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Plug-in Electric Vehicles: Market Analysis and Used Price Forecast

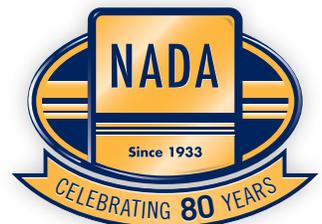
AT A GLANCE

How PEV federal tax credits increase lender risk

How PEV value retention compares to gas-powered and hybrid vehicles

The potential for higher gasoline prices to benefit PEV demand

How PEV depreciation is expected to change over the next two years



It may seem hard to believe, but more than a hundred years ago, many early drivers considered electric vehicles a preferable alternative to automobiles powered by fossil fuels.

Both European and U.S. cities embraced electric vehicles because they were easier to use — they didn't require strenuous cranking to start or challenging manual shifting while driving. Operating distance was generally in the 35 to 50 mile-per-charge range, and some models were able to exceed 150 miles on a single charge. Surprisingly, these figures are in line with today's electric plug-in vehicles.

But despite their perceived benefits, the earliest electric vehicles were heavier, slower and significantly more costly than their gas-powered counterparts. Ultimately, these drawbacks, in addition to cheap fuel and advances in gas engine manufacturing and technology (particularly the invention of the electric starter), encouraged mass adoption of the internal combustion engine as the primary power source for automobiles.

Fast-forward a century and electric propulsion has once again carved out a place in the automotive spotlight, due in large part to federal regulations that aim to address global climate change and the nation's dependency on oil imports.

Manufacturers have been selling notable quantities of hybrid-electric vehicles — or vehicles in which an internal combustion engine is assisted by, and solely responsible for charging, an electric motor — for nearly a decade now.

However, plug-in electric vehicles, or vehicles that require an electrical outlet to fully charge their batteries, have only been available on a larger scale for a little over two years.

NADA's latest Market Analysis and Used Price Forecast report describes plug-in electric vehicle progress in both new vehicle sales and used value retention, and discusses NADA's near-term expectations for used plug-in prices.

THE ROAD BACK TO EVs

Today's federal regulations aimed at addressing global climate change and overcoming the nation's dependency on oil imports, are driving a movement back toward electric vehicles (EVs).

The National Highway Traffic Safety Administration (NHTSA) and the Environmental Protection Agency (EPA), through their respective authorities to establish Corporate Average Fuel Economy (CAFE) and greenhouse gas (GHG) emissions levels, have jointly developed a national program of standards that requires new passenger car and light-duty truck fuel economy to improve from a combined average of 27.5 miles per gallon (mpg) in 2010 to 54.5 mpg by 2025.

To meet these aggressive government requirements, automotive manufacturers rely on a variety of in-market or planned technological advances, with the electric powertrain being one of the most prominent.

EVs help manufacturers meet their required corporate average by simply increasing the mean fuel economy of their respective car and truck fleets. But they help in another way, as well. The EPA and NHTSA have enacted incentive programs that increase the weight of an EV sale (and alternative fuel vehicles in general) in a manufacturer's compliance calculation.

Hybrid electric vehicles (HEVs), the first modern form of electrification, merged the familiar internal combustion engine with an electric motor powered by the proven chemistry found in nickel-metal hydride (NiMH) rechargeable batteries. HEV fuel economy is superior to similarly equipped internal combustion engine (ICE) models, but the powertrain system remains materially dependent on fossil fuels.

Enter plug-in EVs.

Plug-in EVs (PEVs) operate strictly on electricity, or they increase the dedicated use of electric-only power, which further minimizes the use of fossil fuels and the emission of GHGs. Models in this category are commonly described as "plug-in hybrid electric vehicles," or PHEVs. This made PEVs a logical next step toward the powertrain diversification required by the NHTSA's and the EPA's more rigid standards.

Supporting the mass introduction of PEVs and PHEVs was the advancement of the lithium-ion battery. Prior to automotive use, it was widely found in smaller consumer electronic products (laptop computers, cell phones, etc.). More energy-dense than the NiMH batteries found in HEVs, lithium-ion batteries allow for more driving range on a single charge. This, of course, raises the real-world practicality of an all-dependent (or more significantly dependent) EV.

