



Research Report

Electric Vehicles: Ten Predictions for 2012

Published 4Q 2011

Published in partnership with:

plugin**cars.com**

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Section 1

INTRODUCTION

The range of choices in plug-in electric vehicles (including both battery electric vehicles and plug-in hybrids) will become more diversified in 2012 with the introduction of the Toyota Prius Plug-in Hybrid, the Ford Focus EV, the Tesla Model S, the Volvo V-70, and others. These new vehicles expand the options for consumers by providing a variety of styles and all-electric driving ranges. With new and retooled assembly lines finishing vehicles as close to full production as possible and vehicles available in most major metropolitan areas, the global market for plug-in electric vehicles (PEVs) will grow to more than a quarter million vehicles in 2012.

However, throughout 2012, electric vehicle (EV) and battery manufacturers in the United States will continue to face scrutiny due to the “Solyndra Effect.” That is, clean technology companies that have received federal funding will remain under the media microscope. Several automakers will fail to meet their sales targets, and by the end of the year it will become clear that the Obama administration’s goal of 1 million PEVs on American roads by 2015 is unreachable. Meanwhile, the auto industry will work to overcome the perception that PEVs are less safe than internal combustion engine (ICE) vehicles. The Volt fires that occurred during a National Highway Traffic Safety Administration (NHTSA) test in 2011 created a stumbling block in terms of support for PEVs. Indeed, one of the biggest challenges for the industry is consumer understanding of the capabilities of EVs.

Many consumers do not understand the differences between hybrids and plug-in vehicles and their assumptions about key differences from ICEs, such as expected maintenance cost, are often ill-informed. Educational marketing will be part of the focus for many EV makers throughout 2012. Consumers will be disappointed by the higher price tag of EVs, and many price-sensitive potential customers will wait for price reductions before considering an EV purchase.

Regionally, groups supporting the introduction of EVs will be tracking sales to prepare for the impact on the power grid and to plan for the installation of sufficient EV charging infrastructure. These areas, including the 14 cities participating in the Clinton Climate Initiative’s Electric Vehicle Network and 16 Clean Cities public-private partnerships in the United States, will be center stage in 2012 in terms of building awareness of and integrating EVs. The United States will also see the last of the electric vehicle supply equipment (EVSE) funded by Department of Energy grants installed.

The Asia Pacific region will continue to lead the world in the sales of EVs. China and Japan will be early leaders in the adoption of vehicle-to-grid (V2G) technologies, as well as in propelling fuel cell vehicles (FCVs) closer to their planned commercialization in 2015. In this white paper, Pike Research discusses our predictions for ten influential trends in the EV industry to watch for 2012.

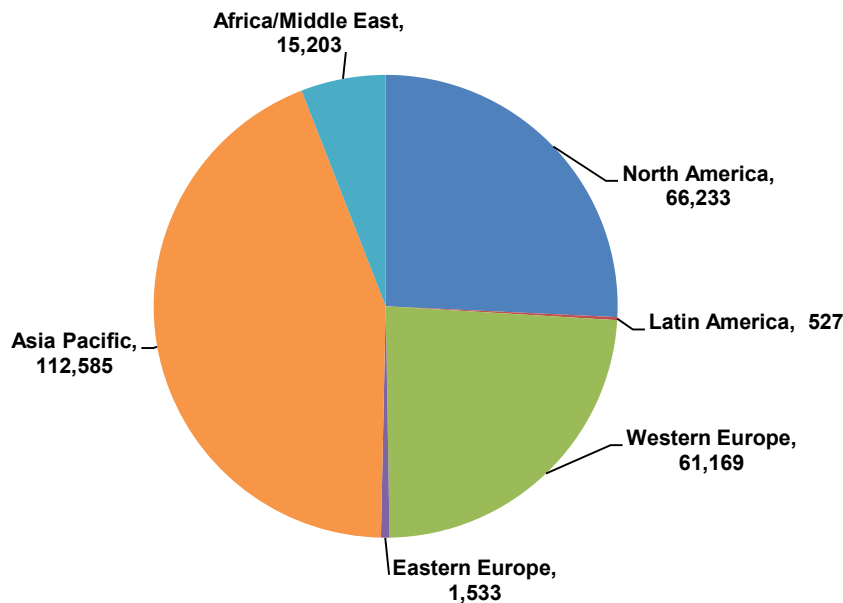
Section 2

ELECTRIC VEHICLES: TEN PREDICTIONS FOR 2012

1. **The global availability and increasing sales of EVs will put an end to the “are they for real?” speculation.**

