Plugging Vehicles into Clean Energy

Five voluntary paths are available to link clean energy with vehicle electrification, thereby attracting potential buyers who remain uncertain about the environmental benefits of plug-in electric vehicles. The increased energy awareness that accompanies vehicle electrification can also be leveraged to reach broader energy efficiency and renewable energy goals.

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I. The Plug-in Electric Vehicle Clean Energy Nexus

While driving a plug-in electric vehicle (PEV) in California emits only about one-quarter as much greenhouse gas pollution as the average new U.S. passenger vehicle, many customers within the PEV market segment are motivated by a desire to drive completely ''emissions free.''[1] Maximizing the ''green'' advantage of PEVs could be important to support early commercialization and market expansion. Almost half of respondents in an international study conducted by Accenture reported that knowing electric vehicles were charged with renewable electricity would encourage them to buy one.[2] Researchers from Simon Fraser University and the University of California at Davis found that combining ''green energy'' with PEVs caused conventional car buyers participating in a design exercise to purchase PEVs 23 percent more frequently.[3]

Electrification of transportation also presents a singular opportunity to raise the energy awareness of consumers in the

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electricity sector. Some 67 percent of participants in a year-long study conducted by the University of California at Davis and BMW reported that driving an electric version of the MINI Cooper, the ''MINI E,'' changed the way they think about energy.[4] In fact, several participants installed solar panels and undertook building energy efficiency upgrades. Once people plug-in their vehicle, they often start thinking differently about the source of their electricity. Even in the U.S., where climate change and related topics are not necessarily as top-of-mind as in Europe, MINI E drivers became much more aware of their ''fuel'' and most thought that it should come from renewable resources by the end of their lease period.[5]

California's electricity mix is already one of the cleanest in the nation and will only get cleaner as the state makes progress towards its goal of procuring one-third of its electricity from renewable resources by the end of this decade.[6] Nevertheless, providing PEV drivers and other stakeholders with clear paths to drive ''emissions free'' could be an effective method to increase PEV sales by providing a clear and simple message about the environmental benefits of PEVs. Further, addressing non-tailpipe emissions could also counter the negative environmental narrative promoted by critics of vehicle electrification. Policies and programs that promote both PEVs and clean energy could further improve the public perception of electric vehicles and support the expansion of renewable energy and energy efficiency.

II. Five Potential Means to Link Plug-in Vehicles and Clean Energy

A. On-site energy efficiency upgrades

Energy efficiency is generally the lowest-cost resource to offset increased electricity usage from PEV charging and does not create any local or greenhouse gas pollutants. The increased energy awareness that accompanies vehicle electrification provides an opportunity to help meet California's ambitious energy efficiency goals while cutting consumer costs.[7]

In some applications, energy efficiency could potentially help customers who would otherwise lack sufficient electric panel capacity to install PEV charging equipment.

Driving a PEV can increase typical household electricity consumption by about one-third, an amount that can generally be completely offset using readily available residential efficiency upgrades, including lighting, heating, cooling, and building envelope improvements.[8] Businesses can also cost-effectively combine energy efficiency upgrades with PEV charging equipment installations. Nationally, commercial buildings have the potential to reduce load 30 percent using currently available technologies.[9] For example, curbside and garage PEV charging could be offset through the use of highly efficient light-emitting diodes, intelligent lighting and ventilation controls, and other building efficiency options.[10]

In some applications, energy efficiency could potentially help customers who would otherwise lack sufficient electric panel capacity to install PEV charging equipment.[11] Unlike the sunk cost of a larger electric panel, investing in energy efficiency provides a continuing stream of cost savings. Efficiency improvements can also help customers avoid higher utility bills that can result from upper-tier prices or demand charges.[12]

Both Assembly Bill 2853 and Gov. Jerry Brown's ''Zero Emission Vehicle Action Plan'' include directives to increase the number of PEVs in state-owned fleets, the number of state employees who drive PEVs, and the number of PEV charging stations in state-owned buildings and parking facilities.[13] Those installations could be coupled with energy efficiency upgrades to minimize increased energy costs associated with PEV charging.