The first electric models to hit the market in large quantities were Chevrolet's Volt (a PHEV) and Nissan's all-electric Leaf, both of which were released in 2011.

At launch, Chevrolet and Nissan claimed their respective models could achieve ranges of 40 and 100 miles on a single charge, although as a PHEV, the Volt's internal gasoline generator could extend driving range by an additional 300 miles. Initial MSRPs for the least expensive Volt and Leaf variants were \$40,280 and \$32,780, respectively—significantly more than what a consumer could expect to pay for a comparable ICE-equipped model. For example, the price of the Volt was nearly \$20,000 higher than a Chevrolet Malibu LS, while the Leaf's cost was some \$15,000 higher than a well-equipped Nissan Versa.

LIMITATIONS HINDER DEMAND

Initial expectations for the Volt and Leaf were ambitious, but after two full years on the market, sales have consistently fallen well short of manufacturer targets. In 2012, GM had hopes of selling roughly 40,000 Volts in the U.S., while Nissan planned to move some 20,000 Leafs, but actual sales for each came in at 23,461 and 9,819 units, respectively.

The unfulfilled expectations of the Volt and Leaf are a reflection of the primary roadblocks affecting overall plug-in EV demand — limited range and vehicle cost.

Consumers' fear of being stranded if their plug-ins' batteries run out of electricity has been dubbed "range anxiety." This is more of a legitimate concern for PEVs like the Leaf and Ford Focus EV, as their all-electric technology generally limits range to less than 100 miles. In addition, driving conditions — e.g., temperature,

air-conditioner use and driving habits — can affect available mileage. Certain models like Tesla’s Model S can realize a range of more than 200 miles on a single charge, but this type of distance can only be achieved with a larger — and significantly more expensive — lithium-ion battery.

Reduced range isn’t a real issue for PHEVs like the Volt and the Toyota Prius plug-in, due to the availability (in some form) of a range-extending gasoline engine. That said, the term “plug-in” still carries the perception of compromised range in consumers’ minds, and the added cost associated with the more expensive lithium-ion battery remains an issue.

To get an idea of just how expensive lithium-ion battery systems for PEVs and PHEVs are, we can turn to a recent study by global management consultant firm McKinsey & Company. In their report, *Future EV Battery Costs*, McKinsey states that the current cost of a complete automotive lithium-ion battery system ranges from \$500 to \$600 per kilowatt-hour (kWh). Using McKinsey’s estimates, a 24-kWh lithium-ion battery like the one found in the 2013 Nissan Leaf could be responsible for between \$12,000 to \$14,400 of the car’s \$28,800 MSRP (Note: This is a hypothetical estimate). As another example, the base MSRP for Toyota’s plug-in Prius is \$32,000 — \$6,000 more than the starting price of a comparably equipped Prius HEV.

TAX CREDITS SPUR NEW SALES, BUT DEPRESS USED VALUES

To help offset the higher prices of PEVs and PHEVs, the federal government offers tax credits ranging from \$2,500 to \$7,500 to the first registered owner, with the credit amount determined by the size of lithium-ion battery used to drive the vehicle. These credits effectively reduce the cost of a given plug-in once the consumer files their tax returns for the year the vehicle was purchased.

Substantive tax credits can certainly help promote more new sales than would have been achieved otherwise. However, they'll also have a negative impact on future resale value for one basic reason — few consumers are willing to purchase a credit-ineligible, used plug-in EV for more than they would pay for a new one, less the federal tax credit. Therefore, at a minimum, late-model used plug-in prices must logically max out below their new MSRP minus the credit. This is one of the primary reasons used plug-in EV value retention significantly lags other fuel types.

USED CAR VALUE RETENTION: GASOLINE, HYBRID AND PLUG-IN ELECTRIC CARS

NADA Average Trade-in Value divided by typically equipped manufacturer suggested retail price. NADA values from April 2013.