Back in 2009, Pike Research said that the year 2012 would be a “make or break” year for EVs as they transition from limited availability (both in volume and geography) to a viable transportation option for consumers everywhere. We are standing by that prediction. Despite a slower-than-expected start in EV sales, 2012 will likely see sufficient expansion in model selections and global availability of electrified vehicles to establish the category’s permanency. During 2012, Pike Research estimates that global PEV sales will surpass 257,000 units.

Chart 2.1 *Light-Duty PEV Sales, World Markets: 2012*



(Source: Pike Research)

During 2012, the arrival of the first commercial PEVs from automotive stalwarts BMW, Ford, Honda, Toyota, and Volvo, plus newcomers Coda and Fisker, will provide a greater variety of vehicle choices to more parts of the world. Another dozen or more models will be announced during the year, providing that there are no u-turns on the road to vehicle electrification. The PEV manufacturers already in production will have availability in volume throughout most major automotive markets, though countries in Latin America and Africa will see fewer options. In 2013, the question will be, “Remember when we doubted if EVs were for real?”

2. Car sharing services will expand the market for EVs and hybrids.

Car sharing is one of the hottest trends in transportation, with startups and established rental companies launching commercial and peer-to-peer services. Services that enable renting per hour and on demand fit well with EVs because the higher upfront cost of the vehicles can be recovered through higher rates paid for short-term rentals. PEVs can avoid the fees and restrictions that many cities are imposing on emissions from transportation. EVs also tend to be smaller vehicles that are easier to park in the urban areas that car sharing services are targeting.

Table 2.1 Car Sharing Services Offering EVs to Rent

Autolib	Avis
Cambio	Car2Go
City Car Share	Enterprise
Hertz	Mobility
RelayRides	ZipCar

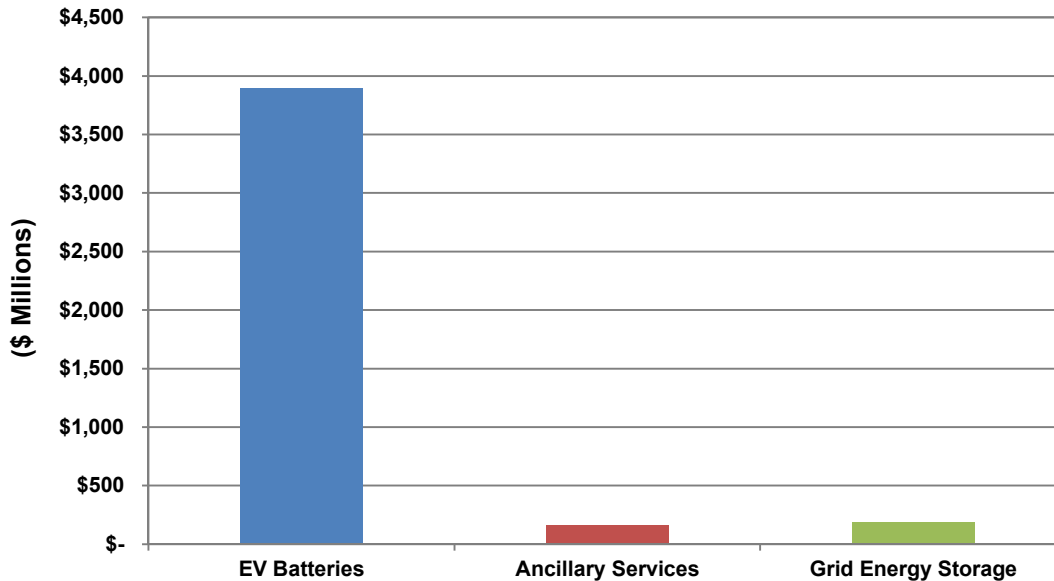
(Source: Pike Research)

