Caesar Rodney Institute

A Review of Gabel Associates, Inc. Report, "Benefit Cost Analysis for Electric Vehicle Adoption in the Delaware DPL Territory"

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Table of Contents

Executive Summary

Delmarva Power has applied for approval by the Delaware Public Service Commission of a "Voluntary Program for Plug in Vehicle (PIV) Charging" in Docket 17-1094. In support of the application, Delmarva has submitted a report by Gabel Associates, Inc. titled, "Benefit Cost Analysis for Electric Vehicle Adoption in the Delmarva DPL Territory" (herein referred to as the Gabel Report[1]). This report reviews key assumptions used in the Gabel Report and finds significant disagreement with the findings:

1) Delmarva's application consists of three very different topics: establishing Time-of-Use rates to encourage charging at off-peak times, subsidizing charging infrastructure investment at ratepayer expense, and subsidizing electric bus purchases at ratepayer expense. Gabel incorrectly conflates all three issues in a single Benefit Cost Analysis (BCA) when each topic should be determined separately.
2) Delmarva Power claims experience with PIV charging is needed. Delmarva sister companies Delmarva Power Maryland, and Baltimore Gas & Electric are already working under utility commission orders to gather the same information on a much larger population base, and six times the existing fleet of PIVs.
3) This study uses more recent, credible sources, such as U.S. government 2018 reports from the Energy Information Agency (EIA), Census Agency, and Environmental Protection Agency (EPA) to establish reasonable assumptions for future PIV fleet size, future battery cost reductions, and the value of externality benefits.

Table 1 below reorganizes the Gabel Report most optimistic BCA compared to a conservative case, and only considers the impacts on non-PIV owners in the DPL Zone. The Delmarva application should be denied as neither "Just", nor "Reasonable", because costs exceed benefits using conservative forecasts to limit ratepayer risk.

Table 1: NPV (5.5% discount factor) Benefit Cost Analysis Comparison Delmarva PIV Plan

BCA for Non-PIV Owners in DPL Zone	**Gabel Report SCT Case $ millions**	**Conservative Case $ millions**
Avoided Wholesale Energy Benefit	$53.9	$25.4
Avoided Capacity/Transmission/Distribution Benefit	$116.4	$54.7
Avoided Emissions Benefit	$123.5	$3.5
Total Benefits	**$293.8**	**$83.5**
Direct Ratepayer Contribution Cost	$2.1	$2.1
Grid Reinforcement Cost	$56.1	$26.4
Non-Utility Charging Infrastructure	$137.8	$64.8
Federal;/State Tax Credits to PIV Owners Cost		$59.4
Total Cost	**$196.0**	**$151.6**

Note: Conservative Case uses EIA fleet size forecasts, and highest confidence, current EPA assumption of health benefits only for avoided emissions above NAAQS, a lower Social Cost of Carbon, and a 7% discount rate.

The costs are real and measureable, but the benefits are theoretical and not measureable, and the ratepayers carry the risk if the benefits don't materialize. To increase the confidence in the benefits, and to remove the risks from the ratepayers, the following is recommended:

1) As the environmental externalities have such a high uncertainty they should be excluded from the BCA.
2) If Delmarva has confidence in the cost savings from increased non-peak electric demand, they should agree to a credit on electric bills for each PIV added to the fleet. If a third party such as PJM or EIA confirms the higher off peak demand is lowering electricity supply charges, then the credit would be zero.
3) The Gabel Report assumes there will be a mechanism to collect avoided fuel tax compensation from PIVs. Docket approval should be delayed until such a fee is legislated.

Background

The current state of the PIV market is epitomized by the Chevrolet Bolt PIV, and the comparable internal combustion engine (ICE) Cruze compact hatchback. The Bolt costs $17,000 more, the buyer may invest another $1,300 in a home charger, and the Delaware Division of Motor Vehicles will charge an extra $765 Document Fee for a total initial cost differential of about $19,000. Over the expected 100,000 mile life of the Bolt battery pack the owner will save about $5,250 in fuel costs as electricity is cheaper than gasoline. However, our analysis indicates the difference in vehicle resale value wipes out the fuel savings, an issue the Gabel Report doesn't address. Also in our analysis other cost factors, such as, finance charges, maintenance, auto insurance, and fuel tax compensation are a wash. Bottom line, The Bolt will cost about $8,000 more over the 8 year, 100,000 life of the vehicle.

