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# The Importance of Model Utility Policies For Vehicle Electrification

*An analysis of the nation's most comprehensive effort by a utility regulatory body to prepare for plug-in vehicles suggests that uniformly supportive utility policies and active utility engagement on a national scale will be critical to the expansion of the clean-vehicle market.*

*Max Baumhefner, Simon Mui and Roland Hwang*

**Max Baumhefner** is a Sustainable Energy Fellow with the Natural Resource Defense Council's Energy & Transportation Program. His work focuses on vehicle electrification with an emphasis on utility policies. Mr. Baumhefner received his J.D. from the University of California at Berkeley School of Law.

**Simon Mui** is a scientist with NRDC's Energy & Transportation Program. His work focuses on advocacy and research on clean vehicles and fuels. He received his Masters of Science in Technology & Policy and Ph.D. in Materials Engineering from the Massachusetts Institute of Technology with a focus on electrochemistry and lithium ion batteries.

**Roland Hwang** is the NRDC's Transportation Program Director. He received his Masters of Science in Mechanical Engineering from the University of California at Davis. He also received a Masters degree in Public Policy from the University of California at Berkeley.

## I. Introduction

Meeting long-term climate and environmental goals will likely require extensive electrification of the vehicle fleet. The economics of plug-in vehicles depend upon maximizing savings relative to gasoline. The price of electricity as a motor vehicle fuel, as well as the ease of plugging in, and the environmental benefits of plug-in electric vehicles, will largely be determined by the decisions of utilities and state utility regulators. At the direction of the state legislature, the California Public Utilities Commission

(CPUC, or the "Commission") initiated a proceeding in 2009 to overcome barriers to the widespread deployment and use of electric vehicles. This multi-year rulemaking is the nation's most comprehensive effort by a utility regulatory body to prepare for plug-in vehicles. Such regulatory proceedings should be framed by three principles: (1) removing barriers to a thriving plug-in vehicle market; (2) minimizing costs and avoiding adverse grid impacts associated with vehicle charging and; (3) maximizing the customer, utility system, and environmental

benefits of vehicle electrification. To date, the Commission has unanimously adopted two decisions that balance these three principles. This article describes the most important of the Commission's actions and argues that many of these policies and solutions could be leveraged by other jurisdictions. Uniformly supportive utility policies and active utility engagement on a national scale will be critical to the expansion of the plug-in electric vehicle market. This article argues broadly that the spread of model utility policies will play a critical role in the creation of a national market for plug-in vehicles. Section II explains how the economics of plug-in electric vehicles are dependent upon utility policies and offers three principles to guide regulatory efforts to facilitate widespread vehicle adoption. Section III summarizes the most important actions taken by the Commission in its ongoing rulemaking to remove barriers to widespread vehicle electrification. Section IV asserts that leveraging this effort to spread model utility policies would foster a thriving national plug-in vehicle market.

## II. The Importance of Utilities and Utility Regulators to Vehicle Electrification

The widespread use of electricity as a transportation fuel could significantly reduce America's dependence on

petroleum and protect consumers from the volatility of the world oil market.<sup>1</sup> Large-scale vehicle electrification coupled with low-carbon electricity generation is also a core strategy to meet long-term greenhouse gas reduction goals.<sup>2</sup> Such a transformation of the transportation sector demands the active participation of utilities and utility regulators, whose decisions will largely determine the price and availability of

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### *Regional variability in utility PEV policies could pose a barrier to widespread adoption.*

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electricity as a transportation fuel, as well as the environmental, societal, and consumer benefits of vehicle electrification.

