THE PROMOTION OF ELECTRIC VEHICLES

In the United States

A Landscape Assessment

A Plug In America Special Report

April 2015

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Acknowledgements

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CONTENTS

EXECUTIVE SUMMARY

Focusing on the first four years of the modern era of plug-in electric vehicles (PEVs) in the United States, research by Plug In America reveals a number of encouraging signs. Approximately 300,000 PEVs now ply the nation's roadways, an impressive achievement for a new vehicle category.

At the same time, PEV advocates have struggled to identify barriers to success and put in place measures to eliminate them. The goal of our research for this report was not so much to identify what has gone right so far — we certainly want more of that — but to pinpoint where improvements need to be made. These are highlighted in the report as eleven Key Findings, grouped into the areas of marketing, public policy, and potential sources of additional promotional support.

Gleaned from internal discussions among Plug In America's staff and directors, recommendations follow each of the findings in the report. These recommendations serve to inform decisionmakers and to stimulate actions to grow the PEV marketplace.

Key Themes

- Despite media reports to the contrary, PEV sales are actually on a path to the near elimination of the need for petroleum-based fuels to power the nation's automobile fleet.
- Industry data show that consumer satisfaction with these new vehicles is overwhelmingly positive. The advantages of dramatically lower operating cost, significantly reduced impact to the environment, convenience of fueling at home, and the pleasure of a better driving experience combine to generate enthusiasm for this new vehicle category.
- National awareness of PEVs remains low, exacerbated by restricted availability of many models in the marketplace and largely uncoordinated promotional campaigns. Additionally, inconsistent governmental policies form a patchwork quilt across the country, which is understandably difficult for consumers to grasp.
- The transition to PEVs aligns profoundly with environmental goals to reduce pollution and address climate change. Electrified drivetrains can eliminate petroleum use in vehicles, replacing it with power from an ever-cleaner electricity grid. PEVs act synergistically to reduce pollution, decarbonize the grid, advance smart technology, and improve our economy.
- Leveraging the real-world experience of seasoned PEV drivers by proactively seeking their guidance is critical to accelerating market growth.
- There exists clear opportunity to catalyze PEV market growth by tapping more deeply the resources of supportive actors, from industry to government to philanthropic foundations.

It is the conclusion of this report that accelerating the growth of the PEV market requires that stakeholders collaborate more effectively toward a shared aim. Importantly, this means working beyond local or narrow organizational interests to align promotional efforts across all fifty states. Additional resources must be brought to bear, notably from philanthropic foundations.

INTRODUCTION

The modern introduction of plug-in electric vehicles to the marketplace began in earnest at the beginning of 2011. Starting with only three offerings, the Chevy Volt, Nissan LEAF, and Tesla Roadster, availability has grown to over two dozen models at the beginning of 2015. Having devoted itself for over a decade to getting these cars on the road, Plug In America chose to take stock of where the PEV market now stands, four years in, to better inform what needs to happen to take electric vehicle (EV) adoption to the next level.

The United States is on a sales and technology path that could largely eliminate the use of oil for personal transportation vehicles within thirty years.

We should note at the outset our particular interest in emerging EV promotion efforts nationally, as opposed to cataloging local instances of market adoption. Our approach was to assemble a broad view of current PEV market promotional efforts currently underway across the United States. Research for the project included a review of publicly available literature, access to private materials held by key market stakeholders, and direct interviews with a host of market participants including auto manufacturers, utilities, local and state policymakers, advocates from non-governmental organizations (NGOs) and market enablers.

The scope of the project naturally grew given ever-increasing PEV penetration across the country. The initial view afforded by our interviews and research reveals a mostly uncoordinated set of local and state actors – numbering in the hundreds if not thousands – working to achieve one of the most audacious environmental and technological goals imaginable: changing the dominant fuel source for personal vehicles in the United States. This effort is crucial to the US achieving greenhouse gas (GHG) stabilization goals implied by a two-degree Celsius global temperature rise. The 80% reduction in US greenhouse gas emissions required by 2050 is consistent with scenarios where electric vehicles capture 80% of the US light duty vehicle market over the same timespan.

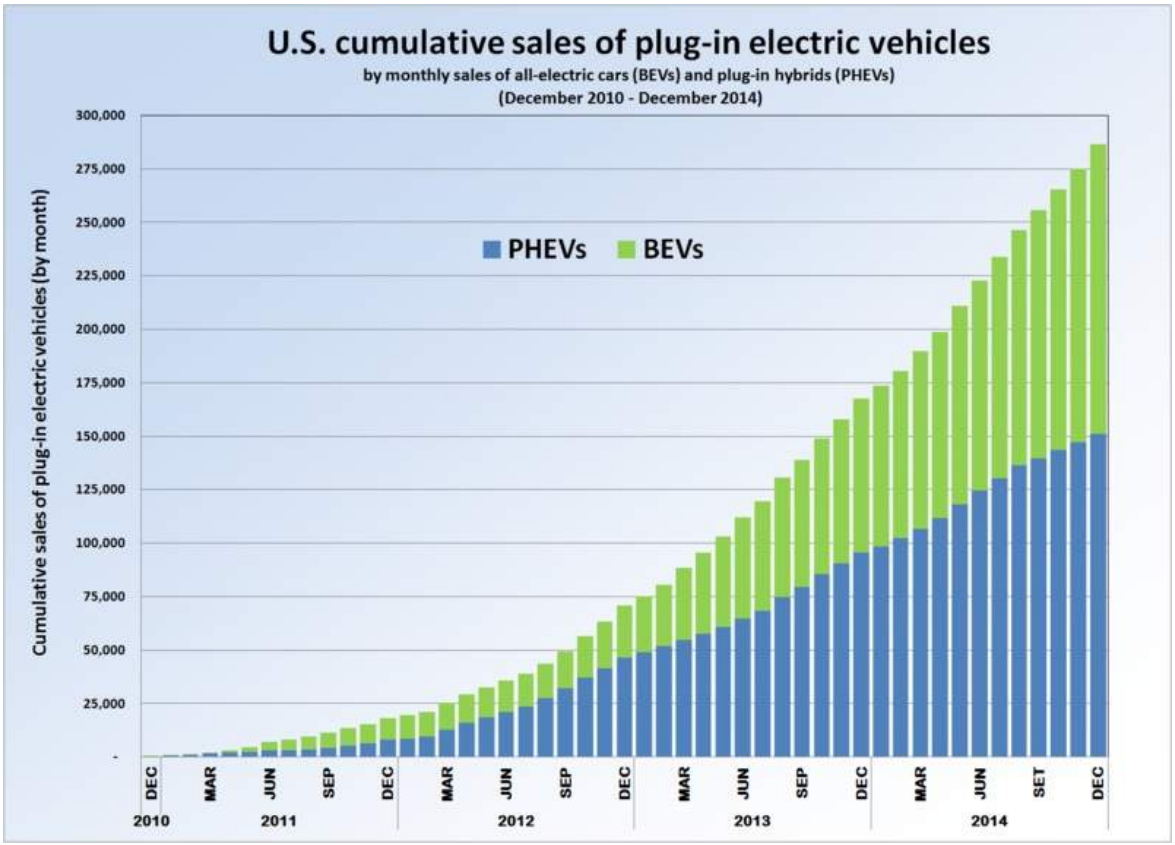
Significant coordination will be required to achieve that goal given a January 2015 starting point of nearly 300,000 PEVs on US roads, against a national backdrop of over 250 million fossil-fuel powered vehicles. Yet, early market gains by the current generation of vehicles suggest that, with the right support, achieving the goal is feasible. To date, however, local and state stakeholders leading the effort largely lack meaningful financial support, and promotional efforts that do exist are often piecemeal and uncoordinated. Providing that support will be the major challenge ahead.

Despite awareness of the challenges involved in growing the PEV sector significantly, respondents expressed decided optimism and enthusiasm related to the PEV deployment trajectory ahead. Notably, the marketing math related to the vehicles simply being on roads may undergird the optimism. Beginning from their 2011 starting point, if every vehicle on the road were to spur slightly less than one additional sale per year, the ongoing market feedback loop would grow to

capture 100% of new vehicle sales over the next 25 years. Surprising as it sounds, market performance over the last four years is within mere thousands of vehicle sales of that projection. The United States is on a sales and technology path that could largely eliminate the use of oil for personal transportation vehicles within thirty years.

The United States leads the world in plug-in electric vehicle adoption with a 45% share of global sales.[1] *Forbes* magazine reports that "demand for electric vehicles is rapidly rising around the world mainly due to a relatively less harmful impact on the environment and lower operating costs, as compared to gasoline-powered engines."[2] The Electric Drive Trade Association's (EDTA) July 2014 market snapshot provided an excellent overview of market performance to date.[3]
Key highlights include:

- Roughly 100% growth in the number of PEVs on US roads between June 2013 and June 2014 – from 111,962 to 222,590.
- 8,389 public EV charging locations with 20,420 stations installed.
- 19 available models from ten manufacturers – BMW, Chevy, Fiat, Ford, Honda, Mercedes, Mitsubishi, Nissan, Tesla and Toyota.
- 20 additional models expected through 2016 including vehicles from new manufacturers such as Audi, Kia, Porsche and VW.



