NJBPU Electric Vehicle Infrastructure (EVI) Stakeholder Work Group

December 20, 2017

Follow-up Task 1 Questions

Energy Efficiency of Plug-In Electric Vehicles

The energy efficiency of any vehicle may be measured and compared in several different ways. The most holistic is a two part evaluation termed "well to wheels" as follows:

1. Tank to Wheels
2. Well to Tank

1. Tank to Wheels (aka Pump to Wheels)

The energy efficiency evaluation of the fuel in the tank to supply the motion of the vehicle is called "tank to wheel". A tank to wheels energy efficiency evaluation could include gasoline, biofuels, hydrogen or electricity as the fuel in the tank to supply the motion of the vehicle. For this proceeding we are focused on gasoline for the Internal Combustion Engine (ICE) vehicles and electricity for Plug-In Electric Vehicles (EVs or PEVs) to supply the fuel for the motion of the vehicle.

As reported by the US Environmental Protection Agency (USEPA) and US Department of Energy (USDOE) on https://www.fueleconomy.gov , PEVs are significantly more energy efficient when compared to ICE vehicles under their tank to wheels analysis. The USDOE reports that EV are 74% to 94% efficient in converting the fuel (electricity) in the EV tank (batteries) into motion. This is compared to just 12% to 22% efficiency for the ICE vehicles in converting gasoline in the fuel tank to motion. See https://www.fueleconomy.gov/feg/atv-ev.shtml and https://www.fueleconomy.gov/feg/atv.shtml

The website http://www.fueleconomy.gov/ reports tank to wheels efficiency in terms of Miles Per Gallon Equivalent (MGPGe). The top 100 – plus vehicles in terms of MPGe rating are all PEVs.

2. Well to Tank

The second part of the overall energy efficiency evaluation to produce or generate the fuel and get the fuel to the tank is called "well to tank". This evaluation compares the energy efficiency of the production or generation of the fuel that goes into the tank. This fuel could include gasoline, hydrogen, biofuels or electricity as the fuel. For PEVs this includes the electric generation, transmission and distribution system processes. For ICE vehicles this includes the oil extraction, refining and gasoline distribution processes.

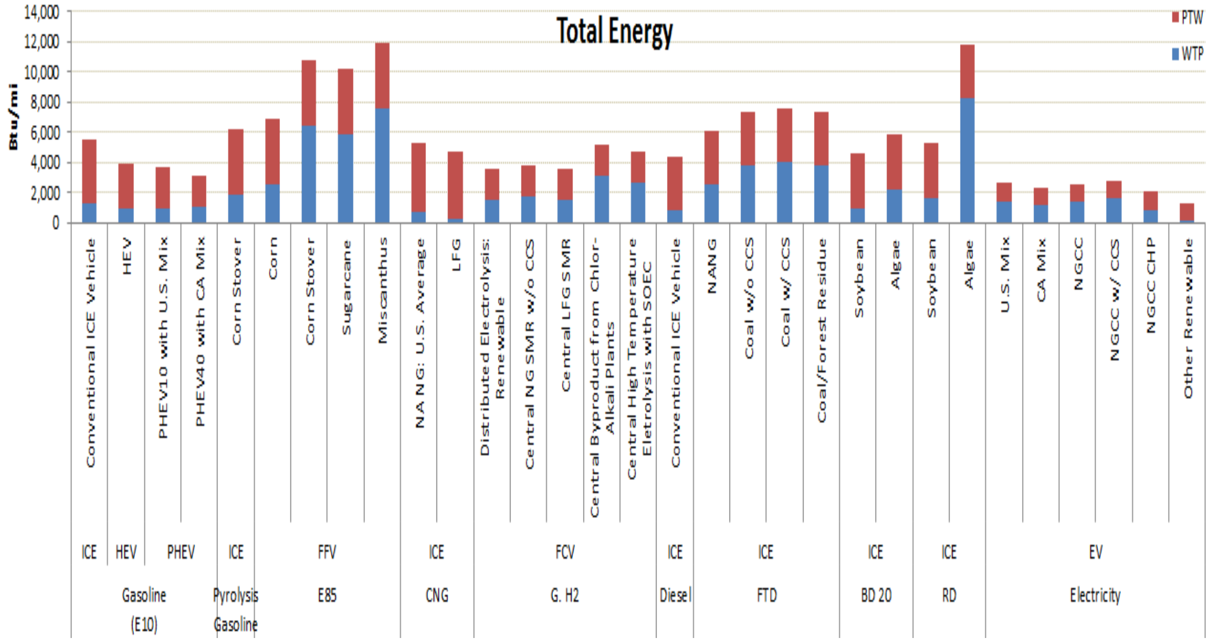
In terms of ICE vehicles and PEV, the well to tank energy efficiency evaluation is highly dependent on the electric generation source. Compared to coal and nuclear electricity generation, gasoline production through a refinery system is more efficient. For natural gas electricity generation this analysis depends on the combustion technology. Natural gas combined cycle electricity generation is about as efficient as refinery production of gasoline and natural gas simple cycles electricity generation is less efficient. However, in terms of renewable electricity generation like solar and wind, these generation sources are more efficient than gasoline production.

