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Electric Vehicle Transportation Center

Electric Vehicle Sales and Future Projections

Dr. David Block
Mr. John Harrison
Florida Solar Energy Center
1679 Clearlake Road
Cocoa, FL 32922-5703
E-mail: block@fsec.ucf.edu

Submitted to:

Ms. Denise Dunn
Research and Innovative Technology Administration
1200 New Jersey Avenue, SE
Washington, DC 20590
E-mail: denise.dunn@dot.gov

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Report on

Electric Vehicle Sales and Future Projections

David Block, John Harrison
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1. Summary

The objective of this research is to evaluate historical vehicle sales as a basis to determine future projections of electric vehicles sales and cumulative values within the U.S. and by selected states. The results for the U.S. show that the cumulative sales of electric vehicles through 2013 is 167,600 vehicles with 96,700 sold in 2013 or that 58% of total vehicles were sold in 2013. Depending upon the escalation rate selected, the 10 year future U.S. cumulative sales (2023) are predicted to be from 1.8 to 7.3 million vehicles. Future predictions were also done for the states of Florida, Hawaii, Alabama and for comparison purposes for Georgia, California and New York. The process used was the same as done for the U.S. beginning with known values for 2013 and then using a 10, 15, 20, 25 and 35 percent growth rate.

2. Electric Vehicle Definitions

Plug-in Electric Vehicle (PEV): This refers to any vehicle that plugs into the electric grid for all or part of its power source. PEVs are battery-electric vehicles (BEV) such as the Nissan Leaf, plug-in hybrid electric vehicles (PHEVs) such as the Chevy Volt, or extended-range electric vehicles (EREVs).

Hybrid Electric Vehicle (HEV): HEV vehicles are those that combine a conventional internal combustion engine (ICE) propulsion system with an electric propulsion system. HEVs do not receive energy from the grid and do not have the ability for grid recharging. The traditional Toyota Prius is an HEV. HEVs are not considered in this analysis.

3. Methodology

Future projections will be based on the following factors:

1. Historical sales of the vehicles
2. Historical sales of similar vehicles
3. Historical total sales of U.S. vehicles
4. Future growth rate escalation factors
5. Notes on projections by other literature sources
6. Future PEV sales by state
7. Special governmental or other incentives that could cause growth

4. Results

Following the outline in Methodology above, the results follow.

4.1. Historical PEV Sales

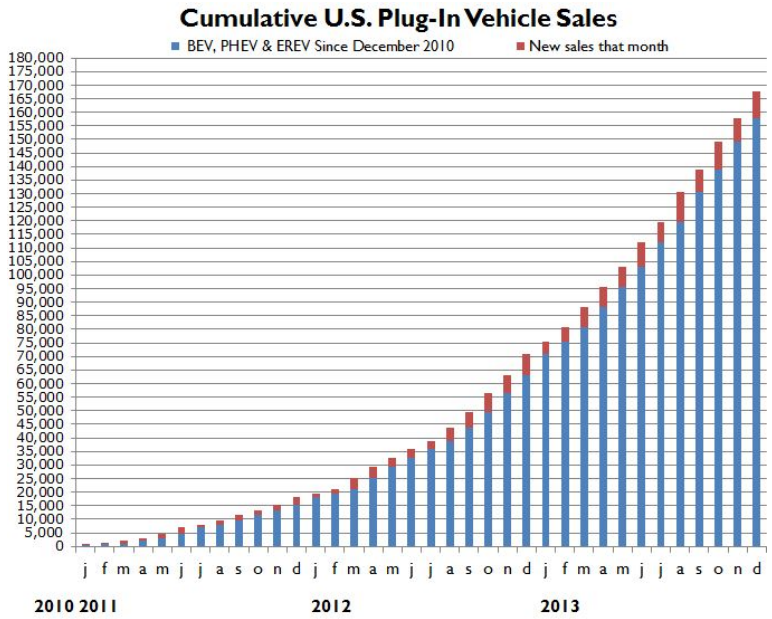
Many references present the U.S. PEV sales for 2011, 2012, and 2013 (the only years PEVs were available). The historical U.S. data in table form is as follows (from Reference 1):