Existing energy efficiency programs, such as those

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administered by electric utilities and other parties, can be leveraged to offset PEV charging. In fact, California Senate Bill 1340 expanded the scope of Property Assessed Clean Energy programs, which provide financing for distributed generation and energy efficiency upgrades, to include PEV charging infrastructure and the CALGreen building code contains voluntary provisions for both energy efficiency and PEV readiness.[14] ''Energy Upgrade California'' and similar programs could provide information about energy efficiency to PEV owners, a segment of the population likely to adopt energy efficiency measures. Similarly, energy efficiency outreach programs could provide information about the benefits of PEVs to those interested in driving on electricity. ''Energy service companies'' and other private energy efficiency contractors could also target commercial and residential customers installing PEV charging equipment.

In sum, the increased energy awareness that results from the use of electricity as a transportation fuel can drive cost-effective energy efficiency, further improving the economics of vehicle electrification, while existing energy efficiency programs could provide a platform to educate interested customers as to the benefits of PEVs. Coordinating these efforts would help California meet its long-term environmental goals.

B. On-site renewable generation

On-site renewable electricity provides a tangible connection between vehicle charging and clean energy. Nearly 40 percent of the first wave of PEV drivers in California own rooftop solar systems, and an additional 17 percent report an intention to install solar within a year.[15] Several existing state programs, as well as emerging private sector collaborations, could build upon this synergy.

On-site renewable electricity provides a tangible connection between vehicle charging and clean energy.

The California Solar Initiative grants rebates for rooftop photovoltaic systems. The size of the system that can be installed under the program is limited by total on-site load at the customer premises with the amount of the rebate varying depending on estimated or actual system performance.[16] California is currently phasing out the rebate program, as the market no longer requires the same degree of public support, though a federal tax credit remains in place. The California Public Utilities Commission is also currently considering an investment plan recommended by the California Energy Commission which, among other items, includes additional funding for the New Solar Homes Partnership, a program that provides incentives for rooftop solar on new construction.[17] In keeping with the state's loading order prioritizing energy efficiency, to qualify under the program, homes must be at least 15 percent more efficient than required by state building codes.[18] The policy justification for the additional funding for the New Solar Homes Partnership is partially based on the potential connection between distributed generation and plug-in vehicles.[19] In addition, the South Coast Air Quality Management District has issued a solicitation for 5 MW of distributed on-site renewable electricity for transportation fuel in the District.[20]

Net energy metering (NEM) is another policy that facilitates implementation of distributed generation. Net energy metering is an accounting and crediting approach that allows customers with on-site generation to receive bill credits for energy exported to the grid when their systems are producing electricity in excess of on-site need. These bill credits are applied toward their energy bills, which helps address the fact that solar systems generate electricity during the day, while electric vehicles are most likely to be charged during the night. The California Public Utilities

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Commission recently clarified that NEM new enrollments will be allowed until the end of 2014, pending completion of a review of program costs and benefits, including costs to non-participating customers.[21]

Private sector partnerships are also underway to meet the demonstrated consumer interest in both PEVs and on-site renewables. Ford and Nissan have partnered with SunPower, and BMW has partnered with Real Goods Solar to offer residential customers the opportunity to offset their vehicle electricity demand through renewable energy.[22] Clipper Creek, a manufacturer of PEV charging equipment, recently announced a similar partnership with SolarCity.[23] On-site solar may also be an attractive strategy for businesses to avoid potential demand charges, especially if they are charging during hours of peak electricity demand.

In addition to these efforts, the National Renewable Energy Laboratory is investigating the use of on-site renewables to power both battery electric and hydrogen fuel cell vehicles.[24] The potential for synergies across these technologies should be considered when setting public and private R&D priorities.

C. Off-site renewable generation

Some utilities offer customers the opportunity to contract directly with renewable energy providers or purchase shares in local renewable energy projects. The Sacramento Municipal Utility District's ''Solar Shares'' program allows customers to purchase a portion of the electricity generated by a local 1 MW solar farm. San Diego Gas & Electric recently applied for approval from the California Public Utilities Commission for a ''Share the Sun'' program, which allows customers to contract directly with solar developers for electricity delivered by San Diego & Gas Electric. Such programs allow PEV drivers who would like to install on-site renewables, but who are unable to do so, a chance to provide tangible support for renewable generation. Utilities that already offer off-site renewable programs should consider targeting PEV drivers in outreach efforts, and utilities with increasing numbers of PEV customers should consider developing off-site renewable programs to meet the potential customer demand.