Model Year	Make / Model	Style	Fuel Type	NADA Avg. Trade-in Value	Typically Equipped MSRP	Used Value Retention
2012	Honda Civic	Sedan 4D LX 1.8L I4	Gasoline	\$14,137	\$19,328	73%
2012	Toyota Corolla	Sedan 4D LE 1.8L I4	Gasoline	\$12,952	\$18,705	69%
2012	Honda Insight	Hatchback 5D EX 1.3L I4 Hybrid	Hybrid	\$15,650	\$22,755	69%
2012	Toyota Prius	Liftback 5D 1.8L I4 Hybrid	Hybrid	\$18,590	\$27,783	67%
2012	Chevrolet Cruze	Sedan 4D LS 1.8L I4	Gasoline	\$12,502	\$18,865	66%
2012	Chevrolet Volt	Sedan 4D Premium Navigation 1.4L I4 Electric	Plug-in Hybrid	\$24,855	\$43,030	58%
2012	Nissan Leaf	Hatchback 5D SL Electric	Plug-in EV	\$19,292	\$38,100	51%
2012	Mitsubishi i	Hatchback 5D SE Electric	Plug-in EV	\$14,605	\$37,975	46%
2011	Toyota Prius	Liftback 5D 1.8L I4 Hybrid	Hybrid	\$17,240	\$26,014	66%
2011	Honda Civic	Sedan 4D LX 1.8L I4	Gasoline	\$12,487	\$19,225	65%
2011	Toyota Corolla	Sedan 4D LE 1.8L I4	Gasoline	\$11,877	\$18,360	65%
2011	Chevrolet Cruze	Sedan 4D LS 1.8L I4	Gasoline	\$11,602	\$18,655	62%
2011	Honda Insight	Hatchback 5D EX 1.3L I4 Hybrid	Hybrid	\$13,300	\$23,147	57%
2011	Chevrolet Volt	Sedan 4D Premium 1.4L I4 Electric	Plug-in Hybrid	\$21,785	\$42,990	51%
2011	Nissan Leaf	Hatchback 5D SL Electric	Plug-in EV	\$15,367	\$34,570	44%

Source: NADA

To put it another way, tax credits effectively reduce both new and used vehicle prices in a manner similar to manufacturer cash incentives. However, there is a distinct difference between the two, with risk implications for banks and finance companies. With a typical cash incentive, the new vehicle price is immediately reduced by the amount of the incentive; this figure then becomes the basis for what is ultimately financed by a bank. As such, should the consumer default, the bank's loss exposure isn't worsened because both new and used vehicle prices were affected by the incentive.

When purchasing a new plug-in EV, however, the federal tax credit — i.e., the incentive — isn't reflected in the booked loan even though the credit has a lowering effect similar to cash incentives on used vehicle prices. This means that unless lenders have implemented unique loan-to-value requirements for plug-in vehicles, their equity stake and risk position in a new PEV or PHEV loan are greater than they would be with traditional incentives. That being said, new technology and high new vehicle prices will naturally limit plug-in EV purchases to prime credit — thus low-risk — consumers.

Leasing, on the other hand, allows for a more attainable point of entry and a lower monthly payment, primarily because the federal tax credit remains with the lease company, which uses it to reduce the amount of principle financed. In fact, R. L. Polk registration data shows that leasing was the dominant form of retail deliveries last year, with 51 percent of all new PEV and PHEV transactions being leases in 2012.

PLUG-IN DEPRECIATION WILL REMAIN HIGH

The keys to increasing sales for PEVs and PHEVs primarily revolve around increasing operable range and reducing new vehicle prices.

But as we've discussed, the only way to extend full-electric range is to use larger, more expensive lithium-ion batteries. Theoretically, as the technology continues to develop and economies of scale improve, costs associated with the batteries will decline. But by many accounts, numerous technological and production advances must fall into place before we see any meaningful price reductions.

Range anxiety and cost aside, plug-in EVs face a long list of other significant hurdles, including few public charging stations, expensive residential fast-charging equipment and the fear of new technology. In addition, it's expected that engineering advances in ICE powertrains will continue to generate significant improvements in fuel economy, which will do little to help plug-in appeal.