Table 1

PEV SALES	PHEV	BEV	YEARLY TOTAL	CUMULATIVE SALES
2010	326	19	345	345
2011	7,671	10,064	17,735	18,080
2012	38,584	14,251	52,835	70,915
January 2013	2,354	2,022	4,376	-
February 2013	2,789	2,616	5,405	-
March 2013	3,079	4,553	7,632	-
April 2013	2,735	4,403	7,138	-
May 2013	3,209	4,545	7,754	-
June 2013	4,169	4,573	8,742	-
July 2013	3,499	3,943	7,442	-
August 2013	6,407	4,956	11,363	-
September 2013	4,477	3,650	8,127	-
October 2013	6,367	3,733	10,100	-
November 2013	4,903	3,390	8,833	-
December 2013	5,020	4,790	9,790	-
2013 Total	49,008	47,694	96,702	167,617

A plot of PEV yearly and cumulative sales is shown below in Figure 1. Note that 58% of the total sales occurred in 2013.

Figure 1 (from Reference 1)



4.2. Historical Sales of Hybrid Electric Vehicles (HEV)

Although this study does not involve hybrid vehicles (HEVs), the historical sale trends of HEVs are of interest in looking at future PEV trends. Hybrid vehicles were introduced in the U.S. in 1999 and the year 2013 was the largest sales year at 495,530 HEV vehicles. Table 2 below presents the yearly sales and the cumulative sales of HEVs.

Table 2. Yearly HEV Sales

Year	Sales	Cumulative
1999	17	17
2000	9,350	9,367
2001	20,287	29,654
2002	35,000	64,654
2003	47,525	11,2179
2004	88,000	20,0179
2005	215,000	415,179
2006	250,000	665,179
2007	352,274	1,017,453
2008	313,673	1,331,126
2009	290,292	1,621,418
2010	274,210	1,895,628
2011	266,329	2,161,957
2012	434,645	2,596,602
2013	495,530	3,092,132

The growth rate of HEVs will depend upon the year that is used as the base year. Using the year 2000, the growth rate for the 13 year cumulative sales to 2013 is 32.8% and using the year 2005 or 2007 as the first year gives a 14% growth rate to 2013.

4.3. Historical Total U.S. Vehicle Sales

The historical total of U.S. light vehicle sales is also of interest and is presented in Table 3. Table 3 shows an increase of sales from 11.8 million in 2007 to 15.5 million vehicles in 2013. Table 3 also presents the total sales of HEV and PEV vehicles (as a percentage) of total sales for each year.

Table 3. U.S. Total Vehicle Sales

YEAR	TOTAL U.S. SALES (million vehicles)	% HEV of Total	% PEV of Total
2007	11.8	2.99	--
2008	13.3	2.39	--
2009	10.5	2.78	--
2010	11.6	2.37	--
2011	12.7	2.09	0.14
2012	14.4	3.01	0.37
2013	15.5	3.19	0.62
Average	**12.8**	**2.70**	**0.38**

4.4. Future PEV Sales Predictions

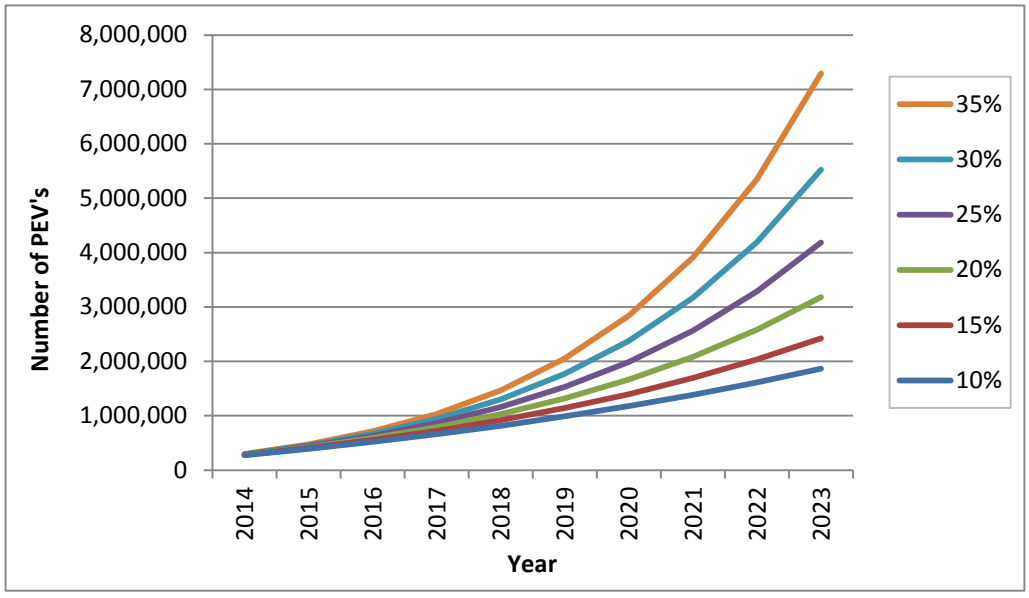
The prediction of future events relies on past events and an assumed future growth rate. In the above Sections 1, 2 and 3, past (historical) vehicle sales data have been presented. Many references have been evaluated for future PEV predictions; however, the work presented here is based on assuming growth rates of 10, 15, 20, 25 and 35% from the historical or 2013 values. Using these growth values, the future values are presented in Table 4 and in Figure 2. The references values are then placed on these growth curves which will give the reader the estimate of the future depending upon the growth rate assumed.