#### **A. The economics of plug-in electric vehicles hinge upon utility policies**

To achieve mass-market success, plug-in electric vehicles (PEVs) must be cost-effective, absent public subsidy. Given that purchase price parity with conventional vehicles will be difficult to achieve in the short term, the economics of vehicle electrification depend upon maximizing savings relative to

gasoline. Plug-in vehicle advocates and analysts often rely upon the average U.S. residential electricity price of 11.5 cents per kWh to demonstrate the significant fuel cost savings available to those considering the switch from gasoline to electricity.<sup>3</sup> Driving a modern PEV on that average price is equivalent to driving a 30-mile-per-gallon conventional vehicle on \$1.18 per-gallon gasoline.<sup>4</sup>

However, Americans do not buy "average" electricity. Prices vary tremendously by utility territory, by customer class, and depending on the structure of the rate, can vary by season, time-of-day, with marginal consumption, and by peak demand. For example, residential customers in Pacific Gas & Electric territory may pay as much as 33.5 cents per kWh on a standard rate for marginal consumption above a baseline allotment, whereas customers in neighboring Sacramento Municipal Utility District can pay as little as 7.9 cents per kWh for off-peak electricity on a PEV rate.<sup>5</sup> The difference between the two is the difference between \$3.42 and \$0.81 gallon gasoline.<sup>6</sup> In short, the economics of vehicle electrification require that utilities offer and customers choose rate plans that encourage charging when savings relative to gasoline are the greatest.

Thankfully, utility regulators have the authority to ensure that the electric industry is prepared for widespread vehicle electrification. State regulatory agencies, such as the California

Public Utilities Commission, have a long history of working with the electric industry to ensure the energy services customers require are provided in a socially and environmentally responsible manner. The CPUC, in particular, has demonstrated national leadership in promoting energy efficiency as the most cost-effective and sustainable resource.<sup>7</sup> Vehicle electrification presents a singular opportunity for utility regulators to extend their efforts to encourage energy efficiency beyond the building sector that has traditionally been their domain.

#### **B. Principles for model utility policies**

Regional variability in utility PEV policies could pose a barrier to widespread adoption. Automakers may initially target specific regional markets with large early-adopter populations, but in the longer term, plug-in vehicles must compete nationally. Standardization of utility PEV policies across jurisdictions could improve the prospects for mass-market success. Regional regulations should reflect local considerations, but the following principles should be universally applicable:

1. *Remove barriers to a thriving plug-in vehicle market.*
2. *Minimize costs and avoid adverse grid impacts associated with vehicle charging.*
3. *Maximize the customer, utility system, and environmental benefits of vehicle electrification.*

### **III. The California Public Utilities Commission's Leadership**

California Senate Bill 626 (Kehoe, 2009) directed the Commission to "evaluate policies to develop infrastructure sufficient to overcome any barriers to the widespread deployment and use of plug-in hybrid and electric vehicles."<sup>8</sup> In the multi-year

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rulemaking initiated in response, the Commission has grappled with numerous issues that require balancing the three principles described above. A broad spectrum of stakeholders, including utilities, automakers, consumer groups, charging equipment manufacturers, and environmental organizations, have been active in the proceeding. This multi-year effort has resulted in volumes of party comments, several white papers, and two substantial Commission decisions. The rulemaking is divided into three phases, the most important aspects of which are described below.

#### **A. Phase One (2009–2010)**

After soliciting comments from parties on a broad range of topics, the Commission chose to focus first on clarifying the extent of its jurisdiction over plug-in vehicle charging service providers. The specific question addressed was whether or not such companies fall under the definitions of "electrical corporation" and "public utility" as used in California's Public Utility Code.<sup>9</sup> Resolution of this statutory interpretation question hinges upon whether or not the equipment used by such companies to charge PEVs delivers or furnishes "electricity for heat, light, or power."<sup>10</sup>

