



## RESEARCH REPORT

# Electric Vehicles: 10 Predictions for 2013

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## Section 1

### INTRODUCTION

If 2012 was the year when the plug-in electric vehicle (PEV) industry shifted from neutral to first gear, then the industry will be racing ahead in second gear in 2013. As Pike Research predicted last year, during 2012 the doubts about the long-term viability of the PEV market were put to rest. Sales of PEVs in 2013 will continue to outpace the first years of hybrid vehicle sales as more than 210,000 PEVs will be sold globally and more than three dozen PEV models will debut. Consumers will have a much greater variety in vehicle types and in all-electric range, while consumer familiarity with the capabilities of the segment will also greatly increase.

California will continue to drive PEV sales in the United States as purchases will expand into smaller urban and suburban regions with more dealers beginning to offer the vehicles. In China, the PEV market will begin to reap the benefits of the many international automotive joint-ventures (JVs) that have developed during prior years. The industry will not be without its casualties and consolidation as several startup electric vehicle (EV) companies are likely to be absorbed or discontinue operations during the year.

Electric vehicle charging infrastructure, which is now accessible in many large cities in the developed world, provides a baseline of public charging to pacify anxious EV drivers and will be more frequently utilized in 2013. Increasingly detailed analytics about PEV sales and charging habits will be the basis for identifying the most suitable locations for public EV charging. This data will begin to offer value to vehicle manufacturers and utilities as the percentage of PEV sales in some cities will approach double digits.

Across the globe, government incentives for PEV manufacturing and charging infrastructure will trail off as many governments will not be able to justify funding incentives while they continue to cope with austerity measures. This reduction in government participation has led to lowered expectations for 2013 and beyond, which the industry is using as the basis for its decisions. More realistic goals will lead to greater satisfaction and a healthier and more mature industry. Pike Research identifies 10 influential trends that will propel the EV industry forward in 2013.

## Section 2

### **ELECTRIC VEHICLES: 10 PREDICTIONS FOR 2013**

#### **1. Capital Veers from Vehicles to Battery Components**

Private funding for the industry has largely dried up for EV companies looking to start a business or expand in 2013. Many of the automotive startups of the last few years are have failed or are floundering due to much lower than anticipated demand for EVs, and venture capitalists and private equity companies that were waiting for vehicle sales to ramp up have felt their patience wear thin. The lack of funding opportunities will force some companies to exit the market or be acquired on less than generous terms.

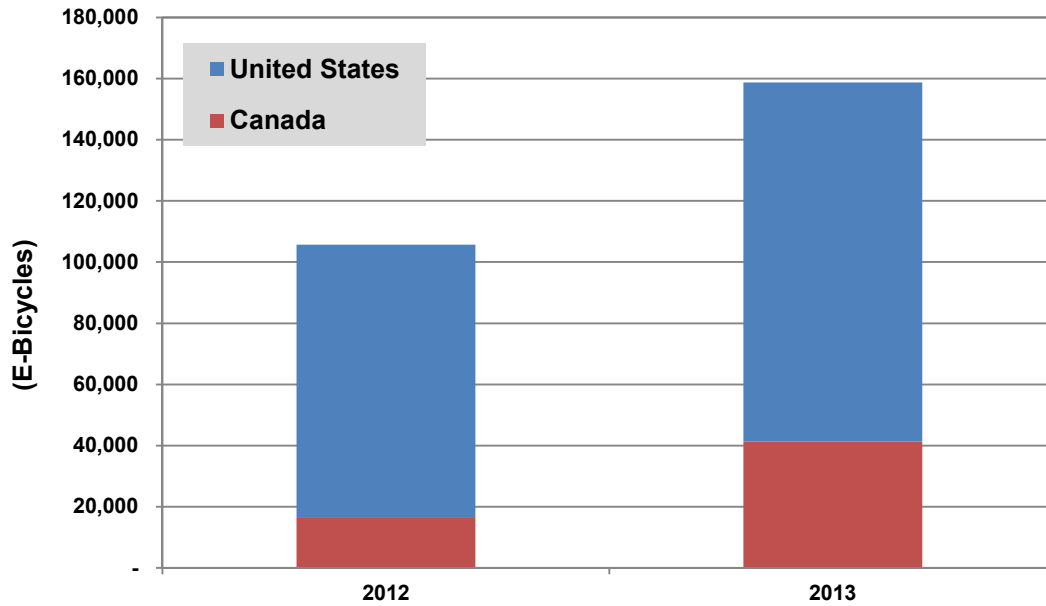
Investment in battery companies was robust during the past 4 years, but during 2013, investment will shift toward developing battery components, rather than companies that develop complete packs. Several battery pack companies fell on hard times in 2012, again due to high costs of production and underwhelming demand from the EV market. For 2013, chemical conglomerates, such as Dow Energy Materials and BASF, will continue to invest heavily in anode, cathode, and electrolyte material research and development (R&D). Established players will face increasing competition from smaller companies and the recent startups.

