save more than \$2.5 billion in medical costs, lost workdays and reduced mortality.<sup>13</sup> Encouraging more use of PEVs can help the Valley achieve attainment levels, which would create economic benefits as well as foster a healthier community.

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<sup>12</sup> Hall, Jane. The Benefits of Meeting Federal Clean Air Standards.

<sup>13</sup> Bedsworth, Louise Wells. Climate Change Challenges: Vehicle Emissions and Public Health in California. Public Policy Institute of California. March 2010.

# The Use of Incentives to Encourage Plug-in Electric Vehicle Adoption

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## I. Background

Despite the numerous benefits and reports of widespread owner satisfaction with plug-in electric vehicles (PEVs),<sup>1</sup> their high initial purchase price compared to conventional internal combustion engine (ICE) vehicles remains an obstacle to adoption. This price differential discourages consumers who are reluctant to spend more up front on a new vehicle despite the fact that PEVs have lower total cost of ownership than many ICEs.<sup>2</sup>

As was the case when hybrid vehicles were introduced, incentives in the form of rebates and tax credits have been instrumental in enticing early adopters to purchase PEVs. According to statistics from the 2013 California Plug-in Electric Vehicle Driver Survey (released May 2013), 91% of San Joaquin Valley respondents indicated that the state rebate was an important motivation for purchasing a PEV; nearly 68% said the state rebate was a “very important” or “extremely important” motivation. These results are almost identical to survey respondent motivations statewide.

## II. San Joaquin Valley Incentive Programs

The San Joaquin Valley Air Pollution Control District (SJVAPCD) administers three unique incentive programs to encourage consumer PEV demand: Drive Clean! Rebate Program, New Alternative Fuel Vehicle Program<sup>3</sup> and Hybrid and Zero Emission Truck and Bus Voucher Incentive Project (HVIP) Plus-up. Purchasing an alternative fuel vehicle seems economically feasible through such generous incentives.

Table 1 is an overview of the incentives available for PEV drivers in the San Joaquin Valley.

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<sup>1</sup> California Center for Sustainable Energy, “California Plug-in Electric Vehicle Driver Survey Results,” May 2013. <http://energycenter.org/index.php/incentive-programs/clean-vehicle-rebate-project/vehicle-owner-survey/3464-may-2013-survey>

<sup>2</sup> Electrification Coalition, “State of the Plug-in Electric Vehicle Market: EV Market Outlook” July 25, 2013. [www.Electrificationcoalition.org](http://www.Electrificationcoalition.org)

<sup>3</sup> This program is associated with the Public Benefit Grant Program.



Table 1: Incentives for Plug-in Electric Vehicles

<i>Incentive</i>	<i>Benefits</i>
<b>California-Wide</b>	
<b>California Clean Vehicle Rebate Project</b>	Rebates of up to \$2,500 are available for California purchasers or lessees of light-duty zero emission vehicle and PEVs.
<b>Hybrid and Zero Emission Truck and Bus Voucher Incentive Project (HVIP)</b>	Grants vouchers from \$8,000 to \$45,000 for the purchase of each eligible hybrid or electric truck or bus.
<b>San Joaquin Valley-specific</b>	
<b>HVIP Plus-Up</b>	San Joaquin Valley fleets can add up to \$30,000 more per HVIP voucher.
<b>Drive Clean!</b>	Provides rebates for the purchase of new, clean-air vehicles for SJV residents. Rebates range from \$2,000 for PHEV and \$3,000 for a BEV.
<b>Drive Clean! Charging Station Rebate*</b>	Residential charger installations can reap up to a \$1,000 rebate. Public charger installations can receive a rebate of up to 50% of the unit and installation cost.
<b>New Alternative Fuel Vehicle Program</b>	Provides a maximum of \$20,000 per vehicle with a cap of \$100,000 per public agency per year for new alternative fuel vehicle purchases.
<b>City-specific</b>	
<b>PACE HERO Financing</b>	Fresno residents can now benefit from Western Riverside Council of Governments (WRCOG)'s HERO program. It allows financing for permanently-affixed energy efficiency and renewable energy products, including EVSE.