US plug-in electric vehicle cumulative sales by month by type of powertrain from December 2010 up to December 2014.[4]

Though beyond the scope of the EDTA snapshot, the US freeway-capable EV market also includes a range of electric motorcycles, utility vans, and passenger buses. While tiny compared to overall light duty vehicle sales, month-to-month sales growth for plug-ins has been robust and potential market tipping points are coming into view.[5,6] The national market share for PEVs grew from 0.14% in 2011 to 0.67% through the first part of 2014.[7] The highest-ever market share for plug-in vehicles was achieved in October 2013 with 0.85% of new car sales.[8] The bellwether California market, accounting for roughly one-third of national car sales,[9] has crossed the 1% of new vehicle sales threshold (1.2%) and Hawaii, Washington and Oregon are close behind.[10] Some observers postulate that upon crossing the 5% of new vehicle sales threshold, the PEV market will create a virtuous cycle of ever growing market share as more vehicles on the road generate ever more awareness about the positive experience of driving electric.[11]

Other states and cities also provide important examples of market acceleration. In June 2014, The *Wall Street Journal* reported that Atlanta had become the nation's second leading metropolitan market for PEVs, thanks to a mix of aggressive local purchase incentives, access to high occupancy vehicle (HOV) lanes, and favorable electricity rates.[12] The Atlanta market evolved dramatically, given it was not considered by automakers as a launch market for plug-in models.[13]

Consumer Perception

Consumer perception of the quality of the new crop of electric cars has been consistently reported as very high by leading market publications. A PEV has been the top choice in *Consumer Reports'* owner satisfaction survey for the past three years: the Chevy Volt, twice (2011 and 2012) and the Tesla Model S, once (2013).[14] Owners of the Model S gave it a 99 out of 100 points, virtually unprecedented for the survey.[15]

The Tesla Model S gets top ratings from consumers. Photo credit: Tesla Motors.

Consumers' experience accessing electricity to charge their vehicles has proven significantly less burdensome than initially forecast. Approximately half the owners of PEVs usually or always access electricity at 120V (Level 1, or L1) using the connector provided as standard equipment with every PEV. This aligns with Department of Energy (DOE) data proving that most vehicles, including conventional internal combustion engine (ICE) vehicles, drive under 40 miles per day, including commuting. Initial focus on long recharge times from empty to full have proven largely irrelevant in real world experience with PEVs. This is not surprising, of course, for plug-in hybrids, which are capable of receiving a full charge overnight at 120V. More surprising, but important to note, L1 charging has proven convenient, adequate and less expensive for over half of Nissan LEAF drivers, despite initial manufacturer focus on ensuring 240V (Level 2, or L2) charging capability for these vehicles.

The mix of plug-in hybrid and pure battery-electric vehicles (BEVs) demonstrates the importance of providing consumers a choice for how to drive electric miles, almost irrespective of the overall range enabled by those miles. With an EPA-rated 35-mile all-electric range backed up by a gasoline-powered engine, the first generation Chevy Volt has demonstrated the promise of the electric mile choice. By June 2014, owners of the Volt had driven over a combined 500 million all-electric miles; some 63% of total miles driven.[16]

The Chevy Volt, an extended-range electric vehicle (EREV), was the top choice in Consumer Report's owner satisfaction survey for 2011 and 2012. Photo credit: C. Davids.

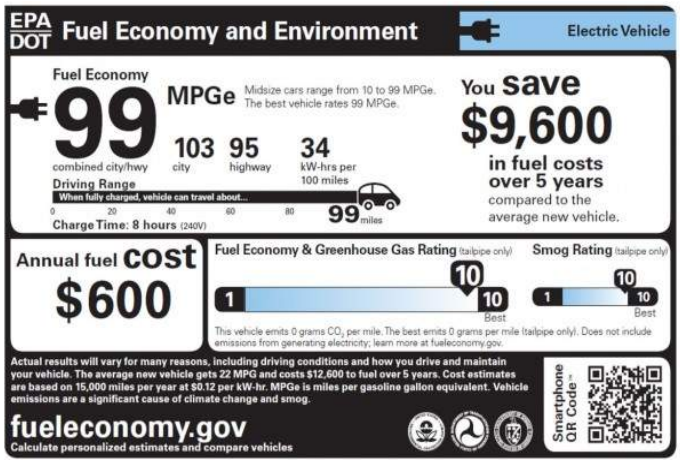
THE PLUG-IN ELECTRIC VEHICLE PROMOTION LANDSCAPE

Our interviews and research reveal a patchwork of PEV promotional efforts across various jurisdictions. While innovative, they lack a strong, coherent focus. Despite a number of actors engaged in various limited initiatives, the US has yet to embark upon either a sustained or consistent national market mobilization effort for PEVs.

Federal Government PEV Promotion Landscape

In his 2011 State of the Union address, President Obama called for putting one million electric vehicles on the road by 2015. According to the Congressional Budget Office (CBO), between 2012 and 2019 the federal government will spend $7.5 billion on policies to boost the US PEV industry, primarily embodied in the federal tax credit for the purchase of electric vehicles.[17] By contrast, major oil producers will receive tax benefits of roughly $4 billion per year (or $28 billion during the CBO's timeframe), and the tax code allows these same oil producers to pay income tax at a roughly 13-14% rate, far below the 35% top corporate rate.[18]

In hindsight, one of the most notable achievements of The American Recovery and Reinvestment Act (ARRA) may be the range of initiatives it offered for stimulating PEV adoption. Starting in January 2009, federal tax credits were made available for new PEV purchases that fit standards set by the policy. The program delivered loan guarantees for battery manufacturers (an extension of the Advanced Vehicle Technologies Manufacturing program first signed into law by President George W. Bush) and to bring electric vehicle manufacturing to the United States through plants in Tennessee, Delaware, and California. ARRA also spurred infrastructure investments and offered support for communities across the country to develop readiness plans for integrating PEVs into their communities through infrastructure plans, and code and rule updates, among other initiatives. While federal incentive policy has clearly played a significant role in supporting the overall US PEV market, the federal EV promotion landscape is mostly a patchwork of initiatives. The US Department of Energy and the Environmental Protection Agency (EPA) sponsor the website fueleconomy.gov which breaks out information on PEVs in its "Advanced Cars and Fuels" category.[19] The EPA has created an electric vehicle label to help identify the cars and their fuel savings.[20] And, of course, the EPA is the agency responsible for determining the range claims allowed to be advertised by automobile manufacturers.



The EV Everywhere Grand Challenge represented the 2012 update of the President's initiative to spur EV adoption. Investments in improved battery technology, electric drive systems, vehicle lightweighting strategy, climate control technology, and charging infrastructure were prioritized, as was training on issues related to EV adoption for first responders and others. The Grand Challenge also initiated the DOE Workplace Charging Challenge aimed at boosting tenfold the number of companies offering workplace charging within five years.[21] Key findings in the recently released *Workplace Charging Challenge Progress Update 2014: Employers Take Charge* point to the fact that the program is working; workplace charging is growing in popularity and impact.[22]

The US military is investing heavily in PEVs.
US Air Force photo by Master Sgt. Jeffrey Allen.

Direct outreach by the federal government to promote PEVs is currently dominated by the US Department of Energy's Clean Cities program. Founded in 1993, Clean Cities coalitions across the country provide informational, technical, and financial resources to federally regulated fleets and voluntary adopters of alternative fuels and vehicles. Coalitions are primarily located in major metropolitan areas throughout the United States.[23] Though Clean Cities focuses on the entire portfolio of alternative fuel vehicles (AFVs), the 100 individual coalitions offer a natural connection point for engaging consumers in various markets with PEVs.

Finally, the US government vehicle fleet merits mention. The federal government owns or leases 254,059 vehicles, excluding the military and the US Postal Service.[24] Recognizing the economic, environmental and strategic benefits of vehicles that do not rely on fossil fuels, the US military is investing heavily in PEVs. According to a recent report from Navigant Research, the US Department of Defense (DOD) will acquire more than 92,400 EVs for non-tactical purposes from 2013 to 2020.[25]

Regional PEV Promotion Landscape

The most significant regional effort to promote PEVs in the US is the 8-state Memorandum of Understanding (MOU) process involving California, Connecticut, Maryland, Massachusetts, New York, Oregon, Rhode Island, and Vermont. In a MOU initially signed in October 2013, these states committed to taking steps aimed at putting 3.3 million electric vehicles on the road by 2025. A follow up action plan released in May 2014 outlined 11 actions they could take in support of the MOU, ranging from providing incentives to spurring fleet purchases to promoting charging infrastructure. Notably, the top action identified was "Promote the availability and effective marketing of all plug-in electric vehicle models in our states." [26] Priority multi-state actions identified in the plan include:

- Create an MOU-state web-based "zero emission vehicle (ZEV) landing page" to provide consumers and dealers with up-to-date information on ZEVs that are available in each state and links to state and automaker websites.
- Invite automobile dealers and dealer associations to join the MOU states and automobile manufacturers in the ongoing "New Collaboration for ZEV Success" initiative to encourage dealer education, consumer awareness, and effective marketing for the full range of ZEVs in our states.
- Collaborate with automakers and dealers to identify, evaluate, and implement creative financing approaches and other effective strategies to reduce vehicle purchase price and increase ZEV sales.
- Collaborate with automobile manufacturers, dealers, Clean Cities programs, and other stakeholders to incorporate ZEV outreach and education events for consumers in conjunction with auto shows, Earth Day celebrations, and National Plug In Day.
- Institute programs to identify and highlight "ZEV champions" among dealers through Governor recognition.