Parties to the proceeding were in general agreement that the Commission should not subject such companies to the full extent of utility regulation, but differed in their statutory interpretation. The Commission's initial proposed decision relied upon a previous decision finding that companies offering natural gas for use in vehicles did not fit within the statutory definition of a natural gas utility, an exemption which was later codified by the legislature.<sup>11</sup> At the time, no such parallel exemption existed for electric vehicle charging, but soon after the Commission issued its proposed decision, a bill was introduced that would have created a similar exemption and would also have granted the Commission limited authority over charging service companies in order to maintain the

environmental performance and integrity of the electrical grid.<sup>12</sup>

Partially in response to this legislation, the Commission heavily revised its original proposed decision, maintaining its finding that charging service companies acting as utility customers did not meet the definition of "public utility," but identifying other sources of regulatory authority upon which it would rely to ensure the integrity of the electrical grid.<sup>13</sup> Specifically, the Commission cited its existing authority over procurement at wholesale, the terms upon which customers receive utility service, interoperability standards, demand response and energy efficiency programs, and utility tariffs.<sup>14</sup> Furthermore, the Commission found that Senate Bill 626 granted specific jurisdiction to adopt rules governing PEV charging.<sup>15</sup>

Under the framework established by the Phase One decision, companies that simply receive utility service will be treated as utility customers and will be subject to rates and terms of service authorized by the Commission, and companies that procure electricity at wholesale will be subject to the same set of regulations and requirements as any other entity wishing to access to wholesale markets directly. This framework was eventually codified by the legislature.<sup>16</sup>

By providing regulatory certainty for electric vehicle charging companies, the Phase

One decision draws upon the first principle of removing barriers to a thriving plug-in vehicle market. Likewise, by identifying sources of authority other than full utility regulation upon which it will rely to respond to a rapidly evolving market, the Commission incorporated the second principle of minimizing adverse impacts to the electrical grid. Striking this balance also addresses the third principle of maximizing

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customer, utility system, and environmental benefits of vehicle electrification, though this is more squarely addressed in Phase Two.

#### **B. Phase Two (2010–2011)**

The Phase Two decision weighs rubber-meets-road issues critical to the success of the early electric vehicle market. The decision makes it clear that electrification of vehicles is a "critical component" of California's efforts to reduce greenhouse gas emissions in the transportation sector.<sup>17</sup> The decision adopts the following goals from the

California Plug-in Electric Vehicle Collaborative strategic plan<sup>18</sup>:

1. Ensure that consumer experiences with electric vehicles are overwhelmingly positive;
2. Promote electric vehicle cost reductions such that they are cost competitive with conventional vehicles;
3. Integrate electric vehicle charging smoothly into an increasingly clean, efficient, reliable, and safe electricity grid;
4. Advance energy security, air quality, climate change, and public health goals;
5. Take early strategic action to promote electric vehicle-related job creation and economic benefits in California; and
6. Facilitate mainstream adoption of electric vehicles.

These goals fit well within the three principles for model utility PEV policies articulated above and frame the specific policies adopted by the Phase Two decision, the most important of which are described below. The decision also makes it clear that California's investor-owned utilities will play a "critical role in the transportation sector."<sup>19</sup>

#### **1. Notification**

Even in California, the largest PEV market in the country, vehicle charging is only forecasted to account for 3 percent of total electricity delivered in 2020 and is not expected to require significant new investments in generation or transmission assets.<sup>20</sup> However, the instantaneous demand of a



single PEV can be comparable to that of an entire home, which could result in local distribution system impacts if not properly managed.<sup>21</sup>

If utilities are to minimize the costs of integrating such potentially demanding loads, they must receive timely notification as to the location of PEV charging. The cost of replacing a transformer on an emergency basis can be twice that of a planned upgrade.<sup>22</sup>

Notification is also essential to facilitate targeted customer outreach regarding PEV rate options, policies, and programs. Existing utility rules generally require customers to provide notification whenever they add significant new load, but customers are often oblivious as to this requirement and only contact the utility if something goes wrong.<sup>23</sup> Accordingly, utilities must be proactive in their efforts to identify which customers have PEVs. Potential sources of actionable information include automakers, auto dealers, charging equipment installers, local building permit offices, the Department of Motor Vehicles (DMV), and smart meters.