The EV battery industry continues to await commercially viable breakthroughs in energy and power density that could lead to a new level of performance. Nano-scale components and activated carbon will be among the more popular technologies in 2013, and will be used to raise additional funding and tout new plateaus of performance in private research facilities as well as in government and research laboratories.

#### **2. System Integration Puts Electric Bikes on the Map**

The number of brands offering e-bicycles has exploded in recent years, thanks in part to the maturation of the industry's supply chain. Component suppliers are partnering with either electric motor or battery manufacturers to provide complete drivetrains for comprehensive solutions that shorten the time for new bike manufacturers to come to market. This trend will continue to prompt sales of e-bikes in North America to grow by more than 50% in 2013 to more than 158,000 bikes. Globally, the e-bike market will grow by 10% to more than 33.6 million units during that year.

**Chart 2.1** *Electric Bicycle Sales, North America: 2012-2013*



(Source: Pike Research)

The e-scooter market may also see increased drivetrain solutions in the next year as that market continues to grow and new competitors look to improve quality and performance. The overcapacity in the battery market will likely send battery manufacturers looking for electric motor partners, so Pike Research expects to see several new agreements between these groups during 2013.

A similar trend is expected for e-motorcycles in 2013, but this market is likely to remain more customized. E-motorcycles are much more performance-oriented, with acceleration, top speed, and range all playing a critical part in the purchase decision. Large well-known motorcycle brands and the higher performance requirements of the vehicles indicate that, while some suppliers will likely offer complete drivetrain products in this market, the e-motorcycle original equipment manufacturers (OEMs) are less likely to gravitate toward a simplified solution.

**3. 48-Volt Batteries Put a Charge into Stop-Start Systems**

The stranglehold of the 12-volt battery over electrified vehicles will begin to slowly loosen in 2013 as these vehicles demand increasingly more power and reliability than the legacy energy storage system can provide. Automakers have been shifting subsystems from mechanical to electrical to make vehicles more fuel efficient, which are proving, in some applications, to be more than 12-volt architectures can handle.

Stop-start and micro-hybrid vehicles require greater reliability and charge acceptance from regenerative braking than some 12-volt batteries can provide. Several battery manufacturers including AllCell Technologies, Balqon, and Saft are stepping up with 48-volt lead-acid and

lithium ion (Li-ion) offerings. These higher power batteries will last longer and allow the hotel load systems, such as heating and cooling, to continue to operate when the engine is off without causing the all-too-familiar phenomenon of the headlights dimming due to insufficient power. These higher power batteries are also being introduced in electric bicycles, which should enable battery manufacturers to reduce manufacturing costs by producing in greater volumes.