Car sharing services that are focusing on appealing to young, environmentally oriented urbanites are beginning to integrate EVs into their fleets. Most of the major car sharing services will have at least one model of EV in their fleets by the end of 2012. Automakers looking to maximize the visibility of the limited number of vehicles during their rollouts are making vehicles available to car sharing and car rental agencies in the hopes that a few hours behind the wheel of an EV will encourage some folks to become EV buyers. Mass purchases from rental (and other) fleets will also help automakers in their march towards increased production. Individuals who are eschewing vehicle ownership for environmental reasons will be more likely to rent an EV than a gas-powered car when they do need the temporary use of a vehicle.

3. **Battery production will get ahead of vehicle production.**

Manufacturers of lithium ion batteries in the United States spent 2011 readying new and established factories for the expected surge in PEV sales. The 2009 American Recovery and Reinvestment Act provided funding for scaling up production so that the United States can compete with Japan, Korea, and China in EV batteries. Most of the award recipients (including Saft, EnerDel, Johnson Controls, LG Chem, and Dow Kokam) have their facilities fully online and ready to produce.

Chart 2.2 Lithium Ion Battery Revenue, United States: 2012



(Source: Pike Research)

However, PEV sales have trailed expectations, largely due to delays in model launches and the limited availability of vehicles since manufacturers are restricting vehicle sales to specific regions. If PEV sales do not accelerate to match the forecast levels for 2012, a potential glut in batteries could occur during the year, which would likely reduce the cost of batteries as manufacturers seek to unload excess inventory. Some battery manufacturers are already starting to feel the pinch of excess production. Some of these batteries could be redirected toward the smaller grid energy storage and ancillary services market, which is also expected to see considerable growth during 2012.

4. **Road tax legislation in the United States that will require PEV owner contributions will fail.**

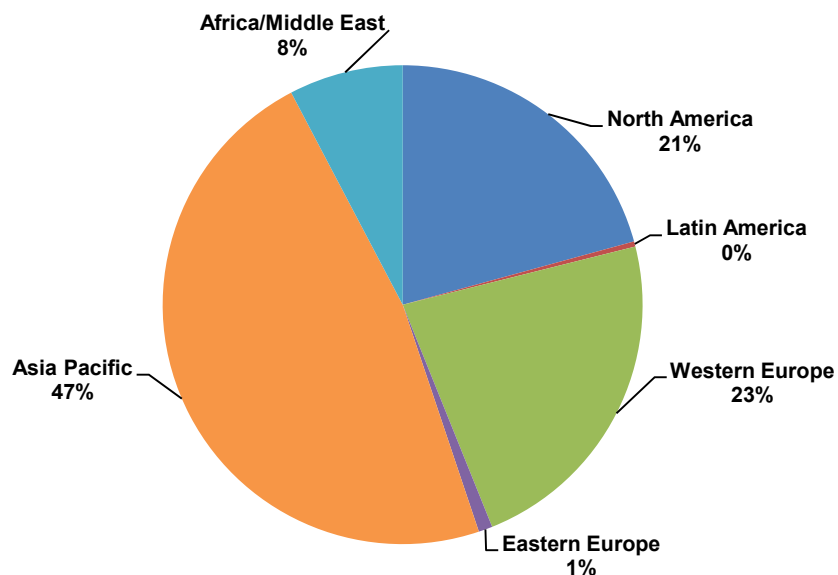
Funding for road maintenance is in a dire condition in nearly every state. The federal Highway Trust Fund, which provides much of the money, is nearly broke. Revenue from gas taxes has been shrinking due to increases in fuel economy and vehicle electrification that reduces the fuel per mile traveled. Some states, including Oregon, Hawaii, Colorado, and others, began exploring a vehicle miles traveled (VMT) tax as early as 2007. Such a tax targets hybrids and EVs that do not pay their “fair share” for use of the roads. Several of these plans are similar to VMT schemes currently used in Europe.