The pursuit of many of these potential sources is already underway. During the course of the rulemaking, the Natural Resources Defense Council convened a group of stakeholders to negotiate various issues before the Commission. This group facilitated the development of voluntary agreements between automakers and utilities by which

the addresses of consenting PEV customers are made available to utilities. Senate Bill 859 (Padilla, 2011), which was sponsored by the California Electric Transportation Coalition, allows the DMV to share address-level information to utilities to facilitate service planning.<sup>24</sup> Utilities are also developing pilot programs to gather information from building permits (which are public records) issued for charging

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equipment installations. Smart meter data is another promising source of information, as charging at 3.3 kW and above can create a distinct profile recognizable by computer algorithms.

Efforts to improve utility notification are ongoing, as it is essential to facilitate targeted customer outreach and strategic hardening of the distribution system. While the CPUC lacks authority over many potential sources of actionable information and its jurisdiction does not extend beyond California, by directing utilities to pursue scalable solutions, the Phase Two decision explicitly aims “to

support the development of a national notification system.”<sup>25</sup>

## *2. Utility customer education and outreach*

Just as it is imperative that utilities receive notification as to which of their customers have PEVs, it is equally important that customers be made aware of utility PEV rates, programs, and policies. The Phase Two decision established guiding principles for utility education and outreach efforts related to vehicle electrification, including the following:<sup>26</sup>

Each utility has an obligation to use funds to provide its customers with information regarding the choices available for metering arrangements, rates, demand response programs, Electric Vehicle service equipment, equipment installation, safety, reliability, and off-peak charging. Each utility has an obligation to use funds for targeted Electric Vehicle education and outreach to educate customers about the environmental and societal benefits of Electric Vehicles consistent with the state’s policy goals related to the reduction of greenhouse gas emissions set forth in AB 32.

The targeted education and outreach programs of California’s investor-owned utilities include an extensive Web presence, the use of social and traditional media, and direct outreach to numerous stakeholders including, auto dealers, local building permit offices, electrical contractors, advocacy groups,

trade associations, and communities with large concentrations of PEVs.

Such comprehensive efforts require dedicated personnel, leadership from utility executives, and regulatory authorization for the recovery of reasonably incurred expenses. The Phase Two decision recognizes that targeted education and outreach now, when the plug-in vehicle market is still nascent, is critical to ensure long-term success.

### 3. Rate design

Rate design is the primary tool by which utility regulatory commissions can influence customer charging behavior. As the Phase Two decision states, "rate structures can convey the costs and environmental impacts of the supply and demand of electricity to consumers, providing incentives for individuals to make choices consistent with the collective good."<sup>27</sup> Rate designs that incorporate lower prices during off-peak periods also provide customers the ability to maximize their savings relative to gasoline. The Phase Two decision further notes that off-peak charging could facilitate the integration of increasing levels of wind generation, which often occurs at night.<sup>28</sup>

Standard residential rates in California are designed to encourage conservation, with tiered pricing that reflects the principle, "the more you use, the more you pay." Once a certain baseline allotment is exceeded,

prices increase significantly. On such rates, marginal consumption associated with vehicle charging is often subject to upper-tier prices that offer minimal cost savings relative to gasoline. While California's tiered residential rates vary with marginal consumption, they do not vary by time-of-day. Accordingly, they do not encourage customers to



charge when there is spare capacity in the system. The Commission's Phase Two decision establishes rate design principles for plug-in vehicles that are meant to encourage off-peak charging and maximize savings relative to gasoline, stating that PEV rates should not vary with marginal consumption, but by time of day.<sup>29</sup>

The costs of accommodating PEV charging can vary significantly depending on the rate of charge. Charging at 3.3 kW or lower can generally be integrated with minimal impacts to the distribution system, but charging at higher levels of power could require more extensive system upgrades in the

residential context.<sup>30</sup> To encourage lower-power PEV charging, the Commission considered the use of "demand charges," which increase according to peak power requirements. Demand charges are common features of commercial and industrial rates, but the Commission determined their use in the residential context was not warranted at this point.<sup>31</sup>

In total, the Phase Two decision establishes principles for PEV rate design that should further its first three enumerated goals of ensuring consumer experiences are positive, achieving cost parity with conventional vehicles, and smoothly integrating vehicle charging into the electrical grid. The decision also directs utilities to revisit PEV rate design in the 2013–14 timeframe, informed by real-world data gathered in the intervening period, as described in section 3.2.7.