Voluntary purchases of RECs could prove a scalable and affordable means to both support renewable electricity development and improve the public perception of the environmental benefits of vehicle electrification.

D. Voluntary purchases of renewable energy certificates

Voluntary purchases of renewable energy certificates (RECs) by utilities, charging service companies, automakers, and consumers could prove a scalable and affordable means to both support renewable electricity development and improve the public perception of the environmental benefits of vehicle electrification. Innovators in this area would be well suited for recognition at the U.S. EPA's ''Green Power Leadership'' awards.

1. Definition of RECs

When a renewable energy facility operates, two products are created: (1) the electrical energy; and (2) the renewable attributes of that energy. These renewable or ''green'' attributes can be sold separately as RECs.

The Center for Resource Solutions (CRS) is the nation's leading certifier of RECs. The CRS ''Green-e'' certification requires that the underlying electricity be produced by a qualifying resource built within the last 15 years. The purchaser of a Green-e certified REC has the sole right to make renewable claims about the associated electricity. To ensure the exclusivity of this right, CRS verifies that RECs sold are ''retired'' on behalf of the purchaser, are not sold to another entity, or used to meet regulatory obligations. RECs are not reviewed for ''additionality,'' i.e.,

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whether a specific project would have been built absent anticipated revenue from the sale of RECs. Any investment decision in a renewable energy project is contingent upon many factors, including availability of transmission lines, financing, tax incentives, and power purchase agreements. The revenue available from the sale of RECs is only a single component. However, a functioning REC market supports additional investment toward renewable energy by providing a revenue stream that would not otherwise exist. This should foster investments that would not otherwise be made.[25]

2. Buying and selling RECs

RECs are often purchased by electricity providers to comply with state renewable energy goals, or renewable portfolio standards (RPS). Those goals vary state to state and sometimes stipulate that the entity purchasing RECs must also purchase the underlying electricity, and may require certain percentages of in-state generation or generation from preferred resources.[26] Accordingly, the price of RECs that can be used for compliance purposes varies tremendously depending on the requirements of the relevant state mandate.[27]

In voluntary markets, RECs are typically purchased by organizations wishing to ''green'' their electricity or by electricity providers that offer customers voluntary ''green pricing'' programs. Because voluntary markets are not subject to the supply constraints imposed by specific state policies, REC prices can be lower than in compliance markets. Of course, buyers are free to stipulate requirements such as proximity to their state's electricity grid and can buy RECs that could otherwise be used for compliance with state RPS, ensuring a high degree of additionality.

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The cost of purchasing RECs sufficient to cover an electric vehicle's annual consumption appears to be very small relative to both the cost of a vehicle and the cost of the electricity necessary to charge it. Two to 4 MWh, i.e., 2 to 4 RECs representing 1 MWh each, would be sufficient to cover most PEV owners' annual electric driving needs.[28] Currently, wholesale REC prices are low in most markets, though trending upwards. The cost of REC purchases sufficient to meet annual vehicle consumption would be likely under $20.[29]

3. PEV owner-purchased RECs

Individual electric vehicle drivers can easily purchase Green-e certified RECs online, though entities such as corporate buyers wishing to purchase at scale can often secure lower prices.[30] Intel, Kohls Markets, and Whole Foods are examples of corporations that purchase large quantities of RECs.

4. Utility-supplied RECs

PEV drivers with access to utility green pricing programs can already choose to have their utility retire RECs on their behalf sufficient to meet their household electricity consumption. Many utilities, including Sacramento Municipal Utility District, Los Angeles Water and Power, and smaller regional utilities already offer customers voluntary green pricing programs.[31] Pacific Gas & Electric and San Diego Gas & Electric both recently applied for approval of green pricing options from the California Public Utilities Commission.[32] RECs purchased for such green pricing programs are in addition to those required by RPS.

Many utility REC programs in California have been remarkably successful. The 20 percent participation rate in the City of Palo Alto Utilities program leads the nation, and both PacifiCorp and Sacramento Municipal Utility District were in the top four utilities nationwide for voluntary renewable energy sales per year.[33] Nationally,

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however, only around 2 percent of those utility customers who have the option to choose green pricing do so.[34] Utilities wishing to expand green pricing programs could offer PEV-specific programs, or could leverage the increased energy awareness that accompanies vehicle electrification to increase participation in existing programs. Vehicle electrification could also encourage greater numbers of utilities to offer green pricing programs.