The VMT pilot projects in the United States have helped to spawn the introduction of bills in several state legislatures, but these bills have thus far proven unpopular with the public. While the need to raise revenue makes some form of new tax inevitable, tracking vehicles for the miles they use (because it could include sensitive GPS data) is as much of a third rail for privacy reasons as an increase in the overall gas tax is for political reasons. We can expect several of these bills to go to a vote in 2012, but the chances of passage are slim. Another approach would be to assess an annual road tax as part of the registration tax on all vehicles to make up the difference. A yearly fee based on average vehicle usage that *also adjusts for* greenhouse gas emissions would be more palatable to EV owners.

5. The Asia Pacific region will become the early leader in vehicle-to-grid (V2G).

The market for vehicles that can provide power to a building or the grid will be in its infancy in 2012 and will be driven primarily by fleets that can derive the most value from a vehicle's battery. Asia Pacific (47% global share in 2012) will dominate this market because the higher penetration of PEVs in the region will create a sufficient amount of power potential for the grid. China, where the grid is less reliable than in other regions and which will see increasing power demand, has a strong need for ancillary services via energy storage devices such as batteries.

Chart 2.3 V2G-Enabled Vehicle Sales, World Markets: 2012



(Source: Pike Research)

Japan will be the early leader in the vehicle-to-building (V2B) subcategory thanks largely to interest from the country's automotive industry. In the wake of the tsunami and earthquake in Japan in the spring of 2011, Nissan and Mitsubishi decided to offer equipment that would enable vehicles to provide power to a building in emergency situations when the grid is unavailable. Nissan's commitment to V2G is global, as the company has partnered with GE to collaborate of V2G technology development.

6. PEV prices will continue to disappoint (and exclude) many consumers.

Many potential EV buyers were disappointed that Nissan raised the price of the Leaf for 2012. While the Chevrolet Volt will sell for \$1,000 less, the car comes without several features that were standard but consumers now must pay for as options. According to data from Pike Research's annual *Electric Vehicle Consumer Survey*, the optimal price for a PEV to engage consumers is \$23,750. With the 2012 Toyota Prius PHEV (\$32,000), the Honda Fit BEV (\$36,625), and the Ford Focus EV (\$39,995) all north of \$30,000 (before federal incentives), consumers hoping for an affordable EV ride have been left wanting.

Pike Research does not expect this trend to stop with any other PEVs that are announced in 2012. The vehicles on sale in 2012 will not benefit from recent cost reductions in batteries or from the potential for a short-term battery glut (see prediction 3 above) in 2012. The batteries in these vehicles were ordered before 2012, so any flexibility in reducing vehicle pricing will not occur until 2013 or 2014 at the earliest. Automakers are recouping the huge investments in R&D and retooling the plants to assemble these new technology vehicles. Thus, charging more to the early adopters is not unexpected.

7. Third-party EV charging companies will dominate public charging sales.

Commercial entities looking to offer EV charging at their locations can choose between purchasing the equipment and maintaining and managing any revenue flow themselves, or partnering with an EVSE service company to handle some or all of the details. Companies that choose to keep the equipment largely under their own control have the advantage of setting the fee structure or giving away charging for free if the goal is to attract customers.

EVSE service companies such as 350 Green, Car Charging Group, and Plug-in Vehicle Solutions offer an intriguing alternative by assuming the capital cost (and risk). While the property owners may have to pay for the installation of the equipment, these companies handle the maintenance and set up the fee structure for customer charging. This path of least resistance is a rapidly growing trend, with companies such as Wal-Mart, Icon Parking, and Simon Property Group electing to partner with an EVSE service company. During 2012, it is likely that these companies will install more units than any other equipment provider.

