

Plug-in Electric Vehicle Road Tax Analysis

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Introduction

The Idaho National Laboratory (INL) was asked if there is a known method for determining an annual fee for battery electric vehicles (BEVs) and plug-in hybrid electric vehicles (PHEVs), since the BEVs pay no road tax and the PHEVs pay only a partial road tax. These road taxes are based on gasoline purchases and the state fuel tax on each gallon of gasoline sold. Since INL was not aware of a method that used historical vehicle data, the below methods were developed. Actual use data from 21,627 BEVs and PHEVs was used. This data has been collected via various testing and analysis activities that the INL was involved in. The data includes 84 million miles of on-road data. Note that the INL takes no official position on the tax policies of the State of Idaho. This analysis was conducted per a request by the Idaho Association of Highway Districts.

Battery Electric Vehicles – Annual Miles Driven on Electricity

To estimate annual electric miles driven by BEVs, the weighted average distance traveled by 6,877 Nissan Leafs, Ford Focus Electrics and Honda Fit Electrics (Figure 1) is calculated. $(4039 / 6877 \times 9697) + (2193 / 6877 \times 9548) + (645 / 6877 \times 9680)$. The average is **9,648 annual electric vehicle miles traveled (eVMT) per BEV**. Note that this data represents a sample of 43.5 million miles of on-road data for BEVs that never use gasoline.

Plug-in Hybrid Electric Vehicles - Annual Miles Driven on Electricity

To estimate annual electric miles driven by PHEVs, the weighted average distance traveled by 14,750 Chevrolet Volts, Ford C-Max Energi, Honda Accord, and Toyota Prius PHEVs (Figure 1), must be calculated only using eVMT. Note that PHEVs, by nature of the technology, can be driven by using the electric energy stored in the vehicle's battery that is recharged via connecting to the electric grid, or by gasoline stored in the vehicle's gasoline tank. The PHEV all-electric miles driven are also known as eVMT. This analysis is based on publicly available results of previous analysis conducted by the INL (Figure 1)ⁱ. $(1867 / 14750 \times 9112) + (5368 / 14750 \times 4069) + (5803 / 14750 \times 4337) + (189 / 14750 \times 3336) + (1523 / 14750 \times 2484) = \mathbf{4,640 \text{ annual eVMT per PHEV}}$. Note that this data represents a sample of 40.5 million miles of on-road data.

Analysis Results



	Nissan LEAF *	Chevrolet Volt *	Ford Focus Electric	Ford C-Max Energi	Ford Fusion Energi	Honda Fit EV	Honda Accord PHEV	Toyota Prius PHEV
Number of Vehicles	4,039	1,867	2,193	5,368	5,803	645	189	1,523
Number of Vehicle Months	35,294	20,545	12,622	38,096	32,022	6,090	1,437	15,676
Total Vehicle Miles Traveled VMT (miles)	28,520,792	20,950,967	10,043,000	39,376,000	33,098,000	4,912,920	1,794,494	19,772,530
Total Calculated Electric Vehicle Miles Traveled eVMT (miles)	28,520,792	15,599,508	10,043,000	12,918,000	11,572,000	4,912,920	399,412	3,224,981
Avg. Monthly VMT	808.1	1,019.8	795.7	1,033.6	1,033.6	806.7	1,248.8	1,261.3
Avg. Monthly eVMT	808.1	759.3	795.7	339.1	361.4	806.7	278	207.0
estimated Annual VMT	9,697	12,238	9,548	12,403	12,403	9,680	14,986	15,136
estimated Annual eVMT	9,697	9,112	9,548	4,069	4,337	9,680	3,336	2,484
Data Format Description	Key-On / Key-Off	Key-On / Key-Off	Enhanced Key-On / Key-Off			Trip Summary		Trip Summary
Geographic Characterization	CA, OR, WA, AZ, TX, TN, GA, D.C., PA, IL	CA, OR, WA, AZ, TX, TN, GA, D.C., PA, IL	Nationwide			CA, OR, NJ, MD, CT, MA, RI, NY	CA, NY	ZEV States and other states

* <http://avt.inel.gov/pdf/EVProj/eVMTMay2014.pdf>

Minimally Charged Vehicles are Not Excluded from analysis. These data include 14% of Accord PHEVs that achieve between 0-50 monthly eVMT

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Figure 1. Slide 8 from the Idaho National Laboratory (INL) presentation “eVMT Analysis of On-Road Data from Plug-In Hybrid Electric and All-Electric Vehicles”. For the entire presentation, see http://avt.inel.gov/pdf/prog_info/eVMTAnalysisResultsOct2014.pdf.