5. Automaker and electric vehicle charging-company-supplied RECs

Automakers and electric vehicle charging companies can also purchase RECs on behalf of their customers in order to further improve the public perception of electric vehicles and encourage additional sales. REC purchasing by automakers or electric vehicle charging companies would also ensure that all of their customers, in any utility service territory, would have the option to support clean energy.

BMW recently announced a partnership with Green Mountain Energy to offer customers leasing the BMW ''ActiveE'' the opportunity to purchase Green-e certified RECs sufficient for vehicle charging over the life of the two-year lease for a single payment of $48.[35] Participating customers receive a window decal for their ActiveE reflecting the decision to drive on wind energy.

E. Facilitating the integration of variable renewable resources

The California Renewable Energy Resources Act of 2011 obligates electricity providers operating in California to procure at least 33 percent of their retail service from eligible renewable resources by the year 2020.[36] PEV electricity consumption will not significantly add to overall renewable electricity utility procurement requirements. Even if all of California's projected 2020 PEV fleet were to drive exclusively on green electricity, it would equate to around 2 to 3 percent of the total renewable electricity that would be required to meet California's statewide renewable energy goal.[37] In fact, PEVs offer the opportunity to facilitate the integration of large-scale renewables that do not necessarily coincide with peak demand, such as wind, which often peaks during the evening and nighttime hours when vehicles are most often charged.[38]

Time-variant rates, including ''time-of-use'' block rates, already encourage off-peak charging when wind turbines are often most productive. Time-variant rates are generally designed to reflect the variable cost of service, including wholesale prices and generation from eligible renewable resources. Rates can be set on a whole-house basis for residential customers, or specifically for PEV load if separately metered. Time-of-use rates available to California PEV customers have set prices for different blocks of hours during the day, with high prices during peak hours and lower prices during off-peak hours. **Figure 1** shows that San Diego Gas & Electric has been very successful in coupling time-of-use pricing with active customer education and outreach. Approximately 80 percent of PEV charging in the San Diego area occurs between midnight and 5:00 A.M.

PEVs could potentially provide even larger grid benefits for California renewables integration if charging times could be managed to match real-time renewable generation while still meeting customer needs. One option to match charging to real-time generation is to provide an information service from the California Independent System

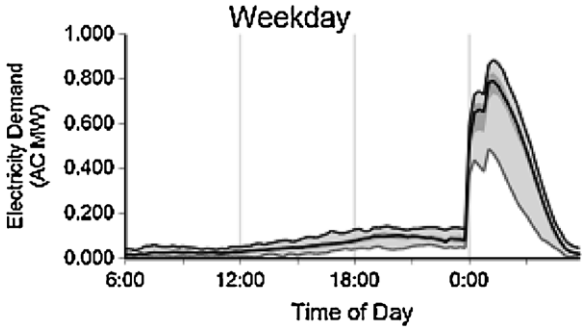


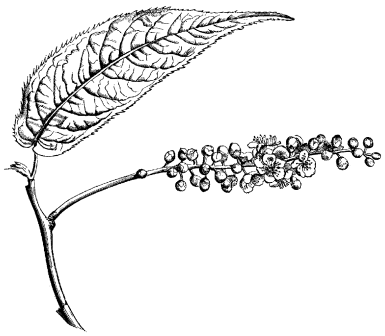
Figure 1: San Diego Gas & Electric PEV Charging Profile[39]

Operator to the customer via utility advanced metering infrastructure, the Internet, or other means. Customers could then adjust their charging schedule to match the availability of renewable generation. General Motors and PJM Interconnect are currently testing the customer information option, leveraging the Chevy Volt's ''OnStar'' system to match charging to renewable generation.[40]

Alternatively, a customer could pre-authorize flexible charging schedules within certain parameters or a company could actively manage battery charging. For instance, Project Better Place and PJM Interconnect have studied control by a ''Central Network Operator'' as a potential cost savings measure in the Baltimore-Washington area.[41] In 2009, BMW demonstrated this potential in a partnership with the European utility, Vattenfall, matching the charging needs of a MINI E fleet with intermittent wind energy.[42]

Businesses with existing energy management systems could test algorithms to shape PEV load in response to forecasted renewable generation. Companies that own and charge batteries leased to customers that can aggregate load and leverage existing battery charging control networks may provide an additional opportunity to match charging to renewable generation. Intelligent load management could also help customers avoid higher on-peak prices and demand charges.