The Gabel Report assumes there is significant value of environmental externalities to offset the cost differential. They report a 9 ton savings in carbon dioxide emissions over the 100,000 mile life of the average PIV (actual 12.5 ton advantage for the Bolt compared to the Cruze, see page 11), along with co-benefits of the avoided health cost from lower air pollution emission. The $19,000 initial cost premium means the carbon dioxide emission reduction may cost over $1,520 a ton. The Gabel Report values carbon dioxide emissions reductions at $55 a ton in 2035. The most recent Regional Greenhouse Gas Initiative (RGGI) allowance auction had a price of $4.50 a ton, comparable to the current U. S. Environmental Protection Agency estimate of the 2035 value of between $2 and $9 a ton. Depending on PIVs for carbon dioxide emission benefits costs 338 times the RGGI program. Using the latest, most conservative EPA assumptions reduces the Gabel Report externalities estimate by 94 percent.

The price differential for PIVs is a huge barrier to market success. The Bolt receives a $7,500 federal Investment Tax Credit (ITC), a $3,500, state grant, and $500 state grant towards the in home charger. The federal tax credit will wind down in 2019 as only the first 200,000 vehicles qualify. The federal grants come from all tax payers, and the state grants come from RGGI allowance revenue paid for by all electric customers. Since higher income families are the primary current customers for PIVs, the subsidies transfer money from the poor to the rich.

The federal tax credit phases out after PIV model sales exceed 200,000 vehicles. The Tesla models, and the Chevrolet Bolt, together representing over 80 percent of PIV sales in February, 2018, according to the EV Obsession website (https://evobsession.com/electric-car-sales/), will no longer be eligible for the federal ITC sometime in 2019. A lot of uncertainty surrounds the future cost of PIVs, and the continuation of government subsidies. That means the forecast of future sales is likewise uncertain.

The higher cost of the Bolt is driven by the cost of the battery pack. The announced replacement cost for the battery pack is about $16,000. The key question for PIV market success is how fast battery cost will fall. The Gabel Report assumes the price premium for PIV vehicles will disappear in 2031, and there may be about 80,000 PIVs in the DPL zone by 2035. In contrast, the EIA, in its 2018 Annual Energy Outlook (AEO) expects the price premium for vehicles like the Bolt will still be $11,000 in 2035, and the PIV fleet may be about 37,000 vehicles, assuming government subsidies continue.

Another barrier to PIV sales is range anxiety, the concern there will be nowhere to recharge the battery. The Gabel Report states on page 29 the utility program "seeds the market", and leverages the proposed $2.2 million Delmarva investment into $297 million in matched investment by other parties. The Gabel report estimates 5,565 public charging stations will be needed by 2035, and the Delmarva program would represent 0.07% of the charging stations in Delaware. It is a huge stretch to assume Delmarva's direct investment in only four public charging stations is needed to boost the PIV market in a meaningful way.

Delmarva plans to invest $400,000 in BEV buses. DNREC's Kathleen Harris responded in DPA-7 that DNREC has received $9.5 million as part of the Volkswagen Mitigation Trust Fund which can be used for electric buses. The Delmarva investment would be an un-needed duplication if the sole purpose is to gather information. Gabel offers no bus specific BCA, and I calculate no offsetting benefits.

PIV Delaware Fleet Forecast Detail

A key assumption is the future size of the PIV fleet out to 2035. On page 9 of the Gabel Report a chart shows annual PIV sales projections from various sources for the period 2017 to 2025, and trend lines for conservative (19%/yr.), moderate (27%/Yr.) and aggressive (37%/yr.) growth forecasts, assuming a national starting point of 250,000 vehicles in 2017. Gabel states, because of Delaware specific incomes, demographics per capita vehicle ownership, and Delaware PIV incentives, "These factors support the estimated growth rates of 40% a year for BEVs, and 30% a year for PHEV's (34.9% blended rate)". Gabel has basically chosen an aggressive growth rate. Furthermore, while the forecasts from the various sources only extend to 2025, Gabel extends these aggressive growth rates out to 2035.