Well to Wheels

The chart below combines the wells to tank evaluation and the tank to wheels evaluation for a full well to wheels evaluation for all different type of fueled vehicles. (See https://greet.es.anl.gov/public/images/greet_sample_total_energy.png. The analysis was performed by the Argonne National Laboratory (ANL) for the USDOE AFDC using the Greenhouse gases, Regulated Emissions and Energy use in Transportation (GREET) model. (See https://greet.es.anl.gov/publication-c2g-2016-report)

Because of the significant difference in the tank to wheels energy efficiency of PEV over ICE vehicles, it is the USDOE AFDC conclusion that regardless of the fuel source for electric generation or the generation technology, EVs will be more energy efficient overall than ICE vehicles.

Based on the chart below and the analysis available on the ANL website, EVs are almost 3 times (300%) more energy efficient than a equivalent ICE vehicle under similar conditions. Based on the analysis below, on a well to wheels basis the ICE vehicle would have a 21 miles per gallon (MPG) rating versus the EV under a US electric generation mix of 58 MPGe versus the EV under a full renewable mix of 114 MPGe.



To cite some examples of fuel savings of PEVs vs average new vehicles, as reported in fueleconomey.gov – mandated window stickers:

- 2017 Chevrolet Bolt (all electric) $4,250 in fuel cost savings over five years
- 2016 Chevrolet Volt (a Plug-in Hybrid Electric Vehicle PHEV) $5,500 in fuel cost savings over five years

A PEV owner would get to the same locations with the same level of service using three (3) times less energy on a Btu basis and save about 50% of the cost. It is estimated that an PEV owner as an average New Jersey driver, even after paying the same amount of highway tax, would save over $500 per year or approximately $1,000 on a household basis.

Since the well to tank evaluation is highly dependent of the generation source for electricity within a state or region, the BPU has contracted with the Rutgers Laboratory for Energy Smart Systems (LESS) to conduct this state specific analysis.

Stakeholder Questions:

1 USDOE – AFDC Findings

1.1 Are the analysis and findings of the USDOE AFDC and ANL accurate and supported by other independent analysis? Please cite why or why not.

1.2 Should the NJBPU run the ARL GREET model for several different types of EV, ICE vehicles and other alternate fuel vehicles under different New Jersey driving conditions for various New Jersey electric generation mixes? Or not?

1.3 If the Rutgers LESS energy efficiency evaluation shows favorable results for PEVs under NJ driving conditions and a NJ energy mix, how should that information be leveraged by the BPU to accelerate the pace of EV adoption in NJ? If not what actions should be taken by BPU?

2 Energy Efficiency

2.1 Would an EV fueled by electricity from the current New Jersey electric generation sources be more efficient, less efficient or the same level of energy efficiency than the EVs noted in the ANL analysis? If so why? If not why not?

2.2 Would an EV fueled by a New Jersey electric generation mix meet the definition of **conserving energy** in the definition for energy efficiency as set forth at N.J.S.A. 48:3-98.1? If so why? If not why not?