Several actions will help further the benefits of PEV deployments for meeting renewables targets. The first is educating customers on the benefits of time-variant rates and making such rates accessible to all utility customers. More active load management would require communications systems, protocols, and technology, as well as appropriate



rate structures. Developing and demonstrating the technology and systems for active load shaping should be a priority for public and private sector PEV and renewable electricity R&D.

In the longer term, vehicle-to-grid (''V2G'') technology which leverages vehicle batteries to provide distributed energy storage to support the grid may offer further opportunities to integrate renewable resources and lower costs since vehicles are parked for the vast majority of the day. The technology faces challenges including battery durability, utility distribution network management, and two-way coordination between PEV owners and utilities. However, as noted in a recent California Plug-in Electric Vehicle Collaborative workshop on the subject, several V2G pilot projects are underway, and Gov. Brown's ''2012 ZEV Action Plan'' calls for the California Independent System Operator to develop a ''V2G Roadmap'' to enable the commercialization of V2G technology and services.[43]

It should also be noted that fuel cell electric vehicles, along with efficient gasoline-powered vehicles and the PEVs being discussed here, are part of California's strategy to reduce GHG by 80 percent in 2050 and cut conventional pollutants. Renewable hydrogen for fuel cell vehicles faces several challenges and opportunities similar to those facing PEVs. California has set a requirement for 33 percent renewable hydrogen, which can be produced both from renewable electricity and other renewable feed stocks such as biogas.

III. Conclusion

Gov. Brown's Executive Order focused on zero-emission vehicles includes a goal of reducing the state's greenhouse gas emissions by 80 percent relative to 1990 levels by the year 2050.[44] California has a golden opportunity to leverage PEV technology, renewable electricity, and energy efficiency programs to meet this goal while reducing the state's dependence on oil and fostering a clean energy economy. Coordinating the state's PEV and clean energy programs would set a global precedent. Were

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California its own country, it would have the third-largest number of PEV deployments behind the U.S. without California and Japan.[45] Specific near-term opportunities for California policy-makers and stakeholders include:

- Co-promoting utility and other PEV, energy efficiency, distributed generation, off-site renewable, and green pricing programs.
- Targeting ''Energy Upgrade California'' and similar energy efficiency education and outreach programs at potential and current PEV owners and leveraging existing energy efficiency programs to educate customers about the benefits of PEVs.
- Coordinating the installation of vehicle charging equipment with energy efficiency upgrades at state-owned buildings and parking structures.
- Encouraging PEV drivers, utilities, PEV charging companies, and automakers to purchase RECs sufficient to offset PEV driving.
- Conducting the customer education and outreach necessary to ensure PEV charging occurs during off-peak hours when adverse impacts to the distribution grid are minimized and the potential to integrate off-peak renewable resources is the greatest.
- Supporting the development of communications systems and pilot projects to demonstrate managed PEV charging to match large-scale renewables availability, while exploring research of vehicle-to-grid technology in the longer term.■

Endnotes:

1. U.S. EPA, *Beyond Tailpipe Emissions*, at http://www.fueleconomy.gov/feg/Find.do?action=bt2. Note that the calculator compares electric vehicles to the average new U.S. passenger vehicle including both cars and light trucks/sport utility vehicles.

2. Accenture, *Plug-in Electric Vehicles Changing Perceptions, Hedging Bets*, 2011, at 16.

3. K.S. Kurani, J. Axsen, N. Caperello, K. Bedir and J. Tyree Hagerman, Consumers, Plug-in Electric Vehicles, and Green Electricity, presented at ''Plug-in Electric Vehicles and Clean Energy in California,'' Sacramento, Calif., Oct. 24, 2012.

4. Tom Turrentine, Dahlia Garas, Andy Lentz and Justin Woodjack, *The UC Davis MINI E Consumer Study*, May, 2011, at 71. Available at http://www.its.ucdavis.edu/?page_id=10063&pub_id=1470.

5. *Id.* at 70.

6. *See* California Senate Bill X1-2, 2011.

