New Jersey Support for Plug-in Hybrid Electric Vehicles

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INTRODUCTION. The State of New Jersey has developed plans for dealing responsibly with the climate crisis. The principal approach is to reduce greenhouse gas (GHG) emissions, primarily carbon dioxide produced by burning the fossil fuels coal, oil, and natural gas. Of these fuels, coal emits the most carbon dioxide per unit of energy utilized, but because New Jersey already uses very little coal, oil is the biggest contributor to the state's emissions, and most of this is from the transportation sector. In 2018, for example, transportation was responsible for 42% of all GHG emissions in New Jersey[1]. Consequently, if future emissions are to be significantly lower, transportation fuel use will have to undergo radical change. Electric vehicles offer a promising approach to accomplishing this.

BACKGROUND. A battery electric vehicle (BEV) is driven by an electric motor that is powered by a battery. A plug-in hybrid electric vehicle (PHEV) is similar but differs from a battery electric vehicle in two ways. First, in addition to the electric motor used to propel it, it has an ordinary internal combustion engine that runs on gasoline or diesel fuel. Second, its battery is much smaller than the one in a BEV.

These two differences have ramifications. Most important is the fact that the PHEV can run on gasoline, because this fuel is readily available almost everywhere, and a gasoline fill-up requires only about five minutes. The BEV, on the other hand, needs access to electricity, either from a public charging station, of which there are presently very few, or from an ordinary 110-volt or 220-volt outlet, which can charge the battery only slowly. The range of a PHEV can easily be 500, or even 600, miles, whereas the range of a BEV is typically closer to 200 miles. This means that the owner of a BEV needs to plan trips carefully so as not to drain the battery to zero and be stranded where there is no way to recharge it. This need is the principal cause of "range anxiety", a term that describes a major impediment to the widespread adoption of BEVs by the general public.

[1] State of New Jersey Department of Environmental Protection "2018 Statewide Greenhouse Gas Emissions Inventory, October 2019", Figure 1

There is another important ramification. If a BEV is only used for short trips, the limited range poses no problem, and the vehicle can be charged at home overnight. But the PHEV, if it is to run on electricity as much as possible (which is the primary reason for owning a PHEV), must generally be recharged more often than once daily, since its battery is generally not large enough to cover distances of more than two or three typical trips (9.7 miles/trip is the national average).

The long-term goal for electric vehicles is to improve the BEV battery as well as the charging infrastructure (or perhaps develop a battery-swapping infrastructure), so that a BEV can take long trips as casually as is now possible with ordinary cars and trucks that run on gasoline or diesel fuel. But in the short-term, the PHEV is the more practical car, because it can use electricity for its many short trips and use gasoline for the less frequent longer ones. Eventually, as technological and infrastructure improvements make the BEV more practical, the PHEV will be phased out; but this process might well take decades.

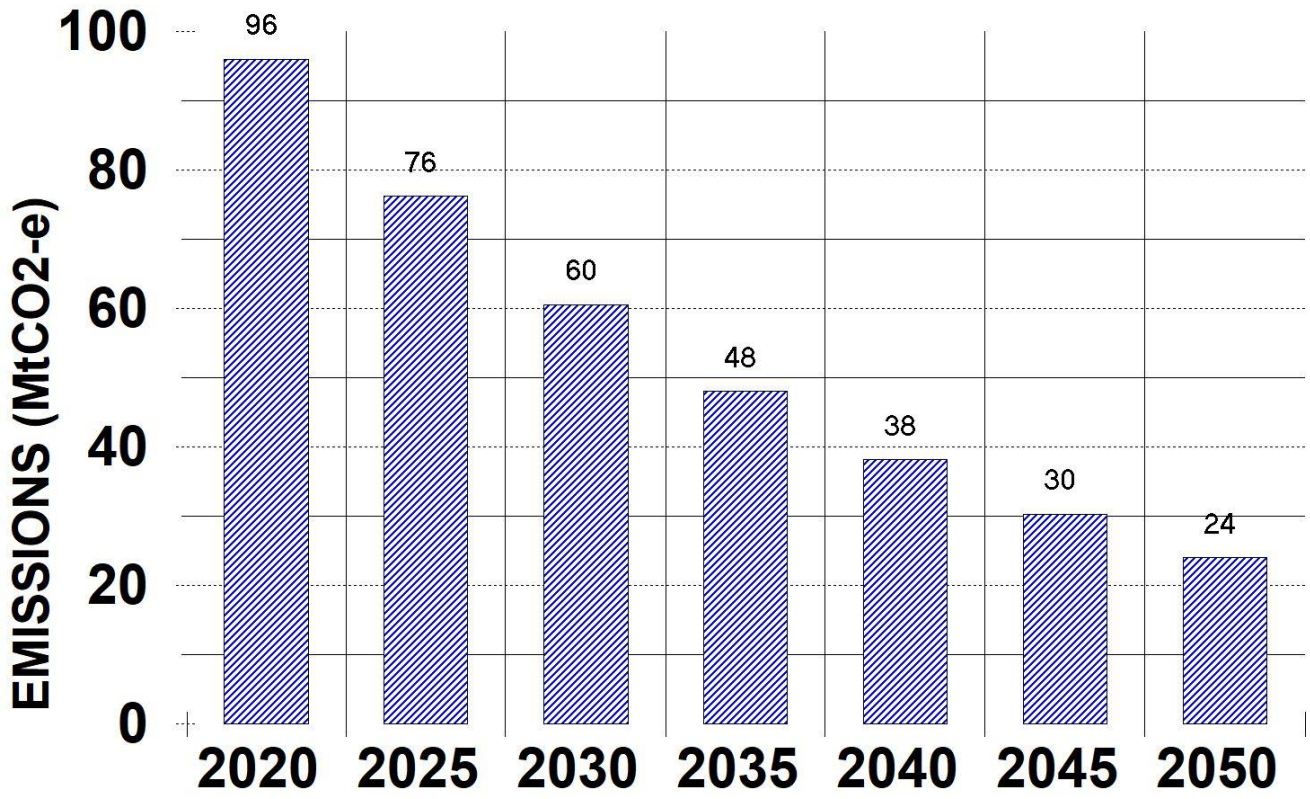
New Jersey provides support for BEVs in two ways. First it provides an exemption from sales tax on the purchase price of the car. Second, it has authorized utility companies to offer electricity rate plans that favor charging at night. In contrast to the BEV situation, the PHEV has essentially no state support in New Jersey. No tax exemption, not even a partial one, has been made available to PHEVs. Furthermore, a time-of-day rate plan is not advantageous for a PHEV, since charging the smaller battery must be done essentially whenever the vehicle returns home from a trip.