In contrast, the EIA AEO 2018, Table 40, "Light Duty Vehicle Stock by Technology Type", assumes a net annual fleet growth rate of 38% a year from 2017 to 2025 for BEVs, and

12% a year for PHEVs. However, from 2025 to 2035, the fleet growth rate drops to 2.5% a year for BEVs, and -1.5% a year for PHEVs. The fleet change rate includes new sales minus retirements as vehicles age out. Table 2 compares the Delaware fleet size estimate by the Gabel Report to an estimate using the EIA Table 40 data.

Table 2: Comparative PIV Fleet Size - thousands

Year	Gabel Report Forecast	US EIA Forecast
2025	6.0	12.0
2035	80.0	37.4

U.S. EIA, Annual Energy Outlook 2018,
Table 40 "Light Duty Vehicle Stock by Technology Type",
https://www.eia.gov/outlooks/aeo/tables_ref.php

As mentioned above, the Gabel Report claims certain Delaware demographics might encourage a higher rate of PIV ownership in Delaware. In Table 3 we show the statistical correlation of PIV ownership in the top twenty states with the demographic issues Gabel highlighted as being favorable. Zero equals no correlation, and 1 or -1 equals perfect positive or negative correlation. Generally, a result between 0.2 and -0.2 is considered to be no correlation. We see no correlation based on the number of households with no vehicles, a weak correlation with Median Household Income and vehicles per capita, and a strong negative correlation with the percent of owner occupied homes. There is a modest correlation between PIV ownership and access to High Occupancy Vehicle (HOV) lanes, however, Delaware has no HOV lanes. The Gabel Report claims of Delaware being especially favorable to PIV ownership are simply wrong.

Table 3: Demographic Correlation with PIV Ownership in Top Twenty PIV States, Appendix 1

Demographic	Correlation
Median Household Income	0.29
% Owner Occupied Housing	-0.60
Vehicles per 1000 People	0.23
% Households With No Vehicle	-0.15
PIV Incentive Investment per State	0.88
Access to HOV lanes	0.43

The flattening growth rate for the PIV fleet in the EIA forecast reflects a slowing rate of price reductions after 2025 of PIV vehicles. U.S. EIA, Table 53, "New Light Duty Vehicle Pricing", shows significant price reductions for PIVs through 2025, but modest changes thereafter as shown in Table 4. Presumably, much of the price differential between vehicle types, and changes over time, are related to battery cost. Battery prices should come down as volume increases, but the rate of improving economies of scale decline with time. The EIA forecast reflects that fact.

Supporting this notion, Tesla has built the largest lithium ion battery manufacturing plant in the world which will double battery capacity worldwide, and claims it was producing at a 20

gigawatts-hour rate in mid-2018, about 30% of eventual capacity[2]. However, Greentech Media reported Tesla raised the price of its Powerwall battery pack over 7% in April, 2018, suggesting battery costs are not dropping[3]. The Powerwall is produced at the Tesla battery factory. The Gabel Report states on Page 28, section 1, they have assumed a 10% a year price reduction for PIVs from 2018 to 2030, with no reductions beyond 2030 when PIVs will have no price premiums compared to conventional vehicles. The EIA estimate of price reduction varies from 1% a year for PHEV with a 40 mile range to 2.5% a year a BEV with a 300 mile range after 2025, a dramatic difference in assumptions. The average price premium for PIVs in 2035 could still be as high as about $10,000.