7. *See* California Air Resources Board, *Climate Change Scoping Plan*, Dec. 2008; California Public Utilities Commission, *California Long Term Energy Efficiency Strategic Plan*, Sept. 2008.

8. The average U.S. household uses 11,500 kWh per year (Energy Information Agency, *Table 5.A: Residential Average Monthly Bill by Census Division, and State 2010*.) A PEV with an efficiency of 0.33 kWh per mile that is driven 10,000 miles per year would increase the average home consumption by less than one-third, an amount that can be offset using readily available technologies (Rich Brown, Sam Borgeson, Jon Koomey and Peter Biermayer, *U.S. Building-Sector Energy Efficiency Potential*, Sept. 2008, Table 2.) For reference, current Nissan Leaf drivers are averaging approximately 7,900 miles per year. (*See* Ecotality, *EV Project Quarterly Report, Second Quarter*, 2012. See http://www.theevproject.com/documents.php. Note: estimation assumes linear vehicle adoption throughout quarter in question.) Of course, PEV utility is expected to increase as technology improves and more charging infrastructure is deployed. Electric mileage for plug-in hybrid drivers will also depend on individual driving patterns. For reference, according to Chevy's ''On-Star'' data, Volts are being driven 62 percent on electricity.

9. *Id.*

10. Streetlight and garage energy efficiency opportunities are described in the references below. For instance, the saving described below for a San Mateo County garage retrofit would save enough electricity to power roughly 80 light-duty PEVs per day drawing enough power to drive 25 miles each. (Jordan Shackelford and Terry Pang, *LED Street Lighting and Network Controls*, 2010; Jordan Shackelford and Terry Pang, *Street Lighting Network Controls Market Assessment Report*, 2010; and Energy Solutions, *San Mateo County Drives Down Electricity Costs in Parking Garage By 67% with Efficient T8 Lamps and Wireless Lighting Controls*.)

11. This is, of course, dependent on inspectors accounting for energy efficiency upgrades when conducting load calculations.

12. Some utility tariffs incorporate marginal pricing, whereby prices increase according to marginal consumption, with higher prices for the upper tiers of consumption. Utility tariffs can also include demand charges, which are based on power requirement (e.g., kilowatts), as opposed to power consumed (e.g., kilowatt-hours) and are meant to recover capacity costs imposed on the electrical grid.

13. *See* California Assembly Bill 2583, 2012; and Governor's Interagency Working Group on Zero-emission Vehicles, *Draft 2012 ZEV Action Plan*, Sept. 2012.

14. *See* California Senate Bill 1340, 2010; Jordan Shackelford, Alex Chase, Michael McGaraghan and Stuart Tartaglia, *Reducing Barriers to Electric Vehicle Adoption through Building Codes*, 2012.

15. California Center for Sustainable Energy, *California PEV Owner Survey*, Aug. 2012, at 9.

16. California Public Utilities Commission, *California Solar Initiative Program Handbook*, Sept. 2012.

17. *See:* California Energy Commission, *The Electric Program Investment Charge: Proposed 2012-14 Triennial Investment Plan*, Oct. 2012, at 192.

18. California's ''loading order'' requires the procurement all cost-effective energy efficiency before other resources. *See: Energy Action Plan – 2008 Update*; *Final 2005 Energy Action Plan II*; and *Final 2003 Energy Action Plan I*.

19. *See:* California Energy Commission, *The Electric Program Investment Charge: Proposed 2012-14 Triennial Investment Plan*, Oct. 2012, at 194.

20. Alfonso Baez, *Session 2: Stationary and Infrastructure: Renewable Energy Generation to Support Electric Transportation*.

21. California Public Utilities Commission, *CPUC Takes Action to Support Solar by Clarifying Net Metering Cap*, 2012. For a prior evaluation, see California Public Utilities Commission, *Introduction to the Net Energy Metering Cost Effectiveness Evaluation*, Mar. 2010.

22. Ford, *Here Comes the Sun*, 2011; Sunpower, *SunPower Helps Nissan LEAF Owners Further Reduce Emissions and Save on Electricity Costs*, 2011; BMW, *BMW of North America Selects Real Goods Solar for Solar Partnership*, 2012.