### 4. Metering

The Phase Two decision adopts goals for metering policy with respect to PEV load, including promoting consumer choice and improving consumer experiences, achieving functionality sufficient to ensure the smooth integration of PEV charging, promoting innovation in metering technology, and encouraging off-peak charging.<sup>32</sup>

California's investor-owned utilities offer two types of PEV rates. The "whole-home" option places both PEV-load and non-vehicle load on a time-of-use rate using the primary utility service

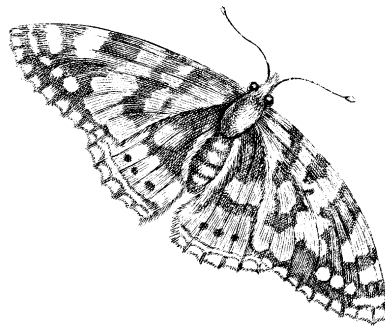
meter. This is the simplest manner to ensure PEV charging is accomplished on rates that provide time-variant pricing, but can cause significant bill increases for customers unable to shift non-vehicle load to off-peak hours, such as those who work from home, or for low-consumption customers accustomed to lower-tier prices. The separately metered option allows customers to keep non-vehicle load on standard residential rates, and move PEV load onto time-of-use rates using a second meter. This can mitigate a significant increase in the total utility bill. However, the electrical work required to accommodate separate metering complicates the installation process and can be expensive. Depending on the logistics of the particular site, customer costs can range from a few hundred, to several thousand dollars.<sup>33</sup>

Recognizing this undermines the goal of promoting consumer choice and makes PEV-only rates impractical for many customers, the Phase Two decision directs California's investor-owned utilities to develop a "submetering protocol" to facilitate the use of submeters for billing purposes.<sup>34</sup>

The Commission defines a submeter as a meter placed downstream of the primary service meter.<sup>35</sup> To generate a PEV-specific bill, consumption measured on a submeter must be subtracted from the total consumption measured on the primary service meter. Submeters embedded in charging equipment

or in vehicles could potentially simplify installation and reduce costs relative to separate meters, though it may be several years before revenue grade embedded meters are available for utility billing purposes.

In addition to enabling consumer choice between rate options, a low-cost dedicated metering solution could also be



needed to comply with the California Air Resources Board requirement for "direct" metering of electricity used to generate "Low Carbon Fuel Standard" credits and could eventually prove necessary to facilitate the collection of road taxes.<sup>36</sup>

#### 5. Cost recovery

The spectre of overloaded transformers is useful to focus the attention of utility regulators, but policymakers should proceed with caution before altering existing rules governing the recovery of such costs from utility customers. Electric vehicle load is simply another load amongst many others. If it is inherently

unique, it is because it results in significant emissions reductions and because it can be shifted to off-peak hours relatively easily. Nevertheless, some stakeholders argue that the Commission should alter its cost recovery framework in anticipation of widespread PEV charging.<sup>37</sup> PEV-specific fees and charges would pose a significant barrier to consumer adoption.

The Phase Two decision recognizes that no such fees exist for comparable loads such as hot tubs and air conditioners and that it would be unwise to alter the existing cost recovery framework to discourage fuel switching that is critical to the state's environmental goals.<sup>38</sup>

#### 6. Demand response and load management

The Phase Two decision states "intelligent load management and smart charging have the potential to lower costs for all customers and facilitate the integration of renewable energy."<sup>39</sup> Efforts to tap this potential will be informed by the load research required by the Phase Two decision. However, specific load management programs for PEVs will be considered within the larger context of the Commission's "Smart Grid" and demand response proceedings.

