One Million Electric Vehicles By 2015

February 2011 Status Report

Executive Summary

President Obama's goal of putting one million electric vehicles on the road by 2015 represents a key milestone toward dramatically reducing dependence on oil and ensuring that America leads in the growing electric vehicle manufacturing industry. Although the goal is ambitious, key steps already taken and further steps proposed indicate the goal is achievable. Indeed, leading vehicle manufacturers already have plans for cumulative U.S. production capacity of more than 1.2 million electric vehicles by 2015, according to public announcements and news reports. While it appears that the goal is within reach in terms of production capacity, initial costs and lack of familiarity with the technology could be barriers. For that reason, President Obama has proposed steps to accelerate America's leadership in electric vehicle deployment, including improvements to existing consumer tax credits, programs to help cities prepare for growing demand for electric vehicles and strong support for research and development.

Introduction

"With more research and incentives, we can break our dependence on oil with biofuels, and become the first country to have a million electric vehicles on the road by 2015"
- President Barack Obama, 2011 State of the Union

In his 2011 State of the Union address, President Obama called for putting one million electric vehicles on the road by 2015 – affirming and highlighting a goal aimed at building U.S. leadership in technologies that reduce our dependence on oil.[1] Electric vehicles ("EVs") – a term that includes plug-in hybrids, extended range electric vehicles and all- electric vehicles -- represent a key pathway for reducing petroleum dependence, enhancing environmental stewardship and promoting transportation sustainability, while creating high quality jobs and economic growth. To achieve these benefits and reach the goal, President Obama has proposed a new effort that supports advanced technology vehicle adoption through improvements to tax credits in current law, investments in R&D and competitive programs to encourage communities to invest in infrastructure supporting these vehicles.

While several high profile vehicle market introductions such as the Chevrolet Volt and the Nissan Leaf have been initiated, questions

remain regarding the potential to reach the 2015 goal. Production capacity must be established, and technology, vehicle cost and infrastructure barriers must be addressed to achieve large-scale market introduction. This report provides a progress update toward achieving the goal:

- The status of vehicle sales and future production volume estimates
- Current federal government policies, investments, research and development, and demonstration efforts supporting the deployment of EVs
- EV consumer demand

This is an exceedingly dynamic and competitive field. Major announcements by companies and governments worldwide are made on a frequent basis. The plans of global companies and the policy initiatives of governments will surely change and shape the development of technology and markets during the next five years.

Where We Are Today

In 2010, the U.S. economy continued recovery from recession. As part of that recovery, sales of U.S. light-duty vehicles rebounded to approximately 12 million in 2010 from less than 10 million in 2009. Historically, U.S. sales of new light duty passenger vehicles ranged from 15-16 million per year from 2005-2008.[2] Conventional hybrid electric vehicles (HEVs) have been on sale in the U.S. for over ten years, and today sales have grown to almost three percent of total light-duty vehicles. Over 1.6 million HEVs have been sold over the past six years.[3] To reach the one million vehicle goal, EVs will need to average just under 1.7 percent of sales through 2015 (assuming sales of 12 million light-duty vehicles per year).

With increases in the Corporate Average Fuel Economy (CAFE) standards, vehicle manufacturers are required to increase fuel economy through 2016, with further increases beyond 2016 under consideration. On March 30, 2009, the National Highway Traffic Safety Administration (NHTSA) published the final rule raising CAFE standards for both cars and light trucks. These new standards will encourage the expanded market entry of electric drive technologies.

Market for Electric Drive Vehicles Expected to Increase

Over the past few years, interest in EVs in the U.S. auto industry has surged, with manufacturers beginning to introduce new generations of EVs. For example, in 2010 General Motors introduced the Chevrolet Volt extended range electric vehicle into the U.S. market. The Volt can travel up to 40 miles using power from its lithium-ion battery pack. After that, the Volt can travel up to 375 miles in extended range using its internal combustion engine electric generator. GM has announced plans to build 15,000 Chevy Volts in 2011 and 45,000 in 2012. Based on news reports, the company is working on plans to increase its production target for 2012 to 120,000. (See Table references.) In late 2010, Nissan introduced the Leaf, a 100-mile range all-electric vehicle that incorporates an advanced lithium-ion battery as its sole power source.