The Importance of Charging Infrastructure Initiatives

Charging infrastructure initiatives have also lent themselves to regional collaboration and promotion activities. The "West Coast Electric Highway" involves collaboration between the Washington State Department of Transportation (DOT) and the Oregon Department of Transportation (ODOT) to provide DC fast-charging stations every 25 to 50 miles along Interstate Highway 5 and other important Pacific Northwest roadways. On the East Coast, the Northeast Electric Vehicle Network, a project of the Transportation & Climate Initiative of the Northeast and Mid-Atlantic States, is working to play a similar role across the busy roadways connecting cities in that region. Its efforts have helped spur the installation of over 1,000 public electric vehicle charging stations.[27]

Cross-regional PEV Promotion Efforts

The nation's largest cross-regional PEV promotion effort, National Drive Electric Week (referred to by its former name, National Plug In Day, in the 8-state MOU action plan) was, quite significantly, developed outside governmental or industry promotion efforts, pointing to one key finding: driver-led efforts, largely volunteer, have proven to be an extremely important part of the PEV promotion effort. From its 2011 inception, which took place in 29 cities, National Drive Electric Week (NDEW) has grown to include events in over 150 locations. Some government and industry support has begun to aid these efforts, at most a few hundred thousand dollars, out of a combined government and industry multi-billion dollar promotional effort. The events introduce 90,000 or more people to PEVs primarily through test drives, show and tells and educational outreach. Analysis by Plug In America suggests that NDEW may be significantly boosting PEV sales in the weeks immediately following each year's event.[28]

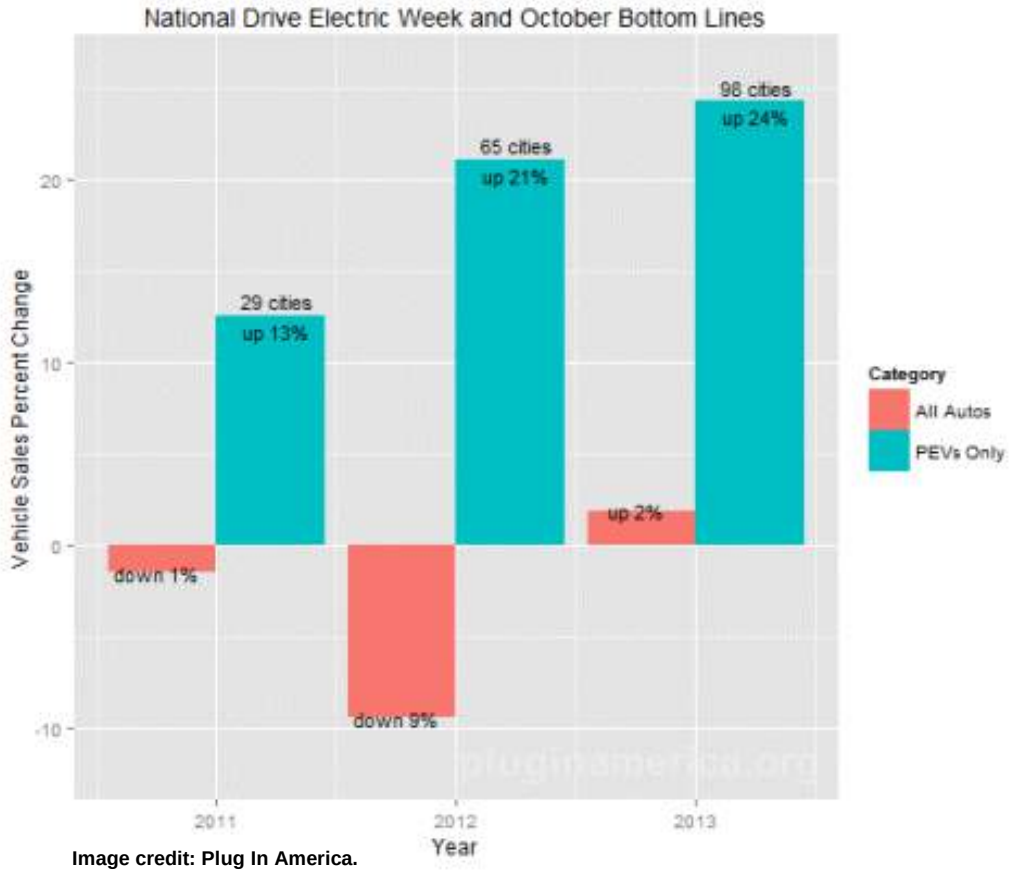


Image credit: Plug In America.

National Drive Electric Week is a nationwide celebration to heighten awareness of today's wide-spread availability of plug-in vehicles and highlight the benefits of all-electric and plug-in hybrid-electric cars, trucks, motorcycles, and more. The events introduce people to the cars primarily through test drives, show and tells and educational outreach.

2014 National Drive Electric Week event in San Antonio, TX. Photo collage credit: Luis, Ram.

The regional landscape also includes a coordinated municipal effort. In 2014 the San Francisco Bay Area's Metropolitan Transportation Commission and Bay Area Air Quality Management District, in collaboration with a consortium of electric vehicle organizations, launched the Experience Electric – The Better Ride campaign. This initiative represented the nation's first effort by regional transportation and air quality entities to conduct a systematic EV promotion campaign to help achieve their transportation-related GHG emissions reduction goals. Notably, the campaign was built around explicit test-drive events. A total of 21 events delivered thousands of PEV test drives and gathered survey data to demonstrate their market impact.[29]

State PEV Promotion Landscape

EV gathering. Idaho State Capitol building in the background. Photo Credit: Zack Waterman.

Across the country, states are developing plans to increase the number and use of PEVs. The 2013 ZEV Action Plan,[30] published by the Office of California State Governor Edmund G. Brown, includes a roadmap geared towards putting 1.5 million ZEVs on California highways by 2050. The Multi-State ZEV Action Plan highlights the EV collaboration among eight states, providing a summary of the current state of the ZEV market and offering specific actions to help accelerate development of that market.[31] The Washington State Electric Vehicle Action Plan outlines the state's strategies to increase the adoption of PEVs to help meet its goal of having 50,000 PEVs on Washington's roads by 2020.[32]

Individual states are also working to promote PEV use across a host of policy fronts. Legislative actions reflect a vast array of policy and code issues involving PEVs. Thirty-nine states have enacted some form of incentives for PEVs, including tax credits for vehicle purchases and charging station installations, HOV/HOT lane exemptions, sales tax abatement, and direct rebates. The National Conference of State Legislatures' (NCSL) website has an interactive map and table indicating hybrid and electric vehicle incentives for each state.[33] The convergence of incentives and their impact on the market is demonstrated no better than in Atlanta, which during 2013-2014, catapulted to a local market leadership position.[34]

State and local agencies are incorporating PEVs into their fleets to help reduce GHG emissions and achieve sustainability goals.[35] The Washington State Department of Transportation (WSDOT) became the first state agency in the country to negotiate a leasing agreement to procure a number of Nissan LEAF electric cars for official use.[36]

The Role of Task Forces

In a number of states, task forces comprised of a mix of public/private participants have played an important role in fostering discussions about issues affecting PEVs. In California, the Plug-In Electric Vehicle Collaborative (PEVC) has played that role since 2010. In partnership with the California Air Resources Board (CARB), its Plug-In Electric Vehicle Resource Center provides a one-stop shop for consumers interested in learning more about the vehicles.[37] The PEVC played a key role in conceiving and shepherding the state's "Drive the Dream" initiative, a 2013 convening in which 40 Fortune 500 CEOs in the state committed to purchasing over 2,000 charging stations and 1,500 PEVs by September 2014.

WSDOT's Secretary of Transportation Lynn Peterson with the agency's first Nissan LEAF. Photo credit: WSDOT.

Massachusetts used the March 2013 meeting of its Electric Vehicle Roundtable, which included over 90 public/private stakeholders, to sharpen its thinking about launching PEV purchase incentives, and also fostered the creation of the Massachusetts Electric Vehicle Task Force.[38]

Automobile Dealer Involvement

As noted in the 8-state MOU plan, states have begun exploring opportunities to recognize dealers that take a leadership role in promoting PEV sales. In Feb. 2014, the State of Connecticut launched its first in the nation "Revolutionary Dealer Award" aimed at recognizing dealers who sell the most and greatest percentage of PEVs. The Connecticut Automotive Retailers Association worked with the CT Department of Energy and Environmental Protection to launch the program.[39] The dealer recognition program provides an important venue for hosting an Electric Vehicle Day at the Connecticut State Capital. The Hawaii Automobile Dealers Association and Hawaiian Electric Company have consistently promoted PEVs at the First Hawaiian International Auto Show, held annually in Honolulu. (Hawaii is tied with Washington State for the number two ranking of PEV sales per capita.)