Table 4: Light Duty Vehicle Pricing by Technology Type, midsize car – thousands $2017

Technology Type	2017	2025	2035
Gasoline ICE	23.4	24.9	25.1
Gasoline/electric hybrid	28.8	29.3	28.8
BEV 100 mile range	39.5	33.5	31.7
BEV 200 mile range	48.3	38.8	36.2
BEV 300 mile range	60.9	46.1	42.3
PHEV 10 mile range	33.9	32.6	31.4
PHEV 40 mile range	39.2	35.9	34.2

U.S. EIA, Annual Energy Outlook 2018, Table 53, "New Light Duty Vehicle Pricing", https://www.eia.gov/outlooks/aeo/tables_ref.php

The Gabel Report also claims the existing Delaware incentives of up to $3,500 a vehicle, and up to $500 for charger installation, plus the proposed Delmarva charger subsidies, and Time-of-Use rates will boost PIV sales in Delaware, if continued. However, in response to discovery question 2-2.53 from the Delaware Public Advocate, Gabel replies the Delaware incentives for PIVs are not included in the BCA.

We do agree incentives are the key to overcoming the obstacle of high PIV prices. The correlation between the rate of PIV ownership, and the amount of money a state has invested in subsidies is 0.88 (Table 3). PIV sales have collapsed in jurisdictions that end incentives. Dr. Wayne Winegarden reports for the Pacific Research Institute in his article titled "Costly Subsidies for the Rich"[4],

> *For example, after Hong Kong eliminated its tax break for EVs in April 2017, registrations of new Tesla electric cars in Hong Kong fell from 2,939 to zero. Similarly, after Georgia eliminated its $5,000 EV subsidy in 2015, EV sales fell 89 percent in two months. These drastic sales reductions are an indication that the demand for EVs is based solely on the distortions created by government subsidies.*

Similar rapid growth forecasts were made for gas/electric hybrids but market share growth has stalled, and hasn't moved much beyond early adopters. EIA Table 40 data shows market share peaked at about 3 percent in 2013, and has fallen to about 2 percent of annual sales as gasoline prices fell.

I recommend any BCA include a conservative case using the EIA PIV forecasts for both volume forecast and the price premium forecast. The risk the forecast may be much lower without the continuation of federal and state subsidies should be highlighted. We also recommend the $3,500 per vehicle Delaware, and $7,500 per vehicle federal subsidies be assumed to continue indefinitely.

Another barrier to PIV sales is range anxiety, the concern there will be nowhere to charge the battery if it runs out of charge. The Gabel Report states on page 29 the utility program "seeds the market", and leverages the proposed $2.2 million Delmarva investment into $297 million in matched investment by other parties, and counts the additional investment as a benefit. It is a huge stretch to assume Delmarva's direct investment of $892,000 in 114 charging stations, only four of which are public charging stations, is needed to boost the PIV market in a meaningful way. DNREC's Kathleen Harris responded to Delaware Public Advocate (DPA) question 2, there are 37 public charging stations already in Delaware, so the Delmarva program would increase availability of public charging stations by 11 percent. Further, the Gabel report estimates 5,565 public charging stations will be needed by 2035, and 140,737 residential charging stations. The Delmarva program would represent 0.07% of the charging stations in Delaware.

DNREC provided the usage rate of its Dover public charging station over an eighteen month period ending in December, 2017, as only about 1% of the time with similar usage rates in four other stations in Kent and Sussex Counties. If there is additional charging infrastructure built by others in Delaware it will not be a result of the Delmarva program, and there doesn't appear to be a large demand for existing public stations.

The Benefit of Carbon Dioxide and Air Pollution Emission Reductions

The EPA repeal of the Clean Power Plan was published in the Federal Register in October, 2017, and was followed by the announcement of its replacement, the Affordable Clean Energy Rule (ACE) in December, 2017. Both actions made new assumptions about the value of emission reductions following presidential Executive Order 13783 published in March, 2017[5] disbanding the Interagency Working Group, and listing its work as no longer representative of government policy. This replaces earlier EPA guidance on how to calculate the value of emission reductions, and should have been used in the Gabel Report. The older Interagency Working Group estimate of the Social Cost of Carbon made basic errors such as comparing global benefits to domestic cost, and used a 3 percent discount rate instead of both a 3 percent and 7 percent rate required by the Office of Management & Budget Circular A-4. The old 2035 estimate at a 3 percent discount rate was $55/ton[6], and the new estimate is $9/ton falling to $2/ton if a 7 percent discount rate is used[7].