2.3 Would an EV fueled by a New Jersey electric generation mix meet the definition of **using less electricity or natural gas** in the definition for energy efficiency as set forth at N.J.S.A. 48:3-98.1? If so why? If not why not?

3.0 Electric Systems Impacts

3.1 What could be the expected percentage increase in electric energy attributable to EVs result in by 2025, 2030 and 2050?

3.2 What could be the expected impacts and costs (positive and negative) on generation, transmission and distribution systems by the years 2025, 2030 and 2050?

4.0 Grid Integration, Demand Response and V2X (consisting of Vehicle to Grid (V2G), Vehicle to House (V2H), etc.

4.1 What is the state of the technology that could allow the EV to be utilized as a demand response technology? What is the availability of the technology now and how/when will that availability evolve? What actions should NJBPU take to take advantage of the use of EVs as demand response technology? If not why not?

4.2 V2X: Is the two way communication of the EV to the grid a commercially available technology or not? If so why? If not why not? What is the availability of the technology now and how/when will that availability evolve? What actions should NJBPU take and when to take advantage of the use of EVs in V2X technology?

4.3 Could the EV electric customer access the energy markets directly, through an aggregator or Network Operations Center (NOC), through the electric utility or blockchain?

4.4 If the EV could be utilized as a demand response technology in a two way communication with the grid, distribution and/or transmission, would the EV meet the definition of demand side management in N.J.S.A. 48:3-51? If so why? If not why not?

4.5 What are the types and level of benefits to the grid of EVs in a demand response program and what would be the overall costs to develop and implement this program?

4.6 If the EV could be utilized as a demand response technology, should the BPU consider changes to demand charges? If so why? If not why not?

4.7 Should the BPU consider the use of telematics (such as Con Edison's SmartCharge New York program) in any demand response program and to address changes to demand charges. If so why? If not why not?

4.8 If the EV is not using less electricity or natural gas per the definition for energy efficiency as set forth at N.J.S.A. 48:3-98.1 and the EV could be utilized as demand response for the EV to meet the definition of demand side management in N.J.S.A. 48:3-51, what could be the expected impacts on the grid for increased generation capacity by 2025, 2030 and 2050? What could be the level of costs and over what timeframe?

4.9 If there is an increase in electric energy usage from the increase in EV but not a generation capacity increase because of demand response of EV what would the increase efficiency of the grid be in 2025, 2030 and 2050? If not why not?

5.0 Electric Vehicle Supply Equipment (EV Charging Station) State of the Competitive Market

5.1 Is vehicle charging a fully competitive market across all market sectors (e.g. residential, public L2, public DCFC, low income communities and Multi Unit Dewllings)? If not which market sectors are not competitive and why not? Which market sectors are competitive? What is the business case for the EVSE industry and where does the business case fail?

5.2 If the charging market sections are not competitive should the utilities be allowed to develop managed charging programs for the non-competitive charging market sections? If not why not?

5.3 If the charging market sections are competitive should the utilities be allowed to develop managed charging programs for the competitive charging market sections? If not why not?

5.4 If the utilities are allowed to develop managed charging programs is there a time limit or other criterion that should be imposed on this participation? If so what timeframe? Should any utility managed charging program have a sunset date?

5.5 If the utilities are allowed to develop managed charging programs what guidelines should be developed for this participation? If not why not?

6.0 Utility Role in "Charge Ready"

6.1 Should electric utilities engage in rate-based "Charge Ready" programs? What additional measures beyond Charge Ready are appropriate in non-competitive markets? Should utilities offer rebates on EV chargers or own/operate EV chargers in non-competitive markets?

7.0 Advanced Metering Infrastructure (AMI) - Smart Grid / Smart Meters

7.1 What policies should the Board establish to take advantage of AMI, Smart Grid / Smart Meters with respect to the EV market?

7.2 Would a utility managed charging program support and supplement any smart grid (SG) or automatic meter initiatives (AMI)? If not why not and what programs should be developed instead of AMI? If so what would be the level and value of the benefit to and from the AMI programs. If not describe why not and what would be the level of value in any other program?