Photo credit: Hawaii Automobile Dealers Association.

The Role of Electric Utilities

In some states, respondents noted that electric utilities play a role in promoting PEVs. Utilities can provide PEV-specific rates and information related to electric cars on their websites and via monthly bill stuffers. Some utilities go farther. For example, Puget Sound Energy is offering a $500 rebate for new EV owners who purchase a home charging station. The NCSL website has an interactive map and a table indicating hybrid and electric vehicle incentives for each state, including those offered by utilities. Examples of such incentives include PEV charging rate incentives, electric vehicle supply equipment (EVSE) financing, EVSE rebate programs and EVSE tax credits.[40]

The Edison Electric Institute, a trade association that represents all US investor-owned electric companies, is urging that utilities take a more active role in promoting the growth of the PEV marketplace. Besides providing a new source of revenue, PEVs charging on the grid can help utilities manage increased amounts of renewable energy resources and control demand.[41]

PEV Incentives Play a Significant Role in State Economies

Two reports recently released by the nonpartisan organization Securing America's Future Energy (SAFE) validate the economic impact of PEV incentives. Not only have Georgia's Zero Emission Vehicle Tax Credit and Washington's Alternative Fuel Vehicle Sales Tax Exemption stimulated sales of electric vehicles, but analysts concluded the absence of these incentives would cost the states $252 million and $68 million in future GDP, respectively.

http://www.secureenergy.org/policy/GeorgiaEVs

http://www.secureenergy.org/WashingtonEVs

Test Drives and Education Yield Important Benefits

Our research further noted the PEV stakeholder sentiment that test drives and informational sessions held at state capitals have yielded important benefits in a number of states.[42] Notably, however, respondents indicated that no states had yet coalesced behind major outreach campaigns, beyond publicizing their own incentive programs and web-based PEV information resources for the consumer.

Municipal PEV Promotion Landscape

The City of Seattle's Motor Pool includes over 40 Nissan LEAFs. Photo credit: Mike McGinn.

Cities stand at the front lines of the PEV adoption challenge. City efforts to enable access to charging, streamline permitting for installation of charging stations and address charging issues confronting multi-unit dwellings (MUDs) can make significant contributions to clearing the way for PEVs. The city of Seattle has been a national leader with its plug-in ready plan that includes elements familiar to many cities that have aimed to speed EV adoption:[43] Seattle's model is to:

- Streamline the permitting process and provide consumer information for installing home and commercial charging stations.
- Identify code changes for new construction to make it easier to install charging stations.
- Simplify the process for establishing charging stations in the public right-of-way.
- Install charging stations on city property for city fleets and public charging.
- Coordinate with surrounding cities and King County to develop a regional PEV infrastructure strategy.
- Explore market demand for plug-in vehicles, and the infrastructure needs for likely EV purchasers.
- Provide education on the benefits of electric vehicles.

City Programs

Drive Electric NYC, a project of the New York City Mayor's office, provides an overview of PEV initiatives related to America's largest US city, including links to PlaNYC and its GHG reduction goals for the region.[44] The cities of Boston, Philadelphia, and New York are trading lessons learned about PEV promotion with each other. NGOs are working to fill the niche for local information about PEVs in targeted cities. For example, PlugInChicagoMetro.org, a project of the Environmental Law and Policy Center, provides a one-stop shop with information about PEVs in Chicago. The Urban Sustainability Directors Network provides a peer-to-peer forum where sustainability staff from over 100 cities in the US and Canada can trade information about their efforts to promote PEVs.[45]

Cities like Chicago have begun integrating battery electric buses into their public transit fleets, providing customers with a cleaner, quieter ride.[46] The electrification of mass transit has substantial climate benefits including decreased emissions and improved air quality. As more and more public transit systems utilize clean energy, they become natural outreach platforms for vehicle electrification more broadly. San Francisco's legacy electric public transportation system, which lowers its carbon emission transit profile, also provides a model for the development of electrified urban transit systems and its benefits.

These various efforts notwithstanding, respondents noted that cities have yet to capitalize on their substantial access to and credibility with their residents to aggressively promote PEVs through direct engagement programs**.** No city is currently sponsoring an organized test drive program for residents interested in exploring PEVs.

Corporate PEV Adoption and Support

Photo credit: US Department of Energy.

In 2011, General Electric (GE) CEO Jeff Immelt announced that the company would purchase 25,000 PEVs by 2015, making GE the world leader in utilizing the vehicles for its fleet.[47] GE has since revisited that claim, changed their decision and backed off on their original pledge. The reason – customers of GE's corporate fleet-services unit wanted more vehicle options. In response, GE has now included natural gas-powered pickups and propane-fueled vehicles. This becomes a somewhat cautionary tale for the state of corporate adoption of PEVs.

Companies are wrestling with a number of challenges related to PEV adoption. In certain markets, companies took advantage of opportunities related to workplace charging with grants to install L2 EVSE. Many corporations used the funding to offer free PEV charging as a perk, spurring a strong uptake in PEV purchases by employees for commuting. There were many unforeseen

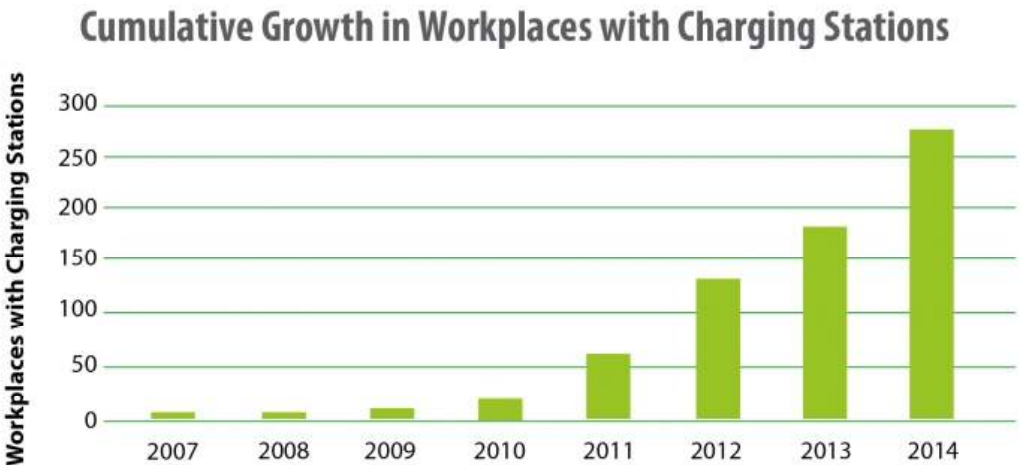


Image credit: US Department of Energy.

repercussions of offering limited L2 charging, as vehicle adoption quickly increased, overwhelming charging availability. This resulted in unwillingness on the part of some companies to expand EVSE infrastructure due to the high cost of networked L2 equipment originally funded and an increasing preference for limiting usage through monetization or time restrictions. To the extent that ever increasing PEV adoption is the prime motivation of PEV promotion, it has become evident that this goal is frequently best served by providing low cost slow charging (L1), and ubiquity.

Companies like Microsoft have installed EV charging stations for employee and vendor use. Photo credit: C. Davids.

Companies have a number of methods they can use to promote PEV use beyond workplace charging. Some companies are offering new vehicle purchase incentives as well as integrating PEVs into their fleets and car share programs. A significant and inexpensive promotional step companies can take is to provide reasonably-priced slow charging for their employees.

Corporate work on PEV promotion is almost universally linked to the active process of setting policy related to vehicle use and charging infrastructure. Beyond that, corporate outreach to promote PEVs is mostly non-existent among the overwhelming majority of corporate campuses. A relative handful of larger companies with growing EV driver populations have participated in test-drive campaigns involving either particular car manufacturers or have allowed their employees to participate in informal gatherings at their facilities. Respondents noted that systematically unlocking EV outreach to employees at work, combined with free or low cost access to electricity, could attract significantly more EV drivers.[48]

Electric Car Sharing Programs

Electric car sharing programs also offer substantial promise in the urban landscape. Some automakers have launched their own PEV car sharing programs, such as the BMW DriveNow initiative. In May 2014, Indianapolis announced its BlueIndy program. The 500 cars ultimately planned for the effort would make it the nation's largest plug-in car share program. Of the roughly two dozen car sharing programs in the US, most now incorporate at least a few plug-in models in their fleets. It should be noted that government grants and tax benefits largely spurred the introduction of plug-ins to these fleets.

BMW ActiveE electric vehicles offered in DriveNow, BMW's car sharing program in San Francisco. Photo credit: BMW Group.