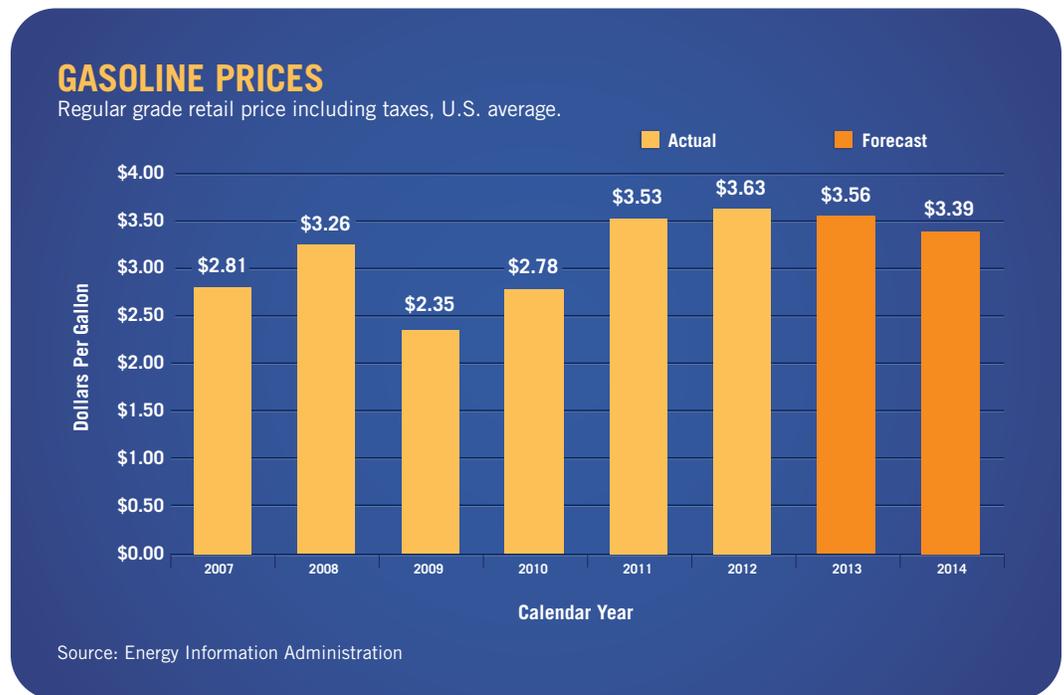
While significant progress in terms of range, price and infrastructure shortcomings

seems very unlikely within the next two years, one factor stands a better chance of substantively improving near-term plug-in EV fortunes: higher gasoline prices.

But after four years of progressive growth, it appears fuel prices are set to level off for a time.

Per the U.S. Energy Information Administration (EIA), the net import of liquid fuels as a share of consumption has fallen from a high of 60 percent in 2005 to an estimated 41 percent in 2012, and the EIA expects the net import share to fall to 32 percent in 2014.

This decreased dependence on liquid fuel imports is primarily the result of crude oil production growth from shale U.S. oil formations that have been made accessible by a process known as hydraulic fracturing (or “fracking”). The ongoing growth in domestic crude oil production is expected to play a pivotal role in lowering gasoline prices from an annual average of \$3.63 per gallon to \$3.56 and \$3.39 per gallon in 2013 and 2014, respectively.



Of course, the factors affecting new plug-in EV demand will also be in play on the used side of the market. In addition, long-term durability and maintenance concerns will impose a higher rate of depreciation on plug-in EVs.

These concerns have been evident on HEVs over the years as, over time, a HEV premium relative to a comparable ICE model swiftly erodes — even to the point where used prices actually become inverted in certain cases.

NADA OFFICIAL USED CAR GUIDE®: HYBRID VEHICLE PREMIUMS

Higher rates of used vehicle depreciation caused by age concerns erode hybrid-to-gas premiums over time. Values from April 2013.