However, this model also presents a risk. The EVSE service companies' business models depend on rapid growth in signing up customers and creating revenue from their locations to offset the considerable capital and operating costs. Should revenue not keep up, properties could find themselves with equipment that they cannot or do not want to maintain.

8. Germany, South Korea, and Japan will see the most progress toward the commercialization of FCVs and rollout of hydrogen infrastructure in 2012.

Automakers continue to say 2015 will mark the start of commercial FCV rollout. Germany, South Korea, and Japan are making the most progress toward hitting that target. In Germany, the increased development of fuel cells and hydrogen (both mobile and stationary applications) has been reinforced by the government's initiative to shut down nuclear power plants and increase renewables. Hydrogen is being promoted for energy storage.

The South Korean government, Hyundai-Kia, and oil and gas companies are jointly investing \$100 million annually in fuel cell and hydrogen infrastructure research. In late 2011, Hyundai delivered four FCVs to the European Commission's Fuel Cells and Hydrogen Joint Undertaking. The company is also participating in German and

Scandinavian deployment schemes, which reaffirms the sense that Europe is an early target for FCVs.

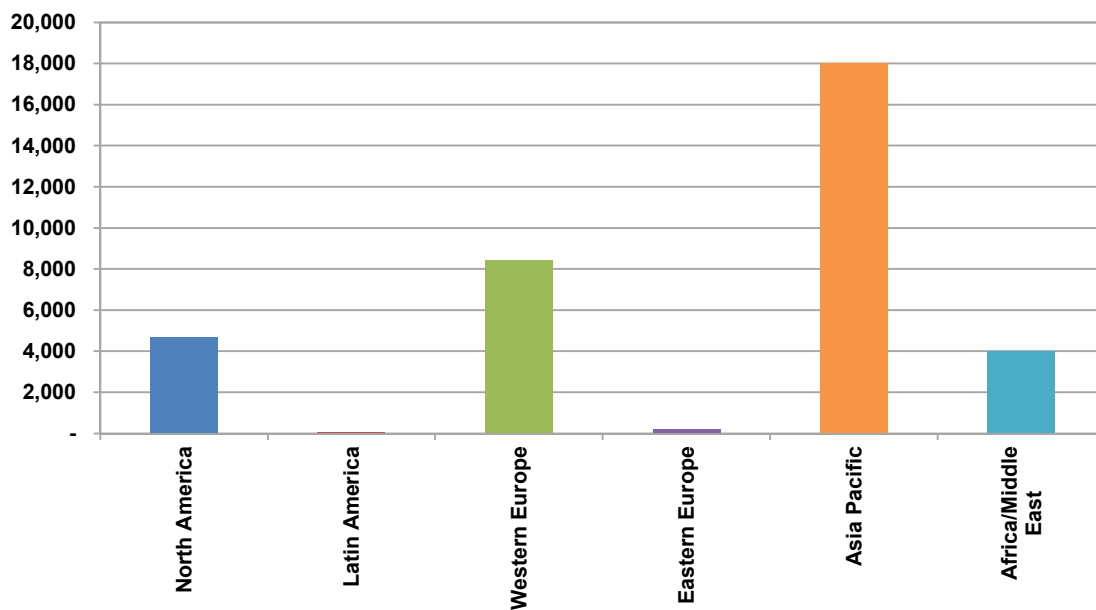
In Japan, FCVs are part of the government’s fuel cell commercialization roadmap for 2011-2014 for validating the technology and building out infrastructure ahead of commercialization. Nissan recently announced a third-generation fuel cell stack that the company claims more than doubles the energy density while reducing the amount of platinum required.

By contrast, in the United States, the DOE’s shift away from fuel cells and toward plug-ins and hybrids has contributed to uncertainty around the fuel cell car market. While the ultimate goal across the globe is commercialization of FCVs by 2015, Pike Research expects more news from outside the United States in the near term.