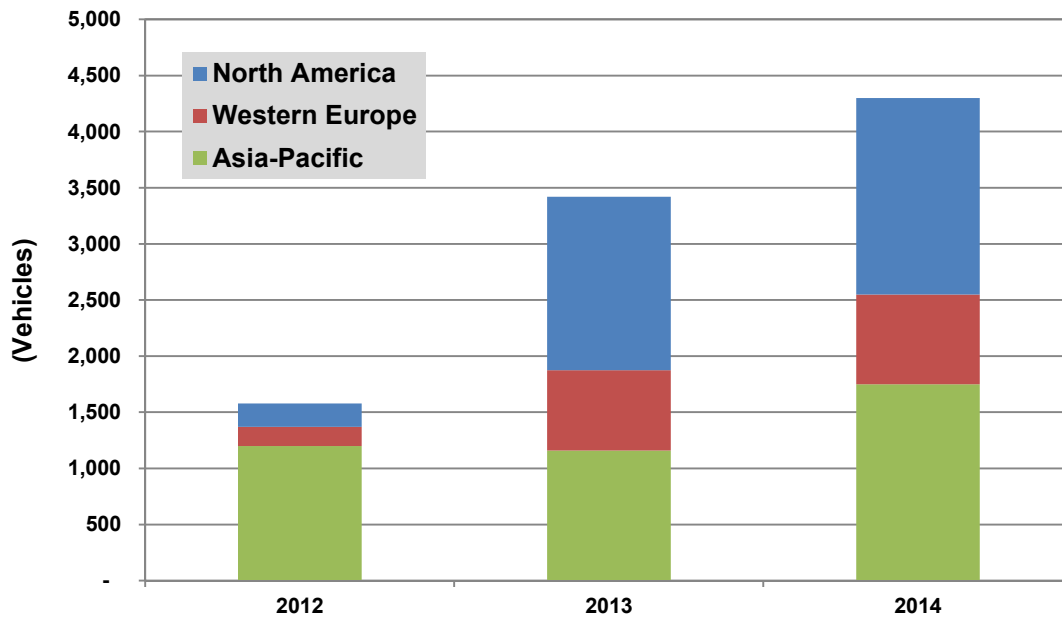
The idea of standardizing on higher voltage batteries was tried and failed more than a decade ago (42-volt batteries came and went), but at the time, converting all onboard electronics to the higher voltage was viewed as impractical, and the cost of DC-to-DC converters was prohibitive. Since then, the cost has come down and reliability of converters has improved. Automakers looking to comply with emissions regulations will squeeze more fuel economy out of their vehicles in 2013 by expanding the electrification of hybrid vehicle systems and Pike Research expects several to design vehicles to take advantage of 48-volt batteries.

#### **4. More than 3,400 Fuel Cell Vehicles Hit the Road**

The minority of automakers that have been investing more in fuel cell than in plug-in technology have responded to slower than anticipated PEV sales by reaffirming their commitment to commercializing fuel cell vehicles (FCVs). Pike Research projects that 3,442 FCVs will ship in 2013 from vendors that include Toyota, Daimler, Hyundai, and Honda.

In 2011, this cadre of FCV believers was committed to commercializing the technology by 2014 or 2015 and 2013 will see the first low-volume series production rollouts from Hyundai, Daimler, and Toyota. However, the majority of these vehicles will not reach consumers' hands. They will be deployed through agreements with fleets and made available to qualified participants in public trials.

**Chart 2.2 Fuel Cell Light Vehicle Pre-Commercial Deployments, World Markets: 2012-2014**



(Source: Pike Research)

During 2013, Pike Research anticipates an escalation of the announcements of the vehicle models used for the 2015 commercial introductions, as well as production quantity and price targets. A split will occur between OEMs that plan to target private and public fleets as an early market or those that will head straight for the mainstream passenger car market (more likely to be Honda and Toyota). Announcements about these higher levels of limited production are likely to be overhyped due to the progress, while simultaneously being criticized due to the slow pace of commercialization. In the United States, the thawing of the U.S. DOE's freeze-out of FCVs that occurred during the past few years will continue in 2013 with increased funding. However, the United States will not return to its global fuel cell leadership role.

**5. Battery Swapping Gives Way to Battery Financing**

Battery swapping pioneer Better Place hit a major roadblock in 2012 when many of its top executives departed, making 2013 a critical year for the company. Better Place has failed to capture the expected number of subscribers to its EV service in the initial launch market of Israel and borrowed money to continue the expensive build-out of battery swap stations in Denmark. The service provides lower cost vehicles (without the batteries) and customers pay subscription fees for access to battery swapping stations and charging equipment. This model assumes that several automakers will come on board to enable the cost of the infrastructure to be shared across many battery electric vehicle (BEV) owners, but so far, only Renault has designed its vehicle to be compatible with Better Place's battery swapping technology. Despite these considerable challenges, the battery swapping idea still has its proponents, such as Project Greenway in Slovakia, but the focus will shift from fleets to even more specialized applications, such as taxis. The concept will fade further into the rearview mirror in 2013. A

more diversified Better Place, with a greater emphasis on managing EV infrastructure and providing services to utilities and grid operators, is likely to emerge.