23. SolarCity, *SolarCity to Make Solar-Powered Electric Vehicle Charging Available Across its Service Territory*, 2011.

24. National Renewable Energy Laboratory, *NREL Improves System Efficiency and Increases Energy Transfer with Wind2H2 Project, Enabling Reduced Cost Electrolysis Production*, Nov. 2010; Power Electronics Technology, *NREL Explores Benefits of Solar-Powered Charging for Plug-in HEVs*, Jan. 24, 2008.

25. For more details see Center for Resource Solutions, *Greene-e Long Disclosure*, 2012.

26. To comply with California's procurement mandate, utilities must generally purchase both the electricity and the associated RECs. This requirement is sometimes referred to as ''bundling.''

27. Ryan Wiser, *State of the States: Update on RPS Policies and Progress*, 2010, at 19.

28. This is equal to 6,000–12,000 miles per year at 0.33 kWh per mile. Mileage for individuals could vary from this band.

29. Consumers can buy RECs online from sites such as ''buycleanenergy.org/'' for about $5 each. Accordingly, $20 would be sufficient for 12,000 miles of driving, which, as noted in endnote eight, exceeds current PEV driving patterns. Of course, entities purchasing in larger quantities can secure lower prices.

30. For example, the Web site ''buycleanenergy.org/'' outlines three simple steps for individuals wishing to purchase RECs.

31. Sacramento Municipal Utility District's ''Greenenergy'' program charges 1 cent per kWh, which goes towards general REC purchases. Other programs give customers the option of choosing what percentage of their monthly electricity usage will be met by RECs; Anaheim Public Utilities allows customers to purchase additional 100 kWh blocks of RECs in increments of $1.50 per month. Los Angeles Water and Power's ''Green Power'' program bundles RECs and the associated power and allows customers to choose what percent of their power they would like to be renewable.

32. Pacific Gas & Electric, *PG&E Announces New Green Energy Program to Give Electric Customers More Renewable Options*, April, 2012; San Diego Gas & Electric, *Application of San Diego Gas & Electric Company (U 902 E) for Authority to Implement Optional Pilot Program to Increase Customer Access to Solar Generated Electricity*, Jan. 2012.

33. National Renewable Energy Laboratory, *NREL Highlights 2010 Utility Green Power Leaders*, 2011.

34. Lori Bird, Claire Kreycik and Barry Friedman, *Green Power Marketing in the Unites States: A Status Report (11th Edition)*, Oct. 2008, at 5–6.

35. Green Mountain Energy, *Support Renewable Energy to Contribute to a Greener Grid and a Cleaner Future for Your BMW ActiveE*, 2012. This program provides RECs sufficient to cover three years of driving 15,000 miles per year.

36. California Senate Bill X1-2, 2011.

37. A total of 78.8 to 90.5 terawatt-hours of renewable electricity will be needed in 2020 to comply with the RPS. (California Energy Commission, *Proposed Method to Calculate the Amount of New Renewable Generation Necessary to Comply with Policy Goals*, Table 1, at 3.) One million PEVs with an average efficiency of 0.33 kWh per mile, each driven 10,000 electric miles per year, would increase demand by 3.3 terawatt-hours. The incremental renewable procurement to go from 33 percent to 100 percent renewable electricity would be about 2.2 terawatt-hours, or 2–3 percent of available renewable electricity.

38. *See* Ecotality, *EV Project Quarterly Report, Second Quarter*, 2012.

39. *Id.*

40. OnStar News, *Volt Owners May Soon Get Charged with Renewable Energy*, Jan. 23, 2012.

41. Stephen Schneider, Rob Bearman, Hugh McDermott, Xu Xu, Scott Benner and Ken Huber, *An Assessment of the Price Impacts of Electric Vehicles on the PJM Market*, 2011.

42. Vattenfall AG, *Klimaentlastung durch den Einsatz erneuerbarer Energien im Zusammenwirken mit emissionsfreien Elektrofahrzeugen* (Climate Change Mitigation Through Usage of Renewable Energy Sources in Combination with Emission Free Electric Vehicles), Mar. 2011.

43. *See* Governor's Interagency Working Group on Zero-emission Vehicles, *Draft 2012 ZEV Action Plan*, Sept. 2012.

44. Office of Edmund G. Brown Jr., *Executive Oder B-16-2012*, Mar. 23, 2012.

45. International Council on Clean Transportation, *Tracking Markets and Performance*, 2012.

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