The Gabel Report, page 16, states each PIV will avoid 9 tons of carbon dioxide emissions over the forecast period. The average price differential in 2035 between PIVs and ICE vehicles is about $10,000. That means each ton of carbon dioxide reductions costs $1122, twenty times more than Social Cost of Carbon used by the Gabel Report to value reduced carbon dioxide emissions, 561 times the most conservative estimate of the value of emission reductions.

The EPA has also reduced the estimates of the benefits of ozone and $PM_{2.5}$ (fine particle) air pollution avoidance. In the ACE Rule, Regulatory Impact Analysis (RIA), Table 4-11[7] the avoided health benefits of reduced emissions are provided for several cases, and three different concentration response functions.

In the past the only concentration response function used was the assumption fine particle and ozone pollution had harmful health impacts at any level, and responded in a linear fashion. For example, half the concentration exposure resulted in half the health impacts. This is generally known as a No Threshold Model. What the EPA points out in the ACE and CPP repeal actions is, while this may be true, the assumption has great uncertainty. In fact, in toxicology there is always a threshold. Consider both digitalis and aspirin are poisonous at high doses, but both have important medical benefits at lower doses.

The EPA now lays out health benefits in two other cases. The bulk of the various toxicological, clinical and epidemiological evidence in the studies used by the EPA tend to cluster around a narrow range of minimum exposure concentrations termed the Lowest Measured Level (LML).

The EPA also uses a more rigorous standard for the science used to set National Ambient Air Quality Standards (NAAQS), and is set at higher exposure levels. For example the NAAQS for fine particle pollution is set at a maximum exposure of 12 micrograms per cubic meter compared to about half that exposure at the LML, and essentially zero in the case of No Threshold limits. However, the certainty of the health benefits estimates goes up when the concentration response function is set for exposures only above the LML, or NAAQS. In denying DNRECs Section 126 Petition regarding upwind power plants, the EPA conducted detailed Modeling and demonstrated Delaware would be in full NAAQS attainment in the early 2020s[8].

Table 5: Summary ACE Rule Concentration Response Function Cases for 2035, 3%/yr. Discount

Concentration Response Function	**Average Emissions Reductions Benefits Billions 2016$**	**% of No Threshold Case**
No Threshold	$6.65	
Above Lowest Measured Level	$3.25	49%
Above NAAQS	$0.55	8%

The average avoided health benefits for the Reference Case in ACE, RIA Table 4-11

The bottom line is the Gabel report should include a conservative case using the updated 96% lower estimate of the global warming benefit of reduced carbon dioxide emissions, and the 92% lower health benefit of reduced fine particle and ozone emissions. The Gabel Report provides a calculated Net Present Value of $123.5 million for the benefits of avoided emissions in a table on page 36 of their report. A conservative value using the ACE estimates would be

about $7.4 million. The $7.4 million is further reduced to $3.5 million by considering the 53 percent reduction in PIV fleet size forecast.

The Benefit Cost Analysis to PIV Owners

The Gabel Report assumed savings for PIV owners including, "The long term NET savings reflect the combination of avoided gasoline costs, incurred electricity for charging, and avoided costs for maintenance. The analysis also assumes that PIVs incur an additional expense that replenishes lost gas tax revenues to ensure infrastructure funding (Page 32 d)". The alternative analysis below also includes the impact of document fees, financing, insurance, and the residual value of the vehicles at the 100,000 mile point. One of the more popular, and lower cost, Battery Electric Vehicles with a medium range (238 miles with 60 KWh battery) is the 2019 Chevrolet Bolt which compares to the Chevrolet Cruze Hatchback in size and features[9], and will be used in this BCA.

The Gabel Report assumed a PIV is retired from the fleet after 8 years or 100,000 miles, the length of the typical battery warranty. Battery replacement is likely to be prohibitively expensive. Replacement of the Bolt battery costs $15,734 [10]. Retiring a PIV may also cost the vehicle owner a fee to dispose of the batteries so there may be little residual value for a PIV. A typical conventional gasoline Internal Combustion Engine (ICE) vehicle remains in the fleet for fifteen years, and for example, an eight year old Cruze with 100,000 miles has a Kelly Blue Book value of about $5,364.