\*This program is not yet available; for the most updated information visit <http://valleyair.org/grants/driveclean.htm>.

### a. Drive Clean! Rebate Program

The Drive Clean! Rebate Program was created as a result of the California Air Resources Board's desire to increase outreach efforts and deployment of PEVs in the San Joaquin Valley. Since the introduction of the program in March 2012, the board's Clean Vehicle Rebate Project (CVRP) has seen an uptick in

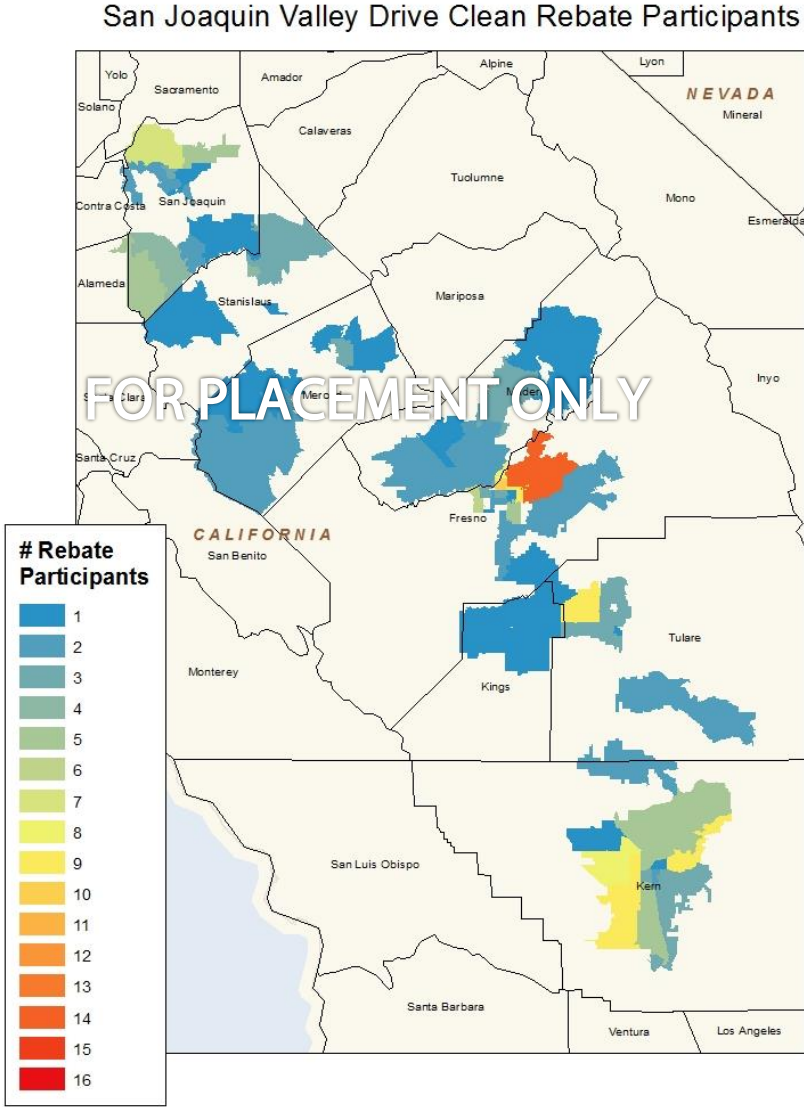


rebate activity for the San Joaquin Valley that can be seen in Figure 1.<sup>4</sup> However, the pattern of rebates in the SJV APCD largely follows that of the state as a whole (Figure 2). As a result, it is difficult to attribute the increase in PEV adoption (as measured by CVRP applications) to the implementation of the Drive Clean! program.

The San Joaquin Valley APCD's Drive Clean! Program is planning to expand to include rebates for the purchase and installation of eligible Level 2 EVSE. When the charging station rebate becomes available, it will be provided on a first-come, first-serve basis, as long as funding is available. The charging station rebate will be available for residential and commercial installations.