9. Employers will begin to purchase EV chargers in large numbers.

Employers looking to attract and retain young professionals will begin to offer free or low-cost EV charging at work in 2012. Workplace charging can effectively double the range of a BEV when employees know that they can reliably charge at the office. The average workday provides more than enough time for a Level 2 EV charger to fully replenish a BEV’s battery pack, and several PHEVs could share a charger during the workday. Wireless charging is also set to get “real world” tests through increased workplace charging partnerships.

Chart 2.4 Workplace EVSE Sales, World Markets: 2012



(Source: Pike Research)

In the United States, companies such as Adobe, SAP, and Google have already installed dozens of chargers, and 2012 will see hundreds of global companies following suit. The Asia Pacific region, with its huge office towers and dense population in cities such as Seoul, Tokyo, and Beijing, will lead the world in workplace charging installations during the year with 18,000 charging stations. Some employers will use the charging equipment and

vehicle batteries to earn revenue from demand response and other ancillary services, a win-win situation for the company and the employees.

10. EVs will begin to function as home appliances.

In many households, the EV will be the device that consumes the most energy and power. In 2012, manufacturers of the vehicles – as well as charging equipment – will introduce technology that will enable EVs to interact with other home appliances. Automakers want EVs to be good “citizens” in balancing their energy requirement with the rest of the building, which requires establishing communications with smart meters, home energy management devices, and other types of appliances.

In 2011, Ford, GM, Audi, BMW, Daimler, Porsche, and Volkswagen agreed to support the HomePlug Green PHY communications standard, which will allow information about charging requirements to be passed over the powerline so that it can be shared with home devices. The HomePlug Green PHY specification is an internationally supported standard that enables smart grid devices to communicate via powerline. For example, an EV could coordinate with the clothes dryer or pool pump to make sure that the power consumption doesn't surpass a certain threshold. Other long-term applications could include downloading music or movies to the vehicle. The first vehicles demonstrating this capability will likely be out in 2012, with commercialization soon to follow.

Section 3

ADDITIONAL READING

Vehicle to Grid Technologies

V2G Applications for Demand Response, Vehicle to Building, Frequency Regulation, and Other Ancillary Services: Market Analysis and Forecasts

<http://www.pikeresearch.com/research/vehicle-to-grid-technologies>

Electric Vehicle Batteries

Lithium Ion Batteries for Hybrid, Plug-in Hybrid, and Battery Electric Vehicles: Market Analysis and Forecasts

<http://www.pikeresearch.com/research/electric-vehicle-batteries>

Electric Vehicle Charging Equipment

Level 1 and Level 2, DC Fast Charging (CHAdeMO), and Wireless EVSE: Market Analysis and Forecasts

<http://www.pikeresearch.com/research/electric-vehicle-charging-equipment>

Electric Vehicle Market Forecasts

Global Forecasts for Light-Duty Hybrid, Plug-in Hybrid, and Battery Electric Vehicles: 2011-2017

<http://www.pikeresearch.com/research/electric-vehicle-market-forecasts>

Fuel Cell Vehicles

Passenger Vehicles, Medium and Heavy Duty Trucks, Transit Buses, Hydrogen ICEs, and Fueling

<http://www.pikeresearch.com/research/fuel-cell-vehicles>

Energy Storage Systems for Ancillary Services

Frequency Regulation, Voltage Support, Short Duration Renewables Integration, Spinning Reserves, Electric Supply Reserve Capacity, and Load Following: Market Analysis and Forecasts

<http://www.pikeresearch.com/research/energy-storage-systems-for-ancillary-services>

Energy Storage on the Grid

Long Duration Energy Storage Systems: Compressed Air, Pumped Storage, NaS Batteries, Hydrogen Storage, Flow Batteries, and Lithium Ion Batteries for Utility-Scale Storage

<http://www.pikeresearch.com/research/energy-storage-on-the-grid>

Section 4

ACRONYM AND ABBREVIATION LIST

Battery Electric Vehicle	BEV
Electric Vehicle Supply Equipment	EVSE
Electric Vehicle.....	EV
Fuel Cell Vehicle	FCV
General Electric.....	GE
Internal Combustion Engine.....	ICE
National Highway Traffic Safety Administration	NHTSA
Plug-in Electric Vehicle	PEV
Plug-in Hybrid Electric Vehicle	PHEV
Research and Development.....	R&D
U.S. Department of Energy	DOE
Vehicle Miles Traveled	VMT
Vehicle-to-Building	V2B
Vehicle-to-Grid	V2G