Lithium ion batteries in PIVs are currently being recycled on a limited basis as the value of the reclaimed materials doesn't cover the cost of recovery[11]. Theoretically, used batteries still hold a charge, and could be used for electrical grid energy storage, but the small savings from used batteries, after shipping and processing, may not be worth the loss of performance in the storage system.

As shown in Table 4, a price premium for PIVs continues through 2035. PIV buyers will either pay a higher price for their vehicles without federal and state subsidies, or subsidies will continue to offset the cost. Either way the cost is still there. The difference is who pays. If subsides end the PIV buyer pays and the added cost should be applied to the PIV owner's BCA as a cost. If the subsidies continue the cost is shifted to society as a whole. The Gabel Report simply ignores the cost differential. Gabel assumes the state subsidy ends by 2031, and the federal tax credit continues, but is paid by taxpayers in other states. However, if the PIV market grows to a significant share of the vehicle market, PIVs will be sold in every state. Delaware taxpayers will pay for the federal subsidies used in Delaware. I recommend both the federal and state subsidies be assumed to continue through 2035.

The base level Bolt has a Manufacturers Suggested Retail Price (MSRP) plus destination charge of $37,495, compared to the Cruze at $20,495. The Bolt qualifies for the Federal $7,500 ITC, and the Delaware $3,500 grant, plus $500 towards a charger. An in home Level 2 charger is estimated to cost $1305 [12]. The net after subsidy price for the Bolt, including the charger, is $27,300 versus $20,495 for the Cruze. Five year financing cost for the $6800 difference at a 4.5

percent interest rate would be $806. An actual insurance quote came in $158 higher over five years for the more expensive Bolt.

Much is made about the difference in maintenance costs between ICE and PIV vehicles. However, the basic difference is ICE vehicles need to change the engine oil and filter every 5,000 miles, and the air filter every 30,000 miles. The oil and filter will be changed about 19 times in 100,000 miles at $55/change (actual quote), or $1045 total. Air filters will be changed three times for $25 each (actual quote) for a total cost of $75. Regenerative brakes on the Bolt might save brake wear, but the Bolt (3,563 pounds) is 26 percent heavier than the Cruze (2,835 pounds) adding extra wear on brakes and tires, so tire and brake costs will be ignored for this BCA. The higher maintenance cost for the Cruze is essentially offset by the higher finance and insurance costs for the Bolt.

Titling a new vehicle in Delaware requires payment of a 4.5% document fee based on the purchase price. The Bolt owner will pay the document fee on the $17,000 difference in purchase price, or an extra $765. The Cruze will use 2703 gallons of gasoline in 100,000 miles, and will pay $0.414/gallon in federal and state fuel taxes, or $1119, to be used for highway maintenance and expansion. To even up the contribution the Bolt owner should pay an additional $354 fee on top of the current document fee.

The Cruze has a combined EPA mileage estimate of 37 miles per gallon. The Bolt gets 3.6 miles per KWh. The Cruze will use 2703 gallons of gasoline at $2.60/gallon for a fuel cost of $7,028, and emits 18.9 pounds/gallon of E10 gasoline[13], or 25.5 tons of CO_2. The Bolt will use 27,778 KWh of electricity $0.064/KWh at the current Delmarva residential rate, or $1,778 in fuel cost, and emits 0.933 pounds/KWh (PJM Systems Mix)[14], or 13 tons of CO_2, 12.5 tons less than the Cruze.

Table 6 provides a comparison after 100,000 miles of travel based on the above assumptions, and the Bolt costs 36 percent more than the Cruze including resale value or 10 percent more excluding the resale value.