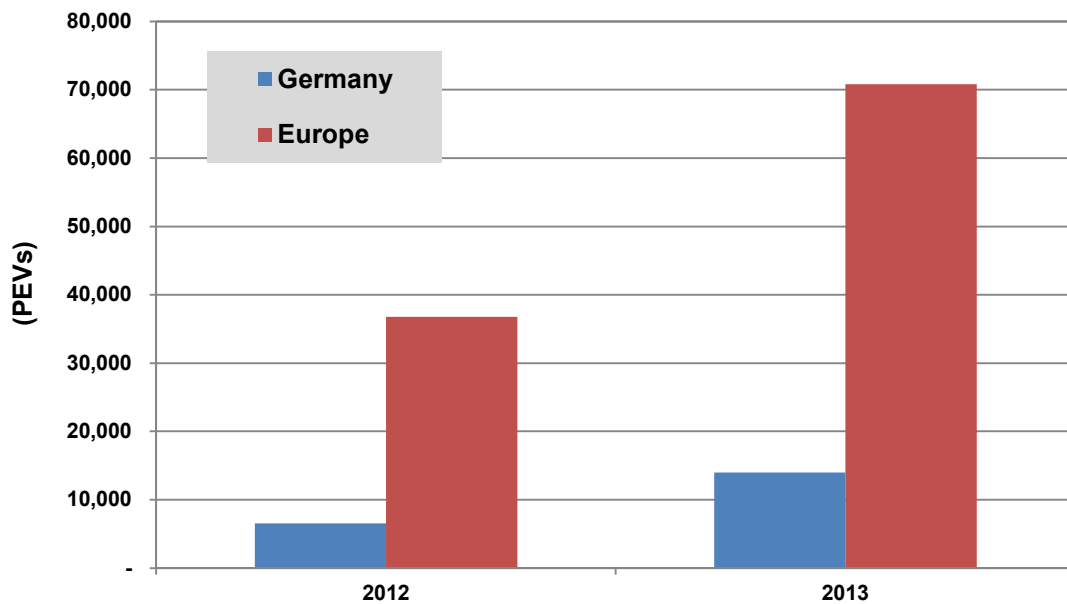
The idea of separating the vehicle and battery cost will grow in 2013 as more companies are likely to follow the lead of Renault and lease the batteries separately. A lease option greatly reduces the upfront cost of the vehicle, while also reducing the uncertainty of real-world battery performance. Corporations are much better equipped to repurpose end-of-life EV batteries than individuals and will be able to sell into the growing market for grid energy storage. Battery leasing has also been adopted by Mia Electric and Daimler in Europe, and will begin to spread to Asia Pacific and North America by the end of 2013.

**6. Germany Leads Europe’s PEV Growth**

Like other regions of the world, the European PEV market has developed more slowly than expected. The largest German automakers have trailed their counterparts in Japan and the United States in launching electrified vehicles, but in 2013, they will come to market with at least seven models that will energize sales throughout the continent.

Volkswagen will lead the pack with two VW-branded plug-in hybrid EVs (PHEVs) and two BEVs, while the company’s Audi division will launch two e-tron PHEVs. BMW will begin to sell its long awaited BEV (the i3). The arrival of these vehicles will help the German PEV market more than double in 2013 to reach nearly 14,000 vehicles. Overall, Western Europe’s PEV market will grow at a similar rate to reach nearly 70,000 vehicles, with Germany representing the largest single market.

**Chart 2.3 PEV Sales, Germany and Europe: 2012-2013**



(Source: Pike Research)

The German PEV market has also been slowed by disagreements over charging standards, but those differences are largely in the past. German and American OEMs have united behind the SAE's Combo Charger that enables both AC and faster DC charging through a single charge port, which reduces the manufacturing cost and simplifies plugging in for consumers. The momentum will continue with the combination of German OEMs more fully participating and PEVs from France, Sweden, the United Kingdom, and imports, which will drive Europe's PEV market past 200,000 units annually beginning in 2014.

#### **7. Coasting Technology Pushes Internal Combustion Engine Vehicles Closer to Hybrids**

Yet another technology that blurs the line between HEVs and conventional internal combustion engines (ICEs) will become popular in concept vehicles that will be showcased during 2013. Stop-start technology, which is now popular in Europe and spreading to all four corners of the globe, enables an ICE vehicle's engine to turn off when the brake is depressed and the car slows to a stop. That same concept is extending to enable an engine to be shut off when going downhill or at other times when the driver's foot comes off the accelerator, and then restarted as necessary; this is known as a fuel-efficient coasting technology.

According to early results from companies including Audi and BMW, coasting technology can reduce fuel consumption by as much as 10%. Coasting can be integrated with cruise control systems to further optimize fuel usage. Similar to stop-start systems upon which the technology builds, a more powerful starter-motor and battery pack are required, but the substantial fuel savings will more than justify the added cost.