Table 4. PEV Sales Predictions

Yearly Predictions		10%	15%	20%	25%	30%	35%
2013	96,702						
2014		106,000	111,000	116,000	121,000	126,000	131,000
2015		117,000	128,000	139,000	151,000	163,000	176,000
2016		129,000	147,000	167,000	189,000	212,000	238,000
2017		142,000	169,000	201,000	236,000	276,000	321,000
2018		156,000	195,000	241,000	295,000	359,000	434,000

2019		171,000	224,000	289,000	369,000	467,000	585,000
2020		188,000	257,000	347,000	461,000	607,000	790,000
2021		207,000	296,000	416,000	576,000	789,000	1,067,000
2022		228,000	340,000	499,000	720,000	1,025,000	1,440,000
2023		251,000	391,000	599,000	901,000	1,333,000	1,944,000
Cumulative Growth							
2013	168,000						
2014		274,000	279,000	284,000	289,000	294,000	299,000
2015		391,000	407,000	423,000	440,000	457,000	475,000
2016		520,000	554,000	590,000	629,000	670,000	713,000
2017		662,000	723,000	791,000	865,000	946,000	1034,000
2018		817,000	918,000	1,032,000	1,160,000	1,305,000	1,468,000
2019		989,000	1,141,000	1,320,000	1,529,000	1,772,000	2,053,000
2020		1,177,000	1,399,000	1,667,000	1,990,000	2,378,000	2,843,000
2021		1,,384,000	1,695,000	2,083,000	2,566,000	3,167,000	3,910,000
2022		1,612,000	2,035,000	2,582,000	3,287,000	4,193,000	5,350,000
2023		1,863,000	2,426,000	3,180,000	4,188,000	5,526,000	7,295,000

Figure 2. PEV Sales



4.5. Projections by Other Literature Sources

Growth predictions have been made by the authors of References 2, 3, 4, 5, and 6. In this section, the results from these references are examined for assumed growth rates. In Reference 2, the number of PEVs in the year 2014 is predicted as 304,000. This value will give

a one year growth rate of 12%. Comparing the four other references in a similar fashion, gives the following results.

Reference 3 – Global EV Outlook. This reference states that the growth rate used is 20%.
Reference 4 – University of California, Berkeley. Predicts 2.5 million PEVs by 2020 or 20% growth rate.
Reference 5 – ECOtality, North America. Predicts 2.5 million PEVs by 2020 or 20% growth rate.
Reference 6 – Center for Automotive Research. Predicts 140,000 sold in 2015 or 20% growth rate.

Note that four of the five above references predict a 20% growth rate.

4.6. Future PEVs by State

The next phase of this report is to predict the sales and cumulative values of PEVs for the states of interest. These predictions will be done for Florida, Hawaii, Alabama and for comparison purposes for Georgia, California and New York. The process used will be the same as done above for the U.S. beginning with known values for 2013 and then using a 10, 15, 20, 25 and 35 percent growth rate. The determination of the number of PEVs by state is not directly found, however, there are several methods that were used for the 2013 values. First, the U.S. PEV sales are determined by ratioing with state population to the U.S. population. Also References 7, 8, 9, 10 and 11 all give state values, but not exact numbers for 2013. Comparing the state sales values with known values in some cases and with calculated values, the second column in Table 5 was selected as the 2013 values for each state of interest.