National PEV Promotion Campaigns

In an effort to promote PEVs in the US, trade association groups have launched national electric vehicle outreach campaigns over the past several years. Common among these campaigns is the goal of raising public awareness of PEVs, primarily through the use of online media. The operating budgets of each of these efforts appear to have remained relatively constant, or have even decreased, despite universal agreement among the community PEV stakeholders in the intervening years that outreach and education are critical to stimulating growth of the electrified vehicle segment. Certainly, when compared to the promotional efforts for new products in other industries, the dollars spent to date by the relevant trade associations to promote PEVs have been remarkably few.

GoElectricDrive

Annual budget $1M [49]

Started in 2010, The GoElectricDrive Foundation is the charitable arm of the Electric Drive Transportation Association. Its mission is to "to enable and accelerate mass-market adoption of electric drive vehicles by the American public."[50] The campaign's primary assets include a website with plug-in vehicle information and resources, social media properties on Facebook and Twitter, and an ongoing media outreach function that includes gathering and packaging information related to PEV vehicle sales. The outreach impact of GoElectricDrive appears to be primarily related to grasstops media. The campaign has helped blunt negative or erroneous reporting related to PEVs.[51] Market snapshots produced by the campaign track ongoing PEV market progress for key audiences.

The Electric Generation

Annual budget unknown [52]

The Electric Generation is a program created by the Edison Electric Institute to promote PEVs and widespread adoption of electricity as a transportation fuel. The campaign is largely built around a website and social media feeds that endeavor to grow a critical mass of current and future drivers of plug-in hybrid and all-electric vehicles to "spread the message that electricity makes driving better."

The Electrification Coalition

Annual budget $2M [53]

Spun out of the nonpartisan policy organization Securing America's Future Energy (www.secureenergy.org), the Electrification Coalition published its seminal "Electrification Roadmap" in 2009,[54] supporting their view that the most significant long-term solution to reducing oil dependency is the electrification of transportation. The coalition's July 2014 report, *State of the Plug-in Electric Vehicle Market,* is the first in a series of analyses that will assess the current market and technical outlook for PEVs in the US.[55] Additional reports focusing on policy have followed, the most recent being evaluations of the impact of PEV incentives on the GDP of the states of Georgia and Washington (see sidebar on page 11).

PLUG-IN ELECTRIC VEHICLE MARKETING

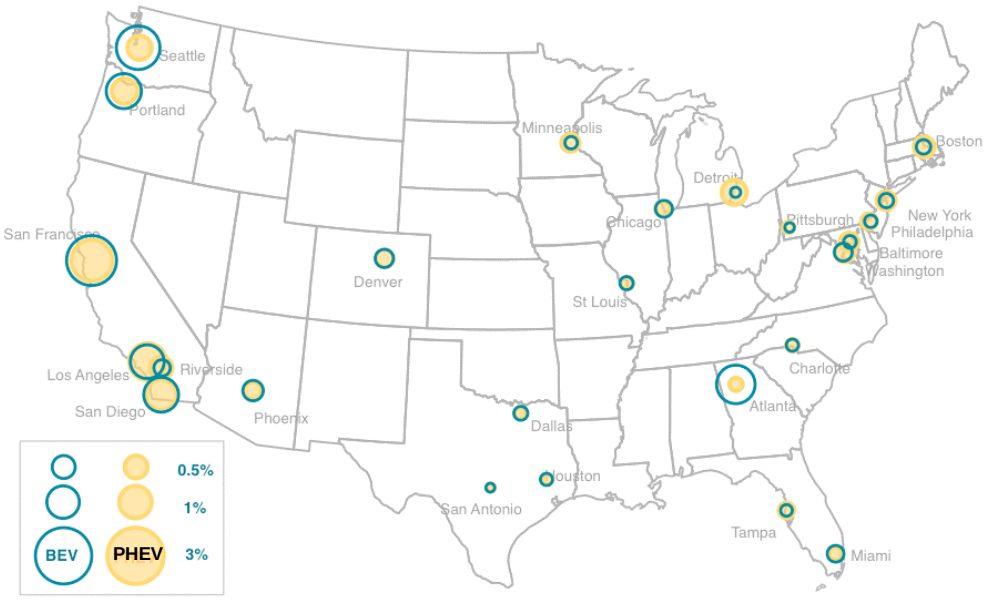
Respondents identified a host of limitations related to particular vehicle manufacturer outreach efforts. While individual automakers clearly have an important role to play in marketing and mobilizing support for their particular vehicles, introducing PEVs as a vehicle category in their own right will require complementary work by other market actors.

#1 Lack of awareness about PEVs and the technology remains a roadblock to widespread adoption

In its 2013 review of barriers to PEV deployment, the National Academy of Sciences found that "most potential PEV customers have little knowledge or experience with them. Lack of familiarity with this new category of vehicles, and their operation and maintenance, creates a substantial barrier to widespread PEV deployment."[56] The national adoption map illustrates the significance of major metropolitan areas to date.[57] Cities along the east and west coasts dominate sales, with a handful of other large cities comprising the balance of market penetration. As shown in the graphic below, the leading cities of Atlanta, Seattle, Portland, San Francisco, Los Angeles and San Diego each have 3-7 times greater BEV and/or PHEV new vehicle shares than the national averages.[58] The challenge ahead lies in extending PEV availability and acceptance to the rest of country.

RECOMMENDATION

Entities committed to the widespread success of the PEV category should be empowered to promote its growth. Providing funding to stakeholders who have a narrow self interest, such as a specific vehicle or infrastructure solution, is a less than optimal use of public dollars. Such practices miss the opportunity to send an inclusive signal or sense about the steps being taken to accelerate market adoption.



New plug-in electric vehicle shares in 25 most populous US cities in 2013 (based on IHS Automotive data). Source: International Council on Clean Transportation.

#2 PEV availability is significantly restricted

The PEV adoption picture is clouded by severe limits on vehicle availability from place to place. Many models represent so-called “compliance cars” in that they are produced only in limited numbers to satisfy regulatory requirements. Very few vehicles are readily available for purchase in all fifty states. California is the only state in the country where the entire range of plug-in electric vehicles can be found. This is because of its ZEV program, created and overseen by the California Air Resources Board. And only one manufacturer, Tesla Motors, is committed exclusively to electric cars. Certainly, for the major automakers, PEVs currently represent a tiny portion of their business.

Industry observers highlight the challenges of supporting vehicles outside of market hot spots to ensure a positive customer experience. As noted on the Cars.Com “Kicking Tires” blog, even if a car company says that a particular electric vehicle is offered in your state, not all of its dealers in that state have committed to selling them. To be able to carry a manufacturer’s PEV models, dealers are required to conduct additional sales and technical training, buy specialized service tools and equipment, and install one or more charging stations at the dealership. Some dealers are less than enthusiastic about making the additional investment required to support PEVs.[59]

After conducting a national secret-shopper survey, *Consumer Reports* wrote, “you would think that if you were to go to a car dealership that sold electric cars, a salesperson would want to sell you one. But that that’s true only some of the time...” [60] Their field research found that only 15 of 85 dealers randomly chosen across four states had more than 10 vehicles in inventory. Some dealers actually refused to show PEVs to prospects, even though they had vehicles in stock. Other dealers openly discouraged customers from buying the cars or denied knowledge of the existence of vehicles in their manufacturers product line. Some 35 of the dealers actively encouraged customers to purchase gasoline-powered cars.

RECOMMENDATION

Policymakers need to work beyond the local level by collaborating with their counterparts across the country to create incentives for automakers to market their cars nationwide. Interested PEV customers do not understand why, for example, the Chevrolet Spark BEV is available in only three states, while its stablemate, the Volt, can be bought in all 50 states. Such cognitive dissonance works to undermine perceptions of automaker confidence in their own technology, slowing the growth of the PEV sector.

#3 A small number of automakers dominate the PEV market

Vehicle sales data for the first eleven months of 2014 show that over 93 percent of PEV sales in the US were generated by six automakers. Ranked by number of units delivered, these are: Nissan, Ford, GM, Tesla, Toyota, and BMW. Consensus among respondents to Plug In America's inquiries is that these manufacturers have achieved their success levels by demonstrating a real commitment to the PEV category, with the remaining companies relegating themselves to "also-ran" status by virtue of only offering compliance cars in ZEV states.

While overall PEV sales have increased steadily since the beginning of 2011, the only step-function increases have happened when another serious player began to ship their product. One irony is that the so-called compliance cars are well executed and owners who get them are highly satisfied with their purchases.