The data in Figure 1 are based on data provided by the respective automotive manufacturers and shared with the INL for analysis during recent projects. A total of 158.5 million miles of data was provided to the INL, and the analysis results in Figure 1 used a subset of the data.

In order to calculate approximate fees for BEVs and PHEVs, the actual fuel taxes of comparable vehicles sizes and models were used (Table 1). Based on the combined city and highway test results published in the Department of Energy’s and Environmental Protection Agency’s 2014 Fuel Economy Guide, miles per gallon (mpg) use was identified. Therefore, a per mile fuel tax was calculated by dividing Idaho’s per gallon fuel tax of \$0.25 per gallon by the mpg of each internal combustion vehicle to develop a weighted average of 33.4 mpg. This same exercise could be repeated for each unique model, but it was assumed a single annual fee would be developed either for all BEVs and PHEVs, or one annual fee for BEVs and a second one for PHEVs. The calculations are discussed below.

Comparative Gasoline Vehicles – Fuel Economy

Table 1. PHEV and BEV models, and the comparative internal combustion engine (ICE) vehicle or hybrid electric vehicle (if an ICE model is not available) are listed below.

PHEV and BEV Models	ICE Model	ICE MPG ¹	2014 Fuel Economy Guide Page
Nissan Leaf	2014 Nissan Versa	35	P. 12
Chevrolet Volt	2014 Chevrolet Cruze	30	P. 14
Ford Focus BEV	2014 Ford Focus	31	P. 11
Ford C-Max Energi	2014 Ford Fiesta	34	P. 9
Ford Fusion Energi	2014 Ford Fusion	28	P. 14
Honda Fit EV	2014 Honda Civic HEV	30	P. 15
Honda Accord PHEV	2014 Honda Accord	29	P. 14
Toyota Prius PHEV	2014 Toyota Prius	50	P. 16
Average	Average	33.4	

1. Model Year 2014 Fuel Economy Guide
<http://www.fueleconomy.gov/feg/pdfs/guides/FEG2014.pdf> Combined mpg test results are used.

Calculated Fuel Tax per Mile Results

ICE Vehicles

The Idaho gasoline fuel tax is \$0.25 (<http://tax.idaho.gov/i-1119.cfm>). Based on the average miles per gallon of gasoline of 33.4, the average 2014 vehicle would pay the equivalent of \$0.007485 in fuel tax per mile driven ($\$0.25 / 33.4 \text{ mpg}$).

BEVs

Based on an average of 9,648 annual eVMT per year by BEVs, a calculated equivalent annual fuel tax would be \$72.22 ($9648 \times \0.007485).

PHEVs

Based on an average of 4,640 annual eVMT per year by PHEVs, a calculated equivalent annual fuel tax would be \$34.73 ($4640 \times \0.007485).

Company Profile

Idaho National Laboratory is one of DOE's 10 multi program national laboratories. The laboratory performs work in each of DOE's strategic goal areas: energy, national security, science, and the environment. Idaho National Laboratory is the nation's leading center for nuclear energy research and development. Day-to-day management and operation of the laboratory is the responsibility of Battelle Energy Alliance.

For more information about INL, visit www.inl.gov

For more information about the INL activity that produced this analysis, visit <http://avt.inel.gov/>

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ⁱ For a complete presentation on the methods used to calculate electric vehicle miles traveled by PHEVs, see: http://avt.inel.gov/pdf/prog_info/HybridSymposium2015CarlsonShirk.pdf