Table 5. PEV Sales for year 2023 by State

Sales	2013	10%	15%	20%	25%	30%	35%
US	96,702	251,000	391,000	599,000	901,000	1,333,000	1,944,000
FL	7,500	19,000	30,000	46,000	70,000	103,000	151,000
HA	1,800	5,000	7,000	11,000	17,000	25,000	36,000
AL	1,000	3,000	4,000	6,000	9,000	14,000	20,000
GA	3,500	9,000	14,000	22,000	33,000	48,000	70,000
CA	30,000	78,000	121,000	186,000	279,000	414,000	603,000
NY	3,400	9,000	14,000	21,000	32,000	47,000	68,000

Using the process of summary and sales for each year, Table 6 presents the cumulative sales for the year 2023 by state.

Table 6. Cumulative Sales by State

Cumulative Growth	2013	10%	15%	20%	25%	30%	35%
US	168,000	1,863,000	2,426,000	3,180,000	4,188,000	5,526,000	7,295,000

FL	7,500	139,000	183,000	241,000	319,000	423,000	560,000
HA	1,800	33,000	44,000	58,000	77,000	102,000	134,000
AL	1,000	19,000	24,000	32,000	43,000	56,000	75,000
GA	3,500	65,000	85,000	113,000	149,000	197,000	261,000
CA	30,000	526,000	700,000	935,000	1,247,000	1,662,000	2,211,000
NY	3,400	60,000	79,000	106,000	141,000	188,000	251,000

4.7. Barriers and Activities to Overcome Barriers

4.7.1. Barriers

The growth of PEVs during the beginning phase will be dependent upon the types of barriers and the actions or incentives to overcome the barriers. The barriers to large scale PEVs usage are as follows:

1. Vehicle cost.
2. Vehicle mileage between charging.
3. Vehicle maintenance and, in particular, battery life.
4. Availability of charging stations.
5. Charging time.
6. Infrastructure, standards, and permitting.
7. Public knowledge and education.

4.7.2. Actions to Overcome Barriers

President Obama announced the EV Everywhere Grant Challenge in March 2012. This announcement led the U. S. Department of Energy to set a technical action plan as follows (Reference 10).

The technical targets for the DOE PEV program fall into four areas: battery R & D; electric drive system R & D; vehicle light weighting; and advanced climate control technologies. Specific goals include:

- Cutting battery costs from their current $500/kWh to $125/kWh
- Eliminating almost 30% of vehicle weight through light weighting
- Reducing the cost of electric drive systems from $40/kW to $8/kW

These technical goals have a 15 year time frame.

The DOE challenges give actions toward barriers 1, 2, and 3. Barriers 4 and 5 are both in varying stages of development depending upon the location. For example, Orlando, FL has 300 Level 1 and Level 2 charging stations available for EVs. DC or fast charging is becoming more available throughout the U.S.

Barriers 6 and 7, Infrastructure, standards, and permitting, and education, again are solvable problems, but remain barriers dependent upon the U.S. location. An example of a standards

problem is the fact that present DC chargers have different plugs for charging dependent upon the vehicle manufacturer. This difference presents problems for public charging stations as to what type of plug for the public agency to supply.

5. Concluding Remarks

Predicted values of PEV yearly sales and cumulative sales have been presented based on 2013 data. As additional sales data is received, the results will be updated. The results for the U.S. show that the cumulative sales of EVs through 2013 is 167,600 vehicles with 96,700 sold in 2013 or that 58% of total vehicles were sold in 2013. Depending upon the escalation rate selected, the 10 year future U.S. sales (2023) are predicted to be from 250,000 to 1.9 million per year and the cumulative vehicles on the roads would be from 1.9 to 7.3 million vehicles. Comparing the presented results with predictions from other sources, a growth rate of 20% appears to be the most appropriate. A 20% growth rate will give U.S. sales of approximately 600,000 PEVs per year and cumulative sales of 3.2 million vehicles for 2023. This same 20% growth rate will give sales in Florida, Hawaii and Alabama of 46,000, 11,000 and 6,000, respectively. The cumulative vehicle sales for these three states are 241,000, 58,000, and 32,000 vehicles. California is predicted to sell 186,000 vehicles per year with cumulative sales of 935,000 vehicles.

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