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<sup>4</sup> California Air Resources Board, "Assembly Bill 118 Air Quality Improvement Program Funding Plan for Fiscal Year 2013-14", June 25, 2013, page 14. <http://www.arb.ca.gov/msprog/aqip/fundplan/fundplan.htm>



As of October 2013, there have been over 530 rebates issued through the CVRP in the SJVAPCD. Of these, 87% have been issued since the launch of the Drive Clean! Rebate Program.

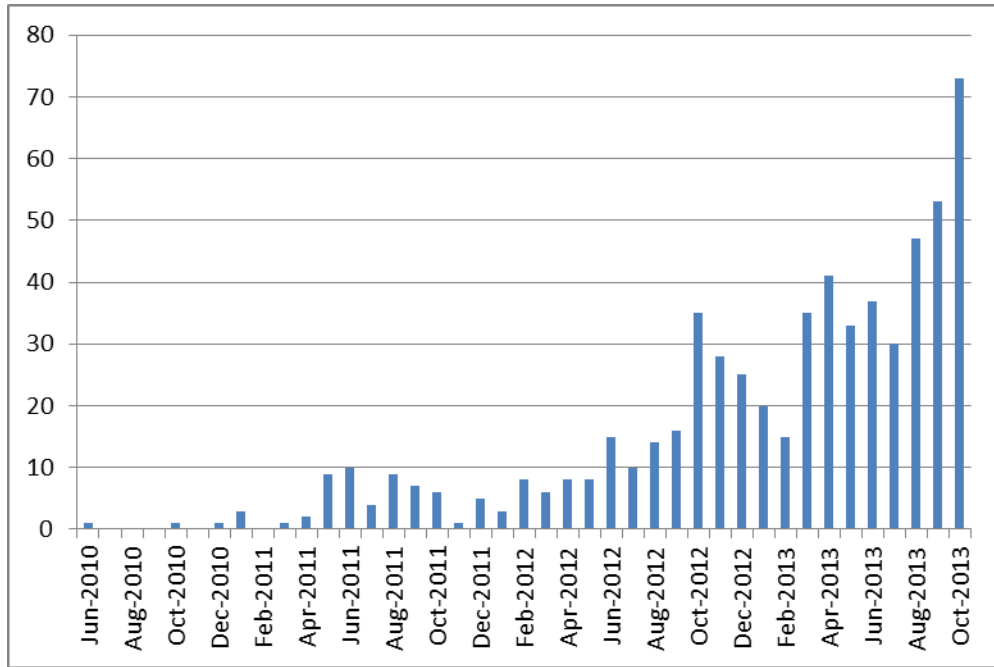


Figure 1: Applications for CVRP Rebates in San Joaquin Valley Air Pollution Control District

As of October 2013, the Drive Clean! program has approved over 315 rebates worth a total of \$838,000.