Table 6: Chevrolet Bolt vs. Cruze Cost Comparison after 100,000 Miles Driven

	Bolt	**Cruze**
Net Initial Cost	$27,300	$20,495
Finance Charge Difference	$806	$0
Fuel Cost	$1,778	$7,028
DMV Document Fee Difference	$765	$0
Fuel Tax Compensation	$354	$0
Engine oil, oil filter, air filter	$0	$1,120
Auto Insurance Difference	$158	$0
Resale Value	$0	($5,364)
Total Cost	$31,161	$23,279

Other maintenance costs such as tires, brakes, wipers, and lights are assumed to be equal

Conclusion

The values of key assumptions in the Gabel Report are significantly overstated:

1. Gabel – Premium cost of PIV vehicles will drop 41% on average by 2031 to become competitive with ICE vehicles, and government subsidies will stop
   EIA – Premium cost of PIV will only drop 22% on average by 2035, and the current amount of government subsidies will need to continue through the 2019 to 2035 period
2. Gabel – PIV fleet size in the Delmarva DPL zone will grow 35 percent a year, to 80,000 vehicles
   EIA – PIV fleet will grow 23 percent a year to 37,400 vehicles
3. Gabel – Certain demographics in Delaware will cause fleet size to grow faster than the average state
   U.S. Census – Correlations of historical demographic data to fleet size by state disprove the claim Delaware PIV fleet size will grow faster than other states
4. Gabel - The NPV of the benefits of avoided health costs of reduced emissions is $123.5 million
   EPA – Using more up-to-date assumptions the value falls 97 percent to $3.5 million
5. Gabel – PIV owners will experience benefits 4.6 times costs
   CRI Bolt vs. Cruze actual – PIV owners will experience 1.36 higher costs than benefits
6. Gabel – Non-PIV owners will experience benefits 1.5 times costs
   EIA/EPA – Non-PIV owners will experience costs 1.82 times benefits

The Delmarva Power application for the "Voluntary Program for Plug in Vehicle (PIV) Charging" in Docket 17-1094 should be denied as neither "Just", nor "Reasonable", because costs exceed benefits. Our study uses more recent, credible sources, such as U.S. government 2018 reports from the Energy Information Agency, Census Agency, and Environmental Protection Agency to establish reasonable assumptions in an alternative Benefit Cost Analysis.

Notes:

1) Gabel Associates, July 6, 2018, "Benefit Cost Analysis for Electric Vehicle Adoption in the Delaware DPL Territory", file:///C:/Users/dtste/AppData/Local/Packages/Microsoft.MicrosoftEdge_8wekyb3d8bbwe/TempState/Downloads/Original%20Report%20(1).pdf
2) Tesla website https://www.tesla.com/gigafactory
3) Greentech Media, "Tesla Quietly Raised the Price of Powerwall", April 19,2018, https://www.greentechmedia.com/articles/read/tesla-quietly-raised-the-price-of-the-powerwall#gs.37Bq7kY
4) Pacific Research Institute, "Costly Subsidies for the Rich", February, 2018, Wayne Winegarden, https://www.pacificresearch.org/government-electric-car-subsidies-are-costly-subsidies-for-the-rich-finds-new-study/
5) Executive Order 13783, Section 5, published March, 2017, https://www.whitehouse.gov/presidential-actions/presidential-executive-order-promoting-energy-independence-economic-growth/

6) Interagency Working Group on Social Cost of Greenhouse Gases, United States Government, August, 2016, Table ES-1, Page 4, https://www.epa.gov/sites/production/files/2016-12/documents/sc_co2_tsd_august_2016.pdf
7) Affordable Clean Energy Rule, Regulatory Impact Analysis, Table 4-1, page 4-4, and Table 4-11, page 4-39 https://www.epa.gov/sites/production/files/2018-08/documents/utilities_ria_proposed_ace_2018-08.pdf
8) EPA Section 126 response, EPA-HQ-OAR-2018-0295, Federal Register, https://www.gpo.gov/fdsys/pkg/FR-2018-06-08/pdf/2018-12453.pdf
9) Chevrolet website, https://www.chevrolet.com/cars/cruze-compact-car/specs-trims
10) Transport Evolved, November, 2018 Chevy Bolt 60 KWh = $15,734 or $262/KWh, https://transportevolved.com/2017/06/15/should-you-worry-about-battery-replacement-costs-for-electric-cars/
11) Energy Storage News, "Recycle vs. Reuse: Why EV batteries may not often get a second-life as stationary storage systems", January 25, 2017, https://www.energy-storage.news/blogs/recycle-vs-reuse-why-ev-batteries-may-not-often-get-a-second-life-as-statio
12) Home Fixated, https://homefixated.com/level-2-charger-installation/
13) U.S. EIA, "How much carbon dioxide is produced from burning gasoline and diesel fuel?", https://www.eia.gov/tools/faqs/faq.php?id=307&t=11
14) PJM Interconnection, LLC, Systems Mix November, 2017, to October, 2018, https://gats.pjm-eis.com/gats2/PublicReports/PJMSystemMix