Honda Civic

Model Year	Sedan 4D LX Auto Avg. Trade-in Value	Sedan Hybrid Avg. Trade-in Value	Hybrid Premium
2012	\$14,137	\$17,587	\$3,450
2011	\$12,487	\$14,987	\$2,500
2010	\$11,192	\$13,342	\$2,150
2009	\$10,187	\$11,437	\$1,250
2008	\$8,817	\$9,417	\$600
2007	\$8,072	\$8,247	\$175
2006	\$7,017	\$6,942	(\$75)
2005	\$5,225	\$4,675	(\$550)

Ford Escape

Model Year	Utility 4D XLT 4WD 3.0L V6 Avg. Trade-in Value	Utility 4D 4WD 2.5L I4 Hybrid Avg. Trade-in Value	Hybrid Premium
2012	\$18,525	\$22,725	\$4,200
2011	\$16,575	\$21,075	\$4,500
2010	\$14,425	\$16,650	\$2,225
2009	\$11,985	\$14,060	\$2,075
2008	\$10,212	\$12,262	\$2,050
2007	\$7,947	\$9,247	\$1,300
2006	\$6,262	\$6,862	\$600
2005	\$4,900	\$5,275	\$375

Source: NADA

When taken as a collective — technology limitations, moderating gasoline prices and age concerns — NADA expects used plug-in EV depreciation to continue to outpace the overall market’s rate of loss by a significant margin in the coming years.

To illustrate this, NADA has developed composite series for ICE, HEV and plug-in EV cars. The former two series consist of small displacement models sourced from compact and mid-size car segments. It should be noted that while the plug-in EV composite thus far has been dominated by Chevy Volt and Nissan Leaf sales data, the series should be viewed as a proxy for all plug-ins through the forecast period.

In 2012, NADA estimates that plug-in EVs depreciated by an annual rate of 31.5 percent, which means that as a collective, PEV and PHEVs lost nearly a third of their value in a year's time. By comparison, equivalent ICE and HEV models experienced substantially lower depreciation rates of 12.4 and 14.0 percent, respectively.

In model-specific terms, the May 2012 edition of the *NADA Official Used Car Guide* noted that the 2011 versions of the Volt and Leaf carried respective Average Trade-in Values of \$31,060 and \$24,857. By May 2013, values for each model had fallen by some \$10,000 to \$21,235 and \$14,792, respectively.

Conversely, Average Trade-in Values for a similar vintage Toyota Prius hybrid fell by \$4,735 to \$16,490, while values for a Ford Fusion equipped with a four-cylinder gasoline engine dropped by \$3,150 to \$16,490.

As stated earlier, we don't expect to see significant near-term progress toward breaking down the more imposing obstacles faced by plug-in EVs. In addition, anticipated changes in fundamental used price drivers, especially gasoline prices, will also do little to change the high rate of plug-in EV depreciation through 2014.

However, we do expect to see subtle improvements in the rate of PEV and PHEV depreciation over the coming years, as the technology develops more of a track record and earns more of a reputation for reliability. This would be directionally consistent with depreciation trends observed in early hybrids, which initially depreciated at annual rates of 24 to 26 percent before gradually improving to a range of 16 to 18 percent within a span of five years.

Given these points, NADA estimates that the rate of plug-in EV depreciation will improve just mildly over the next two years. Specifically, we expect the annual rate of used plug-in value loss to decrease from 31.5 percent in 2012 to 29.7 and 27.4 percent in 2013 and 2014, respectively.

USED VEHICLE DEPRECIATION: GASOLINE, HYBRID AND PLUG-IN ELECTRIC CARS

Actual and predicted annual rates of used vehicle price depreciation.

Powertrain Type	Actual		Forecast	
	CY2012	CY2013	CY2013	CY2014
ICE	-12.4%	-13.3%	-16.8%	-16.8%
Hybrid	-14.0%	-16.9%	-18.5%	-18.5%
PEV	-31.5%	-29.7%	-27.4%	-27.4%

Source: NADA

Conversely, NADA expects that a combination of factors — particularly growing used vehicle supply and the shifting of consumer tastes back to new vehicles — will see ICE and HEV depreciation steadily worsen from 2012’s exceptionally strong figures to 16.8 and 18.5 percent, respectively, by 2014. Regardless, for the foreseeable future, it remains that the value proposition of a plug-in EV will be substantially worse than that of its two counterparts.

In dollar terms, this means a plug-in EV worth \$20,000 in 2012 is predicted to lose \$9,792 of its value by the end of 2014, while similarly priced gasoline and hybrid vehicles are expected to lose \$5,573 and \$6,455, respectively, over the same period.