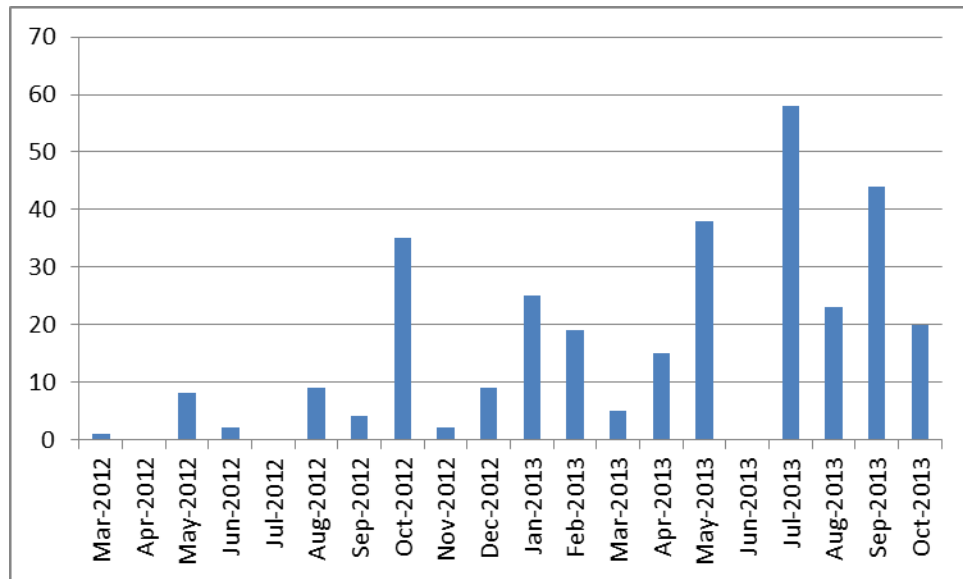


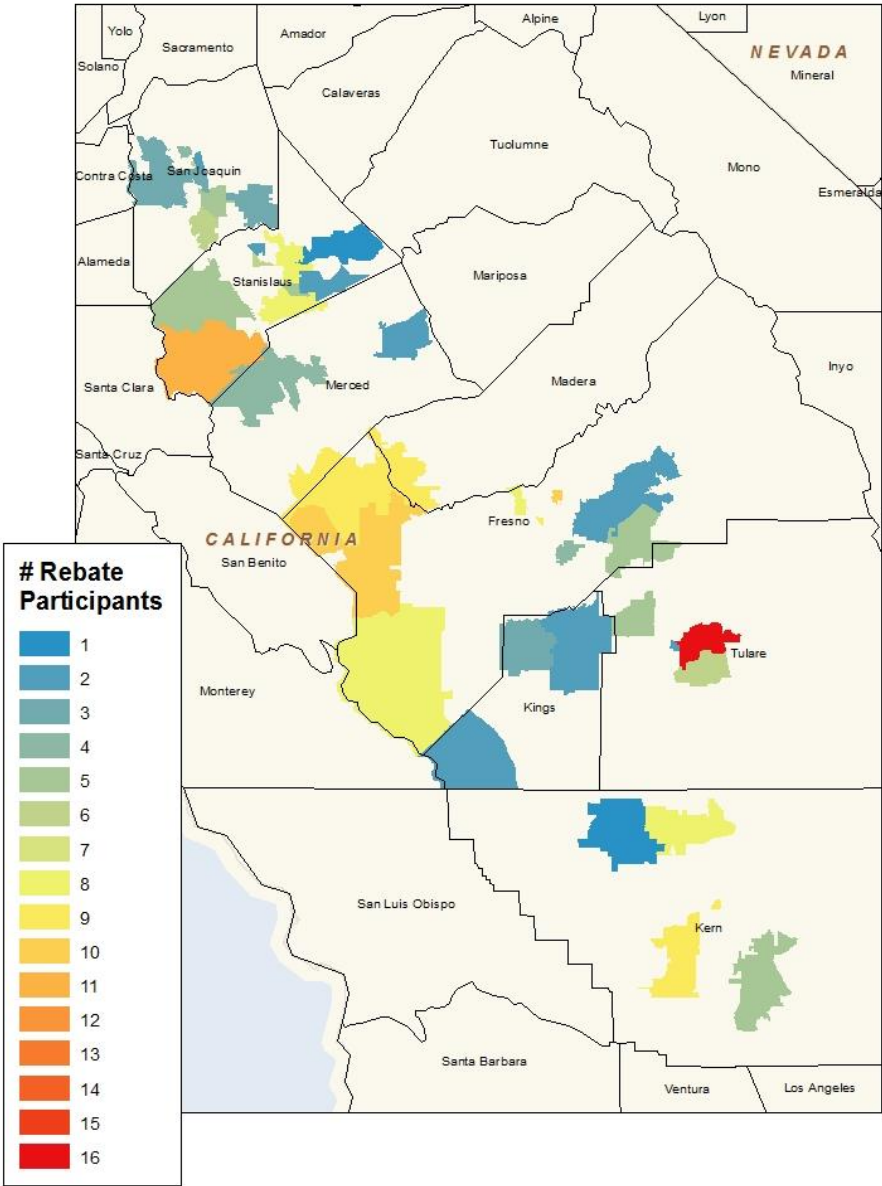
Figure 2: Applications for Drive Clean! Rebates in San Joaquin Valley Air Pollution Control District