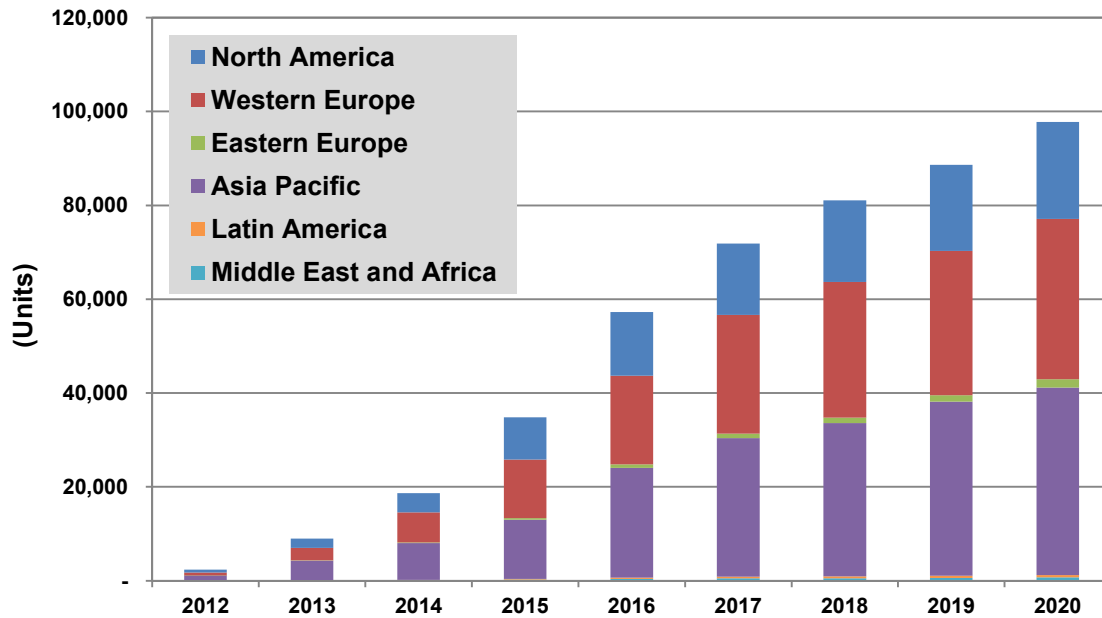
Despite the promise of coasting technology, the technical challenges and liability issues (e.g., who is responsible and how can it be verified if the power brakes do not immediately respond because the engine is off?) could slow the introduction of the technology in production vehicles. Nevertheless, this technology will be the center of frequent discussion during 2013.

#### **8. Slow versus Fast Charging Debate Intensifies**

During the first few years of public EV charging equipment infrastructure build-out, the majority of units installed were Level 2 (up to 7.2 kW) chargers. Fast DC charger deployments have been limited to a handful of government- or corporate-sponsored initiatives, such as the West Coast Electric Highway along I-5 in the United States, two industry initiatives in Japan, and a Renault network of chargers in France.



**Chart 2.4 DC Charging Station Units by Region, World Markets: 2012-2020**



(Source: Pike Research)

However, 2013 will see a greater diversity of charging rates as the lines between fast and slow charging begin to blur and more host sites opt for less expensive Level 1 charging equipment. In the workplace, where many employee vehicles spend 4 to 8 hours parked, Level 1 charging can fully recharge most vehicle battery packs (especially in PHEVs), increasing the preference for cheaper equipment that has less impact on peak power consumption. Likewise, more homeowners will deem Level 1 chargers adequate for overnight charging of PHEVs. During 2013, the mid-range of charging speeds (between 7 kW and 50 kW) will become occupied in the United States by faster Level 2 chargers that can produce AC power at up to 18 kW (where the infrastructure supports higher power) and with lower power DC chargers, while in Europe, 22.7 kW chargers are already growing in popularity, and Renault is pushing 43 kW charging.

Despite the evolution of charging equipment, some EV enthusiasts will continue to espouse that EVs will only grow in demand if supported by large networks of fast DC chargers, and a few new fast-charging networks, such as Tesla Motor's Superchargers, will dot the landscape in 2013. However, that viewpoint will be increasingly hard to validate as more PEV drivers learn to depend on slower charging.

## 9. Europe Enables Driving Without Borders

The concept of e-mobility was introduced to enable PEV owners to reach their destination without worrying about being stranded far from a convenient location to charge. This requires not only a network of AC and DC charging stations at strategic locations to enable mobility, but also a communications infrastructure that guides drivers to charging locations and a seamless payment system for charging services.