#### 7. Load research and cost tracking

The Phase Two decision orders California's investor-owned utilities to conduct research to

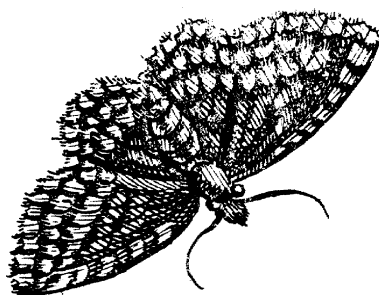


analyze how metering and rate design impact charging behavior, track costs associated with vehicle integration, determine how participation in demand response programs affects charging patterns, evaluate PEV use in multi-dwelling units, and examine the impacts of public charging at various power levels.<sup>40</sup>

This research is partially intended to inform future Commission cost allocation and recovery policies. However, tracking costs associated with distribution upgrades necessary to integrate vehicle charging should not be equated with the attribution of such costs to PEV customers. Attribution based on chronology is inherently flawed. For example, it is arbitrary to declare that Jane's PEV bought in February *caused* a transformer to exceed its capacity when Joe's hot tub installed in January brought the transformer to the point where the addition of any significant load would necessitate an upgrade. The electrical grid does not recognize seniority. Accordingly, the estimates resulting from the Commission-mandated cost tracking should not be used to justify policies that treat PEV load differently than other comparable loads.

While cost tracking is inherently difficult, the load research into customer charging behavior required by the Phase Two decision should be extremely useful to inform load management programs and PEV rate design. The decision requires

that future filings modifying PEV rate designs are to include "an analysis of Electric Vehicle charging load profiles, the costs and benefits of Electric Vehicle integration and charging, and consumer response to Electric Vehicle time-of-use price differentials."<sup>41</sup> Because California is the largest early PEV market in the country, this load



research will benefit from relatively large sample sizes and should prove useful for regulators and utilities in other states preparing for vehicle electrification.

### C. Phase Three

The Commission's rulemaking is ongoing. Many policies adopted in Phase One and Phase Two require implementation and persistent action. The CPUC has kept the proceeding open to facilitate continued party engagement and to ensure its efforts are informed by real world experiences gained during the early deployment period. Phase Three is defined broadly here to

capture all relevant Commission activity, including:

- An assessment report published in late 2011 detailing utility efforts to secure timely notification and steps needed to create a scalable solution.<sup>42</sup>
- The development of a "Sub-Metering Protocol" to explore potentially lower-cost metering solutions.
- Intelligent load management programs to minimize costs, maximize benefits, and integrate greater levels of intermittent renewable resources.
- Load research and cost tracking to inform future PEV rate design and cost allocation policies.

These efforts will largely determine the price of electricity as a transportation fuel in California for the foreseeable future. The cost-effectiveness of driving on electricity in the state will also be affected by another open Commission proceeding that will determine how utilities should return proceeds from the sale of Low Carbon Fuel Standard credits to PEV customers.<sup>43</sup>

## IV. Conclusion

California is the single largest PEV market in the country. According to automakers, over half of the first widely available modern PEVs have been sold in the state.<sup>44</sup> California's Air Resources Board recently adopted "Zero Emission

Vehicle'' regulations that will ensure approximately one in seven new cars sold in California in 2025 will be partly or fully electric-drive.<sup>45</sup> The strategic plan of the California Plug-in Electric Vehicle Collaborative, whose members include state officials, automakers, advocacy groups, charging equipment manufacturers, and utilities, outlines a path to achieve widespread vehicle electrification in the state.<sup>46</sup> This plan relies heavily upon the CPUC and the utilities under its jurisdiction.