The Role of Versioning

"Versioning," or using a unique or unusual design for a PEV model, is also important to highlight in understanding today's market. Some industry observers note that the current selection of PEVs seems intended more to bring potential brand-jumping customers into showrooms than actually delivering the mainstream appeal required for them to become a core business product.[61] A wide range of media coverage reflects the view that electric vehicles are considered to be marginal designs. For example, The New York Times notes in an otherwise favorable review of the Mercedes B-Class Electric Drive that "this is a Mercedes first and an electric car second."[62]

2014 U.S. PEV Sales

January through December – Data from InsideEVs.com

	Ranked by manufacturer		
1	**Nissan LEAF**	**30,200**	**25.2%**
2	**Ford: Energi(2) + Focus Electric**	**21,947**	**18.3%**
3	**GM: Chevy Volt + Cadillac ELR + Spark EV**	**21,260**	**17.8%**
4	**Tesla: Model S**	**17,300**	**14.5%**
5	**Toyota: Prius Plug-In + RAV4 EV**	**14,448**	**12.1%**
6	**BMW: i3 + i8**	**6,647**	**5.6%**
7	Daimler: Smart ED	2,594	2.2%
8	Fiat: 500e	1,793	1.5%
9	Porsche: Panamera + Cayenne Hybrids	979	0.8%
10	Honda: Accord PHEV + Fit EV	856	0.7%
11	Mercedes: B-Class Electric	774	0.6%
12	Kia: Soul EV	359	0.3%
13	VW: e-Golf	357	0.3%
14	Mitsubishi: iMiEV	196	0.2%
	Total	**119,710**	**100.0%**

Leading industry proponents also fall into the versioning trap. For instance, commenting on the anticipated extended range 2017 LEAF, Nissan executives stated that the next-generation LEAF will have a more mainstream design. "The current LEAF is aiming too much at an EV-like appearance," said Mamoru Aoki, Nissan's global design chief. "Tesla doesn't look EV at all. The Tesla S just looks nice, very sporty, sleek, but very authentic."[63] Moving PEVs out of the "EV-like appearance" box and into the mainstream will require harmonizing electrification within a manufacturer's full vehicle lineup.

BMW i3. Photo credit: BMW Group.

BMW, on the other hand, bucks conventional wisdom by endowing the i3 with a design sufficiently different as to suggest they desire to compete entirely within the PEV space, rather than appealing to their legacy customers. This is borne out by early sales data indicating that the overwhelming majority of BMW i3 customers are new to the brand with approximately 80% of i3 buyers purchasing a BMW for the very first time.[64]

Ford Ranger EV.
Photo credit: Geoff Shepherd.

Finally, obvious vehicle categories for electrification – multi-purpose crossover vehicles, SUVs, and light duty trucks – have yet to be actively introduced and promoted in the US by manu-facturers, These vehicles typically have ample room for battery packs as well as carrying capacity for a modest increase in weight. Available in California under the original ZEV mandate, the Chevrolet S10 and Ford Ranger EV were complemented in the utility category by the venerable first-generation Toyota RAV4 EV, many of which are still on the road as of this report.

The Mitsubishi Outlander PHEV, a top-selling model outside of the US.
Photo credit: Mitsubishi Motors Corp.

The Mitsubishi Outlander PHEV is a current example of a vehicle in high demand in every market where it is sold, which, notably, does not include the US. The Outlander PHEV has been avail-able in Europe for over two years. Its introduction into the US market has repeatedly been delayed and is now scheduled for sometime in 2016. The Nissan e-NV200, a small plug-in utility van, has not moved beyond test fleets in the US, despite its use of proven battery and drivetrain components shared with the successful LEAF hatchback.

The Nissan e-MV200, a plug-in utility van. Photo credit: FedEx Corporation.

RECOMMENDATION

We must ensure that public policy does not penalize companies that make a greater effort to grow the PEV market. Automakers who have delivered the bulk of the PEVs on the road should not suffer the loss of incentives, while competitors with lesser intentions continue to benefit. Incentives need to be created to spur the introduction of more light-duty utility PEVs.

#4 There is a clear lack of a coordinated national promotional effort in the media

PEV media advertising has largely had only limited success, because the legacy agencies serving the auto manufacturers have been slow to grasp the best positioning strategies for the technology. It has taken until 2014 to begin to see an increase in the number of advertisements that capture the fun and excitement of driving an electric car.[65] Initially, the messaging was much different. Industry observer and Hollywood producer Dean Devlin found substantial shortcomings. In an interview with *Green Car Reports*, he stated, "the Volt is an amazing, groundbreaking car, and the LEAF is a gigantic breakthrough – but they're being sold as medicine."[66]

Tradition is also playing a role in setting the pace at which the broader automobile industry will embrace plug-in electric vehicles.[67] PEVs represent a disruptive technology that reformulates most aspects of the auto manufacturer, dealer, service, and fuel supply equation for personal cars. In the US alone, this interlocking range of economic interests represents over $1 trillion in annual economic activity – over $600 billion in franchise dealer sales, roughly $500 billion in gasoline sales, and over $80 billion in the auto repair industry.[68,69,70]

Most long-time auto industry participants point to the 100-year track record of the current technology and related business model as overwhelmingly positive for consumers and global economic growth.[71] Adapting to a completely new vehicle paradigm will require reallocation of resources across the personal vehicle market. Some industry observers believe that as much as $500 billion hangs in the balance for consumers, given the lower total cost of ownership for PEVs. Certainly, the transition to PEVs represents a major challenge for an industry that employs more than 50 million people, either directly or indirectly, around the world.[72]

Other respondents observed that as PEVs become increasingly mainstream, so will PEV promotion efforts. The universe of PEV-aware consumers will grow. That growing importance creates a dynamic where driver groups can provide a sustained voice on policy matters. Greater scrutiny of consumer ranks could also capture the large number of PEV owners who identify themselves as politically conservative, including such luminaries as George Schulz. The former US Secretary of State during the Reagan administration drives a Nissan LEAF.[73] These voices must be highlighted as PEV deployment campaigns mature.

RECOMMENDATION

Led by committed automakers and utilities, a nationwide advertising campaign should be launched to raise public awareness of the benefits of PEVs. The dairy industry's successful "Got Milk?" campaign is an example of stimulating demand for a product sector beyond the local or supplier-specific level.[74]

#5 Test-drive events are highly successful at driving sales

While policymakers have flagged vehicles sales in their goals and policy statements, the US currently lacks a planned and ongoing outreach campaign aimed at introducing first-time drivers to PEVs. Respondents interviewed for this project identified test drives (aka "ride-and-drives") as a crucial component of garnering vehicle sales.

That said, the only systematic test drive outreach campaigns in the US aimed at the entire PEV category have been National Drive Electric Week and the Experience Electric outreach program in the San Francisco Bay Area. Beyond these, test drive events have been the province of car manufacturers, independent organizations and individual PEV proponents.

The Plug In @ Work program sponsored by Plug In America is an example of an outreach campaign conducted by an independent organization. Plug In @ Work brings PEVs to a company or corporate campus for a daylong product fair featuring test drives and information about making the shift to clean, electric transportation. For more information about the program, visit www.pluginamerica.org/plug-in-at-work

Neighbors of all ages learn about EVs at an Electric DriveWay block party. Photo credit: C. Davids.

Plug in America also encourages electric car owners to host an Electric DriveWay Party as a way to educate friends, neighbors and co-workers who have yet to drive a PEV. Participants can see EVs, take test drives and get their questions answered in a non-sales-oriented atmosphere. A *Getting Started* document and party planning tips can be found on Plug In America's website. www.pluginamerica.org/ElectricDriveWay

RECOMMENDATION

Test-drive events should be promoted much more, given the results of efforts like National Drive Electric Week. Government and corporate events should be paired when possible with the rollout of simple and low-cost employee access to charging for vehicles at workplaces.

THE ROLE OF PUBLIC POLICY IN GROWING THE PEV MARKET

#6 Transitioning to PEVs is critical to meeting US environmental goals

According to the US Environmental Protection Agency, the transportation sector accounts for 27% percent of US GHG emissions, second only to the electricity sector in terms of overall climate pollution.[75] Experts generally agree that GHG concentrations can get no greater than 400-450 parts per million (ppm) to avoid the most extreme threats posed by global climate change.[76,77] Achieving a 450 ppm CO_2 stabilization goal will require industrialized nations to reduce their GHG emissions 80% by 2050.[78] Emissions from the US transportation sector will need to fall by as much, or more, within that timeframe to support this goal.

The emergence of plug-in electric vehicles offers the clearest path forward in the climate logic for transportation.

Transportation as an environmental issue sits at the intersection of a host of complicated, tightly interwoven social and policy considerations. Driving down GHG emissions from transportation will require smarter urban planning and wider use of public transport. Substantive infrastructure commitments to increase the use of bicycles and walking can make a dramatic difference in many locations.[79] Yet the question of petroleum use in cars remains. For years, policymakers have explored clean fuel alternatives in the light-duty segment from a technology-neutral standpoint.[80] Recent years have seen a range of options for reducing petroleum dependency, including the use of biodiesel, corn ethanol, and natural gas fuels. Overall efficiency improvements have been made to ICE powertrains, largely brought about through increased use of turbocharging and the development of gasoline-electric hybrids.

The emergence of plug-in electric vehicles offers the clearest path forward in the climate logic for transportation. PEVs can eliminate petroleum use in vehicles and replace it with power from an ever-cleaner electricity grid. Moreover, the vehicles sit at the center of a potentially virtuous circle of disruptive technology convergence that presents substantial pollution and greenhouse gas reduction benefit, including: a cleaner grid, smart-grid technologies, widespread use of distributed renewable resources, secondary markets for vehicle batteries, and vehicle-to-grid (V2G) integration that could potentially help smooth utility electricity loads while providing a home for excess renewable resources – both at night and during the day in certain electricity markets.[81] PEVs are alone among decarbonization options in the vehicle sector in how they potentially reinforce these other important aspects of decarbonized utility and transportation sectors.