The 2011 Chevrolet Volt

The 2011 Nissan Leaf

The production capacity of EV models announced to enter the U.S. market through 2015 should be sufficient to achieve the goal of one million EVs by 2015. The table below shows EVs expected to enter the U.S. commercial market over the next few years, including the production capacity by year, based on manufacturer announcements and media reports. Major auto manufacturers such as Chrysler, BYD, Coda, Honda, Mitsubishi, Hyundai, Toyota, Volkswagen and Volvo are not included in this table, but have announced or are expected to introduce EVs in this time period. Because the U.S. is a major market for these automakers, it is likely that additional production capacity of several hundred thousand EVs is not accounted for in this table.

Estimated U.S. Supply of Electric Vehicles from 2011 through 2015

Manufacturer and Model	**2011**	**2012**	**2013**	**2014**	**2015**	**Total**
Fisker Karma PHEV	1,000	5,000	10,000	10,000	10,000	36,000
Fisker Nina PHEV		5,000	40,000	75,000	75,000	195,000
Ford Focus EV		10,000	20,000	20,000	20,000	70,000
Ford Transit Connect EV	400	800	1,000	1,000	1,000	4,200
GM Chevrolet Volt	15,000	120,000	120,000	120,000	120,000	505,000
Navistar eStar EV (truck)	200	800	1,000	1,000	1,000	4,000
Nissan LEAF EV	25,000	25,000	50,000	100,000	100,000	300,000
Smith Electric Vehicles Newton EV (truck)	1,000	1,000	1,000	1,000	1,000	5,000
Tesla Motors Model S EV		5,000	10,000	20,000	20,000	55,000
Tesla Motors Roadster EV	1,000					1,000
Think City EV	2,000	5,000	10,000	20,000	20,000	57,000
Cumulative Total						1,222,200

Note: The above numbers have been taken from announced production figures and media reports. In some cases more conservative estimates have been used due to: delays that have occurred since announced

production levels, ramp rates to reach full production, consideration of the size of the market segment for that vehicle, and possible exportation of vehicles manufactured in the U.S. See the reference table for citations.

Policy

In recent years there have been a number of federal and state policy initiatives to encourage the introduction and sales of EVs. Industry can achieve its planned production with the support of policies that encourage investment in manufacturing facilities, enable technology demonstration and deployment and provide incentives to promote adoption and drive consumer demand.

Manufacturing Investments

Through the Recovery Act, the United States made an unprecedented investment to build our domestic manufacturing capacity and secure our position as a global leader in advanced lithium-ion battery technology. This investment includes:

- $2.4 billion in loans to three of the world's first electric vehicle factories in Tennessee, Delaware, and California.
- $2 billion in grants to support 30 factories that produce batteries, motors, and other EV components. Companies are matching the funding dollar for dollar, doubling the impact of taxpayer investments. These grants are enabling companies to build the capacity to produce 50,000 EV batteries annually by the end of 2011 and 500,000 EV batteries annually by December 2014.

Deployment, Demonstration, and Outreach

Recovery Act funds are also supporting the largest-ever coordinated demonstration of EVs, including nearly 13,000 vehicles and more than 22,000 electric charging points in more than 20 cities across the country. Companies are matching this $400 million public investment dollar for dollar. This effort will provide important and detailed real-world operational data on vehicle usage, time-of-use and charging patterns, and potential impacts on our nation's electrical grid. The demonstrations will document lessons learned that help streamline infrastructure permitting processes and make data available that can alleviate consumer uncertainty and help transition EVs from clusters of early adopters to national, mainstream use. Coordinated with this large-scale demonstration are programs to educate code officials, first responders, technicians, and engineers, who are critical components of the human infrastructure needed for a successful transition to electric-drive transportation, both in terms of consumer acceptance and public safety.

The Department of Energy is also working with local leaders in their efforts to encourage EV adoption and drive consumer demand. Through a new competitive program, seed funding will help communities across the country with regulatory streamlining, infrastructure investments, vehicle fleet conversions, deployment of EV incentives, partnerships with major employers/retailers, and workforce training. The FY12 budget request seeks to expand this initiative so that up to 30 communities could receive grants of up to $10 million to help catalyze EV deployment (see text box on page 6).[4]