To put it another way, the steeper rate of depreciation will mean a more expensive plug-in EV will actually be worth less than an ICE-equipped car after a period of time.

LOOKING FURTHER AHEAD

Plug-in EVs clearly face stout challenges in the years ahead, but considering the finite nature of fossil fuels and the negative repercussions associated with their energy use, there is certainly potential for plug-in technology to assume a large share of the automotive marketplace in the future.

In the near term, the addition of new models and investments made by and between manufacturers, utility companies and other private organizations will help stoke additional demand for plug-in EVs. This will be especially true in urban areas, where the use of plug-ins is more practical.

And as the recent surge in 2013 Nissan Leaf sales has shown, adopting methods to substantially lower new plug-in EV prices (Nissan slashed the base price of the '13 Leaf by \$6,400) makes it possible to quickly increase the quantity of units demanded by consumers.

That being said, plug-in EVs appear set to remain a fringe alternative powertrain solution for years to come. In fact, forecaster LMC Automotive predicts that the plug-in EV share as a percentage of overall new vehicle sales will grow from 0.4 percent in 2012 to just 1.5 percent through 2020 (HEV share is expected to rise to 6.1 percent over the same period).

Plug-in EVs face an uphill battle on the used side of the market as well, and not just because of unfavorable market conditions. Concerns surrounding durability, maintenance and longevity as EVs age affect used prices more so than prices for their ICE counterparts. All other influencing factors being equal, this imposes a higher rate of depreciation on electric vehicles, especially early on in the technology's lifecycle — exactly where plug-in EVs are today. But as we've discussed, this novelty will wear off over time and plug-in EV depreciation will ultimately benefit as a result.

Armed with a deeper understanding of those factors affecting used prices today and how anticipated changes to these drivers will influence depreciation in the near term, lenders and other industry professionals with long-term interests in used plug-in electric vehicles can better manage programs and standards designed to reduce the risk associated with future used vehicle prices.

About NADA

NADA Used Car Guide

Since 1933, NADA Used Car Guide has earned its reputation as the leading provider of market-reflective vehicle valuation products, services and information to businesses throughout the U.S. and worldwide. NADA collects and analyzes more than one million combined wholesale and retail automotive-related transaction prices per month. Its guidebooks, auction data, analysis and data solutions offer automotive, financial, insurance and government professionals the timely information and reliable solutions they need to make better business decisions. Visit nada.com/b2b

NADA Analytics & Consulting

NADA's analytics team is charged with maintaining and advancing NADA's internal forecasting models and for developing customized forecasting solutions for automotive clients. NADA's analytics team has deep industry experience and is well versed in the nuance and complications involved with forecasting in the automotive market.

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AuctionNet data is available either as an annual subscription or in back history for specific years, or it can be customized and /or aggregated based on client needs.

NADA's Used Supply Forecast

NADA's used supply forecast is an estimate of the number of vehicles expected to be offered for sale in the future. NADA calculates used supply volume as the pool of potential vehicles that could return to the market — as represented by all new vehicle sales — and the probability that a vehicle will return from a particular source (e.g., rental, consumer lease, consumer purchase, etc.) after a predicted use period. For example, vehicles sold to rental car companies and consumers each have a specific probability curve associated with the historical likelihood to return to the used market after a given use period. The product of the vehicle pool and the return probability is the expected value of the volume of returned vehicles, which is aggregated to create the used supply volume. NADA calculates used vehicle supply down to the vehicle level.

NADA's used supply forecast data is available either as a one-time deliverable or an annual subscription and can be customized based on client needs.

NADA's Used Vehicle Price Forecast

NADA's used vehicle price forecast is based on expectations for changes to key market drivers, combined with coefficients that estimate how each of these impacts used vehicle prices. Expectations for changes to macroeconomic drivers are based on a consensus view from professional forecasting organizations with adjustments made by NADA economists. Endogenous depreciation, seasonal patterns and expectations for new vehicle prices and incentives are estimated by NADA economists and the editorial team. Relationship coefficients are estimated by NADA's proprietary statistical model.



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