### b. Public Benefit Grant Program

The Public Benefit Grant Program was created as a way to encourage PEV adoption among public institutions' fleets in the SJVAPCD. The grant is the only one of its kind offered by an air district in California. Through October 2013, the program has disbursed rebates for 260 PEVs in the amount of \$3.4 million

San Joaquin Valley Public Benefit Rebate Participants





### c. Hybrid and Zero Emission Truck and Bus Voucher Incentive Project (HVIP) and San Joaquin Valley Air Pollution Control District HVIP Plus-up

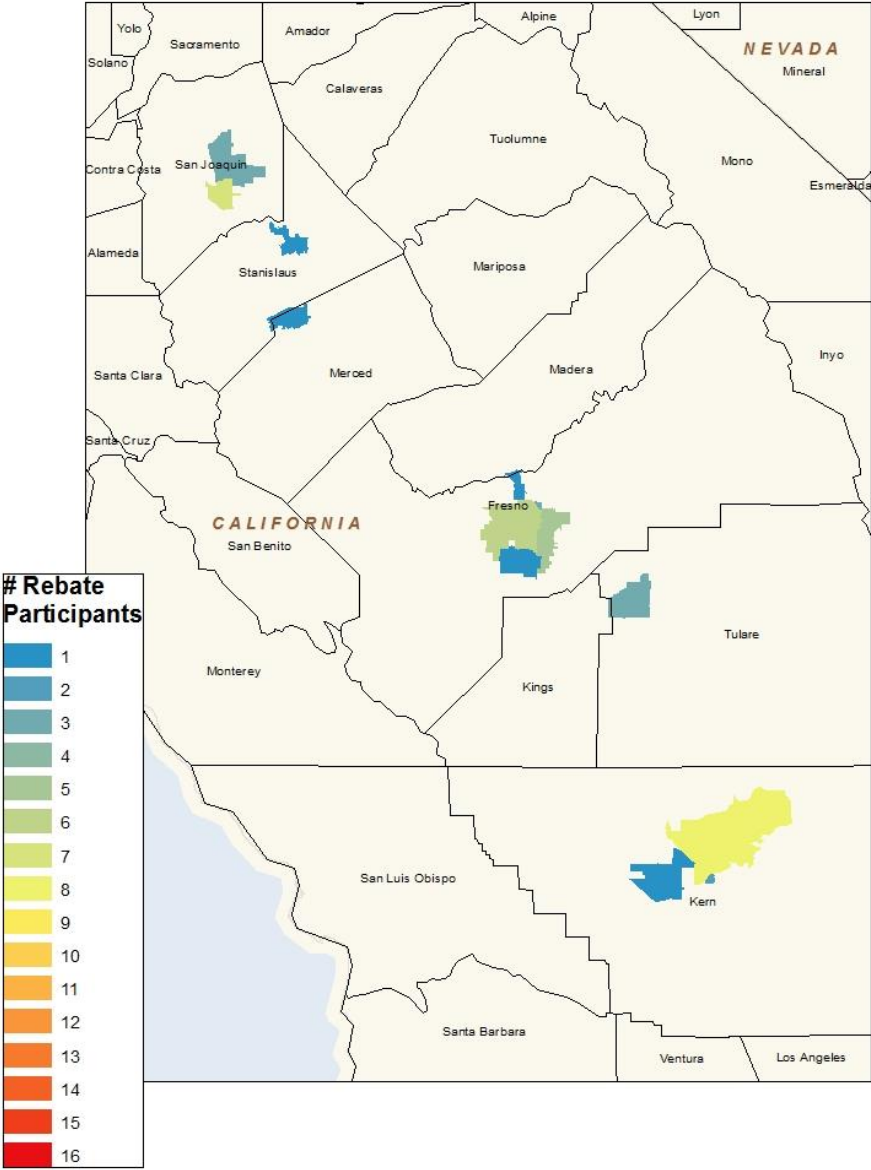
The HVIP program was created by CARB in 2009 to accelerate the deployment of hybrid and zero-emission medium- and heavy-duty vehicles and vehicle technology in California.<sup>5</sup> In July 2012, the HVIP began offering special incentives, known as the HVIP Plus-up, to vehicles operating in the SJVAPCD. Since its start, the HVIP Plus-up has disbursed rebates for 42 vehicles totaling \$875,000.