MOTIVATION. Is widespread ownership of PHEVs important to New Jersey, and if so, why? New Jersey plans to reduce greenhouse gas (GHG) emissions by 2050 to 20% of the 2006 level[2], which was 120.6 MtCO2-e. (In 2018, it was 97.0 MtCO2-e.) By 2021, 22.5% of electricity generated in New Jersey is to be from renewables. (As of January 2019, only 2.6% was from renewables.)

The 2021 renewables target is probably impossible to achieve. The 2050 emissions goal is a very difficult one. To get a better feel for just how hard this is, suppose that the emissions are reduced exponentially over the intervening three decades, starting in 2020 at 96 MtCO2-e. The intermediate targets every five years would be approximately 2025:76, 2030:60, 2035:48, 2040:38, 2045:30, 2050:24. This 2025 intermediate target requires a

[2] Global Warming Response Act, (GWRA) (P.L. 2007, c.112), July 6, 2007

reduction of 20 MtCO2-e from the 2020 level. How will this be accomplished in just 5 years? The two sectors that contributed the most to the 2018 emissions profile were transportation and electricity generation at 40.6 and 18.1 MtCO2-e respectively. These sectors are probably also the easiest ones to deal with. But if most of the cuts come from them, it means cutting 1/3 or more of their emissions in 5 years, a tall order for sure. How do we cut out 1/3 of all gasoline and diesel fuel? (And how do we replace 1/3 of all fossil-fuel burning power plants?) Surely the PHEV will have to be a critical part of any plan that proposes to solve this problem.



WHAT IS WRONG WITH THIS PICTURE? The problem is that large numbers of New Jersey residents will have to replace the vehicles they own with ZEVs (Zero Emission Vehicles) for which they may not want to pay a premium. Presently the most versatile ZEV is the PHEV (actually only a partial ZEV). But this versatility comes at a price, because the PHEV has two different motors, one fueled by electricity and the other fueled by gasoline. In order to reduce the buyer's extra expense for this dual system, the federal government authorized a tax credit of between $2,500 and $7,500 depending on the size of the battery. (However, this tax credit phases out after a model has sold 200,000 vehicles.) Many states

offer additional incentives for PHEVs, but not New Jersey. However, neither the federal government nor New Jersey does anything to lower the cost of running a PHEV on electricity, which is, of course, the way it should be run in order to reduce GHG emissions. Residential electricity in New Jersey averaged about 15.7¢ per kWh[3] in January 2019, slightly more expensive than the national residential average of 12.4¢ per kWh. Using fuel efficiency values for the 2017 Prius Prime PHEV as an example, at 15.7¢ per kWh, a gallon of gasoline would have to cost over $3.55, more than gasoline actually costs, for the owner to save half by running on electricity.

In a nutshell, here is what's wrong with this picture: (1) New Jersey offers no discount on the purchase of a PHEV, and (2) electricity is too expensive in New Jersey to be of significant benefit to a PHEV owner. That buying and operating a PHEV is too expensive in New Jersey is obvious from the registration numbers: as of June 2019 New Jersey had less than 12,000 registered PHEVs, well under 1% of the 2.8 million registered cars.

WE CAN FIX THIS PICTURE. To make PHEVs attractive to New Jersey residents, the net purchase price of a PHEV must be no greater than the purchase price of a comparable non-PHEV. First, the state government should provide an exemption from the sales tax on the purchase of a PHEV. Second, the per-mile cost of the electricity used to drive the vehicle must be well below the per-mile cost of gasoline. In other words, "electric miles" must be significantly cheaper than "gasoline miles". The state government, in particular the Board of Public Utilities and the Department of Environmental Protection, should investigate the details and produce a plan to implement a rate structure that will motivate large numbers of New Jersey residents to buy and drive PHEVs, so that the state can reduce GHG emissions from the transportation sector.

[3] www.eia.gov/electricity/monthly/epm_table_grapher.php?t=epmt_5_6_a