RECOMMENDATION

The significant environmental benefits of PEVs signal a need to emphasize policies and programs that further stimulate growth of this sector. This is especially apropos, given that among AFV deployments, PEV sales momentum and technology readiness will remain well ahead of the alternatives for the foreseeable future. Environmental policy support for PEVs should become as strong as it is for renewable electricity generation.

#7 PEV policy alignment is needed at all levels

Our discussions with stakeholders have revealed an interesting intersection between the makeup of today's current PEV fleet and the carefully negotiated set of clean air policies (particularly CARB's ZEV credit system) and incentives related to PEVs. In particular, the federal tax incentive for PEVs based on battery size may be producing an interesting, and unintended, market distortion.[82]

Only three vehicles on the road today were designed from the ground up around battery technology – the Nissan LEAF, Tesla Model S, and the BMW i3.

Except for Tesla Motors, which builds vehicles with 250 miles or more of range, the driving range achieved by most PEVs on the market today stands at no more than 80 to 100 miles. Plug-in hybrids have much shorter all-electric range, but can drive farther overall by relying on gasoline backup. Only three vehicles on the road today were designed from the ground up around battery technology – the Nissan LEAF, Tesla Model S, and BMW i3. The remainder of PEVs available to consumers are simply adapted versions of gasoline-powered models.

The combination of ZEV credits and the federal tax benefit create an incentive for manufacturers to build vehicles in the 80-100 mile range or lower. While those vehicles meet the daily driving needs of most consumers, many in the electric vehicle community believe that a truly disruptive electric vehicle should have at least 120 to 150 miles of real-world range and be targeted at a mid price point. The total cost of ownership for such vehicles could make the car a compelling choice for Americans in the mainstream. Study respondents were unaware of any manufacturers beyond Tesla, Nissan and BMW actively developing vehicles to fit that specification, even though evidence from individual vehicles offered by each manufacturer suggests that such a clean sheet vehicle combining their best, strongest assets is technologically possible and cost feasible.[83]

While it is impossible for outside observers to understand the internal product development dynamics of automakers, the government policy framework provides one clue. Respondents noted that policy incentives decrease considerably for longer-ranged PEVs. The federal incentive is capped at a certain battery size and the structure of CARB's ZEV credits make development and delivery of small numbers of hydrogen fuel cell vehicles more attractive to some automakers than electric vehicles with longer range. There is currently no policy incentive, such as additional ZEV credits, for automakers to offer pure battery-electric vehicles with greater range.

RECOMMENDATION

While efforts to promote the PEV market must necessarily continue in an environment dominated by petroleum-fueled vehicles, creating a more effective policy framework must be part of that effort. Policies that spur development of EVs with longer range could potentially offer a path to deeper market penetration.

#8 Existing PEV best practices and driver expertise need to be shared widely

Respondents commented on the host of policy issues confronting the PEV deployment challenge, including purchase incentives, state and local building codes, and rate programs for PEVs from utility regulators. Gas taxes for roads and the treatment of PEVs vis-à-vis that question has led certain states to propose or impose onerous fees on PEVs extracted at the point of registration renewals.[84] Another set of tightly linked issues confront the vehicles in the congestion mitigation sector, where transportation agencies aimed at reducing vehicle miles traveled (VMT) as a means to promote better air quality may view PEVs as potentially aligned with part but not all of their agenda.

New policy frameworks are needed to incentivize the ubiquitous deployment of vehicle charging infrastructure, particularly related to vehicles owned by residents of multi-unit dwellings, work-places, and for new construction. Over time, state-based vehicle charging standards, perhaps modeled on renewable portfolio standards but expressed as a percentage of parking spaces enabled for electric vehicle charging, may emerge as important market enablers. However, that work must factor in accessibility issues that have arisen in certain locales related to installing charging capability in parking spaces.

The federal government is home to a vast array of potential PEV promotion assets, notably the tax credit for PEV purchases. At the same time, other policies work to slow market acceptance. An illustration of this is the lack of clarity as to whether or not the Internal Revenue Service will treat free workplace charging as a taxable employee benefit.

Respondents agreed that creating, updating, and regularly circulating an ongoing set of policy best practices is an ongoing need in the years ahead. Stakeholders for that information include state

A NEW TOOL FOR REGULATORS: ELECTRIC VEHICLE MILES TRAVELED (e-VMT)

It is important to note that projecting the GHG reduction potential for PEVs requires the estimation of electric vehicle miles traveled (e-VMT), both for pure battery electric and plug-in hybrids. The emissions profile of the local electrical grid must also be taken into consideration, including time dependencies. Given the pace of technology diffusion ahead, it may be difficult to produce reliable models that capture the many interrelated dynamics at work with PEVs.

For years, plug-in vehicle advocates have debated the pros and cons of pure battery versus plug-in hybrid vehicles. Experience from past years demonstrates that the distinction is largely meaningless. Given the capability to drive on electricity, consumers tend to optimize their electric miles traveled, or e-VMT. Popularizing and promoting options for securing maximum e-VMT is a crucial task for the years ahead.

That said, policymakers interested in PEV sales should not trade vehicle sales targets for e-VMT targets. A sustained electrification market for transportation requires putting significant number of vehicles on the road as well as growing e-VMT.[85] And policy measures that require increasing percentages of qualified electric vehicle sales have been effective at bringing those vehicles to the marketplace.

and federal policymaker offices, utility regulatory agencies, state-based energy, transportation, and environmental agencies, municipal rulemakers, corporate sustainability officers, and fleet supervisors, among others. There exist well-developed PEV ordinances and policies in a number of states, but these data remain unknown across much of the country. The most efficient path could be for a national entity to facilitate dissemination of this information.

An excellent example of the need to disseminate PEV best practices involves charging station signage. All too often, station site hosts or municipalities are unaware of the existence of standardized signage that has been created specifically for PEV charging. States including California, Hawaii and Washington already have these signs in their ordinances. The use of proper signs informs users and greatly reduces the likelihood that non-PEVs will improperly park in the spaces reserved for PEVs. To the left is an example of standardized code-compliant parking space signage for PEV charging stations.[86] Examples of regulatory signs for EV charging and parking facilities can be found on the US DOT Federal Highway Administration's website.[87] Providing directional (wayfinding) signage to EV charging station locations is another critical need.

Another example involves the need to better leverage the experience and behavior of seasoned PEV drivers. For instance, although access to public charging is often identified as a requirement by policymakers and consumers contemplating a PEV purchase, actual PEV owners are, in fact, much less concerned, because little charging winds up being done at public charging stations unless it is free or reasonably priced.

RECOMMENDATION

Align charging infrastructure support with learning from actual user experience. Previous policies and grants have been geared toward a one-size (Level 2) fits all approach despite clear evidence that as much as one half of all charging is done at Level 1.

RECOMMENDATION

Government policy should avoid giving incentives on the one hand and taking them away with the other, as has been the case in some states. For example, efforts to target and collect road-tax revenue not captured when using electricity as a vehicle "fuel" are premature. The appropriate way to solve this problem is to develop a comprehensive new taxing mechanism that will cover the coming multitude of new alternative vehicle fuels.

A VAST FIELD OF POTENTIAL SUPPORT EXISTS FOR PEVS

#9 PEVs enjoy widespread bipartisan support among the nation's legislators

A hidden asset in the effort to promote the adoption of electric vehicles is the widespread bipartisan support among the nation's legislators. PEVs powered by clean, domestically produced electricity currently have no obvious opponents outside of the entrenched petroleum industry. Employee unions, electric utilities, public health proponents, equity advocates, environmentalists, veterans groups, and others are aligned behind the values associated with the electrification of transportation.[88]

> *"Electric vehicles will help us clean our air, create more jobs and reduce our dependence on foreign oil."*
>
> *– Washington State Governor Jay Inslee*

This range of potential support also points to a near term challenge, and opportunity, for the market transformation work needed. Plug In America's research found that no one organization in today's policy landscape across the United States currently provides a ready meeting place for such a spectrum of interests.[89] As new interest groups emerge promoting a particular PEV perspective, risk grows that this early window of broad support could get lost in unnecessary politicization of the issues. Respondents noted that electrification opponents have been actively engaged in encouraging that politicization.[90]

This consideration spotlights the need to leverage background support using entities that are PEV-knowledgeable, but not otherwise politically engaged. Capitalizing on the opportunity afforded by PEVs in the years ahead requires harnessing the collective political clout of the entire range of PEV stakeholders. This combined strength could grow to unprecedented significance as the number of PEV drivers grows to include supporters from every part of the country. Respondents noted that developing this nascent political potential could be hugely beneficial to later policy work on a host of sustainable-energy issues.[91]

RECOMMENDATION

Establish a national PEV umbrella organization where the full range of stakeholder perspectives are represented. Modeled after California's Plug-In Electric Vehicle Collaborative (PEVC), it would serve as a meeting place for sharing latest developments affecting the marketplace and be a mechanism for bringing all states to parity on PEV knowledge. The focus would be on best practices. Like the California PEV Collaborative, the organization would not engage in lobbying.