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<sup>5</sup> California HVIP website. <http://www.californiahvip.org/about-the-project>



### San Joaquin Valley HVIP - Plus Up Rebate Participants



### III. Conclusion

Rebates for PEV purchases help lower the initial cost of ownership. This is especially important for the San Joaquin Valley residents who may shy away from the high cost of PEVs. Though it is unclear





whether or not the rise in PEV adoption in the Valley is due to rebates, they are certainly a strong incentive for purchasing a new PEV.

To further incentivize PEV adoption, there needs to be a way to lower the cost of EVSE installations as well. Oftentimes, though a Level 2 EVSE can cost as little as \$500, its installation cost could be at least double the price of the equipment. Therefore, further incentives for equipment or installation would encourage EVSE deployment.<sup>6</sup> Currently, there are not many incentives for the procurement and installation of EVSE, aside from a federal tax credit that is set to expire at the end of 2013.

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<sup>6</sup> Ricky Hanna, CEO of Electric Vehicles International, August 1, 2013 SJV PEVCC Meeting

# The Impact of Electric Vehicle Supply Equipment Installations on the Local Workforce and Economy

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## I. Background

Electric vehicle chargers, otherwise known as electric vehicle supply equipment (EVSE), are essential to driving a plug-in electric vehicle (PEV). EVSE is often located inside residential garages so that PEVs can charge overnight and are found at public locations and workplaces so that drivers can extend electric miles traveled in the day. There is a serious need to install more publicly available EVSE to support the expanding PEV market.

The global revenue of EVSE sales in 2013 was \$567 million and is expected to increase to \$5.8 billion by 2022.<sup>1</sup> Electric vehicles sales also are increasing and predicted to contribute to nearly 100,000 additional jobs by 2030.<sup>2</sup> Communities throughout the San Joaquin Valley can position themselves to gain economic benefits by preparing for the growing EVSE and PEV markets.

## II. Current Infrastructure and PEVs in the San Joaquin Valley

Despite holding a small share of the California PEV market, the San Joaquin Valley is host to a growing community of PEV drivers living and traveling in the region. The number of light-duty PEVs in the region is rapidly increasing each year as well as the number of medium- and heavy-duty electric vehicles.

To support these drivers, there are seven publically available Level 1 EVSE and 31 Level 2 EVSEs and seven DC Fast Chargers<sup>3</sup> in the San Joaquin Valley.<sup>4</sup>

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<sup>1</sup> *Electric Vehicle Charging Equipment*, Navigant Research. <http://www.navigantresearch.com/research/electric-vehicle-charging-equipment>

<sup>2</sup> Roland-Holst, David, "Plug-in Electric Vehicle Deployment in California: An Economic Assessment" University of California, Berkeley. September 2012. [http://are.berkeley.edu/~drwh/CERES\\_web/index.html](http://are.berkeley.edu/~drwh/CERES_web/index.html)

<sup>3</sup> These fast chargers are Tesla Superchargers, intended only for Tesla use.

<sup>4</sup> As of November 2013.



### III. Jobs Needed for PEV and EVSE Deployment

According to a 2011 Brookings Institution study, the battery manufacturing and electric vehicle industry have supported more than 32,000 permanent jobs in the United States. Job growth in electric vehicle technologies has been increasing by over 6% each year. Approximately 54% of electric vehicle technology jobs require a high school diploma or less, and the average annual salary in the industry is over \$38,000.<sup>5</sup>

#### a. Plug-in electric vehicle occupations

The following occupations are needed for the development, production, sale and maintenance of electric vehicles.<sup>6</sup>

<i>Occupations that Support PEVs</i>	
Customer service representatives	Team assemblers
Computer software engineers, applications and systems software	Electricians
Computer programmers	Machinists
Electronics/electrical/industrial/mechanical/materials/chemical engineers	Engineering technicians
Engine and other machine assemblers	Automotive service technicians/mechanics
Retail sales/marketing	Community college/university training programs

#### b. Electric vehicle supply equipment installation occupations

EVSE installations are made by local service providers and cannot be outsourced. EVSE manufacturers find local contractors and businesses to procure and install charging stations.