Incentives

Tax incentives and other measures have been proven effective in providing the additional boost needed for mainstream consumers to choose EVs. The Recovery Act established tax credits for purchasing electric vehicles ($2,500 - $7,500 per vehicle, depending on the battery capacity) and conversion kits to retrofit conventionally powered vehicles with electric vehicle capability ($4,000 per vehicle, maximum). The President has also proposed transforming the existing $7,500 EV tax credit into a more accessible and even more attractive rebate at the dealership.[5] In addition, nearly 40 U.S. states and the District of Columbia have adopted other measures promoting electric-drive vehicle usage, including high occupancy vehicle (HOV) privileges and waived emissions inspections, as well as tax credits/rebates and preferred purchase programs.[6]

New Initiatives to Support Advanced Technology Vehicles

President Obama is proposing three steps to address consumer demand and position the United States as a global leader in manufacturing and deploying next-generation vehicle technologies:

- **Make electric vehicles more affordable with a rebate up to $7,500**: The President is proposing to transform the existing $7,500 tax credit for electric vehicles into a rebate that will be available to all consumers immediately at the point of sale.

- **Advance innovative technologies through new R&D investments:** Building on Recovery Act investments, the President's Budget proposes enhanced R&D investments in electric drive, batteries, and energy storage technologies.

- **Reward communities that invest in electric vehicle infrastructure through competitive grants**: To provide an incentive for communities to invest in EV infrastructure and remove regulatory barriers, the President is proposing a new initiative that will provide grants to up to 30 communities that are prioritizing advanced technology vehicle deployment.

Source: http://www.whitehouse.gov/the-press-office/2011/01/26/vice-president-biden-announces-plan-put-one-million-advanced-technology-

Advancing Technologies through R&D

The President has announced that the FY 2012 Budget will include enhanced R&D investments in battery and other electric drive technologies.[7] Investments will support R&D initiatives through DOE's Vehicle Technologies Program, as well as a new Energy Innovation Hub devoted to developing better batteries and energy storage capacity to support electric vehicles and other technologies. This focus on continued innovation complements ongoing R&D to support the development of critical technologies needed for

the widespread introduction of electric drive vehicles. These efforts include battery development, power electronics and electric motors, and electric drive vehicle systems.

A123 Systems Battery Module

Battery technology today is greatly different from that of the 1990s. The General Motors EV-1 had a range of 80 to 140 miles, but initially used lead-acid batteries having limited energy density, which resulted in a two-passenger vehicle, relatively short battery life, and a long recharging time. By contrast, today's lithium-ion battery technology allows the Leaf, Volt, and other EVs to be 4- or 5-passenger vehicles, with an extended warranty on battery life, and much faster charging times. The Volt's lithium-ion battery technology is over 70 percent lighter than the EV-1's original lead-acid battery technology.

Vehicle manufacturers currently employ lithium-ion batteries with excess capacity to ensure the batteries meet a ten-year battery life target. As greater confidence in battery life under real-world driving conditions develops, the amount of excess capacity installed is expected to decrease, and thus cost should decrease as well. GM recently announced that the Chevrolet Volt battery will now be operated using more than 65 percent of total capacity, instead of 50 percent, demonstrating continued improvement in today's lithium-ion batteries.[8] Next-generation lithium-ion batteries are likely to employ advanced electrodes such as silicon-based nanostructured anodes (instead of graphite), and high-capacity manganese-based cathodes, resulting in a significant increase in energy density and reduction in cost. New technologies continue to move from DOE laboratories to market– most recently Argonne National Laboratory has licensed advanced cathode technology to General Motors and battery suppliers LG Chem and Envia. These companies will now have the opportunity to build on DOE's technology innovation with further improvements and specific market applications.

Recovery Act investments will help cut battery costs. DOE and U.S. industry have invested over $3 billion in battery manufacturing facilities using Recovery Act and matching funds. Increasing the production output of a battery plant from 10,000 units/year to 100,000 units/year can directly reduce battery costs by 30-40 percent.[9] DOE's established cost target of $300/kWh by 2015 is an aggressive but achievable goal for lithium-ion batteries. Electric vehicle battery prices are expected to drop due to increased manufacturing know-how and economies-of-scale, learning curve improvements, lower-cost battery materials, and technical advancements in battery design.

DOE supports a broad portfolio of electric drive vehicle battery R&D that spans basic research to applied development. The Office of Science supports fundamental basic energy research on enabling materials through the Energy Frontiers Research Centers. The Applied Research Projects Agency - Energy (ARPA-E) conducts transformational research on revolutionary, "game-changing" energy storage technology. And the Office of Energy Efficiency and Renewable Energy (EERE) battery R&D is focused on applied

development and demonstration of advanced batteries to enable a large market penetration of electric drive vehicles.