Section 5

TABLE OF CONTENTS

Section 1	1
Introduction	1
Section 2	2
Electric Vehicles: Ten Predictions for 2012	2
1. The global availability and increasing sales of EVs will put an end to the “are they for real?” speculation.	2
2. Car sharing services will expand the market for EVs and hybrids.	3
3. Battery production will get ahead of vehicle production.	4
4. Road tax legislation in the United States that will require PEV owner contributions will fail.	4
5. The Asia Pacific region will become the early leader in vehicle-to-grid (V2G).	5
6. PEV prices will continue to disappoint (and exclude) many consumers.	6
7. Third-party EV charging companies will dominate public charging sales.	6
8. Germany, South Korea, and Japan will see the most progress toward the commercialization of FCVs and rollout of hydrogen infrastructure in 2012.	6
9. Employers will begin to purchase EV chargers in large numbers.	7
10. EVs will begin to function as home appliances.	8
Section 3	9
Additional Reading	9
Section 4	10
Acronym and Abbreviation List	10
Section 5	11
Table of Contents	11
Section 6	12
Table of Charts and Figures	12
Section 7	13
Sources and Methodology	13
Notes	13

Section 6

TABLE OF CHARTS AND FIGURES

Chart 2.1	Light-Duty PEV Sales, World Markets: 2012	2
Chart 2.2	Lithium Ion Battery Revenue, United States: 2012	4
Chart 2.3	V2G-Enabled Vehicle Sales, World Markets: 2012.....	5
Chart 2.4	Workplace EVSE Sales, World Markets: 2012	7
Table 2.1	Car Sharing Services Offering EVs to Rent	3

Section 7

SOURCES AND METHODOLOGY

Pike Research's industry analysts utilize a variety of research sources in preparing Research Reports. The key component of Pike Research's analysis is primary research gained from phone and in-person interviews with industry leaders including executives, engineers, and marketing professionals. Analysts are diligent in ensuring that they speak with representatives from every part of the value chain, including but not limited to technology companies, utilities and other service providers, industry associations, government agencies, and the investment community.

Additional analysis includes secondary research conducted by Pike Research's analysts and the firm's staff of research assistants. Where applicable, all secondary research sources are appropriately cited within this report.

These primary and secondary research sources, combined with the analyst's industry expertise, are synthesized into the qualitative and quantitative analysis presented in Pike Research's reports. Great care is taken in making sure that all analysis is well-supported by facts, but where the facts are unknown and assumptions must be made, analysts document their assumptions and are prepared to explain their methodology, both within the body of a report and in direct conversations with clients.

Pike Research is an independent market research firm whose goal is to present an objective, unbiased view of market opportunities within its coverage areas. The firm is not beholden to any special interests and is thus able to offer clear, actionable advice to help clients succeed in the industry, unfettered by technology hype, political agendas, or emotional factors that are inherent in cleantech markets.

NOTES

CAGR refers to compound average annual growth rate, using the formula:

$$\text{CAGR} = (\text{End Year Value} \div \text{Start Year Value})^{(1/\text{steps})} - 1.$$

CAGRs presented in the tables are for the entire timeframe in the title. Where data for fewer years are given, the CAGR is for the range presented. Where relevant, CAGRs for shorter timeframes may be given as well.

Figures are based on the best estimates available at the time of calculation. Annual revenues, shipments, and sales are based on end-of-year figures unless otherwise noted. All values are expressed in year 2011 U.S. dollars unless otherwise noted. Percentages may not add up to 100 due to rounding.

Published 4Q 2011

© 2011 Pike Research LLC
1320 Pearl Street, Suite 300
Boulder, CO 80302 USA
Tel: +1 303.997.7609
<http://www.pikeresearch.com>

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