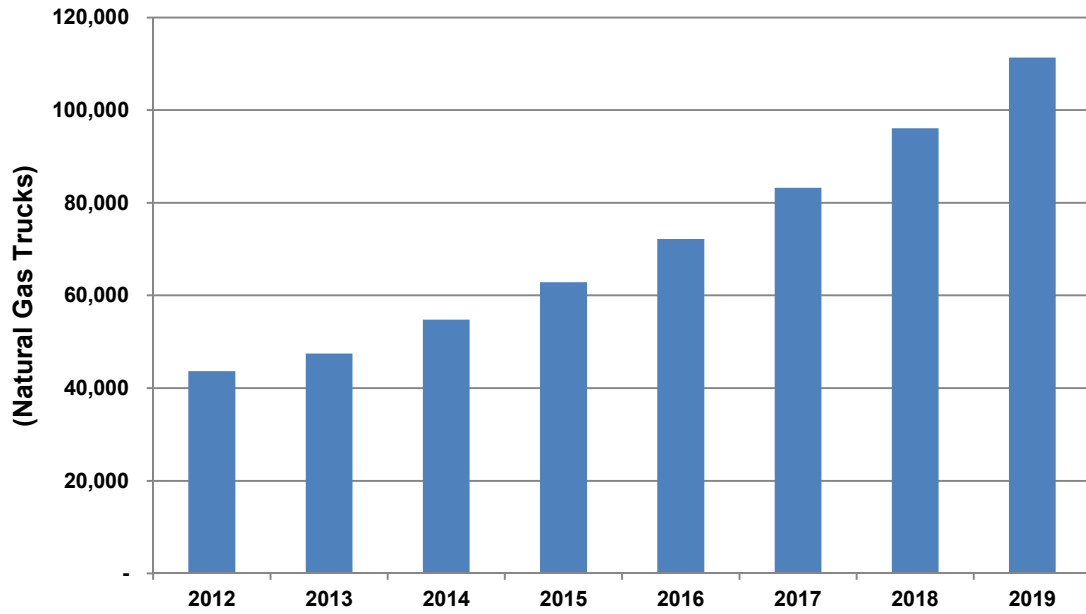
That dream is becoming reality in Europe, which will show the greatest progress in simplifying PEV driving in 2013. IBM will demonstrate an intelligent backend system for managing public EV charge points, interacting with the power grid and enabling registered users to charge their vehicles anywhere in Ireland using a single ID card. Similar projects are underway in Portugal, Denmark, and Spain. The ambitious goal is to have a billing and communication system in place by 2015 that will work across Europe, thanks in part to funding from the European Union's Green eMotion Project. In Germany, the Hsubject project, backed by BMW, Bosch, Daimler, enBW, RWE, and Siemens, is creating a national system of eRoaming for a single payment system that will be up and running in 2013. No such coordinated national or even regional efforts have taken place in the United States as competing charging networks have yet to agree on standards for payments or customer identification. The European e-Mobility model will first be put to the test in 2013 and if it proves successful in promoting the adoption and use of PEVs, their American counterparts are likely to at least begin the conversation about a national system later in the year.

**10. The Natural Gas Glut Will Tamper Interest in Plug-in Electric Trucks**

Due to extensive discoveries of shale natural gas reserves across the globe during the past few years, the price of natural gas has dipped, while fuel production has expanded rapidly. This has resulted in increasing interest in manufacturing and purchasing natural gas trucks, which will deter interest in purchasing plug-in electric trucks or in manufacturers launching new models in 2013.

Despite rebounding prices of natural gas, interest in natural gas trucks remains strong, and the plug-in medium and heavy duty truck market will continue to languish. Sales of natural gas trucks will grow to more than 47,000 vehicles sold in 2013. Plug-in trucks have the advantage of being able to utilize the infrastructure being built for light duty PEVS, while natural gas truck demand is hampered by a more limited number of refueling stations.

**Chart 2.5 Annual Global Natural Gas Medium and Heavy Duty Truck Sales: 2012-2019**



(Source: Pike Research)

However, purchases of lower-carbon electric trucks will increase in 2014 in the United States when new fuel economy rules for trucks come into effect. The price of diesel fuel continues to fluctuate from month to month, but remains relatively low compared to gasoline in most regions. Natural gas as a vehicle fuel, however, will trump both fuels in cost and emissions, resulting in continued interest growth throughout 2013.

## Section 3

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## Section 5

### 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 its 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.

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### 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 2012 U.S. dollars unless otherwise noted. Percentages may not add up to 100 due to rounding.

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