Appendix 1

Electric vehicle ownership by state compared to demographics

State	2011-2016 EV Ownership	2016 Population	EV/1000 People	2016$ Median Household Income	2004 % Owner Occupied Homes	2017 Vehicles/1000 people	2016 % No Households with no car	2017 EV Subsidy Cost $million	CA ZEV	2015 HOV Access
California	257,937	39,296,476	6.56	$ 66,637	58.5	840	7.6	456.8	yes	1
Hawaii	5,306	1,428,683	3.71	$ 72,133	58.9	872	8.4	2		1
Washington	21,647	7,280,934	2.97	$ 70,310	64.1	870	7			0
Oregon	11,407	4,085,989	2.79	$ 59,135	63	896	7.9		yes	0
Georgia	25,502	10,313,620	2.47	$ 53,527	67.7	829	6.9	147		1
Colorado	8,523	5,530,105	1.54	$ 70,566	68.6	919	5.4	23.9		0
Connecticut	5,139	3,587,685	1.43	$ 75,923	69.7	860	9.1	3.7	yes	0
Maryland	8,285	6,024,752	1.38	$ 73,760	69.5	690	9.2	7.2	yes	1
Massachusetts	9,118	6,823,721	1.34	$ 72,266	64.6	820	12.5	5.8	yes	0
New Jersey	11,584	8,978,416	1.29	$ 68,468	68.1	665	11.6			0
Michigan	12,102	9,933,445	1.22	$ 57,091	74.7	870	8			0
Arizona	8,049	6,908,642	1.17	$ 57,100	68.7	823	6.7			0
New York	20,326	19,836,286	1.02	$ 61,437	55.6	539	29.2	0.8	yes	1
Florida	20,228	20,656,589	0.98	$ 51,176	70.5	796	6.9			0
Illinois	11,293	12,835,726	0.88	$ 61,386	69.2	825	10.8			0
Virginia	7,160	8,414,380	0.85	$ 66,451	69.2	840	6.4			0
Texas	17,031	20,656,589	0.82	$ 58,146	65.1	797	5.6			0
Pennsylvania	8,806	12,787,085	0.69	$ 60,979	72.8	798	11.2			0
North Carolina	6,251	10,156,689	0.62	$ 53,764	69	790	6.3			1
Ohio	6,260	11,622,554	0.54	$ 53,985	69.8	910	8.4			0
				0.290139225	-0.600428737	0.231313955	-0.1487056	0.881552907		0.429387

Notes

EV Ownership "top twenty states with EV ownership 2011-2016 https://cleantechnica.com/2017/05/04/us-electric-car-sales-state-whos-1-ohio-california/

Population U.S. Census 2016

Median Household Income U.S. Bureau of Economic Analysis Table H-8 Median Household Income 1984 - 2016

Percent Owner Occupied Homes 1) StateMaster.com http://www.statemaster.com/graph/hou_per_of_occ_hou_uni_tha_are_own-housing-percent-occupied-units-owner

Vehicles per Capita 2) Wikipedia from calculations from vehicle the U.S. Department of Transportation registrations, and population from the U.S. Census https://en.wikipedia.org/wiki/List_of_U.S._states_by_vehicles_per_capita

Percent households no cars available American Community Survey, U.S. Census https://www.census.gov/acs/www/about/why-we-ask-each-question/vehicles/?sec_ak_reference=18.805832b8.1539143566.aabe9d5

EV Subsidies Cost, Strata "The Current State of Electric Vehicle Subsidies", Oct, 2017, file:///C:/Users/dtste/Documents/Strata%20EV%20study.pdf

High Occupancy Vehicle Lanes and Alternative Fuel Vehicles, U.S. Department of Energy, https://afdc.energy.gov/laws/HOV