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<sup>5</sup> *Sizing the Clean Economy*, Brookings Institute. 2011.

<sup>6</sup> *Electric Vehicles: The Market and Its Future Workforce Needs*, Los Angeles County Economic Development Corporation (August 2012)



<b>EVSE Installation Occupations</b>	
Electricians	General contractors (concrete cutting, trenching, etc.)
Electronics/network specialists	Software developers
Sales/marketing	Maintenance/cleaning
Engineering (civil, electrical) for larger installations	

**c. Electric vehicle supply equipment installation – utility side**

Upgrades to local and regional electric transmission lines may be necessary to accommodate EVSE infrastructure. Investments by local public utilities will have positive impacts on local workforce and economies as much of this work is contracted to local construction firms. Therefore, electricians, engineers, construction trade/contractors and network specialists will be in demand.

**d. Job growth in the San Joaquin Valley<sup>7</sup>**

There are several counties within the San Joaquin Valley whose fastest growing jobs are occupations needed in the EVSE and PEV market.

<b>County</b>	<b>Occupation</b>
Kern County	Environmental technician, software developers, systems software
Madera County	Automotive body and related repairs, team assemblers, product promoters
Tulare County	Information security analysts, web developers computer network architects
Stanislaus County	Helpers, construction trades, supervisors, construction and extraction workers
Fresno County	Helpers, construction trades

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<sup>7</sup> California Employment Development Department. <http://www.edd.ca.gov>.



## IV. Economic Impact

### a. Reduced gasoline consumption fuels local growth through expenditure shifting

A 2012 study looking at the economic impact of PEVs details how money saved at the gas pump is spent on other goods and services desired by households that create on average 16 times more jobs in the local economy.<sup>8</sup> Household and enterprise funds diverted from the fossil fuel supply chain finance new demand for consumer goods and local, in-state services. Furthermore, the jobs created from expenditures shifting away from fossil fuels are distributed broadly across sectors and are not restricted to green technology jobs.

### b. EVSEs generate economic benefits to nearby retail shops

Public charging stations (generally Level 2) can have positive impacts on local businesses by drawing PEV drivers who want to charge while they shop or dine. Installing public charging stations in central business districts can be an added visit motivation for customers looking to shop, dine or experience other entertainment options.

*Money saved at the pump from driving a PEV is money spent on other goods and services that create on average 16 times more jobs in the local economy.*

DC fast chargers, which are often installed near transit corridors, draw PEV drivers for a 15-30 minute charge. Placing these chargers near coffee shops, convenience stores or shopping can attract out-of-town visitors.

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<sup>8</sup> Roland-Holst, David, "Plug-in Electric Vehicle Deployment in California: An Economic Assessment" University of California, Berkeley. September 2012. [http://are.berkeley.edu/~drwh/CERES\\_web/index.html](http://are.berkeley.edu/~drwh/CERES_web/index.html)



If retail shops add charging stations, they can have their customers pay a fee for use. Hosting EVSE can cost as little as \$500 for the infrastructure with more than \$27,000 in financial returns.<sup>9,10</sup>

## V. Conclusion

There are jobs and financial benefits available in every step of the PEV and EVSE supply chains. These include jobs in manufacturing and EVSE installations and the economic benefit in hosting EVSE. Because the San Joaquin Valley has job growth in many occupations represented in the EVSE and PEV markets, local businesses and workers should take advantage of technical programs such as the Electric Vehicle Infrastructure Training Program to acquire the skills needed for the PEV industry.

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<sup>9</sup> This is the present value of financial returns for one-hour connections if there are ten connections per day (priced at \$1 per hour plus a \$1 connection fee.)

<sup>10</sup> *Southern California Plug-in Electric Vehicle Readiness Plan*, UCLA Luskin Center. December 2012.