The Commission's multi-year rulemaking is the most comprehensive effort in the nation to accelerate the PEV market. Regulators in other states should consider taking advantage of the considerable

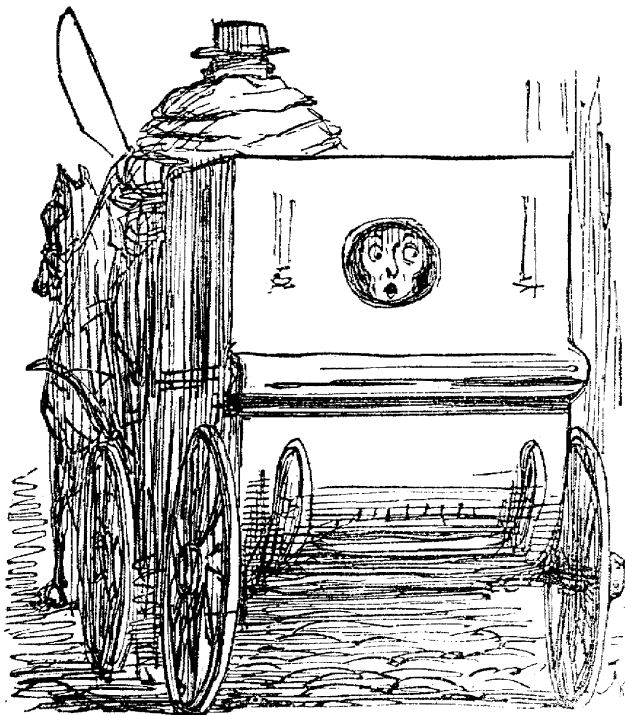
body of knowledge that has been produced as a result of the CPUC effort. Specific regulations will necessarily reflect regional conditions, but many of the policies adopted in California could easily be adapted to other jurisdictions. Furthermore, the principles and goals described above should be universally applicable. The time to initiate similar proceedings is now. This year alone, automakers will introduce around a dozen new plug-in models in targeted states, while General Motors and Nissan will make the Volt and Leaf available across the country.<sup>47</sup>

Creating regulatory uniformity across jurisdictions would remove a potential barrier to a thriving national PEV market. The experience of filling

up at a gas station, while inconvenient compared to refueling at home, is essentially the same across the nation. The process required to plug in should be standardized as much as possible. Likewise, while gasoline prices vary regionally, the differences are slight compared to the variation in the price of electricity as a transportation fuel. Drivers across America should have access to rates that maximize savings relative to gasoline and encourage off-peak charging.

The CPUC's rulemaking described above is intended to make this vision a reality. The policies adopted in the first two phases of the rulemaking are critical to this effort, but the Commission's work is far from complete. Armed with the real world data from the early deployment, the Commission's actions in Phase Three will also set precedents for utility regulators across the country to consider as ever increasing numbers of customers in their states plug in.

The single most important lesson to draw from California's experience is that the decisions of utilities and utility regulators will have a profound impact upon the future of America's transportation sector. Just as the oil industry was instrumental to the success of the internal combustion engine, the electric industry will play a central role in determining the fate of the electric vehicle. ■



*The single most important lesson to draw from California's experience is that the decisions of utilities and utility regulators will have a profound impact upon the future of America's transportation sector.*

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17. California Public Utilities Commission, *Decision 11-07-029*, 2011, at 3.
18. *Id.*
19. *Id.* at 6.
20. California Public Utilities Commission, *Joint IOU Assessment Report for PEV Notification*, Rulemaking 09-08-009, 2011, at 13. *Note:* driving 10,000 miles on electricity would only increase the average American annual household consumption by about a third assuming 0.34 kWh/mile PEV efficiency, and average annual residential electricity consumption of just under 11,000 kWh per household. *See:* Energy Information Agency, *Table 5A. Residential Average Monthly Bill by Census Division, and State*, 2009.
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