Consumer Demand

While leading manufacturers already have plans for cumulative U.S. production capacity of more than one million electric vehicles by 2015, according to public announcements and news reports, production will only reach levels supported by consumer demand. What issues will influence purchasing decisions?

Fleet buyers tend to make vehicle purchasing decisions based on the total cost of vehicle ownership; retail vehicle consumers tend to focus on initial price. The Boston Consulting Group report on "Batteries for Electric Vehicles" concluded that with current incentives and oil prices in the United States, EV purchasers will reach lower total ownership costs within 3 to 5 years of operation.[10] These increasingly favorable economics for EVs aren't going unnoticed by fleet buyers. General Electric announced that they will purchase 25,000 EV by 2015[11] – a strong indication that as EV total cost of ownership falls below that of conventional vehicles, fleet purchasers will respond positively.

With the exception of a small segment of the new car buyer population, automobile consumers tend to be risk-averse, preferring well-proven technology. With automotive purchases generally the second largest financial purchase most families make, behind only housing, cost is considered carefully. And while automobile consumers do consider fuel consumption, they tend to discount future fuel savings. Studies have shown that consumers tend to assume that current fuel prices are good estimates of future prices.[12] Thus purchasers during periods of high fuel prices value fuel efficiency more than purchasers during periods of low fuel prices.

While availability of the current $7,500 tax credit is attractive to consumers, the President's proposal to convert this credit to benefit the consumer at the point-of-sale will likely make the incentive even more attractive since consumers will not have to wait until the end of the year to receive the credit.[13]

Although consumers have proven to be highly sensitive to initial price, they are also willing to pay premiums for vehicle options or attributes that resonate with them. EVs have unique attributes which may appeal to consumers. Exceptionally quiet operation, high torque (good acceleration), and low lifetime operating costs are examples of attributes that will attract consumers. Other features may also prove attractive to consumers, such as avoiding the gasoline refueling experience. In addition, car purchasing decisions are influenced by style and statements of personal identity; the powertrain configurations of EVs will provide styling options not available to conventionally powered vehicles.

Fuel price matters when consumers make automobile purchasing decisions. If oil prices increase, or expectation of further oil price increases becomes prevalent,[14] interest in EVs will likely increase as well.

There is clearly substantial consumer interest in electric vehicles, as demonstrated by the larger-than-anticipated pre-orders for the Nissan Leaf and the Chevrolet Volt. Whether this interest translates into sales beyond the initial "early adopter" market will depend on initial consumer experience with these early vehicles, and on how that experience is communicated and perceived by the rest of the car buying public. Uncertainties about EVs – including their resale value, range and availability of convenient charging facilities -- may impose sales barriers.

As noted earlier, there is considerable work underway to develop data on performance and reliability of EVs, and to communicate that information to the public. The performance and cost effectiveness of the early EVs in the market will be a major but unknowable factor in how many EVs are on the road by 2015. The cumulative impacts of the various policy initiatives, the experience of the early purchasers of electric-drive vehicles and future oil prices will all play a role in determining future consumer demand.

Summary

In his 2011 State of the Union address, President Obama called for putting one million electric vehicles on the road by 2015 – affirming and highlighting a goal aimed at building U.S. leadership in technologies that reduce our dependence on oil. This goal represents a key milestone in transforming our national vehicle fleet, a transformation that will deliver significant benefits for the American people, including:

- Dramatically reducing petroleum dependence and improving transportation sustainability;
- Improved environmental stewardship;
- Job creation and economic growth.

Government policies are critical enablers which influence the rate that advanced vehicles are adopted on a large scale. In addition to existing policies, the Administration's new three-part plan supports electric vehicle manufacturing and adoption through improvements to tax credits in current law, investments in R&D, and a new competitive program to encourage communities to invest in electric vehicle infrastructure. These policies will help attain the 2015 goal.

Reaching the goal is not likely to be constrained by production capacity. Major vehicle manufacturers have announced (or been the subject of media reports) that indicate a cumulative electric drive vehicle manufacturing capacity of over 1.2 million vehicles through 2015.

Strong incentives, research and development, and assistance in establishing manufacturing and infrastructure is underway or planned. These activities directly support consumer demand of these technologies, and mitigate some of the uncertainty associated with the large-scale adoption of electric drive vehicles.

References

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