RECOMMENDATION

A second national PEV organization should be established to focus on PEV policy and legislative advocacy. This new "Electric Vehicle Alliance" would work to unify today's policy patchwork across the states with the goal of expanding vehicle availability and stimulating market growth nationwide.

#10 Experienced PEV drivers are the best evangelists

Respondents pointed to the significant role current PEV drivers play in introducing newcomers to the cars. The makeup of PEV drivers is currently poorly understood, but there is general agreement they are higher income, technologically savvy, well connected within their communities, and representative of the entire US political spectrum.

New PEV drivers clearly have a role to play in promoting the vehicles to others. Word-of-mouth validation for the cars is the most important marketing tool available.[92] Drivers have taken to street corners and online forums to advocate for the proliferation of PEVs. To date, consumer-based promotion efforts have relied almost entirely on volunteers, yet most agree that their work has been hugely successful.

National Plug In Day event, Burlington, VT. Photo credit: State of Vermont.

Presented by Plug In America, the Electric Auto Association, and Sierra Club, National Drive Electric Week (originally known as National Plug In Day) grew in 2014 to include events in 152 cities, reaching over 90,000 consumers. This growth and success has been achieved almost exclusively using volunteer supporters and PEV drivers.

PEV drivers also regularly blunt inaccurate reporting from leading publications. A notable example was the uproar over a 2013 *The New York Times* article purportedly misrepresenting the range of the Tesla Model S experienced by one of its reporters when he took the car on a road trip from Washington, DC to Boston. Model S owners, and Tesla CEO Elon Musk, took the paper to task for grossly mismanaging charge stops, not to mention not following the recommendations laid out in the car's instruction manual.[93] Similarly, drivers are quick to enter comments online following articles that fail to make fair comparisons between PEV and ICE vehicles regarding total cost of operation and true "well to wheels" environmental impact.

RECOMMENDATION

The real-world experience of drivers must be more systematically captured and disseminated as validated evidence to assist decision makers in weighing consumer and public interest issues related to PEVs. Automakers and charging infrastructure providers should openly share relevant focus-group data gleaned from customers. Academic and other research entities should solicit the input of experts from well-qualified PEV advocacy organizations to assist them in designing higher quality surveys to better inform policymakers and decisionmakers intent on promoting the growth of the PEV sector.

Philanthropy Icon to Come

#11 Philanthropic foundations need to take a more active role

Given the careful public-interest balancing required to gather the right technical, policy, and outreach support for PEVs, a number of stakeholders interviewed for this report suggested that philanthropic organizations can play an unmatched, perhaps even crucial, role in catalyzing PEV acceleration in the years ahead. No other actor, corporate, government, or NGO, has the capacity to develop the deep strategic sensibility about the needs of the vehicle electrification effort, and follow that up with targeted assistance aimed at achieving specific deployment goals.

At first glance, the notion of supporting efforts that essentially promote vehicle sales might appear like a poor match for philanthropy, particularly given that the cars are being sold by some of the world's largest for-profit companies. However, a closer examination of PEVs and their relationship to the traditional business model for these companies (built around selling gasoline-powered vehicles) reveals that electrification of transportation might not grow at a fast enough pace unless philanthropic foundations take a more active role.

Once PEV category awareness, enabling policy, and technical work have advanced sufficiently, philanthropists should reasonably expect that the market itself will drive PEV adoption toward broader deployment goals. Philanthropy can play a vital role during the still sensitive early market acceleration. After this phase, the market should be strong enough to carry the electric vehicle deployment effort on its own.

RECOMMENDATION

The foundations that have so far made the connection between their particular strategic goals and the profound ability of PEVs to further those goals must use their resources to fill the promotional gaps in pubic policy and corporate marketing shortcomings exposed elsewhere in this report. They must use their influence in the philanthropic space to educate and stimulate other foundations to do the same.

List of Terms

Battery electric vehicle (BEV) – Any vehicle that operates exclusively on power from the electric grid that is stored in the vehicle's batteries.

Charger – *see electric vehicle charger.*

Charging station – *see electric vehicle charging station.*

Charging system – *see electric vehicle charging system.*

Electric vehicle (EV) – A generic term used throughout this report to refer to battery electric vehicles (BEVs), plug-in electric vehicles (PEVs), plug-in hybrid electric vehicles (PHEVs), neighborhood electric vehicles (NEVs), and electric motorcycles.

Electric vehicle charger – An electrical appliance designed specifically to charge batteries within one or more electric vehicles. A dual charger is one that can charge two vehicles simultaneously. Charger styles include pedestal and wall or pole-mounted.

Electric vehicle charging station (EVCS) – A public or private parking space that is equipped with and served by a charger that has as its primary purpose the transfer of electrical energy to a battery or other energy storage device in an electric vehicle. A complete charging station includes appropriate signage, and may include other features, such as pavement markings, bollards, wheel stops, etc.

Electric vehicle charging system – The complete EV charging installation at a public or commercial site, consisting of one or more charging stations, communications, directional signage, and an operating plan that covers usage, maintenance, data collection, and billing (as appropriate).

Electric vehicle supply equipment (EVSE) – The equipment necessary on the premises to support the charging of an electric vehicle.

Extended range electric vehicle (EREV) – A plug-in hybrid with a built-in range extender unit, which is a gasoline powered internal combustion engine. Examples are the Chevy Volt and the BMW i3 (with the optional range extender).

internal combustion engine (ICE) – Engines that burn gasoline or other fuel for energy, found in every conventional vehicle (including hybrids) today.

Kilowatt – A unit of power (rate of energy use), equal to 1,000 watts.

Kilowatt-hour – A unit of electrical energy equal to consuming 1,000 watts for one hour.

Miles per gallon equivalent (MPGe) – A measure of the average distance traveled per unit of energy consumed. Used by the Environmental Protection Agency (EPA) to compare energy consumption of EVs with the fuel economy of conventional ICE vehicles.

Plug-in electric vehicle (PEV) – A generic term used throughout this report to refer to either a battery electric vehicle (BEV) or a plug-in hybrid electric vehicle (PHEV).

Plug-in hybrid electric vehicle (PHEV) – A vehicle that uses electricity from the grid as an energy source, along with another fuel, such as gasoline. Examples include the Chevy Volt and Toyota Plug-in Prius.

Zero emission vehicle (ZEV) – A vehicle that does not produce any tailpipe emissions. A BEV would qualify, but a PHEV would not.

ELECTRIC VEHICLE CHARGING LEVELS

LEVEL 1 (L1) refers to charging at 120V. This can be from an ordinary outlet using a portable charging device or from a dedicated Level 1 station that has the proper electronics and plug to connect directly to a plug-in electric vehicle. Current draw is generally limited to 12A, which yields 1.44 kilowatts (kW) rate of charge.

LEVEL 2 (L2) refers to charging at higher voltage, 208V to 240V. The current limit for these stations is typically 30 to 32 amps (~7 kW), but can be anything from 15A to 80A (up to 19.2 kW). A ChargePoint/Coulomb Level 2 Charging Station is shown to the right.

DC FAST CHARGE This charging method uses specialized high-power equipment which delivers high voltage DC (300V to 400V) current directly to the battery. Charging is controlled by the vehicle, at rates between 20 and 130 kW. To the right, a Blink DC Fast Charge Station; photo by ECOtality.

For more information about electric vehicle charging levels, visit pluginamerica.org, Understanding Electric Vehicle Charging

Acronyms

AC – Alternating Current

AFV – Alternative Fuel Vehicle

ARRA – American Recovery and Reinvestment Act of 2009

BEV – Battery Electric Vehicle

CARB – California Air Resources Board

CBO – Congressional Budget Office

CNG – Compressed Natural Gas

DC – Direct Current (used in DC fast charging)

DOD – Department of Defense

DOE – Department of Energy

DOT – Department of Transportation

EAA – Electric Auto Association

EDTA – Electric Drive Transportation Association

EPA – Environmental Protection Agency

EREV – Extended Range Electric Vehicle

EV – Electric Vehicle

EVSE – Electric Vehicle Supply Equipment

e-VMT – Electric Vehicle Miles Traveled

FHWA – Federal Highway Administration

GE – General Electric

GHG – Greenhouse Gas

HOT – High Occupancy Toll

HOV – High Occupancy Vehicle

ICE – Internal Combustion Engine

kW – Kilowatt

kWh – Kilowatt-hour

L1 – Level 1 (charging)

L2 – Level 2 (charging)

MOU – Memorandum of Understanding

MUD – Multiple Unit Dwelling

NCSL – National Conference of State Legislatures

NDEW – National Drive Electric Week

NGO – Non-governmental Organization

ODOT – Oregon Department of Transportation

PEV – Plug-in Electric Vehicle

PEVC – Plug-in Electric Vehicle Collaborative

PHEV – Plug-in Hybrid Electric Vehicle

ppm – Parts Per Million

SAFE – Securing America's Future Energy

V2G – Vehicle to Grid

VMT – Vehicle Miles Traveled

WSDOT – Washington State Department of Transportation

ZEV – Zero Emission Vehicle

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